RECLAMATION

Managing Water in the West

Biological Assessment for Operation of the Lewiston Orchards Project, Idaho

October 2009 – Final
Corrected January 2010

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Snake River Area

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

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

ERRATA

In January 2010, corrections were made to the October 2009 Final Version files. The corrections that were made were:

i	The title page and all page footers were updated to include the phrase "Corrected January 2010."
vi	The capital "T" in Total phosphorus was made lower case.
vii	Line 2.4.1 was brought up and joined with the first letter, which was inadvertently on the previous line.
viii	The numbering convention was removed from lines 3.2.4.1 and 3.2.4.2 for consistency with the other subsections.
xii	The page numbers listed for Table 3-2 and Table 3-3 were missing hyphens between chapter and page number.
xii	Table 5-7 had an extra space after the word "storage."
xiii	Figure 3-1 had an extra space after the word "in."
3-5	In the fourth sentence in the third paragraph the extra word "the" was removed before "late May."
3-13	In the first sentence in the fourth paragraph the word "a" was added after the word "is."
3-15	The numbering convention was removed from line 3.2.4.1 for consistency with the other subsections.
3-17	The numbering convention was removed from line 3.2.4.2 for consistency with the other subsections.
4-4	Website listed in the last bullet on the page was updated to http://www.idwr.idaho.gov/waterboard/waterplanning/minimum%20stream%20flow/minimum_stream_flow.htm.
4-10	In Table 4-2, the second column of the last line should be 4.00, not 40.
5-1	In three instances in the second paragraph, "Waha Lake" was corrected to be "Lake Waha."
5-6	In the last sentence on the page the numbers were made consistent with the rest of the sentence: 0.0 cfs and 2.0 cfs.

5-23	Footnote referenced was included on the page.
7-45	In the first sentence of the last paragraph the word “Creek” was uncapitalized.
7-46	In the first sentence on the page the word “Creek” was uncapitalized.
7-58	After the heading “County Road and Highway Projects,” the word “The” was removed.
8-5	In the first sentence on the page the work “to” was added after the word “believed.”
B-1	In the page heading, a hyphen and space were added after “Appendix B.”

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Acronyms and Abbreviations

7DADM	7-day average of daily maximum
af	acre-feet
afy	acre-feet per year
APA	Administrative Procedures Act
BA	Biological Assessment
BPA	Bonneville Power Administration
CFR	Code of Federal Regulations
cfs	cubic feet per second
cfu	colony forming units
CI	confidence interval
cm	centimeters
cm/sec	centimeters per second
CMP	corrugated metal pipe
CRLMA-s	Clearwater River lower mainstem population
CWA	Clean Water Act
DEQ	Idaho Department of Environmental Quality
DO	dissolved oxygen
DPS	distinct population segment
EFH	essential fish habitat
ENSO	El Niño Southern Oscillation
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FMP	fisheries management plan
ft/sec	feet per second
GIS	geographic information systems
HDPE	high-density polyethylene
HSC	habitat suitability criteria
HUC	hydrologic unit code
ICTRT	Interior Columbia Basin Technical Recovery Team
IDAPA	Idaho Administrative Procedures Act

IDFG	Idaho Department of Fish and Game
IDWR	Idaho Department of Water Resources
IFIM	Instream Flow Incremental Methodology
IPCC	Intergovernmental Panel on Climate Change
IWRB	Idaho Water Resource Board
km	kilometer
LOID	Lewiston Orchards Irrigation District
MaSA	major spawning area
mg/L	milligrams per liter
MiSA	minor spawning area
mL	milliliter
mm	millimeter
MOA	memorandum of agreement
MPG	major population group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
O&M	operations and maintenance
OP	ortho-phosphorus
PA	Proposed Action
Parties	Reclamation, NMFS, the Tribe, and LOID
PCEs	primary constituent elements
PDO	Pacific Decadal Oscillation
PHABSIM	physical habitat simulation
Project	Lewiston Orchards Project
Reclamation	U.S. Bureau of Reclamation
R/S	recruits per spawner
SCA	supplemental comprehensive analysis
Settlement	2004 Nez Perce Water Rights Settlement
SOD	Safety of Dams
SRBA	Snake River Basin Adjudication
SSTEMP	stream segment temperature

State	State of Idaho
TMDL	total maximum daily load
TN	total nitrogen
TP	total phosphorous
Tribe	Nez Perce Tribe
TSS	total suspended solids
TRT	technical recovery team
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VSP	viable salmonid population
WUA	weighted usable area

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Chapter 1 INTRODUCTION

1.1 Purpose of the Biological Assessment

The Bureau of Reclamation (Reclamation) is consulting with the National Marine Fisheries Service (NMFS) pursuant to Section 7(a) (2) of the Endangered Species Act (ESA). This Biological Assessment (BA) describes and analyzes future effects of the Operation and Maintenance (O&M) of the Lewiston Orchards Project (Project) on ESA-listed species and designated critical habitat. In addition, this document includes the effects on Essential Fish Habitat (EFH) as required under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996.

This BA details the proposed future Project operation and its potential effects to threatened Snake River steelhead distinct population segment (DPS) and associated critical habitat; and EFH for Chinook and coho salmon. Reclamation is reconsulting because the previous Biological Opinion issued by NMFS on March 31, 2006, was remanded by U.S. District Court of Idaho in a summary judgment issued on April 8, 2008.

1.1.1 How to Use this Document

Because this document consults on both ESA-listed species and critical habitat, as well as EFH species, the analyses are presented as follows:

- Chapter 1, “Introduction,” briefly defines the purpose of the BA, and summarizes the species listed under ESA and MSA.
- Chapter 2, “Background and Legal Framework,” provides a description of the Project history and sets the boundaries for Reclamation’s decision-making authorities.
- Chapter 3, “Project Description,” identifies the facilities, configuration, and function of the Project within the watershed.
- Chapter 4, “Proposed Action,” describes the future operation of the Project, which is the subject of this consultation. The Proposed Action (PA) differs from the historic operations described in Chapter 3.

- Chapter 5, “Hydrologic Conditions,” explains the hydrologic conditions under historic operations, and compares those to conditions that are expected with implementing the PA.

- Chapter 6, “Water Quality,” identifies water quality conditions under historic and current Project operations, and identifies how the PA may or may not influence water quality in the future.

- Chapter 7, “Snake River Steelhead,” provides an analysis of the impacts of Reclamation’s PA on ESA-listed Snake River steelhead and associated designated critical habitat. Other actions and factors that impact steelhead and critical habitat—both within and outside of the Action Area—also are discussed.

- Chapter 8, “Essential Fish Habitat,” provides an analysis of the impacts of Reclamation’s PA on EFH in the Project Action Area.

- Chapter 9, “Literature Cited,” provides a listing of citations for the entire document.

- Appendix A, “Nez Perce Settlement Components,” describes the Nez Perce Tribe (Tribe) Settlement (Settlement) in more detail.

- Appendix B, “Hydromet Data,” provides information supplemental to the Chapter 3, “Project Description,” focused on data describing facility operational ranges over the period of record.

- Appendix C, Technical memo “Derivation of 2003 to 2008 Unregulated Flows in Sweetwater Creek near Lewiston Orchards, Idaho,” that contains additional information and results for the analysis used to estimate stream flows in Sweetwater and Webb creeks without the Project water operations. Although the subject of this BA is comparison of existing project operations to the PA, the technical memorandum in this appendix provides additional insight on unregulated hydrology.

- Appendix D, “Snake River Steelhead Recovery Planning, Objectives, and Status in the Lower Clearwater,” describes recovery goals in more detail.

- Appendix E, “Habitat Transect Plots,” contains stream transect cross sections from Sweetwater and Webb creeks during the cooperative data collection effort in October 2008.

1.2 Project Location and Proposed Action

The Project is located in northern Idaho on a bench south of the Clearwater River near the City of Lewiston. The Project collects water from the Craig Mountain drainage area that is partially located on the Nez Perce Reservation. Project features consist of three storage reservoirs (Soldiers Meadow, Lake Waha, and Reservoir A), four smaller diversion structures (Captain John, West Fork Sweetwater, Webb, and Sweetwater), one pump in Lake Waha, and associated canals. Webb diversion dam, Webb Canal, Reservoir A and some portions of Sweetwater Canal are located within the Tribe's Reservation boundary. The rest of the Project affects streams that flow into and through the Nez Perce Reservation (see Figure 1-1, "Lewiston Orchards Project Map").

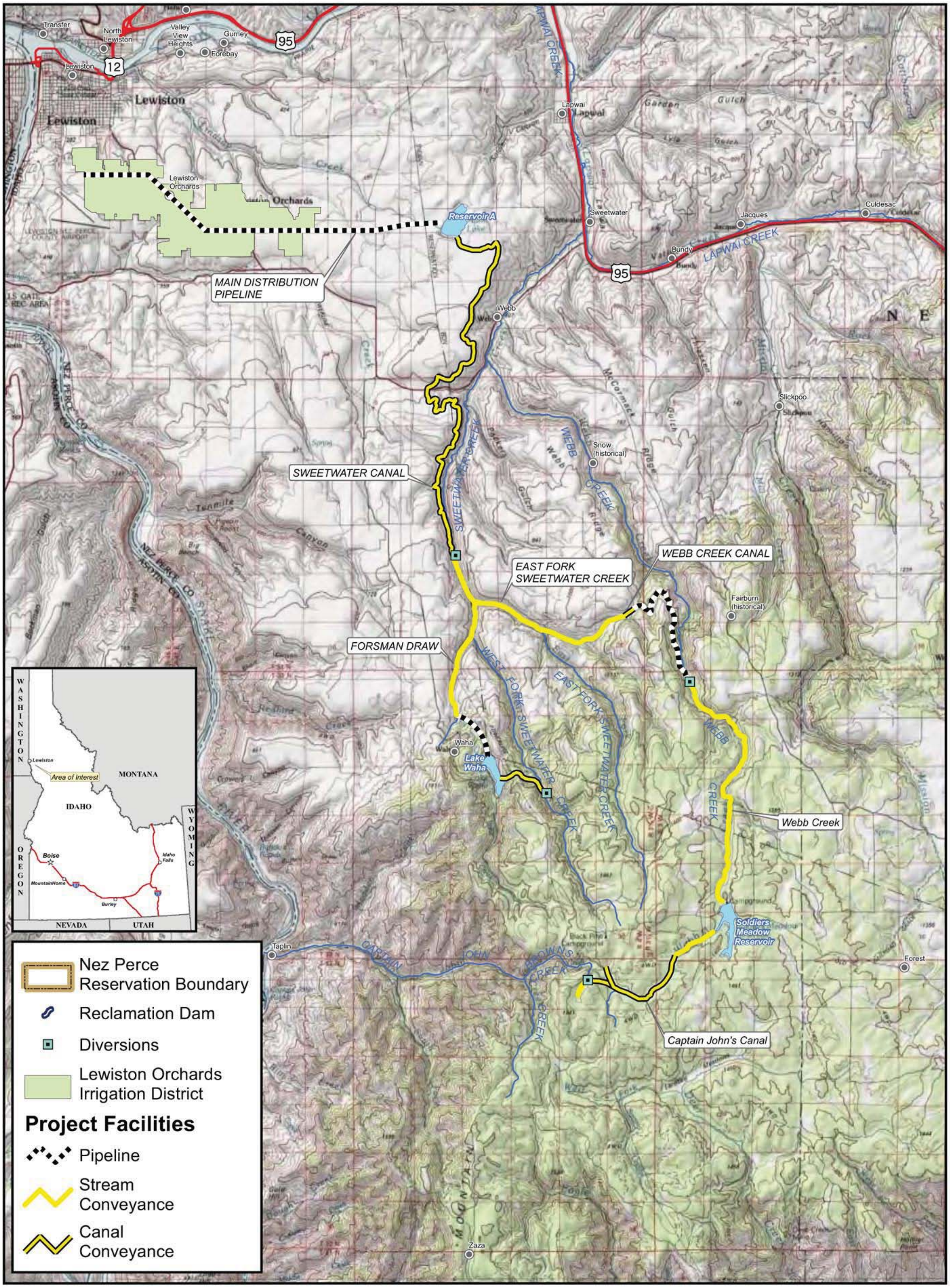
The Project delivers water to approximately 3,792 acres located on the bench area above Lewiston, Idaho, known as the Lewiston Orchards, for irrigation of lawns, pastures, orchards, and businesses. The Project is managed locally by the Lewiston Orchards Irrigation District (LOID).

Originally a privately owned project, Reclamation took ownership on July 31, 1946 (60 Stat. 717, Public Law 79-569), as described in Chapter 2, "Background and Legal Framework." Reclamation has since rehabilitated or rebuilt most of the Project features. A detailed description of the Project features and historic operations is provided in Chapter 3, "Project Description."

The PA is the future operation and routine maintenance of the Project, including storage and release of water from Soldiers Meadow, Lake Waha, and Reservoir A; diversion of water at four diversion structures (listed above); and routine maintenance at the facilities and canals. A detailed description of the PA is provided in Chapter 4, "Proposed Action."

1.3 Action Area

Reclamation defines the "Action Area" as all areas to be affected directly or indirectly by the federal action, in this case, Project O&M activities. Project facilities and features lie predominantly within the Lapwai Creek Basin (a tributary to the Clearwater River); the small Captain John diversion and canal are within the Snake River Basin. The Action Area affected by Project O&M includes reservoirs and stream reaches used by the Project to divert, store, and deliver water.



This document may contain graphical representations of property boundaries. It is not a legal description of the property, and is for general reference only. Neither the authors, Reclamation, or any other party involved in preparing the material and data displayed here warrant or represent that the information is in every respect complete and accurate, and are not held responsible for errors or omissions.

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Drawn by: J. Jones
Date: Sept. 29, 2009

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Lewiston Orchards Project Map
Figure 1-1

2 1 0 2
Miles

Evaluation of ESA-listed species, designated critical habitat, and EFH focus on the aquatic environments that may be influenced by Reclamation's PA. The Action Area begins at the furthest upstream effect (that is, the uppermost point of diversion) and continues down through all storage and conveyance facilities to the location of the farthest downstream effect. For this PA, the effects of the operations on Captain John Creek are evaluated to its confluence with the Snake River and the effects of all other operations are evaluated to the confluence of Lapwai Creek with the Clearwater River. The Project also operates Reservoir A in the Lindsay Creek watershed, which is a tributary to the Clearwater River; however, Lindsay Creek is not accessible to fish (NMFS 2006a); thus, there are no listed fish or designated critical habitat in the watershed and no analysis is necessary for this portion of the Action Area.

1.4 ESA-Listed Species

1.4.1 ESA Listings in the Action Area

Two listed species are included in this BA:

- Snake River steelhead (*Oncorhynchus mykiss*), listed as a threatened DPS January 5, 2006 (71 CFR 834).
- Spring/summer Chinook salmon (*Oncorhynchus tshawytscha*), listed as a threatened evolutionarily significant unit (ESU) on April 22, 1992 (57 Code of Federal Regulations [CFR] 14653).

1.4.2 Snake River Steelhead

1.4.2.1 ESA Listing

Snake River steelhead DPS (*O. mykiss*) were listed as threatened on January 5, 2006 (71 CFR 834). Steelhead present in the Lapwai Basin and tributaries and the Clearwater, Snake, and Salmon river basins are part of the Snake River steelhead DPS. This DPS covers all wild steelhead below impassable barriers, as well as six hatchery programs: Tucannon River, Dworshak National Fish Hatchery, Lolo Creek, North Fork Clearwater, East Fork Salmon River, and the Little Sheep Creek/Imnaha River Hatchery.

1.4.2.2 Critical Habitat

Critical habitat for the Snake River steelhead DPS was designated on September 2, 2005 (70 CFR 52630). This designation covered 8,049 miles (12,954 kilometers [km]) of stream within 289 watersheds.

A total of 26.5 miles of stream are listed as critical habitat for Snake River steelhead in the Action Area. Initially, 38.4 miles of stream within the Action Area were proposed for listing. However, stream segments running through Tribal lands (7.9 miles) were withdrawn from listing at the request of the Tribe, creating discontinuities in the critical habitat designation. Specific mileages of critical habitat along Webb, Sweetwater, and Lapwai Creeks, as well as assessment of current conditions and potential PA impacts are provided in Section 7.3, “Critical Habitat.”

1.4.3 Snake River Chinook Salmon

1.4.3.1 ESA Listing

Snake River spring/summer Chinook salmon in the Snake River Basin and tributaries were listed as threatened on April 22, 1992. Listed spring/summer Chinook salmon are present in the Action Area in the lower 6 miles of Captain John Creek (57 CFR 14653). A reintroduced stock of Snake River spring/summer Chinook salmon are present in the Clearwater and Lapwai basin. These Chinook salmon are not listed under the ESA because the existing population is reintroduced stock and not considered part of the ESU.

Snake River fall Chinook salmon also are ESA-listed, but the Action Area is not part of the distribution or habitat for this stock. As such, this BA does not evaluate any effects on Snake River fall Chinook salmon.

1.4.3.2 Critical Habitat

Critical habitat for spring/summer Chinook salmon was listed on December 28, 1993 (58 CFR 14653), and revised on October 25, 1999 (64 CFR 57399). Critical habitat in the Action Area is located on Captain John Creek, downstream of a waterfall near stream mile 6.0 that is a migration barrier. However, the timing and duration of the PA has no effect on critical habitat in Captain John Creek, as discussed in Section 1.4.3.3, “Justification for No Effect Findings.”

1.4.3.3 Justification for No Effect Findings

Captain John Creek

The lower 6 miles of Captain John Creek is thought to provide spawning and rearing habitat for Snake River steelhead and rearing habitat for Snake River spring/summer Chinook salmon, and is designated critical habitat for these two species. The upstream end of this 6-mile reach is defined by a waterfall that represents an impassable barrier to steelhead and salmon.

The Project diversion in the Captain John Creek watershed is located in the uppermost portion of the Captain John Creek watershed, on an ephemeral unnamed tributary 3 miles upstream of the waterfall. The diversion captures water from a very small portion of the overall watershed. The watershed has numerous larger unregulated tributaries yielding most of the runoff volume to the Creek, as shown in Figure 1-1. Further, the diversion operates only in the spring runoff period (typically in late April or early May) and, except for years with abundant spring rainfall, it diverts water for only a few weeks.

Given that the Project diversion is in an area inaccessible to listed steelhead and salmon and captures only a minor portion of springtime runoff in the watershed, it has no effect on listed species or critical habitat in lower Captain John Creek. This determination was supported in the *2006 NMFS Biological Opinion* for this Project (NMFS 2006a). Therefore, this portion of the Project will not be discussed further in this BA.

1.5 Essential Fish Habitat

Chinook salmon and coho salmon habitat in the lower Clearwater and Snake rivers is listed as EFH under the MSA. The impacts to EFH are detailed in Chapter 8 of this document.

1.6 Request for an Opinion

Each federal agency has an obligation to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or destroy or adversely modify its critical habitat unless that activity is exempt pursuant to the ESA (16 United States Code [USC] 1536(a) (2); 50 CFR 402.03). Under relevant regulation 50 CFR 402.12(f), the "contents of a biological assessment are at the discretion of the federal agency and will depend on the nature of the federal action." Reclamation followed 50 CFR 402.12(f) and the

Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities under Section 7 of the Endangered Species Act (USFWS and NMFS 1998) in developing the content of this BA.

This document provides a detailed assessment of the effects of the PA on ESA-listed species and designated critical habitat. This BA fulfills the requirements of 50 CFR 402.14(c) and Reclamation requests a Biological Opinion for the effects of its PA on Snake River steelhead and critical habitat in the Action Area located within Sweetwater, Webb, and Lapwai creeks.

Chapter 2 BACKGROUND AND LEGAL FRAMEWORK

2.1 Project History and Authorization

2.1.1 Early Project History

Prior to European settlement, the confluence of the Clearwater and Snake rivers provided a natural hunting and fishing ground for Indians. Early settlers found the climate at the lower elevation provided for comfortable living with a good growing season for crops and orchards. These settlers made their living by dryland farming, mining, and lumbering. In 1906, a private company initiated irrigation in the Project area with the construction of the Sweetwater Creek Canal and Reservoir A, to deliver irrigation and domestic water to individuals living on the bench above Lewiston, Idaho.

In 1915, irrigation supply was augmented by pumping water from Lake Waha. Later, in 1922, the LOID formed and constructed the following improvements: increased capacity in Reservoir A from 2,000 to 3,000 acre-feet (af); constructed Soldiers Meadow reservoir; and constructed Webb creek diversion dam and necessary conveyance systems to move water from Webb creek drainage to Sweetwater creek drainage. In 1934, the water supply again was supplemented by construction of the Captain John Creek diversion.

In the 1940s, the facilities in the LOID were in disrepair and LOID requested assistance from the federal government to improve the Project. This assistance would be provided by (or through) Reclamation.

2.1.2 Federal Project Authorization

The 1902 Reclamation Act created the Reclamation Service as part of the U.S. Geological Survey (USGS). This was not an organic act and it did not set a broad charter of authority for the Reclamation Service; each project needed specific approval. Subsequent Acts in 1910 and 1939 evolved federal authorization procedures and responsibilities for Reclamation projects, with Congress retaining the power to authorize a project through the regular legislative process. Authorizing legislation is an important consideration in Reclamation projects because it states the authorized project purpose and determines the use of storage water and the limits within which a federal facility can be operated.

On May 31, 1946, the Project was found to be feasible by the Acting Secretary of the Interior, pursuant to the Reclamation Project Act of August 4, 1939. The Act of July 31, 1946 (60 Stat. 717, Public Law 79-569) specifically authorized construction of the Project in accordance with the recommendations of the Regional Director, as described in his report dated December 3, 1945 (Reclamation 1945). Reclamation's authority was and remains to construct and operate the Project for purposes limited to irrigation and municipal and industrial water supply. Flood control, fish and wildlife, recreation and other potential purposes are not included in Project authorization. Under this authority, Reclamation constructed the irrigation works and domestic water facilities on a reimbursable basis according to the terms of a September 10, 1947, contract with LOID (Reclamation, 1947). Descriptions of Project facilities and operations are proved in Chapter 3, "Project Description."

2.2 Tribal Interests

The Tribe entered into a treaty with the United States in June 1863 that set the current boundaries for the Nez Perce Reservation. The Tribe has a great interest in future operation of the Project because some of the Project facilities are located within the Nez Perce Indian Reservation boundaries. Additionally, the Project collects drainage from the Craig Mountain watersheds and alters the stream hydrology in Webb Creek, Sweetwater Creek, and Lapwai Creek. These streams run though the Nez Perce Reservation and are part of the treaty fisheries areas of the Tribe.

Snake River salmon and steelhead are a significant Tribal cultural resource and an important element of the Indian Trust Assets promised to the Tribe by the Federal government. The Tribe has been working throughout the Pacific Northwest to promote recovery of theses listed species and is currently a co-manager, along with the state and federal agencies, of the fisheries resources in the Columbia and Snake river basins. The Project Action Area is part of that management area.

2.3 Consultation History

Reclamation first initiated consultation on the Project with NMFS in 1998, within the context of larger consultation on the effects of ongoing O&M activities at all Reclamation facilities in the Snake River Basin, upstream from Lower Granite Dam. Effects of the Project were not fully evaluated in Reclamation's 1998 BA; consequently, the Project was not part of the NMFS 1999 Biological Opinion. Since

1999, consultation on the Project has proceeded as an independent consultation, focusing only on the Project area.

On April 26, 2001, Reclamation submitted a supplemental BA to NMFS describing the effects of the Project. About the same time, Reclamation, NMFS, the Tribe, and LOID (the Parties), the Parties to the Snake River Basin Adjudication (SRBA) were discussing issues concerning future water rights of the Tribe. These discussions included the facilities and operations of Project. Consequently, NMFS did not initiate consultation upon receipt of the 2001 Project Supplemental BA, assuming that the SRBA settlement for the Nez Perce water rights claims could change the Project, and or eliminate the need for consultations. The Project later was dropped from the SRBA Indian water rights settlement negotiations, and consultation on the Project was resumed. Between July 2004 and July 2005, Reclamation and NMFS deliberated on details and analyses related to a Biological Opinion for the Project.

Also during this time several changes in critical habitat and delineation of Snake River Basin steelhead occurred. The Snake River steelhead DPS was listed on January 5, 2006, replacing the Snake River steelhead ESU. Critical habitat for the Snake River steelhead ESU was withdrawn on September 29, 2003, and redesignated for the Snake River steelhead DPS on September 2, 2005.

A Biological Opinion was completed by NMFS for the Project on March 1, 2006 (NMFS 2006a).

The Tribe filed lawsuit against NMFS and Reclamation under the Administrative Procedures Act (APA) and ESA. Under the APA, the Tribe charged NMFS with being arbitrary and capricious in their conclusions in the 2006 Biological Opinion. On April 7, 2008, the U.S. District Court for Idaho ruled in favor of the Tribe. To avoid a court-ordered injunction on Project operations, Reclamation, NMFS, the Tribe, and LOID participated in court-ordered mediation and reached a settlement that included a remand of the March 2006 Biological Opinion without vacatur while the agencies reconsulted. During the remand period, NMFS and Reclamation agreed to collaborate with the Tribe to discuss and develop items to be included in the PA and to narrow areas of disagreement on scientific and technical information. This collaboration has resulted in modifications and improvements to the Project operations and routine maintenance, which are reflected in the PA described in Chapter 4, “Proposed Action.”

2.4 Water Rights and Administration

2.4.1 Idaho Water Rights Administration

The right to use water in Idaho is allocated based on the prior appropriation system, whereby, the earlier water user has a better right in times of water shortage than those who developed their water uses later. The right to use water in a shortage is legally enforceable through a water right, which describes the priority date, purpose of use, rate and/or volume, place of use, season of use, and point of diversion. A water right licensing process, administered by Idaho Department of Water Resources (IDWR), is required to establish a water right; although, until 1971, a surface water right also could be established by beneficial use.

2.4.2 Snake River Basin Adjudication

A general adjudication of water rights in the Snake River Basin was filed on December 19, 1987, and is ongoing (Fifth District Court, State of Idaho, County of Twin Falls, case number 39576: State of Idaho ex rel. v. the United States; the State of Idaho [State]; and all claimants to the use of water from the Snake River Basin water system). The adjudication of water rights requires all water users to file a claim to preserve their right to use it. The adjudication of the water rights also includes federal reserve water rights associated with Tribal water rights. The result will be a decree of all Snake River Basin Water Rights established by any legal means up through 1987, including those rights on the Clearwater River and its tributaries.

The Tribe's water rights were addressed by the Settlement and the Snake River Water Rights Act of 2004 (PL 108-447). Details of the Settlement are provided in Section 2.5, "Nez Perce Settlement and Tribal Coordination." The LOID was not included in the Settlement and the Project water rights were not addressed in the negotiation settlement.

2.4.3 Water Rights for the Lewiston Orchards Project

As discussed above, the Project was constructed by private interests beginning in 1906. These private interests obtained State water rights, generally through the licensing process. Early established water rights on the Project were adjudicated by the 1916 Siegrist Decree. In 1948, LOID deeded its water rights to the United States, pursuant to LOID's repayment contract with Reclamation. Throughout the West, Reclamation holds state water rights for its projects and complies with the various states' administration of water rights where its projects are located, pursuant to Section 8 of the 1902 Reclamation Act.

Reclamation is participating in the SRBA, as the holder of state water rights, pursuant to the McCarran Act Amendment, which waives the United States' sovereign immunity for general adjudications. Consequently, in the SRBA, Reclamation filed claims to all of its project water rights in the Snake River Basin, including those for the Project. The SRBA procedures call for IDWR to investigate the claims and file Recommendations to the Court. IDWR's Recommendation is summarized in Table 2-1. As shown on the table, Project water rights are a combination of storage rights and instream flow rights. All of the water rights were recommended with a remark stating that all together the rights are limited to the irrigation of a combined total of 3,792 acres in a single irrigation season.

Table 2-1. SRBA recommendations for water rights associated with the Project.

SRBA Water Right No	Source	Water Right & Beneficial Use	
85-02146	Webb Creek for storage in Soldiers Meadow Lake	2000 acre-feet per year (afy) storage	Irrigation and municipal
85-02147	Capt John Creek for storage Soldiers Meadow Lake	20 cubic feet per second (cfs) 2,000 afy	Irrigation and municipal
85-02049	Lake Waha	10 cfs (combined with No. 85-2063 may not exceed 10 cfs)	Irrigation and municipal
85-02063	Lake Waha	10 cfs	Irrigation and municipal
85-15424	Lake Waha	3,497.5 afy storage	Irrigation and municipal
85-11087	Lake Waha from West Fork Sweetwater Creek	20 cfs	Irrigation and municipal
85-00016	Sweetwater Creek	87 cfs natural flow diversion to storage	Irrigation and municipal
85-04483	Sweetwater Creek to be diverted into Sweetwater Canal for storage in Mann Lake	10,500 af storage	8,000 irrigation storage 1,000 stockwater storage 1,500 municipal storage
85-2065	Webb Creek	40 cfs	Irrigation and municipal

The Tribe filed formal objections to various elements of this water right recommendation. Pursuant to established procedures, each element objection initiated a subcase under the SRBA. LOID filed a motion to participate in these subcases, and this motion was granted. The United States, LOID, and the Tribe have been negotiating the resolution of the SRBA subcases.

2.5 Nez Perce Settlement and Tribal Coordination

As noted above, the Tribe's water rights were negotiated through the SRBA. During general adjudication, the McCarran Amendment (43 USC 666) requires the Federal government to assert its water right claims for adjudication in State court. In 1993, the United States, as Trustee for the Tribe, and the Tribe in its own behalf, filed water right claims for reserved water rights in the SRBA for fish habitat and habitat protection, with a "time immemorial" priority date. The claims involved substantial volumes of water.

This claim resulted in lengthy negotiations that culminated in the Nez Perce Water Rights Settlement (NPT et al. 2004) in May 2004. The United States approved the Settlement as the Snake River Water Rights Act of 2004. Idaho and the Tribe approved the Settlement on March 24, 2005, and March 29, 2005, respectively. LOID was not signatory to the negotiated settlement.

The settlement consists of three components: the Nez Perce Tribal, the Salmon/Clearwater, and the Snake River Flow components. The following summarizes key elements of each component. Appendix A, "Nez Perce Settlement Components," provides more information about the Settlement. The Nez Perce Tribal component addresses the Tribe's consumptive water rights claims on-reservation, provides funds for water development, and resolves other on- and near-reservation issues. This component gave the Tribe, in conjunction with an intergovernmental board comprised of the Tribe, U.S. Army Corps of Engineers (USACE), Bonneville Power Administration (BPA), NMFS, and the State, use of 200,000 af of water stored in Dworshak Reservoir, located on the North Fork Clearwater River on the Reservation. This water can be used for flow augmentation and temperature control (cooling) in the lower Snake River in August and September. This measure is intended to benefit juvenile and adult fall Chinook and adult steelhead by contributing cooler water to the lower Snake River into September when reservoir temperatures are high.

The Salmon/Clearwater component addresses fish habitat protection throughout the Salmon River and Clearwater River basins through a cooperative agreement under Section 6 of the ESA that includes establishment of instream flows in the Clearwater River and its tributaries, including Webb, Sweetwater, and Lapwai creeks. Consequently, stream flow rights on over 200 rivers, streams, and creeks in the Salmon River and Clearwater River basins that the Tribe identified as Tribal Priority Streams for critical spawning and rearing habitat for ESA-listed spring Chinook salmon, steelhead ("A" and "B" run), and fall Chinook salmon are held in trust for the public by the Idaho Water Resource Board (IWRB). The objective of establishing minimum stream flows is to ensure these streams are not dewatered to a level that impairs spawning and rearing or other ecological functions that support salmon, steelhead, and the aquatic environment.

The Tribal priority streams have been developed into “A” and “B” list groups based on the level of existing development. A list are considered non-developed and B list are considered developed. Webb Creek, Sweetwater Creek, and Lapwai Creek were among the rivers on the B list.

The State enacted a statute that allows the rental of water through the Idaho State Water Bank to meet these instream flows (Idaho Administrative Procedures Act [IDAPA] 42-1507). As described later, Reclamation will use this process when providing Project water for instream use under this PA.

The Snake River Flow component addresses flows from the Snake River upstream of Brownlee Reservoir and the conditions for use of water for flow augmentation. The PAs described in Reclamation’s 2004 Upper Snake BA and 2007 Upper Snake BA are consistent with the terms of the Snake River Flow component of the Settlement. Under the Settlement, Idaho Code 42-1763B was reenacted to authorize the rental and protection to the state line of up to 487,000 af of water annually for flow augmentation from traditional sources for the 30-year term of the agreement (through 2034).

Chapter 3 PROJECT DESCRIPTION

3.1 Overview

The Project provides irrigation and domestic water supply to approximately 18,000 patrons in a 3,729-acre service area southeast of Lewiston, Idaho. This water supply is provided by storage and conveyance facilities developed in three basins: Captain John Creek, Sweetwater Creek (including Webb Creek, the largest tributary of Sweetwater Creek), and Lindsay Creek. A general overview of the Project is provided in the following paragraphs. More detailed descriptions of Project facilities, including physical development, operational parameters, capacities and limitations, are provided in Section 3.2, “Facilities and Operations.”

3.1.1 Service Area Characteristics and Use of Water Supply

When originally developed in 1906, the service area of the Project consisted primarily of fruit orchards. Now, residential areas have expanded so that more than 76 percent of the land within the LOID boundary is in ownership parcels of less than 2 acres, with parcels averaging 0.55 acre in size. The remaining 24 percent of the land in the District is in ownerships averaging less than 5 acres. Subdividing is expected to continue.

Water provided by the Project is currently used for irrigation of landscapes and crops in the LOID service area; primary crops include hay, grain, and pasture. The Project was authorized for, and did initially provide, domestic water supply to LOID patrons; however, domestic supply is now provided from groundwater, through a system developed by LOID independent of the federal project. The domestic supply system of the Project (including a water filtration plant) is retained as a domestic supply backup in case of groundwater system failure.

3.1.2 Project Facilities—Storage and Conveyance System

Authorized Project facilities include three small storage reservoirs (Soldiers Meadow, Lake Waha, and Reservoir A), four diversion structures (located on Captain John Creek, West Fork Sweetwater Creek, Webb Creek, and the main stem of Sweetwater Creek), feeder canals and pipelines, and the domestic water system noted in Section 3.1.1.

As noted, Project facilities are located in three basins: Captain John Creek, Sweetwater Creek, and Lindsay Creek. The Captain John Creek Basin is involved only via a small diversion dam in its headwaters, from which water is diverted each spring to the Sweetwater Basin. With the exception of the Captain John Creek diversion, water supply for the Project is collected from the Sweetwater Creek Basin (including Sweetwater Creek and its main tributary, Webb Creek), where Soldiers Meadow Reservoir, Lake Waha, and the diversion dams are located. From the Sweetwater Basin, water is diverted to Reservoir A in the Lindsay Creek basin.

Referring to Figure 1-1, Project facilities and system configuration are further described below.

- **Captain John Creek Basin Elements**: The Captain John diversion is located in a small basin at the headwaters of Captain John Creek. Water from this diversion is conveyed via canal and excavated channel to the watershed of Webb Creek, where it is stored in Soldiers Meadow Reservoir.

- **Sweetwater Basin—Webb Creek Elements**: Water from the headwaters of Webb Creek (and the Captain John diversion) is stored in Soldiers Meadow Reservoir. From the reservoir, water is released into the natural Webb Creek channel, from which (approximately 6 miles downstream of the dam) it is diverted at the Webb Creek diversion dam and conveyed via the Webb Canal to East Fork Sweetwater Creek, and ultimately to the mainstem of Sweetwater Creek, where it is diverted into the Sweetwater Canal via the Sweetwater Diversion Dam.

- **Sweetwater Basin—Sweetwater Creek Elements**: Water from West Fork Sweetwater Creek is diverted via West Fork diversion dam and the Waha Feeder Canal into Lake Waha, a natural lake with no natural outlet. Water stored in Lake Waha is pumped from the lake and conveyed to the mainstem of Sweetwater Creek via a pipeline and a tributary of West Fork Sweetwater Creek known as Forsman Draw. On the mainstem of Sweetwater Creek, the Sweetwater diversion dam feeds water to the Sweetwater Canal, which conveys the water supply out of the Sweetwater Basin into the Lindsay Basin.

- **Lindsay Creek Basin Elements**: Water from the Sweetwater Basin (via the Sweetwater Canal) is stored in Reservoir A. From this reservoir, water is supplied directly to the LOID service area via pipeline and the Project distribution system.

3.2 Facilities and Operations

Project facilities and historic operations are summarized in this section. More detailed information on stream flow volumes and facility operations is provided in Appendix B, “Hydromet Data.”

3.2.1 Captain John Creek Elements

3.2.1.1 Description

Project facilities in the Captain John Creek Basin consist of a small diversion/impoundment structure on Captain John Creek and the Captain John Canal which conveys water from the diversion into the headwaters of Webb Creek in the Sweetwater Basin. The first half mile of the canal has a 36-inch half round corrugated steel liner that was installed in 1991 to 1992. At the end of the steel liner, the canal enters an excavated earthen section that discharges into Soldiers Meadow Reservoir. The capacity of these facilities is approximately 6.3 cfs (Metz 2009).

The Captain John diversion structure and a portion of the Captain John Canal

3.2.1.2 Operation

The Captain John diversion is operated only in the early spring when water is available, typically in late April or early May. Without abundant spring rainfall, this diversion typically provides water for only a few weeks. It seldom operates at its full capacity.

3.2.2 Sweetwater Basin—Webb Creek Elements

3.2.2.1 Soldiers Meadow Dam and Reservoir

Description

Soldiers Meadow Dam is an embankment dam located on the headwaters of Webb Creek, approximately 26 miles southeast of Lewiston, Idaho. The dam was originally constructed as a random earthfill embankment by private interests in 1922, with ownership transferred to Reclamation in 1947. The dam was modified in 1986 under the Safety of Dams (SOD) program. The following description and specifications are for the facility as modified in 1986.

The dam is a zoned earthfill structure with a structural height of 68 feet and a crest length of 630 feet at crest elevation 4529.0. It impounds a reservoir containing approximately 2,370 af of active storage at a water surface elevation of 4517.9. The upstream face of the dam is protected by a riprap blanket above elevation 4500.0, and the downstream face is seeded with native grasses.

The spillway is located approximately 300 feet east of the right abutment of the dam, and has a discharge capacity of 7,040 cfs at reservoir water surface elevation 4526.0. It consists of the following items:

- A grouted, riprap-lined inlet channel
- Left and right spillway dike embankments
- An uncontrolled trapezoidal weir at crest elevation 4517.9
- Six 48-inch corrugated metal pipes (CMPs) passing under the dam access road approximately 80 feet downstream from the spillway weir
- An excavated and riprapped discharge channel with six drop structures formed by a vertical section of CMP; the upstream portion of the riprap lining of the discharge channel is grouted

The outlet works are located to the right of the embankment section and include a fish-screen-enclosed intake structure containing two side-by-side 12-inch by 12-inch inclined slide gates for regulating the outflow. The screen structure is located upstream of the outlet gates in order to prevent larger debris from damaging or impeding the gates, and to prevent fish from becoming entrained in the outlet works. The screen consists of half-inch by 2-inch carbon steel flat bars on 4-1/2-inch centers, covered with stainless steel fabric panels with 1-inch square openings (Reclamation 1999).

Soldiers Meadow Reservoir

Operation

Typically, the Soldiers Meadow dam outlet works gates are closed between mid-September and mid-October of each year and remain closed to store water until the start of the irrigation season.

Inflows to the reservoir occur mainly during the January to June period and vary considerably from year to year. Due to the small size and relatively low elevation of the watershed, inflows are significantly impacted by spring rains. In most years, the total flow into Soldiers Meadow Reservoir is substantially less than the reservoir capacity. Because of this variability, carryover storage from previous years is essential to assuring a reliable supply of water.

The reservoir typically reaches its maximum levels in late May or early June. In wet years, water may be released from the reservoir in April or May as a flood control measure, as was the case in 2003. In most years, LOID begins releases from Soldiers Meadow in June or July for irrigation water, with the highest rates of release occurring in July and August. In dry years, releases for irrigation use may begin as early as late May. Over the 2000 through 2008 period of record, releases from the reservoir averaged: 1.5 cfs in April, 1.8 cfs in May, 3.5 cfs in June, 8.1 cfs in July, 7.8 cfs in August, 4.0 cfs in September, and 0.4 cfs in October. Discharge from the reservoir less than 1 cfs is related primarily to normal seepage and not part of active operations (see Appendix B, "Hydromet Data," for further detail).

Snow surveys of the Soldiers Meadow drainage area are made monthly from January through April by LOID in cooperation with the Snow Survey Section of the U.S. Soil Conservation Service. Precipitation records are kept through the year. Comparison of prior-year records with current conditions are made to estimate potential inflows.

Operating procedures limit active capacity to 2,370 af plus a surcharge of 1,139 af (to be used only during a flood that exceeds outlet capacity). In the event of a spring flood, the outlet works are fully opened in order to limit the reservoir elevation to 4526.0 (3.0 feet below the crest of the dam) if possible.

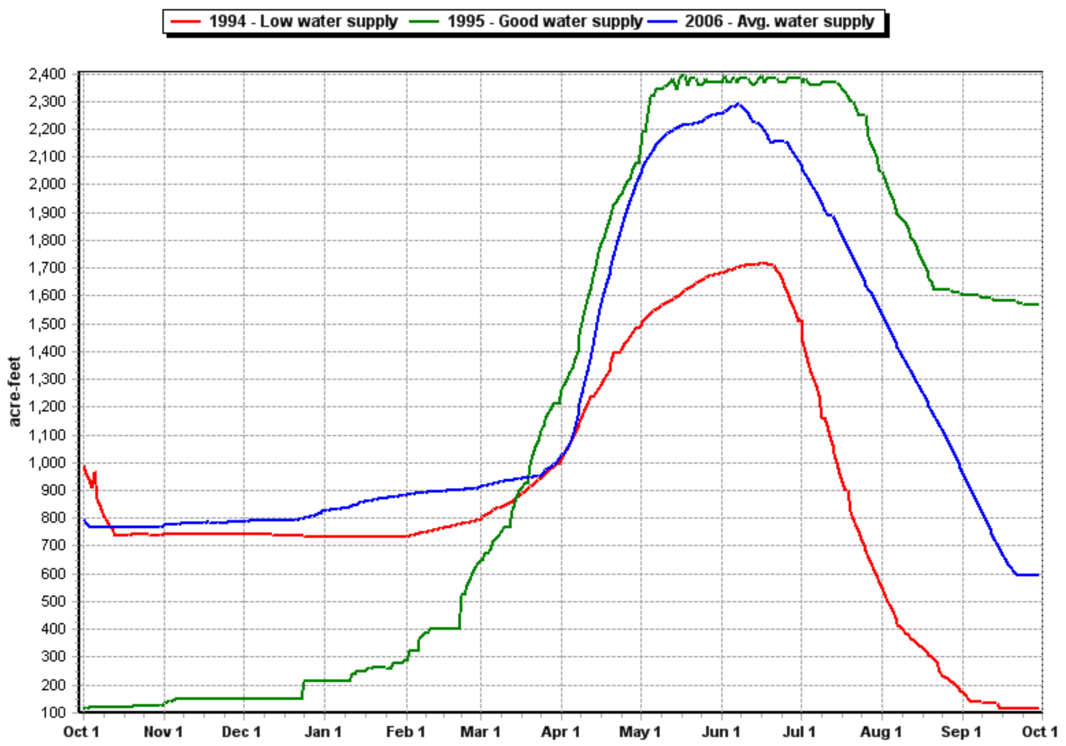
Should flood conditions appear imminent, the River and Reservoir Operations Group, U.S. Bureau of Reclamation, Pacific Northwest Regional Office, Boise, Idaho, assists in establishing criteria for current conditions.

The maximum reservoir water surface elevation to date since completion of the 1986 dam safety modifications was 4518.4 feet on April 26, 1989. The maximum historic release through the spillway and outlet works was 145 cfs, on April 26, 1989. The maximum downstream safe channel capacity in Webb Creek is 150 cfs.

Figure 3-1 graphs Soldiers Meadow storage volume for water years representative of low, good, and average water supplies conditions (such as reservoir inflows) and under historic Project operations. Daily data collected in the 2000 to 2008 period of record for reservoir storage volume, including average monthly volumes and associated water surface elevations, are provided in Appendix B, "Hydromet Data."

As shown on Figure 3-1, in wetter years (like 1995), the reservoir can fill from nearly empty and end the season with water to carry over the winter; however, in dry years (such as 1994), releases from the reservoir to meet Project demand may exceed inflows, with less storage at the end of September than was carried over from the previous year. The latter case in particular demonstrates the importance of carryover storage. In 1994, the reservoir would have been empty in July without the 700 af in the reservoir from the previous season.

Figure 3-1. Soldiers Meadow Reservoir storage volume hydrographs in low, average, and good water supply conditions.



3.2.2.2 Webb Creek Diversion Dam and Canal

Description

The Webb Creek diversion dam is located approximately 15 miles southeast of Lewiston, Idaho, and 6 miles downstream of Soldiers Meadow Dam. Water from the diversion dam is conveyed to the East Fork of Sweetwater Creek by the Webb Canal. The diversion capacity of these facilities is approximately 20 cfs.

The diversion dam is a rock fill overflow weir-type structure with a structural height of 20 feet. The outlet works include two rising stem slide gates that release water into two 30-inch concrete pipes. One of these pipes diverts water into the pipeline and canal; the other passes water through the dam into the creek below for sluicing purposes. The dam is equipped with a compound rectangular weir mounted to the spillway crest and a water level sensor to measure forebay elevation. The weir blade and level sensor allow LOID to measure and control water passing the dam. Automatic controls can also adjust the gates to regulate flows into the Webb Creek pipeline/canal and maintain the forebay level.

The canal consists of a 7,800-foot-long section of 30-inch pre-cast concrete pipe beginning at the diversion dam, and a 500-foot earth-lined channel at the downstream end of the pipeline. Flows in the canal are measured at a Cipolletti weir at the downstream end of the pipeline section. This site also is equipped to record and transmit flow data to the LOID office.

The Webb Creek diversion structure. Photo at right shows compound measurement weir on the dam crest.

Measurement weir below pipe outlet on Webb Canal

Operation

Currently, LOID begins diverting natural flow from Webb Creek (from the watershed downstream of Soldiers Meadow dam) in late February or early March of each year.

During irrigation season, both instream flows and releases from Soldiers Meadow (as needed) are diverted from Webb Creek via the Webb Canal to Sweetwater Creek and to Reservoir A via the Sweetwater diversion and canal. Table 3-1 shows the average monthly diversion rates in the Webb Canal for the 2003 through 2008 period of record.

Table 3-1. Average monthly diversion rates into/through the Webb Canal.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	0.00	7.50	13.30	18.00	14.60	3.70	11.10	9.70	4.80	0.20	0.00	0.00
2004	0.00	0.00	8.80	6.30	11.60	9.90	10.00	11.30	0.60	0.60	1.00	0.00
2005	0.00	0.00	3.00	9.50	9.20	4.40	8.70	9.40	8.10	7.40	0.00	0.00
2006	0.00	0.00	10.00	18.30	5.90	8.30	8.60	8.70	7.30	0.20	0.00	0.00
2007	0.00	0.00	18.10	14.80	4.60	3.60	6.70	11.00	5.40	0.00	0.00	0.00
2008	0.00	0.00	0.00	17.90	17.70	15.40	9.50	5.90	10.30	0.00	0.00	0.00
Avg.	0.00	1.20	8.90	14.10	10.60	7.50	9.10	9.30	6.10	1.40	0.20	0.00

3.2.3 Sweetwater Basin—Sweetwater Creek Elements

3.2.3.1 West Fork Diversion Dam and Waha Feeder Canal

Description

The West Fork diversion dam is located in the upper reaches of the West Fork Sweetwater Creek. Water from the dam is conveyed for storage in Lake Waha by the Waha Feeder Canal. The diversion capacity of these facilities is approximately 15 cfs.

The diversion dam is a small concrete structure approximately 2 feet high. The canal is comprised of a pipeline section which daylights into an open canal and rock channel before discharging into Lake Waha. Flows in the canal are measured at a Cipolletti weir at the downstream end of the pipeline section.

West Fork Diversion Dam

Waha Feeder Canal near head and drop into Lake Waha at end of Canal

Operation

The West Fork diversion and Waha Feeder Canal diverts water when available; the diversion is a passive feature, with no gate automation. As shown on Table 3-2, during the 2000 through 2008 period of record (see Appendix B, “Hydromet Data”), diversions occur primarily in March through June, with the highest average rate (8 cfs) in April and the lowest average rate (1.9 cfs) in June. However, Table 3-2 also illustrates the wide variability in local hydrologic conditions; for example, diversions can occur as early as January and last as late as July; in fact, in 2006, water was diverted during warm, rainy weather in November and December.

Table 3-2. Average monthly diversion rates into/through the Waha Feeder Canal.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	0.00	0.50	4.80	9.90	4.30	1.30	0.00	0.00	0.00	0.80	0.00	0.00
2001	0.00	0.20	6.60	13.50	7.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.10	0.10	1.40	12.00	3.00	4.60	0.00	0.00	0.00	0.00	0.00	0.00
2003	1.90	3.70	7.70	7.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2004	0.00	0.00	3.30	2.40	14.00	4.70	0.00	0.00	0.00	0.00	0.00	0.00
2005	0.40	0.40	0.40	4.40	7.30	1.30	0.00	0.00	0.00	0.00	0.00	0.00
2006	0.00	0.00	1.10	11.90	2.50	1.40	0.10	0.00	0.00	0.00	0.50	0.80
2007	0.10	1.50	6.90	5.50	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.70	4.50	12.00	4.20	0.00	0.00	0.00	0.00	0.00	0.00
Avg.	0.30	0.70	3.70	8.00	5.70	1.90	0.00	0.00	0.00	0.10	0.10	0.10

3.2.3.2 Lake Waha and Lake Waha Pump

Description

Lake Waha is a natural lake used by the Project as an offstream reservoir. Located approximately 1 mile southeast of the village of Waha, the lake is contained in a natural bowl created by a prehistoric landslide. It has no natural surface outlet; natural outflow from the lake is via seepage through subsurface strata that emerges in downstream springs (Sweetwater Springs—described further in Chapter 5, “Hydrologic Conditions”). The storage capacity of the lake is 6,900 af; however, there is no historic record of the lake reaching this capacity.

Lake Waha

The lake is filled primarily by Lake Creek and from natural springs, with most inflow occurring during the March-to-June period each year. This natural inflow is supplemented with surface water diverted from the West Fork Sweetwater Creek via the West Fork diversion dam and Waha Feeder Canal. Maximum fill occurs in May or June. As water levels in the lake rise and peak in the springtime, seepage losses from the lake increase and then decline as the levels drop. Much of the seepage from the lake ultimately reaches Sweetwater Creek through subsurface strata.

Historically, water surface elevations at the lake were measured manually using a staff gauge. These records are of uncertain accuracy and were recorded too infrequently to create a useful data record. In 2004, monitoring equipment was installed to read, record, and transmit water surface elevations on the lake to Reclamation’s Hydromet system. This measurement station began collecting data in the fall of 2004, providing a complete record for 4 years. Between 2005 and 2008, the maximum storage in Lake Waha was 4,808 af (on June 18, 2008), and the minimum amount of storage was 2,590 af (on September 24, 2007). The average for the 4-year period was 3,195 af with an average water surface elevation of 3371.42 feet.

Because the lake has no surface outlet, LOID draws water from storage via a pump station located on a floating platform at the north end of Lake Waha. The pump intake is located about 13 feet below the water surface. The pump discharge is in a high-density polyethylene (HDPE) pipe secured to floating blocks, which serve as alignment and flotation. The Lake Waha Pump electrical controls and transformers are located on the hillside adjacent to the lake. The discharge line continues from the lakeshore in an underground pipeline that discharges via Forsman Draw to the West Fork of Sweetwater Creek.

Lake Waha Pump and part of the outlet pipeline

Operation

LOID pumps water from Lake Waha as an important supplement to surface water supplies from Webb and Sweetwater creeks. Water from this facility is used to finish the irrigation season, generally when supply from Soldiers Meadow Reservoir is insufficient to meet system demands or is exhausted. Historically, this has translated into pumping beginning in June or July and lasting through September.

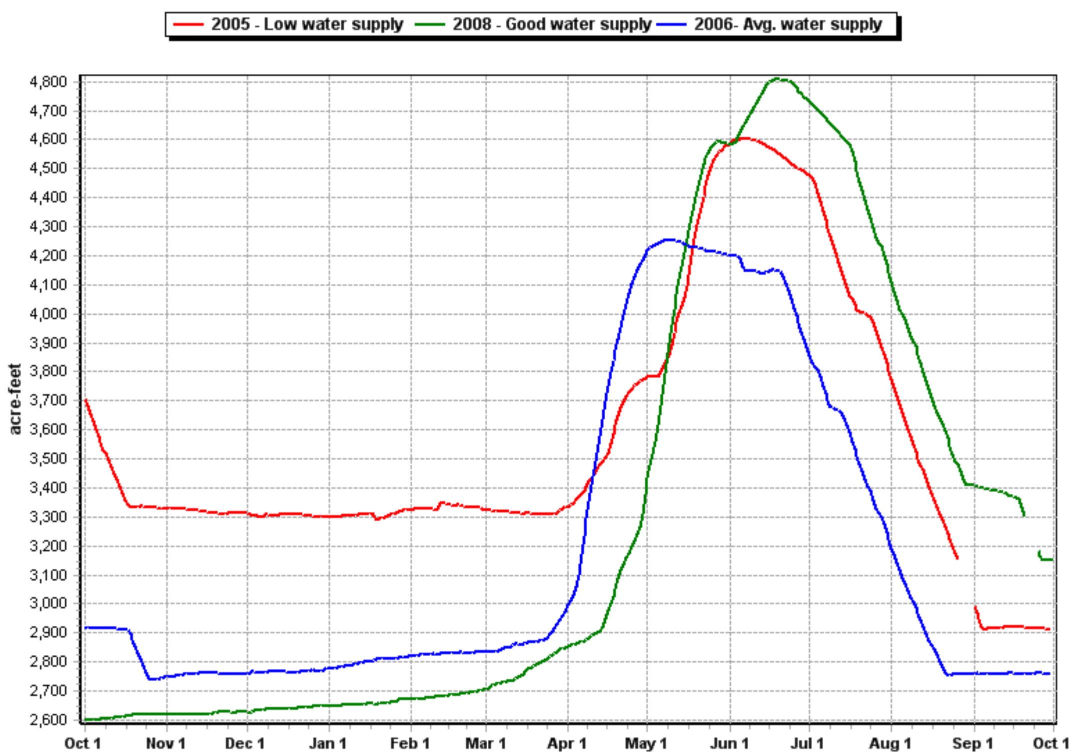
LOID tries to minimize the drawdown of Lake Waha as much as possible. The reasons for this center on concerns related to refill and long-term storage, managing pumping costs, and avoiding damage to the pumping plant. In the first regard, because of insufficient inflows, it is more difficult to refill once it is drawn down to low levels. As the lake's water elevation drops, pumping lift increases and the output of the pumping plant is reduced, which increases pumping cost. Finally, as the intake of the floating pump gets closer to the bottom of the lake, there is an increased risk of pump damage due to intake of sediment and rocks.

Historic annual Project withdrawals from Lake Waha average approximately 720 af, but have ranged from 0 to 2,500 af. There are no diversions from the lake from November to April, and normally not in October, May, or June.

Figure 3-2 graphs Lake Waha storage volume for water years representative of low, good, and average water supplies conditions under historic inflow and Project operations conditions. Daily data collected in the 2000 to 2008 period of record for Lake Waha storage volume, including average monthly volumes and associated water surface elevations, are provided in Appendix B, "Hydromet Data."

Comparison of storage volumes at the beginning and end of each water year demonstrates the impacts of the variable water supply. In addition, by noting the end-of-season storage volume of the dry year (2005), the value of carryover storage can be observed. The end-of-season storage would be substantially lower without water from the previous year. Consecutive dry years can be particularly detrimental.

Figure 3-2. Lake Waha storage volume patterns in dry, average, and wet years.



3.2.3.3 Sweetwater Creek Diversion Dam and Sweetwater Canal

Description

The Sweetwater diversion dam is located about 12 miles southeast of Lewiston, Idaho. It diverts water from the mainstem of Sweetwater Creek into the Sweetwater Canal.

The dam is a rock fill overflow weir-type structure with a structural height of 12 feet. The headworks include a 5-foot by 4-foot slide gate that has a combined diversion capacity of 77 cfs (although diversions are generally limited to $\leq$30 cfs by the design capacity of the Sweetwater Canal).

The diversion structure is equipped with a weir blade in the overflow spillway section and a Stevens Recorder that measures forebay elevation. Remote operating and measurement equipment is installed at the outlet works into the Sweetwater Canal, the bypass into Sweetwater Creek (located in the canal sluice way at the dam), and the Sweetwater dam overflow weir.

Measured sluice outlet for bypass flow at Sweetwater diversion dam. Water is flowing over compound weir on dam crest at upper left.

The Sweetwater Canal begins at the Sweetwater diversion dam and extends for about 9 miles to Reservoir A.

The canal begins as a 5-foot by 5-foot concrete box flume that is approximately 1.81 miles (9,565 feet) long. It then continues into a lined portion for approximately 1,800 feet. This section was lined between the 2006 and 2007 seasons with an impervious membrane protected on both sides by geo-textile layers. The lining also is covered with a protective layer of shotcrete. The remaining 6.4 miles of the Sweetwater Canal are earth-lined, with the exception of short sections that have been lined with compacted earthfill, pipe, or membrane liners.

The end of the Sweetwater Canal spills over a 4-foot Cipolletti weir into the Mann Lake (Reservoir A) Feeder Canal. The water is either diverted from the feeder canal to a siltation basin or it is diverted down the upper reaches of the Lindsay Creek channel before entering into Reservoir A.

Measuring flume in transition from original bench flume to lined section of Sweetwater Canal and dewatered photo of lined Sweetwater Canal reach

Operation

Table 3-3 shows the average monthly diversions into Sweetwater Canal over the 2003 to 2008 period of record. As shown, peak rates of diversion occur in June, July, and August, with highest average over the 6-year record of 22.1 cfs in July. Historically diversions have begun as early as February and can continue into October. In response to the remand settlement agreement and as part of the PA described in Chapter 4, the beginning of diversions is now generally targeted for March (as in 2008); however, hydrologic and climatic conditions will likely continue to warrant diversions in February of some years.

Table 3-3. Average monthly diversion rates into/through the Sweetwater Canal.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	0.0	8.1	12.4	2.7	9.5	13.6	23.6	29.4	25.4	4.7	0.0	0.0
2004	0.0	1.77	21.18	19.25	10.35	13.27	24.30	23.94	6.30	10.99	0.00	0.00
2005	0.0	0.0	9.1	19.6	8.0	14.0	24.5	28.8	11.9	9.8	2.3	0.0
2006	0.0	8.4	11.9	7.5	16.0	18.0	17.7	9.0	1.9	0.0	0.0	0.0
2007	0.0	2.0	14.2	18.6	7.7	19.0	21.7	16.9	6.2	0.0	0.0	0.0
2008	0.0	0.1	4.7	14.1	23.5	21.9	20.6	18.9	14.6	0.0	0.0	0.0
Avg.	0.0	3.4	12.2	13.6	12.5	16.6	22.1	21.2	11.1	4.2	0.4	0.0

3.2.4 Lindsay Creek Basin Elements—Reservoir A

3.2.4.1 Description

Reservoir A dam is an embankment dam, located on Lindsay Creek, approximately 7 miles southeast of Lewiston, Idaho. The dam impounds Mann Lake, which is fed by the Sweetwater Canal. The Project was originally constructed by private interests beginning in 1906. Reservoir A dam was built and modified in numerous stages. Information on some of the early work is sketchy and detailed information frequently conflicts between drawings and reports. Construction of Reservoir A dam started in 1906 with a design consisting of two initial parallel homogeneous earthfill embankments, followed by placement of hydraulic earthfill material between the embankments. However, the center portion of the dam was never completed to its full height. Both embankments have a length of approximately 2,200 feet, and a structural height of about 60 feet.

The dam was later modified under the SOD program in 1998. The reservoir previously had an active capacity of 3,000 af at elevation 1808, but due to dam safety concerns, the maximum water surface elevation in the reservoir was restricted to elevation 1800 feet. This reduces maximum storage capacity to 1,960 af. Reclamation has completed a preliminary evaluation of the SOD restrictions and in late September 2009 decided to revise the restriction to elevation 1,804, which would permit an additional 480 af of storage (maximum storage of 2,440). Modeling performed for the PA has considered the potential additional storage of 500 af above the historic minimum in order to assess possible impacts.

The spillway is located 1,500 feet to the right of the dam on the north rim of the reservoir. The uncontrolled spillway channel is unlined and discharges into Soldiers Canyon Creek. A 1989 survey showed the spillway channel to be 35 feet wide and 175 feet long, with a crest elevation of 1810.0 feet. There has never been flow through the spillway channel, and discharge capacity is unknown.

The outlet works consist of a 36-inch pipe through both embankments. There is an inclined concrete intake on the upstream face of the upstream embankment along with a 34.25-inch by 48-inch emergency slide gate. On the downstream side of the lower embankment is a 36-inch gate valve, along with a steel fish screen tank and an 18-inch butterfly valve for serving as an outlet drain to Lindsay Creek.

The outlet works capacity is estimated to be 70 cfs with the reservoir at the top of the active conservation pool elevation of 1800, and with the emergency gate and the 18-inch butterfly valve fully open.

Reservoir A

3.2.4.2 Operation

The dam is located off-channel from Sweetwater Creek on the plateau near the upper reaches of the Lindsay Creek drainage. Drainage area upstream of the dam is 0.98 square miles. The outlet gates of Reservoir A dam are kept fully open year-round, and reservoir releases are controlled by water-user demands from the two independent closed pressure-type irrigation and fire systems.

The normal irrigation season is from April 15 to October 15. Peak irrigation demand extends from about July 1 to August 30. During non-irrigation season, the system providing this service must remain pressurized to provide fire protection through the distribution system. Stock water also is released during the non-irrigation season.

There is no inflow forecasting procedure for Reservoir A. The natural drainage area is negligible and inflow is primarily dependent upon deliveries from the Sweetwater Canal.

The maximum reservoir water surface elevation to date is 1810.3, and the date it occurred is unknown. Since the reservoir restriction of 1800 feet (top of active storage) was implemented in 1991, the reservoir water surface has not exceeded elevation 1800. However, as noted above, the restriction has been modified to 1804 feet as of September 2009; storage to this new maximum likely will be seen in 2010.

The maximum historic releases and associated dates through the spillway and outlet works are unknown, and there are no records of spillway discharge.

The maximum safe downstream channel capacity of Lindsay Creek is estimated by LOID personnel as 50 cfs.

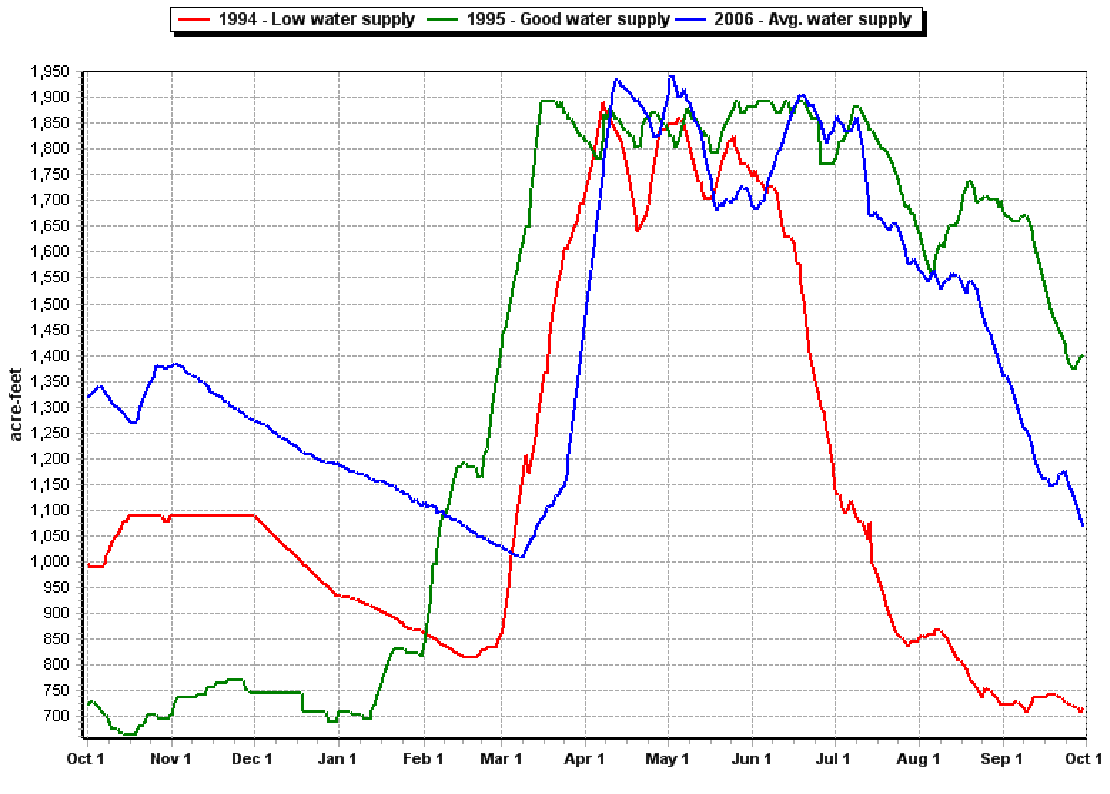
The LOID generally begins filling the reservoir in the spring, when high stream flows are available. The reservoir usually fills in May or June and generally stays nearly full into mid-June. In some dry years, when irrigation demand starts early in the year, the reservoir begins to drop in May. Once stream flows decline, stored water is moved down from Soldiers Meadows and Lake Waha. The reservoir drafts through the summer as irrigation demands exceed inflows to the reservoir. Since the timing and amount of precipitation in the Sweetwater Basin can vary significantly from year to year, it is important for LOID to carry over as much stored water as possible in Mann Lake, Soldiers Meadow, and Lake Waha reservoirs in order to help insure adequate supply in the subsequent irrigation season.

The reservoir also supplies water for livestock water during the winter, requiring some drafting during the non-irrigation season, and provides water for fire protection for the city of Lewiston. In the latter regard, in order to maintain adequate water and pressure for fire protection, at least 500 af of water has been kept in the reservoir at all times (water surface elevation 1782.8 feet). LOID is currently evaluating the possibility of a reduction in this fire pool to 100 af. This evaluation is not expected to be complete until early 2010; however, modeling performed for the PA has considered the potential of drafting Reservoir A below the 500 af historic minimum in order to test operations under proposed minimum instream flows.

Figure 3-3 illustrates the operations of Mann Lake during 3 water years that can be characterized as having a low water supply (1994), a good water supply (1995), and an average water supply (2006). Daily data collected in the 2000 to 2008 period of record for Lake Waha storage volume, including average monthly volumes and associated water surface elevations, are provided in Appendix B, “Hydromet Data.”

In years of abundant supply with sustained stream flows, the reservoir levels can be filled and maintained near full well into the summer. In average years when the stream flows drop off earlier, Reservoir A is sustained with releases of stored water from Soldiers Meadow and Lake Waha. Reservoir A is allowed to draft significantly in July and August in order to maintain as much storage higher in the system as possible. In dry, hot years, the reservoir may start drafting in late May or June to meet early season irrigation demand.

Figure 3-3. Reservoir A storage volume patterns in dry, average, and wet years.



Chapter 4 PROPOSED ACTION

4.1 Introduction

The PA is future operations and routine maintenance of the Project, including storage and release of water from Soldiers Meadow Reservoir, Lake Waha and Reservoir A; diversion of water at Captain John Creek diversion, Webb Creek diversion, West Fork Sweetwater diversion, and Sweetwater Creek diversion; and routine maintenance of storage, conveyance, access, and appurtenant facilities.

The Snake River steelhead is the focus of this BA and analysis. This species' distribution and Project operations overlap in the stream habitats downstream from Sweetwater and Webb diversion dams. Therefore, much of the PA focuses on providing instream flows downstream of these two dams.

4.2 Background and Context

The process through which this PA has been developed benefitted from a number of activities, studies, data sets, and modeling tools that were not available to support prior efforts. This PA is based on significantly improved technical/scientific data and analysis.

The following key factors and considerations combined to influence and support development of the PA:

- Remand period collaborative process
- New technical data to support the basis for specifying minimum instream flows
- More in-depth understanding of relevant legal frameworks related to provision of instream flows

An overview of each of these factors/considerations is provided next.

4.2.1 Remand Period Collaborative Process

As specified in the May 2008 Stipulated Agreement and Order of Remand, Reclamation and NMFS agreed to collaborate with Tribe at each stage throughout the development of the PA and Biological Opinion.

From September 2008 through April 2009, the Parties engaged in a collaborative work process as part of the developing the PA. The objectives of this process were to develop the items to be included in the PA and reach agreement or narrow areas of disagreement on scientific and technical information.

The Parties met eight times during the collaborative process and conducted several conference calls between meetings. The Parties continued to collaborate throughout the development of the BA.

Key activities and results of this process that directly influenced development of the PA included:

- Collection of field data to characterize physical habitat conditions along Sweetwater and Webb creeks;
- Modeling of fish habitat in Sweetwater and Webb creeks using the physical habitat simulation (PHABSIM) program package;
- Development of improved hydrologic and operational analysis tools to test the feasibility, reliability and potential tradeoffs associated with candidate flow regimes;
- Articulation of several fundamental concepts that would characterize the PA and directly address issues and concerns with the prior PA evaluated in the 2006 Biological Opinion (NMFS 2006a). The concepts include the following:
    - Eliminating the proposal for a drought exemption/drought contingency, and specifying a minimum instream flow regime that can be provided in all years.
    - Eliminating a short-term transition period, and implementing the proposed instream flow regime immediately upon issuance of the Biological Opinion.
    - Setting minimum target instream flows during the irrigation operation season and foregoing diversion at the Sweetwater and Webb diversion dams when instream flows are less.
    - Providing summertime (juvenile rearing) instream flows higher than specified minimums when available, based on hydrologic and storage conditions (guided by specific hydrologic/storage volume criteria).
- Finalization and agreement on ramping rates and the sediment removal and gravel replacement plan at Sweetwater diversion dam.

4.2.2 Scientific and Technical Basis for Specifying Minimum Instream Flows

Reclamation's prior PA, as well as related analysis in the Supplemental Biological Assessment (Reclamation 2001), was based in large part on indirect and extrapolated data related to the estimation of available stream flows and the assessment of flow-habitat relationships in the Action Area. Uncertainties inherent in this situation were compounded by the lack of hydrologic data and the availability of only rudimentary hydrologic/project operations modeling tools. The work effort conducted in developing the present PA has sought to directly address these limitations, as described next.

- **Action Area—Specific Habitat Data and Modeling:** In the previous PA, the identification of necessary minimum stream flows for Webb and Sweetwater creeks relied on various applications of the Instream Flow Incremental Methodology (IFIM). The PA presented in this BA also uses this methodology, but relies on more complete, site-based data sets that result in improved information informing the analysis. This improved information includes complete transect data collected at two test flows in Webb Creek and three test flows in Sweetwater Creek.

  As part of the remand period collaborative process, stream cross-section data was gathered in October 2008 at 40 locations along Sweetwater Creek and 20 locations along Webb Creek. This area-specific information allowed modeling of flow-habitat relationships for both streams. The Parties in the collaborative process agreed that the PHABSIM package was the appropriate tool to be used in the habitat modeling effort and jointly made decisions necessary for model input and calibration. Reclamation conducted the habitat modeling work from November 2008 through January 2009, and the methods and results were summarized in Lewiston Orchards Project Instream Flow Assessment for Sweetwater and Webb creeks (Reclamation 2009c).

- **Hydrologic Data and Modeling:** Reclamation has collected detailed hydrologic data for the Project area since 2003. Thus, entering the remand period collaborative process and developing a new PA, a 6-year data set (2003 to 2008) was available to include in the analysis. While neither this nor any other data set can eliminate uncertainty related to variability of hydrologic conditions in the Action Area, the new data do provide area-specific information for a variety of water-year types that was not previously available.

  Related to the hydrologic and operations analysis, Reclamation has refined and further developed its analytical capability for testing the feasibility and long-term reliability of candidate flow regimes. The resulting Microsoft® Excel®-based spreadsheet model provides significantly improved understanding of the interrelationships and interdependencies among hydrologic conditions, instream flows, irrigation deliveries, reservoir carry-over (a central variable influencing year-to-year reliability), and other aspects of Project operations. When used with the 6 years of hydrologic data, this spreadsheet analysis contributed to Reclamation’s decisions for and specification of the proposed instream flow regime.

Overall, the result of this work is a significantly improved scientific and technical foundation on which to base a proposed instream flow regime and other aspects of the PA. While some limitations in the available data and associated uncertainty unavoidably remain, the present PA is based primarily on Action Area-specific information and analysis, rather than indirect, extrapolated sources.

4.2.3 Legal Framework for Providing Instream Flows

In developing a PA for the Project, fulfilling the requirements and responsibilities related to the ESA/EFH was the primary goal. However, the legal framework within which this action can be implemented also includes Project contract requirements, Congressionally specified Project purposes, and State water rights summarized here:

- The terms of Reclamation’s September 10, 1947, repayment contract entitle each assessable acre of land in the LOID to an irrigation water supply not to exceed 2.2 af per acre measured at the point of delivery to each operating unit. This does not account for conveyance needs, evaporation, or losses in the system to groundwater. The contract recognizes that that there may be periods where the full irrigation amount may not be available and allows for the LOID to determine a lesser but uniform amount of irrigation water to be furnished based on water supply. All active capacity of the Project storage facilities is contracted to the LOID.
- In the July 31, 1946, act that established the Project, Congress did not include fish and wildlife as an authorized Project purpose; therefore, Reclamation is limited in its ability to operate the Project for these purposes. Reclamation can use the State of Idaho Water Bank system to release Project water for fish and wildlife purposes. Using this legal system, Project water is placed into the Water Bank by willing contract holders, then leased to the instream flow right held by the Idaho Water Resources Board. Instream flow rights for Sweetwater and Lapwai Creeks were established by State law in 2006 (Idaho Code Section 42-15070) as: 0.8 cfs for summer rearing and 14.2 cfs for spring spawning, 4.7 cfs for summer rearing and 39.9 cfs for spring spawning, and 18 cfs for summer rearing and 209 cfs for spring spawning in Webb, Sweetwater, and Lapwai creeks, respectively. A complete summary of the instream water rights can be found at http://www.idwr.idaho.gov/waterboard/waterplanning/minimum%20stream%20flow/minimum_stream_flow.htm.

- Instream flows will be provided by the LOID through the Idaho State Water Bank, consistent with Project authorities and Idaho State law. The Project will forego storage in Reservoir A and diversions at Sweetwater and Webb Creek diversion dams to provide the minimum flows described in this PA. The biological analyses included in this document rely on the Idaho State Water Bank system to deliver this water to the mouth of Lapwai Creek. Reclamation's authority and ability to control this water ends at the Webb and Sweetwater diversion dams where the bypass flows will be provided.

4.3 Proposed Action—Future Project Operations and Maintenance

As mentioned previously, the PA is future operations and routine maintenance of the Project, including storage and release of water, diversion and conveyance of water, and routine maintenance of storage, conveyance, access, and appurtenant facilities.

The PA for the Project foregoes storage and diversions to provide instream flows past Sweetwater Creek and Webb Creek diversion dams. This is in contrast to historic operations through which the LOID diverted all available water up to the maximum capacity of Project storage and conveyance facilities, often resulting in little or no instream flow in either creek during the summer months. The proposed instream flow regime, based on new hydrologic and habitat modeling and the best scientific information available, will supplant the interim instream flows specified and provided in 2008 and 2009 pursuant to court settlement agreement.

In addition to instream flows, the PA includes operations and maintenance actions governing flow ramping rates and sediment/gravel management to mitigate impacts to fish habitat, procedures for dealing with emergency situations (such as equipment failure); commitments for monitoring and documentation of PA implementation; and a specified duration of the PA.

Each of these elements of the PA is described in this section according to the outline below. Overall, the PA has been designed to fulfill Reclamation's responsibilities and requirements related to listed fish pursuant to the ESA and other relevant regulations including the MSA Essential Fish Habitat.

- Instream flow regime
- Operational criteria
    - Measurement locations
    - Ramping
- Maintenance
    - Description of maintenance activities
    - Sediment and gravel management

- Contingency/emergency response procedures
- Monitoring and documentation
- Duration of the PA

4.3.1 Instream Flow Regime

4.3.1.1 Description and Specification

The proposed instream flow regime for the Project is shown on Table 4-1, with explanations of the major aspects of the proposal provided in the following paragraphs. For both Webb and Sweetwater creeks, instream flows are specified for the reaches below the respective diversion dams (that is, flow values represent the rate that will be bypassed at the diversion dams). Steelhead distribution and critical habitat are only located downstream of the Sweetwater and Webb diversion dams.

Table 4-1. Instream flow releases (cfs) for Sweetwater and Webb Creeks.

Life Stage:	**Juvenile Rearing**	**Spawning**			**Juvenile Rearing**								
Month:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep 1-15	Sep 16-30	Oct	Nov	Dec
Sweet-water Creek	I[a]	7.8/I[b]	7.8/I	7.8	3.0	2.5-3.5	2.5-3.5	2.5-3.5	2.5-3.5	2.5	2.5	I	I
Webb Creek	I	4.0/I	4.0/I	4.0	1.5	1.0-2.0	1.0-2.0	1.0-2.0	1.0-2.0	1.0	1.0	I	I

[a] Months shown as "I" (November to January) are those when the Project will not divert water at Webb and Sweetwater creek diversion dams. In these months, all stream flow reaching the diversion dams will be bypassed. For Webb Creek, the "I" flow is composed of all runoff downstream from Soldiers Meadow Dam; for Sweetwater Creek this value is composed of all runoff downstream from Lake Waha except for runoff diverted by the West Fork diversion.

[b] Months shown with a "[value]/I" specification (February and March) are those in which either the specified stream flow will be provided or all inflow (I) to the Webb and Sweetwater diversion dams (as described above) will be bypassed, whichever is less. The specified minimum flow will be provided when inflows to the diversion dams are higher than these minimums and the dams are being operated; the "I" flow will be provided if/when inflows to the dams are below specified minimums, in which case the dams will not be operated (i.e. no diversions will occur).

The proposed instream flow regime addresses all months of the year, but focuses on the months when the Project is normally operating (that is, when the main diversions—the Webb Creek and Sweetwater Creek diversion dams—are operating and directly impacting ESA-listed steelhead and critical habitat).

Minimum flow specifications for some months include an “I” (inflow) designator to reflect months when the Webb and Sweetwater creek diversions will not be operated (November to January), or low flow conditions that may occur for periods of time in February and March. Under the latter condition, when the inflows to Webb and Sweetwater Creek diversion dams are below the specified minimum flow, all inflow to the diversion dams will be bypassed. For Webb Creek, the “I” flow is composed of all runoff from the watershed upstream of the diversion below Soldiers Meadow dam; for Sweetwater Creek this value is composed of all runoff from the watershed upstream of the dam, except for any diversions occurring at the West Fork diversion and being conveyed to Lake Waha.

November through January Period

The Project does not operate the Webb Creek and Sweetwater Creek diversion dams during the months of November through January. During these months, all available instream flow reaching the dams will be bypassed unrestricted.

