UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
Portland, Oregon 97232-1274

https://doi.org/10.25923/r94p-xe17

April 6, 2021

Refer to NMFS No: WCRO-2021-00020

Charles Mark
Forest Supervisor
Salmon-Challis National Forest
1206 South Challis Road
Salmon, Idaho 83467

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Authorizing Operation and Maintenance of Water Diversions located on the Salmon-Challis National Forest in the Lemhi River Watershed, HUC 17060204, Lemhi County, Idaho

Dear Mr. Mark:

Thank you for your letter of September 18, 2020, and the January 6, 2021, email transmitting amended proposed actions for the Salmon-Challis National Forest's (SCNF) biological assessment for Authorizing Operation and Maintenance of Water Diversions in the Lemhi River watershed (multiple activities). The enclosed document contains a biological opinion (Opinion) prepared by NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 *et seq.*). This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 CFR 45016).

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action.

In this Opinion, NMFS concludes that the actions, as proposed, are not likely to jeopardize the continued existence of Snake River spring/summer Chinook salmon and Snake River Basin steelhead and are not likely to result in destruction or adverse modification of their designated critical habitat.

As required by section 7 of the ESA, NMFS provides an incidental take statement (ITS) with the Opinion. The ITS describes reasonable and prudent measures (RPMs) NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements, which the federal agency and any person who performs the action must comply with to carry out the RPMs. Incidental take from actions that meet these terms and conditions will be exempt from the ESA take prohibition.

Although the SCNF did not make ESA determinations for Southern Resident killer whales (*Orcinus orca*) and their critical habitat, NMFS' analysis identified potential impacts on the whale's prey base. For this reason, and in accordance with NMFS' policy on marine mammals, the attached document concludes the proposed action "may affect," but is "not likely to adversely affect" Southern Resident killer whales and their critical habitat.

This document also includes the results of our analysis of the action's likely effects on EFH pursuant to section 305(b) of the MSA, and includes four Conservation Recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. Section 305(b)(4)(B) of the MSA requires federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH Conservation Recommendations, the SCNF must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many Conservation Recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, NMFS asks that you clearly identify the number of Conservation Recommendations accepted.

Please contact Jim Morrow, Snake River Basin Office at 208-378-5695 (jim.morrow@noaa.gov) or Bill Lind at 208-391-1282 (bill.lind@noaa.gov) if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Michael P. Tehan
Assistant Regional Administrator
Interior Columbia Basin Office

Enclosure

cc: T. Ford – SCNF
K. Schade – SCNF
L. Berglund – USFWS
C. Colter – SBT

bcc: SBO – Read File; File copy; J. Morrow; B. Lind; M. Tehan

Morrow:Lind:LemhiRiverWatershedWaterDiversions:20200514:WCRO-2021-00020

cc Addresses

Tom Ford
Salmon Challis National Forest
tom.ford@usda.gov

Kelly Schade
Salmon-Challis National Forest
Kelly.schade@usda.gov

Laura Berglund
U.S. Fish and Wildlife Service
laura_berglund@fws.gov

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Authorization of Operation and Maintenance of Existing Water Diversions on the Lemhi River Watershed of the Salmon-Challis National Forest, HUC 17060204

Lemhi County, Idaho

Action Agency: United States Forest Service, Salmon-Challis National Forest

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Snake River steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No
Snake River spring/summer Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
Southern Resident Killer Whale (*Orcinus orca*)	Endangered	No	-	No	-

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: Michael P. Tehan
Assistant Regional Administrator

Date: April 6, 2021

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

ACRONYMS

ACRONYM	DEFINITION
AOP	Aquatic Organism
BA	Biological Assessment
BLM	Bureau of Land Management
BMP	Best Management Practices
cfs	Cubic Feet Per Second
COE	U.S. Army Corps of Engineers
CWA	Clean Water Act
DADM	Dailey Maximum
dB	Decibel
DNA	Deoxyribonucleic Acid
DPS	Distinct Population Segment
DQA	Data Quality Act
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
FLPMA	Federal Land Policy and Management Act
HUC	Hydrologic Unit Code
ICTRT	Interior Columbia Technical Recovery Team
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDWR	Idaho Department of Water Resources
IP	Intrinsic Potential
ISAB	Independent Science Board
ITS	Incidental Take Statement
LEMHI	Lemhi Weir
LLRTP	Lower Lemhi River Screw Trap
LRPA	Lemhi River Population Area
MPG	Major Population Group
MSA	Magnuson-Stevens Fishery Conservation and Management Act of 1976
MSL	Mean Sea Level
NEPA	National Environmental Policy Act
NFS	National Forest System
NFSR	North Fork Salmon River
NMFS	National Marine Fisheries Service
ODFW	Oregon Department of Fish and Wildlife
OMP	Operations and Maintenance Plan
Opinion	Biological Opinion
OSC	Office of Species Conservation
PBF	Physical Biological Features

ACRONYM	DEFINITION
PCE	Primary Constituent Element
PFMC	Pacific Fishery Management Council
PIT	Passive Integrated Transponder
POD	Points of Diversion
POU	Place of Use
Program	Salmon-Challis National Forest Program
RHCA	Riparian Habitat Conservation Areas
RM	River Mile
RPA	Reasonable and Prudent Alternative
RPM	Reasonable Prudent Measures
SAR	Smolt to Adult Return
SCNF	Salmon-Challis National Forest
SRKW	Southern Resident Killer Whale
SUA	Special Use Authorization
USBWP	Upper Salmon Basin Watershed Project
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Services
USGS	U.S Geological Survey
VSP	Viable Salmonid Population
WDFW	Washington Department of Fish and Wildlife

1. INTRODUCTION

This introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

National Marine Fisheries Service (NMFS) prepared the biological opinion (Opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended. We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600. We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Snake Basin Office.

1.2 Consultation History

Within the Lemhi River watershed, water diversion on and across land that is currently administered by the Salmon-Challis National Forest (SCNF) has been ongoing since the late 1860s. Prior to 2002, U.S. Forest Service (USFS) discretion regarding water-diversion related activities was unclear. When Snake River spring/summer Chinook salmon were listed in 1992, the SCNF began ESA section 7 consultation on ongoing activities. However, because SCNF discretion was unclear, the diversion and transmission of water was not included in those consultations.

Discretion regarding water diversions on federal land was clarified by court decisions issued during 2002 – 2004. Informal consultation on water diversions on National Forest System (NFS) land in the SCNF began in June 2002, when the SCNF entered into an agreement to settle a lawsuit over diversions on SCNF-administered lands (Western Watershed Project v. Matejko 2002). However, many aspects of the consultations proved to be complex and, as a consequence, the first biological opinion on SCNF water diversions was not issued by NMFS until 2012. Between February 27, 2012, and December 27, 2016, NMFS issued nine biological opinions on water diversion related activities on the SCNF (Table 1). Together, these nine biological opinions covered all SCNF watersheds with water diversions that “may affect” (as determined by the SCNF) anadromous fishes or their habitat.

Table 1. Water Diversion related consultations with the SCNF, geographic areas covered, and date completed.

Consultation Title	Geographic Area Covered	Date Completed
Diversions located on the SCNF in the Lemhi River Watershed, Hydrologic Unit Code (HUC) 17060204, Lemhi County, Idaho (multiple actions). NMFS No. 2005/00061	Lemhi River drainage	February 27, 2012
Diversions located on National Forest Lands in the Upper Salmon River Watershed, HUCs 1706020117 and 1706020118, Custer County, Idaho. NMFS No. 2004/01982	Mainstem Salmon River and tributary drainages between river miles (RM) 335 and 313.	August 10, 2012
Water Diversion Activities in the Camas Creek Drainage, HUCs 1706020601, 1706020602, and 1706020603, Lemhi County, Idaho (12 projects). NMFS No. 2004/00015	Camas Creek drainage (tributary of the Middle Fork Salmon River)	March 31, 2014
Authorization of Operation and Maintenance of Existing Water Diversions in the Lower Canyon Watershed, HUCs 1706020108 and 1706020109, Custer County, Idaho. NMFS No. WCR-2014-1386	Mainstem Salmon River and tributary drainages between RM 363 and 347.	December 29, 2015
Authorization of Operation and Maintenance of Existing Water Diversions on the North Fork Salmon River Ranger District, HUC 1706020306, Lemhi County, Idaho. NMFS No. WCR-2015-3282	North Fork Salmon River drainage	December 29, 2015
Authorization of Operation and Maintenance of Existing Water Diversions on the Middle Fork Salmon River Subbasin, HUCs 1706020506, 1706020601, and 1706020603, Custer and Lemhi Counties, Idaho. NMFS No. WCR-2015-2829	Middle Fork Salmon River drainage, except the Camas Creek and Big Creek drainages.	December 29, 2015
Authorization of Operation and Maintenance of Existing Water Diversions on the Middle Salmon River Watershed of the SCNF, HUCs 1706020301, 1706020302, 1706020303, 1706020304 and 1706020305, Lemhi County, Idaho. NMFS No. WCR-2016-4505	Mainstem Salmon River and tributary drainages between RMs 304 and 237, except the Pahsimeroi River, Lemhi River, and North Fork Salmon River drainages.	December 12, 2016
Authorization of Operation and Maintenance of Existing Water Diversions on the Lower Salmon Watershed of the SCNF, HUCs 1706020307, 1706020308, 1706020313, 1706020701 and 1706020702, Lemhi and Idaho Counties, Idaho. NMFS No. WCR-2016-5724	Mainstem Salmon River and tributary drainages between RMs 237 and 135, except the Middle Fork Salmon River and Panther Creek drainages.	October 27, 2016
Authorization of Operation and Maintenance of Water Diversions in the Panther Creek Watershed, HUC 17060203, Lemhi County, Idaho. NMFS No. NWR-2004-1983	Panther Creek drainage	December 27, 2016

This consultation covers water diversions on lands administered by SCNF in the Lemhi River watershed. The Lemhi River watershed is defined by the SCNF as all land in the Lemhi River fourth field HUC (i.e., HUC 17060204). This Opinion is the second NMFS biological opinion covering water diversion related activities on SCNF land in the Lemhi River Watershed.

The first NMFS biological opinion on water diversion related activities in the Lemhi River watershed was issued by NMFS on February 27, 2012 (2012 Opinion) (NMFS No. 2005/00061). Although court decisions in the early-2000s generally clarified USFS discretion regarding water diversions, discretion over individual water diversions is dependent on factors such as date that the diversion was established; modifications to the diversion system since establishment; and whether or not the diversion system also includes points of diversion (POD) on non-NFS land. When the 2012 Opinion was issued, there were substantial knowledge gaps regarding SCNF discretion over individual diversions and imperfect knowledge of the relationship of POD on SCNF land and POD on private and/or Bureau of Land Management (BLM) land. Also, clarification of property boundaries since 2012 revealed one additional diversion on NFS land that was previously thought to be on private land.

Increased knowledge of SCNF discretion over individual water diversions, improved knowledge of diversion locations and NFS boundaries, and improved knowledge of water diversion systems, were important factors in the decision to reinitiate consultation on water diversions on SCNF land in the Lemhi River watershed. The 2012 Opinion covered authorization of 12 water diversions and the current consultation covers 17. There were three diversions included in the 2012 Opinion that are not covered in the current consultation, and six of the diversions in the current consultation were not covered by the 2012 Opinion (Table 2). One diversion, the Mill Creek D.C. Ditch diversion on Mill Creek, was described in early consultation documents but was excluded from both the 2012 Opinion and the current consultation due to assertion (and subsequent confirmation) of Revised Statute (RS) 2339[1] status.

On December 15, 2017, the SCNF sent NMFS a draft biological assessment (BA) that analyzed the effects of authorizing continued operation and maintenance of water diversions on SCNF lands in the Lemhi River watershed. NMFS provided comments to the SCNF via e-mail on February 12, 2018, and the SCNF conveyed a revised draft BA to NMFS via an internet download on July 9, 2019. On September 10, 2019, NMFS provided comments on the second draft BA to the SCNF and on February 20, 2020, the SCNF sent a letter transmitting the final BA to NMFS. That BA determined that the proposed actions would likely adversely affect Chinook salmon, steelhead, Chinook salmon designated critical habitat, steelhead designated critical habitat, and Chinook salmon EFH. The SCNF determined that the proposed actions would have no effect on Snake River sockeye salmon (*Oncorhynchus nerka*) or designated critical habitat for sockeye salmon. NMFS responded to the SCNF by letter on March 5, 2020, indicating that the information contained in the BA was sufficient to initiate formal consultation.

Between December 15, 2017, and June 15, 2020, NMFS and the SCNF collaborated via numerous e-mails, phone conservations, conference calls, and in-person meetings. That collaboration also included the Idaho Office of Species Conservation (OSC), Idaho Department of Fish and Game (IDFG), Idaho Department of Water Resources (IDWR), and the Upper Salmon Basin Watershed Project (USBWP). NMFS issued a discussion draft Opinion to the SCNF on July 8, 2020, and NMFS and the SCNF agreed to extend the consultation for an additional 90 days to revise the proposed action to more thoroughly protect aquatic resources. The discussion draft Opinion concluded that the proposed action would likely jeopardize the

[1] Revision of the 1866 Act titled: "An act granting the Right of Way to Ditch and Canal Owners over the Public Lands and for other purposes."

continued existence of Chinook salmon and steelhead, and would likely adversely modify Chinook salmon and steelhead designated critical habitat. Between July 8, 2020, and September 17, 2020, NMFS and the SCNF continued to collaborate on a revised proposed action that would avoid jeopardizing listed species or adversely modifying designated critical habitat. On September 18, 2020, the SCNF transmitted a BA amendment to NMFS and formal consultation on the revised proposed action was initiated upon its receipt.

During October, 2020, the SCNF became aware of changed circumstances that necessitated authorization of an additional water diversion. This change to the proposed action, and the resultant changes in effects on streamflow and ESA listed fishes, were described in a revised BA that was transmitted to NMFS on January 6, 2021. Over the course of the consultation, both NMFS and the SCNF used information from two reports on the effects of operating water diversions on flow. These reports were similar, which sometimes resulted in confusion, including some confusion with the January 6, 2021, BA. On January 13, 2021, the SCNF sent NMFS an e-mail clarifying the need to only use information from the most recent report on the effects of diversion operations on flow.

Table 2. Water diversions on NFS land in the Lemhi River watershed that were included in the 2012 Opinion but not in the current consultation, or that are included in the current consultation but were not covered by the 2012 Opinion.

Diversion Name	2012 Opinion	Current Consultation	Comments
Big Timber Creek	No	Yes	These five diversions were excluded from the 2012 consultation due to assertion of RS 2339 status. That status could not be verified and these diversions are therefore included in the current consultation.
Basin Creek 1	No	Yes	
Basin Creek 2	No	Yes	
Basin Creek 3	No	Yes	
East Fork Hayden Creek	No	Yes	
Hood Gulch	No	Yes	This diversion was originally thought to be on private land but subsequent investigations revealed it to be on NFS land.
Hayden Creek	Yes	No	This diversion is not currently in use and the water right holders do not currently plan to use it.
Geertson Creek	Yes	No	The SCNF determined that operation and maintenance of this diversion would have no effect on ESA-listed fishes.

During the course of the drafting the Opinion, NMFS, in collaboration with the SCNF, supplemented the information in the BA with additional information from a variety of sources, including: Streamflow gage data from the U.S. Geological Survey (USGS), IDWR, and Idaho Power Corporation; descriptions of water rights from IDWR; topographic data from USGS topographic maps and from Google Earth; and fish sampling data from IDFG, Washington Department of Fish and Wildlife (WDFW), Oregon Department of Fish and Wildlife (ODFW), and from the Intensively Monitored Watershed program. The SCNF also provided additional information on fish sampling and flow modeling and assisted with obtaining information from other agencies.

Although the SCNF did not make ESA determinations for Southern Resident killer whales (SRKW) (*Orcinus orca*) or their designated or proposed critical habitat, NMFS' review of the actions' effects on Chinook salmon and steelhead identified potential impacts on the prey availability for the whales. For this reason, and in accordance with NMFS' guidance on marine mammal consultations (Stelle 2013), this document also provides an analysis of effects, concluding with a determination of "may affect, not likely to adversely affect" for SRKW and their designated and proposed critical habitat (Section 2.12). Because NMFS is proposing to revise the SRKW critical habitat designation, Section 2.12 also serves as a conference concurrence.

A draft copy of the proposed action and terms and conditions was sent to the Shoshone-Bannock Tribes on February 1, 2021. The Shoshone-Bannock Tribes did not provide comments.

1.3. Proposed Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (50 CFR 402.02).[2] The proposed actions covered by this Opinion are: (1) USFS authorization of existing water diversions and associated facilities on NFS land in the Lemhi River watershed; and (2) development and implementation of a SCNF Program (Program) to facilitate restoration of Chinook salmon and steelhead habitat in the Lemhi River watershed. The diversions will be authorized with either a special use authorization (SUA) or a Ditch Bill Act[3] easement. The duration of the SUAs would be 30 years and the easements would be permanent. Each of the authorizations will include an operation and maintenance plan (OMP) that is designed to protect public resources. These OMPs (for both SUAs and easements) include the following:

- The District Ranger must approve all access and maintenance routes outside of the ditch/diversion right-of-way.
  - The permit holder shall repair all damage resulting from such use.
- The permittee shall be responsible for prevention and control of soil erosion and gullying on land covered by the easement and the land adjacent thereto, resulting from operations and maintenance of granted use.
- The permittee will remove all obstructions from the diversion structure.
- The permittee will revegetate or otherwise stabilize all ground where the soil has been exposed.
- The permittee will be responsible for control of and spread of noxious weeds, as identified by the USFS and the local County weed list.

[2] For EFH, federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a federal Agency (50 CFR 600.910).]
[3] October 27, 1986, amendment of Title V of the Federal Land Policy and Management Act (FLPMA).

- The permittee will not use herbicides on the authorized right-of-way except as permitted in writing by the SCNF.[4]

- When required by applicable laws and regulations, the permittee will obtain necessary permits from the state and the U. S. Army Corps of Engineers (COE) for all work in natural channels in advance of performing such work.
- The permit holder shall inspect the facility prior to use each year and make necessary repairs. Work that is considered other than routine maintenance and/or minor repairs shall be discussed in advance with the District Ranger. All repairs shall be acceptable to, and completed by, the date agreed to by the permit holder and the District Ranger.

    - All maintenance operations and ground disturbing work will incorporate the design features and best management practices listed in the BA.

- The permit holder shall contact the District Ranger for approval before proceeding with work that is other than routine operations. Some of these situations include:

    - Bringing in and using heavy equipment.

    - Replacing or maintaining any part of the water transmission system where such activity disturbs or affects roads on NFS land.

    - Using other than approved maintenance routes for access.

    - Motorized use in a closed area in an emergency situation.

    - Removal and disposal of significant amounts of vegetation and silt and deposition of the same, if on NFS land.

    - Burning, application of seed mixtures, chemical application or other means of vegetation control measures.

    - Reconstruction or re-routing of a portion of the canal or pipeline (the latter would also entail a new easement or SUA.

- If any items of archaeological, paleontological, or historic value, including but not limited to historic or prehistoric artifacts, structures, monuments, human remains and funerary objects (grave goods), are discovered, the permit holder shall immediately cease all activities that may disturb such items and notify the District Ranger. The holder shall not resume activities until the District Ranger gives written approval. Failure to comply with this stipulation may result in civil or criminal penalties under the Archaeological Resources Protection Act of 1979.

[4] Herbicide use will be in accordance with the SCNF non-wilderness area invasive plant consultation WCR-2015-3863 (NMFS 2016).

- The permit holder shall perform the following mitigation measures at the water diversion to avoid or reduce adverse effects on ESA-listed fish species and their habitats:
  - Obtain approval from the SCNF prior to upgrade or installation activities and follow the parameters of the approval.
  - When it is determined feasible and is required by the SCNF, ensure that the diversion is equipped with a fish screen and bypass system deemed appropriate by the SCNF. The fish screen and bypass system must meet NMFS and/or U.S. Fish and Wildlife (FWS) criteria, and be operational at any time water is being diverted. Screen installation will be conducted in accordance with measures outlined in the Idaho Habitat Restoration Programmatic Biological Opinion (NMFS 2019).
  - Equip diversion with a headgate, which meets the design standards of the IDWR, the administering agency for the water right. The headgate must be completely closeable without leakage, controllable, and lockable. Ditch may be dewatered prior to installation.
  - Equip diversion with a measuring device, which meets the design standards of the IDWR.
  - Diversion structures must allow upstream and downstream passage for all ESA-listed fish species/life history stages associated with the stream where the diversion is located.
  - Work that is considered other than routine maintenance and/or minor repairs shall be accomplished utilizing design features and best management practices(BMPs) stipulated in NMFS (2008). A USFS fish biologist or designee may be required to be on-site to ensure ESA-listed species life history stages and their critical habitat are protected.
  - Minimize impacts associated with the diversion and ditch operation and maintenance by avoiding sediment production, vegetation destruction, and stranding/killing fish trapped in ditches during dewatering. Repair any leakage due to a malfunctioning diversion structure as soon as possible to prevent streambank washout or erosion and to avoid sediment deposition in stream.
  - Maintenance activities will be done in accordance with measures outlined in the USDA Forest Service's Best Management Practices Handbook as well as the BMPs listed in NMFS (2008).
  - When possible, install headgate, measuring device, and fish screen (when required) during low flow conditions, which typically occur from late summer through fall.
  - If necessary to block flow from entering ditches, it must be done with structures such as cofferdams, constructed of non-erodible material like sandbags, bladder bags, or

other means that divert water. Flow must not be blocked with material obtained from the stream or floodplain.

  - Follow parameters of the state water right. Adjust the volume of water being removed from the stream based on level of use. Water must not be diverted when it is not needed for the beneficial use associated with the water right.

  - Record on the SCNF Forest-provided form at least once per week, the amount of water being diverted. The form can be obtained from the SCNF and it must be submitted either electronically or hardcopy to the SCNF by December 31 of each year.

  - Investigate options for minimizing the amount of water diverted when water is not needed and implement any effective options that are found.

  - Work with the SCNF to determine and document the status and condition of the water system and access routes at least annually. The holder shall report the status and condition of the water system to the SCNF annually using a form to be provided by the SCNF.

- The SCNF may choose to salvage fishes that are entrained in irrigation diversions. Fishes entrained in diversions may be captured using dip nets, seines, or via electrofishing. If electrofishing is employed, it will be conducted in accordance with NMFS guidelines (NMFS 2000). All captured Chinook salmon, *Oncorhynchus mykiss*, and bull trout, will be transported to suitable sites for release. Release sites will be designated prior to commencing salvage.

In addition to these measures, the OMPs for some of the diversions will include diversion specific measures designed to further minimize effects on aquatic resources. Descriptions of the water diversions that will be authorized, source streams, diversion specific minimization measures, etc., are in section 1.3.1. A brief overview of monitoring associated with the diversion authorizations is in section 1.3.2. The SCNF habitat improvement plan is described in section 1.3.3.

1.3.1. Water Diversions Associated with the Proposed Action

Seventeen water diversions on NFS land would be authorized by the proposed action and one diversion would be moved from NFS land to private land. Locations of the 17 water diversions that would be authorized are depicted in Figure 1. These diversions are part of twelve separate diversion systems that serve a total of 28 water rights that allow diversion of up to 48.80 cubic feet per second (cfs) that is used to irrigate a total of 1,878.8 acres (Table 3). Four of the diversions that would be authorized, the Big Bear Creek Diversion (1.3.1.1), the Big Timber Creek Diversion (1.3.1.3), the Big Eightmile Creek Diversion (1.3.1.6) and the East Fork Hayden

Creek Diversion (1.3.1.10), are in occupied anadromous fish habitat. The rest are in reaches that are not currently occupied by anadromous fishes[5].

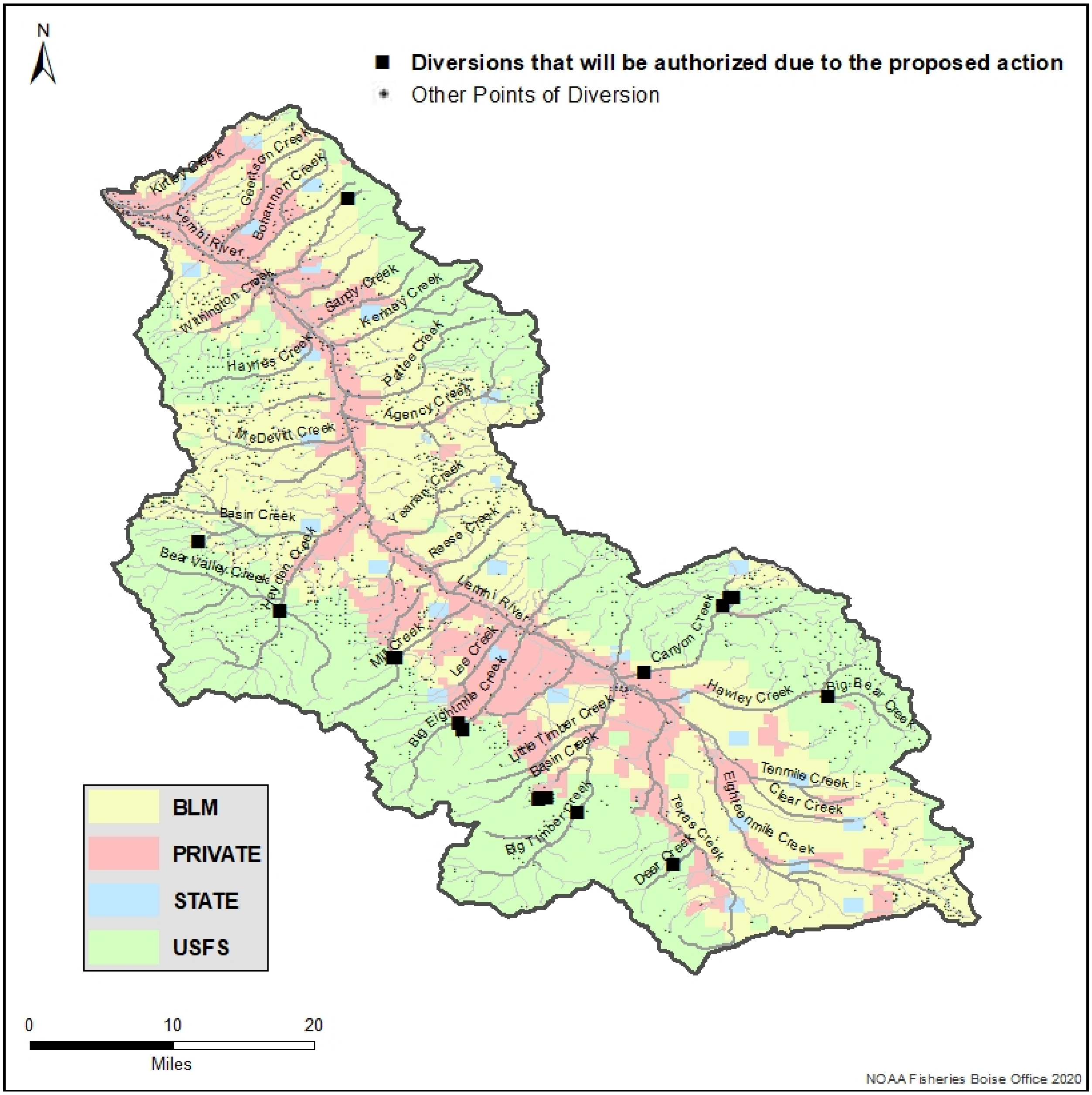


Figure 1. Location map of water diversions that would be authorized due to the proposed action.

[5] Because adult steelhead migrate upstream when flows are high and are strong swimmers and jumpers, they may occasionally pass obstacles that natural resource agencies consider to be complete fish passage barriers. Steelhead may therefore occasionally occur in stream reaches that are currently considered, by natural resource agencies, to be unoccupied by anadromous fishes. The analysis in this opinion considers the chance of steelhead occurrence in "unoccupied" stream reaches to be sufficiently small that it can be discounted.

Table 3. Proposed authorizations of water diversions on SCNF administered land in the Lemhi River watershed

Authorization	Water Rights	Source Stream	Diversion Rate (cfs)	Acres Irrigated
Big Bear Creek Diversion	74-22 74-15767	Big Bear Creek, tributary of Hawley Creek	2.0[1]	59.3
Deer Creek Diversion	74-121A 74-143 74-103 74-78 74-77	Deer Creek, tributary of Texas Creek	4.59	134.2
Big Timber Creek Diversion	74-56 74-15658	Big Timber Creek, tributary of the Lemhi River	2.0[2]	89.6
Basin Creek Diversion Complex (three PODs)	74-2088 74-2095 74-2148 74-15662 74-15663	Basin Creek, tributary of Big Timber Creek	1.12[3]	53[4]
Upper Canyon Creek Diversion	74-7304	Canyon Creek, tributary of the Lemhi River	2.41[5]	120.6
Hood Gulch Creek and Unnamed Tributary Diversions (two PODs)	74-1125	Unnamed tributary of Canyon Creek Hood Gulch Creek, tributary of Canyon Creek		
Canyon Creek Diversion #1[6]	74-158 74-159 74-160 74-2289	Canyon Creek, tributary of the Lemhi River	6.75	573.3
Big Eightmile Creek Devil's Canyon Creek Diversions (two PODs)	74-2304B	Big Eightmile Creek, tributary of the Lemhi River	0.6	17.7
	74-2304A	Devil's Canyon Creek, tributary of Big Eightmile Creek	1.8	72.2
Mill Creek Strupp Diversion	74-2294	Mill Creek, tributary of the Lemhi River	5.0	155
Mill Creek Peterson Diversion	74-287 74-288B	Mill Creek, tributary of the Lemhi River	6.8	121.6
East Fork Hayden Creek Diversion	74-1072 74-1073	East Fork Hayden Creek, tributary of Hayden Creek	11.68	584[7]
McNutt Creek Diversion	74-266 74-821	McNutt Creek, tributary of Basin Creek (Hayden drainage)	1.29	64.2
West Fork Wimpey Creek Diversion	74-214 74-215 74-15740	West Fork Wimpey Creek, tributary of Wimpey Creek	9.51	407.4
Total[8]			**48.80**	**1,878.8**

1. The sum of the maximum diversion rates for these two water rights is 2.64 cfs but the conditions of approval limit the combined diversion rate to 2.0 cfs.
2. The sum of the maximum diversion rates for these two water rights in 2.45 cfs but the conditions of approval limit the combined diversion rate to 2.0 cfs.
3. The Basin Creek diversion complex consists of ten PODs and is used to irrigate 340 acres, but only three of the PODs are on NFS land. The three PODs that are on NFS land, and that would be authorized by the proposed action, are used to divert approximately 1.12 cfs to irrigate 53 acres.
4. See number 3.
5. The sum of the maximum diversion rates for these two water rights in 3.52 cfs but the conditions of approval limit the combined diversion rate to 2.41 cfs.
6. This diversion is scheduled to be moved to private land in 2022 and will therefore be authorized for the 2021 irrigation season only. The diversion rate and the acres irrigated are not included in the totals.
7. The East Fork Hayden Creek diversion is part of a system that includes 17 water rights and is used to irrigate 1,036.7 acres. The 584 acres irrigated is an estimate based on the amount of water diverted and irrigation requirements identified in the 1978 Lemhi Decree.
8. Does not include the diversion rate or the acres irrigated for the Lower Canyon Creek Diversion, see number 5.

1.3.1.1 Big Bear Creek Diversion

The mainstem Lemhi River begins at the confluence of Texas and Eighteenmile Creeks, approximately 56 miles upstream from the confluence of the Lemhi and Salmon Rivers. Hawley Creek flows into Eighteenmile Creek approximately 2.03 miles upstream from the confluence of Eighteenmile and Texas Creeks, and Big Bear Creek flows into Hawley Creek approximately 9.85 miles upstream from Eighteenmile Creek. The Big Bear Creek Diversion is on Big Bear Creek approximately 0.63 miles upstream from Hawley Creek. The diversion serves two water rights (74-22, 74-15767) with a combined maximum diversion rate of 2.0 cfs that is used to irrigate 59.3 acres. The diversion ditch runs approximately 0.67 miles to the place of use, which is adjacent to Hawley Creek just downstream from the confluence of Big Bear and Hawley Creeks.

The Big Bear Creek Diversion was inactive from 2007 through 2019. The place of use was purchased by a new owner in 2019 and water diversion resumed in October 2020. The diversion structure consists of a rock weir that spawns 25% to 50% of the stream channel and does not impair upstream fish passage. The diversion is equipped with a lockable headgate and a measuring device that are operable but in poor condition. The diversion is accessible via an open USFS road. Operation and maintenance of the diversion will be authorized with an SUA. The authorization will require the headgate and measuring device to be in good condition and will require regular maintenance of all infrastructure that is on NFS land. The authorization also requires installation of a fish screen, built to NMFS standards, prior to the 2027 irrigation season.

1.3.1.2 Deer Creek Diversion

The mainstem Lemhi River begins at the confluence of Texas and Eighteenmile Creeks, approximately 56 miles upstream from the confluence of the Lemhi and Salmon Rivers. Deer Creek flows into Texas Creek approximately 14 miles upstream from the confluence of Texas and Eighteenmile Creeks. The Deer Creek Diversion POD is on Deer Creek approximately 1.9 miles upstream from Texas Creek. The diversion dam consists of boulders, dirt, and logs and although it has not been maintained in many years, it is still effective and diverts 90-100% of the flow into the ditch. The diversion is not equipped with a headgate and it cannot be turned off without major modifications, and it therefore operates year-round. The diversion appears to supplement flow in Sourdough Gulch (the next tributary of Texas Creek upstream from Deer Creek) and ultimately Texas Creek. Information on the fate of fish entrained in the Deer Creek Diversion is currently lacking, but it appears that entrained fishes may have relatively unimpaired access to habitat in Texas Creek. If that is the case, then equipping the Diversion with fish screens and headgates may not be the best strategy for minimizing entrainment effects. The SCNF proposes working with IDWR to develop a long-term plan for operation and maintenance of the Deer Creek Diversion that will minimize adverse effects on fishes in Deer and Texas Creeks.

The Deer Creek Diversion serves five water rights with a combined maximum diversion rate of 4.59 cfs that may be used to irrigate as much as 196.2 acres. However, a portion of the place of use (POU) irrigated via the Deer Creek Diversion can also be irrigated with water diverted from Sourdough Gulch Creek and Texas Creek via PODs on non-NFS lands. A comparison of the conditions of approval for Deer Creek, Sourdough Gulch Creek, and Texas Creek water rights suggests that 134.2 acres of irrigation is dependent on operation of the Deer Creek Diversion.

1.3.1.3 Big Timber Creek Diversion

Big Timber Creek flows into the Lemhi River approximately two miles downstream from the confluence of Texas and Big Eighteenmile Creeks (i.e., the upstream end of the Lemhi River) and approximately 54 miles upstream from the confluence of the Lemhi and Salmon Rivers. The Big Timber Creek Diversion POD is on Big Timber Creek approximately 10.7 miles upstream from the Lemhi River. This diversion serves two water rights with a combined maximum diversion rate of 2.0 cfs that is used to irrigate 89.6 acres. The diversion dam consists of sticks, logs, rocks, and mud; it spans 5% to 10% of the stream channel; and it is in poor condition. A headgate and measuring device are currently present but are in poor condition and the measuring device is not functional. The ditch runs roughly parallel to Big Timber Creek, across NFS land, for approximately one mile to the POU on private land. The authorization will require the headgate and measuring device to be in good condition and will require regular maintenance of all infrastructure that is on NFS land. The authorization also requires installation of a fish screen, built to NMFS standards, prior to the 2027 irrigation season.

A POD on non-NFS land also serves the POU. However, the SCNF measured 2.33 cfs (i.e., 117% of the allowable maximum diversion rate) being diverted via the Big Timber Creek Diversion on July 3, 2018. The large amount of water diverted suggests that the POU is primarily irrigated via the Big Timber Creek Diversion. The easement will limit the diversion rate to the amount stipulated in the water right (i.e. 2.0 cfs).

1.3.1.4 Basin Creek Diversion Complex

Basin Creek flows into Big Timber Creek approximately 6.5 miles upstream from the Lemhi River. The Basin Creek Diversion Complex (Complex) consists of three PODs on NFS land, designated Basin Creek 1, Basin Creek 2, and Basin Creek 3, for the purposes of this consultation. These three PODs are on Basin Creek approximately 4.4 miles upstream from Big Timber Creek; they currently consist of rocks, logs, etc.; are in generally poor condition; and they currently are not equipped with headgates, measuring devices, or fish screens. There are currently no clear access routes for diversion monitoring/maintenance. The authorization will require installation and maintenance of headgates and measuring devices, regular maintenance of all diversion facilities on NFS land, and will address access issues. However, it will not require installation of fish screens.

The Complex is part of a larger diversion system consisting of as many as ten PODs (including the three on NFS land) which serve five water rights with a combined maximum diversion rate of 5.1 cfs that is used to irrigate 340 acres. The BA states that approximately 53 acres of the POU are irrigated via the three PODs on SCNF land. The SCNF measured the amount of water diverted at the USFS PODs on August 7, 2013, and August 14, 2017. On those dates, the amount of water diverted was consistent with irrigation of approximately 53 acres.

1.3.1.5 Upper Canyon Creek Diversions

The Upper Canyon Creek Diversions consist of three PODs: (1) The Canyon Creek Diversion #4; (2) the Hood Gulch Diversion, and (3) the Unnamed Tributary Diversion. Canyon Creek flows into the mainstem Lemhi River approximately 0.7 miles downstream from the confluence of Texas and Eighteenmile Creeks (i.e., the upstream end of the Lemhi River) and approximately 55 miles upstream from the confluence of the Lemhi and Salmon Rivers. Hood Gulch Creek historically flowed into Canyon Creek approximately 9.2 miles upstream from the Lemhi River, but it has been completely diverted onto the POU for many years and the historic channel no longer conveys water to Canyon Creek. The Unnamed Tributary flows into Canyon Creek approximately 8.6 miles upstream from the Lemhi River. The Canyon Creek Diversion 4 is on Canyon Creek approximately 9.8 miles upstream from the Lemhi River; the Hood Gulch Diversion is on Hood Gulch Creek approximately 0.5 miles upstream from Canyon Creek; and the Unnamed Tributary Diversion is on the unnamed tributary approximately 0.37 miles upstream from Canyon Creek. These three PODs serve two water rights with a combined maximum diversion rate of 2.41 cfs that is used to irrigate 120 acres. All of the irrigation within the POU is dependent on operation of the Upper Canyon Creek Diversions.

Canyon Creek Diversion #4 consists of a headgate in the Canyon Creek stream channel that, when closed, diverts water down the diversion ditch. Presumably, the diversion is turned off by opening the headgate, thus allowing water to flow freely down Canyon Creek. The diversion ditch is in poor condition, but the chance of failure is low due to the small size of the ditch and the relatively flat topography. The diversion is not equipped with a traditional headgate (i.e., on

the diversion ditch), a measuring device, or a fish screen. The authorization will require modification of the diversion to facilitate unimpaired upstream fish passage, regular maintenance of all infrastructure on NFS land, and installation of a traditional headgate and measuring device. The authorization will not initially require a fish screen, but a fish screen may be required if ESA-listed fishes recolonize this reach of Canyon Creek.
The Hood Gulch Diversion is immediately upstream from the POU and diverts the entire creek onto the POU. The diversion is not equipped with a headgate or measuring device and there is currently no way to turn the diversion off. The historic stream channel has not had any flow for many years and is overgrown and difficult to see. The authorization will require regular maintenance of all infrastructure on NFS land and installation of a flow measuring device. Although not stated in the BA, the authorization will require installation of a headgate that will route water down the historic stream channel when it is not needed for irrigation. The authorization will not initially require a fish screen but a screen may be required if ESA-listed fishes are documented in Hood Gulch Creek.

The Unknown Tributary Diversion is just upstream from the POU and typically diverts the entire stream onto the POU. The diversion is not equipped with a headgate or measuring device and there is no apparent way to turn the diversion off. However, water does flow down the original stream channel, at least occasionally, but possibly just during high flows. The authorization will require regular maintenance of all infrastructure on NFS land, installation of a flow measuring device, and installation of a headgate that will route water down the stream channel when not needed for irrigation.

1.3.1.6 Big Eightmile Creek Diversion

Big Eightmile Creek flows into the Lemhi River approximately 45 miles upstream from the confluence of the Lemhi and Salmon Rivers. The Big Eightmile Creek Diversion POD is on Big Eightmile Creek approximately 7.9 miles upstream from the Lemhi River and immediately across the creek from the mouth of Devil's Canyon Creek. The diversion ditch runs for approximately 0.25 miles to the POU on private land. This diversion serves one water right with a maximum diversion rate of 0.6 cfs that is used to irrigate 17.7 acres. The one water right has a relatively junior priority date, which typically results in the diversion being turned off by mid-July. The Big Eightmile Creek diversion dam is a rock weir that also apparently facilitates operation of streamflow gage 13304490 (i.e., Big Eightmile Creek below Devil's Canyon near Leadore, ID). The rock weir raises the water level sufficiently to flow down the diversion ditch. The ditch is equipped with a headgate and measuring device, but does not have a fish screen. The headgate is located approximately 300 feet down the ditch from the POD and is in fair condition. The ditch is in need of maintenance, but is not currently at risk of failure.

The Big Eightmile Creek Diversion is one of four diversions that would be authorized in currently occupied anadromous fish habitat. Authorization of the Big Eightmile Creek Diversion will include a schedule of use based on historic and current use, installation of a fish screen before the 2027 irrigation season, upgrade of the headgate, and reconfiguration of the diversion, as needed, to minimize entrainment of fishes. Prior to installation of the fish screen, the SCNF may salvage fishes in the ditch to reduce the entrainment effects. The schedule of use will be developed in conjunction with the IDWR and the water user. Plans for reconfiguration of the diversion to minimize fish entrainment, including design and installation of the fish screen, will be approved by IDFG.

1.3.1.7 Devil's Canyon Creek Diversion

Devil's Canyon Creek flows into Big Eightmile Creek approximately 7.9 miles upstream from the Lemhi River. The Devil's Canyon Creek Diversion POD is on Devil's Canyon Creek approximately 0.5 miles upstream from Big Eightmile Creek. The ditch runs for approximately 0.7 miles to the POU on private land. The ditch is in poor condition and has a history of failure resulting in resource damage. The diversion is equipped with a headgate and measuring device that are in good condition, but it does not have a fish screen. This diversion serves one water right with a maximum diversion rate of 1.8 cfs that is used to irrigate 72.2 acres. The water right is relatively junior and as a result, is typically not used past early July. Authorization will include a schedule of use based on historic and current use, and regular maintenance of all infrastructure on NFS land. The authorization will not require installation of a fish screen. The schedule of use will be developed in conjunction with IDWR and the water user. The SCNF will work with the permittee to upgrade the ditch so as to minimize chance of ditch failure.

1.3.1.8 Mill Creek Strupp Diversion

Mill Creek historically flowed into the Lemhi River approximately 41 miles upstream from the confluence of the Lemhi and Salmon Rivers. Mill Creek has been completely dewatered throughout the irrigation season for many years and topographic maps show the creek ending at a Lemhi River irrigation ditch. However, a recent habitat restoration project has partially connected Mill Creek to the mainstem Lemhi River via Little Springs Creek. The Mill Creek Strupp Diversion is one of three Mill Creek diversions on NFS land. The other two are the Mill Creek Peterson (described in section 1.3.1.9), and the Mill Creek D. C. Ditch Diversion that was excluded from consultation because its RS2339 status was verified.

The Mill Creek Strupp Diversion is on a side channel of Mill Creek approximately 5.9 miles upstream from the Lemhi River. The diversion is equipped with a wooden headgate that is in fair condition, and a measuring device that meets IDWR standards. The diversion dam consists of rocks placed in the side channel and does not constitute an upstream passage barrier. The diversion does not have a fish screen. The ditch is in good condition and there is a low risk of ditch failure. The Mill Creek Strupp Diversion serves one water right with a maximum diversion rate of 5.0 cfs that is used to irrigate 155 acres. This water right is very junior and as a consequence, is turned off for most of the irrigation season. From 2008 through 2018, the diversion was operated for an average of 17.5 days per irrigation season, was typically turned off by late June, and was usually operated at less than the maximum diversion rate. Authorization of the Mill Creek Strupp Diversion will include a season of use based on historic and current use but will not require installation of a fish screen.

1.3.1.9 Mill Creek Peterson Diversion

The Mill Creek Peterson Diversion is on the Mill Creek main channel almost immediately across from the Mill Creek Strupp Diversion (see section 1.3.1.7). The Mill Creek Peterson Diversion dam at one time consisted of rocks and a tarp, but those have since washed out and, because the diversion is only used during high flows, will likely not be replaced. The diversion is equipped with a sliding steel headgate and a measuring device that meets IDWR standards. The Mill Creek Peterson Diversion ditch is in fair condition and is relatively low risk for failure. The ditch extends for several miles to the POU on private land. The diversion is not equipped with a fish screen.

The Mill Creek Peterson Diversion serves two water rights with a combined maximum diversion rate of 6.8 cfs that is used to irrigate 121.6 acres. The water rights are senior to the one served by the Mill Creek Strupp Diversion but are junior to many other Mill Creek water rights, which results in the diversion being turned off for most of the irrigation season. From 2008 through 2018, the diversion was operated an average of 41 days per irrigation season, with much of that operation at levels below the maximum diversion rate. Authorization of the Mill Creek Peterson Diversion will include a season of use based on historic and current use but will not require installation of a fish screen.

1.3.1.10 East Fork Hayden Creek Diversion

Hayden Creek flows into the Lemhi River about 30.3 miles upstream from the confluence of the Salmon and Lemhi Rivers. East Fork Hayden Creek flows into Hayden Creek approximately ten miles upstream from the Lemhi River. The East Fork Hayden Creek Diversion is on East Fork Hayden Creek approximately 0.20 miles upstream from Hayden Creek. This diversion is equipped with a headgate, measuring device, and fish screen. The diversion dam consists of rocks and tarps, spans 100% of the stream channel during low flows, and is a partial barrier to upstream fish migration. The diversion ditch was converted to a pipeline in 2016, which greatly reduced chance of adverse effects due to ditch/pipe failure. The pipeline runs approximately 1.9 miles across NFS land, and then another four miles on non-NFS land to the POU. This diversion serves two water rights with a combined maximum diversion rate of 11.68 cfs. The BA states that the diverted water will be used to irrigate 232 acres, however, the two water rights listed in the BA can be used to irrigate up to 1,036.7 acres and the amount of water diverted is sufficient to irrigate at least 584 acres (based on the duty of water in Idaho of 0.02 cfs per acre). We therefore presume that the proposed action of authorizing operation of the East Fork Hayden Creek Diversion will result in irrigation of at least 584 acres. If the pipe extends to the POU and the diversion is operated continuously from May through August 2,826, acre-feet will be delivered to the field, which would be sufficient to irrigate 807 acres. This suggests that the estimate of 584 irrigated acres is very conservative.

The East Fork Hayden Creek Diversion is one of four diversions that would be authorized by the proposed action and is in currently occupied anadromous fish habitat. The authorization of the East Fork Hayden Creek Diversion will include provisions for the permittee to maintain all diversion structures in working order, ensure that the fish screen and bypass system is working as designed, and to manage the existing diversion dam so as to provide unimpaired upstream fish passage at all times. In conjunction with the authorization, the SCNF will: (1) Work with the permittee and appropriate state and federal agencies to ensure that unimpaired fish passage is maintained over the long term; (2) work with the permittee and the IDFG screen shop to reduce fording East Fork Hayden Creek; (3) limit fording to off highway vehicles that are maintained in a clean, leak free condition and will ensure that there are no Chinook salmon redds in East Fork Hayden Creek downstream from the ford if fording occurs after August 7; (4) identify flows needed to maintain fish passage and fish habitat function in East Fork Hayden Creek downstream from the diversion; and (5) develop and implement a plan for improving fish habitat between the diversion and the SCNF boundary.

1.3.1.11 McNutt Creek Diversion

McNutt Creek is a small stream in the Hayden Creek drainage. Hayden Creek flows into the Lemhi River about 30.3 miles upstream from the confluence of the Salmon and Lemhi Rivers; Basin Creek flows into Hayden Creek approximately 3.5 miles upstream from the Lemhi River; and McNutt Creek flows into Basin Creek approximately 5.7 miles upstream from Hayden Creek. The McNutt Creek Diversion is on McNutt Creek about one mile upstream from Basin Creek. This diversion serves two water rights with a combined maximum diversion rate of 1.29 cfs that is used to irrigate 64.2 acres. The POU is also served by a POD on non-NFS land. However, the SCNF measured 2.00 cfs (i.e., 155% of the allowable maximum diversion rate) being diverted via the McNutt Creek Diversion on July 16, 2018. The large amount of water diverted suggests that the POU is primarily irrigated via the McNutt Creek Diversion. The terms and conditions in the authorization will limit diversion rate to the amount stipulated in the water right (i.e., 1.29 cfs).

The McNutt Creek diversion dam is in a step-pool cascade reach and utilizes one of the boulder/log steps as a diversion dam. This “dam” extends across about half of the stream channel and is not a barrier to fish passage. The diversion is not equipped with a headgate, measuring device, or a fish screen. The ditch is in good condition and the risk of adverse effects due to ditch failure is low. The authorization will require installation of a headgate and measuring device but not a fish screen.

1.3.1.12 West Fork Wimpey Creek Diversion

Wimpey Creek flows into the mainstem Lemhi River about 12.5 miles upstream from the confluence of the Lemhi and Salmon Rivers. West Fork Wimpey Creek flows into Wimpey Creek approximately 3.3 miles upstream from the Lemhi River and the West Fork Wimpey Creek Diversion is on West Fork Wimpey Creek about 4.2 miles upstream from Wimpey Creek. The diversion dam spans the entire stream channel and there are two steel headgates, one that controls flow in the creek and the other that controls flow in the ditch. The diversion is equipped with a measuring device but there is no screen or bypass system. The diversion typically takes all of the flow in West Fork Wimpey Creek and, when operating, is usually a complete barrier to upstream fish passage. The proposed SUA would not require the diversion to be screened or fish passable. However, because most of West Fork Wimpey Creek is possibly not fish bearing (see Section 2.4.2.7), fish passage and entrainment may not be an issue.

The West Fork Wimpey Creek Diversion moves water from West Fork Wimpey Creek to East Fork Bohannon Creek. The water transmission is via a pipe for the first 4,100 feet, and then via an open ditch that empties into East Fork Bohannon Creek. The water is then diverted from East Fork Bohannon Creek and transmitted to the POU. The West Fork Wimpey Creek Diversion serves three water rights with a combined maximum diversion rate of 9.51 cfs that is used to irrigate approximately 407.4 acres[6]. The authorization will require regular maintenance of all diversion infrastructure on NFS land, but will not change current operations, will not require installation of a fish screen, will not require bypass flows in West Fork Wimpey Creek, and will not require fish passage at the diversion dam.

1.3.1.13 Canyon Creek Diversion #1

The Canyon Creek Diversion #1 is located on Canyon Creek approximately 1.5 miles upstream from the Lemhi River. This diversion serves four water rights with a combined maximum diversion rate of 6.74 cfs. In late 2021 or early 2022, the diversion POD will be relocated from SCNF land to private land and the new diversion structure will meet NMFS criteria for screening and upstream fish passage. The removal and relocation of the diversion to private land will be covered by the Idaho Habitat Restoration programmatic consultation (NMFS 2019). Moving this diversion is possible because the water diversion and use can be feasibly accomplished without operating or maintaining infrastructure on NFS land. The SCNF proposes authorizing operation of this diversion during the 2021 and 2022 irrigation seasons, but because the diversion will not be on SCNF land after the 2022 irrigation season, no authorizations are proposed for subsequent years. The benefits of improving fish passage at the POD will be applied toward the restoration goals described in Section 1.3.3.

1.3.2. Monitoring of Water Diversion Operation and Maintenance

The BA describes monitoring of water diversion operation and maintenance that will be conducted by the permittee and by SCNF personnel. The monitoring includes: Documentation of the condition of water diversions, transmission facilities, and all associated structures and infrastructure on NFS land; documentation of any diversion maintenance that is not routine; documentation of any diversion specific habitat restoration that is implemented; and measuring and recording the amount of water diverted. Monitoring of habitat restoration activities is described in Section 1.3.3.

1.3.3. Conservation Program

The SCNF has been working to restore Chinook salmon and steelhead habitat on NFS lands in the Lemhi River drainage since 1992 when Chinook salmon were listed as threatened under the ESA. This work has resulted in elimination of fish passage barriers in Wright and Kadletz Creeks, construction of livestock exclusion fences on over 20 miles of stream, and actively restoring approximately six miles of stream habitat. These habitat restoration projects were developed and implemented by SCNF personnel as part of their regular duties, and due to

[6] Because the West Fork Wimpey Creek Diversion is part of a larger system that includes Bohannon Creek and spring sources, the amount of irrigation that is dependent on operation of the West Fork Wimpey Creek Diversion is not precisely known.

modifications of ongoing activities, such as administration of grazing allotments. With very few exceptions, the habitat restoration projects have been exclusively on NFS lands.

The Program will facilitate restoration of Chinook salmon and steelhead habitat in the Lemhi River drainage. Although a continuation of ongoing habitat restoration efforts will form the core of the Program, additional resources allocated toward restoration, identifiable goals (see Section 1.3.3.1), and interagency oversight (see Sections 1.3.3.2 and 1.3.3.3), will differentiate the Program from existing habitat restoration efforts. The primary purpose of the Program will be to increase SCNF involvement in Chinook salmon and steelhead habitat restoration throughout the Lemhi River drainage. This will be accomplished by specifically assigning SCNF staff to develop, implement, and run the Program. The primary job duties of assigned staff will be: (1) Facilitating USFS participation in efforts to restore Chinook salmon and steelhead habitat on BLM, State, and private land, where mechanisms and authorities allow; (2) implementing Chinook salmon and steelhead habitat restoration projects on NFS land; and (3) evaluating habitat restoration projects to determine if project goals were achieved. The Program is expected to grow and evolve as more is learned about funding sources, habitat limiting factors, and habitat restoration opportunities. Neither the SCNF nor NMFS can pre-identify the entire suite of possible habitat improvement actions, or even the types of actions. As the Program evolves and new information is considered, habitat improvement actions are expected to increase both in number and complexity. The following list reflects the current ideas regarding the anticipated focus of Program staff. SCNF staff assigned to the Program will:

- Seek out and apply for grants to fund restoration of stream habitat and tributary connectivity.

- Identify mechanisms to facilitate USFS participation in habitat restoration on non-NFS land.

- Facilitate allocation of NFS resources (e.g., large wood, grants, and personnel) to fish habitat restoration on non-NFS lands.

- Work with the USBWP, IDFG, IDWR, Natural Resources Conservation Service, BLM, Bonneville Power Administration, and the Shoshone-Bannock Tribes to identify, develop, and implement habitat restoration projects on USFS, BLM, State, and private land in the Lemhi River drainage.

- Work with water users, the IDWR Water Transactions Program, and the IDWR Board, to identify projects that can be implemented to improve fish habitat.

- Work with private landowners to identify, develop, and implement habitat restoration projects.

The SCNF role in developing and implementing projects could range from facilitating relationship building among stakeholders to serving as the lead agency implementing the project. Examples of projects that will be implemented in the foreseeable future, include:

- Assisting the IDFG with implementing the Canyon Creek Diversion #1 fish passage project by ensuring compliance with the National Environmental Policy Act (NEPA), the ESA, and the State Historical Preservation Office regulations.

- Providing up to 1,000 trees with rootwads for the IDFG Eagle Valley Lemhi Restoration Project and Trout Unlimited's Big Springs Lemhi River Restoration Project.

- Identifying other no-bid sale areas for rootwads within the Lemhi Valley, and coordinating with partners to place the rootwads where needed to improve habitat.

- Completing cultural surveys for FY21 NEPA work for the Upper Lemhi River Aquatic Organism Passage (AOP) and Fisheries Enhancement Project that includes the authorization of 3 AOP projects and over 18 miles of low-tech habitat improvement projects in high value Chinook salmon and steelhead reaches.

There are a number of projects in the planning stages that, if implemented, will improve anadromous fish habitat. Establishment of the Program, and USFS commitment to its funding, will increase the probability that these projects are implemented. Projects in the planning stage include:

- 2021 NEPA for the Upper Lemhi River Aquatic Passage and Fisheries Enhancement Project (described above).

- Hawley, Big Bear, and Reservoir Creeks Low-Tech Project Implementation in 2021 using USBWP's contract with the Youth Employment Program and other partners, such as the Shoshone-Bannock Tribes.

- Working with Idaho Transportation Department on the Highway 29 Canyon Creek Culvert Replacement with field visits planned for 2021.

- Submitting grant and funding requests for design assistance for three crossings on Canyon Creek, including the one mentioned above.

- Working with BLM and USFS Foresters, identifying shared stewardship opportunities for large wood/rootwad projects within the Lemhi River drainage.

- Assisting the BLM in developing language for upcoming Categorical Exclusion for the purposes of large wood supply needs.

The primary purpose of the Program will be to offset the adverse effects of authorizing water diversions on SCNF land. This will be accomplished by increasing SCNF habitat restoration activities and facilitating SCNF participation in habitat restoration projects on non-NFS land. Most of the currently occupied Chinook salmon and steelhead habitat is downstream from NFS land, and consequently, much of the habitat restoration facilitated by the Program should occur on non-NFS land. Some of the types of activities in which the SCNF might engage includes:

- Providing large wood for habitat restoration on NFS, BLM, state, and private land.
- Procuring USFS funds to assist with projects implemented by other federal agencies.
- Identifying USFS authorities that may allow for applying USFS funds to habitat restoration projects conducted by state agencies, tribes, or non-governmental organizations.
- Assisting IDFG and IDWR with NEPA processes and ESA section 7 consultation on habitat restoration projects funded by other (than the USFS) federal agencies.
- Continue serving on the USBWP board.
- Evaluate mechanisms to exercise existing USFS water rights where doing so will produce meaningful improvements to anadromous salmonids in the Lemhi and Salmon Rivers.
- Work with water users, the IDWR Water Transactions Program, and the IDWR Board, to improve streamflow.

1.3.3.1 Program Goals

Through improvements in quality of occupied habitat and/or access to habitat that is reasonably certain to be occupied, increase productivity of the Lemhi River Chinook salmon and steelhead populations sufficiently to offset the effects of authorizing operation and maintenance of water diversions on SCNF land in the Lemhi River drainage. In order to completely offset the risk over the long term, the Program will continue to operate for a minimum of 10 years after the estimated adverse impacts of diversion operation are offset. Continuing the Program will also account for uncertainties in the adverse effects estimates, will provide additional support for the SCNF's ESA Section 7(a)(1) obligations, will contribute to attaining objectives identified in NMFS' recovery plans (NMFS 2017), and may facilitate adaptation of the Program to other NFS actions with long term adverse effects on Chinook salmon and steelhead.

The primary goals of the Program are:

1. Provide a framework for SCNF participation in Chinook salmon and steelhead habitat restoration in the Lemhi River drainage.
2. Increase productivity of steelhead rearing habitat in the Lemhi River drainage sufficiently to completely offset the adverse effects of the proposed action (i.e., 1.3% based on the average annual number of outmigrants from the Lemhi River population for 2008-2017[7])

[7] The number of steelhead outmigrants from the Lemhi River population was calculated by multiplying the estimated number of steelhead outmigrants past the Lemhi Weir screw trap (LEMHIW) for 2008-2017 (i.e., 17,117), by the ratio of the amount of steelhead intrinsic potential in the Lemhi River drainage and the amount upstream from the LEMHIW trap (i.e. 3,682,012 / 2016573). This results in an estimate of 31,253 juvenile steelhead outmigrating from the Lemhi River drainage, annually.

within five years after authorizing operation and maintenance of water diversions on NFS land.

3. Increase productivity of Chinook salmon rearing habitat in the Lemhi River drainage sufficiently to completely offset the adverse effects of the proposed action (i.e., 2.0% based on the average annual number of outmigrants past the Lower Lemhi River screw trap (LLRTP) trap from 2006-2015[8]) within ten years after authorizing operation and maintenance of water diversions on NFS land.

4. Continue implementation of the Program for an additional ten years after the productivity goals in #2 and #3 are met, or until the Working Group determines that the increased risks to the Chinook salmon and steelhead populations (from water diversion authorizations) are completely offset.

1.3.3.2 Establishment and Operation of a Joint SCNF/NMFS Working Group

Because the Program is new and is designed for maximum flexibility, ongoing collaboration between the SCNF and NMFS will be needed to review and evaluate progress. The SCNF is responsible for establishing the Program to facilitate restoration of Chinook salmon and steelhead habitat in the Lemhi River drainage. NMFS will provide technical expertise as part a joint SCNF/NMFS Working Group (Working Group) consisting of at least one representative each from the SCNF and the NMFS Southern Snake Branch Office. The Working Group will determine: (1) The benefits of completed restoration projects, expressed as the number of juvenile Chinook salmon and steelhead migrating downstream past the Lemhi Weir (LEMHIW) screw trap; and (2) the proportion of benefits of each restoration project that are attributable to the Program.

The Working Group will also continue collaborating to address uncertainties regarding the amount of water use that is dependent on diversion authorizations. Management of the diversion authorizations will likely result in collection of additional information on the amount of water use that is dependent on the authorizations. This, in turn, will likely result in more accurate estimates of the effects of diversion authorizations on flow, and on Chinook salmon and steelhead. The Working Group will consider new information that may become available and will determine if the Program Goals remain appropriate for offsetting the effects of the action.

1.3.3.3 Working Group Organization and Duties

NMFS Southern Snake Branch and the SCNF will assign Working Group members. The Working Group will meet at least quarterly and will produce at least one report per year. The report will summarize the Program activities and accomplishments. The Working Group may invite non-Working Group personnel from NMFS, SCNF, or other agencies and organizations, to

[8] The LLRTP screw trap is located approximately four miles upstream from the mouth of the Lemhi, which is downstream from all of the currently used spawning habitat. The average annual estimated number of outmigrants past the LLRTP screw trap was 36,460 for 2006-2015.

participate in meetings for advisory purposes. The Working Group will be responsible for determining:

- Benefits of restoration projects;
- Proportion of benefits attributable to the program;
- Amount of irrigation that is dependent on USFS authorizations; and,
- Evaluation of project goals in light of new information.

1.3.3.4 Quantifying Benefits of Restoration Projects

Determining the Quantity of Habitat Affected by Restoration – The amount of habitat affected by restoration actions will be expressed in terms of Chinook salmon and steelhead intrinsic potential (IP). When the affected stream reaches have Chinook salmon and steelhead IP, then the amount of habitat considered to be affected will be the actual amount of Chinook salmon and/or steelhead IP in the restoration area. When affected stream reaches have steelhead IP only but no Chinook salmon IP, the amount of Chinook salmon habitat affected will be determined by multiplying steelhead IP by 0.382 (See Appendix A, Table A.I.14). In streams that do not have IP because they are too small, the Working Group will calculate IP using methods described in Cooney and Holzer (2006), but modified so that streams are not automatically excluded due to size. If information needed to calculate IP is not available, the Working Group will be responsible for surveying the site and collecting the required information. With the exception of streams that are too small to have steelhead IP, the techniques for determining the amount of habitat affected by restoration activities are the same as those that were used to determine the amount affected by diversion authorizations (see Appendix A).

Quantifying Effects of Flow Improvement Projects – The estimated effects on flow will be expressed as percent of average monthly flow for each affected reach. For each affected reach, the effect on flow will be input into the line equations in Appendix A and the result will be averaged across the year. The population-wide effect will then be calculated based on the amount of habitat (expressed as IP) affected by the restoration project. The effects will be calculated for habitat that is used by rearing Chinook salmon and/or steelhead at the time of the analysis, or that will likely be reoccupied due to fish passage improvement projects. The methods used to quantify the effects of flow improvement projects are the same as those that were used to quantify effects of the diversion authorizations (see Appendix A). Projects that improve flow will typically involve diversions on non-NFS land, but could also involve diversions on NFS land, if the project reduces water use to levels below those analyzed in Section 2.5[9].

[9]Unimpaired migration is a condition of authorization for a number of the diversions. In some cases, changes in diversion operation may be necessary to achieve this. The effects of operating the diversions were analyzed assuming that all passage requirements would be met, even if that required maintaining a minimum streamflow downstream from the diversion. However, the effects on flow and fish downstream from the diversions were analyzed using models that did not consider the effects of maintaining a minimum flow. Therefore, any improvement in fish habitat downstream from authorized diversions, due to changes in diversion operation, will be considered a benefit that is attributable to the Program.

Quantifying Effects of Barrier Removal/Tributary Reconnection Projects – The benefit of removing migration barriers and/or reconnecting dewatered tributaries will be calculated by multiplying the amount of habitat (expressed as IP) that is expected to be reoccupied by rearing juveniles, or that is shown to be reoccupied by monitoring; by the average number of juvenile outmigrants per IP. The result will be expressed as juvenile Chinook salmon and/or steelhead outmigrants. The average number of outmigrants per IP will be based on screw trap data described in Appendix A. The criteria for determining if habitat upstream from barrier/reconnection projects can be considered to be reoccupied by rearing juveniles are described in the following two bullets:

- For Chinook salmon, all habitat that is within two miles upstream from known occupied spawning habitat will be considered to be reoccupied by rearing Chinook salmon if: (1) The structures (Structures) that blocked upstream fish passage are modified (or replaced) so as to meet NMFS' criteria for upstream and downstream fish passage; (2) the habitat is physically connected to known, occupied Chinook salmon spawning habitat by continuous surface flow; and (3) there are no natural fish passage barriers that might limit reoccupation. In addition, habitat that is recolonized by adult Chinook salmon will also be considered to be reoccupied by juvenile rearing Chinook salmon. Adult Chinook salmon spawning habitat will be considered to be recolonized if: (1) The Structures meet NMFS' criteria for upstream and downstream fish passage; (2) the reach is connected to known, occupied Chinook salmon spawning habitat by continuous surface flow; and (3) adult Chinook salmon are documented spawning in the reconnected reach. Newly reconnected habitat may also be considered to be recolonized by adult Chinook salmon if: (1) The Structures meet NMFS' criteria for upstream and downstream fish passage; (2) the potentially reconnected habitat has sufficient flow for Chinook salmon spawning; (3) stream reaches downstream from the Structure meet Thompson's criteria (Thompson 1972) for salmon passage; (4) 7DADM water temperatures downstream from the Structure do not exceed 20º C; and (5) the Working Group concludes that recolonization by adult Chinook salmon is likely.

- Because adult steelhead migrate upstream when flows are high, modifying structures so that they meet NMFS' criteria for fish passage is typically sufficient for steelhead to recolonize upstream habitat. Therefore, reoccupation of upstream habitat by steelhead will be assumed to have occurred when: (1) The Structures meet NMFS' criteria for upstream and downstream fish passage; and (2) the stream reach is at least seasonally connected to known occupied steelhead habitat by surface flow; and (3) resident *O. mykiss* currently occupy the potentially reconnected habitat. Habitat that is not currently occupied by resident *O. mykiss* will be considered to be reoccupied when: (1) The Structures meet NMFS' criteria for upstream and downstream fish passage; (2) the stream reach is at least seasonally connected to known occupied steelhead habitat by surface flow; and (3) *O. mykiss* are documented upstream from the Structure(s).

The Canyon Creek Diversion #1 fish passage project is an example of a project that will likely result in juvenile Chinook salmon reoccupying currently unoccupied rearing habitat. This project will replace the diversion structure with one that meets NMFS' criteria for upstream fish passage and fish screening. This project was originally scheduled to be implemented prior to the 2021 irrigation season, but the difficulty of changing the legal description of the POD location delayed the project. Because the project will be delayed, the anticipated benefits were not incorporated into the analysis of effects. However, those anticipated benefits were calculated and are included in Appendix B. When the project is complete, a portion of the benefits will be applied toward meeting the Program goals.

Improving Stream Habitat (other than flow and fish passage) – For each project, the Working Group will estimate: 1) The amount of habitat (area) that will be improved; 2) the density (fish/area) of juvenile Chinook salmon and steelhead rearing in the affected habitat prior to project implementation; and 3) the expected density (fish/area) of juvenile Chinook salmon and steelhead rearing in the affected habitat after the project is complete. These estimates will be used to calculate the expected increase in the number of rearing Chinook salmon and steelhead, which will then be converted to number of outmigrants so as to be comparable to the estimated adverse effects of diversion authorizations. This will be accomplished by multiplying the number of rearing juveniles by a correction factor determined by dividing the average survival, to Lower Granite Dam, of fish tagged as rearing juveniles by survival of those tagged at screw traps. If those data are not available for the Lemhi River drainage, then data from other Salmon River drainage populations, such as the data in Table 4, can be used. Based on data in Table 4, the number of outmigrants is 0.605 times the number of rearing juveniles.