February through October Period

Within the February through October operational period, instream flows are intended to support spawning, incubation, and juvenile rearing for Snake River steelhead. The PA addresses each of these life stages/periods, as described below.

Spawning and Incubation

Spawning and incubation occur simultaneously through much of the spawning season. Spawning requires higher flows than incubation; therefore, minimum flows needed to support spawning are proposed during this period. As shown on Table 4-1, spawning flows will be provided when the Project begins diverting water at Webb and/or Sweetwater diversion dams through April 30. Over this time period, LOID will forgo diversion at Sweetwater and Webb diversion dams and storage at Reservoir A as necessary to provide a minimum of 4.0 cfs in Webb Creek and 7.8 cfs in Sweetwater Creek.

Minimum spawning flows in February and March shown on Table 4-1 include the “I” (inflow) designator to reflect conditions that can occur primarily in February and early March, prior to the beginning of the spring runoff period. According to modeling performed as part of PA development, these conditions occur frequently in February and for a few days in early March in most years when temperatures are cool and dry and thawing of the snow pack has not yet started. These conditions result in less inflow to the dams than the specified instream flows. When such conditions occur, all inflow to the Sweetwater and Webb creek diversions will be bypassed unrestricted.

Also important is the fact that springtime (spawning season) runoff volumes in the Action Area frequently exceed Project storage and conveyance facility capacities, often by a wide margin, and are bypassed at the diversion dams. These springtime high flows occur for periods of time in all years on Sweetwater and Webb creeks, as documented in Chapter 5, “Hydrologic Conditions.” Magnitude and timing of these flows are dependent on climatic conditions such as air temperature, solar radiation, and precipitation. However, these annual events provide channel maintenance flows and spawning flows in excess of the proposed specified minimums.

Incubation and Juvenile Rearing

During May, both incubation and juvenile rearing are expected to occur in the Action Area. Juvenile rearing requires higher stream flows than incubation. Therefore, target minimum stream flows focus on values to provide adequate juvenile rearing conditions. On May 1, instream flows will be ramped down from the proposed minimum spawning stream flows (per ramping specifications in Section 4.3.2.2. “Ramping”) to 3.0 cfs in Sweetwater Creek and 1.5 cfs in Webb Creek. These flows are expected to support incubation and juvenile rearing.

The PA flow regime for Project operations in May through October is specified in three parts: May, June through mid-September, and mid-September through October. In all cases, the minimum flows shown on Table 4-1 will be provided with no drought contingency or exemption; Reclamation believes that these proposed minimum flows meet relevant requirements for ESA-listed fish in the Action Area, based on the best available scientific information. In the June through mid-September period, additional flows are proposed on an “as available” basis. These additional stream flows are the result of discussions and analyses during the remand collaborative process that requested higher summertime instream flows during years when more water is available. Flows to support juvenile rearing during this time period will be from 2.5 to 3.5 cfs in Sweetwater Creek and 1.0 to 2.0 cfs in Webb Creek. Details on the criteria to be used in determining when and to what extent flows above the minimum values will occur are provided next.

Additional Juvenile Rearing Flows in June through Mid September—Specification and Criteria

Up to an additional 2.0 cfs (allocated as 1.0 cfs each in Webb and Sweetwater creeks, as explained next) will be provided when conditions permit. Due largely to the high variability in local hydrologic and climatic conditions, the ability of the Project to provide these “opportunity-based” additional flows cannot be determined until the status of combined storage in Soldiers Meadow Reservoir and Reservoir A is assessed on June 1. At this time, the ability of the Project to provide additional juvenile rearing flows will be assessed and the instream flow value for June through mid-September will be determined and implemented.

The amount of additional stream flow that will be provided will be determined based on the extent to which combined storage on June 1 exceeds 3,800 af. The relationship between combined storage volume and summer instream flow is illustrated by the dotted line on Figure 4-1. On this figure, combined storage is related to total instream flow (Webb and Sweetwater creeks combined; thus, from a minimum of 3.5 cfs to a maximum of 5.5 cfs[1]). Table 4-2 portrays how this relationship would be implemented in terms of storage volume benchmarks and the proposed allocation to Sweetwater and Webb creeks.

Figure 4-1. Total juvenile rearing flows as a function of combined storage.

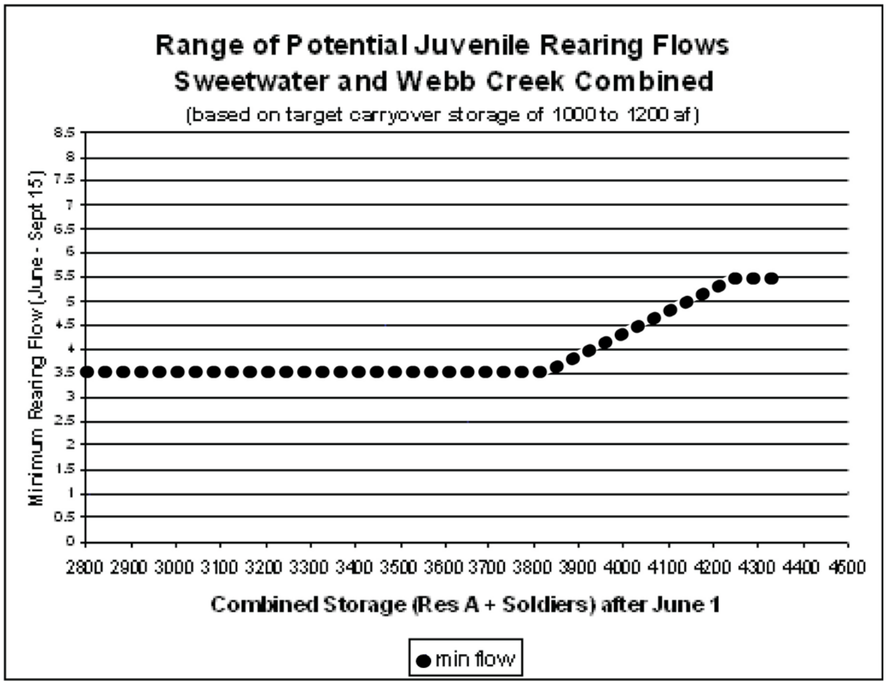


Table 4-2. Increments of additional juvenile rearing flow as a function of combined storage.

Combined Storage (af):	≤3,800	3,900	4,000	4,100	4,200	≥4,250
Sweetwater Creek (cfs)	2.50	3.00	3.40	3.50	3.50	3.50
Webb Creek (cfs)	1.00	1.00	1.00	1.30	1.80	2.00
Total Juvenile Rearing Flow (cfs)	3.50	4.0	4.40	4.80	5.30	5.50

[1] Given the configuration and operation of Project facilities, summer instream flows can be allocated to either Sweetwater Creek or Webb Creek in any combination.

In reviewing Table 4-2, it will be noted that the first 1.0 cfs of additional flow is proposed to be allocated to Sweetwater Creek; additional flows would be allocated to Webb Creek only after 3.5 cfs is being provided in Sweetwater Creek. This priority on Sweetwater Creek is based on hydrologic analyses and data that support that more water is naturally available in this portion of the basin, as well as a higher quality and quantity of spawning and rearing habitat. This decision also follows the desires expressed by Tribal representatives during the remand collaborative process. As noted above, spawning flows higher than the minimums specified in the PA normally occur for periods of time each year and the Project is unable to control the timing and duration of these flows. Therefore, no specific provision for higher spawning flows or channel maintenance flows is necessary. This results in a focus on summertime/juvenile rearing flows, with a priority on Sweetwater Creek.

As discussed in Chapter 5, “Hydrologic Conditions,” Reclamation has reviewed available data to gain insight on the frequency at which the additional juvenile rearing flows can be expected to be provided. Modeling of the PA flow regime using the 2003 to 2008 hydrologic record indicates that the full 2.0 cfs additional flows would have been provided in 2 of the 6 years; review of 2009 conditions indicates that the full 2.0 cfs additional flow also would have been available in this year. In addition, 2 other years would have had an incremental increase of 0.7 to 0.9 cfs of additional flows; the other 2 years would have been at the minimum flow. Given these findings, Reclamation conservatively estimates that some increment of additional juvenile rearing flows can be expected in 50 to 60 percent of years.

4.3.2 Operational Criteria

4.3.2.1 Instream Flow Measurement

Water measurement related to compliance with the stream flows in the PA will be made using the weirs installed on the Sweetwater and Webb diversion dams. Water measurement over these weirs exceeds the accuracy of measuring discharge in a natural channel. Data from these measurement points will be posted and archived on Reclamation’s public website (http://www.pn.usbr.gov/hydromet).

Stream flows will be measured continuously at the Sweetwater and Webb diversion dams. The automated gates adjust continuously to maintain designated stream flow within the capabilities of the equipment. The measurement and gate automation are expected to stay within 15 percent of the intended minimum bypass stream flow.

Reclamation historically has measured Reservoir outflow at Soldiers Meadow and Reservoir A, and has recently installed measurement equipment on the pump at Lake Waha. These measurements will continue for the duration of the PA.

4.3.2.2 Ramping

Ramping of stream flows is intended to make gradual changes during gate operations that avoid stranding fish in dewatered or pooled areas when stream flows are reduced (diversion gates opened) or flushing fish downstream when increasing stream flows (diversion gates closed). These gradual alterations in stream flow are intended to allow fish that are rearing in the streams sufficient time to adjust to changes in stream habitat. Stream flow ramping will be implemented at the Sweetwater and Webb diversion headgates during the following periods: initial opening of the headgates at the start of the irrigation season; down-ramping from spawning flows to juvenile rearing flows on May 1; during the end of the irrigation season when the headgates are closed; and any other time that the headgates are opened or closed during the irrigation season for operation or maintenance purposes.

Maximum gate adjustments for ramping are:

- At high flow (>70 cfs), the maximum gate adjustment will be 10 cfs per day
- At moderate flow (20 to 70 cfs), the maximum gate adjustment will be 5 cfs per day
- At low flow (<20 cfs), the maximum gate adjustment will be 0.5 cfs per 12-hour period

These ramping criteria will be used at all times, unless equipment failure or malfunction occurs.

4.3.3 Maintenance

4.3.3.1 Description of Maintenance Activities

Routine maintenance consists of flushing of sediment accumulations at the Sweetwater Canal headgate and periodic mechanical removal of fine sediment that accumulates above the Sweetwater diversion dam. These sediment removal activities will be discussed in more detail below. Maintenance activities also include repairs and minor modifications to the structures, such as repair and replacement of gate operation hardware; water measurement equipment; and canal improvements and maintenance. These repairs and modifications will be to the structure, gates, or canals, and will not affect the bypass stream flows or water quality.

The O&M of the Project also includes road and canal maintenance necessary to reliably divert and deliver water. Road and canal maintenance are important to prevent failure of the facilities. LOID maintains 15.2 miles of gravel and/or dirt road and 14.3 miles of earthen canal, concrete flume, or pipeline between the Sweetwater and Webb Creek diversion dams and Reservoir A. About 1.5 miles, 10.6 miles, and 3.1 miles of the gravel and dirt roads are located in the Lindsay, Sweetwater, and Webb drainages, respectively. In addition, LOID has less than 5 miles of unmaintained vegetated two-track that is infrequently traveled by vehicle (about once per year) used to access the West Fork diversion canal and the Captain John Creek diversion canal. The other dams and facilities are accessed on county roads not maintained by the LOID.

Road maintenance includes occasional grading of the road surface, maintenance of culverts, and maintenance of road drainage. About 40 percent of the road surfaces are gravel or rock. These maintenance activities are necessary to maintain the road for safe travel, to minimize road effects, and to ensure access to the canals and the diversion dams; and they require heavy equipment, trucks, and manual labor. The rock is purchased from commercial sources.

Canal lining and other canal maintenance is conducted during the winter months when the canal is dewatered. Canal projects occur on the ridgeline away from the creek and riparian habitat and do not impact instream flows or the creek and riparian environment.

4.3.3.2 Sediment and Gravel Removal

LOID removes accumulated sediment upstream of the diversion dam at Sweetwater Creek once every 3 to 4 years. Much of this sediment is sand and silt-sized material; however, some spawning-sized gravel is trapped and removed from the stream during this activity. Reclamation has agreed to a sampling and management plan to account for and replace the spawning gravel removed during this activity.

A spatially distributed sub-sampling scheme will be used to estimate the amount of spawning-size gravels removed from the stream during excavation. The diversion pool will be divided into thirds both width-wise and length-wise to create a grid with nine rectangles. Sediment from the stream bottom will be removed from the middle of each section using a sampling container with known volume. The sediment will be run through geologic sieves with sizes that will capture the documented spawning-size gravel for steelhead. For each sample, the proportion of the sample volume to the volume of spawning-size gravel will be calculated. This proportion will be averaged for all the samples taken, and this average proportion will be used to determine the amount of gravel to replace downstream of the diversion dam from the amount of total excavated sediment. The amount of gravel replaced will equal or exceed this estimate of the amount of spawning-size gravel removed.

Washed gravel will be replaced downstream of the diversion dam when this activity is conducted in an amount (estimated in cubic yards) similar to that removed from the stream. This gravel will be delivered to the stream according to best management practices that will minimize impact to the stream banks and riparian vegetation and will be spread by hand alongside the wetted stream channel to avoid piling and disconnecting the stream habitats. These gravels will be placed in the active streambed to be distributed downstream during subsequent high water events.

4.3.4 Contingency/Emergency Response Procedures

Occasional deficits in minimum flows are anticipated due to circumstances such as rapid drops in the water table, operational limitations, unforeseeable circumstances such as mechanical failures, natural events that prevent normal operation, or emergency repairs or maintenance that require suspension of minimum flows. Reclamation will communicate with NMFS as soon as possible to determine the appropriate course of action if such circumstances arise and minimum flow targets cannot be met as described.

Occasional interruptions in stream flow measurement and bypass flows may occur due to technical difficulties with automation and measurement equipment. Reclamation and LOID will strive to minimize these occurrences. However, when the automation equipment is not operational, the headgates will be adjusted once each day to provide the intended minimum bypass stream flow.

4.3.5 Monitoring and Documentation

Reclamation and LOID will maintain stream flow measurement at the diversion dams and the canals to document compliance with the minimum bypass stream flows in the PA. Reclamation will submit an annual report to the NMFS annually due on May 20 documenting operation activities and bypass stream flow compliance relevant to this consultation.

4.3.6 Duration of Proposed Action

This PA is intended to cover the continued operations and maintenance of the Project for the period starting January 31, 2010, through January 31, 2020.

Chapter 5 HYDROLOGIC CONDITIONS

5.1 Basin Watershed Characteristics

Sweetwater Creek Watershed (which includes Webb Creek) drains the north face of the Craig Mountains, with a drainage area of approximately 83 square miles and ranging from an elevation of just under 5000 feet in its headwaters to 1110 feet at its confluence with Lapwai Creek. The watershed receives between 15 to 25 inches of precipitation annually, depending on location. The majority of the annual precipitation falls in the winter and spring months, with the heavier amounts occurring in the headwaters in the form of snow. Runoff patterns are dominated by both snowmelt runoff and by rain on the lower elevations, with occasional larger flows caused by rain on snow events in the winter, or large, purely rain events in the spring. Summers are characterized by dry and hot conditions with transient thunderstorms that do not appreciably add to the water supply.

A unique feature of the Sweetwater Creek Basin is the complex of springs downstream of Waha Lake. Waha Lake was formed by a massive landslide in prehistoric times that dammed a tributary of the West Fork Sweetwater Creek. There is no natural outlet for Waha Lake; rather, water seeps through the relatively porous landslide materials and emerges in a series of springs beginning about 1/4 mile downstream. This spring component, though seasonally variable, provides year-round flows into Sweetwater Creek, in contrast to most other tributaries that are essentially ephemeral in nature. The role of these springs in local hydrology is discussed further in subsequent sections.

5.1.1 Hydrologic Data Set

A robust dataset of daily hydrologic data is required to analyze the historic and proposed operations of the Project, particularly considering the small scale of flows in the basin and the precise instream flow values anticipated in the PA. Unfortunately, such a dataset does not exist prior to 2003. Various daily and monthly data extend back prior to 2003, but the data are sporadic and missing in several key locations, especially the daily stream flow values for the flows past the diversion points. Without these flow data, it is impossible to know how much water went past the diversions that could have been captured, nor how much water was in the channel to meet biological needs. What *is* known, is that all available flows were typically diverted during irrigation season (up to canal capacities), which meant the channels downstream of the diversion points dried out at some point in the late spring/early summer.

This lack of stream flow data presented significant challenges in earlier efforts to characterize the operations of the Project. Gaging stations were installed in 2003 to correct this deficiency. These stations, located at the mouth of Sweetwater Creek, mouth of Webb Creek, and below the Sweetwater diversion, provided a more complete data record from 2003 through 2008. These data, combined with reservoir storage and release data available from Reclamation’s Hydromet database, and diversion and delivery data available from LOID, provides a daily dataset for the period 2003 through 2008 that can be used for analyzing the operations of the Project. The dataset required efforts to fill in missing periods of data and to correct obvious data errors, but it represents a complete dataset that could be used in calculating unregulated flows (without Project influences), and for creation of a spreadsheet-based operations model by which to test various operating schemes as part of formulating the PA. The 2003 to 2008 daily hydrologic dataset is more fully described in Appendix C, “Derivation of 2003 to 2008 Unregulated Flows in Sweetwater Creek near Lewiston Orchards, Idaho.”

Reclamation recognizes the limitations imposed in utilizing such a short period of record in its analysis. However, given the level of precision demanded for this BA, it was determined that using this known dataset (rather than a synthetic or estimated data set derived for a longer period of record) offered the best opportunity for producing results that could be deemed reliable and reproducible in real-time operations. Despite the short record, Reclamation believes that the 2003 to 2008 dataset represents a fairly wide range of hydrologic conditions, as discussed next.

5.1.1.1 Water Year Types Represented in the 2003 to 2008 Record

Without a long-term historic period of record, we do not know precisely the type of water years 2003 to 2008 represented in the basin; however, other gaged streams in the area can be used as a surrogate and provide qualitative information. The preferred gage to use is Lapwai Creek since it is geographically the closest and Sweetwater Creek is within the Lapwai Creek drainage. Data for Lapwai Creek were available from 1975 through 2008; unfortunately, no data exists for 2005 and 2006. Total flow volume (in af) at Lapwai Creek for the January through June period was summed up for each year, and individual years were compared to the long-term (32-year) average. Table 5-1 shows a ranked listing of these years and their comparison to average. This analysis indicates that 2003 (132 percent) was likely a wet year, and that 2008, 2004, and 2007 (69 percent, 60 percent, 55 percent, respectively) would be considered dry years. The ranked data shows that much wetter and much drier years are likely possible, perhaps by a factor of 2 or more. The ranked values also indicate a high degree of variability in the drainage, ranging from 17 percent on the low end to 280 percent on the biggest year. This variability would also apply to Sweetwater Creek, due to its relatively low elevation headwaters and reliance on rainfall as well as snow to provide its runoff.

Table 5-1. Ranked January to June runoff volumes for Lapwai Creek (1975 to 2008).

Accumulated Volume (af): January 1 to June 30		
Year	**Volume**	**% avg**
1996	124629	280
1997	114385	257
1982	95034	214
1979	89704	202
1976	75592	170
1984	71171	160
1978	68118	153
1999	62079	140
2003	58751	132
1989	55567	125
1986	49577	112
1995	47770	107
1975	47629	107
1985	41903	94
1980	41169	93
2002	35111	79
1993	34718	78
2001	33962	76
1983	33822	76
2000	33039	74
1991	32521	73
1990	31375	71
2008	30756	69
1998	29810	67
1981	29157	66
1987	28179	63
2004	26735	60
2007	24448	55
1988	15175	34
1994	11647	26
1977	9022	20
1992	7354	17

For 2005 and 2006 (years of missing Lapwai Creek data), Lolo Creek near Greer was used as a general indicator of the water year type. Lolo Creek's period of record was 1980 to 2008. The range of January to June volume for Lolo Creek is less variable than for Lapwai Creek, ranging from 51 percent to 183 percent. Based on the 29-year average for Lolo Creek, 2005 was 75 percent of average and 2006 was 96 percent of average. 2005 was ranked in the bottom 6 years, indicating that it was likely a dry year on Sweetwater Creek.

Based on the analysis, the water year types in the 2003 to 2008 record for Sweetwater Creek likely can be summed up as shown in Table 5-2.

Table 5-2. Water year types for Sweetwater Creek.

Year	Conditions
2003	Wet
2004	Dry
2005	Dry
2006	Near Average
2007	Dry
2008	Dry[1]

Runoff conditions in 2008 were rather unique; a very cold spring prevented early season snowmelt, and delayed the freshet at least 1 month later than typical. Runoff did not begin in earnest until May, peaked in mid-May, and continued strong into late June. Drafting of reservoirs did not begin until July after the flows receded. So despite a below average runoff, the timing of it was very positive for water supply and 2008 was the best year operationally in the 6-year set. In contrast, 2003 was a wet year, but the runoff occurred early (March and April) and bypassed the diversions, with subsequent early drafting of the reservoirs.

The 2003 to 2008 period of record certainly does not represent the full range of potential hydrologic conditions, particularly since it is predominated by below average conditions. However, this sequence of primarily dry years provides Reclamation an opportunity to test PA flows against a challenging series of years in

[1] Timing of runoff was very important for this year; see discussion following this table.

terms of water supply. Reclamation's intention in its PA is to provide minimum flows that both support the required biological functions and that can be met in all years, without the need for a drought exemption. In years with less runoff than experienced in the 2003 to 2008 period, there is no provision for lower flows and any shortages will be borne by LOID. In better water years, conditions will only be improved, in terms of either better carry-over storage going into the next year or the likelihood of higher conservation flows (or both). While likely not a "worst case" series of years, the 2003 to 2008 period represents a persistently dry period in Idaho[2] that has created substantial water supply issues for water managers throughout the State. In that regard, Reclamation believes that analyzing this period of record adds confidence that the PA flows can be met in all other years without the need to reconsult.

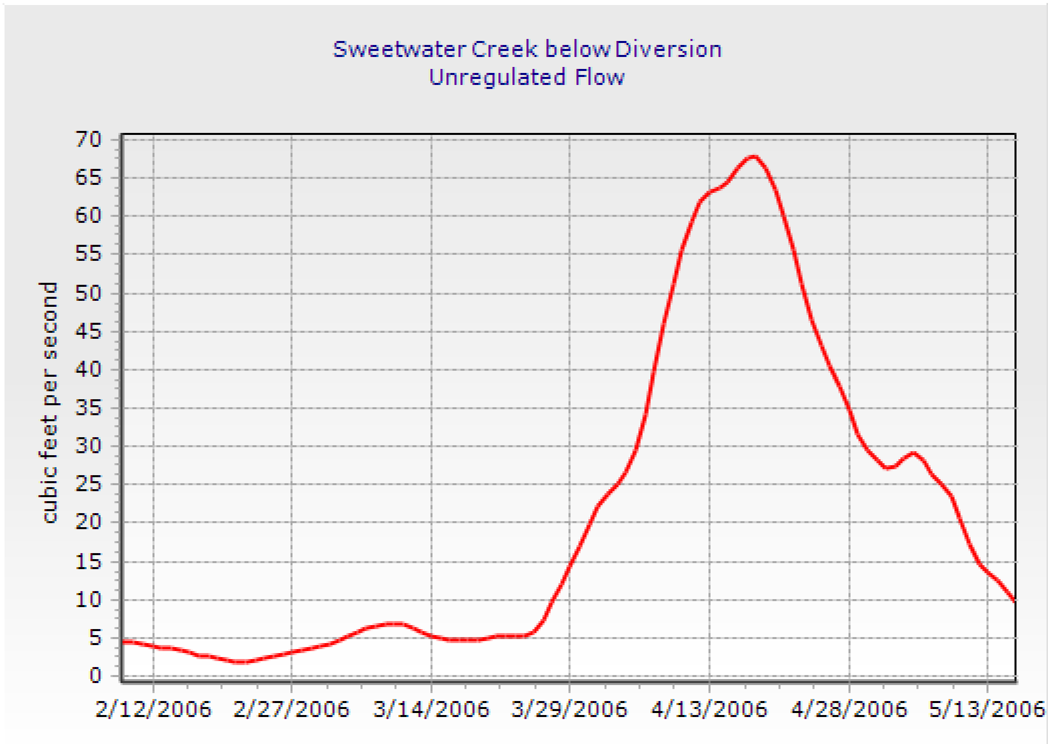
5.1.2 Unregulated flows

As discussed in Section 5.1.1, "Hydrologic Data Set," daily hydrologic measurement for Sweetwater and Webb creeks is limited to a 6-year period of record from 2003 to 2008. Additionally, the hydrology in the basin was manipulated by the Project during this 2003 to 2008 period of record, making it difficult to characterize hydrology without the Project. To meet this challenge, a dataset of mean daily unregulated flows was created to estimate the hydrology in the basins without the Project (see Appendix C, "Derivation of 2003 to 2008 Unregulated Flows in Sweetwater Creek near Lewiston Orchards, Idaho").

The annual hydrographs created in this effort show that the timing of peak runoff in the basin is highly variable, and can range anywhere from March 1 (ascending limb starting as early as February 1) to June 1 (descending limb extending as late as June 30). It is important to note that the start of the freshet can be very inconsistent, and the estimated target spawning flows in the PA are not always available naturally until mid-March in some years, or may briefly drop below prescribed spawning levels during cold or dry spells. For example, Figure 5-1 shows unregulated flows for Sweetwater Creek below the diversion dam for spring of 2006. Note how the freshet did not begin in earnest until late March. The peak flow frequently has a bimodal or multimodal shape, which reflects the dual snowmelt and rainfall driven events in the higher and lower elevations in the basin.

[2]The persistent drought conditions are considered to have begun in the spring of 2000 in many basins in Idaho.

Figure 5-1. Estimated unregulated hydrograph for Sweetwater Creek, below the diversion dam, mid-February through mid-May 2006.



The magnitude of runoff events also varies considerably from year to year. In Webb Creek, the maximum annual flow ranged from a minimum value of about 40 cfs in 2005 to a maximum of about 94 cfs in 2008. At Sweetwater Creek diversion dam, the maximum estimated peak flow in the data set ranged from a minimum of 30 cfs to a maximum value of 77 cfs. The stream flow estimates for the mouth of Sweetwater Creek, which includes Webb Creek and Sweetwater Creek upstream of Webb Creek, ranged from a minimum of 100 cfs in 2005 to a maximum of 170 cfs in 2008.

Stream flows in Sweetwater and Webb creeks fall to base flows between mid-May and late-June in most years, depending on runoff and precipitation conditions. Estimates of summertime minimum stream flows ranged from: 0.0 cfs to 3.0 cfs at the mouth of Webb Creek, 2.0 cfs to 9.0 cfs at Sweetwater diversion dam[3], and about 2.0 cfs to 10.0 cfs at the mouth of Sweetwater Creek.

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[3] Calculated unregulated flows dropped to near 0 cfs for a couple days in 2007, but this is likely due to data errors. Discharges from Big Springs would have always provided at least 1.5 to 2 cfs.

Appendix C, “Derivation of 2003 to 2008 Unregulated Flows in Sweetwater Creek near Lewiston Orchards, Idaho,” provides a full set of figures illustrating estimated unregulated flows and further demonstrating the dynamic character of the streams in the Sweetwater Basin.

5.1.3 Sweetwater Springs

The geology and resulting groundwater-surface water interactions in the West Fork Sweetwater Creek Basin and Lake Waha create a unique hydrologic setting. A large natural landslide in pre-historic times formed Lake Waha by disconnecting it from the unnamed tributary to the West Fork Sweetwater Creek where it is located. Lake Waha does not have a natural surface outflow. The water percolates through the ground and resurfaces at springs located in a draw downstream. Several springs were piped into one collection chamber, which is often called Sweetwater Springs or Big Springs or Twenty-one Ranch Springs.

The historical (pre-Project) data indicate that prior to installation of the pumping facility (from 1907 to 1915) water surface elevations in Lake Waha ranged from 3,386 to 3,407 feet, and fluctuated seasonally with the lowest elevations during the winter months and the highest elevations during the spring months. During this period of record, the lake had an average annual water surface fluctuation of 11 feet (Reclamation 1945).

These historical data indicate what discharge would be expected from these springs without manipulation of Lake Waha water surface from the Project (Table 5-3). These data indicate a winter minimum measured outflow of 1.5 cfs, and summertime (July/August) outflows ranging from 2.0 to 6.0 cfs. The average flows at the springs do not appear to have changed significantly from the pre-Project measurements (Morehead et al. 2005).

Table 5-3. Maximum, minimum, and mean outflows from Big Springs near Waha, Idaho, 1907 to 1915 (Reclamation 1945).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Max	4.1	3.5	3.1	3.3	4.6	5.9	7.0	9.6	7.1	6.0	4.6	3.6
Min	2.0	1.8	1.6	1.6	1.7	1.9	2.1	2.2	2.6	2.1	2.0	1.9
Mean	2.9	2.7	2.6	2.7	2.6	3.1	3.7	4.9	5.3	4.4	3.7	2.9

5.1.4 Climate Trends

A number of reports have recently addressed the prospects and implications for climate change in the Pacific Northwest and the Columbia River Basin. The climate models used in the 4th Intergovernmental Panel on Climate Change (IPCC)

Assessment Report are models that can be applied to large-scale geographical areas, such as the size of the entire Columbia River Basin. Ongoing work continues on "downscaling" these models so they can be applied in a more precise manner to smaller areas, such as sub-regions within the Columbia River Basin or even individual tributaries. As this effort to downscale moves forward, it may someday be possible to more precisely model the impact to small tributaries such as Sweetwater Creek. Lacking these data, we can only speak in general terms about the potential impacts of future climate change.

Temperature and precipitation regimes during the last century have primarily been dominated by natural variations and known climate cycles such as the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). Distinguishing between short climate cycles and long-term climate trends is not easy. Precipitation over the last century has displayed several wet and dry periods, with no clear "trend." In fact, the climate models used in the IPCC Assessment Report provide for a modest range of projected precipitation scenarios that all fall within the natural variability that occurred over the last century. It is not until late in the 21st century that most models project long-term increases in winter precipitation and decreases in summer precipitation.

Air temperatures are a different matter. Although temperature variability over the last century has occurred, there is still a distinguishable warming trend. For the Pacific Northwest, this trend has been a 1.0°C increase since 1900, or about 50 percent more than the global warming average over the same period. In fact, the latest climate models project a warming of 0.1 to 0.6°C per decade over the next century. This rate of warming has the potential in itself to alter the hydrology and water conditions of the Columbia River Basin in general, and Sweetwater Creek in particular. In a basin reliant on cooler winter temperatures to store the impending water supply in the snowpack, warmer temperatures could have the following impacts:

- Warmer temperatures will result in a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring melt season.
- With a shift to more rain and less snow, the snowpacks will diminish in those areas that typically accumulate and store water until the spring freshet. With a smaller snowpack, these watersheds will see their runoff diminished and exhausted earlier in the season, resulting in lower stream flows in the March through June period.
- River flows in general and peak river flows are likely to increase during the winter due to more precipitation falling as rain rather than snow.

- Water temperatures will continue to rise, especially during the summer months when lower stream flows and warmer air temperatures will contribute to the problem.

The most noticeable changes will occur in the “transient snow” watersheds or low elevation basins where the threshold between freezing and non-freezing temperatures will be much more sensitive to warming. In this regard, Sweetwater Creek may be particularly susceptible since its headwaters are relatively low elevation and its flow regime is already made up of a variable mix of winter and spring rain events and snowmelt runoff. Warming temperatures would likely change the balance of this mix to a more rain-driven basin, which would create even more variable runoff conditions than exist today. In this scenario, less snow would accumulate and it would melt out sooner. The result likely would be higher flows in the February through April period, and less flow (snowmelt) during May and June. Summer flows would be less affected since they are often down to base conditions by July, even now. However, reservoir storage would be more heavily relied upon to meet irrigation and instream flow demands, and carry-over would be less than currently anticipated. With consistently earlier runoff, it may be necessary to modify current diversion practices to enable diversions earlier in the season, particularly February, to take advantage of available flows.

At this time, changes to water supply or runoff volumes appear to be more susceptible to shorter climatic cycles than to a perceptible longer-term trend. It is important to note that historical variability in the hydrology of Sweetwater Creek likely falls within the range of variability that would be expected with future climate change. In analyzing the flows in Lapwai Creek for the last 32 years, it was determined that January through June runoff volumes were highly variable in both timing and volume, ranging anywhere from 17 percent to 280 percent of average. Current operating practices are designed to work in this highly variable hydrology, and wholesale changes likely will not be necessary, especially given the gradual nature of climate change when compared to the limited timeframe (10 years) anticipated under a Biological Opinion.

5.2 Historic Project Operations

The hydrologic regime in the Lapwai River Basin has been altered by over 100 years of irrigation and other water development activities. Irrigation development first began in the basin in the 1860s when farmers diverted water from tributaries of Lapwai Creek. Irrigation became widespread in the early 1900s. The Project is the major water user on the Sweetwater and Webb Creek drainages, with some minimum independent water users located along lower Sweetwater Creek. There is widespread independent water use on the Lapwai Creek above and below the confluence of Sweetwater Creek.

Reclamation rehabilitated the Project in the 1940s. The following section describes the hydrologic changes that have occurred in Sweetwater Creek as a result of these water development activities.

For the analysis in this BA, it is critical to differentiate historical operations and associated hydrologic conditions prior to 2007 from the current conditions since water operations at the Project have changed in response to the ongoing Section 7 ESA consultation activities and litigation.

Prior to 2007, all water at the Webb and Sweetwater diversion dams was diverted into the Project canals, leaving zero instream flow immediately downstream of these two dams. This condition continued on Webb Creek through the 2008 irrigation season. However, in recent years (2007 to 2009), stream flows have been provided past the diversion dams as specified in the 2006 Biological Opinion (NMFS 2006a) or the stipulated agreement, as applicable. The following discussions focus on Project operations prior to these recent changes related to ESA consultation.

5.2.1 Stream Flows

5.2.1.1 Webb Creek

Typical historic operation was for LOID to begin diverting water from Webb Creek in February or March, taking all stream flow arriving at the diversion dam into the Webb canal up to that facility’s capacity. During the spring months, stream flow came from spring snow melt and rain events. Typically, available stream flow exceeded the capacity of the diversion and some surplus flow would spill over the dam in March, April, May, and sometimes in June (Figure 5-2). In the summer, starting around June, the diversion would reroute storage water released from Soldiers Meadow Reservoir into Webb Creek over to Sweetwater Creek; under these conditions, instream flows are supplemented with storage release to match the diversion capacity. Typically, no flow would pass over the dam in the summer except during an occasional rain event. Stream flow at the mouth would decline from May through early July. In early July, the stream would typically fall to zero stream flow. The creek below the diversion dam was typically dry in the riffles with puddles and still water remaining in some of the pools. Stream flow would typically peak between 25 and 75 cfs during the spring (April/May) and decline to base flow of 0 cfs during the summer and early fall, as shown in Table 5-4. Both Figure 5-2 and Table 5-4 are based on the 6-year period of record for this stream; however, these data are considered representative of historic operations.

Figure 5-2. Stream flows on Webb Creek (cfs) 2002 to 2008.

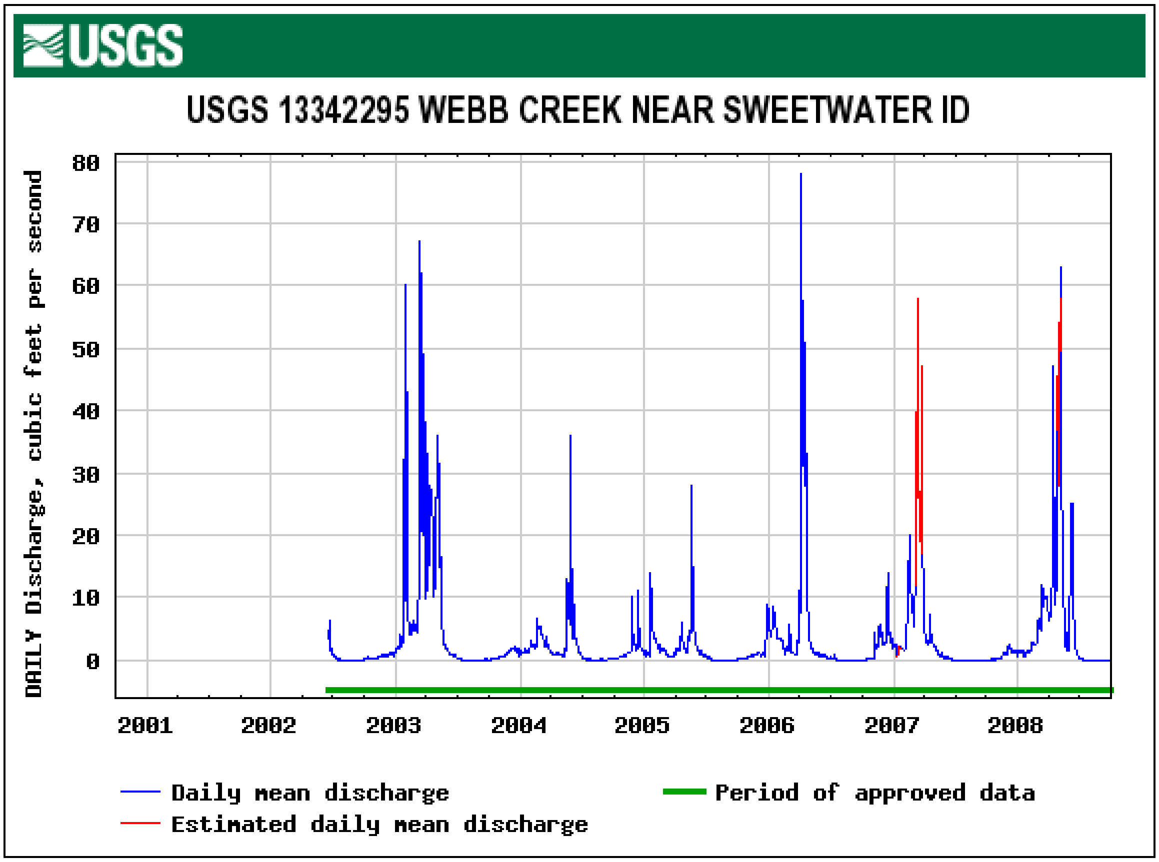


Table 5-4. Summary of stream flows measured at the mouth of Webb Creek 2002 to 2008.

Month	Maximum	Minimum	Mean
January	32	0.55	3.2
February	60	0.82	4.5
March	67	0.55	9.9
April	78	0.76	13
May	63	0.43	7.6
June	25	0.02	2.6
July	0.96	0	0.14
August	0.07	0	0.01
September	0.42	0.03	0.04
October	3.2	0	0.21
November	10	0.13	1.2
December	14	0.26	2.2

5.2.1.2 Sweetwater Creek

The period of record for this stream flow gage is June 2002 to present. Water operations prior to 2007 consistently dewatered Sweetwater Creek at the diversion dam in the summer months. (As noted earlier, beginning in 2007, LOID has forgone storage to provide instream flow as required by the 2006 Biological Opinion and the subsequent stipulated agreement).

During the spring months, stream flow comes from spring snow melt and rain events. Typically, available stream flow exceeded the capacity of the diversion and some flow would spill over the dam in March, April, May, and sometimes in June (see Figure 5-3. Note: Data shown is from the mouth of Sweetwater Creek; the diversion dam is approximately 8 miles upstream from the mouth). In the summer starting around June, the diversion dam is capable of diverting all available inflow, and it typically did so prior to 2007. A major source of this inflow during summer months is stored water released from Soldiers Meadow and diverted over to Sweetwater Creek. Stream flows measured at the mouth when all the stream flow was going into the canal represent stream flow gains in the creek, including any water flowing in from Webb Creek. During the years of record prior to 2007, minimum summertime stream flow measurements were as low as 0.3 to 0.4 cfs. When the irrigation diversion is off during these years, wintertime stream flows (from November to February) ranged from 2 to 185 cfs. Springtime peak flows typically exceed 100 cfs and may occur in any month between February and May. Tables 5-5 and 5-6 provide monthly maximum, minimum and mean flow data for the period of record at the mouth of Sweetwater Creek. Table 5-5 represents the entire 2003 to 2008 period of data, and is most applicable for the winter and spring months (November to May); for the summer months, the data in this table are less accurate due to the change in operations that occurred in 2007. Table 5-6 provides insight into the effect of the 2007 change in operations, highlighting the difference in June to October data for the 2003 to 2006 versus 2007 to 2008 time periods, particularly for the minimum values.

Figure 5-3. Stream flows measured at the gage near the mouth of Sweetwater Creek 2002 to 2008.

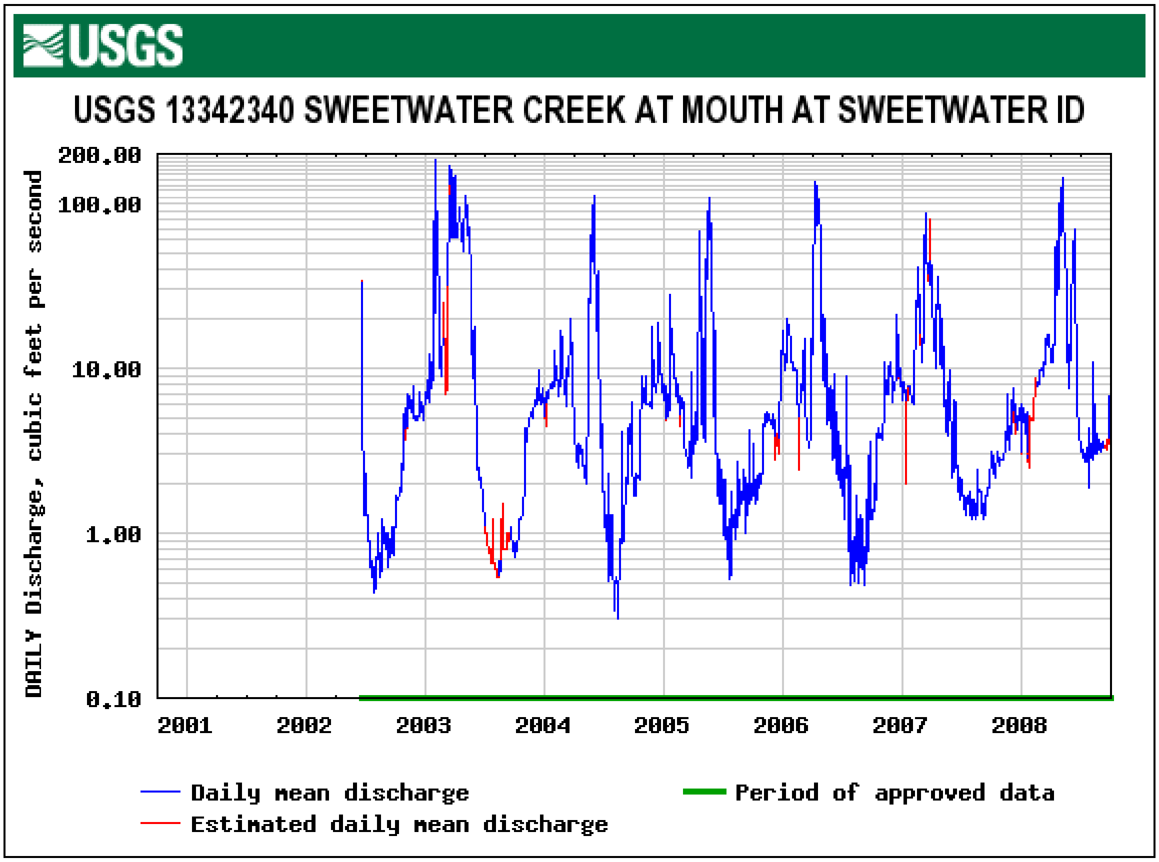


Table 5-5. Summary of stream flows at the gage near the mouth of Sweetwater Creek 2002 to 2008.

Month	2002 to 2008		
	Maximum	**Minimum**	**Mean**
January	120	2	10
February	185	2.4	14
March	169	2.2	24
April	146	2.5	36
May	144	2	31
June	69	1.1	9.2
July	9	0.43	1.5
August	11	0.3	1.5
September	6.8	0.49	1.9
October	17	0.72	2.6
November	18	2.8	5.7
December	21	2.7	7.3

Table 5-6. Summary comparison of summer stream flows at the gage near the mouth of Sweetwater Creek 2002 to 2006 versus 2007 to 2008.

Month	2002 to 2006			2007 to 2008		
	Maximum	**Minimum**	**Mean**	**Maximum**	**Minimum**	**Mean**
June	62	1.1	7.3	69	1.6	13.2
July	9	0.43	1.16	4.3	1.3	2.3
August	4.1	0.3	.97	11	1.2	2.75
September	6.3	0.49	1.58	6.8	1.2	2.89
October	9	0.72	2.56	17	2.2	4.33

5.3 Future Hydrologic Conditions

5.3.1 Development of Hydrologic Simulation Model

A spreadsheet-based simulation model was developed for the Project using the same 2003 to 2008 daily dataset that was used in the estimation of unregulated flows (see Section 5.2.1.1, “Webb Creek,” for additional details). The purpose of the model was to serve as a “reoperation” tool where various minimum flow strategies could be tested to determine impacts to reservoir storage, irrigation supply, and instream flows. The model was designed to replicate the operation of the irrigation system on a daily timestep basis, with logic to alter operations as needed to meet minimum instream flows as the highest priority before irrigation demands are met. (In other words, any shortages in supply are manifested as reduced irrigation diversions or lower reservoir carry-over.) The model operates on a continuous basis, where the results from the end of 1 year carry forward to begin the next. Although the logic within the spreadsheet is fairly complex, it basically functions as follows:

1. Webb Creek minimum flows are met by first reducing the diversion to the Webb Creek canal. This reduced diversion means less water is transferred over to Sweetwater Creek, thus reducing the amount available for diversion there as well. If cutting the Webb Creek diversion is not enough to meet Webb Creek minimum, then additional flow is “ordered” from Soldiers Meadow Reservoir to make up the difference.

2. Sweetwater Creek minimum flows are met by reducing the diversion to the Sweetwater Canal. This means less water flowing down the Sweetwater Canal

into Reservoir A, and thus an increase in the draft rate at Reservoir A to meet irrigation deliveries.

3. Additional water is “ordered” from Soldiers Meadow Reservoir, if needed, to keep Reservoir A from being depleted too early; this serves to keep the reservoirs balanced while meeting irrigation demands. This water is only released up to the amount that the Webb Creek Canal has capacity to transfer to Sweetwater Creek.

Due to minimum flows being the highest priority, any shortages in the system are shown as reduced irrigation deliveries or reduced reservoir storage at the end of the season. There may be limited occasions where minimum flows cannot be met simply because there is not enough water available in the stream even after completely shutting off canals. This is consistent with Reclamation’s commitment to provide minimum flows any time the diversions are operating (and in this situation, diversions would be turned off).

The spreadsheet model incorporated the actual operations of Lake Waha during the 2003 to 2008 period. No attempt was made to “reoperate” Lake Waha, and instead its historic releases (springs and pumped) were hardwired into the model and appear as tributary inflow upstream of the Sweetwater diversion dam. The reason behind this simplification is twofold. First, there are insufficient daily data for reservoir storage and spring discharge for the entire 2003 to 2008 period. Second, any manipulation in the operation of Lake Waha would result in different reservoir levels, which would alter the spring discharges both in quantity and in timing. The relationship between reservoir level and spring discharge is not clearly defined and any flow changes would be of questionable reliability (see Section 5.1.4, “Climate Trends,” for further discussion).

5.3.2 Modeled Results for the Proposed Action

The PA flows listed in Chapter 4 were incorporated into the spreadsheet model to analyze the results that would have occurred in the 2003 to 2008 period of operations. As described in Chapter 4, “Proposed Action,” the PA flows attempt to balance minimum instream flows with reduced irrigation deliveries, while maintaining adequate reservoir carry-over storage in most years. This carry-over storage provides a buffer for a subsequent drought and/or increases the ability to refill and thus provide higher instream flows the following year.

The resulting modeled stream flows for Webb Creek at the mouth, Sweetwater Creek below the diversion dam, and Sweetwater Creek at the mouth are shown in the following series of figures. Due to the amount of data, and to facilitate readability, three figures are provided for each of these three locations: the first shows the modeled full-year hydrograph for all 6 years in the hydrologic record, the second and third focus on the March through September period of typical Project operation and show the modeled hydrograph for 2003 to 2005 and 2006 to 2008, respectively. Figures 5-4 through 5-6 show the modeled data for the Webb Creek location; Figures 5-7 through 5-9 are for the upper Sweetwater Creek location; and Figures 5-10 through 5-12 cover the lower Sweetwater Creek location. Discussion of system performance in terms of meeting PA spawning and juvenile rearing flows is presented following the set of figures.

Figure 5-4. Webb at mouth, modeled annual flow regime.

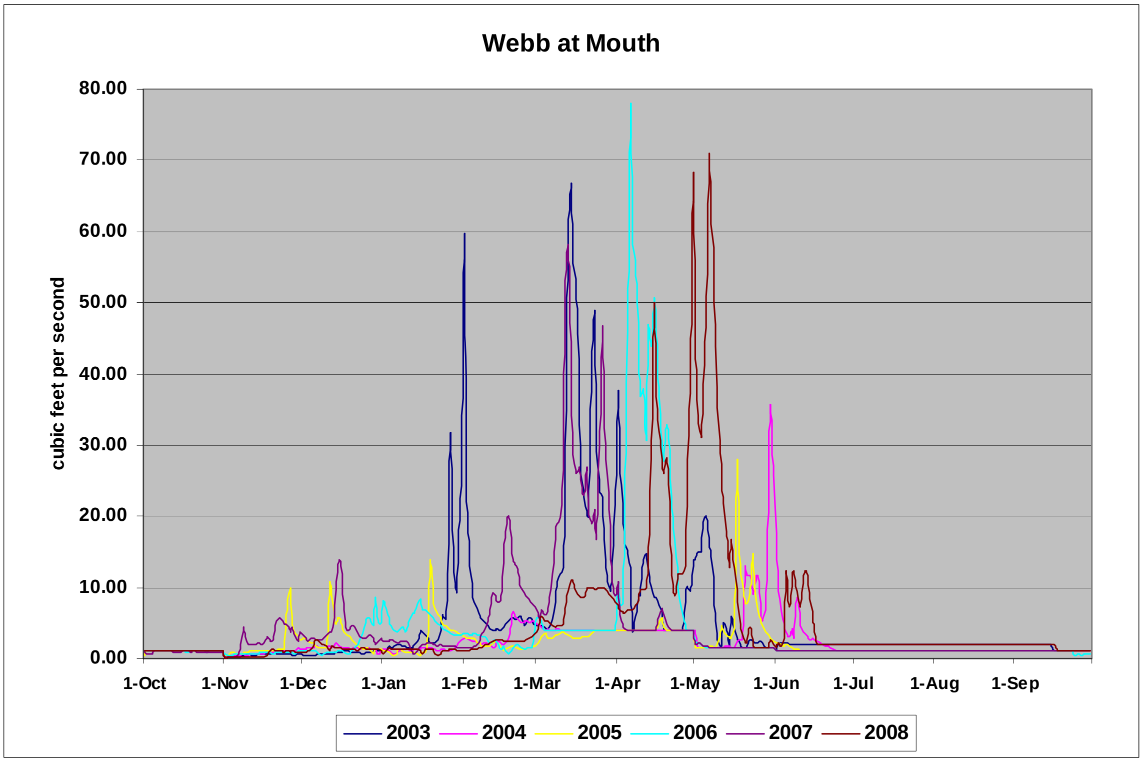


Figure 5-5. Webb at mouth, modeled April to September flows (2003 to 2005).

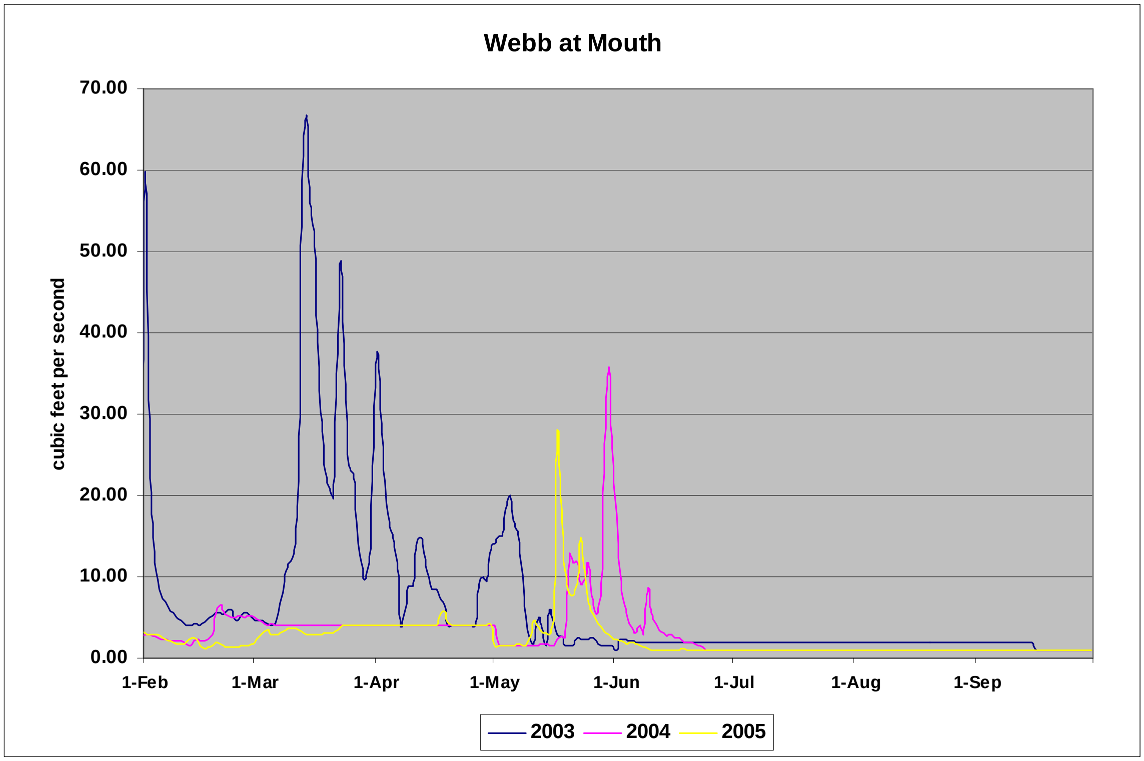


Figure 5-6. Webb at mouth, modeled April to September flows (2006 to 2008).

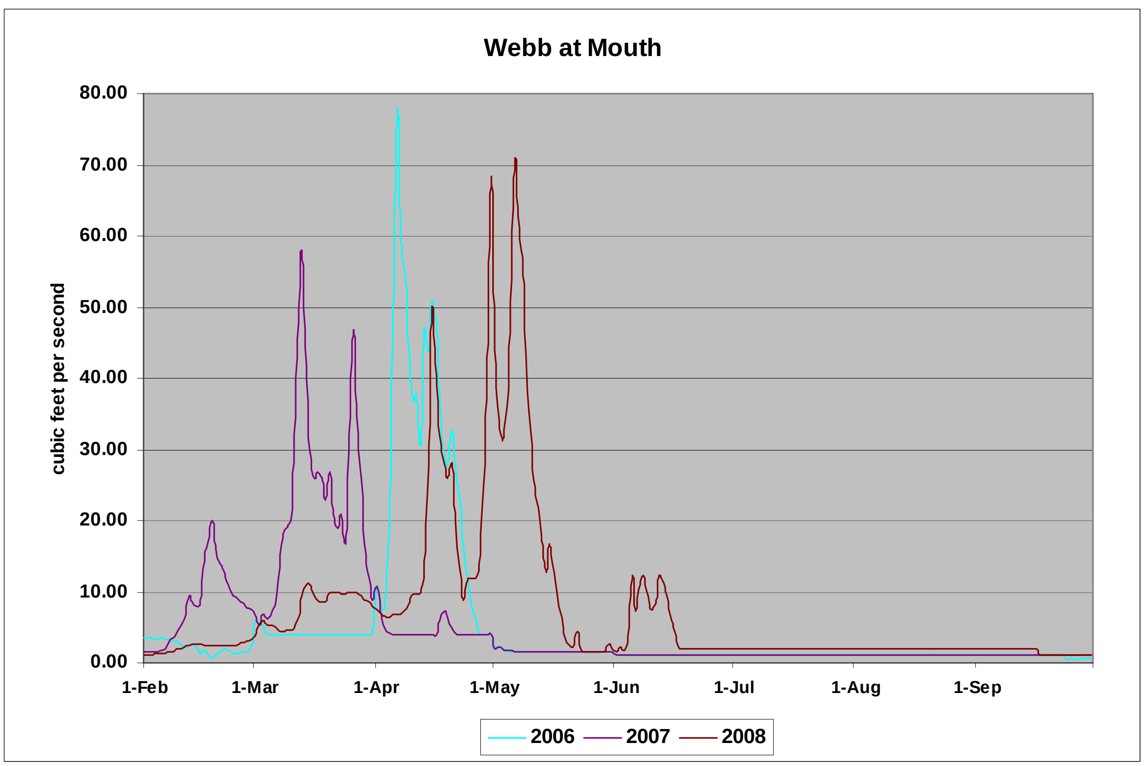


Figure 5-7. Sweetwater below diversion, modeled annual flow regime.

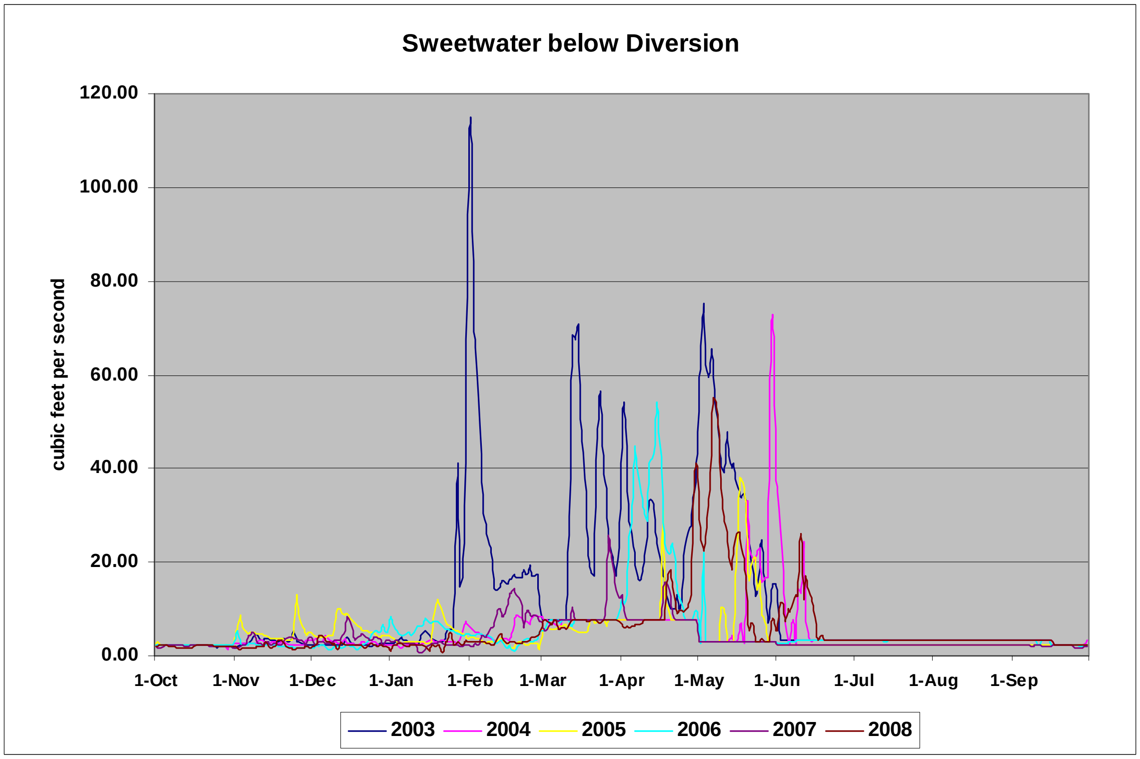


Figure 5-8. Sweetwater below diversion, modeled April to September flows (2003 to 2005).

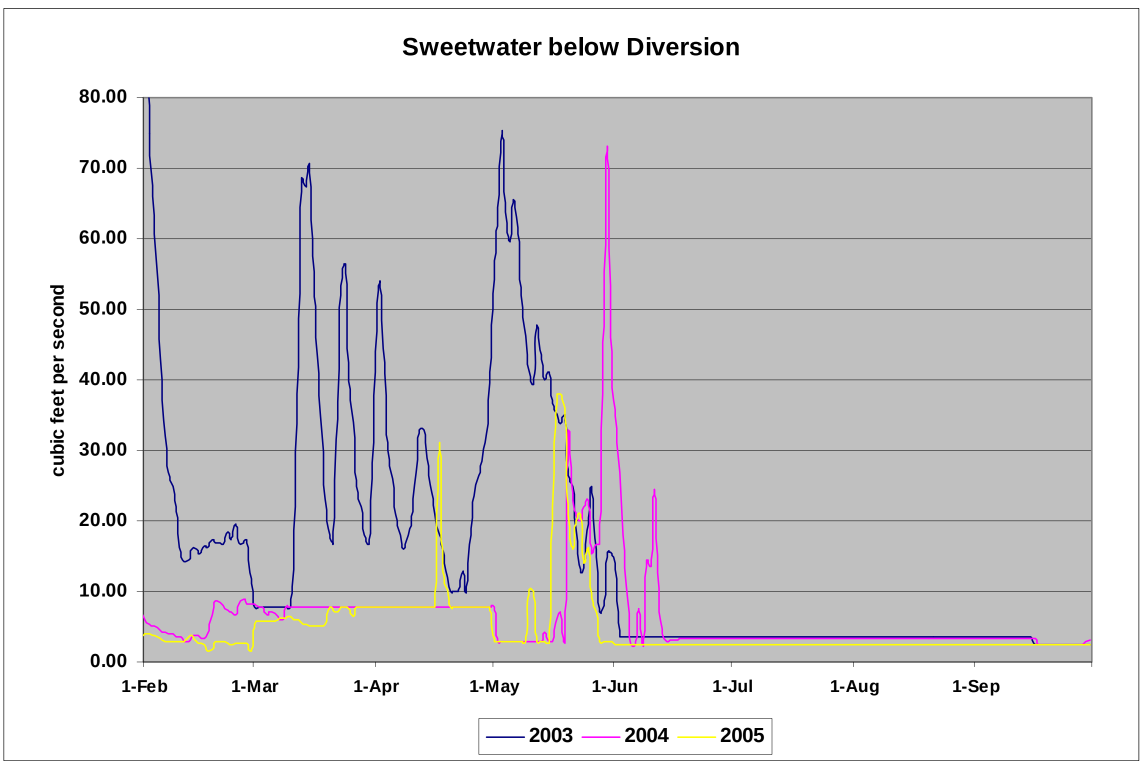


Figure 5-9. Sweetwater below diversion, modeled April to September flows (2006 to 2008).

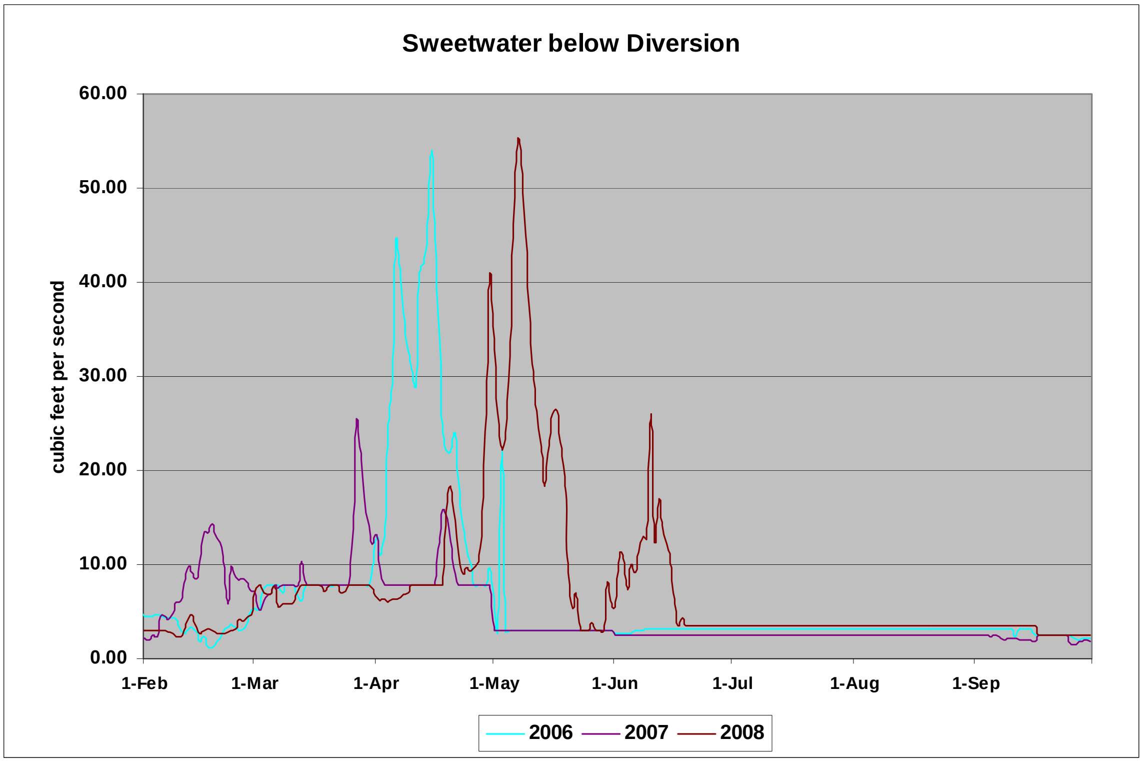


Figure 5-10. Sweetwater at mouth, modeled annual flow regime.

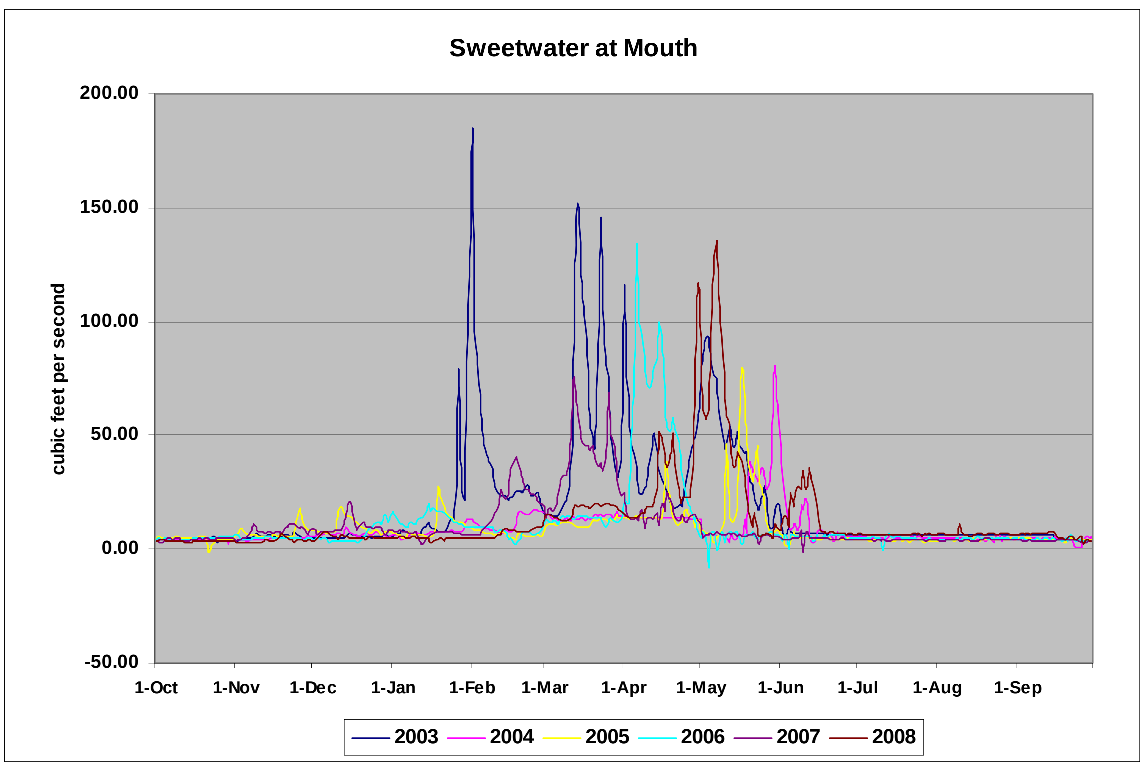


Figure 5-11. Sweetwater at mouth, modeled April to September flows (2003 to 2005).

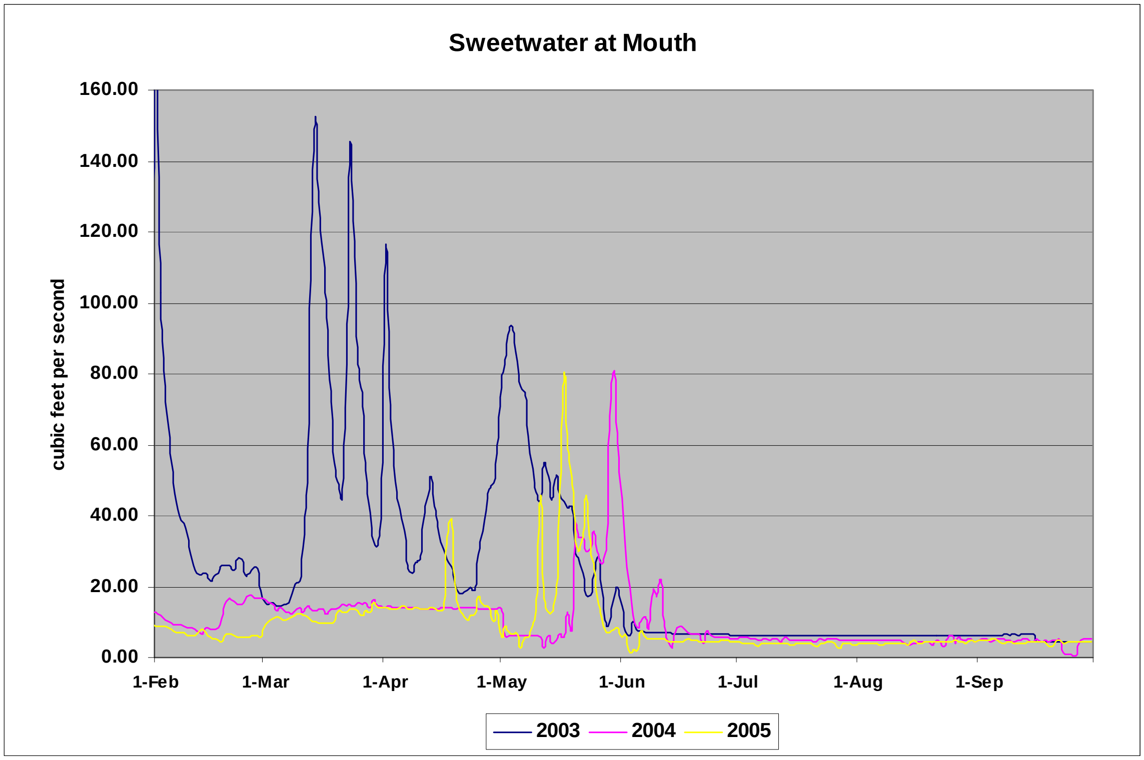
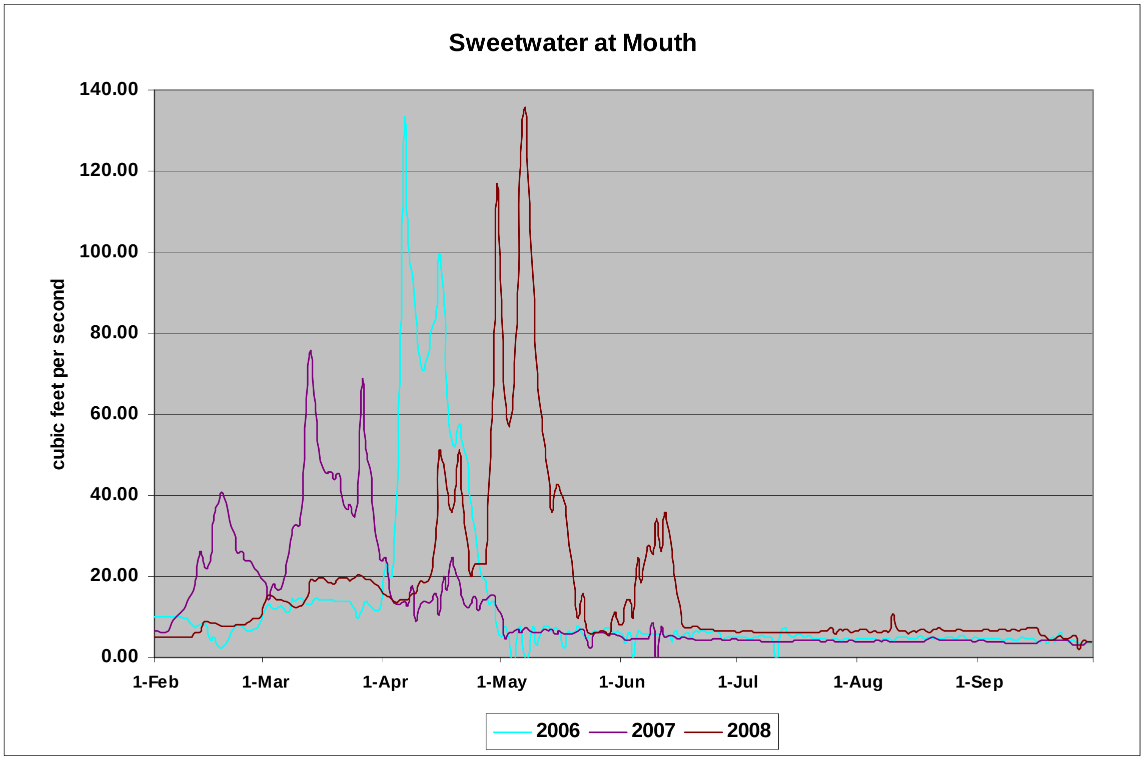


Figure 5-12. Sweetwater at mouth, modeled April to September flows (2006 to 2008).



Note: Although not shown on the March to September plots, the minimum flows in late September continue until the end of October.

5.3.2.1 Spawning Period Flows

For the February through June period, consistent with the unregulated flow results, flows are typically quite variable in most years modeled. PA minimum spawning flows of 4.0 cfs at the Webb Creek diversion dam and 7.8 cfs at the Sweetwater Creek dam are met in March and April of all years modeled. The only exceptions are brief periods in March of 2005 on Webb Creek where available flows would have been in the 2.8 cfs range, and in March of 2005 and 2008 on Sweetwater Creek where flows would have been in the 5 to 6 cfs range. These conditions are due to a late start of the freshet and water not being available even with the diversion dams shut off. Otherwise, flows often exceed the minimum spawning flows, ranging from 4 cfs to over 70 cfs on Webb Creek and 8 cfs to 75 cfs on Sweetwater Creek.

Flows in February are more variable and are often below the targeted spawning flows simply because it remains winter and the spring freshet has not started. These winter flows typically range from 2.5 to 7 cfs in Sweetwater Creek at the dam, and 1 to 3.5 cfs in Webb Creek at the dam. However, the model assumed there were no Project diversions occurring during February, so these flows represent what was available to be passed downstream at the diversion dams.

5.3.2.2 Juvenile Rearing Flows

As described in Chapter 4, “Proposed Action,” the PA specifies minimum flows for juvenile rearing to be met in all years (May through October when the Project is operating, as shown in Table 4-1 in Chapter 4). The PA also provides for additional summer flows as a function of combined storage on June 1 each year (to be provided from June 1 through September 15, according to the sliding scale shown in Figure 4-1 and Table 4-2).

To test the potential for the additional summer flows, flows below the diversion dams in the June to September 15 period were modeled for each year in the 2003 to 2008 hydrologic record, using the proposed sliding scale. The results are listed on Table 5-7. As shown on Table 5-7, instream flows would have been at the PA-specified minimum (3.5 cfs combined) in 2 of the 6 years (2005 to 2007). The full 2.0 cfs in additional flows would have been provided in 2003 and 2008[4], and an

[4] It also is notable that the full 2.0 cfs in additional, opportunity-based flow would have been provided in 2009, based on recently available data (data not available for the modeling work reflected herein).

incremental increase in additional flows of 0.9 cfs and 0.7 cfs would have been provided in 2004 and 2006, respectively.

Table 5-7. Minimum flows based on maximum combined storage in Soldiers Meadow Reservoir and Reservoir A after June 1.

	Combined Minimum Flow[5], Sweetwater and Webb Creeks
2003	5.5 cfs
2004	4.4 cfs
2005	3.5 cfs
2006	4.2 cfs
2007	3.5 cfs
2008	5.5 cfs

Reclamation recognizes that it would be informative to provide a more thorough analysis of the frequency with which the higher "opportunity-based" instream flows can be expected. However, the lack of an accurate and reliable daily hydrologic dataset beyond the 2003 to 2008 period precludes such an analysis. It has been suggested that adjacent drainages (Lapwai Creek, Asotin Creek, and Lolo Creek) with more complete data records could be used to create a synthetic dataset to examine frequencies. Due to the precision required for analysis of the PA, the unique character of the Sweetwater Creek drainage, and the limited number of extra years of record available, Reclamation does not believe this effort would yield results that could be relied upon with any degree of confidence for this scope of analysis. Any information would be qualitative at best; however, based on the results during the 2003 to 2008 period (and 2009[6]), Reclamation anticipates that higher instream flows would potentially be available roughly 50 percent to 60 percent of the years, and more frequently in a wetter series of years than that represented in the 2003 through 2008 record.

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[5] As discussed in Chapter 4, "Proposed Action," Project facility configuration allows minimum juvenile rearing flows to be allocated as desired to Webb and/or Sweetwater creeks. Data in this table is total juvenile rearing flow; flows in each creek would be allocated as shown in the PA (see Table 4-3).

[6] As discussed in Chapter 4, "Proposed Action," Project facility configuration allows minimum juvenile rearing flows to be allocated as desired to Webb and/or Sweetwater creeks. Data in this table is total juvenile rearing flow; flows in each creek would be allocated as shown in the PA (see Table 4-3).

Chapter 6 WATER QUALITY

6.1 Introduction

Current water quality and stream temperature conditions were assessed through previous data collection efforts of the Tribe, as well as data collections in 2008 by Reclamation. In this chapter, the effects of the PA on temperature and sediment in the Project Action Area are discussed. In addition, other water quality conditions are discussed as they relate to the Clean Water Act (CWA). This discussion is important in understanding the water quality conditions in the Action Area and the potential degree of influence of the PA on these conditions.

6.2 Current Water Quality Conditions

The CWA requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation’s waters. States and tribes must adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters, whenever possible.

Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (that is, water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every 2 years. For waters identified on this list, states and tribes must develop water quality improvement plans known as total maximum daily loads (TMDLs) that establish allowable pollutant loads set at levels to achieve water quality standards. The most recent approved 303(d) list for the State is the *2002 Integrated Report* (DEQ 2005). A draft of the *2008 Integrated Report* has been submitted to the U.S. Environmental Protection Agency (USEPA) and is currently under review. The Idaho Department of Environmental Quality (DEQ) is expecting a decision from USEPA in 2009.

The 303(d) listing process and subsequent TMDL development is initiated when beneficial uses are not being supported, which is generally identified through exceedance of criteria or through bioassessment of the existing or designated beneficial uses. Primary water quality problems identified in the lower Lapwai Creek, Sweetwater Creek, and Webb Creek drainages include water temperature, sediment, bacteria, nutrients, dissolved oxygen (DO), pesticides, organic enrichment, and unknown pollutants (DEQ 2005). Unknown pollutants generally are listed as a result of the bioassessment process used by DEQ.

For water bodies that lie within the Nez Perce Reservation, a Memorandum of Agreement (MOA) was developed among the Tribe, USEPA, and DEQ. Under the MOA, the Tribe and USEPA jointly develop TMDLs for these water bodies. In 1999, the USEPA and Tribe (DEQ et al. 1999) developed the TMDL for Winchester Lake and Lapwai Creek from the headwaters of Lapwai Creek to the outflow from Winchester Lake. The Tribe currently is involved in the TMDL process for the Clearwater Subbasin, in which TMDLs for Webb, Sweetwater, and lower Lapwai creeks are being developed. Table 6-1 summarizes the 303(d) listed water bodies and assessment unit segments listed in the 2002 Integrated Report, and TMDL development on those reaches.

Table 6-1. State of Idaho 2002 integrated report listings for Webb, Sweetwater, and Lapwai creeks.

Assessment Unit	Listed Pollutants[a]	TMDL Target Completion
Webb Creek – from Source to Sweetwater Creek		
ID17060306CL007_02	Bac, Nut, Low DO, Sed, Temp	2009
Sweetwater Creek – from Source to Webb Creek		
ID17060306CL006_02	Bac, Nut, Low DO, Pest, Sed, Temp	2009
ID17060306CL006_03	Bac, Nut, Org, Low DO, Pest. Sed, Temp	2009
ID17060306CL006_04	Bac, Nut, Org, Low DO, Pest. Sed, Temp	2009
Sweetwater Creek – from Webb Creek to Lapwai Creek		
ID17060306CL005_02	Not Assessed (Integrated Report Section 3)	
ID17060306CL005_04	Supporting Some Uses (Integrated Report Section 2)	
Lapwai Creek – from Source to Winchester Lake		
ID17060306CL010_02	Bac, Nut, Low DO, Sed, Temp	3/22/1999
ID17060306CL010_03	Bac, Nut, Low DO, Sed Temp	3/22/1999
Lapwai Creek – from Winchester Lake to Sweetwater Creek		
ID17060306CL008_02	Not Assessed (Integrated Report Section 3)	
ID17060306CL008_03	Unknown Pollutant	2009
ID17060306CL008_04	Bac, Nut, Low DO, Sed, Temp	2009
Lapwai Creek – from Sweetwater Creek to Mouth		
ID17060306CL004_02	Not Assessed (Integrated Report Section 3)	
ID17060306CL004_05	Not Identified in Integrated Report	

[a]Idaho 2002 Integrated Report: Bac - Bacteria, Low DO – Low Dissolved Oxygen, Nut – Nutrients, Org – Organic Enrichment, Pest – Pesticides, Sed – Sediment, siltation, Temp – Temperature, Unknown – unknown pollutant Bioassessment

State water quality standards require that surface waters of the State be protected for beneficial uses, wherever attainable (IDAPA 58.01.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses. The water quality criteria (narrative and numeric) that are relevant for the designated and existing beneficial uses for Lapwai, Sweetwater, and Webb creeks are discussed below. The beneficial uses for Lapwai Creek have been designated and include cold water aquatic life, salmonid spawning, primary contact recreation, drinking water supply, and special resource water (IDAPA 58.01.02.120.08). Sweetwater and Webb creeks currently are undesignated. Presumed uses for these undesignated systems include cold-water aquatic life and secondary contact recreation (IDAPA58.01.02.101.01).

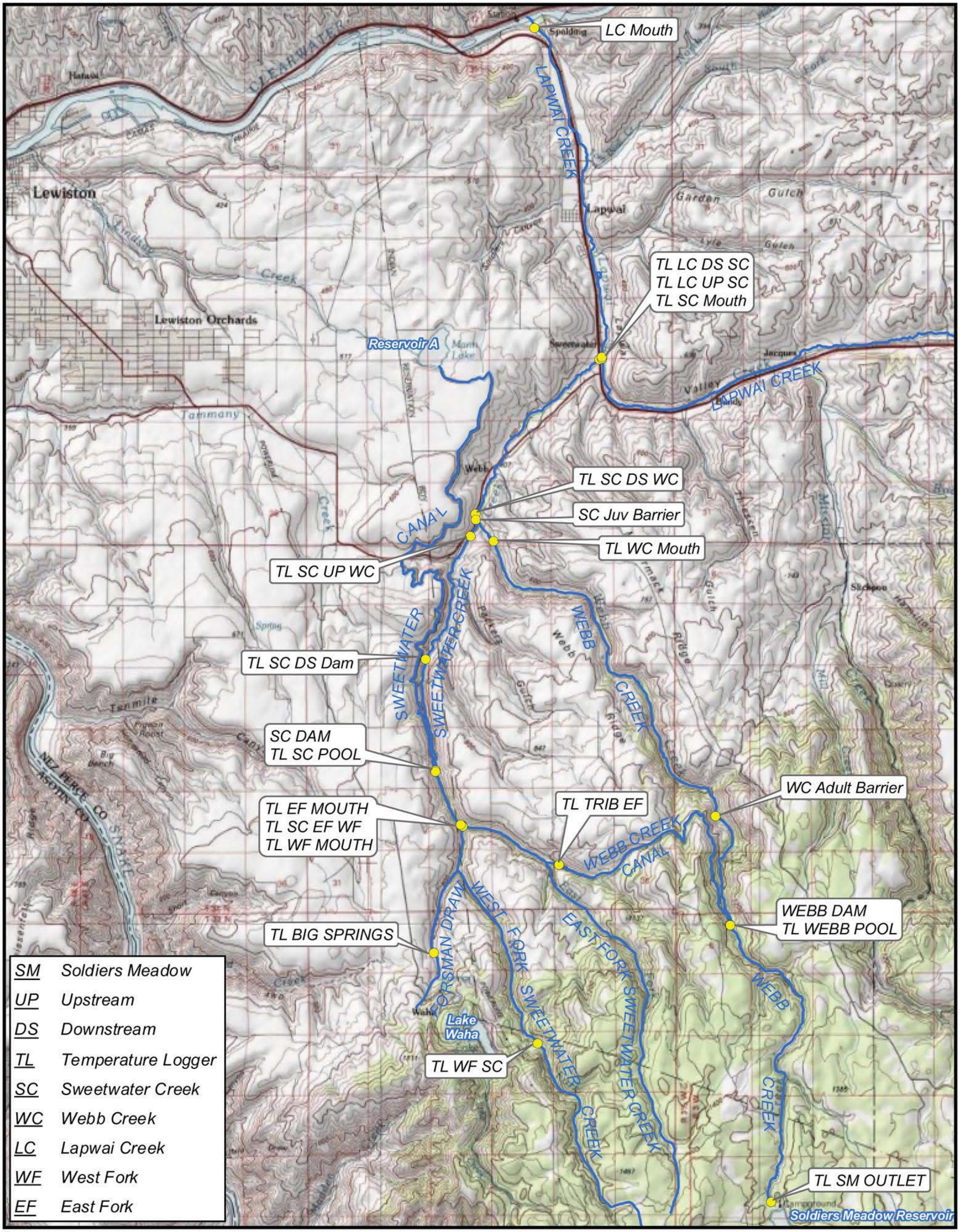
Numeric water quality standards have been developed by the State and approved by USEPA for temperature, DO, and pathogens, among others. These standards and a summary of whether streams in the Action Area meet those standards during the period of record are presented in Table 6-2.

The standards for nutrients and sediment are narrative standards. A narrative standard states that the level of a pollutant cannot exceed quantities that impair beneficial uses. Because these pollutants do not have numeric standards, surrogate numeric targets are often proposed in TMDLs or water quality assessments. In addition, USEPA has developed national guidelines for specific nutrients such as total phosphorous, which provide numeric guidelines for assessment. These narrative guidelines also are presented in Table 6-2.

6.2.1 Sources of Water Quality Data

The Tribe collected water quality data from several locations throughout Webb, Sweetwater, and Lapwai creeks, among others in 2003, 2004, and 2005 (NPT 2003b, 2004a, 2005). These data were part of a larger trend-monitoring study that began in 2003. Data were collected in the summer months with optical stowaway recording loggers, grab samples, or Hydrolab MiniSonde® at three randomly located monitoring sites in each system, in addition to having one fixed monitoring location at the mouth of each system.

Reclamation began collecting water temperature data in the drainages associated with the Project in the summer of 2008. Optical stowaway water temperature loggers were placed at several locations within the Sweetwater, Webb, and Lapwai creek drainages; these locations are illustrated on Figure 6-1. Typically, these loggers were placed above and below diversion points and at the mouths of tributaries. Additionally, in September of 2008, water chemistry grab samples were collected from Sweetwater Creek, Lapwai Creek, and Lake Waha.



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Drawn by: J. Jones
Date: Sept. 29, 2009

Temperature Logger Locations
Figure 6-1

Despite both of these data collection efforts, a significant water chemistry data gap exists to fully describe existing water quality conditions in the basins. Table 6-2 provides a summary of whether the stream meets those standards based on the water quality data available. The discussion following the table describes existing water quality conditions based on these two sources.

Table 6-2. Idaho Water Quality Standards and Current Conditions Summary.

Pollutant	**Standards in Effect in Idaho**	**Stream**	**Current Conditions**
Temperature	*Cold water aquatic life:* Instantaneous maximum water temperatures of 22°C (71.6°F) or less with a daily average of no greater than 19°C (66.2°F) *Salmonid spawning:* Instantaneous maximum water temperatures of 13°C (55.4°F) or less with a daily average no greater than 9°C (48.2°F)	Lapwai Creek	Exceeds the State of Idaho 19°C maximum daily average for 23 days, and the 22°C instantaneous maximum standard for 29 days.
		Sweetwater Creek, upstream of diversion dam	Does not exceed 19°C daily average, nor does it exceed a 22°C instantaneous maximum.
		Webb Creek, above the Webb Creek diversion and below Soldiers Meadow Reservoir	Does not exceed 19°C maximum daily average, and does not exceed the 22°C instantaneous maximum.
		Webb Creek, above the confluence with Sweetwater Creek	Exceeds 19°C maximum daily average for 4 days (June 29 to 30, July 3, and August 7), and the 22°C instantaneous maximum for 5 days.
		Sweetwater Creek, downstream of diversion dam	Exceeds 19°C maximum daily average for 7 days (June 29-July 6, 2008), and exceeds the 22°C instantaneous maximum for 10 days.
Sediment	Shall not exceed quantities which impair designated beneficial uses: DEQ and USEPA protective level for salmonids ranges from 25 milligrams per liter (mg/L) to 80 mg/L total suspended solids (TSS)	Webb Creek	8.47 mg/L TSS
		Sweetwater Creek	10.83 mg/L TSS
		Lapwai Creek	6.35 mg/L TSS

Table 6-2. Idaho Water Quality Standards and Current Conditions Summary.

Pollutant	Standards in Effect in Idaho	Stream	Current Conditions
Pathogens	*Primary contact recreation:* Single sample of 576 *E. coli* colony forming units (cfu) per 100 milliliter (mL) *Secondary contact recreation:* Single sample of 406 *E. coli* organisms per 100 mL	*Measured at four stations for 3 years. Numbers indicate minimum and maximum levels measured and total number of exceedances out of the 12 sampling events for each creek.*	
		Webb Creek	25 to 2,419 cfu/100 mL; total of four exceedances
		Sweetwater Creek	9 to 2,419 cfu/100 mL; total of seven exceedances
		Lapwai Creek	14 to 460 cfu/100 mL; total of three exceedances
Dissolved oxygen	1-day minimum of not less than 6.0 mg/L or 90 percent saturation, whichever is greater	*Data below reflect a 3-year monitoring period.*	
		Webb Creek	6.77 to 11.13 mg/L
		Sweetwater Creek	8.58 to 10.23 mg/L
		Lapwai Creek	6.98 to 10.35 mg/L
Nutrients and Phosphorous	Surface waters shall be free from excess nutrients that can cause visible slime growth or other nuisance aquatic growths impairing designated beneficial uses; USEPA national guideline is 0.1 mg/L total phosphorous (TP); Columbia Plateau sub-ecoregion specific stream guideline is 0.030 mg/L TP	Webb Creek	All samples collected exceed the ecoregion maximum guideline levels: 0.058 mg/L at the mouth; 0.15 mg/L at the headwaters
		Sweetwater Creek	All samples collected exceed the ecoregion maximum guideline levels: 0.075 mg/L at the mouth; 0.17 mg/L at the headwaters
		Lapwai Creek	All samples collected exceed the ecoregion levels: 0.069 mg/L at the mouth; 0.23 mg/L at the headwaters

For tribes and states wishing to develop new water quality standards for temperature, the USEPA has developed guidance documents (USEPA 2003). This guidance differs from the Idaho standards, suggesting 16°C (60.8°F) expressed as a 7-day average of daily maximum (7DADM) temperature for core juvenile salmonid rearing, 18°C (64.4°F) 7DADM for salmonid migration and non-core juvenile rearing, and 20°C (68°F) 7DADM for salmonid migration. These criteria are not discussed because they have not yet been approved by the USEPA or adopted by the State of Idaho or the Tribe.

6.2.2 Temperature

The temperature of stream water usually varies on seasonal and daily time scales, and differs by location according to climate, elevation, extent of streamside vegetation, and the relative importance of groundwater inputs. Other factors affecting stream temperatures include solar radiation, cloud cover, evaporation, humidity, air temperature, wind, inflow of tributaries, and width to depth ratio. Diel temperature fluctuations are common in small streams, especially if stream-side shade is lacking, because of diel changes in air temperature and absorption of solar radiation during the day. Aquatic species are restricted in distribution to a certain temperature range, and many respond more to the magnitude of temperature variation and amount of time spent at a particular temperature rather than an average value (USEPA 1991). Although species have adapted to cooler and warmer extremes of most natural waters, few taxa are able to tolerate very high temperatures. Reduced oxygen solubility at high water temperatures can compound the stress on fish caused by marginal DO concentrations.

The Nez Perce Tribe Department of Fisheries Management Watershed Division collected hourly stream temperatures at various locations throughout the three watersheds during the summers of 2003 through 2005, prior to the Project releasing instream flows under the ESA consultation process. Summary statistics for these data are presented in several reports prepared by the Tribe. As noted by the Tribe, USEPA water temperature guidance for core juvenile rearing was exceeded in all streams monitored, at every location monitored, and in all years when monitoring was conducted (NPT 2003b, 2004a, 2005). For many site locations, USEPA temperature guidance was exceeded for the majority of the data set.

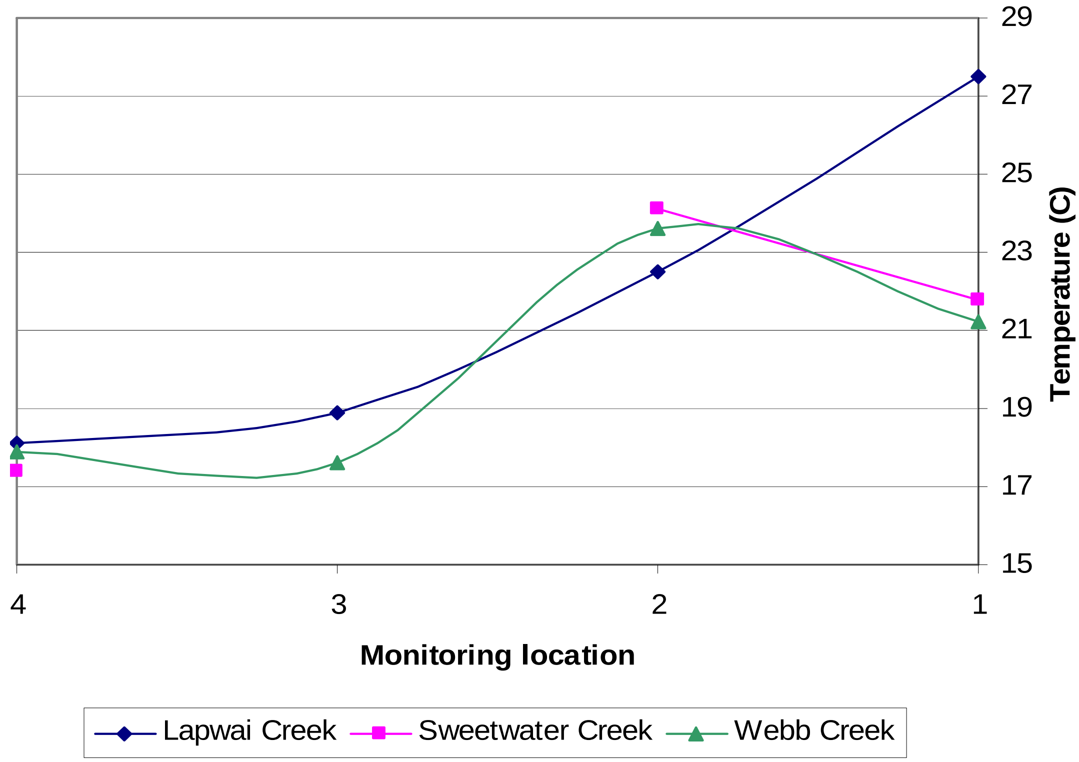
Reclamation staff collected hourly stream temperatures at various locations throughout the three watersheds during the summer of 2008 when instream flows were 2.0 cfs (the highest summertime stream flows to this date), and in some cases, the data collection period ran through to the end of October. Summary statistics for these data are presented in this document.

6.2.2.1 Webb Creek

The Tribe collected hourly stream temperatures at various locations throughout Webb Creek during the summers of 2003 through 2005. Data were collected at four locations. Station 1 was located at the mouth of Webb Creek, Station 2 approximately 3 km upstream, Station 3 below the Webb diversion dam, and Station 4 upstream from the diversion dam.

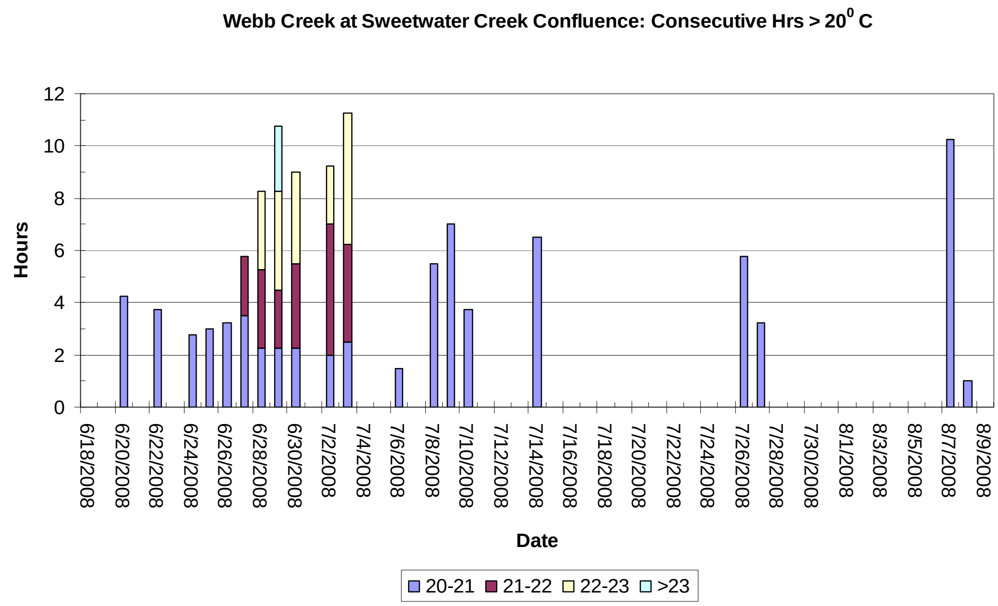
At Station 1, the 2005 data collection period began on June 21 with temperatures measured at 18.61°C 7DADM, while the upper location (Station 4), above the Webb Creek diversion, began on July 21 with temperatures at approximately 16.95°C 7DADM. As the summer progressed, temperatures increased and peaked at both sample locations between July 23 and August 10. At the mouth of Webb Creek, this 7DADM temperature peak was 21.17°C, while the data collection point above the Webb Creek diversion (Station 4) peaked at 17.93°C. A third monitoring location, below the Webb diversion dam, had summertime peak temperatures (7DADM) of 17.6°C. This longitudinal trend suggests that Webb Creek, under historic Project operations (when no bypass flows were provided past the diversion dam), gains heat from the diversion to approximately 3 km from the confluence with Sweetwater Creek. In the last 3 km of Webb Creek, water temperatures decrease, potentially because of groundwater recharge to the system. Webb Creek may then provide a localized cooling effect on Sweetwater Creek (see Figure 6-2).

Figure 6-2. Longitudinal trend in peak 7DADM temperature in each of three stream systems monitored by the Nez Perce Department of Fisheries Resource Management in 2005. Sites are numbered from downstream (1) to upstream (4).



Reclamation collected temperature data from the Webb Creek system in several locations. The first of these was just above the confluence with Sweetwater Creek. Data collection began on February 17 and extended through December 18, 2008. This data collection captures almost a full year of the temperature regime seen in Webb Creek under historic Project operations—that is, no summer bypass flows past the diversion dam. In this data set, Webb Creek exceeds 19°C maximum daily average for 4 days (June 29 to 30, July 3, and August 7), and exceeds the 22°C instantaneous maximum for 5 days. These exceedances occurred on June 29 to 30, and July 2 to 3. An analysis of the frequency and duration of stream temperatures above 20°C for Webb Creek at the confluence with Sweetwater Creek is shown in Figure 6-3 (based on Reclamation's 2008 data).

Figure 6-3. Hourly frequency distribution of stream temperatures exceeding 20, 21, 22, and 23°C in the Webb Creek system at the Sweetwater Creek confluence.



The second Reclamation data collection location was from above the Webb Creek diversion. Data collection began on August 14 and extended through September 26, 2008. In this data set, Webb Creek does not exceed the 19°C daily average, nor does the stream exceed the 22°C instantaneous maximum..

Reclamation collected data at a third location on Webb Creek at the outflow from Soldiers Meadow Reservoir. Data collection began on July 26 and extended through September 25, 2008. In this data set, Webb Creek does not exceed any of the established temperature criteria. This likely is because of the modulating effect from the reservoir discharge. The diel variation at this location averaged approximately 1°C throughout the data collection period and likely corresponded to the temperature of the reservoir. In July, stream temperatures ranged from between 8 and 9°C, and by the end of August the stream temperatures had increased slightly and varied between 10 to 11°C. This progression continued through the middle of September when stream temperatures varied between 13 and 14°C. By the end of September, the reservoir likely began to cool as stream temperatures began to fall. The diel variation during this period remained approximately 1°C and ranged between 12 and 13°C.

6.2.2.2 Sweetwater Creek

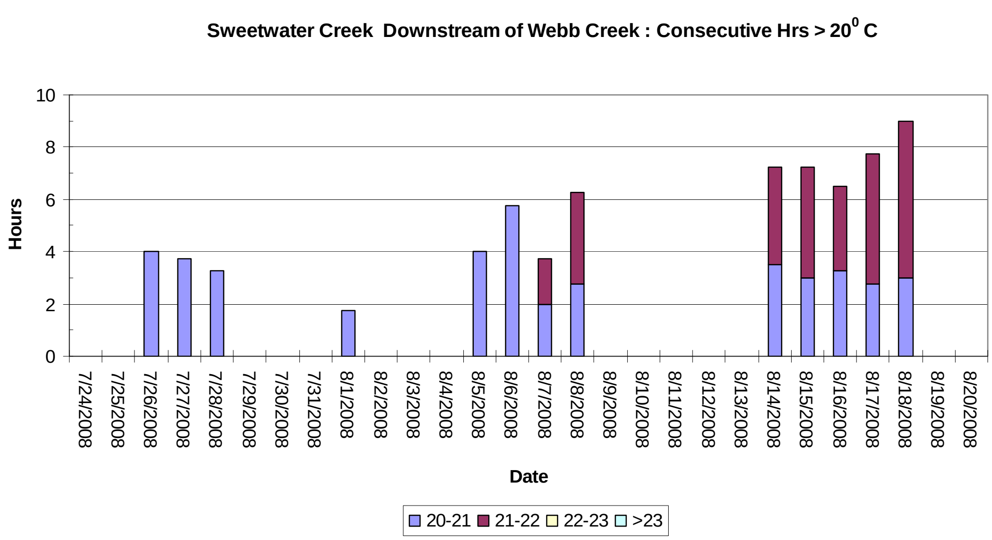
The Tribe also collected hourly stream temperatures at various locations throughout Sweetwater Creek during the summers of 2003 through 2005. Data were collected following the same fixed point and random location processes as Webb Creek. Station 1 was located near the mouth of Sweetwater Creek, Station 2 approximately

1.5 km upstream from the confluence, Station 3 upstream from the Webb Creek confluence, and Station 4 upstream from the Sweetwater diversion dam.

Sweetwater Creek exhibits a similar longitudinal trend in temperature as Webb Creek (see Figure 6-2). Data collected at Station 1 began the 2005 data collection period above 18°C 7DADM, while Station 4, upstream from the Sweetwater diversion dam, recorded temperatures about 14.80°C 7DADM. As the summer progressed, temperatures increased and peaked at all sample locations between July 24 and August 2. At the mouth of Sweetwater Creek, this 7DADM temperature peak was 21.79°C, while at the data collection point above the Sweetwater diversion dam, it peaked at 17.38°C. A third monitoring location, above the Webb Creek confluence, had summertime peak temperatures (7DADM) of 24.1°C. This longitudinal trend suggests that Sweetwater Creek gains heat from the headwaters areas through to the confluence with Webb Creek. Following the confluence with Webb Creek, the stream cools before joining Lapwai Creek and may then provide a localized cooling effect on Lapwai Creek.

Reclamation collected temperature data from the Sweetwater system in several locations during 2008 (see Figure 6-1). The first of these was just below the Webb Creek confluence. Data collection began on July 26 and extended through October 23, 2008. Again, only the latter portion of the annual temperature regime is captured by this data set. In this data set, Sweetwater Creek below Webb Creek exceeds 19°C maximum daily average for 1 day (August 18, 2008), but does not exceed the 22°C instantaneous maximum. Frequency and duration of stream temperatures above 20°C is shown in Figure 6-4 (based on Reclamation's 2008 data).

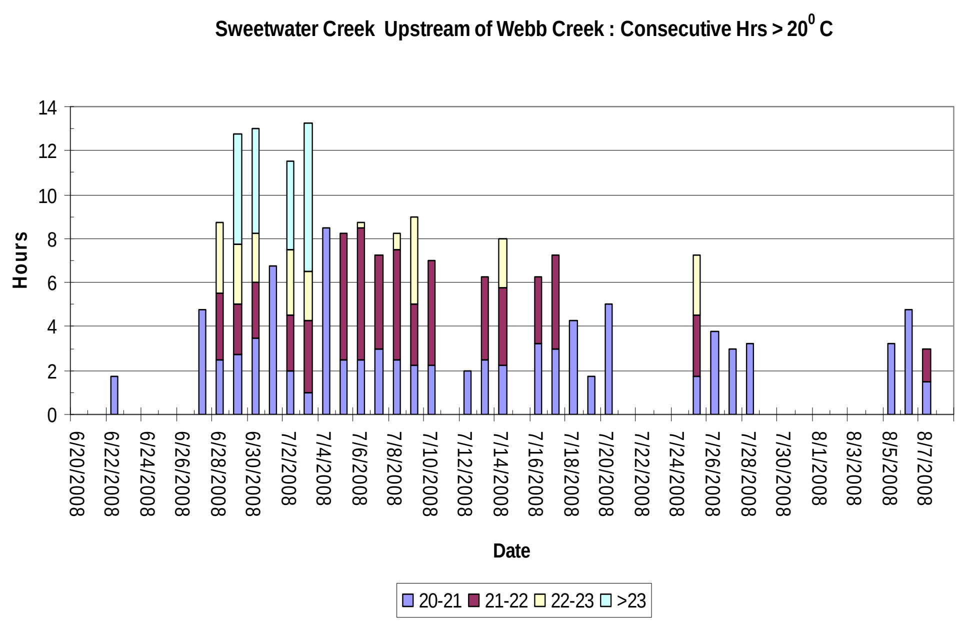
Figure 6-4. Hourly frequency distribution of stream temperatures exceeding 20, 21, 22, and 23°C in the Sweetwater Creek system downstream from the Webb Creek confluence.



The second Reclamation data collection location was from above the Webb Creek confluence. Data collection began on January 13 and extended through December 17, 2008. In this data set, Sweetwater Creek above Webb Creek confluence exceeds the 19°C maximum daily average for 7 days in late June to early July (June 29 to July 6), and exceeds the 22°C instantaneous maximum for 10 days (June 28 to 30, July 2 to 3, 6, 8 to 9, 14, and 25).

Frequency and duration of stream temperatures above 20°C is shown in Figure 6-5. The difference between the frequency and duration of temperature collected at the two Reclamation locations may indicate a significant cooling of Sweetwater Creek below the confluence with Webb Creek.

Figure 6-5. Hourly frequency distribution of stream temperatures exceeding 20, 21, 22, and 23°C in the Sweetwater Creek system upstream from the Webb Creek confluence.

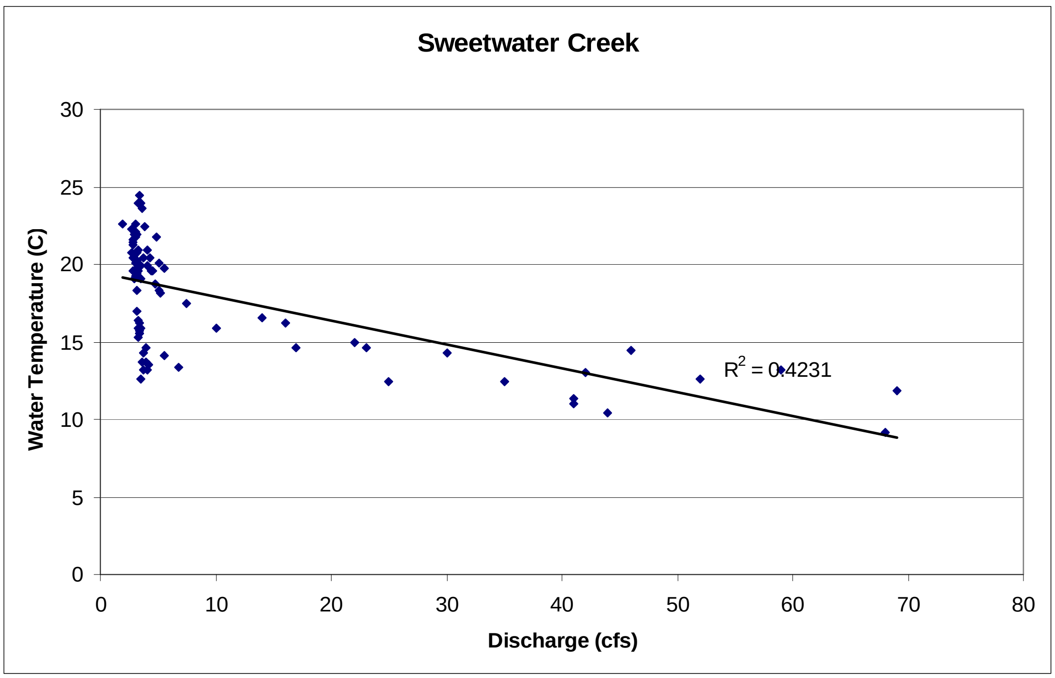


As shown in Figure 6-4 and 6-5, the summertime and fall rearing temperatures in Sweetwater Creek during 2008 exceeded 22°C. Upstream of the confluence with Webb Creek 22° C was exceeded for 17 days, while downstream of the confluence with Webb Creek 22°C was exceeded for 7 days. Water storage and diversion may increase observed summertime stream temperatures; however, temperatures are within those observed in other locations in the Lapwai Creek Basin outside the Action Area (Kennedy and Hartson 2009), as well as those recorded in Big Bear Creek in the nearby Potlatch River Basin (IDFG 2008b).

Stream temperatures during March and April 2008 in Sweetwater Creek upstream of Webb Creek (where the highest stream temperatures are expected) ranged from 1.5 to

12.8°C, with the 7DADM ranging from 5.2 to 10.0°C (Reclamation 2009a). The highest temperatures recorded during March and April 2008 at Sweetwater Creek upstream of Webb Creek were 11.5, 12.7, and 11.5°C on April 12, 13, and 14, respectively. These temperatures were associated with stream flows below the Sweetwater diversion dam of 3.1, 3.2, and 11.1 cfs (Figure 6-6). In the following 2 weeks, stream temperature fell appreciably and the daily maximum temperatures ranged from 4.3 to 9.6°C. On April 28, stream temperature increased to 10.5°C with a corresponding stream flow past the Sweetwater diversion dam of 35 cfs (Reclamation 2009a).

Figure 6-6. Stream temperatures (C) measured at Sweetwater Creek upstream from Webb Creek and stream discharge (cfs) measured near the mouth of Sweetwater Creek, June 1 through September 20, 2008.



Maximum daily stream temperatures in Sweetwater Creek upstream of Webb Creek were above 16°C on 7 days in May 2008 (Figure 6-7 and Table 6-3). These higher temperatures do not directly relate to stream flow during this period; instead, higher stream temperatures likely are an effect of weather conditions and solar radiation to the stream. To explore this relationship, a simple linear regression analysis of stream temperature was compared between air temperatures and stream flow collected during 2008. Springtime is important spawning and incubation period, and also has a wide range of stream flows and warming air temperatures. The resulting correlation coefficient for stream temperature and air temperature in the spring is approximately 0.84, while the same coefficient for stream temperature and discharge is 0.07, indicating that air temperature has a greater correlation with stream temperature than stream discharge (Figure 6-8 and Figure 6-9). This positive relationship between stream temperature and stream discharge is expected during the spring period when day length and solar radiation are increasing. However, when including temperature and stream flow data spanning the entire year (January 13 through December 12, 2008), the correlation coefficient for stream and air temperatures increased to 0.896 while the slope remains similar. Further, the relationship between stream temperature and discharge is substantially weaker, dropping to 0.0003 and reducing the slope to nearly zero.

Figure 6-7. Stream flow (cfs) at Sweetwater diversion dam, maximum, and minimum water temperature (°C) in Sweetwater Creek upstream from Webb Creek and maximum air temperature (°C) measured at the Lewiston Airport during spawning and incubation periods during 2008.

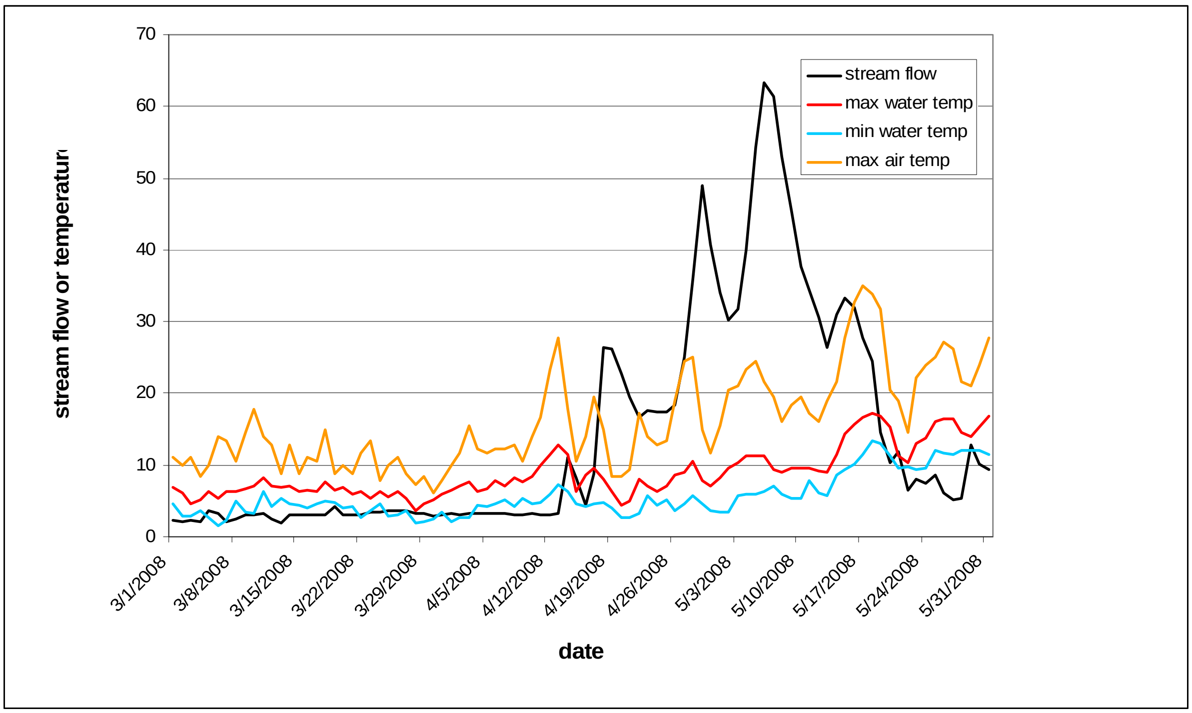


Table 6-3. Dates during the late May 2008 period when maximum daily stream temperature exceeded 16°C, along with maximum air temperature (°C) measured at the Lewiston Airport and associated stream flow past the Sweetwater diversion dam.

Date	Maximum Stream Temperature (°C)	Maximum Air Temperature (°C)	Stream flow (cfs)
May 17	16.7	35	27.8
May 18	17.2	33	24.4
May 19	16.8	31	14.5
May 20	15.2	20.5	10.2
May 21	11.3	18.9	11.9
May 22	10.4	14.4	6.5
May 23	13.1	22.2	8.0
May 24	13.8	23.9	7.5
May 25	16.0	25	8.7
May 26	16.4	27	6.2
May 27	16.5	26	5.2
May 28	14.5	21.1	5.3
May 29	14.0	23.9	12.7
May 30	15.3	27.8	10.1
May 31	16.8	28	9.4

Figure 6-8. Relationship of maximum water temperature (°C) measured at Sweetwater Creek upstream of Webb Creek with maximum air temperatures (°C) recorded at the Lewiston Airport between March 1 and May 31, 2008.

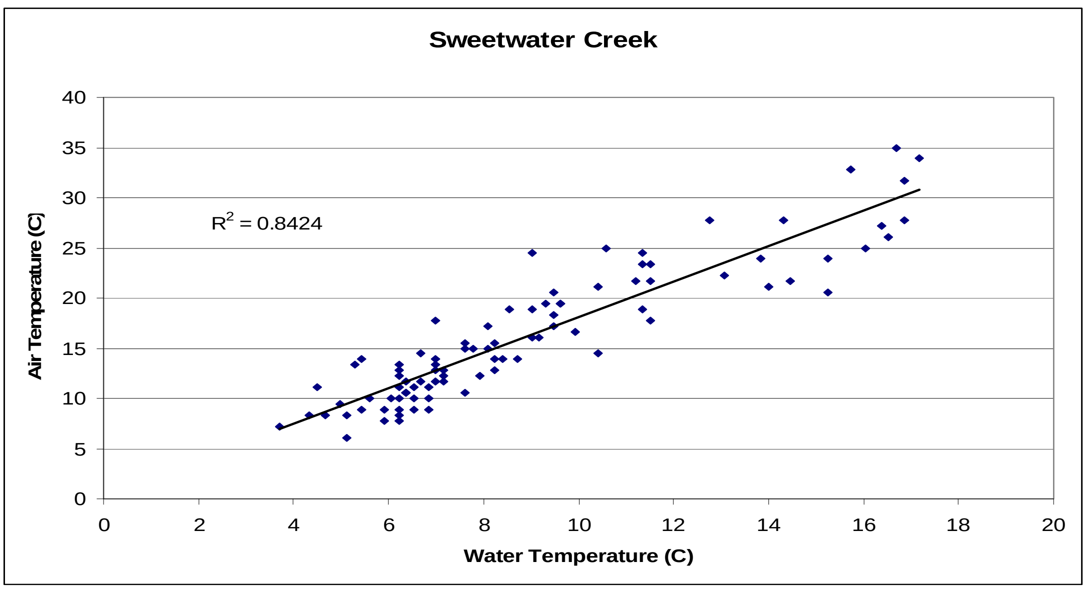
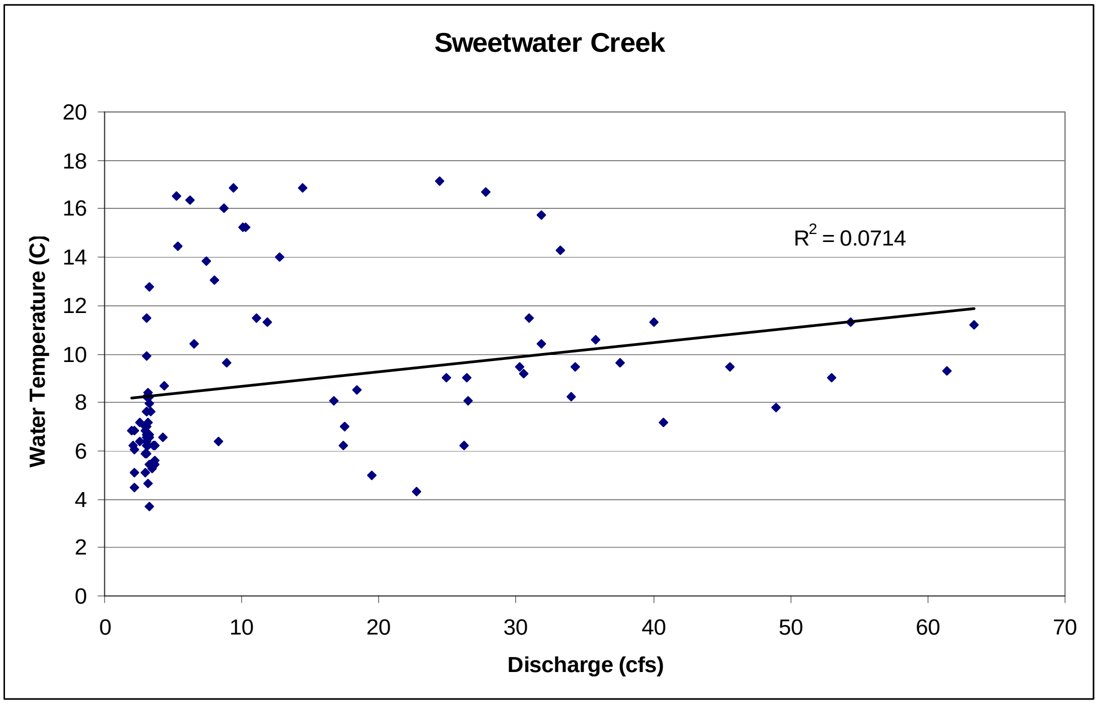


Figure 6-9. Relationship of maximum water temperature (°C) measured at Sweetwater Creek upstream of Webb Creek with stream flows (cfs) past the Sweetwater diversion dam between March 1 and May 31, 2008.



A similar linear regression analysis was performed for the summertime temperatures (June 1 through September 20, 2008) at this site to examine the high temperature-low flow period. These data show a weak inverse relationship (R^2=0.42) between stream discharge and stream temperatures (Figure 6-6). This plot shows a clump of data points below about 7 cfs stream flow with a broad range in associated summertime temperatures (about 13 to 24°C). These data indicate that at stream flows less than about 10 cfs there is little relationship between stream temperature and stream discharge (Figure 6-6). Other factors, such as stream-side shade, are likely working synergistically with air temperatures and discharge to influence stream temperature. These numerous variables are included in the stream segment temperature (SSTEMP) model used in the summertime temperature analysis described in Section 6.3, "Proposed Action Effects on Water Quality," which indicates a result similar to these measured stream temperatures.

Reclamation also collected temperature data downstream from the Sweetwater diversion dam. Data collection began on July 22 and extended through October 22, 2008. Again, only the latter portion of the annual temperature regime is captured by this data set. In this data set, Sweetwater Creek does not exceed 19°C on a daily average, nor does it exceed a 22°C instantaneous maximum.

When considering the above locations for measurement of water temperature on Sweetwater Creek, it is notable that 2008 was the first year that instream flows of 2 cfs were being provided in Sweetwater Creek pursuant to the remand settlement agreement. In 2006 and 2007, 1 cfs was provided, pursuant to the 2006 Biological Opinion. In years prior to 2006 no bypass flows were provided.

Reclamation collected data at a fourth location on Sweetwater Creek below the confluence with the East Fork and West Fork Sweetwater Creek. Data collection began on July 26 and extended through October 24, 2008. In this data set, Sweetwater Creek does not exceed 19°C daily average nor does it exceed the 22°C instantaneous maximum.

A fifth data logger was placed in Sweetwater Creek in the pool upstream from the Sweetwater diversion dam. This logger was affected by water surface fluctuations at the canal headgate, leaving the logger out of the water for a majority of the collection period. No further analysis of these data was conducted.

Reclamation collected temperature data from several tributaries to Sweetwater Creek. These data can be used to assess the existing temperature regime of the tributaries entering Sweetwater Creek. Data were collected from three tributary locations. These locations were at the mouth of the East Fork and at two locations in the West Fork. Monthly average temperatures at these locations are presented in Table 6-4.

Table 6-4. Monthly average temperatures recorded between July 23 and October 24, 2008, in the East Fork and West Fork of Sweetwater Creek.

	West Fork Mouth	West Fork Upper	East Fork Mouth
July	13.54°C	12.31°C	14.28°C
August	13.45°C	12.74°C	14.67°C
September	11.56°C	8.98°C	11.57°C
October	8.47°C	5.83°C	7.06°C

Data collection from the upper location of the West Fork of Sweetwater Creek began on July 22 and extended through October 23, 2008. In this data set, the upper portion of the West Fork Sweetwater Creek does not exceed 19°C on a daily average, nor does it exceed a 22°C instantaneous maximum. In comparison with the USEPA-suggested temperature, guidance there was only 1 day where stream temperatures exceeded the 16°C 7DADM (August 19). Additionally, at this location the stream does not exceed 20°C for any length of time. Average daily temperature fluctuations were approximately 2°C over the entire data set. Average daily temperature fluctuations ranged between 12 and 15°C throughout July and August, and 9 to 13°C through to mid-September.

Data collection from the mouth of the West Fork of Sweetwater Creek began on July 26 and extended through October 24, 2008. These recorded temperatures are affected by inflows from the upper West Fork basin, Big Springs outflows, and periodic pumping from Lake Waha. Again, only the latter portion of the annual temperature regime is captured by this data set. In this data set, the West Fork Sweetwater Creek does not exceed 19°C on a daily average, nor does it exceed a 22°C instantaneous maximum. Additionally, at this location the stream does not exceed 20°C for any length of time. Average daily temperature fluctuations were approximately 3°C and ranged between 12°C and 16°C throughout July and August.

Data collection from the mouth of the East Fork of Sweetwater Creek began on July 26 and extended through October 23, 2008. These data are influenced by diversions from Webb Creek, primarily consisting of releases from Soldiers Meadow. In this data set, the East Fork Sweetwater Creek does not exceed 19°C on a daily average, nor does it exceed a 22°C instantaneous maximum. The stream does not exceed 20°C for any length of time. Average daily temperature fluctuations were approximately 3°C and ranged between 13°C and 16°C throughout July and August, and 9°C to 13°C through September.

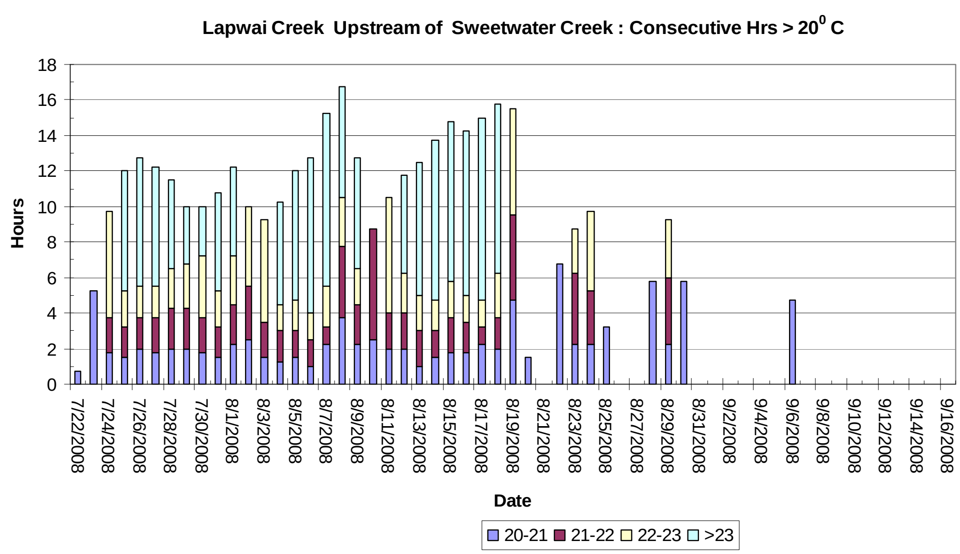
6.2.2.3 Lapwai Creek

The Tribe collected hourly stream temperatures at various locations throughout Lapwai Creek during the summers of 2003 through 2005. Data were collected at four locations. Station 1 was located at the mouth of Lapwai Creek; Station 2 approximately 1 km southeast of Culdesac, Idaho, approximately 23 km from the mouth; and Stations 3 and 4 are located 33 and 34.5 km from the mouth, respectively. Stations 2, 3, and 4 are upstream of Sweetwater Creek and the Project affected area. Data from these sites provide important reference for the basins.

Data collected by the Tribe in 2005 contain the longest annual period of record and illustrate the seasonality of the latter portion of the summer. In 2005, data collection began on June 15 and ended September 21. In general, all the data collection points in Lapwai Creek exceeded 16°C 7DADM from the onset of data collection. Without data from earlier in the year, it is difficult to determine when water temperatures typically start to rise. As the summer progressed, temperatures increased and peaked at all sample locations between August 4 and 14. At the mouth of Lapwai Creek, this 7DADM temperature peak was 27.5°C while at the data collection point above Sweetwater Creek peaked at 22.5°C. In comparison, the upper two data collection locations in Lapwai Creek peaked at 18.9 and 18.1°C. This indicates that significant heating of the Lapwai system occurs in the lower segment of the system. This is shown in Figure 6-2, which represents period of record peak 7DADM temperatures at each of the four tribal monitoring locations for each of the three systems. However, data were not available for station 3 of Sweetwater Creek.

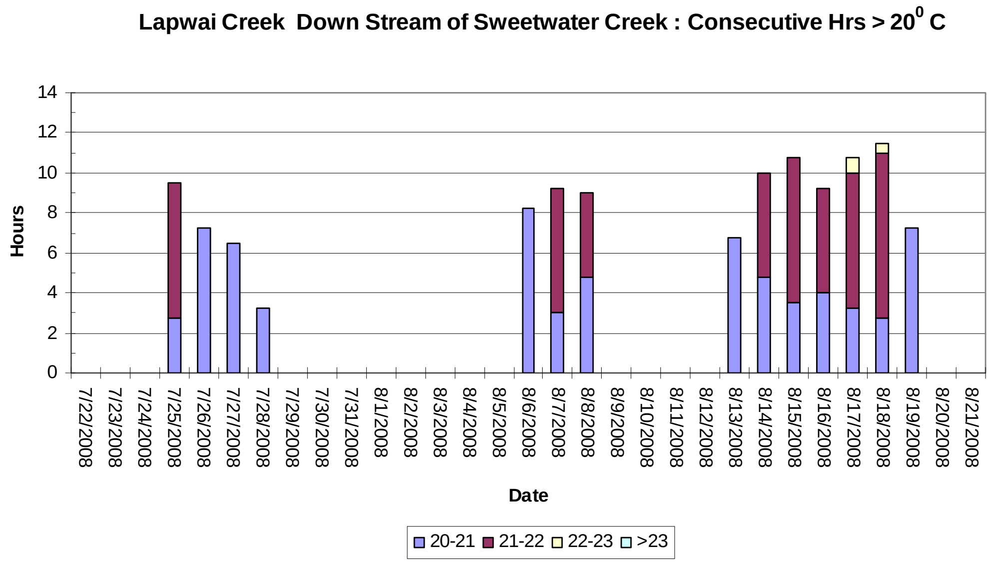
Reclamation also collected temperature data at three locations in Lapwai Creek (see Figure 6-1). The first of these was just above the Sweetwater Creek confluence. Data collection began on July 22 and extended through October 22, 2008. Again, only the latter portion of the annual temperature regime is captured by this data set. In this data set, Lapwai Creek above Sweetwater Creek exceeds the State of Idaho water quality standard 19°C maximum daily average for 23 days, and exceeds 22°C instantaneous maximum standard for 29 days. These exceedances began near July 24 and ran through to approximately the end of August. Frequency and duration of stream temperatures above 20°C is shown in Figure 6-10.

Figure 6-10. Hourly frequency distribution of stream temperatures exceeding 20, 21, 22, and 23°C in the Lapwai system upstream from the Sweetwater Creek confluence.



The second Reclamation data collection location on Lapwai Creek was downstream from the Sweetwater Creek confluence. Data collection began on July 22 and extended through October 23, 2008. In this data set, Lapwai Creek below Sweetwater Creek exceeds 19°C daily average for 7 days in early August (August 7 to 8, 15 to 19), and exceeds the 22°C instantaneous maximum for 2 days (August 17 to 18). An analysis of the frequency and duration of stream temperatures above 20°C is shown in Figure 6-10 and Figure 6-11. Comparing the frequency and duration of the temperature data upstream and downstream of the Sweetwater Creek confluence indicates that the cooling effect of Sweetwater Creek on Lapwai Creek appears to be localized. This temperature effect does not extend downstream to data loggers at the mouth of Lapwai Creek.

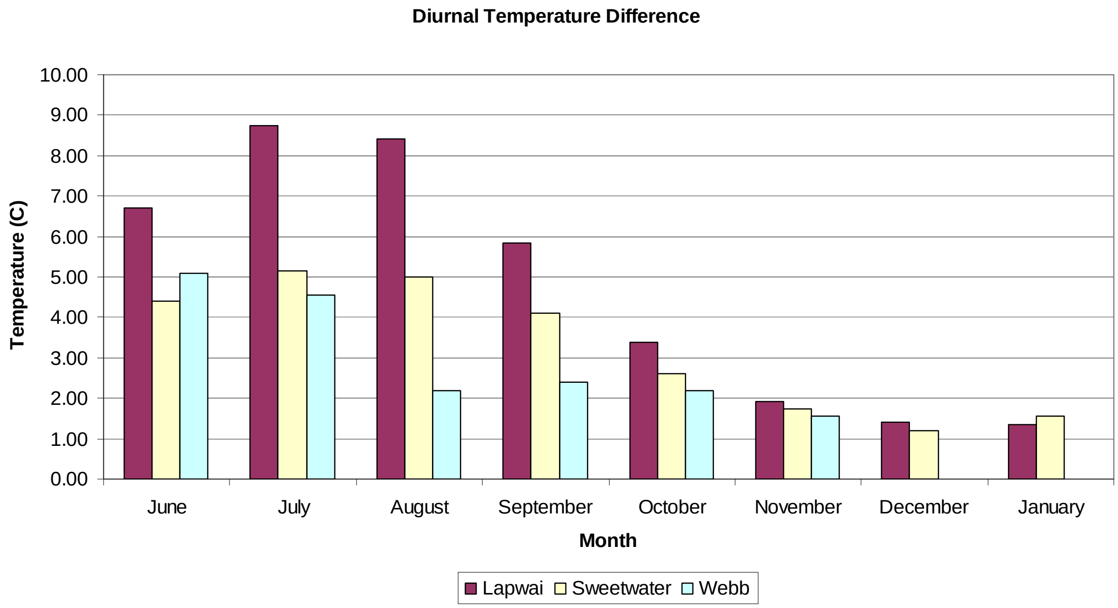
Figure 6-11. Hourly frequency distribution of stream temperatures exceeding 20, 21, 22, and 23°C in the Lapwai system downstream from the Sweetwater Creek confluence.



6.2.2.4 Diel Temperature Pattern

Daily temperature fluctuations (warmer daytime temperatures and cooler nighttime temperatures) are natural and important for coldwater stream biota particularly during the warmer months of the year in lower elevation habitats when maximum daily temperatures may limit activity and increase metabolic demand. The difference between daily maximum and daily minimum temperatures was averaged on a monthly basis at the mouths of Lapwai, Sweetwater, and Webb creeks from the 2005 data collected by the Tribal Fisheries Resource Management Department and is presented in Figure 6-12. These differences illustrate the temperature fluctuations the biota experience in the different systems on a daily basis. As shown in Figure 6-12, Webb Creek has the smallest average daily temperature difference, averaging approximately 2°C in August. This suggests a large buffering capacity of the riparian zone or a greater influence of groundwater to the system. In comparison, Lapwai Creek experiences wide fluctuations in daily temperature. These temperature fluctuations average approximately 8.5°C in August. The data set for August is more robust than those for June and July, so the temperature fluctuations for those 2 months shown in Figure 6-12 should be viewed with caution. This suggests that ground water connectivity in Lapwai Creek and/or riparian shading is minimal in the lower segment. Diel fluctuations measured at the mouth of Sweetwater Creek average approximately 5°C in August, as well as in June and July.

Figure 6-12. Monthly average temperature difference between measured daily maximum daily and minimum.



6.2.3 Sediment

Sediment suspended in the water column can adversely affect aquatic life. Many fish species are adapted to the high suspended sediment levels of short duration that commonly occur during natural spring runoff events. However, longer durations of exposure can interfere with feeding behavior, damage gills, reduce available food, reduce growth rates, smother eggs and fry in the substrate, damage habitat, and induce mortality. Eggs, fry, and juveniles are particularly sensitive to suspended sediment, although at high enough concentrations, adult fish are affected as well.

Total suspended solids (TSS) concentrations include the amount of solids suspended in the water, whether mineral (such as soil particles) or organic (such as algae). The TSS test measures the actual weight of material per volume of water. A comprehensive review of TSS criteria conducted by DEQ and USEPA (DEQ and USEPA 1998) suggests that 25 mg/L is a highly protective threshold for salmonids. This threshold can be variable, but likely ranges from about 25 mg/L to 80 mg/L, depending on duration.

Sediment sources from the Project activities include canals to divert water and roads used to access and maintain these canals. Water column data in the Webb, Sweetwater, and Lapwai creek drainages related to sediment pollution are few and disparate, and do not lend themselves to a systematic analysis. The Tribal Department of Fisheries Resource Management Watershed Division collected water quality and instream habitat parameters over the course of 4 years in Lapwai, Sweetwater, and Webb creeks. Water chemistry and instream habitat parameters were collected at a single point in time, generally in July or August, and at the same monitoring locations used for the temperature data logger collection points each year (see station location descriptions presented above). This results in 12 data points for each stream. Reclamation collected water chemistry data from three locations in September 2008; one from Lake Waha and two locations on Sweetwater Creek.

In general, TSS in all three systems is very low as measured under base flow conditions Average TSS for all data points in the three systems is 8.55 mg/L. Average TSS for each Lapwai, Sweetwater, and Webb creeks were 6.35, 10.83, and 8.47 mg/L respectively. Few trends could be determined from the small data set. It appears that in all three systems there is much higher TSS in the headwaters than at the mouths (Table 6-5). None averaged greater than 25 mg/L, and in only two cases did a single value exceed 25 mg/L, once each at station 4 in Sweetwater and Webb creeks.

TSS is likely to be higher during the spring runoff period. Most tributaries in the Clearwater system appear turbid during this time period; however, no data is available in the Action Area to quantify TSS levels. Turbidity can be primarily related to parent geology and to a variety of land management activities such as grazing and timber harvest within the watersheds.

Turbidity is a surrogate measurement for TSS. Quantitatively, turbidity is a measurement of the attenuation or scattering of a light beam by suspended solids, both particulate and dissolved, in the water column. TSS is a quantitative measurement of the mass of particles suspended in a sample. As a surrogate, turbidity can be affected by more than just particle concentration. Water color due to dissolved solids and temperature, as well as the shape, size and mineral composition of particles can affect a turbidity reading. In addition, comparison of turbidity readings between studies can be problematic due to a lack of a common method of turbidity instrumentation (Gray and Glysson 2003).

Table 6-5. Average total suspended solid concentrations collected August to September by the Nez Perce Tribe (2003 to 2005) and Reclamation (2008).

Creek	Station 1	Station 2	Station 3	Station 4	Reclamation
Lapwai	3.00 mg/L	2.00 mg/L	7.70 mg/L	12.67 mg/L	
Sweetwater	3.33 mg/L	3.00 mg/L	14.67 mg/L	22.33 mg/L	12 mg/L
Webb	2.00 mg/L	4.33 mg/L	3.53 mg/L	24.00 mg/L	
Lake Waha					1 mg/L

6.2.4 Other Water Chemistry

The following water quality parameters are an important component of the habitat and the current environmental conditions that are affecting Snake River steelhead in the Action Area. They are generally related to the activities that occur in the basin unrelated to the Project. These other parameters can provide insight into the general sources of pollutants in the three watersheds. Additionally, as TMDLs are written in these watersheds for these pollutants many of the best management practices that will be adopted will address non-Project sources of pollutants. These best management practices will aid and assist in the reduction of exceedances for temperature as well.

6.2.4.1 Pathogens

Pathogens are a small subset of microorganisms (such as certain bacteria, viruses, and protozoa), which if taken into the body through contaminated water or food, can cause sickness or even death. Some pathogens also are able to cause illness by entering the body through the skin or mucous membranes.

The major sources of pathogens in the watersheds include livestock grazing, confined livestock management, wild game and waterfowl, and failing septic systems. Animals dependent on the stream as a water source contribute bacteria directly to the stream in addition to breaking down stream banks and grazing on streamside vegetation. Table 6-6 shows the measured *E. coli* colony forming units (cfu) bacteria collected from the three creeks during the Nez Perce Tribe Fisheries Resources 2003 to 2005 monitoring period. Exceedances of the water quality criteria are highlighted and illustrate the magnitude of the effect that current land management practices have on water quality in the basins. Generally, high bacterial counts occurred in the Sweetwater Creek watershed. Reclamation data collected at Sweetwater Creek in September of 2008 averaged 58 cfu per 100 mL, and were below detection limits (<2 cfu per 100 mL) in Lake Waha.

Table 6-6. Measured levels of E. coli collected by the Nez Perce Tribe at four stations in three creeks (cfu per 100 mL).

2003				
	Station 1	**Station 2**	**Station 3**	**Station 4**
Lapwai	140	110	14	27
Sweetwater	500	240	**1,600**	159.7
Webb	344.1	**488.4**	240	387.4
2004				
Lapwai	105	61	32	32
Sweetwater	**2,419**	**2,419**	**2,419**	**579**
Webb	**1,203**	**2,419**	36	152
2005				
Lapwai	**460**	**460**	240	**460**
Sweetwater	210	**1,100**	**1,100**	9
Webb	75	25	**1,100**	43

6.2.4.2 Dissolved Oxygen

The Idaho criteria for DO in the water column for cold water aquatic life and salmonid spawning is a 1-day minimum of not less than 6.0 mg/L or 90 percent saturation, whichever is greater. The DO levels in a stream may be reduced by excessive nutrient loading and consequent algae growth. The biological decomposition of algae utilizes oxygen and the increased demand can cause depletions under low flow conditions. Dissolved oxygen measurements were collected by the Nez Perce Tribe Fisheries Resources Department 2003 to 2005.

Instantaneous DO levels in Webb Creek were very close to a criteria deficiency during one sampling event at the mouth (August 27, 2003—6.77 mg/L). Lapwai Creek instantaneous DO levels ranged from 6.98 to 10.35 mg/L during the 3-year monitoring period. Sweetwater Creek instantaneous DO levels ranged from 8.58 to 10.23 mg/L, and in Webb Creek, the instantaneous DO ranged from 6.77 to 11.13 mg/L. While these data show an adequate amount of DO in the water column, no diel measurements were taken to determine the range of DO throughout the night. In general, the data from the three systems indicate that daytime DO levels do not exceed State water quality standards.

6.2.4.3 Nutrients

Nuisance aquatic growth can adversely impact water quality of a system. Algae and rooted aquatic macrophytes of various types grow in the water and on the beds of streams. Algae and macrophytes grow where the substrate is suitable and sufficient nutrients (nitrogen and phosphorus) are available to support growth. When nutrients exceed the quantities needed to support primary productivity, algae blooms, and dense macrophyte growths may develop. Subsequent death and decay of the aquatic vegetation creates an oxygen demand. If the demand is high enough due to large algae blooms and growths, DO concentrations in the water body may decline to low levels that harm fish.

Idaho's narrative standard for nutrients states: "surface waters shall be free from excess nutrients that can cause visible slime growth or other aquatic growths impairing beneficial uses" (IDAPA 58.01.02.200.06).

Phosphorus

Total phosphorus (TP) consists of both particulate and dissolved fractions of both organic and inorganic phosphorus compounds. Dissolved phosphorus consists of all forms of phosphorus in solution, whether organic or inorganic. Phosphorus in solution in surface waters occurs almost solely as phosphates. Ortho-phosphorus (OP) is the form that plants can use, and thus best correlates to short-term stimulation of growth.

Phosphorus data were collected by the Nez Perce Tribe Fisheries Resources Department 2003 to 2005 and by Reclamation in 2008. The data from the samples collected in 2008 by Reclamation are similar to the data from the Tribe. In general, all three stream systems have indicators that water quality is impaired by excess nutrients. The most striking is the elevated phosphorus found throughout all three streams; however, there are several data gaps, such as nighttime DO sags, that must be filled before impairments could be definitively identified. Additionally, the source of the phosphorus in the systems has not been identified. The high levels of pathogen indicators may give some suggestion of likely sources of nutrients.

Nitrogen

Nitrogen data were also collected by the Nez Perce Tribe Fisheries Resources Department 2003 to 2005 and are summarized here. Total nitrogen (TN) to TP ratios (TN:TP) indicate that the three systems generally contain excess phosphorus. Average TN:TP for the Nez Perce data set was approximately 12. However, there are several instances where the systems change to excess nitrogen with TN:TP ratios ranging from 20 to 40. In general, the headwater or upstream locations contained more nitrogen than the downstream locations in Sweetwater and Webb Creek. Lapwai Creek contained more nitrogen compounds in the upstream locations than in the downstream locations. The TN data also lend evidence to the phosphorus information indicating that excess nutrients are impairing the water quality of the Webb, Sweetwater, and Lapwai creek drainages. Coupled with the pathogen information these parameters suggest that land use practices in the basins affect water quality. However, the data gaps that were identified for the TP data set exist for this data set as well, and should be addressed before a comprehensive water quality assessment could be made.

6.3 Proposed Action Effects on Water Quality

6.3.1 Water Temperature Effects

The effects of the PA on summertime stream temperatures were estimated from a SSTEMP model (USGS 2002) constructed and validated for the stream segments of concern and the proposed minimum flows. This modeling effort tests the hypothesis/expectation that increases in instream flows provided by the PA will result in decreases in stream temperatures during the summer/fall low flow months of the irrigation season (July through October).

For Webb Creek, Reclamation modeled only the proposed minimum summertime (juvenile rearing) flow of 1.0 cfs below the diversion dam. For Sweetwater Creek, four different flows were modeled: existing conditions (2.0), 2.5, 3.5, and 4.5 cfs. Results for Sweetwater Creek indicate that minimal temperature differences will occur between 2.5, 3.5, and 4.5 cfs stream discharge levels modeled. The temperature differences seen in the model results are well within the model error terms, which range from 0.42 to 1.40°C. Further, the mean daily temperatures that would result from any of the Sweetwater Creek stream flow levels tested cannot be statistically distinguished from the existing conditions. As a result, caution should be used in the interpretation of the differences between existing conditions and the PA.

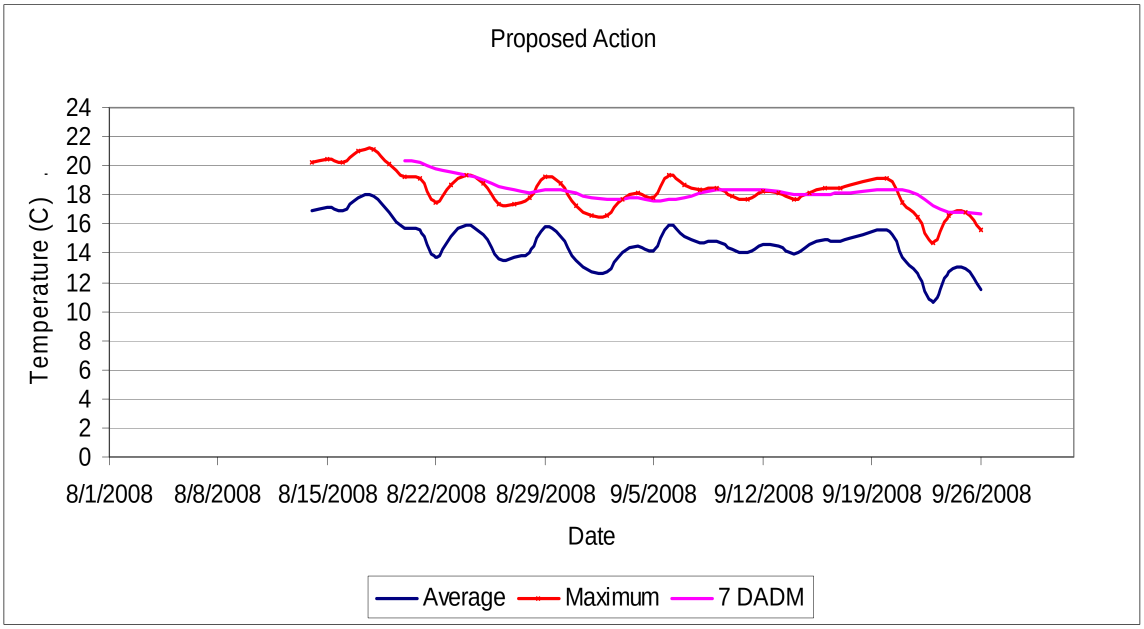
The model also performed more poorly for maximum temperature and could not be calibrated to existing maximum conditions using the same calibration data for average temperature conditions. Furthermore, the SSTEMP model was designed as a predictive model for average temperatures, not necessarily for maximum temperatures. Because of this, the following discussion centers on average modeled stream temperatures.

Modeled stream temperatures appear to be largely determined by inflow temperatures to the stream segment of concern. Inflow temperatures incorporate the influence of 21 ranch springs on the modeled upper segments of Sweetwater Creek. These stream temperatures are then influenced by ambient air temperature, humidity, shade, and solar radiation. Shade is likely the largest factor affecting stream temperatures (Reclamation 2009a). For lower Lapwai Creek, a mass balance calculation was used to predict stream temperatures (Reclamation 2009b). The results are summarized for specific stream segments below.

6.3.1.1 Webb Creek

Modeled maximum temperatures for Webb Creek in August range from 17.27 to 21.11°C (see Figure 6-13). Additionally, modeled average temperature peaks at approximately 18°C. Based on the assumptions in the model, the PA (1.0 cfs minimum summer flow measured at the diversion dam) should not result in an exceedance of the Idaho water quality standards. Due to historic operations that provided zero discharge in the segment below the diversion for much of the summer, the SSTEMP model for historic conditions could not be calibrated or validated. However, the model was calibrated and validated for six other segments of the Webb Creek and Sweetwater Creek drainages. Our assumption that these same parameters that were measured, estimated, or used as defaults in those segments, which produced acceptable results, would provide similar results for the segment below the Webb Creek diversion. Additionally, we assumed that the PA flow would reach the mouth of Webb Creek with no loss to the groundwater or any gains from accretion flow.

Figure 6-13. Estimated modeled temperatures in Webb Creek with the Proposed Action.



6.3.1.2 Sweetwater Creek

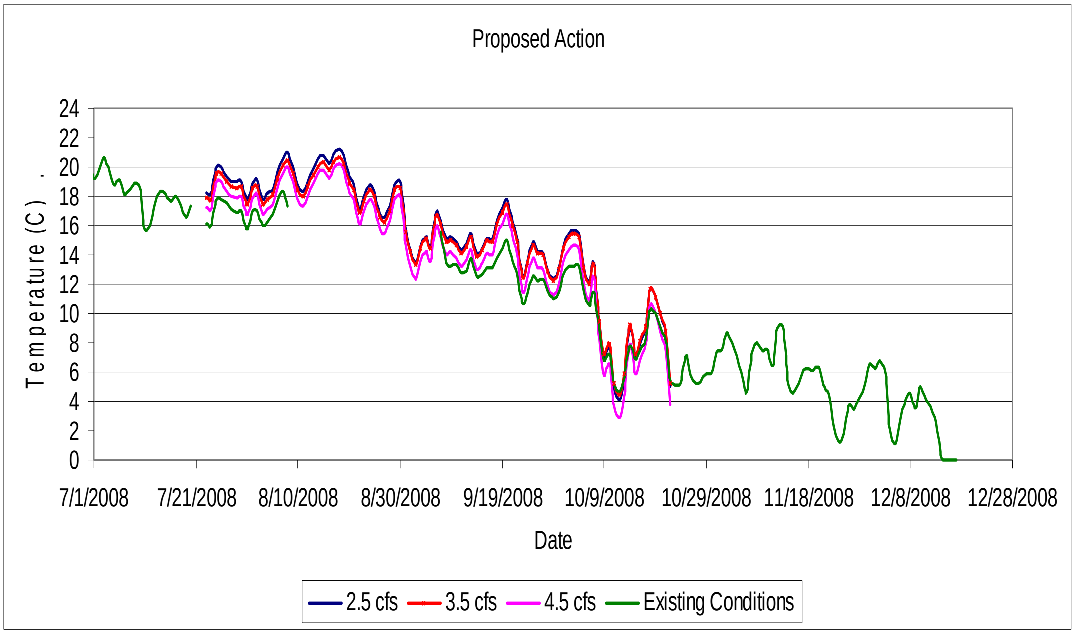
Water is routed throughout the Sweetwater Basin creating increases or decreases in flow and associated temperature effects in various locations in the basin. The temperature effects from the Project to the reaches upstream of the Sweetwater diversion dam could not be determined through the use of the model. Data characterizing conditions in these reaches is limited; however, it should be noted that the cooling effect of 21 ranch springs is embedded in the modeling work with incorporation of inflow temperature for subsequent downstream segments. Therefore, the modeling effort in Sweetwater Creek focuses on the segments downstream of the diversion dam accessible to steelhead where the diversion of water has the fullest, most complete data set, more robust responses from the model, and likely the greatest potential to affect the temperature of the stream.

Estimated modeled temperature data from Sweetwater Creek between the diversion dam and the confluence with Webb Creek indicates that the proposed minimum flows (2.5 cfs) will produce the warmest temperatures in the stream of the four conditions. The proposed minimum flows are estimated to be approximately 1°C warmer than existing average temperatures measured in July, August, September, and October 2008 with a 2.0 cfs bypass stream flow past Sweetwater diversion dam (see Figure 6-14). This warming effect with the 0.5 cfs increase in stream flow could be a function of two factors: model error as noted above, or an increase in the width to depth ratio in the stream that provides more surface area for solar radiation. A summertime stream flow of 3.5 cfs at Sweetwater diversion dam results average stream temperature approximately 0.86°C warmer than existing average temperatures, while 4.5 cfs at Sweetwater diversion dam results in average stream temperatures approximately equal to the existing conditions (Table 6-7).

Table 6-7. Temperature effects predicted from SSTEMP model for Sweetwater Creek between the diversion dam and the confluence with Webb Creek. The data indicates the change in temperature (positive or negative) in degrees Celsius for three different bypass flows compared to existing conditions.

Month	2.5 cfs Bypass v. Existing Conditions (2008)	3.5 cfs Bypass v. Existing Conditions (2008)	4.5 cfs Bypass v. Existing Conditions (2008)
July	1.05 warming	0.65 warming	0.02 warming
August	1.05 warming	0.65 warming	0.02 warming
September	1.11 warming	0.92 warming	0.03 warming
October	1.18 warming	1.24 warming	0.03 warming

Figure 6-14. Average daily temperatures, predicted from the model as a result of the Proposed Action, in the segment of Sweetwater Creek from the diversion to Webb Creek.

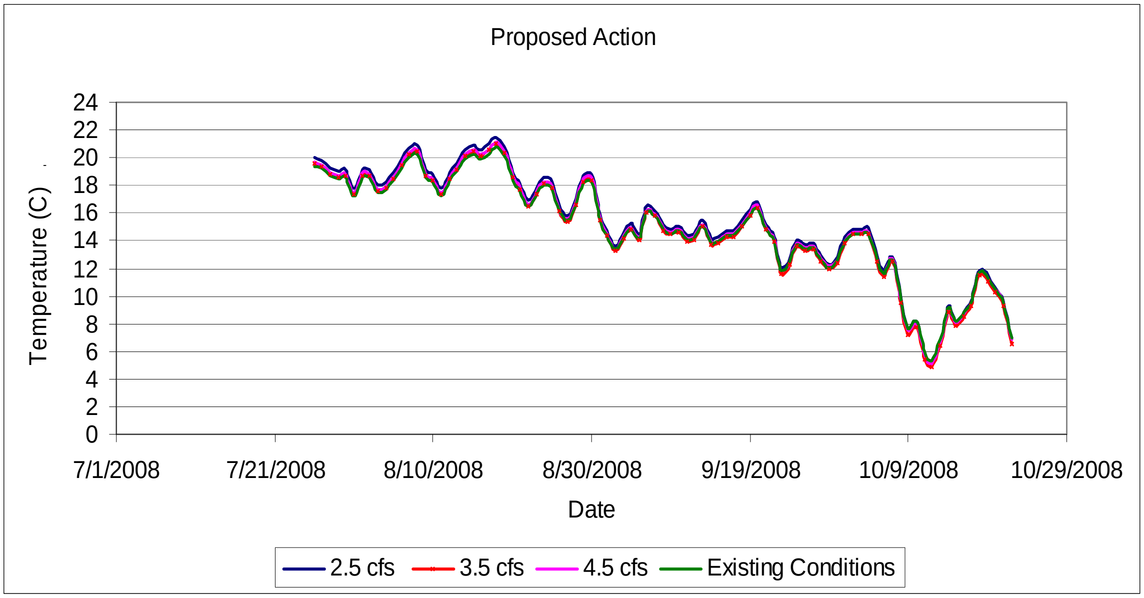


Modeled temperature data from Sweetwater Creek between the Webb Creek confluence and the mouth indicates little difference between the average daily temperature for summertime flows of 2.5, 3.5, and 4.5 cfs, and existing conditions. The PA will provide 2.5 to 3.5 cfs past Sweetwater Creek diversion dam and 1.0 to 2.0 cfs past Webb Creek diversion dam for a total minimum proposed stream flow of 3.5 to 5.5 cfs in lower Sweetwater Creek not accounting for spring inflows in this reach The model output indicates that bypass stream flow of 2.5 cfs result in approximately 0.4°C warmer temperatures than existing average temperatures measured at 2.0 cfs in July, August, September, and October 2008; 3.5 cfs flow provides average stream temperatures close to existing conditions; 4.5 cfs bypass flow results in approximately a 0.14°C warming of the average stream temperatures compared to existing conditions (Table 6-8 and Figure 6-15). This result is possibly explained by an increase in stream width, which would allow more heat inputs at this stream flow.

Table 6-8. Average monthly temperature effects predicted from SSTEMP model for Sweetwater Creek between the Webb Creek confluence and the mouth. The data indicates the change in temperature (positive or negative) in degrees Celsius.