Information that can be used to estimate benefits of restoration projects includes, but is not necessarily limited to: Monitoring data from completed habitat restoration projects in the Lemhi River drainage; monitoring data from completed projects in drainages with habitat limiting factors similar to those in the Lemhi drainage; the Idaho Habitat Natural Production Monitoring reports; and data presented in peer reviewed literature. For projects that will likely result in increasing benefits over time (e.g. grazing enclosures, revegetation, bioengineering), the Working Group will estimate long-term effects using monitoring data from similar projects and/or data presented in peer reviewed literature. These numbers will be expressed as the equivalent number of juveniles moving downstream past the LEMHIW screw trap, so as to be comparable to estimated effects of authorizing diversions.

Table 4. Survival to Lower-Granite Dam of Chinook Salmon tagged during summer in rearing habitat at screw traps while migrating downstream.

Stream	Year	Survival to Lower Granite Dam		Ratio of Survivals
		Tagged During Rearing[1]	Tagged at a Screw Trap[2]	
Marsh Creek	1993	0.183	0.315	0.581
Marsh Creek	1994	0.115	0.261	0.441
Marsh Creek	1998	0.225	0.327	0.688
Marsh Creek	1999	0.147	0.253	0.582
E. F. Salmon River	1994	0.110	0.271	0.406
S. F. Salmon River	1993	0.134	0.204	0.658
S. F. Salmon River	1994	0.090	0.143	0.630
S. F. Salmon River	1998	0.120	0.158	0.760
S. F. Salmon River	1999	0.130	0.184	0.706

Stream	Year	Survival to Lower Granite Dam		Ratio of Survivals
		Tagged During Rearing[1]	Tagged at a Screw Trap[2]	
Secesh River	1998	0.144	0.190	0.758
Secesh River	1999	0.158	0.355	0.445
Min				**0.406**
Max				**0.760**
Average				**0.605**

1. From Zabel and Achord (2004).
2. From data presented in the Idaho Anadromous Emigrant Monitoring annual reports.

1.3.3.5 Calculating the Proportion of Project Benefits that are Attributable to the Program

Some projects will be implemented solely by the USFS. For those, 100% of the benefit will be attributed to the Program. However, many projects will likely be conducted by two or more agencies working cooperatively. The Working Group will review those projects and will estimate the total amount of resources that were, or will be, utilized to complete the project. The information reviewed will include the project budgets, but resources that may not be reflected in the budgets will also be estimated. Generally, the proportion of the benefits that are attributed to the Program will be equal to the proportion of resources that were provided to the project by the Program. However, in some instances, SCNF involvement may be the only reason a project occurs. In those instances, the Working Group may determine that a higher proportion of the project benefits are attributable to the SCNF. This will require documentation sufficient to support the conclusion (e.g., landowner or partner statement, collaborator consensus, etc.).

The Canyon Creek Diversion #1 fish passage project is an example of a project that will be administered by a number of cooperating agencies utilizing multiple funding sources. The benefits of this project have been calculated and are included in Appendix A. When the project is complete, the proportion of benefits that are attributable to the Program will be applied to meeting the Program goals.

1.3.3.6 Expected Implementation

The SCNF will immediately allocate personnel to begin developing the Program. However, full implementation of the Program will likely require development of new USFS protocols for working with other federal agencies, state agencies, and private landowners; and may require identification and development of funding sources. Therefore, full implementation of the Program may take as long as five years and progress may be variable throughout the duration of the Program.

Although full implementation of the Program may require a substantial amount of time, SCNF participation in habitat restoration activities is ongoing and will continue as the Program is developed. Steelhead are more widely distributed on SCNF land than Chinook salmon. Steelhead will therefore likely benefit more than Chinook salmon during the early stages of the Program, when most restoration projects are likely to be on NFS land. Also, because projects on SCNF land will likely be implemented entirely by the SCNF, all of the benefits will be attributed to the Program. In contrast, because occupied Chinook salmon habitat on SCNF land is limited, Program benefits to Chinook salmon will be slower to accrue.

In summary, the Program may take as long as five years to fully implement, but because the Program will incorporate ongoing habitat restoration efforts, benefits will begin accruing early in the implementation process. Benefits to steelhead will likely accrue faster than benefits to Chinook salmon. A 1.3% increase in steelhead productivity (based on annual average outmigrants for 2008-2017) will likely be achieved by year five, and a 2.0% increase in Chinook salmon productivity (based on average annual outmigrants for 2006-2015) will likely be achieved by year ten. Additional benefits should continue to accrue after the initial productivity improvement goals are met.

1.3.3.7 Additional Information on the Relationship of Diversion Authorizations and Water Use.

The BA included the best currently available information on the flow effects of operating the diversions that will be authorized due to the proposed action. However, some of the diversions that will be authorized are part of larger systems that also include diversions on non-NFS land, and some of the diversions are very close to SCNF boundaries and therefore could possibly be moved to private or state land. Because of these two factors, there was substantial uncertainty regarding the effects on flow that can be specifically attributed to the action of authorizing the diversions. As more information is gathered through the authorization process, and through ongoing monitoring, more accurate estimates of flow affects that can be directly attributed to authorizing diversions on NFS-land, will likely be feasible. More accurate estimates of flow effects will, in turn, result in more accurate estimates of the effects of diversion authorizations on fish and habitat. The Working Group will evaluate new information, as it becomes available, and will ensure that Project goals remain appropriate for offsetting the adverse effects of authorizing diversions on NFS land.

1.3.3.8 Evaluation of New Information on Authorized Water Diversions

During the process of authorizing water diversions, the SCNF will obtain additional information on the amount of irrigation that is dependent on the authorizations, the feasibility of moving diversions to state or private land, and the relationship of diversions on NFS land to those on non-NFS land. The Working Group will evaluate new information, as it becomes available, and will determine if the Program Goals remain appropriate for offsetting the adverse effects of the diversion authorizations. If, based on the new information, the Working Group determines that the Program goals are no longer appropriate; it will prepare a report for the SCNF Supervisor and the NMFS Southern Snake River Branch Chief. The report will include: (1) Recommendations for actions that could be taken to ensure that Program goals remain appropriate; and (2) the information and analyses used to make the recommendations. The SCNF Supervisor and the NMFS Southern Snake River Branch Chief will determine if action is needed to ensure that Program goals remain appropriate for offsetting adverse effects of the diversion authorizations.

1.3.3.9 Monitoring and Reporting

Projects will be monitored to determine if the expected changes to habitat are achieved. For example, flow improvement projects will be monitored to determine if the expected improvement in flow is achieved, fish passage projects will be monitored to determine if structures meet NMFS' criteria, and stream channel and floodplain improvement projects will be monitored to determine if the post project stream habitat is functioning as expected. Project evaluations should apply the best available local habitat models where doing so improves the Working Group's confidence in the benefits of individual actions.

The SCNF will be responsible for monitoring of projects implemented by the SCNF. For projects that are implemented by other agencies or organizations, the Working Group will typically rely on monitoring conducted by the implementing agency, or their agents, to determine the benefits of the project. However, if monitoring by the implementing agency is inadequate, additional monitoring by the SCNF may be needed to quantify benefits of the project.

Monitoring of fishes (population size, density, distribution, etc.) can be used to adjust the expected benefits of habitat restoration. However, with the exception of recolonization of steelhead habitat that does not currently contain resident *O. mykiss*, fish sampling is not absolutely necessary to calculate the benefits of restoration projects. Typically, benefits on fishes and fish habitat will be derived from information presented in agency reports and in the peer-reviewed literature.

The Working Group will meet at least quarterly to evaluate progress on development and implementation of the Program. The Working Group will be responsible for producing at least one report per year that describes Program activities, benefits of Program activities on fish and fish habitat, and progress toward offsetting effects of the diversion authorizations. These reports can be included in the Lemhi River drainage annual monitoring report for water diversion related activities, or they can be submitted as separate documents.

1.3.4 Consequences of the Proposed Action

We considered whether or not the proposed action would cause any other activities and determined that it would cause the following activities: (1) Maintenance of water diversion systems on NFS land; (2) diversion of water from streams on NFS land; (3) transmission of water across NFS and non-NFS land; (4) irrigation of non-NFS land; and (5) restoration activities on NFS and non-NFS land. The effects of these activities are described in Section 2.5.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an

Opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The proposed action is "not likely to adversely affect" SRKW or its designated or proposed critical habitat. Our concurrence with this determination is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.12).

2.1 Analytical Approach

This Opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This Opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably, diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02). The designations of critical habitat for Chinook salmon and steelhead use the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this Opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this Opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species, destroy, or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.

- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) Directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

- If necessary, suggest a reasonable and prudent alternative (RPA) to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

This Opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02.

The Opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species. Table 5 describes the Federal Register notices and notice dates for the species under consideration in this Opinion.

Table 5. Listing status, status of critical habitat designations and protective regulations, and relevant Federal Register decision notices for ESA-listed species considered in this Opinion.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon *(Oncorhynchus tshawytscha)*			
Snake River spring/summer-run	T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Steelhead (*O. mykiss*)			
Snake River Basin	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160

Note: Listing status: 'T' means listed as threatened under the ESA; 'E' means listed as endangered.

2.2.1. Status of the Species

This section describes the present condition of the Snake River spring/summer Chinook salmon evolutionarily significant unit (ESU) and the Snake River Basin steelhead distinct population segment (DPS). NMFS expresses the status of a salmonid ESU or DPS in terms of likelihood of persistence over 100 years (or risk of extinction over 100 years). NMFS uses McElhaney et al.'s (2000) description of a viable salmonid population (VSP) that defines "viable" as less than a 5 percent risk of extinction within 100 years and "highly viable" as less than a 1 percent risk of extinction within 100 years. A third category, "maintained," represents a less than 25 percent risk within 100 years (moderate risk of extinction). To be considered viable, an ESU or DPS should have multiple viable populations so that a single catastrophic event is less likely to cause the ESU/DPS to become extinct, and so that the ESU/DPS may function as a metapopulation that can sustain population-level extinction and recolonization processes (ICTRT 2007). The risk level of the ESU/DPS is built up from the aggregate risk levels of the individual populations and major population groups (MPGs) that make up the ESU/DPS.

Attributes associated with a VSP are: (1) Abundance (number of adult spawners in natural production areas); (2) productivity (adult progeny per parent); (3) spatial structure; and (4) diversity. A VSP needs sufficient levels of these four population attributes in order to: safeguard the genetic diversity of the listed ESU or DPS; enhance its capacity to adapt to various environmental conditions; and allow it to become self-sustaining in the natural environment (ICTRT 2007). These viability attributes are influenced by survival, behavior, and experiences throughout the entire salmonid life cycle, characteristics that are influenced in turn by habitat and other environmental and anthropogenic conditions. The present risk faced by the ESU/DPS informs NMFS' determination of whether additional risk will appreciably reduce the likelihood that the ESU/DPS will survive or recover in the wild.

2.2.1.1. Snake River Spring/Summer Chinook Salmon

The Snake River spring/summer Chinook salmon ESU was listed as threatened on April 22, 1992 (57 FR 14653). This ESU occupies the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho. Several factors led to NMFS' conclusion that Snake River spring/summer Chinook were threatened: (1) Abundance of naturally produced Snake River spring and summer Chinook runs had dropped to a small fraction of historical levels; (2) short-term projections were for a continued downward trend in abundance; (3) hydroelectric development on the Snake and Columbia Rivers continued to disrupt Chinook salmon runs through altered flow regimes and impacts on estuarine habitats; and (4) habitat degradation existed throughout the region, along with risks associated with the use of outside hatchery stocks in particular areas (Good et al. 2005). On May 26, 2016, in the agency's most recent 5-year review for Pacific salmon and steelhead, NMFS concluded that the species should remain listed as threatened (81 FR 33468).

Life History. Snake River spring/summer Chinook salmon are characterized by their return times. Runs classified as spring Chinook salmon are counted at Bonneville Dam beginning in early March and ending the first week of June; summer runs are those Chinook adults that pass Bonneville Dam from June through August. Returning adults will hold in deep mainstem and tributary pools until late summer, when they move up into tributary areas and spawn. In general, spring-run Chinook salmon tend to spawn in higher-elevation reaches of major Snake River tributaries in mid- through late August; and summer-run Chinook salmon tend to spawn lower in Snake River tributaries in late August and September (although the spawning areas of the two runs may overlap).

Spring/summer Chinook salmon usually follow a "stream-type" life history characterized by rearing for a full year in the spawning habitat and migrating to the ocean in early to mid-spring as age-1 smolts (Healey 1991). Eggs are deposited in late summer and early fall, incubate over the following winter, and hatch in late winter and early spring of the following year. Juveniles rear through the summer, and most overwinter and migrate to sea in the spring of their second year of life. Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer-rearing or overwintering areas. Snake River spring/summer Chinook salmon return from the ocean to spawn primarily as 4- and 5-year-old fish, after 2 to 3 years in the ocean. A small fraction of the fish return as 3-year-old "jacks," heavily predominated by males (Good et al. 2005).

Spatial Structure and Diversity. The Snake River ESU includes all naturally spawning populations of spring/summer Chinook in the mainstem Snake River (below Hells Canyon Dam) and in the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins (57 FR 23458), as well as the progeny of 13 artificial propagation programs (85 FR 81822). The hatchery programs include the McCall Hatchery (South Fork Salmon River), South Fork Salmon River Eggbox, Johnson Creek, Pahsimeroi River, Yankee Fork Salmon River, Panther Creek, Upper Salmon River (Sawtooth Hatchery), Tucannon River (conventional and captive broodstock programs), Lostine River, Catherine Creek, Lookingglass Creek, Upper Grande Ronde River, and Imnaha River programs. The historical Snake River ESU likely also included populations in the Clearwater River drainage and extended above the Hells Canyon Dam complex.

Within the Snake River ESU, the Interior Columbia Technical Recovery Team (ICTRT) identified 28 extant and 4 extirpated or functionally extirpated populations of spring/summer-run Chinook salmon (Table 6) (ICTRT 2003; McClure et al. 2005). The ICTRT aggregated these populations into five MPGs: Lower Snake River, Grande Ronde/Imnaha Rivers, South Fork Salmon River, Middle Fork Salmon River, and Upper Salmon River. For each population, Table 6 shows the current risk ratings that the ICTRT assigned to the four parameters of a VSP (spatial structure, diversity, abundance, and productivity).

Spatial structure risk is low to moderate for most populations in this ESU (NWFSC 2015) and is generally not preventing the recovery of the species. Spring/summer Chinook salmon spawners are distributed throughout the ESU albeit at very low numbers. Diversity risk, on the other hand, is somewhat higher, driving the moderate and high combined spatial structure/diversity risks shown in Table 6 for some populations. Several populations have a high proportion of hatchery-origin spawners—particularly in the Grande Ronde, Lower Snake, and South Fork Salmon MPGs—and diversity risk will need to be lowered in multiple populations in order for the ESU to recover (ICTRT 2007; ICTRT 2010; NWFSC 2015).

Abundance and Productivity. Historically, the Snake River drainage is thought to have produced more than 1.5 million adult spring/summer Chinook salmon in some years (Matthews and Waples 1991), yet in 1994 and 1995, fewer than 2,000 naturally produced adults returned to the Snake River (ODFW and WDFW 2019). From the mid-1990s and the early 2000s, the population increased dramatically and peaked in 2001 at 45,273 naturally produced adult returns. Since 2001, the numbers have fluctuated between 32,324 (2003) and 4,183 (2019), and the trend for the most recent five years (2015-2019) has been generally downward (ODFW and WDFW 2020). Although most populations in this ESU have increased in abundance since listing, 27 of the 28 extant populations remain at high risk of extinction due to low abundance/productivity, with one population (Chamberlin Creek) at moderate risk of extinction (NWFSC 2015).

Furthermore, the most recent returns indicate that all populations in the ESU were below replacement for the 2013 brood year (Felts et al. 2019)[10] which reduced abundance across the ESU. All currently extant populations of Snake River spring/summer Chinook salmon will likely have to increase in abundance and productivity in order for the ESU to recover (Table 6).

Table 6. Summary of viable salmonid population parameter risks and overall current status for each population in the Snake River spring/summer Chinook salmon ESU. (NWFSC 2015).

MPG	Population	VSP Risk Parameter		Overall Viability Rating
		Abundance/ Productivity	**Spatial Structure/ Diversity**	
South Fork Salmon River (Idaho)	Little Salmon River	*Insf. data*	Low	High Risk
	South Fork Salmon River mainstem	High	Moderate	High Risk
	Secesh River	High	Low	High Risk
	East Fork South Fork Salmon River	High	Low	High Risk
Middle Fork Salmon River (Idaho)	Chamberlain Creek	Moderate	Low	Maintained
	Middle Fork Salmon River below Indian Creek	*Insf. data*	Moderate	High Risk
	Big Creek	High	Moderate	High Risk
	Camas Creek	High	Moderate	High Risk
	Loon Creek	High	Moderate	High Risk
	Middle Fork Salmon River above Indian Creek	High	Moderate	High Risk
	Sulphur Creek	High	Moderate	High Risk
	Bear Valley Creek	High	Low	High Risk
	Marsh Creek	High	Low	High Risk
Upper Salmon River (Idaho)	North Fork Salmon River	*Insf. data*	Low	High Risk
	Lemhi River	High	High	High Risk
	Salmon River Lower Mainstem	High	Low	High Risk
	Pahsimeroi River	High	High	High Risk
	East Fork Salmon River	High	High	High Risk
	Yankee Fork Salmon River	High	High	High Risk
	Valley Creek	High	Moderate	High Risk
	Salmon River Upper Mainstem	High	Low	High Risk
	Panther Creek			***Extirpated***
Lower Snake (Washington)	Tucannon River	High	Moderate	High Risk
	Asotin Creek			***Extirpated***
Grande Ronde and Imnaha Rivers (Oregon/ Washington)	Wenaha River	High	Moderate	High Risk
	Lostine/Wallowa River	High	Moderate	High Risk
	Minam River	High	Moderate	High Risk
	Catherine Creek	High	Moderate	High Risk
	Upper Grande Ronde River	High	High	High Risk
	Imnaha River	High	Moderate	High Risk
	Lookingglass Creek			***Extirpated***
	Big Sheep Creek			***Extirpated***

Status of the Lemhi River Chinook Salmon Population. The Lemhi River Chinook salmon population includes all Chinook salmon that spawn in the Lemhi River drainage. This population

[10] The return size is not known until five years after the brood year. Preliminary results for the 2019 redd counts indicate that the 2014 brood year will be below replacement for the vast majority (possibly all) of the populations in the Snake River spring/summer Chinook salmon ESU.

is one of two within the Upper Salmon River MPG classified as "very large," based on historic size. The Lemhi River drainage was historically very productive and it continues to produce relatively large-sized juvenile outmigrants, indicating that it retains a potential for high productivity. The Lemhi River Chinook salmon population area is in the lower part of the Upper Salmon MPG, and the population therefore provides connectivity between the Upper Salmon MPG and the Middle Fork Salmon and South Fork Salmon MPGs. Regular stocking of Chinook salmon in the Lemhi River ended in the late 1970s and no Chinook salmon have been stocked since 2003. Due to its classification as very-large, its location in the lower part of the MPG, and the low level of hatchery influence, the proposed recovery goal for this population is viable (i.e., low risk of extinction over 100 years) (NMFS 2017). The minimum population abundance to achieve viable status is 2,000 returning spawners (10-year geomean). The minimum population growth rate needed to achieve viable status at the minimum abundance is 1.34.

Lemhi River Chinook Salmon Spatial Structure/Diversity. Lemhi River Chinook salmon historically spawned throughout the mainstem Lemhi River (Gebhards 1959), likely spawned in at least ten Lemhi River tributaries and in Carmen Creek (NMFS 2017), and possibly spawned in the mainstem Salmon River downstream from the mouth of the Lemhi River. Currently, spawning regularly occurs in upper Lemhi River[11] and in Hayden Creek, periodically occurs in Bear Valley Creek (tributary of Hayden Creek), and occasionally occurs in the mainstem Lemhi River downstream from Hayden Creek and in Big Springs Creek (tributary of the upper Lemhi River). Chinook salmon spawning in Big Springs Creek was first documented in 2015 and is likely the result of past and ongoing habitat restoration. Although there have been some minor improvements in spawning distribution, spawning currently occurs in only one of the five spawning areas and, as a consequence, spatial structure risk is high (NMFS 2017). Spatial structure could be improved by reestablishing spawning in Texas Creek, Eighteenmile Creek, Carman Creek, or on the lower Lemhi River mainstem. Reestablishment of spawning in the lower Lemhi River mainstem would also restore viability of the summer-run component of the population, thus improving population diversity.

The Lemhi River Chinook salmon population historically consisted of spring-run fish that spawned in the upper Lemhi River mainstem, Lemhi River tributaries, and Carman Creek; and summer-run fish that spawned in the lower Lemhi River and possibly in the Salmon River. A hydropower generation facility was operated on the Lemhi River, approximately one mile upstream from the mouth, from 1897 (Furness 1989) through 1954 (Gebhards 1959). While the hydropower facility was operating, adult Chinook salmon could only pass upstream in high flows during spring runoff (Gebhards 1959). Although this passage impediment depressed the entire population, the later migrating summer-run fish were disproportionately impacted and were nearly eliminated. After the hydropower facility was decommissioned in 1954, the number of spawners began to increase, particularly in the upper Lemhi River, but there was also some spawning in the lower Lemhi River, suggesting that a portion of the summer-run persisted (Gebhards 1959). Even after the hydropower facility was decommissioned, "push up" diversion dams and summertime dewatering of the lower 8.3 miles of the Lemhi River continued to disproportionately impact late-migrating Chinook salmon. By the 1990s, there was essentially no

[11] The upper Lemhi River is approximately 16 miles long and includes the mainstem Lemhi River from the confluence of Hayden Creek upstream to the confluence of Texas and Eighteenmile Creeks.

spawning downstream from Hayden Creek (i.e., historic spawning habitat for the summer-run component), and the population appeared to consist entirely of spring-run fish.

In 2010, a Passive Integrated Transponder (PIT) tag-scanning array was installed near the Lemhi River mouth and late-migrating (i.e., after mid-July) adult Chinook salmon have been detected every year since. The percentage of the population that has exhibited summer-run migration timing is related to lower Lemhi River flow (Figure 2) suggesting that further improvement of flow in the lower Lemhi River could help facilitate reestablishment of the summer-run life history component. Large-scale projects designed to restore spawning and rearing habitat in the lower Lemhi River began in the late 2010s. Although the primary justification for these projects is to improve rearing and overwintering habitat for Chinook salmon spawned in the upper Lemhi River and Hayden Creek, improving habitat in the lower Lemhi River should also help facilitate reestablishment of the summer-run. However, until spawning is documented in reaches that were historically used by summer-run fish, the summer-run component of the population will continue to be considered lacking.

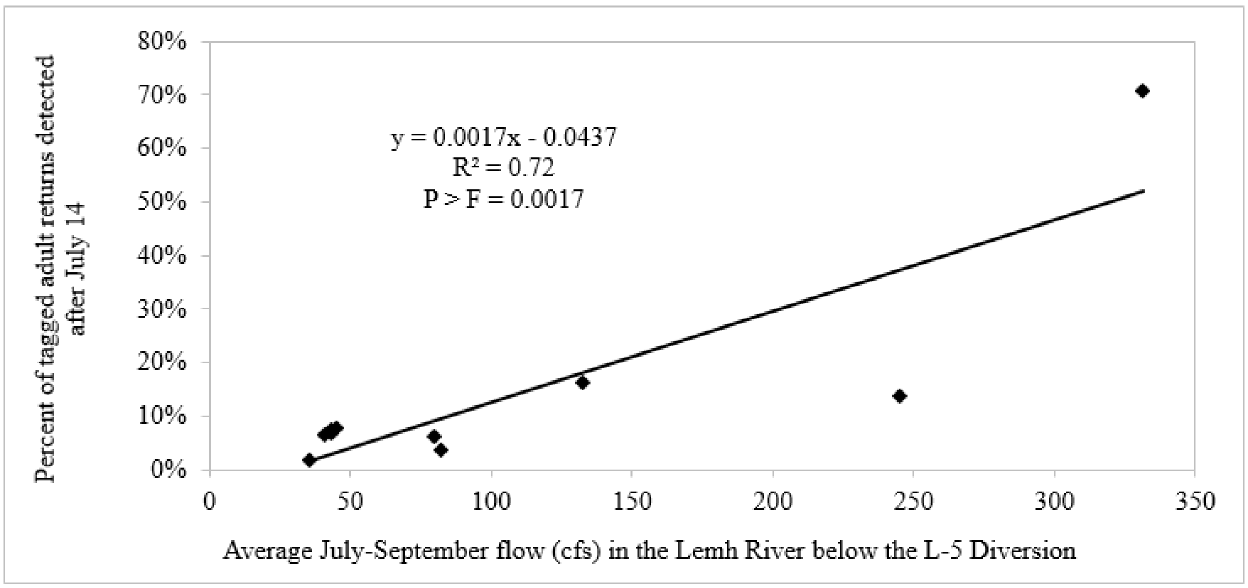


Figure 2. Percentage of adult PIT-tagged Chinook salmon detected migrating into the Lemhi River after July 14 vs. average July-September flow measured in the Lemhi River below the L-5 diversion (river mile 7).

Life history diversity of the Lemhi River Chinook salmon population has also been constrained by selective pressures on juveniles. The Lemhi River Chinook salmon population produces both yearling and subyearling smolts (Arthaud *et al.* 2010), with subyearling smolts migrating through the hydropower system and entering the ocean later in the spring than yearling smolts. Adult return rates of these late migrating subyearlying smolts are very low (possibly zero) (Copeland and Venditti 2009; Arthaud *et al.* 2010). Reasons for very low survival subyearling smolts from spring/summer Chinook salmon populations are not completely known, but are likely related to habitat conditions in the migration corridor and/or the estuary that are not currently conducive to survival of small smolts migrating late in the season. regardless of the precise reasons, the high mortality of late migrating subyearling smolts increases the life history diversity risk of the Lemhi River Chinook salmon population (NMFS 2017).

Because Lemhi River Chinook salmon currently spawn in only one of five spawning areas, spatial structure risk for this population is high. Because the summer-run component of the population is largely lacking, and because mortality of subyearling smolts is high, diversity risk for this population is high. Because both spatial structure and diversity risks are high, the combined spatial structure/diversity risk for the Lemhi River Chinook salmon population is high. Habitat and streamflow improvements in the lower Lemhi River, and improved late season migration conditions, should reduce the spatial structure/diversity risk for this population.

Lemhi River Chinook Salmon Abundance/Productivity. The IDFG has conducted index reach (i.e., single pass) redd counts in the Lemhi River since 1957 and multiple pass counts since 1996. In addition, IDFG has conducted multiple pass redd counts in Hayden and Bear Valley Creeks (Hayden Creek drainage) since 2002. The multiple pass redd counts that have been conducted since 2002 represent a near census of Chinook salmon redds in the Lemhi River population area. Fortunately, the index reach counts continue to run in conjunction with the multiple pass counts, which facilitates estimation of historic population sizes and productivities (growth rates).

In the late 1960s, the 10-year geomean abundance was greater than 1,500 spawners, which dropped to fewer than 100 spawners in the late 1990s, and has fluctuated between 100 and 285 spawners since that time (Figure 3). During approximately the same time, the number of juvenile outmigrants (production) dropped by approximately 91% and the number of juvenile outmigrants per spawner (productivity) dropped by approximately 56% (Figure 4). The drop in juvenile production could be caused by “out of basin” factors that reduce the number of adult returns, but the drop in productivity can only be explained by spawning and/or rearing conditions within the Lemhi River drainage.

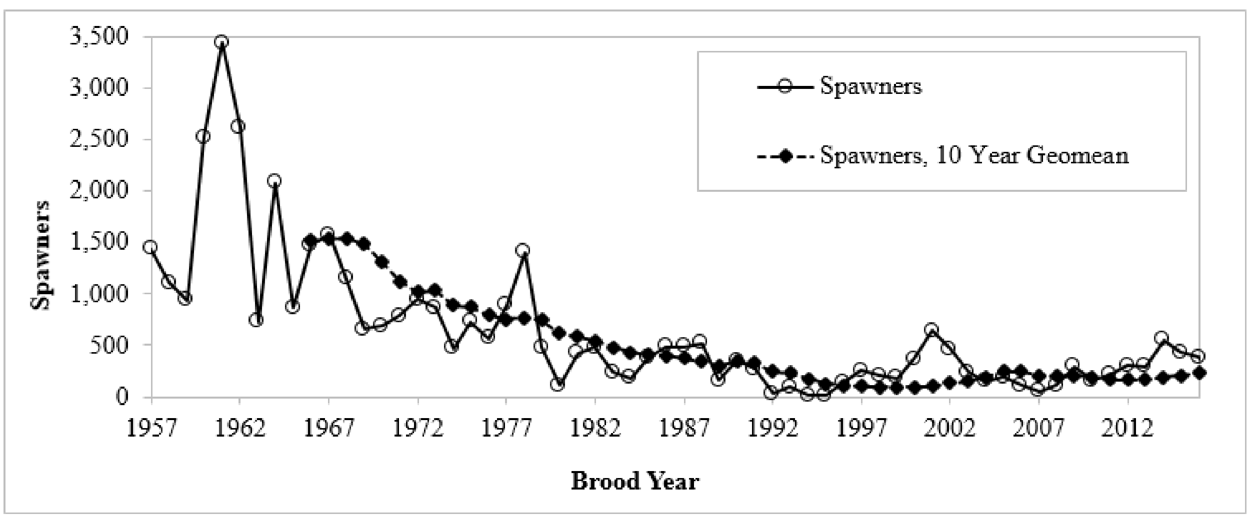


Figure 3. Estimated number of spawners returning to the Lemhi River drainage, each year and 10-year geomean, based on index reach and non-index reach redd counts and assuming two returning spawners for each redd.

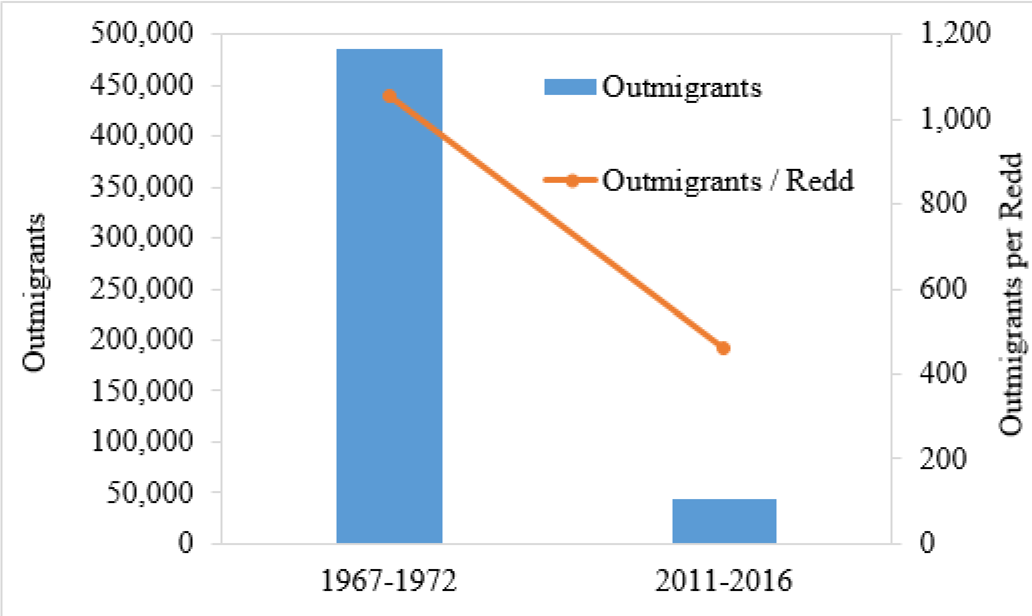


Figure 4. Decline in juvenile Chinook salmon production (outmigrants) and productivity (outmigrants per red) between 1967-1972 and 2011-2016

Since listing in 1992, juvenile production has increased more than fourfold (Figure 5) but productivity has not increased (Figure 6). Given that density dependence is ubiquitous in Chinook salmon populations (Walters et al. 2013), the fact that there was no appreciable decrease in productivity with a four-fold increase in abundance, indicates that spawning and/or rearing habitat has likely improved somewhat. However, even with the improvements that have occurred since listing, juvenile production and productivity is a fraction of the levels seen in the late 1960s and early 1970s. The density versus productivity relationships presented by Walters et al. (2013) indicates that, at current habitat capacity, a smolt to adult return (SAR) rate of 9% would be required to achieve a moderate rate of extinction and a SAR rate of 40% would be needed to achieve low risk. A SAR rate of 9% is unlikely, and the population is therefore likely to remain at high risk of extinction until productivity within the Lemhi River drainage is increased. A SAR rate of 40% is probably unachievable, indicating that an increase in capacity will almost certainly be needed to achieve viable status. Flow during the freshwater rearing life stage is a primary driver of Chinook salmon productivity in the Lemhi River (Arthaud et al. 2010).

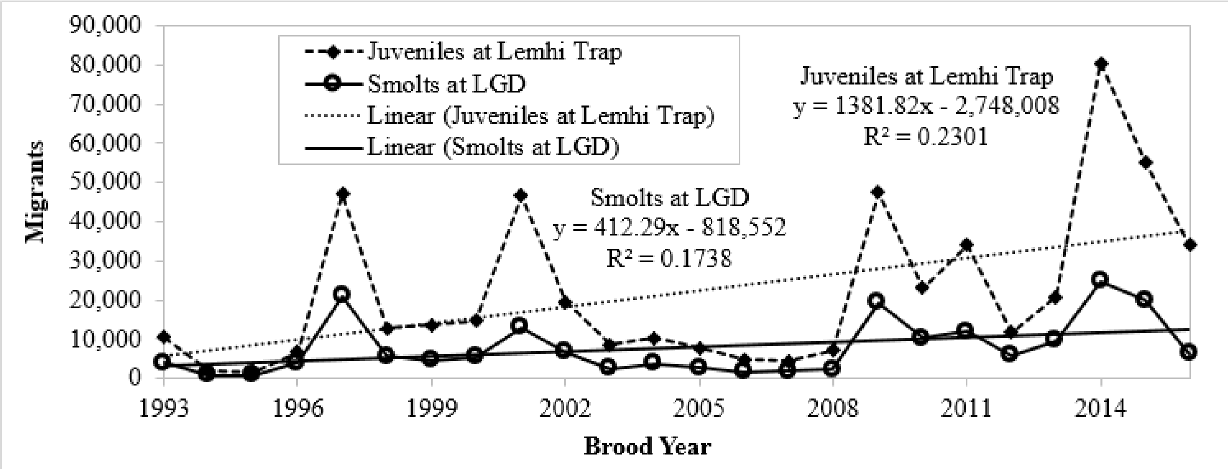


Figure 5. Lemhi River Chinook salmon juvenile production measured as total number of juveniles (fry, parr, and smolts) migrating downstream past the Lemhi weir trap, and as number of smolts surviving to Lower Granite Dam, for brood years 1993 through 2016.

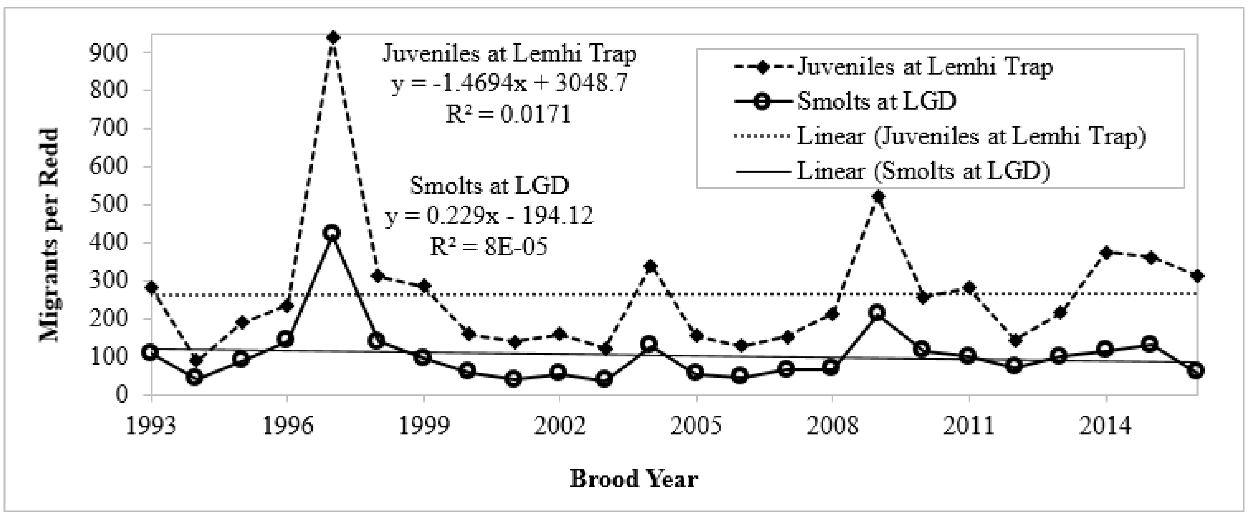


Figure 6. Lemhi River Chinook salmon productivity measured as total number of juveniles per redd (fry, parr, and smolts) migrating downstream past the Lemhi Weir trap and as a number of smolt per redd surviving to Lower Granite dam.

There have also been improvements in number of returning spawners and whole life cycle productivity. Since the low point in the late-1990s, the number of spawners (10-year geomean) in the Lemhi River Chinook salmon population area has increased from fewer than 100 to approximately 270 and whole life cycle population productivity (10-year geomean) has increased from 0.51 to 1.53. The current population size is greater than the minimum needed to achieve “maintained” status. However, the current population productivity is less than needed to achieve “maintained” status at the current population size[12]. Therefore, in spite of improvements over the past three decades, the Lemhi River Chinook salmon population remains at high risk of

[12] At a population size of 295 returning adults, population productivity would have to be 1.7 or greater to achieve moderate risk of extinction (i.e. “maintained” status).

extinction due to low abundance/productivity. Also, the last three returns (2017-2019) have been below replacement, indicating that the positive trends in abundance and productivity, may have ended.

Status of Snake River Spring/Summer Chinook Salmon Summary. Twenty-seven of the twenty-eight extant Chinook salmon populations are at high risk of extinction due to low abundance/productivity (24 populations) or have insufficient data to make a determination (3 populations). Nine of the populations are at low risk, 14 are at moderate risk, and five are at high risk of extinction due to spatial structure/diversity. Overall, twenty-seven of the twenty-eight extant populations are at high risk of extinction and one is at moderate risk. The Lemhi River Chinook salmon population size has increased since listing, but it remains at high risk of extinction due to low abundance/productivity. The population is unlikely to achieve moderate risk of extinction without an increase in habitat capacity and achieving low risk will be nearly impossible without an increase. The Lemhi River Chinook salmon population is also at high risk of extinction due to low spatial structure/diversity and is the only population with a high spatial structure/diversity risk that is due entirely to habitat perturbations (i.e., not due to hatchery influence).

2.2.1.2 Snake River Basin Steelhead

The Snake River Basin steelhead was listed as a threatened ESU on August 18, 1997 (62 FR 43937), with a revised listing as a DPS on January 5, 2006 (71 FR 834). This DPS occupies the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho. Reasons for the decline of this species include substantial modification of the seaward migration corridor by hydroelectric power development on the mainstem Snake and Columbia Rivers, and widespread habitat degradation and reduced streamflows throughout the Snake River basin (Good et al. 2005). Another major concern for the species is the threat to genetic integrity from past and present hatchery practices, and the high proportion of hatchery fish in the aggregate run of Snake River Basin steelhead over Lower Granite Dam (Good et al. 2005; Ford 2011). On May 26, 2016, in the agency's most recent 5-year review for Pacific salmon and steelhead, NMFS concluded that the species should remain listed as threatened (81 FR 33468).

Life History. Adult Snake River Basin steelhead enter the Columbia River from late June to October to begin their migration inland. After holding over the winter in larger rivers in the Snake River basin, steelhead disperse into smaller tributaries to spawn from March through May. Earlier dispersal occurs at lower elevations and later dispersal occurs at higher elevations. Juveniles emerge from the gravels in 4 to 8 weeks, and move into shallow, low-velocity areas in side channels and along channel margins to escape high velocities and predators (Everest and Chapman 1972). Juvenile steelhead then progressively move toward deeper water as they grow in size (Bjornn and Rieser 1991). Juveniles typically reside in freshwater for 1 to 3 years, although this species displays a wide diversity of life histories. Smolts migrate downstream during spring runoff, which occurs from March to mid-June depending on elevation, and typically spend 1 to 2 years in the ocean.

Spatial Structure and Diversity. This DPS includes all naturally-spawning steelhead populations below natural and manmade impassable barriers in streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho, as well as the progeny of six artificial propagation programs (85 FR 81822). The hatchery programs include Dworshak National Fish Hatchery, Salmon River B-run, South Fork Clearwater B-run, East Fork Salmon River, Tucannon River, and the Little Sheep Creek/Imnaha River steelhead hatchery programs. The Snake River Basin steelhead listing does not include resident forms of *O. mykiss* (rainbow trout) co-occurring with steelhead.

The ICTRT identified 24 extant populations within this DPS, organized into five MPGs (ICTRT 2003) (Table 7). The ICTRT also identified a number of potential historical populations associated with watersheds above the Hells Canyon Dam complex on the mainstem Snake River, a barrier to anadromous migration. The five MPGs with extant populations are the Clearwater River, Salmon River, Grande Ronde River, Imnaha River, and Lower Snake River. In the Clearwater River, the historic North Fork population was blocked from accessing spawning and rearing habitat by Dworshak Dam. Current steelhead distribution extends throughout the DPS, such that spatial structure risk is generally low. For each population in the DPS, Table 7 shows the current risk ratings for the parameters of a VSP (spatial structure, diversity, abundance, and productivity).

The Snake River Basin DPS steelhead exhibit a diversity of life-history strategies, including variations in freshwater and ocean residence times. Traditionally, fisheries managers have classified Snake River Basin steelhead into two groups, A-run and B-run, based on ocean age at return, adult size at return, and migration timing. A-run steelhead predominantly spend 1-year in the ocean; B-run steelhead are larger with most individuals returning after 2 years in the ocean. New information shows that most Snake River populations support a mixture of the two run types, with the highest percentage of B-run fish in the upper Clearwater River and the South Fork Salmon River; moderate percentages of B-run fish in the Middle Fork Salmon River; and very low percentages of B-run fish in the Upper Salmon River, Grande Ronde River, and Lower Snake River (NWFSC 2015). Maintaining life history diversity is important for the recovery of the species.

Diversity risk for populations in the DPS is either moderate or low. Large numbers of hatchery steelhead are released in the Snake River, and the relative proportion of hatchery adults in natural spawning areas near major hatchery release sites remains uncertain. Moderate diversity risks for some populations are thus driven by the high proportion of hatchery fish on natural spawning grounds and the uncertainty regarding these estimates (NWFSC 2015). Reductions in hatchery-related diversity risks would increase the likelihood of these populations reaching viable status.

Abundance and Productivity. Historical estimates of steelhead production for the entire Snake River basin are not available, but the basin is believed to have supported more than half the total steelhead production from the Columbia River basin (Mallet 1974, as cited in Good et al. 2005). The Clearwater River drainage alone may have historically produced 40,000 to 60,000 adults (Ecovista et al. 2003), and historical harvest data suggests that steelhead production in the Salmon River was likely higher than in the Clearwater (Hauck 1953). In contrast, at the time of listing in 1997, the 5-year geomean abundance for natural-origin steelhead passing Lower

Granite Dam, which includes all but one population in the DPS, was 11,462 adults (Ford 2011). Abundance began to increase in the early 2000s, with the single year count and the 5-year geomean both peaking in 2015 at 45,789 and 34,179, respectively (ODFW and WDFW 2019). Since 2015, the numbers have declined steadily with only 8,284 natural-origin adult returns counted in 2019 (ODFW and WDFW 2020). Even with the recent decline, the 5-year geomean abundance for natural-origin adult returns was 18,469 in 2019 (ODFW and WDFW 2020) which is about 72% greater than the abundance when steelhead were first listed as threatened.

Population-specific abundance estimates are available for some steelhead populations. Of the populations for which we have data, three (Joseph Creek, Upper Grande Ronde, and Lower Clearwater) are meeting minimum abundance/productivity thresholds and several more have likely increased in abundance enough to reach moderate risk (Table 7). Despite these recent increases in abundance, the status of many of the individual populations remains uncertain, and four out of the five MPGs are not meeting viability objectives (NWFSC 2015). In order for the species to recover, more populations will need to reach viable status through increases in abundance and productivity.

Table 7. Summary of viable salmonid population parameter risks and overall current status for each population in the Snake River Basin steelhead DPS (NWFSC 2015). Risk ratings with "?" are based on limited or provisional data series.

MPG	Population	VSP Risk Parameter		Overall Viability Rating
		Abundance/ Productivity	**Spatial Structure/ Diversity**	
Lower Snake River	Tucannon River	High?	Moderate	High Risk?
	Asotin Creek	Moderate?	Moderate	Maintained?
Grande Ronde River	Lower Grande Ronde	N/A	Moderate	Maintained?
	Joseph Creek	Very Low	Low	**Highly Viable**
	Wallowa River	N/A	Low	Maintained?
	Upper Grande Ronde	Low	Moderate	**Viable**
Imnaha River	Imnaha River	Moderate?	Moderate	Maintained?
Clearwater River (Idaho)	Lower Mainstem Clearwater River*	Moderate?	Low	Maintained?
	South Fork Clearwater River	High?	Moderate	High Risk?
	Lolo Creek	High?	Moderate	High Risk?
	Selway River	Moderate?	Low	Maintained?
	Lochsa River	Moderate?	Low	Maintained?
	North Fork Clearwater River			*Extirpated*
Salmon River (Idaho)	Little Salmon River	Moderate?	Moderate	Maintained?
	South Fork Salmon River	Moderate?	Low	Maintained?
	Secesh River	Moderate?	Low	Maintained?
	Chamberlain Creek	Moderate?	Low	Maintained?
	Lower Middle Fork Salmon R.	Moderate?	Low	Maintained?
	Upper Middle Fork Salmon R.	Moderate?	Low	Maintained?
	Panther Creek	Moderate?	High	High Risk?
	North Fork Salmon River	Moderate?	Moderate	Maintained?
	Lemhi River	Moderate?	Moderate	Maintained?
	Pahsimeroi River	Moderate?	Moderate	Maintained?
	East Fork Salmon River	Moderate?	Moderate	Maintained?
	Upper Mainstem Salmon R.	Moderate?	Moderate	Maintained?
Hells Canyon	Hells Canyon Tributaries			*Extirpated*

*Current abundance/productivity estimates for the Lower Clearwater Mainstem population exceed minimum thresholds for viability, but the population is assigned moderate risk for abundance/productivity due to the high uncertainty associated with the estimate.

Status of the Lemhi River steelhead Population. The Lemhi River steelhead population includes all steelhead that spawn in the Lemhi River drainage and in the mainstem Salmon River, and Salmon River tributaries, between the Lemhi River and the North Fork Salmon River. The Lemhi River steelhead population is classified as an intermediate sized population requiring a minimum population size of 283 or 1,000 returning spawners, respectively, to achieve "maintained" or "viable" status. The Lemhi River steelhead population must achieve at least "maintained" status for the DPS to recover, but the recovery plan target for the population is "viable" (NMFS 2017).

Lemhi River Steelhead Spatial Structure/Diversity. The Lemhi River steelhead population has three major spawning areas (Upper Lemhi, Lower Lemhi, and Hayden Creek) and two minor spawning areas (Carmen Creek and Tower Creek). The two minor spawning areas were historically unoccupied due to passage barriers, but restoration activities have improved passage somewhat and IDFG has documented adult steelhead in both Carmen and Tower Creeks. Steelhead presence in the three major spawning areas has been continuous, but access to steelhead spawning habitat has improved somewhat due to habitat restoration activities. Because all of the spawning areas are occupied, spatial structure risk is low (NMFS 2017). However, diversity risk is moderate due to habitat constraints, particularly limited access to tributary spawning habitat, and due to large numbers of hatchery steelhead stocked in the Lemhi and Salmon Rivers (NMFS 2017). The overall spatial structure/diversity risk for the Lemhi River steelhead population is moderate.

Lemhi River Steelhead Abundance/Productivity. Because steelhead spawn in the spring, when flows are typically too high to identify redds, and because steelhead utilize small streams that are difficult to sample, steelhead redd counts are rarely attempted and, as a consequence, historic trend data are not available for most steelhead populations, including the Lemhi population. However, in 2013, IDFG began publishing the results of a program designed to estimate returns to individual steelhead populations based on a combination of tag/recapture methodologies and genetic analyses. These estimates are now available for the 2011-2018 returns (Table 8). These estimated returns for the Lemhi River steelhead population are closely correlated to the number of wild steelhead counted at Lower Granite Dam, which allows a rough estimation of steelhead returns for 2019-2020 (Figure 7).

Abundance of Lemhi River steelhead was sufficient to achieve moderate risk of extinction from 2011 through 2016 but productivity dropped below 1.0 (indicating a declining population) in 2012 (Table 8) and has likely been substantially less than 1.0 every year since. In 2017, estimated abundance dropped below the 283 adults needed to achieve moderate risk of extinction and has likely remained below that level since (Table 8). The best available estimates of Lemhi River adult steelhead returns indicates that the Lemhi River steelhead population is currently at high risk of extinction due to low abundance and productivity. Productivity of steelhead in the upper Lemhi River is dependent on flow and density in rearing habitat (Appendix A) suggesting that improving flow and improving access to rearing habitat would reduce risk of extinction.

Table 8. Estimated number of adult steelhead returning to the Lemhi River steelhead population area, population productivity calculated assuming a four year generation time and no repeat spawning, number of wild steelhead counted at Lower Granite Dam during the year prior to the return to the spawning reaches, and number of adult steelhead returning to the Lemhi River steelhead population area calculated using the relationship depicted in Figure 7.

Return Year			Wild	Adult Returns to the
2011	1,556	1.25	61,278	1,971
2012	1,636	0.70	48,105	1,462
2013	947	0.28	31,426	819
2014	917	0.17	33,634	904
2015	1,950	NA	52,151	1,619
2016	1,150	NA	39,272	1,121
2017	271	NA	23,786	524
2018	160	NA	14,844	178
2019	NA	NA	12,135	74
2020	NA	NA	12,277	79

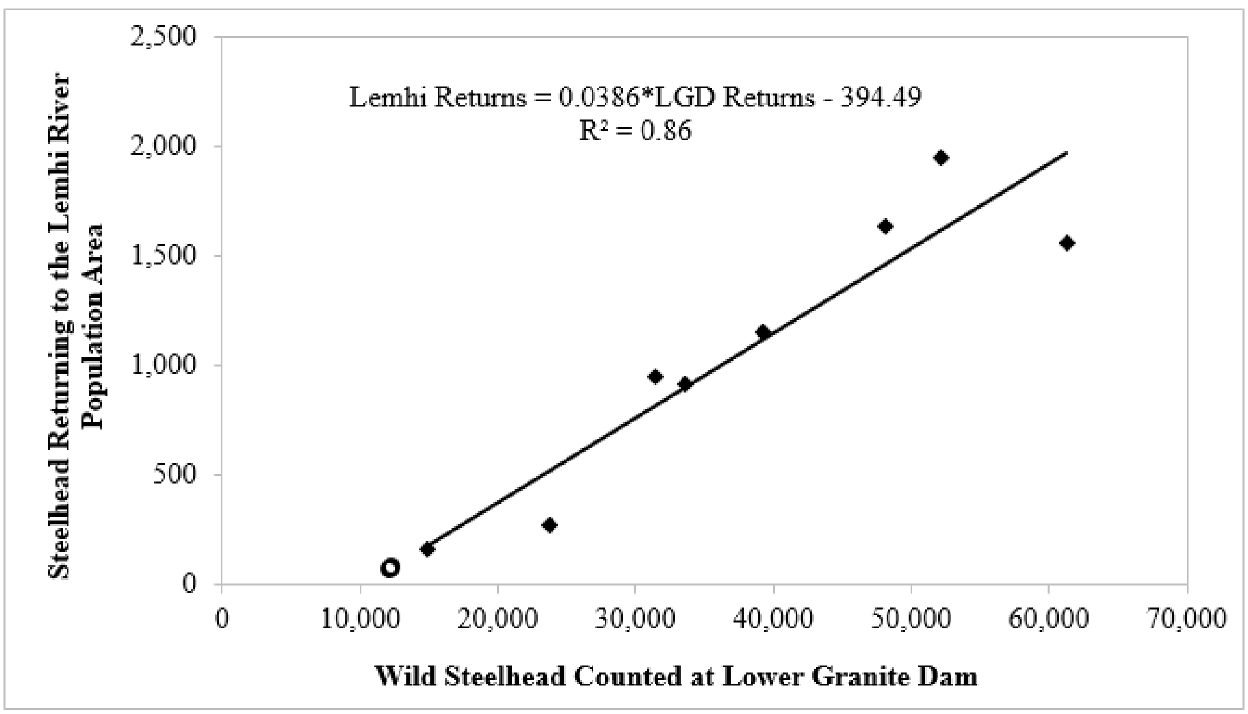


Figure 7. Relationship of the estimated number of adult steelhead returning to the Lemhi River steelhead population area[13] versus the number of wild steelhead counted at Lower Granite Dam during the previous year, for return years 2011-2018 (diamonds). The

[13] From IDFG reports to Bonneville Power Administration.

circles are the Lemhi River returns for 2019-2020 extrapolated from the 2011-2018 relationship.

Status of Snake River Steelhead Summary. Of the 24 extant Snake River steelhead populations, two are at low or very low risk of extinction, 18 are at moderate risk, and four are at high risk of extinction. However, all of the moderate and high risk determinations were made with very limited abundance/productivity data (NMFS 2017). The number of wild steelhead migrating over Lower Granite Dam has steadily declined since 2015 but remains higher than when the DPS was first listed. Although the Lemhi River steelhead population was tentatively classified as moderate risk of extinction (NMFS 2017), the most up-to-date information indicates that it is actually at high risk of extinction due to low abundance/productivity.

2.2.2. Status of Critical Habitat

In evaluating the condition of designated critical habitat, NMFS examines the condition and trends of PBFs, which are essential to the conservation of the ESA-listed species because they support one or more life stages of the species. Proper function of these PBFs is necessary to support successful adult and juvenile migration, adult holding, spawning, incubation, rearing, and the growth and development of juvenile fish. Modification of PBFs may affect freshwater spawning, rearing or migration in the action area. Generally speaking, sites required to support one or more life stages of the ESA-listed species (i.e., sites for spawning, rearing, migration, and foraging) contain PBFs essential to the conservation of the listed species (e.g., spawning gravels, water quality and quantity, side channels, or food) (Table 9).

Table 9. Types of sites, essential physical and biological features, and the species life stage each PBF supports.

Site	Essential Physical and Biological Features	Species Life Stage
Snake River Basin Steelhead[a]		
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity & floodplain connectivity to form and maintain physical habitat conditions	Juvenile growth and mobility
	Water quality and forage[b]	Juvenile development
	Natural cover[c]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[c]	Juvenile and adult mobility and survival
Snake River Spring/Summer Chinook Salmon		
Spawning & Juvenile Rearing	Spawning gravel, water quality and quantity, cover/shelter (Chinook only), food, riparian vegetation, space (Chinook only), water temperature and access (sockeye only)	Juvenile and adult
Migration	Substrate, water quality and quantity, water temperature, water velocity, cover/shelter, food[d], riparian vegetation, space, safe passage	Juvenile and adult

[a] Additional PBFs pertaining to estuarine, nearshore, and offshore marine areas have also been described for Snake River steelhead and Middle Columbia steelhead. These PBFs will not be affected by the proposed action and have therefore not been described in this Opinion.

[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.
[c] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
[d] Food applies to juvenile migration only.

Table 10 describes the geographical extent within the Snake River of critical habitat for the two species covered in this Opinion. Critical habitat includes the stream channel and water column with the lateral extent defined by the ordinary high-water line, or the bankfull elevation where the ordinary high-water line is not defined. In addition, critical habitat for Chinook salmon includes the adjacent riparian zone, which is defined as the area within 300 feet of the line of high water of a stream channel or from the shoreline of standing body of water (58 FR 68543). The riparian zone is critical because it provides shade, streambank stability, organic matter input, and regulation of sediment, nutrients, and chemicals.

Table 10. Geographical extent of designated critical habitat within the Snake River for ESA-listed salmon and steelhead.

ESU/DPS	Designation	Geographical Extent of Critical Habitat
Snake River spring/summer Chinook salmon	58 FR 68543; December 28, 1993. 64 FR 57399; October 25, 1999.	All Snake River reaches upstream to Hells Canyon Dam; all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon within the Salmon River basin; and all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon within the Hells Canyon, Imnaha, Lower Grande Ronde, Upper Grande Ronde, Lower Snake-Asotin, Lower Snake-Tucannon, and Wallowa subbasins.
Snake River Basin steelhead	70 FR 52630; September 2, 2005	Specific stream reaches are designated within the Lower Snake, Salmon, and Clearwater River basins. Table 21 in the Federal Register details habitat areas within the DPS's geographical range that are excluded from critical habitat designation.

Spawning and rearing habitat quality in tributary streams in the Snake River varies from excellent in wilderness and roadless areas to poor in areas subject to intensive human land uses (NMFS 2015; NMFS 2017). Critical habitat throughout much of the Interior Columbia (which includes the Snake River and the Middle Columbia River) has been degraded by intensive agriculture, alteration of stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer streamflows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in non-wilderness areas. Human land use practices throughout the basin have caused streams to become straighter, wider, and shallower, thereby reducing rearing habitat and increasing water temperature fluctuations.

In many stream reaches designated as critical habitat in the Snake River basin, streamflows are substantially reduced by water diversions (NMFS 2015; NMFS 2017). Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence et al. 1996). Reduced tributary streamflow has been identified as a major limiting factor for Snake River spring/summer Chinook salmon and Snake River Basin steelhead (NMFS 2017).

Many stream reaches designated as critical habitat for these species are listed on the Clean Water Act 303(d) list for impaired water quality, such as elevated water temperature (IDEQ 2018). Many areas that were historically suitable rearing and spawning habitat are now unsuitable due to high summer stream temperatures, such as some stream reaches in the Upper Grande Ronde. Removal of riparian vegetation, alteration of natural stream morphology, and withdrawal of water for agricultural or municipal use all contribute to elevated stream temperatures. Water quality in spawning and rearing areas in the Snake River has also been impaired by high levels of sedimentation and by heavy metal contamination from mine waste (e.g., IDEQ and USEPA 2003; IDEQ 2001).

The construction and operation of water storage and hydropower projects in the Columbia River basin, including the run-of-river dams on the mainstem lower Snake and lower Columbia Rivers, have altered biological and physical attributes of the mainstem migration corridor. These alterations have affected juvenile migrants to a much larger extent than adult migrants. However, changing temperature patterns have created passage challenges for summer migrating adults in recent years, requiring new structural and operational solutions (i.e., cold-water pumps and exit "showers" for ladders at Lower Granite and Lower Monumental dams). Actions taken since 1995 that have reduced negative effects of the hydrosystem on juvenile and adult migrants include:

- Minimizing winter drafts (for flood risk management and power generation) to increase flows during peak spring passage;
- Releasing water from storage to increase summer flows;
- Releasing water from Dworshak Dam to reduce peak summer temperatures in the lower Snake River;
- Constructing juvenile bypass systems to divert smolts, steelhead kelts, and adults that fall back over the projects away from turbine units;
- Providing spill at each of the mainstem dams for smolts, steelhead kelts, and adults that fall back over the projects;
- Constructing “surface passage” structures to improve passage for smolts, steelhead kelts, and adults falling back over the projects; and,
- Maintaining and improving adult fishway facilities to improve migration passage for adult salmon and steelhead.

2.2.2.1. Chinook Salmon Designated Critical Habitat in the Lemhi River Population Area

Chinook salmon designated critical habitat within the Lemhi River population area (LRPA) includes the entire mainstem Lemhi River, the mainstem Salmon River from the confluence of the Lemhi River (RM 258.7) downstream to the mouth of the North Fork Salmon River (NFSR) (RM 236.9), all historically accessible streams draining into the Lemhi River, and all historically accessible streams draining the Salmon River between the Lemhi River and the NFSR. Most of the human-made fish passage barriers in the LRPA predate biological surveys of tributary streams and precise descriptions of historic Chinook salmon use of habitat in the LRPA are therefore not available.

Based on Chinook salmon habitat use of restored tributaries in the Lemhi River drainage, we presume that Chinook salmon rearing likely occurred in all second and higher order tributaries of the Lemhi and Salmon Rivers. If this presumption is correct, then Chinook salmon likely utilized portions of 24 Lemhi River tributary drainages (Table 11) and six Salmon River tributary drainages (Table 12). Prior to restoration, only two of the Lemhi River tributary drainages were considered occupied by Chinook salmon and spawning occurred in only one (Table 11). Since restoration, Chinook salmon use eight Lemhi River tributary drainages for rearing and currently spawn in two of those (Table 11). Four of the six-second and higher order Salmon River tributaries within the LRPA are currently unoccupied and the other two may be used by rearing Chinook salmon (Table 12).

Table 11. Lemhi River tributary drainages that either currently support Chinook salmon spawning and/or rearing or likely supported it prior to development of water resources. These and all other historically accessible streams are designated critical habitat for Chinook salmon.

Stream Name	Current Status
Agency Creek	Unoccupied, seasonally dewatered, barriers
Baldy Creek	Unoccupied, seasonally dewatered, barriers
Big Eightmile Creek	Rearing in lower reaches since restoration, seasonally dewatered
Big Springs Creek	Historic rearing, spawning since restoration, connected
Big Timber Creek	Rearing in lower reaches since restoration, barriers
Bohannon Creek	Rearing in lower reaches since restoration, barriers
Canyon Creek	Rearing in lower reaches since restoration, barriers
Eighteenmile Creek	Rearing in lower reaches since restoration, barriers
Geertson Creek	Unoccupied, seasonally dewatered, barriers
Hawley Creek	Possible rearing in lower reaches since restoration, barriers
Hayden Creek	Historic and current spawning and rearing, connected
Haynes Creek	Unoccupied, seasonally dewatered, barriers
Kenney Creek	Rearing in lower reaches since restoration, barriers
Kirtley Creek	Unoccupied, seasonally dewatered, barriers
Little Eightmile Creek	Unoccupied, seasonally dewatered, barriers
Little Springs Creek	Rearing since restoration, connected
Mill Creek	Unoccupied, seasonally dewatered, barriers
Pattee Creek	Unoccupied, seasonally dewatered, barriers
Reese Creek	Unoccupied, seasonally dewatered, barriers
Sandy Creek	Unoccupied, seasonally dewatered, barriers
Texas Creek	Unknown, possible rearing in the lower reaches
Wimpey Creek	Rearing in the lower reaches
Withington Creek	Unoccupied, seasonally dewatered, barriers
Yearean Creek	Unoccupied, seasonally dewatered, barriers

Table 12. Second order and higher Salmon River tributary drainages within the LRPA. These and all other historically accessible streams are Chinook salmon designated critical habitat.

Stream Name	Current status
Carmen Creek	Possible rearing since restoration, seasonally dewatered, barriers
Fourth of July Creek	Unoccupied, seasonally dewatered, barriers
Kriley Creek	Unoccupied, seasonally dewatered, barriers
Tower Creek	Unoccupied, seasonally dewatered, barriers
Wagonhammer Creek	Possible rearing, connected
Wallace Creek	Unoccupied, seasonally dewatered, barriers

The largest single factor affecting Chinook salmon designated critical habitat in the LRPA is diversion and use of water for irrigated agriculture. There are approximately 86,000 acres of irrigated agriculture in the LRPA, and another 61,000 acres in the Salmon River drainage upstream from the LRPA. This intensive water use seasonally dewaters approximately 70% of second order and higher Lemhi and Salmon River tributaries within the LRPA, reduces base flow in the mainstem Lemhi River by more than 70%, and reduces base flow in the Salmon River portion of the LRPA by approximately 40%. These impacts on streamflow adversely affect all of the migration and rearing PBFs throughout the LRPA, and adversely impacts all spawning PBFs, in both currently used and historic spawning reaches. The impacts of intensive water use on summer water temperature and cold water refugia in the lower mainstem Lemhi River (downstream from RM 30), may be the primary factor in the virtual elimination of Chinook salmon spawning in that reach. Historic and current use of the Salmon River portion of the LRPA is not well known, but recent PIT-tag scanning array data suggest that substantial numbers of juvenile Chinook salmon might rear in that reach and could be adversely affected by the high water temperatures, lack of temperature refugia, and reduced base flows.

The condition of Chinook salmon designated critical habitat, within the LRPA, is reflected in juvenile Chinook salmon production and productivity. Between 1960 and 2000, water was allocated to irrigate an additional 5,227 acres in the Lemhi River drainage, which represents an increase of 9.4%. This increase in irrigation reduced flow available for Chinook salmon spawning and rearing by approximately 7,579-acre feet/year. During the same time, Chinook salmon juvenile production (number of juvenile outmigrants) dropped by approximately 91% and productivity (juveniles outmigrants per spawner) dropped by approximately 56% (Figure 4). The drop in juvenile production was partially due to reduced number of spawners caused by construction and operation of Snake River dams, but the drop in productivity can only be attributed to changes within the LRPA. Current habitat capacity is not sufficient to achieve recovery objectives (Appendix A). Furthermore, the decreased productivity occurred in spite of improvements in diversion screening, fish passage, and riparian habitat (see Section 2.2.2.2), indicating that the increased water use more than offset the habitat improvement efforts. Very little additional water allocation has occurred since 2000, but irrigation efficiency has improved as water users continue to convert from flood irrigation to more efficient systems. Improved irrigation efficiency can increase consumptive use (Samani and Skaggs 2008; Contor and Taylor 2013; Pfeiffer and Lin 2014; Perry et. al 2017; Grafton et. al 2018), leaving less water for other uses, such as Chinook salmon spawning, rearing, and migration.

Designated critical habitat within the Lemhi River Chinook salmon population area has also been degraded by channelization (NPCC 2004), levee construction and maintenance (NMFS 2018), bank stabilization (NMFS 2018), construction and maintenance of roads (NPCC 2004), livestock grazing (NPCC 2004), and conversion of uplands and wetlands into agricultural land. These factors have reduced shade, increased sediment, decreased bank stability, simplified habitat, and reduced the amount of fish habitat in the LRPA. Chinook salmon PBFs, within the LRPA, that are adversely affected by these factors include: Substrate, water temperature, spawning gravel, water quality, cover/shelter, food, riparian vegetation, and space.

More than 30% of the Chinook salmon designated critical habitat in the LRPA is currently not accessible due to migration barriers caused by irrigation diversions. Because it is upstream from most of the water diversions, much of this currently inaccessible habitat is in relatively good condition. Data presented by Walters et al. (2013) indicates that habitat capacity will have to increase substantially in order to meet recovery objectives. Although some of the increase can be realized through improving the quality of currently accessible habitat, the magnitude of the increase that will be needed for the population to recover suggests that restoring access to currently inaccessible habitat, will also be needed.

2.2.2.2. Habitat Restoration within the Lemhi River Population Area

Habitat restoration activities in the LRPA began in 1958 when the IDFG screen shop started addressing fish passage impediments caused by irrigation diversions (Delarm and Wold 1985). Habitat restoration activities have included: Screening irrigation diversions to reduce entrainment of juvenile salmonids; improvement of upstream fish passage at diversion dams; fencing livestock out of riparian areas; increasing base flow in specific stream reaches; planting riparian vegetation; construction of instream habitat structures; and reconstruction of historic stream channels and floodplains. These activities have: Reduced entrainment of downstream migrating juveniles; dramatically improved riparian habitat on the upper mainstem Lemhi River and Big Springs Creek; improved late summer/early fall upstream and downstream passage conditions in the lower 8.3 miles of the Lemhi River; reestablished Chinook salmon rearing in tributary streams; and reestablished Chinook salmon spawning in Big Springs Creek. Improved juvenile production without a loss in productivity, described in the previous section, is an indication that habitat improvement activities have improved spawning and/or rearing habitat in the Lemhi River drainage. Also, the proportion of juveniles that complete rearing in the upper Lemhi River has been on an increasing trend (Figure 8), indicating that late rearing and overwinter habitat may have improved due to habitat restoration activities.

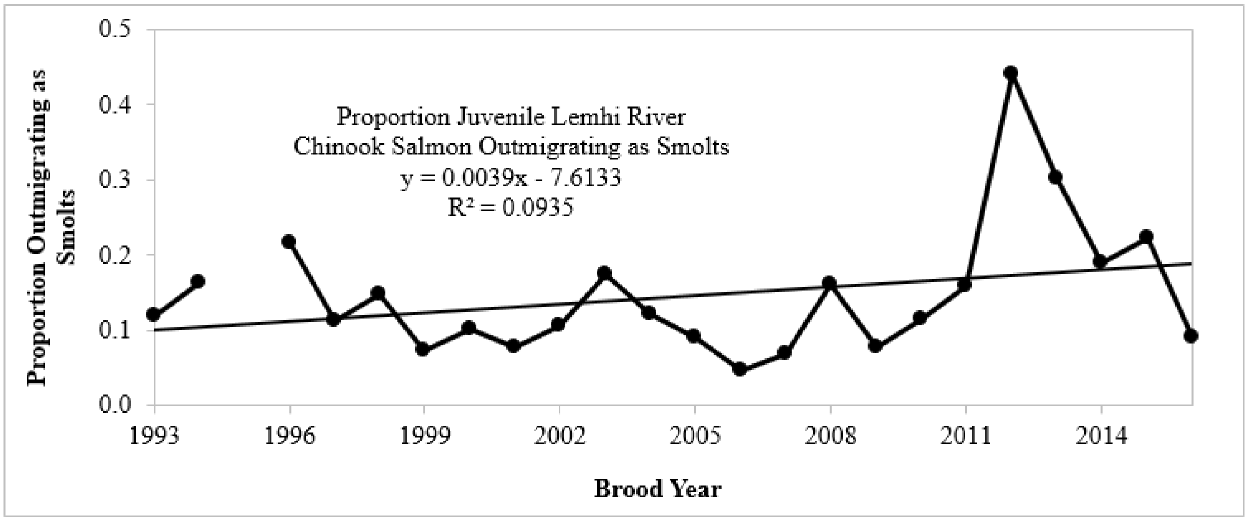


Figure 8. Proportion of juvenile Lemhi River Chinook salmon that complete rearing in the upper Lemhi River and migrate downstream past the Lemhi Weir trap as smolts, for brood years 1993 through 2016.

2.2.2.3. Steelhead Designated Critical Habitat in the Lemhi River Population Area

Steelhead designated critical habitat in the LRPA includes the mainstem Salmon River between the NFSR and the Lemhi River, the entire mainstem Lemhi River, portions of four Salmon River tributary drainages (i.e., Wagonhammer, Fourth of July, Tower, and Carman Creeks), and portions of seven Lemhi River tributary drainages (i.e., Bohannon, Wimpey, Wittington, Kenney, Hayden, Big Springs, and Texas Creeks). All of the steelhead critical habitat within the LRPA is also Chinook salmon critical habitat and the factors affecting steelhead critical habitat are essentially the same as those affecting Chinook salmon critical habitat (see section 2.2.2.1). Likewise, habitat restoration in the LRPA has affected steelhead critical habitat in much the same way as it has affected Chinook salmon critical habitat (see section 2.2.2.2). However, because steelhead can utilize spawning habitat in seasonally connected tributaries, habitat restoration may have improved overall spawning and rearing habitat for steelhead more than it has for Chinook salmon. There is insufficient information to determine if the Lemhi River steelhead population could recover with the currently available habitat, but the information that is available indicates that improvements in access to, and quality of, spawning and rearing habitat would increase the chance of achieving recovery objectives.

2.2.2.4. Status of Designated Critical Habitat Summary

Chinook salmon and steelhead designated critical habitat in the LRPA have been altered by development, particularly development of water resources for use in irrigated agriculture. This development has degraded all freshwater PBFs, but particularly the freshwater rearing PBFs. Although habitat restoration has improved Chinook salmon critical habitat within the LRPA, overall productivity of rearing habitat is a fraction of what it was in the late 1960s and early 1970s, and a fraction of what is needed to meet recovery objectives. Because steelhead can utilize spawning in seasonally connected tributaries, overall improvement in steelhead spawning and rearing habitat, due to restoration activities, may be greater than it has been for Chinook salmon, however further improvements would improve the chance of achieving recovery objectives.

2.2.3. Climate Change Implications for ESA-listed Species and their Critical Habitat

Climate change is affecting aquatic habitat and the rangewide status of Snake River spring/summer Chinook salmon and Snake River Basin steelhead. The U. S. Global Change Research Program reports average warming of about 1.3°F from 1895 to 2011, and projects an increase in average annual temperature of 3.3°F to 9.7°F by 2070 to 2099 (CCSP 2014). Climate change has negative implications for ESA-listed anadromous fishes and their habitats in the Pacific Northwest (CIG 2004; Scheuerell and Williams 2005; Zabel et al. 2006; ISAB 2007). According to the Independent Science Advisory Board (ISAB), these effects will cause the following:

- Warmer air temperatures will result in diminished snowpack and a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring/summer melt season;

- With a smaller snowpack, watersheds will see their runoff diminished earlier in the season, resulting in lower flows in the June through September period, while more precipitation falling as rain rather than snow will cause higher flows in winter, and possibly higher peak flows; and,

- Water temperatures are expected to rise, especially during the summer months when lower flows co-occur with warmer air temperatures.

These changes will not be spatially homogeneous across the entire Pacific Northwest. Low-lying areas are likely to be more affected. Climate change may have long-term effects that include, but are not limited to, depletion of important cold-water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species.

Climate change is predicted to cause a variety of impacts to Pacific salmon (including steelhead) and their ecosystems (Mote et al. 2003; Crozier et al. 2008a; Martins et al. 2012; Wainwright and Weitkamp 2013). The complex life cycles of anadromous fishes, including salmon, rely on productive freshwater, estuarine, and marine habitats for growth and survival, making them particularly vulnerable to environmental variation. Ultimately, the effects of climate change on salmon and steelhead across the Pacific Northwest will be determined by the specific nature, level, and rate of change and the synergy between interconnected terrestrial/freshwater, estuarine, nearshore, and ocean environments.

The primary effects of climate change on Pacific Northwest salmon and steelhead include:

- Direct effects of increased water temperatures on fish physiology;

- Temperature-induced changes to streamflow patterns;

- Alterations to freshwater, estuarine, and marine food webs; and,
- Changes in estuarine and ocean productivity.

While all habitats used by Pacific salmon will be affected, the impacts and certainty of the change vary by habitat type. Some effects (e.g., increasing temperature) affect salmon at all life stages in all habitats, while others are habitat-specific, such as streamflow variation in freshwater, sea-level rise in estuaries, and upwelling in the ocean. How climate change will affect each stock or population of salmon also varies widely depending on the level or extent of change, the rate of change, and the unique life-history characteristics of different natural populations (Crozier et al. 2008b). For example, a few weeks' difference in migration timing can have large differences in the thermal regime experienced by migrating fish (Martins et al. 2011).

Temperature Effects. Like most fishes, salmon are poikilotherms (cold-blooded animals); therefore, increasing temperatures in all habitats can have pronounced effects on their physiology, growth, and development rates (see review by Whitney et al. 2016). Increases in water temperatures beyond their thermal optima will likely be detrimental through a variety of processes, including increased metabolic rates (and therefore food demand), decreased disease resistance, increased physiological stress, and reduced reproductive success. All of these processes are likely to reduce survival (Beechie et al. 2013; Wainwright and Weitkamp 2013; Whitney et al. 2016).

By contrast, increased temperatures at ranges well below thermal optima (i.e., when the water is cold) can increase growth and development rates. Examples of this include accelerated emergence timing during egg incubation stages, or increased growth rates during fry stages (Crozier et al. 2008a; Martins et al. 2011). Temperature is also an important behavioral cue for migration (Sykes et al. 2009), and elevated temperatures may result in earlier-than-normal migration. While there are situations or stocks where this acceleration in processes or behaviors is beneficial, there are also others where it is detrimental (Martins et al. 2012; Whitney et al. 2016).

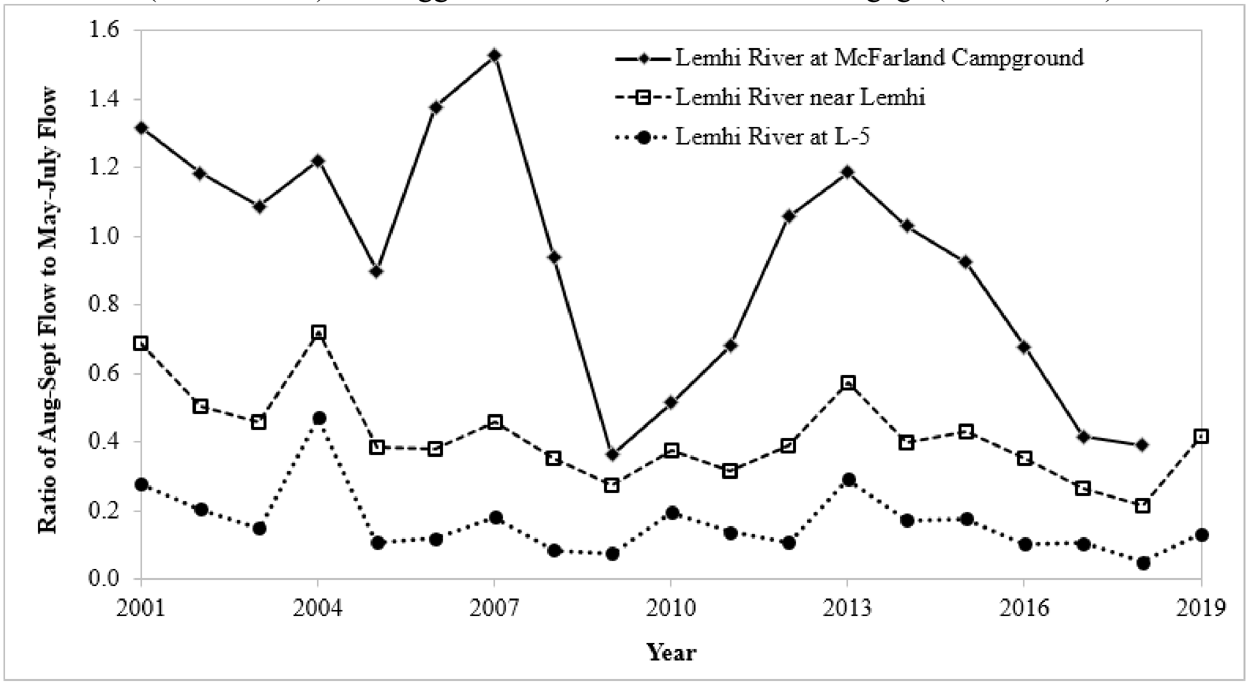
Freshwater Effects. Climate change is predicted to increase the intensity of storms, reduce winter snow pack at low and middle elevations, and increase snowpack at high elevations in northern areas. Middle and lower-elevation streams will have larger fall/winter flood events and lower late-summer flows, while higher elevations may have higher minimum flows. How these changes will affect freshwater ecosystems largely depends on their specific characteristics and location, which vary at fine spatial scales (Crozier et al. 2008b; Martins et al. 2012). For example, within a relatively small geographic area (the Salmon River basin in Idaho), survival of some Chinook salmon populations was shown to be determined largely by temperature, while in others it was determined by flow (Crozier and Zabel 2006). Certain salmon populations inhabiting regions that are already near or exceeding thermal maxima will be most affected by further increases in temperature and, perhaps, the rate of the increases. The effects of altered flow are less clear and likely to be basin-specific (Crozier et al. 2008b; Beechie et al. 2013). However, flow is already becoming more variable in many rivers, and this increased variability is believed to negatively affect anadromous fish survival more than other environmental parameters (Ward et al. 2015). It is likely that this increasingly variable flow is detrimental to multiple salmon and steelhead populations, and to other freshwater fish species in the Columbia River basin.

Stream ecosystems will likely change in response to climate change in ways that are difficult to predict (Lynch et al. 2016). Changes in stream temperature and flow regimes will likely lead to shifts in the distributions of native species and provide "invasion opportunities" for exotic species. This will result in novel species interactions, including predator-prey dynamics, where juvenile native species may either be predators or prey (Lynch et al. 2016; Rehage and Blanchard 2016). How juvenile native species will fare, as part of "hybrid food webs," which are constructed from natives, native invaders, and exotic species, is difficult to predict (Naiman et al. 2012).

Uncertainty in Climate Predictions. There is considerable uncertainty in the predicted effects of climate change on the globe as a whole, and on the Pacific Northwest in particular. Many of the effects of climate change (e.g., increased temperature, altered flow, coastal productivity, etc.) will have direct impacts on the food webs that species rely on in freshwater, estuarine, and marine habitats to grow and survive. Such ecological effects are extremely difficult to predict even in fairly simple systems, and minor differences in life-history characteristics among stocks of salmon may lead to large differences in their response (e.g. Crozier et al. 2008b; Martins et al. 2011, 2012). This means it is likely that there will be "winners and losers," meaning some salmon populations may enjoy different degrees or levels of benefit from climate change while others will suffer varying levels of harm. Climate change is expected to impact anadromous fishes during all stages of their complex life cycle. In addition to the direct effects of rising temperatures, indirect effects include alterations in flow patterns in freshwater and changes to food webs in freshwater, estuarine, and marine habitats. There is high certainty that predicted physical and chemical changes would occur; however, the ability to predict bio-ecological changes to fish or food webs in response to these physical/chemical changes is extremely limited, leading to considerable uncertainty. In addition to physical and biological effects, there is also the question of indirect effects of climate change and whether human "climate refugees" will move into the range of salmon and steelhead, increasing stresses on their respective habitats (Dalton et al. 2013; Poesch et al. 2016).

Climate change may have already affected salmonid habitat in the Pacific Northwest. Mean annual temperatures across the Northwest have increased at a rate of 0.41º F (0.23ºC) per decade during 1996-2015, possibly due to climate change (Isaak et al. 2018) and, since 1858, flows in the Columbia River have declined 8-9% due to climate change (Naik and Jay 2011). Within Idaho, temperatures have increased by 1.5º F (0.83ºC), the number of warm days and nights have increased, and precipitation has probably become more variable since 1900 (Runkle and Kunkel 2020). Within the action area, summer base flow (August-September) has decreased (Appendix A) and the ratio of summer base flow to spring runoff flow (May-July) has declined since 2001 (Figure 9). While these changes are consistent with the temperature and precipitation changes described by Runkle and Kunkel (2020), they could also be at least partially due to changes in irrigation practices. Regardless of the precise causes, the observed temperature and flow changes across the Northwest, and the flow regime changes within the action area, will likely exacerbate the adverse effects of the proposed action.

Figure 9. The ratio of summer base flow (average August-September) and spring flow (average May-July) measured at three gages in the mainstem Lemhi River from 2001 through 2019. The decline in base flow/spring flow ratio is significant at the Lemhi River at McFarland Campground gage ($P < F = 0.008$) and the Lemhi River near Lemhi gage ($P < F = 0.01$) and suggestive at the Lemhi River at L-5 gage ($P < F = 0.08$)



Summary. Climate change is expected to impact Pacific Northwest anadromous fishes during all stages of their complex life cycle. In addition to the direct effects of rising temperatures, indirect effects include alterations in stream-flow patterns in freshwater and changes to food webs in freshwater, estuarine, and marine habitats. There is high certainty that predicted physical and chemical changes will occur; however, the ability to predict bio-ecological changes to fish or food webs in response to these physical/chemical changes is extremely limited, leading to considerable uncertainty. As we continue to deal with a changing climate, management actions may help alleviate some of the potential adverse effects (e.g., hatcheries serving as a genetic reserve and source of abundance for natural populations, increased riparian vegetation to control water temperatures, etc.).

Climate change is expected to make recovery targets for Chinook salmon and steelhead populations more difficult to achieve. Climate change is expected to alter critical habitat by generally increasing temperature and peak flows and decreasing base flows. Although changes will not be spatially homogenous, effects of climate change are expected to decrease the capacity of critical habitat to support successful spawning, rearing, and migration. Habitat action can address the adverse impacts of climate change on Chinook salmon and steelhead. Examples include restoring connections to historical floodplains and freshwater and estuarine habitats to provide fish refugia and areas to store excess floodwaters, protecting and restoring riparian vegetation to ameliorate stream temperature increases, and purchasing or applying easements to lands that provide important cold water habitat and cold water refugia (Battin et al. 2007; ISAB 2007).

Some of the diversions associated with the proposed action will be authorized by 30-year SUAs and the others will be authorized with permanent easements. The effects of the proposed action will therefore likely occur while climate change-related effects are expected to become more evident within the range of the Snake River spring/summer Chinook salmon ESU and the Snake River Basin steelhead DPS. Of particular concern is the reduction in base flows, within the action area, that has been ongoing since flow records have been kept and will likely continue.

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). The proposed action will result in operation and maintenance of water diversions and water transmission facilities on NFS land in the Lemhi River watershed. Maintenance activities will affect stream channel and riparian habitat near the PODs and will also affect riparian habitat along the portion of the water transmission facilities that are in riparian habitat conservation areas (RHCAs). Operating the diversions will reduce streamflow in all reaches downstream from the PODs, including the entire mainstem Lemhi River and the mainstem Salmon River downstream from the mouth of the Lemhi River. According to guidance provided in Tehan (2014), action areas of flow related consultations should include downstream reaches in which the effect would be greater than 1% of the lowest base flows. Under this guidance, the action area includes the mainstem Salmon River from the mouth of the Lemhi River (RM 259) downstream to the mouth of the Middle Fork Salmon River (RM 199). The influx of water from the Middle Fork Salmon River doubles the size of the mainstem Salmon River such that the effect of the proposed action is less than 1% of the lowest base flows.

There are many streams in the Lemhi River watershed that do not have, and are not downstream from, water diversions on NFS land. These streams will not be affected by the proposed authorization of water diversions. However, the proposed action also includes implementation of a habitat restoration program that could result in restoration activities throughout the Lemhi River watershed. The action area therefore includes the entire Lemhi River watershed and, as described above includes the mainstem Salmon River from RM 259 downstream to RM 199. The action area is used by all freshwater life history stages of threatened Chinook salmon and steelhead and streams within the action area are designated critical habitat for Chinook salmon and steelhead. Except for areas above natural barriers to fish passage, the action area is also EFH for Chinook salmon (PFMC 1999), and is in an area where environmental effects of the proposed project may adversely affect EFH for this species.

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline 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 consultations, and the impact of state or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

The action area includes the vast majority of currently accessible spawning and rearing habitat for the Lemhi River Chinook salmon population and a large part of the accessible spawning and rearing habitat for the Lemhi River steelhead population. The Lemhi River Chinook salmon population must achieve at least maintained status (moderate risk of extinction) for the Snake River spring/summer Chinook salmon ESU to recover, but the recovery goal for the population is viable (low risk of extinction). Likewise, the Lemhi River steelhead population must achieve maintained status for the Snake River Basin steelhead DPS to recover, but the recovery goal for the population is viable. The occupied Chinook salmon designated critical habitat within the action area is absolutely necessary for continued persistence of the Lemhi River Chinook salmon population, and expansion of spawning and rearing into currently unoccupied designated critical habitat will likely be necessary for the population to recover. All of the steelhead designated critical habitat within the action area is currently occupied and is necessary for both continued persistence and recovery of the Lemhi River steelhead population.

It is worth noting that the water diversions that would be authorized by the proposed action are currently operating and are likely to continue to operate until the SUAs or easements are issued. Therefore, effects of historic and current operation and maintenance of the diversions are considered part of the Environmental Baseline section, while future effects that would occur after issuance of the permits and easements are considered effects of the action and are described in the analysis of effects sections. This temporal separation is necessary given the ongoing nature of activities that would be permitted by the proposed actions.

2.4.1 Environmental Baseline in the Mainstem Salmon River

The mainstem Salmon River portion of the action area extends from the confluence of the Lemhi River mouth (RM 259) downstream to the Middle Fork Salmon River mouth (RM 199). Neither Chinook salmon nor steelhead have been documented spawning in this reach but it may have been spawning habitat prior to development. This reach is rearing and migration habitat for the Salmon River Upper Mainstem, Valley Creek, Yankee Fork Salmon River, East Fork Salmon River, Pahsimeroi River, Salmon River Lower Mainstem, and the Lemhi River Chinook salmon populations; and rearing and migration habitat for the Salmon River Upper Mainstem, East Fork Salmon River, Pahsimeroi River, and Lemhi River steelhead populations.

Fish habitat in the mainstem Salmon River has been affected by mining, construction and maintenance of roads, livestock grazing, conversion of uplands and wetlands into agriculture land, construction and maintenance of diversions, and extensive water use for irrigated agriculture. These activities have adversely affected riparian and instream habitat in the mainstem and most tributaries, with resultant increases in water temperature and sediment; reduced access to riparian wetlands, side channels, and tributary stream habitat; and reduced cold water refugia (NMFS 2017). Although impacts on riparian and instream habitat are largely caused by activities within the action area, impacts on flow are caused by water use both within and upstream from the action area, with most use occurring upstream (Chamberlin 2006).

Water has been appropriated to irrigate approximately 147,000 acres in the Salmon River drainage upstream from the Middle Fork Salmon River. Irrigation of this amount of land results in consumptive use of about 213,150 acre-feet per year (assuming 1.45 acre feet per acre per year), or about 14% of the annual flow of the Salmon River at Shoup, Idaho (i.e., USGS gage 13307000 at RM 208). Actual amount of water diverted during the irrigation season might be as much as 2,940 cfs (assuming diversion of 0.02 cfs per acre, Idaho Code § 42-202), or about 67% of the average flow (measured at the Shoup gage) during the irrigation season (May to September), or more than 100% of the remaining base flow, suggesting that summer base flow in the mainstem Salmon River portion of the action area may be less than half the amount present prior to development of water resources. Habitat restoration actions implemented since 1992 have resulted in approximately 2,300 acres of irrigated agriculture taken out of production in the Salmon River drainage upstream from the Middle Fork Salmon River. Also, agreements to leave flow in the lower Lemhi River have slightly improved summer flow in the Salmon River. However, since 1980, an average of 93 acres of new irrigation has been added annually, suggesting that, even with habitat restoration, flow baseline conditions in the mainstem Salmon River portion of the action area have deteriorated since 1980 and are likely continuing to deteriorate. Also, since 1980 mean August flow in the Salmon River at Salmon, Idaho has declined by 355 cfs, or approximately 30%. This decline could be due to additional irrigation, increase in irrigation efficiency which reduces summer flow (Venn *et al.* 2004), to climate change, or to a combination of all of these factors. Although there are no obvious problems with fish passage, the magnitude of flow impacts suggests that instream flows in the mainstem Salmon River portion of the action area are not functioning appropriately.

The available data suggest that the mainstem Salmon River portion of the action area is not functioning appropriately for water temperature. Temperature logger data collected by the USFS are available for the mainstem Salmon River portion of the action area for August of 2000, 2007, 2009, and 2010. The maximum 7 day average of the daily maximum (DADM) temperature for these years were 21.8º (71.2ºF) in 2000, 19.3ºC (66.7ºF) in 2007, 18.9ºC (66.0ºF) in 2009, and 19.7º C (67.4ºF) in 2010 (NMFS 2016). During August, 2001, an aerial survey using Forward Looking Infrared technology recorded afternoon water temperatures greater than 22.5ºC (72.5ºF) throughout the mainstem Salmon River portion of the action area (IRZ 2002). During summer 2002, daily maximum temperatures in the Salmon River below the Lemhi River exceeded 20º C (68ºF) from late June through mid-August, peaking near 25º C (77ºF) in early July (Waterbury 2003) Although limited, the data that are available indicate that water temperature in the mainstem Salmon River portion of the action area likely exceeds all U.S. Environmental Protection Agency (EPA) and State of Idaho standards for salmonids. High summer water temperature is considered a limiting factor for anadromous salmonids in the upper Salmon River (Ecovista 2004). Factors affecting water temperature in the upper Salmon River include: reduction in flow, irrigation return flow, and reduction in shade (Ecovista 2004).

2.4.2 Environmental Baseline in the Lemhi River Drainage

The Lemhi River drainage (i.e., the Lemhi River fourth field HUC 17060204) encompasses 807,446 acres with elevations ranging from more than 10,000 feet above mean sea level (msl) in the Bitterroot and Lemhi mountains, to 3,924 feet above msl at the confluence with the Salmon

River (IDEQ 1999). The USFS, BLM, and State of Idaho administers 39.7%, 39.0%, and 3.1%, respectively, of the land in the drainage and (18.2%) is privately owned (IDEQ 1999). The mainstem Lemhi River originates at the confluence of Texas and Eighteenmile Creeks at an elevation of 5,952 feet above msl and flows approximately 60 miles north to the mouth. The Idaho Department of Environmental Quality (IDEQ) has identified 259.48 miles of streams in the Lemhi River drainage that are impaired by pollutants, primarily from non-point sources such as road and agriculture runoff (IDEQ 2012). The IDEQ also identified 90.48 miles of streams that are impaired by low flow alterations and/or other flow alterations, primarily due to water diversion and use (IDEQ 2012). However, the IDEQ only includes stream reaches that were assessed and therefore under reports the actual miles of streams that are impaired by flow alterations.

Fish habitat in the Lemhi River drainage has been affected by construction and maintenance of roads, livestock grazing, channelization and straightening of stream channels, conversion of uplands and wetlands into agriculture land, construction and maintenance of water diversions, and extensive water use for irrigated agriculture. It has also been affected by habitat restoration activities that have improved habitat in the mainstem Lemhi River and some tributary streams, and has increased connectivity between the mainstem and tributaries. Some of these activities, such as livestock grazing on federal lands, federally funded road construction and maintenance, federally permitted bank stabilization, and habitat restoration, have undergone ESA section 7 consultation. Even with ESA section 7 consultation, and habitat restoration, riparian and instream habitat in the mainstem and most tributaries continues to be adversely affected, with resultant increases in water temperature and sediment; reduced access to riparian wetlands, side channels, and tributary stream habitat; and reduced cold water refugia (NMFS 2017). Although habitat perturbations are caused by a variety of factors, many of the habitat limitations in the Lemhi River drainage are directly or indirectly related to water diversion and use.

Streamflow throughout the Lemhi River drainage is reduced by water diversions with the vast majority of diverted water being used for irrigation. There are 60,695 acres of irrigated agriculture in the Lemhi River drainage (IDWR unpublished 2009). Based on a duty of water[14] of 0.02 cfs per acre (Fereday et al. 2001), total water diversions would be approximately 1,214 cfs. However, water users in the Lemhi River drainage are allowed to divert more than their water right when flows are available (Lemhi Decree 1978) so substantially more than 1,214 cfs might be diverted during spring runoff[15]. The amount of water diverted exceeds streamflow on the mainstem and most of the tributaries. This is possible because some of the diverted water returns to streams via surface runoff and subsurface flow, making it available to be diverted again. However, some of the diverted water is consumptively used (i.e., removed from the water budget) due to evapotranspiration[16]. In the Lemhi River drainage, irrigating an acre of land for

[14] Duty of water is the amount of water customarily required to accomplish the purposes of the water right. In Idaho, the duty of water for irrigation is 0.02 cfs per acre.

[15] The terms and conditions of the NFS authorizations will limit diversion rates to the amount stipulated in the water rights.

[16] A water budget is a method for measuring the amount of water entering, stored within, and leaving a watershed. Water enters a watershed through precipitation and leaves as surface flow, subsurface flow, evaporation, and transpiration (i.e., use by plants). Evapotranspiration is a combination of evaporation and transpiration resulting

one growing season consumptively uses about 1.45 acre feet of water (Lemhi Decree 1978). Therefore, irrigating 69,959 acres removes about 88,008 acre-feet from each year's water budget. Based on flows measured near the Lemhi River mouth (i.e., USGS 13305310), 88,008 acre-feet represents 33.4% of the average annual water budget for the Lemhi River drainage. This water use completely dewaters the lower reaches of most of the tributary streams[17] for most of the irrigation season and historically dewatered the lower Lemhi River for portions of the irrigation season. Since 1960, the amount of irrigated land has increased by 5,227 acres (IDWR GIS database 2009), or approximately 9.4%, suggesting that streamflow baseline conditions have declined over the past 50 years, with a corresponding reduction in Chinook salmon productivity (see Figure 4 in Section 2.2.1.1). Improvements in irrigation and water transmission efficiency (see Section 2.2.2.1; NMFS 2017b) have likely further altered flows and population productivity.

Efforts to improve survival of anadromous salmonids in the LRPA have been ongoing since the late 1950s (Delarm and Wold 1985). Most of the early efforts involved screening of irrigation diversions to reduce entrainment of juveniles (Delarm and Wold 1985) but efforts to improve spawning, rearing, and migration habitat have been ongoing since at least the early 1990s (Uthe et al. 2017). Restoration projects are often implemented by multiple cooperating state and federal agencies, including the SCNF (see Section 1.3.3.). Short-term adverse effects are often addressed with programmatic consultations (i.e., NMFS 2000a; NMFS 2008; NMFS 2013; NMFS 2019; NMFS 2020), but some projects are covered by individual consultations. Some important milestones of habitat restoration in the LRPA include: Maintenance of flows in the lower 8.7 miles of the mainstem Lemhi River since 2002; the first documented use of reconnected tributary stream habitat by rearing juvenile Chinook salmon in 2009 (Uthe et al. 2017); and the first documented Chinook salmon spawning in Big Springs Creek in 2015 (Idaho Fish and Wildlife Information System website). Although improvements have been documented at a project or short stream reach scale (Haskell et al. 2019), documenting improvements at a population level are more difficult (see Figure 6 in Section 2.2.1.1). However, there are some indications that the cumulative effects of ongoing habitat restoration are benefiting the Lemhi River Chinook salmon population (Haskell et al. 2019; Hillman et al. 2019).

2.4.2.1 Environmental Baseline in the Mainstem Lemhi River

From a standpoint of water use, fish habitat quality and fish distribution, the mainstem Lemhi River can be divided into three reaches: (1) The lower Lemhi River, between the Salmon River and the L-6 diversion (RM 8.3); (2) The middle Lemhi River, extending from the L-6 diversion upstream to Hayden Creek (RM 30.2); and (3) The upper Lemhi River, extending from Hayden Creek upstream to the confluence of Texas and Eighteenmile Creeks. Based on a comparison of consumptive use and the annual water budget, the upper Lemhi River is the most flow impaired. During most years, the lowest flows in this reach occur in late spring, when water availability is high, and then increase slightly as summer progresses (Figure 10). The increase in flow as water

---

from irrigation. Water removed from a water budget through evapotranspiration is no longer available for surface or subsurface flow.

[17] Most of the tributary drainages constitute separate water districts that are not obligated to allow water to flow to the mainstem Lemhi River. The exceptions are Hayden Creek and Big Springs Creek, which are in the same water district as the mainstem, and therefore have to allow water to flow to the mainstem Lemhi River so it will be available to senior water users.

availability typically declines is possibly due to curtailment of irrigation withdrawals in order to satisfy senior water users downstream. Although possibly the most flow impaired, this reach has not been completely dewatered, again possibly due to requirements to deliver water to downstream users. Flow impairment notwithstanding, water temperature and condition of stream channel and riparian habitat are generally better in the upper Lemhi River than in the other two reaches. The upper Lemhi River is the primary spawning area for Chinook salmon in the mainstem Lemhi River and flow in this reach, during Chinook salmon rearing, influences juvenile Chinook salmon productivity (Arthaud et al. 2010).

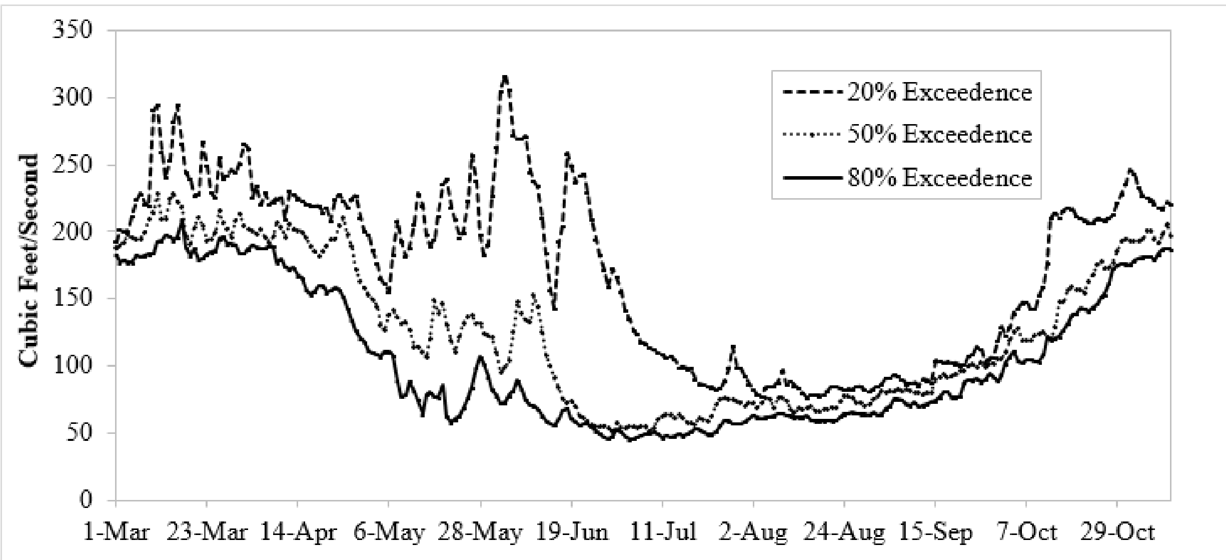


Figure 10. Daily 80%, 50%, and 20% exceedance flow at the Lemhi River at McFarland Campground gage (river mile 37) for 2011-2019.

The middle Lemhi River is the least flow impacted of the mainstem reaches. This is probably due to a combination of demand for water from senior users at the downstream end of the reach, and an influx of flow from Hayden Creek, at the upstream end (See Section 2.4.2.7). Although the least flow impaired, habitat in this reach has been degraded by past channelization and channel straightening; and the resultant channel incision, disconnection from the floodplains, etc. (NMFS 2017). Chinook salmon historically spawned throughout the middle Lemhi River (Gebbahrds 1959) but, since the 1990s, spawning in this reach has been rare and confined to the upper portions of the reach. Although currently of limited use as spawning habitat, the middle Lemhi River is probably the most important rearing reach for Lemhi River Chinook salmon, and possibly also for Lemhi River steelhead. The importance of this reach for Chinook salmon spawned in the upper Lemhi River has been known for decades but the importance for Hayden Creek fish has only become apparent since 2006 when the Hayden Creek screw trap was installed. Chinook salmon spawned in Hayden Creek, move into the middle Lemhi River earlier, at a younger age, at a smaller size, and often at higher numbers, compared to Chinook salmon spawned in the upper Lemhi River. Due to the combination of relatively reliable flows (compared to the other two reaches), importance as rearing habitat, and legacy stream channel/floodplain issues, the middle Lemhi River is a prime reach for aggressive habitat restoration. A relatively aggressive habitat restoration project (Eagle Valley Ranch project) has recently been implemented in the lower portion of the middle Lemhi River, which should improve baseline conditions and may also provide a template for future projects (NMFS 2017a).

Prior to 2001, the lower Lemhi River was regularly dewatered during the irrigation season. Through a combination of informal agreements, leasing of water rights, purchase of water rights, and modifying water diversion systems, continuous surface flow has been maintained through this reach since 2001. The current minimum flows are 35 cfs for 80% of the time from the start of the irrigation season to July 1, and 25 cfs for the other 20% of that time; and 25 cfs from July 1 through the end of the irrigation season. Stream habitat quality in the lower Lemhi River is relatively poor, characterized by long riffles and few pools. The lower Lemhi River was historically spawning habitat (Gebbahrds 1959) and is currently rearing habitat but, due to poor habitat quality, it is primarily utilized as migration habitat.

The current minimum flow of 25 cfs is approximately 6.5% of the unimpaired mean annual discharge, which is substantially less than the absolute minimum recommended by Tenant (1976) (i.e., 10% of mean annual discharge) to protect aquatic resources in montane streams. A flow of 25 cfs in this reach also does not meet the Thompson (1972) minimum depth criteria for migrating adult Chinook salmon (Waterbury 2003). But Chinook salmon have been documented migrating through this reach when flows were 25 cfs, so some passage is possible at the current minimum flow. The proportion of the Chinook salmon run migrating into the Lemhi River after July 14 is related to flow in the lower Lemhi River (see Figure 2 in section 2.2.1.1), suggesting that increasing late season flows would improve success of late migrants, potentially improving both population diversity and abundance. Although habitat function, and specifically fish passage, in the lower Lemhi River is better than it was prior to 2001, additional restoration is needed to meet the bare minimums needed for acceptable habitat function.

The three-mainstem Lemhi River gages with records beginning prior to 2000 show moderate long-term declines in summer baseflow (August-September). They also show that there has been a substantial reduction in the ratio of summer baseflow to spring (May-July) flow (Figure 9). The long-term declines could be due to increased amount of irrigation over time, but there has been little to no increase in irrigated acreage since 2000, suggesting that the change in the ratio of baseflow to spring flow is due to climate change, changes in irrigation practices, or to a combination of climate change and irrigation practices. Modernizing irrigation systems can adversely affect water budgets (Ward and Pulido-Velazquez 2008; Contor and Taylor 2013) and base flows (Venn et al. 2004), and the general trend in the Lemhi River drainage is a shift to more modern irrigation systems. There could also be a synergic effect of climate change and irrigation, if a warming climate results in longer growing seasons and higher evapotranspiration rates (Van Kirk and Naman 2008). Regardless of the mechanisms driving the baseflow changes, achieving recovery objectives for the Lemhi River Chinook salmon and steelhead populations will be more difficult if the current trends continue.

2.4.2.2 Environmental Baseline in Eighteenmile, Hawley, and Big Bear Creeks

Habitat in lower Big Bear Creek is generally in good condition with a vigorous riparian community, stable streambanks, inputs of large wood, and at least adequate habitat complexity. The only water diversion is the one that would be authorized by the proposed action and the future (i.e., after authorization) baseline condition for flow is therefore unimpaired. There is a culvert at the Forest Service Road 279 crossing that may be a partial barrier to fish passage, but otherwise, habitat in the action area portion of Big Bear Creek is generally in good condition and is possibly in very good condition.

Habitat quality in Hawley Creek ranges from nearly pristine to extremely degraded. There are two streamflow gages on Hawley Creek, one approximately 7.6 miles upstream from the mouth and upstream from most of the diversions (Upper Gage), and one approximately 0.5 miles upstream from the mouth and downstream from all of the diversions (Lower Gage). There are no tributaries between these gages. The shape of the hydrograph at the upper gage is typical for unimpaired streams in the area, with high flows occurring from May through July and base flows for the remainder of the year (Figure 11). In contrast, flow at the lower gage is typically very low from early May through late October with "normal" base flows for the remainder of the year (Figure 12). In spite of the lack of tributaries between the gages, "base" flow, outside of the irrigation season, is approximately 60% higher at the Lower Gage compared to the Upper Gage, suggesting substantial ground water influence. The relatively high base flows (i.e., approximately half the magnitude of peak flows) measured at the Upper Gage suggest that Hawley Creek may have historically been very high quality rearing habitat.

For many years, habitat conditions in the Eighteenmile Creek drainage were among the worst in the Lemhi River subbasin. Until 2005, the lower six miles of Hawley Creek was dried year round by an earthen dam that diverted the entire flow into an irrigation ditch. In 2005, the dam was replaced with a headgate/check structure that allowed water to flow in the historic Hawley Creek channel during the non-irrigation season (Morris and Sutton 2007). Initially, this restored surface flow failed to make it to Eighteenmile Creek because the Hawley Creek channel was so degraded from decades of dewatering (Morris and Sutton 2007). Improved stream channel function since 2006 has facilitated improved flows such that lower Hawley Creek is currently dewatered for only short periods during relatively dry years, although the hydrograph remains substantially impaired (Figure 12).

Like Hawley Creek, Eighteenmile Creek was captured by an irrigation ditch (the Whitefish Ditch), which removed most of the flow year round. The Whitefish Ditch was removed in 2008, restoring connection of Eighteenmile Creek to the Lemhi River. Numerous habitat restoration projects have been implemented since 2005, resulting in removal of fish passage barriers, screening of diversions, installation of beaver dam analogs, and improved efficiency of diversion/irrigation systems. Fish sampling and PIT tag scanning array data collected since 2013 indicates that adult and juvenile steelhead are utilizing habitat in Eighteenmile and Hawley Creeks, and juvenile Chinook salmon are rearing in lower Eighteenmile Creek. Although no Chinook salmon spawning has been documented, one PIT tagged adult Chinook salmon was detected migrating up Eighteenmile Creek in 2018, indicating that reestablishment of Chinook salmon spawning is possible. There was a streamflow gage on lower Eighteenmile Creek that operated from June, 2008 through October, 2009. Although limited, data from that gage indicate that surface flow in lower Eighteenmile Creek extends through the irrigation season, but is probably not sufficient for unimpaired upstream passage for adult Chinook salmon or steelhead (Figure 13). However, habitat restoration that has been implemented in upstream reaches since 2009 may have improved summer flows in lower Eighteenmile Creek.

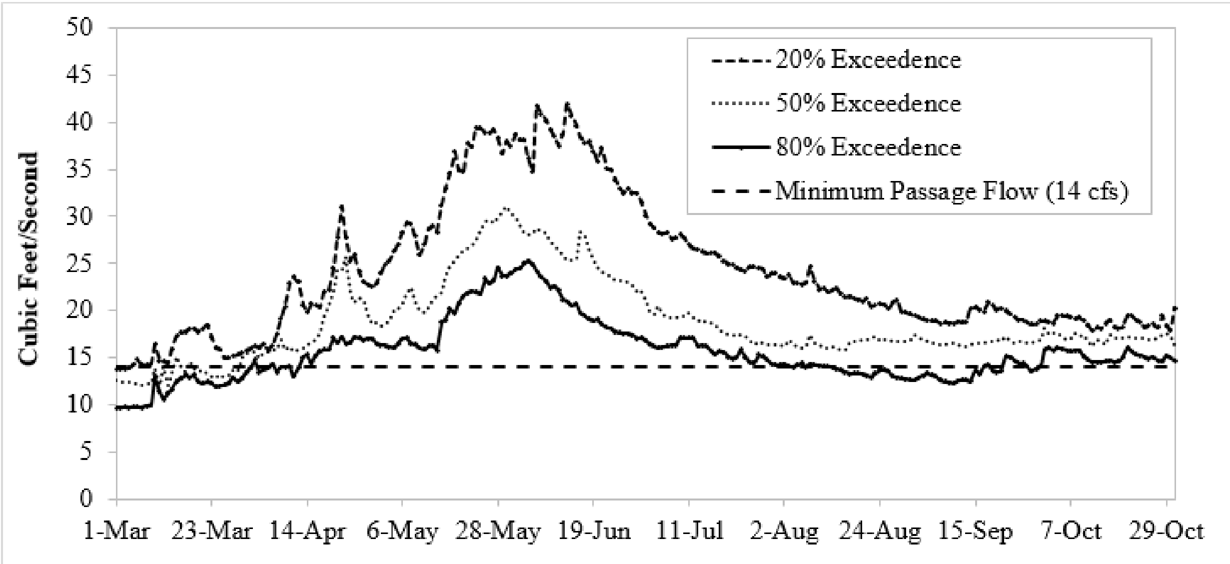


Figure 11. Daily 80%, 50%, 20% exceedance flow and the minimum flow needed to meet minimum passage depths in upper Hawley Creek Gage, located approximately 7.6 miles upstream from the confluence of Hawley and Eighteenmile Creeks.

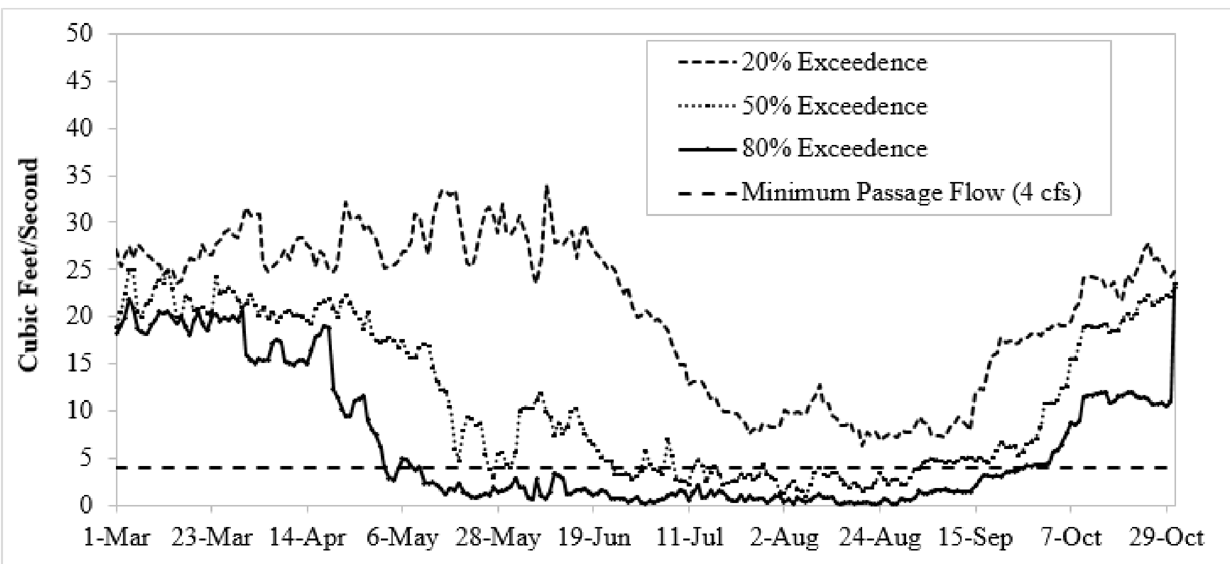


Figure 12. Daily 80%, 50%, 20% exceedance flow and the minimum flow needed to meet minimum passage depths at the lower Hawley Creek gage, located approximately 0.5 miles upstream from the confluence of Hawley and Eighteenmile Creeks.

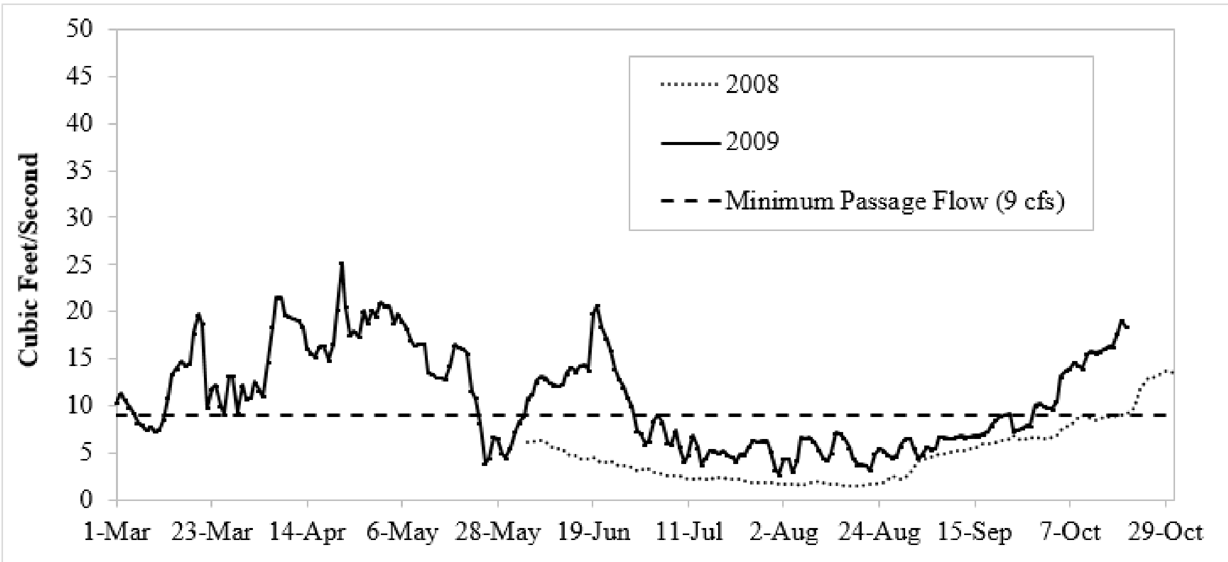


Figure 13. Daily flow in 2008 and 2009 and the minimum flow needed to achieve minimum passage depth, in lower Eighteenmile Creek, approximately 0.68 miles upstream from the confluence of Eighteenmile and Texas Creeks.

Depth versus streamflow relationships presented in Morris and Sutton (2007) suggest that water depth in lower Hawley Creek would be sufficient for passage at a flow of approximately four cfs. Based on data from the PIT tag-scanning array near the mouth of the Lemhi River, adult Chinook salmon could be migrating upstream in the Lemhi River from May 1 through September 15. Flows in lower Hawley Creek are less than the minimum to achieve passage depths for 96% of that time during 80% exceedance years and 46% of that time during 50% exceedance years (Figure 12). During 20% exceedance years, passage in lower Hawley Creek is possibly not appreciably limited by flow. Assuming that adult steelhead migrate upstream in the Lemhi River and tributaries from February 1 through May 31, flows in lower Hawley Creek are less than the minimum needed to achieve adequate passage depths for 21% of the migration in 80% exceedance years, 1.6% of the time during 50% exceedence years, and are possibly not limited by flow during 20% exceedence years (Figure 12). However, the depth versus flow data presented in Morris and Sutton (2007) were taken approximately six miles upstream from the mouth and are therefore not likely applicable to the entire lower Hawley Creek reach. Also, the Hawley Creek stream channel has changed substantially and data collected 15 years ago may not be representative of current conditions.

Baseline conditions in Big Bear Creek are generally good and habitat in Big Bear Creek is probably utilized by spawning and rearing steelhead. Baseline conditions in the lower six miles of Hawley Creek have improved dramatically since 2005 and habitat in Hawley Creek is utilized by both adult and juvenile steelhead. Baseline conditions in the lower two miles of Eighteenmile Creek have also improved; habitat in that reach is utilized by adult steelhead, juvenile steelhead, and juvenile Chinook salmon; and adult Chinook salmon are at least occasionally present.

Although baseline conditions have improved and Chinook salmon and steelhead have recolonized habitat in the Eighteenmile Creek drainage, summer flow in the lower reaches of both Hawley and Eignteenmile Creeks remain low and are likely impairing recolonization of habitat, especially for Chinook salmon.

2.4.2.3 Environmental Baseline in Texas and Deer Creeks

Unlike most Lemhi River tributaries, surface flow is present in the lower reaches of Texas Creek throughout the irrigation season, although it has been greatly reduced by water diversion and use. As is typical, information on steelhead spawning is lacking, but presence of juvenile *O. mykiss* in the upper reaches suggests that steelhead spawn in Texas Creek. Fish sampling data are not available for the lower ten miles of Texas Creek. However, Chinook salmon spawning in Texas Creek would likely have been noticed, so we presume that Chinook salmon do not currently spawn in Texas Creek. Because lower Texas Creek has consistent surface flow and is adjacent to known occupied Chinook salmon spawning and rearing habitat, we also presume that juvenile Chinook salmon are likely present in the lower reaches of Texas Creek. Riparian and stream channel habitat in the lower 2.5 miles of Texas Creek are in relatively good condition, but the reach immediately upstream is channelized and has little riparian vegetation. In Lemhi River tributaries that do not currently have Chinook salmon spawning, rearing is limited to the lowest one to three miles. Because Texas Creek is adjacent to occupied Chinook salmon habitat, habitat quality in the lower 2.5 miles is conducive to Chinook salmon rearing, and juvenile Chinook salmon rear as far as three miles upstream from spawning habitat, we presume that rearing Chinook salmon utilize the lower 2.5 miles of Texas Creek. Because Chinook salmon rearing is limited to the lowest one to three miles of non-spawning tributaries, and because habitat quality upstream from mile 2.5 is poor, we presume that Chinook salmon rearing upstream from mile 2.5 is negligible.

There are two streamflow gages on Texas Creek, one located approximately 400 feet, and the other approximately 4.9 miles, upstream from the mouth. Both gages show baseflow conditions extending through the peak runoff months (i.e., May and June) indicating that flow is heavily impacted by water use (Figures 14 and 15). However, based on data from these two gages, water use does not completely dewater Texas Creek. The lack of a period of regular dewatering is unusual among Lemhi River tributaries and suggests that flow is not as heavily impacted as it is in most Lemhi River tributary streams. These streamflow gage data also suggest that Chinook salmon and steelhead likely use Texas Creek more than most other tributaries.

Depth versus streamflow relationship data are not available for Texas Creek. Based on habitat studies in the two adjacent tributary drainages (Eighteenmile Creek and Big Timber Creek), we presume that adequate passage depth for migrating Chinook salmon and steelhead in Texas Creek corresponds to a flow of about 10 cfs. Based on data from the PIT tag-scanning array near the mouth of the Lemhi River, adult Chinook salmon could be migrating upstream in the Lemhi River from May 1 through September 15. Flows near the mouth of Texas Creek are less than the minimum to achieve passage depths for 79% of that time during 80% exceedance years and 37% of that time during 50% exceedance years (Figure 14). During 20% exceedance years, passage in lower Texas Creek is possibly not appreciably impaired by low flows. Assuming that adult steelhead migrate upstream in the Lemhi River and tributaries from February 1 through May 31, flows in lower Texas Creek are less than the minimum needed to achieve adequate passage depths for 1.7% of the migration in 80% exceedance years (Figure 14). In 50% and 20% exceedance years, steelhead migration is possibly not impaired by low flows in lower Texas Creek.

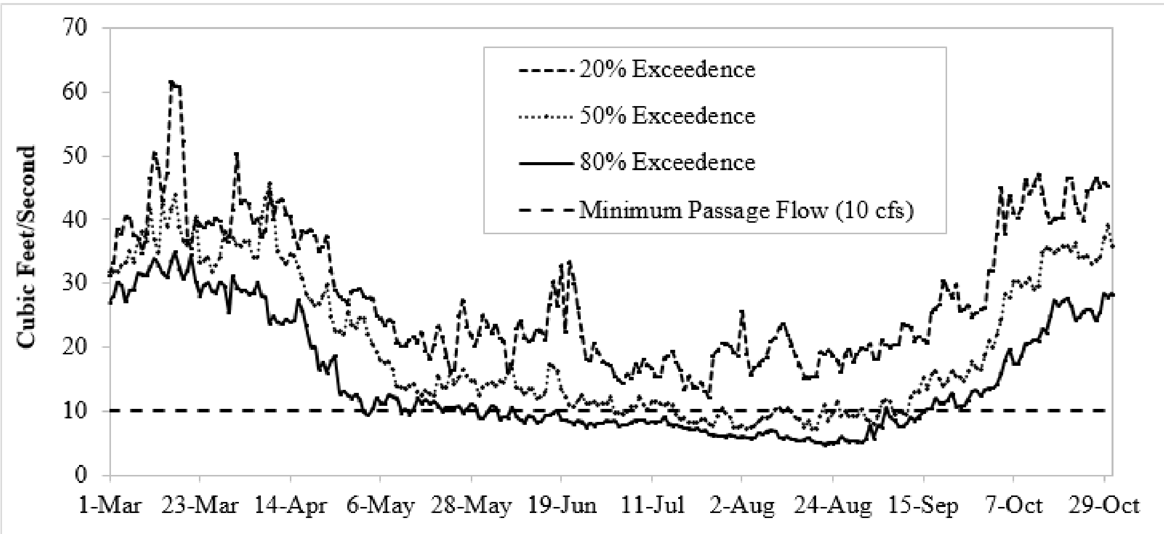


Figure 14. Daily 80%, 50%, 20% exceedance flow and the assumed minimum flow needed to meet minimum passage depths in lower Texas Creek (Lemhi River above L-63 Diversion Gage). The assumed minimum passage flow was based on surveys in nearby, similarly sized tributaries. The Lemhi River above L-63 Diversion Gage is approximately 400 feet upstream from the confluence of Texas and Eighteenmile Creeks.

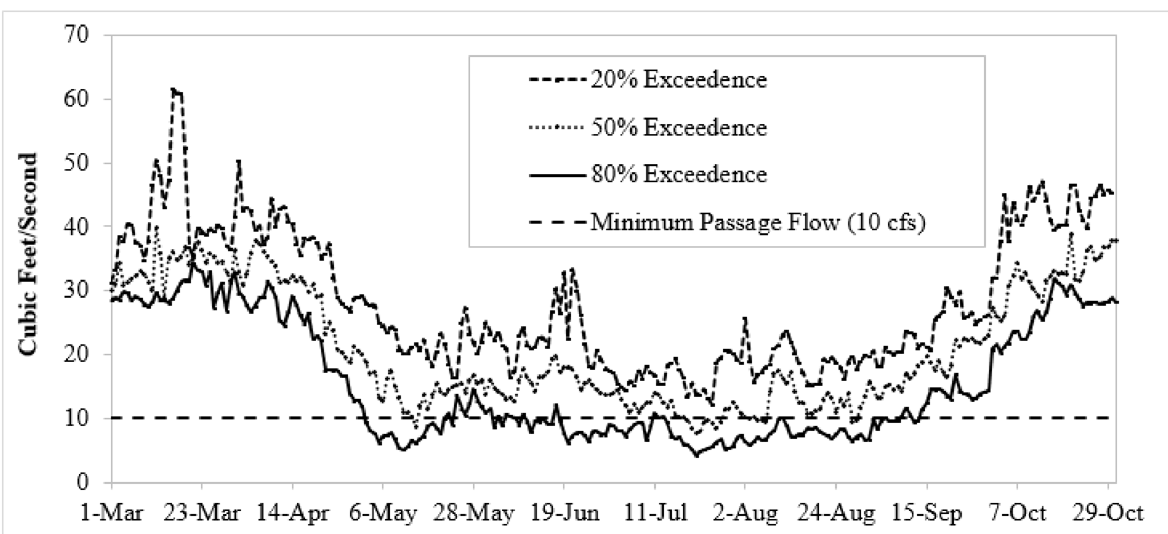


Figure 15. Daily 80%, 50%, 20% exceedance flow and the assumed minimum flow needed to meet minimum passage depths at the Texas Creek gage, located approximately 4.9 miles upstream from the confluence of Texas and Eighteenmile Creeks. The assumed minimum passage flow was based on surveys in nearby, similarly sized tributaries.

At the upper Texas Creek gage, approximately 4.9 miles upstream from the mouth, flows are less than needed to achieve minimum passage depths for 15% of the steelhead migration in 80% exceedance years, and would likely meet minimum passage depths throughout the steelhead migration during 50% and 20% exceedence years. For Chinook salmon, flows are less than needed to achieve minimum passage depths for 62% of the time in 80% exceedence years, 3.6% of the time in 50% exceedence years, and would likely not impair Chinook salmon migration in 20% exceedence years. If adult Chinook salmon were able to get past seasonal barriers at irrigation diversions, they would probably have enough flow to migrate upstream in Texas Creek during most years.

Deer Creek historically flowed into Texas Creek approximately 14 miles upstream from the confluence of Texas and Eighteenmile Creeks. The lower 1.3 miles of Deer Creek historically flowed over an alluvial fan and through at least three separate channels. Because the creek flowed through multiple channels over an alluvial fan, it may have been too shallow for upstream fish passage for much of the year. Historic salmonid occupancy of Deer Creek is therefore unknown. As described in Section 1.3.1.1, the Deer Creek Diversion currently operates year round, diverting 90-100% of the flow into the ditch. This consolidates lower Deer Creek and moves it to the south, so that it flows into Texas Creek one to two miles upstream from the historic Deer Creek mouths. This condition has probably persisted since the early 1900s and has eliminated most habitat functions in the lower 1.9 miles of the historic Deer Creek stream channels. However, the presence of bull trout (*Salvelinus confluentus*) and brook trout (*S. fontinalis*) in Deer Creek (upstream from the diversion) suggests that the ditch provides some connectivity to Texas Creek. Also, riparian and stream channel habitat have developed along and within the ditch, and the ditch likely provides habitat function similar to a "natural" stream that has been extensively straightened. The Texas Creek number 13 diversion ditch intercepts both the Deer Creek ditch and the historic Deer Creek stream channels, substantially impairing functional connectivity between Deer and Texas Creeks. Deer Creek is not designated critical habitat for steelhead and *O. mykiss* and have not been documented in Deer Creek or in the Deer Creek diversion ditch. Because historic fish passage conditions in Deer Creek are unknown, status of Chinook salmon designated critical habitat is also unknown.

2.4.2.4 Environmental Baseline in Big Timber Creek

Big Timber Creek was historically spawning and rearing habitat for Chinook salmon and steelhead but a combination of physical fish passage barriers and dewatering eliminated access for Chinook salmon, probably in the early 1900s, and greatly reduced access for steelhead. In 2006, IDFG, in conjunction with multiple state and federal agencies and private land owners, implemented a program to reestablish anadromous fish access to habitat in Big Timber Creek. To date, the program has removed numerous fish passage barriers by modifying water diversion structures, and replacing one road culvert, so that the structures meet fish passage criteria. The program has also established a minimum streamflow of 6.0 cfs, in the lower two miles of Big Timber Creek. This was accomplished by transferring senior Big Timber Creek water rights from the historic POD on lower Big Timber Creek to a new POD downstream on the mainstem Lemhi River. Although there are no instream flow water rights for Big Timber Creek, the minimum flow is maintained by "calling" for the water at the new POD on the Lemhi River, thus converting lower Big Timber Creek to a delivery reach. During most years, this arrangement regulates flow in lower Big Timber Creek from early-July through the end of September.

Chinook salmon do not currently spawn in Big Timber Creek but juveniles rear in the lower reaches. Rearing Chinook salmon were first documented in Big Timber Creek in 2012 with increased numbers, and upstream distribution, observed in subsequent years (Uthe et al. 2017). Although the lower 6.7 miles of Big Timber Creek are free of physical fish passage barriers, streamflow, albeit improved, remains inadequate for adult Chinook salmon passage (Figure 16). As of 2016, the lower three miles of Big Timber Creek was occupied by juvenile Chinook salmon and adult Chinook salmon remained absent.

Some steelhead may have been present in Big Timber Creek prior to restoration, but their numbers and distribution have generally increased since implementation of the reconnection program (Uthe et al. 2017). The Carey Act Diversion Dam, located 6.7 miles upstream from the mouth of Big Timber Creek, is a barrier to upstream fish passage when the diversion is operating (i.e., when the riser boards are in place), but adult steelhead can probably pass when the diversion is not operating. This leaves two possible windows for adult steelhead to migrate past the dam, one in the early spring prior to irrigation turn on and one during the irrigation season when diversion is curtailed to satisfy senior water users. The water rights served by the Carey Act Diversion are junior and are sometimes curtailed as early as late May, likely facilitating some adult steelhead passage during the latter part of the migration. Large number of juvenile steelhead have been captured and tagged upstream from the Carey Act Dam and some of those have been detected at dams in the Columbia and Snare Rivers migrating to the ocean. Because the Dam is likely passible during parts of the adult steelhead migration and large numbers of juvenile steelhead are present upstream from the Dam, we presume that steelhead occupy habitat in Big Timber Creek upstream from the Carey Act Dam.

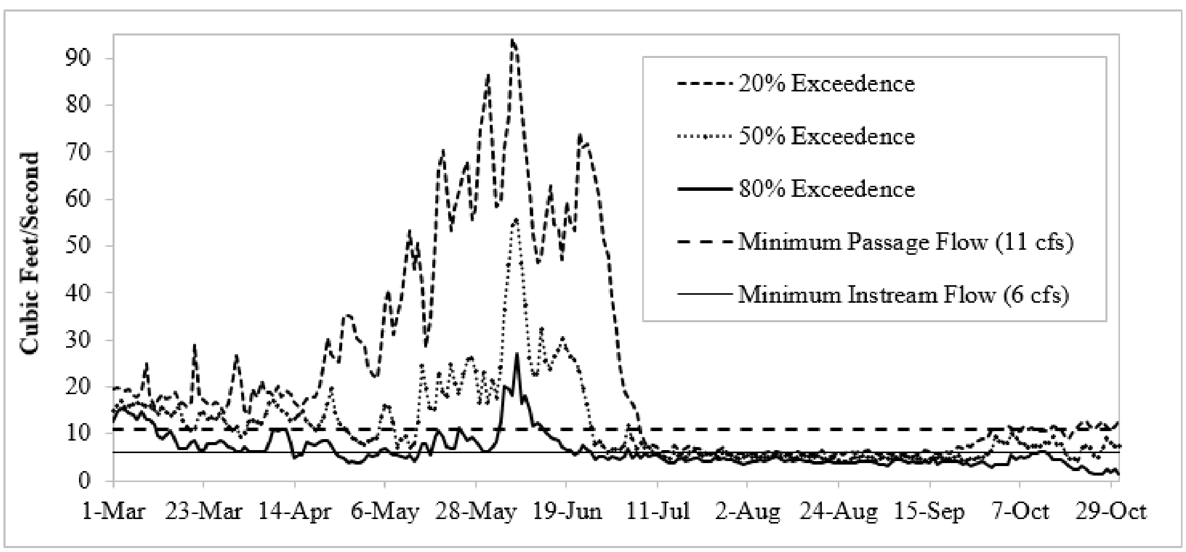


Figure 16. Daily 80%, 50%, 20% exceedance flow; the minimum flow needed to meet minimum passage depths; and the minimum instream flow at the Big Timber Creek lower gage, located approximately one mile upstream from the Lemhi River. The minimum passage flow is from Sutton and Morris (2004).

There are two streamflow gages on Big Timber Creek, one located approximately one mile, and the other approximately 6.9 miles, upstream from the mouth. The upstream gage is upstream from 87% of the water diversion and therefore represents a near natural hydrograph (Figure 17), whereas the downstream gage is downstream from all of the water diversions and therefore represents the most flow impaired reach of Big Timber Creek. However, unlike the upper mainstem Lemhi River, and some of the other tributary streams, flow in lower Big Timber Creek regularly peaks during spring runoff (early May through mid-July), indicating that during most years, flow during spring runoff exceeds the demand by water users. During the base flow period (mid-July through the end of the irrigation season) flow in lower Big Timber Creek is maintained by water use agreements established through the Big Timber Creek reconnection program.

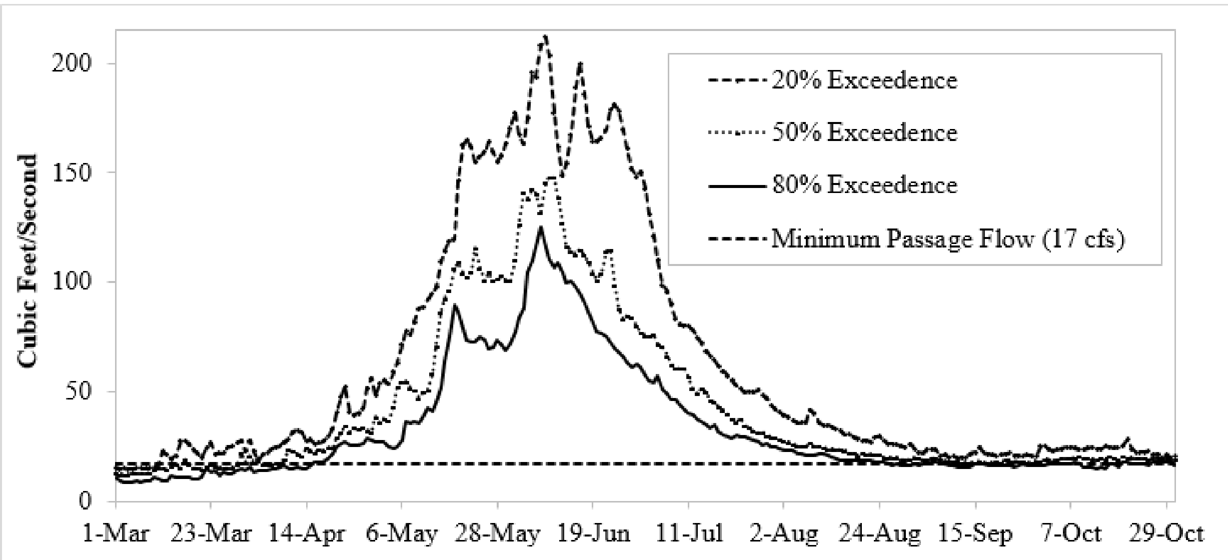


Figure 17. Daily 80%, 50%, 20% exceedance flow and the minimum flow needed to meet minimum passage depths at the Big Timber Creek upper gage, located approximately 6.9 miles upstream from the Lemhi River. The minimum passage flow is from Sutton and Morris (2004).

Based on data from the PIT tag-scanning array near the mouth of the Lemhi River, adult Chinook salmon could be migrating upstream in the Lemhi River from May 1 through September 15. Flows near the mouth of Big Timber Creek are less than the minimum needed to achieve passage depths for 90% of that time during 80% exceedence years, 65% of that time during 50% exceedence years, and 51% of that time during 20% exceedence years (Figure 17). Assuming that adult steelhead migrate upstream in the Lemhi River and tributaries from February 1 through May 31, flows in lower Big Timber Creek are less than the minimum needed to achieve adequate passage depths for 71% of the migration in 80% exceedence years, and 16% of the migration in 50% exceedence years. During 20% exceedence years, flows are likely sufficient for unimpaired steelhead migration into Big Timber Creek.

Basin Creek flows into Big Timber Creek approximately 0.5 miles upstream from the Carey Act Diversion dam and the Basin Creek Complex diversions are approximately 4.4 miles upstream from Big Timber Creek. The Big Timber Creek diversion is approximately 10.7 miles upstream from the mouth of Big Timber Creek and approximately four miles upstream from the Carey Act

Diversion Dam. Because both diversions are upstream from the Carey Act Diversion Dam, neither is in currently occupied anadromous fish habitat. However, because there are no known natural fish barriers in Basin or Big Timber Creeks, downstream from the diversions, both are in Chinook salmon designated critical habitat. Neither Basin nor Big Timber Creeks are designated critical habitat for steelhead.