Month	2.5 cfs bypass v. Existing (2.0 cfs)	3.5 cfs bypass v. Existing	4.5 cfs bypass v. Existing
July	0.58 warming	0.15 warming	0.27 warming
August	0.57 warming	0.13 warming	0.26 warming
September	0.33 warming	-0.08 cooling	0.10 warming
October	0.11 warming	-0.28 cooling	-0.05 cooling

Figure 6-15. Average daily temperatures, predicted from the model as a result of the Proposed Action, in the segment of Sweetwater Creek from below Webb Creek to the confluence with Lapwai Creek.

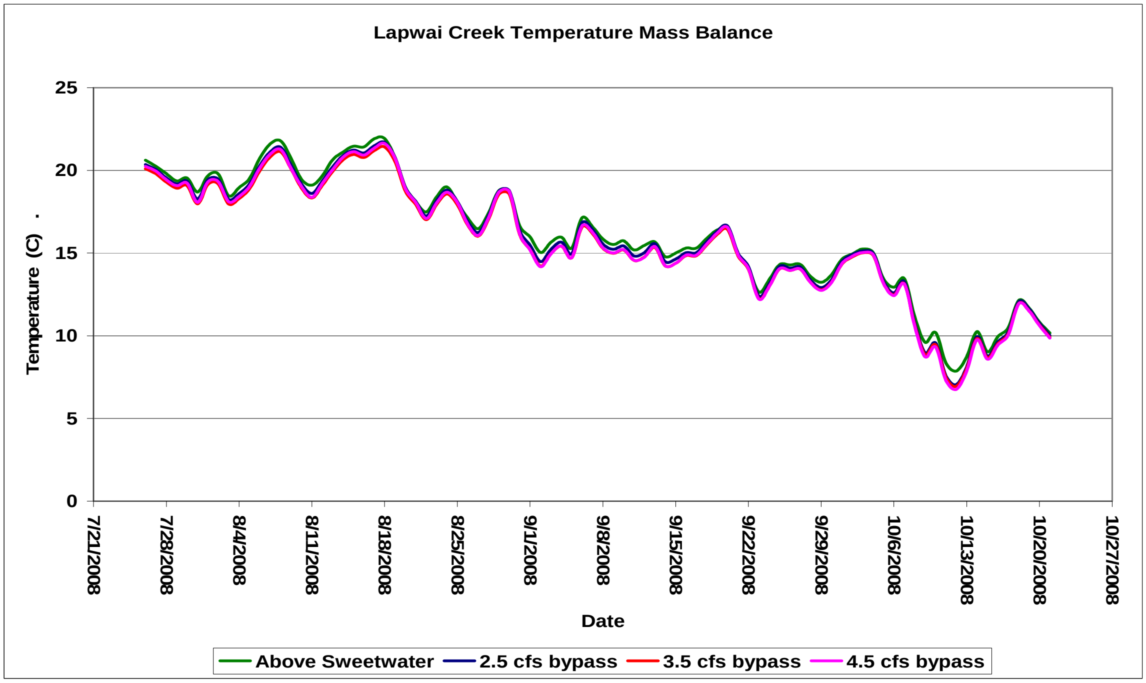


6.3.1.3 Lapwai Creek

Estimating the effect of the PA on water temperature on lower Lapwai Creek was not successful using the SSTEMP model. Therefore, Reclamation conducted a mass balance calculation of the modeled stream temperatures in Sweetwater Creek and existing data collected in Lapwai Creek above the Sweetwater confluence. Estimating and separating the flows from Lapwai Creek and Sweetwater Creek were problematic. The USGS operates a stream flow gauge (Lapwai Creek Gauge # 13342450) downstream from the Sweetwater confluence (USGS 2009). At face value, it is simple enough to subtract the existing flow records from Sweetwater Creek from the Lapwai Gauge. The remainder then should represent the contribution from the upper Lapwai Watershed; however, there are several discharge sources and diversions located within the reach between Sweetwater Creek and the gauge (Reclamation 2009b). These may over- or underestimate the effect of Sweetwater Creek on the Lapwai Creek water temperature, depending on the magnitude of the withdrawal or discharge. As a result, the following discussion should be considered a conservative estimate until those losses and gains are more fully understood.

Graphically, there is little difference between the existing upstream daily average temperature and the PA (Figure 6-16). In 2008, with the 2.0 cfs instream flow bypassed at Sweetwater diversion dam, there was a very slight cooling effect of Sweetwater Creek on Lapwai Creek. This effect is likely localized due to degraded riparian corridor conditions, among others factors, in lower Lapwai Creek.

Figure 6-16. Lapwai Creek mass balance comparison with existing average daily temperature and the Proposed Action.



The proposed minimum flows in Sweetwater Creek will maintain the cooling effect and will reduce temperature in Lapwai Creek near the confluence with Sweetwater Creek on average approximately 0.26°C over the temperatures measured in 2008. Ultimately, this is the result of increased discharge from Sweetwater Creek. A summertime stream flow of 4.5 cfs (combined bypass flow from Sweetwater Creek and Webb Creek) will cool Lapwai Creek on average approximately 0.46°C more than the existing condition, while 5.5 cfs will cool Lapwai Creek by approximately 0.42°C over the existing temperature. The estimated slight loss in temperature benefit with the additional bypass stream flow likely is due to changing width depth ratios in the lower portion of Sweetwater Creek with increasing discharge. Table 6-9 and Figure 6-16 present the monthly average temperatures differences between the existing temperatures and the various bypass proposals in Lapwai Creek, due to the mixing with Sweetwater Creek.

Table 6-9. Expected monthly average temperature benefit to Lapwai Creek near Sweetwater Creek estimated from a mass balance calculation.

Month	Existing-3.5 cfs bypass	Existing –4.5 cfs bypass	Existing – 5.5 cfs bypass
July	0.25°C cooling	0.52°C cooling	0.38°C cooling
August	0.25°C cooling	0.50°C cooling	0.38°C cooling
September	0.24°C cooling	0.45°C cooling	0.43°C cooling
October	0.30°C cooling	0.42°C cooling	0.48°C cooling

6.3.2 Total Suspended Sediment Effects

Sediment sources from the Project activities include canals to divert water and roads used to access and maintain these canals. However, Project-related dams also capture fine sediments in the creeks. Fine sediment accumulations near the head gates of the canals are periodically flushed past the dams. The gate automation system opens the gate daily to pass any debris or fine sediment that could impede gate operation. This sediment is a small amount that accumulates in the canal intake, which was transported by the creek. Therefore, this activity does not add sediment to the creek.

Soldiers Meadow Reservoir and Sweetwater diversion dam both capture fine sediment. The fine sediments captured at Sweetwater diversion dam will be removed from the creek via the gravel excavation plan in the PA. This action may improve fine sediment conditions and reduce cobble embeddedness in the steelhead habitat downstream of the diversion dam. Therefore, the contribution of fine sediment from the earthen canals is likely mitigated by the dams capturing and removing fine sediments in the Project effected area. Webb Creek diversion is located in a steep boulder channel and does not capture fine sediment to the extent that sediment removal activities need to be conducted at this site.

Many other non-point sediment sources are present in the basin, including parent geology, farming, grazing, timber harvest, bank erosion, off-road vehicle use, and public and private roads. Most of the Project roads are located on the ridgelines away from the stream. Much of the canals are lined with pipe or concrete-reducing potential erosion of sediment. Reservoir content below about 300 af in Soldiers Meadow Reservoir is thought to mobilize sediment from the reservoir bottom. Therefore, the PA leaves a minimum content in Soldiers Meadow Reservoir to prevent the water quality effects from this condition. The pumping from Lake Waha occurs above the lake bottom at about 13 feet lake depth. Therefore, sediment contribution from this activity is considered negligible.

Measured total suspended sediment concentrations in the basin are low (less than 25 mg/L. A study on suspended sediment effects to *O. mykiss* trout found indications of physiological stress at suspended sediment concentrations 50 to 100 mg/L and an effect at concentrations greater than 50 mg/L when conditions persisted for 14 or more days (Newcombe and Jensen 1996). Suspended sediment concentrations measured in Sweetwater and Webb creeks under base flow conditions are at low levels. These levels give an indication that suspended sediment recruitment into the system is low. Coupled with the presence of dams and diversion structures that capture and retain sediment it is likely that sediment concentrations during other times of the year will also be low and should not affect steelhead spawning and rearing in the streams. Furthermore, the PA does not alter the operation or configuration of the facilities in a manner that will alter sediment contributions to the Sweetwater Basin.

6.4 Summary

Current water quality conditions in Webb, Sweetwater, and Lapwai creeks indicate that these three systems are impaired. In most cases, this impairment is the result of nonpoint sources activities not associated with the Project. Stream temperature data collected in the Webb Creek, Sweetwater Creek, and Lapwai Creek watersheds describe the temperature regime of these systems. Data collected prior to 2008 indicate that Webb Creek occasionally does not meet water quality standards, and sometimes exceeds maximum temperature standards during the summer and fall rearing period. Sweetwater Creek generally meets water quality standards, but does evidence occasional exceedances of maximum temperatures in the summer and fall rearing period. Lapwai Creek does not meet water quality standards throughout the summer, as well as exceeding recommended maximum rearing temperatures for approximately 30 days.

Finally, the effects of the PA on temperature and sediment in the Action Area cannot be distinguished statistically from the existing conditions seen in 2008. A more complete statistical comparison of the model output and conditions seen in 2008 are available in a Reclamation draft stream temperature modeling technical memorandum (Reclamation 2009b).

Chapter 7 SNAKE RIVER STEELHEAD

7.1 Introduction

This chapter presents analysis of the potential effects of the Project PA on Snake River steelhead, originally listed as a threatened ESU in 1997 (62 CFR 43937) and relisted as a DPS January 5, 2006 (71 CFR 834) and critical habitat for steelhead, designated on September 2, 2005 (70 CFR 52630). To provide context for the effects analysis and conclusions, relevant information is provided on the biological and habitat requirements of steelhead, the status of the local steelhead population in terms of species recovery planning, and other actions and factors that may be affecting the species within and outside of the Action Area. The chapter is organized as follows:

- **Section 7.2, "Biology and Populations,"** focuses on perspectives related to steelhead biology and populations, reporting on life history and habitat requirements, current conditions, and potential impacts of the PA on steelhead in the Action Area.

- **Section 7.3, "Critical Habitat,"** focuses on steelhead critical habitat, reporting on existing conditions and potential impacts of the PA.

- **Section 7.4, "Impact Summary and Conclusion,"** summarizes the expected impacts related to both steelhead utilizing the Action Area and critical habitat.

- **Section 7.5, "Other Factors Affecting the Steelhead,"** reviews other actions or factors that may be affecting steelhead in the Columbia Basin, and more locally, in the Lapwai Basin.

7.2 Biology and Populations

7.2.1 Life History and Habitat Requirements

O. mykiss exhibits the greatest diversity of life history strategies for salmonids native to North America. This diversity includes multiple return times for adults during spawning migrations, varying periods of fresh water and ocean residency, and plasticity of life history between generations (WDFW 2006). The species has two life history forms that are present in the Snake River Basin, anadromous and resident

(Behnke 1992). The anadromous form, commonly called steelhead, migrates to the ocean to rear for 1 to 2 years, and is protected under the ESA. The resident form, called redband trout, remains in fresh water for their entire life cycle, and is not protected under the ESA (WDFW 2006). These life history forms oftentimes co-exist within the same stream basin (Docker and Heath 2003, Narum et al. 2004). The two life history types are indistinguishable as parr, and the size of the trout and the location of adult rearing and migration are typically used to distinguish the adults (Narum et al. 2004).

There is no taxonomic distinction between the resident and anadromous life history types. Genetically the two life history types are more similar within a basin than within the same life history type across basins (Docker and Heath 2003, Narum et al. 2004). Interbreeding between life history types occurs, and in some basins numerous returning steelhead (up to 40 percent) have had at least one non-anadromous parent (WDFW 2006). Resident redband trout can produce smolt outmigrants; however, their survivability to return as adults is lower than the other types of crosses (Thrower et al. 2004, WDFW 2006). The steelhead-steelhead cross produces the largest proportion of smolt outmigrants (WDFW 2006).

Inland steelhead in the Columbia River Basin including the Snake River Basin are summer steelhead (Behnke 1992; NMFS 1996). Snake River summer steelhead are further divided into A-run and B-run groups. At Bonneville Dam, migration timing and fish length (generally indicative of time spent rearing in the ocean) are typically used to distinguish A-run steelhead from B-run steelhead. A-run steelhead are generally less than 78 centimeters (cm) in length, while B-run fish are generally greater than 78 cm in length. These designations were based on an observed bimodal migration timing of adult steelhead at Bonneville Dam and differences in age (1-ocean versus 2-ocean) and adult size observed among Snake River steelhead. Adult A-run steelhead enter fresh water from June to August; as defined, the A-run fish pass Bonneville Dam before 25 August (CBFWA 1990, IDFG 1994). Adult B-run steelhead enter fresh water from late August to October, passing Bonneville Dam after 25 August (CBFWA 1990, IDFG 1994). At Lower Granite Dam, run-timing separation was not observed, and the groups were separated based on length of residence in the ocean and body size (IDFG 1994, in NMFS 1996). A-run steelhead are defined as predominately 1 year in the ocean, while B-run steelhead are defined as predominately 2 years in the ocean (IDFG 1994). Idaho’s A-run steelhead usually are found in the Snake and Salmon rivers. The B-run steelhead most often return to the Clearwater River, but some return to tributaries in the Salmon River. Adult B-run steelhead are also thought to be, on average, 75 to 100 millimeter (mm) larger than A-run steelhead of the same age; this is attributed to their longer average residence in salt water (Bjornn 1978, CBFWA 1990, CRFMP TAC 1991) (information from: http://www.nwfsc.noaa.gov/publications/techmemos/tm27/intro.htm).

Although the A and B runs are considered separate groups, the research on steelhead populations in the Snake River in Idaho is indicating that there is overlap between the characteristics that distinguish these groups. For example, studies on Fish Creek, tributary to the Lochsa River in the upper Clearwater River Basin (and part of the Lochsa River population of the Clearwater River major population group [MPG]), have documented returning adults ranging from 62 to 95 cm in length and ocean residences ranging from 1 to 3 years. This population is considered to be B-run, yet 32 percent of returning adults reared in the ocean for 1 year (IDFG 2008a, ICTRT 2007a). Similar results have been found in adult steelhead returning to the Potlatch River, a population considered A-run. Steelhead returning to this weir during 2007 ranged in size from 56 to 85 cm in length and ocean residences ranging from 1 to 2 years. Steelhead thought to spend 1 year in the ocean comprised 23 percent of this run (IDFG 2008b). Data from these two studied populations indicate that individuals in the A-run Potlatch River are skewed toward smaller size fish with a shorter length of ocean residence, whereas the individuals from the B-run population in Fish Creek are skewed toward a larger fish with a longer length of ocean residence, particularly for female steelhead. Yet, these findings also support that steelhead exhibit a diversity of life history strategies within single populations (NMFS 1996).

Recent genetic analyses group juvenile steelhead samples from Mission Creek (a tributary in Lapwai Creek) closest to the Potlatch Basin samples and other samples from the lower Clearwater tributaries. These samples are distinct from the Dworshak National Fish Hatchery samples and other B-run populations sampled (Nielsen et al. 2009). These data support the A-run designation in the lower Clearwater tributaries that does not appear to have been inter-breeding with other local hatchery B-run steelhead.

Steelhead in the Snake River Basin migrate more than 400 miles to the mouth of the Columbia River. The downstream migrating smolts and the returning upstream migrating adults must pass eight hydroelectric dams and reservoirs on the mainstem Snake and Columbia rivers. The majority of steelhead home to their natal streams to spawn. Spawning typically occurs during the rising hydrograph and prior to peak flows (NMFS 2006a). Incubation occurs unattended in the streambed, and adults either die or migrate back downstream to the ocean. Juvenile steelhead rear in fresh water for 1 to 4 years and rear 1 to 4 additional years in the ocean. This variable life history can result in 13 different combinations of fresh water and ocean ages with extensive overlap between generations. Age combinations of 2 to 3 years in streams and 2 or 3 years in the ocean are the most common (Meehan and Bjornn 1991). The iteroparous life history trait is observed in steelhead populations with some steelhead surviving for up to four spawning events. Post-spawning survival of steelhead is inversely related to the migration distance in the Columbia River Basin (Wertheimer and Evans 2005), and was estimated to range from 2 to 4 percent in the Clearwater River in Idaho, prior to the construction of the lower Snake River dams (Whitt 1954).

7.2.1.1 Spawning

Timing of adult and juvenile migrations varies with elevation and latitude. Steelhead spawning in the North Fork Clearwater and Salmon River tributaries occurs from late March through early July, peaking between April 20 and May 10 (Orcutt et al. 1968). Steelhead may select a site for redd construction based on many different factors including; water depth, water velocity, water temperature, gravel size, local hydraulics, and available cover. When spawning, the female steelhead digs a nest called a redd pocket in the gravel on the streambed. Her digging activity will construct the redd pocket and remove undesirable fines and small gravel. Due to this systematic excavation of finer sediments, the water permeability of the egg pocket greatly exceeds that of surrounding substrate. The size of the sediment particles moved by the female depends on her body size and on the substrate composition at the site in the streambed. Water currents caused by the redd pocket retain sperm during fertilization and deposit the eggs in crevices around the upstream end of the larger substrate remaining at the bottom of the redd pocket (Chapman 1988).

The female steelhead will continue spawning building additional redd pockets upstream from the first (Chapman 1988; Bjornn and Reiser 1991). Due to the excavation of multiple redds, adequate spawning areas average 5.5 square meters (59 square feet) ranging from 2.1 square meters to 11.2 square meters (23 to 121 square feet) (Orcutt et al. 1968; Pauley et al. 1986). Steelhead redds documented in the Deschutes River, Oregon were smaller in area (average 2.5 square meters) (Zimmerman and Reeves 2000), but it is unclear whether these different studies are measuring the same attributes (single redds versus multiple redds) to determine whether this difference in observed redd area is comparable.

Redd construction is thought to require a minimum water depth of 20 cm (7.9 inches) and a preferred velocity of 37 to 100 centimeters per second (cm/sec) (1.2 to 3.3 feet/second [ft/sec]) (Swift 1976). Average redd conditions have been documented as 54 cm (21.3 inches) water depth and a mean water velocity of 71.43 cm/sec (2.3 ft/sec) in the Deschutes River, Oregon (Zimmerman and Reeves 2000). Egg depth ranges from 18 to 43 cm for Chinook salmon and 8 to 22 cm for smaller rainbow trout (Chapman 1988).

Gravel size is one of several factors important in the selection of a redd site. In general, the substrate needs to be highly permeable to allow for water flow within the gravel to provide oxygen and remove waste products. Steelhead redds have been shown to consist of gravels ranging from 1.3 to 11.4 cm (0.51 to 4.49 inches) diameter (Orcutt et al. 1968; Pauley et al. 1986).

With the natural diel temperature fluctuations, the upper end of optimal temperatures during adult migration is 22 to 23°C or a 7-day average maximum of 16 to 17°C (Hicks 2000). During spawning behavior, water temperatures ranging from 3.9 to 9.4°C are typical; however, some studies have documented spawning temperature at 12.8°C (Pauley et al. 1986; Richter and Kolmes 2005).

7.2.1.2 Incubation and Emergence

Incubation requirements are a complex interaction between many extra-gravel and intra-gravel variables, including DO, water temperature, biochemical oxygen demand, substrate size, channel gradient, channel morphology, water depth, water discharge and velocity, permeability and porosity of gravel and velocity of water through the redd pocket (Chapman 1988, Bjornn and Reiser 1991). Incubation success depends upon conditions from fertilized egg to alevin, and also upon emergence of fry from the substrate. Egg pocket structure and composition influence survival during both incubation and emergence (Chapman 1988). Steelhead eggs require 4 to 7 weeks to hatch and the alevins require another 3 to 7 days to absorb the yolk and become free swimming (Pauley et al. 1986).

The amount of time for incubation to occur is temperature-dependent with steelhead requiring about 85 days at 4°C and 26 days at 12°C to reach 50 percent hatch (Bjornn and Reiser 1991). Spawning steelhead have been seen in Lapwai Creek between March 1 and April 14 in previous years (Taylor 2003). Eggs incubating in the gravel at about 12°C (observed April/May temperatures in Sweetwater Creek range from 10 to 15°C (50 to 60°F)) would require less than 50 days to hatch.

Substrate size in the redd has been found to affect the survival of the eggs and alevins (Chapman 1988). Eggs in substrate with 20 to 25 percent fines (less than 6.4 mm or 0.25 inches) displayed reduced survival and emergence rates and only 10 percent of alevins emerged in concentrations of fines greater than 50 percent (Chapman and Bjornn 1969; Tappel and Bjornn 1983). Silt can not only cause problems with the rates of flow through the gravel in a redd, but it can also build up on the eggs and reduce oxygen diffusion across the membrane of the egg (Greig et al. 2007).

Flow velocities within the gravel between 5 and 100 cm (2 and 39 inches) per hour has been shown to be optimal for maintaining high oxygen concentrations and removing waste products (Pauley et al. 1986). Decaying organic material in the substrate has been shown to use up oxygen and can lead to low oxygen levels for the eggs (Greig et al. 2007). One study conducted in artificial channels found that steelhead redds could withstand up to 5 weeks of dewatering with no significant reduction in survival to hatching, alevin quality, growth rate, or quality of emerged fry. Conditions in these dewatered redds were a sediment moisture content at least

4 percent by weight and temperatures within the tolerance range for incubation (Reiser and White 1983).

Lethal temperatures occur below 0°C. The upper end of optimal temperatures for incubation is thought to be a 1-day maximum of 13.5 to 14.5°C and a 7-day average maximum of 13 to 14°C in a stream with diel temperature fluctuation (Hicks 2000). DO conditions are directly linked to water temperature. Increasing temperatures during incubation will speed development but increases oxygen demand (Greig et al. 2007), and distress to incubating eggs has been observed at oxygen concentrations less than 6 mg/L (Pauley et al. 1986). At temperatures over 15°C, increased mortality is seen and fry emerging from a maximum incubation temperature over 16°C are smaller (Richter and Kolmes 2005). Incubation temperatures between 4 and 9°C allow for high survival rates (92 percent), temperatures up to 15°C have fair survival (78 percent), and only 7 percent survival is seen at temperatures over 16°C (Richter and Kolmes 2005).

7.2.1.3 Juvenile Rearing

Juvenile steelhead (40 to 180 mm length) usually occupy sites with velocities up to about 40 cm/sec (1.3 ft/sec) (Everest and Chapman 1972, Pauley et al. 1986, Bjornn and Reiser 1991). Densities of juvenile steelhead decline when velocities are greater than 45 cm/sec (1.5 ft/sec) (Everest and Chapman 1972). The smaller (age 0) steelhead use velocities less than 15 cm/sec (0.5 ft/sec) in Idaho streams (Everest and Chapman 1972; Rubin 1990). Rubin (1990) indicated that age 0+ steelhead had difficulty swimming in velocities exceeding 25 cm/sec (0.8 ft/sec). Streams where the anadromous life history type of juvenile *O. mykiss* dominate are predominantly smaller size classes (age 0 and 1 trout) (for examples see Rubin 1990; NPT 2003a, 2004b, 2005). The prevalence of these smaller size classes in the natal tributaries in Idaho is attributed to the migratory behavior exhibited by the life history type to move downstream from natal tributaries in the fall to over-winter in larger streams (Chapman and Bjornn 1969) and by the nature of the anadromous life history type to outmigrate to the ocean and estuary to rear from parr to adult.

Over-winter survival of age 0 steelhead and rainbow trout is an interaction between size of the trout at the onset of winter, water temperatures, cover, and food availability. Age 0 trout that are too small or too large entering the winter months have reduced over-winter survival (Smith and Griffith 1994, Connolly and Petersen 2003).

Optimal conditions for the production of macroinvertebrate food items for steelhead are thought to occur in the following ranges: velocities ranging from 31 to 110 cm/sec (1.0 to 3.6 ft/sec), stream depths ranging from 0.1 to 0.9 meters (5 to 36 inches) and sediment sizes ranging from 3.2 to 30.4 cm (1.3 to 12 inches) (Reiser and Bjornn

1979; Pauley et al. 1986). Greater water velocities increases the potential for drift feeding, but also increases metabolic costs and decreases prey detection and capture probability (Piccolo et al. 2008). Instream cover is very important for fish to avoid predation and bioenergetic costs of competition and aggressive interactions. However, for food protection, overhanging vegetation is considered more critical because it provides cover from predation as well as terrestrial food sources (Pauley et al. 1986).

Juvenile steelhead prefer temperatures between 7.2 and 14.5°C with the optimal temperature up to 17.2°C. Optimal temperatures for rearing fry are 10°C (Nielsen and Lisle 1994, Pauley et al. 1986). A 7-day average maximum of 16.6 to 17.5°C and a 1-day maximum of 21 to 23°C have been suggested in systems with daily temperature fluctuation as the upper end of optimal temperatures for rearing (Hicks 2000). Temperatures above 22.5°C are associated with reduced feeding behavior and growth rates with the upper lethal temperature at 25°C (NMFS 1997; Richter and Kolmes 2005). Food needed to prevent weight loss is three times greater at 22.5°C than it is at 6.9°C (7.5 percent body weight per day compared to 2.2 percent body weight per day) (Wurtsbaugh and Davis 1977). Even with unlimited food that could compensate for higher metabolic costs, in a natural enclosure fish grew better at lower temperatures than higher temperatures (Boughton et al. 2007). Foraging stops between 22 and 23°C and fish move to cold water refugia (Nielsen and Lisle 1994). Rainbow trout have been shown to use colder water areas even when DO concentrations are very low (NMFS 1997). The incipient lethal limit of DO concentrations is around 3.1 mg/l (NMFS 1997).

Migration survival downstream to the estuary is related to size, with larger smolts having higher ocean survival. Smolts outmigrating from the Keogh River, Alaska at 200 mm were eight times more likely to survive to spawn than smolts that outmigrated at 140 mm (Ward et al. 1989). Size of smolts at migration also has been shown to influence ocean residence time with larger smolts spending less time in the ocean (Ward et al. 1989).

7.2.1.4 Habitat Requirements and Instream Flow Incremental Methodology

IFIM is a tool developed to assess fish habitat tradeoffs against other uses of water. PHABSIM is a series of computer programs used in the IFIM specifically to measure the effects of various stream flows on fish habitat. PHABSIM is not intended to be a replacement for population studies, basic research into fish or benthic ecology, biological innovation, or common sense (Gore and Nestler 1988).

The HABTAE program of PHABSIM requires hydraulic information and habitat usability information to generate a relationship between stream discharge and habitat value, which is expressed as a unitless measure called weighted usable area (WUA).

The usability information is based on the assumption that fish exhibit discrete and quantifiable preferences for a range of velocities, depths, and cover/substrate characteristics and is expressed as habitat suitability criteria (HSC). HSC are species and life stage specific, and based on suitability indices that scale habitat variables between 0 (unsuitable) and 1 (most utilized). HSC are developed from densities of observed fish related to various habitat parameters (primarily depth and velocity). Because HSCs are input values used to describe acceptable (or optimal) habitat, they strongly influence the results of a PHABSIM study.

The IFIM methodology has described processes appropriate for developing the HSC (USFWS 1986). In instream flow deliberations, scientists should agree on the HSC prior to generating any model results (USFWS 1986). Reclamation relied primarily on the HSC from the SRBA process as "best available science" because: 1) the documented habitat requirements for steelhead in Idaho were comparable to the values supporting these HSCs (Reclamation 2009c), 2) the SRBA criteria were well-developed, researched, peer-reviewed and found adequate in court hearings related to instream flow rights throughout the Snake River Basin in Idaho; 3) the criteria were developed specifically for steelhead utilizing natal tributaries in the Snake River Basin; and 4) the criteria were developed by and for the Nez Perce and Shoshone-Bannock tribes in Idaho used in the instream flow claims relevant to the Action Area. For steelhead, HSC were developed for juvenile rearing and adult spawning life stages.

Comparing the documented habitat requirements (as cited in Section 7.2.1.3, "Juvenile Rearing,") to the HSC for juvenile rearing steelhead from the SRBA process supports that the WUA values generated from these criteria are expected to provide the necessary rearing habitat for juvenile steelhead. Juvenile steelhead (40 to 180 mm length) usually occupy sites with velocities up to about 40 cm/sec (1.3 ft/sec) and depths greater than 0.2 m (Everest and Chapman 1972, Pauley et al. 1986, Bjornn and Reiser 1991). Densities of juvenile steelhead decline when velocities are greater than 45 cm/s (1.5 ft/s) (Everest and Chapman 1972). Most age 0 steelhead use velocities <0.5 ft/sec (15 cm/sec) in Idaho streams and had difficulty swimming in velocities exceeding 25 cm/s (0.8 ft/s) (Everest and Chapman 1972; Rubin 1990). These values are consistent with the SRBA juvenile velocity criteria (Table 7-1). Age 0 and 1 juvenile steelhead (the smaller size classes) are the most abundant in the natal tributary streams in the Snake River Basin comprising more than 90 percent of the abundance of *O. mykiss* trout in most streams (for examples see Rubin 1990; NPT 2003b, 2004a, 2006).

Table 7-1. The Snake River Basin Adjudication juvenile steelhead rearing habitat suitability criteria (EA Engineering 1991a).

Velocity (ft/sec)	Suitability Index	Depth (feet)	Suitability Index
0	0	0	0
0.2	0.15	0.3	0.2
0.3	0.9	0.6	0.65
0.5	0.97	1	0.96
0.7	1	1.2	1
1.2	1	10	1
1.4	0.75		
1.8	0.25		
2.0	0		
8.0	0		

Because of the exclusive emphasis on physical habitat in PHABSIM, other highly important biological factors are not accounted for, such as individual bioenergetics, behavior, local movements, food provision rates, metabolic costs of maintaining swimming position, competition for territories, predator interactions, and mortality risk (Anderson et al. 2006). Habitat use involves a complex tradeoff between responses among these numerous abiotic and biotic factors that changes with flow (Anderson et al. 2006). Therefore, although it often is assumed that this habitat selection indicates a requirement, the consequences of losing a strongly selected habitat and occupying a less selected one are usually unclear (Rosenfeld 2003). Therefore, physical habitat analyses should only be interpreted when considering these limitations and the dynamic, variable stream environment.

There is no standard determination of the proportion of maximum WUA to avoid impacts to the target fisheries population. In fact, attempts to relate WUA to fish population biomass have largely failed (Gore and Nesler 1988, Mathur et al. 1985, Rosenfeld 2003). In addition, stream hydrology, hence WUA, are dynamic variables that continually change in the natural stream environment. At times, for example, streams may fall below arbitrarily selected WUA value under conditions like high flows or drought. Therefore, WUA estimates should not be examined outside of the hydrologic context of the stream and should not be considered a static required target.

Considering the limitations of the scientific methods of IFIM outlined above, stream flows for the PA were derived and tested in the following process:

1) Collect channel cross section and velocity data under a range of stream flows

2) Interpret physical habitat and WUA estimates in the study streams

3) Estimate and examine unregulated hydrology

4) Estimate target stream flows during the proposed operation period according to biologic needs

5) Test the feasibility of providing stream flows and triggers via the spreadsheet model presented in Chapter 5, “Hydrologic Conditions.”

As the methodology states, Reclamation relied heavily on physical site and habitat attributes and local hydrology to identify the bypass stream flows in the PA.

7.2.2 Current Conditions

7.2.2.1 Status and Trends

The Snake River steelhead DPS is one of six steelhead DPSs in the Columbia River Basin, five of which are listed under the ESA. The ESA recognizes DPSs as legitimate units for listing. These DPSs are the only divisions below the species or subspecies taxonomic level recognized by the Act (61 CFR 4722-4725). Finer population subdivisions, discussed below, have been designated for salmon and steelhead in the Columbia Basin for viable salmonid population (VSP) analysis and recovery planning purposes.

The Snake River steelhead DPS has six MPGs including Lower Snake River, Clearwater River, Grande Ronde River, Salmon River, Imnaha River, and Hells Canyon (NMFS 2005). The Clearwater River MPG extends from the confluence of the Clearwater River with the Snake River east to the Idaho/Montana border. It includes five extant populations including the Clearwater River lower mainstem population (CRLMA-s) of interest in this consultation, as well as one extirpated population (North Fork Clearwater River) blocked by construction of Dworshak dam (NMFS 2006c). Other populations in the Clearwater River MPG include Lolo Creek, and the Selway, Lochsa, and South Fork Clearwater rivers. The geographical extent of the Clearwater River MPG, along with the other five Snake River steelhead MPGs, is shown in Figure 7-1. Figure 7-2 provides a more detailed view of the Clearwater River MPG and its five extant and one extirpated populations. Figure 7-3 illustrates the percentage of five major spawning areas (MaSAs) and 16 minor spawning areas (MiSAs) that make up the CRLMA-s (NMFS 2006c). Lapwai Creek is one of the five MaSAs in the Clearwater River lower mainstem population. Others include Upper Potlatch River, Big Canyon Creek, Clear Creek, and Lawyer Creek.

The Clearwater River MPG steelhead exhibit a wide range of traits across the area occupied by the MPG, as illustrated in part by the fact that the area supports both A-run and B-run fish, and fish occupy and spawn in a wide range of elevations and habitat types.

Figure 7-1. Distribution of the Snake River steelhead DPS and the six major population groups.

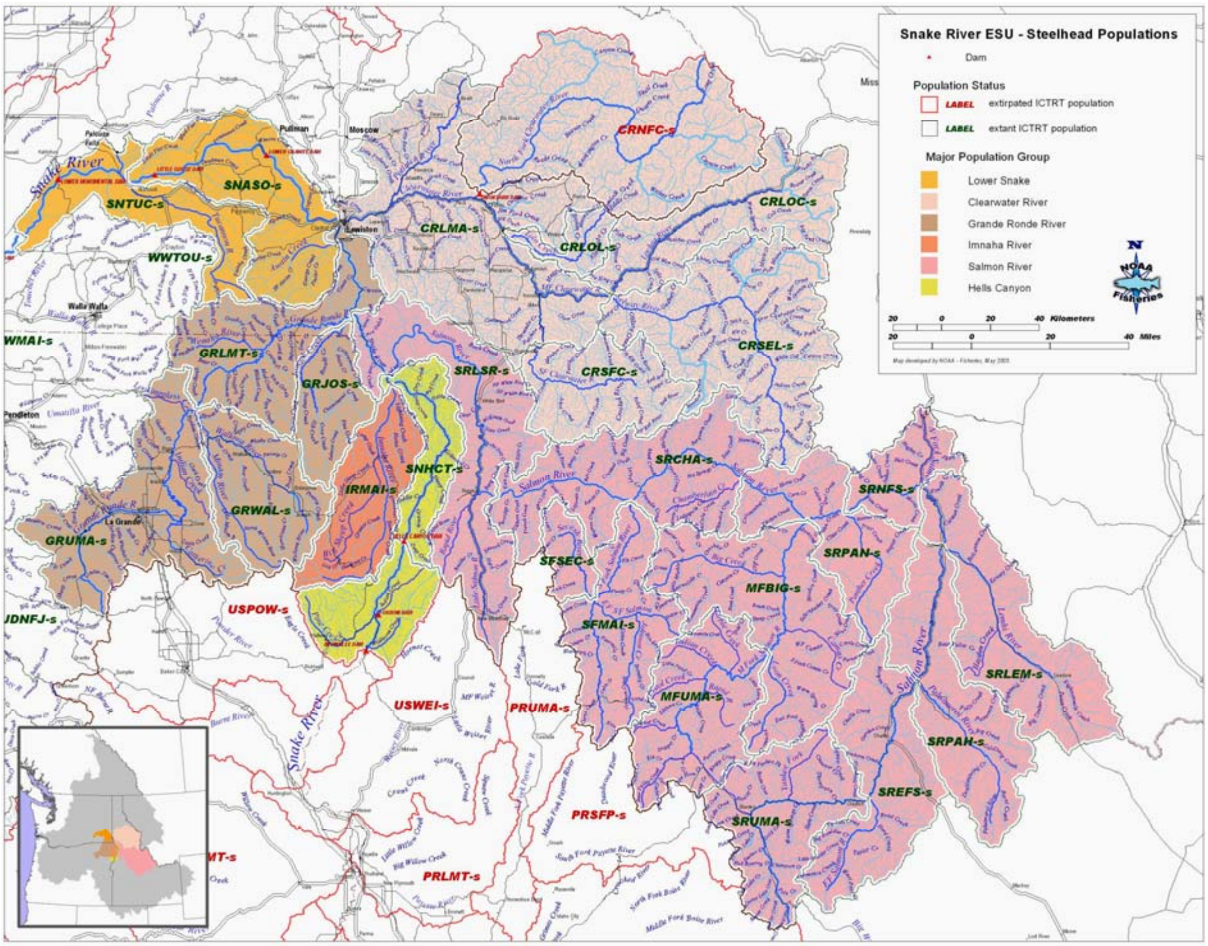
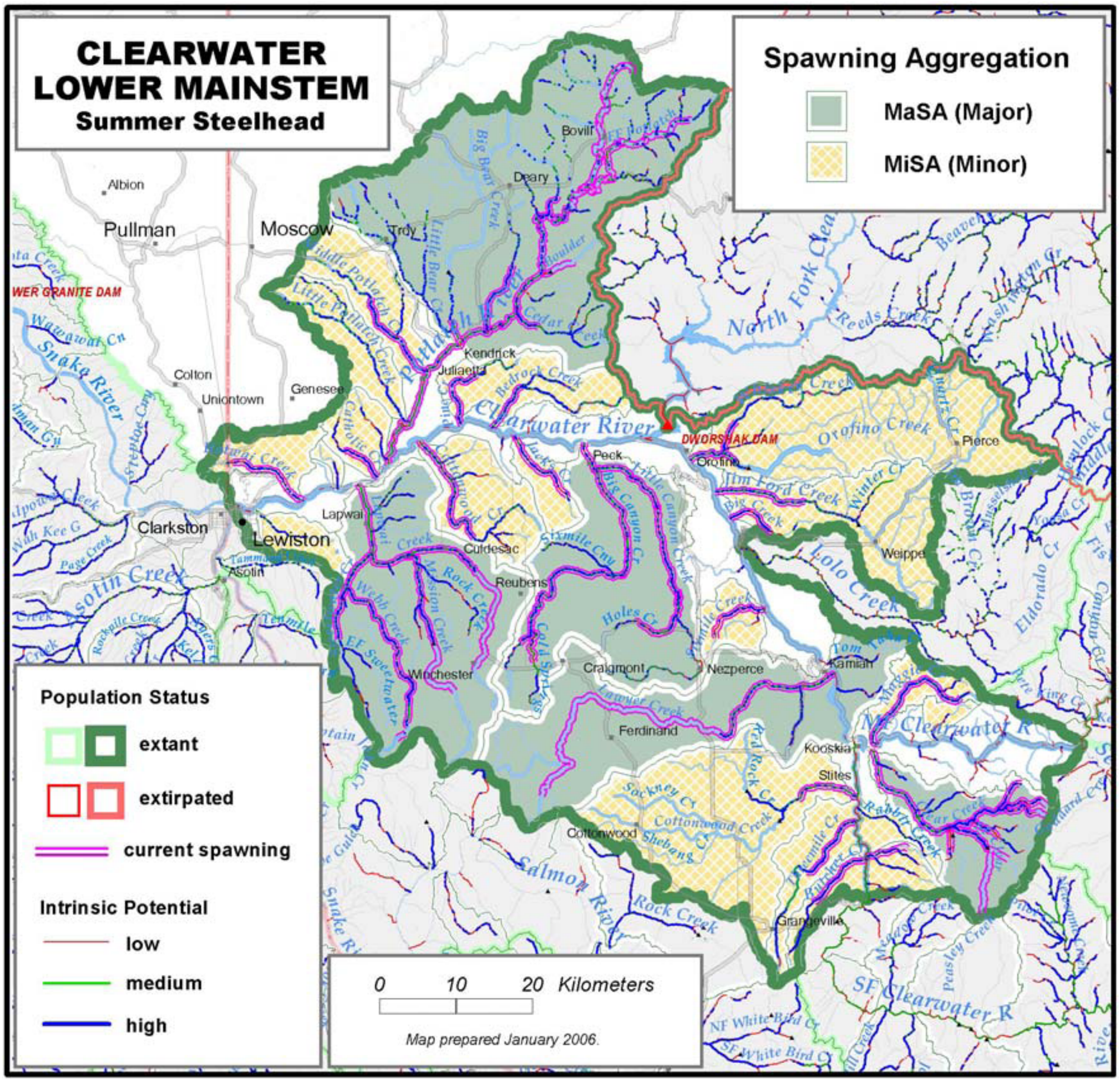
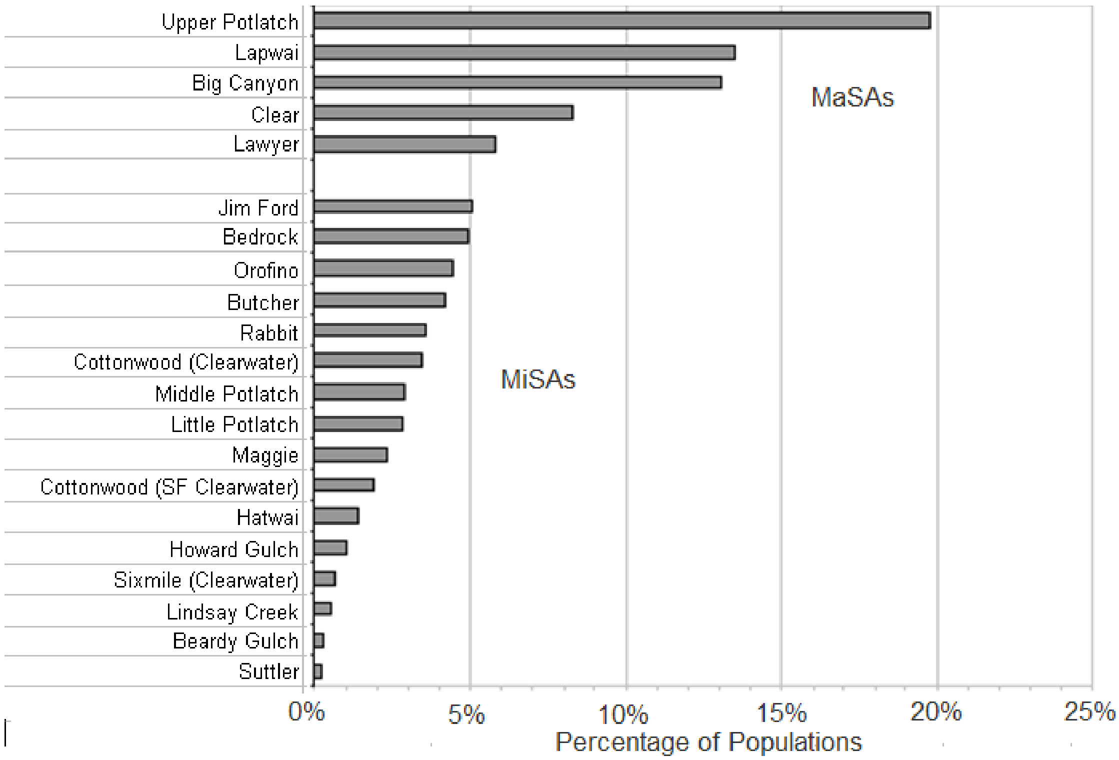


Figure 7-2. Clearwater River Lower Mainstem steelhead major and minor spawning areas.



(Source: NMFS 2009a)

Figure 7-3. Proportion of MaSAs and MiSAs that makeup the Clearwater River Lower Mainstem steelhead population.



(Source: NMFS 2009a)

The CRLMA-s is distinguished from the rest of the basin by its A-run life history; a break in habitat characteristics separates it from the South Fork Clearwater River upstream of the town of Harpster, Idaho. North Fork samples (represented by resident fish and Dworshak NFH hatchery stock) are the most consistently genetically divergent samples from the Clearwater Basin. Lolo Creek is sufficiently geographically isolated from other steelhead spawning areas that any significant straying is unlikely. Samples from the Lochsa and Selway rivers are somewhat genetically similar, but large numbers of spawners, basin size, and distance support the classification of independent populations in the two rivers (modified from NMFS 2009b).

The CRLMA-s consists of A-run summer steelhead, Lolo Creek has both A- and B-run summer steelhead, while three other populations are B-run fish (NMFS 2008a) (Table 7-2). The CRLMA-s population is considered a "large" population with dendritic complexity (ICTRT 2007a). The Interior Columbia Basin Technical Recovery Team (ICTRT) has determined that a large population of steelhead would require a minimum abundance threshold of 1,500 adult fish to achieve a 5 percent risk of extinction in 100 years (ICTRT 2007b).

Table 7-2. Six independent populations in the Clearwater River steelhead MPG, along with their ICTRT threshold size category and life history type.

Independent Populations	Size Category		Life History Type
Clearwater River lower mainstem	Large	1,500	A-run
South Fork Clearwater	Intermediate	1,000	B-run
North Fork Clearwater (extirpated)	Large		B-run
Lolo Creek	Basic	500	A- & B-run
Selway River	Intermediate	1,000	B-run
Lochsa River	Intermediate	1,000	B-run

(Source: ICTRT 2007b)

The Project is a relatively small area located within a portion of the Lapwai Basin. The Project Action Area encompasses Sweetwater Creek, Webb Creek, and the lower 9 miles of Lapwai Creek. The Sweetwater/Webb creek watershed comprises approximately one-third of the total Lapwai Creek watershed area. This Action Area impacts a percentage of one of five major spawning groups in the Clearwater River lower mainstem A-run steelhead population.

7.2.2.2 Viable Salmonid Population Concept

Four factors are used by NMFS to assess the viability of salmonid populations: abundance, productivity (or population growth rate), spatial structure, and genetic diversity (McElhany et al. 2000). Each of these factors is discussed below in relation to the Clearwater River MPG and Snake River steelhead DPS.

Due to the extensive migration behavior of steelhead, many factors outside of the Action Area influence survival and abundance, such as ocean and estuary conditions, commercial and recreational harvest, and hydropower facilities in the mainstem Columbia and Snake rivers.

Abundance

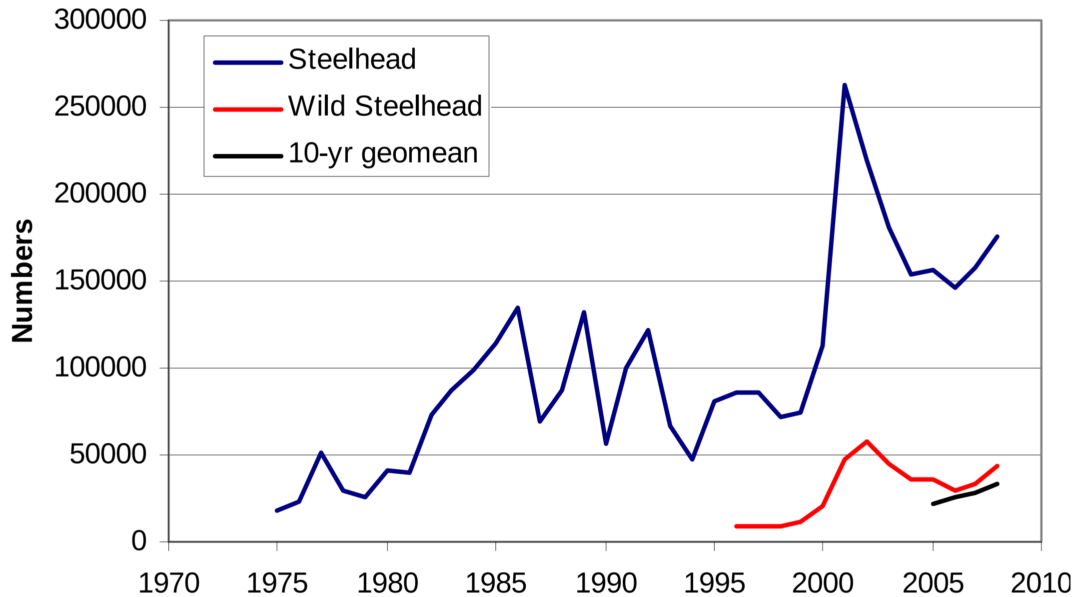
The overall abundance of adult steelhead (Snake River steelhead DPS) returning to the Snake River Basin in Idaho (as well as some tributaries in northeast Oregon) is reflected by counts at Lower Granite Dam. Table 7-3 and Figure 7-4 provide the count data at the dam for total adult steelhead (1975 through 2008), and wild steelhead (distinguished in the counts beginning in 1994). Figure 7-5 illustrates the annual pattern of adult steelhead migration timing at Lower Granite Dam. Quantitative adult return information specifically for the Clearwater River MPG or its independent populations, such as the Clearwater River lower mainstem, is not available. It is also relevant to note that the counts at Lower Granite Dam do not represent returns of the entire Snake River steelhead DPS since some steelhead populations spawn and rear in Snake River tributaries downstream from the dam.

Table 7-3. Returns of adult Snake River steelhead to Lower Granite dam from 1975 to 2008. (Wild steelhead from 1994 to 2008 are a subset of all steelhead; The 10-year geometric mean is calculated for wild fish only).

Year	Steelhead	Wild Steelhead	10-year geometric mean	Year	Steelhead	Wild Steelhead	10-year geometric mean
1975	17,311			1992	121,456		
1976	23,017			1993	66,700		
1977	51,076			1994	47,550	9,436	
1978	29,960			1995	80,853		
1979	25,046			1996	86,072	9,583	
1980	40,454			1997	85,917	8,991	
1981	40,234			1998	72,017	9,559	
1982	72,840			1999	74,440	11,740	
1983	86,753			2000	113,021	20,580	
1984	98,930			2001	262,568	47,716	
1985	114,477			2002	218,718	57,291	
1986	134,321			2003	180,672	45,391	
1987	69,334			2004	154,389	36,209	
1988	87,047			2005	155,783	35,977	22,425
1989	132,575			2006	145,991	29,836	25,123
1990	56,939			2007	157,214	32,998	28,611
1991	100,367			2008	175,156	43,641	33,303

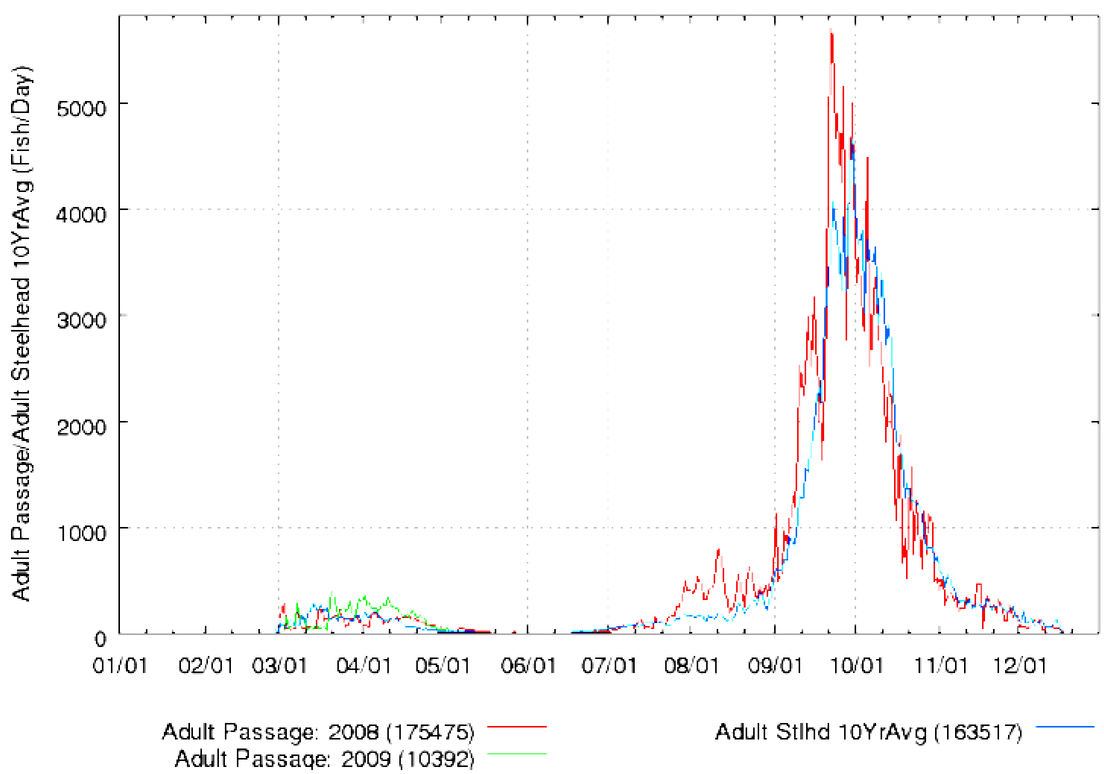
(Source: FPC 2009)

Figure 7-4. Adult steelhead returns (total, wild, and 10-year geometric mean) to Lower Granite dam from 1975 to 2008.



(Source: FPC 2009)

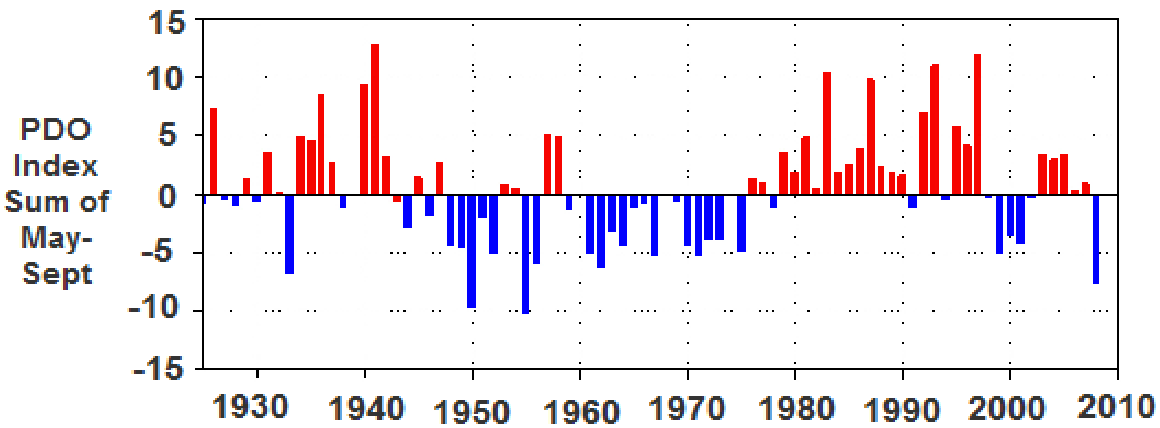
Figure 7-5. Timing of adult steelhead counts passing upstream at Lower Granite dam 2008 and 10-year average.



(Source: DART 2009)

As shown on Table 7-3 and Figure 7-4, counts of adult steelhead at Lower Granite Dam have varied from a low of 17,311 in 1975 to a high of 262,568 in 2001; returning wild steelhead numbers have ranged from 8,991 in 1997 to a high of 57,291 in 2002. From 1975 through 2000, Snake River steelhead DPS adult returns at Lower Granite Dam varied substantially, most likely due to a combination of factors, not the least of which were poor ocean conditions resulting from a positive (warm) PDO (Figure 7-6) and unfavorable trends/fluctuations in the suite of factors that contribute to or affect ocean productivity (NMFS 2009c). This was followed by a substantial increase in adult returns in 2001, reflecting improved ocean conditions beginning in late 1998. After 2001, ocean conditions have continued to fluctuate, and recent adult returns have declined somewhat. However, even the low recent adult returns of 145,991 in 2006 is greater than adult returns for any year from 1975 to 2000.

Figure 7-6. Pacific Decadal Oscillation time series from 1925 to 2008 showing warm (unfavorable for salmon) ocean conditions prevailing from the late 1970s to the late 1990s.



(Source: NMFS 2009d)

The 10-year geometric mean was calculated for wild steelhead from 2005 to 2008, consistent with the approach of the ICTRT (2007a). These data are also shown on Table 7-3 and Figure 7-4. A 10-year geometric mean represents approximately two generations of annual natural spawners. Note that these adult returns do not include those Snake River steelhead destined for areas downstream from Lower Granite Dam. Note also that recent 10-year geometric means for wild steelhead counted at Lower Granite Dam have increased steadily over the last 4 years, as shown in Figure 7-4 and Table 7-3.

Productivity

The Supplemental Comprehensive Analysis (SCA) (NMFS 2008a) provided a rigorous analysis for three concurrent ESA consultations, including the 2008 *U.S. v.*

Oregon Management Agreement. The SCA is probably the most comprehensive and up-to-date analysis conducted for listed salmon ESUs and steelhead DPSs available for the Columbia River Basin. Relative to Snake River steelhead, it describes the condition of the Snake River steelhead DPS, and contains an analysis of prospective actions in hydro, habitat, hatcheries and harvest, and predator management that are expected to improve juvenile fish survival and, therefore, the populations of listed Columbia River salmon ESUs and steelhead DPSs. While this BA is limited in scope to the Project, improvements in juvenile survival and adult returns of Snake River steelhead resulting from implementation of the prospective actions in the 2008 Biological Opinions that are expected to improve survival and returns of adult salmon and steelhead are likely to be manifest in improved survival of populations of Snake River steelhead, including the CRLMA-s.

As stated in the SCA (NMFS 2008a), "population-specific estimates are not available for populations in this MPG [Clearwater River], so productivity and extinction risk are inferred from average A-run and average B-run population estimates, coupled with Prospective Actions [in the 2008 FCRPS Biological Opinion] that are specific to each population."

Productivity for the Clearwater River MPG and its five extant populations that lack population-specific estimates is inferred by application of average A-run and B-run estimates where data were available to estimate productivity. This approach allocated the aggregate run of natural-origin steelhead at Lower Granite Dam to the various populations (NMFS 2009a). Average estimated productivity, or recruits per spawner (R/S) for A-run steelhead, estimated by the ICTRT for "average A-run" steelhead and applied to the CRLMA-s, is 1.09 with 95 percent confidence interval (CI) from 0.56 to 2.12. In the Clearwater River MPG, the A-run steelhead (principally the CRLMA-s) have substantially better productivity as measured by R/S, compared to the three populations of B-run fish (NMFS 2008a). The median 20-year population growth rate (lambda) is 1.05 (95 percent CI 0.50 to 2.23) (NMFS 2008a). The changes in density-independent survival, or the "gap," for CRLMA-s steelhead is negative 0.92 (-0.92) (NMFS 2008a) based on the base case R/S equals 1.09 (NMFS 2008a). This indicates that there is no survival "gap" to be made up for these A-run steelhead, and indicates that the A-run steelhead population is stable or increasing. As stated in the SCA, the proportional changes in Clearwater River lower mainstem steelhead average base period survival expected from completed actions and current human activities that are likely to continue into the future is 1.03 (NMFS 2008a). Likewise, NMFS (2008a) noted that the base to current adjustment is 1.03 for actions or proportional changes in Snake River steelhead average base period survival expected from completed actions and current human activities that are likely to continue into the future (implemented in previous biological opinions, such as hydro, tributary and estuarine habitat, avian and marine mammal predation, and harvest and hatcheries actions) and not yet realized (or soon to be realized). This is the total survival improvement multiplier.

As noted above, there is little population-specific adult or juvenile abundance or productivity information available for the CRLMA-s or the Clearwater River MPG. The analyses indicate that on average A-run fish do not have a survival gap, and the 2008 Biological Opinion on the *U.S. v. Oregon* Management Agreement states that lambda and the BRT abundance trend are expected to be greater than 1.0 for all five populations of the Clearwater MPG. Nevertheless the ICTRT determined that the CRLMA-s was at high risk, based on lack of information regarding these two VSP parameters.

Spatial Structure and Diversity

NMFS (2006c) identified five MaSAs and 16 MiSAs within the CRLMA-s (Figure 7-3). Lapwai Creek with its tributaries, including Sweetwater and Webb creeks among others, is one of the five MaSAs. The extensive distribution of major and minor spawning areas in the CRLMA-s provides a range of conditions across the landscape that support steelhead and a wide range of opportunities for persistence of the population in the face of possible environmental disturbance. Table 7-4 from the NMFS draft Snake River steelhead recovery plan (NMFS 2006c) shows how several metrics and factors are rolled up to the population level to determine a risk assessment score. NMFS (2008a) notes in the SCA that CRLMA-s population is at very low risk for spatial structure and low risk for diversity, resulting in an overall low risk rating for these two combined VSP parameters.

Summary of VSP Factors and Recovery Objectives

Recovery plans describe targets and opportunities to improve populations and habitat for viable steelhead populations for which ESA protection would no longer be necessary. Although recovery of a species as highly migratory and widespread as the Snake River steelhead will require extensive coordination and multiple recovery actions throughout the Columbia Basin, recovery objectives were discussed and considered in context of developing the PA during the collaborative meeting process.

Table 7-4. Spatial structure and diversity scoring table.

			Risk Assessment Scores		
Metric*	**Metric**	**Factor**	**Mechanism**	**Goal**	**Population**
A.1.a	VL (2)	VL (2)	Very Low Risk (Mean = 1.67)	Very Low Risk	**Low Risk**
A.1.b	L (1)	L (1)			
A.1.c	VL (2)	VL (2)			
B.1.a	L (1)	L (1)	Low Risk	Low Risk	
B.1.b	L (1)	L (1)			
B.1.c	VL (2)	VL (2)			
B.2.a (1)	L (1)	M (0)	Moderate Risk		
B.2.a (2)	L (1)				
B.2.a (3)	L (1)				
B.2.a (4)	n/a				
B.3.a	VL (2)	VL (2)	Very low risk		
B.4.a	M (0)	M (0)	Moderate risk		

* Key to metrics:

A.1.a	Number and spatial arrangement of spawning areas
A.1.b	Spatial extent or range of population
A.1.c	Increase or decrease in gaps or continuities between spawning areas
B.1.a	Major life history strategies
B.1.b	Phenotypic variation
B.1.c	Genetic variation
B.2.a	Spawner composition
B.2.a (1)	Out-of-DPS strays
B.2.a (2)	Out-of-MPG strays from within the DPS
B.2.a (3)	Out-of-population within MPG strays
B.2.a (4)	Within-population hatchery spawners
B.3.a	Distribution of populations across habitat types
B.4.a	Selective change in natural processes or selective impacts

Source: NMFS 2006b

As noted above, the minimum abundance target for the CRLMA-s population is 1,500 natural-origin adult returns. Because information is lacking for overall CRLMA-s population abundance and productivity, the population is, by default, rated at high risk for both of these VSP factors. The population is considered low risk for spatial structure and diversity.

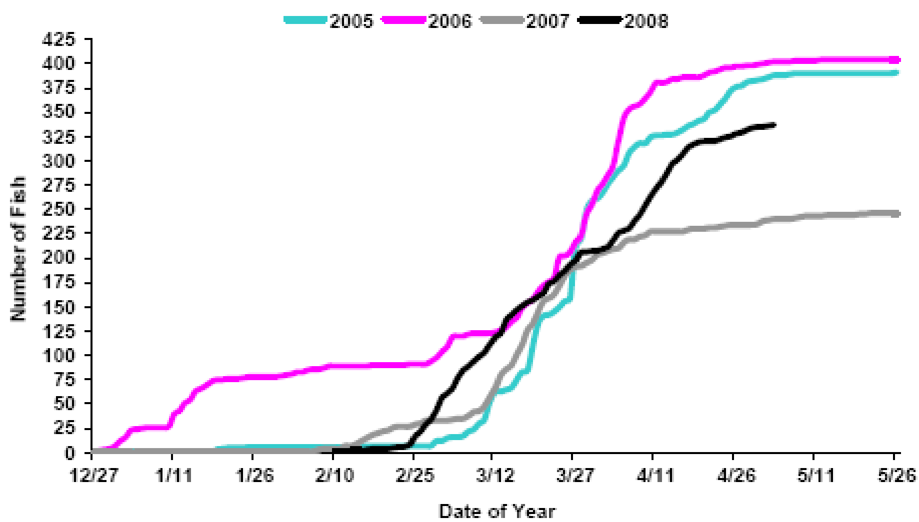
Using the relative proportions/roles of the major and minor spawning areas in the CRLMA-s illustrated on Figure 7-3, the Potlatch Basin is expected to contribute approximately 20 percent of population abundance, which translates to about 300 spawners; the combined adult return population estimates for Big Bear and Little Bear creeks in the Potlatch Basin were 266, 77, and 174 in 2005, 2006, and 2007, respectively (IDFG 2006a, 2006b, 2007). An additional 77 spawners are estimated in the East Fork of the Potlatch River (Nielsen et al. 2009). Therefore, when considering additional contributions from other known spawning areas located in this basin, it is possible that the Potlatch is a substantial way toward meeting this recovery goal. The Lapwai Creek Basin, of which the Project streams are part, is expected to contribute about 14 percent of the CRLMA-s population, translating to about 210 spawners. Estimates indicate that Mission Creek is supporting an effective population size (typically smaller than the census population size) of 59 spawners (Nielsen et al. 2009). Estimates of effective population size or adult escapement for other portions of this basin are not available, due in part to challenges of monitoring and sampling during the peak spring runoff when adult steelhead return to spawn in natal streams.

Further discussion of recovery objectives is provided in Appendix D, “Snake River Steelhead Recovery, Planning, Objectives, and Status in the Lower Clearwater.”

7.2.2.3 Migration Behavior in Nearby Basins

Most of the adult Snake River steelhead migrate upstream past Lower Granite Dam during the fall preceding their spawning season in the spring (Figure 7-5). These adult steelhead over-winter in the Clearwater, Salmon, and Snake rivers. Conditions may occur during wetter climatic cycles that provide higher tributary instream flows during this winter holding period. These higher flows, such as those that occurred in 2006 in Asotin Creek, may encourage some adult steelhead to move into tributary habitats earlier than during other years, as shown on Figure 7-7. However, the majority of adult steelhead move upstream and subsequently downstream during the months of March and April (WDFW 2006, 2007, 2008; IDFG 2006a, 2006b, 2007).

Figure 7-7. Adult steelhead migrating upstream at the Asotin Creek weir 2005-2008.



(Source: WDFW 2009)

Steelhead studies that include the current operation of adult migration weirs are conducted in two basins near Lapwai Creek; these are the Potlatch River (tributary to the Clearwater River about 3 miles from Lapwai Creek) and Asotin Creek (tributary to the Snake River about 18 miles from Lapwai Creek). The Potlatch River Basin is considered to be most similar to the Sweetwater Basin because: it is located closer to Lapwai Creek in the same MPG, and subpopulation group (Clearwater River Lower Mainstem A-run) thereby displaying similar phenotypic characteristics and local adaptations (ICTRT 2003); the location of the two weirs are in tributaries (Big Bear and Little Bear creeks) comparable in elevation and basin size as Sweetwater Creek (see Table 7-5); and Asotin Creek has more hatchery influence (up to 18 percent of the adult returns) than the populations in the lower Clearwater (less than 2 percent of the adult returns).

Table 7-5. Comparison of basin area (square miles) and elevation (feet) at weir locations in Potlatch River and Asotin Creek basins to the mouth of Sweetwater Creek.

Stream	Basin Area (square miles)	Elevation (feet)
Sweetwater Creek	84	1100
Little Bear, tributary to Potlatch River	62	1300
Big Bear, tributary to Potlatch River	94	1300
Asotin Creek	173	950

Spawning migration data collected at the weirs in the Potlatch tributaries for the period 2005 to 2008 demonstrate that, with few exceptions, steelhead spawning is completed in March and April. These data are presented in the effects discussion in Figures 7-13 and 7-14 in Section 7.2.3.1, “Spawning.”

Spawning and incubation temperatures in Big Bear Creek are similar to those measured in Sweetwater Creek. Stream temperatures at the end of May at the weir site in Big Bear Creek are exceeding temperatures where survival of incubating eggs will be impacted (IDFG 2008a).

Juvenile outmigration has also been monitored in the Potlatch and Asotin basins. Both of these local populations have spring and fall outmigration periods. Juvenile steelhead can outmigrate from the natal tributaries during any time of the year; however, most juvenile steelhead outmigrate from natal tributaries during the spring (before June 1) and between mid-December and mid January. In Asotin Creek, the juvenile outmigration trap was operated during the spring and fall months in 2006 and 2007. Data collected between 2005 and 2007 indicated that 50 percent of the springtime juvenile outmigrants pass the trap before early May (May 3 to 10), and 90 percent of these migrants pass the trap by the end of May (May 23 to June 2) (WDFW 2006, 2007, 2008). The fall sampling indicates that a substantial portion (25 to 54 percent) of the juvenile steelhead can outmigrate during the fall/winter months (sampled October through January) (WDFW 2007, 2008). Examination of the raw data from this study indicates that the longer the trap was operated into the winter the greater proportion of total outmigrating steelhead were captured during this sample period (Table 7-6).

Table 7-6. Estimated proportion of steelhead parr and smolt outmigration sampled at Asotin Creek trap.

Year	Date start	Date end	Percent of total Outmigrants
2004	November 3	December 12	5.6
2005	September 27	December 7	8.4
2006	October 5	December 29	28.4
2007/2008	October 3	January 12	54.2

Steelhead returning to Asotin Creek have been shown to rear in fresh water from 1 to 4 years and spend 1 to 2 years in the ocean before returning to spawn (WDFW 2006, 2007, 2008). Steelhead returning to the Potlatch drainage are slightly different, spending 2 to 3 years in fresh water and another 1 to 3 years in salt water before returning to spawn (IDFG 2006a, 2006b, 2007). Population estimates for Big Bear Creek in the Potlatch Basin ranged from 9,187 to 14,164 juvenile outmigrants between 2005 and 2007. Population estimates for juvenile outmigrants from Asotin Creek ranged from 27,287 to 50,375 between 2004 and 2007.

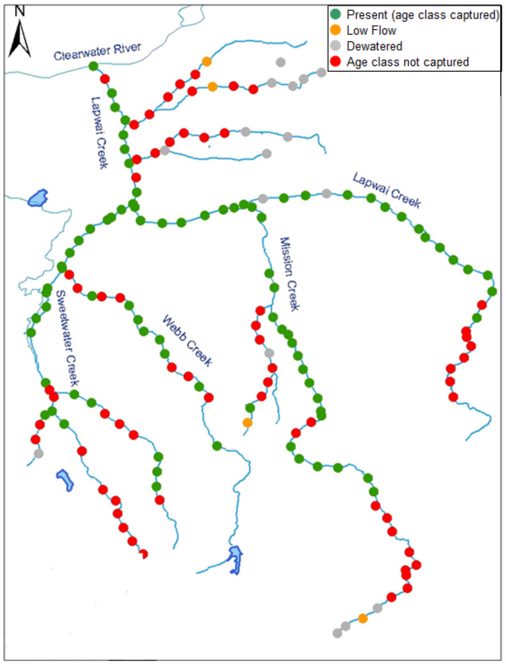
7.2.2.4 Steelhead in the Lapwai Drainage

Steelhead spawning and early rearing occurs throughout the Lapwai Basin and major tributaries. Spawning steelhead have been observed in the mainstem Lapwai Creek upstream from Garden Gulch and downstream of Tom Beall Creek (Taylor 2003; Weigel 2009).

Figures 7-8 through 7-10 illustrate relative distribution of *O. mykiss* in Lapwai Creek and its tributaries, as documented by the Tribe in the summer season of 2003, 2004, and 2006. Data are shown on these figures for age 0, 1, and 2 fish, respectively. Overall, *O. mykiss* are documented throughout most of basin, with the exception of a relative absence in the headwaters of the tributaries. Most individuals are ages 0 and 1, suggesting that most fish outmigrate from the sampling area at these ages. Very few age 2 individuals are documented except in Mission Creek, possibly indicating a resident population.

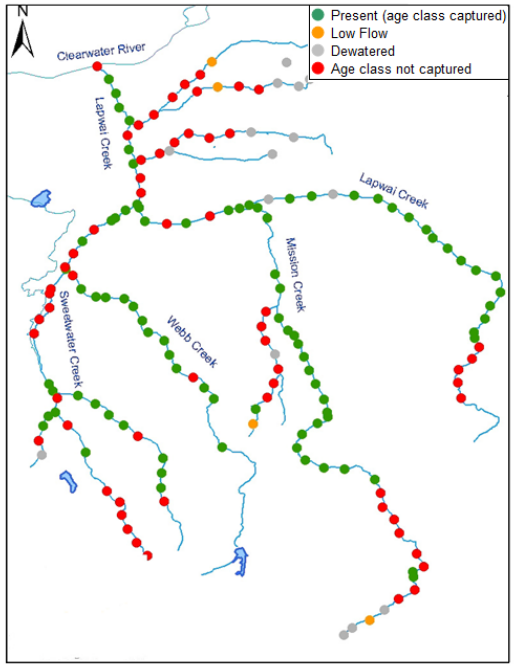
These data do not distinguish between returning listed steelhead and resident redband trout. Populations above known migration barriers—particularly the Sweetwater diversion dam and waterfalls in Webb Creek—are redband trout and not listed steelhead.

Figure 7-8. Age 0 *O. mykiss* presence in the Lapwai drainage.



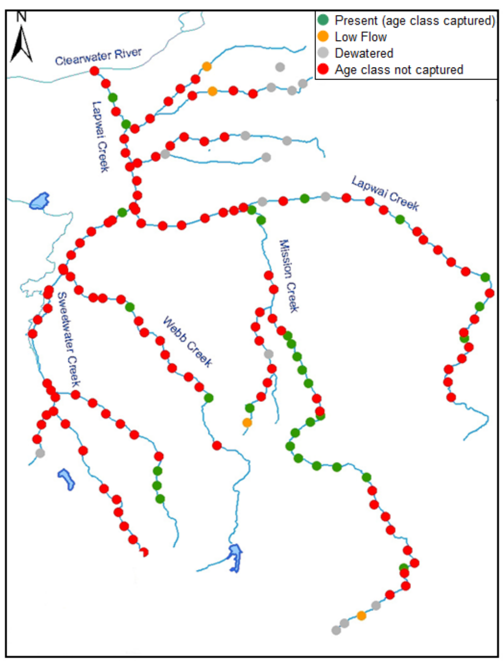
(Source: NPT 2003, 2004, 2006)

Figure 7-9. Age 1 *O. mykiss* presence in the Lapwai drainage



(Source: NPT 2003, 2004, 2006)

Figure 7-10. Age 2 *O. mykiss* presence in the Lapwai drainage

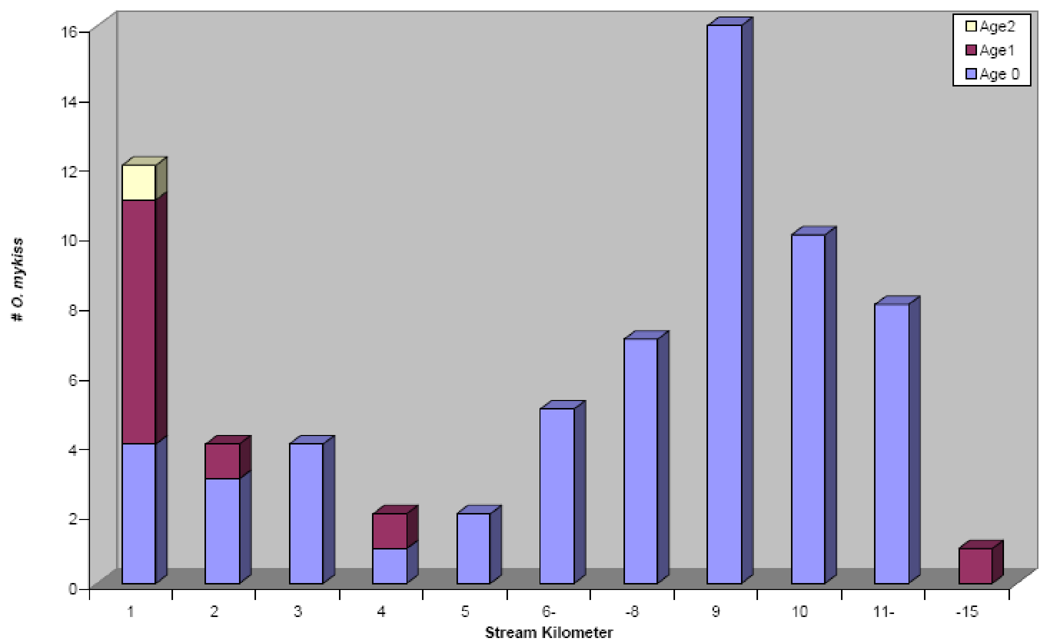


(Source: NPT 2003, 2004, 2006)

Figure 7-11 and Figure 7-12 show densities of *O. mykiss* from these Tribe surveys conducted June 30 through July 19, 2003, on Sweetwater and Lapwai Creeks, and

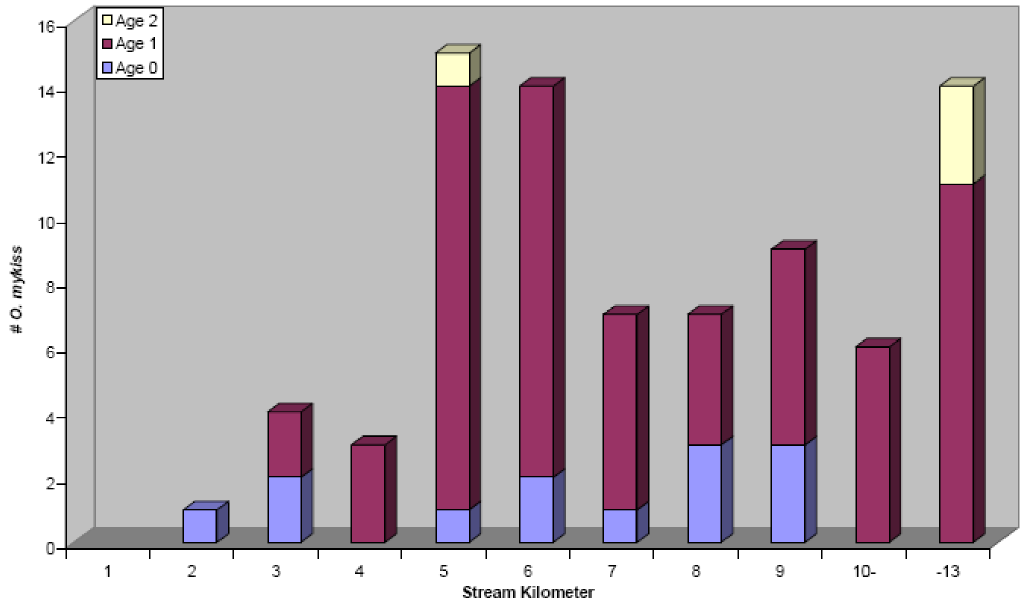
July 6 through 19, 2004, on Webb Creek. Stream flows past the Sweetwater and Webb diversion dams were zero during these sampling events. These surveys used single pass electrofishing; thus, densities are based on actual fish captured rather than a population estimation technique. As illustrated on Figure 7-11 and Figure 7-12, steelhead were found at every kilometer point, but one along these creeks that had enough water to electrofish (missing kilometer points on the figures were locations with insufficient water to electrofish). Steelhead densities on Sweetwater Creek were 0.034 fish/m^2. Densities were slightly higher in Webb Creek with 0.05 fish/m^2. In terms of age distribution, Webb Creek showed a higher percentage of older fish than Sweetwater Creek. The fact that Sweetwater Creek was surveyed a year earlier than Webb Creek may account for some of the differences in densities and age class structure.

Figure 7-11. Number of *O. mykiss* captured by electrofishing in Sweetwater Creek. Stream kilometer numbering is from the mouth moving upstream.



(Source: NPT 2003a)

Figure 7-12. Number of *O. mykiss* captured by electrofishing in Webb Creek.



(Source: NPT 2004b)

The Tribe surveys in Sweetwater and Webb creeks found that the vast majority of *O. mykiss* sampled are the smaller size classes (age 0 and 1). Age 0 and 1 juvenile steelhead (the smaller size classes) are the most abundant in the natal tributary streams in the Snake River Basin comprising more than 90 percent of the abundance of *O. mykiss* trout in most streams not stocked with hatchery steelhead (for examples see Rubin 1990; NPT 2003a, 2004b, 2006).