2.4.2.5 Environmental Baseline in Canyon Creek

Water rights in the Canyon Creek drainage have a combined maximum diversion rate of 21.1 cfs, which is used to irrigate 1,015.6 acres. There are an additional 30.1 cfs of high flow supplements that can be diverted during times when water availability is sufficient to satisfy all of the water rights.[18] There is one gage in Canyon Creek, located 0.14 miles upstream from the mouth that has been in operation since 2008. Efforts to improve flow in lower Canyon Creek have been ongoing since 1999 and the gage data indicate that complete dewatering has not occurred since 2010; however, flows have approached 1.0 cfs as recently as the summer of 2018. During normal to wet years, there are small peaks in flow during spring runoff, but during dry years, baseflow conditions extend through the irrigation season (Figure 18).

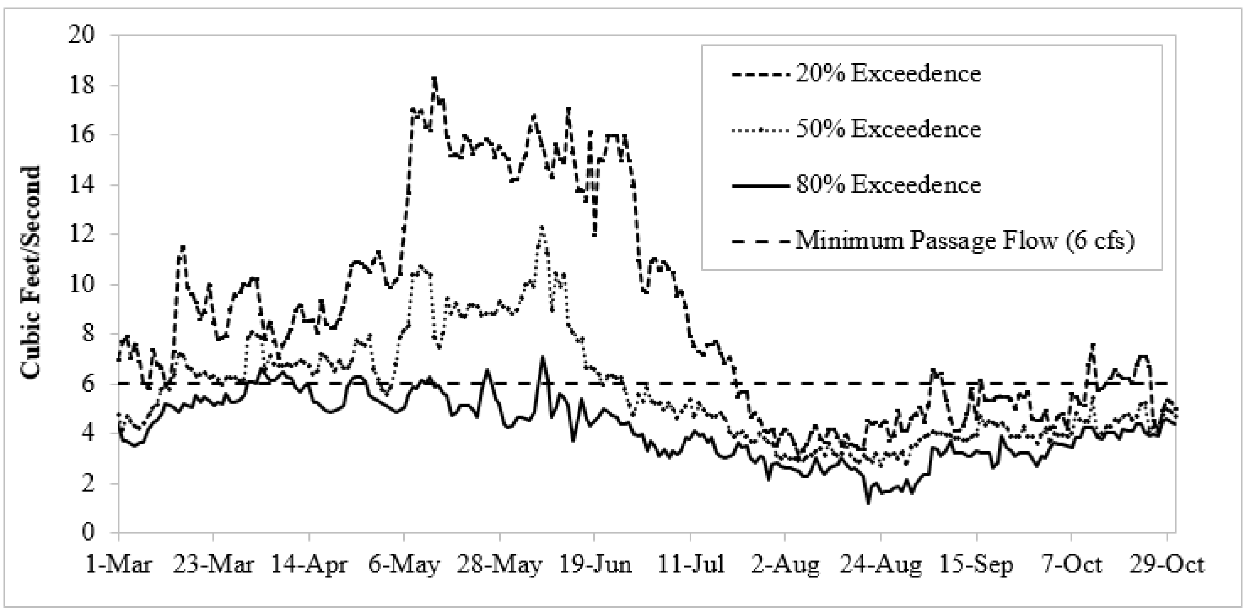


Figure 18. Daily 80%, 50%, 20% exceedance flow and the minimum flow needed to meet minimum passage depths at the Canyon Creek gage, located approximately 1.4 miles upstream from the Lemhi River. The minimum passage flow is from Sutton and Morris (2004).

Canyon Creek was historically used as spawning and rearing habitat by both Chinook salmon and steelhead, but anadromous fish access was eliminated in the early 1900s by a combination of physical passage barriers and dewatering. Prior to 2007, the Whitefish Ditch crossed Canyon Creek approximately 0.21 miles upstream from the mouth. This ditch captured all of the

[18] The point of diversion for approximately four cfs of Canyon Creek water rights have been transferred to the upper Lemhi River as part of a project to improve streamflow in lower Canyon Creek.

remaining flow[19] in Canyon Creek and was a physical barrier to fish passage. Habitat restoration in Canyon Creek began in 1999, but prior to 2007 improvements in flow and fish passage were limited. In 2007, the Whitefish Ditch was removed, which reestablished fish passage at the ditch and improved flow between the ditch and the Lemhi River. Subsequent projects further improved flow in the lower 1.25 miles of Canyon Creek, but low flows during the irrigation season continue to constitute a partial barrier to fish migration in the lower 1.25 miles of Canyon Creek (Figure 18).

There are currently two physical fish passage barriers in Canyon Creek, one located at an irrigation diversion, 1.5 miles upstream from the mouth, and the other at a culvert crossing of Highway 28, located 4.9 miles upstream from the mouth. The lower barrier likely blocks all Chinook salmon upstream movement, but adult steelhead can probably migrate past it during high flows in the spring. The Highway 28 culvert may be a complete upstream barrier, but some adult steelhead could possibly migrate past it during wet years. Juvenile Chinook salmon were first documented in the lower 1.5 miles Canyon Creek in 2011 and they appear to be consistently using that reach as rearing habitat (Uthe et al. 2017). Although *O. mykiss* are distributed throughout the drainage, the anadromous life history form (i.e., steelhead) is probably confined to the lower 4.9 miles below the Highway 28 culvert. Adult steelhead have been documented migrating into Canyon Creek, but adult Chinook salmon are currently absent.

Based on data from the PIT tag-scanning array near the mouth of the Lemhi River, adult Chinook salmon could be migrating upstream in the Lemhi River from May 1 through September 15. Flows near the mouth of Canyon Creek are less than the minimum to achieve passage depths for 85% of that time during 80% exceedence years, 48% of that time during 50% exceedence years, and 34% of that time during 20% exceedence years (Figure 18). Assuming that adult steelhead migrate upstream in the Lemhi River and tributaries from February 1 through May 31, flows in lower Canyon Creek are less than the minimum needed to achieve adequate passage depths for 76% of the migration in 80% exceedence years, for 35% of the migration in 50% exceedence years, and for 16% of the time in 20% exceedence years.

The Canyon Creek Complex is upstream from currently occupied anadromous fish habitat, but resident *O. mykiss* are present throughout Canyon Creek, including near the Canyon Creek Diversion 4 and the historic mouths of Hood Gulch Creek and the Unnamed Tributary. Canyon Creek is designated critical habitat for Chinook salmon and, if Hood Gulch Creek and the Unnamed Tributary were accessible to rearing salmonids in their undeveloped state, then they are also Chinook salmon designated critical habitat. Neither Canyon Creek, Hood Gulch Creek, nor the Unnamed Tributary are designated critical habitat for steelhead.

2.4.2.6 Environmental Baseline in Eightmile and Devils Canyon Creeks

There are numerous diversions on non-NFS lands in the Big Eightmile Creek drainage. It is difficult to determine the exact number of PODs with available information, but diversions in the Big Eightmile Creek drainage serve approximately 58 water rights (including high flow supplements) that are used to irrigate 5,385 acres. The combined maximum diversion rate is

[19] The Whitefish Ditch diverted water from springs in the Eighteenmile Creek drainage, but it also captured any flow that remained in Canyon Creek after the Canyon Creek drainage water rights had been satisfied.

probably between 122 cfs and 206 cfs, depending on how high flow supplements are administered. There are two gages on Big Eightmile Creek, located approximately 3.8 miles and 7.3 miles upstream from the Lemhi River. Flows at the upper gage are relatively unimpaired, with baseflow conditions beginning in mid to late-summer and extending until late winter (Figure 19). In contrast, flows at the downstream gage are affected by numerous water diversion, with peak flows during spring runoff approximately half of those at the upstream gage, and with baseflow conditions beginning earlier, and more suddenly (Figure 20). The lowest reach of Big Eightmile Creek was historically dewatered, but complete dewatering has probably not occurred since removal of the Lemhi Big Springs Creek-05 (LBSC-05) ditch in 2012-2013.

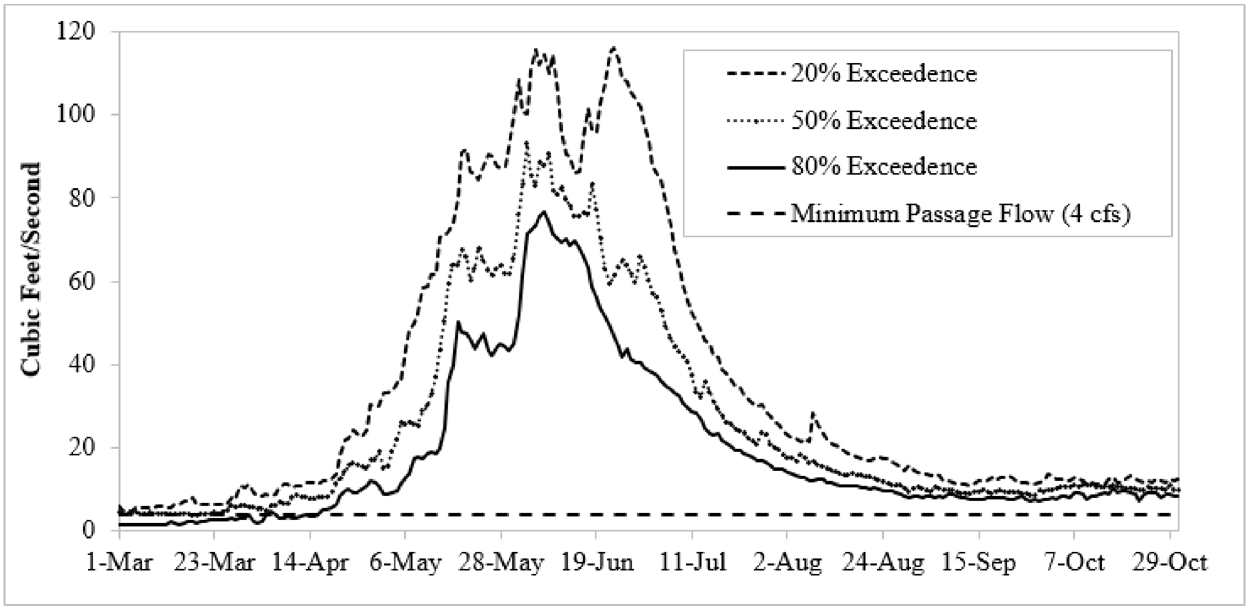


Figure 19. Figure 19. Daily 80%, 50%, 20% exceedance flow and the minimum flow needed to meet minimum passage depths at the Big Eightmile upper gage, located approximately 7.2 miles upstream from the Lemhi River. The minimum passage flow is from Sutton and Morris (2005).

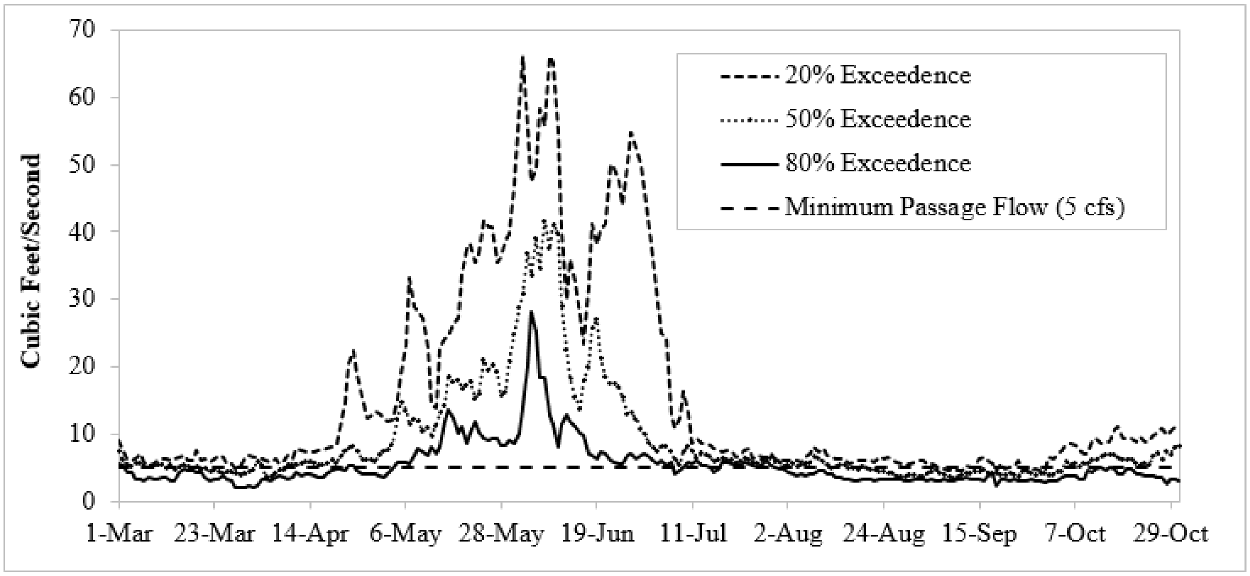


Figure 20. Daily 80%, 50%, 20% exceedance flow and the minimum flow needed to meet minimum passage depths at the Big Eightmile lower gage, located approximately 3.8 miles upstream from the Lemhi River. The minimum passage flow is from Sutton and Morris (2005).

Big Eightmile Creek was historically spawning and rearing habitat for steelhead, rearing habitat for Chinook salmon, and was probably spawning habitat for Chinook salmon, although due to the small size of the creek, Chinook salmon spawning may have only occurred during certain conditions (e.g., during wet years and/or during years with large adult returns). Anadromous fish access to Big Eightmile Creek was eliminated in the early 1900s by physical barriers associated with water diversions. The most downstream of these was the LBSC-05 ditch that crossed Big Eightmile approximately 0.5 miles upstream from the mouth, was a complete barrier to upstream fish passage, and dewatered the lower 0.5 miles of Big Eightmile Creek. In 2012 and 2013, the LBSC-05 ditch was piped under Big Eightmile Creek thereby eliminating the fish passage barrier and rewatering the lower 0.5 miles of Big Eightmile Creek. Juvenile Chinook salmon were first documented rearing in the lower 1.0 miles of Big Eightmile Creek in 2014 (unpublished data obtained from the StreamNet Data Store https://app.streamnet.org/datastore_search_classic.cfm?id=703&keywords=roving) and subsequent sampling and PIT tag-scanning array data[20] indicates that Chinook salmon are consistently rearing and overwintering in lower Big Eightmile Creek. Steelhead rearing has been documented in Big Eightmile Creek as far as 6.2 miles upstream from the mouth and the PIT tag-scanning array data indicates that adult steelhead successfully migrate into Big Eightmile Creek.

Based on data from the PIT tag-scanning array near the mouth of the Lemhi River, adult Chinook salmon could be migrating upstream in the Lemhi River from May 1 through September 15. Flows at the lower Big Eightmile Creek gage are less than the minimum to achieve passage depths for 35% of that time during 80% exceedence years, 20% of that time during 50% exceedence years, and 4% of that time during 20% exceedence years (Figure 20).

[20] IDFG installed a PIT tag-scanning array approximately 0.3 miles upstream from the mouth of Big Eightmile Creek in 2015.

However, there are numerous water diversions between the lower gage and the mouth and discrete flow measurements suggest that flow in lower Big Eightmile Creek is rarely suitable for upstream migration of adult Chinook salmon.

Assuming that adult steelhead migrate upstream in the Lemhi River and tributaries from February 1 through May 30, flows at the lower Big Eightmile Creek gage are less than the minimum needed to achieve adequate passage depths for 57% of the migration in 80% exceedence years, and for 15% of the migration in 50% exceedence years, and less than 1% of the time during 20% exceedence years. However, there are numerous water diversions between the lower gage and the mouth and discrete flow measurements suggest that, during the irrigation season, flow near the mouth of Big Eightmile Creek is substantially less than it is at the lower gage. Because steelhead migration begins before the irrigation season and extends through the spring runoff, flows might be adequate for much of the steelhead run.

Fish sampling conducted since 2012 indicates that the lower 1.0 miles of Big Eightmile Creek is occupied Chinook salmon rearing and overwintering habitat. Although habitat in this reach of Big Eightmile Creek is severely degraded by water diversions, the PIT tag-scanning array data suggests that it is important for rearing and overwintering Lemhi River Chinook salmon. The upstream extent of steelhead occupancy is not precisely known, but the existing fish sampling and PIT tag-scanning array data indicate that all accessible steelhead habitat in Big Eightmile Creek is probably occupied. Fish sampling and intrinsic potential habitat data suggests that most of Devil's Canyon Creek is probably not occupied steelhead habitat although steelhead are present in Big Eightmile Creek at the mouth of Devil's Canyon Creek and might utilize the lowest reaches. Quality of occupied steelhead habitat within the action area ranges from very good, near the Big Creek Diversion, to severely degraded in the lower reaches.

Big Eightmile Creek is not designated critical habitat for steelhead but steelhead are present, including near the Big Eightmile Creek diversion and in the diversion ditch. Big Eightmile Creek is designated critical habitat for Chinook salmon and Chinook salmon have recently been documented rearing in the lower reaches. Due to seasonal passage barriers downstream, there are currently no Chinook salmon present near the diversion. If habitat restoration continues, Chinook salmon may reoccupy more of Big Eightmile Creek and could eventually be present near the diversion.

Bull trout have been documented in Devil's Canyon Creek as far upstream as the Devil's Canyon Creek diversion, but no other fish species have been observed. Devil's Canyon Creek is not designated critical habitat for steelhead. Although steelhead have not been documented in Devil's Canyon Creek, the proximity to habitat with known presence of steelhead and the lack of fish passage barriers as evidenced by presence of bull trout, indicates that steelhead presence in Devil's Canyon Creek is likely. Devil's Canyon Creek is designated critical habitat for Chinook salmon. Due to passage barriers in downstream reaches of Big Eightmile Creek, there are currently no Chinook salmon in Devil's Canyon Creek or in Big Eightmile near the mouth of Devil's Canyon Creek. If habitat restoration continues, Chinook salmon could reoccupy more of Big Eightmile Creek and could possibly use habitat in the lower reaches of Devil's Canyon Creek.

2.4.2.7 Environmental Baseline in Mill Creek

Mill Creek historically flowed into the Lemhi River approximately 41 miles upstream from the confluence of the Lemhi and Salmon Rivers. Based on size of the drainage, flows in upstream reaches, geology, current fish assemblage, and proximity to occupied Chinook salmon and steelhead habitat, Mill Creek is considered historic Chinook salmon and steelhead spawning and rearing habitat. Topographic maps show Mill Creek ending at a Lemhi River irrigation ditch, which has led to some erroneous conclusions regarding historic use by anadromous salmonids. The Little Springs Creek habitat improvement project resulted in partial reconnection of Mill Creek to the Lemhi River via Little Springs Creek, theoretically reestablishing access to Mill Creek when flows are available. In practice, lower Mill Creek is completely dewatered throughout most of the irrigation season and anadromous fishes have not been documented in Mill Creek. Until minimum flows are established in lower Mill Creek, anadromous fish habitat in the Mill Creek drainage will probably remain unoccupied.

Mill Creek is not designated critical habitat for steelhead but it is designated critical habitat for Chinook salmon. Mill Creek is currently occupied by bull trout and cutthroat (*O. clarkii*) but resident *O. mykiss* are apparently absent. Due to disconnection between Mill Creek and the Lemhi River, there are currently no steelhead or Chinook salmon in Mill Creek.

2.4.2.8 Environmental Baseline in the Hayden Creek Drainage

Hayden Creek flows into the mainstem Lemhi River at RM 30.3. The Hayden Creek drainage encompasses 91,427 acres, 66% of which is administered by the USFS, 24% by BLM, 1.4% by the State of Idaho, and 8.6% is private. There are approximately 115 irrigation water rights in the Hayden Creek drainage with a combined maximum diversion rate of 120.4 cfs that is used to irrigate 4,142 acres. Irrigating 4,142 acres removes approximately 6,006 acre feet from the annual water budget. Based on flows measured at the IDWR Hayden Creek gage (located near the mouth), 6,006 acre feet represents 8.8% of the annual water budget, suggesting that the Hayden Creek drainage is relatively lightly developed compared to the Lemhi River watershed as a whole. Unlike most Lemhi River tributaries, mainstem Hayden Creek is not dewatered, the lowest flows recorded are likely sufficient for upstream migration of anadromous salmonids (Figure 21), and there are no physical barriers blocking fish migration. However, two Hayden Creek tributary streams, Basin Creek and East Fork Hayden Creek, are sufficiently dewatered to impair upstream fish passage.

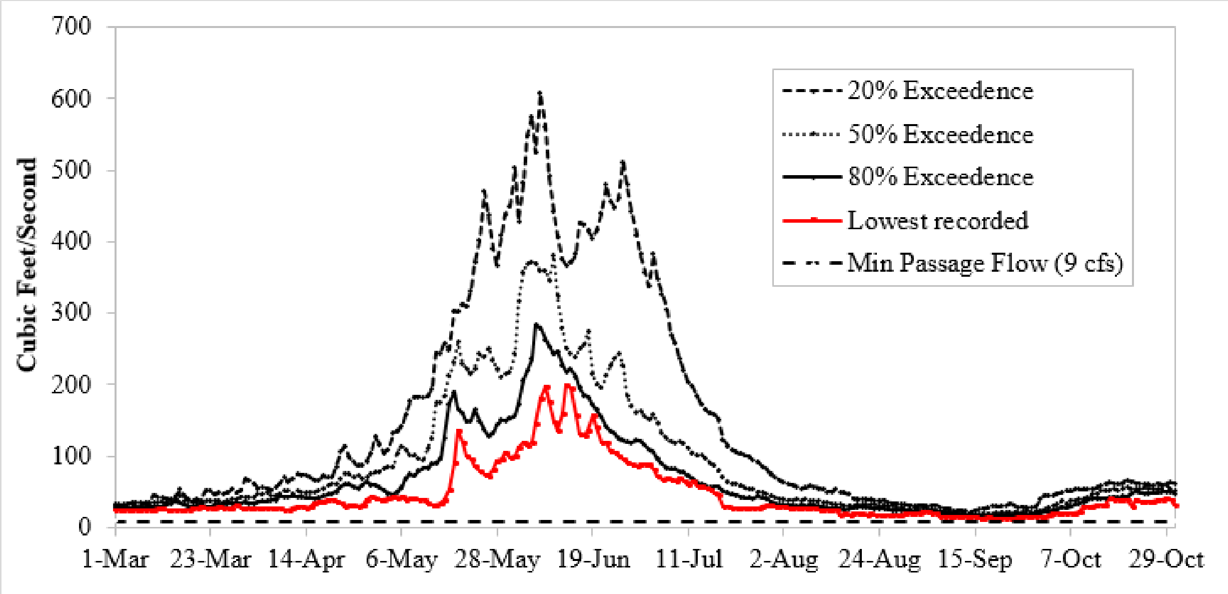


Figure 21. Daily 20%, 50%, and 80% exceedance flow, the lowest flow on record, and the minimum flow needed to meet minimum passage depths in lower Hayden Creek (from Sutton and Morris 2005) at the Hayden Creek gage for 2006-2019.

Basin Creek flows into Hayden Creek 3.5 miles upstream from the Lemhi River. The lower reaches of Basin Creek are completely dewatered for most of the irrigation season and the Hayden Creek Road crossing near the mouth is possibly a fish passage barrier at low flows. We presume that some adult steelhead are able to migrate into Basin Creek during most years and that steelhead habitat in the Basin Creek drainage is occupied. Because Chinook salmon migrate later in the season, when Basin Creek is usually dewatered, we presume that Chinook salmon habitat in the Basin Creek drainage is not currently occupied.

McNutt Creek flows into Basin Creek approximately 5.7 miles upstream from Hayden Creek. McNutt Creek is designated critical habitat for Chinook salmon but not for steelhead. The IDFG lists McNutt Creek as occupied habitat for cutthroat trout and bull trout and McNutt Creek has intrinsic potential habitat for steelhead. Basin Creek has been seasonally dewatered for many years which has limited distribution of anadromous fishes. Because of poor habitat conditions in Basin Creek, Chinook salmon or steelhead presence in McNutt Creek is unlikely. If habitat in Basin Creek is improved, steelhead will likely be present in McNutt Creek and Chinook salmon could possibly be present in the lower reaches.

East Fork Hayden Creek flows into Hayden Creek ten miles upstream from the Lemhi River. The East Fork Hayden Creek Diversion is approximately 0.2 miles upstream from the mouth and is currently a seasonal fish passage barrier that likely precludes Chinook salmon access to habitat in East Fork Hayden Creek. This barrier also likely limits upstream movement of steelhead into East Fork Hayden Creek. However, the proposed action includes provisions to address this passage barrier. Therefore, when the proposed action is implemented, this fish passage barrier will no longer be part of the baseline. Because there will not be a fish passage barrier in East Fork Hayden Creek after the proposed action is implemented, we presume that Chinook salmon and steelhead habitat in East Fork Hayden Creek will be occupied.

East Fork Hayden Creek is designated critical habitat for steelhead and Chinook salmon and steelhead presence has been documented. Chinook salmon have not been documented in East Fork Hayden Creek. However, both adult and juvenile Chinook salmon are present in Hayden Creek at the mouth of East Fork Hayden Creek indicating that intermittent presence of Chinook salmon in lower East Fork Hayden Creek is likely. The proximity of Chinook salmon also suggests that Chinook salmon might utilize habitat in East Fork Hayden Creek if it is improved.

The Hayden Creek drainage likely contains the best quality accessible anadromous salmonid habitat in the Lemhi River basin. When measured as average number of Chinook salmon smolts reaching Lower Granite Dam per redd (brood years 2006-2013), habitat in the Hayden Creek drainage (194 smolts/redd) is approximately twice as productive as habitat in the upper Lemhi River (96 smolts/redd). However, it is only about half as productive as the essentially undeveloped Marsh Creek drainage (341 smolts/redd), suggesting that there is potential for improving Chinook salmon and steelhead habitat in Hayden Creek.

2.4.2.9 Environmental Baseline in Wimpey and West Fork Wimpey Creeks

Water diversions in the Wimpey Creek drainage are used to serve 51 irrigation water rights (including high flow supplements) that are used to irrigate up to 1,212.6 acres. The combined maximum allowable diversion rate is between 23.53 cfs and 64.03 cfs, depending on utilization of high flow supplements, which is likely dependent on time of year and/or flow levels. There are no streamflow gages in the Wimpey Creek drainage, but a comparison of the estimated streamflow from Streamstats and the maximum allowable diversion rates, suggests that portions of Wimpey Creek could be dewatered for much of the irrigation season. Murphy and Yanke (2003) described Wimpey Creek as disconnected from the Lemhi River during the irrigation season. However, more recent anecdotal evidence suggests that flow in lower Wimpey Creek is sufficient to support rearing salmonids throughout the summer. Based on a fish sampling surveys conducted from 2002 through 2017, juvenile Chinook salmon and juvenile steelhead rear throughout the lower 1.1 miles and 3.5 miles of Wimpey Creek, respectively.

There are no streamflow gages in the Wimpey Creek drainage and depth versus discharge information is not available for Wimpey Creek. We are therefore unable to estimate the amount of time that flows are adequate for upstream passage of adult Chinook salmon and steelhead. However, adult steelhead have been documented in Wimpey Creek and are likely able to migrate upstream prior to irrigation turn on and possibly during portions of the spring runoff. Adult Chinook salmon have not been documented in Wimpey Creek and, because adult Chinook salmon typically move into tributaries during late summer, flows are unlikely to be adequate for migration of adult Chinook salmon.

The action area includes West Fork Wimpey from the mouth upstream to the West Fork Wimpey Creek Diversion (approximately 4.2 miles). West Fork Wimpey Creek is not designated critical habitat for steelhead. There is a cascade approximately 20 feet high-located 0.3 miles upstream from the mouth of West Fork Wimpey Creek. Fish sampling data indicate that this cascade is a long-standing natural barrier to fish migration (Murphy and Yanke 2003). Most of West Fork Wimpey Creek, including the reach containing the Diversion, is therefore not Chinook salmon designated critical habitat (see Section 2.4.2.7). Mainstem Wimpey Creek is designated critical habitat for both steelhead and Chinook salmon, is currently occupied by steelhead, and the lower reaches are utilized by rearing Chinook salmon.

2.4.2.10 Environmental Baseline in Bohannon and East Fork Bohannon Creeks

Adult Chinook salmon have not been documented in Bohannon Creek but juveniles currently rear throughout the lowest 2.9 miles of the creek. Although Chinook salmon spawning does not currently occur in Bohannon Creek, habitat restoration has been ongoing in Bohannon Creek and future use by adult Chinook salmon is possible. Based on data from the PIT tag-scanning array near the mouth of the Lemhi River, adult Chinook salmon could be migrating upstream in the Lemhi River from May 1 through September 15. Flows at the lower Bohannon Creek gage are less than the minimum to achieve passage depths for 76% of that time during 80% exceedence years, 54% of that time during 50% exceedence years, and 46% of that time during 20% exceedence years (Figure 22). Although Chinook salmon spawning has not been documented in Bohannon Creek, the available flow and depth discharge data suggests that adult Chinook salmon migration into Bohannon Creek is possible.

Steelhead are widespread throughout the Bohannon Creek drainage. Assuming that adult steelhead migrate upstream in the Lemhi River and tributaries from February 1 through May 31, flows at the lower Bohannon Creek gage are less than the minimum needed to achieve adequate passage depths for 89% of the migration in 80% exceedence years, and for 68% of the migration in 50% exceedence years, and less than 41% of the time during 20% exceedence years. Adult steelhead have been documented migrating over the Bohannon Creek PIT tag-scanning array when flows were as low as 2.8 cfs at the Bohannon Creek gage suggesting that upstream migration is possible when flows are less than seven cfs. However, the PIT tag-scanning array is less than 300 feet upstream from the Lemhi River and the ultimate success of steelhead attempting to migrate as such low flows is not currently known.

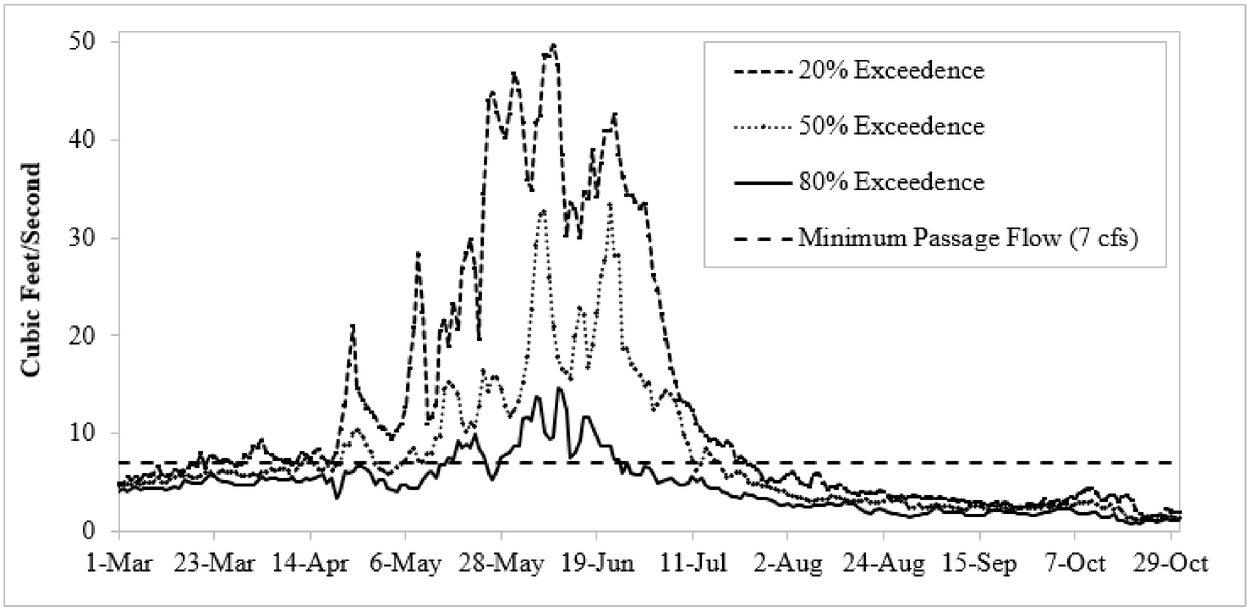


Figure 22. Daily 50%, and 20% exceedance flow and the minimum flow needed to meet minimum passage depths (from Sutton and Morris 2005) in lower Bohannon Creek at the Bohannon Creek lower gage for 2008-2019, which is located approximately one mile upstream from the Lemhi River.

Baseline Conditions Summary: Baseline conditions in the action area are impaired by land use activities, channel modifications, bank stabilization, etc., but a primary factor is water diversion and use for irrigated agriculture. Habitat restoration has been ongoing since the late 1990s and has resulted in localized improvements in salmonid habitat quality; increases in the quantity of accessible salmonid habitat; localized increases in streamflow; and localized increases in salmonid productivity. However, overall, base flow conditions are declining, salmonid productivity is not increasing on a population scale, and both production and productivity of juvenile Chinook salmon remains a fraction of levels seen in the late-1960s and early 1970s.

2.5 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

The proposed action includes: (1) Authorization of operation and maintenance of water diversions on NFS land in the Lemhi River watershed; and (2) development and implementation of the Program that will facilitate habitat restoration activities in the Lemhi River watershed. Authorization of operation and maintenance of water diversions will result in: (1) Maintenance of water diversion systems on NFS land; (2) diversion of water from streams on NFS land; (3) transmission of water across NFS and non-NFS land; (4) irrigation of non-NFS land; and (5) restoration activities on NFS and non-NFS land. These activities will reduce flow in reaches downstream from the authorized diversions, impair upstream fish passage in some of the affected tributary streams, entrain downstream migrating fishes, and will result in disturbed streambanks and stream channels. Development and implementation of the Program will result in improvement of stream channel and riparian habitat. These activities will occur while summer base flows continue to decline due to climate change (see Section 2.2.3) and possibly due to increased irrigation and irrigation efficiency (see Section 2.2.2.1).

2.5.1 Effects on Chinook Salmon and Steelhead

Authorizing operation and maintenance of diversions on NFS land in the Lemhi River watershed will reduce the amount of flow present in occupied Chinook salmon and steelhead habitat. The flow reductions will occur throughout the irrigation season, which extends from early spring through early fall, and includes periods of both high (spring runoff) and low (summer baseflow) water availability. The irrigation season also includes periods during which Chinook salmon and steelhead are incubating, rearing, migrating, holding (pre-spawn), and spawning in the affected occupied habitat.

Snake River spring/summer Chinook salmon and Snake River Basin steelhead spend the juvenile rearing phase of their life cycles in streams and must procure all food needed to survive and grow in those "rearing" streams. Food availability for stream dwelling salmonids is generally positively related to streamflow across the entire range of base flows (Harvey *et al.* 2006; Hayes *et al.* 2007; Davidson *et al.* 2010) and this relationship can extend into spring (i.e., higher) flows (Davidson *et al.* 2010). Also, juvenile salmon grow measurably faster during years in which floodplains are inundated, presumably due to increased production of invertebrates (Jager 2014), indicating that flood flows are also important for rearing salmon. Reducing streamflow, and the resultant reduction in food availability, reduces individual growth (Harvey *et al.* 2006) and population productivity (Nislow *et al.* 2004) of stream dwelling salmonids. In addition to food, juvenile stream dwelling anadromous salmonids must have access to instream object cover and in-water escape cover to rear successfully (Hardy *et al.* 2006); and reducing flow generally reduces access to escape cover (Hardy *et al.* 2006a). Reduction in streamflow caused by surface water diversions can also result in long-term increases in fine sediments in stream substrates (Baker *et al.* 2011) and increased summer water temperature (Rothwell and Moulton 2001; Tate *et al.* 2005; Miller *et al.* 2007). Cold water refugia are important for rearing juvenile Chinook salmon and steelhead (Sauter *et al.* 2001; Richter and Kolmes 2005) and for pre-spawning adult Chinook salmon (Berman and Quinn 1991; Torgersen *et al.* 1999), suggesting that reducing water from cold tributary streams would likely adversely affect rearing Chinook salmon and steelhead, and possibly holding adult Chinook salmon.

Year class strength of many salmonid populations is positively related to streamflow (Ricker 1975; Mathews and Olson 1980; Mitro et al. 2003; Elliott et al.1997; Nislow et al. 2004; Arthaud et al. 2010; Beecher et al. 2010). A review of 46 studies found that salmonid demography was usually positively, and was never negatively, related to summer flow (Kovach et al. 2016). Arthaud et al. (2010) determined that streamflow affected year class measured as outmigrating juveniles, which in turn affected number of returning adults, resulting in a relationship of rearing streamflow and whole life cycle productivity. Because of size, the adult life stages of anadromous salmonids are often perceived to be the most limiting with respect to streamflow. However, the available literature indicates that flow during the rearing life stages is often a limiting factor (Mathews and Olson 1980; Mitro et al. 2003; Elliott et al. 1997; Nislow et al. 2004; Arthaud et al. 2010; Beecher et al. 2010) and can be the primary limiting factor (Mathews and Olson 1980; Elliott et al. 1997; Arthaud et al. 2010; Beecher et al. 2010) for stream dwelling salmonids. Although this Opinion does describe effects on adult migration, the quantified effects of the proposed action on Chinook salmon and steelhead are based on relationships of "rearing" streamflow and population productivity, which are presumably driven by food availability, access to suitable cover, and possibly by water temperature. These relationships do not likely capture factors that are affected by flow, but typically do not change quickly with changes in flow, such as substrate quality and health of riparian vegetation. As such, the quantified analyses in this Opinion may underestimate long-term adverse effects of the proposed actions on Chinook salmon and steelhead.

The effects of authorizing water diversions on NFS land in the Lemhi River watershed on Chinook salmon and steelhead are described in sections 2.5.1.1 – 2.5.1.9 and the beneficial effects of the Program on Chinook salmon and steelhead are described in section 2.5.1.10. The effects of the proposed action on designated critical habitat are described in section 2.5.2.

The proposed action will: (1) Alter flows in stream reaches through which adult Chinook salmon and steelhead migrate; (2) result in entrainment of fishes moving downstream past the PODs; (3) result in capture and handling of fishes entrained in diversion ditches; (4) alter flows in stream reaches utilized by spawning and rearing Chinook salmon and steelhead; (5) result in maintenance activities that could disturb fishes; (6) result in maintenance activities that could affect riparian and stream channel habitat; and (7) result in a long-term increase in habitat restoration activities in the Lemhi River drainage. The effects on adult fish passage are described in terms of the amount of time that affected tributary stream reaches have adequate depths for upstream passage. The entrainment effects are expressed as the number of juvenile migrants killed, with the mechanism for mortality being physical entrainment in the diversion. In this respect, the entrainment pathway is similar to other activities that result in physical capture and/or killing of fish without affecting habitat. The effects of altering flow are expressed as a percent change in population productivity, which is then converted to number of outmigrating juveniles, based on the amount of habitat affected. The mechanism for increased mortality (or survival) is the change in the capacity of rearing habitat to produce salmonids. The effects of increased rearing habitat in Canyon Creek are expressed as a change in productivity, which is then converted into a change in the number of outmigrants so as to be comparable to the flow and entrainment effects. Likewise, effects of future habitat restoration will be expressed as the number of outmigrants so as to be comparable to flow and entrainment effects (see Section 1.3.3). As with the flow effects, the mechanism for beneficial effects of habitat restoration is a change in the capacity of habitat to produce salmonids. Because the effects of the action are expressed in terms of reductions of productivity and/or outmigrants, positive effects, due to improving flow, increasing accessible rearing habitat, or other habitat improvements are denoted by negative numbers.

2.5.1.1 Effects of Authorizing Operation and Maintenance of the Big Bear Creek Diversion

The Big Bear Creek Diversion is the only diversion in the Eighteenmile Creek drainage that will be authorized by the SCNF. This diversion is located on Big Bear Creek approximately 0.67 miles upstream from Hawley Creek. This diversion serves two water rights with a combined maximum diversion rate of 2.0 cfs that are used to irrigate 59.3 acres. The Big Bear Creek Diversion is upstream from occupied Chinook salmon habitat but it is in occupied steelhead habitat. Because it is in occupied steelhead habitat, maintenance of the diversion will likely affect steelhead and operation of the diversion could result in entrainment of steelhead.

Snow cover and high streamflow typically preclude maintenance of the Big Bear Creek Diversion during steelhead spawning and incubation. Routine maintenance is therefore not likely to affect adult steelhead or steelhead redds, but it will likely affect rearing juveniles that are present throughout the year. Potential effects of routine maintenance include: Disturbance of juveniles in the immediate vicinity of the POD; and turbidity pulses at and immediately downstream from the POD. Measures to reduce adverse effects of routine diversion maintenance activities are described in the BA and summarized in Section 1.3 of this Opinion. Those measures will ensure that effects of routine maintenance activities on steelhead are confined to the immediate vicinity of the POD, are low intensity, and are short duration. Because the measures described in the BA should be effective at reducing adverse effects of routine diversion maintenance activities, the effects of such activities on rearing steelhead will likely be very minor.

Authorization of the Big Bear Creek Diversion will require installation of a fish screen and a new headgate within five years of the initial authorization. The fish screen therefore should be in place and operating before the 2027 irrigation season. Installation of fish screens can result in adverse effects on anadromous fishes and their habitat, such as short-term increases in sediment and turbidity; localized reduction in riparian vegetation; short-term dewatering of work areas; disturbance of fish due to construction activities; and handling of fish during salvage operations in work areas. There are currently three programmatic consultations that are used to address the effects of fish screen installation in the Lemhi River drainage (NMFS 2000a; NMFS 2019; NMFS 2020). The fish screen and headgate will be installed as part of IDFG's ongoing fish screening program (i.e., Screen Shop) and ESA Section 7 consultation will be via programmatic consultation. The SCNF will work with the Screen Shop to ensure that all regulatory requirements are met so that installation can be completed prior to the 2027 irrigation season.

Operating the Big Bear Creek Diversion will result in entrainment of juvenile steelhead. In small high elevation streams, like Big Bear Creek, juvenile steelhead move downstream throughout the year, but they would only be vulnerable to entrainment when the diversion is operating (i.e., May through September). The proportion of migrating juvenile salmonids entrained in surface water diversions is variable (Simpson and Ostrand 2012) but is likely to be approximately equal to (Simpson and Ostrand 2012), or slightly less (Walters *et al.* 2012) than the proportion of flow diverted. Based on information presented in the BA, operation of the Big Bear Creek Diversion would remove an average of 1.66 cfs during May through September, or approximately 11.6% of flow at the POD. We therefore presume that operation of the Big Bear Creek Diversion would entrain 11.6% of juvenile steelhead migrating downstream past the POD during May through

September. Juvenile steelhead could move downstream past the POD throughout the year but only those moving from May through September would be vulnerable to entrainment. Therefore, only approximately 4.8% of all steelhead rearing upstream from the diversion would likely be entrained. Steelhead habitat upstream from the Big Bear Creek Diversion represents 1.77% of the habitat upstream from the LEMHIW trap, and an average of 15,482 juvenile steelhead migrate downstream past the trap each year, so we presume that approximately 113 juvenile steelhead move downstream past the POD each year. Based on these data, operation of the Big Bear Creek Diversion would result in entrainment of an average of 13 juvenile steelhead per year.

Until the fish screen is installed, the SCNF plans to periodically conduct fish salvage operations in the Big Bear Creek Diversion. Only steelhead that are already entrained in the diversion will be captured during salvage operations, and captured steelhead will be quickly moved to Big Bear Creek and released. Salvage operations could, therefore, reduce the number of steelhead killed due to entrainment. However, because salvage will likely occur for a very small percentage of the time that the diversion is operating, salvage will probably result in a very small reduction in the number of steelhead killed. We therefore presume that, until the diversion is screened, the vast majority of entrained steelhead will likely be killed. Because only steelhead that are already entrained in the diversion will be captured, salvage operations will not increase the number of steelhead captured or killed due to the proposed action.

After the Big Bear Creek Diversion is screened, entrained steelhead will be continuously routed back to Big Bear Creek, via the fish bypass system, whenever the diversion is operating. Although salmonids entrained in screened diversions could experience a variety of adverse effects (e.g., delayed migration, disorientation, increased exposure to predators), survival is typically greater than 97% (Simpson and Ostrand 2012; Walters *et al.* 2012). Because 97% of steelhead entrained in the diversion will likely survive, and approximately 13 juvenile steelhead will be entrained annually, less than one per year would likely be killed due to entrainment in the Big Bear Creek Diversion, after the diversion is screened.

In addition to the entrainment effects, the proposed action will also affect Chinook salmon and steelhead by reducing flow in occupied spawning and rearing habitat in the Eighteenmile Creek drainage. Operation of the Big Bear Creek Diversion will reduce flow in occupied steelhead habitat in Big Bear, Hawley, and Eighteenmile Creeks and in occupied Chinook salmon habitat in Eighteenmile Creek. The effects of operating the Big Bear Creek Diversion on flow in occupied Chinook salmon and steelhead habitat in the Eighteenmile Creek drainage are summarized in Table 13.

Table 13. Effects of operating the Big Bear Diversion on flow in Big Bear, Haeley, and Eighteenmile Creeks.

Stream Reach		Effect of the Proposed Action on Flow					
		May	Jun	Jul	Aug	Sep	Oct
Big Bear Creek from the diversion to Hawley Creek	CFS	0.32	2.00	2.00	2.00	2.00	0.25
	% of Flow[1]	1.77	9.39	14.29	15.75	16.95	2.23
Hawley Creek from Big Bear Creek to the HC #2 Diversion	CFS	0.23	0.66	0.76	0.66	0.52	0.25
	% of Flow[2]	0.94	2.61	4.22	4.10	3.11	1.47
Hawley Creek from the HC #2 Diversion to Eighteenmile Creek	CFS	0.10	0.59	0.76	0.64	0.48	0.25
	% of Flow[3]	0.86	8.12	24.97	40.17	8.92	1.28
Eighteenmile Creek downstream from Hawley Creek	CFS	0.08	0.59	0.76	0.64	0.48	0.25
	% of flow[4]	0.58	4.64	18.96	19.08	7.66	2.58

1. Based on the 50% exceedence flow estimated using StreamStats.
2. Based on 50% exceedence flow calculated using data from the Hawley Creek upper gage, located approximately 7.6 miles upstream from the mouth of Hawley Creek.
3. Based on 50% exceedence flow calculated using data from the Hawley Creek upper gage, located approximately 0.50 miles upstream from the mouth of Hawley Creek.
4. Based on data collected in 2008 and 2009 at the Eighteenmile Creek gage, located approximately 0.68 miles upstream from the confluence of Texas and Eighteenmile Creeks.

Adult steelhead typically migrate upstream in the Lemhi River, and presumably in Eighteenmile, Hawley, and Big Bear Creeks, anytime from February 1 through May 31 (121 days). Based on the available flow data and stage discharge data, Eighteenmile Creek and Hawley Creek would have sufficient flow for upstream passage of adult steelhead for 45% and 98% of that time of that time, respectively, during a 50% exceedence flow year. Incorporating the estimated effects of the proposed action into the flow and stage discharge data indicates that the proposed action would not appreciably reduce the amount of time that flow was sufficient for upstream steelhead migration in either Eighteenmile or Hawley Creeks. Flow and stage discharge data are not available for Big Bear Creek, but the estimated effect on flow when adult steelhead would be migrating is small, suggesting that the effect on adult steelhead would also be small.

Adult Chinook salmon typically migrate upstream in the Lemhi River, and presumably in lower Eighteenmile and Hawley Creeks, anytime from May 1 through September 15 (138 days). Based on the available flow and stage discharge data, flow in Eighteenmile Creek would be sufficient to meet minimum passage depth in 38 days, from May 1 through September 1, without the proposed action and 29 days with the proposed action. In Hawley Creek during a 50% exceedence year, flow would be sufficient to meet minimum passage depth in 75 days, from May 1 through September 15, without the proposed action, and 69 days with the proposed action. Therefore, the proposed action would reduce the amount of time that flow is sufficient for upstream migration of Chinook salmon in Eighteenmile Creek by 24%, and by 8% in Hawley Creek. Because Hawley Creek is typically not utilized (currently) by adult Chinook salmon, actual adverse effects on adult Chinook salmon in Hawley Creek would probably be rare, and the overall effect on migrating Chinook salmon would likely be very small. Although there is some evidence of adult Chinook salmon use of habitat in Eighteenmile Creek, that use is likely very rare and the overall effect on adult Chinook salmon in Eighteenmile is therefore probably very small. Also, the effects of the proposed action in Eighteenmile are based on very limited flow data from 2008 and 2009. Habitat improvement projects implemented since 2009 have probably improved flow baseline conditions in Eighteenmile Creek, which would somewhat reduce the adverse effects of the proposed action on Chinook salmon migration in Eighteenmile Creek.

Operation of the Big Bear Creek Diversion will reduce flow in occupied steelhead habitat in Big Bear, Hawley, and Eighteenmile Creeks and in occupied Chinook salmon habitat in Eighteenmile Creek. The proposed action would reduce flow in Eighteenmile Creek, between Hawley Creek and the confluence of Eighteenmile and Texas Creeks, by an average of 8.92% from May through October. This reach of Eighteenmile Creek is utilized by rearing Chinook salmon and the reduction in flow corresponds to a 3.27% reduction in Chinook salmon productivity (Appendix A). The affected reach of Eighteenmile Creek represents 5.2% of occupied Chinook salmon habitat upstream from the LEMHIW trap and approximately 21,081 juvenile Chinook salmon migrate downstream past the trap each year. The effects of the proposed action in Eighteenmile Creek would therefore reduce Chinook salmon juvenile outmigrants by approximately 32 fish each year.

The reduction in flow due to the proposed action would affect steelhead habitat in Big Bear Creek downstream from the Big Bear Creek Diversion, in Hawley Creek downstream from Big Bear Creek, and in Eighteenmile Creek downstream from Hawley Creek. The average impacts (May through October) measured as a percentage of average monthly flow, range from 2.74% in upper Hawley Creek to 14.04% in lower Hawley Creek, with corresponding reductions in steelhead productivity ranging from 1.03% to 7.89% (Table 14). The affected stream reaches in the Eighteenmile Creek drainage contain 146,344 m^2 of steelhead intrinsic potential, or approximately 7.26% of the steelhead habitat upstream from the LEMHIW trap. The reduced flow due to authorization of the Big Bear Creek Diversion will likely result in an average of 59 fewer out-migrating steelhead each year.

Operation of the Eighteenmile Creek Diversion would reduce flow in the mainstem Lemhi River by approximately 169-acre feet per year. This effect on flow would affect migrating, spawning, incubating, and rearing Chinook salmon and steelhead. The effects of the proposed action on Chinook salmon and steelhead in the Lemhi River are described in section 2.5.1.8.

Table 14. Summary of effects of authorizing operation and maintenance of the Big Bear Creek Diversion on flow and steelhead productivity in Big Bear, Hawley, and Eighteenmile Creeks.

Stream Reach	Percent Reduction in Flow (average May – October)	Percent Reduction in Productivity	Habitat Affected (m^2 of IP)	Reduction in Outmigrants
Big Bear Creek, Diversion to mouth	10.06	5.09	5,907	2
Hawley Creek, Big Bear Crek to Hawley Creek #2	2.74	1.03	33,202	3
Hawley Creek, Hawley Creek # 2 to Eighteenmile Creek	14.05	7.89	70,706	41
Eighteenmile Creek from Hawley Creek to the mouth	8.92	4.62	36,528	12
Total				59

2.5.1.2 Effects of Authorizing Operation and Maintenance of the Deer Creek Diversion

Fish sampling data are lacking for Texas Creek but based on stream gradient, habitat quality (i.e. flow and lack of habitat barriers), and proximity to known occupied habitat, Chinook salmon likely utilize habitat in the lowest 2.5 miles of Texas Creek. Also based on stream gradient and habitat quality, steelhead probably utilize most stream reaches downstream from the mouth of Deer Creek and possibly some stream reaches upstream. The limited fish sampling in Deer Creek has only documented bull trout and brook trout. We therefore presume that the lower 2.5 miles of Texas Creek is occupied Chinook salmon habitat, all of Texas Creek downstream from Deer Creek is occupied steelhead habitat, and that Deer Creek is currently not occupied by Chinook salmon or steelhead. Because Deer Creek is not currently occupied by anadromous fishes, maintenance of the diversion will not affect Chinook salmon or steelhead and operation of the diversion will not result in entrainment of Chinook salmon or steelhead. Likewise, reduction of flow in Deer Creek, due to operation of the diversion, will not locally affect Chinook salmon or steelhead. However, flow reduction due to operation of the Deer Creek Diversion will affect Chinook salmon and steelhead in Texas Creek.

The Deer Creek Diversion serves five water rights (74-121A, 74-143, 74-103, 74-78, and 74-77) with a combined maximum diversion rate of 4.59 cfs. Some of the POUs irrigated with Deer Creek Diversion water rights can also be irrigated with water diverted from Sourdough Gulch Creek and Texas Creek on non-NFS lands. A comparison of the conditions of approval for Deer Creek, Sourdough Gulch Creek, and Texas Creek water rights suggests that 134.2 acres of irrigation is dependent on operation of the Deer Creek Diversion. The BA states that if the Deer Creek Diversion was not operated, thereby leaving flow in Deer Creek downstream from the diversion, that water could still be delivered to the POUs without facilities on NFS land. However, most of the non-NFS land downstream from the Deer Creek Diversion is administered by the BLM, which, for new diversions, would have similar permitting requirements as the USFS. Therefore, until more information becomes available (see Section 1.3.3) we presume that 134.2 acres of irrigation would be a consequence of authorizing the operation and maintenance of the Deer Creek Diversion.

The BA analyzed the impacts of operating the Deer Creek Diversion on flow in Deer and Texas Creeks and provided estimates of consumptive use of water that would occur due to operation of the diversion. However, those analyses assumed that 196.2 acres would be irrigated via the Deer Creek Diversion when the actual amount is likely 134.2 acres. We therefore reduced the estimated flow impacts described in the BA, by a factor of 0.68 (i.e., 134.2/196.2). The results are summarized in Table 15.

Reduction of flow in Texas Creek will adversely affect migrating adult Chinook salmon and steelhead. Depth versus streamflow relationship data are not available for Texas Creek. However, Texas Creek is similar in drainage area, channel gradient, and is in the same general location as Eighteenmile, Canyon, and Big Timber Creeks. In those streams, the minimum depth for migrating Chinook salmon and steelhead (Thompson 1972) corresponds to streamflows ranging from 9 cfs to 11 cfs (Sutton and Morris 2004; Sutton and Morris 2006; Morris and Sutton 2007). We therefore presumed that minimum depth for upstream migrating adults in Texas Creek would correspond to a flow of approximately 10 cfs. Adult Chinook salmon typically migrate upstream in the Lemhi River, and presumably in lower Texas Creek, anytime from May 1 through September 15 (138 days). During a median (i.e., 50% exceedence) flow year, without the proposed action, flow in lower Texas Creek would be greater than 10 cfs on 99 days from May 1 through September 15 and with the proposed action, would be greater than 10 cfs on 87 days. Therefore, the proposed action of authorizing operation of the Deer Creek Diversion would reduce the amount of time that depth in lower Texas Creek is suitable for Chinook salmon passage, by approximately 12%. The effects would be greater during dryer than normal years and less during wet years, with possibly no reduction in the amount of time with suitable passage depths during 20% exceedance and wetter years. However, because Texas Creek is not typically utilized (currently) by adult Chinook salmon, actual adverse effects on adult Chinook salmon in Texas Creek are probably rare, and the overall effect on migrating Chinook salmon is likely very small.

Table 15. Impacts of operating the Deer Creek Diversion on flow in Deer and Texas Creeks.

Stream Reach		Effect of the Proposed Action on Flow					
		May	Jun	Jul	Aug	Sep	Oct
Deer Creek, Diversion to Mouth	CFS	6.4	7.2	2.7	2.4	2.2	2.0
	% of Flow[1]	100	100	100	100	100	100
Texas Creek, Deer Creek To Mouth	CFS	0.47	0.94	0.86	0.57	0.41	0.10
	% of Flow[2]	2.909	5.685	7.139	4.301	2.231	0.3103
	% of Flow[3]	2.727	5.108	7.392	5.664	2.83	0.3223

1. Based on 50% exceedence flow estimated using StreamStats (2017).
2. Based on the 50% exceedence flow estimated using data from the Texas Creek gage, located on Texas Creek approximately 4.9 miles upstream from the mouth of Texas Creek
3. Based on the 50% exceedence flow estimated using data from the Lemhi River above L-63 Diversion gage, which is located on Texas Creek approximately 400 feet upstream from the mouth.

Adult steelhead typically migrate upstream in the Lemhi River, and presumably in lower Texas Creek, anytime from February 1 through May 31 (121 days). During a median (i.e. 50% exceedence) flow year, without the proposed action, flow in lower Texas Creek would be greater than 10 cfs for the entire 121 days from February 1 through May 31 and, with the proposed action, would be greater than 10 cfs on 119 days. Therefore, the proposed action of authorizing operation of the Deer Creek Diversion would reduce the amount of time that depth in lower Texas Creek is suitable for adult steelhead passage, by approximately 1.7%. At the upstream gage, the proposed action would reduce the amount of time that adequate passage depths are achieved by one day, or approximately 0.8%. The effects would be greater during dryer than normal years and less during wet years, with possibly no reduction in the amount of time with suitable passage depths during 20% exceedance and wetter years.

The reduction in flow due to the proposed action will adversely affect juvenile Chinook salmon and steelhead rearing in Texas Creek. The proposed action would reduce flow in Texas Creek by an average of 3.89% from May through October (Table 15). This reduction in flow corresponds to a 1.4% reduction in Chinook salmon productivity (Appendix A). The currently occupied habitat in Texas Creek represents 4.8% of occupied Chinook salmon habitat upstream from the Lemhi Weir Screw Trap (LEMHIW) and approximately 21,081 juvenile Chinook salmon migrate downstream past the LEMHIW trap each year. The effects of the proposed action in Texas Creek would therefore reduce Chinook salmon juvenile outmigrant production by approximately 14 fish. The reduction in flow, due to the proposed action, corresponds to a 2.0% reduction in productivity of steelhead rearing in Texas Creek. The affected reach of Texas Creek constitutes 10.4% of steelhead habitat upstream from the LEMHIW trap and an average of 15,482 juvenile steelhead migrate downstream past the trap each year. The effects of the proposed action in Texas Creek would therefore reduce juvenile steelhead production by approximately 31 fish.

Operation of the Deer Creek Diversion would reduce flow in the mainstem Lemhi River by approximately 196-acre feet per year. This effect on flow would affect migrating, spawning, incubating, and rearing Chinook salmon and steelhead. The effects of the proposed actions on Chinook salmon and steelhead in the Lemhi River are described in section 2.5.1.8.

2.5.1.3 Effects of Authorizing Operation and Maintenance of the Big Timber Creek and Basin Creek Diversions

The proposed action would authorize four water diversions on NFS land in the Big Timber Creek drainage. One of these is on Big Timber Creek (Big Timber Creek Diversion) and three are on Basin Creek (Basin Creek Complex), a tributary of Big Timber Creek. All of these diversions are upstream from currently occupied Chinook salmon habitat and the Basin Creek Complex is upstream from currently occupied steelhead habitat. However, the Big Timber Creek Diversion is in occupied steelhead habitat. Because it is in occupied steelhead habitat, maintenance of the diversion will likely affect steelhead and operation of the diversion could result in entrainment of steelhead.

Snow cover and high streamflow typically preclude maintenance of the Big Timber Creek Diversion during steelhead spawning and incubation. Routine maintenance is therefore not likely to affect adult steelhead or steelhead redds, but it will likely affect rearing juveniles that are present throughout the year. Potential effects of routine maintenance include: Disturbance of juveniles in the immediate vicinity of the POD; and turbidity pulses at and immediately downstream from the POD. Measures to reduce adverse effects of routine diversion maintenance activities are described in the BA and summarized in Section 1.3 of this Opinion. Those measures will ensure that effects of routine maintenance activities on steelhead are confined to the immediate vicinity of the POD, are low intensity, and are short duration. Because the measures described in the BA should be effective at reducing adverse effects of routine diversion maintenance activities, the effects of such activities on rearing steelhead will likely be very minor.

Authorization of the Big Timber Creek Diversion will require installation of a fish screen and a new headgate within five years of the initial authorization. The fish screen therefore should be in place and operating before the 2027 irrigation season. Installation of fish screens can result in adverse effects on anadromous fishes and their habitat, such as short-term increases in sediment and turbidity; localized reduction in riparian vegetation; short-term dewatering of work areas; disturbance of fish due to construction activities; and handling of fish during salvage operations in work areas. There are currently three programmatic consultations that are used to address the effects of fish screen installation in the Lemhi River drainage (NMFS 2000a; NMFS 2019; NMFS 2020). The fish screen and headgate will be installed as part of IDFG's ongoing fish screening program (i.e., Screen Shop) and ESA Section 7 consultation will be via programmatic consultation. The SCNF will work with the Screen Shop to ensure that all regulatory requirements are met so that installation can be completed prior to the 2027 irrigation season.

Operating the Big Timber Creek Diversion will result in entrainment of juvenile steelhead. In small high elevation streams, like upper Big Timber Creek, juvenile steelhead move downstream throughout the year, but they would only be vulnerable to entrainment when the diversion is operating (i.e., May through September). The proportion of migrating juvenile salmonids entrained in surface water diversions is variable (Simpson and Ostrand 2012) but is likely to be approximately equal to (Simpson and Ostrand 2012), or slightly less (Walters *et al.* 2012) than the proportion of flow diverted. Based on information on Appendix II of the BA, operation of the Big Bear Timber Diversion would remove an average of 0.57 cfs during May through September, or approximately 0.68% of flow at the POD. We therefore presume that operation of the Big Eightmile Creek Diversion would entrain 0.68% of juvenile steelhead migrating downstream past the POD during May through September. Juvenile steelhead could move downstream past the POD throughout the year but only those moving from May through September would be vulnerable to entrainment. Therefore, only approximately 0.28% of all steelhead rearing upstream from the diversion would likely be entrained. Steelhead habitat upstream from the Big Bear Creek diversion represents 3.85% of the habitat upstream from the LEMHIW trap, and an average of 15,482 juvenile steelhead migrate downstream past the trap each year, so we presume that approximately 249 juvenile steelhead move downstream past the POD each year. Based on these data, operation of the Big Timber Creek Diversion would result in entrainment of an average of two juvenile steelhead per year.

Until the fish screen is installed, the SCNF plans to periodically conduct fish salvage operations in the Big Timber Creek Diversion. Only steelhead that are already entrained in the diversion will be captured during salvage operations, and captured steelhead will be quickly moved to Big Timber Creek and released. Salvage operations could, therefore, reduce the number of steelhead killed due to entrainment. However, because salvage will likely occur for a very small percentage of the time that the diversion is operating, salvage will probably result in a very small reduction in the number of steelhead killed. We therefore presume that, until the diversion is screened, the vast majority of entrained steelhead will likely be killed. Because only steelhead that are already entrained in the diversion will be captured, salvage operations will not increase the number of steelhead captured or killed due to the proposed action.

After the Big Timber Creek Diversion is screened, entrained steelhead will be continuously routed back to Big Timber Creek, via the fish bypass system, whenever the diversion is operating. Although salmonids entrained in screened diversions could experience a variety of adverse effects (e.g., delayed migration, disorientation, increased exposure to predators), survival is typically greater than 97% (Simpson and Ostrand 2012; Walters *et al.* 2012). Because 97% of steelhead entrained in the diversion will likely survive, and approximately two juvenile steelhead will be entrained annually, less than one per year would likely be killed due to entrainment in the Big Timber Creek diversion, after the diversion is screened.

Reduction of flow, due to the proposed action, will adversely affect Chinook salmon and steelhead in the occupied reaches of Big Timber Creek. The Basin Creek Complex consists of three PODs that serve five water rights with a combined maximum diversion rate of 5.1 cfs that is used to irrigate 340 acres. However, the water rights served by the Basin Creek Complex are also served by an additional seven PODs on non-NFS land. Also, flow at the Basin Creek Complex PODs is not sufficient to irrigate 340 acres. The BA stated that approximately 53 acres is irrigated via the three Basin Creek PODs on NFS land, and the measured amount of diverted at those three PODs is consistent with irrigation of 53 acres. However, the analysis in the BA considered the effects of irrigating the full 340 acres. Because the BA described the effects of irrigating the full 340 acres, we multiplied those effects by 53/340 to better represent the actual effect that would occur due to the proposed action.

The Big Timber Creek Diversion consists of one POD that serves two water rights with a combined maximum diversion rate of 2.0 cfs that is used to irrigate 89.6 acres. Although the POU is also served by a POD on non-NFS land, the amount of water diverted at the Big Timber Creek Diversion suggests that irrigation of the POU is primarily a consequence of the proposed action. The effects of authorizing the Basin Creek Complex and the Big Timber Creek Diversion on flow in Big Timber Creek are summarized in Table 16.

Table 16. Impacts of operating the Big Timber Creek and Basin Creek Diversions on flow in Big Timber Creek.

Stream Reach		**Effects of the Proposed Action on Flow**					
		May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Big Timber Creek, Big Timber Creek Diversion to Basin Creek	CFS	0.69	1.25	0.92	-0.01	0	0
	% of Flow[1]	0.79	0.96	1.65	-0.04	0	0
Big Timber Creek, Basin Creek to Carey Act Dam	CFS	0.91	1.64	1.17	0.16	0.12	0.06
	% of Flow[1]	1.05	1.25	2.11	0.62	0.61	0.15
Big Timber Creek, Carey Act Dam to mouth	CFS	0.91	1.64	1.18	0	0	0.03
	% of Flow[2]	3.33	4.27	9.96	0	0	0.45

1. Based on the 50% exceedence flow estimated using data from the Big Timber Creek upper gage, which is located on Big Timber Creek approximately 6.7 miles upstream from the mouth.
2. Based on the 50% exceedence flow estimated using data from the Big Timber Creek lower gage, which is located on Big Timber Creek approximately 1.0 miles upstream from the mouth.

The proposed action will adversely affect adult Chinook salmon migration into Big Timber Creek. The minimum depth for migrating Chinook salmon and steelhead (Thompson 1972) in lower Big Timber Creek corresponds to a streamflows of approximately 11 cfs (Sutton and Morris 2004). Adult Chinook salmon typically migrate upstream in the Lemhi River, anytime from May 1 through September 15 (138 days). Although adult Chinook salmon have not been documented in Big Timber Creek, the habitat restoration that has been ongoing since 2006 could eventually result in reestablishment of Chinook salmon spawning. During a median (i.e., 50% exceedence) flow year, without the proposed action, flow in lower Big Timber Creek would be greater than 11 cfs on 48 days from May 1 through September 15, and with the proposed action, would be greater than 11 cfs on 47 days. Therefore, the proposed action of authorizing operation of the Basin Creek Complex and the Big Timber Creek Diversion would reduce the amount of time that depth in lower Big Timber Creek is suitable for Chinook salmon passage, by approximately 2%. The proposed action would probably not reduce the amount of time that Big Timber Creek meets minimum passage depths during the steelhead migration.

The proposed action will adversely affect juvenile Chinook salmon rearing in Big Timber Creek. Although physical passage barriers have mostly been addressed in the lower 6.7 miles of Big Timber Creek, Chinook salmon have only been documented in the lowest three miles and only juveniles have been observed. We therefore presume that the proposed action would affect rearing Chinook salmon in the lower three miles of Big Timber Creek. From mid-July through September, flow in this reach of Big Timber Creek would be approximately six cfs regardless of the proposed action (see Section 2.4.2.4). However, the proposed action would reduce flow from May through early July and again in October. This reduction in flow would reduce productivity of Chinook salmon rearing in Big Timber Creek by 0.97% (Appendix A). This reach of Big Timber Creek contains 5.5% of the currently occupied Chinook salmon habitat upstream from the LEMHIW trap and approximately 21,081 juvenile Chinook salmon migrate downstream past the trap each year. The effects of the proposed action on Chinook salmon rearing in Big Timber Creek would therefore reduce the number of Chinook salmon juvenile outmigrants by approximately 12 fish each year.

As described in Section 2.4.2.4, the number of juvenile steelhead rearing in Big Timber Creek has increased since implementation of the reconnection program and steelhead are likely currently distributed throughout mainstem Big Timber Creek. The proposed action will reduce flows in all reaches of Big Timber Creek downstream from the Big Timber Creek Diversion (Table 16). The average impacts (May through October) measured as a percentage of average monthly flow, range from 0.56% immediately downstream from the Big Timber Creek Diversion, to 3.00% downstream from the Carey Act Diversion Dam. Overall, this reduction in flow corresponds to a 0.27% to 1.36% reduction in productivity of steelhead rearing in Big Timber Creek (Appendix A). The affected reach of Big Timber Creek constitutes 7.38% of steelhead habitat upstream from the LEMHIW trap, and an average of 15,482 juvenile steelhead migrate downstream past the trap each year. The effects of the proposed action in Big Timber Creek would therefore reduce juvenile steelhead production by approximately 11 fish each year.

Operation of the Big Timber Creek Diversion and the Basin Creek Complex would reduce flow in the mainstem Lemhi River by approximately 244.9-acre feet per year. This effect on flow would affect migrating, spawning, incubating, and rearing Chinook salmon and steelhead. The effects of the proposed action on Chinook salmon and steelhead in the Lemhi River are described in section 2.5.1.8.

2.5.1.4 Effects of Authorizing Operation and Maintenance of the Upper Canyon Creek Diversions

The Upper Canyon Creek Diversions includes three PODs that serve two water rights with a combined maximum diversion rate of 2.41 cfs that is used to irrigate 120.6 acres. These are the only PODs used to irrigate the POU. As described in section 2.4.2.4, the lower 1.5 miles of Canyon Creek is occupied Chinook salmon habitat and the lower 4.9 miles is occupied steelhead habitat. All of the diversion structures associated with the Upper Canyon Creek Diversions are upstream from currently occupied Chinook salmon and steelhead habitat. Because the diversions are upstream from occupied habitat, diversion maintenance activities will not affect Chinook salmon or steelhead and operation of the diversions will not result in entrainment of Chinook salmon or steelhead. However, operation of the Upper Canyon Creek Diversions will reduce flow in occupied Chinook salmon and steelhead habitat in the lower 1.5 miles and 4.9 miles, respectively, of Canyon Creek. These effects are summarized in Table 17.

Table 17. Impacts of operating the Canyon Creek Diversions on flow in Canyon Creek.

Stream Reach		Effect of the Proposed Action on Flow					
		May	Jun	Jul	Aug	Sep	Oct
Canyon Creek, Highway 29 culvert to the mouth (i.e., lowest 4.9 miles)	CFS	0.71	1.18	1.54	1.28	0.98	0.27
	% of Flow[1]	6.83	11.37	26.92	39.37	23.23	5.47

1. Based on the 50% exceedence flow estimated using data from the Canyon Creek gage, located approximately 0.14 miles upstream from the mouth of Canyon Creek

The minimum depth for upstream migrating adult Chinook salmon and steelhead in Canyon Creek corresponds to a flow of approximately six cfs (Sutton and Morris 2006). Adult Chinook salmon typically migrate upstream in the Lemhi River anytime from May 1 through September 15 (138 days). During a median (i.e., 50% exceedence) flow year, without the proposed action, flow in lower Canyon Creek would be greater than six cfs on 79 days from May 1 through September 15 and with the proposed action, would be greater than six cfs on 52 days. Therefore, the proposed action of authorizing operation of the Upper Canyon Creek Diversions would reduce the amount of time that depth in lower Canyon Creek is suitable for Chinook salmon passage, by approximately 34%. The effects would be greater during dryer than normal years and less during wet years. However, because Canyon Creek is not currently utilized by adult Chinook salmon, actual adverse effects on migrating adult Chinook salmon in Canyon Creek are not likely to occur.

Adult steelhead typically migrate upstream in the Lemhi River, and presumably in lower Canyon Creek, anytime from February 1 through May 31 (121 days). During a median (i.e. 50% exceedence) flow year, without the proposed action, flow in lower Canyon Creek would be greater than six cfs on 78 days from February 1 through May 31 and, with the proposed action, would be greater than six cfs on 75 days. Therefore, the proposed action of authorizing operation of the Upper Canyon Creek Diversions would reduce the amount of time that depth in lower Canyon Creek is suitable for adult steelhead passage, by approximately 4%. The effects would be greater during dryer than normal years and less during wet years, with possibly no reduction in the amount of time with suitable passage depths during 20% exceedance and wetter years.

The proposed action will adversely affect Chinook salmon rearing in the lower 1.5 miles of Canyon Creek. The proposed action would reduce flow in Canyon Creek by an average of 18.87% from May through October (Table 15). This reduction in flow corresponds to a 7.1% reduction in Chinook salmon productivity (Appendix A) and would affect all of the currently occupied Chinook salmon habitat. The currently occupied habitat in Canyon Creek represents 1.44% of occupied Chinook salmon habitat upstream from the LEMHIW trap and approximately 21,081 juvenile Chinook salmon migrate downstream past the trap each year. The effects of the proposed action in Canyon Creek would therefore reduce Chinook salmon juvenile outmigrants by approximately 22 fish each year.

The proposed action will adversely affect steelhead rearing in the lower 4.9 miles of Canyon Creek. The reduction in flow, due to the proposed action corresponds to a 9.7% reduction in productivity of steelhead rearing in Canyon Creek. The affected reach of Canyon Creek constitutes 2.43% of steelhead habitat upstream from the LEMHIW trap and an average of 15,482 juvenile steelhead migrate downstream past the trap each year. The effects of the proposed action in Canyon Creek would therefore reduce juvenile steelhead production by approximately 37 outmigrants each year.

Operation of the Upper Canyon Creek Diversions would reduce flow in the mainstem Lemhi River by approximately 362-acre feet per year. This effect on flow would affect migrating, spawning, incubating, and rearing Chinook salmon and steelhead. The effects of the proposed actions on Chinook salmon and steelhead in the Lemhi River are described in section 2.5.1.8.

2.5.1.5 Effects of Authorizing Operation and Maintenance of the Devil's Canyon Creek Diversion and the Big Eightmile Creek Diversion

There are two diversions in the Big Eightmile Creek drainage that will be authorized by the proposed action, the Devil's Canyon Creek Diversion and the Big Eightmile Creek Diversion. The Devil's Canyon Creek Diversion is located on Devil's Canyon Creek approximately 0.5 miles upstream from Big Eightmile Creek and the Big Eightmile Creek Diversion is on Big Eightmile Creek immediately across from the mouth of Devil's Canyon Creek. These two diversions serve two water rights with a combined diversion rate of 2.4 cfs that are used to irrigate a total of 89.9 acres. These diversions serve separate POUs and their operations are not related, but both will affect flow in Big Eightmile Creek from the mouth of Devil's Canyon Creek downstream to the Lemhi River.

The Devil's Canyon Creek Diversion is upstream from occupied Chinook salmon and steelhead habitat. Maintenance of the Devil's Canyon Creek Diversion will not affect Chinook salmon or steelhead and operation of the diversion will not result in entrainment of Chinook salmon or steelhead. The Big Eightmile Creek Diversion is upstream from occupied Chinook salmon habitat but it is in occupied steelhead habitat. Because the Big Eightmile Creek Diversion is in occupied steelhead habitat, maintenance of the diversion will likely affect steelhead and operation of the diversion could result in entrainment of steelhead.

Snow cover and high streamflow typically preclude maintenance of the Big Eightmile Creek Diversion during steelhead spawning and incubation. Routine maintenance is therefore not likely to affect adult steelhead or steelhead redds, but it will likely affect rearing juveniles that are present throughout the year. Potential effects of routine maintenance include: Disturbance of juveniles in the immediate vicinity of the POD; and turbidity pulses at and immediately downstream from the POD. Measures to reduce adverse effects of routine diversion maintenance activities are described in the BA and summarized in Section 1.3 of this Opinion. Those measures will ensure that effects of routine maintenance activities on steelhead are confined to the immediate vicinity of the POD, are low intensity, and are short duration. Because the measures described in the BA should be effective at reducing adverse effects of routine diversion maintenance activities, the effects of such activities on rearing steelhead will likely be very minor.

Authorization of the Big Eightmile Creek Diversion will require installation of a fish screen and a new headgate within five years of the initial authorization. The fish screen therefore should be in place and operating before the 2027 irrigation season. Installation of fish screens can result in adverse effects on anadromous fishes and their habitat, such as short-term increases in sediment and turbidity; localized reduction in riparian vegetation; short-term dewatering of work areas; disturbance of fish due to construction activities; and handling of fish during salvage operations in work areas. There are currently three programmatic consultations that are used to address the effects of fish screen installation in the Lemhi River drainage (NMFS 2000a; NMFS 2019; NMFS 2020). The fish screen and headgate will be installed as part of IDFG's ongoing fish screening program (i.e., Screen Shop) and ESA Section 7 consultation will be via programmatic consultation. The SCNF will work with the Screen Shop to ensure that all regulatory requirements are met so that installation can be completed prior to the 2027 irrigation season.

Operating the Big Eightmile Creek Diversion will result in entrainment of juvenile steelhead. In small high elevation streams, like Big Eightmile Creek, juvenile steelhead move downstream throughout the year, but they would only be vulnerable to entrainment when the diversion is operating (i.e., May through September). The proportion of migrating juvenile salmonids entrained in surface water diversions is variable (Simpson and Ostrand 2012) but is likely to be approximately equal to (Simpson and Ostrand 2012), or slightly less (Walters *et al.* 2012) than the proportion of flow diverted. Based on information on Appendix II of the BA, operation of the Big Eightmile Creek Diversion would remove an average of 0.15 cfs during May through September, or approximately 0.32% of flow at the POD. We therefore presume that operation of the Big Eightmile Creek Diversion would entrain 0.32% of juvenile steelhead migrating downstream past the POD during May through September. Juvenile steelhead could move downstream past the POD throughout the year but only those moving from May through September would be vulnerable to entrainment. Therefore, only approximately 0.13% of all steelhead rearing upstream from the diversion would likely be entrained. Steelhead habitat upstream from the Big Eightmile Creek diversion represents 1.76% of the habitat upstream from the LEMHIW trap, and an average of 15,482 juvenile steelhead migrate downstream past the trap each year, so we presume that approximately 272 juvenile steelhead move downstream past the POD each year. Based on these data, operation of the Big Eightmile Creek Diversion would result in entrainment of an average of 0.35 juvenile steelhead per year, or approximately one steelhead every three years.

Until the fish screen is installed, the SCNF plans to periodically conduct fish salvage operations in the Big Eightmile Creek Diversion. Only steelhead that are already entrained in the diversion will be captured during salvage operations, and captured steelhead will be quickly moved to Big Eightmile Creek and released. Salvage operations could reduce the number of steelhead killed due to entrainment. However, because salvage will likely occur for a very small percentage of the time that the diversion is operating, salvage will probably result in a very small reduction in the number of steelhead killed. We therefore presume that, until the diversion is screened, the vast majority of entrained steelhead will likely be killed. Because only steelhead that are already entrained in the diversion will be captured, salvage operations will not increase the number of steelhead captured or killed due to the proposed action.

After the Big Eightmile Creek Diversion is screened, entrained steelhead will be continuously routed back to Big Eightmile Creek, via the fish bypass system, whenever the diversion is operating. Although salmonids entrained in screened diversions could experience a variety of adverse effects (e.g., delayed migration, disorientation, increased exposure to predators), survival is typically greater than 97% (Simpson and Ostrand 2012; Walters *et al.* 2012). Because 97% of steelhead entrained in the diversion will likely survive, and fewer than one juvenile steelhead will be entrained annually, steelhead will rarely be killed in the Big Eightmile Creek Diversion, after the diversion is screened.

In addition to the entrainment effects, the proposed action will also affect Chinook salmon and steelhead by reducing flow in occupied spawning and rearing habitat in Big Eightmile Creek. Operation of the Big Eightmile Creek and Devil's Canyon Creek Diversions will reduce flow in occupied steelhead habitat between Devil's Canyon Creek and the mouth of Big Eightmile Creek, and in occupied Chinook salmon habitat in the lower mile of Big Eightmile Creek. The effects of operating the Devil's Canyon Creek and Big Eightmile Creek Diversions on flow in occupied Chinook salmon and steelhead habitat in Big Eightmile Creek are summarized in Table 18.

Table 18. Effects of operating the Devil's Canyon Creek and the Big Eightmile Creek Diversions on flow in Big Eightmile Creek. The impacts on flow in the lowest reach of Big Eight Mile Creek are equal to the estimated consumptive use of water resulting from operating Diversions.

Stream Reach		**Effect of the Proposed Action on Flow**					
		May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Big Eightmile Creek Diversion to upstream extent of Chinook salmon rearing	CFS	0.50	1.46	0.56	0.04	0.01	0
	% of Flow[1]	1.00	1.84	1.47	0.26	0.10	0
	% of Flow[2]	2.42	4.69	3.65	0.80	0.23	0
Big Eightmile Creek, upstream extent of Chinook salmon rearing to mouth	CFS	0.32	1.22	0.59	0.16	0.08	0
	% of flow[3]	2.28	4.40	3.50	5.39	7.62	0

1. Based on data from the Big Eightmile Creek upper gage, located approximately 7.9 miles upstream from the Lemhi River.
2. Based on data from the Big Eightmile Creek lower gage, located approximately 3.8 miles upstream from the Lemhi River.
3. Based on the flow estimates for the lower mile of Big Eightmile Creek (downstream from all diversions) that were presented in the biological assessment.

The minimum depth for upstream migrating adult Chinook salmon and steelhead in Big Eightmile Creek corresponds to a flow of approximately five cfs (Sutton and Morris 2005). Streamflow gage data are not available for the most flow-limited reaches near the mouth of Big Eightmile Creek, but the estimated flows presented in the BA suggests that the proposed action would have a small adverse effect on fish passage during August and September. This could adversely affect migration of adult Chinook salmon into Big Eightmile Creek, but because adult Chinook salmon do not currently utilize habitat in Big Eightmile Creek, actual effects would be rare. Because adult steelhead complete their migration before August, there would possibly not be an effect on adult steelhead migrating in Big Eightmile Creek.

The proposed action would reduce flow in Chinook salmon occupied habitat in lower Big Eightmile Creek by an average of 3.86% from May through October (Table 18). This reduction in flow corresponds to a 1.49% reduction in Chinook salmon productivity (Appendix A) and would affect all of the currently occupied Chinook salmon habitat in Big Eightmile Creek. The currently occupied habitat represents 0.57% of occupied Chinook salmon habitat upstream from the LEMHIW trap and approximately 21,081 juvenile Chinook salmon migrate downstream past the trap each year. The effects of the proposed action in Big Eightmile Creek would therefore reduce Chinook salmon juvenile outmigrants by approximately two fish each year.

The reduction in flow, due to the proposed action would affect steelhead habitat in Big Eightmile Creek from the mouth of Devil's Canyon Creek downstream to the Lemhi River. The average impacts (May through October) measured as a percentage of average monthly flow, range from 0.77% immediately downstream from Devil's Canyon Creek, to 3.86% near the mouth. Overall, this reduction in flow corresponds to a 0.37% to 2.06% reduction in productivity of steelhead rearing in Big Eightmile Creek (Appendix A). The affected reach of Big Eightmile Creek constitutes 3.81% of steelhead habitat upstream from the LEMHIW trap, and an average of 15,482 juvenile steelhead migrate downstream past the trap each year. The effects of the proposed action in Big Eightmile Creek would therefore reduce juvenile steelhead production by approximately seven fish each year.

Operation of the Devil's Canyon and the Big Eightmile Creek Diversions would reduce flow in the mainstem Lemhi River by approximately 113-acre feet per year. This effect on flow would affect migrating, spawning, incubating, and rearing Chinook salmon and steelhead. The effects of the proposed action on Chinook salmon and steelhead in the Lemhi River are described in section 2.5.1.8.

2.5.1.6 Effects of Authorizing Operation and Maintenance of the Mill Creek Peterson Diversion and the Mill Creek Strupp Diversion

There are two diversions in the Mill Creek drainage that will be authorized by the proposed action. These are the Mill Creek Strupp Diversion and the Mill Creek Peterson Diversion. The Mill Creek Strupp Diversion is located on a side channel of Mill Creek approximately 5.9 miles upstream from the Lemhi River, and the Mill Creek Peterson Diversion is on the Mill Creek main channel almost immediately across from the Mill Creek Strupp Diversion. These two diversions serve three water rights with a combined maximum diversion rate of 11.8 cfs that are used to irrigate a total of 276.6 acres. Because both of the diversions are upstream from occupied habitat, diversion maintenance activities will not affect Chinook salmon or steelhead and operation of the diversions will not result in entrainment of Chinook salmon or steelhead. Likewise, because Chinook salmon or steelhead does not currently occupy Mill Creek, the flow reductions in Mill Creek will not affect Chinook salmon or steelhead. However, operation of the Mill Creek Peterson and the Mill Creek Strupp Diversions will reduce flow in the mainstem Lemhi River by approximately 396 acre feet per year, which will affect Chinook salmon and steelhead. These effects are described in section 2.5.1.8.

2.5.1.7 Effects of Authorizing Operation and Maintenance of the East Fork Hayden Creek and the McNutt Creek Diversions

There are two diversions in the Hayden Creek drainage that will be authorized by the proposed action. These are the East Fork Hayden Creek Diversion, near the mouth of East Fork Hayden Creek, and the McNutt Creek Diversion in the Basin Creek drainage. The fish sampling data presented in the BA suggests that McNutt Creek is not currently occupied by anadromous fishes, but operating the McNutt Creek Diversion will affect flows in downstream reaches that are currently occupied. The East Fork Hayden Creek Diversion POD is in occupied habitat and its authorization will affect anadromous fishes via a number of pathways, such as: entrainment; reduction of flows in occupied habitat; disturbance during maintenance; and increased turbidity due to maintenance activities.

The East Fork Hayden Creek Diversion is on East Fork Hayden Creek approximately 0.20 miles upstream from the confluence of East Fork Hayden Creek and Hayden Creek. The diversion serves two water rights with a combined maximum diversion rate of 11.68 cfs that is used to irrigate up to 1,036.7 acres, however, until more information becomes available (see Section 1.3.3) this analysis assumes that operation of the diversion would result in irrigation of approximately 584 acres (see Section 1.3.1.9). The POD is in occupied steelhead habitat and is immediately adjacent to occupied Chinook salmon habitat. Although the diversion is currently a partial fish passage barrier, the OMP will include provisions to meet fish passage criteria and, therefore, authorization of the diversion will not impair upstream migration of steelhead or Chinook salmon[21]. Because the diversion is in occupied steelhead habitat and is very near to occupied Chinook salmon habitat, routine maintenance of the diversion will likely affect Chinook salmon and steelhead. Potential effects of routine maintenance include: Disturbance of adults and juveniles in the immediate vicinity of the POD, and turbidity pulses at and immediately downstream from the POD. Measures to reduce adverse effects of routine diversion maintenance activities are described in the BA and summarized in Section 1.3 of this opinion. These measures include work windows to reduce effects on adults and redds, and BMPs to lower turbidity and sedimentation. These measures will ensure that effects of routine maintenance activities on Chinook salmon and steelhead are confined to the immediate vicinity of the POD, are low intensity, and are short duration. Because the measures described in the BA should be effective, effects of routine maintenance activities on Chinook salmon and steelhead will likely be very minor.

Chinook salmon have not been documented upstream from the East Fork Hayden Creek Diversion and we therefore presume that operating the diversion will not result in entrainment of Chinook salmon. Operating the East Fork Hayden Creek Diversion will result in entrainment of juvenile steelhead. Juvenile steelhead are likely to be moving downstream past the East Fork Hayden Creek POD throughout the year, but they would only be vulnerable to entrainment when the diversion is operating (i.e., April through October). The proportion of migrating juvenile salmonids entrained in surface water diversions is variable (Simpson and Ostrand 2012) but is likely to be approximately equal to (Simpson and Ostrand 2012), or slightly less (Walters *et al.*

[21] These provisions could reduce the impacts on flow. If that occurs, the effects on Chinook salmon and steelhead will be applied toward the Program goals. See footnote 9.

2012) than the proportion of flow diverted. Based on the information in Appendix II of the BA, operation of the East Fork Hayden Creek Diversion would remove an average of 8.0 cfs during May through September, or approximately 58.4% of the flow at the POD. We therefore presume that operation of the East Fork Hayden Creek Diversion would entrain 58.4% of juvenile steelhead migrating downstream during May through September. Juvenile steelhead could move downstream past the POD throughout the year but only those moving from May through September would be vulnerable to entrainment. Therefore, only approximately 24.3% of all steelhead rearing upstream from the diversion would likely be entrained. Steelhead habitat upstream from the East Fork Hayden Creek POD represents 0.94% of the habitat upstream from the LEMHIW trap, and an average of 15,482 juvenile steelhead migrate downstream past the trap each year, so we presume that approximately 146 juvenile steelhead move downstream past the POD each year. Based on these data, operation of the East Fork Hayden Creek Diversion would result in entrainment of approximately 35 juvenile steelhead each year. Although salmonids entrained in screened diversions could experience a variety of adverse effects (e.g., delayed migration, disorientation, increased exposure to predators), survival is typically greater than 97% (Simpson and Ostrand 2012; Walters et al. 2012). Because 97% of steelhead entrained in the diversion will likely survive, one juvenile steelhead per year would likely be killed due to entrainment in the East Fork Hayden Creek Diversion.

The McNutt Creek Diversion is on McNutt Creek, which is a small tributary of Basin Creek, which flows into mainstem Hayden Creek 3.5 miles upstream from the Lemhi River. The diversion serves two water rights with a combined maximum diversion rate of 1.29 cfs that is used to irrigate 64.2 acres. Because the POD is upstream from occupied Chinook salmon and steelhead habitat, maintenance of the diversion will not affect Chinook salmon or steelhead and operating the diversion will not result in entrainment of Chinook salmon or steelhead. Operation of the McNutt Creek Diversion will reduce flow in occupied steelhead habitat in the lowest 5.7 miles of Basin Creek and in occupied Chinook salmon and steelhead habitat in the lowest 3.5 miles of Hayden Creek. Operation of the East Fork Hayden Creek Diversion will reduce flow in occupied Chinook salmon and steelhead habitat in the lower 0.20 miles of East Fork Hayden Creek and the lower ten miles of mainstem Hayden Creek. Effects of operating the McNutt Creek and East Fork Hayden Creek Diversions on flow in occupied Chinook salmon and steelhead habitat in the Hayden Creek drainage are summarized in Table 19.

Table 19. Impacts of operating the McNutt Creek and the East Fork Hayden Creek Diversions on flow in East Fork Hayden Creek, Basin Creek, and Hayden Creek

Stream Reach		Effect of the Proposed Action on Flow					
		May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
East Fork Hayden Creek, Diversion to Mouth	CFS	5.37	9.80	9.75	8.13	7.18	0.76
	% of Flow[1]	23.7	25.2	58	96.8	94.5	10.2
Hayden Creek, EF Hayden Creek to Reference Point C	CFS	5.37	9.80	9.75	8.13	7.18	0.76
	% of Flow[2]	3.25	3.47	8.64	22.2	29.8	1.58
Hayden Creek, Reference Point C to Basin Creek	CFS	2.51	5.56	7.48	4.92	2.95	0.76
	% of Flow[2]	1.52	1.97	6.64	13.47	12.24	1.58
Basin Creek, McNutt Creek to Mouth	CFS	0.27	0.61	0.83	0.65	0.44	0.11
	% of Flow[3]	1.50	2.88	8.31	12.80	9.89	1.59
Hayden Creek, Basin Creek to Mouth	CFS	2.78	6.17	8.31	5.57	3.39	0.87
	% of Flow[2]	1.68	2.18	7.37	15.25	14.07	1.81

1. Based on flow estimate using Streamstats.
2. Based on data from the Hayden Creek Gage located near the mouth of Hayden Creek.
3. Based on flow estimate using Streamstats.

The lowest flows on record in Hayden Creek are likely sufficient for upstream migration of Chinook salmon and steelhead (see section 2.4.2.7) and they presumably occurred with the East Fork Hayden Creek and the McNutt Creek Diversions operating. We therefore conclude that authorizing operation of the East Fork Hayden Creek and the McNutt Creek diversions would not affect Chinook salmon and steelhead migration into Hayden Creek. Neither streamflow gage data nor depth/flow information are available for Basin Creek. However, anecdotal evidence indicates that Basin Creek is dry for most of the irrigation season. Operation of the McNutt Creek Diversion would therefore likely have a substantial adverse effect on adult steelhead migration into Basin Creek.

Operating the East Fork Hayden Creek and the McNutt Creek Diversions will reduce flow in occupied Chinook salmon and steelhead habitat in the Hayden Creek drainage. Because flow is related to Lemhi River Chinook salmon and steelhead productivity, operating the Diversions will reduce productivity of Chinook salmon and steelhead rearing in the Hayden Creek drainage. The estimated reduction in productivity, amount of occupied habitat affected, and the estimated impact, expressed as out-migrating juveniles, are summarized in Table 20.

The effects of the proposed actions on Chinook salmon and steelhead in the Hayden Creek drainage will reduce the number of out-migrating steelhead by an average of 59 per year (58 due to reduced flow and one due to entrainment) and 365 Chinook salmon per year (all due to reduced flow). Operating the East Fork Hayden Creek and the McNutt Creek Diversions will also reduce flow in occupied Chinook salmon and steelhead habitat in the mainstem Lemhi River by approximately 1,635-acre feet per year. Those effects are described in Section 2.5.1.8.

Table 20. Flow related effects of operating the McNutt Creek and East Fork Hayden Creek Diversions on Chinook salmon (CS) and steelhead (SH) in Hayden Creek and East Fork Hayden Creek, and on flow and SH in Basin Creek.

Stream Reach	Reduction in Productivity		Habitat Affected (IP m^2)		Reduction in Outmigrants	
	CS	SH	CS	SH	CS	SH
EFHC, Diversion to mouth	12.1%	24.7%	97	260	5	<1
Hayden Creek, EFHC to Reference Point C	2.79%	6.28%	7,747	33,773	93	16
Hayden Creek, Reference Point C to Basin Creek	1.55%	3.31%	10,443	47,589	70	12
Hayden Creek, Basin Creek to the mouth	1.76%	3.75%	25,884	63,155	196	18
Basin Creek, McNutt Creek to the mouth	NA	3.20%	NA	45,590	NA	11
Total					**365**	**58**

2.5.1.8 Effects of Authorizing Operation and Maintenance of West Fork Wimpey Creek Diversion

The West Fork Wimpey Creek Diversion is located on West Fork Wimpey Creek 4.2 miles upstream from Wimpey Creek and 7.5 miles upstream from the Lemhi River. This diversion serves three water rights with a combined maximum diversion rate of 9.51 cfs. The diverted water is transmitted to East Fork Bohannon Creek and is rediverted from East Fork Bohannon and Bohannon Creeks to irrigate up to 497.5 acres. A review of the conditions of approval for these water rights suggests that only 407.4 acres of irrigation is dependent on operation of the West Fork Wimpey Creek diversion and the impacts on flow presented in the BA were estimated assuming the lower acreage. Because the POD is upstream from occupied Chinook salmon and steelhead habitat (see Section 2.4.2.8), maintenance of the diversion will not affect Chinook salmon or steelhead and operating the diversion will not block Chinook salmon or steelhead migration or result in entrainment of juveniles. Also, because only the lowest reach of West Fork Wimpey Creek is occupied anadromous fish habitat, the reduction of flow in West Fork Wimpey Creek will have a very small effect on steelhead and will not affect Chinook salmon. However, operating the West Fork Wimpey Creek Diversion will alter flow in occupied Chinook salmon and steelhead habitat in Wimpey and Bohannon Creeks, and in occupied steelhead habitat in East Fork Bohannon Creek, which will affect Chinook salmon and steelhead. The effects of operating the West Fork Wimpey Creek Diversion on flow in Wimpey, East Fork Bohannon, and Bohannon Creeks are summarized in Table 21.

Table 21. Impacts of operating the West Fork (WF) Wimpey Creek Diversion on flow in Wimpey Creek, East Fork (EF) Bohannon Creek, and Bohannon Creek. The negative numbers indicate an increase in flow.

Stream Reach	CFS or % of Mean Monthly Flow	May	Jun	Jul	Aug	Sep	Oct
Wimpey Creek, WF Wimpey Creek to the mouth[1]	CFS	0.22	2.78	3.87	3.61	2.59	0.28
	% Flow	1.65	16.55	99.74	100	100	6.57
EF Bohannon Creek, transfer ditch to mouth[2]	CFS	-0.02	-1.63	-3.25	-3.83	-3.06	0
	% Flow	-0.34	-11.8	-27.7	-86.1	-68.5	0
Bohannon Creek, EF Bohannon Creek to mouth[3]	CFS	-0.02	-1.63	-3.16	-3.83	-3.06	0
	% Flow	-0.13	-6.09	-29.0	-106.0	-121.0	0

1. Wimpey Creek and flows are estimated using Streamstats.
2. EF Bohannon Creek flows were taken from the BA and were probably estimated using StreamStats.
3. Bohannon Creek flows are from the lower Bohannon Creek gage.

Depth versus streamflow relationships data are not available for Wimpey Creek. However, Wimpey Creek is similar in drainage area, channel gradient, and elevation as Bohannon Creek and the drainages are adjacent to each other. We therefore presume that minimum passage depth in Wimpey Creek is similar to the estimated passage depth for lower Bohannon Creek (i.e., approximately seven cfs). Streamflow gage data are not available for Wimpey Creek, but the estimated flows presented in the BA suggest that the proposed action would have a substantial adverse effect, possibly reducing flow below the minimum passage depth for all of August and the first half of September. This could substantially reduce the chance of reestablishment of Chinook salmon spawning in Wimpey Creek. Because steelhead migrate earlier in the season when flows are typically higher, the proposed action would have a much smaller effect on adult steelhead migration in Wimpey Creek.

The proposed action would also affect fish passage in Bohannon Creek, but because the effect on flow is positive, the effect on fish passage would also be positive. The minimum depth for upstream migrating adult Chinook salmon and steelhead in Bohannon Creek corresponds to a flow of approximately seven cfs (Sutton and Morris 2006). Adult Chinook salmon typically migrate upstream in the Lemhi River anytime from May 1 through September 15 (138 days). During a median (i.e., 50% exceedence) flow year, without the proposed action, flow in lower Bohannon Creek would be greater than seven cfs on 64 days from May 1 through September 15 and with the proposed action, would be greater than seven cfs on 73 days. Therefore, the proposed action of authorizing operation of the West Fork Wimpey Creek Diversion would increase the amount of time that depth in lower Bohannon Creek is suitable for Chinook salmon passage, by approximately 14% during a 50% exceedence year. Because the effects on flow would be very small early in the irrigation season when steelhead would be migrating upstream (Table 19), the proposed action would have very little effect on upstream migration of steelhead in Bohannon Creek.

Because operating the West Fork Wimpey Creek Diversion will reduce flow in occupied Chinook salmon and steelhead habitat in Wimpey Creek, and because flow is related to Lemhi River Chinook salmon and steelhead productivity, operating the Diversion will reduce productivity of Chinook salmon and steelhead rearing in Wimpey Creek. However, operating the Diversion will also increase flow in the affected reaches of East Fork Bohannon and Bohannon Creeks, which will increase productivity of Chinook salmon and steelhead rearing in the Bohannon Creek drainage. The estimated changes in productivity, amount of occupied habitat affected, and the estimated effects expressed as out-migrating juveniles, are summarized in Table 22. Operating the West Fork Wimpey Creek Diversion will also reduce flow in the Lemhi River by 591 acre-feet per year. Those effects are described in Section 2.5.1.8.

Table 22. Flow related effects of operating the West Fork Wimpey Creek Diversion on Chinook salmon (CS) and steelhead (SH) in Wimpey, East Fork Bohannon, and Bohannon Creeks.

Stream Reach	Reduction in Productivity		Habitat Affected (IP m^2)		Reduction in Outmigrants	
	CS	SH	CS	SH	CS	SH
Wimpey Creek, WF Wimpey Creek to the mouth	21.50%	18.3%	3,647	27,341	32	59
EF Bohannon Creek, transfer ditch to mouth	NA	-15.1%	0	230	0	>-1
Bohannon Creek, EF Bohannon Creek to mouth	-8.32%	-20.6%	9,417	33,223	-38	-63
Total					**-6***	**-4***

* In this instance, a negative number represents a benefit to fish.

2.5.1.9 Effects of Authorizing Operation and Maintenance of the Canyon Creek #1 Diversion

The Canyon Creek Diversion #1 is located on Canyon Creek approximately 1.5 miles upstream from the Lemhi River. This diversion will be moved to private land prior to the 2023 irrigation season. The proposed action would authorize operation and maintenance of this diversion at its current location on NFS lands until the diversion structure can be moved to private land.

Moving the Canyon Creek #1 Diversion to private land is possible because water can be feasibly diverted and transmitted to the place of use, via gravity, without crossing NFS land. Because water can be feasibly diverted and transmitted to the place of use, via gravity, without crossing NFS land; diversion, transmission, and use of water would likely occur regardless of the proposed action. Because division, transmission, and use of water on private land would likely occur regardless of the proposed action, those activities are not a consequence of the proposed action and the flow effects of operating the diversion on private land are also not a consequence of the proposed action. The removal and relocation of the diversion to private land will be covered by the Idaho Habitat Restoration programmatic consultation (NMFS 2019).

The diversion is a partial barrier to upstream fish passage when it is operating and when it is not operating. When the diversion is moved to private land, the old diversion dam will be removed, thus removing the partial fish passage barrier. The proposed action would authorize routine maintenance of the Canyon Creek # 1 diversion for the 2021 and 2022 irrigation seasons. Potential effects of routine maintenance include disturbance of juveniles in the immediate vicinity of the POD; and turbidity pulses at and immediately downstream from the POD. Measures to reduce adverse effects of routine diversion maintenance activities are described in the BA and summarized in Section 1.3 of this Opinion. Those measures will ensure that effects of routine maintenance activities on Chinook salmon and steelhead are confined to the immediate vicinity of the POD, are low intensity, and are short duration. Because the measures described in the BA should be effective at reducing adverse effects of routine diversion maintenance activities, the effects of such activities on rearing Chinook salmon and steelhead will likely be very minor.

2.5.1.10 Mainstem Lemhi River

The proposed action will authorize operation and maintenance of 17 PODs and portions of 17 water transmission structures (i.e., ditches and pipes) on NFS land. One consequence of this action is irrigation of approximately 1,878.8 acres which will consumptively use (via evapotranspiration) approximately 3,678.3 acre feet of water per year. Water consumptively used via evapotranspiration is removed from the water budget, which will reduce flows in all stream reaches downstream from the PODs, including all reaches of the mainstem Lemhi River. We used data from 11 streamflow gages, six on the mainstem Lemhi River and five on tributary streams, to characterize flow in the mainstem Lemhi River. The gages used and average monthly flow in eight contiguous reaches of the mainstem Lemhi River, are in Table 23.

The estimated effects of the proposed action, expressed as CFS and as percent of average monthly flow, for the eight contiguous reaches of the mainstem Lemhi River, are in Table 24. These effects are equal to the average consumptive use resulting from authorizing operation of the 17 PODs and water transmission structures on NFS land in the Lemhi River Watershed.

Table 23. Streamflow gages used to describe flow in reaches of the mainstem Lemhi River that are affected by the proposed action and average monthly flow in each reach from May through October.

Stream Reach	Gages	Average Monthly Flow (cfs)					
		May	Jun	Jul	Aug	Sep	Oct
Texas/Eighteenmile Creeks to Canyon Creek	Lemhi River above L-63, Eighteenmile Creek	35.4	33.4	19.4	15.9	23.3	49.6
Canyon Creek to Big Timber Creek	Lemhi River above L-63, Eighteenmile Creek, Canyon Creek	43.0	38.1	23.3	18.1	26.5	60.0
Big Timber Creek to Big Eightmile Creek	Lemhi River above Big Springs Creek, Big Springs Creek	122	134	86.7	80.7	88.9	125
Big Eightmile Creek to Mill Creek	Lemhi River at Cottom Lane	148	170	107	84.6	97.7	153
Mill Creek to Hayden Creek	Lemhi River at McFarland Campground	119	150	100	86.9	94.1	154
Hayden Creek to Wimpey Creek	Lemhi River at Lemhi	301	520	272	139	150	243
Wimpey Creek to L-6 Diversion	Lemhi River at Baker, Bohannon Creek	436	626	258	124	131	258
L-6 Diversion to Mouth	Lemhi River above L-5	306	634	213	50.7	59.3	228

Note: When multiple gages were used, the average monthly flow is the sum of the average monthly flows measured at each gage.

Table 24. Impacts of the proposed action on flow in the mainstem Lemhi River expressed as cfs and as percent of the average monthly flow in the affected reach (see Table 23).

Stream Reach		Effect of the Proposed Action on Flow					
		May	Jun	Jul	Aug	Sep	Oct
Texas/Eighteenmile Creeks to Canyon Creek	CFS	0.55	1.53	1.58	1.18	0.86	0.35
	% of Flow	1.56	4.58	8.16	7.44	3.69	0.70
Canyon Creek to Big Timber Creek	CFS	1.09	2.71	3.12	2.46	1.84	0.62
	% of Flow	2.54	7.11	13.40	13.58	6.94	1.03
Big Timber Creek to Big Eightmile Creek	CFS	2.00	4.35	4.30	2.62	1.96	0.65
	% of Flow	1.64	3.25	4.95	3.25	2.20	0.52
Big Eightmile Creek to Mill Creek	CFS	2.29	5.10	4.89	2.78	2.04	0.65
	% of Flow	1.55	3.00	4.57	3.29	2.08	0.42
Mill Creek to Hayden Creek	CFS	3.32	7.75	7.07	3.12	2.39	0.65
	% of Flow	2.79	5.17	7.03	3.59	2.54	0.42
Hayden Creek to Wimpey Creek	CFS	6.11	13.93	15.37	8.69	5.78	1.51
	% of Flow	2.03	2.68	5.65	6.24	3.86	0.62
Wimpey Creek to L-6 Diversion	CFS	7.86	17.45	18.30	9.52	5.98	1.78
	% of Flow	1.80	2.79	7.09	7.70	4.57	0.69
L-6 Diversion to Mouth	CFS	7.86	17.45	18.30	0	5.98	1.78
	% of Flow	2.57	2.75	8.60	0	10.09	0.78

Note: Because flow downstream from L-6 would be maintained at 25 cfs during August regardless of the proposed action, the effect in that reach is presumed to be zero during August.

Reducing flow in the mainstem Lemhi River will adversely affect rearing Chinook salmon and steelhead. The estimated reduction in productivity in each reach, the amount of Chinook salmon and steelhead habitat in each reach, and the consequent reduction in the number of outmigrants, are summarized in Table 25. The effect of the proposed action on Chinook salmon and steelhead rearing in the mainstem Lemhi River would result in approximately 275 fewer Chinook salmon and 200 fewer steelhead outmigrants during each year that the permitted diversions operate.

Table 25. Effects of the proposed action on flow and on Chinook salmon and steelhead in the mainstem Lemhi River.

Stream Reach	Reduction in Productivity		Habitat Affected (IP m^2)		Reduction in Outmigrants	
	CS	SH	CS	SH	CS	SH
Texas/Eighteenmile Creeks to Canyon Creek	1.38%	2.18%	14,546	6,250	8	1
Canyon Creek to Big Timber Creek	2.36%	3.78%	17,502	23,430	17	7
Big Timber Creek to Big Eightmile Creek	0.83%	1.30%	12,310	197,129	4	20
Big Eightmile Creek to Mill Creek	0.79%	1.24%	85,418	129,461	27	12
Mill Creek to Hayden Creek	1.13%	1.77%	210,213	345,218	97	47
Hayden Creek to Wimpey Creek	0.76%	1.83%	292,249	517,937	84	73
Wimpey Creek to L-6 Diversion	0.90%	2.13%	43,464	105,551	15	17
L-6 Diversion to Mouth	0.87%	1.99%	69,010	152,835	22	23
Total					**275**	**200**

2.5.1.11 Effects of the Proposed Action on Chinook Salmon and Steelhead In The Mainstem Salmon River

The proposed action would reduce flow in the mainstem Salmon River downstream from the Lemhi River from May through October. The average reduction in flow would range from 0.12% in October to 0.64% in July. Chinook salmon and steelhead rear in this reach of the Salmon River and would be adversely affected by the reduction in flow caused by the proposed action. However, most rearing occurs in the Lemhi River drainage and, as a consequence, the relationship between rearing flow in the Salmon River and Chinook salmon and steelhead productivity is not apparent. Migration flow in the Salmon River is related to population productivity but based on the information in the BA, the proposed action would not appreciably affect Salmon River flows during migration. Summer water temperatures in the Lemhi River are substantially colder than temperatures in the Salmon River and reducing flow in the Lemhi River would likely reduce the amount of available cold-water refugia. However, in all but the wettest years, flow in the lower Lemhi River is maintained at approximately 25 cfs for the entire month of August by instream flow agreements. Because flows in the lower Lemhi River are regulated during the time when cold water refugia is most important, we presume that the proposed action would have very little effect on cold water refugia in the Salmon River. Because relationships of rearing flow in the Salmon River and Chinook salmon and steelhead population productivity are not apparent, the proposed action would not appreciably affect migration flow in the Salmon River, and flows in the lower Lemhi River are largely regulated during August, we presume the effects of the proposed action on Chinook salmon and steelhead in the mainstem Salmon River are minor.

2.5.1.12 Effects of the SCNF Restoration Program

Much of the Chinook salmon and steelhead habitat in the Lemhi River drainage is in poor condition and would benefit from restoration (see Sections 2.2.2 and 2.4.2). The SCNF will implement a conservation program (Program) that will: (1) Increase the amount of salmonid habitat restoration implemented by the SCNF; and (2) increase SCNF participation in, and contributions to, habitat restoration projects implemented by other Federal agencies, state agencies, and nongovernmental organizations. The primary purpose of the Program will be to apply additional USFS resources to restoration activities in the Lemhi River drainage. The Program will achieve that purpose through activities such as applying for funding from USFS and non-USFS sources; participating in interagency habitat restoration planning and implementation efforts; and implementing habitat restoration projects. These actions will not always have successful outcomes. For example, grant applications will not always result in funding and projects that enter the initial planning stages will not always be implemented. However, because failures are anticipated and are incorporated into the overall strategy, the Program will likely result in a substantial number of successful outcomes, which should, over time, result in an increased amount of habitat restoration in the Lemhi River drainage.

The Program will increase the amount of habitat restoration by contributing to existing federal, state, and non-governmental habitat restoration programs, and by increasing the amount of SCNF implemented habitat restoration. Fish habitat restoration in the Lemhi River drainage ranges from extensive, such as fencing livestock out of riparian areas, to intensive, such as complete reconstruction of stream channels. Regardless of the lead agency or organization, all restoration projects are designed, reviewed, implemented by natural resource professionals who are familiar with the latest habitat restoration techniques. Past and ongoing habitat restoration in the Lemhi River drainage includes: improving streamflow in selected reaches; improving fish passage at water diversions and road crossings; reconstructing stream channels and side channels; reconnection of floodplains to main channels; installation of instream habitat structures; exclusion of grazing from riparian areas; installation of beaver dam analogs; and reconnecting tributary streams to the mainstem. Future habitat restoration in the Lemhi River drainage will continue to utilize the latest information on habitat restoration techniques.

Restoration of salmonid stream habitat increases salmonid abundance, biomass (Binns 2004; Pierce et al. 2013; Polivka and Claeson 2020; Whiteway et al. 2010) and habitat capacity (Polivka and Claeson 2020). Restoring the quality of stream habitat also improves salmonid migration and use of spawning areas (Pierce et al. 2014), potentially increasing population productivity. Although stream habitat restoration can be durable (Binns 2004) it often requires ongoing maintenance and adaptive management to be successful over the long term (Moore and Rutherfurd 2017; Pierce et al. 2013). Because salmonid stream habitat restoration typically results in increased salmonid abundance and population productivity, and because habitat restoration in the Lemhi River drainage is designed and implemented by professionals who are familiar with the latest techniques and monitoring needs, increasing the amount of habitat restoration in the Lemhi River drainage will likely increase productivity of the Lemhi River Chinook salmon and steelhead populations.

The initial goals of the Program are: (1) Increase productivity of Chinook salmon rearing habitat in the Lemhi River drainage sufficiently to completely offset the adverse effects of the proposed action (i.e., 2.0% based on the average annual number of outmigrants past the Lower Lemhi River screw trap (LLRTP) trap from 2006-2015[22]) within ten years after authorizing operation and maintenance of water diversions on NFS land; and (2) increase productivity of steelhead rearing habitat in the Lemhi River drainage sufficiently to completely offset the adverse effects of the proposed action (i.e., 1.3% based on the average annual number of outmigrants from the Lemhi River population for 2008-2017[23]) within five years after authorizing operation and maintenance of water diversions on NFS land[24]. Although there are substantial uncertainties regarding success of actions implemented by the Program, the monitoring and adaptive management described in the BA should ensure that the Program results in additional Chinook salmon and steelhead habitat restoration and that the restoration is effective. Because salmonid stream habitat restoration typically results in greater salmonid abundance, increasing the amount of habitat restoration in the Lemhi River drainage should result in increased productivity of the Lemhi River Chinook salmon and steelhead populations. Continuation of the program after the initial goals are met should result in additional benefits to Chinook salmon and steelhead and should ensure the long-term success of restoration projects. This analysis presumes that the Program will be implemented as described, projects associated with the Program will improve Chinook salmon and steelhead habitat, and the Program goals will be achieved.

2.5.1.13 Effects of Monitoring on Chinook Salmon and Steelhead

The proposed action includes monitoring the condition of water diversions, the operation of water diversions, and the effectiveness of habitat restoration projects. Monitoring of fish distribution and density may also occur, but is optional. None of the monitoring will involve activities that are likely to affect fish habitat. Monitoring the condition of water diversions, the operation of water diversions, and the effectiveness of restoration projects will not require entering streams is therefore unlikely to result in disturbance of Chinook salmon or steelhead. Monitoring of fish distribution and/or density, if it occurs, will be conducted using standard snorkeling techniques and therefore could result in disturbance of adult or juvenile Chinook salmon and juvenile steelhead. Because there will be no attempt to pursue or capture fishes, and because standard snorkeling techniques are designed to minimize disturbance, the monitoring will likely result in only minor disturbance of Chinook salmon and steelhead and is not likely to result in harm or harassment.

2.5.1.14 Summary of the Effects on Chinook Salmon and Steelhead

The proposed action would: (1) Reduce the amount of time that tributary streams have adequate depth for adult Chinook salmon and steelhead migration; (2) result in entrainment of juvenile steelhead in irrigation diversions; (3) reduce the amount of flow in occupied Chinook salmon and steelhead rearing habitat; (4) increase the amount of accessible Chinook salmon rearing habitat in Canyon Creek; and (5) increase the amount of habitat restoration implemented in the Lemhi

[22] See footnote 8.
[23] See footnote 7.
[24] The initial goals are based on the adverse effects described in sections 2.5.1.1 - 2.5.1.9. If these effects are adjusted based on new information described in section 1.3.3, the initial goals may also be adjusted.

River drainage. Because the current distribution of adult Chinook salmon is limited to the mainstem Lemhi River, Hayden Creek, and Big Springs Creek, the effect of the proposed action on migrating adult Chinook salmon will be very small. Because adult steelhead migration into tributary streams occurs prior to and early in the irrigation season, when flows are typically the greatest, the effect of the proposed action on migrating steelhead will likely be very small. When expressed as outmigrating juveniles, the entrainment pathway will result in one steelhead killed annually, and the flow pathway will result in an average of 715 fewer Chinook salmon and 413[25] fewer steelhead annually (Table 26). The reduction in the capacity of the affected habitat to produce juvenile Chinook salmon and steelhead will annually reduce productivity of the Lemhi River Chinook salmon and steelhead populations by an average of 2.0% and 1.3%, respectively, which will likely result in an annual average of seven fewer adult Chinook salmon returns and 11[26] fewer adult steelhead returns. Over the long-term, the proposed action will likely result in an increase in productivity for both populations, which should eventually result in an increase in adult returns for both populations. Because the net reduction in steelhead and Chinook salmon population productivity would last only five and ten years, respectively, both populations are likely to persist until the beneficial effects of the proposed action are realized.

Table 26. Summary of initial impacts of the proposed actions on Chinook salmon and steelhead, expressed as a reduction in the number of juvenile outmigrants.

Stream Reach	Pathway	Effect (number of juveniles)	
		CS	SH
Big Bear Creek, headwaters to Diversion	Entrainment	0	13
Big Bear Creek, Diversion to mouth	Rearing Flow	0	2
Hawley Creek, Big Bear Creek to HC #2 Diversion	Rearing Flow	0	3
Hawley Creek, HC #2 Diversion to mouth	Rearing Flow	0	41
Eighteenmile Creek, Hawley Creek to mouth	Rearing Flow	32	12
Texas Creek, Deer Creek to mouth	Rearing Flow	14	31
Big Timber Creek, headwaters to Diversion	Entrainment	0	2
Big Timber Creek, Diversion to Basin Creek	Rearing Flow	0	1
Big Timber Creek, Basin Creek to Carey Act Dam	Rearing Flow	0	<1
Big Timber Creek, Carey Act Dam to mouth	Rearing Flow	12	9

[25] The density of steelhead was calculated by dividing the average number of steelhead migrating downstream from the Lemhi Weir screw trap by the total area of intrinsic potential (IP) upstream from the screw trap, assuming that all IP was accessible. This likely overestimated the amount of accessible habitat and therefore underestimated actual density upstream from the screw trap. This calculated density was then applied to all steelhead habitat in the drainage, including habitat that is probably much more productive than the upper Lemhi River (such as the Hayden Creek drainage); this likely further underestimated actual steelhead density. Because steelhead density was likely underestimated, both the average number of steelhead outmigrants and the effects expressed as number of outmigrants, were likely underestimated. However, the effect expressed as a percentage of the population is probably relatively accurate.

[26] The effect of the proposed action was converted to adult returns by multiplying the percent reduction in population productivity by the average number of adult returns for 2010-2019. The effect is much larger for steelhead than it is for Chinook salmon because the average number of steelhead adult steelhead returns was much greater than the average number of Chinook salmon returns. The steelhead out-migrant to adult return rate calculated with these numbers would be 2.6%, which is higher than typically reported. As described above, the number of steelhead outmigrants was likely underestimated, which would tend to overestimate the out-migrant to adult return rate.

Stream Reach	Pathway	Effect (number of juveniles)	
		CS	SH
Canyon Creek, Highway 28 culvert to mouth	Rearing Flow	22	37
Big Eightmile Creek, headwaters to Diversion	Entrainment	0	<1
Big Eightmile Creek, Devil's Canyon Creek to mouth	Rearing Flow	2	7
East Fork Hayden Creek, headwaters to diversion	Entrainment	0	1
East Fork Hayden Creek, diversion to mouth	Rearing Flow	5	<1
Hayden Creek, EFHC to Reference Point C	Rearing Flow	93	16
Hayden Creek, Reference Point C to Basin Creek	Rearing Flow	70	12
Basin Creek, McNutt Creek to mouth	Rearing Flow	0	11
Hayden Creek, Basin Creek to mouth	Rearing Flow	196	18
Wimpey Creek, West Fork Wimpey Creek to mouth	Rearing Flow	32	59
East Fork Bohannon Creek, inflow to mouth	Rearing Flow	0	<1
Bohannon Creek, EFBC to mouth	Rearing Flow	-38	-63
Lemhi R., Texas/Eighteenmile Creeks to Canyon Creek	Rearing Flow	8	1
Lemhi R., Canyon Creek to Big Timber Creek	Rearing Flow	17	4
Lemhi R., Big Timber Creek to Big Eightmile Creek	Rearing Flow	4	20
Lemhi R., Big Eightmile Creek to Mill Creek	Rearing Flow	27	12
Lemhi R., Mill Creek to Hayden Creek	Rearing Flow	97	47
Lemhi R., Hayden Creek to Wimpey Creek	Rearing Flow	84	73
Lemhi R., Wimpey Creek to L-6 Diversion	Rearing Flow	15	17
Lemhi R., L-6 Diversion to Mouth	Rearing Flow	23	23
Total		**715**	**413**

Note: Chinook salmon juvenile outmigrants includes subyearlings and yearlings and steelhead juvenile outmigrants includes subyearlings, yearlings, and two-year-olds. Negative numbers indicate a positive impact (increase in outmigrants).

2.5.2 Effects on Chinook Salmon and Steelhead Designated Critical Habitat

Chinook salmon designated critical habitat in the action area includes all stream reaches that are presently, or were historically, accessible to Chinook salmon. Monitoring conducted since the mid-2000s has demonstrated that juvenile Chinook salmon will move into non-spawning tributary streams to rear, and will move up to three miles upstream seeking suitable rearing habitat. Under historic conditions, when Chinook salmon spawning distribution extended into the larger tributaries and rearing densities were much higher, juvenile Chinook salmon may have moved further into non-spawning reaches than they currently do. We therefore presume that Chinook salmon designated critical habitat includes all stream reaches that are not upstream from natural fish passage barriers.

The BA states that the SCNF does not consider the Deer Creek, Basin Creek, Canyon Creek Complex, Devils Canyon Creek, Big Eightmile Creek, Mill Creek Strupp, Mill Creek Peterson, McNutt Creek, or the West Fork Wimpey Creek Diversions to be in Chinook salmon designated critical habitat. With the exception of the Deer Creek, McNutt Creek, and West Fork Wimpey Creek Diversions, there is no evidence of natural fish passage barriers between the diversions and currently occupied Chinook salmon habitat. NMFS therefore considers the Basin Creek, Canyon Creek Complex, Devils Canyon Creek, Big Eightmile Creek, Mill Creek Strupp, and Mill Creek Peterson Diversions to be within Chinook salmon designated critical habitat. A brief discussion of our rationale with regards to Deer Creek, McNutt Creek, and West Fork Wimpey Creek Diversions follows.

Deer Creek historically flowed over an alluvial fan, which may have resulted in inadequate depth for upstream migration of adults. However, the Deer Creek Diversion is less than two miles upstream from Texas Creek, Texas Creek is historic Chinook salmon spawning habitat, juveniles regularly move more than two miles up non-spawning tributaries to rear, and depths were likely adequate for juvenile migration. The Deer Creek Diversion is, therefore, in Chinook salmon designated critical habitat.

Stream gradient in McNutt Creek is steep, which could limit upstream fish migration. However, the stream gradient from Basin Creek upstream to the McNutt Creek Diversion is six to eight percent, which anadromous salmonids can typically ascend. Also, there are no documented natural barriers downstream from the Diversion. The McNutt Creek Diversion is, therefore, in Chinook salmon designated critical habitat, albeit probably near the upstream extent due to increasing stream gradient upstream from the Diversion.

There is a cascade approximately 20 feet-high located approximately 0.3 miles upstream from the mouth of West Fork Wimpey Creek. IDFG surveyed West Fork Wimpey Creek and determined that the cascade is a complete barrier to upstream fish migration (Murphy and Yanke 2003). The West Fork Wimpey Creek Diversion is upstream from the cascade and, therefore, is not in Chinook salmon designated critical habitat. The West Fork Wimpey Creek Diversion is the only diversion that would be authorized by the proposed action that is not in Chinook salmon designated critical habitat.

Steelhead designated critical habitat within the action area includes: The lower 12.8 miles of Texas Creek; East Fork Hayden Creek from the East Fork Hayden Creek Diversion downstream to Hayden Creek; Hayden Creek from East Fork Hayden Creek downstream to the mouth; Bohannon Creek from East Fork Bohannon Creek downstream to the mouth; Wimpey Creek from West Fork Wimpey Creek downstream to the mouth; the entire mainstem Lemhi River, and the mainstem Salmon River from the Lemhi River downstream to the Middle Fork Salmon River.

2.5.2.1 Non-Flow Effects of the Proposed Actions on Riparian and Stream Channel Habitat

Routine maintenance of water diversions and water transmission structures will result in adverse effects on Chinook salmon designated critical habitat in Big Bear Creek, Deer Creek, Big Timber Creek, Basin Creek (tributary of Big Timber Creek), Canyon Creek, the unnamed tributary of Canyon Creek, Hood Gulch Creek, Devil's Canyon Creek, Big Eightmile Creek, Mill Creek, East Fork Hayden Creek, and McNutt Creek; and will result in adverse effects on steelhead designated critical habitat in East Fork Hayden Creek. Routine maintenance activities have the potential to injure or kill riparian plants, expose areas of bare soil, destabilize streambanks, introduce fine sediment into streams, and introduce fuel and/or lubricating oils into streams.

Measures to reduce adverse effects of routine diversion maintenance activities are described in the BA and summarized in Section 1.3 of this Opinion. These measures include: Establishment of approved access routes; requirements to revegetate disturbed areas; and application of standard best management practices to reduce sediment delivery to streams and minimize chance of fuel/oil spills. These measures will ensure that effects of routine maintenance activities on Chinook salmon and steelhead designated critical habitat are confined to the immediate vicinity of the POD, are low intensity, and are short duration. Because the measures described in the BA should be effective, effects of routine maintenance activities on Chinook salmon and steelhead, designated critical habitat will likely be very minor.

2.5.2.2 Flow Effects of the Actions on Designated Critical Habitat

Authorizing operation of water diversions will reduce flow in Chinook salmon designated critical habitat in all affected stream reaches except East Fork Bohannon and Bohannon Creeks; and will reduce flow in steelhead designated critical habitat in Texas, East Fork Hayden, Hayden, and Wimpey Creeks. The authorizations will increase flow in Chinook salmon and steelhead designated critical habitat in East Fork Bohannon and Bohannon Creeks. The magnitude of these flow alterations are presented in Section 2.5.1. Altering flow will primarily affect the water quantity PBF but because streamflow drives many of the processes that determine quality of salmonid habitat, it will also affect the other PBFs described in Table 9. Streamflow in the Lemhi River drainage is severely degraded (see Section 2.4.2 and NMFS 2017) and is a primary limiting factor for recovery of Chinook salmon and steelhead (NMFS 2017).

Alterations in streamflow affect water quality (Ebersole et al. 2001; Poole & Berman 2001; Dahm et al. 2003; Ebersole et al. 2003; May & Lee 2004; Miller et al. 2008), amount and/or availability of drifting invertebrates (Townsend & Hildrew 1976; Elliott 2002; Boulton 2003; Lake 2003; Nislow et al. 2004; Harvey et al. 2006; Hayes et al. 2007; Miller et al. 2007; Carlisle et al. 2011; Jager 2014; Caldwell et al. 2018), refugia available for rearing salmonids (Hardy et al. 2006) and quality of salmonid migration habitat (Thompson 1972; Cragg-Hine 1985; Mitchell and Cunjak 2007). Through these pathways, authorizing operation of water diversions will affect Chinook salmon water quality, cover/shelter, food, space, water temperature, and safe passage PBFs; and steelhead water quality, forage, natural cover, and free of artificial obstructions PBFs. These effects on PBFs largely coincide with flow alterations, beginning as soon as the flow alteration begins and ending relatively soon after cessation of the flow alterations. These pathways are also likely the primary drivers of the fish population versus flow relationships used in Section 2.5.1 to quantify the effects on Chinook salmon and steelhead.

Some of the flow alterations resulting from authorizing water diversions will be positive (i.e., Bohannon Creek), but most effects on occupied Chinook salmon and steelhead designated critical habitat will be negative. These effects will annually reduce productivity of the Lemhi River Chinook salmon and steelhead populations by 2.0% and 0.87[27]%, respectively (see Section 2.5.1). All of the affected steelhead designated critical habitat is currently occupied, but much of the affected Chinook salmon designated critical habitat is not. Chinook salmon distribution has been expanding in affected tributary streams, the habitat restoration programs facilitating this expansion will likely continue, and the water diversion authorizations will be long-term (30-years to permanent). Chinook salmon recolonization of some of the affected, but currently

[27]This does not include the effects on habitat in Big Bear, Hawley, Eighteenmile, Big Timber, Canyon, Big Eightmile, and Basin Creeks because those creeks are not steelhead designated critical habitat.

unoccupied, stream reaches will therefore likely occur while the authorizations are in effect. For the foreseeable future, the vast majority of Chinook salmon recolonization will likely occur in the lower and middle reaches of tributary streams, where the effects of authorizing water diversions will be similar to those in currently occupied habitat. Chinook salmon designated critical habitat that will be seasonally dewatered due to the authorizations (i.e., Deer Creek, the unnamed tributary of Canyon Creek, Hood Gulch Creek, and Basin Creek) is a substantial distance upstream from currently occupied habitat and is also upstream from a number of fish passage barriers, and is therefore unlikely to be reoccupied in the foreseeable future.

Although most of the adverse effects of the diversion authorizations could be quickly reversed if water diversion and use ceased, there are no provisions to change water diversion or use due to an increase in Chinook salmon habitat occupancy. Which means that Chinook salmon in newly occupied designated critical habitat will have lower growth and survival than they would without the authorizations. Therefore, the effects of the authorizations on currently unoccupied Chinook salmon designated critical habitat will negatively affect recovery of the Lemhi River Chinook salmon population. However, because it is not possible to predict how much Chinook salmon habitat will be reoccupied, the overall effects on recovery cannot be quantified.

Alterations in streamflow also affect the health of riparian vegetation (Lake 2003; Richter and Richter 2000) and condition of stream substrates (Wilcock et al. 1996; Baker et al. 2011). Through these pathways, authorizing water diversions will affect the steelhead substrate PBF, and the floodplain connectivity to form and maintain physical habitat conditions PBF; and the Chinook salmon spawning gravel, riparian vegetation, and substrate PBFs. These factors do not change quickly with flow, do not likely exhibit large year-to-year variations, and likely persist for a relatively long period after the flow alteration ceases. These factors are therefore not likely reflected in the fish population versus flow relationships used to quantify the effects described in Section 2.5.1. These factors will reduce productivity of salmonid habitat in all affected stream reaches, except East Fork Bohannon and Bohannon Creeks, and will tend to impair achievement of recovery objectives.

2.5.2.3 Effects of the Conservation Program on Designated Critical Habitat

The Program is designed for maximum flexibility regarding the location and types of restoration projects. Restoration projects associated with the Program could occur anywhere in the Lemhi River drainage and the types of restoration could include, but is not limited to: riparian fencing, installation of large woody debris structures, reconstruction of channelized stream channels, installation of beaver dam analogs, construction of side channels, gravel enhancement, regrading of floodplains, culvert replacement, improving fish passage at water diversions, screening of water diversions, moving points of diversion to enhance flow in specific reaches, and flow enhancement through leasing or acquisition of water rights. Because the Program could result in a wide variety of habitat restoration, it could benefit a variety of Chinook salmon and steelhead PBFs through a number of different pathways. For example, assisting with restoration of channelized reaches of the Lemhi River would directly improve floodplain connectivity, natural cover, cover/shelter, riparian vegetation, and spawning gravel PBFs. The direct improvements in floodplain connectivity and riparian vegetation would, in turn, result in improved food production, thus improving the food and forage PBFs. Also, the restoration of floodplain processes would also result in further improvement of the riparian vegetation PBF and may result in long-term improvement of the water quality and water temperature PBFs. Because projects that would be advanced by the Program have not yet been identified, the number of PBFs that would be benefited cannot be precisely determined. However, because the Program is designed to facilitate a wide variety of habitat restoration, and because it will operate for more than ten years, it could potentially improve any of the Chinook salmon and steelhead PBFs listed in Table 9. This analysis is based on the presumption that the Program will be implemented as described, projects associated with the Program will improve Chinook salmon and steelhead habitat, and the Program goals will be achieved.

The purpose of the Program is to increase the amount of habitat restoration that would occur in the Lemhi River drainage. Although the Program would represent a new source of habitat restoration resources, it would operate in conjunction with existing habitat restoration efforts. Habitat restoration projects in the Lemhi River drainage are designed and implemented using current information from the peer-reviewed literature. In addition, the Lemhi River drainage is one of Idaho's two intensively monitored watersheds (Uthe et al. 2017), which results in a relative abundance of data that is used in habitat restoration planning. Because habitat restoration in the Lemhi River drainage is planned and implemented using current techniques and a relative abundance of drainage-specific data, and because the Program will operate within the existing restoration infrastructure, the Program will likely result in benefits to Chinook salmon and steelhead critical habitat.

The primary goal of the Program is to offset the adverse effects of authorizing water diversions on Chinook salmon and steelhead population productivity. The monitoring described in Section 1.3.3 should ensure that Program progress is adequate to achieve this primary goal. Because the Program will likely be effective in offsetting adverse effects of authorizing water diversions, and because the pathway for offsetting the adverse effects will be improved habitat quality and accessibility, the overall long-term habitat effects of the proposed action will likely be neutral or positive.

Some of the habitat restoration activities that are implemented or advanced by the Program will have adverse effects on Chinook salmon and steelhead designated critical habitat. Adverse effects of habitat restoration on designated critical habitat are typically due to short-term increases in fine sediment that may temporally degrade the water quality PBF. In the Lemhi River drainage, these effects are typically addressed via programmatic consultation (e.g., NMFS 2019) however, some are occasionally addressed via individual consultation (e.g., NMFS 2017a). Based on completed projects in the Lemhi River drainage, the adverse effects of restoration activities on designated critical habitat will probably be due to increases in fine sediment, are likely to be minor, and are likely to be short duration (NMFS 2017a; NMFS 2019).

All of the occupied and potentially occupied Chinook salmon habitat in the Lemhi River drainage is also Chinook salmon designated critical habitat, and all of the habitat restoration associated with the Program will occur in occupied and potentially occupied Chinook salmon habitat. Therefore, all of the habitat restoration that is associated with the Program will benefit Chinook salmon designated critical habitat. Because all of the habitat restoration associated with the Program would benefit Chinook salmon designated critical habitat, and because the Program would offset adverse effects of authorizing water diversions, the overall long-term effects of the proposed action on Chinook salmon designated critical habitat in the Lemhi River drainage would be neutral or positive.

Much of the occupied and potentially occupied steelhead habitat in the Lemhi River drainage is not steelhead designated critical habitat, and therefore, a portion of the habitat restoration associated with the Program will likely benefit steelhead habitat that is not steelhead designated critical habitat. This could result in a situation wherein adverse effects on steelhead occupied habitat are successfully offset but the overall effect of the proposed action on steelhead designated critical habitat is negative. However, because the Program would offset the adverse effects on Chinook salmon occupied habitat, and the vast majority of Chinook salmon occupied habitat is also steelhead designated critical habitat, the overall effects of the proposed action on steelhead designated critical habitat are likely to be neutral or positive over the long term.

2.5.2.4 Summary of the Effects on Designated Critical Habitat

Authorizing operation and maintenance of water diversions on NFS land will affect the Chinook salmon water quality, cover/shelter, food, space, water temperature, spawning gravel, riparian vegetation, substrate, and safe passage PBFs; and the steelhead water quality, forage, natural cover, substrate, floodplain connectivity to form and maintain the physical habitat conditions, and free of artificial obstructions PBFs. Implementation of the Program will result in a variety of habitat restoration activities that will occur over a period of at least ten years. Although the PBFs that will be benefited cannot be precisely determined, the breadth and duration of the Program should insure that the overall benefit on Chinook salmon and steelhead PBFs will be sufficient to offset the adverse effects of authorizing diversions. Overall, the long-term effect of the proposed action on Chinook salmon and steelhead designated critical habitat will likely be neutral or positive.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future 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 and 402.17(a)). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the status section (Section 2.2).

Operation and maintenance of surface and ground water diversions that are not subject to ESA section 7 consultation will continue. Diversions that are not subject to ESA section 7 consultation include those that are on private and state land, but also includes numerous diversions on federal land that, for a variety of reasons, do not require federal agency authorization. Operation and maintenance of water diversions that are not subject to ESA section 7 consultation will continue to alter flows in Chinook salmon and steelhead habitat throughout most of the action area (see Section 2.4). These effects will likely change as water is appropriated to irrigate more land and as irrigation methods change.

Some water diversions that are currently subject to ESA section 7 consultation will be moved to non-NFS land. While this will reduce the effect of water diversion related activities that are subject to ESA section 7 consultation, it will not reduce the overall effects on ESA listed fishes and their habitat. In fact, moving water diversions off NFS land could result in a long term increase in adverse effects because operation of the diversions will not be subject to NFS permit terms and conditions.

New irrigation water rights in the Lemhi River drainage have been approved as recently as February 2020, and there is no indication that approval of new water rights will cease. Not all new water rights result in additional irrigation and some actually facilitate efforts to improve flows to restore fish habitat. However, some of the recently approved water rights in the Lemhi River drainage will result in irrigation of new (i.e., formally not irrigated) land, and others will supplement irrigation on currently irrigated land, both of which will increase water use, reduce streamflow, and will reduce quality of Chinook salmon and steelhead habitat. The recent approval of water rights suggests that appropriation of water to irrigate new land and to supplement irrigation on existing POUs will continue, which will result in increased water use, reduced flows, and reduced quality of Chinook salmon and steelhead habitat.

Prior to the 1960s, essentially all of the irrigation in the Lemhi River drainage was via flooding. Flood irrigation is relatively inefficient, meaning that the ratio of water applied to water used (i.e., used by the plants to grow) is high. Although there has been a continual shift to more efficient methods, a substantial amount of land is still flood irrigated. Improving the efficiency of irrigation systems can have a variety of effects, including: reduction of wetlands (Peck and Lovvorn 2001), increase in consumptive use (Contor and Taylor 2013), and reduction in the amount of water available for other uses, such as environmental flows (Ward and Pulido-Velazquez 2008). Increasing irrigation efficiency can substantially increase crop yields (Dorratcaque 1986), providing an incentive to convert to more efficient irrigation systems. Therefore, the current trend of conversion to more efficient systems will probably continue, with resultant adverse effects on the water budget, and possibly on anadromous fishes and anadromous fish habitat.

State programs to protect Chinook salmon and steelhead from the effects of irrigation in the Lemhi River drainage began with the establishment of the fish screen program in the late 1950s. Currently, the IDWR, Idaho OSC, and IDFG are working to improve Chinook salmon and steelhead habitat in the Lemhi River drainage. These efforts have improved flows, removed fish passage barriers, and restored stream channel and floodplain habitat in the mainstem Lemhi River and at least eight tributary streams (see Section 2.4). These state programs will likely continue and will continue to make incremental improvements in Chinook salmon and steelhead habitat.