The University of Idaho began a study in 2008 to identify the effects of stream flow on juvenile steelhead growth and survival in the Project Action Area. This ongoing study also has sample sites in other areas of the Lapwai Basin to provide information to compare effects and assess fish movement patterns within the basin (Kennedy and Hartson 2009). In 2008, lower densities of steelhead were found in Sweetwater Creek, but those fish in Sweetwater Creek were documented to have higher summer growth and condition factor than age 1 *O. mykiss* trout in other areas of the Lapwai Basin (Kennedy and Hartson 2009). Sweetwater Creek also had a much lower proportion of the population sampled as age 0 trout and one site in Sweetwater Creek had no age 0 trout sampled. This age class has typically been present during other years (NPT 1983, 2003b).

Survival estimates (not taking into account emigration) were higher in Mission and Sweetwater creeks, ranging between 0.6 and 0.7 for age 1 *O. mykiss* trout (Kennedy and Hartson 2009). Survival estimates in upper Lapwai Creek were much lower at 0.33 (Kennedy and Hartson 2009). Growth and survival estimates (including possible emigration) are likely influenced by fish density and stream temperature; therefore, these data need to be further explored to account for these interactions. The growth and survival of juvenile steelhead at the Webb Creek sites were not summarized. Age 0 steelhead were present during the first summer sampling event (Kennedy and Hartson 2009), but the sample site was dewatered during July, August, and September and the juvenile steelhead may have moved out of the area or died.

When comparing the different fisheries population data sets, it is important to note that available studies were conducted during different years (for example, Sweetwater Creek during 2003 and Webb Creek during 2004) and data from different years or different sampling seasons (June versus August) may not be comparable due to varying environmental conditions and fish community interactions and movements. For example, stream flow conditions in Webb Creek resulted in 22 days versus 77 days of zero stream flow at the mouth of Webb Creek under the same water operation regime in 2004 and 2008, respectively. Further, during the 2003 sampling period, stream flows at the mouth of Sweetwater Creek averaged 0.77 cfs, with no bypass flow while in 2008 the stream flows averaged 3.40 cfs with the 2 cfs bypass flow at the Sweetwater diversion dam.

Juvenile salmonids likely move among stream habitats to maximize conditions. Providing sufficient stream flow to connect stream habitats will allow rearing salmonids in these creeks to seek more favorable thermal or cover refugia, particularly during more physiologically stressful periods, such as during high summer temperatures. Steelhead were found to be surviving in stream segments where the maximum temperature was 27.2°C, but it is unknown if there was cooler water providing localized thermal refugia (NPT 1983). The movements of juvenile steelhead have not been studied in the Lapwai Basin; therefore, the role of Sweetwater Creek for rearing fish in the basin is not fully understood. A bedrock intrusion (falls) located in Sweetwater Creek immediately upstream from the confluence with Webb Creek may deter the upstream movement of juvenile steelhead into the upper reach of Sweetwater Creek (Reclamation 2007). The presence of these falls would encourage upstream migrating fish from other locations in the basin to either rear in Sweetwater Creek downstream from Webb Creek and/or utilize the rearing habitat in Webb Creek.

7.2.3 Effects of the Proposed Action on Steelhead

The effects of the PA on Snake River steelhead have been analyzed for each of the creeks in the Action Area (Webb, Sweetwater, and Lapwai). The analysis and discussion focuses on stream flow, temperature, and suspended sediment which are the habitat parameters that can be altered by Project activities. The results are presented below for each life stage (spawning, incubation, and juvenile rearing).

7.2.3.1 Spawning

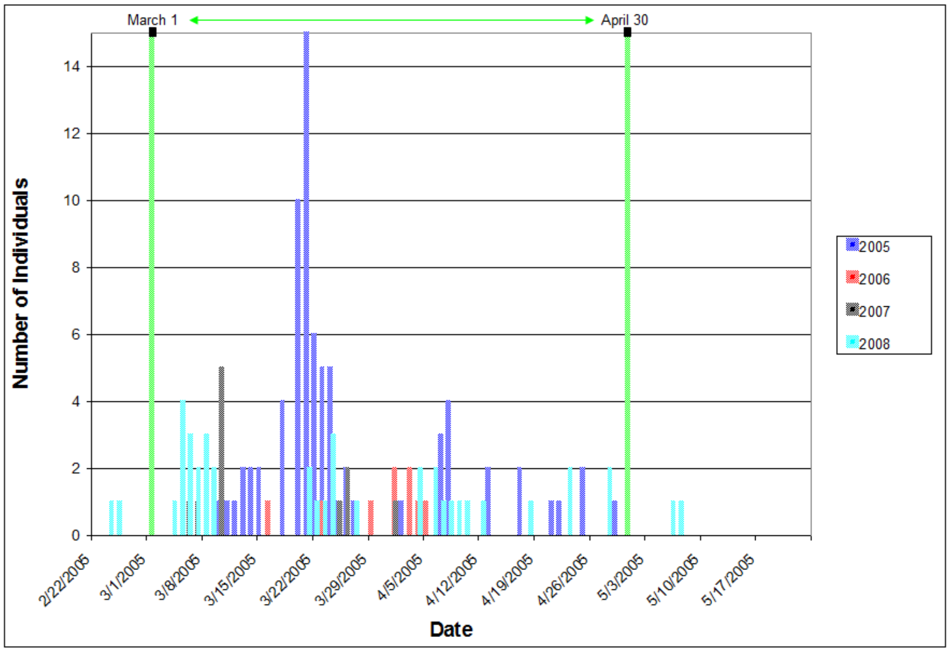
Spawning Period Stream Flows

The amount, timing, and duration of stream flows are important for spawning steelhead. Spawning flows require more stream discharge than juvenile rearing flows due to higher velocities and depths necessary for adult steelhead spawning (see Section 7.2.1.1, “Spawning,” for description). Redd construction is thought to require a minimum water depth of 20 cm (7.9 inches) and a preferred velocity of 37 to 100 centimeters per second (cm/sec) (1.2 to 3.3 feet/second [ft/sec]) (Swift 1976). Habitat utilization and preferences required for adult steelhead to spawn are included as part of the HSC used in the PHABSIM analysis on Webb and Sweetwater creeks (Reclamation 2009c), and are comparable to the biological requirements of the species. Therefore, stream flows recommended for spawning steelhead associated with the WUA identified from this analysis are expected to provide the necessary depths and velocities for successful spawning.

Stream flows greater than 47 cfs in Webb and upper Sweetwater creeks will not benefit spawning steelhead as measured as WUA. Because steelhead are migrating and spawning near the spring peak in the hydrograph, it is expected that adult steelhead are adapted to these stream flow effects and adjust behavior and migration timing to seek favorable habitat and optimize survival and reproductive opportunities. In addition, Project facilities are not able to control these peak stream flows beyond the maximum canal capacity.

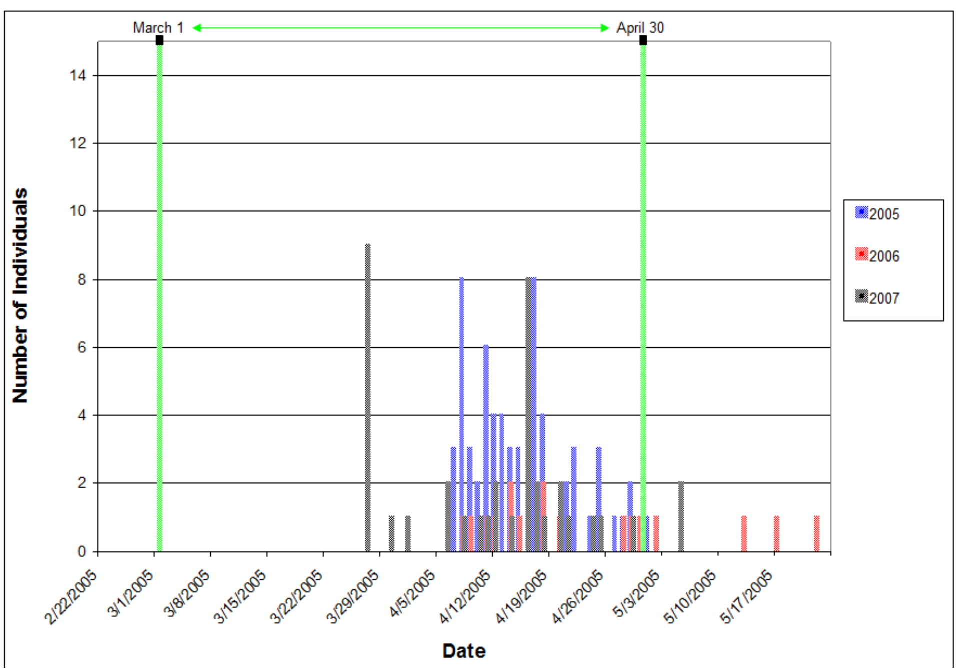
Although the PA provides for minimum spawning flows during February, March, and April whenever the Webb and/or Sweetwater diversions are operating, it is the March and April timeframe when most spawning occurs as supported by data collected from nearby steelhead populations at the Potlatch and Asotin Creek weirs (Figure 7-7, 7-13, and 7-14). Data compiled from 2004 to 2008 at the Big Bear weir in the Potlatch basin show that 97 percent of adult steelhead spawn during March and April (Figure 7-13 and Figure 7-14). However, the earliest this weir has been installed is February 26 and steelhead that could have migrated past the site earlier would not have been recorded.

Figure 7-13. Weir counts for upstream-migrating steelhead from Big Bear Creek, Potlatch River drainage, 2005 to 2008.



(Source: IDFG 2006a)

Figure 7-14. Weir counts for downstream-migrating steelhead from Big Bear Creek, Potlatch River drainage, 2005 to 2008.



(Source: IDFG 2006a)

The Asotin Creek adult migration data from 2005 through 2008 shows some winter migration in this population. During 2005/2006, steelhead began migrating into the tributary between late December and mid-January, a year with unusually high wintertime stream flows (WDFW 2007). The Asotin Creek population has a greater influence of hatchery steelhead (~20 percent), whereas the lower Clearwater A-run steelhead have little to no hatchery influence (<3 percent). The lack of hatchery influence is a distinct characteristic of the A-run steelhead populations in the lower Clearwater MPG (ICTRT 2003), and could be an explanation for the early run timing expressed in the Asotin Creek population (McLean et al. 2003). In 2007, a small proportion of adult steelhead began entering the weir in mid-February (Figure 7-7). Although the date of the earliest arrivals appears to vary at the Asotin Creek weir, the date when 50 percent of the migrants have passed the weir is consistently between March 20 and 27 (WDFW 2009). The early migrants are likely taking advantage of warmer and wetter wintertime climatic conditions that increase wintertime stream flows.

Because adult steelhead could migrate into the Action Area during February and because early spawning opportunities are important to the population, the PA includes minimum spawning flows for this month whenever operating the Sweetwater or Webb diversion dams. However, the following analysis on the impacts of the proposed operations and resulting stream flows is centered on March and April because most of the steelhead migrate during these 2 months and the opportunity for operation of the diversion dams during February is expected to be very limited.

When the Webb and Sweetwater diversions are not being operated (November through January or February), inflows to the Webb Creek diversion downstream of Soldiers Meadow Dam, and all inflows to Sweetwater diversion dam (except any water diverted to Lake Waha by the West Fork diversion structure) will bypass the dams. In this manner, wintertime stream flows (November through the start of operations in February or March) would follow the natural hydrograph being driven by climatic conditions with peak flows coinciding with rain or snowmelt events. During this period, early migrating adult steelhead would primarily be affected by the climatic or hydrologic conditions that are variable and largely not controlled by the Project. Steelhead hold in the larger river habitats until stream flows increase and conditions are favorable for upstream migration; therefore, low stream flows during the February and early March period are largely dependent on climatic conditions and are not expected to impact spawning success.

The PA specifies that the Project will bypass (forgo diversion of) stream flows for spawning steelhead of 4.0 cfs in Webb Creek and 7.8 cfs in Sweetwater Creek when operating Webb and Sweetwater diversion dams during February, March, and April. If flows at the diversion dams are less than these values, the diversion dams will not be operated and all flow reaching the dams will be bypassed. These minimum spawning period stream flows in combination with the naturally occurring high runoff flows are expected to be sufficient to provide spawning habitat and access for steelhead in these streams.

In March and April, when most spawning occurs, the hydrologic analysis indicates that stream flows predicted when implementing the PA would have ranged from 2.0 to 77.8 cfs at the mouth of Webb Creek and 5.1 to 70.4 cfs at the Sweetwater diversion dam. These flows combine for a range of at least 7.1 to 148.2 cfs in lower Sweetwater Creek downstream from the confluence with Webb Creek. The analyses indicate that more than 50 percent of the maximum WUA will be available for an average of 90 percent of the spawning period in both Sweetwater and Webb creeks. Furthermore, most of the spawning habitat (80 to 100 percent WUA) will be provided for more than 60 percent of the days during the March/April spawning period in Sweetwater Creek (Table 7-7, Figure 7-15, 7-16).

Table 7-7 Predicted stream flows, associated percent WUA, and number of days stream flows are met during the March and April for the 6 years in the analysis.

Flow (cfs)	WUA	Minimum # of Days	Maximum # of Days	Average # of Days
Webb Creek				
6.4 to 31[a]	80 to 100 percent	2	45	21
4 to 45[a]	50 to 100 percent	40	61	55
Upper Sweetwater Creek				
7.8 to 31	80 to 100 percent	37	59	47
3.2 to 45	50 to 100 percent	52	61	59

[a] PHABSIM modeling for Webb Creek indicates that spawning habitat (as expressed in WUA) is maximized at 11.5 cfs; both below and above this benchmark, spawning habitat decreases, reaching 80 percent WUA at 6.4 and 31 cfs. Since 12 cfs was the highest flow for which WUA was estimated for Webb Creek, model results for Sweetwater Creek were used as surrogate for higher flow values. The two stream reaches are roughly comparable in size and WUA values; and the Sweetwater Creek flow-WUA values are considered reasonable approximations for Webb Creek for the purposes of high stream flow comparisons.

Figure 7-15. Predicted stream flows (cfs) in Webb Creek in March and April for the 6 years analyzed in relation to 50 percent and 80 percent WUA for spawning steelhead.
(*Stream flows estimated for the upper 50 percent and 80 percent WUA from upper Sweetwater Creek were used for this analysis—see footnote to Table 7-7*)**.**

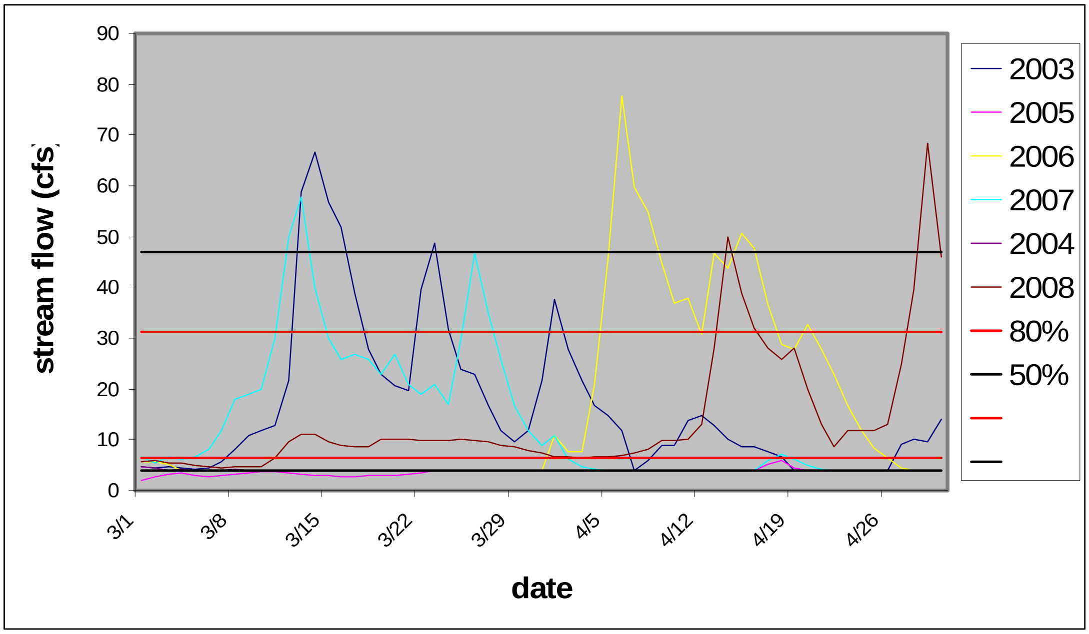
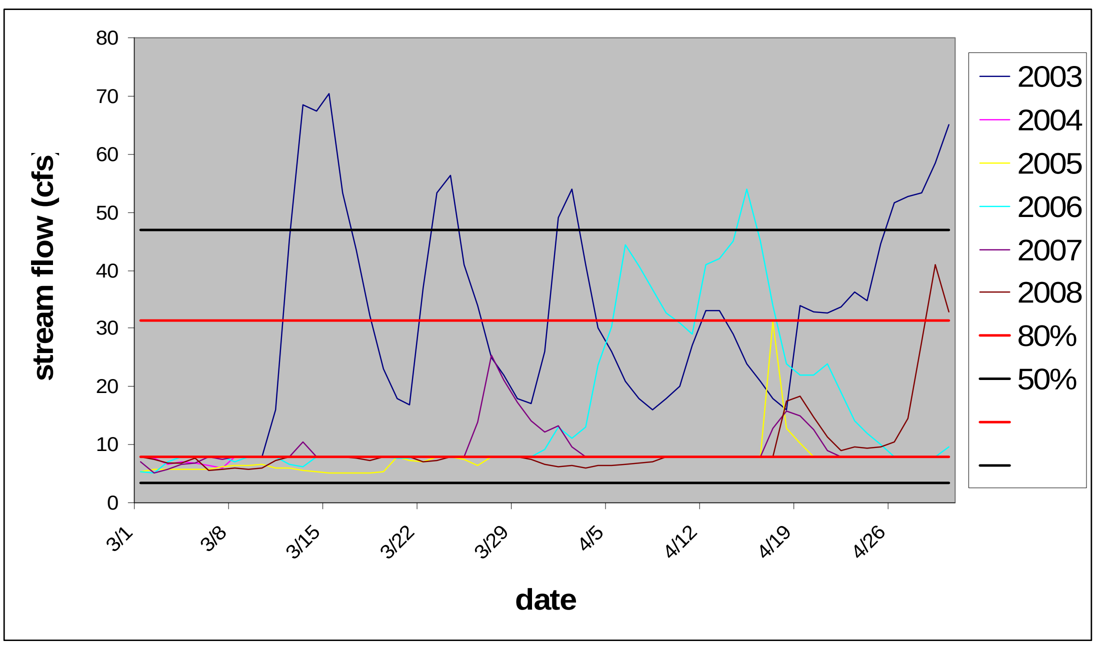


Figure 7-16. Predicted stream flows (cfs) in upper Sweetwater Creek in March and April for the 6 years analyzed in relation to 50 percent and 80 percent WUA for spawning steelhead.



Early spawners are thought to represent a greater contribution than late spawners to steelhead populations in the basin due to more favorable water temperature conditions for incubation because temperature increases in May are expected to reduce incubation survival from these later spawning adults. In addition, the earlier spawners are utilizing habitat watered at lower stream flows that will remain watered through the incubation period increasing the likelihood of survival and emergence from the redd.

Stream flows on May 1 will be ramped down to 1.5 cfs in Webb Creek and 3.0 cfs in Sweetwater Creek, according to the ramping rates and procedures specified in the PA. The proposed May stream flows will provide water depths in Sweetwater Creek at least 0.5 foot depth for adult steelhead migration (Reclamation 2009c). Migration conditions in Webb Creek are harder to predict because measured stream flows during May are highly variable ranging from 0.43 to 63 cfs (USGS 2009). During the years of record prior to 2008, the stream flows on the lower end of this range would be from inflows gained downstream from the Webb diversion dam, whereas stream flows at the higher end of the range would be these inflow gains combined with spill past the diversion dam. These data indicate at least 0.5 cfs stream flow gain in addition to the proposed 1.5 cfs bypass flow at the lowest flows for most of May. The proposed reductions in stream flow may encourage any post-spawned steelhead remaining in the creeks to move downstream, and are expected to provide sufficient connectivity for these fish to outmigrate.

In Lapwai Creek, spawning steelhead have been observed downstream from the Sweetwater Creek confluence, and suitable spawning gravels are present in the Creek, particularly between Sweetwater Creek and Garden Gulch (Reclamation 2009a). Minimum proposed spawning flows in Webb and Sweetwater creeks will combine with the stream flow from the rest of the Lapwai Basin to provide suitable spawning flows in Lapwai Creek downstream of Sweetwater Creek. Mean daily stream flow during March and April in lower Lapwai Creek exceeds 126 cfs for the period of record (USGS 2009). These stream flows, considering channel characteristics, should be sufficient to provide adequate spawning and incubation habitat in Lapwai Creek downstream from Sweetwater Creek; however, the channel cross section data were not collected on Lapwai Creek to identify specific stream flows and associated depths and velocities.

In summary, an unknown number of early migrating spawners in Webb and Sweetwater creeks in February and early March (due to periods of lower spawning flows as described above) may be delayed or limited in spawning habitat. However, little storage and diversion is occurring during the lower flow winter months. Stream flows exceeding the spawning flows typically occur from mid-March through April and delays to these pre-spawned fish are not expected to affect spawning success.

These winter stream flows are largely dependent on climatic conditions and habitat is expected to be available to early spawning steelhead when these conditions occur. The amount of available spawning habitat will vary throughout the spring with the amount of stream flow in the streams. More than 50 percent of the maximum available spawning habitat will be provided, on average, 90 percent of the time during March and April when most spawning activity occurs. A few later migrating spawning steelhead in these creeks (estimated at 3 percent of the total numbers of spawners) will not be provided the higher minimum spawning flows; however, these fish likely would not contribute much to the population reproduction (less than 7 percent expected egg survival) due to higher stream temperatures that occur during the May incubation period (see Section 7.2.3.2, “Incubation and Emergence”). The PA is not expected to impact the spawning steelhead in lower Lapwai Creek.

Spawning Period Temperature

The stream temperatures in the Action Area during spawning (February, March, and April) under the PA are not expected to be appreciably different from those measured in 2008; these measured temperatures were suitable for steelhead spawning.

Stream temperatures in Sweetwater Creek near Webb Creek (where the highest stream temperatures are expected) during March and April 2008 ranged from 1.5 to 12.8°C with the 7-day daily average ranging from 5.2 to 10.0°C (Reclamation 2009a). The highest temperatures recorded during March and April 2008 at Sweetwater Creek upstream of Webb Creek were 11.5, 12.7, and 11.5°C on April 12, 13, and 14, respectively. These temperatures were associated with stream flows at the Sweetwater diversion dam of 3.1, 3.2, and 11.1 cfs. On April 28, stream temperature was 10.5°C even with a corresponding stream flow past the Sweetwater diversion dam of 35 cfs (Reclamation 2009a). In general, springtime stream temperatures appear to be more related to air temperature and solar radiation than stream flow (as shown in Chapter 6, “Water Quality”). The literature cites water temperatures ranging from 3.9 to 12.8°C as adequate for spawning. Since the PA is anticipated to be within that range, no temperature-related impacts are expected on spawning in Webb and Sweetwater creeks.

Spawning Period Sediment

The springtime peak flow period during which steelhead typically spawn is also the time when most sediment is mobilized in the stream and when channel erosion processes occur. Adult steelhead are fairly tolerant to high suspended sediment loads. Upstream migrating steelhead have been shown to stop moving if sediment loads are greater than 4,000 mg/L (Pauley et al. 1986). TSS values collected during base flows conditions were very low (<25 mg/L) indicating that suspended sediment recruitment into the system is low. It is expected that TSS levels would likely be higher than base flow conditions during the spring spawning period, typical of any stream during this period. In addition, the Project dams reduce fine sediment transport throughout the year. Therefore, sediment concentrations during the spring spawning period are not expected to be high enough to impact migrating and spawning steelhead present in the Action Area.

7.2.3.2 Incubation and Emergence

Stream Flows

During the earlier portion of the spawning period (February through April), the spawning and incubation life cycles are occurring simultaneously in the stream. However, after the later migrating adults spawn, incubation occurs in the stream without the associated spawning activities. Flows needed for egg incubation are not necessarily the same as those for adult spawning (Bjornn and Reiser 1991), and HSC for incubating steelhead eggs have not been developed. Velocity and depth needs for incubating steelhead eggs are much lower than those needed for other life stages (See Section 7.2.1.2, “Incubation and Emergence”). Although studies have shown that incubating eggs can survive several weeks of dewatering without any measurable effects to the emergent fry (see Section 7.2.1.2), it is unclear whether the emerging fry will be able to travel into the water column upon becoming free-swimming if the redd pocket is dewatered. Therefore, the primary concern for this life stage is to provide stream flows sufficient to maintain adequate circulation through the redd pocket to meet egg incubation needs and allow emergent fry to migrate from the redd pocket to the surface water habitat.

The length of time required for incubation is largely dependent on spawning dates and stream temperature, which can vary annually. Spawning steelhead have been observed on the mainstem Lapwai Creek on March 5, 2003, April 14, 2003 (Taylor 2003) and on April 12, 2007 (Weigel 2009). In the similar environment of the Potlatch Basin, most post-spawning adults move past the Big Bear Creek weir between March 29 and April 19, but in most years between April 6 and 19 (Figure 7-12 and Figure 7-13). Steelhead egg development takes 30 days at 10.5°C (51°F) for a total of 558 temperature units (CDFG 1976). Using a spawning date of March 5, 2008 and calculating 558 temperature units from observed stream temperatures recorded in Sweetwater Creek, hatching would have occurred on April 19, 2008. Using a spawning date of April 15, 2008 and calculating required temperature units from observed stream temperatures recorded in Sweetwater Creek, hatching would have occurred on May 20, 2008. Therefore, incubation is expected to occur from the first successfully spawned redd through about mid-May.

The PA would provide minimum stream flows during the incubation and emergence period in May of 1.5 cfs past the Webb diversion dam and 3.0 cfs past the Sweetwater diversion dam. Reclamation examined water surface elevation in relation to potential spawning habitat (that is, the extent to which potential spawning habitat remains watered) at transects measured along both Webb and Sweetwater creeks in October 2008 for the proposed stream flows for May (Reclamation 2009c). For lower Sweetwater Creek, flows of 3.5 and 4.5 cfs were examined because this reach represents the combined contribution of bypass flows from Sweetwater and Webb creeks. The habitat transects indicate that all potential spawning habitat identified will remain watered at the proposed stream flows in Sweetwater and Webb creeks. In addition, Web Creek is expected to have stream flow gains downstream from the diversion dam that will increase stream flows in May at least 0.5 cfs.

Impacts to incubation can also occur if steelhead spawn in watered habitat when stream flows are greater than the target minimum stream flows and then fall to the proposed minimums in May. This effect can occur naturally due to the timing of steelhead spawning near the peak of the hydrograph; however, based on the transect data collected in October 2008, much of the spawning and incubation habitat is located in the main channels; therefore, this additional affect of possible dewatering of redds is expected to be small.

Transect data were not collected on lower Lapwai Creek to evaluate the effects of water withdrawals on incubation in this reach. Stream flows in Lapwai Creek during May 2003, 2004, 2007, and 2008 ranged from 13 to 316 cfs (USGS 2009). The higher end of this range is expected to provide adequate incubation habitat to the extent that this habitat is present; the effect on incubation of stream flows at the lower end of this range is unknown. Spawning and incubation would be limited in lower Lapwai Creek due to stream temperatures (USGS 2009) that regularly exceed lethal incubation temperatures during May. Overall, springtime stream flows in the Action Area are highly variable in magnitude and timing (See Chapter 5, “Hydrologic Conditions”). Steelhead (and other stream biota) adapt behaviorally to these variable environmental conditions making the effects of these variable stream flows difficult to predict. Therefore, the PA may impact steelhead eggs incubating in the redds and emerging fry during lower water years in lower Lapwai Creek; however this impact is thought to be limited by high stream temperatures unrelated to the effects of the Project that would substantially reduce survival of incubating eggs in the Creek.

Temperature

As discussed in Chapter 6, “Water Quality,” water temperatures associated with the PA in Sweetwater Creek is not expected to differ appreciably from 2008. However, the Webb Creek bypass flows during the incubation period in May will increase from 0 cfs at the Webb diversion dam to 1.5 cfs under this new PA. Temperature data collected during 2008 on Sweetwater Creek upstream from Webb Creek (where the highest temperatures are expected) recorded water temperatures from mid-April through May ranging from 2.8 to 17°C (Reclamation 2009a). Stream temperatures greater than 15°C were recorded for 10 days during May, and maximum daily stream temperatures greater than 16°C were recorded for 7 days during May (Reclamation 2009a).

Stream temperatures greater than 15°C are associated with reduced survival during incubation. This temperature regime would be expected to have detrimental effects on incubating steelhead eggs. However, these higher temperatures are not reflective of a direct relationship between temperature and stream flow during this period. Instead, higher stream temperatures are more likely an effect of weather conditions and solar radiation to the stream (for example, as shown on Figure 6-6 in Chapter 6, "Water Quality," stream temperature in Sweetwater Creek above Webb Creek varies in a relatively direct relationship with air temperature). Therefore, the PA is not expected to measurably impact incubation temperatures in Webb and Sweetwater creeks.

Incubation habitat in lower Lapwai Creek (downstream from Sweetwater Creek) appears to be limited by high stream temperatures (USGS 2009) that regularly exceed lethal incubation temperatures during May. These springtime stream temperatures are largely an effect of water temperatures in upper Lapwai Creek, air temperature, solar radiation, and lack of streamside shade in this reach. The Project effects on stream temperatures in lower Lapwai Creek are too small to be detectable (see discussion of effects in Chapter 6, "Water Quality").

Sediment

Measured total suspended sediment levels in Sweetwater and Webb creeks during low flows similar to those proposed during the incubation period are very low (<25 mg/L) (as shown in Chapter 6), and are within the range of tolerance for *O. mykiss* (Newcombe and Jensen 1996). Sediment levels are not expected to increase from the PA as activities affecting this parameter have not changed in the last 20-plus years of the Project activities. Sediment levels are below those expected to impact steelhead.

7.2.3.3 Juvenile Rearing

Stream Flows

Juvenile salmonid habitat criteria are the hardest to describe as they attempt to cover a wide range of size classes and resulting swimming abilities and behaviors. This is complicated by the mobile nature of this life stage and rapidly changing use of habitat over time and space. In addition, juvenile steelhead tend to use more heterogeneous habitat than other species, such as juvenile Chinook salmon (Rubin 1990). Habitat selection depends on a range of variables not incorporated in PHABSIM, such as temperature, food, predators, and population densities (Bjornn 1971; Bugert et al. 1991; Nielsen and Lisle 1994; Shirvell 1994; Rosenfeld 2003, Anderson et al. 2006).

Habitat utilization and preferences required for juvenile steelhead to rear are included as part of the HSC used in the PHABSIM analysis on Webb and Sweetwater creeks (Reclamation 2009c). Stream flows recommended for juvenile rearing steelhead from this analysis provide the depths and velocities necessary for successful rearing.

The PA specifies that the Project will bypass (forgo diversion) stream flows when operating Sweetwater and Webb Creek diversion dam for juvenile rearing steelhead of 1.0 to 2.0 cfs in Webb Creek and 2.5 to 3.5 cfs in Sweetwater Creek at each respective diversion dam. The low ends of these ranges are minimums that would be provided whenever the diversion dams are operating; above these minimums, flows would be determined based on reservoir content as of June 1 each year, as described in Chapter 4 “Proposed Action.” These higher flows have the potential (based on the 6 years of hydrologic record) of occurring in 50 to 60 percent of the years.

Provision of lower flows in Webb Creek is supported by the results of the hydrologic analysis conducted during PA development, which indicate that under unregulated hydrologic conditions, late summer stream flows in Webb Creek can fall to 0.2 cfs or lower. This condition is consistent with the hydrology of small tributaries in the lower Clearwater River basin that can dewater and disconnect during low flow periods, yet still maintain populations of steelhead. Thus, in the case of Webb Creek, the PA would provide a stream flow greater than what would be in the stream during the summer and early fall months without the Project, and will provide some late summer and fall mitigation for juvenile steelhead rearing when the diversion dam is operating.

For Sweetwater Creek, preliminary data collected by the University of Idaho in 2008 at a flow of 2.0 cfs indicate that age 1 *O. mykiss* growth and condition factors at sites in Sweetwater Creek are comparable to or exceed those at other sites in the basin outside of the Action Area (such as upper Lapwai Creek and Mission Creek). Survival (estimated on the number of recaptured fish) in Sweetwater Creek is believed to be comparable to Mission Creek (site is located upstream from the impacts associated with residential development along the creek) and about double the estimate for upper Lapwai Creek (Kennedy and Hartson 2009). Interactions between temperature, fish density, and fish growth are unexplored in these data. However, as preliminary data, they indicate that the proposed stream flow of 2.5 cfs released in Sweetwater Creek may provide conditions similar to those in other less impacted creeks, such as the Mission Creek site, and appear to be sufficient to allow for growth and survival for juvenile steelhead.

IFIM data were not collected on Lapwai Creek to incorporate depth, velocity, cover and sediment attributes into the analysis. Therefore, connectivity is the only stream variable that can be discussed in this reach. The proposed minimum releases (3.5 cfs combined releases from Sweetwater and Webb creeks) will combine with stream flow gains from springs in lower Sweetwater Creek to provide about 4.5 cfs at the mouth of Sweetwater Creek. This stream flow will combine with the stream flow from upper Lapwai Creek increasing the stream flow to about 5.5 cfs. This stream flow is expected to provide connectivity of stream habitat in Lapwai Creek (Reclamation 2009a) allowing rearing juvenile *O. mykiss* ability to move upstream and downstream to seek out favorable microhabitats.

During the late fall and winter months when the Sweetwater diversion dam is not in operation, stream flows in the basin that accumulate downstream from Lake Waha and the West Fork diversion (to Lake Waha) will be passed at the Sweetwater diversion dam. Similarly, when the Webb Creek diversion dam is not operating, stream flows that accumulate below Soldiers Meadow Dam will be passed at the Webb diversion dam. Project operations under the new PA in the winter are not changing from previous years, and are not expected to alter fall and winter stream flows from those observed in previous years. During these months, juvenile steelhead are present in the Action Area. The late fall/winter storage operation, however, is expected to have little impact on rearing steelhead.

Stream flows in the fall are typically very low and do not begin to increase from the summer base flow conditions until the onset of fall/winter precipitation, which may not occur until November or later in many years. These low flows are naturally occurring conditions and are not a result of storage operations. Fall and winter inflows to Soldiers Meadow Reservoir are similarly quite small, with a daily average of 0.45 cfs for the October through December period (2003 to 2008 water years), with many readings in the 0.25 cfs or less range. January inflows are not much higher, with an average of 0.92 cfs (ranging from 0.5 to 2.0 cfs), nor are February inflows (average of 1.02 cfs, range of 0.42 to 2.82 cfs).

The West Fork diversion does not operate until sufficient tributary flows caused by precipitation occur. This primarily limits operation to the spring freshet. Infrequently, during unusually warm and wet climatic conditions, enough water is present to operate during the fall/winter months. However, under these conditions, precipitation is occurring in the basin and higher stream flows will be present in Sweetwater Creek.

Juvenile steelhead parr and smolts are expected to outmigrate during any time of the year; however most juveniles outmigrate in the spring and winter months. During the spring months, most juvenile steelhead are expected to outmigrate before June 1 and most will benefit from the higher spring flows that occur during each year’s freshet.

Winter outmigration can be triggered by precipitation or climatic conditions (reduced water temperatures) that encourage fish to outmigrate to over-winter habitat. In Asotin Creek, most juvenile steelhead outmigrating during this period are captured between mid-December and mid-January. Wintertime stream flows typically increase in the Action Area during these months. Increases in stream flow during the fall and winter period are dependent on precipitation events and other climatic conditions.

The minimum predicted November through January stream flows in Webb Creek will not maintain connectivity in all locations of the steelhead distribution for an average of 35 days (range 25 to 58 days) during these months. However, the higher stream flows that result from precipitation events will provide connectivity and will allow juvenile steelhead to outmigrate. The low flows and loss of connectivity in Webb Creek is expected to be a natural hydrologic condition (as discussed above). The minimum stream flows on Sweetwater Creek also could fall below levels that will maintain connectivity, but would be very rare and isolated events. Modeling of the PA showed this would occur for 2 days in 2007 and 2008 each. These small reaches (several feet distance) of disconnected stream for this very short duration are not expected to alter juvenile steelhead survival or behavior.

Temperature

Water storage and diversion likely increase observed summertime stream temperatures. However, temperatures that are expected to affect steelhead growth and feeding are limited to a maximum of 8 hours in duration. These effects may alter the behavior of the juvenile rearing steelhead during the brief high temperature periods, but are not expected to cause direct mortality to the trout due to daily fluctuations in temperatures and the limited duration of the daily maximum temperatures. For example, summertime and fall season rearing temperatures in Sweetwater Creek during 2008 exceeded 22°C (the documented temperature when *O. mykiss* stop feeding and seek thermal refugia) for up to 8 hours on 7 days downstream of confluence with Webb Creek and on 17 days upstream of Webb Creek. Temperatures outside of the period of daily maximum are suitable for steelhead, and the trout will be expected to be more active during the times of the day when temperatures are cooler. Temperature modeling performed for this assessment does not predict a measurable change in stream temperature with the additional bypass stream flow past the Sweetwater diversion dam. Within the flow range of the PA, summertime temperature effects to the stream are related primarily to riparian and climatic conditions, rather than stream flow.

Much of the mainstem Lapwai Creek has excessively high water temperatures that exceed lethal temperatures for *O. mykiss*. Therefore, much of lower Lapwai Creek likely functions primarily as a migratory corridor. This is supported by temporal fluctuations in the fish community observed at the lower Lapwai Creek site and the lack of juvenile *O. mykiss* present in this reach (Kennedy and Hartson 2009). In addition, temperatures are within those observed in other locations in the Lapwai Creek Basin outside the effects of the Project (Kennedy and Hartson 2009).

Wintertime water temperatures are not expected to be substantially effected by the Project operations. Wintertime stream temperatures are primarily influenced by air temperature and climatic conditions.

Sediment

Total suspended sediment is lowest during the low flow periods (summer and early fall). The measured total suspended sediment levels in Sweetwater and Webb creeks is very low, as reported in Chapter 6, "Water Quality," and is within the range of tolerance for *O. mykiss* (Newcombe and Jensen 1996). The PA would not increase suspended sediment, and therefore will not impact juvenile rearing steelhead.

7.3 Critical Habitat

7.3.1 Introduction

This section describes the effects of the PA on Snake River steelhead critical habitat within the Action Area. The ESA requires that the designation of critical habitat be based on the conditions that are found at the time of designation. An occupied area must contain one or more of the primary constituent elements (PCEs) to be eligible for designation as critical habitat and cannot be designated as critical habitat unless it contained physical or biological features essential to the conservation of the species at the time of designation (70 FR 52630). The ESA does not permit an area lacking such features to be designated as critical habitat in the hope that it may over time acquire such features (70 FR 52630). Since the designation was based on conditions which existed at the time the critical habitat was listed, this analysis looks at the effects of this PA on the existing critical habitat conditions.

In designating critical habitat, NMFS focused on the known physical and biological features, referred to as PCEs, within the designated area that are essential to the conservation of the species and that may require special management considerations or protection. Critical habitat consists of the following PCE: spawning sites; rearing sites; migration corridors; estuary; nearshore marine areas; and offshore marine areas. The streams in this consultation include spawning and rearing sites, and migration corridors. Critical habitat for steelhead was designated on September 2, 2005

(70 CFR 52630), and the PCEs in this habitat were considered functional to support the listing of this habitat.

Table 7-8 shows the lengths of Webb, Sweetwater, and Lapwai creeks that are designated critical habitat for Snake River steelhead in the Action Area.[1] These listed lengths do not include portions of the streams on Tribal lands, which were withdrawn from the critical habitat designation by request of the Tribe.

The watershed and land ownership in the Webb, Sweetwater, and lower Lapwai creeks is mostly private, intermixed with Indian-owned parcels. Lands within the basin are used for timber harvest, grazing, irrigated farming, urbanization, and road development. Impacts related to these land uses affect the stream habitat in the Action Area.

Table 7-8. Amounts of total stream length qualifying as critical habitat (km) and listed critical habitat (km) in Sweetwater, Webb, and lower Lapwai creeks from the diversion dams to the mouth of Lapwai Creek.

Stream	Total Stream Length downstream from diversion dams (km)	Total Stream Length accessible to steelhead (km)	Listed Critical Habitat
Webb Creek (diversion dam to mouth)	15.20	11.60	11.60
Sweetwater Creek (diversion dam to mouth)	13.40	13.40	8.00
Lapwai Creek (Sweetwater Creek to mouth)	9.80	9.80	4.50
Total	38.40	34.80	26.50

7.3.2 Current Conditions

Webb Creek, from the waterfall downstream of the diversion dam to the mouth, flows through several private parcels that are primarily used for grazing and timber harvest. Impacts to the habitat include unprotected road crossings, grazing in the riparian, and livestock impacts to the banks and channel. These impacts have increased sediment loads and reduced riparian shading to the stream. Cobble embeddedness measurements taken from potential spawning habitat ranged from 5 to 12 percent in lower Webb Creek (Weigel 2009).

[1] As noted in Chapter 1, Captain John Creek also has designated critical habitat for steelhead; however the PA has no effect on this habitat—a determination supported in the 2006 NMFS Biological Opinion for this Project (NMFS 2006a).

Sweetwater Creek, between the diversion dam and the confluence with Webb Creek, flows through private land that is used primarily for grazing. Impacts to the habitat include road crossings, road encroachment, grazing in the riparian, and livestock impacts to the banks and channel. Several residences are located near the stream. Similar to Webb Creek, these impacts have increased sediment loads and reduced riparian shading to the stream. Cobble embeddedness measurements taken from potential spawning habitat ranged from 8 to 10 percent (Weigel 2009).

The lower portion of Sweetwater Creek follows County Highway P2 from upstream of Webb Creek to the mouth. The creek has been impacted by the road, and much of the channel in this area has been altered with bank stabilization and levees to accommodate the road, bridges, homes, and farms. These impacts have resulted in increased sediment loads, unstable banks, and channelization (Reclamation 2008). Much of the channel is disconnected from the active floodplain and habitat complexity has been reduced. This channel alteration prevents dissipation of hydraulic energy in the channel during high flow events, increasing the sediment transport of smaller gravel-sized sediments. In locations where the creek maintains a functional floodplain, spawning-sized gravels tend to be abundant (Reclamation 2008). Eight private irrigation pumps are located along lower Sweetwater Creek. These irrigation pumps do not have fish screens designed to protect the pump intakes and velocities from harming juvenile fish rearing in the stream (Reclamation 2007).

Lower Lapwai Creek flows primarily along the State Highway 95 and railroad transportation corridors. The creek is constrained by these transportation corridors on one or both banks in all locations downstream from Sweetwater Creek. The presence and construction of this transportation corridor has reduced the active stream channel and riparian habitat, and has resulted in increased sediment loads, bank cutting, channel downcutting, and reduced habitat complexity and stream side shading. The highway is mostly located on the west side of the stream, but crosses the stream channel numerous times. Levees have been installed along the stream reducing the active channel from a multiple, braided channel to a substantially narrower single-stream channel with incised banks. In locations where the creek maintains a functional floodplain and particularly multiple braided channels, spawning-sized gravels are abundant (Reclamation 2009a). There are seven irrigation pumps withdrawing surface water from lower Lapwai Creek to adjacent pastures and grain fields. These irrigation pumps do not have fish screens designed to protect the pump intakes and velocities from harming juvenile fish rearing in the stream (Reclamation 2009a).

Current conditions related to stream flow, temperature and sediment are described in Chapters 5, “Hydrologic Conditions,” and Chapter 6, “Water Quality,” herein.

7.3.3 Effects of Proposed Action on Critical Habitat

Effects associated with the PA that could impact critical habitat are similar to those previously discussed and related to steelhead biology and populations. The amount of stream flow effects the amount of space and numerous attributes (such as depth and velocity) that will influence the quality of the stream habitat. These effects to stream flow must be considered in context of the hydrograph (such as water availability), and are summarized below in reference to the PCEs.

The analyses in the previous sections of this document indicate that the PA will not have a measurable effect on stream temperature. Stream temperatures are substantially influenced by factors other than stream flow, such as air temperature, solar radiation and stream-side shade (see Chapter 6, “Water Quality”); therefore, temperature will not be discussed further in relation to critical habitat.

7.3.3.1 Stream Flow

Spawning, Incubation and Emergence

As discussed in Sections 7.2.3.1, “Spawning,” and 7.2.3.2, “Incubation and Emergence,” the PA will maintain spawning flows February through April for adult steelhead spawning and incubation whenever the Project is operating; during these months, if the Project is not operating, all flows reaching the Webb and Sweetwater Creek diversion dams will be bypassed. During May, minimum flows of 1.5 cfs in Webb Creek and 3.0 cfs in Sweetwater Creek will be maintained.

In March and April, when most spawning occurs, hydrologic modeling performed as part of PA development indicates that stream flows predicted when implementing the PA would have ranged from 2.0 to 77.8 cfs in Webb Creek (measured at the mouth) and 5.1 to 70.4 cfs in Sweetwater Creek (measured at the diversion dam). These flows combine for a range of 7.1 to 148.2 cfs in lower Sweetwater Creek (measured at the mouth). The analyses indicate that more than 50 percent of the maximum WUA will be available for about 90 percent of the spawning period in both Sweetwater and Webb creeks. Furthermore, most of the spawning habitat (80 to 100 percent WUA) will be provided for more than 60 percent of the days during the March/April spawning period in Sweetwater Creek (See Section 7.2.3.1, “Spawning,” including Table 7-7, Figure 7-15 and Figure 7-16).

Habitat in Webb and Sweetwater creeks during the incubation and emergence life stage will be suitable until stream temperatures exceed the tolerance range for the species in mid-May. Overall, the PA will maintain stream flow over potential spawning habitat to allow for the development and emergence of steelhead eggs from potential redd pockets. The implementation of the PA would improve conditions of the critical habitat in Webb Creek and Sweetwater Creek during the spawning, incubation and emergence life stage over those that existed at the time of designation.

Lapwai Creek has the least amount of listed critical habitat (4 km) within the Action Area. Much of the hydrology of lower Lapwai Creek is dependent on the majority of the basin (<60 percent) which is outside the influence of the Project. Stream flows as described in Section 7.2.1, “Life History and Habitat Requirements,” are expected to be adequate for spawning, incubation, and emergence during all conditions except in years of very low precipitation.

Juvenile Rearing

The PA will maintain minimum rearing flows in Webb (1.0 to 2.0 cfs) and Sweetwater (2.5 cfs to 3.5 cfs) creeks while the Sweetwater and Webb diversion dams are being operated. Provision of lower flows in Webb Creek is supported by the results of the hydrologic analysis conducted during PA development, which indicate that under unregulated hydrologic conditions, late summer stream flows in Webb Creek can fall to 0.2 cfs or lower. This condition is consistent with the hydrology of small tributaries in the lower Clearwater River basin that can dewater and disconnect during low flow periods, yet still maintain populations of steelhead. Thus, in the case of Webb Creek, the PA would improve conditions of the critical habitat over those that existed at the time of listing by providing a stream flow greater than what would be in the stream during the summer and early fall months without the Project, and will provide some late summer and fall mitigation for juvenile steelhead rearing when the diversion dam is operating.

During the late fall and winter months when the Webb and Sweetwater diversion dams are not in operation, stream flows in the creek downstream from Soldiers Meadow Dam and the West Fork diversion will be consistent with flow present at the time of designation. Increases in stream flow during the fall and winter period are dependent on precipitation events and other climatic conditions. Project operations under the new PA in the winter are not changing from previous years, and are not expected to alter fall and winter stream flows from those observed in previous years. In the 6 years analyzed, wintertime stream flows are expected to range from 0.1 cfs to 31.8 cfs in Webb Creek and 0.7 cfs to 13.0 cfs in Sweetwater Creek downstream from the diversion dam. The low flows in Webb Creek are primarily the result of the hydrology of the basin (as discussed related to late summer flows above).

The minimum predicted November through January stream flows in Webb Creek will not maintain connectivity in all locations of listed critical habitat for an average of 35 days (range 25 to 58 days) during these months. However, the higher stream flows that result from precipitation events will provide connectivity and will allow juvenile steelhead to outmigrate. Loss of connectivity in Webb Creek is expected to be a natural hydrologic condition. The minimum stream flows on Sweetwater Creek also could fall below levels that will maintain connectivity predicted on 2 days in 2007 and 2008 each. The small dewatered reach (several feet stream distance) of disconnected stream for this very short duration are not expected to alter juvenile steelhead survival or behavior. These flow conditions existed at the time of designation and the implementation of the PA is not expected to alter these conditions.

Channel cross section data were not collected on Lapwai Creek to incorporate depth, velocity, cover and sediment attributes into the analysis. Therefore, connectivity is the only stream variable that can be discussed in this reach. The proposed minimum releases (3.5 cfs combined releases from Sweetwater and Webb creeks) will combine with stream flow gains from springs in lower Sweetwater Creek to provide about 4.5 cfs at the mouth of Sweetwater Creek. This stream flow will combine with the stream flow from upper Lapwai Creek increasing the stream flow to about 5.5 cfs. This stream flow is expected to provide connectivity of stream habitat in Lapwai Creek (Reclamation 2009a) allowing rearing juvenile *O. mykiss* ability to move upstream and downstream to seek out favorable microhabitats. The implementation of the PA would improve conditions of the critical habitat in Lapwai Creek over those that existed at the time of designation.

7.3.3.3 Sediment

The specific effects of the PA related to sediment are discussed in Section 7.2.3, “Effects of the Proposed Action on Steelhead.” Sediment inputs to the stream resulting from the PA are minimal and not expected to change. The actions related to maintenance and operation of the facilities and access roads has not changed from previous years. Total suspended sediment levels in the stream have been well below levels that impact steelhead.

Soldiers Meadow, Webb, and Sweetwater dams collect fine sediment transporting in the creek thereby reducing suspended sediment and cobble embeddedness in the stream channel downstream of these dams. Spawning gravels that are collected by the Sweetwater diversion dam are proposed to be replaced in the channel downstream in an amount estimated to be similar to the amount removed during excavation. Webb diversion dam has very large sediment and does not affect spawning size gravels. The road and canal maintenance activities will not increase sediment contributions to the creek, which are currently low. The dams and associated gravel removal plan will have a beneficial effect by reducing sediment contributions to critical habitat.

7.4 Impact Summary and Conclusion

Impact findings related to steelhead biology and populations (discussed in Section 7.2, “Biology and Populations”), and steelhead critical habitat (discussed in Section 7.3, “Critical Habitat”) are summarized in Tables 7-9 and 7-10, respectively. Conditions in lower Lapwai Creek are largely influenced by factors outside of the Project activities and Action Area. In addition, Lapwai Creek has the smallest amount (4 km) of listed critical habitat.

Table 7-9. Summary of impacts by life stage, factor, and stream for listed Snake River steelhead in the Action Area.

Life Stage and Factors	Stream	Identified impacts and conclusions
Spawning		
Stream flow	Webb	Late spawners (~3 percent of returning adults—after April 30) will not benefit from higher spawning flows. Early spawners may be delayed but this is not expected to limit spawning success.
	Sweetwater	Same as Webb Creek
	Lapwai	Possible continued impacts to spawning steelhead during low flow years—primarily a function of climate and precipitation factors; data not available to define or quantify impact.
Temperature	Webb	Meets steelhead requirements
	Sweetwater	Meets steelhead requirements
	Lapwai	Meets steelhead requirements
Sediment	Webb	No change over existing conditions. No indication that sediment levels will cause adverse impact; baseflow data and influence of dams as sediment traps suggest sediment contributions could be cancelled by sediment storage
	Sweetwater	Same as Webb Creek
	Lapwai	Same as Webb Creek
Incubation and Emergence		
Stream flow	Webb	Meets steelhead requirements
	Sweetwater	Meets steelhead requirements
	Lapwai	Improvement over existing condition however , some impacts may continue during dry years (no data available to quantify impact), no impacts during wet years
Temperature	Webb	Stream temperatures in later portion of incubation period reduce incubation survival; however unrelated to Project effects
	Sweetwater	Same as Webb Creek
	Lapwai	Same as Webb Creek

Table 7-9. Summary of impacts by life stage, factor, and stream for listed Snake River steelhead in the Action Area.

Life Stage and Factors	Stream	Identified impacts and conclusions
Sediment	Webb	No adverse impact
	Sweetwater	No adverse impact
	Lapwai	No adverse impact
Juvenile Rearing		
Stream flow	Webb	No adverse impact; Natural (unregulated) stream flows less than 0.4 cfs; stream flows in spring (May and June) will be reduced by Project diversion, stream flows in summer/fall will be greater than would have been available in the stream without the Project
	Sweetwater	No adverse impact. Steelhead expected to grow and survive comparable to other areas in the basin
	Lapwai	No impacts identified
Temperature	Webb	Impact not detectable
	Sweetwater	Impact not detectable
	Lapwai	Impact not detectable
Sediment	Webb	No adverse impact
	Sweetwater	No adverse impact
	Lapwai	No adverse impact

Table 7-10. Summary of impacts to designated critical habitat--by PCE, factor and stream for listed Snake River steelhead in the Action Area.

PCE	Stream	Impact Assessment Findings
Physical Habitat Conditions	Webb	Channel maintenance flows provided
	Sweetwater	Channel maintenance flows provided
	Lapwai	Channel maintenance flows provided
Spawning, Incubation, and Emergence		
Stream flow	Webb	Improves critical habitat conditions as compared with conditions at time of designation; Spawning flows sufficient amount, timing and duration
	Sweetwater	Improves critical habitat conditions as compared with conditions at time of designation; Spawning flows sufficient amount, timing and duration
	Lapwai	Improves critical habitat conditions as compared with conditions at time of designation Possible limitation to spawning steelhead during low flow years may still exist, data not available to quantify if these flows will improve habitat conditions. Impact in early spring primarily climate and precipitation dependent
Sediment	Webb	Will not change critical habitat conditions as compared with conditions at time of designation. Baseflow data and influence of dams as sediment traps suggest sediment contributions could be cancelled by sediment storage. Sediment levels below levels that impact spawning habitat
	Sweetwater	Same as Webb Creek
	Lapwai	Will not change critical habitat conditions as compared with conditions at time of designation. Sediment effects from impacts outside the Project activities and Action Area.
Juvenile Rearing		
Streamflow	Webb	No change to critical habitat conditions as compared with conditions at time of designation; springtime reductions in stream flow are mitigated with summer/fall stream flows greater than unregulated estimates; connectivity maintained
	Sweetwater	Will not change critical habitat conditions as compared with conditions at time of designation; sufficient rearing conditions and connectivity maintained
	Lapwai	Will not change critical habitat conditions as compared with conditions at time of designation; stream flows largely dependent on impacts outside of the Action Area; expected to maintain connectivity
Sediment	Webb	No change to critical habitat conditions as compared with conditions at time of designation baseflow data and influence of dams as sediment traps suggest sediment contributions could be cancelled by sediment storage. Sediment levels very low and not expected to change
	Sweetwater	Same as Webb Creek
	Lapwai	Will not change critical habitat conditions as compared with conditions at time of designation. Baseflow data and influence of dams as sediment traps suggest sediment contributions could be cancelled by sediment storage. Sediment levels very low and not expected to change

7.5 Other Factors Affecting the Steelhead

7.5.1 Introduction

Analysis and effects determinations presented in Section 7.2 to Section 7.4 center directly on how the PA for the Project will affect listed steelhead. Effects of the PA also should be viewed in context with other factors and actions outside the control of the Project that also may impact to steelhead. Overviews of these factors and actions are provided below, organized into those outside of the Action Area and those within the Action Area.

7.5.2 Factors Outside of the Action Area

7.5.2.1 Ocean Conditions

Pacific salmon and steelhead spend some part of their life in the ocean and can attain about 95 percent of their adult weight during ocean residency. The ocean, therefore, is an important component of the species' life cycle. Physical and biological conditions in the ocean, notably the complex physical and biological interactions occurring in the northern California Current off Oregon and Washington, have been shown to affect the growth and survival of Pacific Northwest juvenile salmon (Pearcy 1992). Several important physical and biological factors in the ocean that can affect salmon and steelhead survival and growth to maturity include temperature, primary, and secondary production, and abundance and distribution of prey and predators. These factors have been shown to vary widely.

NMFS researchers at the Northwest Fisheries Science Center in Seattle have conducted studies in the northern California Current since 1996 (NMFS 2009c). They have amassed substantial data and have assembled three sets of ecosystem indicators that help describe oceanic conditions and ecological interactions that influence survival and growth and are expected to help forecast future years' adult salmon returns. The three sets of ecosystem indicators, along with their physical and biological components are:

- Large-scale ocean and atmospheric indicators: PDO and Multivariate El Niño-Southern Oscillation Index
- Local and regional physical indicators: sea surface temperature, coastal upwelling, physical spring transition, deep water temperature and salinity

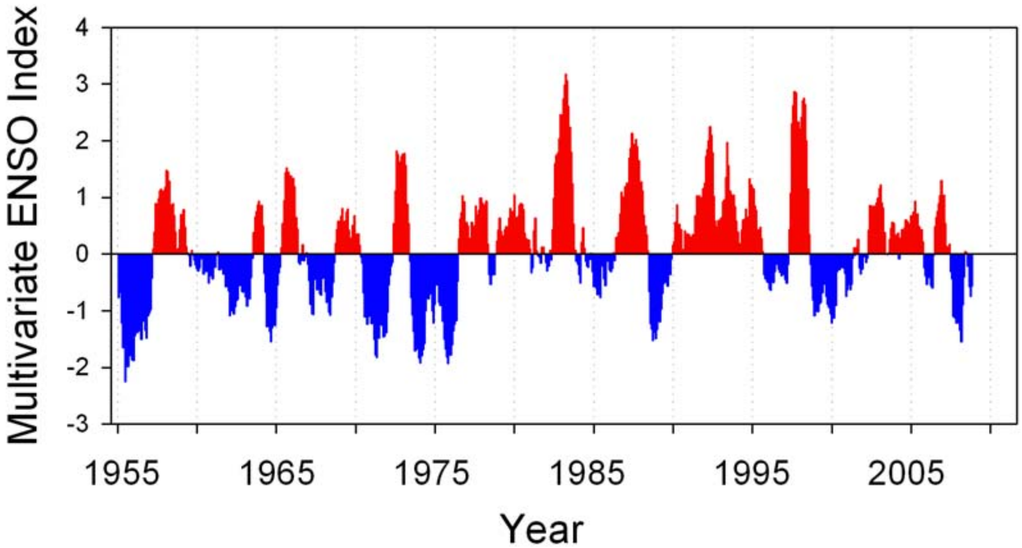
- Local biological indicators: copepod biodiversity, northern copepod anomalies, biological spring transition, spring Chinook salmon-June, and coho salmon-September

These ecosystem indicators were developed from recorded observations of biological conditions in coastal waters off Oregon and Washington since 1998, although the effects of some of the indicators have been known for much longer. The NMFS researchers and others have found that productivity of the ocean in the northern California Current is influenced on an annual basis by long-term and short-term phenomena such as the PDO and ENSO events. The PDO is a climate index based upon patterns of variation in sea surface temperature of the Northeastern Pacific Ocean (Mantua et al. 1997). As an example, Figure 7-6 shows the May to September PDO index from 1925 to 2008. The PDO has a roughly 20- to 30-year cycle. Cool water or negative conditions of the PDO generally result in good juvenile salmonid survival.

The ENSO index is defined as 3-month averages of sea surface temperature departures from normal for a region of the equatorial Pacific Ocean (Niño 3.4 region; 120W-170W, 5N-5S). This region of the tropical Pacific Ocean contains a band of cool water that extends along the equator from the coast of South America to the central Pacific Ocean. Departures from average of sea surface temperatures in this region are important in determining major shifts in the pattern of tropical rainfall, which in turn influences the jet streams and patterns of temperature and precipitation around the world (NMFS 2009e).

The El Niño component of the ENSO index is a phenomenon in the equatorial Pacific Ocean characterized by a positive sea surface temperature departure from normal (for the 1971 to 2000 base period) greater than or equal in magnitude to 0.5°C, averaged over 3 consecutive months. The La Niña component by contrast is a phenomenon characterized by a negative sea surface temperature departure from normal (for the 1971 to 2000 base period) in the same region greater than or equal in magnitude to 0.5°C, averaged over 3 consecutive months (NMFS 2009e). El Niño and La Niña can interact with the PDO to influence both terrestrial and oceanic climatic conditions. Figure 7-17 shows variation in the ENSO index from 1955 to present.

Figure 7-17. Example of El Niño Southern Oscillation events and the Multivariate El Niño Southern Oscillation Index from 1955 to present.



Among the several local and regional physical indicators, it was found that strong coastal upwelling from about May to September resulting from northerly and northwesterly coastal winds recycles nutrients from depth to surface waters and stimulates production of food items for juvenile salmon and steelhead. The strength of upwelling varies from year to year and within each year, as does the date of the physical spring transition to upwelling. Sea surface temperature influences the distribution and abundance of predators of juvenile salmon such as Pacific hake (*Merluccius productus*) and Pacific mackerel (*Scomber japonicus*), and, overlapping with local biological indicators, prey such as the northern and southern assemblage of copepods and other zooplankton. The northern or cold water assemblage of copepods usually predominates in the Washington/Oregon coastal zooplankton community in summer, especially with cooler sea surface temperatures, whereas the warm water assemblage usually dominates during winter. The cold water group of copepods includes Pseudocalanus mimus, Acartia longiremis, and Calanus marshallae, which provide a more lipid-rich source of higher-quality prey for juvenile salmonids than the warm water group of copepods.

Physical and biological conditions vary widely in the northern California Current. Between 1977 and 1998, the northern California Current was warm and relatively unproductive; as a result, juvenile salmon survival was poor and salmon numbers in the Pacific Northwest declined substantially. Two of the largest tropical El Niño events of the century occurred during these 22 years: one in 1983 and another during 1997 to 1998. These events occurring in the equatorial ocean contributed to exceptionally warm ocean temperatures in the northern California Current.

During the past 10 years, conditions in the northern California Current have been particularly variable, with the 1997 to 1998 El Niño, followed by 4 years of tropical La Niña events, which contributed to a period of cool and productive ocean conditions. During this period, Pacific Northwest salmon numbers increased substantially. However, in late 2002, ocean conditions reversed, and warm conditions prevailed for the next 4 years. This return to a warm phase coincided with a decline in adult return rates of both coho and yearling Chinook salmon, reversing the trend of high adult returns observed from 2000 to 2003.

Researchers are continuing to develop a better understanding of atmospheric-oceanic linkages and the complex physical and biological interactions that occur in the ocean and which influence juvenile and adult salmon and steelhead survival, although additional research needs to be done.

7.5.2.2 Climate Change

Recently, the Independent Scientific Advisory Board (ISAB 2007) described how the potential impacts of climate change may alter precipitation and temperature levels in the Columbia Basin and, in particular, impact the habitat and several life-stages of salmon and steelhead in the Pacific Northwest. The data and analysis is on the ISAB and the climate models are applied to large-scale geographical area such as the Columbia basin and are not specific to small tributaries such as the Lapwai Basin. Additionally, it is important to realize that the timeframe and ultimate extent of climate change is not clearly understood. Many climate change predictions describe changes up to 100 years, which is much longer range than the proposed 10-year duration of the requested Biological Opinion. The ISAB (2007) identified several likely effects of projected climate changes on Columbia basin salmon. Listed below are those that may pertain to the Snake River steelhead in the Action Area:

- Warmer temperatures will result in a shift to more winter/spring rains, which may alter the seasonal hydrograph. With reduced snowpack and greater rainfall, the timing of stream flow will likely shift, depreciably reducing spring and summer stream flow, and increasing peak river flows (ISAB 2007). In relation to the Action Area, a shift to warmer and wetter winters will benefit the earlier spawning steelhead by providing more suitable spawning habitat during periods when incubation and emergence conditions will maximize survival. The PA will continue to provide stable minimum summer stream flows for juvenile rearing salmon and steelhead.
- Anticipated water temperature increases, and the subsequent depletion of cold water habitat, could reduce the areal extent of suitable inland salmon habitats (ISAB 2007). Much of the Action Area suffers from spring and summer stream temperatures that are at the edge of the species tolerance. However, this factor is largely unrelated to stream flow and beyond the control of the Project. Therefore,

on shorter timeframes (~20 years), aggressive habitat restoration could counter increases in temperature due to climate change. Yet, if the climate trend continues on the longer term (>50 years), temperature increases will likely result.

- Increases in seasonal water temperature could accelerate the rate of egg development and lead to earlier emergence (ISAB 2007). However, steelhead in the Action Area should shift to an earlier spawning and incubation period, which likely would not result in an impact to the species. For example, if summertime temperatures increase in magnitude and duration, earlier emergence could be critical to extending the growing season and mitigating for reduced summertime growth.
- Earlier snowmelt and earlier, higher spring flows, warmer temperatures, and a greater proportion of precipitation delivered as rain rather than snow, may cause spring Chinook salmon and steelhead yearlings to smolt and emigrate to the estuary and ocean earlier in the spring. The early emigration coupled with a projected delay in the onset of coastal upwelling could cause these fish to enter the ocean before foraging conditions are optimal. The first few weeks in the ocean are thought to be critical to the survival of salmon off Oregon and Washington, so a growing mismatch between smolt migrations and coastal upwelling would likely have significant negative impacts on early ocean survival rates (ISAB 2007). These impacts are outside the Action Area and outside the control of the Project. Certainly, timing and magnitude of high flows would be impacted, but the understanding on ocean and estuary survival is speculative at this time.
- Increases in mortality also may be caused by fish pathogens and parasites as these organisms often do not become injurious until their host becomes thermally stressed (ISAB 2007). High temperatures in the Action Area are discussed above, and certainly, if habitat restoration cannot limit these temperature effects, then fish disease will be coupled with stress, lethal water temperatures, and reduced survival.

7.5.2.3 Commercial, Recreational and Tribal Harvest

Commercial, Recreation and Tribal harvest of Snake River steelhead occur in the Clearwater and Lapwai basins. This activity is covered under the U.S. versus Oregon Management Agreement Biological Opinion. This opinion examines the effects of Tribal and Non-Tribal harvest of Columbia Basin salmon and steelhead (NMFS 2008a). This opinion concluded that A-run Snake River steelhead are increasing (population growth rate >1.0), and issues an Incidental Take Permit for harvest on these species. Snake River steelhead from the Clearwater MPG are subject to this harvest, and harvest is allowed within the Action Area and along the migratory corridors necessary for steelhead survival.

7.5.3 Factors within the Action Area

Numerous activities impact the stream habitat and fisheries populations in Lapwai Creek and tributaries. Likely, the greatest impacts will occur from the maintenance and improvements to the state and county road network. Yet, several agencies are working in partnership to improve watershed condition to benefit fisheries and aquatic populations in the basin. The identified projects are expected to be conducted using various best management practices to reduce effects to water quality, riparian vegetation, and stream habitat during and after construction. The watershed restoration program has a planning timeline of at least 10 years; therefore, this program is expected to continue Project implementation and effects similar to those implemented in recent years and identified through the planning process.

7.5.3.1 Fish Stocking

Little stocking of fish by Idaho Department of Fish and Game (IDFG) has occurred in the streams in the Lapwai Basin since 1967, but stocking of multiple species has occurred in Lake Waha, Winchester Lake (Lapwai Lake), Reservoir A (Mann Lake), and Soldiers Meadow Reservoir. Brook trout were once stocked in Sweetwater Creek and an unspecified strain of rainbow trout was stocked in Webb Creek from 1979 to 1981. The lakes and reservoirs in the system have been stocked with many different varieties of rainbow trout, as well as cutthroat trout, splake, channel catfish, Kokanee, coho salmon, tiger muskie, a hybrid steelhead/cutthroat cross, and some aquatic invertebrates (IDFG 2009).

In general, in all of the water bodies, different strains of rainbow were stocked as fry (0 to 3 inches) and fingerlings (3 to 6 inches) from the late 1990s through 2005. In more recent years, triploid strains of rainbow have been stocked as fingerlings and catchables (6+ inches). All water bodies have also had fry and fingerling Kokanee stocked in 2001 and 2002. Winchester Lake has had catchable tiger muskie and channel catfish stocked recently. Reservoir A has had catchable channel catfish stocked since 2000.

In 1999 and 2000, approximately 300,000 coho salmon smolts were released in the Lapwai Creek drainage (Johnson et al. 2001, Larson and Walker 2002). In 2008, the Tribe released approximately 275,000 coho salmon smolts below the Sweetwater Springs Hatchery. Another 275,000 coho salmon smolts were released at three different locations in Lapwai Creek at: the Mission Creek Bridge, the Sweetwater Creek Bridge, and another site further upstream of the town of Culdesac.

Fish Disease

In 2005, whirling disease (*Myxobolus cerebralis*) was detected in rainbow trout reared at Sweetwater Springs Hatchery, a privately owned facility located along lower Sweetwater Creek. These detections subsequently led to the hatchery closure in 2006. An exposure study using hatchery rainbow trout in Sweetwater and Lapwai creeks in 2005 found that the disease is present in Sweetwater Creek, and was more prevalent at the site near Packers Gulch than at the site near the Sweetwater Springs Hatchery, 48 percent versus 6.5 percent of trout exposed were positive for spores. *M. cerebralis* spores were not detected in fish exposed in the Lapwai Creek sites, although there was genetic evidence of *M. cerebralis* in 2 individuals from these trials (IDFG 2005). The infection intensity was determined to be low in comparison to other streams in Idaho and was not found to be detrimental to wild fish in these streams (IDFG 2005).

All rainbow trout from the study exposed in the Lapwai Creek sites died of *Ichthyophthirius multifilius* (commonly called white spot disease), a ciliate, free-swimming protozoa. Sites on Lapwai Creek were located near the mouth, downstream from Sweetwater Creek, and near Mission Creek. None of the fish in Sweetwater Creek had post-exposure symptoms of *I. multifilius* (IDFG 2005). Susceptibility to *I. multifilius* increases with increased stress, such as high temperatures and impaired water quality. The experimental trials were conducted in October when stream temperatures ranged from 8 to 17°C at the experimental sites (IDFG 2005); therefore, it is unlikely that the experimental fish were stressed with high temperatures during exposure. There are no other references to *I. multifilius* in Lapwai Creek. The high mortality on the experimental trout could have been due to conditions in Lapwai Creek combined with the experimental confinements.

7.5.3.2 Transportation Projects

U.S. Highway 95, the primary north/south route in Idaho, parallels the entire length of the mainstem Lapwai Creek. The state has identified the following projects:

- Replace up to seven existing bridges targeted for implementation in 2011
- Install a passing lane between Sweetwater and Mission creeks within the next 10 years (Funkhouser 2009)
- In addition, the State has identified a project to connect the slow vehicle lanes into one (additional) continuous passing lane in the upper Lapwai canyon between mile posts 279.7 and 283.8 upstream of Culdesac, Idaho. This Project does not have an identified timeline for implementation (Funkhouser 2009).

County Road and Highway Projects—Nez Perce County maintains the paved local Highway P2 (Webb Road) and Waha Road, and several gravel roads that travel along the creeks, ridgelines and across the basin and tributaries throughout the Sweetwater Creek Basin. The following projects are planned and/or foreseeable to occur:

- Webb Road—three projects located over 7 miles between the Waha Road intersection and U.S. Highway 95 for widening and road improvements and a bridge replacement over Sweetwater Creek. Design begins on these projects in 2009 and they will be implemented in phases expected to take the next 6 to 10 years.
- Webb Ridge Road—widening and replacement of the existing bridge over Webb Canal. Project expected to be conducted in the next 3 to 5 years and will likely be conducted when the canal is dry, minimizing effects to water quality.
- County Bridge to Sweetwater—replace existing bridge over Lapwai Creek to access the town of Sweetwater from U.S. Highway 95. Project expected to be conducted within 3 to 5 years.
- Culvert replacements—culvert replacements are likely to occur on the various gravel roads in the drainage. These projects are unidentified at this time and conducted on an as-needed basis (Moore 2009).

7.5.3.3 Watershed Restoration Projects

The Lapwai Creek Watershed Rehabilitation Project was originally funded by BPA in 1999 to complete a watershed analysis. Since that time, the Nez Perce Watershed Division has been working on resource assessments and Project implementation throughout the Lapwai Creek watershed. Restoration and protection activities have included native revegetation, riparian protection fencing, road decommissioning, and other Best Management Practices. Project partners include the Nez Perce Soil and Water Conservation District, Nez Perce Water Resources and Land Services departments. Funding for projects has been provided through BPA, State of Idaho Office of Species Conservation–Pacific Coastal Salmon Recovery Funds, U.S. Fish and Wildlife Service (USFWS), and NMFS's community-based restoration program.

This program has completed several planning and inventory projects, as well as numerous habitat restoration projects in the basin. Completed habitat restoration projects include:

- Construction and maintenance of 15 miles of riparian protection fence
- Noxious and invasive weed control
- Decommission of 5 miles of road
- Removal of fish passage barrier (Don Herndon Bridge, Lapwai Creek) opening access to 9.27 miles of stream habitat
- Installation of one bridge over lower Sweetwater Creek to eliminate the use of three unprotected stream crossings

- Protection of two spring-fed tributaries from livestock impacts on lower Sweetwater Creek
- Installation of an off-stream livestock watering system (Sweetwater Creek)
- Replanting native stream-side vegetation (Sweetwater and Lapwai creeks)

In addition to these habitat enhancement projects, this program annually collects fisheries population data (electrofishing) and stream habitat data since 2003. These data sets were combined in a format compatible with geographic information systems (GIS) and with other available watershed-wide data sets developed by the Nez Perce Soil and Water Conservation District and the Nez Perce Water Resources Division. These data and analyses were used to develop the *Strategy for the Ecological Restoration of Lapwai Creek Watershed*, a document intended to direct efforts and resources toward the highest priority restoration projects and areas of the Lapwai Creek Watershed. This document has not yet been finalized, but is intended to guide and prioritize restoration projects in the Lapwai watershed for the next 10 years.

This program has also identified the following future projects for implementation:

- Implementation of high priority stream/watershed restoration projects on 10 properties identified through the Natural Resource Assessment Management Protocol in 2009.
- Construction of 500 feet of riparian fencing to exclude livestock from two Tribal allotments along mainstem Lapwai Creek and restore 0.84 acres of wetland and 2.5 acres of riparian restoration located within the excluded riparian buffer.
- Construction of 2,000 feet of riparian fencing to exclude livestock from the riparian zone, install 100 feet of bank stabilization, and restore 13.5 acres of riparian and wetland area.

Chapter 8 ESSENTIAL FISH HABITAT

8.1 Background and Proposed Action

8.1.1 Background

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan (FMP). The MSA requires federal agencies to consult with NMFS on all actions, or PAs, authorized, funded, or undertaken by the agency, that may adversely affect EFH (MSA 305[b][2]). There are federal FMPs covering Pacific salmon, groundfish, and coastal pelagic species. EFH is designated for Chinook, coho, and Puget Sound pink salmon (PFMC 1999). Only Chinook and coho salmon occur in or near the Project Action Area.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (MSA Section 3). “Waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; “substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “necessary” means the habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species’ full life cycle (50 CFR 600.110). Adverse effect means any impact that reduces quality and/or quantity of EFH, and may include direct (that is, contamination or physical disruption), indirect (for example, loss of prey or reduction in species fecundity), and site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by the PFMC), and longstanding, naturally-impassable barriers (such as natural waterfalls). Freshwater EFH consists of four major components: spawning and incubation; juvenile rearing; juvenile migration corridors; and adult migration corridors and adult holding habitat. Assessment of potential adverse effects to these species' EFH from the PA is based, in part, on this information. This analysis addresses potential effects of the PA to Chinook and coho salmon freshwater EFH in the following streams:

1. Captain John Creek, from the headwaters of the North Fork to its mouth.
2. All portions of the Webb Creek and Sweetwater Creek drainages below impassable barriers and where flows are altered by the Project.
3. The mainstem of Lapwai Creek from the confluence with Sweetwater Creek downstream to its mouth

Appendix A to Amendment 14 of the Pacific Coast Salmon Plan (PFMC 1999) listed EFH for Chinook salmon and coho salmon in the Snake and Columbia rivers downstream from Hells Canyon Dam. EFH was delineated by 4^{th}-field hydrologic unit codes (HUCs). The Action Area is contained within 4^{th}-field HUCs 17060306 (Clearwater River) and 17060103 (Lower Snake River-Asotin) (Figure 8-1). These two HUCs with the EFH-designated species, affected ESU, and life history use are shown in Table 8-1.

8.1.2 Proposed Action

The PA is the ongoing operations and routine maintenance activities for the Project. In general, the PA includes (see Chapter 4, "Proposed Action" for details and specifications):

- Storage and release of water in reservoirs and from dams that Reclamation owns and constructed for Congressionally authorized purposes. Storage and releases occur in accordance with authorized purposes, Reclamation contracts, and in accordance with State law and Reclamation-held water rights.
- Carriage and diversion of water into facilities that Reclamation owns or operates and that are associated with the authorized Project.
- Routine maintenance at dams, reservoirs, and diversion structures.
- Forgoing diversions at Webb and Sweetwater diversion dams to provide minimum instream flows when the Project is being operated (February/March through October). Proposed flows, at Webb and Sweetwater diversions respectively, are: 4.0 and 7.8 cfs in February, March and April for spawning, 1.5 and 3.0 cfs in May, and 1.0 and 2.5 cfs in June through October for juvenile rearing. No drought contingency or exemption is proposed.

Table 8-1. Snake and Columbia River basin HUCs with designated Chinook and coho salmon essential fish habitat, ESU, and life history use.

HUC	Hydrologic Unit Name	Species [1]	Current or Historic Distribution [1]	ESU	Life History Use [2]
17060306	Clearwater River	Chinook salmon	Current habitat in HUC outside of the Action Area; Action Area not suitable for species	Not ESA-listed	S, R, M
		Coho salmon	Occupied, established by reintroduction	Not ESA-listed	
17060103	Lower Snake River - Asotin	Chinook salmon	Currently accessible	Snake River fall Chinook salmon Snake River spring/summer Chinook salmon	S, R, M
		Coho salmon	Currently accessible but not occupied habitat (reintroduction efforts not conducted in this HUC)	Not ESA-listed	

[1] Information obtained from PFMC (1999) Tables A-1 and A-6.

[2] S = spawning, R = rearing, M = migration

The Action Area consists of Sweetwater and Webb creeks downstream from the Sweetwater and Webb diversion dams, and Lapwai Creek from the confluence with Sweetwater Creek downstream to its confluence with the Clearwater River. The Action Area does not include the mainstem of the Clearwater River, since diversion of water from Sweetwater and Webb creeks does not measurably alter stream flows in the Clearwater River. Captain John Creek, which drains into the Snake River, is also part of the Action Area. The lower reach of Captain John Creek is thought to serve as rearing habitat for Snake River spring/summer Chinook salmon. A passage barrier at stream mile 6.0 limits upstream migration of fish and is considered the upstream extent of salmon habitat in the creek.