The cumulative effects will have both negative and positive impacts on Chinook salmon and steelhead and their habitat within the action area. Although there have been no statistically detectable changes in juvenile production, anecdotal evidence suggests that there have been recent improvements in rearing conditions in the Lemhi River drainage (see Section 2.2). As state natural resource agencies continue to strategically direct habitat improvement projects, the overall cumulative effects on Chinook salmon and steelhead might be positive.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's Opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

The USFS proposes authorizing operation and maintenance of water diversions via permanent easements and 30-year duration SUAs. As previously described, authorizing the operation and maintenance of water diversions on NFS land will reduce flow available for migrating adult Chinook salmon and steelhead, will result in entrainment of juvenile steelhead, and will reduce flow in occupied Chinook salmon and steelhead habitat. The effects on adult Chinook salmon and steelhead will likely be very small and the entrainment effects will result in death of approximately one juvenile steelhead each year that the authorized diversions operate. Reducing flow in occupied Chinook salmon and steelhead habitat will reduce the capacity of habitat to produce Chinook salmon and steelhead, which will reduce growth and survival of rearing juvenile Chinook salmon and steelhead, resulting in approximately 715 fewer out-migrating Chinook salmon and 413 fewer out-migrating steelhead, each year that the authorized diversions operate. The USFS also proposes to develop and implement the Program, which will increase the SCNF's involvement in habitat restoration in the Lemhi River drainage.

Development and implementation of the Program will increase SCNF involvement in habitat restoration in the Lemhi River drainage. Increasing SCNF involvement in habitat restoration will increase the amount of habitat restoration that occurs, which will improve the quality and quantity of accessible Chinook salmon and steelhead habitat. Increasing quality and quantity of available habitat will increase the capacity of habitat to produce Chinook salmon and steelhead. The initial goals of the Program are: (1) Completely offset the adverse effects on Chinook salmon population productivity within ten years of authorizing water diversions on SCNF land; and (2) completely offset the adverse effects on steelhead population productivity within five years of authorizing water diversions on NFS land. If the estimated amount of land irrigated as a consequence of authorizing water diversions on NFS land does not change, restoration activities will have to increase productivity of the Chinook salmon and steelhead populations by 2.0%[28] and 1.3%[29], respectively, to achieve these initial goals. Because the Program will continue after

[28] See footnote 8.
[29] See footnote 7.

the initial goals are met, the effects of the proposed action on Chinook salmon and steelhead will likely be positive over the long term.

The Lemhi River Chinook salmon and steelhead populations are currently at high risk of extinction due to low abundance/productivity. The decreases in productivity will begin during the first year that diversions are authorized and will result in approximately seven fewer adult Chinook salmon and 11 fewer adult steelhead returning each year. Because benefits of the Program would take longer to accrue, the net adverse effect on population productivity could affect up to ten-year classes of Chinook salmon and up to five-year classes of steelhead. Although both populations are at high risk of extinction over 100 years, the current size and year to year variability of the populations suggests neither is likely to go extinct during the next ten years, even considering productivity reductions due to authorizing the diversions. Although the probability of either population becoming extinct during the next ten years is low, the probability that one or more year classes will be sufficiently small to adversely affect long-term population fitness (i.e., life history expression, genetics, etc.), is much higher. Because the Program would continue after the initial population productivity goals are met, any long-term effects on population fitness, due to decreased productivity during the initial five to ten years, should be completely offset by long-term increases in productivity.

The recovery objective for the Lemhi River Chinook salmon population is low risk of extinction and the current status is high risk of extinction due to low abundance/productivity. Authorizing water diversions on NSF land will result in a net reduction of productivity of Chinook salmon designated critical habitat in the entire action area. The Program will result in improvements in the quality of Chinook salmon designated critical habitat, which should offset the reduction caused by authorizing water diversions. Because of the ongoing improvement in quality of Chinook salmon designated critical habitat, the long-term effect of the proposed action on Chinook salmon population productivity will be positive.

The recovery objective for the Lemhi River steelhead population is moderate risk of extinction and the current risk is high risk of extinction due to low abundance/productivity. Authorizing water diversions on NFS land will adversely affect steelhead designated critical habitat in Texas, Hayden, East Fork Hayden, and in the mainstem Lemhi and Salmon Rivers; and will benefit steelhead designated critical habitat in East Fork Bohannon, and Bohannon Creeks. The effect of authorizing diversions on steelhead designated critical habitat will be negative. The Program will result in increased productivity in occupied steelhead habitat within the Lemhi River drainage. Because much of the occupied steelhead habitat in the Lemhi River drainage is not steelhead designated critical habitat, the productivity goal for steelhead could be met without positively affecting steelhead designated critical habitat. However, because the vast majority of Chinook salmon occupied habitat is also steelhead designated critical habitat, achieving the Program's goals for Chinook salmon productivity will likely result in substantial benefits to steelhead designated critical habitat. Therefore, the long-term effect of the proposed action on steelhead designated critical habitat is likely to be positive.

Baseline conditions in the action area are impaired by land use activities, channel modifications, bank stabilization, etc.; but a primary factor is water diversion and use for irrigated agriculture. The activities that impair baseline conditions (e.g., grazing, road maintenance, water use, etc.)

will continue throughout the duration of the proposed action; and summer base flows will likely continue to decline due to climate change, increased irrigation, and possibly due to increased irrigation efficiency. Habitat restoration has been ongoing since the late 1990s and has resulted in: Localized improvements in salmonid habitat quality; increases in the quantity of accessible salmonid habitat; localized increases in stream flow, and localized increases in salmonid productivity. In spite of the habitat restoration, overall base flow conditions are declining, salmonid productivity has not increased appreciably at the population scale, and both production and productivity of juvenile Chinook salmon remains a fraction of levels seen in the late-1960s and early 1970s. The proposed action will result in reduced streamflow, which will tend to degrade baseline conditions. The proposed action will also increase the amount of habitat restoration[30], which will result in a net improvement of baseline conditions over the long term.

Most of the land use and water diversion activities that impair salmonid habitat in the Lemhi River drainage occur on private and state land, or occur on Federal land with little or no federal discretion. Most of these activities will likely continue and additional water will likely be appropriated for irrigation, further impairing salmonid habitat. State programs to restore salmonid habitat will also likely continue, which will somewhat offset adverse effects of land use activities and water diversion.

Effects of the proposed action will likely coincide with climate change-related effects across the range of Snake River spring/summer Chinook salmon and Snake River Basin steelhead. Although climate change-related effects are difficult to precisely predict, the current trends indicate that climate change will make recovery objectives more difficult to achieve and will exacerbate the effects of authorizing water diversions on NFS land. Most notably, climate change will likely lead to a reduction in base flows, which is also the primary adverse effect of the diversion authorizations. However, because the proposed action also includes implementation of the Program, the overall long-term effects of the proposed action will tend to ameliorate the effects of climate change.

The proposed action is not likely to appreciably reduce the likelihood of survival or recovery of the Lemhi River Chinook salmon population because: (1) The Lemhi River Chinook salmon population is not likely to go extinct during the next ten years; (2) the effect of the proposed action on Chinook salmon population productivity will be positive after ten years; and (3) the long-term positive effects of the proposed action that will occur after year ten will offset possible reductions in population fitness due to poor year classes prior to year ten. Because the proposed action will not appreciably reduce the likelihood of survival or recovery of the Lemhi River Chinook salmon population, it likewise will not appreciably reduce the likelihood of survival or recovery of the Upper Salmon River Chinook salmon MPG. Because the proposed action will not appreciably reduce the likelihood of survival or recovery of the Upper Salmon River Chinook salmon MPG, it will also not appreciably reduce the likelihood of survival or recovery of the Snake River spring/summer Chinook salmon ESU. In reaching this conclusion, NMFS

[30] Some of the habitat restoration that will be implemented or advanced due to the Program might improve flow, but flow improvement is not necessary to achieve the Program goals. A substantial amount of the restoration will likely involve projects that do not directly improve flow.

considered the number, reproduction, and distribution of Snake River spring/summer Chinook salmon.

The proposed action is not likely to appreciably diminish value of Chinook salmon designated critical habitat within the Snake River spring/summer Chinook salmon ESU because: (1) The proposed action includes implementation of the Program that is designed to improve quality of Chinook salmon designated critical habitat; and (2) the long-term effect of the proposed action, on quality of Chinook salmon designated critical habitat, will be positive.

The proposed action will not appreciably reduce the likelihood of survival or recovery of the Lemhi River steelhead population because: (1) The Lemhi River steelhead population is not likely to go extinct during the next five years; (2) the effect of the proposed action on steelhead population productivity will be positive after five years; (3) the long-term effects of the proposed action, that will occur after year five, will offset possible reductions in fitness due to poor year classes prior to year five. Because the proposed action will not appreciably reduce the likelihood of survival or recovery of the Lemhi River steelhead population, it will also not appreciably reduce the likelihood of survival or recovery of the Salmon River steelhead MPG. Because the proposed action will not appreciably reduce the likelihood of survival or recovery of the Salmon River steelhead MPG, it will not appreciably reduce the likelihood of survival or recovery of the Snake River Basin steelhead ESU. In reaching this conclusion, NMFS considered the numbers, reproduction, and distribution of Snake River Basin steelhead.
The proposed action is not likely to appreciably diminish the value of steelhead designated critical habitat within the Snake River Basin steelhead DPS because: (1) The proposed action includes implementation of the Program that is designed to improve quality of Chinook salmon and steelhead PBFs in the Lemhi River drainage; (2) the long-term effect of the proposed action on quality of occupied Chinook salmon PBFs will be positive; (3) because most occupied Chinook salmon habitat is also steelhead designated critical habitat and the net long term effect on Chinook salmon occupied habitat will be positive, the net long-term effect of the proposed action on steelhead designated critical habitat is also likely to be positive.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' Opinion that the proposed action is not likely to jeopardize the continued existence of Snake River spring/summer Chinook salmon and Snake River Basin steelhead and is not likely to destroy or adversely modify their designated critical habitat.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). On an interim basis, NMFS interprets "harass" to mean, "Create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

The proposed action is reasonably certain to result in incidental take of ESA-listed species. NMFS determined that incidental take is reasonably certain to occur as follows: (1) The proposed action will reduce flow in all stream reaches downstream from the water diversions that will be authorized on NFS land; (2) most of the affected habitat is occupied by Chinook salmon and/or steelhead; (3) reducing flow in occupied Chinook salmon and steelhead habitat will reduce growth and survival of rearing Chinook salmon and steelhead; (4) juvenile steelhead will enter the East Fork Hayden Creek Diversion and will have to exit via the juvenile bypass system, which will delay downstream migration and increase mortality; (5) juvenile steelhead will enter the Big Bear Creek, Big Timber Creek, and Big Eightmile Creek Diversions before they are screened, and will likely be killed due to entrainment; (6) steelhead entrained in the Big Bear Creek, Big Timber Creek, and Big Eightmile Creek Diversions could be captured and handled due to fish salvage activities; (7) and juvenile steelhead will be entrained in the Big Bear Creek, Big Timber Creek, and Big Eightmile Creek Diversions, after they are screened, and will have to exit via the juvenile bypass systems, which will delay downstream migration and increase mortality.

The take exempted by this ITS is the loss of Snake River spring/summer Chinook salmon and Snake River Basin steelhead from these circumstances. NMFS has quantified an average annual reduction in production, due to the proposed action, of 715 Chinook salmon outmigrants and 413 steelhead outmigrants. However, changes in production cannot be monitored sufficiently to ensure that amount and extent of take is not exceeded. This is because: (1) Chinook salmon and steelhead production is estimated using screw trap data which lack the precision needed to monitor changes of the scale anticipated due to the proposed action; (2) population density of Chinook salmon and steelhead varies greatly from year to year; (3) fish harmed due to increased environmental stress caused by the reductions in flow would be difficult to distinguish from fish harmed due to environmental stress that normally occurs or that is caused by baseline actions; and (4) counting juvenile fishes entering or exiting water diversions is not practicable. Even if take that occurred within the action area could be adequately quantified, monitoring total take due to the proposed actions would still not be feasible because some mortality due to effects of the proposed action in the action area is likely to occur during the downstream migration or in the estuary. This is because fish growth is related to streamflow (Harvey et al. 2006; Davidson et al. 2010), so reducing streamflow in rearing habitat likely reduces the size of downstream migrating smolts. Smaller smolts have higher mortality outside of the natal tributaries (Zabel and Achord 2004), which results in lower smolt-to-adult return rates.

When take cannot be adequately quantified, NMFS describes the extent of take through the use of surrogate measures of take that would define the limits anticipated in this Opinion. As established above in Section 2.5, reduction of streamflow due to water diversion and use would result in the vast majority of take due to the proposed action, with a smaller amount of take caused by entrainment of juveniles in water diversions. Presence and condition of fish screens is relatively easy to monitor and ascertain and, as a quantifiable habitat indicator, the amount of water diverted and the amount of land irrigated can be accurately measured. In this case, the extent of take will be described as the amount of water diverted, the amount of land irrigated, and fish screen status. The amount of water diverted and the amount of land irrigated are casually linked to incidental take from reduced flow because both are directly related to the reduction of flow downstream from the diversions. The presence and use of fish screens is casually linked to incidental take from entrainment and fish salvage because mortality of entrained fishes and any associated salvage of entrained fish increases with the continued presence of unscreened diversions (i.e. mortality increases by more than a factor of 30 in unscreened diversions). The extent of take exempted by this ITS would be exceeded if: (1) The amount of water diverted via any of the water diversions authorized by the proposed action exceeds the diversion rates described in Table 3; (2) the amount of land irrigated by each diversion exceeds the amount described in Table 3; (3) the East Fork Hayden Creek Diversion is operated without a fish screen in place and functioning; and (4) the Big Bear Creek Diversion, the Big Timber Creek Diversion, or the Big Eightmile Creek Diversion is operated after the 2026 irrigation season without a fish screen[31] in place and functioning. Numbers 3 and 4 are coextensive with the proposed action but still serve as effective reinitiation triggers because the monitoring requirements will provide adequate opportunities to check through the course of the action whether these surrogates are being exceeded.

2.9.2 Effect of the Take

In the Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). NMFS believes that full application of conservation measures included as part of the proposed action, together with use of the RPMs described below, are necessary and appropriate to minimize the impact of incidental take of listed species due to implementation of the proposed action.

[31] The effects of installing fish screens will be addressed through programmatic consultation (see NMFS 2000a, NMFS 2019, NMFS 2020).

The USFS and the permittees shall:

1. Minimize effects of entrainment in the East Fork Hayden Creek, Big Bear Creek, Big Timber Creek, and Big Eightmile Creek Diversions.
2. Minimize effects of fish salvage.
3. Minimize take due to reducing flow in steelhead and Chinook salmon habitat.
4. Ensure completion of a monitoring and reporting program to confirm that the terms and conditions of this ITS are effective in avoiding and minimizing incidental take from permitted activities and ensure that incidental take is not exceeded.

<u>2.9.4 Terms and Conditions</u>

The terms and conditions described below are non-discretionary, and the USFS and the permittees must comply with them in order to implement the RPMs (50 CFR 402.14). The USFS and the permittees have a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the USFS or the permittee to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement RPM 1 (minimize entrainment effects):

    a. The East Fork Hayden Creek Diversion permittee will only operate the diversion when a fish screen is in place and when the fish screen and juvenile bypass system are functioning as designed.

    b. The SCNF will ensure that the Big Bear Creek, Big Timber Creek, and Big Eightmile Creek Diversions are screened before the 2027 irrigation season.

    c. After the 2026 irrigation season, the Big Bear Creek Diversion, the Big Timber Creek Diversion, and the Big Eightmile Creek Diversion permittees will only operate the diversions when the fish screens are in place and when the fish screens and juvenile bypass systems are functioning as designed.

2. The following term and condition implements RPM 2 (minimize salvage effects):

    a. Salvage of fishes entrained in diversions, if employed, will be conducted in accordance with NMFS guidelines (NMFS 2000), release sites will be designated prior to commencing salvage, and all captured anadromous salmonids will be transported to designated release sites and released.

3. The following terms and conditions implement RPM 3 (minimize take due to reducing flow):

   a. The USFS will ensure that all authorized water diversions are equipped with appropriate measuring devices.

   b. The USFS, in collaboration with IDWR, will determine allowable operational periods of use, for each diversion, based on historic and current use.

   c. The permittees will ensure that the amount of water diverted does not exceed the diversion rates described in Table 3 in section 1.3.1[32].

   d. The permittees will ensure that authorized water diversions are not operated outside of the operational period of use stipulated in the OMP or the season of use stipulated in the water right.

   e. The SCNF will obtain the information necessary to accurately determine the amount of land that is irrigated due to operation of the authorized water diversions and will coordinate with NMFS on evaluating new information and assessing the Program goals in light of that new information.

4. The following terms and conditions implement RPM 4 (monitoring and reporting)

   a. The SCNF shall ensure that the monitoring described in Section 1.3.3 and Appendix C is conducted.

   b. The SCNF will prepare annual monitoring reports that includes:

      (1) Operation and maintenance plans for water diversion authorizations finalized during the year.

      (2) Changes to existing water diversion operation and maintenance plans that are made during the year.

      (3) A description of progress on installation of fish screens on the Big Bear Creek, Big Timber Creek, and Big Eightmile Creek Diversions.[33]

      (4) A list of fish salvaged in the Big Bear Creek, Big Timber Creek, and Big Eightmile Creek Diversions and the fate of salvaged fishes.

---

[32] The amount of flow in a surface water diversion is determined by the water level in the source stream and the headgate setting. Because water levels in source streams are variable and headgate adjustments are somewhat imprecise, maintaining a consistent flow in a diversion ditch requires frequent adjustment, and some trial and error. Due to these factors, diversion rates up to 20% greater than those listed in Table 3 can occur for up to 24 hours before an exceedance is declared.

[33] Will be needed until the screen installation is complete.

(5) Until unimpaired upstream fish passage is established at the East Fork Hayden Creek Diversion, via changes to the OMP and/or physical changes to the diversion structures, a description of temporary measures employed to ensure unimpaired fish passage at the East Fork Hayden Creek Diversion.

(6) A description of progress on establishing unimpaired fish passage at the East Fork Hayden Creek Diversion via changes to the OMP and/or physical changes to the diversion structures.[34]

(7) Results of investigations to determine the amount of land irrigated with water diverted via the East Fork Hayden Creek Diversion.[35]

(8) A description of the condition of water diversions in streams that have ESA-listed fishes on NFS land in the Lemhi River subbasin.

(9) Amount of water diverted at each diversion described in Table 3 in Section 1.3.1.

(10) Any exceedances of diversion rates or operation of diversions outside of the season of use.

(11) Actions taken to address conditions resulting in exceedances of diversion rates.

The SCNF shall submit the reports to:

National Marine Fisheries Service
Attention: WCRO-2021-00020
800 East Park Boulevard
Plaza IV, Suite 220
Boise, Idaho 83712-7743

or to:nmfswcr.srbo@noaa.gov

c. NOTICE: If a steelhead or salmon becomes sick, injured, or killed as a result of project-related activities, and if the fish would not benefit from rescue, the finder should leave the fish alone, make note of any circumstances likely causing the death or injury, location and number of fish involved, and take photographs, if possible. If the fish in question appears capable of recovering if rescued, photograph the fish (if possible), transport the fish to a suitable location, and record the information described above. Adult fish should generally not be disturbed unless circumstances arise where an adult fish is obviously injured or killed by proposed activities, or some unnatural cause. The finder must contact NMFS Law Enforcement at (206) 526-6133 as soon as possible. The finder may be asked to carry out instructions provided by

[34] Will be needed until unimpaired upstream fish passage is reestablished.
[35] Will be needed until the investigations are complete.

Law Enforcement to collect specimens or take other measures to ensure that evidence intrinsic to the specimen is preserved.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. **Implement RA-1 in PACFISH (USFS and BLM 1995) –** The USFS should work to improve baseline conditions for Chinook salmon and steelhead and their habitat in the Upper Salmon River watershed. This includes identifying and cooperating with Federal, Tribal, State and local governments to secure instream flows needed to maintain riparian resources, channel conditions, and aquatic habitat. The USFS should also work with the parties identified in RA-1 to find ways to keep conserved water instream throughout the Upper Salmon River watershed.

2. The USFS should take appropriate action to ensure that all wild and scenic river water rights, that are downstream from the project area, are satisfied.

2.11 Reinitiation of Consultation

This concludes formal consultation for Authorization of Operation and Maintenance of Existing Water Diversions on the Lemhi River Watershed of the Salmon-Challis National Forest. As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the NMFS where discretionary federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The proposed federal action in the biological opinion identifies four primary goals for the Program and provides a timeline for achieving those goals (Section 1.3.3.1). Failure to meet those goals in the identified timeline would require reinitiation of the consultation under 50 CFR 402.16(a)(2) or (3) as this new information or modification to the federal action would not have been analyzed in this Opinion.

2.12 "Not Likely to Adversely Affect" Determinations

On November 18, 2005, NMFS listed the SRKW DPS as endangered under the ESA (70 FR 69903). The SRKW DPS (*Orcinas orca*) is composed of a single population that ranges as far south as central California and as far north as Southeast Alaska. Although the entire DPS has the potential to occur along the outer coast at any time during the year, occurrence along the outer coast is more likely from late autumn to early spring. SRKWs have been repeatedly observed feeding off the Columbia River plume in March and April during peak spring Chinook salmon runs (Krahn et al. 2004; Zamon et al. 2007; Hanson et al. 2008; and Hanson et al. 2010). For this reason, the eastern Pacific Ocean, where SRKW overlap with Chinook salmon from the Columbia River basin is also included in the action area due to potential impacts on the whale's prey base.

The final listing rule identified several potential factors that may have resulted in the decline or may be limiting recovery of SRKW including quantity and quality of prey, toxic chemicals, which accumulate in top predators, and disturbance from sound and vessel traffic. The rule further identified oil spills as a potential risk factor for the small population of SRKW. The final recovery plan includes more information on these potential threats to SRKW (73 FR 4176).

NMFS designated critical habitat for the SRKW DPS on November 29, 2006 (71 FR 69054) and is proposing to revise that designation (https://www.fisheries.noaa.gov/action/critical-habitat-southern-resident-killer-whale). Designated critical habitat for SRKW includes approximately 2,560 square miles of Puget Sound, excluding areas with water less than 20 feet deep relative to extreme high water. The SRKWs spend considerable time in the Georgia Basin from late spring to early autumn, with concentrated activity in the inland waters of Washington State around the San Juan Islands, and typically move south into Puget Sound in early autumn (NMFS 2008a). While these are seasonal patterns, SRKW have the potential to occur throughout their range (from Central California north to the Queen Charlotte Islands) at any time during the year. As such, six new areas along the U.S. West Coast are included in the proposed revisions to the critical habitat designation (84 FR 49214).

Southern Resident killer whales consume a variety of fish species (22 species) and one species of squid (Ford et al. 1998; Ford et al. 2000; Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016), but salmon are identified as their primary prey. Southern Residents are the subject of ongoing research, including direct observation, scale and tissue sampling of prey remains, and fecal sampling. Scale and tissue sampling from May to September indicate that their diet consists of a high percentage of Chinook salmon (monthly proportions as high as >90 percent) (Hanson et al. 2010; Ford et al. 2016). The diet data also indicate that the whales are consuming mostly larger (i.e., older) Chinook salmon. Deoxyribonucleic acid (DNA) quantification methods are also used to estimate the proportion of different prey species in the diet from fecal samples (Deagle et al. 2005). Ford et al. (2016) confirmed the importance of Chinook salmon to the Southern Residents in the summer months using DNA sequencing from whale feces. Salmon and steelhead made up to 98 percent of the inferred diet, of which almost 80 percent were Chinook salmon. Coho salmon (*O. kisutch*) and steelhead are also found in the diet in spring and fall months when Chinook salmon are less abundant. Specifically, coho salmon contribute to over 40 percent of the diet in late summer, which is evidence of prey shifting at the end of summer towards coho salmon (Ford et al. 1998; Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016). Less than 3 percent each of chum salmon (*O. keta*), sockeye salmon (*O. nerka*), and steelhead were observed in fecal DNA samples collected in the summer months (May through September). Prey remains and fecal samples collected in inland waters during October through December indicate that Chinook and chum salmon are primarily contributors to the whales' diet

(Hanson et al. 2021). Observations of whales overlapping with salmon runs (Wiles 2004; Zamon et al. 2007; Krahn et al. 2009), and collections of prey and fecal samples have occurred in the winter months. Preliminary analysis of prey remains and fecal samples sampled during the winter and spring in coastal waters indicated that the majority of prey samples were Chinook salmon (80 percent of prey remains and 67 percent of fecal samples were Chinook salmon), with a smaller number of steelhead, chum salmon, and halibut (Hanson et al. 2021). The occurrence of K and L pods off the Columbia River in March suggests the importance of Columbia River spring-run stocks of Chinook salmon in their diet (Hanson et al. 2013) at that time of year. Chinook salmon genetic stock identification from samples collected in winter and spring in coastal waters included 12 U.S. west coast stocks, and over half of the Chinook salmon consumed originated in the Columbia River (Hanson et al. 2021) for the K and L pods (primarily fall-run stocks). Based on genetic analysis of feces and scale samples, Chinook salmon from Fraser River stocks dominate the diet of Southern Residents in the summer (Hanson 2011).

The proposed action will not have any direct effects on SRKW; however, it may indirectly affect the quantity of prey available to them. As described in the above Opinion and ITS, the proposed action may result in the loss of an average of seven adult Chinook salmon each year for up to ten years. The ocean range of Snake River spring/summer Chinook salmon (Weitkamp 2010) overlaps with the known range and designated critical habitat of SRKW. The loss of seven Chinook salmon each year could reduce the SRKW's available prey base in the Pacific Ocean for up to ten years.

Given the total quantity of prey available to SRKWs, the reduction in prey due to the proposed action will be extremely small. The above Opinion did not identify any potential for the proposed action to influence the quality (size) and/or quality (contaminant levels) of Chinook salmon. NMFS finds that the proposed action will not have anything more than minimal effects on productivity, diversity, or distribution of ESA-listed Chinook salmon, and therefore the effects to the quantity of prey available to the whales in the long term across their vast range is expected to be very small. For these reasons, the proposed action will have an insignificant effect on SRKW, and therefore, NMFS finds that the proposed action may affect, but is not likely to adversely affect SRKW. Likewise, because so few of the SRKW prey will be affected by the action, the effect to the prey base PBF is insignificant. Because NMFS has proposed a revision to the SRKW critical habitat designation, this section also serves as a conference concurrence.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH (CFR 600.905(b)).

This analysis is based, in part, on the EFH assessment provided by the SCNF and descriptions of EFH for Pacific Coast Salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in Section 1.3 of this document. The action area includes areas designated as EFH for spawning, rearing, and migration life-history stages of Chinook salmon. The PFMC (2014) has identified five habitat areas of particular concern (HAPC), which warrant additional focus for conservation efforts due to their high ecological importance. Three of the five HAPC are applicable to freshwater and include: (1) Complex channels/floodplain habitats; (2) thermal refugia; and (3) spawning habitat. Implementation of the proposed action will affect these three HAPCs.

3.2. Adverse Effects on Essential Fish Habitat

The adverse effects of the proposed action on Chinook salmon habitat are described in Sections 2.5.1 and 2.5.2 of the Opinion. The primary adverse effect will be caused by a reduction in flow, which will reduce quality of Chinook salmon habitat throughout the entire mainstem Lemhi River and in portions of eight Lemhi River tributary systems. These adverse effects include: reduction of connectivity between streams and floodplains; reduction of thermal refugia at tributary mouths; and a reduction of depth and an increase of temperature in spawning habitat. These adverse effects will likely occur for at least 30 years. The proposed action will result in consumptive use of water, which could reduce quality of Chinook salmon EFH in river reaches downstream from the Lemhi River.

3.3. Essential Fish Habitat Conservation Recommendations

To minimize the adverse effects in Section 3.2, NMFS proposes the following EFH conservation recommendations:

1. The USFS should ensure that all authorized water diversions are equipped with appropriate measuring devices.
2. The permittees should ensure that the amount of water diverted does not exceed the diversion rates described in Table 3.

3. The SCNF should implement the Program described in Section 1.3.3.

4. The SCNF should obtain the information necessary to accurately determine the amount of land that is irrigated due to operation of the authorized water diversions and will adjust the goals of the Program accordingly.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, approximately 500 acres of designated EFH for Pacific Coast salmon.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the SCNF must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the SCNF have agreed to use alternative timeframes for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the SCNF must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the SCNF. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The SCNF must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The DQA specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this Opinion is the SCNF. Other interested users could include permittees and easement holders. Individual copies of this Opinion were provided to the SCNF. The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3. Objectivity

Information Product Category: Natural Resource Plan.

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this Opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

5. References

Arthaud, D. L., C. M. Greene, K. Guilbault, and J. V. Morrow Jr. 2010. Contrasting life-cycle impacts of stream flow on two Chinook salmon populations. Hydrobiologia 655:171–188.

Asch, R. 2015. Climate change and decadal shifts in the phenology of larval fishes in the California Current ecosystem. PNAS:E4065-E4074, 7/9/2015.

Baker, D.W., B.P. Bledsoe, C.M. Albano, and N.L. Poff. 2011. Downstream effects of diversion dams on sediment and hydraulic conditions of Rocky Mountain streams. River Research and Applications 27: 388-401.

Battin, J., and coauthors. 2007. Projected impacts of climate change on salmon habitat restoration. Proceedings of the National Academy of Sciences of the United States of America 104(16):6720-6725.

Beckman, B. 2018. Estuarine growth of yearling Snake River Chinook salmon smolts. Progress report. Northwest Fisheries Science Center, Seattle, Washington, 7/3/2018.

Beecher, H. A., B. A. Caldwell, S. B. DeMond, D. Seiler, and S. N. Boessow. 2010. An Empirical Assessment of PHABSIM Using Long-Term Monitoring of Coho Salmon Smolt Production in Bingham Creek, Washington. North American Journal of Fisheries Management 30:1529–1543

Beechie, T., H. Imaki, J. Greene, et al. 2013. Restoring Salmon Habitat for a Changing Climate. River Research and Application 29:939-960.

Berman, C.H. and T.P. Quinn. 1991. Behavioural thermoregulation and homing by spring Chinook salmon, Oncorhynchus tshawytscha (Walbaum), in the Yakima River. Journal of Fish Biology 39:301-312.

Bjornn, T. C. and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83–138 *in* W.R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society, Special Publication 19. Bethesda, Maryland.

Binns, A. N. 2004. Effectiveness of Habitat Manipulation for Wild Salmonids in Wyoming Streams. North American Journal of Fisheries Management 24:911–921.

Black, B., J. Dunham, B. Blundon, J. Brim Box, and A. Tepley. 2015. Long-term growth-increment chronologies reveal diverse influences of climate forcing on freshwater and forest biota in the Pacific Northwest. Global Change Biology 21:594-604. DOI: 10.1111/gcb.12756.

Boulton, A. J. 2003. Parallels and contrasts in the effects of drought on stream macroinvertebrate assemblages. Freshwater Biology 48: 1173–1185.

Caldwell, T. J., G. J. Rossi, R. E. Henery, and S. Chandra. 2018. Decreased streamflow impacts fish movement and energetics through reductions to invertebrate drift body size and abundance. River Research and Applications 34:965-976.

Carlisle, D. M., D. M. Wolock, and M. R. Meador. 2011. Alteration of streamflow magnitudes and potential ecological consequences: a multiregional assessment. Frontiers in Ecology and the Environment. 9(5):264-270

Chamberlin, S. 2006. Snake River Basin: assessment of irrigated agriculture. National Marine Fisheries Service, Snake Basin Office, unpublished report. 7 pp.

Chapman, D., W. Platts, D. Park and M. Hill. 1990. Status of Snake River sockeye salmon. Final Report to PNUCC, June 26. Don Chapman Consultants Inc.: Boise, Idaho. 96 p.

Cheung, W., N. Pascal, J. Bell, L. Brander, N. Cyr, L. Hansson, W. Watson-Wright, and D. Allemand. 2015. North and Central Pacific Ocean region. Pages 97-111 in N. Hilmi, D. Allemand, C. Kavanagh, and et al, editors. Bridging the Gap Between Ocean Acidification Impacts and Economic Valuation: Regional Impacts of Ocean Acidification on Fisheries and Aquaculture. DOI: 10.2305/IUCN.CH.2015.03.en.

Climate Change Science Program (CCSP). 2014. Climate Change Impacts in the United States. Third National Climate Assessment. U.S. Global Change Research Program. DOI:10.7930/J0Z31WJ2.

Climate Impacts Group (CIG). 2004. Overview of Climate Change Impacts in the U.S. Pacific Northwest, 7/29/2004.

Cooney, T. and D. Holzer. 2006. Appendix C: Interior Columbia Basin Stream Type Chinook Salmon and Steelhead Populations: Habitat Intrinsic Potential Analysis. ICTRT Viability Criteria Review Draft. Northwest Fisheries Science Center, Seattle WA. http://www.nwfsc.noaa.gov/trt/ trt_documents/appendix_c_viability_3_15_2007.pdf.

Contor, B. A., and R. G. Taylor. 2013. Why improving irrigation efficiency increases total volume of consumptive use. Irrigation and Drainage 62(3): 273-278

Copeland, T. and D.A. Venditti. 2009. Contribution of three life history types to smolt production in a Chinook salmon (Oncorhynchus tshawytscha) population. Canadian Journal of Fisheries and Aquatic Sciences. 66:1658-1665.

Cragg-Hine, D. 1985. The assessment of the flow requirements for upstream migration of salmonids in some rivers of North-West England. Pages 209-215 in J. S. Alabaster, Editor, Habitat Modification and Freshwater Fisheries. Proceedings of a Symposium of European Inland Fisheries Advisory Commission. 278 pp.

Crozier, L. and R. W. Zabel. 2006. Climate impacts at multiple scales: evidence for differential population responses in juvenile Chinook salmon. Ecology 75:1100-1109. DOI: 10.1111/j.1365-2656.2006.01130.x.

Crozier, L. G., R. W. Zabel, and A. F. Hamlet. 2008a. Predicting differential effects of climate change at the population level with life-cycle models of spring Chinook salmon. Global Change Biology 14:236-249. DOI: 10.1111/j.1365-2486.2007.01497.x.

Crozier, L. G., A. P. Hendry, P. W. Lawson, T. P. Quinn, et al. 2008b. Potential responses to climate change for organisms with complex life histories: evolution and plasticity in Pacific salmon. Evolutionary Applications 1:252-270. DOI: 10.1111/j.1752-4571.2008.00033.x.

Dahm, C. N., M. A. Baker, D. I. More, and J. R. Thibault. 2003. Coupled biogeochemical and hydrological responses of streams and rivers to drought. Freshwater Biology 48: 1219–1231.

Dalton, M., P. W. Mote, and A. K. Stover. 2013. Climate change in the Northwest: implications for our landscapes, waters and communities. Island Press, Washington, D.C.

Dauble, D. D. and D. R. Geist. 2000. Comparisons of mainstem spawning and habitats for two populations of fall Chinook salmon in the Columbia River Basin. Regulated Rivers: Research and Management 16:345-361.

Davidson, R. S., B. H. Letcher. and K. H. Nislow. 2010. Drivers of growth variation in juvenile Atlantic salmon (Salmo salar): an elasticity analysis approach. Journal of Animal Ecology 79: 1113–1121.

Deagle, B. E., D. J. Tollit, S. N. Jarman, et al. 2005. Molecular scatology as a tool to study diet: analysis of prey DNA in scats from captive Steller sea lions. Molecular Ecology 14:1831-1842. DOI: 10.1111/j.1365-294X.2005.02531.x.

Decker, S. A., M. J. Bradford, and P. S. Higgins. 2008. Rate of biotic colonization following flow restoration below a diversion dam in the Bridge River, British Columbia. River Research and Applications 24: 876-883.

Delarm, M. A., and E. Wold. 1985. Columbia River Fisheries Development Program Screening of Irrigation Diversions. NOAA Technical Memorandum NMFS F/NWR-12. 44 pp. Appendices.

Dorratcaque, D. E. 1986. Lemhi River Habitat Improvement Study. Bonneville Power Administration Project No. 84-28.

Ebersole, J. L., W. J. Liss and C. A. Frissell, 2001. Relationship between stream temperature, thermal refugia and rainbow trout Oncorhynchus mykiss abundance in arid-land streams in the northwestern United States. Ecology of Freshwater Fish 10: 1–10.

Ebersole, J. L., W. J. Liss and C. A. Frissell. 2003. Thermal heterogeneity, stream channel morphology, and salmonid abundance in northeastern Oregon streams. Canadian Journal of Fisheries and Aquatic Sciences 60: 1266–1280.

Ecovista, Nez Perce Tribe Wildlife Division, and Washington State University Center for Environmental Education. 2003. Draft Clearwater Subbasin Assessment, Prepared for Nez Perce Tribe Watersheds Division and Idaho Soil Conservation Commission. 463 p. http://www.nwcouncil.org/fw/subbasinplanning/clearwater/plan/Default.htm

Ecovista. 2004. Salmon Subbasin Management Plan. Contracted by Nez Perce Tribe Watershed Division and Shoshone-Bannock Tribes. 221 pp.

Elliott, J. M., M. A. Hurley, and J. A. Elliott. 1997. Variable effects of droughts on the density of a sea-trout *Salmo trutta* population over 30 years. The Journal of Applied Ecology 34(5):1229-1238.

Elliott, J. M. 2002. The drift distances and time spent in the drift by freshwater shrimps, *Gammarus pulex*, in a small stony stream, and their implications for the interpretation of downstream dispersal. Freshwater Biology 47:1403–1417.

Everest, F. H. and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. Journal of the Fisheries Research Board of Canada 29(1):91-100.

Felts, E. A., B. Barnett, M. Davison, C. J. Roth, J. R. Poole, R. Hand, M. Peterson, and E. Brown. 2019. Idaho adult Chinook Salmon monitoring. Annual report 2018. Idaho Department of Fish and Game Report 19-10.

Fereday, J. C., C. H. Meyer, and M. C. Creamer. 2001. Handbook on Idaho water law. Givens Pursley LLP, Attorneys at Law. Boise, Idaho. 167 pp. Appendices.

Fisher, J., W. Peterson, and R. Rykaczewski. 2015. The impact of El Niño events on the pelagic food chain in the northern California Current. Global Change Biology 21: 4401-4414. DOI: 10.1111/gcb.13054, 7/1/2015.

Ford, J. K. B., G. M. Ellis, L. G. Barrett-Lennard, et al. 1998. Dietary specialization in two sympatric populations of killer whales (Orcinus orca) in coastal British Columbia and adjacent waters. Canadian Journal of Zoology 76:1456-1471.

Ford, J. K. B., G. M. Ellis, and K. C. Balcomb. 2000. Killer whales: the natural history and genealogy of Orcinus orca in British Columbia and Washington. Second edition. UBC Press, Vancouver, British Columbia.

Ford, J. K. B. and G. M. Ellis. 2006. Selective foraging by fish-eating killer whales Orcinus orca in British Columbia. Marine Ecology Progress Series 316:185-199. DOI: 10.3354/meps316185, 7/3/2006.

Ford, M.J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-113, 281 p. http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/multiple_species/5-yr-sr.pdf

Ford, M. J., J. Hempelmann, M. Hanson, et al. 2016. Estimation of a Killer Whale (Orcinus orca) Population's Diet Using Sequencing Analysis of DNA from Feces. PLoS ONE 11(1):e0144956. DOI: 10.1371/journal.pone.0144956, 1/6/2016.

Foreman, M., W. Callendar, D. Masson, J. Morrison, and I. Fine. 2014. A Model Simulation of Future Oceanic Conditions along the British Columbia Continental Shelf. Part II: Results and Analyses. Atmosphere-Ocean 52(1):20-38. DOI: 10.1080/07055900.2013.873014.

Furness, M. 1989. Electrical Power in Salmon. Patchwork: Pieces of Local History. May 1989, Pages 55-63.

Gebhards, S.V. 1959. The effects of irrigation on the natural production of Chinook salmon (*Oncorhynchus tshawtscha*) in the Lemhi River, Idaho. A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science. Utah State University 54 pp.

Good, T.P., R.S. Waples, and P. Adams (editors). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-66, 598 p.

Grafton R. G., J. Williams, C. J. Perry, F. Molle, C. Ringler, P. Steduto, B. Udall, S. A. Wheeler, Y. Wang, D. Garrick, R. G. Allen et al. 2018. The paradox of irrigation efficiency: Higher efficiency rarely reduces water consumption irrigation efficiency. Science 361(6404): 748-750.

Hanson, M. B. and C. K. Emmons. 2008. Annual residency patterns of Southern Resident killer whales in the inland waters of Washington and British Columbia. October 2, 2008. Unpublished report. NWFSC, Seattle, Washington.

Hanson, M. B., R. W. Baird, J. K. B. Ford, J. Hempelmann-Halos, D. M. Van Doornik, J. R. Candy, C. K. Emmons, G. S. Schorr, B. Gisborne, K. L. Ayres, S. K. Wasser, K. C. Balcomb, K. Balcomb-Bartok, J. G. Sneva, and M. J. Ford. 2010. Species and stock identification of prey consumed by endangered Southern Resident killer whales in their summer range. Endangered Species Research 11:69–82. DOI: 10.3354/esr00263.

Hanson, B. 2011. Southern Residence Killer Whale diet as determined from prey remains and fecal samples. In: Evaluating the Effects of Salmon Fishereis on Southern Resident Killer Whales: Workshop 1, September 21-23, 2011. NOAA Fisheries and DFO (Fisheries and Oceans Canada) Seattle, Washington.

Hanson, M. B., J. A. Nystuen, and M. O. Lammers. 2013. Assessing the coastal occurance of endangered killer whales using autonomous passive acoustic recorders. Journal of the Acoustical Society of America 134(5):3486-3495. DOI: 0001-4966/2013/134(5)/3486/10/, 11/1/2013.

Hansen, M. B., C. K. Emmons, M. J. Ford, M. Everett, K. Parsons, L. K. Park, J. Hempelmann, D. M. Van Doornik, G. S. Schorr, J. K. Jacobsen, M. F. Sears, M. S. Sears, J. G. Sneva , R. W. Baird, L. Barre. 2021. Endangered predators and endangered prey: Seasonal diet of Southern Resident killer whales. PLOS ONE. https://doi.org/10.1371/journal.pone.0247031.

Hardy, T. B., T. Shaw, R. C. Addley, G. E. Smith, M. Rode, and M. Belchik. 2006. Validation of Chinook fry behavior based escape cover modeling in the lower Klamath River. International Journal of River Basin Management 4: 1–10.

Hardy, T.B., R.C. Addley, and E. Saraeva. 2006a. Evaluation of Instream Flow Needs in the Lower Klamath River. Phase II, final report prepared for: U.S. Department of the Interior. 229 pp.

Harvey, B. C., R. J. Nakamoto, and J. L. White. 2006. Reduced streamflow lowers dry-season growth of rainbow trout in a small stream. Transactions of the American Fisheries Society 135: 998–1005.

Haskell, C. A., A. L. Puls, K. Griswold. 2019. Key Findings and Lessons Learned from Pacific Northwest Intensively Monitored Watersheds. Pacific Northwest Aquatic Monitoring Partnership. 63 pages. Available at https://www.pnamp.org/document/15052. 63 pp.

Hauck, F. R. 1953. The Size and Timing of Runs of Anadromous Species of Fish in the Idaho Tributaries of the Columbia River. Prepared for the U.S. Army, Corps of Engineers by the Idaho Fish and Game Department, April 1953. 16 pp.

Hayes, J., W., N. F. Hughes, L. H. Kelly. 2007. Process-based modelling of invertebrate drift transport, net energy intake and reach carrying capacity for drift-feeding salmonids. Ecological Modelling 207: 171-188.

Healey, M. C. 1991. Life history of chinook salmon (*Oncorhynchus tshawytscha*). Pages 80 *in* C. Groot, and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, Canada.

Hillman, T, G. Pess, and T. Beechie. 2019. Evaluation of intensively monitored watershed projects. Report to NOAA Fisheries, Portland, OR. 49 pp.

Hollowed, A. B., N. A. Bond, T. K. Wilderbuer, W. T. Stockhausen, Z. T. A'mar, R. J. Beamish, J. E. Overland, et al. 2009. A framework for modelling fish and shellfish responses to future climate change. ICES Journal of Marine Science 66:1584-1594. DOI:10.1093/icesjms/fsp057.

Interior Columbia Technical Recovery Team (ICTRT). 2003. Independent populations of Chinook, steelhead, and sockeye for listed evolutionarily significant units within the Interior Columbia River domain. Working Draft. July 2003. 173 pp.

ICTRT. 2007. Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs. Review Draft, March 2007. 90 pp., Appendices.

ICTRT. 2007. Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs, Review Draft March 2007. Interior Columbia Basin Technical Recovery Team: Portland, Oregon. 261 pp. https://www.nwfsc.noaa.gov/research/divisions/cb/genetics/trt/trt_documents/ictrt_viability_criteria_reviewdraft_2007_complete.pdf

ICTRT 2010. Current Status Reviews: Interior Columbia River Basin Salmon ESUs and Steelhead DPSs. Volume I: Snake River Basin ESUs/DPS, Snake River spring/summer Chinook salmon ESU, Snake River steelhead DPS, Snake River fall Chinook salmon ESU, Snake River sockeye salmon ESU. 827 pp.

IDEQ (Idaho Department of Environmental Quality). 1999. Lemhi River watershed TMDL: Allocation of nonpoint source pollutants in the water quality limited watersheds on the Lemhi River Valley. Idaho Department of Health and Welfare. Division of Environmental Quality. Boise, Idaho. 187 p.

Idaho Department of Environmental Quality (IDEQ). 2001. Middle Salmon River-Panther Creek Subbasin Assessment and TMDL. IDEQ: Boise, Idaho. 114 p.

IDEQ and U.S. Environmental Protection Agency (EPA). 2003. South Fork Clearwater River Subbasin Assessment and Total Maximum Daily Loads. IDEQ: Boise, Idaho. 680 p.

IDEQ. 2012. Lemhi River Subbasin total maximum daily loads and five-year review. Addendum to the Lemhi River Subbasin Assessment and TMDL. Prepared by: Technical Services, State Office, Idaho Department of Environmental Quality. October 2012. 210 pp.

IDEQ. 2018. Idaho's 2016 Integrated Report, Final. IDEQ: Boise, Idaho. 563 pp.

IDWR unpublished 2009. Data provided to the National Marine Fisheries Service by Idaho Department of Water Resources.

Independent Scientific Advisory Board (ISAB). 2007. Climate change impacts on Columbia River Basin fish and wildlife. ISAB Climate Change Report, ISAB 2007-2, Northwest Power and Conservation Council, Portland, Oregon.

Interior Columbia Technical Recovery Team (ICTRT). 2003. Working draft. Independent populations of Chinook, steelhead, and sockeye for listed evolutionarily significant units within the Interior Columbia River domain. NOAA Fisheries. July.

Isaak, D. J., C. H. Luce, D. L. Horan, G. L. Chandler, S. P. Wollrab, and D. E. Nagel. 2018. Transactions of the American Fisheries Society 147:566–587.

IRZ Consulting. 2002. Final report: Paired color infrared and thermal infrared imaging and analysis for selected Idaho streams. Prepared for: Idaho Department of Environmental Quality, August 28, 2002. 27 pp.

Jager, H. I., 2014. Thinking outside the channel: Timing pulse flows to benefit salmon via indirect pathways. Ecological Modeling 273: 117-127

Kovach, R.P., C.C. Muhlfeld, R. Al-Chokhachy, J.B. Dunham, B.H. Letcher, and J.L. Kershner. 2016. Impacts of climatic variation on trout: a global synthesis and path forward. Reviews in Fish Biology and Fisheries 26(2):135-151.

Krahn, M. M., M. J. Ford, W. F. Perrin, P. R. Wade, R. P. Angliss, M. B. Hanson, B. L. Taylor, G. M. Ylitalo, M. E. Dahlheim, J. E. Stein, R. S. Waples. 2004. 2004 Status Review of Southern Resident Killer Whales (Orcinus orca) under the Endangered Species Act. US Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-62, Seattle, WA, xvii+73pp.

Krahn, M. M., M. B. Hanson, G.S. Schorr, et al. 2009. Effects of age, sex and reproductive status on persistent organic pollutant concentrations in "Southern Resident" killer whales. Marine Pollution Bulletin 58: 1522-1529.

Lake, P. S. 2003. Ecological effects of perturbation by drought in flowing waters. Freshwater Biology 48: 1161–1172.

Lemhi Decree. 1978. Proposed findings of water rights in the Lemhi River Basin. Civil Case no. 4948.

Limburg, K., R. Brown, R. Johnson, B. Pine, R. Rulifson, D. Secor, K. Timchak, B. Walther, and K. Wilson. 2016. Round-the-Coast: Snapshots of Estuarine Climate Change Effects. Fisheries 41(7):392-394, DOI: 10.1080/03632415.2016.1182506.

Lynch, A. J., B. J. E. Myers, C. Chu, L. A. Eby, J. A. Falke, R. P. Kovach, T. J. Krabbenhoft, T. J. Kwak, J. Lyons, C. P. Paukert, and J. E. Whitney. 2016. Climate Change Effects on North American Inland Fish Populations and Assemblages. Fisheries 41(7):346-361. DOI: 10.1080/03632415.2016.1186016, 7/1/2016.

Martins, E. G., S. G. Hinch, D. A. Patterson, M. J. Hague, S. J. Cooke, K. M. Miller, M. F. Lapointe, K. K. English, and A. P. Farrell. 2011. Effects of river temperature and climate warming on stock-specific survival of adult migrating Fraser River sockeye salmon (*Oncorhynchus nerka*). Global Change Biology 17(1):99–114. DOI:10.1111/j.1365-2486.2010.02241.x.

Martins, E. G., S. G. Hinch, D. A. Patterson, M. J. Hague, S. J. Cooke, K. M. Miller, D. Robichaud, K. K. English, and A. P. Farrell. 2012. High river temperature reduces survival of sockeye salmon (*Oncorhynchus nerka*) approaching spawning grounds and exacerbates female mortality. Canadian Journal of Fisheries and Aquatic 69:330–342. DOI: 10.1139/F2011-154.

Mathews, S. B. and F. W. Olson. 1980. Factors affecting Puget Sound coho salmon (*Oncorhynchus kisutch*) runs. Canadian Journal of Fisheries and Aquatic Sciences 37:1373-1378

Matthews, G. M., R. S. Waples. 1991. Status Review for Snake River Spring and Summer Chinook Salmon. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-F/NWC-200. https://www.nwfsc.noaa.gov/publications/scipubs/techmemos/tm201/

May, C. L. and D. C. Lee. 2004. The relationships among in channel sediment storage, pool depth, and summer survival of juvenile salmonids in Oregon Coast Range streams. North American Journal of Fisheries Management 24: 761–774.

McClure, M., T. Cooney, and ICTRT. 2005. Updated population delineation in the interior Columbia Basin. May 11, 2005 Memorandum to NMFS NW Regional Office, Co-managers, and other interested parties. NMFS: Seattle, Washington. 14 p.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-42, Seattle, Washington, 156 p.

Miller, S. W., D. Wooster, and J. Li. 2007. Resistance and resilience of macroinvertebrates to irrigation water withdrawals. Freshwater Biology 52: 1–17.

Miller, S. C., S. E. Reeb, P. A. Wright, and T. E. Gillis. 2008. Oxygen concentration in the water boundary layer next to rainbow trout (Oncorhynchus mykiss) embryos is influenced by hypoxia exposure time, metabolic rate, and water flow. Canadian Journal of Fisheries and Aquatic Sciences 65: 2170–2177.

Mitchell and Cunjak. 2007. Relationship of upstream migrating adult Atlantic salmon (Salmo salar) and stream discharge within Catamaran Brook, New Brunswick. Canadian Journal of Fisheries and Aquatic Sciences. 64:563-573.

Mitro, M. G., A. V. Zale, and B. A. Rich. 2003. The relation between age-0 rainbow trout (Oncorhynchus mykiss) abundance and winter discharge in a regulated river. Canadian Journal of Aquatic Sciences 60:135-139

Moore, H. E. and I. D. Rutherfurd. 2017. Lack of maintenance is a major challenge for stream restoration projects. River Resources and Application 2017:1-13.

Morris, C., and R. Sutton. 2007. Instream Flow Assessment Hawley Creek and Eighteenmile Creek, Idaho. U.S. Department of the Interior, Bureau of Reclamation, Snake River Area Office Boise, Idaho. 161 pp.

Mote, P. W., E. A. Parson, A. F. Hamlet, et al. 2003. Preparing for Climatic Change: The Water, Salmon, and Forests of the Pacific Northwest. Climatic Change 61:45-88.

Murphy, P., and J. Yanke. 2003. Wimpey Creek Fisheries Report. Idaho Fish and Game Anadromous Screen Program Region 7 – Salmon, ID. March 2003. 32 pp.

Naik, P.K. and D.A. Jay. 2011. Distinguishing human and climate influences on the Columbia River: Changes in mean flow and sediment transport. Journal of Hydrology 404: 259-277.

Naiman, R. J., J. R. Alldredge, D. A. Beauchamp, P. A. Bisson, J. Congleton, C. J. Henny, N. Huntly, R. Lamberson, C. Levings, E. N. Merrill, W. G. Pearcy, B. E. Rieman, G. T. Ruggerone, D. Scarnecchia, P. E. Smouse, and C. C. Wood. 2012. Developing a broader scientific foundation for river restoration: Columbia River food webs. Proceedings of the National Academy of Sciences of the United States of America 109(52):21201-21207.

National Marine Fisheries Service (NMFS). 1985. Columbia River fisheries development program screening of irrigation diversions. NOAA Rechnical Memorandum NFS F/NWR-12. June 1985. 44 pp. Appendices.

NMFS. 1992. Federal Register Notice: Threatened status for Snake River spring–summer Chinook salmon, threatened status for Snake River fall Chinook salmon. Federal Register 57:78(22 April 1992):14653–14663.

NMFS 2000. Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act. National Marine Fisheries Service. Portland, Oregon and Santa Rosa, California.

NMFS 2000a. Informal Consultation on Mitchell Act Diversion Screening Programs. January 31, 2000, memorandum from William Stelle, Jr. to R. Z. Smith. 2 pp.

NMFS. 2006. National Marine Fisheries Service's comments and preliminary recommended terms and conditions for an application for a major new license for the Hells Canyon hydroelectric project (FERC No. 1971). National Marine Fisheries Service, Seattle, Washington. January 24, 2006.

NMFS. 2008. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Issuance of authorization to install, operate, and maintain lockable controlling works, flow measuring devices, and fish screens; Upper Salmon River Basin, 17060201, 17060202, 17060203, 17060204; Lemhi, Custer, and Blaine Counties, Idaho.

NMFS. 2008a. Recovery plan for southern resident killer whales (Orcinus orca). Prepared by the National Marine Fisheries Service, Northwest Regional Office. https://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/killer_whales/esa_status/srkw-recov-plan.pdf

NMFS. 2013. Endangered Species Act Section 7 Formal Programmatic Biological and Conference Opinion, Letter of Concurrence, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Bonneville Power Administration's Habitat Improvement Program III (HIP III) KEC-4. 161 pp.

NMFS. 2015. ESA Recovery Plan for Snake River Sockeye Salmon (*Oncorhynchus nerka*), June 8, 2015. NOAA Fisheries, West Coast Region. 431 p. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/snake/snake_river_sockeye_recovery_plan_june_2015.pdf

NMFS. 2016. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Authorization of Operation and Maintenance of Existing Water Diversions on the Middle Salmon River Watershed of the Salmon-Challis National Forest, HUCs 1706020301, 1706020302, 1706020303, 1706020304 and 1706020305, Lemhi County, Idaho. 121 pp. Appendices.

NMFS. 2016a. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fisheries

NMFS. 2017. ESA Recovery Plan for Snake River Spring/Summer Chinook & Steelhead. NMFS. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/snake/Final%20Snake%20Recovery%20Plan%20Docs/final_snake_river_spring-summer_chinook_salmon_and_snake_river_basin_steelhead_recovery_plan.pdf

NMFS. 2017a. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Phase II of the Eagle Valley Lower Lemhi Restoration Sub-Reach 3 Project, HUC 1706020408, Lemhi County, Idaho. 59 pp. Appendices.

NMFS. 2017b. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Coleman Hydroelectric Project (FERC No. 13629-002) located in the Lemhi River Watershed, HUC 17060204, Latitude 44.68168, Longitude -113.39353, Lemhi County, Idaho. 118 pp. Appendices.

NMFS 2018. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Carmen Levee Rehabilitation Project, Salmon River Lemhi County, Idaho, HUC 170602030404 Lemhi levee construction and bank stabilization. 55 pp.

NMFS 2019. Reinitiation of the Programmatic Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Habitat Restoration Projects in the Salmon River

Basin (HUC 170602), Clearwater River Basin (HUC 170603), Hells Canyon Subbasin (HUC 17060101), and Lower Snake-Asotin Subbasin (HUC 17060103), Idaho. 125 pp. Appendices.

NMFS 2020. Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Fish and Wildlife Habitat Improvement Program (HIP 4) in Oregon, Washington and Idaho. 114 pp. Appendix.

Nislow, K. H., A. J. Sepulveda, and C. L. Folt. 2004. Mechanistic linkage of hydrologic regime to summer growth of age-0 Atlantic salmon. Transactions of the American Fisheries Society 133: 79–88.

Northwest Fisheries Science Center (NWFSC). 2015. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. 356 p.

NPCC 2004. Salmon Subbasin Assessment. Prepared for the Northwest Power and Conservation Council. May 28, 2004. 358 pp.

Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife (ODFW and WDFW). 2019. 2019 Joint Staff Report: Stock Status and Fisheries for Spring Chinook, Summer Chinook, Sockeye, Steelhead, and other Species. Joint Columbia River Management Staff. 97 pp.

Oregon Department of Fish and Wildlife and Washington Department of Fish and Wildlife (ODFW and WDFW). 2020. 2020 Joint Staff Report: Stock Status and Fisheries for Spring Chinook, Summer Chinook, Sockeye, Steelhead, and other Species. Joint Columbia River Management Staff. 98 pp.

Pacific Fishery Management Council (PFMC). 1998. Description and identification of essential fish habitat for the Coastal Pelagic Species Fishery Management Plan. Appendix D to Amendment 8 to the Coastal Pelagic Species Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon. December.

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

PFMC. 2007. U.S. West Coast highly migratory species: Life history accounts and essential fish habitat descriptions. Appendix F to the Fishery Management Plan for the U.S. West Coast Fisheries for Highly Migratory Species. Pacific Fishery Management Council, Portland, Oregon. January.

PFMC. 2005. Amendment 18 (bycatch mitigation program), Amendment 19 (essential fish habitat) to the Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington groundfish fishery. Pacific Fishery Management Council, Portland, Oregon. November.

PFMC. 2008. Management of krill as an essential component of the California Current ecosystem. Amendment 12 to the Coastal Pelagic Species Fishery Management Plan. Environmental assessment, regulatory impact review & regulatory flexibility analysis. Pacific Fishery Management Council, Portland, Oregon. February.

PFMC. 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon.

Pearcy, W. G. 2002. Marine nekton off Oregon and the 1997–98 El Niño. Progress in Oceanography 54:399–403.

Pearcy, W. G. and S. M. McKinnell. 2007. The Ocean Ecology of Salmon in the Northeast Pacific Ocean-An Abridged History. American Fisheries Society 57:7-30.

Peck, D. E., and J. R. Lovvorn. 2001. The importance of flood irrigation in water supply to wetlands in the Laramie Basin, Wyoming, USA. Wetlands 21(3): 370-378.

Perry C., P. Steduto, and F. Karajeh. 2017. Does improved irrigation technology save water? A review of the evidence. Discussion paper on irrigation and sustainable water resources management in the Near East and North Africa irrigation efficiency. 42 pp.

Peterson, W., J. Fisher, J. Peterson, C. Morgan, B. Burke, and K. Fresh. 2014. Applied Fisheries Oceanography Ecosystem Indicators of Ocean Condition Inform Fisheries Management in the California Current. Oceanography 27(4):80-89. 10.5670/oceanog.2014.88.

Pfeiffer, L., and C.-Y. Cynthia Lin 2014. Does efficient irrigation technology lead tor educed groundwater extraction? Empirical evidence. Journal of Environmental Economics and Management. 67:189-208.

Pierce, R., C. Podner, and K. Carim. 2013. Response of wild trout to stream restoration over two decades in the Blackfoot River Basin, Montana. Transactions of the American Fisheries Society 142: 68–81.

Pierce, R., C. Podner, T. Wendt, R. Shields, and K. Carim. 2014. Westslope cutthroat trout movements through restored habitat and coanda diversions in the Nevada Spring Creek Complex, Blackfoot Basin, Montana. Transactions of the American Fisheries Society 143:230–239.

Poesch, M. S., L. Chavarie, C. Chu, S. N. Pandit, and W. Tonn. 2016. Climate Change Impacts on Freshwater Fishes: A Canadian Perspective. Fisheries 41:385-391.

Polivka, C. M. and S. M. Claeson. 2020. Beyond redistribution: In-stream habitat restoration increases capacity for young-of-the-year Chinook salmon and steelhead in the Entiat River, Washington. North American Journal of Fisheries Management 40:446–458.

Poole, G. C. & C. H. Berman. 2001. Profile: an ecological perspective on in-stream temperature: natural heat dynamics and mechanisms of human-cause thermal degradation. Journal of Environmental Management 27: 787–802.

Rehage J. S. and J. R. Blanchard. 2016. What can we expect from climate change for species invasions? Fisheries 41(7):405-407. DOI: 10.1080/03632415.2016.1180287.

Richter, A. and S.A. Kolmes. 2005. Maximum temperature limits for Chinook, coho, and chum salmon, and steelhead trout in the Pacific Northwest. Reviews in Fisheries Science 13:23–49.

Richter, B.D. and H.E. Richter. 2000. Prescribing flood regimes to sustain riparian ecosystems along meandering rivers. Conservation Biology 14:1467-1478.

Ricker, W. S., 1975. Computation and interpretation of biological statistics of fish populations. Bulletin Fisheries Research Board of Canada 191: 382.

Rothwell, E. and M. Moulton. 2001. Influence to stream temperatures from diversions. Monitoring 2001, Sawtooth National Recreation Area. 14 pp.

Runkle, J., K. E. Kunkel, R. Frankson, S. Champion, and L. Stevens. 2020. NOAA National Centers for Environmental Information, State Summaries 149-ID. 4 pp.

Samani, Z., and R. K. Skaggs. 2008. The multiple personalities of water conservation. Water Policy 10: 285-294.

Sauter, S.T., J. McMillan, and J. Dunham. 2001. Salmonid Behavior and Water Temperature. EPA Issue Paper 1. Prepared as Part of EPA Region 10 Temperature Water Quality Criteria Guidance Development Project. 36 pp.

Scheuerell, M. D. and J. G. WIlliams. 2005. Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (Oncorhynchus tshawytscha). Fisheries Oceanography 14(6):448–457.

Simpson, W.G. and K.G. Ostrand. 2012. Effects of Entrainment and Bypass at Screened Irrigation Canals on Juvenile Steelhead. Transactions of the American Fisheries Society 141:599–609.

Spence, B., G. Lomnicky, R. Hughes, and R.P. Novitski. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp.: Corvallis, Oregon.

Sutton, R. and C. Morris. 2004. Instream Flow Assessment Big Timber Creek, Idaho. Department of the Interior, Bureau of Reclamation, Snake River Area Office, Boise, Idaho. 119 pp.

Sutton R., and C. Morris. 2005. Instream Flow Assessment Big Eightmile Creek, Bohannon Creek, and Hayden Creek, Idaho. U.S. Department of the Interior, Bureau of Reclamation, Snake River Area Office, Boise, Idaho. 183 pp.

Sutton, R. and C. Morris. 2006. Instream flow assessment upper Lemhi River and Canyon Creek, Idaho. U. S. Department of the Interior, Bureau of Reclamation, Snake River Area Office, Boise, Idaho. 166 pp.

Sykes, G. E., C. J. Johnson, and J. M. Shrimpton. 2009. Temperature and Flow Effects on Migration Timing of Chinook Salmon Smolts. Transactions of the American Fisheries Society 138:1252-1265.

Tate, K.W., D.F. Lile, D.L. Lancaster, M.L. Porath, J.A. Morrison, and Y. Sado. 2005. Statistical analysis of monitoring data aids in prediction of stream temperature. California Agriculture 59(3):161-167.

Tehan, M. 2014. May, 13, 2014, Memorandum from Michael Tehan, assistant regional administrator for the National Marine Fisheries Service, West Coast Region (WCR), Columbia Basin Office to the WCR Columbia River Office.

Tennant, D. L. 1976. Instream flow regimes for fish, wildlife, recreation, and related environmental resources. Pages 359-373 in J. F. Osborn and C. H. Allman, eds. Instream Flow Needs, Volume II. American Fisheries Society, Bethesda, USA.

Thompson, K. 1972. Determining stream flows for fish life. In: Proceedings, Instream Flow Requirements Workshop, Pac. Northwest River Basin Comm., Vancouver, Washington. 31-50 pp.

Torgersen, C.E., D.M. Price, H.W. Li, and B.A. McIntosh. 1999. Multiscale thermal refugia and stream habitat associations of Chinook salmon in northeastern Oregon. Ecological Applications 9(1): 301-319

Townsend, C. R. and A. G. Hildrew. 1976. Field experiments on the drifting, colonization, and continuous redistribution of stream benthos. Journal of Animal Ecology 45: 759–772.

Van Kirk, R. W., and S. W. Naman. 2008. Relative effects of climate and water use on base-flow trends in the Lower Klamath basin. Journal of the American Water Resources Association 44(4): 1035-1052.

Verdonck, D. 2006. Contemporary vertical crustal deformation in Cascadia. Tectonophysics 417(3):221-230. DOI: 10.1016/j.tecto.2006.01.006.

Venn, B.J., D.W. Johnson, and L.O. Pochop. 2004. Hydrologic impacts due to change in conveyance and conversion from flood to sprinkler irrigation practices. Journal of Irrigation and Drainage Engineering. May/June: 192-200.

Uthe, P., B. Knoth, T. Copeland, A. E. Butts, B. J. Bowersox, and J. Diluccia. 2017. Intensively Monitored Watersheds and Restoration of Salmon Habitat in Idaho: Ten-Year Summary Report. Idaho Department of Fish and Game, IDFG 17-14. December 2017. 203 pp.

Wainwright, T. C. and L. A. Weitkamp. 2013. Effects of Climate Change on Oregon Coast Coho Salmon: Habitat and Life-Cycle Interactions. Northwest Science 87(3):219-242.

Walters, A.W., D.M. Holzer, J.R. Faulkner, C.D. Warren, P.D. Murphy, and M.M. McClure. 2012. Quantifying cumulative entrainment effects for Chinook salmon in a heavily irrigated watershed. Transactions of the American Fisheries Society 141:1180-1190.

Walters, A. W., T. Copeland, and D. A. Venditti. 2013. The density dilemma: limitations on juvenile production in threatened salmon populations. Ecology of Freshwater Fish 22(4): 508-519.

Ward, F. A. and M. Pulido-Velazquez. 2008. Water conservation in irrigation can increase water use. Proceedings of the National Academy of Sciences 105(47): 18215-18220.

Ward, E. J., J. H. Anderson, T. J. Beechie, G. R. Pess, and M. J. Ford. 2015. Increasing hydrologic variability threatens depleted anadromous fish populations. Global Change Biology 21(7):2500-2509.

Waterbury, B. 2003. Lemhi River Monitoring Plan, 2002 Annual Progress Report. Idaho Department of Fish and Game. Salmon, Idaho. 128 pp.

Weitkamp, L. A. 2010. Marine Distributions of Chinook Salmon from the West Coast of North America Determined by Coded Wire Tag Recoveries. Transactions of the American Fisheries Society 139:147-170.

Western Watershed Project v. Matejko. 2002. Partial settlement agreement and stipulation for partial dismissal of claims. United States District Court for the District of Idaho. No. CIV 01-0259-E-BLW.

Whiteway, S. L., P. M. Biron, A. Zimmermann, O. Venter, and J. W. A. Grant. 2010. Do in-stream restoration structures enhance salmonid abundance? A meta-analysis. Canadian Journal of Fisheries and Aquatic Sciences 67:831-841.

Whitney, J. E., R. Al-Chokhachy, D. B. Bunnell, C. A. Caldwell, et al. 2016. Physiological Basis of Climate Change Impacts on North American Inland Fishes. Fisheries 41(7):332-345. DOI: 10.1080/03632415.2016.1186656.

Wilcock, P.R., G.M. Kondolf, W.V.G. Matthews, and A.F. Barta. 1996. Specification of sediment maintenance flows for a large gravel river. Water Res. Res. 32(9): 2911-2921.

Wiles, G. J. 2004. Washington State Status Report for the Killer Whale. Washington Department of Fish and Wildlife, Olympia, 3/1/2004.

Yamada, S., W. T. Peterson, and P. M. Kosro. 2015. Biological and physical ocean indicators predict the success of an invasive crab, Carcinus maenas, in the northern California Current. Marine Ecology Progress Series 537:175-189. DOI: 10.3354/meps11431.

Zabel, R. W., M. D. Scheuerell, M. M. McClure, et al. 2006. The Interplay Between Climate Variability and Density Dependence in the Population Viability of Chinook Salmon. Conservation Biology 20(1):190-200, 2/1/2006.

Zamon, J. E., T. J. Guy, K. Balcomb, and D. Ellifrit. 2007. Winter observation of southern resident killer whales (Orcinus orca) near the Columbia River plume during the 2005 Chinook salmon (Oncorhynchus tshawtscha) spawning migration. Northwestern Naturalist, 88(3): 193-198.

6. APPENDIX A.

Effects of reducing flow on Lemhi River Chinook salmon and steelhead, relationships of density on productivity, and long-term flow trends in the Lemhi River.

Supporting Data and Analyses

Table of Contents

I. Quantifying the Flow-related Effects of the Proposed Action on Chinook Salmon and Steelhead

The biological assessment (BA) used the Lemhi River Basin Model (LRBM) (Borden 2015) to determine the amount of water that would be consumptively used due to the proposed action, and used the Mike Basin Model (Mike Model) (DHI 2006) to estimate the effects of the proposed action on flow in Lemhi River tributary streams. The results of these modeling efforts are presented in the BA as average monthly impact in cubic feet per second (cfs). The Mike Model results are presented for each diversion for May through September and the LRBM results are presented for May through October. The analyses in this Opinion are based on the results of the LRBM and the Mike Model that are presented in the BA. However, we made adjustments when the modeling results suggested that effects on flow were less than the amount of water consumptively used, and when the amount of land irrigated due to the proposed action was different than the amount of irrigation analyzed in Mike Model and LRBM models.

Water diverted from streams for irrigation either evaporates, is taken up by the irrigated plants and transpired into the atmosphere, returns to the stream as surface flow, or returns to the stream as groundwater. When accounting for water in a water budget, water that evaporates and water that is transpired are combined into a single measure known as evapotranspiration. Water that is evapotranspired is said to be consumptively used, it has been lost to the local water budget, and it therefore does not return to the stream. Because water lost to evapotranspiration does not return to the stream, the effect of diverting water on streamflow must be equal to or greater than the amount of water lost to evapotranspiration (i.e., consumptively used). Therefore, when the modeled effect on flow was less than the estimated consumptive use, we assumed that the actual effect on flow was equal to the estimated consumptive use.

Some of the diversions that the U.S. Forest Service (USFS) would authorize by the proposed action are part of larger irrigation systems that also include diversions on non-USFS land. For these diversions, estimating the amount of irrigation that is dependent on the proposed action requires an examination of factors such as: water right details, amount of flow available at the point of diversion (POD), type of water transmission facility, irrigation methods, and topography. The BA included some of this information but did not incorporate it into estimates of flow effects. Adjustments were therefore needed in order to accurately describe the effects of some of the diversions on flow. These adjustments were diversion-specific and are described in the tributary sections, below.

The BA analyzed the effects of the proposed action on flow and consumptive use for May through October only. We presume that the lack of analysis of effects for November through April implies that the effects during that time are sufficiently small that they can be ignored. We therefore assumed that the effects of the proposed action on flow would be zero from November through April. This assumption is also supported by climate data, which indicates that minimum daily temperatures at the places of use are typically below freezing for November through April, suggesting that consumptive use of water would be very low during that time.

After estimating the effects of the proposed action on flow, we used relationships of fish population productivity and measured streamflow to analyze the effects of reducing flow on Chinook salmon and steelhead. For Chinook salmon in all tributary streams except Hayden

Creek, and in the mainstem Lemhi River upstream from Hayden Creek, we used the relationships of outmigrants per redd moving past the LEMHIW trap, and flow measured at the Lemhi River at McFarland Campground gage (Figure A.I.1). For Chinook salmon in Hayden Creek, we used the relationships of outmigrants per redd, measured at the HAYDC trap, and flow measured at the Hayden Creek gage (Figure A.I.2). For the mainstem Lemhi River downstream from Hayden Creek, we used the relationships of outmigrants per redd moving past the LEMHIR trap and flow measured at the Lemhi River near Lemhi gage (Figure A.I.3) and at the Lemhi River below L-5 Diversion gage (Figure A.I.4). For steelhead in all reaches analyzed, we used the relationship of *Oncorhynchus mykiss* return year redds per stock year redds and streamflow measured at the McFarland Campground gage (Figure A.I.5). For all relationships, streamflow was expressed as percentage of mean monthly flow and relationships were calculated for each month from May through October.

The importance of flow for survival and growth of stream dwelling salmonids is well documented in the peer-reviewed literature. Most of these studies involve "summer" flow and typically indicate that conditions during the late-spring – early-fall period are very important. Although fewer in number, studies of "winter" flow indicate that conditions during the late-fall – early-spring period are also important. The relationship between Chinook salmon and steelhead population productivity and mean monthly flow, measured at the Lemhi River near Lemhi gage, is positive for each month of the year, suggesting that flow is important throughout the year. Also, flows in the Lemhi River drainage are correlated throughout the year, making the determination of the most "important" period difficult. We therefore assumed that "summer flow" and "winter flow" are equally important for survival and growth of rearing Chinook salmon and steelhead. Under this assumption, we averaged the estimated effects for each month across the entire year. Because we also assumed that the diversion authorizations would have no effect on flow from November through March, the averages included zero values for those months. The methods used to estimate the effects on Chinook salmon and steelhead are summarized as follows:

1. Estimate the effect of the proposed action on flow (cfs), for each month from May through October, in each affected stream reach, using the information provided in the BA.

2. Convert the effect on flow expressed as cfs into a percent of average flow in the affected reaches.

3. Input the effects on flow (from number 2 above), for each month and each stream reach, into the regression equations from the fish population versus flow relationships, and then calculate an average effect for the year, assuming zero effects from November through April.

4. Determine the amount of each stream reach that is occupied by Chinook salmon and steelhead and express that as m^2 of intrinsic potential habitat (IP).

5. Calculate the number of fish produced per habitat unit (i.e., m^2 of IP) by dividing the average number of outmigrants (annual) by the amount of occupied IP upstream from the

screw trap. For steelhead, this calculation was made for the Lemhi Weir trap (LEMHIW). For Chinook salmon, this calculation was made for the LEMHIW trap, the Lemhi River trap (LEMHIR) and the Hayden Creek trap (HAYNDC).

6. Multiply the number of fish produced per habitat unit (described in number 5) by the percent reduction estimated for the stream reach in question (described in number 3), and then multiply the product by the amount of habitat (i.e., m^2 of IP) in the stream reach in question (described in number 4).

The specific methods used to accomplish these tasks differed among stream reaches and are described in the following sections.

Figure A.I.1. Chinook salmon outmigrants per redd measured at the Lemhi Weir screw trap (LEMHIW) versus rearing streamflow measured at the Lemhi River at McFarland Campground gage. Brood years were 1996-2016 for May through July. Due to missing flow data, brood years were 1996-1998 and 2000-2016 for September, and 2003-2009 and 2011-2016 for October. These relationships were used to estimate the effects of the proposed action on Chinook salmon rearing in the Lemhi River upstream from Hayden Creek, and in Bohannon, Wimpey, Canyon, Texas, Big Timber, and Big Eight Mile Creeks.

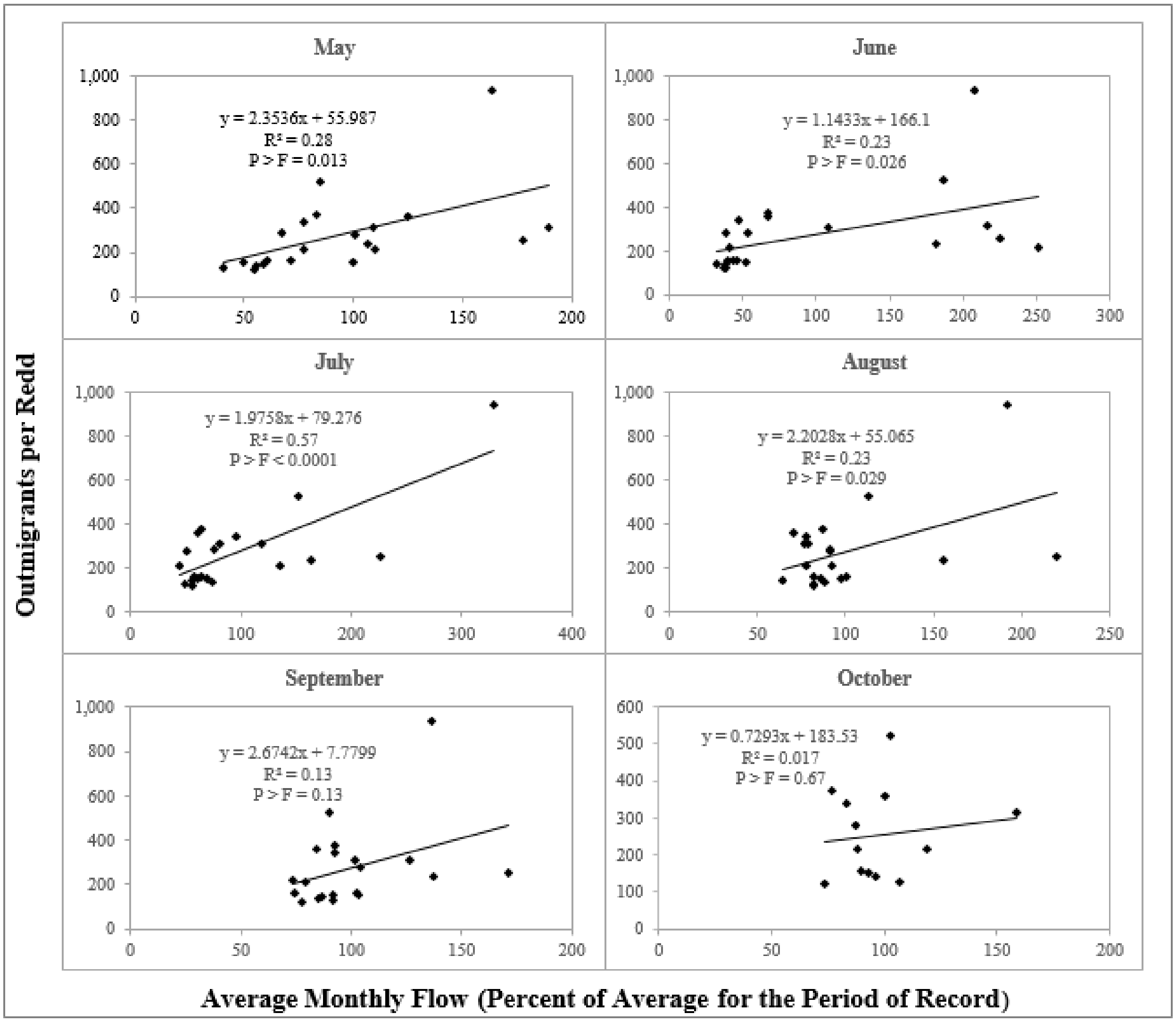


Figure A.I.2. Chinook salmon outmigrants per redd measured at the Hayden Creek screw trap (HAYDNC) versus rearing streamflow measured at the Hayden Creek gage for brood years 2005-2016. These relationships were used to estimate the effects of the proposed action on Chinook salmon rearing in Hayden Creek and East Fork Hayden Creek.

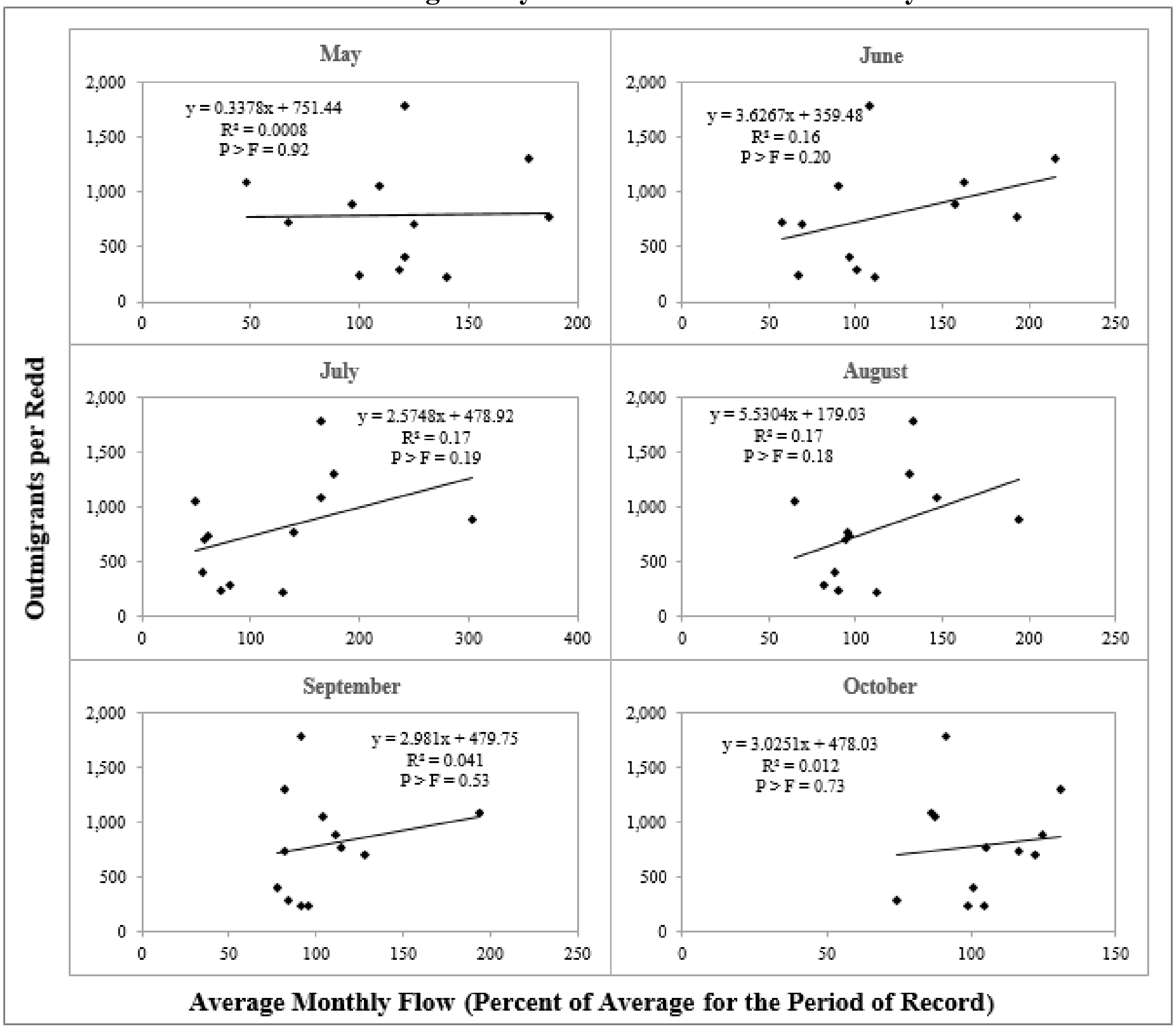


Figure A.I.3. Chinook salmon outmigrants per redd measured at the Lemhi River screw trap (LEMHIR) versus flow measured at the Lemhi River at Lemhi gage. Brood years were 2005-2009 and 2012-2015 for May through September; and 2005-2009 and 2012-2014 for October. These relationships were used in conjunction with the relationships in Figure A.I.4, to estimate the effects of the proposed action on Chinook salmon rearing in the mainstem Lemhi River downstream from Hayden Creek.

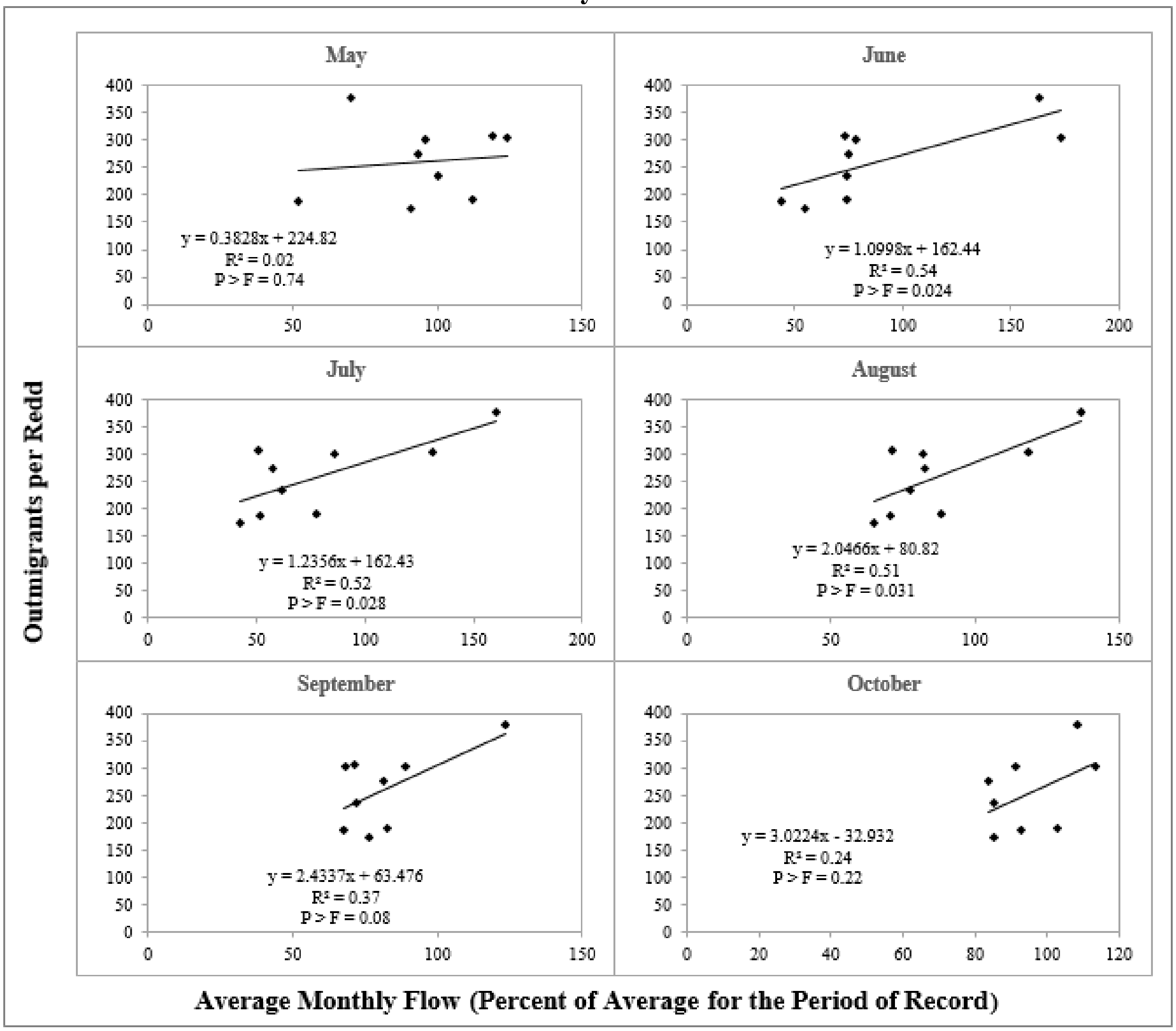


Figure A.I.4. **Chinook salmon outmigrants per redd measured at the Lemhi River screw trap (LEMHIR) versus flow measured at the Lemhi River above the L-5 Diversion gage for brood years were 2005-2009 and 2012-2015. These relationships were used in conjunction with the relationships in Figure A.I.3, to estimate the effects of the proposed action on Chinook salmon rearing in the mainstem Lemhi River downstream from Hayden Creek.**

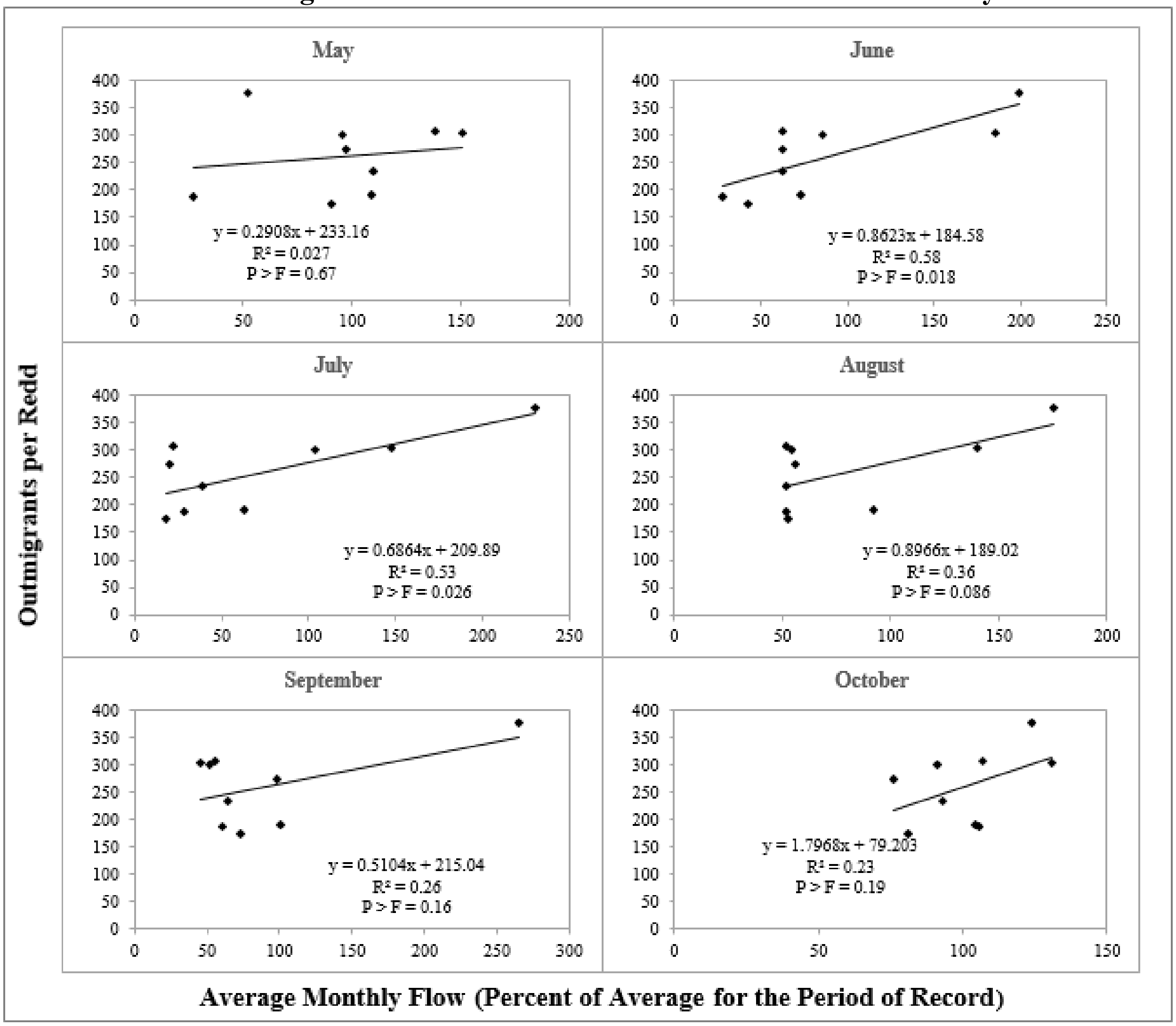
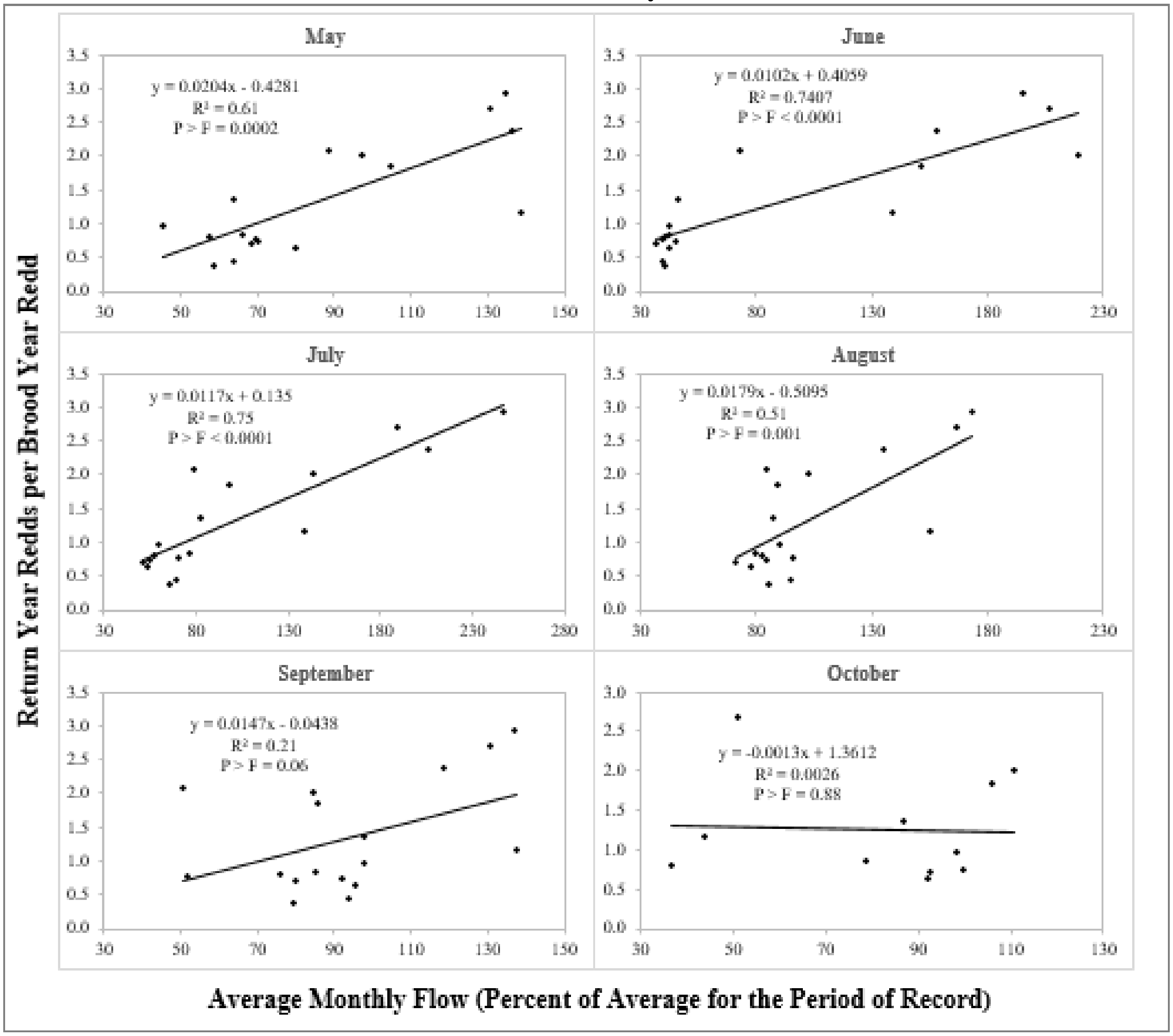


Figure A.I.5. Lemhi River *Oncorhynchus mykiss* whole life cycle productivity versus flow measured at the McFarland Campground gage for brood years 1997 – 2013. These relationships were used to estimate the effect of the proposed action on steelhead rearing in the mainstem Lemhi River and in affected tributary streams.



Eighteenmile Creek

The Big Bear Creek Diversion is the only water diversion in the Eighteenmile Creek drainage that is associated with the proposed action. The diversion is on Big Bear Creek approximately 0.67 miles upstream from the confluence of Big Bear and Hawley Creeks. Operation of the Big Bear Creek Diversion will reduce flows in the lower 0.67 miles of Big Bear Creek, the lower 9.85 miles of Hawley Creek, the lower 2.03 miles of Eighteenmile Creek, and the entire mainstem Lemhi River.

The effects of operating the Big Bear Creek Diversion on flow in downstream reaches were taken directly from the BA. When the modeled effects in the BA were less than the consumptive use, we assumed that the effect on flow was equal to the consumptive use. There are two streamflow gages on Hawley Creek and there was a gage on lower Eighteenmile Creek that operated from June, 2008 through October, 2009. We estimated flows in Big Bear Creek using the USGS Streamstats analysis tool (https://www.usgs.gov/mission-areas/water-resources/science/streamstats-streamflow-statistics-and-spatial-analysis-tools?qt-science_center_objects=0#qt-science_center_objects). We used data from the upper Hawley Creek gage to characterize flow in Hawley Creek between Big Bear Creek and the Hawley Creek #2 Diversion and we used data from the lower Hawley Creek gage to characterize flow from the Hawley Creek #2 Diversion to Eighteenmile Creek. We used the limited data from the Eighteenmile Creek gage to characterize flow in the Eighteenmile Creek downstream from Hawley Creek.

All of the affected stream reaches are occupied steelhead spawning and/or rearing habitat. The mainstem Lemhi River and the affected reach of Eighteenmile Creek are occupied Chinook salmon spawning and/or rearing habitat. Although there are no known migration barriers downstream from the diversion, Chinook salmon have not been documented in Hawley or Big Bear Creeks. We calculated the effect of the proposed action on productivity of Chinook salmon rearing in Eighteenmile Creek by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure A.I.1, and averaging over the entire year (including zero effects from November through April). We then used the outmigrants per accessible IP upstream from the LEMHIW trap and the amount of Chinook salmon IP in the lower 2.03 miles of Eighteenmile Creek to calculate the reduction in the number of Chinook salmon outmigrants. Effects of the proposed action on flow, Chinook salmon productivity, and Chinook salmon production in Big Timber Creek are in Table A.I.1.

Table A.I.1. Effects of the proposed action on flow in Eighteenmile Creek and on Chinook salmon rearing in Eighteenmile Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.08	0.59	0.76	0.64	0.48	0.25
Average monthly flow at the Eighteenmile Creek gage (cfs) (2008-2009)	13.84	12.72	4.01	3.35	6.26	9.68
Flow effect (%)	0.58%	4.64%	19.0%	19.1%	7.66%	2.58%
Productivity effect	0.47%	1.89%	13.5%	15.3%	7.44%	0.74%
Average productivity effect (assumed zero effect from Nov – Apr)	3.28%					
Chinook salmon IP in the lower 2.03 miles of Eighteenmile Creek (m^2)	23,831					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	32					

We calculated the effect of the proposed action on productivity of steelhead rearing in Eighteenmile Creek by inputting the estimated impacts, expressed as a percentage of average monthly flow, into the line equations in Figure A.I.5, and averaging over the entire year (including zero effects from November through April). We then used the outmigrants per accessible IP upstream from the LEMHIW trap and the amount of steelhead IP in the lower 0.67 miles of Big Bear Creek, the lower 9.85 miles of Hawley Creek, and the lower 2.03 miles of Eighteenmile Creek to calculate the reduction in the number of steelhead outmigrants. Effects of the proposed action on flow, steelhead productivity, and steelhead production in the Eighteenmile Creek drainage are in Tables A.I.2 – A.I.5.

Table A.I.2. Effects of the proposed action on flow in Big Bear Creek and on steelhead rearing in Big Bear Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.32	2.00	2.00	2.00	2.00	0.25
Average monthly flow estimated with Streamstats	18.1	21.3	14.0	12.7	11.8	11.2
Flow effect (%)	1.77%	9.39%	14.3%	15.8%	16.9%	2.23%
Productivity effect	2.24%	6.71%	12.8%	22.0%	17.5%	-0.24%
Average productivity effect (assumed zero effect from Nov – Apr)	5.01%					
Steelhead IP the lower 0.67 miles of Big Bear Creek (m^2)	5,907					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	2					

Table A.I.3. Effects of the proposed action on flow in Hawley Creek between Big Bear Creek the Hawley Creek #2 Diversion and steelhead rearing between Big Bear Creek and the Hawley Creek #2 Diversion.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.23	0.66	0.76	0.66	0.52	0.25
Average monthly flow at the Hawley Creek upper gage (cfs) (2008-2019)	24.46	25.32	18.00	16.12	16.72	16.96
Flow effect (%)	0.94%	2.61%	4.22%	4.10%	3.11%	1.47%
Productivity effect	1.19%	1.86%	3.79%	5.73%	3.22%	-0.16%
Average productivity effect (assumed zero effect from Nov – Apr)	1.28%					
Steelhead IP in Hawley Creek between Big Bear Creek and the Hawley Creek #2 Diversion (m^2)	33,202					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	3					

Table A.I.4. Effects of the proposed action on flow in Hawley Creek between the Hawley Creek #2 Diversion and Eighteenmile Creek and on steelhead rearing between the Hawley Creek #2 Diversion.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.10	0.59	0.76	0.64	0.48	0.25
Average monthly flow at the Hawley Creek lower gage (cfs) (2008-2019)	11.69	7.27	3.04	1.59	5.38	19.57
Flow effect (%)	0.86%	8.12%	25.0%	40.2%	8.92%	1.28%
Productivity effect	1.08%	5.80%	22.4%	56.2%	9.22%	-0.14%
Average productivity effect (assumed zero effect from Oct – Apr)	7.50%					
Steelhead IP in Hawley Creek between the Hawley Creek #2 Diversion and Eighteenmile Creek (m^2)	70,706					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	41					

Table A.I.5. Effects of the proposed action on flow in Eighteenmile Creek downstream from Hawley Creek and on steelhead rearing in Eighteenmile Creek downstream from Hawley Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.08	0.59	0.76	0.64	0.48	0.25
Average monthly at the Eighteenmile Creek gage (cfs) (2008-2009)	13.84	12.72	4.01	3.35	6.26	9.68
Flow effect (%)	0.58%	4.64%	19.0%	19.1%	7.66%	2.58%
Productivity effect	0.73%	3.32%	17.0%	26.7%	7.93%	-0.27%
Average productivity effect (assumed zero effect from Oct – Apr)	4.43%					
Steelhead IP in Eighteenmile Creek downstream from Hawley Timber Creek (m^2)	36,528					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	12					

Authorization of the Big Bear Creek Diversion would reduce flow in the mainstem Lemhi River by 168.8 acre feet per year. The effects of this flow reduction on Chinook salmon and steelhead rearing in the mainstem Lemhi River will be described in the Mainstem Lemhi River section.

Texas Creek

Chinook salmon and steelhead rearing in Texas Creek will be affected by operation of the Deer Creek Diversion. The BA described the effects on flow that would result from irrigating 196.2 acres, but only approximately 134.2 acres of irrigation is likely dependent on the proposed action. We therefore divided the estimated effects on flow and consumptive use, described in the BA, by 0.68 (i.e., 134.2/196.2) to estimate the actual effects of the proposed action on flow in occupied habitat in Texas Creek.

There are two streamflow gages on Texas Creek, the Lemhi River above the L-63 Diversion gage and the Texas Creek gage. In spite of the name, the Lemhi River above the L-63 Diversion gage (lower gage) is actually on Texas Creek, approximately 400 feet upstream from the mouth. The Texas Creek gage (upper gage) is approximately 4.9 miles upstream from the mouth. We used data from both of these gages to calculate the effects of the proposed action on Chinook salmon and steelhead rearing in Texas Creek.

We calculated the effect of the proposed action on productivity of Chinook salmon rearing in Texas Creek by inputting the estimated impacts, expressed as a percentage of average monthly flow, into the line equations in Figure A.I.1, and averaging over the entire year (including zero effects from November through April). We did this separately with data from the upper and lower gages and then averaged the results. We then used the outmigrants per accessible IP upstream from the LEMHIW trap and the amount of Chinook salmon IP in the lower 2.5 miles of Texas Creek to calculate the reduction in the number of Chinook salmon outmigrants. Effects of the proposed action on flow, Chinook salmon productivity, and Chinook salmon production in Texas Creek are in Table A.I.6.

Table A.I.6. Effects of the proposed action on flow in Texas Creek and on productivity of Chinook salmon rearing in Texas Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.47	0.94	0.86	0.57	0.41	0.10
Average monthly flow at the Texas Creek upper gage (cfs) (2008-2019)	16.2	16.5	12.0	13.4	18.4	33.1
Flow effect (%) calculated at the upper gage	2.91	5.68	7.19	4.30	2.23	0.31
Average monthly flow at the Texas Creek lower gage (cfs) (2008-2019)	17.3	18.3	11.7	10.1	14.5	31.8
Flow effect (%) calculated at the lower gage	2.73	5.11	7.39	5.66	2.83	0.32
Productivity effect, calculated with data from the upper gage	2.35%	2.32%	5.13%	3.44%	2.17%	0.09%
Productivity effect, calculated with data from the lower gage lower gage	2.20%	2.08%	5.28%	4.53%	2.75%	0.09%
Average productivity effect (assumed zero effect from Nov – Apr)	1.36%					
Occupied Chinook salmon IP in the lower 2.5 miles of Texas Creek (m^2)	24,518					

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	14					

We calculated the effect of the proposed action on productivity of steelhead rearing in Texas Creek by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure A.I.5, and averaging over the entire year (including zero effects from November through April). We did this separately with data from the upper and lower gages and then averaged the results. We then used the outmigrants per accessible IP upstream from the LEMHIW trap and the amount of steelhead IP in the lower 14 miles of Texas Creek to calculate the reduction in the number of steelhead outmigrants. Effects of the proposed action on flow, steelhead productivity, and steelhead production in Texas Creek are in Table A.I.7.

Table A.I.7. Effects of the proposed action on flow in Texas Creek and on steelhead rearing in Texas Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.47	0.94	0.86	0.57	0.41	0.10
Average monthly flow at the Texas Creek upper gage (cfs) (2008-2019)	16.2	16.5	12.0	13.4	18.4	33.1
Flow effect (%) calculated at the upper gage	2.91	5.68	7.19	4.30	2.23	0.31
Average monthly flow at the Texas Creek lower gage (cfs) (2008-2019)	17.3	18.3	11.7	10.1	14.5	31.8
Flow effect (%) calculated at the lower gage	2.73	5.11	7.39	5.66	2.83	0.32
Productivity effect, calculated with data from the upper gage	3.69%	4.07%	6.46%	6.02%	2.31%	-0.03%
Productivity effect, calculated with data from the lower gage lower gage	3.46%	3.65%	6.64%	7.93%	2.93%	-0.03%
Average productivity effect (assumed zero effect from Nov – Apr)	1.96%					
Steelhead IP in the affected reach of Texas Creek (m^2)	206,063					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	31					

The BA did not model the effect of operating the Deer Creek Diversion on flow in the Lemhi River; however, the effect must be equal to or greater than the consumptive use resulting from operating the diversion. As described above, authorizing operation of the Deer Creek Diversion will result in irrigation of 134.2 acres, which will result in consumptive use of approximately 196 acre feet per year. The effects of operating the Deer Creek Diversion on Chinook salmon and steelhead in the mainstem Lemhi River are described in Mainstem Lemhi River section.

Big Timber Creek

There are two water diversion systems in the Big Timber Creek drainage that are associated with the proposed action, the Big Timber Creek Diversion and the Basin Creek Diversion Complex. The current upstream extent of anadromous fish access in Big Timber Creek is the Carey Act Diversion Dam, located 6.7 miles upstream from the mouth. Both of the water diversion systems associated with the proposed action are upstream from the Carey Act Diversion Dam and both, therefore, affect the entire section of mainstem Big Timber Creek that is currently accessible to anadromous fishes.

The effects of operating the Big Timber Creek Diversion on flow in Big Timber Creek were taken directly from the BA. The analysis of the Basin Creek Diversion Complex, that was included in the BA, described the effects of operating ten PODs, only three of which are on National Forest System (NFS) land. The BA described the effects of irrigating the full 340 acres, but estimated that 53 of the 340 total acres could be irrigated via the three PODs on NFS land and the diversion flow measurements included in the BA were consistent with irrigation of approximately 53 acres. Because only 53 of the 340 acres would likely be irrigated via the Basin Creek Complex, we multiplied the effects described in the BA by 53/340 to approximate the actual effects of authorizing operating the Basin Creek Complex.

There are two streamflow gages on Big Timber Creek, one approximately one mile upstream from the mouth and downstream from all of the Big Timber Creek water diversions (lower gage), and one approximately 0.1 miles upstream from the Carey Act Diversion Dam (upper gage). We used data from the upper gage to characterize the effects of the proposed action on flow in reaches upstream from the Carey Act Diversion Dam (i.e., unoccupied reaches) and data from the lower gage to characterize effects in the occupied reaches.

Although there are currently no known fish passage barriers in the lower 6.7 miles of Big Timber Creek, Chinook salmon have only been documented in the lowest three miles of the creek and we therefore only considered the lowest three miles to be occupied Chinook salmon habitat. We calculated the effect of the proposed action on productivity of Chinook salmon rearing in Big Timber Creek by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure A.I.1, and averaging over the entire year (including zero effects from November through April). We then used the outmigrants per accessible IP upstream from the LEMHIW trap and the amount of Chinook salmon IP in the lower three miles of Big Timber Creek to calculate the reduction in the number of Chinook salmon outmigrants. Effects of the proposed action on flow, Chinook salmon productivity, and Chinook salmon production in Big Timber Creek are in Table A.I.8.

Table A.I.8. Effects of the proposed action on flow in Big Timber Creek and on Chinook salmon rearing in Big Timber Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.91	1.64	1.18	0	0	0.031
Average monthly flow at the Big Timber Creek lower gage (cfs) (2008-2019)	27.5	38.5	11.8	5.0	5.2	7.0

Effect or Factor	Month					
	May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Flow effect (%) calculated at the lower gage	3.33%	4.27%	9.96%	0%	0%	0.45%
Productivity effect calculated with data from the lower gage	2.96%	1.74%	7.11%	0%	0%	0.13%
Average productivity effect (assumed zero effect from Nov – Apr)	0.99%					
Chinook salmon IP in the lower 3.0 miles of Big Timber Creek (m^2)	28,716					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	12					

For the steelhead analysis, we divided Big Timber Creek into three reaches: The Big Timber Creek Diversion to Basin Creek, Basin Creek to the Carey Act Diversion Dam, and the Carey Act Diversion Dam to the Lemhi River. We characterized the effects of the proposed action on steelhead rearing in the two upper reaches using data from the upper gage, and used data from the lower gage to characterize the effects in the Carey Act Dam to Lemhi River reach. Effects of the proposed action on flow, steelhead productivity, and steelhead production in the Big Timber Creek Diversion to Basin Creek, Basin Creek to the Carey Act Diversion Dam, and the Carey Act Diversion Dam to the Lemhi River reaches are in Tables A.I.9, A.I.10, and A.I.11, respectively.

Table A.I.9. Effects of the proposed action on flow and on steelhead rearing in Big Timber Creek between the Big Timber Creek Diversion and Basin Creek.

Effect or Factor	Month					
	May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Flow effect (cfs)	0.69	1.25	0.92	-0.01	0.00	0.00
Average monthly flow at the Big Timber Creek upper gage (cfs) (2006-2019)	86.9	130.9	55.9	26.0	19.2	20.6
Flow effect (%) calculated at the upper gage	0.79%	0.96%	1.64%	-0.04%	0%	0%
Productivity effect, calculated with data from the upper gage	1.01%	0.68%	1.48%	-0.05%	0%	0%
Average productivity effect (assumed zero effect from Nov – Apr)	0.27%					
Steelhead IP (m^2)	55,920					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	1					

Table A.I.10. Effects of the proposed action on flow and on steelhead rearing in Big Timber Creek between Basin Creek and the Carey Act Dam.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.91	1.64	1.18	0.16	0.12	0.03
Average monthly flow at the Big Timber Creek upper gage (cfs) (2006-2019)	86.9	130.9	55.9	26.0	19.2	20.6
Flow effect (%) calculated at the upper gage	1.05%	1.26%	2.11%	0.62%	0.61%	0.15%
Productivity effect, calculated with data from the upper gage	1.33%	0.90%	1.89%	0.87%	0.63%	-0.02%
Average productivity effect (assumed zero effect from Nov – Apr)	0.48%					
Steelhead IP (m^2)	4,217					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	<1					

Table A.I.11. Effects of the proposed action on flow and on steelhead rearing in Big Timber Creek between the Carey Act Dam and the Lemhi River.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.91	1.64	1.18	0	0	0.031
Average monthly flow at the Big Timber Creek lower gage (cfs) (2008-2019)	27.5	38.5	11.8	5.0	5.2	7.0
Flow effect (%) calculated at the lower gage	3.33%	4.27%	9.96%	0%	0%	0.45%
Productivity effect, calculated with data from the lower gage	4.22%	3.05%	8.95%	0%	0%	-0.05%
Average productivity effect (assumed zero effect from Nov – Apr)	1.38%					
Steelhead IP in the lower 6.7 miles of Big Timber Creek (m^2)	88,671					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	9					

The BA did not model the effect of operating the Big Timber Creek Diversion or the Basin Creek Diversion Complex on flow in the Lemhi River; however, the effect must be equal to or greater than the consumptive use resulting from operating the diversions. Authorizing the Big Timber Creek Diversion would result in irrigation of 89.6 acres and consumptive use of approximately 173.4-acre feet per year. Assuming that authorizing the Basin Creek Diversion Complex would result in irrigation of 30% of the 340 acres that could be irrigated with the larger diversion system (i.e., the Basin Creek Diversion Complex and seven PODs on non-NFS land), then authorizing the Basin Creek Diversion Complex would result in irrigation of 53 acres and consumptive use of 71.5 acre feet. Authorization of the Big Timber Creek Diversion and the Basin Creek Diversion Complex would therefore reduce flow in the mainstem Lemhi River by 245-acre feet per year. The effects of this flow reduction on Chinook salmon and steelhead rearing in the mainstem Lemhi River will be described in the Mainstem Lemhi River section.

Canyon Creek

The Canyon Creek Complex consists of three PODs, all of which serve the same water rights, are used to irrigate the same place of use (POU), and are upstream from the current upstream extent of anadromous fish occupancy. The effect of the proposed action presented in the BA was less than the consumptive use for June through October, but slightly greater than consumptive use for May. Because the effect cannot be less than the consumptive use, we assumed that the effect of the proposed action on flow in Canyon Creek for June through October was equal to the estimated consumptive use.

There is one streamflow gage on Canyon Creek located approximately 0.14 miles upstream from the mouth. We used data from this gage to characterize the effects of the proposed action on flow in the lower 4.9 miles of Canyon Creek. We calculated the effect of the proposed action on productivity of Chinook salmon rearing in Canyon Creek by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure 1, and averaging over the entire year (including zero effects from November through April). We then used the outmigrants per accessible IP upstream from the LEMHIW trap and the amount of Chinook salmon IP in the lower 1.5 miles of Canyon Creek to calculate the reduction in the number of Chinook salmon outmigrants. Effects of the proposed action on flow, Chinook salmon productivity, and Chinook salmon production in Canyon Creek are in Table A.I.12.

Table A.I.12. Effects of the proposed action on flow in Canyon Creek and on Chinook salmon rearing in Canyon Creek.

Effect or Factor	Month					
	May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Flow effect (cfs)	0.71	1.18	1.54	1.28	0.98	0.27
Average monthly flow at the Canyon Creek gage (cfs) (2008-2018)	10.4	10.4	5.7	3.3	4.2	4.9
Flow effect (%)	6.83%	11.37%	26.92%	39.37%	23.23%	5.47%
Productivity effect, calculated with data from the Canyon Creek gage	5.52%	4.64%	19.22%	31.48%	22.54%	1.56%
Average productivity effect (assumed zero effect from Nov – Apr)	7.10%					
Chinook salmon IP in the lower 1.5 miles of Canyon Creek (m^2)	7,566					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	22					

We calculated the effect of the proposed action on productivity of steelhead rearing in Canyon Creek by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure 5, and averaging over the entire year (including zero effects from November through April). We then used the outmigrants per accessible IP upstream from the LEMHIW trap and the amount of steelhead IP in the lower 4.9 miles of Big Timber Creek to calculate the reduction in the number of steelhead outmigrants. Effects of the proposed action on flow, steelhead productivity, and steelhead production in Big Timber Creek are in Table A.I.13.

Table A.I.13. Effects of the proposed action on flow in Canyon Creek and on steelhead rearing in Canyon Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.71	1.18	1.54	1.28	0.98	0.27
Average monthly flow at the Canyon Creek gage (cfs) (2008-2018)	10.4	10.4	5.7	3.3	4.2	4.9
Flow effect (%)	6.83%	11.37%	26.92%	39.37%	23.23%	5.47%
Productivity effect, calculated with data from Canyon Creek gage	8.66%	8.13%	24.18%	55.10%	24.02%	-0.58%
Average productivity effect (assumed zero effect from Nov – Apr)	9.74%					
Steelhead IP in the lower 4.9 miles of Big Timber Creek (m^2)	48,992					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	37					

The BA did not model the effect of operating the Canyon Creek Diversion Complex on flow in the Lemhi River; however, the effect must be equal to or greater than the consumptive use resulting from operating the diversion. According to the BA, operating the Canyon Creek Complex will result in consumptive use of approximately 349 acre feet per year. The effects operating the Canyon Creek Diversion Complex on Chinook salmon and steehead rearing in the mainstem Lemhi River will be described in the Mainstem Lemhi River section.

Big Eightmile Creek

There are two diversions in the Big Eightmile Creek drainage that will be authorized by the proposed action, the Devil's Canyon Creek Diversion and the Big Eightmile Creek Diversion. The Devil's Canyon Creek Diversion is located on Devil's Canyon Creek approximately 0.5 miles upstream from the confluence of Devils Canyon and Big Eightmile Creeks, and the Big Eightmile Creek Diversion is on Big Eightmile Creek immediately across from the mouth of Devil's Canyon Creek. The BA described the effects of the proposed action on flow in Big Eightmile Creek; however, the estimated effects for the lowest reach were less than the estimated consumptive use for May, July, August, September, and for the year. We therefore assumed that the effect of the proposed action on flow in lower Big Eightmile Creek in May, July, August, and September was equal to the consumptive use resulting from authorizing the diversions.

There are two streamflow gages on Big Eightmile Creek, located approximately 7.3 miles (upper gage) and 3.8 miles (lower gage) upstream from the mouth. There are numerous diversions between the lower gage and the upstream extent of known Chinook salmon occupancy (i.e., approximately one mile upstream from the mouth) such that flows at the lower gage are not necessarily representative of flows in occupied Chinook salmon habitat in Big Eightmile Creek. However, the BA estimated average monthly flows in lower Big Eightmile Creek and we used those data to characterize the effect of the proposed action on Chinook salmon and steelhead rearing in the lowest mile of the creek. We used data from both the upper and lower gage to characterize the effects of the proposed action on steelhead rearing between the mouth of Devil's Canyon Creek and the upstream extent of known Chinook salmon occupancy.

Big Eightmile Creek does not have Chinook salmon IP but juvenile Chinook salmon rear and overwinter in lower Big Eightmile Creek indicating that it is important habitat. However, Big Eightmile Creek does have steelhead IP. We divided Chinook salmon IP by steelhead IP, for all streams in the Lemhi River drainage that contain both, to get an average ratio of Chinook salmon to steelhead IP (Table A.I.14). We then divided the steelhead IP in the lower mile of Big Eightmile Creek by the average ratio of Chinook salmon to steelhead IP to quantify the amount Chinook salmon habitat in Big Eightmile Creek that is currently occupied by Chinook salmon. We also used this method to quantify the amount of occupied Chinook salmon habitat in other streams that have steelhead IP but do not have Chinook salmon IP (i.e., Wimpey, Bohannon, and East Fork Hayden Creeks).

Table A.I.14. Ratio of Chinook Salmon to steelhead IP for Lemhi River drainage streams with both, and extrapolated Chinook salmon IP in stream reaches that are affected by the proposed action and have modeled IP for steelhead only.

Stream	Chinook Salmon IP	Steelhead IP	Ratio
Agency Creek	20,126	99,824	0.2016
Carmen Creek	20,754	96,107	0.2159
Canyon Creek	34,817	96,299	0.3616
Hawley Creek	41,389	103,908	0.3983
Hayden Creek & Bear Valley Creek	60,778	137,921	0.4407
Big Timber Creek	81,789	226,510	0.3611
Eighteenmile Creek	112,952	274,936	0.4108
Texas Creek	114,604	223,568	0.5126
Lemhi River	857,981	1,474,756	0.5818
Average	**149,466**	**303,759**	**0.3872**
Stream Reach	**Extrapolated Chinook Salmon IP**	**Steelhead IP**	
Big Eightmile Creek, lowest mile	3,056	7,894	**Ratio set at 0.3872**
Lowest 0.2 miles of EF Hayden Creek	101	260	
Lowest 1.1 miles of Wimpey Creek	3,783	9,771	
Lowest 2.9 miles of Bohannon Creek	9,767	25,227	

We calculated the effect of the proposed action on productivity of Chinook salmon rearing in Big Eightmile Creek by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure A.I.1, and averaging over the entire year (including zero effects from November through April). We then used the outmigrants per accessible IP upstream from the LEMHIW trap and the estimated (see previous paragraph) amount of Chinook salmon IP in the lower mile of Big Eightmile Creek to calculate the reduction in the number of Chinook salmon outmigrants. Effects of the proposed action on flow, Chinook salmon productivity, and Chinook salmon production in Big Eightmile Creek are in Table A.I.15.

Table A.I.15. Effects of the proposed action on flow in Big Eightmile Creek and on Chinook salmon rearing in Big Eightmile Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.32	1.22	0.59	0.16	0.08	0
Average monthly flow (cfs) (modeled, from the BA)	14.05	27.72	16.84	2.97	1.05	NA
Flow effect (%)	2.28%	4.40%	3.50%	5.39%	7.62%	0
Productivity effect, calculated modeled flow data	1.84%	1.79%	2.50%	4.31%	7.39%	0%
Average productivity effect (assumed zero effect from Nov – Apr)	1.49%					
Chinook salmon IP in the lower mile of Big Eightmile Creek (m^2)	3,056					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	2					

For the steelhead analysis, we divided Big Eightmile Creek into an upper reach and a lower reach. The upper reach extends from Devil's Canyon Creek downstream to Reference Point F (2.6 miles upstream from the mouth), and the lower reach extending from Reference Point F downstream to the mouth. We characterized the effects of the proposed action on steelhead rearing in the upper reach separately with data from the upper and lower gages, and then averaged the results. We used the estimated average monthly flows provided in the BA to characterize effects of the proposed action on steelhead rearing in the lower reach. Effects of the proposed action on flow, steelhead productivity, and steelhead production in the upper and lower reaches of Big Eightmile Creek are in Tables A.I.16 and A.I.17, respectively. The line equations in Figure A.I.5 were used in all analyses of effects on steelhead in Big Eightmile Creek.

Authorizing operation of the Devil's Canyon Creek and the Big Eightmile Creek Diversions would reduce flow in the upper and lower reaches of Big Eightmile Creek which would reduce the average number of steelhead migrants from the upper and lower reaches by two fish and four fish, respectively, for a total reduction of six outmigrants from Big Eightmile Creek.

The BA did not model the effect of operating the Devil's Canyon Creek or the Big Eightmile Creek Diversions on flow in the Lemhi River; however, the effect must be equal to or greater than the consumptive use resulting from operating the diversions. According to the BA, operating the Devil's Canyon Creek and the Big Eightmile Creek Diversions will result in consumptive use of approximately 113 acre feet per year. The effects operating the Devil's Canyon Creek and the Big Eightmile Creek Diversions on Chinook salmon and steehead rearing in the mainstem Lemhi River will be described in the Mainstem Lemhi River section.

Table A.I.16. Effects of the proposed action on flow in the upper reach of Big Eightmile Creek and on steelhead rearing in the upper reach of Big Eightmile Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.50	1.46	0.56	0.04	0.01	0.00
Average monthly flow at the Big Eightmile Creek upper gage (cfs) (2005-2019)	49.9	79.3	38.2	15.3	10.1	10.7
Flow effect (%) calculated at the upper gage	1.00%	1.84%	1.47%	0.26%	0.10%	0%
Average monthly flow at the Big Eightmile Creek lower gage (cfs) (2008-2019)	20.7	31.1	15.3	5.0	4.3	6.5
Flow effect (%) calculated at the lower gage	2.42%	4.69%	3.65%	0.80%	0.23%	0%
Productivity effect, calculated with data from the upper gage	1.27%	1.32%	1.32%	0.37%	0.10%	0%
Productivity effect, calculated with data from the lower gage lower gage	3.07%	3.36%	3.28%	1.12%	0.24%	0%
Average productivity effect (assumed zero effect from Nov – Apr)	0.66%					
Steelhead IP, Devil's Canyon Creek to Reference Point F (m^2)	49,442					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	3					

Table A.I.17. Effects of the proposed action on flow in the lower reach of Big Eightmile Creek and on steelhead rearing in the lower reach of Big Eightmile Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.32	1.22	0.59	0.16	0.08	0
Average monthly flow (cfs) (modeled, from the BA)	14.05	27.72	16.84	2.97	1.05	NA
Flow effect, calculated at the lower gage	2.28%	4.40%	3.50%	5.39%	7.62%	0%
Productivity effect, calculated with modeled flow data	2.89%	3.15%	3.15%	7.54%	7.88%	0%
Average productivity effect (assumed zero effect from Nov – Apr)	2.06%					
Chinook salmon IP in the lower mile of Big Eightmile Creek (m^2)	27,388					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	4					

Mill Creek

Because Mill Creek is not currently occupied by Chinook salmon or steelhead, we did not attempt to estimate the effects of reducing flow on the productivity of salmonid habitat in Mill Creek. According to the BA, operating the Mill Creek Strupp and the Mill Creek Peterson Diversions will result in consumptive use of approximately 396 acre feet per year. The effects of operating these two diversions on Chinook salmon and steelhead rearing in the mainstem Lemhi River will be described in the Mainstem Lemhi River section.

Hayden Creek

There are two water diversions in the Hayden Creek drainage that will be authorized by the proposed action, the East Fork Hayden Creek Diversion and the McNutt Creek Diversion. The East Fork Hayden Creek Diversion is on East Fork Hayden Creek approximately 0.20 miles upstream from the confluence of East Fork Hayden Creek and Hayden Creek, and the McNutt Creek Diversion is on McNutt Creek, which is a small tributary of Basin Creek. Basin Creek flows into mainstem Hayden Creek 3.5 miles upstream from the Lemhi River.

Within the Hayden Creek drainage, there are a total of four analysis reaches for Chinook salmon and six for steelhead. Three of the analysis reaches for both species are in mainstem Hayden Creek. These are: East Fork Hayden Creek to reference point C, reference point C to Basin Creek, and from Basin Creek to the Lemhi River. East Fork Hayden Creek, from the diversion to the mouth, is an analysis reach for both species; and Basin Creek, from McNutt Creek downstream to the mouth, is an analysis reach for steelhead only.

The analysis of the effects of the East Fork Hayden Creek Diversion that was provided in the BA assumed that authorizing the diversion would result in irrigation of 250.8 acres. The diversion is likely used to irrigate at least 584 acres. We therefore multiplied the consumptive use estimates provided in the BA by 584/250.8. This resulted in adjusting the estimated effects on flow in May from the POD downstream to reference point C, and for the entire irrigation season downstream from reference point C.

We used the relationship of Hayden Creek Chinook salmon productivity and flow in Hayden Creek to analyze the effects on Chinook salmon rearing in Hayden Creek (Figure A.I.2). Hayden Creek Chinook salmon juveniles tend to move downstream into the lower Lemhi River sooner than fish spawned in the upper Lemhi River, and consequently tend to survive at lower rates to Lower Granite Dam (LGD) (Table A.I.18). We multiplied the effects of the proposed action, expressed as number of outmigrating juvenile Chinook salmon, by a correction factor (see Table A.I.18) so as to express the effect as "equivalent" juveniles migrating out of the upper Lemhi River.

The effects of the proposed action on Chinook salmon rearing in East Fork Hayden Creek and Hayden Creek are in Tables A.1.19 – A.1.22.

Table A.I.18. Estimated number of Chinook salmon outmigrants moving past the Lemhi weir (LEMHIW) and the Hayden Creek (HAYDNC) screw traps, the number surviving to Lower Granite Dam, crude migration survivals estimated by dividing the number surviving to LGD by the number moving downstream past the screw traps, and a ratio of crude survival of juvenile Chinook salmon spawned in Hayden Creek to those spawned in the upper Lemhi River.

Brood Year	Outmigrants Enumerated at the Screw Traps		Smolts Surviving to Lower Granite Dam		Crude Survival from the Lemhi/Haden Confluence to Lower Granite Dam		Ratio of Crude Survival
	Hayden Creek	Upper Lemhi River	Hayden Creek	Upper Lemhi River	Hayden Creek	Upper Lemhi River	
2005	3,369	7,743	1,037	2,730	0.3078	0.3526	0.8730
2006	9,110	4,843	2,650	1,706	0.2909	0.3523	0.8258
2007	55,223	4,376	7,026	1,842	0.1272	0.4209	0.3023
2008	11,777	7,035	4,617	2,224	0.3920	0.3161	1.2401
2009	18,430	47,560	2,847	19,238	0.1545	0.4045	0.3819
2010	32,961	23,019	5,733	10,231	0.1739	0.4445	0.3913
2011	20,013	33,952	5,490	12,047	0.2743	0.3548	0.7731
2012	19,040	11,722	3,703	5,873	0.1945	0.5010	0.3882
2013	7,860	20,878	2,033	9,597	0.2587	0.4597	0.5627
2014	77,221	80,386	3,900	24,842	0.0505	0.3090	0.1634
2015	63,389	55,176	12,452	19,994	0.1964	0.3624	0.5421
2016	43,792	34,065	6,068	6,387	0.1386	0.1875	0.7390
Ave	**30,182**	**27,563**	**4,796**	**9,726**	**0.2133**	**0.3721**	**0.5986**

Table A.I.19. Effects of the proposed action on flow in East Fork Hayden Creek and on Chinook salmon rearing in East Fork Hayden Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	5.37	9.80	9.75	8.13	7.18	0.76
Average monthly flow (cfs) (modeled, from the BA)	22.70	38.90	16.80	8.40	7.60	7.40
Flow effect (%), calculated with modeled flow data	23.66%	25.19%	58.04%	96.79%	94.47%	10.23%
Productivity effect, calculated with data from the lower gage lower gage	1.03%	12.65%	20.30%	73.09%	36.25%	3.96%
Average productivity effect (assumed zero effect from Nov – Apr)	12.10%					
Chinook salmon IP EF Hayden Creek from the Diversion to the Hayden Creek (m^2)	97					
Outmigrants per m^2 of IP upstream from HAYDNC	0.721984098					
Effect as outmigrants from Hayden Creek	8					

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Ratio of survival HAYDNC migrants to LGD and LEMHW migrants to LGD	0.598576308					
Effects as outmigrants from the Lemhi River	5					

Table A.1.20. Effects of the proposed action on flow in Hayden Creek from East Fork Hayden Creek downstream to Reference Point C and on Chinook salmon rearing in that reach.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	5.37	9.80	9.75	8.13	7.18	0.76
Average monthly flow (cfs), Hayden Creek gage (2000 - 2019)	165.1	282.6	112.8	36.6	24.1	47.9
Flow effect (%), calculated with Hayden Creek gage data	3.25%	3.47%	8.64%	22.24%	29.79%	1.58%
Productivity effect, calculated with data from the Hayden Creek gage	0.14%	1.74%	3.02%	16.80%	11.43%	0.61%
Average productivity effect (assumed zero effect from Nov – Apr)	2.78%					
Chinook salmon IP in Hayden Creek from EF Hayden Creek to Reference Point C (m^2)	7,747					
Outmigrants per m^2 of IP upstream from HAYDNC	0.721984098					
Effect as outmigrants from Hayden Creek	156					
Ratio of survival HAYDNC migrants to LGD and LEMHW migrants to LGD	0.598576308					
Effects as outmigrants from the Lemhi River	93					

Table A.I.21. Effects of the proposed action on flow in Hayden Creek from Reference Point C to Basin Creek and on Chinook salmon rearing in that reach.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	2.51	5.56	7.48	4.92	2.95	0.76
Average monthly flow (cfs), Hayden Creek gage (2000 - 2019)	165.1	282.6	112.8	36.6	24.1	47.9
Flow effect (%), calculated with Hayden Creek gage data	1.52%	1.97%	6.64%	13.47%	12.24%	1.58%
Productivity effect, calculated with data from the Hayden Creek gage	0.07%	0.99%	2.32%	10.17%	4.70%	0.61%
Average productivity effect (assumed zero effect from Nov – Apr)	1.55%					
Chinook salmon IP in Hayden Creek from Reference Point C to Basin Creek (m^2)	10,443					

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Outmigrants per m^2 of IP upstream from HAYDNC	0.721984098					
Effect as outmigrants from Hayden Creek	117					
Ratio of survival HAYDNC migrants to LGD and LEMHW migrants to LGD	0.598576308					
Effects as outmigrants from the Lemhi River	70					

Table A.I.22. Effects of the proposed action on flow in Hayden Creek from Basin Creek to the mouth and on Chinook salmon rearing in that reach.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	2.78	6.17	8.31	5.57	3.39	0.87
Average monthly flow (cfs), Hayden Creek gage (2000 - 2019)	165.1	282.6	112.8	36.6	24.1	47.9
Flow effect (%), calculated with Hayden Creek gage data	1.68%	2.18%	7.37%	15.25%	14.07%	1.81%
Productivity effect, calculated with data from the Hayden Creek gage	0.07%	1.10%	2.58%	11.51%	5.40%	0.70%
Average productivity effect (assumed zero effect from Nov – Apr)	1.75%					
Chinook salmon IP in Hayden Creek from Basin Creek to the Lemhi River (m^2)	25,884					
Outmigrants per m^2 of IP upstream from HAYDNC	0.721984098					
Effect as outmigrants from Hayden Creek	328					
Ratio of survival HAYDNC migrants to LGD and LEMHW migrants to LGD	0.598576308					
Effects as outmigrants from the Lemhi River	196					

We used the relationship of upper Lemhi River *O. mykiss* whole life cycle productivity and rearing streamflow (Figure A.I.5) to analyze the effects of the proposed action on steelhead rearing in the Hayden Creek drainage. Because the steelhead analysis used a flow versus productivity relationships for the upper Lemhi River, a correction factor was not needed to express the effects as outmigrants from the Lemhi River. The estimated effects of the proposed action on steelhead rearing in the Hayden Creek drainage are in Tables A.I.23 – A.I.27.

Table A.I.23. Effects of the proposed action on flow in East Fork Hayden Creek and on steelhead rearing in East Fork Hayden Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	5.37	9.80	9.75	8.13	7.18	0.76
Average monthly flow (cfs) (modeled, from the BA)	22.70	38.90	16.80	8.40	7.60	7.40

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (%), calculated with modeled flow data	23.66%	25.19%	58.04%	96.79%	94.47%	10.23%
Productivity effect, calculated with modeled flow data	30.04%	18.02%	52.09%	100%	97.72%	-1.08%
Average productivity effect (assumed zero effect from Nov – Apr)	24.66%					
Steelhead IP in EF Hayden Creek from the diversion to the mouth (m^2)	260					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	<1					

Table A.I.24. Effects of the proposed action on flow in Hayden Creek from East Fork Hayden to Reference Point C and on steelhead rearing in that reach.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	5.37	9.80	9.75	8.13	7.18	0.76
Average monthly flow (cfs), Hayden Creek gage (2000 - 2019)	165.1	282.6	112.8	36.6	24.1	47.9
Flow effect (%) calculated with Hayden Creek gage data	3.25%	3.47%	8.64%	22.24%	29.79%	1.58%
Productivity effect, calculated with data from the Hayden Creek gage	4.12%	2.48%	7.76%	31.13%	30.81%	-0.17%
Average productivity effect (assumed zero effect from Nov – Apr)	6.29%					
Steelhead IP in Hayden Creek from EF Hayden Creek to Reference Point C	33,773					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	16					

Table A.I.25. Effects of the proposed action on flow in Hayden Creek from Reference Point C to Basin Creek and on steelhead rearing in that reach.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	2.51	5.56	7.48	4.92	2.95	0.76
Average monthly flow (cfs), Hayden Creek gage (2000 - 2019)	165.1	282.6	112.8	36.6	24.1	47.9
Flow effect (%), calculated with Hayden Creek gage data	1.52%	1.97%	6.64%	13.47%	12.24%	1.58%
Productivity effect, calculated with data from the Hayden Creek gage	1.93%	1.41%	5.96%	18.85%	12.66%	-0.17%
Average productivity effect (assumed zero effect from Nov – Apr)	3.31%					

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Steelhead IP in Hayden Creek from EF Hayden Creek to Reference Point C (m^2)	47,589					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	12					

Table A.I.26. Effects of the proposed action on flow in Hayden Creek from Basin Creek to the Lemhi River and on steelhead rearing in that reach.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	2.78	6.17	8.31	5.57	3.39	0.87
Average monthly flow (cfs), Hayden Creek gage (2000 - 2019)	165.1	282.6	112.8	36.6	24.1	47.9
Flow effect (%) calculated with Hayden Creek gage data	1.68%	2.18%	7.37%	15.25%	14.07%	1.81%
Productivity effect, calculated with data from the Hayden Creek gage	2.14%	1.56%	6.62%	21.34%	14.55%	-0.19%
Average productivity effect (assumed zero effect from Nov – Apr)	3.75%					
Steelhead IP in Hayden Creek from Basin Creek to the Lemhi River (m^2)	63,155					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	18					

Table A.I.27. Effects of the proposed action on flow in Basin Creek from McNutt Creek to Hayden Creek, and on steelhead rearing in that reach.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.27	0.61	0.83	0.65	0.44	0.11
Average monthly flow (cfs) (Modeled using Streamstats)	18.0	21.2	9.99	5.08	4.45	6.94
Flow effect (%), calculated with modeled flow data	1.50%	2.88%	8.31%	12.80%	9.89%	1.59%
Productivity effect, calculated with modeled flow data	1.90%	2.06%	7.46%	17.91%	10.22%	-0.17%
Average productivity effect (assumed zero effect from Nov – Apr)	3.20%					
Steelhead IP in Basin Creek between McNutt Creek an Hayden Creek (m^2)	45,590					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	11					

Wimpey Creek and Bohannon Creek

The proposed action will authorize operation of the West Fork Wimpey Creek Diversion. This is the only diversion that will be authorized by the proposed action in the Wimpey Creek drainage. The West Fork Wimpey Creek Diversion diverts water from West Fork Wimpey Creek and injects it into East Fork Bohannon Creek. The water is subsequently diverted from East Fork Bohannon and Bohannon Creeks and used for irrigation in the Bohannon Creek drainage. Operation of the West Fork Wimpey Creek Diversion will reduce flow in occupied steelhead habitat in lower West Fork Wimpey Creek and in occupied Chinook salmon and steelhead habitat in Wimpey Creek downstream from West Fork Wimpey Creek. Because this diversion is part of an interbasin transfer, its operation will result in increased flow in occupied steelhead habitat in East Fork Bohannon Creek and in occupied Chinook salmon and steelhead habitat in Bohannon Creek downstream from East Fork Bohannon Creek.