8.2 Species Status and Life History in Action Area

8.2.1 Chinook salmon

Spring/summer and fall Chinook salmon occur in or near the Project Action Area in the Clearwater and Snake rivers. Spring/summer Chinook salmon spawn in tributary streams where the juveniles rear for 1 year in fresh water after emerging from the gravel and outmigrate relatively swiftly as 1-year-old smolts or parr. Fall Chinook salmon (not expected to occur in the Action Area) spawn in larger rivers at lower elevations and the juvenile fish begin their downriver migration through the lower Snake River and Columbia River to the estuary and ocean as age-0 subyearlings the summer/fall after they hatch.

Adult spring/summer Chinook salmon migrate up the Snake River from spring to about mid-August and spawn during late summer low flows. These salmon tend to use small, higher elevation streams for spawning and early rearing.

Temperature for adult migration and spawning activity ranges from 5.6 to 13.9°C, optimum temperature for incubation and early rearing ranges from 5.0 to 14.4°C, while optimum temperature for juveniles rearing in fresh water ranges from 12 to 14°C (PFMC 1999).

Redds of spring/summer Chinook salmon usually are 3.3 to 6.0 m^2 in size, with depth ≥ 24 cm and velocity from about 30 to 91 cm/sec; suitable substrate ranges in size from about 1.3 to 10.2 cm (Bjornn and Reiser 1991). Water depth for rearing juveniles ranges from about 10 to 120 cm.

Some spring/summer Chinook salmon spawning occurs in tributaries downstream from Hells Canyon Dam, but most of the production occurs in high elevation tributaries of the Salmon River, Grande Ronde River, and Clearwater River.

Spring/summer Chinook salmon are not believed to spawn or rear in Lapwai or Sweetwater creeks (NMFS 2006a). While one juvenile Chinook salmon was reported near the mouth in Lapwai Creek in 2003 (NPT 2003a), the increased densities of coho salmon in the basin makes visual identification between juveniles of these two salmon species difficult. The adult migration and spawning timing of Chinook salmon coincides with the summer maximum temperatures and low base flows. Excessively high summer temperatures combined with low base flows in the basin are believed to not provide suitable habitat for this species (NMFS 2006a). These conditions are not related to Project effects in the basin.

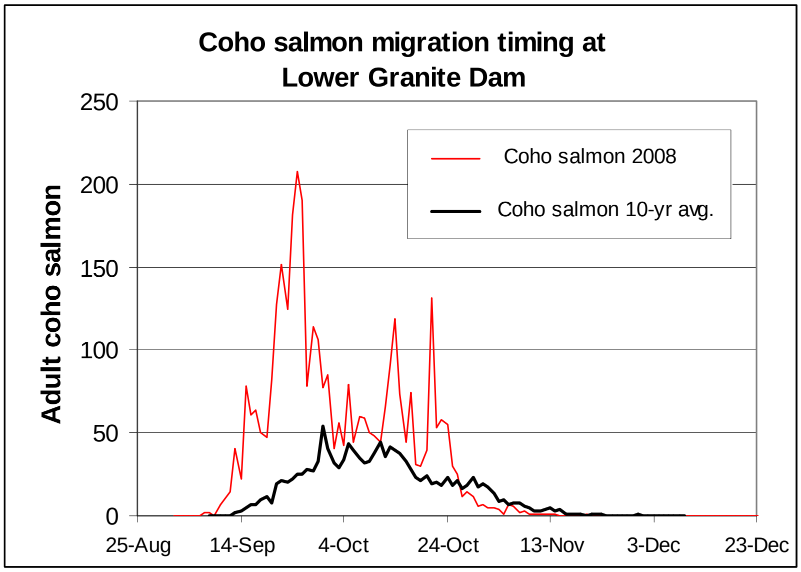
Spring/summer Chinook salmon are thought to spawn and rear in the lower 6 miles of Captain John Creek.

8.2.2 Coho Salmon

Coho salmon were extirpated from the Snake River Basin around 1986; one adult coho salmon each was counted at Lower Granite dam in 1985 and 1986, with no fish counted in 1984 (FPC 2009). The Tribe initiated a Clearwater River coho salmon restoration program in 1994 through the *U.S. v. Oregon* process. Adults first returned in 1997 when 85 adult coho salmon were counted at Lower Granite Dam. Annual hatchery releases since 1999 have been 1.1 million juveniles consisting of 830,000 smolts and 270,000 parr into various tributaries in the Clearwater River Basin. The population is supported principally by hatchery production, although adult coho spawning has been observed in tributary streams including lower Lapwai Creek, indicating that some natural spawning is occurring (NPT 2009). Juvenile coho salmon are present in the Action Area (Kennedy and Hartson 2009).

Adult coho salmon cross Lower Granite Dam from about September 8 to about November 30, with higher adult counts around the first 2 weeks of October (DART 2009). Figure 8-4 shows adult coho salmon migration timing at Lower Granite Dam for 2008 and the 10-year average. Adults would be moving upstream into the Clearwater River to provide broodstock for hatchery production or to spawn naturally from about October to December.

Figure 8-1. Migration timing of coho salmon at Lower Granite dam for 2008 and the 10-year average.



Successful upstream migration of adult coho salmon in tributaries requires a minimum depth of 0.18 m (0.6 ft) (USFWS 1983), and a temperature range of 7.2 to 15.6°C (Bjornn and Reiser 1991). Coho salmon generally spawn in late fall in a temperature range of 4.4 to 9.4°C, with incubation in the range of 4.4 to 13.3°C (Bjornn and Reiser 1991). Suitable spawning gravel is in the size range of 1.3 to 10.2 cm (Bjornn and Reiser 1991) with less than 30 percent fines in tributaries with gradient less than about 3 percent (Reeves et al. 1989). Average redd size for coho salmon is about 2.8 m^2 although adults will use or defend an area about four times larger (USFWS 1951). Early rearing habitat for young coho salmon after emerging from the gravel in the spring is generally backwater pools, dam pools, and beaver ponds, as well as side channels that have low water velocity (<10 cm/sec) and that are relatively shallow (<30 cm) (Reeves et al. 1989). Streams that are structurally complex with stones, logs, and bushes in the water support larger numbers of fry (Scrivener and Andersen 1982 cited in Sandercock 1991). As the fish grow through the summer, they prefer pools and beaver ponds up to 1.2 m deep. Preferred winter rearing habitat includes deep (>80 cm) backwater pools, beaver ponds, deep lateral scour pools; and side channels with an abundance of cover and low water velocity (<0.3 meters/sec) (Reeves et al. 1989). Juveniles rear for a year in fresh water then outmigrate as yearlings in the spring.

8.3 Effects to Pacific Salmon EFH

The lower reach of Captain John Creek is thought to provide rearing EFH for Snake River spring/summer Chinook salmon. The Project does not divert water from Captain Johns Creek (tributary to HUC 17060103, Lower Snake-Asotin) in the fall during the spawning season. As described in Chapter 1, “Introduction,” water diversion in Captain John Creek is limited to the spring high flow period from an intermittent tributary located upstream from the salmon habitat. The Project operations have no discernible effect on the hydrology in Captain John Creek or on EFH for salmon.

The effects of the PA on expected hydrologic and water quality conditions in the Action Area are discussed in Chapter 5, “Hydrologic Conditions,” and Chapter 6, “Water Quality,” in this document.

Chinook salmon and coho salmon have similar habitat requirements and migratory behavior; therefore, the impacts to EFH for both species will be discussed together as salmon. Juvenile salmon will have similar habitat requirements as juvenile steelhead and the impacts related to the PA are discussed in Section 7.2.3.3, “Migration Behavior in Nearby Basins.” In addition, coho salmon densities and returns have been increasing in the Action Area since 1998 indicating that these juvenile salmon are being provided suitable habitat that allow these fish to survive, rear and outmigrate.

A critical difference between coho salmon and steelhead is that adult migration and spawning occurs in October through December coinciding with base flows in the hydrograph. Most coho salmon are counted moving upstream at Lower Granite Dam between mid-September to mid-November with the peak of the run occurring during October (Figure 8-1). These salmon are expected to be entering lower Lapwai Creek in October and November. The PA will be improving stream flows when operating the Sweetwater and Webb diversion dams during October. The diversion dams will not be operated in November, December, and January, and thus stream flows during these months will not be altered from the current condition. Overall, only small amounts of water are diverted or stored by the Project during the low flow period in October and November; therefore, the Project activities have little effect on the hydrograph and spawning period EFH during these months.

Stream flow conditions in tributaries to the lower Clearwater during the fall are typically very low and do not begin to increase from the summer/fall base flow conditions until the onset of fall/winter precipitation. Yet, the greater stream depths required for upstream migration and spawning may only be available when precipitation and associated increases in stream flow allow. Adult salmon will migrate and spawn when these precipitation driven higher stream flows occur (characterized in Section 7.2.3.3, "Migration Behavior in Nearby Basins," in reference to juvenile steelhead). Therefore, access to this habitat during the fall/winter period will be periodic and predominated by opportunities created from rainfall events.

8.4 Mitigation Opportunities

The PA includes the following mitigation opportunities applicable to EFH:

- When Sweetwater or Webb diversion dams are operating, higher minimum stream flows will be provided as compared to historic and existing Project operating conditions.
- The PA will allow for peak stream flows for channel processes and maintenance of habitat.
- The PA will allow for increased minimum springtime stream flows (proposed as steelhead spawning flows) for juvenile salmon outmigration.
- Improved summertime rearing flows on Webb, Sweetwater, and Lapwai creeks will benefit juvenile rearing and migration in the Action Area.
- Spawning gravel replacement downstream from Sweetwater diversion dam will benefit adult salmon that may attempt to spawn naturally.
- The proposed ramping plan will minimize impacts from the Project diversions on salmon habitat and rearing in Sweetwater and Webb creeks.

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Appendix A

Nez Perce Settlement Components

APPENDIX A: NEZ PERCE SETTLEMENT COMPONENTS

A.1 Introduction

The Nez Perce Water Rights Settlement (Nez Perce Tribe et al. 2004) consists of three components, including the Snake River Flow, the Salmon/Clearwater, and the Nez Perce Tribal. Details of the Snake River Flow component are described in Section 1.4 and Appendix C of the *2007 Upper Snake BA* and Chapters 2 and Appendix B of the *2004 Upper Snake BA*. Its elements are incorporated into the PAs that Reclamation is consulting on in this Remand. Information about elements of the other two components that provide potential benefits to ESA-listed anadromous fish is described below.

A.2 Salmon/Clearwater Component

A.2.1 Salmon and Clearwater Habitat Trust Fund

As part of the Settlement, the United States will contribute $38 million (in 2004 dollars) over the course of 5 years, beginning in 2007, for fish and habitat protection projects. The purpose of the fund is to supplement monies otherwise available for habitat protection and restoration in the Salmon River and Clearwater River basins. Congress has appropriated the 2007 dollars; the out-year funding is anticipated to be appropriated on an annual basis.

The fund will be divided into two accounts: one-third of the United States' contribution to the fund will be placed into an account for which the Tribe will develop a process for administration, and the remainder will be placed into an account for the State to implement the Section 6 Cooperative Agreements. The Section 6 Cooperative Agreements are intended to satisfy the requirements of section 7(a) (2) of the ESA. The State will collaborate with the Tribe and the United States to determine how to direct use of the Section 6 account.

The Tribe has not formally dedicated any portion of this funding towards any specific fish or habitat improvement project at this time. The agreement anticipates the State's portion will be used for activities such as riparian fencing, riparian plantings, restoration of large woody debris, improving or protecting flow conditions to augment stream flows, stabilizing sediment sources, and correcting man-made passage barriers such as unscreened diversions, stream crossings, or culverts.

A.2.2 Salmon/Clearwater Minimum Streamflows

As part of the Settlement, implemented in part through the Snake River Water Rights Act of 2004 (Public Law 108-447), the State of Idaho agreed to adopt minimum streamflows in the Salmon River and Clearwater River basins. These basins contain critical spawning and rearing habitat for ESA-listed spring Chinook, steelhead (“A” and “B” run), and fall Chinook salmon. The IWRB now holds in trust for the public, minimum streamflow rights on over 200 rivers, streams, and creeks in the Salmon and Clearwater River basins that the Tribe identified (Tribal Priority Streams) as having important salmon and steelhead spawning and rearing habitat. The intent of establishing minimum streamflows is to ensure these streams are not dewatered to a level that impairs spawning and rearing or other ecological functions that support salmon, steelhead, and the aquatic environment.

The minimum streamflows are subordinated to water rights existing prior to April 1, 2005, and to future domestic, commercial, municipal, and industrial (DCMI) water rights. In issuing any new water rights for future uses that may affect the instream flows, the IDWR will consider the local public interest under Idaho Code Section 42-203(A)5, including but not limited to the protection of fish and wildlife habitat, aquatic life, recreation, aesthetic beauty, transportation and navigation values, and water quality.

The Tribal Priority Streams have been divided into “A” and “B” list groups based on the level of existing use; streams on the “A” list are considered non-developed and streams on the “B” list are considered developed. Tribal Priority Streams have minimum stream flows and future non-DCMI use levels assigned based on land classification, except for streams identified as “Special Areas.” Special Area streams address certain special resource value areas or areas of special concern relative to local uses as agreed to by the Parties to the Settlement. Land classification was established based on the predominant land ownership and, where appropriate, federal land classification existing in a particular stream’s basin.

A.2.2.1 “A” List Tribal Priority Streams

Minimum streamflows were determined based on categories determined by ownership of the lands within the basin. Four ownership categories were identified: State and private, federal non-wilderness, wilderness/Wild and Scenic Rivers, and Special Areas.

For each category, minimum streamflows have been set by month based on estimated hydrology of unimpaired flows, and a reservation for future non-DCMI use equal to a percentage of the minimum monthly median flow value from the estimated hydrology. Minimum streamflows, future allocations, and the floor flow are based on exceedance values. The individual minimum streamflows have been decreed as quantities in cfs as will the future allocation for non-DCMI uses and floor flows. Because these flows are based on estimated flow, the IWRB can, after government to government consultation with the Tribe, change these decreed flows based upon actual flows, if such data become available.

For State and private basins, minimum streamflows have been established for each month of the year at the 50 percent exceedance level of the estimated unimpaired flow, subordinated to a future non-DCMI use in the amount of 25 percent of the lowest median monthly unimpaired flow value.

For federal, non-wilderness basins, minimum streamflows have been decreed for each month of the year at 40 percent exceedance level of the estimated unimpaired flow, subordinated to a future non-DCMI use in the amount of 10 percent of the lowest median monthly unimpaired flow value.

For federal wilderness and Wild and Scenic basins, minimum streamflows have been decreed for each month of the year at the 30 percent exceedance level of the estimated unimpaired flow, subordinated to a future non-DCMI use in the amount of 5 percent of the lowest median monthly unimpaired flow value.

The Special Areas include watersheds that hold special values including high value habitat for fish resources, other special values, and areas where future development opportunities would be preserved. The minimum streamflows and reservations for future non-DCMI use for the special areas differ from the land-based formula described above. Special Areas include:

- **Lower Salmon River below Long Tom Bar to the mouth**: Minimum streamflows for the lower Salmon River downstream of the Wild and Scenic reach are consistent with the existing State application filed for the lower Salmon River below Hammer Creek. The State application for the minimum streamflow in the lower Salmon River addresses the reach from the mouth to Hammer Creek. The minimum streamflows reach in the application will be extended to include the reach of the Salmon below the Little Salmon River.

  The minimum streamflows in the reach between the Little Salmon and designated Wild and Scenic River reach are based on the downstream reach and adjusted for the inflow from the Little Salmon River. The State minimum streamflow is consistent with the Wild and Scenic instream flow for the main Salmon River.

- **South Fork Salmon River and tributaries contained within the Tribal Priority Stream List**: Minimum streamflows are decreed for each month of the year at the 40 percent exceedance level of the estimated unimpaired hydrology, subordinated to a future non-DCMI use in the amount of 5 percent of the lowest median monthly unimpaired flow value.
- **Upper Salmon River Basin**: The upper Salmon River Basin includes a number of tributaries that meet the criteria for “B” list streams. Minimum streamflows established for the tributaries or the mainstem Salmon River are in accord with Wild and Scenic River instream flows and future allocations.
- **Lolo Creek**: Minimum streamflows are decreed for each month of the year at the 40 percent exceedance level of the estimated unimpaired hydrology, subordinated to a future non-DCMI use in the amount of 10 percent of the lowest median monthly unimpaired flow value.
- **Bedrock Creek**: Minimum streamflows are decreed for each month of the year at the 40 percent exceedance level of the estimated unimpaired hydrology, subordinated to a future non-DCMI use in the amount of 10 percent of the lowest median monthly unimpaired flow value.
- **Upper North Fork Clearwater River, Breakfast Creek**: Minimum streamflows are decreed for each month of the year at the 40 percent exceedance level of the estimated unimpaired hydrology, subordinated to a future non-DCMI use in the amount of 10 percent of the lowest median monthly unimpaired flow value.

Future Uses for “A” List streams

The future use allocations will provide water for non-DCMI uses. The Parties will study the overlap of existing uses and future use to determine if additional criteria will assist the Parties in allocating future use. The goal is to avoid reducing streamflows to a level where the unimpaired 80 percent exceedance value is the flow that normally occurs in the stream due to the combination of existing and future use.

A.2.2.2 “B” List Tribal Priority Streams

Minimum streamflows and other non-flow-related actions were developed by the Parties, in conjunction with local stakeholders and communities.

A.2.3 Idaho Forestry Program

The State, NMFS, and the USFWS will enter into a Section 6 cooperative agreement to implement a forest practices program that provides specific stream protection measures, including establishment of riparian no-harvest and restricted-harvest zones, road management measures to reduce delivery of sediment to streams, and culvert replacement requirements to eliminate fish passage barriers. Adaptive management measures, coupled with effectiveness monitoring, will allow for program changes as necessary to achieve the program's objectives. All State forest lands in the Salmon River and Clearwater River basins are currently implementing the program terms; the program will be opened to private enrollment once the cooperative agreement is finalized.

A.2.4. Lemhi River Habitat Improvement Agreements

The State, NMFS and USFWS are currently developing a Section 6 cooperative agreement in conjunction with local water users to establish minimum flows, reconnect tributary streams, and undertake other habitat improvement measures in the Lemhi River Basin. An interim agreement provides for minimum flows on the mainstem of the Lemhi River to address fish passage requirements. Once completed, a similar program will be established on the Pahsimeroi River.

A.3 Nez Perce Tribal Component

As part of the Settlement, the Tribe, in conjunction with an intergovernmental board consisting of the Tribe, USACE, BPA, NMFS, and the State, controls the use of 200,000 af of stored water in Dworshak Reservoir, located on the North Fork Clearwater River on the Reservation.

This water can be used for flow augmentation and temperature control (cooling) in the lower Snake River in August and September. This water is part of the 1.2 million af that is drafted annually for flow augmentation and temperature control. Prior to the Settlement, 1.2 million af was drafted by August 31 of each year. This measure is intended to benefit juvenile and adult fall Chinook and adult steelhead by shaping cool flows into September.

Appendix B

Hydromet Data

APPENDIX B: HYDROMET DATA

This appendix provides available Hydromet data for the following locations in the LOP system:

Stream Flows:

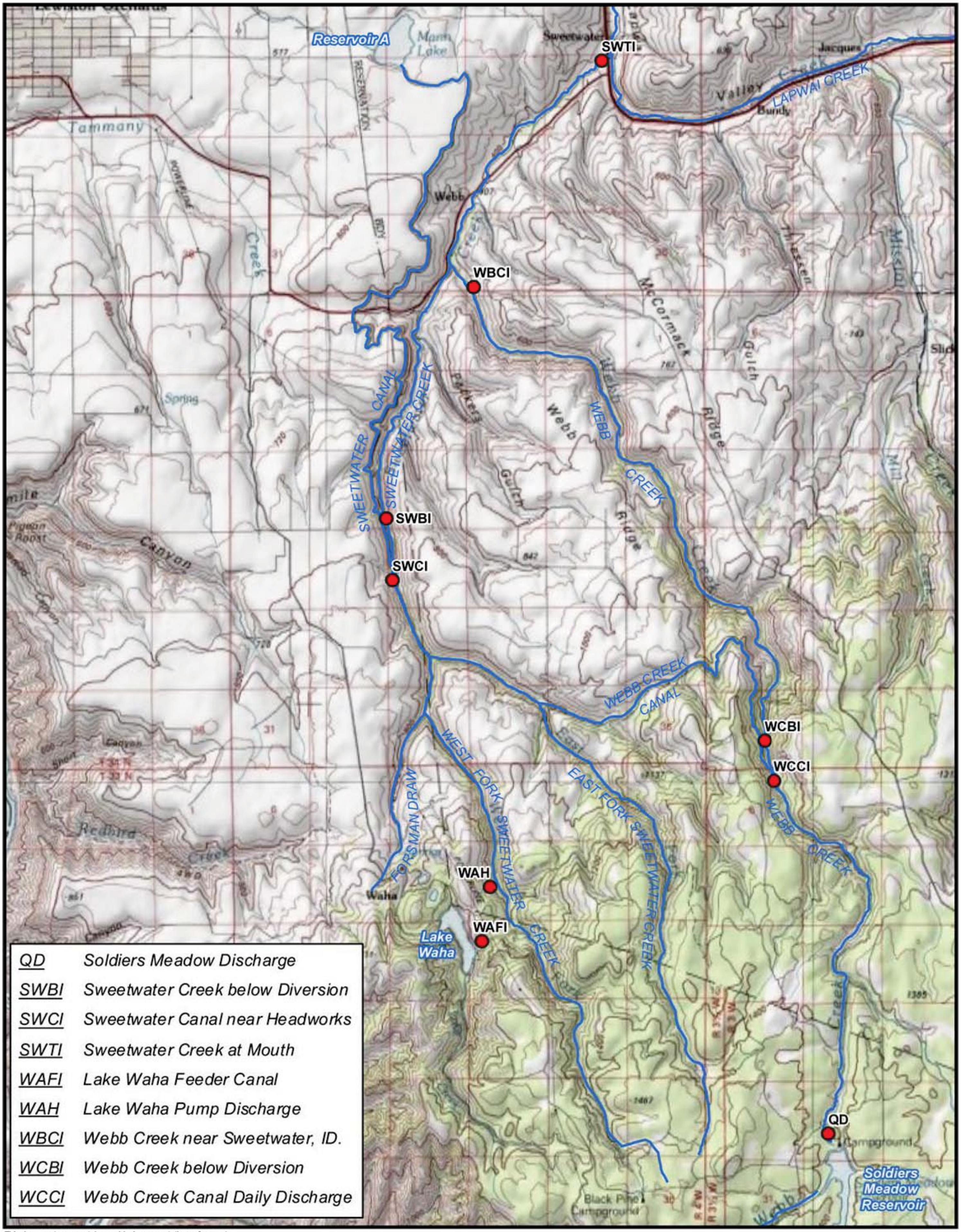
1. Webb Creek Below the Webb Diversion Dam (Period of record: 2002 to 2008)
2. Sweetwater Creek Below the Sweetwater Diversion Dam (Period of record: 2003 to 2008)
3. Sweetwater Creek at the Mouth (Period of record: 2002 to 2008)

Facility Operations:

4. Soldiers Meadow Reservoir Daily Discharge (Period of record: 2000 to 2008)
5. Soldiers Meadow Reservoir Daily Storage and Elevation (Period of record: 2000 to 2008)
6. Lake Waha Daily Storage and Elevation (Period of record: 2000 to 2008)
7. Reservoir A Daily Storage and Elevation (Period of record: 2000 to 2008)
8. Webb Canal Daily Discharge (Period of record: 2003 to 2008)
9. Waha Feeder Canal Daily Discharge (Period of record: 2000 to 2008)
10. Sweetwater Canal Daily Discharge. (Period of record: 2003 to 2008)

In some instances, historic data was unavailable. In those cases, no value was provided in the tables.

The locations of these measurement/data gathering points are illustrated on Figure B-1.



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Date: Sept. 29, 2009

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Lewiston Orchards Project Measurement Locations Figure B-1

1. Webb Creek Below Diversion Dam Daily Discharge Tables (CFS) [WBCI QD]

2002

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1							0.93	0.00	0.01	0.16	0.20	0.56
2							0.79	0.00	0.01	0.18	0.19	0.60
3							0.69	0.00	0.00	0.21	0.19	0.61
4							0.62	0.00	0.00	0.26	0.24	0.65
5							0.58	0.00	0.00	0.32	0.27	0.66
6							0.53	0.00	0.00	0.27	0.26	0.66
7							0.46	0.04	0.00	0.24	0.25	0.70
8							0.57	0.07	0.00	0.22	0.34	0.72
9							0.48	0.06	0.00	0.19	0.51	0.73
10							0.36	0.03	0.00	0.24	0.62	0.76
11							0.29	0.01	0.00	0.39	0.54	0.82
12							0.23	0.00	0.00	0.46	0.51	0.86
13							0.19	0.00	0.00	0.48	0.54	0.84
14							0.18	0.00	0.00	0.43	0.6	0.95
15							0.16	0.00	0.00	0.36	0.62	0.99
16							0.14	0.00	0.00	0.32	0.6	1.00
17							0.11	0.00	0.00	0.30	0.61	1.20
18							0.08	0.00	0.00	0.26	0.66	1.20
19						3.30	0.08	0.00	0.03	0.24	0.76	1.10
20						6.40	0.11	0.00	0.10	0.22	0.82	1.10
21						3.50	0.06	0.00	0.10	0.23	0.69	1.10
22						2.60	0.04	0.00	0.08	0.22	0.62	1
23						2.10	0.02	0.00	0.08	0.23	0.67	1
24						1.80	0.01	0.00	0.08	0.23	0.76	0.71
25						1.60	0.00	0.00	0.08	0.24	0.64	1
26						1.30	0.00	0.03	0.06	0.24	0.61	1
27						1.10	0.00	0.04	0.07	0.25	0.52	1
28						1.00	0.00	0.03	0.07	0.27	0.55	1.10
29						1.70	0.00	0.02	0.10	0.40	0.81	1.20
30						1.30	0.00	0.01	0.13	0.37	0.82	1.20
31							0.00	0.00		0.23		1.20
MIN						1.00	0.00	0.00	0.00	0.16	0.19	0.56
AVG						2.31	0.25	0.01	0.03	0.28	0.54	0.91

Webb Creek Below Diversion Dam Daily Discharge Tables (CFS) [WBCI QD]

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	1.20	60.00	60.00	38.00	26.00	1.70	0.27	0.00	0.00	0.04	0.50	1.30
2	1.30	26.00	26.00	28.00	27.00	1.50	0.26	0.00	0.00	0.04	0.60	1.40
3	1.80	15.00	15.00	22.00	27.00	1.50	0.25	0.00	0.00	0.04	0.57	1.50
4	1.70	9.80	9.80	17.00	34.00	1.40	0.20	0.00	0.00	0.05	0.55	1.50
5	2.00	8.00	8.00	15.00	36.00	1.30	0.17	0.00	0.00	0.06	0.44	1.50
6	2.10	7.10	7.10	12.00	32.00	1.20	0.15	0.00	0.00	0.07	0.48	1.80
7	2.10	6.20	6.20	11.00	31.00	1.10	0.13	0.00	0.00	0.08	0.53	1.60
8	2.00	5.70	5.70	19.00	26.00	1.10	0.15	0.00	0.00	0.09	0.61	1.70
9	1.80	5.20	5.20	22.00	21.00	1.00	0.19	0.00	0.00	0.10	0.57	1.70
10	1.70	4.80	4.80	22.00	18.00	0.97	0.13	0.00	0.00	0.11	0.59	1.70
11	1.70	4.40	4.40	27.00	15.00	0.95	0.07	0.00	0.02	0.12	0.62	1.80
12	1.70	4.20	4.20	28.00	17.00	0.92	0.04	0.00	0.09	0.16	0.67	1.70
13	2.10	4.10	4.10	27.00	16.00	1.00	0.02	0.00	0.09	0.18	0.73	1.80
14	2.50	4.40	4.40	27.00	12.00	1.00	0.02	0.00	0.07	0.20	0.70	2.30
15	4.20	4.10	4.10	27.00	9.50	0.95	0.02	0.00	0.06	0.22	0.72	1.80
16	3.90	4.60	4.60	27.00	6.60	0.87	0.01	0.00	0.06	0.24	0.76	1.60
17	3.40	4.90	4.90	26.00	5.20	0.79	0.00	0.00	0.05	0.27	0.89	1.60
18	2.90	5.40	5.40	25.00	4.40	0.73	0.00	0.00	0.09	0.28	0.89	1.50
19	2.40	5.80	5.80	21.00	3.90	0.82	0.00	0.00	0.14	0.26	0.86	1.40
20	2.30	5.80	5.80	20.00	3.50	0.99	0.00	0.00	0.13	0.27	0.91	1.40
21	2.40	5.60	5.60	18.00	3.10	0.94	0.00	0.00	0.10	0.27	0.91	1.50
22	2.80	6.10	6.10	14.00	2.80	0.84	0.00	0.00	0.08	0.26	0.90	1.50
23	4.10	6.20	6.20	12.00	2.60	0.78	0.00	0.00	0.09	0.26	0.92	1.40
24	6.40	4.70	4.70	10.00	2.50	0.72	0.00	0.00	0.11	0.22	1.10	1.30
25	5.60	5.00	5.00	12.00	2.50	0.63	0.00	0.00	0.10	0.25	1.20	1.70
26	20.00	5.80	5.80	15.00	2.60	0.54	0.00	0.00	0.09	0.27	1.10	1.70
27	32.00	5.70	5.70	22.00	2.30	0.45	0.00	0.00	0.07	0.27	1.20	1.40
28	14.00	5.10	5.10	23.00	2.10	0.38	0.00	0.00	0.05	0.32	1.20	1.40
29	9.50		9.80	22.00	1.90	0.34	0.00	0.00	0.03	0.34	1.60	1.30
30	16.00		12.00	26.00	2.00	0.28	0.00	0.00	0.03	0.35	1.30	0.70
31	29.00		22.00		1.90		0.00	0.00		0.45		1.30
MIN	1.20	4.10	4.10	10.00	1.90	0.28	0.00	0.00	0.02	0.04	0.44	0.70
AVG	6.02	8.56	9.15	21.17	12.82	0.92	0.07	0.00	0.05	0.20	0.82	1.54

Webb Creek Below Diversion Dam Daily Discharge Tables (CFS) [WBCI QD]

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	1.40	2.90	4.70	1.40	0.81	11.00	0.60	0.00	0.09	0.16	0.49	2.90
2	1.30	3.00	4.50	1.30	0.75	6.90	0.50	0.00	0.07	0.16	0.51	2.70
3	1.20	2.70	4.10	1.20	0.71	5.10	0.43	0.00	0.05	0.17	0.96	2.50
4	0.99	2.50	4.30	1.10	0.67	4.00	0.38	0.00	0.06	0.18	0.87	2.40
5	0.84	2.40	4.00	1.00	0.62	3.30	0.34	0.00	0.08	0.19	0.74	2.30
6	0.87	2.30	3.80	0.98	0.56	4.40	0.30	0.00	0.08	0.19	0.67	1.90
7	1.10	2.20	3.60	0.93	0.52	3.30	0.26	0.00	0.07	0.19	0.67	1.60
8	1.20	2.10	4.20	0.88	0.51	8.90	0.24	0.01	0.06	0.20	0.83	1.60
9	1.30	2.20	3.70	0.87	0.49	5.80	0.21	0.05	0.05	0.26	0.93	1.60
10	1.30	2.10	3.30	0.84	0.54	4.50	0.22	0.06	0.04	0.40	1.00	1.80
11	1.20	2.00	2.90	0.81	1.80	3.80	0.30	0.03	0.03	0.36	1.10	11.00
12	1.20	1.70	2.60	0.80	2.00	3.30	0.22	0.01	0.03	0.34	1.10	10.00
13	1.30	1.80	2.50	0.76	1.90	2.90	0.16	0.00	0.06	0.32	1.20	5.60
14	1.30	2.40	2.40	0.78	1.70	3.20	0.13	0.00	0.13	0.31	1.20	5.10
15	1.40	2.20	2.30	1.10	1.60	2.80	0.09	0.00	0.17	0.31	1.20	5.90
16	1.70	2.10	2.30	0.96	2.60	2.70	0.06	0.00	0.22	0.30	1.20	4.40
17	1.60	2.30	2.20	0.89	2.90	2.40	0.05	0.00	0.26	0.32	1.20	4.00
18	1.60	3.00	2.30	0.95	2.80	2.20	0.04	0.00	0.35	0.69	1.30	3.40
19	1.50	5.50	3.80	1.00	13.00	2.10	0.04	0.00	0.42	0.60	1.30	3.30
20	1.40	6.60	2.70	1.10	12.00	2.00	0.07	0.00	0.35	0.50	1.30	2.80
21	1.30	5.80	2.30	1.10	12.00	1.70	0.13	0.00	0.30	0.50	1.30	2.30
22	1.10	5.30	2.20	1.20	9.30	1.50	0.29	0.00	0.27	0.53	1.40	2.00
23	1.30	5.10	2.40	1.10	10.00	1.20	0.27	0.00	0.24	0.56	1.40	1.70
24	1.30	5.10	2.40	1.00	12.00	1.10	0.19	0.00	0.22	0.57	1.50	1.50
25	1.20	5.30	2.20	1.00	6.80	0.93	0.13	0.03	0.21	0.53	7.60	1.60
26	1.20	5.10	2.00	1.00	5.60	0.82	0.07	0.30	0.20	0.49	10.00	1.80
27	1.20	5.30	1.70	0.93	8.00	0.82	0.04	0.30	0.19	0.46	4.90	1.30
28	1.30	5.30	1.60	0.99	25.00	0.75	0.02	0.23	0.18	0.46	3.60	0.92
29	1.80	5.00	1.50	0.95	36.00	0.75	0.00	0.17	0.16	0.45	3.20	1.60
30	2.20		1.40	0.87	26.00	0.62	0.00	0.13	0.16	0.46	2.70	1.50
31	2.70		1.60		18.00		0.00	0.11		0.46		1.50
MIN	0.84	2.10	1.40	0.76	0.49	0.62	0.00	0.00	0.03	0.16	0.49	0.92
AVG	1.36	3.49	2.82	0.99	7.01	3.16	0.19	0.05	0.16	0.38	1.91	3.05

Webb Creek Below Diversion Dam Daily Discharge Tables (CFS) [WBCI QD]

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	1.30	3.30	1.80	1.00	1.60	2.50	0.57	0.00	0.00	0.06	0.62	1.10
2	1.20	3.10	1.40	1.00	1.40	2.40	0.49	0.00	0.00	0.11	0.55	1.10
3	1.10	3.10	1.20	1.20	1.30	2.20	0.45	0.00	0.00	0.23	0.53	1.10
4	0.85	3.00	1.00	1.60	1.30	2.00	0.41	0.00	0.00	0.24	0.58	1.10
5	0.67	2.90	0.98	1.70	1.20	2.20	0.37	0.00	0.00	0.24	0.6	1.20
6	0.77	2.40	0.93	1.80	1.70	2.00	0.31	0.00	0.00	0.23	0.64	1.10
7	1.50	2.30	0.89	1.80	1.90	1.80	0.29	0.00	0.00	0.22	0.69	0.64
8	1.20	2.00	0.88	1.80	1.60	1.60	0.26	0.00	0.00	0.22	0.77	0.52
9	1.10	1.80	0.83	1.70	1.60	1.40	0.36	0.00	0.00	0.22	0.73	0.83
10	1.00	1.80	0.74	1.60	2.90	1.20	0.50	0.00	0.00	0.20	0.77	1.00
11	0.99	1.90	0.65	1.60	4.80	1.10	0.44	0.00	0.00	0.20	0.80	1.00
12	1.00	2.40	0.65	2.20	4.10	1.10	0.35	0.00	0.00	0.23	0.79	0.92
13	1.00	2.60	0.61	2.60	3.50	1.00	0.29	0.00	0.01	0.24	0.73	0.87
14	0.96	2.40	0.59	2.50	3.20	0.95	0.24	0.00	0.03	0.24	0.81	0.96
15	0.64	1.70	0.58	2.40	3.10	0.89	0.20	0.00	0.05	0.24	0.83	1.20
16	0.95	1.20	0.60	2.50	5.00	0.85	0.15	0.00	0.05	0.22	0.87	1.10
17	1.10	1.50	0.64	5.30	28.00	1.00	0.13	0.00	0.06	0.20	0.87	1.00
18	5.50	1.60	0.61	6.00	17.00	1.40	0.12	0.00	0.06	0.19	0.85	0.76
19	14.00	2.00	0.60	4.70	11.00	1.10	0.09	0.00	0.07	0.20	0.81	0.68
20	9.00	1.90	0.56	4.10	8.00	0.85	0.06	0.00	0.07	0.23	0.81	1.10
21	7.20	1.70	0.61	3.60	7.90	0.74	0.04	0.00	0.06	0.25	0.86	1.50
22	6.30	1.50	0.55	3.20	9.40	0.64	0.03	0.00	0.04	0.27	0.88	2.10
23	5.90	1.50	0.61	2.90	15.00	0.61	0.02	0.00	0.04	0.27	0.88	2.70
24	5.10	1.50	0.63	2.70	10.00	0.57	0.01	0.00	0.04	0.28	0.88	3.60
25	4.70	1.50	0.59	2.50	7.00	0.54	0.01	0.00	0.03	0.29	0.88	5.10
26	4.40	1.60	0.65	2.20	5.60	0.49	0.01	0.00	0.04	0.28	0.93	5.80
27	4.20	1.70	0.74	2.10	4.70	0.76	0.00	0.00	0.05	0.33	0.93	5.50
28	4.10	1.90	1.10	2.00	4.00	1.00	0.00	0.00	0.05	0.36	0.81	4.70
29	3.80		1.20	1.80	3.40	0.85	0.00	0.00	0.05	0.38	1.20	8.70
30	3.60		1.00	1.70	3.00	0.68	0.00	0.00	0.04	0.39	1.10	5.10
31	3.40		1.00		2.70		0.00	0.00		0.42		5.10
MIN	0.67	1.50	0.55	1.00	1.20	0.49	0.00	0.00	0.00	0.11	0.53	0.52
AVG	3.18	2.06	0.82	2.46	5.71	1.21	0.20	0.00	0.03	0.25	0.80	2.23

Webb Creek Below Diversion Dam Daily Discharge Tables (CFS) [WBCI QD]

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	8.20	3.60	5.80	11.00	2.70	0.61	0.40	0.00	0.00	0.00	0.16	3.40
2	7.20	3.50	5.80	7.70	2.50	0.66	0.40	0.00	0.00	0.00	0.17	3.00
3	5.40	3.40	5.30	7.80	2.20	0.82	0.34	0.00	0.00	0.00	0.21	2.50
4	4.70	3.40	2.80	21.00	2.00	1.00	0.33	0.00	0.00	0.01	0.24	2.80
5	4.10	3.50	1.90	46.00	1.90	1.00	0.34	0.00	0.00	0.01	0.30	2.80
6	3.80	3.40	1.70	78.00	1.80	0.81	0.36	0.00	0.00	0.02	0.63	2.70
7	4.00	3.40	1.60	60.00	1.80	0.72	0.40	0.00	0.00	0.03	1.30	2.60
8	4.50	3.20	1.40	55.00	1.70	0.84	0.32	0.00	0.00	0.04	4.50	2.60
9	3.80	3.10	1.30	45.00	1.60	0.79	0.24	0.00	0.00	0.04	3.10	2.90
10	4.00	2.60	1.20	37.00	1.40	0.74	0.19	0.00	0.00	0.05	2.10	3.30
11	5.60	2.20	1.20	38.00	1.30	0.68	0.44	0.00	0.00	0.06	1.90	3.70
12	6.50	2.60	1.10	31.00	1.20	0.63	0.96	0.00	0.00	0.06	1.90	3.80
13	6.40	2.70	1.10	47.00	1.20	0.59	0.73	0.00	0.00	0.07	1.90	5.70
14	7.90	2.20	1.10	44.00	1.10	0.81	0.55	0.00	0.00	0.07	2.20	9.80
15	8.50	1.30	1.10	51.00	1.00	0.70	0.41	0.00	0.00	0.08	2.10	14.00
16	7.00	1.90	0.98	48.00	0.94	0.60	0.33	0.00	0.00	0.09	2.20	11.00
17	6.90	1.10	1.00	37.00	0.85	0.58	0.26	0.00	0.00	0.11	3.10	6.90
18	6.50	0.82	1.00	29.00	0.79	0.52	0.20	0.00	0.00	0.12	2.90	4.00
19	6.20	1.20	0.96	28.00	0.77	0.49	0.15	0.00	0.00	0.13	2.50	4.40
20	5.70	1.70	0.95	33.00	1.10	0.45	0.07	0.00	0.00	0.14	4.10	4.70
21	5.40	2.10	0.95	28.00	0.95	0.41	0.03	0.00	0.00	0.16	5.40	4.40
22	4.90	1.90	0.95	23.00	1.10	0.36	0.02	0.00	0.00	0.16	5.70	3.50
23	4.70	1.70	0.95	17.00	0.93	0.33	0.00	0.00	0.00	0.15	5.40	3.10
24	4.20	1.50	0.97	12.00	0.79	0.30	0.00	0.00	0.00	0.16	4.90	2.80
25	4.00	1.40	1.30	8.70	0.87	0.26	0.00	0.00	0.03	0.15	4.60	3.00
26	3.80	1.60	3.00	6.60	1.10	0.21	0.00	0.00	0.03	0.15	3.70	3.20
27	3.60	1.70	2.80	4.70	0.96	0.18	0.00	0.00	0.02	0.16	4.50	3.40
28	3.40	2.50	2.80	3.90	0.87	0.14	0.00	0.00	0.01	0.16	3.20	2.90
29	3.30		2.80	3.20	0.81	0.28	0.00	0.00	0.01	0.17	2.50	2.00
30	3.30		2.80	3.00	0.72	0.44	0.00	0.00	0.01	0.17	3.70	2.50
31	3.40		3.20		0.65	0.65	0.00	0.00		0.16		2.80
MIN	3.30	1.20	0.95	3.00	0.65	0.14	0.00	0.00	0.00	0.01	0.16	2.00
AVG	5.19	2.33	1.99	28.82	1.28	0.57	0.24	0.00	0.004	0.09	2.70	4.20

Webb Creek Below Diversion Dam Daily Discharge Tables (CFS) [WBCI QD]

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	2.50	1.60	6.80	11.00	2.10	0.38	0.05	0.00	0.00	0.00	0.13	1.00
2	2.40	1.50	5.40	6.50	2.40	0.34	0.05	0.00	0.00	0.00	0.14	1.00
3	2.50	1.50	6.80	5.00	2.30	0.29	0.03	0.00	0.00	0.00	0.15	1.20
4	2.60	1.60	6.20	4.40	2.10	0.25	0.01	0.00	0.00	0.00	0.16	1.40
5	2.40	1.70	6.60	3.90	1.90	0.38	0.00	0.00	0.00	0.00	0.15	2.00
.6	2.30	2.10	8.10	3.40	1.80	0.53	0.00	0.00	0.00	0.00	0.16	2.60
7	2.30	2.80	12.00	3.10	1.70	0.49	0.00	0.00	0.00	0.00	0.18	2.40
8	2.40	3.50	18.00	2.90	1.60	0.42	0.00	0.00	0.00	0.01	0.18	2.10
9	2.40	4.30	19.00	3.90	1.50	0.33	0.00	0.00	0.00	0.02	0.18	1.90
10	2.50	5.40	20.00	3.60	1.40	0.62	0.00	0.00	0.00	0.02	0.18	1.80
11	1.90	6.20	30.00	3.10	1.20	0.68	0.00	0.00	0.00	0.01	0.21	1.20
12	0.65	9.40	50.00	2.90	1.10	0.51	0.00	0.00	0.00	0.01	0.22	1.80
13	0.75	8.60	58.00	2.70	1.10	0.45	0.00	0.00	0.00	0.02	0.23	1.60
14	1.20	7.90	40.00	2.60	1.00	0.40	0.00	0.00	0.00	0.03	0.25	1.50
15	1.90	8.30	30.00	2.90	0.93	0.31	0.00	0.00	0.00	0.03	0.29	1.50
16	2.00	15.00	26.00	2.70	0.85	0.27	0.00	0.00	0.00	0.04	0.34	1.40
17	2.10	17.00	27.00	6.20	0.79	0.26	0.00	0.00	0.00	0.04	0.57	1.40
18	2.20	20.00	26.00	7.40	0.75	0.24	0.00	0.00	0.00	0.08	0.84	1.40
19	2.20	16.00	23.00	6.50	0.73	0.18	0.00	0.00	0.00	0.11	1.30	1.40
20	2.10	14.00	27.00	5.10	0.75	0.15	0.00	0.00	0.00	0.12	1.20	1.40
21	2.00	13.00	21.00	4.30	1.00	0.12	0.00	0.00	0.00	0.12	1.10	1.30
22	1.90	11.00	19.00	3.90	1.10	0.09	0.00	0.00	0.00	0.12	1.10	1.20
23	2.00	10.00	21.00	3.70	0.86	0.07	0.00	0.00	0.00	0.11	1.10	1.30
24	1.90	9.30	17.00	3.40	0.75	0.06	0.00	0.00	0.00	0.10	0.86	1.50
25	1.90	8.90	30.00	3.30	0.66	0.06	0.00	0.00	0.00	0.10	1.10	1.30
26	1.80	8.50	47.00	3.00	0.61	0.08	0.00	0.00	0.00	0.10	0.99	1.30
27	1.70	7.80	35.00	2.80	0.63	0.07	0.00	0.00	0.00	0.11	1.10	1.30
28	1.70	7.50	26.00	2.60	0.66	0.05	0.00	0.00	0.00	0.12	1.00	1.30
29	1.70		17.00	2.50	0.60	0.03	0.00	0.00	0.00	0.14	1.00	1.30
30	1.70		12.00	2.40	0.49	0.02	0.00	0.00	0.00	0.14	1.00	1.30
31	1.60		9.10		0.43		0.00	0.00		0.13		1.10
MIN	0.65	1.50	5.40	2.40	0.43	0.02	0.00	0.00	0.00	0.00	0.13	1.10
AVG	1.97	8.01	22.58	4.06	1.15	0.27	0.01	0.00	0.00	0.06	0.58	1.49

Webb Creek Below Diversion Dam Daily Discharge Tables (CFS) [WBCI QD]

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.63	1.30	5.80	6.50	122.02	2.50	0.38	0.00	0.00	0.00	0.50	2.73
2	1.20	1.30	6.00	6.30	89.81	6.50	0.35	0.00	0.00	0.00	0.46	1.69
3	1.50	1.30	5.70	6.10	142.31	13.00	0.28	0.00	0.00	0.00	0.77	2.18
4	1.40	1.30	5.70	6.40	211.83	25.00	0.23	0.00	0.00	0.00	0.85	2.37
5	1.40	1.30	5.50	6.40	69.88	20.00	0.22	0.00	0.00	0.00	1.02	1.70
6	1.30	1.30	5.20	6.60	52.00	24.00	0.18	0.00	0.00	0.00	1.01	1.29
7	1.30	1.50	5.10	7.10	49.00	25.00	0.15	0.00	0.00	0.03	1.21	1.35
8	1.30	1.60	5.10	7.80	37.23	22.00	0.12	0.00	0.00	0.04	1.34	1.63
9	1.40	2.00	5.20	9.40	34.00	19.00	0.10	0.00	0.00	0.05	1.58	1.40
10	1.40	2.20	5.60	9.40	26.00	20.00	0.07	0.00	0.00	0.05	1.72	1.31
11	1.40	2.30	7.10	9.80	21.00	25.00	0.05	0.00	0.00	0.06	1.95	1.18
12	1.40	2.60	9.60	12.00	17.00	23.00	0.03	0.00	0.00	0.20	2.76	1.14
13	1.40	2.80	11.00	25.00	13.00	17.00	0.02	0.00	0.00	0.68	8.23	1.17
14	1.30	2.90	10.00	48.00	17.00	8.10	0.01	0.00	0.00	0.62	7.69	0.50
15	1.20	2.70	9.30	41.00	12.00	4.90	0.00	0.00	0.00	0.59	5.05	0.39
16	0.65	2.70	8.90	35.00	9.60	3.60	0.00	0.00	0.00	0.57	3.92	0.38
17	1.27	2.60	8.40	31.00	6.80	2.80	0.00	0.00	0.00	0.55	3.28	0.36
18	1.43	2.60	8.20	28.00	3.90	2.30	0.00	0.00	0.00	0.56	3.00	0.54
19	1.36	2.60	9.50	31.00	2.60	1.90	0.00	0.00	0.00	0.56	2.82	0.86
20	1.39	2.60	9.70	20.00	2.50	1.70	0.00	0.00	0.00	0.57	2.41	0.81
21	0.61	2.60	9.80	13.00	4.70	1.50	0.00	0.00	0.00	3.06	2.60	0.74
22	0.55	2.60	9.30	8.80	2.30	1.50	0.00	0.00	0.00	5.44	2.44	0.79
23	0.71	2.70	9.40	12.00	1.90	1.30	0.00	0.00	0.00	2.61	2.32	0.74
24	1.14	2.80	9.90	12.00	2.90	1.10	0.00	0.00	0.00	1.70	2.23	0.70
25	1.23	3.10	9.60	12.00	4.30	1.00	0.00	0.00	0.00	1.29	1.98	0.69
26	1.22	3.30	9.40	13.00	2.60	0.86	0.00	0.00	0.00	0.90	1.86	0.64
27	1.37	3.30	9.20	28.00	1.70	0.74	0.00	0.00	0.00	0.78	1.74	0.76
28	1.36	3.70	8.50	56.98	1.40	0.62	0.00	0.00	0.00	0.68	1.72	1.37
29	1.27	4.20	8.10	100.00	2.90	0.49	0.00	0.00	0.00	0.66	2.20	2.42
30	1.18		7.50	219.81	2.20	0.39	0.00	0.00	0.00	0.60	2.26	2.18
31	1.30		7.10		1.50		0.00	0.00		0.52		1.99
MIN	0.55	1.30	5.10	6.10	1.40	0.39	0.00	0.00	0.00	0.00	0.46	0.36
AVG	1.21	2.41	7.88	27.61	31.22	9.23	0.07	0.00	0.00	0.75	2.43	1.23

2. Sweetwater Creek Below Diversion Daily Discharge Tables (CFS) {SWBI QD}

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	2.60	115.00	1.60	79.00	52.00	13.00	0.08	0.02	0.02	0.00	2.80	3.30
2	2.60	75.00	0.60	84.00	52.00	15.00	0.13	0.02	0.01	0.00	2.80	3.40
3	3.30	66.00	0.65	71.00	63.00	15.00	0.07	0.03	0.02	0.00	2.80	3.60
4	3.50	55.00	0.32	60.00	67.00	5.40	0.07	0.03	0.01	0.00	2.70	3.10
5	4.10	43.00	0.31	56.00	63.00	0.10	0.04	0.03	0.01	0.00	2.60	3.00
6	3.50	32.00	0.35	51.00	68.00	0.03	0.09	0.03	0.01	0.00	2.60	4.30
7	3.20	27.00	2.40	48.00	66.00	0.02	0.05	0.02	0.02	0.00	2.60	4.10
8	2.80	25.00	4.80	46.00	58.00	0.02	0.06	0.03	0.09	0.00	2.80	3.40
9	2.70	22.00	9.20	48.00	53.00	0.02	0.07	0.02	0.03	0.01	2.80	3.00
10	2.60	15.00	17.00	50.00	49.00	0.02	0.07	0.01	0.02	0.01	3.10	3.00
11	2.70	7.30	33.00	57.00	47.00	0.03	0.06	0.01	0.01	0.02	3.20	2.80
12	2.80	4.10	62.00	63.00	53.00	0.03	0.04	0.01	0.01	0.01	3.00	2.80
13	4.60	3.20	85.00	63.00	49.00	0.07	0.05	0.04	0.01	0.01	2.90	2.90
14	5.20	3.30	84.00	59.00	47.00	0.15	0.04	0.01	0.01	0.01	2.80	3.60
15	5.10	2.50	87.00	54.00	46.00	0.05	0.04	0.01	0.01	0.01	2.80	2.80
16	4.20	3.70	70.00	51.00	43.00	0.04	0.04	0.07	0.01	0.01	3.10	2.60
17	3.60	3.30	60.00	48.00	39.00	0.04	0.05	0.09	0.01	0.01	3.10	2.60
18	3.20	4.30	49.00	46.00	38.00	0.05	0.08	0.10	0.00	0.01	2.80	2.30
19	3.10	3.90	40.00	42.00	27.00	0.09	0.03	0.11	0.01	0.01	2.90	2.50
20	2.90	3.90	35.00	40.00	19.00	0.11	0.02	0.13	0.00	0.01	2.90	2.70
21	3.10	3.80	34.00	40.00	15.00	0.12	0.02	0.16	0.00	0.01	2.60	2.90
22	3.80	5.40	54.00	40.00	10.00	0.06	0.01	0.33	0.00	0.01	2.30	2.80
23	5.60	4.40	70.00	43.00	8.00	0.03	0.00	0.68	0.00	0.01	2.30	2.60
24	5.60	10.00	73.00	40.00	6.50	0.02	0.01	0.19	0.00	0.01	2.30	2.80
25	6.10	17.00	71.00	34.00	11.00	0.01	0.17	0.06	0.00	0.01	2.30	3.00
26	17.00	17.00	64.00	38.00	13.00	0.00	0.54	0.04	0.00	0.01	2.40	2.90
27	41.00	11.00	55.00	41.00	7.30	0.05	0.06	0.02	0.00	0.02	2.40	2.50
28	15.00	4.00	52.00	43.00	6.20	0.05	0.05	0.02	0.01	0.02	2.40	2.50
29	18.00		48.00	47.00	9.60	0.10	0.04	0.02	0.01	1.30	3.20	2.50
30	50.00		47.00	54.00	11.00	0.09	0.04	0.02	0.01	3.00	3.30	2.30
31	85.00		56.00		10.00		0.03	0.02		2.80		2.50
MIN	2.60	4.00	0.31	34.00	6.20	0.00	0.00	0.01	0.00	0.00	2.30	2.30
AVG	10.27	20.97	40.85	51.20	35.70	1.66	0.07	0.08	0.01	0.24	2.75	2.94

Sweetwater Creek Below Diversion Daily Discharge Tables (CFS) {SWBI QD}

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	2.50	6.10	0.12	0.03	0.00	57.00	0.00	0.03	0.42	0.13	5.10	4.70
2	2.50	5.40	0.10	0.02	0.00	48.00	0.00	0.03	0.29	0.13	5.70	4.30
3	2.50	5.10	0.08	0.01	0.00	39.00	0.00	0.04	1.00	0.13	8.60	4.10
4	2.00	4.90	0.07	0.01	0.00	27.00	0.00	0.05	1.50	0.13	6.20	4.10
5	1.80	4.40	0.06	0.02	0.00	15.00	0.20	0.04	1.40	0.14	5.50	4.00
6	2.00	4.20	0.06	0.03	0.00	25.00	0.61	0.04	1.30	0.16	4.70	3.90
7	2.30	4.10	0.06	0.01	0.01	11.00	0.00	0.04	1.20	0.21	4.90	3.90
8	2.50	3.90	0.88	0.00	0.01	25.00	0.00	0.02	1.10	0.24	4.90	4.50
9	2.60	3.60	3.60	0.00	0.01	24.00	0.00	0.02	1.70	0.19	4.70	4.30
10	2.80	3.50	5.40	0.00	0.04	35.00	0.00	0.01	2.10	0.20	4.60	5.80
11	2.60	3.00	5.60	0.00	7.30	39.00	0.97	0.02	2.30	0.21	4.60	10.00
12	2.50	3.00	5.20	0.00	6.30	34.00	0.72	0.71	2.90	0.22	4.40	9.90
13	2.70	3.50	6.10	0.00	10.00	30.00	0.01	1.20	2.80	0.23	4.20	8.90
14	2.70	3.80	4.70	0.00	14.00	19.00	0.03	0.75	3.40	0.23	3.90	8.60
15	2.90	3.60	5.90	0.02	8.20	6.30	0.02	0.82	3.30	0.22	3.80	8.90
16	3.40	3.40	7.10	0.02	23.00	0.91	0.01	0.66	3.00	0.21	3.70	7.90
17	3.20	4.00	10.00	0.00	24.00	0.00	0.01	0.63	2.30	0.25	3.70	7.30
18	3.00	6.60	13.00	0.01	20.00	0.00	0.00	0.61	3.30	0.26	3.80	6.90
19	3.10	8.60	14.00	0.01	49.00	0.00	0.08	1.40	2.90	0.24	3.60	6.40
20	3.00	8.40	10.00	0.02	53.00	0.00	1.20	0.44	2.50	0.24	3.50	6.00
21	3.20	7.90	9.80	0.01	51.00	3.60	0.04	0.81	2.00	6.20	3.40	5.20
22	2.90	7.40	9.60	0.00	50.00	3.20	0.03	2.50	5.70	13.00	3.40	5.20
23	3.10	7.20	8.90	0.00	52.00	0.00	0.03	3.10	8.80	9.50	3.40	5.00
24	3.10	3.50	8.10	0.00	53.00	0.00	0.02	0.18	8.50	7.40	5.10	5.00
25	3.00	0.15	5.50	0.00	40.00	0.00	0.02	2.90	8.90	6.40	13.00	4.90
26	2.90	0.15	6.50	0.00	35.00	0.00	0.02	1.80	5.40	6.10	9.00	4.60
27	2.80	0.15	4.50	0.00	35.00	0.00	0.04	0.68	0.48	5.90	6.60	4.10
28	3.20	0.13	1.30	0.00	70.00	0.00	0.05	0.46	0.28	5.60	5.70	4.00
29	5.50	0.13	0.04	0.00	103.00	0.00	0.04	0.13	0.30	5.40	4.40	4.40
30	7.20		0.03	0.00	71.00	0.00	0.04	0.65	0.21	5.20	5.10	4.30
31	6.80		0.80		65.00		0.03	0.86		5.30		4.20
MIN	1.80	0.13	0.03	0.00	0.00	0.00	0.00	0.01	0.21	0.13	3.40	3.90
AVG	3.11	4.13	4.75	0.01	27.09	14.73	0.14	0.70	2.71	2.58	5.11	5.65

Sweetwater Creek Below Diversion Daily Discharge Tables (CFS) {SWBI QD}

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	4.00	3.90	0.44	0.06	11.00	1.60	0.04	0.9	0.85	3.40	0.01	1.80
2	3.70	3.90	0.33	0.07	4.40	1.40	0.08	0.85	0.73	1.80	1.60	1.80
3	3.10	3.70	0.26	0.16	0.24	11.00	0.07	0.80	0.69	1.10	2.60	2.50
4	3.00	3.60	0.22	0.99	0.19	16.00	0.11	0.68	0.70	0.68	2.50	2.10
5	2.80	3.30	0.19	1.10	0.16	17.00	0.12	0.59	0.25	0.09	2.40	2.30
6	2.80	3.00	0.18	1.00	13.00	7.80	2.00	0.53	0.16	0.25	2.30	2.00
7	3.00	2.80	0.17	0.35	21.00	0.25	0.34	0.43	0.43	0.34	2.60	1.60
8	3.10	2.90	0.16	1.40	17.00	0.17	0.14	0.77	0.75	0.52	2.60	1.30
9	3.00	2.90	0.16	0.13	7.80	0.06	0.08	1.00	0.37	0.46	2.40	1.80
10	3.00	2.90	0.22	0.08	26.00	0.02	0.09	0.94	0.85	0.41	2.30	2.00
11	3.00	2.90	0.14	0.09	40.00	0.02	0.09	0.86	1.20	0.70	2.50	2.00
12	3.00	3.50	0.12	0.54	33.00	0.02	0.16	0.81	1.20	0.81	2.50	1.80
13	2.90	3.70	0.11	0.96	28.00	0.01	0.16	0.71	1.30	0.89	2.30	1.70
14	2.80	3.00	0.12	0.78	25.00	0.00	0.21	0.78	1.00	0.97	2.30	1.90
15	2.70	2.60	0.15	2.20	28.00	0.02	0.44	2.10	0.77	0.92	2.20	2.20
16	2.70	2.40	0.17	2.40	52.00	0.02	0.42	1.30	0.74	0.42	2.20	2.10
17	3.00	1.60	0.17	37.00	68.00	0.04	0.28	0.54	0.71	0.01	2.20	1.90
18	9.40	1.80	0.22	42.00	52.00	0.04	0.16	1.00	0.75	0.01	2.10	1.70
19	12.00	2.80	0.31	34.00	50.00	0.03	0.16	1.30	1.50	0.00	2.00	1.50
20	11.00	2.90	0.82	26.00	51.00	0.03	0.05	1.20	4.70	0.05	2.00	1.90
21	9.50	2.80	0.07	21.00	46.00	0.09	0.78	1.10	0.99	0.00	2.00	2.20
22	7.20	2.60	0.07	23.00	50.00	0.10	1.10	1.00	0.43	0.00	1.90	2.70
23	6.80	2.40	0.10	24.00	51.00	0.10	0.84	0.9	0.96	0.26	1.90	3.30
24	6.20	2.60	0.09	22.00	44.00	0.08	0.58	0.84	0.94	0.00	1.80	4.00
25	5.70	2.60	0.09	8.10	31.00	0.06	0.05	0.82	0.79	0.00	1.80	5.00
26	5.40	2.70	0.09	0.24	24.00	0.11	0.16	0.78	0.64	0.00	1.80	5.50
27	5.20	2.70	0.78	0.19	22.00	0.11	2.60	0.63	0.88	0.00	1.80	5.10
28	5.00	1.50	7.50	0.15	20.00	0.07	0.96	0.57	0.80	0.00	1.80	5.20
29	4.60		0.37	8.00	16.00	0.06	0.94	0.52	0.79	0.00	1.90	6.70
30	4.30		0.09	12.00	9.10	0.03	0.90	1.10	1.20	0.00	1.80	5.10
31	3.80		0.14		2.20			1.20		0.01		6.30
MIN	2.70	1.60	0.09	0.06	0.19	0.00	0.04	0.43	0.16	0.00	0.01	1.30
AVG	4.76	2.86	0.45	9.00	27.20	1.88	0.47	0.89	0.94	0.45	2.07	2.87

Sweetwater Creek Below Diversion Daily Discharge Tables (CFS) {SWBI QD}

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	8.20	4.50	5.20	14.00	13.00	0.56	0.98	0.50	0.57	0.64	1.70	3.60
2	6.20	4.50	70.00	12.00	3.40	2.50	0.93	0.45	0.42	0.59	1.80	2.80
3	5.20	4.50	10.00	14.00	31.00	3.50	0.40	0.39	0.27	0.52	1.90	2.40
4	4.60	4.60	9.10	24.00	32.00	8.80	0.91	0.33	0.19	0.63	2.30	3.10
5	4.20	4.70	11.00	33.00	12.00	5.30	0.74	0.24	0.14	0.91	2.30	2.90
6	4.20	4.40	14.00	47.00	2.60	0.75	1.40	0.36	0.13	0.80	4.20	2.80
7	4.80	4.40	7.00	43.00	15.00	0.60	0.76	0.64	0.30	0.70	4.20	2.70
8	5.10	4.40	2.00	39.00	23.00	0.41	0.47	0.43	0.44	0.70	5.00	2.70
9	4.50	4.10	2.00	35.00	9.20	0.65	0.49	0.11	0.33	0.65	3.20	2.90
10	5.00	3.00	1.50	34.00	10.00	0.64	0.66	0.91	0.89	0.40	2.60	3.20
11	6.40	2.70	1.20	32.00	9.60	0.17	8.00	0.77	0.71	1.30	2.70	3.30
12	6.40	3.10	0.71	44.00	2.70	0.67	6.40	0.40	0.21	2.10	2.50	3.30
13	6.50	3.30	0.31	72.00	1.80	0.55	3.10	0.25	0.18	2.10	2.70	4.30
14	7.90	2.80	0.28	75.00	2.40	5.10	0.74	0.16	0.42	2.10	2.90	5.50
15	7.80	1.80	0.27	84.00	1.90	0.06	4.30	0.28	0.43	2.30	2.40	8.20
16	7.00	2.30	0.24	75.00	1.60	1.10	1.40	0.35	0.42	3.00	2.60	7.40
17	7.10	1.40	0.25	64.00	8.00	2.50	1.00	0.09	0.31	3.20	2.60	5.50
18	7.20	1.10	0.24	54.00	5.20	0.04	0.57	0.38	0.22	2.60	2.50	3.40
19	7.30	1.50	0.24	52.00	2.70	0.67	0.55	0.16	1.10	2.50	2.40	3.90
20	6.90	2.20	0.24	52.00	4.00	1.20	0.44	0.14	0.73	2.90	3.40	4.30
21	6.50	2.80	0.24	54.00	1.20	0.42	0.39	0.15	2.10	2.40	3.80	4.70
22	5.80	3.30	0.26	49.00	3.50	0.70	0.30	0.09	1.10	2.10	4.10	3.90
23	5.60	3.70	2.70	44.00	3.90	0.58	0.22	0.30	0.24	2.10	4.10	3.70
24	5.30	3.30	12.00	42.00	3.70	0.87	0.44	0.25	0.40	2.10	3.80	3.50
25	5.20	3.00	12.00	40.00	2.60	0.79	0.64	0.36	0.41	2.10	3.60	3.60
26	5.00	3.20	4.20	37.00	5.00	0.57	0.49	0.70	0.36	2.10	3.20	3.90
27	4.80	3.70	4.80	26.00	1.70	3.00	0.84	0.38	0.36	2.10	3.50	3.80
28	4.60	5.10	9.20	11.00	2.70	0.97	2.70	0.13	0.45	2.00	2.70	3.50
29	4.40	5.40	9.40	7.80	2.60	1.10	0.39	0.36	0.60	2.00	2.30	2.50
30	4.60		11.00	17.00	1.60	1.10	0.46	0.65	0.63	2.10	4.10	3.20
31	4.80				1.40		0.57	0.56		1.60		3.20
MIN	4.20	1.10	0.24	7.80	1.20	0.04	0.22	0.09	0.13	0.52	1.70	2.40
AVG	5.78	3.41	4.62	40.89	7.13	1.53	1.34	0.36	0.50	1.72	3.04	3.80

Sweetwater Creek Below Diversion Daily Discharge Tables (CFS) {SWBI QD}

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	3.08	2.10	1.43	24.40	7.46	1.33	0.98	1.00	1.00	1.96	10.24	1.84
2	3.11	2.03	2.01	20.51	12.01	0.99	1.02	1.01	1.01	2.13	1.54	1.86
3	3.23	2.57	2.46	17.54	16.56	1.00	0.99	0.99	1.00	2.33	1.48	2.80
4	3.08	2.39	1.70	16.58	12.47	1.02	1.00	1.00	1.00	2.45	1.56	4.39
5	2.66	4.49	2.76	13.80	10.88	1.14	0.99	1.00	0.99	2.19	1.60	4.34
6	2.74	4.51	2.93	10.71	8.80	1.69	1.05	0.99	0.99	2.02	1.59	3.56
7	2.67	4.16	1.84	8.96	5.08	1.00	1.00	0.99	0.99	1.88	1.59	3.13
8	2.69	4.79	3.00	7.31	3.00	0.99	0.99	0.99	0.99	1.87	1.76	2.90
9	2.72	6.00	3.00	16.94	3.00	1.00	0.98	0.99	0.99	1.83	1.80	2.38
10	2.76	6.21	4.00	12.15	2.99	7.39	0.99	0.98	0.99	1.78	1.85	2.56
11	3.20	7.98	8.00	10.03	3.01	1.62	1.00	0.99	1.00	1.79	1.97	1.37
12	6.11	9.90	12.24	7.43	3.02	1.00	0.99	0.98	0.99	1.83	1.93	2.94
13	8.83	9.12	21.33	5.33	3.01	0.99	0.99	1.00	1.00	1.80	3.03	2.54
14	14.15	8.42	15.00	5.35	3.01	0.99	0.99	1.00	0.99	1.77	1.87	2.37
15	15.09	10.34	8.34	15.53	3.01	1.00	0.99	1.00	0.99	1.75	1.77	2.26
16	19.53	13.52	5.16	10.00	2.35	1.00	0.99	0.99	0.99	1.90	2.12	2.18
17	17.72	13.27	5.12	23.82	2.00	0.99	0.99	1.00	0.99	2.81	2.37	2.20
18	14.32	14.33	5.06	26.93	2.00	1.00	0.98	0.99	0.99	2.25	3.30	2.19
19	10.76	13.15	5.01	25.80	1.96	0.99	0.99	1.00	0.99	2.33	3.24	2.38
20	6.87	12.3	5.24	23.63	2.02	0.99	1.00	1.00	1.00	2.84	2.53	2.38
21	2.55	10.85	5.02	19.92	2.66	0.99	1.01	0.99	0.99	2.89	2.06	2.05
22	2.35	5.85	4.98	18.46	3.91	0.99	1.00	0.99	0.99	2.55	1.77	1.76
23	2.36	1.60	4.99	19.07	6.41	0.99	1.00	0.99	0.99	2.29	1.74	2.44
24	2.3	0.66	5.00	13.34	11.28	1.00	0.99	1.01	1.01	2.13	1.24	2.63
25	2.24	0.25	13.76	12.88	7.03	0.99	1.00	1.03	1.15	2.14	1.75	2.18
26	2.23	0.61	24.90	9.69	3.00	0.98	0.98	1.04	1.56	2.10	1.68	2.22
27	2.22	1.11	36.54	6.64	3.03	1.00	0.98	1.00	1.68	2.06	1.80	2.10
28	2.12	1.39	32.34	5.04	2.99	0.98	1.00	0.99	1.78	2.02	1.74	2.20
29	2.14		28.35	5.01	3.00	1.00	1.01	1.00	2.01	2.13	1.84	2.14
30	2.21		25.23	7.22	3.02	1.00	0.88	1.02	1.85	9.53	1.83	2.16
31	2.18		23.34		2.56		0.99	1.01		21.28		1.66
MIN	2.12	0.25	1.43	5.04	2.02	0.98	0.88	0.99	0.99	1.75	1.48	1.37
AVG	5.49	6.21	10.33	14.00	5.05	1.27	0.99	1.00	1.13	2.99	2.22	2.46

Sweetwater Creek Below Diversion Daily Discharge Tables (CFS) {SWBI QD}

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	1.09		2.22	3.26	34.01	14.93	1.55	2.21	2.18	3.63	2.41	2.74
2	2.42		2.19	3.10	30.25	14.93	2.13	2.06	2.17	3.75	2.55	2.93
3	2.45		2.20	3.33	31.79	11.17	2.21	2.19	2.17	10.28	2.82	3.15
4	2.57		2.19	3.21	40.06	13.68	2.18	2.20	2.20	4.59	2.65	2.74
5	2.54		3.65	3.23	54.36	12.96	2.18	2.19	2.17	4.79	2.59	2.51
6	2.35		3.23	3.22	63.39	14.98	2.19	2.21	2.19	4.21	2.43	2.70
7	2.17		2.08	3.17	61.41	16.56	2.18	3.81	2.19	3.92	2.51	2.79
8	2.13		2.55	3.05	53.01	16.19	2.06	4.19	2.19	3.80	2.61	2.91
9	2.31		3.04	3.06	45.57	31.09	2.19	5.57	2.18	3.61	2.81	2.62
10	2.23		3.01	3.16	37.61	42.47	2.20	2.22	2.18	3.49	3.04	2.50
11	2.35		3.22	3.03	34.34	36.49	2.18	4.14	2.15	3.09	2.70	2.47
12	2.26	4.41	2.56	3.08	30.57	30.31	2.19	2.23	2.14	2.97	3.42	2.41
13	2.24	4.61	1.97	3.25	26.39	24.42	2.18	3.97	2.13	2.89	5.90	2.53
14	2.13	3.32	3.09	11.08	30.98	19.37	2.18	2.20	2.13	2.92	3.53	1.50
15	1.73	2.73	3.09	8.28	33.25	14.69	2.17	2.20	2.14	2.92	2.85	2.55
16	0.87	3.02	3.09	4.35	31.86	10.24	2.22	2.20	2.12	2.87	2.69	2.51
17	2.26	3.12	3.09	8.89	27.79	10.06	2.19	2.19	2.12	2.85	2.57	4.26
18	2.11	2.92	3.09	26.47	24.39	6.02	2.18	2.19	2.13	2.85	2.47	2.17
19	2.20	2.81	4.23	26.24	14.47	3.29	2.55	2.20	2.13	2.85	2.42	0.00
20	2.29	2.72	2.97	22.71	10.25	1.92	2.67	2.20	2.11	2.77	2.36	0.00
21	0.80	2.75	3.00	19.44	11.87	2.20	2.50	2.20	2.06	2.64	2.37	0.00
22	3.08	2.89	3.06	16.73	6.53	2.20	1.47	2.19	2.17	2.65	2.25	0.00
23	3.02	3.05	3.48	17.53	8.00	2.18	2.05	2.20	2.33	8.28	2.22	0.00
24	5.07	3.24	3.52	17.44	7.45	2.19	1.63	2.20	2.23	6.19	2.12	0.00
25	2.27	4.15	3.64	17.47	8.69	2.19	1.67	2.20	2.10	15.21	2.15	
26	2.44	4.03	3.63	18.39	6.19	2.20	2.95	2.19	8.19	3.33	2.25	
27	2.96	4.28	3.66	24.96	5.22	2.19	2.66	2.20	4.63	2.87	2.21	
28	2.64	4.64	3.29	35.83	5.32	2.19	1.72	2.20	3.86	2.83	2.21	
29	2.37	3.35	3.18	48.92	12.74	2.18	2.21	2.20	3.72	2.79	2.67	1.87
30	3.19		2.94	40.73	10.08	2.19	2.18	2.20	3.67	2.74	3.22	3.09
31			3.11		9.41		2.19	2.19		2.38		2.56
MIN	0.80	2.72	1.97	3.10	5.22	1.92	1.47	2.06	2.10	2.38	2.12	0.00
AVG	2.35	3.45	3.01	13.55	26.04	12.26	2.16	2.54	2.60	4.10	2.70	2.06

3. Sweetwater Creek at Mouth Daily Discharge Tables (CFS) [SWTI QD]

2002

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1							1.70	0.50	0.87	1.30	3.70	5.00
2							1.50	0.56	0.81	1.30	3.90	5.20
3							1.40	0.60	0.84	1.40	4.10	5.10
4							1.30	0.59	0.83	1.70	4.40	5.00
5							1.30	0.86	0.73	1.60	4.80	5.00
6							1.20	1.00	0.63	1.60	5.10	5.10
7							1.00	0.94	0.82	1.60	5.30	5.10
8							1.10	0.86	1.00	1.60	5.80	5.10
9							0.90	0.82	0.98	1.60	6.90	4.90
10							0.93	0.70	0.90	1.60	6.70	5.20
11							0.86	0.71	0.82	1.70	5.90	5.10
12							0.71	0.75	0.77	1.80	5.80	5.30
13							0.74	0.74	0.75	1.90	6.10	5.30
14							0.67	0.69	0.72	1.90	6.20	5.90
15							0.66	0.64	0.72	1.90	6.10	7.10
16							0.65	0.55	0.76	1.90	5.80	6.40
17							0.56	0.63	1.00	1.90	5.60	6.20
18							0.55	0.69	1.10	1.90	5.50	6.00
19						34.00	0.56	0.76	0.94	1.90	5.90	5.50
20						25.00	0.68	0.71	0.86	1.90	6.40	5.80
21						6.50	0.64	0.91	0.87	1.90	6.10	5.60
22						3.50	0.63	1.20	0.88	1.90	5.80	5.70
23						2.80	0.60	1.00	0.74	3.70	6.00	5.50
24						2.40	0.62	1.00	0.83	2.40	7.80	4.90
25						2.10	0.50	0.95	0.98	2.60	6.30	5.50
26						1.90	0.44	0.92	1.00	4.50	5.60	5.50
27						1.60	0.58	0.91	1.10	4.50	5.00	5.60
28						1.30	0.47	0.88	1.10	4.90	4.90	5.80
29						2.00	0.48	0.94	1.30	5.70	5.10	6.30
30						2.30	0.53	1.00	1.30	5.00	5.00	6.00
31							0.46	0.94		3.90		6.00
MIN						1.30	0.44	0.50	0.63	1.30	3.70	4.90
AVG						7.12	0.80	.81	0.90	2.42	5.59	5.54

Sweetwater Creek at Mouth Daily Discharge Tables (CFS) [SWTI QD]

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	6.00	185.00	9.50	146.00	86.00	14.00	1.10	0.60	0.80	0.72	3.90	6.00
2	6.10	103.00	8.00	112.00	84.00	18.00	1.10	0.60	0.80	0.77	4.20	6.00
3	7.10	81.00	8.50	93.00	93.00	17.00	1.10	0.60	0.80	0.87	4.30	6.30
4	7.20	65.00	7.00	77.00	111.00	11.00	1.00	0.60	0.80	0.82	4.20	6.10
5	8.40	55.00	7.00	72.00	103.00	3.30	0.95	0.60	0.80	0.83	3.70	6.10
6	7.90	44.00	7.50	66.00	95.00	3.00	1.00	0.60	0.80	0.83	3.60	7.40
7	7.50	40.00	10.00	62.00	95.00	2.80	0.95	0.60	0.85	0.78	4.10	7.60
8	6.80	38.00	15.00	67.00	84.00	2.70	0.95	0.60	1.00	0.80	4.40	6.70
9	6.60	35.00	22.00	70.00	76.00	2.50	1.00	0.55	0.90	0.85	4.30	6.60
10	6.20	28.00	31.00	71.00	70.00	2.40	0.95	0.55	0.90	0.88	4.50	6.70
11	6.30	18.00	48.00	82.00	65.00	2.40	0.85	0.55	0.90	0.91	4.60	7.10
12	6.30	13.00	70.00	89.00	72.00	2.30	0.80	0.55	1.00	0.92	4.60	6.50
13	9.20	11.00	130.00	95.00	69.00	2.50	0.80	0.62	1.00	0.92	4.60	7.30
14	10.00	11.00	169.00	97.00	62.00	2.40	0.80	0.68	1.00	0.95	4.60	9.80
15	12.00	8.90	145.00	83.00	60.00	2.20	0.75	0.61	1.00	1.10	4.80	7.70
16	10.00	10.00	130.00	79.00	55.00	2.10	0.75	0.56	0.99	1.20	5.20	6.80
17	9.20	11.00	115.00	76.00	50.00	2.00	0.75	0.60	0.97	1.20	5.30	6.60
18	8.40	13.00	89.00	74.00	48.00	1.90	0.80	0.71	1.10	1.20	5.20	6.30
19	7.90	13.00	72.00	68.00	37.00	2.00	0.70	0.68	0.98	1.20	5.20	6.00
20	7.50	13.00	66.00	64.00	24.00	2.20	0.70	0.70	0.94	1.20	5.30	6.50
21	7.80	12.00	62.00	62.00	20.00	2.20	0.70	0.75	0.95	1.20	5.40	6.90
22	8.80	15.00	100.00	59.00	15.00	1.90	0.65	1.00	0.95	1.20	5.20	6.80
23	12.00	15.00	162.00	58.00	13.00	1.80	0.65	1.50	0.88	1.30	5.10	6.30
24	14.00	14.00	130.00	55.00	11.00	1.70	0.65	1.00	0.86	1.40	5.10	6.40
25	13.00	24.00	115.00	52.00	14.00	1.70	0.80	0.90	0.85	1.40	5.10	7.30
26	36.00	25.00	103.00	61.00	17.00	1.60	1.20	0.85	0.81	1.50	5.10	7.50
27	79.00	19.00	83.00	69.00	12.00	1.50	0.70	0.80	0.80	1.50	5.10	6.20
28	28.00	9.50	71.00	75.00	8.70	1.40	0.65	0.80	0.77	1.60	5.10	6.40
29	22.00		63.00	76.00	12.00	1.30	0.65	0.80	0.74	1.70	6.50	6.40
30	71.00		62.00	84.00	13.00	1.10	0.65	0.80	0.75	3.20	6.00	5.00
31	120.00		74.00		15.00		0.60	0.80		3.80		5.80
MIN	6.00	8.90	7.00	52.00	11.00	1.10	0.60	0.55	0.74	0.72	3.60	5.00
AVG	18.33	33.19	70.47	76.47	51.28	3.83	0.83	0.72	0.89	1.25	4.81	6.68