We used the relationship of Chinook salmon productivity in the upper Lemhi River versus rearing streamflow (Figure A.I.1) to estimate the effects of the proposed action on occupied Chinook salmon habitat in Wimpey (A.I.28) and Bohannon Creeks (A.I.29).

Table A.I.28. Effects of the proposed action on flow and rearing Chinook salmon in the lowest 1.1 miles of Wimpey Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.22	2.78	3.87	3.61	2.59	0.28
Average monthly flow (cfs) (Modeled using Streamstats)	7.34	11.1	1.97	1.1	0.87	1.31
Flow effect (%), calculated with modeled flow data	1.65%	16.55%	99.74%	100%	100%	6.57%
Productivity effect, calculated with modeled flow data	1.34%	6.75%	71.20%	79.97%	97.05%	1.88%
Average productivity effect (assumed zero effect from Nov – Apr)	21.50%					
Chinook salmon IP in the currently occupied portion of Wimpey Creek (i.e., the lowest 1.1 miles) (m^2)	3,647					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	32					

Table A.I.29. Effects of the proposed action on flow and Chinook salmon in the lowest 2.9 miles of Bohannon Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	-0.02	-1.63	-3.16	-3.83	-3.06	0
Average monthly flow (cfs) from the Bohannon Creek lower gage	15.3	26.8	11.2	3.6	2.5	2.3
Flow effect (%), calculated with modeled flow data	-0.13%	-4.33%	-12.8%	-50.1%	-70.9%	0
Productivity effect, calculated with modeled flow data	-0.11%	-1.77%	-9.14%	-40.1%	-68.8%	0

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Average productivity effect (assumed zero effect from Nov – Apr)	-9.97%					
Chinook salmon IP in the currently occupied portion of Wimpey Creek (i.e., the lowest 1.1 miles) (m^2)	9,417					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	-38					

We used the relationship of upper Lemhi River *O. mykiss* whole life cycle productivity and rearing streamflow (Figure A.I.5) to analyze the effects of the proposed action on steelhead rearing in Wimpey Creek, East Fork Bohannon Creek, and Bohannon Creek (Tables I.A.30 - I.A.32).

Table A.I.30. Effects of the proposed action on flow and rearing steelhead in Wimpey Creek between West Fork Wimpey Creek and the Lemhi River.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.22	2.78	3.87	3.61	2.59	0.28
Average monthly flow (cfs) (Modeled using Streamstats)	7.34	11.1	1.97	1.1	0.87	1.31
Flow effect (percent)	1.65%	16.55%	99.74%	100%	100%	6.57%
Productivity effect, calculated with modeled flow data	2.10%	11.83%	89.58%	100%	100%	-0.70%
Average productivity effect (assumed zero effect from Nov – Apr)	27.98%					
Steelhead IP in Wimpey Creek between West Fork Wimpey Creek and the Lemhi River (m^2)	27,341					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	59					

Table A.I.31. Effects of the proposed action on flow and steelhead rearing in East Fork Bohannon Creek between the diversion outflow and Bohannon Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	-0.02	-1.63	-3.16	-3.83	-3.06	0
Average monthly flow (cfs), from the BA, modeled	5.82	13.81	11.75	4.45	4.47	NA
Flow effect (percent)	-0.34%	-11.8%	-27.7%	-86.1%	-68.5%	0
Productivity effect, calculated with modeled flow data	-0.43%	-8.44%	-24.9%	-120.5%	-70.4%	0
Average productivity effect (assumed zero effect from Nov – Apr)	-18.2%					
Steelhead IP in East Fork Bohannon Creek from the diversion outflow to Bohannon Creek (m^2)	230					

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	-0.321					

Table A.I.32. Effects of the proposed action on flow and steelhead in Bohannon Creek from East Fork Bohannon Creek to the Lemhi River.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	-0.02	-1.63	-3.25	-3.83	-3.06	0
Average monthly flow (cfs) from the Bohannon Creek lower gage	15.3	26.8	11.2	3.6	2.5	2.3
Flow effect (percent)	-0.13%	-6.09%	-29.0%	-106.1%	-120.6%	0
Productivity effect, calculated with modeled flow data	-0.16%	-4.36%	-26.0%	-148.4%	-125.1%	0
Average productivity effect (assumed zero effect from Nov – Apr)	-24.7%					
Steelhead IP in Bohannon Creek between East Fork Bohannon Creek to the Lemhi River (m^2)	33,223					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	-63					

Mainstem Lemhi River from the Confluence of Texas and Eighteenmile Creeks to Canyon Creek

We characterized flow in this reach by adding flows measured at the Lemhi River above L-63 gage to those measured at the Eightmile Creek gage (Table A.I.33). In spite of the name, the Lemhi River above L-63 gage is actually located on Texas Creek approximately one mile upstream from the confluence of Texas and Eighteenmile Creeks. The Eighteenmile Creek gage is located on Eighteenmile Creek approximately 2.8 miles upstream from the confluence of Texas and Eighteenmile Creeks.

The effects on flow in this reach are equal to the estimated consumptive use resulting from operation of the Big Bear Creek and Deer Creek diversions (Table A.1.34). We calculated the effect of the proposed action on productivity of Chinook salmon and steelhead in this reach of the mainstem Lemhi River by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure A.I.1 (Chinook salmon) and Figure A.I.5 (steelhead), and averaging over the entire year (including zero effects from November through April). The results are in Tables A.I.35 and A.I.36.

Table A.I.33. The sum of average monthly flows measured at the Lemhi River above L-63 gage (Discharge.Daily@444054113212001) and the Eighteenmile Creek gage (Discharge.Daily@444006113185101).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008						17.4	8.9	6.8	15.4	33.7		
2009				59.5	31.9	38.8	22.7	15.9	17.6	57.3		
2010				47.3	39.0	48.3	26.4	25.4	39.2	60.1		
2011	46.0	59.0	68.9	74.5	57.6	53.5	37.3	26.0	24.4			
2012				65.3	26.5	12.5	9.3	9.2	12.8			
2013				34.9	13.1	9.1	8.9	6.5	12.4		37.7	
2014					24.0	9.6	8.3	10.0	18.3	44.9		
2015			49.3	34.1	15.4	16.8	12.7	11.7	13.8			
2016			58.0	53.5	35.3	16.9						
2017						43.9	19.5	23.1	42.1	65.7		59.9
2018	68.5	66.5	86.2	76.7	58.8	57.4	20.2	13.8	26.9	64.1	65.3	52.5
2019	62.1	58.4	62.4	75.8	51.9	76.4	38.6	26.1	33.7	22.7		
Ave	**58.9**	**61.3**	**65.0**	**57.9**	**35.4**	**33.4**	**19.4**	**15.9**	**23.3**	**49.8**	**51.5**	**56.2**

Table A.I.34. Estimated consumptive use of water diversions that would be authorized due to the proposed action.

Diversion Name	Cubic Feet per Second						Acre Feet
	May	Jun	Jul	Aug	Sep	Oct	
Big Bear Creek	0.08	0.59	0.76	0.64	0.48	0.25	168.8
Deer Creek	0.47	0.94	0.82	0.54	0.38	0.1	196.1
Canyon Creek Complex	0.54	1.18	1.54	1.28	0.98	0.27	349.2
Big Timber Creek	0.69	1.25	0.92	0	0	0	173.4
Basin Creek Complex	0.22	0.39	0.26	0.16	0.12	0.031	71.5
Big Eightmile Creek	0.05	0.12	0.12	0.16	0.08	0	31.9
Devil's Canyon Creek	0.24	0.63	0.47	0	0	0	81.1
Mill Creek Strupp	0.65	1.74	1.24	0	0	0	219.8
Mill Creek Peterson	0.38	0.91	0.94	0.34	0.35	0	176.4
East Fork Hayden Creek	2.51	5.56	7.48	4.92	2.95	0.76	1,459.5
McNutt Creek	0.27	0.61	0.83	0.65	0.44	0.11	175.6
West Fork Wimpey Creek	1.75	3.52	2.93	0.83	0.2	0.27	575.1
Sum	**7.7**	**16.9**	**17.5**	**8.8**	**5.4**	**1.5**	**3,678.3**

Table A.I.35. Effects of the proposed action on flow and Chinook salmon in the mainstem Lemhi River between the confluence of Texas and Eighteenmile Creeks and Canyon Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.55	1.53	1.58	1.18	0.86	0.35
Average monthly flow (cfs) from the Lemhi River above L-63 and Eighteenmile Creek gages	35.4	33.4	19.4	15.9	23.3	49.8
Flow effect (percent)	1.56%	4.58%	8.16%	7.44%	3.69%	0.70%
Productivity effect, calculated with modeled flow data	1.25%	1.87%	5.83%	5.95%	1.05%	0.68%
Average productivity effect (assumed zero effect from Nov – Apr)	1.39%					
Chinook salmon IP in the mainstem Lemhi River between the confluence of Texas and Eighteenmile Creeks and Cayon Creek (m^2)	14,546					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	8					

Table A.I.36. Effects of the proposed action on flow and steelhead in mainstem Lemhi River between the confluence of Texas and Eighteenmile Creeks and Canyon Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	0.55	1.53	1.58	1.18	0.86	0.35
Average monthly flow (cfs) from the Lemhi River above L-63 and Eighteenmile Creek gages	35.4	33.4	19.4	15.9	23.3	49.8
Flow effect (percent)	1.56%	4.58%	8.16%	7.44%	3.69%	0.70%
Productivity effect	1.97%	3.28%	7.33%	10.42%	3.81%	-0.74%
Average productivity effect (assumed zero effect from Nov – Apr)	2.18%					
Steelhead IP in the mainstem Lemhi River between the confluence of Texas and Eighteenmile Creeks and Cayon Creek (m^2)	6,250					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	1					

Mainstem Lemhi River from Canyon Creek to Big Timber Creek

We characterized flow in this reach by adding flows measured at the Lemhi River above L-63 gage, the Eighteenmile Creek gage, and the Canyon Creek gage (Table A.I.37). The Lemhi River above L-63 and the Eighteenmile Creek gages are described in the previous section. The

Canyon Creek gage is located on Canyon Creek approximately 0.14 miles upstream from the Lemhi River.

The effects on flow in this reach are equal to the estimated consumptive use resulting from operation of the Deer Creek Diversion and the Canyon Creek Complex (Table A.I.34). We calculated the effect of the proposed action on productivity of Chinook salmon and steelhead in the Canyon Creek to Big Timber Creek reach of the mainstem Lemhi River by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure A.I.1 (Chinook salmon) and Figure A.I.5 (steelhead), and averaging over the entire year (including zero effects from November through April). The results are in Tables A.I.38 and A.I.39.

Table A.I.37. The sum of average monthly flows measured at the Lemhi River above L-63 gage (Discharge.Daily@444054113212001), the Eighteenmile Creek gage (Discharge.Daily@444006113185101), and the Canyon Creek gage (Discharge.Daily@44128113214801).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008						25.4	13.1	10.0	22.5	37.3		
2009					45.0	51.9	28.0	18.2	20.6	61.7		
2010				53.4	47.9	71.4	35.0	27.5	43.1			
2011	49.9	62.5	72.6	82.1	71.7	74.9	50.7	31.9	29.5			
2012				74.8	34.2	16.8	12.8	12.4	15.7			
2013				40.2	17.2	13.3	11.3	7.9	15.3			
2014					29.3	12.5	11.6	13.3	22.0			
2015			56.9	40.3	22.3	23.7	17.1	15.1	17.6			
2016			63.6	59.2	43.0	23.2						
2017							27.5	26.6	47.0	72.8		
2018				86.4	76.2	68.2	25.8	18.2	31.8	68.3	65.3	52.5
Ave	**49.9**	**62.5**	**64.4**	**62.4**	**43.0**	**38.1**	**23.3**	**18.1**	**26.5**	**60.0**	**65.3**	**52.5**

Table A.I.38. Effects of the proposed action on flow and Chinook salmon in the mainstem Lemhi River between Canyon Creek and Big Timber Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	1.09	2.71	3.12	2.46	1.84	0.62
Average monthly flow (cfs) from the Lemhi River above L-63, Eighteenmile Creek, and Canyon Creek gages	42.97	38.14	23.29	18.1	26.5	60.04
Flow effect (percent)	2.54%	7.11%	13.40%	13.58%	6.94%	1.03%
Productivity effect	2.05%	2.90%	9.56%	10.86%	1.98%	1.00%
Average productivity effect (assumed zero effect from Nov – Apr)	2.369%					
Chinook salmon IP in the mainstem Lemhi River between the Canyon Creek and Big Timber Creek (m^2)	17,502					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	17					

Table A.I.39. Effects of the proposed action on flow and steelhead in mainstem Lemhi River between Canyon Creek and Big Timber Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	1.09	2.71	3.12	2.46	1.84	0.62
Average monthly flow (cfs) from the Lemhi River above L-63, Eighteenmile Creek, and Canyon Creek gages	42.97	38.14	23.29	18.1	26.5	60.04
Flow effect (percent)	2.54%	7.11%	13.40%	13.58%	6.94%	1.03%
Productivity effect	3.21%	5.08%	12.03%	19.01%	7.18%	-0.11%
Average productivity effect (assumed zero effect from Nov – Apr)	3.77%					
Steelhead IP in the mainstem Lemhi River between Canyon and Big Timber Creeks (m^2)	23,430					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	7					

Mainstem Lemhi River from Big Timber Creek to Big Eightmile Creek

We characterized flow in the Big Timber Creek to Big Eightmile Creek reach of the mainstem Lemhi River by adding flows measured at the Lemhi River above Big Springs and the Big Springs Creek gages. Both of these gages are approximately 0.1 miles upstream from the confluence of Big Springs Creek and the Lemhi River, which is approximately five miles downstream from Big Timber Creek and approximately 1.4 miles upstream from Big Eightmile Creek. The sum of flows measured at these two gages (Table A.I.40) represents flow in the lower third of the Big Timber Creek to Big Eightmile Creek analysis reach.

The effects on flow in this reach are equal to the estimated consumptive use resulting from operation of the Deer Creek Diversion, the Canyon Creek Complex, the Big Timber Creek Diversion, and the Basin Creek Diversion Complex (Table A.I.34). We calculated the effect of the proposed action on productivity of Chinook salmon and steelhead in the Big Timber Creek to Big Eightmile Creek reach of the mainstem Lemhi River by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure A.I.1 (Chinook salmon) and Figure A.I.5 (steelhead), and averaging over the entire year (including zero effects from November through April). The results are in Tables A.I.41 and A.I.42.

Table A.I.40. The sum of average monthly flows measured at the Lemhi River above Big Springs (Discharge.Daily@444343113255701) and the Big Springs Creek – Lower (Discharge.Daily@444339113260001) gages.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005							65.8	69.2	78.3	97.1	123.0	101.3
2006	115.3	122.8	140.9	130.7	80.6	76.9	66.4	71.6	83.4	112.5	137.6	104.7
2007	107.5	129.0	141.8	97.3	74.3	62.5	60.3	69.1	76.2	104.4	116.1	108.2
2008	125.7	134.0	138.8	163.7	116.3	81.7	74.5	74.3	86.2	110.0	140.1	116.2
2009	110.1	126.2	148.2	175.7	128.1	219.2	115.9	94.6	95.5	169.5	168.4	122.6
2010	146.5	148.0	153.2	144.6	128.9	222.0	128.7	106.8	98.9	141.0	165.0	146.0
2011	135.7	174.2	185.1	197.1	169.7	234.2	192.7	110.3	97.3	157.1	167.3	141.8
2012	158.7	166.8	221.8	202.6	127.2	91.7	67.8	76.0	81.5	117.6	147.6	129.6
2013	128.2	150.4	161.8	127.9	74.8	69.0	71.4	71.4	95.8	140.9	142.8	
2014			156.4	149.2	100.4	61.0	53.7	70.0	81.2	118.5	125.9	127.5
2015	112.5	151.3	133.7	115.8	98.8	99.9	86.6	83.3	79.9	94.0	128.5	116.6
2016	122.8	136.7	164.8	150.6	128.7	106.3	70.9	75.3	81.4	101.8	119.4	65.6
2017	119.1	150.6	186.4	140.3	160.9	243.4	97.0	82.9	127.4	135.3	142.4	103.0
2018	173.2	167.3	204.8	187.1	216.1	202.0	65.8	75.5	72.4	145.6	150.6	93.2
2019	148.8	153.7	172.6	169.1	109.5	105.6	83.4	79.5	97.8			
Ave	131.1	147.0	165.0	153.7	122.4	134.0	86.7	80.7	88.9	124.7	141.0	113.6

Table A.I.41. Effects of the proposed action on flow and Chinook salmon in the mainstem Lemhi River between Big Timber Creek and Big Eightmile Creek.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	2.00	4.35	4.30	2.62	1.96	0.65
Average monthly flow (cfs) from the Lemhi River above Big Springs Creek and the Big Spring Creek gages	122.4	134.0	86.7	80.7	88.9	124.7
Flow effect (percent)	1.64%	3.25%	4.95%	3.25%	2.20%	0.52%
Productivity effect	1.32%	1.33%	3.53%	2.60%	0.63%	0.51%
Average productivity effect (assumed zero effect from Nov – Apr)	0.83%					
Chinook salmon IP in the mainstem Lemhi River between the Big Timber and Big Eightmile Creeks (m^2)	12,310					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	4					

Table A.I.42. Effects of the proposed action on flow and steelhead in mainstem Lemhi River between Big Timber Creek and Big Eightmile Creek.

Effect or Factor	Month					
	May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Flow effect (cfs)	2.00	4.35	4.30	2.62	1.96	0.65
Average monthly flow (cfs) from the Lemhi River above Big Springs Creek and the Big Spring Creek gages	122.4	134.0	86.7	80.7	88.9	124.7
Flow effect (percent)	1.64%	3.25%	4.95%	3.25%	2.20%	0.52%
Productivity effect	2.07%	2.32%	4.45%	4.55%	2.28%	-0.055%
Average productivity effect (assumed zero effect from Nov – Apr)	1.29%					
Steelhead IP in the mainstem Lemhi River between Big Timber and Big Eightmile Creeks (m^2)	197,129					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	20					

Mainstem Lemhi River from Big Eightmile Creek to Mill Creek

We used flow data from the Lemhi River at Cottom Lane gage to characterize flow in the Big Eightmile Creek to Mill Creek reach of the mainstem Lemhi River (Table A.I.43). This gage is on the mainstem Lemhi River approximately one mile downstream from Big Eightmile Creek and 3.2 miles upstream from Mill Creek. The effects on flow in this reach are equal to the estimated consumptive use resulting from operation of the Deer Creek Diversion, the Canyon Creek Complex, the Big Timber Creek Diversion, the Basin Creek Diversion Complex, the Big Eightmile Creek Diversion, and Devil's Canyon Creek Diversion (Table A.I.34). We calculated the effect of the proposed action on productivity of Chinook salmon and steelhead in the Big Eightmile Creek to Mill Creek reach of the mainstem Lemhi River by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure A.I.1 (Chinook salmon) and Figure A.I.5 (steelhead), and averaging over the entire year (including zero effects from November through April). The results are in Tables A.I.44 and A.I.45.

Table A.I.43. Mean monthly flow (cfs) measured at the Lemhi River at Cottom Lane gage (Discharge.Daily@444456113283301).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005						98.5	70.5	65.1	74.5	115.2	139.4	114.5
2006	135.4	135.1	206.3	182.8	86.0	87.9	74.8	72.3	88.5	126.1	175.4	157.6
2007	165.4	191.2	219.1	140.7	92.1	93.7	72.8	75.2	87.2	124.2	147.9	161.5
2008	168.6	168.1	167.0	216.0	133.7	92.9	80.1	73.4	88.0	132.5	171.8	145.3
2009	145.4	151.7	168.4	201.0	162.6	305.3	144.7	96.1	101.9	189.8	213.5	175.7
2010	194.3	201.1	206.9	176.7	145.5	288.5	172.8	112.0	112.8	158.1	198.7	170.3
2011	161.8	187.5	192.0	208.7	182.3	295.4	237.9	120.5	113.3	189.1	204.2	180.3
2012	195.3	194.8	234.5	207.8	133.9	117.1	80.8	80.6	94.0	143.1	177.7	159.3
2013	156.7	167.6	173.0	142.4	98.0	89.4	77.4	70.4	88.1	133.8	140.6	139.4
2014	152.7	147.0	160.5	162.7	127.9	95.1	77.0	82.6	90.7	133.2	153.2	155.7
2015	143.7	182.5	154.0	121.2	105.3	128.7	95.8	86.4	90.9	121.6	148.9	147.5
2016	167.1	174.8	187.2	178.0	156.6	138.7	79.7	76.9	89.3	153.0	209.8	161.1
2017	168.3	196.3	226.1	173.9	225.3	315.0	125.3	97.3	144.8	231.2	255.5	204.9
2018	228.8	223.7	260.0	247.3	304.4	286.6	128.1	85.8	102.6	172.0	174.5	167.9
2019	195.0	205.7	229.1	205.7	122.7	122.3	85.4	74.4	99.6	175.6		
Ave	169.9	180.5	198.9	183.2	148.3	170.3	106.9	84.6	97.7	153.2	179.4	160.1

Table A.I.44. Effects of the proposed action on flow and Chinook salmon in the mainstem Lemhi River between Big Eightmile and Mill Creeks.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	2.29	5.10	4.89	2.78	2.04	0.65
Average monthly flow (cfs) from the Lemhi River at the Cottom Lane gage	148.3	170.3	106.9	84.6	97.7	153.2
Flow effect (percent)	1.55%	3.00%	4.57%	3.29%	2.08%	0.42%
Productivity effect	1.25%	1.22%	3.26%	2.69%	0.60%	0.41%
Average productivity effect (assumed zero effect from Nov – Apr)	0.78%					
Chinook salmon IP in the mainstem Lemhi River between Big Eightmile and Mill Creeks (m^2)	85,418					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	27					

Table A.I.45. Effects of the proposed action on flow and steelhead in the mainstem Lemhi River between Big Eightmile and Mill Creeks.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	2.29	5.10	4.89	2.78	2.04	0.65
Average monthly flow (cfs) from the Lemhi River at the Cottom Lane gage	148.3	170.3	106.9	84.6	97.7	153.2
Flow effect (percent)	1.55%	3.00%	4.57%	3.29%	2.08%	0.42%
Productivity effect	1.96%	2.14%	4.10%	4.60%	2.15%	-0.05%
Average productivity effect (assumed zero effect from Nov – Apr)	1.23%					
Steelhead IP in the mainstem Lemhi River between Big Eightmile and Mill Creeks (m^2)	129,461					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	12					

Mainstem Lemhi River from Mill Creek to Hayden Creek

We used flow data from the Lemhi River at McFarland Campground gage to characterize flow in the Mill Creek to Hayden Creek reach of the mainstem Lemhi River (Table A.I.46). This gage is on the mainstem Lemhi River approximately four miles downstream from Mill Creek and approximately seven miles upstream from Hayden Creek. The effects on flow in this reach are equal to the estimated consumptive use resulting from operation of the Deer Creek Diversion, the Canyon Creek Complex, the Big Timber Creek Diversion, the Basin Creek Diversion Complex, the Big Eightmile Creek Diversion, the Devil's Canyon Creek Diversion, the Mill Creek Strupp Diversion, and the Mill Creek Peterson Diversion (Table A.I.34). We calculated the effect of the proposed action on productivity of Chinook salmon and steelhead in the Mill Creek to Hayden Creek reach of the mainstem Lemhi River by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figure A.I.1 (Chinook salmon) and Figure A.I.5 (steelhead), and averaging over the entire year (including zero effects from November through April). The results are in Tables A.I.47 and A.I.48.

Table A.I.46. Mean monthly flow (cfs) measured at the Lemhi River at McFarland Campground gage (Discharge.Daily@ 444809113335701).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997					126.5	272.6	164.1	134.8	129.6			
1998					195.2	311.8	331.3	166.4	128.1			
1999					130.1	161.9	81.9	68.6	95.5			
2000					80.5	57.4	77.0	78.9				
2001					84.8	60.1	65.3	87.6	96.9			
2002					66.6	57.7	74.4	77.0	79.8			
2003					72.4	64.2	58.3	71.3	70.0			
2004					64.8	56.4	56.7	71.5	73.2	112.9		
2005					92.5	70.2	95.8	67.7	87.2	128.3		
2006					59.5	68.6	70.1	84.7	97.2	138.0		

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2007					48.7	57.8	49.0	71.3	86.7	163.7		
2008					118.8	77.5	61.6	75.2	86.4	142.4		
2009					130.5	377.8	135.4	80.3	74.8	182.3		
2010					100.9	280.5	152.8	98.5	84.5	157.4		
2011					211.2	338.5	227.9	191.0	161.1			
2012			275.7	231.3	119.9	79.4	52.2	79.1	98.0	134.5	196.5	184.6
2013	184.0	183.1	196.6	163.9	70.4	47.5	56.5	56.2	81.6	148.0	170.9	166.7
2014	164.0	156.0	195.7	182.6	92.0	62.1	45.4	67.7	69.0	135.9	184.8	181.8
2015	168.6	198.0	173.6	129.9	99.4	100.0	64.9	75.4	87.2	118.3	187.0	
2016		198.2	207.9	194.9	149.0	101.1	61.2	61.3	79.4	154.2	226.0	190.4
2017	305.8	209.2	238.2	197.9	225.1	324.9	119.5	66.3	119.3	243.5	257.7	206.4
2018	221.3	207.1	247.3	246.0	282.2	271.9	109.6	81.5	91.5	191.3	212.3	196.2
2019	207.7	196.7	315.4									
Ave	208.6	192.6	231.3	192.3	119.1	150.0	100.5	86.9	94.1	153.6	205.0	187.7

Table A.I.47. Effects of the proposed action on flow and Chinook salmon in the mainstem Lemhi River between Mill and Hayden Creeks.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	3.32	7.75	7.07	3.12	2.39	0.65
Average monthly flow (cfs) from the Lemhi River at McFarland Campground gage	119.1	150.0	100.5	86.9	94.1	153.6
Flow effect (percent)	2.79%	5.17%	7.03%	3.59%	2.54%	0.42%
Productivity effect	2.25%	2.11%	5.02%	2.87%	0.72%	0.41%
Average productivity effect (assumed zero effect from Nov – Apr)	1.26%					
Chinook salmon IP in the mainstem Lemhi River between Mill and Hayden Creeks (m^2)	210,213					
Outmigrants per m^2 of IP upstream from LEMHIW	0.040595					
Effect as outmigrants	97					

Table A.I.48. Effects of the proposed action on flow and steelhead in the mainstem Lemhi River between Mill and Hayden Creeks.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	3.32	7.75	7.07	3.12	2.39	0.65
Average monthly flow (cfs) from the Lemhi River at McFarland Campground gage	119.1	150.0	100.5	86.9	94.1	153.6
Flow effect (percent)	2.79%	5.17%	7.03%	3.59%	2.54%	0.42%
Productivity effect	3.34%	3.70%	6.31%	5.03%	2.62%	-0.04%
Average productivity effect (assumed zero effect from Nov – Apr)	1.77%					
Steelhead IP in the mainstem Lemhi River between Mill and Hayden Creeks (m^2)	345,218					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	47					

Mainstem Lemhi River from Hayden Creek to Wimpey Creek

We used flow data from the Lemhi River near Lemhi, Idaho gage (USGS 13305000) to characterize flow in the Hayden Creek to Wimpey Creek reach of the mainstem Lemhi River. This gage is on the mainstem Lemhi River approximately 5.7 miles downstream from Hayden Creek and approximately 12.3 miles upstream from Wimpey Creek. The effects on flow in this reach are equal to the estimated consumptive use resulting from operation of the Deer Creek Diversion, the Canyon Creek Complex, the Big Timber Creek Diversion, the Basin Creek Diversion Complex, the Big Eightmile Creek Diversion, the Devil's Canyon Creek Diversion, the Mill Creek Strupp Diversion, the Mill Creek Peterson Diversion, the East Fork Hayden Creek Diversion, and the McNutt Creek Diversion (Table A.I.34). We calculated the effect of the proposed action on productivity of Chinook salmon and steelhead in the Hayden Creek to Wimpey Creek reach of the mainstem Lemhi River by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figures A.I.3 and A.I.4 (Chinook salmon) and Figure A.I.5 (steelhead), and averaging over the entire year (including zero effects from November through April). The results are in Tables A.I.49 and A.I.50.

Table A.I.49. Effects of the proposed action on flow and Chinook salmon in the mainstem Lemhi River between Hayden and Wimpey Creeks.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	6.11	13.93	15.37	8.69	5.78	1.51
Average monthly flow (cfs) from the Lemhi River near Lemhi, Idaho gage (USGS 13305000)	300.6	520.1	271.9	139.2	149.8	243.1
Flow effect (percent)	2.03%	2.68%	5.65%	6.24%	3.86%	0.62%
Productivity effect	0.26%	0.97%	1.92%	3.24%	1.90%	0.56%
Average productivity effect (assumed zero effect from Nov – Apr)	0.76%					
Chinook salmon IP in the mainstem Lemhi River between Hayden and Wimpey Creeks (m^2)	292,249					
Outmigrants per m^2 of IP upstream from the lower Lemhi screw trap	0.037738					
Effect as outmigrants	84					

Table A.I.50. Effects of the proposed action on flow and steelhead in the mainstem Lemhi River between Hayden and Wimpey Creeks.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	6.11	13.93	15.37	8.69	5.78	1.51
Average monthly flow (cfs) from the Lemhi River at the Lemhi River near Lemhi, Idaho gage (USGS 13305000)	300.6	520.1	271.9	139.2	149.8	243.1
Flow effect (percent)	2.03%	2.68%	5.65%	6.24%	3.86%	0.62%
Productivity effect	2.58%	1.92%	5.08%	8.73%	3.99%	-0.07%
Average productivity effect (assumed zero effect from Oct – Apr)	1.83%					
Steelhead IP in the mainstem Lemhi River between Hayden and Wimpey Creeks (m^2)	517,937					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	73					

Mainstem Lemhi River from Wimpey Creek to the L-6 Diversion

We characterized flow in the Wimpey Creek to L-6 Diversion reach of the mainstem Lemhi River by adding flows measured at the Lemhi River at Baker and the Bohannon Creek lower gages. The Lemhi River at Baker gage is on the mainstem Lemhi River immediately upstream from Wimpey Creek and the Bohannon Creek lower gage is on Bohannon Creek approximately 1.1 miles upstream from the Lemhi River. Because records from these two gages have very little overlap, we estimated the mean monthly flow in this reach by adding the mean monthly flows from the two gages (Table A.I.51).

Table A.I.51. Mean monthly flow (cfs) measured at the Lemhi River at Baker (Discharge.Daily@450551113431801) and in lower Bohannon Creek (Discharge.Daily@450720113435601) and the sum of average monthly flows measured.

Lemhi River at Baker												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004						226.3	137.7	94.0	111.9	184.3	256.0	216.0
2005	198.7	198.7	186.7	111.1	262.4	568.3	220.1	97.8	101.4	223.2	269.7	237.9
2006	241.4	241.2	260.6	280.5	446.2	518.5	190.3	105.0	119.5	270.9	341.2	271.5
2007	249.5	249.9	344.4	199.3	387.0	362.2	114.6	90.0	130.5	289.8	301.3	280.5
2008	251.5	246.5	264.1	344.7	437.6	676.4	334.7	128.8	157.2	311.2	340.0	
2009		276.8	314.5	374.2	567.6	1,246	484.2	204.3	150.6			
Ave	**235.3**	**242.6**	**274.1**	**262.0**	**420.1**	**599.6**	**246.9**	**120.0**	**128.5**	**255.9**	**301.6**	**251.5**
Bohannon Creek Lower Gage												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2008							12.0	4.3	3.2	3.0	5.1	5.0
2009	4.2	3.9	5.4	9.3	23.8	24.0	10.3	4.3	3.0	1.8	3.6	3.7
2010	4.2	4.5	6.0	5.9	6.1	35.0	12.5	4.8	3.3	1.8	3.7	5.0
2011	4.9	4.8	5.7	7.3	14.7	59.1	47.5	6.3	3.1	2.1	6.6	6.9
2012	5.2	4.5	5.1	12.4	8.1	9.2	5.2	2.5	1.7	1.2	3.2	4.5
2013	3.7	3.4	4.1	4.1	6.3	6.0	5.7	2.9	2.9	2.6	5.7	6.0
2014	5.1	4.4	6.2	3.5	15.0	15.5	7.7	4.4	2.7	1.7	6.9	6.1
2015	5.3	7.4	6.7	8.6			4.2	2.4	1.9	2.2	6.2	5.3
2016	4.3	4.1	5.5	11.5	14.6	22.6	3.8	2.0	1.7			
2017		4.8	6.6	6.5	23.2	36.3						
2018	8.8	11.3	6.2	9.7	30.4	43.1	10.5	3.3	2.1	3.0		
2019		4.4	5.6	8.3	11.3	16.8	4.0	2.4	2.2	3.8		
Ave	5.1	5.2	5.7	7.9	15.3	26.8	11.2	3.6	2.5	2.3	5.1	5.3
Sum of Ave	**240.4**	**247.8**	**279.8**	**269.9**	**435.5**	**626.4**	**258.1**	**123.6**	**131.0**	**258.2**	**306.8**	**256.8**

The effects on flow in this reach are equal to the estimated consumptive use resulting from operation of the Deer Creek Diversion, the Canyon Creek Complex, the Big Timber Creek Diversion, the Basin Creek Diversion Complex, the Big Eightmile Creek Diversion, the Devil's Canyon Creek Diversion, the Mill Creek Strupp Diversion, the Mill Creek Peterson Diversion, the East Fork Hayden Creek Diversion, the McNutt Creek Diversion, and the West Fork Wimpey Creek Diversion (Table A.I.34). We calculated the effect of the proposed action on productivity of Chinook salmon and steelhead in the Big Timber Creek to Big Eightmile Creek reach of the mainstem Lemhi River by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figures A.I.3 and A.I.4 (Chinook salmon) and Figure A.I.5 (steelhead), and averaging over the entire year (including zero effects from November through April). The results are in Tables A.I.52 and A.I.53.

Table A.I.52. Effects of the proposed action on flow and Chinook salmon in the mainstem Lemhi River between Wimpey Creek and the L-6 Diversion.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	7.86	17.45	18.30	9.52	5.98	1.78
Sum of average monthly flows (cfs) measured at the Lemhi River at Baker and the lower Bohannon Creek gages	435.5	626.4	258.1	123.6	131.0	258.2
Flow effect (percent)	1.80%	2.79%	7.09%	7.70%	4.57%	0.69%
Productivity effect	0.23%	1.01%	2.41%	4.00%	2.25%	0.62%
Average productivity effect (assumed zero effect from Nov – Apr)	0.91%					
Chinook salmon IP in the mainstem Lemhi River between Wimpey Creek and the L-6 Diversion (m^2)	43,464					
Outmigrants per m^2 of IP upstream from the lower Lemhi screw trap	0.037738					
Effect as outmigrants	15					

Table A.I.53. Effects of the proposed action on flow and steelhead in the mainstem Lemhi River between Wimpey Creek and the L-6 Diversion.

Effect or Factor	Month					
	May	Jun	Jul	Aug	Sep	Oct
Flow effect (cfs)	7.86	17.45	18.30	9.52	5.98	1.78
Sum of average monthly flows (cfs) measured at the Lemhi River at Baker and the lower Bohannon Creek gages	435.5	626.4	258.1	123.6	131.0	258.2
Flow effect (percent)	1.80%	2.79%	7.09%	7.70%	4.57%	0.69%
Productivity effect	2.29%	1.99%	6.37%	10.71%	4.72%	-0.07%
Average productivity effect (assumed zero effect from Nov – Apr)	2.13%					
Steelhead IP in the mainstem Lemhi River between Hayden and Wimpey Creeks (m^2)	105,551					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	17					

Mainstem Lemhi River from the L-6 Diversion to the Salmon River

We used flow data from the Lemhi River below L-5 Diversion near Salmon, Idaho gage (USGS 13305310) to characterize flow in the L-6 Diversion to the Salmon River reach of the mainstem Lemhi River. The effects on flow in this reach are the same as for the Wimpey Creek to L-6 Diversion reach, except that the effect in August was assumed to be zero because flow in this reach typically maintained at 25 cfs regardless of flow inputs into the reach. We calculated the effect of the proposed action on productivity of Chinook salmon and steelhead in the L-6 Diversion to Salmon River reach of the mainstem Lemhi River by inputting the estimated impacts, expressed as a percentages of average monthly flow, into the line equations in Figures A.I.3 and A.I.4 (Chinook salmon) and Figure A.I.5 (steelhead), and averaging over the entire year (including zero effects from November through April). The results are in Tables A.I.54 and A.I.55.

Table A.I.54. Effects of the proposed action on flow and Chinook salmon in the mainstem Lemhi River between the L-6 Diversion and the Salmon River.

Effect or Factor	Month					
	May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Flow effect (cfs)	7.86	17.45	18.30	0	5.98	1.78
Average monthly flow (cfs) from the Lemhi River below L-5 gage (USGS 13305310)	305.8	633.9	212.9	50.7	59.3	227.8
Flow effect (percent)	2.57%	2.75%	8.60%	0%	10.09%	0.78%
Productivity effect	0.33%	0.99%	2.92%	0%	4.97%	0.71%
Average productivity effect (assumed zero effect from Nov – Apr)	0.87%					
Chinook salmon IP in the mainstem Lemhi River between Wimpey Creek and the L-6 Diversion (m^2)	69,010					
Outmigrants per m^2 of IP upstream from the lower Lemhi screw trap	0.037738					
Effect as outmigrants	23					

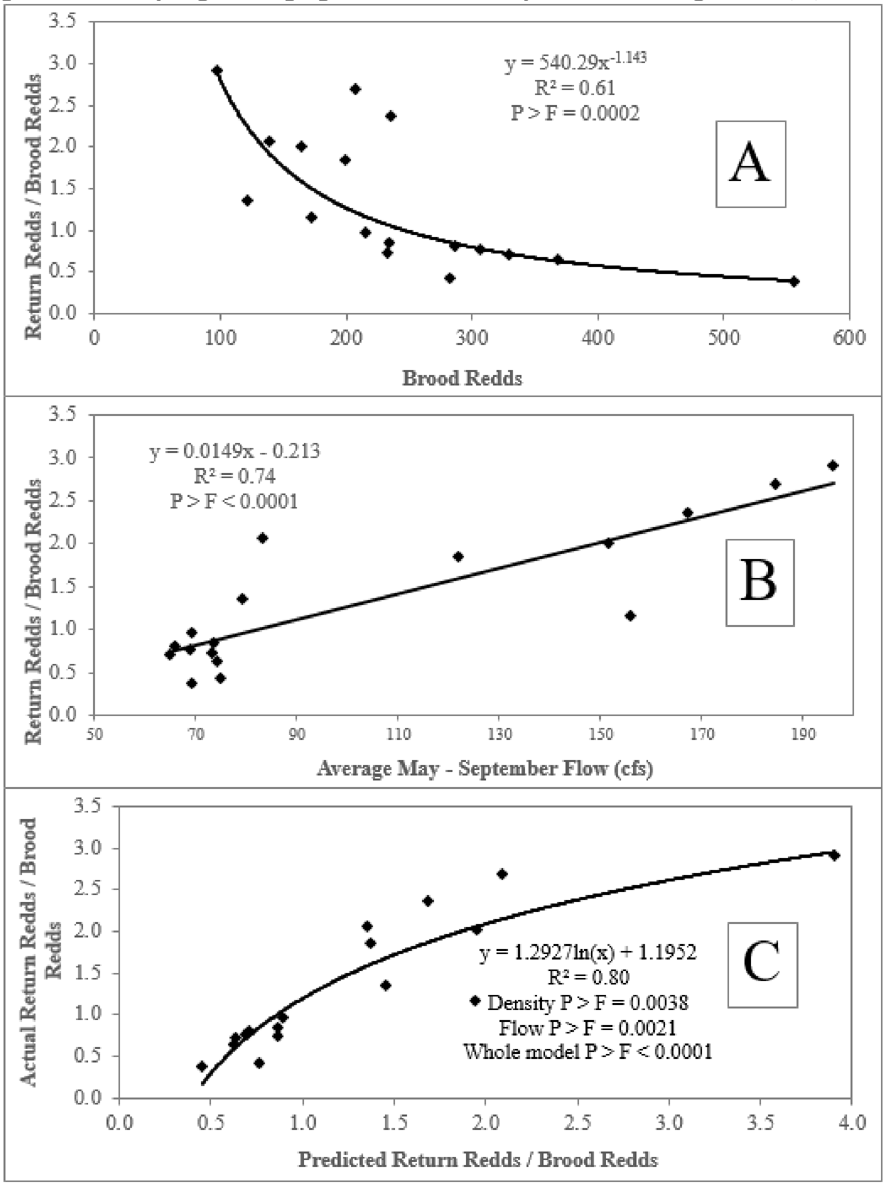
Table A.I.55. Effects of the proposed action on flow and steelhead in the mainstem Lemhi River between the L-6 Diversion and the Salmon River.

Effect or Factor	Month					
	May	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
Flow effect (cfs)	7.86	17.45	18.30	0	5.98	1.78
Sum of average monthly flows (cfs) measured at the Lemhi River at Baker and the lower Bohannon Creek gages	305.8	633.9	212.9	50.7	59.3	227.8
Flow effect (percent)	2.57%	2.75%	8.60%	0%	10.09%	0.78%
Productivity effect	3.25%	1.97%	7.72%	0%	10.44%	-0.08%
Average productivity effect (assumed zero effect from Nov – Apr)	1.99					
Steelhead IP in the mainstem Lemhi River between Hayden and Wimpey Creeks (m^2)	152,835					
Outmigrants per m^2 of IP upstream from LEMHIW	0.007677381					
Effect as outmigrants	23					

II. Lemhi River *Oncorhynchus mykiss* Versus Flow and Population Density

The Idaho Department of Fish and Game has conducted *O. mykiss* redd counts in the upper Lemhi River and Big Springs Creek since 1997. Assuming that these redd counts are an index of the population size and also assuming a four year generation time with no repeat spawning, the whole life cycle productivity is related to both rearing stream flow (i.e., average of the brood year and the following year) and population density. The density relationship indicates that habitat is limiting steelhead population productivity; and also indicates that productivity could be increased by improving quality of currently occupied habitat, by improving access to unoccupied or partially occupied habitat, or by a combination of habitat quality and access improvements. The flow relationship indicates that flow is an important component of habitat quality and that improving flow should improve steelhead population productivity. A multivariate model with rearing flow and population density was a slightly better fit than either of the simple regression models (Figure A.II.1), suggesting that both quality and quantity of accessible habitat are important for Lemhi River steelhead.

Figure A.II.1. Lemhi River *Oncorhynchus mykiss* whole life cycle productivity versus population density (A), rearing flow (B) and a multivariate relationship of whole life cycle productivity against population density and rearing flow (C).

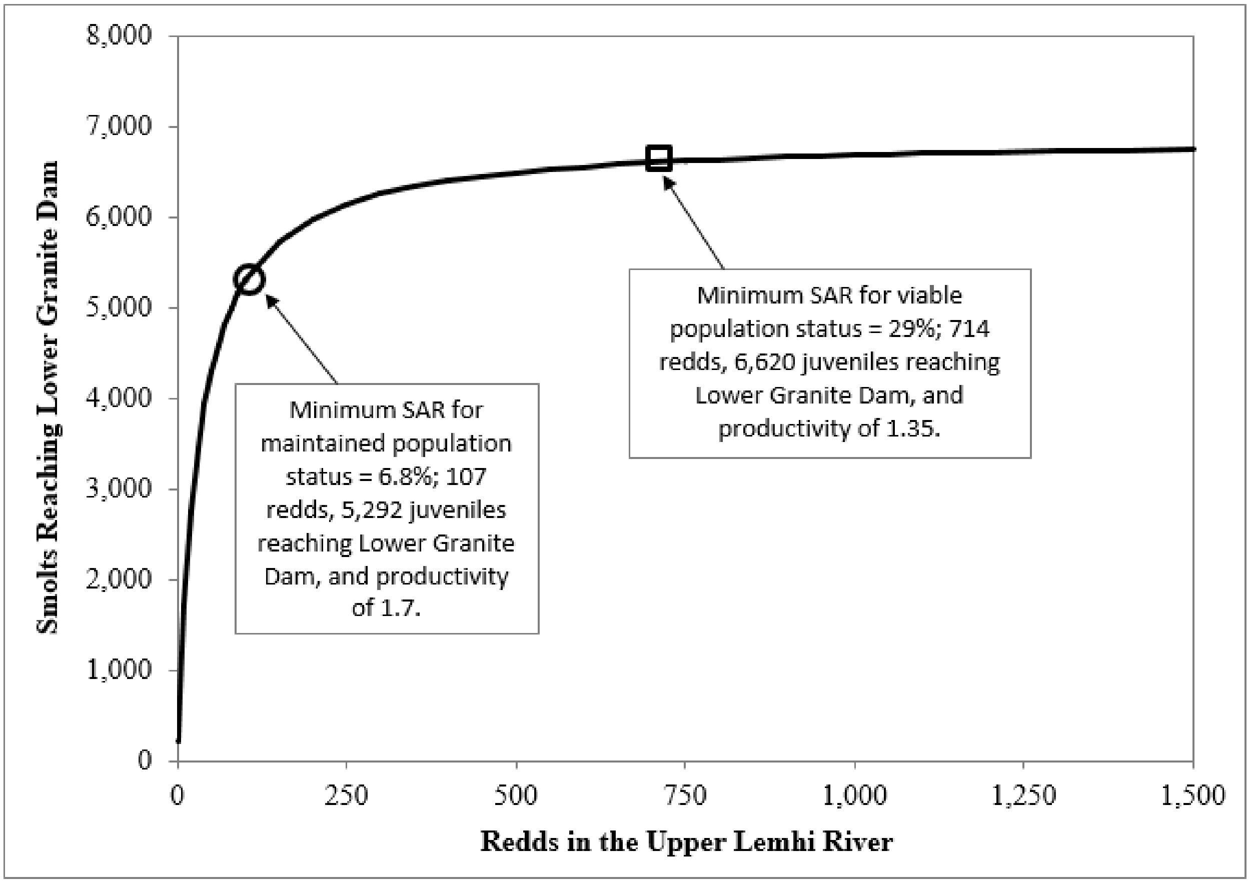


III. Juvenile Chinook Salmon Capacity and Recovery Objectives

Walters et al. (2013) described Beverton-Holt stock recruit relationships for seven Chinook salmon populations in the Salmon River drainage and two populations in the Clearwater River drainage. The relationship for the Lemhi River population is in Figure A.III.1. Due to the location of the LEMHIW screw trap, this relationship only describes the portion of the population spawning in the upper mainstem Lemhi River. Based on redd counts conducted from 2002-2019, 71.4% of the Lemhi River Chinook salmon population spawns in the upper Lemhi River, upstream from the LEMHIW screw trap. The number of redds corresponding to a “maintained” or a “viable” population, depicted in the figure were calculated by multiplying the target population sizes (expressed as redds) by 0.714.

Using the stock/recruit relationship from Walters et al. (2013), we calculated the minimum smolt to adult return rate (SAR) needed to achieve “maintained” and “viable” population status. These were 6.8% SAR for maintained and 29% SAR for viable. The highest Snake River spring/summer Chinook salmon SAR recorded since 1974 is 4.3% (Petrosky et al. 2020) suggesting that achieving a long-term SAR sufficient for the Lemhi River Chinook salmon population to achieve maintained status, is unlikely. Achieving a SAR of 29% would be completely unrealistic for most anadromous salmonid populations, especially populations with a long freshwater migration. Rearing capacity for the Lemhi River Chinook salmon population will have to increase substantially for the population to achieve maintained status and will have to increase dramatically for the population to achieve viable status. Current capacity of the Lemhi River Chinook salmon population area is 18% of the average capacity for the other seven Salmon River Chinook salmon populations described by Walters et al. (2013), suggesting that substantial improvement in Lemhi River Chinook salmon rearing capacity is possible.

Figure A.III.1. Chinook salmon recruit (smolts at Lower Granite Dam) to stock (redds) relationship for the upper Lemhi River from Walters et al. (2013). The circle and square denote population sizes corresponding to the minimum smolt to adult return rate (SAR) needed to achieve "maintained" and "viable," respectively, population status. The population sizes were adjusted assuming that 71.4% of individuals in the Lemhi River Chinook salmon population spawn in the mainstem Lemhi River upstream from Hayden Creek.



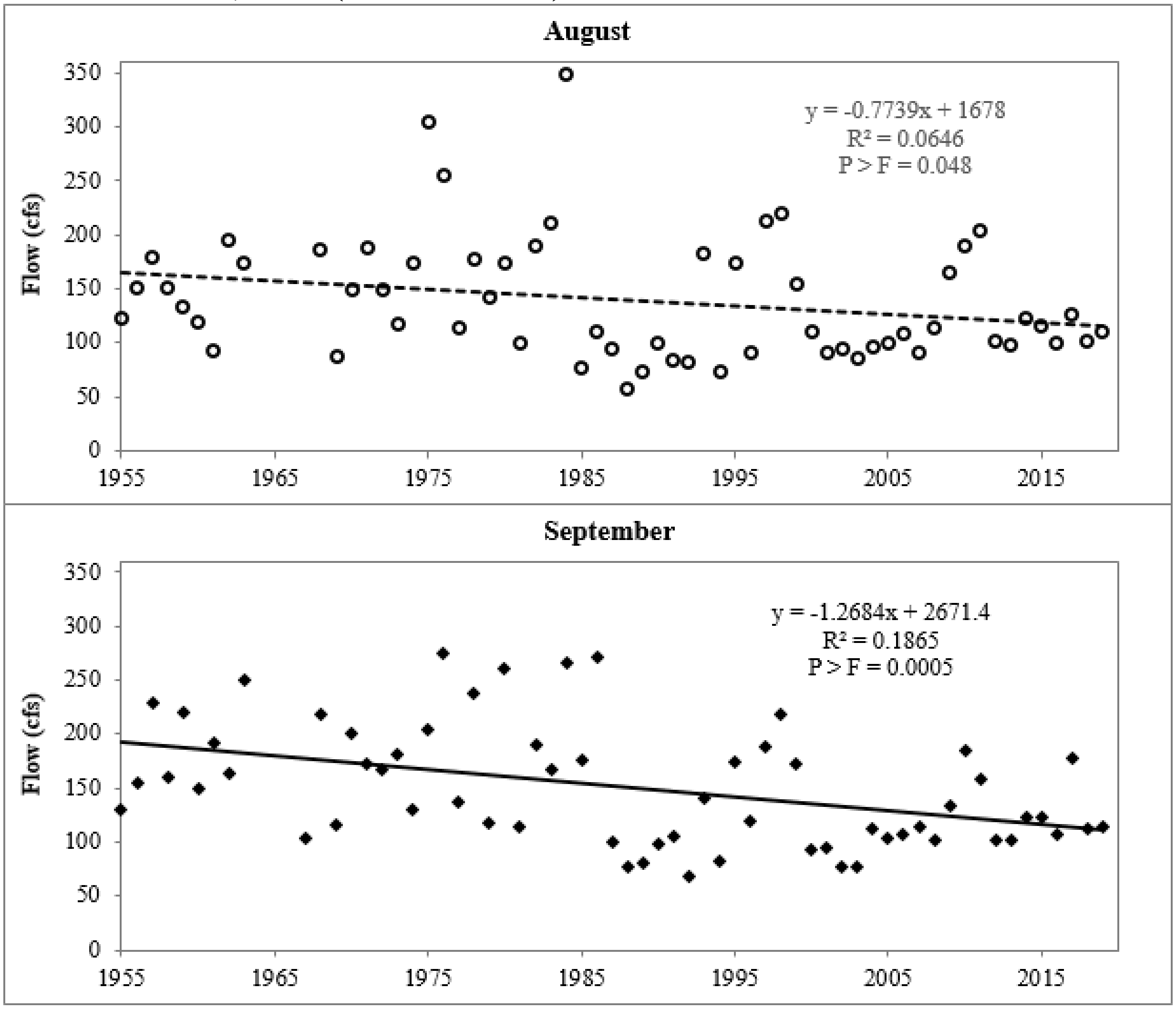
IV. Lemhi River Baseflow Trends

The Lemhi River near Lemhi, Idaho gage (USGS 13305000) has the longest flow record in the Lemhi River drainage. The gage is located approximately five miles downstream from the mouth of Hayden Creek but is upstream from the L-6 and L-7 Diversions. Because of the long duration of the record and the location of the gage downstream from the major tributaries but upstream from the largest diversions, flows at this gage are the best descriptor of overall flow conditions in the Lemhi River drainage. With the exception of August and September, mean monthly flow has changed little since the flow record began in the mid-1950s. Mean monthly flow in August and September has declined significantly since the mid-1950s (Table A.IV.1). Between 1956 and 2019, mean August and September flow declined by approximately 49 cfs and 79 cfs, respectively (Figure A.IV.1), or by 29.7% and 41.2%, respectively.

Table A.IV.1. Years in the record, the line equation, and the probability of a greater F value for regressions of mean monthly flow against year for the Lemhi River near Lemhi, Idaho gage (USGS 13305000).

Month	Years in the Record	Line Equation	P > F
January	1939, 1956-1963, 1968-2020	Flow = 0.0503*Year + 124.8	0.85
February	1939, 1956-1963, 1968-2020	Flow = 0.00921*Year + 49.5	0.71
March	1939, 1956-1963, 1968-2019	Flow = 0.0785*Year + 100.2	0.79
April	1939, 1956-1963, 1968-2019	Flow = -0.3976*Year + 1043.3	0.42
May	1939, 1955-1963, 1968-2019	Flow = -1.006*Year + 2299.7	0.31
June	1939, 1955-1963, 1968-2019	Flow = -1.7481*Year + 3994.8	0.33
July	1955-1963, 1968-2019	Flow = -1.2985*Year + 2853.8	0.30
August	1955-1963, 1968-2019	Flow = -0.7739*Year + 1678.0	**0.048**
September	1955-1963, 1967-2019	Flow = -1.2684*Year + 2671.4	**0.0005**
October	1955-1963, 1967-2015, 2017-2019	Flow = -0.6139*Year + 1463.7	0.18
November	1955-1962, 1967-2019	Flow = -0.0847*Year + 438.3	0.81
December	1938, 1955-1963, 1967-2019	Flow = -0.2074*Year + 639.3	0.39

Figure A.IV.1. Mean August and September flow versus year in the mainstem Lemhi River near Lemhi, Idaho (USGS 13305000).



References

Borden, C., 2015. Lemhi River Basin Model Supporting Documentation. Centered Consulting International, LLC report for the State of Idaho Office of Species Conservation, December 2015. 80 pp.

DHI, 2006. The Lemhi River MIKE BASIN Model: A Tool for Evaluating Stream discharges, Diversion Operations and Surface Water – Ground Water Relationships in the Lemhi River Basin, Idaho. Report for U.S. Bureau of Reclamation, Idaho Governor's Office of Species Conservation, and Idaho Department of Water Resources.

Petrosky, C. E., H. A. Schaller, E. S. Tinus, T. Copeland, and A. J. Storch. 2020. Achieving productivity to recover and restore Columbia River stream-type Chinook salmon relies on increasing smolt-to-adult survival. North American Journal of Fisheries Management ?? find in journal.

Walters, A. W., T. Copeland, and D. A. Venditti. 2013. The density dilemma: limitations on juvenile production in threatened salmon populations. Ecology of Freshwater Fish 22(4): 508-519.

7. Appendix B.

Estimated Benefits of the Canyon Creek Diversion #1 Fish Passage Improvement Project

The Canyon Creek Diversion #1 fish passage improvement project will likely be completely implemented before the beginning of the 2023 irrigation season. This project will replace the Lower Canyon Creek Water Diversion with a diversion that meets NMFS' criteria for upstream fish passage and fish screening. This diversion is located on Canyon Creek approximately 1.5 miles upstream from the mouth. Fish are currently able to migrate upstream past the diversion in the spring, prior to irrigation turn on, and for a short time after turn on when flows are high. However, by mid-summer the diversion is a complete barrier to upstream fish passage and currently marks the upstream extent of juvenile Chinook salmon rearing. Adult Chinook salmon are currently absent from Canyon Creek, probably due to poor passage conditions caused by inadequate flow in the lowest reaches. This project will not improve flow in the lower reaches and will therefore not result in reestablishment of Chinook salmon spawning in Canyon Creek. However, juvenile Chinook salmon utilize lower Canyon Creek for rearing and this project will increase the amount of rearing habitat that juvenile Chinook salmon can access.

Chinook salmon emerge from the spawning gravels in spring and almost immediately begin seeking suitable rearing habitat. Most either rear near the spawning location or disperse downstream, but some disperse upstream. The available, albeit limited, peer-reviewed literature on this subject suggest that juvenile Chinook salmon and coho salmon will utilize rearing habitat up to approximately one mile upstream from spawning habitat (Anderson et al. 2008; Decker et al. 2008). However, monitoring data from the Lemhi River drainage indicate that juvenile Chinook salmon will disperse from one to three miles (average two miles) up tributary streams to rear. We therefore presume that juvenile Chinook salmon will utilize the lower two miles of a reconnected tributary stream for rearing.

Chinook salmon do not currently spawn in Canyon Creek and, therefore, all juvenile Chinook salmon rearing in Canyon Creek are upstream dispersers. The Chinook salmon rearing near the diversion have dispersed at least 1.5 miles upstream from where they were spawned. By the time juvenile Chinook salmon emerge and disperse upstream to the diversion, the diversion is likely a complete barrier, which is likely the reason that Chinook salmon rearing is currently confined to the lower 1.5 miles of Canyon Creek. As described above, monitoring data indicate that juvenile Chinook salmon in the Lemhi River drainage will utilize the lower one to three miles (average two miles) of reconnected tributary streams. We therefore presume that the Lower Canyon Creek Diversion project will extend Chinook salmon rearing an additional one half mile upstream, which will increase the amount of accessible rearing habitat by approximately 3,782 m^2 (40,409 ft^2) (Chinook salmon IP). This increase represents a 0.74% increase in accessible Chinook salmon rearing habitat upstream from the LEMHIW screw trap and an average of 21,081 juvenile Chinook salmon migrate downstream past the screw trap each year. Assuming that juvenile Chinook salmon will rear in the newly accessible habitat at similar densities as in currently accessible habitat, then the project should result in an additional 156 outmigrants each year (average).

Canyon Creek does not currently have sufficient flow for upstream migration of adult Chinook salmon and the project will therefore not affect adult Chinook salmon migration over the short term. However, the project could facilitate upstream migration of adult Chinook salmon if flow conditions improve. Because adult steelhead migrate upstream in early spring and are therefore not currently blocked by the diversion, the project will not affect upstream distribution of Steelhead in Canyon Creek. The project could benefit individual juvenile steelhead moving upstream to find suitable rearing habitat during summer or early fall.

8. APPENDIX C.

Monitoring Operation and Maintenance of Authorized Diversions

Figure C-1. Annual water diversion condition reporting form to be completed by operators of water diversions authorized on NFS land in the Lemhi River drainage.

SALMON-CHALLIS NATIONAL FOREST WATER DIVERSION AND CONVEYANCE REPORTING FORM

Condition and Status Reporting Form for Diversions and Associated Facilities on NFS Lands

Please use this form to document water diversion operation and maintenance for diversions occupying National Forest System lands. Please include any changes, improvements, structure failures, etc. made during the reporting year. As a reminder, prior approval needs to be obtained from the Salmon-Challis NF if upgrades, improvements or otherwise are outside of routine maintenance actions identified in the permit/easement.

Please return this form and the diversion measurement reporting form to the Salmon Challis National Forest, attention: Forest Diversion Coordinator 1206 S. Challis Street, Salmon, ID 83467 annually (by December 31).

Easement/Permit Holder Name:	**Date:**
Diversion Water Source:	
IDWR Water Right #:	

Annual Water Diversion Status and Condition Reporting	Yes	No
Water Diversion Operation and Maintenance		
Has the water system changed from the previous year (changes include point of diversion improvements or alterations, installation of headgates or measuring devices, ditch maintenance, brush removal, structure replacement, etc.)? If yes, please describe the changes (and provide photos if possible) (continue on additional pages if needed):		
Was the water system utilized during the irrigation season? If yes, please provide dates of use for reporting year:		

Page 1

SALMON-CHALLIS NATIONAL FOREST ANNUAL WATER DIVERSION REPORTING FORM (VERSION1.0)

Figure C-2. Continued.

SALMON-CHALLIS NATIONAL FOREST WATER DIVERSION AND CONVEYANCE REPORTING FORM

Annual Water Diversion Status and Condition Reporting	Yes	No
Is any part of the water system in disrepair, in need of maintenance, etc.? If yes, please describe:		
Were there any failures, washouts, etc. on any of the permitted facilities during the reporting year? If yes, please describe, provide photo documentation, location information, and describe how addressed:		
Does the water system have an IDWR approved headgate installed? If no, please explain:		
Does the water system have an IDWR approved measuring device installed? If no, please explain:		
Access Route Condition:		
Has approved access route condition changed from previous year? If yes, please describe:		
Annual Diversion Recording Form		
Were weekly readings recorded on the water measurement log provided to you by the Forest Service? If no, please explain:		

Figure C-3. Annual water use form to be completed for diversions authorized on NFS land in the Lemhi River drainage that are not monitored by water masters.

SALMON-CHALLIS NATIONAL FOREST WATER DIVERSION AND CONVEYANCE REPORTING FORM

This form is NOT required for those diversions within an active water district with a watermaster assigned. This information will not be used for enforcement or regulation of your water right. It is to ensure compliance with Endangered Species Act consultation, and permit/easement administration requirements.

Name: ____________________

Water Source and IDWR Water Right #: ____________________

Diversion Name: ____________________

SECTION I Water Right Holder/Operator Information

(If there are multiple water right holders on a common ditch or conveyance system, please designate the contact person below)

Current Water Right Owner Please check for address correction ☐

Name____________________ Phone____________________

Last, First, MI

Address____________________ Fax____________________

City____________________ Mobile____________________

State & Zip____________________ e-mail____________________

Operator or Contact Person *(if different from owner)*

Name____________________ Phone____________________

Last, First, MI

Address____________________ Fax____________________

City____________________ Mobile____________________

State & Zip____________________ e-mail____________________

Page 3

SALMON-CHALLIS NATIONAL FOREST ANNUAL WATER DIVERSION REPORTING FORM (VERSION1.0)

Figure C-4. Continued.

SALMON-CHALLIS NATIONAL FOREST WATER DIVERSION AND CONVEYANCE REPORTING FORM

SECTION III Water Measurement Log *(measurements must be recorded at least once per week and in units of cubic feet per second.)* PLEASE SHOW TURN ON/TURN OFF DATES

DAY	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30		--------				
31		--------		--------		--------

SALMON-CHALLIS NATIONAL FOREST ANNUAL WATER DIVERSION REPORTING FORM (VERSION1.0)

Figure C-5. Continued.

SALMON-CHALLIS NATIONAL FOREST WATER DIVERSION AND CONVEYANCE REPORTING FORM

SECTION III Water Measurement Log (Continued). *(Measurements must be recorded at least once per week and in units of cubic feet per second.)* PLEASE SHOW TURN ON/TURN OFF DATES

DAY	JULY	AUGUST	SEPT	OCTOBER	NOVEMBER	DECEMBER
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31			--------		--------	

SALMON-CHALLIS NATIONAL FOREST ANNUAL WATER DIVERSION REPORTING FORM (VERSION1.0)

Figure C-6. Salmon-Challis National Forest monitoring strategy for water diversions authorized on NFS land that are on source streams that contain ESA listed fishes on NFS land.

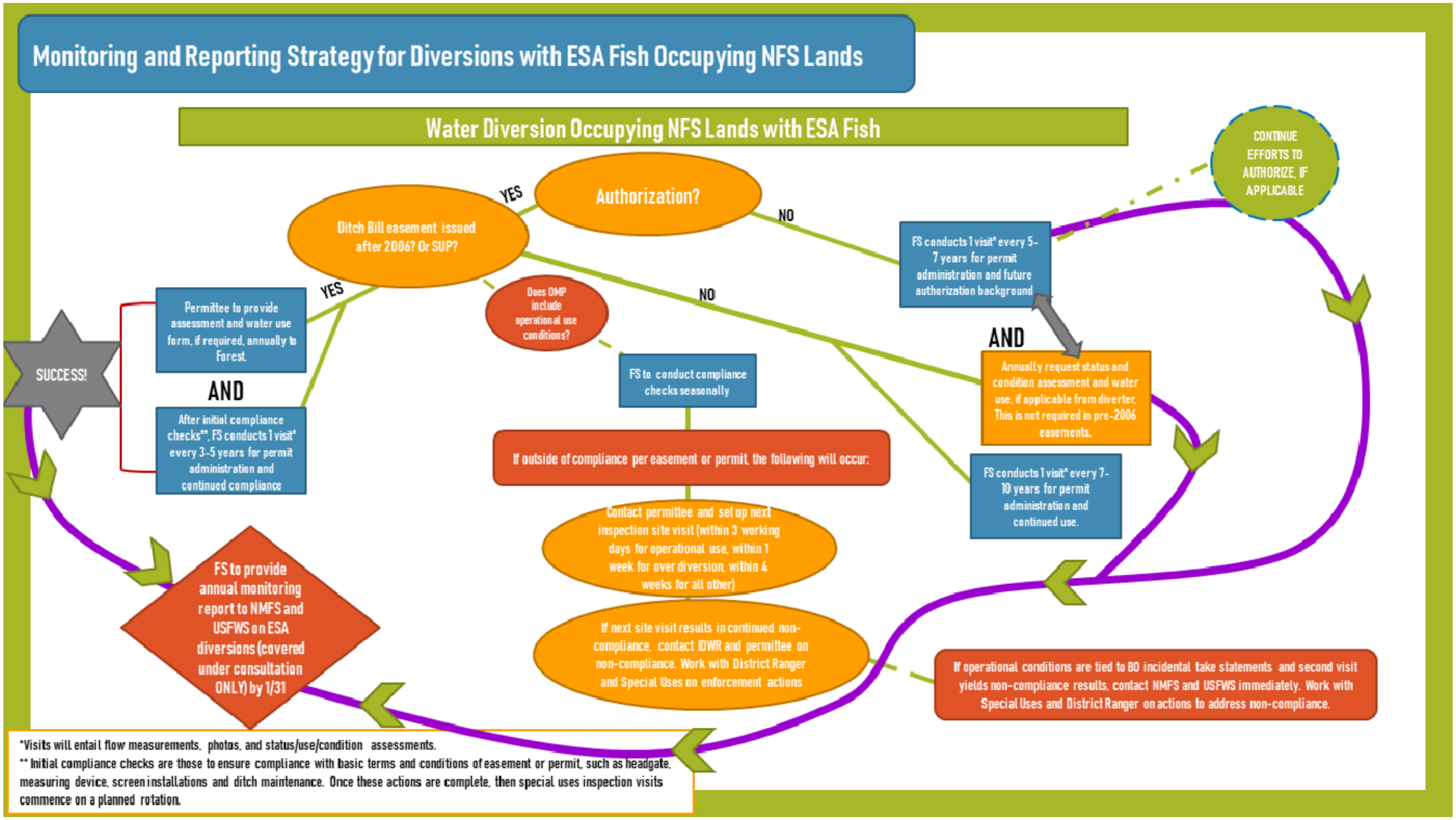


Figure C-7. Salmon-Challis National Forest monitoring strategy for water diversions authorized on NFS land that are on source streams that do not contain ESA listed fishes on NFS land.