Sweetwater Creek at Mouth Daily Discharge Tables (CFS) [SWTI QD]

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	6.20	13.00	7.80	4.30	2.40	62.00	1.80	0.43	1.30	1.90	6.20	8.70
2	6.60	12.00	7.60	3.70	2.30	50.00	1.60	0.34	1.10	1.90	6.40	8.30
3	6.20	11.00	6.90	3.50	2.20	42.00	1.40	0.44	1.10	1.80	9.00	7.70
4	4.50	10.00	7.10	3.30	2.10	33.00	1.20	0.54	2.00	1.80	7.70	7.70
5	4.50	9.80	6.60	3.20	2.00	23.00	0.95	0.53	2.20	1.80	7.00	7.50
6	5.00	9.30	6.10	3.20	2.00	29.00	1.30	0.52	2.20	1.70	6.20	7.20
7	6.00	9.10	5.80	3.10	2.00	17.00	1.00	0.55	1.80	1.80	6.10	7.30
8	6.60	8.70	6.40	3.10	2.00	30.00	0.89	0.51	1.50	1.80	6.30	7.80
9	6.90	8.50	9.60	2.90	2.00	28.00	0.98	0.51	1.60	2.30	6.20	7.70
10	7.40	8.30	9.50	2.70	2.00	33.00	1.00	0.50	2.40	2.20	6.00	8.30
11	7.30	7.90	11.00	2.70	7.40	39.00	1.10	0.40	2.60	2.20	6.00	17.00
12	6.70	7.00	9.80	2.60	9.80	34.00	2.30	0.30	3.60	2.20	6.00	19.00
13	6.70	6.80	10.00	2.50	10.00	30.00	1.10	0.31	3.50	2.20	6.00	16.00
14	6.60	8.40	9.00	2.60	16.00	23.00	0.78	0.37	3.70	2.20	6.00	15.00
15	6.80	8.10	10.00	3.50	12.00	12.00	0.59	0.49	4.40	2.20	6.00	15.00
16	8.00	7.80	10.00	3.30	23.00	6.10	0.51	0.54	4.10	2.10	6.10	14.00
17	7.70	8.40	14.00	3.00	30.00	4.00	0.58	0.58	3.70	2.30	6.00	13.00
18	7.70	11.00	17.00	3.00	25.00	3.60	0.66	0.59	4.50	3.30	6.20	12.00
19	7.90	16.00	20.00	3.10	55.00	3.50	0.73	0.64	4.60	3.00	6.10	11.00
20	7.90	17.00	16.00	3.40	64.00	3.30	1.30	0.91	4.00	2.70	6.00	10.00
21	7.80	16.00	15.00	3.20	64.00	4.30	1.20	0.59	3.50	3.60	5.90	9.30
22	7.60	15.00	15.00	3.30	60.00	7.50	0.89	1.20	4.00	8.90	5.90	9.20
23	7.90	15.00	14.00	3.20	61.00	2.80	1.20	4.10	6.30	9.00	5.80	7.40
24	8.20	13.00	14.00	3.00	66.00	2.40	1.30	1.90	6.20	8.20	6.70	8.10
25	7.90	9.60	11.00	2.80	53.00	2.20	0.81	2.40	6.10	7.40	14	8.50
26	7.60	8.70	12.00	2.70	45.00	2.00	0.61	3.30	5.90	7.20	18	8.30
27	7.60	8.70	8.40	2.60	49.00	2.10	0.60	1.60	2.50	7.20	13	7.50
28	7.90	8.50	7.50	2.60	87.00	1.80	0.56	1.20	1.90	6.80	10	6.40
29	10.00	8.20	4.30	2.60	111.00	1.80	0.48	1.10	1.70	6.40	8.80	7.80
30	13.00		4.00	2.50	91.00	1.70	0.43	0.90	1.80	6.40	8.80	8.00
31	13.00		4.60		75.00		0.46	1.20		6.40		8.10
MIN	4.50	7.00	4.00	2.50	2.00	1.70	0.43	0.30	1.10	1.70	5.80	6.40
AVG	7.47	10.37	10.00	3.04	33.39	17.80	0.98	1.37	3.19	3.90	7.48	9.96

Sweetwater Creek at Mouth Daily Discharge Tables (CFS) [SWTI QD]

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	7.50	9.10	4.20	3.20	14.00	5.20	1.30	1.20	2.10	3.50	3.10	4.60
2	7.10	8.80	3.70	3.00	10.00	5.70	1.10	1.20	2.00	3.20	2.80	4.60
3	6.60	8.80	3.40	3.10	4.20	9.90	1.00	1.20	2.00	1.90	4.60	5.30
4	6.40	8.50	3.30	4.20	3.80	16.00	1.00	1.20	2.20	2.10	4.60	4.40
5	5.40	8.10	3.20	4.90	3.60	17.00	0.92	0.99	2.00	1.70	4.50	4.90
6	4.80	7.30	3.20	5.40	13.00	13.00	2.10	0.93	1.30	1.50	4.50	4.70
7	7.80	7.00	3.10	4.10	24.00	3.80	1.10	0.92	1.10	1.60	4.60	3.20
8	7.20	7.00	3.10	5.20	20.00	3.20	0.99	1.40	1.00	1.70	5.30	2.80
9	6.70	6.20	3.00	4.10	14.00	3.00	0.98	1.40	1.40	1.80	4.70	3.70
10	6.50	6.30	3.00	3.50	29.00	3.00	1.20	1.20	1.30	1.60	4.70	4.00
11	6.40	6.20	2.80	3.70	76.00	3.00	1.00	1.10	1.80	1.70	4.90	4.00
12	6.20	7.40	2.60	4.50	47.00	2.70	0.81	1.20	1.80	2.00	5.00	3.60
13	6.30	8.00	2.50	5.90	38.00	2.10	0.78	1.30	1.90	2.10	5.50	3.40
14	6.10	7.30	2.50	5.10	35.00	2.00	0.70	2.20	2.00	2.20	5.40	3.60
15	5.10	6.00	2.50	6.00	43.00	7.10	0.75	2.70	1.60	2.20	5.30	3.80
16	5.90	5.20	2.60	6.80	73.00	1.70	0.97	1.30	1.60	2.30	5.30	3.70
17	6.70	5.10	2.70	40.00	110.00	2.00	1.00	1.30	1.70	2.00	5.10	3.60
18	13.00	4.50	2.80	68.00	75.00	2.80	0.93	2.10	1.60	1.90	5.00	3.20
19	28.00	6.80	2.80	45.00	65.00	2.60	0.64	1.90	1.50	1.90	5.00	3.00
20	22.00	6.80	3.60	32.00	65.00	2.10	0.53	1.90	4.20	1.90	5.00	4.00
21	19.00	6.40	2.80	25.00	60.00	1.70	0.53	1.80	2.00	1.90	4.90	5.50
22	16.00	5.90	2.60	25.00	64.00	1.50	1.10	1.60	1.80	2.00	4.90	7.20
23	15.00	5.70	2.50	27.00	76.00	1.50	1.40	1.60	1.60	2.00	4.90	9.30
24	14.00	5.80	2.40	25.00	61.00	1.50	1.30	1.50	2.00	2.00	4.70	9.80
25	13.00	5.90	2.20	16.00	40.00	1.50	0.87	1.70	1.90	2.00	4.70	11.00
26	12.00	6.10	2.30	5.50	30.00	1.60	0.56	1.80	1.60	2.20	4.90	12.00
27	12.00	6.20	2.70	5.00	26.00	2.00	1.80	1.60	1.80	2.30	4.60	12.00
28	12.00	5.90	9.40	4.60	24.00	2.40	1.20	1.50	1.70	2.30	4.40	11.00
29	11.00		5.30	8.00	20.00	1.90	1.30	1.60	1.80	2.30	4.80	15.00
30	10.00		3.50	15.00	14.00	1.60	1.20	2.40	2.10	2.30	4.80	12.00
31	9.60		3.30		7.90		1.10	2.00		2.50		13.00
MIN	5.10	4.50	2.20	3.00	3.60	1.50	0.53	0.92	1.10	1.50	2.80	2.80
AVG	10.17	6.73	3.21	13.79	38.24	4.17	1.04	1.54	1.81	2.08	4.75	6.32

Sweetwater Creek at Mouth Daily Discharge Tables (CFS) [SWTI QD]

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	17.00	10.00	12.00	24.00	12.00	3.20	2.10	0.90	1.00	1.30	3.70	8.80
2	15.00	10.00	13.00	21.00	8.50	0.80	2.10	0.85	0.82	1.40	4.40	8.10
3	13.00	10.00	12.00	21.00	14.00	6.80	1.70	0.79	0.70	1.30	4.40	6.70
4	11.00	10.00	13.00	41.00	21.00	6.10	1.70	0.57	0.52	1.30	4.80	8.00
5	11.00	10.00	12.00	76.00	16.00	9.20	1.80	0.57	0.49	1.40	4.90	7.90
6	9.70	9.90	13.00	136.00	7.70	3.90	2.50	0.51	0.50	2.00	6.20	7.60
7	10.00	10.00	15.00	105.00	12.00	3.00	2.50	0.72	0.50	1.60	8.20	7.40
8	12.00	9.80	12.00	97.00	20.00	3.10	1.70	0.74	0.65	1.70	11.00	7.40
9	11.00	9.60	5.40	87.00	14.00	3.10	1.50	0.71	0.82	1.80	9.50	7.60
10	11.00	8.00	6.20	76.00	10.00	3.10	1.20	0.55	0.76	1.80	7.90	8.10
11	13.00	7.50	5.20	74.00	12.00	2.50	3.70	1.70	1.60	1.60	7.90	8.40
12	14.00	8.30	5.00	78.00	7.00	2.60	9.00	1.10	0.91	2.90	7.50	8.50
13	14.00	8.40	4.50	111.00	6.10	2.30	7.00	0.88	0.68	2.90	7.20	11.00
14	16.00	8.10	4.30	114.00	5.70	5.50	3.00	0.75	0.65	2.90	7.00	14.00
15	20.00	4.40	3.90	130.00	5.90	3.20	5.40	0.67	0.96	3.10	7.60	21.00
16	17.00	5.00	3.70	120.00	4.60	2.40	3.00	0.88	0.93	3.90	7.10	19.00
17	18.00	2.90	3.70	95.00	6.60	4.10	2.90	1.20	0.83	4.10	6.90	14.00
18	17.00	2.40	3.50	84.00	7.60	2.40	1.50	0.72	0.78	4.30	7.90	8.70
19	17.00	3.50	3.40	82.00	5.20	2.10	1.70	0.77	0.98	3.80	7.70	10.00
20	17.00	5.00	3.40	88.00	6.70	4.10	1.20	0.56	2.40	4.40	7.30	11.00
21	16.00	7.60	3.40	83.00	5.30	2.70	0.95	0.50	2.50	4.10	8.80	12.00
22	15.00	8.10	3.30	79.00	6.00	3.40	0.84	0.53	3.60	3.80	10.00	10.00
23	14.00	7.60	3.40	69.00	4.80	2.90	0.69	0.69	1.40	3.80	11.00	9.60
24	13.00	7.10	3.80	62.00	5.80	3.30	0.48	0.97	1.30	3.80	11.00	8.90
25	12.00	6.60	11.00	55.00	5.40	3.40	0.59	1.00	1.30	4.00	9.90	9.30
26	12.00	7.00	15.00	49.00	7.70	2.90	0.77	1.30	1.30	4.00	8.90	10.00
27	11.00	7.40	9.20	37.00	4.40	3.40	0.74	1.30	1.20	4.00	9.70	9.80
28	11.00	8.80	8.60	16.00	6.50	1.90	2.60	1.20	1.20	4.00	8.30	8.90
29	10.00		12.00	13.00	6.20	2.00	0.85	0.68	1.20	4.10	6.20	6.40
30	9.70		12.00	14.00	4.10	2.40	0.65	0.76	1.30	4.30	8.50	8.30
31	10.00		14.00		3.90		0.75	1.20		3.90		8.20
MIN	9.70	2.40	3.30	13.00	3.90	0.80	0.74	0.50	0.49	1.30	3.70	6.40
AVG	13.46	7.61	8.06	71.23	8.47	3.39	2.16	0.85	1.13	3.01	7.71	9.83

Sweetwater Creek at Mouth Daily Discharge Tables (CFS) [SWTI QD]

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	8.10	6.40	13.00	36.00	15.00	3.10	1.90	1.50	1.80	2.90	2.80	3.90
2	7.90	6.20	11.00	28.00	14.00	2.20	1.70	1.30	1.60	2.90	2.80	3.90
3	8.00	6.10	15.00	24.00	20.00	2.20	1.80	1.20	1.40	3.10	2.80	4.80
4	8.20	6.70	12.00	22.00	16.00	2.20	1.80	1.30	1.20	3.10	2.80	6.40
5	7.50	8.50	13.00	19.00	15.00	2.50	1.60	1.50	1.30	2.80	2.90	6.90
.6	7.50	10.00	15.00	16.00	12.00	3.40	1.60	1.60	1.50	2.60	2.90	7.50
7	7.20	11.00	20.00	13.00	9.10	2.70	1.40	1.50	1.50	2.50	2.90	7.00
8	7.30	12.00	30.00	16.00	7.10	2.60	1.40	1.60	1.50	2.40	3.00	6.60
9	7.30	14.00	31.00	18.00	6.10	6.40	1.40	1.50	1.50	2.40	3.00	5.80
10	7.40	16.00	31.00	17.00	5.90	3.40	1.40	1.30	1.40	2.30	3.10	6.10
11	5.40	18.00	48.00	15.00	6.00	6.20	1.50	1.30	1.30	2.30	3.20	4.50
12	2.00	26.00	84.00	12.00	6.40	3.00	1.30	1.50	1.40	2.20	3.30	6.10
13	2.40	24.00	87.00	10.00	6.20	3.20	1.40	1.50	1.50	2.20	4.10	5.80
14	4.00	22.00	68.00	12.00	6.40	3.10	1.40	1.40	1.60	2.20	3.80	5.50
15	6.00	24.00	52.00	17.00	5.30	2.70	1.50	1.40	1.70	2.20	3.40	5.40
16	6.60	35.00	44.00	21.00	5.30	2.50	1.60	1.20	1.70	2.30	3.90	5.10
17	7.20	38.00	43.00	28.00	4.10	2.60	1.60	1.30	1.70	3.10	4.50	5.10
18	7.50	41.00	43.00	36.00	4.00	2.50	1.70	1.50	1.90	2.80	5.80	5.00
19	7.80	38.00	41.00	33.00	3.90	2.40	1.70	2.00	1.80	2.90	6.90	5.10
20	7.90	34.00	43.00	30.00	4.60	2.00	1.60	2.40	1.70	3.10	5.60	5.10
21	7.60	31.00	37.00	26.00	5.80	1.90	1.60	2.10	1.90	3.10	4.90	4.90
22	7.70	26.00	34.00	23.00	7.50	1.80	1.50	1.90	1.80	3.00	4.00	4.10
23	7.80	18.00	35.00	24.00	7.20	1.90	1.80	1.80	1.90	2.80	4.60	5.30
24	7.50	16.00	32.00	20.00	9.70	1.90	1.70	1.80	1.90	2.70	3.00	5.70
25	7.20	16.00	46.00	16.00	9.10	2.20	1.50	1.80	2.00	2.60	4.40	5.00
26	7.10	15.00	80.00	15.00	5.20	2.00	1.30	1.80	2.20	2.70	4.10	5.10
27	7.00	14.00	63.00	12.00	5.20	1.90	1.30	1.80	2.20	2.80	4.00	4.90
28	6.70	14.00	58.00	11.00	5.00	1.60	1.30	1.80	2.20	2.70	3.80	4.80
29	6.50		47.00	11.00	4.90	1.70	1.50	1.70	2.80	2.80	3.90	4.90
30	6.50		39.00	10.00	4.60	2.10	1.60	1.60	2.90	2.80	3.90	4.80
31	6.40		35.00		4.00		1.50	1.50		2.80		4.80
MIN	2.00	6.10	11.00	10.00	3.90	1.70	1.30	1.20	1.20	2.20	2.80	3.90
AVG	6.81	19.53	40.32	19.70	7.76	2.66	1.55	1.59	1.76	2.68	3.80	5.35

Sweetwater Creek at Mouth Daily Discharge Tables (CFS) [SWTI QD]

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	4.80	5.00	9.40	13.00	72.00	18.00	3.00	3.50	3.60	4.23	4.81	5.82
2	4.80	5.00	9.40	12.00	65.00	23.00	3.60	3.50	4.00	4.20	4.70	5.98
3	4.80	5.00	9.30	12.00	72.00	26.00	3.30	2.80	3.80	8.23	5.33	6.40
4	5.50	5.00	9.20	12.00	72.00	42.00	3.10	3.20	3.90	6.18	5.19	6.88
5	5.50	5.00	9.80	12.00	95.00	36.00	3.10	2.70	3.80	5.43	5.29	5.91
6	5.20	5.00	11.00	12.00	135.00	41.00	3.00	2.80	4.00	13.44	5.09	5.90
7	5.00	5.00	8.60	12.00	146.00	44.00	3.00	4.70	4.10	4.75	5.09	6.04
8	4.60	5.00	8.70	13.00	127.00	42.00	2.90	5.00	3.90	4.73	5.36	6.53
9	5.40	5.00	9.60	15.00	104.00	52.00	2.90	11.00	4.10	4.68	5.59	6.05
10	5.10	5.00	9.70	15.00	83.00	70.00	2.80	3.50	3.90	4.65	5.95	5.43
11	5.10	6.00	11.00	15.00	69.00	69.00	2.90	5.00	3.90	4.51	5.67	5.18
12	5.10	6.00	14.00	17.00	63.00	60.00	2.90	3.20	3.66	4.40	6.24	5.15
13	5.00	6.00	12.00	25.00	53.00	46.00	2.70	5.28	4.00	4.59	9.91	5.35
14	4.90	6.00	15.00	54.00	44.00	30.00	2.60	3.00	4.00	4.68	9.35	4.09
15	4.90	7.00	14.00	47.00	51.00	21.00	2.70	3.00	4.00	4.72	7.07	12.83
16	4.00	8.10	14.00	38.00	49.00	15.00	2.70	3.50	4.00	4.70	6.34	21.17
17	3.36	8.00	13.00	37.00	44.00	14.00	2.60	3.50	3.96	4.70	5.94	29.79
18	4.36	7.70	14.00	49.00	37.00	10.00	2.60	2.90	3.54	4.70	5.69	21.35
19	4.24	7.70	15.83	58.00	30.00	7.20	3.20	3.10	2.94	4.70	5.57	4.57
20	4.72	7.80	15.06	46.00	21.00	5.40	3.30	3.80	3.49	4.70	5.10	6.11
21	3.89	7.70	16.00	37.00	15.00	5.00	3.30	4.30	3.98	5.87	5.39	23.63
22	5.00	7.80	15.73	28.00	22.00	5.00	2.60	3.90	3.45	7.82	5.21	15.00
23	5.00	7.90	16.40	31.00	12.00	4.60	3.20	3.80	3.46	9.04	5.06	4.57
24	5.00	8.00	16.13	31.00	13.00	4.40	3.30	3.60	3.71	8.73	4.89	4.48
25	5.00	8.80	17.65	31.00	15.00	4.30	1.70	3.80	4.03	16.00	11.06	4.53
26	5.00	9.20	17.00	31.00	11.00	4.00	4.40	4.00	6.64	6.55	4.90	4.50
27	5.00	9.30	16.85	54.00	9.00	4.00	3.70	3.90	5.86	5.26	4.88	4.65
28	5.00	9.80	15.00	79.00	8.20	3.90	3.20	3.80	4.46	4.98	4.75	5.93
29	5.00	10.00	14.00	124.00	17.00	3.50	2.80	3.70	4.30	4.88	5.41	9.63
30	5.00		14.00	91.00	14.00	3.30	3.20	3.60	4.25	4.82	5.94	7.91
31	5.00		13.00	72.00	12.00		3.20	3.50		4.59		6.85
MIN	3.36	5.00	8.60	12.00	8.20	3.30	1.70	2.70	2.94	4.20	4.70	5.15
AVG	4.85	6.86	13.04	36.23	50.97	23.79	3.02	3.90	4.02	5.98	5.89	8.65

4. Soldiers Meadow Reservoir Daily Discharge Tables (CFS) [SOL QD]

2000

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	.19	.23	.29	.34	.51	12.23	15.82	7.71	5.69	.07	.02	.05
2	.19	.25	.30	.40	.53	5.40	15.81	8.09	5.72	.03	.03	.05
3	.20	.24	.30	.41	.54	.50	15.72	8.03	5.67	.02	.03	.05
4	.19	.25	.31	.48	.55	.48	15.74	7.97	5.66	.02	.04	.05
5	.19	.25	.31	.45	.53	.49	15.75	7.95	5.67	.02	.04	.05
6	.22	.24	.31	.45	.53	.49	15.67	7.91	5.69	.02	.04	.05
7	.23	.25	.31	.45	.52	6.41	15.55	7.90	5.65	.02	.04	.05
8	.22	.25	.31	.46	.53	6.25	15.51	7.89	2.08	.02	.04	.05
9	.21	.25	.31	.48	.56	5.40	15.40	7.88	.02	.02	.04	.05
10	.24	.26	.30	.47	.58	3.40	15.94	7.83	.02	.02	.05	.05
11	.22	.27	.30	.45	.59	.46	16.74	7.82	.02	.02	.05	.05
12	.19	.26	.31	.45	.61	.45	16.66	7.85		.02	.05	.06
13	.19	.25	.31	.49	.57	.45	16.57	7.82		.02	.04	.06
14	.19	.27	.30	.49	.56	.46	16.83	7.83		.02	.05	.05
15	.19	.26	.31	.53	.56	.45	17.56	7.82		.02	.05	.05
16	.19	.27	.31	.53	.54	.45	17.51	7.78		.02	.04	.05
17	.20	.28	.31	.51	.53	.45	17.36	7.59		.02	.05	.05
18	.23	.29	.31	.51	.54	.45	17.22	7.50		.02	.05	.05
19	.24	.28	.31	.53	.53	4.04	13.88	7.45	.02	.02	.04	.05
20	.24	.26	.30	.52	.55	8.39	13.05	6.90	.02	.03	.04	.05
21	.24	.26	.30	.51	1.09	10.57	4.88	6.49	.02	.03	.04	.05
22	.25	.28	.30	.55	1.45	12.35	8.69	6.44	.02	.02	.04	.05
23	.26	.31	.32	.53	1.27	13.11	7.72	6.42	.02	.02	.04	.05
24	.25	.30	.31	.54	1.25	13.23	6.95	6.14	.02	.02	.04	.05
25	.25	.29	.31	.55	1.30		7.86	5.89	.02	.02	.05	.05
26	.25	.28	.31	.55	1.38		7.86	5.81	.02	.02	.05	.05
27	.26	.30	.35	.50	1.41	14.85	7.85	5.77	.02	.02	.05	.05
28	.30	.31	.37	.54	1.40	14.89	7.81	5.74	.02	.02	.05	.05
29	.31	.31	.36	.53	1.40	14.85	7.77	5.69	.02	.02	.05	.05
30	.31		.33	.52	.99	15.37	7.74	5.69	.06	.02	.04	.05
31	.31		.33		6.52		7.71	5.65		.02		.05
MIN	.19	.23	.29	.34	.51	.45	4.88	5.74	.02	.02	.02	.05
AVG	.23	.26	.31	.49	.98	5.94	13.00	7.14	1.83	.02	.04	.05

Soldiers Meadow Reservoir Daily Discharge Tables (CFS) [SOL QD]

2001

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	.05	.05	.06	.19	.41	10.60	.27	7.18	8.56	.03	0.00	.08
2	.05	.05	.06	.19	.41	10.65	.28	7.16	8.51	.04	.01	.09
3	.05	.05	.06	.19	.40	10.67	3.33	7.15	8.46	.04	.01	.09
4	.05	.06	.06	.19	.40	10.62	6.69	7.17	8.40	.03	.02	.09
5	.05	.05	.06	.18	.40	5.13	6.71	7.15	8.36	0.00	.02	.09
6	.05	.05	.07	.19	.41	.31	6.76	7.11	8.28	0.00	.02	.09
7	.06	.05	.07	.19	.39	.31	6.73	7.16	7.60	0.00	.03	.09
8	.05	.07	.07	.19	.37	.31	6.64	7.16	7.45	0.00	.03	.09
9	.05	.05	.06	.19	.37	.31	6.61	7.16	7.40	0.00	.03	.09
10	.05	.05	.05	.20	.37	.31	6.76	7.17	7.37	0.00	.04	.09
11	.05	.06	.05	.25	.36	.32	6.78	7.17	7.34	0.00	.04	.09
12	.05	.05	.05	.25	.35	.34	6.75	7.17	7.27	0.00	.05	.09
13	.05	.05	.05	.24	.36	.34	6.76	7.18	7.22	0.00	.05	.09
14	.05	.06	.06	.23	.39	.33	6.75	7.18	7.18	0.00	.08	.09
15	.05	.05	.10	.23	.38	.31	6.71	7.16	7.15	0.00	.06	.09
16	.05	.05	.09	.24	.38	.31	3.88	9.03	7.14	0.00	.05	.09
17	.05	.05	.09	.27	.40	6.55	.28	9.46	7.13	0.00	.08	.09
18	.05	.05	.10	.31	.38	10.79	4.19	9.46	7.07	0.00	.08	.10
19	.05	.05	.16	.30	.38	10.74	6.02	9.46	7.06	0.00	.06	.08
20	.05	.05	.14	.30	.38	10.69	5.92	9.46	3.48	0.00	.07	.08
21	.05	.05	.12	.30	.38	10.60	5.89	9.46	.04	0.00	.08	.09
22	.05	.05	.12	.31	.35	10.57	5.83	9.02	.04	0.00	.09	.09
23	.05	.05	.14	.31	.34	10.56	5.77	9.02	.03	0.00	.09	.11
24	.05	.05	.17	.31	.34	10.58	5.71	9.00	.03	0.00	.09	.12
25	.05	.06	.19	.30	.34	10.52	5.69	8.92	.04	0.00	.09	.12
26	.05	.07	.18	.31	.34	5.86	6.37	8.83	.04	0.00	.09	.11
27	.05	.07	.17	.30	.34	.28	7.24	8.76	.04	0.00	.08	.11
28	.05	.07	.19	.32	.35	.27	7.24	8.74	.05	0.00	.09	.09
29	.05		.18	.31	4.70	.24	7.24	8.71	.04	0.00	.09	.12
30	.05		.19	.39	10.70	.25	7.25	8.68	.03	0.00	.09	.12
31	.05		.22		10.62		7.24	8.62		0.00		.11
MIN	.05	.05	.05	.18	.34	.24	.27	7.11	.03	0.00	.01	.08
AVG	.05	.05	.11	.26	1.18	4.99	5.69	8.13	4.96	.01	.06	.10

Soldiers Meadow Reservoir Daily Discharge Tables (CFS) [SOL QD]

2002

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	.09	.14	.21	.14	.34	.31	4.75	4.48	2.32	8.38	.17	.12
2	.09	.17	.22	.15	.33	.29	4.76	4.49	2.31	8.40	.16	.12
3	.12	.17	.21	.16	.35	.30	4.75	4.45	2.31	7.92	.17	.12
4	.12	.17	.20	.17	.33	.30	4.75	4.47	2.31	2.92	.17	.12
5	.13	.16	.19	.17	.34	5.62	4.75	3.66	2.32	.13	.15	.12
6	.13	.15	.21	.21	.35	10.17	4.70	2.48	2.32	.11	.14	.12
7	.17	.14	.25	.22	.38	6.34	4.73	2.43	2.35	.11	.13	.12
8	.17	.16	.23	.22	.36	3.96	4.74	2.43	2.32	.11	.14	.12
9	.13	.17	.23	.27	.37	3.98	4.69	2.42	2.31	.12	.13	.12
10	.13	.15	.23	.30	.37	7.06	4.66	2.41	2.30	.12	.13	.12
11	.13	.17	.24	.29	.35	9.27	4.66	2.43	2.30	.13	.13	.13
12	.13	.20	.25	.29	.34	9.22	6.18	2.43	5.59	.12	.13	.10
13	.13	.18	.24	.35	.34	8.66	8.15	2.43	8.58	.12	.13	.09
14	.13	.19	.24	.41	.35	5.61	8.17	2.43	8.59	.12	.13	.11
15	.13	.17	.25	.37	.35	2.31	8.21	2.44	8.61	.12	.13	.12
16	.13	.17	.25	.34	.35	.23	8.19	2.46	8.62	.12	.12	.12
17	.13	.17	.25	.31	.35	1.09	8.16	2.45	8.62	.12	.13	.13
18	.13	.18	.25	.33	.35	4.52	8.15	2.46	8.56	.12	.13	.13
19	.13	.19	.25	.35	.33	12.69	11.19	2.39	8.56	.12	.13	.13
20	.14	.18	.25	.35	.36	11.37	13.64	2.33	8.57	.13	.12	.13
21	.13	.17	.24	.36	.38	3.56	13.61	2.36	8.60	.13	.11	.13
22	.14	.19	.24	.35	.38	.23	13.53	2.36	8.56	.13	.12	.13
23	.14	.19	.25	.38	.38	.23	3.45	2.30	8.53	.13	.13	.13
24	.13	.19	.25	.35	.35	.22	.15	2.31	8.50	.13	.13	.13
25	.13	.21	.25	.34	.35	.22	3.81	2.31	8.48	.13	.13	.13
26	.13	.20	.19	.34	.35	.21	5.32	2.34	8.48	.13	.12	.13
27	.15	.19	.13	.38	.35	.21	4.52	2.32	8.43	.15	.12	.13
28	.17	.19	.13	.35	.34	.22	4.50	2.30	8.38	.13	.12	.13
29	.18		.13	.35	.33	2.88	4.50	2.35	8.42	.13	.12	.13
30	.15		.13	.34	.36	4.75	4.49	2.31	8.40	.15	.12	.13
31	.14		.13		.32		4.51	2.31		.17		.13
MIN	.09	.14	.13	.14	.32	.21	.15	2.30	2.30	.11	.12	.09
AVG	.13	.18	.22	.30	1.53	3.87	6.27	2.70	6.15	1.0	.13	.12

Soldiers Meadow Reservoir Daily Discharge Tables (CFS) [SOL QD]

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	.13	.22	.17	.30	12.05	2.73	7.14	15.08	4.50	.02	.05	.05
2	.12	.15	.17	.29	12.05	.19	8.50	15.79	4.38	.02	.05	.05
3	.13	.14	.19	.27	12.09	.19	8.50	15.73	4.39	.02	.05	.05
4	.13	.13	.19	.25	14.80	.19	8.48	15.63	4.40	.02	.05	.05
5	.13	.13	.18	.25	15.94	.19	8.46	15.51	4.42	.02	.07	.05
6	.13	.14	.19	.25	15.89	.19	8.42	15.40	4.53	.02	.06	.07
7	.13	.14	.19	7.47	15.81	.19	8.42	15.26	4.53	.02	.07	.05
8	.13	.13	.19	13.08	15.82	.19	9.57	15.19	4.64	.03	.05	.05
9	.13	.13	.16	13.14	15.79	.19	10.56	14.99	1.85	.03	.05	.05
10	.13	.13	.17	13.11	15.82	.19	10.54	15.30	.04	.04	.05	.05
11	.13	.13	.18	13.18	13.21	.20	10.49	15.93	.03	.04	.05	.05
12	.13	.13	.25	13.22	12.00	.21	10.48	15.85	.02	.04	.05	.05
13	.13	.13	.29	14.18	11.91	.21	10.48	10.27	.03	.04	.04	.05
14	.13	.13	.28	16.91	11.85	.23	10.43	.04	.03	.05	.05	.05
15	.13	.13	.25	18.48	9.81	.22	10.37	2.55	.02	.05	.05	.05
16	.13	.13	.23	18.49	7.52	.22	10.37	5.34	.02	.05	.05	.05
17	.13	.13	.23	18.47	6.68	.18	10.32	5.50	.03	.03	.05	.05
18	.13	.13	.21	18.48	6.68	.14	10.24	5.49	.03	.03	.05	.05
19	.13	.13	.21	18.48	6.67	.16	10.17	5.48	.02	.04	.05	.04
20	.13	.14	.23	18.46	5.39	.18	10.16	5.49	.02	.03	.05	.05
21	.13	.14	.24	15.63	2.33	.17	10.14	5.48	.03	.03	.05	.05
22	.13	.14	.32	12.61	.23	.17	10.12	5.50	.02	.03	.05	.05
23	.15	.15	.27	11.51	.22	.16	10.06	5.45	.02	.04	.05	.05
24	.13	.17	.25	10.05	.21	.16	10.04	5.32	.02	.04	.05	.05
25	.13	.17	.25	9.44	.19	.16	12.66	4.98	.02	.04	.05	.05
26	.23	.16	.25	11.47	.19	2.64	15.11	4.89	.02	.03	.05	.05
27	.16	.16	.25	12.95	.17	5.76	15.06	4.79	.02	.03	.05	.06
28	.13	.18	.25	12.93	3.47	5.72	14.96	4.70	.02	.03	.05	.05
29	.15		.23	12.50	6.69	5.70	14.86	4.70	.02	.05	.05	.05
30	.24		.26	12.10	6.68	5.72	14.76	4.71	.02	.05	.05	.06
31	.25		.31		5.71		14.69	4.61		.05	.05	.05
MIN	.12	.13	.17	.25	.17	.14	7.14	.04	.02	.02	.05	.04
AVG	.14	.14	.23	11.27	8.50	1.90	10.79	9.06	1.27	.03	.05	.05

Soldiers Meadow Reservoir Daily Discharge Tables (CFS) [SOL QD]

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	.05	.09	.08	.13	.17	.29	.19	16.07	.05	.04	.09	.13
2	.05	.08	.08	.12	.18	.28	.20	16.02	.05	.04	.09	.13
3	.05	.08	.09	.12	.18	.27	.19	15.97	.05	.04	.09	.13
4	.07	.08	.09	.12	.19	.26	2.02	15.87	.05	.04	.08	.14
5	.08	.08	.09	.15	.19	.28	5.88	15.73	.05	.04	.08	.14
6	.06	.08	.08	.13	.19	.29	4.78	16.64	.05	.05	.08	.13
7	.07	.08	.08	.14	.18	.29	.19	15.58	.04	.05	.08	.13
8	.05	.08	.08	.15	.19	.32	.19	15.47	.04	.05	.08	.13
9	.05	.08	.09	.15	.19	.31	1.01	15.38	.05	.07	.08	.14
10	.05	.08	.08	.15	.20	.36	2.03	15.25	.04	.07	.08	.17
11	.05	.08	.08	.15	.39	.27	2.05	15.15	.05	.06	.08	.19
12	.06	.08	.08	.16	.25	.25	2.03	15.01	.05	.07	.09	.19
13	.05	.08	.08	.17	.23	.24	2.03	14.87	.05	.06	.09	.18
14	.05	.08	.09	.18	.22	.24	2.00	14.71	.05	.06	.09	.19
15	.06	.08	.09	.19	.23	.24	3.81	14.63	.05	.06	.09	.18
16	.05	.08	.09	.18	.26	.23	5.17	14.53	.05	.05	.09	.18
17	.07	.08	.11	.19	.23	.23	5.16	14.43	.05	.08	.08	.18
18	.06	.09	.12	.19	.25	.23	10.03	14.26	.05	.08	.09	.19
19	.05	.09	.12	.19	.27	.23	15.60	7.08	.05	.08	.09	.19
20	.05	.09	.12	.19	.26	.22	15.60	.06	.07	.09	.09	.19
21	.05	.08	.12	.19	.25	.22	15.60	.04	.06	.09	.09	.19
22	.07	.08	.12	.19	.25	.22	15.52	.06	.06	.09	.09	.19
23	.07	.08	.15	.18	.25	.21	15.44	.06	.05	.09	.09	.19
24	.07	.09	.13	.19	.25	.21	15.35	.05	.04	.09	.12	.19
25	.08	.08	.13	.18	.25	.21	15.25	.08	.04	.08	.20	.19
26	.07	.08	.13	.18	.28	.21	15.77	.06	.04	.08	.13	.19
27	.06	.08	.14	.18	.28	.21	16.48	.06	.04	.08	.13	.19
28	.06	.09	.12	.19	.31	.21	16.39	.04	.04	.08	.13	.18
29	.09	.09	.12	.19	.31	.21	16.32	.04	.04	.09	.13	.19
30	.08		.14	.18	.31	.21	16.23	.04	.04	.09	.13	.19
31	.08		.14				16.16					.19
MIN	.05	.08	.08	.12	.17	.21	.19	.04	.04	.04	.08	.13
AVG	.06	.08	.11	.17	.24	.25	8.22	9.44	.05	.07	.10	.17

.

Soldiers Meadow Reservoir Daily Discharge Tables (CFS) [SOL QD]

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	.19	.16	.12	.13	.18	.19	.16	8.24	7.32	7.20	.04	.05
2	.19	.15	.13	.13	.18	.19	.16	8.24	7.31	6.71	.04	.05
3	.18	.13	.12	.14	.18	.19	.16	8.24	7.26	6.68	.04	.05
4	.19	.14	.12	.15	.19	.18	.16	8.16	7.18	2.71	.04	.04
5	.19	.13	.12	.17	.19	.19	3.10	8.13	6.82	.04	.04	.05
6	.19	.13	.12	.15	.19	.19	6.01	8.12	6.78	.03	.05	.05
7	.19	.13	.12	.15	.19	.19	5.08	8.11	6.76	.03	.05	.07
8	.18	.13	.12	.16	.19	.18	3.68	8.09	3.04	.03	.04	.06
9	.18	.13	.12	.18	.19	.18	2.50	8.05	.05	.03	.04	.08
10	.18	..12	.12	.16	.19	.17	2.72	8.02	.05	.03	.04	.11
11	.19	.12	.11	.18	.16	.19	3.64	8.04	.04	.02	.05	.11
12	.18	.12	.12	.19	.16	.19	5.04	8.03	.05	.03	.04	.08
13	.19	.13	.13	.19	.16	.19	5.06	8.01	.04	.02	.05	.05
14	.19	.13	.12	.18	.16	.19	5.10	7.99	.04	.02	.04	.06
15	.17	.14	.10	.17	.18	.19	5.96	7.95	.04	.02	.04	.06
16	.16	.14	.10	.16	.21	.18	7.32	7.91	.04	.02	.04	.07
17	.17	.15	.12	.20	.20	.19	7.37	7.91	.04	.02	.04	.08
18	.20	.14	.12	.19	.19	.19	7.33	7.82	.04	.02	.04	.06
19	.18	.13	.12	.19	.19	.18	6.69	7.74	4.87	.02	.04	.06
20	.18	.13	.11	.19	.19	.17	11.04	7.68	8.24	.02	.04	.05
21	.17	.12	.12	.18	.19	.16	15.21	7.58	8.06	.02	.04	.06
22	.16	.12	.13	.17	.20	.17	15.12	7.62	7.81	.02	.04	.08
23	.17	.12	.13	.18	.20	.17	15.03	7.58	8.24	.02	.04	.06
24	.17	.12	.13	.17	.19	.17	8.28	7.56	8.22	.02	.04	.05
25	.16	.12	.13	.17	.19	.17	.12	7.51	7.74	.02	.04	.05
26	.16	.12	.13	.17	.19	.16	3.65	7.43	7.30	.02	.05	.06
27	.17	.12	.16	.19	.17	.19	8.34	7.38	7.22	.02	.04	.05
28	.17	.13	.17	.18	.17	.19	8.33	7.38	7.20	.03	.04	.08
29	.16		.13	.19	.17	.17	8.32	7.42	7.23	.03	.05	.06
30	.16		.14	.19	.17	.16	8.31	7.39	7.25	.03	.05	.05
31	.15		.13		.18		8.29	7.35		.04		.06
MIN	.15	.12	.10	.13	.16	.16	.16	7.35	.04	.02	.04	.05
AVG	.18	.13	.12	.17	.70	.18	6.04	7.83	4.74	.77	.04	.06

Soldiers Meadow Reservoir Daily Discharge Tables (CFS) [SOL QD]

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	.06	.07	.11	.15	.28	.21	7.74	8.48	9.19	.02	.03	.04
2	.05	.08	.09	.13	.29	.24	7.61	8.45	9.14	.02	.02	.04
3	.05	.07	.09	.15	.28	.22	7.70	8.40	9.08	.02	.02	.04
4	.05	.07	.10	.19	.28	.26	7.69	8.36	9.03	.02	.02	.03
5	.05	.08	.10	.19	.28	.21	7.59	8.34	8.94	.02	.02	.02
6	.05	.08	.11	.21	.28	.21	7.36	8.31	8.93	.02	.04	.03
7	.05	.08	.11	.18	.31	.21	7.62	8.28	8.89	.02	.05	.02
8	.05	.08	.10	.19	.31	3.83	7.55	8.24	8.84	.02	.04	.02
9	.05	.08	.10	.19	.29	6.37	8.93	8.21	8.77	.02	.03	.02
10	.05	.08	.12	.19	.29	6.34	11.77	8.17	8.58	.02	.02	.02
11	.07	.08	.12	.19	.31	7.77	6.55	8.17	8.47	.02	.02	.02
12	.06	.09	.12	.19	.29	9.65	.11	8.30	8.43	.02	.02	.02
13	.05	.09	.12	.22	.29	9.65	.11	8.11	7.99	.02	.02	.04
14	.08	.08	.13	.21	.28	5.18	3.81	8.09	8.02	.02	.02	.05
15	.08	.08	.12	.25	.28	4.42	8.91	8.07	8.00	.02	.02	.06
16	.07	.09	.11	.24	.27	8.98	8.90	8.01	7.97	.02	.04	.05
17	.06	.10	.13	.24	.25	7.63	8.88	7.47	7.86	.02	.03	.04
18	.06	.12	.13	.24	1.28	7.33	8.85	8.16	7.69	.02	.02	.05
19	.05	.15	.12	.24	2.93	9.71	8.82	8.12	7.59	.02	.02	.04
20	.06	.18	.12	.23	1.70	6.64	8.77	8.09	7.52	.02	.03	.04
21	.07	.13	.10	.24	1.32	.18	8.73	8.07	7.47	.02	.04	.05
22	.08	.09	.08	.25	1.83	.17	8.71	8.01	3.06	.02	.02	.05
23	.07	.09	.09	.27	.26	.17	8.67	7.88	.02	.02	.02	.04
24	.07	.08	.10	.28	.23	.17	8.62	7.18	.02	.02	.03	.04
25	.07	.09	.16	.28	.25	.16	8.57	7.85	.02	.02	.03	.04
26	.08	.08	.12	.27	.25	3.16	8.54	8.91	.02	.02	.03	.04
27	.08	.09	.11	.28	.25	7.83	4.74	9.28	.02	.02	.03	.05
28	.07	.12	.12	.27	.25	7.83	5.14	9.20	.02	.02	.04	.04
29	.07		.13	.28	.24	7.15	8.42	9.18	.02	.02	.04	.05
30	.07		.13	.28	.22	7.05	8.42	9.11	.02	.02	.04	.04
31	.08		.16		.21		8.49	9.22		.03		.04
MIN	.04	.02	.02	.04	.11	.35	.23	.17	.04	.04	.04	.04
AVG	.06	.09	.12	.22	.52	4.30	7.49	8.31	5.99	.02	.03	.04

Soldiers Meadow Reservoir Daily Discharge Tables (CFS) [SOL QD]

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	.04	.05	.06	.22	.21	.16	4.36	5.91	5.66	.02	.02	.09
2	.03	.04	.06	.25	.24	.15	4.17	5.83	5.64	.02	.02	.07
3	.04	.05	.05	.22	.23	.14	6.45	5.80	5.66	.02	.02	.05
4	.04	.04	.05	.22	.24	.15	6.44	5.80	5.80	.02	.02	.04
5	.04	.04	.05	.21	.22	.19	6.77	5.79	6.29	.02	.02	.02
.6	.05	.05	.07	.21	.22	.19	6.73	5.77	5.65	.02	.02	.02
7	.04	.05	.08	.21	.21	.19	6.79	5.77	5.48	.02	.02	.02
8	.04	.05	.08	.21	.21	.16	6.58	5.77	5.42	.02	.02	.02
9	.03	.05	.08	.23	.19	.16	6.61	9.22	5.48	.02	.02	.02
10	.04	.05	.08	.24	.19	.21	6.61	12.37	5.35	.02	.02	.03
11	.05	.05	.12	.22	.20	.19	6.59	14.80	5.43	.02	.02	.02
12	.07	.05	.16	.21	.19	.16	7.85	16.43	5.45	.02	.02	.02
13	.06	.05	.14	.21	.19	.17	8.79	16.33	5.42	.02	.02	.02
14	.05	.05	.12	.21	.21	.16	8.87	16.20	5.40	.02	.02	.02
15	.06	.06	.11	.23	.20	.16	8.83	16.10	5.18	.02	.02	.02
16	.05	.05	.10	.22	.18	.16	8.29	15.99	5.13	.02	.02	.02
17	.05	.05	.12	.25	.18	.17	7.27	15.86	2.30	.02	.02	.02
18	.06	.05	.12	.25	.18	.16	6.44	15.69	.02	.02	.02	.02
19	.09	.05	.12	.23	.19	.14	6.49	15.61	.02	.02	.02	.02
20	.06	.05	.14	.24	.19	.13	6.34	15.52	.02	.02	.02	.02
21	.05	.05	.12	.22	.20	2.80	6.23	15.31	.02	.02	.02	.02
22	.04	.05	.13	.24	.19	5.18	6.19	15.19	.02	.02	.03	.02
23	.04	.05	.13	.23	.19	5.19	6.17	15.27	.02	.02	.03	.02
24	.04	.06	.13	.22	.19	5.23	6.13	15.33	.02	.02	.04	.02
25	.04	.05	.19	.25	.20	5.20	6.12	15.16	.02	.02	.06	.02
26	.04	.05	.19	.22	.18	5.17	6.05	14.84	.02	.02	.06	.02
27	.04	.06	.19	.21	.19	5.13	6.03	11.09	.02	.02	.05	.02
28	.04	.05	.19	.21	.19	5.08	6.01	6.62	.02	.02	.08	.02
29	.05		.19	.21	.18	4.84	5.98	5.90	.02	.02	.08	.03
30	.05		.19	.21	.17	4.73	5.96	5.74	.02	.02	.08	.05
31	.05		.21		.16		5.96			.02		.05
MIN	.03	.04	.05	.21	.16	.13	4.17	5.74	.02	.02	.02	.02
AVG	.05	.05	.13	.22	.20	1.73	6.58	11.57	3.03	.02	.03	.03

Soldiers Meadow Reservoir Daily Discharge Tables (CFS) [SOL QD]

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	.04	.03	.03	.04	.11	.35	11.26	.18	11.63	.04	.04	.05
2	.04	.02	.04	.04	.11	4.73	11.21	.19	11.62	4.02	.05	.07
3	.05	.03	.02	.04	.13	11.12	11.17	.17	11.54	2.83	.04	.07
4	.05	.02	.02	.05	.16	12.70	11.19	.17	11.45	.04	.05	.07
5	.05	.02	.03	.04	.20	12.67	11.15	.17	11.27	.05	.05	.06
6	.05	.02	.03	.04	.21	12.67	11.12	4.37	10.93	.04	.05	.05
7	.05	.02	.03	.04	.23	12.68	11.09	6.82	11.23	.05	.05	.05
8	.05	.02	.02	.04	.24	12.62	11.05	6.36	11.28	.04	.05	.05
9	.05	.02	.02	.04	.23	12.62	11.00	6.35	11.24	.05	.05	.05
10	.05	.02	.03	.04	..25	12.68	10.97	6.36	10.86	4.18	.05	.05
11	.05	.02	.03	.04	.25	12.68	10.42	6.34	10.36	2.44	.05	.05
12	.05	.02	.03	.04	.25	11.76	10.96	6.28	10.29	.04	.05	.05
13	.04	.02	.03	.07	.26	7.65	10.91	6.25	10.30	.04	.05	.05
14	.04	.02	.04	.09	.29	2.25	10.89	6.20	10.67	.05	.07	.07
15	.05	.02	.04	.08	.28	.32	6.19	6.14	10.18	.05	.05	.08
16	.04	.02	.04	.07	.27	3.52	.23	6.06	9.99	.05	.05	.08
17	.04	.02	.04	.08	.27	6.50	2.38	6.02	7.01	.04	.04	.06
18	.04	.02	.04	.08	.27	6.55	6.71	5.95	.06	.05	.05	.05
19	.03	.02	.04	.09	.27	6.59	8.38	5.94	3.75	.04	.05	.06
20	.04	.02	.04	.09	.28	6.58	8.22	6.20	6.72	6.23	.05	.08
21	.04	.03	.04	.08	.31	6.57	8.01	6.18	6.61	5.03	.05	.06
22	.04	.02	.04	.08	.31	6.33	7.74	6.28	6.64	2.57	.05	.06
23	.04	.02	.04	.08	6.01	6.04	7.80	6.24	6.75	4.29	.05	.06
24	.04	.02	.05	.08	10.04	6.04	6.59	6.23	6.69	8.10	.05	.05
25	.04	.02	.04	.09	9.09	6.03	5.24	6.26	6.46	4.85	.05	.06
26	.04	.02	.04	.08	8.08	6.56	6.57	6.23	2.82	.04	.04	.08
27	.07	.02	.04	.10	3.69	6.55	8.98	6.25	.04	.04	.05	.07
28	.09	.02	.05	.14	.32	6.54	7.17	8.22	.04	.04	.05	.07
29	.09	.02	.04	.16	.33	9.02	7.14	11.63	.04	.04	.05	.07
30	.09		.05	.12	.31	11.26	6.56	11.62	.04	.04	.05	.05
31	.05		.04		.33		3.77	11.61		.04		.05
MIN	.04	.02	.02	.04	.11	.35	.23	.17	.04	.04	.04	.05
AVG	.05	.02	.04	.07	1.98	8.00	8.45	5.78	7.62	1.47	.05	.06

5. Soldiers Meadow Reservoir Daily Storage and Elevation Tables
Acre Feet [SOL AF]

2000

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1					2034.00	2357.00	2023.00	1170.00	687.00			
2					2045.00	2333.00	1991.00	1155.00	675.00			
3	829.00				2056.00	2345.00	1958.00	1140.00	664.00			
4					2068.00	2345.00	1915.00	1117.00	653.00			
5					2090.00		1884.00	1102.00	642.00			
6					2090.00		1852.00	1080.00	632.00			
7					2101.00	2357.00	1821.00	1065.00	621.00			
8			973.00		2112.00	2357.00	1790.00	1050.00	610.00			
9					2124.00	2345.00	1760.00	1036.00				
10					2135.00	2345.00	1719.00	1022.00				
11					2157.00	2333.00	1690.00	994.00				
12				1555.00	2169.00	2333.00	1661.00	980.00				
13			994.00	1593.00	2192.00	2345.00	1621.00	966.00				
14				1631.00	2204.00	2345.00	1584.00	946.00				
15				1670.00	2227.00	2345.00	1546.00	926.00				
16				1710.00	2238.00	2345.00	1509.00	912.00				
17			1022.00	1729.00	2250.00	2345.00	1473.00	892.00				
18	848.00			1760.00	2261.00	2345.00	1436.00	880.00				780.00
19				1790.00	2273.00	2345.00	1397.00	860.00				780.00
20				1811.00	2285.00	2333.00		848.00		670.00		
21				1842.00	2297.00	2321.00	1358.00	829.00				
22				1863.00	2297.00	2297.00	1332.00	816.00				
23			1065.00	1894.00	2309.00	2261.00	1316.00	804.00				
24			1065.00	1915.00	2309.00	2238.00	1299.00	792.00				
25				1936.00	2321.00	2215.00	1282.00	780.00				
26				1947.00	2321.00	2181.00	1266.00	768.00				
27			117.008	1969.00	2321.00	2146.00	1250.00	750.00				
28	860.00			1991.00	2333.00	2124.00	1242.00	738.00	621.00		744.00	
29		919.00	1178.00	2001.00	2345.00	2090.00	1226.00	726.00				756.00
30				2012.00	2345.00	2056.00	1202.00	709.00		698.00	744.00	
31	860.00				2369.00		1186.00	698.00				
MIN AF	829.00	919.00	97.03	1555.00	2034.00	2056.00	1186.00	698.00	610.00	670.00	744.00	756.00
MIN ELEV	4500.90	4502.30	4503.10	4510.30	4515.00	4515.20	4506.00	4498.70	4497.10	4498.20	4499.50	4499.70
AVG AF	849.30	919.00	1067.90	1808.70	2209.80	2282.20	1541.10	914.00	641.50	684.00	744.00	772.00
AVG ELEV	4501.20	4502.30	4504.40	4512.90	4516.60	4517.20	4510.15	4502.23	4497.70	4498.40	4499.50	4500.00

Soldiers Meadow Reservoir Daily Storage and Elevation Tables
Acre Feet [SOL AF]

2001

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1		773.00	792.00		1821.00	2273.00	2001.00	1603.00	1058.00	738.00	762.00	792.00
2	756.00				1884.00	2250.00	2001.00	1584.00	1036.00	738.00	768.00	
3					1936.00	2227.00	2001.00	1574.00	1022.00	738.00		
4					1980.00	2204.00	1991.00	1555.00	1001.00	738.00		
5				1163.00	2033.00	2192.00	1969.00	1537.00	987.00	738.00	468.00	
6			810.00		2053.00	2192.00	1958.00	1527.00		738.00	768.00	
7					2090.00	2192.00	1936.00	1509.00	946.00	738.00		
8				1226.00	2112.00	2192.00	1926.00	1500.00	932.00	738.00	768.00	
9	762.00			1242.00	2135.00	2204.00	1915.00	1482.00	912.00	738.00	768.00	
10				1242.00	2157.00	2204.00	1894.00	1464.00	899.00	738.00		
11				1258.00	2181.00	2204.00	1873.00	1445.00	886.00	738.00		
12				1266.00	2192.00	2204.00	1863.00	1428.00	867.00	738.00		
13			822.00	1282.00	2215.00	2204.00	1842.00	1410.00	854.00	744.00	768.00	
14		786.00		1291.00	2227.00	2204.00	1831.00	1401.00	835.00	744.00	773.00	
15					2250.00	2204.00	1821.00	1384.00	822.00	780.00		
16				1316.00	2261.00	2204.00	1811.00	1367.00	804.00		773.00	
17				1332.00	2273.00	2204.00		1349.00	786.00			
18				1349.00	2273.00	2181.00	1811.00	1332.00	773.00			
19				1375.00	2285.00	2146.00	1780.00	1307.00	756.00	750.00		
20			860.00	1393.00	2297.00	2135.00	1770.00	1291.00	738.00			
21				1419.00	2297.00	2112.00	1760.00	1266.00	738.00			
22			873.00	1436.00	2309.00	2090.00	1750.00	1250.00	738.00	750.00		
23				1473.00	2309.00	2068.00	1740.00	1226.00	738.00			
24			905.00	1509.00	2309.00	2045.00	1729.00	1210.00	738.00			
25			926.00	1537.00	2309.00	2023.00	1710.00	1194.00	738.00	756.00		
26			946.00	1584.00	2321.00	2001.00	1700.00	1170.00	738.00	756.00		
27			966.00	1621.00	2321.00	2001.00	1680.00	1155.00	738.00			
28		792.00	987.00	1661.00	2321.00	2017.00	1670.00	1132.00	738.00	756.00		816.00
29			1008.00	1710.00	2321.00	2001.00	1651.00	1117.00	738.00	756.00		
30			1029.00	1760.00	2309.00	2001.00	1631.00	1094.00	738.00	762.00	792.00	
31	773.00				2285.00		1621.00	1080.00		762.00		
MIN AF	756.00	773.00	792.00	1163.00	1821.00	2001.00	1621.00	1080.00	738.00	738.00	468.00	792.00
MIN ELEV	4499.2	4500.00	4500.30	4505.70	4513.00	4514.80	4511.01	4505.60	4499.40	4499.40	4494.20	4500.30
AVG AF	763.70	783.70	901.20	1400.30	2183.969	2141.29	1814.742	1344.50	834.40	746.25	716.00	804.00
AVG ELEV	4499.80	4500.20	4502.04	4508.60	4516.30	4515.90	4512.90	4507.90	4500.90	4499.50	4499.02	4500.50

Soldiers Meadow Reservoir Daily Storage and Elevation Tables
Acre Feet [SOL AF]

2002

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	816.00	867.00	886.00		2001.00	2369.00	2357.00	1926.00	1719.00	1299.00		
2					2023.00	2369.00	2357.00	1915.00	1710.00	1282.00		
3				1022.00	2034.00	2381.00	2345.00	1905.00	1710.00	1258.00		
4					2045.00	2381.00	2333.00	1894.00	1710.00	1258.00		
5				1043.00	2068.00	2381.00	2321.00	1884.00	1700.00			1250.00
6					2079.00	2369.00	2309.00	1873.00	1690.00			1250.00
7					2090.00	2345.00	2297.00	1873.00	1690.00	1258.00		
8	829.00			1109.00	2112.00	2345.00	2297.00	1863.00	1680.00	1258.00	1242.00	
9					2135.00	2357.00	2285.00	1863.00	1680.00			
10				1178.00	2146.00	2369.00	2273.00	1852.00	1670.00			
11				1218.00	2157.00	2369.00	2261.00	1842.00	1661.00		1242.00	
12			912.00	1266.00	2169.00	2357.00	2250.00	1831.00	1661.00			1250.00
13				1324.00	2181.00	2357.00	2238.00	1831.00	1631.00			
14				1428.00	2192.00	2357.00	2215.00	1821.00	1612.00			
15				1527.00	2204.00	2357.00	2204.00	1811.00	1593.00	1250.00		
16	835.00			1593.00	2215.00	2369.00	2181.00	1811.00	1574.00			
17				1641.00	2215.00	2369.00		1800.00	1555.00			
18				1680.00	2227.00	2381.00		1800.00	1546.00			
19				1719.00	2238.00	2381.00	2135.00	1790.00	1527.00		1242.00	
20				1750.00	2238.00	2357.00	2101.00	1780.00	1509.00			1250.00
21				1780.00	2250.00	2345.00	2068.00	1780.00	1491.00	1242.00		
22				1811.00	2261.00	2357.00		1780.00	1464.00	1242.00		
23				1831.00	2285.00	2357.00	2012.00	1770.00	1445.00	1242.00		
24				1852.00	2297.00	2357.00	2012.00	1760.00	1428.00			
25				1873.00	2309.00	2357.00	2012.00	1760.00	1410.00		1250.00	
26			959.00	1894.00	2321.00	2369.00	2001.00	1750.00	1393.00			
27		886.00		1926.00	2333.00	2369.00	1980.00	1750.00	1375.00			
28			966.00	1947.00	2345.00	2369.00	1969.00	1740.00	1349.00	1242.00		
29				1969.00	2345.00	2381.00	1958.00	1740.00	1332.00	1242.00		
30				1980.00	2357.00	2369.00	1947.00	1729.00	1316.00			1250.00
31	867.00		966.00		2357.00		1936.00	1729.00				
MIN AF	816.00	867.00	886.00	1022.00	2001.00	2345.00	1936.00	1729.00	1316.00	1242.00	1242.00	1250.00
MIN ELEV	4500.70	4501.50	4501.80	4503.80	4514.70	4517.70	4514.10	4512.10	4507.60	4506.70	4506.70	4506.80
AVG AF	836.80	876.50	937.80	1575.30	2194.70	2364.40	2158.30	1811.90	1553.10	1255.00	1244.00	1250.00
AVG ELEV	4510.00	4501.60	4502.60	4510.50	4516.40	4517.80	4516.10	4512.90	4510.30	4506.90	4506.70	4506.80

Soldiers Meadow Reservoir Daily Storage and Elevation Tables
Acre Feet [SOL AF]

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1				2068.00	2309.00	2333.00	2261.00	1482.00	867.00	786.00		792.00
2		1393.00		2112.00	2321.00	2333.00	2238.00	1454.00	854.00			
3				2146.00	2333.00	2333.00	2215.00	1419.00	848.00			
4			1518.00	2181.00	2345.00	2333.00	2204.00	1384.00	835.00			
5		1428.00	1518.00	2204.00	2357.00	2333.00	2181.00	1349.00	822.00			792.00
6	1258.00		1527.00	2227.00	2357.00	2333.00	2157.00	1316.00	816.00	780.00		
7		1436.00	1527.00	2250.00	2357.00	2345.00	2135.00	1282.00	810.00		780.00	
8			1537.00	2250.00	2357.00	2345.00	2124.00	1250.00	798.00			792.00
9			1537.00	2250.00	2333.00	2345.00	2101.00	1210.00	792.00			
10		1464.00	1537.00	2250.00	2345.00	2345.00	2079.00	1178.00	792.00	780.00	780.00	
11		1464.00	1546.00	2261.00	2333.00	2345.00	2045.00	1147.00	792.00			
12		1464.00	1546.00	2261.00	2333.00	2345.00	2023.00	1109.00	792.00			
13			1565.00	2273.00	2333.00	2345.00	2001.00	1072.00				
14		1464.00		2285.00	2321.00	2345.00	1980.00	1065.00		780.00	780.00	
15				2285.00	2321.00	2333.00	1947.00	1065.00	792.00			
16			1651.00	2285.00	2309.00	2333.00	1926.00	1058.00				804.00
17	1258.00	1473.00	1680.00	2285.00	2309.00	2333.00		1043.00			780.00	
18		1482.00	1700.00	2273.00	2309.00	2333.00		1029.00				
19		1482.00	1710.00	2261.00	2309.00	2333.00		1015.00	786.00			804.00
20		1482.00	1719.00	2261.00	2309.00	2333.00	1821.00	1008.00		780.00	786.00	
21	1258.00	1491.00	1750.00	2238.00	2309.00	2333.00		994.00				
22			1760.00	2238.00	2321.00	2333.00	1790.00	980.00				
23			1800.00	2250.00	2321.00	2333.00	1770.00	966.00				810.00
24	1266.00	1500.00	1852.00	2250.00	2333.00	2333.00		952.00	786.00	780.00		810.00
25		1509.00	1873.00	2261.00	2333.00	2333.00	1719.00	946.00	786.00		786.00	810.00
26		1509.00	1905.00	2285.00	2345.00	2333.00	1690.00	932.00				810.00
27		1509.00	1926.00	2285.00	2357.00	2321.00	1651.00	919.00				
28	1307.00	1509.00	1947.00	2285.00	2369.00	2309.00	1621.00	912.00		780.00		816.00
29			1969.00	2297.00	2357.00	2285.00	1584.00	899.00	786.00			816.00
30	1324.00		1991.00	2297.00	2345.00	2273.00	1546.00	886.00		780.00		816.00
31	1349.00		2012.00		2333.00		1518.00	880.00				816.00
MIN AF	1258.00	1393.00	1518.00	2068.00	2309.00	1518.00	880.00	786.00	786.00	780.00	780.00	792.00
MIN ELEV	4506.90	4508.50	4509.90	4515.30	4517.40	4509.90	4501.70	4500.20	4500.20	4500.10	4500.10	4500.30
AVG AF	1284.80	1469.60	1708.20	2239.40	2332.30	1920.20	1096.30	807.80	781.30	781.70	781.70	805.70
AVG ELEV	4507.20	4509.40	4511.90	4516.80	4517.60	4513.90	4504.80	4500.60	4500.10	4500.10	4500.10	4500.50

Soldiers Meadow Reservoir Daily Storage and Elevation Tables
Acre Feet [SOL AF]

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1					2034.00	2357.00	2023.00	1170.00	687.00			
2					2045.00	2333.00	1991.00	1155.00	675.00			
3	829.00				2056.00	2345.00	1958.00	1140.00	664.00			
4					2068.00	2345.00	1915.00	1117.00	653.00			
5					2090.00		1884.00	1102.00	642.00			
6					2090.00		1852.00	1080.00	632.00			
7					2101.00	2357.00	1821.00	1065.00	621.00			
8			973.00		2112.00	2357.00	1790.00	1050.00	610.00			
9					2124.00	2345.00	1760.00	1036.00				
10					2135.00	2345.00	1719.00	1022.00				
11					2157.00	2333.00	1690.00	994.00				
12				1555.00	2169.00	2333.00	1661.00	980.00				
13			994.00	1593.00	2192.00	2345.00	1621.00	966.00				
14				1631.00	2204.00	2345.00	1584.00	946.00				
15				1670.00	2227.00	2345.00	1546.00	926.00				
16				1710.00	2238.00	2345.00	1509.00	912.00				
17			1022.00	1729.00	2250.00	2345.00	1473.00	892.00				
18	848.00			1760.00	2261.00	2345.00	1436.00	880.00				780.00
19				1790.00	2273.00	2345.00	1397.00	860.00				780.00
20				1811.00	2285.00	2333.00		848.00		670.00		
21				1842.00	2297.00	2321.00	1358.00	829.00				
22				1863.00	2297.00	2297.00	1332.00	816.00				
23			1065.00	1894.00	2309.00	2261.00	1316.00	804.00				
24			1065.00	1915.00	2309.00	2238.00	1299.00	792.00				
25				1936.00	2321.00	2215.00	1282.00	780.00				
26				1947.00	2321.00	2181.00	1266.00	768.00				
27			1178.00	1969.00	2321.00	2146.00	1250.00	750.00				
28	860.00	919.00		1991.00	2333.00	2124.00	1242.00	738.00	621.00		744.00	
29			1178.00	2001.00	2345.00	2090.00	1226.00	726.00				756.00
30				2012.00	2345.00	2056.00	1202.00	709.00		698.00	744.00	
31	860.00				2369.00		1186.00	698.00				
MIN AF	829.00	919.00	973.00	1555.00	2034.00	2357.00	1186.00	1170.00	610.00	670.00	744.00	756.00
MIN ELEV	4500.90	4502.30	4503.10	4510.30	4515	4517.80	4506	4505.80	4497.10	4498.20	4499.50	4499.70
AVG AF	849.30	919.00	1056.00	1808.70	2209.80	2292.60	1541.10	928.80	641.5	684.00	744.00	772.00
AVG ELEV	4501.20	4502.30	4504.30	4512.90	4516.60	4517.30	4510.20	4502.40	4497.70	4498.50	4499.50	4499.90

Soldiers Meadow Reservoir Daily Storage and Elevation Tables
Acre Feet [SOL AF]

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1								1670.00		804.00		
2					1641.00				1087.00	786.00		
3	1210.00				1651.00			1631.00	1072.00	773.00		
4		1258.00	1274.00	1375.00	1661.00			1612.00	1058.00	762.00		
5							2112.00	1603.00	1043.00			786.00
6					1670.00	2068.00	2101.00	1565.00	1029.00			
7	1218.00		1274.00				2090.00	1555.00	1015.00		773.00	
8		1266.00		1410.00			2068.00	1537.00	1001.00			
9			1282.00		1700.00	2079.00	2068.00	1518.00				792.00
10			1282.00		1719.00		2068.00	1491.00				
11		1266.00	1282.00	1436.00			2056.00	1482.00			780.00	
12	1218.00			1454.00			2045.00	1464.00		762.00		
13						2101.00	2034.00	1445.00				
14		1266.00						1428.00	1001.00		780.00	
15			1291.00				2012.00	1410.00				
16							2001.00	1393.00	1001.00			
17			1291.00			2112.00	1980.00	1375.00		768.00		
18	1234.00			1518.00	1842.00		1958.00	1349.00			780.00	
19	1234.00						1948.00	1332.00	1001.00	768.00		786.00
20					1863.00	2112.00	1926.00	1322.00	973.00			
21	1242.00		1299.00				1894.00	1307.00	952.00	768.00		
22		1266.00					1852.00	1282.00	939.00	768.00	780.00	786.00
23							1821.00	1266.00	919.00			
24		1266.00					1790.00	1250.00	905.00	768.00	780.00	
25			1307.00	1593.00	1958.00			1234.00	892.00			
26	1250.00				1969.00		1790.00		873.00			
27							1770.00	1202.00	854.00	762.00		
28	1250.00	1274.00	1332.00	1621.00		2124.00		1186.00	841.00			
29							1719.00		822.00			
30			1341.00	1640.00				1147.00	810.00		780.00	810.00
31	1258.00				2012.00		1680.00	1124.00		762.00		
MIN AF	1210.00	1258.00	1274.00	1375.00	1641.00	2068.00	1680.00	1124.00	810.00	762.00	773.00	786.00
MIN ELEV	4506.30	4506.90	4507.10	4508.30	4511.20	4515.30	4511.60	4505.20	4500.60	4499.80	4500.00	4500.20
AVG AF	1232.40	1265.00	1294.10	1491.30	1777.30	2094.90	1936.00	1389.80	950.00	770.20	778.25	791.00
AVG ELEV	4506.60	4506.90	4507.30	4509.60	4512.60	4515.50	4514.10	4508.60	4502.80	4499.90	4500.10	4500.30

Soldiers Meadow Reservoir Daily Storage and Elevation Tables
Acre Feet [SOL AF]

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			912.00		2034.00	2250.00	2079.00	1537.00	966.00		605.00	
2					2053.00	2261.00	2068.00	1518.00	952.00	594.00		
3				1036.00	2079.00	2261.00	2045.00	1500.00	932.00	594.00		
4				1058.00	2090.00	2273.00	2034.00	1482.00	905.00	594.00		703.00
5				1080.00	2112.00		2012.00	1464.00	892.00	594.00		
6			926.00	1109.00	2112.00	2285.00	1991.00	1445.00	867.00	594.00	621.00	
7				1155.00	2124.00	2285.00	1980.00	1419.00	854.00	954.00		
8						2297.00	1958.00	1410.00	829.00	594.00		
9			932.00	1226.00	2169.00	2285.00	1947.00	1393.00	810.00	594.00		
10				1266.00	2169.00	2273.00	1926.00	1367.00	786.00	594.00		
11				1316.00	2181.00	2268.00	1894.00	1349.00	762.00	594.00		721.00
12	841.00			1349.00	2192.00	2250.00		1332.00	750.00			
13				1401.00	2192.00	2238.00		1307.00	726.00			721.00
14			939.00	1445.00	2204.00	2227.00	1884.00	1299.00	715.00			
15		899.00	939.00	1491.00	2204.00	2238.00	1863.00	1274.00	698.00			
16			939.00	1546.00	2215.00	2215.00	1842.00	1258.00	681.00			
17	860.00			1603.00		2204.00	1821.00	1242.00	664.00		966.00	
18				1621.00	2215.00	2192.00	1811.00	1226.00	648.00			744.00
19				1661.00	2215.00	2181.00	1790.00	1210.00	626.00			
20				1680.00	22.15.00	2157.00	1770.00	1194.00	610.00		664.00	
21		899.00		1729.00	2215.00	2157.00	1750.00	1178.00	599.00		670.00	
22			946.00	1761.00	2227.00	2157.00	1729.00	1155.00	594.00		675.00	
23				1795.00	2227.00	2157.00	1710.00	1140.00	594.00	605.00		
24				1832.00	2227.00	2157.00	1690.00	1124.00	594.00			
25			956.00	1863.00	2227.00	2157.00	1670.00	1102.00		605.00		
26			966.00	1894.00	2238.00	2146.00	1651.00	1087.00	594.00			762.00
27	873.00		977.00		2238.00	2146.00	1631.00	1065.00	594.00		692.00	762.00
28			977.00	1958.00	2250.00	2124.00	1621.00	1043.00	594.00			
29			990.00	1980.00	2250.00	2112.00	1603.00	1022.00	594.00			
30			998.00	2001.00	2250.00	2101.00	1584.00	1008.00	594.00		698.00	
31	873.00		1008.00		2250.00		1565.00	987.00				
MIN AF	841.00	899.00	912.00	1036.00	2215.00	2101.00	1565.00	987.00	594.00	594.00	605.00	703.00
MIN ELEV	4501.1	4502.00	4502.20	4504.00	4516.60	4515.60	4510.40	4503.30	4496.80	4496.80	4497.00	4498.80
AVG AF	861.80	899.00	954.50	1514.50	2040.11	2205.20	1816.10	1253.90	720.60	623.40	688.40	730.90
AVG ELEV	4501.40	4502.00	4502.80	4509.80	4515.10	4516.50	4512.90	4506.80	4499.10	4497.30	4498.50	4499.30

Soldiers Meadow Reservoir Daily Storage and Elevation Tables
Acre Feet [SOL AF]

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			867.00	1454.00	1958.00	2068.00	1980.00	1491.00	703.00	495.00	509.00	
2	773.00		867.00	1474.00	1969.00	2068.00	1969.00	1473.00	692.00	497.00	509.00	
3			873.00	1500.00	1980.00	2068.00	1958.00	1464.00	681.00	497.00		539.00
4	773.00		873.00	1527.00	1991.00	2068.00	1936.00	1445.00	664.00	500.00		544.00
5				1537.00	1996.00	2061.00	1926.00	1428.00	653.00	500.00	509.00	
6		810.00	873.00	1555.00	2003.00	2068.00	1905.00	1419.00	637.00	500.00		548.00
7				1574.00	2012.00	2068.00	1894.00	1401.00	626.00	500.00	509.00	
8				1593.00	2012.00	2068.00	1873.00	1393.00	611.00	500.00		
9	780.00	810.00		1621.00	2023.00	2068.00	1852.00	1375.00	599.00	500.00		
10			894.00	1641.00	2023.00	2079.00	1842.00	1341.00	584.00	500.00		
11			901.00	1661.00	2023.00	2092.00	1831.00	1324.00	579.00	500.00		553.00
12	792.00	816.00		1670.00	2023.00	2092.00	1811.00	1282.00	558.00	500.00	509.00	
13				1690.00	2034.00	2092.00	1790.00	1250.00	544.00		514.00	553.00
14			959.00	1700.00	2034.00	2092.00	1770.00	1218.00	534.00			553.00
15			987.00	1723.00	2034.00	2092.00	1750.00	1178.00	519.00	501.00		
16	792.00	829.00	1001.00	1740.00	2034.00	2096.00	1729.00	1140.00	509.00	501.00		
17			1022.00	1770.00	2034.00	2096.00	1710.00	1109.00	495.00	501.00		
18			1043.00	1781.00	2034.00	2096.00	1700.00	1073.00	495.00	501.00		558.00
19	798.00		1080.00	1800.00	2034.00	2096.00	1680.00	1039.00	495.00	505.00	524.00	
20			1109.00	1821.00	2034.00	2096.00	1661.00	1008.00	495.00	505.00		564.00
21			1132.00	1831.00	2045.00	2096.00	1650.00	976.00	495.00	507.00		
22		841.00	1148.00	1842.00	2056.00	2079.00	1631.00	946.00	494.00	507.00		
23		848.00	1178.00	1863.00	2056.00	2072.00	1621.00	912.00	494.00	507.00	529.00	
24	798.00		1194.00	1884.00	2056.00	2060.00	1603.00	880.00	494.00	507.00		
25			1226.00	1895.00	2061.00	2045.00	1603.00	841.00	494.00	509.00		
26		854.00	1274.00	1905.00	2062.00	2034.00	1574.00	810.00	491.00	509.00	529.00	569.00
27		860.00	1316.00	1915.00	2062.00	2023.00	1565.00	778.00	491.00			
28		860.00	1349.00	1927.00	2064.00	2012.00	1546.00	756.00	491.00			
29	804.00		1375.00	1938.00	2064.00	2001.00	1537.00	744.00	495.00	509.00		
30			1401.00	1947.00	2064.00	1990.00	1518.00	732.00	495.00	509.00	534.00	
31			1428.00		2064.00		1502.00	721.00		509.00		574.00
MIN AF	**773**.00	810.00	867.00	1454.00	1958.00	1990.00	1980.00	1491.00	703.00	495.00	509.00	539.00
MIN ELEV	4500.00	4500.60	4501.50	4509.20	4514.30	4514.60	4514.50	4509.60	4498.80	4494.80	4495.10	4495.70
AVG AF	787.00	833.80	1086.10	1717.20	2028.00	2065.40	1746.80	1138.70	558.40	502.50	516.70	554.00
AVG ELEV	4500.20	4500.90	4504.70	4511.90	4514.90	4515.30	4512.30	4505.40	4496.10	4495.90	4495.20	4496.02

Soldiers Meadow Reservoir Daily Storage and Elevation Tables
Acre Feet [SOL AF]

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			633.00	698.00	1036.00	2333.00	2238.00	1690.00	1288.00	810.00		
2			636.00	703.00	1065.00	2357.00	2215.00	1689.00	1266.00	810.00		
3			637.00	703.00	1087.00	2369.00	2204.00	1688.00	1234.00	798.00	726.00	770.00
4	579.00		637.00	703.00	1117.00	2369.00	2169.00	1686.00	1210.00			
5			642.00	708.00	1170.00	2369.00	2146.00	1685.00	1186.00			
6			642.00	709.00	1234.00	2363.00	2124.00	1683.00	1163.00	798.00		
7			642.00	712.00	1308.00	2362.00	2112.00	1670.00	1140.00	798.00	726.00	
8			642.00	713.00	1375.00	2358.00	2079.00	1651.00	1117.00	798.00		
9			648.00	715.00	1431.00	2345.00	2056.00	1641.00	1094.00	799.00		778.00
10	584.00		648.00	715.00	1487.00	2345.00	2034.00	1625.00	1065.00	800.00		
11			648.00	721.00	1540.00	2345.00	2012.00	1612.00	1043.00	786.00		
12		615.00	653.00	721.00	1593.00	2345.00	1991.00	1603.00	1022.00		738.00	
13			653.00	727.00	1631.00	2333.00	1969.00	1583.00	1001.00			
14			658.00	738.00	1680.00	2345.00	1947.00	1565.00	978.00	785.00		
15			659.00	747.00	1740.00	2356.00	1915.00	1555.00	959.00	785.00		786.00
16	584.00		662.00	756.00	1800.00	2369.00	1915.00	1540.00	932.00	785.00		
17			664.00	768.00	1863.00	2369.00	1915.00	1527.00	912.00	785.00	752.00	
18			664.00	780.00	1926.00	2369.00	1905.00	1509.00	905.00			
19			670.00	798.00	1980.00	2369.00	1884.00	1500.00	905.00			786.00
20		621.00	672.00	810.00	2034.00	2359.00	1863.00	1482.00	891.00	785.00	756.00	
21			675.00	822.00	2090.00	2355.00	1852.00	1482.00	882.00	773.00		
22			675.00	835.00	2135.00	2347.00	1832.00	1464.00	867.00	762.00		
23	589.00		675.00	848.00	2181.00	2341.00	1821.00	1451.00	855.00	756.00		792.00
24			683.00	860.00	2192.00	2334.00	1800.00	1436.00	841.00	750.00	754.00	
25	594.00		687.00	880.00	2204.00	2325.00	1790.00	1422.00	829.00			
26			687.00	889.00	2215.00	2317.00	1780.00	1411.00	810.00		756.00	
27			692.00	906.00	2215.00	2307.00	1760.00	1397.00		721.00		
28			692.00	932.00	2238.00	2295.00	1740.00	1386.00		721.00		
29		633.00	692.00	971.00	2261.00	2283.00	1729.00	1364.00	810.00	721.00		805.00
30	599.00		698.00	1008.00	2297.00	2261.00	1710.00	1339.00	810.00	721.00	762.00	
31	605.00		698.00		2309.00		1700.00	1314.00		721.00		805.00
MIN AF	579.00	615.00	633.00	698.00	1036.00	2261.00	1700.00	1314.00	810.00	721.00	726.00	770.00
MIN ELEV	4496.50	4497.20	4497.50	4498.70	4504.00	4517.00	4511.80	4507.60	4500.60	4499.10	4499.20	4499.90
AVG AF	589.00	621.00	662.40	783.70	1733.40	2340.40	1934.60	1530.10	994.00	770.40	744.00	786.50
AVG ELEV	4496.6	4497.3	4498.10	4500.20	4512.10	4517.70	4514.10	4510.00	4503.40	449.96	449.50	4500.01

6. Lake Waha Daily Storage and Elevation Tables
Acre Feet

2000

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1												
2		1475.00										
3	1495.00				2520.00							
4												
5							2430.00					
6									1369.00			
7								1872.00				
8							2415.00					
9												
10												
11							2392.00		1342.00			
12												
13							2377					
14				2257.00				1740.00				
15							2362.00					
16												
17												
18												
19				2392.00	2570.00							
20							2325.00					
21							2317.00	1575.00				
22												
23												
24		1515.00					2212.00					
25												
26				2475.00								
27												
28	OFF						2107.00	1490.00	1331.00		1369.00	
29	OFF		1820.00			2470.00						1353.00
30	OFF						2040.00			1364.00		
31	1475.00				2555.00		2025.00					
MIN. AF	1475.00	1475.00	1820.00	2257.00	2520.00	2470.00	2025.00	1490.00	1331.00	1364.00	1369.00	1353.00
MIN. ELEV	3342.42	3342.42	3348.53	3355.78	3359.96	3359.20	3351.98	3342.70	3339.75	3340.37	3340.46	3340.20
AVG AF	1485.50	1495.00	1820.00	2374.67	2548.33	2470.00	2272.91	1669.25	1347.33	1364.00	1369.00	1353.00
AVG ELEV	3342.61	3342.78	3348.53	3357.67	3360.39	3359.20	3356.04	3346.40	3340.05	3340.37	3340.46	3340.20

Lake Waha Daily Storage and Elevation Tables Acre Feet

2001

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1		1347.00	1369.00		2725.00	2867.00		1857.00			1347.00	1326.00
2	1353.00				2792.00	2860.00	2540.00					
3					2822.00	2852.00	2520.00					
4					2860.00	2852.00	2505.00					
5					2890.00		2485.00		1395.00			
6					2905.00	2830.00	2460.00					
7					2915.00	2822.00	2430.00					
8					2925.00		2430.00					
9					2940.00		2377.00					
10					2940.00	2792.00	2347.00					
11					2955.00	2792.00	2325.00					
12					2955.00	2785.00	2298.00					
13					2955.00	2777.00	2272.00					
14					2955.00	2770.00						
15					2962.00	2762.00	2220.00					
16					2662.00	2755.00	2197.00					
17					2962.00	2755.00						
18				2145.00	2962.00	2732.00						
19					2962.00	2732.00	2115.00					
20					2962.00							
21					2940.00							
22					2925.00	2695.00						
23				2347.00	2925.00	2687.00						
24				2385.00	2920.00							
25				2437.00	2910.00		1990.00					
26				2480.00	2905.00							
27				2520.00	2900.00							
28		1369.00		2555.00	2895.00	2717.00						1311.00
29	1347.00			2612.00	2885.00	2605.00						
30				2665.00	2880.00						1326.00	
31	1347.00				2875.00					1347.00		
MIN AF	1347.00	1347.00	1369.00	2145.00	2662.00	2605.00	1990.00	1857.00	1395.00	1347.00	1326.00	1311.00
MIN. ELEV	3340.05	3340.05	3340.50	3353.96	3362.20	3362.30	3351.40	3349.14	3340.95	3340.05	3339.80	3339.40
AVG AF	1349.00	1358.00	1369.00	2460.67	2902.13	2771.95	2344.44	1857.00	1395.00	1347.00	1336.50	1318.50
AVG. ELEV	3340.08	3340.30	3340.50	3359.02	3365.80	3363.82	3357.17	3349.14	3340.95	3340.05	3339.84	3339.50

Lake Waha Daily Storage and Elevation Tables Acre Feet

2002

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	1311.00	1319.00	1315.00									
2												
3					2467.00							
4												
5												
6						2515.00						
7							2612.50					
8												
9					2495.00				1415.00			
10												
11						2550.00						
12					2505.00			1955.00				
13						2627.00		1935.00				
14							2560.00	1915.00				
15												
16					2515.00							
17				2107.00								
18												
19						2710.00						
20												
21								1755.00				
22												
23					2500.00		2510.00					
24				2325.00		2710.00						
25			1405.00								1347.50	
26												1320.00
27		1315.00					2400.00		1405.00			
28						2680.00	2370.00					
29	1319.00				2505.00			1590.00				
30							2302.00			1380.00		
31	1319.00		1405.00		2510.00		2272.50	1550.00				
MIN AF	1311.00	1315.00	1315.00	2107.00	2467.00	2515.00	2272.50	1550.00	1405.00	1380.00	1347.50	1320.00
MIN. ELEV	3339.37	3339.44	3339.44	3353.34	3359.12	3359.87	3356.02	3343.78	3341.13	3340.70	3340.07	3339.54
AVG AF	1316.33	1317.00	1375.00	2216.00	2499.60	2632.00	2432.43	1783.33	1410.00	1380.00	1347.50	1320.00
AVG ELEV	3339.46	3339.48	3340.57	3355.12	3359.64	3361.69	3358.57	3347.88	3341.23	3340.70	3340.07	3339.54

Lake Waha Daily Storage and Elevation Tables Acre Feet

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1				2422.50	2925.00		2635.00	2407.50				
2				2467.50	2925.00	2885.00	2620.00		1810.00			
3				2495.00	2925.00	2880.00		2392.50				
4				2515.00			2605.00	2385.00				
5				2540.00	2955.00	2860.00		2377.50				
6				2555.00	2962.50		2582.50	2370.00				
7				2570.00	2962.50		2575.00	2362.50				
8				2582.00	2962.50	2837.50	2570.00	2355.00	1692.00	1284.00		
9				2597.00			2565.00					
10				2620.00		2815.00	2560.00					
11				2642.50	2977.50	2807.50	2555.00	2332.50				
12				2672.00	2977.50			2317.50	1600.00			
13				2702.00	1977.50		2540.00	2310.00				
14				2732.00	1977.50		2535.00	2310.00				
15				2755.00	1977.50		2530.00	2280.00	1550.00			
16				2785.00	2977.50		2525.00	2242.50				
17				2807.50		2755.00		2212.50				
18				2830.00	2962.00	2747.50		2167.00				
19				2852.50	2962.00	2732.50		2152.50				
20				2867.50	2955.00	2725.00	2500.00	2137.50				
21				2875.00				2100.00				
22				2895.00	2947.50	2710.00	2490.00					
23				2905.00	2932.50	2702.50	2480.00					
24				2905.00		2695.00	2475.00					
25		1605.00	2212.50	2905.00		2680.00		1990.00			1255.00	
26			2250.00				2460.00					
27	1325.00			2910.00	2915.00	2665.00						
28			2325.00	2910.00			2445.00					
29				2915.00	2905.00		2437.50		1293.00			1250.00
30			2362.50	2920.00	2900.00	2642.50						
31			2392.50				2422.50	1854.00		1270.00		
MIN AF	1325.00	1605.00	2212.50	2422.50	1977.50	2642.50	2422.50	1854.00	1293.00	1270.00	1255.00	1250.00
MIN. ELEV	339.63	3345.76	3355.05	3358.43	3351.21	3361.86	3358.43	3349.10	3339.00	3338.58	3338.30	3338.21
AVG AF	1325.00	1605.00	2308.50	2729.31	2807.69	2758.75	2528.93	2252.80	1589.00	1277.00	1255.00	1250.00
MIN. ELEV	3339.63	3345.76	3356.60	3363.17	3364.37	3363.63	3360.09	3355.71	3344.48	3338.72	3338.30	3338.21

Lake Waha Daily Storage and Elevation Tables Acre Feet

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1												
2												
3	1495.00	1475.00			2520.00							
4												
5							2430.00					
6									1369.00			
7								1872.00				
8							2415.00					
9												
10												
11							2392.00		1342.00			
12												
13							2377.00					
14				2257.00				1740.00				
15							2362.00					
16												
17												
18												
19				2392.00	2570.00							
20							2325.00					
21							2317.00	1575.00				
22												
23												
24							2212.00					
25		1515.00										
26				2475.00								
27												
28	OFF						2107.00	1490.00	1331.00		1369.00	
29	OFF		1820.00			2470.00						1353.00
30	OFF						2040.00			1364.00		
31	1475.00				2555.00		2025.00					
MIN AF	1475.00	1475.00	1820.00	2257.00	2520.00	2470.00	2025.00	1490.00	1331.00	1364.00	1369.00	1353.00
MIN. ELEV	3342.42	3342.42	3348.52	3355.78	3359.96	3359.17	3351.98	3342.70	3339.75	3340.37	3340.46	3340.16
AVG AF	1485.00	1495.00	1820.00	2374.67	2548.33	2470.00	2272.91	1669.25	1347.33	1364.00	1369.00	1353.00
AVG ELEV	3342.60	3342.42	3348.52	3357.67	3360.39	3359.17	3356.04	3345.90	3340.05	3340.37	3340.46	3340.16

Lake Waha Daily Storage and Elevation Tables Acre Feet

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1								1765.00	1190.00	1125.00		
2					1765.00							
3							2325.00	1720.00	1160.00			
4				1445.00	1765.00			1700.00	1140.00	1125.00		
5							2275.50	1685.00	1125.00			1011.50
6					1765.00	2445.00	2250.00		1125.00			
7							2112.50	1632.50	1125.00		1007.00	
8				1475.00			2175.00	1605.00	1125.00			
9					1810.00	2445.00	2160.00	1590.00				1016.00
10					1825.00		2137.50	1560.00				
11				1505.00			2100.00				1007.00	
12				1520.00			2077.50	1535.00		1125.00		
13							2055.00	1525.00				
14									1125.00		1007.00	
15						2430.00	2005.00	1490.00				
16							1990.00	1470.00	1125.00			1011.50
17					2020.00		1970.00	1455.00		1125.00		
18				1595.00			1965.00	1440.00		1120.00		
19				1620.00			1950.00	1420.00	1125.00	1100.00		1011.50
20					2190.00	2415.00	1940.00					
21						2407.50	1940.00	1390.00	1125.00	1070.00		
22							1940.00			1050.00	1007.00	1011.50
23								1353.00	1125.00			
24		142.00								1020.50		
25				1730.00	2377.00			1320.00				
26					2385.00		1895.00		1125.00	993.50		
27							1865.00	1293.00				
28		1425.00	1410.00	1755.00		2347.00						
29							1825.00		1125.00			
30			1425.00	1755.00					1125.00		1007.00	1016.00
31	1420.00				2437.50		1775.00					
MIN AF	1420.00	1425.00	1410.00	1445.00	1765.00	2347.00	1775.00	1293.00	1125.00	993.50	1007.00	1011.50
MIN ELEV	3341.42	3341.50	3341.22	3341.87	3347.57	3357.22	3347.75	3339.02	3335.70	3333.03	3333.30	3333.41
AVG AF	1420.00	1425.00	1417.50	1600.00	2033.95	2414.90	2033.09	1523.61	1132.70	1085.40	1007.00	1013.00
AVG ELEV	3341.42	3341.50	3341.37	3344.67	3352.13	3358.28	3352.12	3343.30	3335.90	3334.90	3333.3	3333.45

Lake Waha Daily Storage and Elevation Tables Acre Feet

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			1065.00		2100.00	2085.00	1825.00	1331.00	1011.00		948.00	
2					2107.50	2085.00	1810.00	1320.00	1011.00	1011.00		
3		1050.00	1065.00	1200.00	2115.00	2085.00	1795.00	1297.00	1011.00			
4				1220.00	2122.50	2085.00	1785.00	1279.00	1011.00	1011.00		993.00
5				1245.00	2122.50	2077.00	1770.00	1265.00	1011.00	1007.00		
6			1060.00	1284.00	2122.50	2055.00	1750.00	1245.00	1011.00	989.00	948.00	993.00
7				1336.50	2130.00	2040.00	1735.00	1230.00	1011.00			
8				1380.00		2032.00	1715.00	1215.00	1011.00	964.00		
9			1075.00	1425.00	2130.00	2032.00	1692.00	1200.00	1011.00	950.00		
10		1060.00		1465.00	2137.50	2032.00	1692.00	1185.00	1007.00	936.00		
11			1080.00	1510.00		2032.00	1685.00	1165.00	1007.00	936.00		1002.00
12	1035.00			1545.00	2135.50	2032.00		1150.00	1007.00			
13			1085.00	1585.00	2130.00	2025.00		1135.00	1007.00			1002.00
14			1085.00	1625.00	2130.00	2032.00	1662.50	1120.00	1007.00			
15		1060.00	1090.00	1670.00		2025.00	N/R	1105.00	1007.00			
16			1085.00	1720.00	2122.50	2025.00	1620.00	1085.00	1007.00	940.00		
17	1040.00			1765.00	N/R	2032.00	1595.00	1085.00	1007.00		964.00	
18				1790.00	N/R	2032.00	1575.00	1065.00	1007.00			1025.00
19				1810.00	2115.00	2040.00	1560.00	1050.00	1007.00			
20				1835.00	2115.00	2032.50	1545.00	1035.00	1007.00		964.00	
21		1060.00		1880.00	2107.00	2032.50	1525.00	1020.00	1007.00		968.00	
22			1095.00	1910.00	2107.00	2015.00	1510.00	1002.00	1011.00		972.00	
23				1945.00	2100.00	1995.00	1485.00	1002.00	1007.00	944.00		
24			1095.00	1970.00	2100.00	1975.00	1465.00	1002.00	1007.00			
25			1100.00	1995.00	2100.00	1960.00	1455.00	1002.00		944.00		
26			1110.00	2010.00	2100.00	1935.00	1440.00	1002.00				1050.00
27	1050.00		1120.00		2100.00	1917.50	1420.00	1011.00			984.00	1050.00
28			1130.00	2047.00		1887.50	1415.00	1011.00	1011.00			
29			1140.00	2062.50	2100.00	1865.00	1395.00	1011.00	1011.00			
30			1150.00	2077.50	2092.00	1840.00	1380.00	1011.00	1011.00		989.00	
31	1050.00		1160.00		2092.00			1011.00				
MIN AF	1035.00	1050.00	1060.00	1200.00	2092.00	1840.00	1380.00	1002.00	1011.00	936.00	948.00	993.00
MIN ELEV	3333.90	3334.22	3334.52	3337.23	3356.34	3348.87	3340.66	3333.23	3333.40	3331.81	3332.07	3333.03
AVG AF	1043.80	1057.50	1097.40	1661.00	2112.50	2005.70	1595.80	1114.00	1009.00	964.00	965.00	1011.50
AVG ELEV	3334.09	3334.36	3335.17	3345.75	3353.44	3351.67	3344.58	3335.52	3333.36	3332.42	3332.43	3333.40

Lake Waha Daily Storage and Elevation Tables Acre Feet

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			1230.00	1815.00	2250.00	2190.00	1647.00	1120.00	1007.00	904.00	920.00	
2	1060.00		1240.00	1835.00	2250.00	2197.00	1632.00	1105.00	1007.00	904.00	920.00	
3			1240.00	1865.00	2265.00	2197.00	1605.00	1090.00	1007.00	908.00		924.00
4	1060.00		1240.00	1880.00	2265.00	2182.00	1585.00	1070.00	1007.00	908.00		928.00
5				1895.00	2273.00	2160.00	1570.00	1050.00	1007.00	908.00	920.00	
6		1075.00	1245.00	1910.00	2273.00	2122.00	1565.00	1035.00	1007.00	908.00		928.00
7				1930.00	2273.00	2100.00	1545.00	1020.00	1007.00	908.00	920.00	
8				1940.00	2273.00	2077.00	1525.00	1007.00	1007.00	908.00		
9	1065.00	1085.00		1960.00	2280.00	2047.00	1500.00	1002.00	1007.00	912.00		
10			1275.00	1975.00	2280.00	2020.00	1490.00	1007.00	1002.00	912.00		
11			1284.00	1985.00	2273.00	2015.00	1475.00	1002.00	1002.00	912.00		932.00
12	1070.00	1105.00		1995.00	2273.00	2015.00	1455.00	1002.00	1002.00	912.00	920.00	
13				2005.00	2273.00	2005.00	1435.00	1002.00	1002.00		920.00	932.00
14			1364.00	2010.00	2273.00	1980.00	1420.00	1002.00	1002.00			932.00
15			1400.00	2020.00	2265.00	1970.00	1405.00	1002.00	1002.00	912.00		
16	1075.00	1130.00	1425.00	2032.00	2257.00	1950.00	1385.00	1002.00	1002.00	912.00		
17			1440.00	2062.00	2257.00	1935.00	1364.00	1002.00	1002.00	916.00		
18			1460.00	2070.00	2250.00	1917.00	1347.00	1007.00	989.00	916.00		932.00
19	1070.00		1485.00	2107.00	2250.00	1880.00	1331.00	1007.00	972.00	916.00	924.00	
20			1510.00	2130.00	2235.00	1865.00	1311.00	1007.00	960.00	916.00		932.00
21			1530.00	2145.00	2242.00	1840.00	1293.00	1007.00	944.00	916.00		
22		1185.00	1545.00	2167.00	2242.00	1815.00	1279.00	1011.00	932.00	916.00		
23		1200.00	1570.00	2190.00	2242.00	1800.00	1260.00	1007.00	916.00	916.00	924.00	
24	1075.00		1580.00	2205.00	2242.00	1780.00	1250.00	1007.00	904.00	920.00		
25			1600.00	2212.00	2235.00	1760.00	1235.00	1007.00	900.00	920.00		
26		1215.00	1677.00	2220.00	2235.00	1750.00	1215.00	1007.00	900.00	920.00	924.00	936.00
27		1225.00	1700.00	2227.00	2227.00	1740.00	1200.00	1007.00	904.00			
28		1225.00	1740.00	2235.00	2227.00	1720.00	1180.00	1007.00	904.00			
29	1075.00		1755.00	2242.00	2220.00	1700.00	1170.00	1007.00	904.00	920.00		
30			1775.00	2242.00	2212.00	1677.00	1150.00	1007.00	904.00	920.00	928.00	
31			1800.00		2205.00		1135.00	1007.00		920.00		940.00
MIN AF	1060.00	1075.00	1230.00	1815.00	2205.00	1677.00	1135.00	1002.00	900.00	904.00	920.00	924.00
MIN ELEV	3334.40	3334.73	3337.81	3348.40	3354.90	3346.04	3335.94	3333.22	3331.03	3331.12	3331.50	3331.50
AVG AF	1068.80	1165.56	1474.60	2042.60	2250.70	1938.20	1377.90	1019.50	968.10	913.00	921.80	930.90
AVG ELEV	3334.60	3336.54	3342.40	3352.28	3355.68	3350.53	3340.61	3333.60	3332.50	3331.31	3331.50	3331.68

Lake Waha Daily Storage and Elevation Tables Acre Feet

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			976.00	1080.00	1510.00	2445.00	2545.00	2000.00	1485.00	1293.00		
2			976.00	1080.00	1540.00	2445.00	2540.00	1980.00	1480.00	1293.00		
3			980.00	1085.00	1570.00	2460.00	2530.00	1960.00	1480.00	1293.00	1270.00	1255.00
4	940.00		980.00	1085.00	1600.00	2475.00	2525.00	1940.00	1475.00			
5			984.00	1090.00	1647.00	2485.00	2520.00	1930.00	1475.00			
6			989.00	1090.00	1715.00	2495.00	2515.00	1910.00	1475.00	1293.00		
7			989.00	1095.00	1760.00	2505.00	2510.00	1880.00	1470.00	1293.00	1265.00	
8			989.00	1095.00	1810.00	2515.00	2505.00	1850.00	1470.00	1293.00		
9			989.00	1100.00	1857.00	2525.00	2500.00	1845.00	1470.00	1293.00		1250.00
10	940.00		993.00	1105.00	1917.00	2535.00	2490.00	1830.00	1465.00	1289.00		
11			993.00	1110.00	1960.00	2545.00	2485.00	1810.00	1465.00	1289.00		
12		956.00	998.00	1115.00	1990.00	2560.00	2480.00	1790.00	1460.00		1270.00	
13			1002.00	1120.00	2020.00	2565.00	2475.00	1770.00	1460.00			
14			1007.00	1135.00	2062.00	2575.00	2460.00	1750.00	1460.00	1284.00		
15			1007.00	1155.00	2115.00	2582.00	2452.00	1730.00	1460.00	1284.00		1245.00
16	940.00		1016.00	1175.00	2160.00	2590.00	2445.00	1710.00	1455.00	1284.00		
17			1020.00	1195.00	2205.00	2597.00	2415.00	1685.00	1455.00	1284.00	1265.00	
18			1020.00	1210.00	2250.00	2597.00	2385.00	1662.00	1440.00			
19			1025.00	1235.00	2287.00	2605.00	2347.00	1647.00	1425.00			1245.00
20		964.00	1030.00	1255.00	2325.00	2605.00	2317.00	1625.00	1405.00	1284.00	1265.00	
21			1034.00	1275.00	2370.00	2598.00	2287.00	1610.00		1279.00		
22			1040.00	1288.00	2392.00	2598.00	2257.00	1590.00		1279.00		
23	944.00		1045.00	1302.00	2407.00	2597.00	2227.00	1570.00		1279.00		1245.00
24			1050.00	1315.00	2422.00	2590.00	2197.00	1550.00		1279.00	1260.00	
25	944.00		1050.00	1331.00	2437.00	2583.00	2167.00	1535.00	1311.00			
26			1060.00	1347.00	2445.00	2570.00	2137.00	1525.00	1297.00		1260.00	
27			1060.00	1364.00	2460.00	2565.00	2122.00	1510.00		1275.00		
28			1065.00	1390.00	2452.00	2560.00	2107.00	1490.00		1275.00		
29		972.00	1070.00	1425.00	2454.00	2555.00	2077.00	1485.00	1293.00	1270.00		1250.00
30	952.00		1075.00	1475.00	2454.00	2550.00	2047.00	1485.00	1293.00	1270.00	1255.00	
31	952.00		1075.00		2445.00		2020.00	1485.00		1270.00		1250.00
MIN AF	940.00	956.00	976.00	1080.00	1510.00	2445.00	2020.00	1485.00	1485.00	1270.00	1255.00	1245.00
MIN ELEV	3331.90	3332.20	3332.70	3334.80	3343.05	3358.80	3351.90	3342.60	3342.60	3338.60	3338.30	3338.10
AVG AF	944.00	962.00	1017.60	1200.10	2079.60	2545.70	2347.10	1707.00	1436.40	1283.10	1262.80	1248.10
AVG ELEV	3331.90	3332.40	3333.50	3337.20	3352.90	3360.40	3357.20	3346.60	3341.70	3338.80	3338.40	3338.20

7. Reservoir "A" Daily Storage and Elevation Tables Acre Feet [RSA AF]

2000

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1					2034.00	2357.00	2023.00	1170.00	687.00			
2					2045.00	2333.00	1991.00	1155.00	675.00			
3	829.00				2056.00	2345.00	1958.00	1140.00	664.00			
4					2068.00	2345.00	1915.00	1117.00	653.00			
5					2090.00		1884.00	1102.00	642.00			
6					2090.00		1852.00	1080.00	632.00			
7					2101.00	2357.00	1821.00	1065.00	621.00			
8			973.00		2112.00	2357.00	1790.00	1050.00	610.00			
9					2124.00	2345.00	1760.00	1036.00				
10					2135.00	2345.00	1719.00	1022.00				
11					2157.00	2333.00	1690.00	994.00				
12				1555.00	2169.00	2333.00	1661.00	980.00				
13			994.00	1593.00	2192.00	2345.00	1621.00	966.00				
14				1631.00	2204.00	2345.00	1584.00	946.00				
15				1670.00	2227.00	2345.00	1546.00	926.00				
16				1710.00	2238.00	2345.00	1509.00	912.00				
17			1022.00	1729.00	2250.00	2345.00	1473.00	892.00				
18	848.00			1760.00	2261.00	2345.00	1436.00	880.00				780.00
19				1790.00	2273.00	2345.00	1397.00	860.00				780.00
20				1811.00	2285.00	2333.00		848.00		670.00		
21				1842.00	2297.00	2321.00	1358.00	829.00				
22				1863.00	2297.00	2297.00	1332.00	816.00				
23			1065.00	1894.00	2309.00	2261.00	1316.00	804.00				
24			1065.00	1915.00	2309.00	2238.00	1299.00	792.00				
25				1936.00	2321.00	2215.00	1282.00	780.00				
26				1947.00	2321.00	2181.00	1266.00	768.00				
27			1178.00	1969.00	2321.00	2146.00	1250.00	750.00				
28	860.00	919.00		1991.00	2333.00	2124.00	1242.00	738.00	621.00		744.00	
29			1178.00	2001.00	2345.00	2090.00	1226.00	726.00				756.00
30				2012.00	2345.00	2056.00	1202.00	709.00		698.00	744.00	
31	860.00				2369.00		1186.00	698.00				
MIN AF	829.00	919.00	973.00	1555.00	2034.00	2056.00	1186.00	698.00	610.00	670.00	744.00	756.00
MIN ELEV	1787.90	1789.10	1789.80	1796.24	1800.70	1800.80	1792.40	1786.05	1784.70	1785.60	1786.70	1786.90
AVG AF	849.30	919.00	1056.00	1808.70	2209.80	2282.20	1541.10	914.00	641.50	684.00	744.00	772.00
AVG ELEV	1788.20	1789.10	1790.80	1798.70	1802.20	1802.70	1796.10	1789.05	1785.19	1785.90	1786.70	1787.13

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Reservoir "A" Daily Storage and Elevation Tables Acre Feet [RSA AF]

2001

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1		953.00	970.00	1869.00	1914.00	1803.00	1803.00	1728.00	1602.00	1129.00	1012.00	1037.00
2	1035.00		978.00	1903.00	1903.00	1814.00	1792.00	1728.00	1602.00	1112.00	1021.00	
3			978.00	1925.00	1903.00	1825.00	1771.00	1728.00	1592.00	1095.00		
4			987.00	1925.00	1892.00	1836.00	1749.00	1728.00	1572.00	1079.00		
5		928.00	994.00	1914.00	1880.00	1858.00	1739.00	1739.00	1561.00	1045.00	1029.00	
6			1027.00	1903.00	1892.00	1892.00	1739.00	1739.00	1541.00	1029.00	1029.00	
7		928.00	1035.00	1892.00	1903.00	1892.00	1739.00	1728.00	1521.00	1021.00	1037.00	1012.00
8			1052.00		1903.00	1892.00	1739.00	1717.00	1511.00	1012.00	1037.00	
9	1003.00		1068.00	1869.00	1914.00	1892.00	1728.00	1717.00	1501.00	1004.00	1037.00	
10			1093.00	1858.00	1925.00	1892.00	1777.00	1717.00	1491.00	996.00	1037.00	
11			1129.00	1858.00	1925.00	1880.00	1706.00	1706.00	1471.00	996.00		
12			1164.00	1880.00	1937.00	1880.00	1685.00	1706.00	1452.00	996.00	1037.00	
13			1182.00	1903.00	1937.00	1892.00	1675.00	1696.00	1433.00	996.00	1037.00	
14		913.00	1209.00		1937.00	1892.00	1664.00	1675.00	1413.00	996.00	1037.00	
15			1227.00		1948.00	1892.00	1675.00	1664.00	1403.00	996.00	1037.00	
16	986.00		1253.00	1880.00	1948.00	1869.00	1675.00	1654.00	1393.00	996.00		
17			1281.00	1869.00	1937.00	1848.00	N/R	1644.00	1374.00	996.00		
18			1309.00	1858.00	1914.00	1836.00	1696.00	1634.00	1355.00	989.00		
19			1338.00	1869.00	1903.00	1825.00	1696.00	1634.00	1337.00	989.00	1045.00	
20			1386.00	1903.00	1892.00	1814.00	1706.00	1634.00	1318.00			
21		891.00	1424.00	1914.00	1880.00	1803.00	1717.00	1623.00	1318.00		1054.00	
22		891.00	1453.00	1903.00	1880.00	1792.00	1728.00	1623.00	1299.00	989.00		
23		906.00	1494.00	1892.00	1869.00	1771.00	1728.00	1623.00	1271.00	989.00		
24		913.00	1525.00	1880.00	1859.00	1760.00	1728.00	1634.00	1245.00	989.00		
25			1556.00	1869.00	1836.00	1749.00	1717.00	1634.00	1217.00	989.00		
26		937.00	1587.00	1880.00	1825.00	1747.00	1717.00	1634.00	1199.00	996.00		
27		945.00	1628.00	1903.00	1814.00	1747.00	1706.00	1634.00	1182.00	996.00	1054.00	
28		961.00	1670.00	1914.00	1803.00	1771.00	1706.00	1623.00	1164.00	996.00		949.00
29	953.00		1703.00	1937.00	1814.00	1792.00	1717.00	1623.00	1147.00	996.00		
30			1803.00	1925.00	1803.00	1803.00	1728.00	1613.00	1138.00	1004.00	1037.00	
31	953.00		1836.00		1803.00		1728.00	1613.00		1004.00		
MIN AF	953.00	891.00	703.00	1858.00	1803.00	1747.00	1664.00	1613.00	1138.00	989.00	1012.00	949.00
MIN ELEV	1789.56	1788.80	1786.05	1799.10	1798.60	1798.10	1797.30	1796.80	1791.80	1790.02	1790.30	1789.50
AVG AF	986.00	921.40	1318.00	1891.20	1884.30	1829.20	1720.60	1669.00	1379.40	1013.60	1034.70	999.30
AVG ELEV	1789.97	1789.14	1793.80	1799.40	1799.30	1798.80	1797.80	1797.30	1794.50	1790.30	1790.56	1790.13

Reservoir "A" Daily Storage and Elevation Tables Acre Feet [RSA AF]

2002

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	949.00	857.00	791.00	763.00	1664.00	1925.00	1858.00	1602.00	1675.00	1664.00		
2				791.00	1696.00	1960.00	1848.00	1592.00	1706.00	1664.00		
3				820.00	1717.00	1960.00	1836.00	1592.00	1706.00	1675.00		
4				842.00	1739.00	1914.00	1814.00	1592.00	1696.00	1685.00	1491.00	1374.00
5			769.00	872.00	1771.00	1892.00	1803.00	1613.00	1696.00	1696.00		1374.00
6				903.00	1803.00	1892.00	1792.00	1613.00	1706.00	1696.00		1374.00
7	926.00			933.00	1825.00	1903.00	1781.00	1634.00	1706.00	1696.00		
8				964.00	1858.00	1914.00	1781.00	1634.00	1717.00	1685.00	1471.00	
9	926.00			989.00	1892.00	1948.00	1781.00	1634.00	1728.00			
10				1021.00	1914.00	1960.00	1771.00	1634.00	1728.00			
11	918.00			1054.00	1914.00	1948.00	1749.00	1634.00	1706.00	1654.00		
12		827.00	763.00	1087.00	1892.00	1937.00	1728.00	1654.00	1685.00			1355.00
13				1121.00	1869.00	1925.00	1706.00	1644.00	1664.00			
14				1156.00	1848.00	1925.00	1696.00	1634.00	1654.00			
15	903.00	820.00		1190.00	1869.00	1948.00	1696.00	1623.00	1644.00	1623.00		
16				1226.00	1880.00	1948.00	1685.00	1623.00	1654.00	1623.00		
17				1253.00	1892.00	1948.00	1664.00	1613.00	1654.00	1613.00		
18				1281.00	1903.00	1960.00	1644.00	1613.00	1664.00	1602.00	1433.00	
19			741.00	1318.00	1925.00	1960.00	1623.00	1623.00	1664.00			
20				1346.00	1925.00	1937.00	1613.00	1623.00	1664.00			1327.00
21		798.00		1374.00	1948.00	1925.00	1613.00	1623.00	1664.00	1582.00	1423.00	
22	887.00			1403.00	1960.00	1925.00	1623.00	1634.00	1654.00	1572.00	1423.00	
23				1423.00	1960.00	1937.00	1623.00	1644.00	1664.00			
24				1452.00	1960.00	1925.00	1602.00	1654.00	1664.00	1551.00		
25			728.00	1481.00	1925.00	1914.00	1602.00	1654.00	1654.00	1541.00	1413.00	
26				1521.00	1903.00	1903.00	1602.00	1675.00	1644.00		1413.00	1308.00
27		791.00		1541.00	1914.00	1880.00	1592.00	1675.00	1644.00			1308.00
28	864.00			1582.00	1937.00	1848.00	1592.00	1675.00	1644.00			
29			714.00	1613.00	1937.00	1836.00	1613.00	1664.00	1644.00			
30			728.00	1644.00	1914.00	1848.00	1613.00	1675.00	1654.00	1521.00		
31	857.00		741.00		1914.00		1613.00	1685.00				
MIN AF	857.00	791.00	714.00	763.00	1664.00	1836.00	1592.00	1592.00	1644.00	1521.00	1413.00	1308.00
MIN ELEV	1788.30	1787.41	1786.30	1787.01	1797.30	1798.90	1796.60	1796.60	1797.10	1795.90	1794.80	1793.70
AVG AF	903.80	818.60	746.90	1184.70	1866.60	1918.70	1692.20	1633.70	1673.90	1624.40	1435.00	1341.00
AVG ELEV	1788.90	1797.80	1786.80	1792.34	1799.20	1799.60	1797.60	1797.00	1797.40	1796.90	1795.03	1794.05

Reservoir "A" Daily Storage and Elevation Tables
Acre Feet [RSA AF]

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			1461.00	1925.00	1914.00	1948.00	1355.00	918.00	1012.00	1262.00		933.00
2	1290.00	1226.00	1481.00	1925.00	1925.00	1948.00	1327.00	911.00	1012.00	1245.00		
3			1501.00	1914.00	1960.00	1925.00	1308.00	903.00	1012.00	1226.00		933.00
4		1217.00	1521.00	1903.00	1960.00	1892.00	1281.00	933.00	1012.00	1208.00		
5			1541.00	1903.00	1960.00	1858.00	1253.00	933.00	1012.00	1190.00		926.00
6	1281.00	1217.00	1561.00	1903.00	1960.00	1858.00	1226.00	941.00	1021.00	1173.00		
7			1582.00	1892.00	1948.00	1848.00	1199.00	941.00	1029.00	1156.00	1004.00	
8			1602.00	1880.00	1937.00	1836.00	1190.00	941.00	1045.00	1138.00		
9			1634.00	1880.00		1814.00	1190.00	941.00	1087.00	1129.00		
10	1262.00	1199.00	1654.00	1869.00	1914.00	1792.00	1182.00	933.00	1112.00	1121.00	989.00	911.00
11		1199.00	1675.00	1858.00	1903.00	1781.00	1173.00	941.00	1129.00	1112.00		
12		1208.00	1696.00	1858.00	1903.00	1760.00	1156.00	941.00	1147.00	1104.00		911.00
13		1217.00	1728.00	1848.00		1739.00	1147.00	933.00	1164.00	1093.00	980.00	
14		1245.00	1749.00	1848.00	1880.00	1739.00	1138.00	933.00	1173.00	1087.00	980.00	
15		1262.00	1771.00	1836.00	1869.00	1717.00	1129.00	911.00	1190.00	1087.00		
16		1281.00	1792.00	1836.00	1858.00	1706.00	1112.00	895.00	1182.00	1087.00		903.00
17	1245.00	1299.00	1814.00	1836.00	1848.00	1675.00	1095.00	903.00	1199.00		972.00	
18		1327.00	1836.00	1825.00	1836.00	1644.00	1079.00	911.00	1217.00			
19		1346.00	1848.00	1814.00	1836.00	1613.00	1062.00	911.00	1226.00		964.00	895.00
20		1365.00	1869.00	1803.00	1825.00	1602.00	1045.00	911.00	1235.00	1079.00	964.00	
21	1233.00	1393.00	1892.00	1792.00	1836.00	1592.00	1029.00	911.00	1245.00	1079.00	964.00	
22		1413.00	1914.00	1792.00	1845.00	1582.00	1021.00	918.00	1253.00	1071.00		
23		1433.00	1925.00	1781.00	1858.00	1572.00	1012.00	941.00	1262.00	1062.00		887.00
24	1226.00	1442.00	1960.00	1771.00	1869.00	1541.00	996.00	957.00	1262.00	1054.00		879.00
25		1452.00	1960.00	1771.00	1880.00	1511.00	972.00	972.00	1262.00		949.00	879.00
26		1442.00	1960.00	1792.00	1892.00	1491.00	957.00	972.00	1262.00			879.00
27		1442.00	1960.00	1825.00	1914.00	1452.00	949.00	980.00	1262.00	1045.00		
28	1226.00	1442.00	1948.00	1848.00	1925.00	1433.00	949.00	980.00	1271.00	1037.00		872.00
29			1948.00	1858.00	1925.00	1413.00	941.00	989.00	1271.00			872.00
30	1217.00		1937.00	1880.00	1914.00	1384.00	933.00	989.00	1271.00	1029.00		864.00
31	1217.00		1925.00		1937.00		926.00	996.00		1029.00		864.00
MIN AF	1217.00	1199.00	1461.00	1771.00	1825.00	1384.00	926.00	895.00	1012.00	1029.00	949.00	864.00
MIN ELEV	1792.70	1792.50	1795.30	1798.30	1798.80	1792.30	1789.20	1788.80	1790.30	1790.50	1789.50	1788.40
AVG AF	1241.40	1315.90	1753.30	1846.40	1895.20	1679.00	1101.80	937.00	1156.40	1112.80	971.50	892.00
AVG ELEV	1792.90	1793.80	1798.10	1798.90	1799.40	1797.40	1791.40	1789.40	1792.00	1791.50	1798.80	1788.80

Reservoir "A" Daily Storage and Elevation Tables Acre Feet [RSA AF]

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	864.00		769.00	1521.00	1892.00	1914.00	1836.00	1644.00	1685.00	1365.00		
2	857.00	776.00	783.00	1551.00	1880.00	1892.00	1836.00	1664.00	1675.00	1365.00	1592.00	
3		776.00	791.00	1572.00	1880.00	1892.00	1814.00	1654.00	1664.00	1374.00	1582.00	1471.00
4	849.00	769.00	798.00	1592.00	1869.00	1880.00	1781.00	1654.00	1654.00	1384.00	1582.00	
5		769.00	812.00	1602.00	1848.00	1848.00	1792.00	1654.00	1634.00	1393.00	1582.00	
6		769.00	820.00	1623.00	1848.00	1848.00	1771.00	1644.00	1623.00	1403.00		1463.00
7	842.00		820.00	1644.00	1858.00	1858.00	1749.00	1654.00	1592.00	1423.00		1459.00
8	842.00		827.00	1664.00	1836.00	1880.00	1728.00	1664.00	1572.00	1433.00	1561.00	1451.00
9		763.00	835.00	1675.00	1803.00	1914.00	1728.00	1696.00	1551.00	1452.00	1561.00	1453.00
10		755.00	857.00	1685.00	1803.00	1937.00	1717.00	1685.00	1532.00	1461.00	1551.00	1452.00
11		755.00	887.00	1685.00	1814.00	1948.00	1706.00	1675.00	1501.00	1481.00	1545.00	
12		748.00	903.00	1675.00	1848.00	1925.00	1728.00	1675.00	1491.00	1501.00	1541.00	
13		748.00	941.00	1675.00	1880.00	1914.00	1728.00	1664.00	1491.00	1521.00		1433.00
14			964.00	1685.00	1903.00	1903.00	1706.00	1644.00	1481.00	1541.00		1433.00
15			989.00	1706.00	1892.00	1880.00	1696.00	1634.00	1471.00	1561.00	1532.00	1433.00
16			1021.00	1728.00	1892.00	1880.00	1685.00	1654.00	1461.00	1582.00		1423.00
17			1062.00	1749.00	1914.00	1903.00	1675.00	1654.00	1461.00	1602.00		1423.00
18		735.00	1087.00	1771.00	1914.00	1937.00	1654.00	1634.00	1452.00	1623.00	1521.00	
19			1121.00	1792.00	1937.00	1937.00	1664.00	1623.00	1442.00	1644.00	1511.00	
20	805.00		1147.00	1825.00	1937.00	1937.00	1675.00	1623.00	1442.00	1654.00		1413.00
21			1173.00	1848.00	1937.00	1960.00	1675.00	1602.00	1442.00	1654.00		
22			1208.00	1869.00	1925.00	1948.00	1675.00	1592.00	1433.00	1654.00		
23			1235.00	1880.00	1925.00	1903.00	1675.00	1602.00	1433.00			1403.00
24		721.00	1262.00	1892.00	1914.00	1914.00	1675.00	1613.00	1423.00		1501.00	
25			1290.00	1892.00	1903.00	1925.00	1664.00	1623.00	1393.00	1644.00		
26	791.00	728.00	1327.00	1892.00	1892.00	1892.00	1685.00	1644.00	1374.00	1634.00		
27		741.00	1365.00	1880.00	1914.00	1869.00	1675.00	1664.00	1355.00	1623.00		
28	791.00	748.00	1403.00	1880.00	1937.00	1880.00	1664.00	1675.00	1346.00	1613.00		
29		763.00	1433.00	1903.00	1948.00	1858.00	1664.00	1685.00	1346.00	1613.00	1481.00	1374.00
30			1461.00	1903.00	1937.00	1836.00	1654.00	1685.00	1355.00	1606.00	1481.00	1374.00
31			1491.00		1925.00		1644.00	1685.00		1601.00		
MIN AF	791.00	721.00	769.00	1521.00	1803.00	1836.00	1644.00	1592.00	1346.00	1365.00	1481.00	1374.00
MIN ELEV	1787.40	1796.40	1787.10	1795.90	1798.60	1798.90	1797.10	1796.60	1794.00	1794.30	1795.50	1794.40
AVG AF	825.80	755.30	1051.60	1734.80	1887.80	1898.30	1708.20	1648.60	1487.80	1525.70	1537.80	1427.00
AVG ELEV	1787.90	1786.90	1790.80	1797.90	1799.40	1799.50	1797.50	1797.20	1795.60	1795.90	1796.07	1794.90

Reservoir "A" Daily Storage and Elevation Tables Acre Feet [RSA AF]

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			1182.00	1384.00		1914.00	1771.00	1532.00	1572.00	1306.00	1374.00	
2			1182.00	1403.00	1914.00	1925.00	1749.00	1521.00	1561.00	1320.00	1374.00	
3	1365.00		1190.00	1433.00	1903.00	1948.00	1728.00	1511.00	1561.00	1320.00	1374.00	
4		1271.00	1199.00	1461.00	1903.00		1706.00	1501.00	1582.00	1327.00		
5			1199.00	1491.00	1925.00		1685.00	1491.00	1582.00	1337.00		1271.00
6			1199.00	1521.00	1948.00	1914.00	1675.00	1481.00	1572.00	1337.00		
7	1355.00		1208.00	1561.00		1914.00	1664.00	1511.00	1572.00	1327.00	1365.00	
8		1262.00	1208.00	1592.00		1925.00	1654.00	1501.00	1582.00	1327.00		
9			1208.00	1634.00	1937.00	1937.00	1664.00	1491.00	1561.00	1318.00		1253.00
10			1208.00	1664.00	1937.00	1937.00	1675.00	1481.00	1521.00	1318.00		
11		1245.00	1208.00	1685.00	1960.00	1937.00	1685.00	1471.00	1521.00	1299.00	1346.00	
12	1346.00		1208.00	1728.00	1948.00	1937.00	1685.00	1461.00	1491.00	1299.00		
13	1337.00		1208.00	1760.00	1937.00	1937.00	1675.00	1461.00	1461.00	1299.00		
14	1337.00	1235.00	1208.00	1792.00		1925.00	1664.00	1481.00	1452.00	1290.00	1337.00	
15			1190.00	1825.00		1914.00	1644.00	1481.00	1452.00			
16			1190.00	1858.00		1903.00	1634.00	1471.00	1423.00			1226.00
17		1217.00	1190.00	1903.00	1914.00	1892.00	1654.00	1461.00	1393.00	1271.00	1337.00	
18	1327.00	1217.00	1208.00	1914.00	1914.00	1903.00	1644.00	1471.00	1384.00	1262.00	1318.00	
19	1318.00		1208.00	1914.00	1937.00	1903.00	1634.00	1461.00	1355.00	1262.00		1217.00
20			1208.00	1925.00	1948.00	1903.00	1623.00	1461.00	1318.00	1281.00		
21	1318.00		1217.00	1937.00		1892.00	1602.00	1501.00	1327.00	1290.00		
22		1208.00	1217.00	1948.00		1880.00	1592.00	1481.00	1337.00	1308.00	1299.00	1208.00
23			1226.00		1925.00	1858.00	1582.00	1471.00	1327.00	1318.00		
24	1299.00	1199.00	1226.00		1914.00	1836.00	1602.00	1491.00	1318.00	1337.00		
25			1235.00	1925.00	1903.00	1814.00	1592.00	1521.00	1327.00	1346.00		
26	1299.00		1245.00	1914.00	1925.00	1792.00	1561.00	1511.00	1308.00	1355.00		
27	1290.00		1253.00	1925.00	1937.00	1771.00	1541.00	1501.00	1299.00	1374.00		
28	1290.00	1182.00	1271.00	1948.00	1937.00	1771.00	1532.00	1532.00	1308.00	1374.00		
29			1299.00	1960.00	1925.00	1781.00	1521.00	1532.00	1308.00			
30			1327.00	1960.00	1914.00	1781.00	1511.00	1521.00	1299.00		1271.00	1190.00
31	1281.00		1355.00		1903.00		1541.00	1541.00		1365.00		
MIN AF	1281.00	1182.00	1182.00	1384.00	1903.00	1771.00	1511.00	1461.00	1299.00	1262.00	1271.00	1190.00
MIN ELEV	1793.40	1792.30	1792.30	1794.50	1799.50	1798.30	1795.80	1795.30	1793.60	1793.20	1793.30	1792.40
AVG AF	1317.40	1221.80	1220.70	1736.20	1925.50	1879.80	1631.30	1492.70	1431.40	1315.30	1333.30	1222.10
AVG ELEV	1793.80	1792.80	1792.70	1797.90	1799.70	1799.30	1796.90	1795.60	1794.90	1793.80	1793.90	1792.70

Reservoir "A" Daily Storage and Elevation Tables Acre Feet [RSA AF]

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			1029.00	1442.00	1880.00	1696.00	1836.00	1561.00	1355.00		872.00	
2				1491.00	1914.00	1685.00	1858.00	1551.00	1346.00	1045.00	864.00	
3		1095.00	1021.00	1521.00	1937.00	1685.00	1858.00	1541.00	1355.00	1029.00		
4				1572.00	1937.00	1685.00	1848.00	1532.00	1327.00	1012.00		805.00
5				1623.00	1914.00	1696.00	1848.00	1532.00	1318.00	996.00		
6			1012.00	1664.00	1892.00	1706.00	1825.00	1561.00	1299.00	980.00	864.00	798.00
7				1706.00	1903.00	1728.00	1825.00	1551.00	1281.00	989.00		
8			1012.00	1749.00	1903.00	1739.00	1836.00	1541.00	1262.00	1004.00		798.00
9			1004.00	1792.00	1892.00	1749.00	1858.00	1532.00	1245.00	1012.00	864.00	
10		1087.00	1004.00	1836.00	1869.00	1771.00	1848.00	1521.00	1245.00	1012.00		
11			1021.00	1880.00	1858.00	1792.00	1825.00	1521.00	1226.00	1021.00		791.00
12	1156.00		1029.00	1914.00	1848.00	1803.00	N/R	1532.00	1208.00	1012.00		
13	1156.00		1037.00	1937.00	1836.00	1814.00	1739.00	1561.00	1190.00	1004.00		
14			1045.00	1925.00	1825.00	1825.00	1685.00	1551.00	1182.00			
15		1079.00	1054.00	1925.00	1803.00	1848.00	1654.00	1551.00	1156.00			783.00
16			1062.00	1925.00	1781.00	1858.00	1675.00	1532.00	1147.00	972.00		
17	1147.00		1071.00	1914.00	1749.00	1880.00	1664.00	1532.00	1156.00	964.00	835.00	
18			1087.00	1903.00	1717.00	1892.00	1664.00	1521.00	1147.00			776.00
19			1095.00	1892.00	1685.00	1892.00	1654.00	1521.00	1138.00			
20			1104.00	1892.00	1685.00	1903.00	1654.00	1541.00	1138.00		835.00	
21		1054.00	1112.00	1880.00	1685.00	1903.00	1644.00	1532.00	1147.00		835.00	
22			1121.00	1873.00	1685.00	1892.00	1634.00	1521.00	1156.00		827.00	
23	1129.00		1129.00	1870.00	1696.00	1880.00	1654.00	1511.00	1164.00	926.00		
24			1129.00	1858.00	1696.00	1880.00	1644.00	1491.00	1164.00	926.00		
25			1138.00	1848.00	1696.00	1869.00	1634.00	1461.00	1156.00	911.00		
26			1173.00	1836.00	1696.00	1848.00	1623.00	1442.00	1138.00			755.00
27	1121.00		1208.00	1814.00	1706.00	1836.00	1613.00	1452.00	1121.00		820.00	755.00
28			1262.00	1803.00	1717.00	1825.00	1592.00	1433.00	1104.00			
29			1308.00	1825.00	1717.00	1814.00	1551.00	1403.00	1079.00			
30			1346.00	1858.00	1717.00	1825.00	1582.00	1393.00	1062.00		812.00	
31	1112.00		1393.00		1717.00		1572.00	1374.00				
MIN AF	1112.00	1054.00	1004.00	1442.00	1685.00	1685.00	1551.00	1374.00	1062.00	911.00	812.00	755.00
MIN ELEV	1791.50	1790.80	1790.00	1795.10	1797.50	1797.50	1796.20	1794.40	1790.90	1789.01	1787.70	1786.90
AVG AF	1136.80	1078.80	1107.50	1787.40	1788.80	1803.40	1708.00	1505.40	1195.90	984.80	840.00	779.60
AVG ELEV	1791.80	1791.09	1791.50	1798.50	1798.50	1798.60	1797.70	1795.70	1792.50	1789.90	1788.07	1787.25

Reservoir "A" Daily Storage and Elevation Tables Acre Feet [RSA AF]

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			695.00	1327.00	1960.00	1582.00	1561.00	1393.00	1308.00	911.00	695.00	
2	741.00		708.00	1355.00	1948.00	1551.00	1551.00	1403.00	1318.00	898.00	688.00	
3			714.00	1384.00	1960.00	1521.00	1532.00	1384.00	1283.00	895.00		
4	735.00		821.00	1403.00	1960.00	1481.00	1522.00	1365.00	1245.00	887.00		
5			728.00	1433.00	1960.00	1461.00	1511.00	1384.00	1245.00	872.00	674.00	
6		661.00	735.00	1461.00	1948.00	1471.00	1495.00	1365.00	1253.00	872.00		
7			735.00	1481.00	1937.00	1491.00	1481.00	1346.00	1217.00	872.00	668.00	
8			748.00	1501.00	1925.00	1501.00	1501.00	1365.00	1192.00	849.00		
9	721.00		769.00	1521.00	1925.00	1501.00	1491.00	1374.00	1190.00	835.00		
10			791.00	1541.00	1914.00	1514.00	1481.00	1346.00	1190.00	827.00		
11			812.00	1572.00	1903.00	1541.00	1471.00	1318.00	1129.00	827.00		
12	708.00		827.00	1592.00	1880.00	1561.00	1461.00	1337.00	1129.00	812.00	655.00	
13			857.00	1592.00	1869.00	1561.00	1442.00	1318.00	1129.00		655.00	623.00
14			879.00	1634.00	1858.00	1582.00	1442.00	1299.00	1104.00			
15			911.00	1656.00	1836.00	1582.00	1461.00	1327.00	1071.00	783.00		
16	695.00		941.00	1685.00	1814.00	1592.00	1452.00	1346.00	1071.00	769.00		
17			972.00	1717.00	1792.00	1602.00	1442.00	1327.00	1045.00	769.00		
18			996.00	1739.00	1760.00	1602.00	1433.00	1312.00	1029.00	769.00		
19	695.00		1021.00	1760.00	1739.00	1602.00	1423.00	1327.00	1037.00	763.00	648.00	
20			1045.00	1781.00	1728.00	1592.00	1413.00	1337.00	1046.00			616.00
21			1071.00	1803.00	1728.00	1582.00	1403.00	1347.00	1039.00			
22			1087.00	1825.00	1728.00	1561.00	1433.00	1369.00	1024.00	741.00		
23			1104.00	1848.00	1739.00	1561.00	1423.00	1393.00	1033.00	735.00		
24	681.00		1129.00	1869.00	1728.00	1561.00	1403.00	1384.00	1021.00	735.00		
25			1138.00	1880.00	1717.00	1561.00	1413.00	1365.00	1005.00	728.00		
26		661.00	1164.00	1880.00	1685.00	1572.00	1433.00	1384.00	996.00	721.00		610.00
27		674.00	1199.00	1925.00	1664.00	1551.00	1413.00	1375.00	989.00			
28		688.00	1217.00	1937.00	1664.00	1551.00	1403.00	1355.00	957.00			
29	668.00		1245.00	1948.00	1654.00	1541.00	1413.00	1365.00	933.00	708.00		
30			1272.00	1960.00	1634.00	1551.00	1393.00	1365.00	921.00	708.00		
31			1299.00		1613.00		1374.00	1331.00		708.00		604.00
MIN AF	668.00	661.00	695.00	1327.00	1613.00	1461.00	1374.00	1299.00	708.00	648.00	648.00	604.00
MIN ELEV	1785.60	1785.50	1786.00	1793.90	1796.80	1795.30	1794.40	1793.60	1786.00	1785.30	1785.30	1784.50
AVG AF	701.30	669.00	947.70	1656.00	1805.70	1546.60	1451.40	1353.30	796.23	666.40	669.00	611.40
AVG ELEV	1786.10	1785.60	1789.50	1797.20	1798.60	1796.20	1795.20	1794.20	1787.50	1785.60	1785.60	1784.70

Reservoir "A" Daily Storage and Elevation Tables Acre Feet [RSA AF]

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1				625.00	1087.00	1675.00	1869.00	1592.00	1534.00	1393.00		
2				625.00	1112.00	1706.00	1858.00	1572.00	1534.00	1374.00		
3				625.00	1138.00	1739.00	1836.00	1582.00	1521.00	1355.00	1095.00	1011.00
4	601.00			625.00	1156.00	1771.00	1825.00	1562.00	1511.00			
5				625.00	1164.00	1803.00	1803.00	1542.00	1501.00			
6				625.00	1182.00	1838.00	1803.00	1509.00	1510.00	1328.00		
7				625.00	1199.00	1875.00	1781.00	1481.00	1510.00	1328.00	1079.00	
8					1226.00	1909.00	1760.00	1471.00	1497.00	1309.00		
9				625.00	1238.00	1937.00	1749.00	1481.00	1497.00	1305.00		994.00
10	597.00			627.00	1254.00	1937.00	1739.00	1481.00	1471.00	1282.00		
11				630.00	1271.00	1937.00	1728.00	1471.00	1471.00	1271.00		
12		567.00		638.00	1290.00	1914.00	1706.00	1461.00	1461.00		1079.00	
13				638.00	1299.00	1925.00	1717.00	1452.00	1455.00			
14				655.00	1327.00	1925.00	1696.00	1442.00	1444.00	1240.00		
15				681.00	1355.00	1948.00	1675.00	1433.00	1433.00	1226.00		989.00
16	592.00			714.00	1365.00	1937.00	1664.00	1431.00	1423.00	1217.00		
17				735.00	1374.00	1937.00	1634.00	1442.00	1403.00	1208.00	1057.00	
18				748.00	1384.00	1948.00	1613.00	1433.00	1393.00			
19			575.00	776.00	1393.00	1948.00	1602.00	1423.00	1384.00			972.00
20		561.00		798.00	1403.00	1957.00	1623.00	1403.00	1376.00	1182.00	1045.00	
21			585.00	827.00	1423.00	1955.00	1613.00	1433.00	1389.00	1173.00		
22				857.00	1452.00	1971.00	1613.00	1461.00	1403.00	1164.00		
23	586.00			879.00	1481.00	1975.00	1634.00	1465.00	1428.00	1156.00		964.00
24			597.00	911.00	1511.00	1971.00	1644.00	1487.00	1452.00	1147.00	1034.00	
25			602.00	941.00	1541.00	1963.00	1634.00	1487.00	1461.00			
26			602.00	964.00	1551.00	1956.00	1634.00	1498.00	1461.00		1023.00	
27			608.00	996.00	1572.00	1938.00	1634.00	1507.00	NOR	1121.00		
28			612.00	1012.00	1582.00	1927.00	1623.00	1526.00	NOR	1121.00		
29		554.00	615.00	1029.00	1602.00	1918.00	1613.00	1527.00	1442.00	1112.00		957.00
30	579.00		620.00	1063.00	1623.00	1880.00	1602.00	1526.00	1423.00	1107.00	1023.00	
31	578.00		624.00		1654.00		1602.00	1535.00		1107.00		957.00
MIN AF	578.00	554.00	575.00	625.00	1087.00	1675.00	1602.00	1403.00	1376.00	1107.00	1023.00	957.00
MIN ELEV	1784.20	1783.80	1784.10	1784.90	1791.20	1797.40	1796.70	1797.70	1794.40	1791.40	1790.40	1789.60
AVG AF	587.30	559.00	601.40	758.10	1353.00	1893.40	1691.50	1485.00	1453.90	1222.20	1050.90	975.10
AVG ELEV	1784.30	1783.80	1784.50	1786.90	1794.20	1799.40	1797.60	1794.50	1795.20	1792.80	1790.80	1789.80

8. Webb Canal Daily Discharge Tables (CFS) {WCCI QJ}

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	18.40	4.30	18.11	18.11	9.90	7.10	14.40	4.90		0.00	0.00
2	0.00	18.40	4.30	18.11	18.11	4.60	9.70	15.30	4.90		0.00	0.00
3	0.00		3.90	18.11	18.11	4.60	9.40	15.30	4.60	0.30	0.00	0.00
4	0.00	17.60	3.60	18.11	18.11	3.80	9.40	15.30	4.60		0.00	0.00
5	0.00	14.90	3.60	18.11	18.11	3.80	9.40	15.30	4.60		0.00	0.00
6	0.00	7.40	3.60	18.11	18.11	3.50	9.40	15.30	4.60	0.30	0.00	0.00
7	0.00	6.30	3.60	18.11		2.90	9.40	15.30	4.60		0.00	0.00
8	0.00		3.60	18.11		2.80	9.90	15.30	5.10		0.00	0.00
9	0.00	6.90	3.90	18.11	18.11		11.60	15.30	5.10		0.00	0.00
10	0.00	7.80	6.90	18.11	18.11	2.80	11.40	14.90			0.00	0.00
11	0.00	3.30	12.70	18.11	18.11	2.80	11.40	15.80			0.00	0.00
12	0.00	3.90	17.30	18.11	18.11	2.50		15.80			0.00	0.00
13	0.00	6.90	17.90	18.11		2.80	10.90	15.80			0.00	0.00
14	0.00	6.10	17.90	18.11		2.80				0.30	0.00	0.00
15	0.00	5.60	18.40	18.11		2.50	10.90	0.50			0.00	0.00
16	0.00	5.95	18.40	18.11		2.10	10.90	5.60			0.00	0.00
17	0.00	5.95	18.40	18.11	17.30	1.90		6.00			0.00	0.00
18	0.00	5.60	18.40	18.11	17.30	1.70		6.00			0.00	0.00
19	0.00	5.60	18.40	18.11	17.30	2.10		6.00			0.00	0.00
20	0.00	5.60	18.40	18.11	15.60	3.10	10.50	6.00		0.30	0.00	0.00
21	0.00	5.60	18.10	18.11	12.70			6.00			0.00	0.00
22	0.00	5.60	18.10	17.60	8.40	2.20	10.50	6.00			0.00	0.00
23	0.00	6.30	18.10	17.60		2.00	10.30	6.00			0.00	0.00
24	0.00	4.30	18.10	17.60	6.70	1.70		5.80		0.30	0.00	0.00
25	0.00	4.30	18.10	17.60	10.30			5.40			0.00	0.00
26	0.00	5.60	17.60	18.11	13.00	1.70	15.60	5.40			0.00	0.00
27	0.00	5.60	17.60	18.11	8.20	7.10	15.60	5.30			0.00	0.00
28	0.00	4.30	17.60	18.11	6.50	7.10		5.30		0.00	0.00	0.00
29	0.00		17.60	18.11	12.10	7.10	15.60	5.30		0.00	0.00	0.00
30	0.00		17.60	18.11	11.60	7.10	14.40	5.30		0.00	0.00	0.00
31	0.00		17.60		12.30			4.90		0.00		
MIN	0.00	4.30	3.60	17.6	6.50	1.70	7.10	.50	4.60	.30	0.00	0.00
AVG	0.00	7.45	13.34	18.04	14.60	3.67	11.11	9.66	4.78	0.17	0.00	0.00

Webb Canal Daily Discharge Tables (CFS) {WCCI QJ}

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	0.00	9.40		17.90	2.90	16.3	0.50			0.00
2	0.00	0.00	0.00	8.80		17.90		16.10				0.00
3	0.00	0.00	0.00	8.80	2.50	17.90		16.10			1.40	0.00
4	0.00	0.00	0.00	8.80	2.10	13.20				0.60		0.00
5	0.00	0.00	0.00	8.80	2.10		6.00	16.10			0.60	0.00
6	0.00	0.00	0.00	9.20	2.10	17.90	9.00	15.80		0.60		0.00
7	0.00	0.00	0.00	8.60	2.00	11.60		15.80				0.00
8	0.00	0.00	0.00	8.00		17.90	1.60	15.80				0.00
9	0.00	0.00	5.60	7.20	2.00	17.90	1.60	15.60	0.50			0.00
10	0.00	0.00	8.40	6.00	1.70	17.30	3.60	15.30				0.00
11	0.00	0.00	8.00	6.00	16.80	15.30	3.90	15.30		0.60		0.00
12	0.00	0.00	8.40	5.60	13.90	13.90	3.60					0.00
13	0.00	0.00	9.90	5.80	11.20	12.10	3.50	15.10				0.00
14	0.00	0.00	9.40	5.80	9.90	12.50	3.50	15.10		0.60		0.00
15	0.00	0.00	10.90	6.30	8.40	11.40	3.10	15.10				0.00
16	0.00	0.00	11.20	5.80	17.30	8.40	6.10	14.90	0.90			0.00
17	0.00	0.00	13.90	5.80		7.20	6.10	14.60	0.60	0.60		0.00
18	0.00	0.00	17.30	5.80	13.90	6.70	6.10	14.60				0.00
19	0.00	0.00	17.30	6.00	17.90	6.70	16.10	14.60				0.00
20	0.00	0.00	13.90	7.60		5.80	16.30	0.50	0.60			0.00
21	0.00	0.00	13.90	6.30	18.40	5.40	16.30					0.00
22	0.00	0.00	14.90	5.80	18.10	4.40	15.80					0.00
23	0.00	0.00	15.60	5.10	18.10	4.30	15.80	1.70				0.00
24	0.00	0.00	15.60	4.80	18.10	3.90	15.80	1.70				0.00
25	0.00	0.00	13.70	4.10	17.60	3.50	15.80	1.70				0.00
26	0.00	0.00	13.70	4.10	17.60	3.20	15.80	1.00				0.00
27	0.00	0.00		3.50	17.60	2.90	16.60	0.70	0.60	0.60		0.00
28	0.00	0.00		4.10	18.40	2.80	16.60					0.00
29	0.00	0.00	10.90	3.90		2.80	16.60					0.00
30	0.00		10.50	3.50		2.90	16.30	0.50	0.60			0.00
31			12.70				16.30					0.00
MIN	0.00	0.00	0.00	3.50	2.00	2.80	2.90	.50	.50	.60	.60	0.00
AVG	0.00	0.00	8.82	6.31	11.64	9.85	10.03	11.25	0.61	0.60	1.00	0.00

Webb Canal Daily Discharge Tables (CFS){WCCI QJ}

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00						9.70		8.20		
2	0.00	0.00	1.60		4.30				9.00			
3	0.00	0.00						9.70	8.80	7.10		
4	0.00	0.00	1.20		4.80			9.70	8.80	6.90		
5	0.00	0.00		8.80			1.40	9.70	8.60			
6	0.00	0.00			7.40	6.90	7.80		8.60			
7	0.00	0.00	2.10				6.30	9.70	8.60			
8	0.00	0.00						9.40				
9	0.00	0.00	2.10	9.70	5.80	4.40	4.40	9.40				
10	0.00	0.00	2.20		10.90		4.30					
11	0.00	0.00	1.60				4.30	9.40				
12	0.00	0.00		7.60			6.30					
13	0.00	0.00		8.20		3.60	6.10	9.40				
14	0.00	0.00										
15	0.00	0.00	1.60				6.10	9.40				
16	0.00	0.00						9.40				
17	0.00	0.00	1.60				8.00	9.40				
18	0.00	0.00						9.20				
19	0.00	0.00		17.60			7.10	9.20				
20	0.00	0.00			18.10	2.90		9.20				
21	0.00	0.00	2.40				16.30		8.20			
22	0.00	0.00					16.30	9.20	8.20			
23	0	0.00					16.30	9.20	7.60			
24	0.00	0.00					16.10	9.20	8.20			
25	0.00	0.00	2.60					9.20	8.20			
26	0.00	0.00		8.40	15.30							
27	0.00	0.00					9.90	9.20	7.20			
28	0.00	0.00	9.30			4.40	9.70	9.20	7.20			
29	0.00			6.30			9.40		7.20			
30	0.00		8.00					9.20	7.20			
31	0.00				7.10			9.20				
MIN	0.00	0.00	1.60	6.30	4.30	2.90	1.40	9.20	7.20	6.90		
AVG	0.00	0.00	3.03	9.51	9.21	4.44	8.67	9.37	8.11	7.40		

Webb Canal Daily Discharge Tables (CFS){WCCI QJ}

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1				18.10	12.50	2.80	8.40		9.40			
2				18.10	11.20	2.50	8.40	9.00	9.40	0.30		
3				18.40	9.90	4.60		9.00	9.40			
4				18.40	8.80	6.10	8.40	9.00	9.40			
5				18.60	8.00		8.20	9.00	9.20			
6				18.60	7.20	5.30	8.00	8.80	9.20			
7				18.60	7.40	4.40		8.80	9.00			
8						6.50	8.20		9.00			
9			5.30	18.60	6.50	11.40	8.20	8.80	9.00			
10				18.60	6.00	11.80	8.40	8.60	8.40	0.10		
11				18.60	5.40	10.70	8.60	8.60	8.40			
12				18.60	5.10	13.40		8.60	8.20			
13			4.40	18.60	4.80	12.70		8.60	8.00			
14				18.60	4.30	18.40	0.20	8.60	8.20			
15			3.50	18.60		5.30	9.70	8.40				
16			3.50	18.60	3.20	13.00	9.70	8.40	8.00			
17				18.60		14.10	9.70	8.40	8.00			
18				18.60	2.90	9.90	9.70	8.60	8.00			
19				18.60	5.60	12.30	9.70	8.60	7.80			
20				18.60	8.20	14.60	9.70	8.60	7.80			
21				18.60	3.50		9.70	8.40	7.80			
22			2.90	18.90	7.60	2.90	9.40	8.40				
23				18.90	3.50	2.80	9.40	8.40	8.40			
24			5.10	18.60	3.20	2.50		7.20	1.70			
25				18.60	3.80		9.00	7.20	0.50			
26				18.60	5.80	2.10	9.20	9.00	0.50			
27			17.90		4.80	8.60	9.20	9.90	0.50			
28			14.60		4.60	8.40		9.90				
29			17.30	14.40	5.10	8.40	9.00	9.40				
30			16.80	15.60	3.50	8.40	9.00	9.40				
31			18.10		3.20		9.00	9.40				
MIN			2.90	14.40	2.90	2.10	.20	7.20	.50	.10		
AVG			9.95	18.30	5.91	8.29	8.64	8.72	7.33	0.20		

Webb Canal Daily Discharge Tables (CFS){WCCI QJ}

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1				18.10	8.00	1.60	5.10	5.80	5.60			
2				18.10	7.40	1.50	4.60	5.80	5.60			
3				17.30	10.90	1.50	6.90	5.80	5.60			
4				18.10	7.80	1.40	6.70	5.80	5.60			
5				18.10	7.40	1.60	7.10	5.80	6.10			
.6				14.60	6.50	2.20	7.10	5.80	5.60			
7				13.20	6.50	2.10	6.90	5.80	5.40			
8				12.50	5.60	2.00	6.70	5.80	5.40			
9				18.10	5.60	1.70	6.70	5.80	5.40			
10				14.10	5.10	11.60	6.70	11.40	5.30			
11				12.50	4.90	5.10	6.70	13.00	5.10			
12				12.10	4.40	3.60	6.70	15.60	5.40			
13				10.90	4.10	2.90	8.60	15.60	5.30			
14				10.30	3.90	2.80	9.00	15.60	5.30			
15				15.30	3.60	2.40	9.00	15.60	5.30			
16				12.10	3.50	2.10	8.80	15.30	5.10			
17				18.10	3.10	2.10	8.00	15.30	5.10			
18				18.10	2.80	2.00	6.50	15.10				
19				18.10	2.60	1.60	6.50	15.10				
20				18.10	2.80	1.50	6.50	15.10				
21				18.10	4.30	1.50	6.30	14.90				
22				18.10	7.20	6.10	6.30	14.90				
23				16.30	3.60	6.10	6.30	14.60				
24				13.90	3.50	6.10	6.30	14.60				
25				16.10	3.10	6.10	6.30	14.40				
26				12.50	2.60	6.10	6.00	14.40				
27			17.90	11.60	2.60	6.10	6.00	13.90				
28			18.10	10.30	2.60	5.80	6.00	6.90				
29			18.10	9.40	2.50	5.80	6.00	6.00				
30			18.10	8.80	2.10	5.80	6.00	5.60				
31			18.10		1.60		6.00	5.60				
MIN			17.90	8.80	1.60	1.40	4.60	5.60	5.10			
AVG			18.06	14.76	4.59	3.63	6.72	10.99	5.42			

Webb Canal Daily Discharge Tables (CFS){WCCI QJ}

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1					17.90	17.90	13.40	0.80	11.60			
2					17.90	17.90	13.20	0.80	11.60			
3					17.90	17.90	13.20	0.80	11.60			
4					17.90	17.90	12.50	0.80	11.40			
5					17.90	17.90	12.50	0.80	11.20			
6					17.90	17.90	12.50	0.80	10.70			
7					17.90	17.90	12.30	7.40	10.70			
8					17.90	17.90	12.50	6.50	10.90			
9					17.90	17.90	12.50	6.50	10.90			
10					18.10	17.90	12.10	6.30	10.70			
11					18.40	17.90	10.90	6.50	10.30			
12					18.40	17.90	11.40	6.30	10.30			
13					18.10	17.90	11.40	6.30	10.10			
14					18.40	17.60	11.40	6.30	10.70			
15					18.40	15.60	11.40	6.10	9.90			
16					18.40	14.90	1.50	6.10	9.70			
17					18.90	17.60	1.30	6.10	9.70			
18				17.90	18.10	16.30	6.00	6.10				
19				17.90	18.10	15.60	9.20	6.00				
20				17.90	18.10	13.90	8.60	6.70	7.10			
21				17.90	18.10	13.40	8.40	6.70	7.10			
22				17.90	18.10	13.90	8.20	6.70				
23				17.90	17.10	13.90	8.20	6.50				
24				17.90	18.10	11.40	8.40	6.50				
25				17.90	18.10	10.70	6.00	6.30				
26				17.90	17.60	10.70	5.40	6.70				
27				17.90	16.30	10.30	13.00	6.70				
28				17.90	10.90	10.10	7.40	6.50				
29				17.90	17.90	9.90	7.40	11.60				
30				17.90	17.60	13.40	6.70	11.60				
31					15.80		6.70	11.60				
MIN				17.90	15.80	9.90	1.30	.80	7.10			
AVG				17.90	17.68	15.40	9.54	5.85	10.33			

9. Lake Waha Feeder Canal Tables (CFS){WAFI QJ}

2000

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	3.64	9.65	3.94	5.42	0.00	0.00	0.00	0.00		0.00
2	0.00	0.00	3.64	9.65	4.42	4.91	0.00	0.00	0.00	0.00		0.00
3	0.00	0.00	3.64		4.10	0.00	0.00	0.00	0.00	0.00		0.00
4	0.00	0.00	3.94		5.25	0.00	0.00	0.00	0.00	1.18		0.00
5	0.00	0.00	4.42		4.91	0.00	0.00	0.00	0.00	0.53		0.00
6	0.00	0.00	4.42		4.91	0.00	0.00	0.00	0.00			0.00
7	0.00	0.00	4.42		4.58	0.00	0.00	0.00	0.00			0.00
8	0.00	0.00	3.94	19.16	4.26	0.00	0.00	0.00	0.00			0.00
9	0.00	0.00	3.64		4.91	0.00	0.00	0.00	0.00			0.00
10	0.00	0.00	3.64		5.25	4.26	0.00	0.00	0.00			0.00
11	0.00	0.00	3.64	13.19	4.91	4.26	0.00	0.00	0.00			0.00
12	0.00	0.00	2.49	13.43	5.95	3.19	0.00	0.00	0.00			0.00
13	0.00	0.00	2.91	14.61	8.62	3.05	0.00	0.00	0.00			0.00
14	0.00	0.00	2.91	16.33	9.44	2.77	0.00	0.00	0.00			0.00
15	0.00	0.00	2.91	16.33	9.03	2.49	0.00	0.00	0.00			0.00
16	0.00	0.00	3.64	16.33	8.62	2.49	0.00	0.00	0.00			0.00
17	0.00	0.00	3.05	11.82	8.62	2.49	0.00	0.00	0.00			0.00
18	0.00	0.00	3.05	11.15	7.82	2.23	0.00	0.00	0.00			0.00
19	0.00	0.00	3.64	9.44	5.95	2.23	0.00	0.00	0.00			0.00
20	0.00	0.00	2.77	9.23	5.42	0.00	0.00	0.00	0.00	0.79		0.00
21	0.00	0.00	3.05	7.05	4.42	0.00	0.00	0.00	0.00			0.00
22	0.00	0.00	3.05	9.23	0.00	0.00	0.00	0.00	0.00			0.00
23	0.00	0.00	6.31	7.05	0.00	0.00	0.00	0.00	0.00		0.00	0.00
24	0.00		6.50	5.25	0.00	0.00	0.00	0.00	0.00		0.00	0.00
25	0.00	2.63	6.50	5.42	0.00	0.00	0.00	0.00	0.00		0.00	0.00
26	0.00	2.63	6.50	5.25	0.00	0.00	0.00	0.00	0.00		0.00	0.00
27	0.00	2.63	7.05	4.75	0.00	0.00	0.00	0.00	0.00		0.00	0.00
28	0.00	3.64	9.65	5.08	0.00	0.00	0.00	0.00	0.00		0.00	0.00
29	0.00	3.64	9.65	4.42	2.91	0.00	0.00	0.00	0.00		0.00	0.00
30	0.00		9.65	4.42	0.00	0.00	0.00	0.00	0.00	2.1	0.00	0.00
31	0.00		9.65				0.00	0.00		1.98		0.00
MIN	0.00	0.00			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	0.00	0.542	4.77	9.92	4.28	1.33	0.00	0.00	0.00	0.823	0.00	0.00

Lake Waha Feeder Canal Tables (CFS){WAFI QJ}

2001

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	0.00	13.43	23.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	12.96	23.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	11.82	23.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	11.82	17.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	3.64	0.00	10.29	16.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	2.49	1.62	10.72	13.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	2.63	2.10	10.29	11.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	2.49	3.64	9.86	11.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	4.58	9.03	10.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	4.58	8.02	9.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	4.58	8.02	7.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	3.79	7.24	7.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	4.26	7.24	6.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	5.25	6.68	7.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	5.25	6.68	7.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	4.91	7.05	6.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	4.58	10.29	5.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	4.58	14.37	4.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	7.05	15.84	4.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00		8.22	14.86	4.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00		8.42	14.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	9.03	13.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.19	8.82	15.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.19	10.07	16.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.19	14.37	18.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.19	16.33	24.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.19	15.1	23.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.20	14.14	24.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00		14.14	23.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00		12.50	24.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00		12.50		0.00		0.00	0.00	0.00	0.00	0.00	0.00
MIN	0.00	0.00	0.00	6.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	0.00	.164	6.59	13.5	7.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Lake Waha Feeder Canal Tables (CFS){WAFI QJ}

2002

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	0.00	5.25	7.63	3.34	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	5.25	7.63	3.34	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	5.25	7.24	2.77	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	5.60	5.95	2.49	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	7.44	5.60	2.23	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	9.65	4.91	2.10	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	11.15	3.79	1.86	0.00	0.00	0.00	0.00	0.00	0.00
8		0.00	0.00	11.15	3.79	1.86	0.00	0.00	0.00	0.00	0.00	0.00
9	1.74	0.00	0.00	11.60	3.34	2.23	0.00	0.00	0.00	0.00	0.00	0.00
10	1.39	0.00	0.00	18.37	3.34	11.15	0.00	0.00	0.00	0.00	0.00	0.00
11	1.06	0.00	0.00	19.95	3.34	19.42	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	1.08	20.49	3.64	14.37	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	1.39	20.49	3.94	12.05	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	1.29	21.03	4.26	10.29	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	1.39	21.03	4.10	7.63	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	1.29	21.03	4.10	6.31	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	1.08	17.86	0.00	5.25	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	1.18	14.61	0.00	7.44	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	1.08	11.60	0.00	5.08	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.88	10.50	0.00	4.10	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.88	9.65	0.00	3.49	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	1.08	10.07	0.00	3.49	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	1.51	10.50	0.00	2.77	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	1.29	2.23	9.23	4.42	2.49	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	1.18	2.36	8.82	4.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	3.05	8.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	4.91	9.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	4.26	8.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00		3.94	7.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00		3.64	7.44	4.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00		4.10		3.64		0.00	0.00		0.00		0.00
MIN	0.00	0.00	0.00	5.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	.14	.09	1.38	11.95	3.01	4.59	0.00	0.00	0.00	0.00	0.00	0.00

Lake Waha Feeder Canal Tables (CFS){WAFI QJ}

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	19.42	1.08	11.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	12.96	1.08	11.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	9.03	1.08	11.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	6.87	1.08	11.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	5.60	1.08	10.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	5.60	1.08	9.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	3.34	1.08	7.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	3.34	1.08	7.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	2.77	1.18	7.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	2.77	1.74	9.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	1.98	3.34	11.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	1.98	5.95	11.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	2.23	13.90	11.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	1.98	19.95	11.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	1.86	12.50	10.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	2.10	12.50	10.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	1.98	12.50	10.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	1.98	12.50	10.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	1.62	12.50	9.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	1.62	9.03	9.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	1.62	9.03	9.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	1.86	9.65	10.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	1.86	12.50	10.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	1.39	12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	1.51	12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	1.29	12.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	8.45	1.29	11.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	7.52	1.29	9.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	5.49		7.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	15.13		7.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	22.12		9.86		0.00	0.00	0.00	0.00		0.00		0.00
MIN	0.00	1.29	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	1.89	3.68	7.73	7.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Lake Waha Feeder Canal Tables (CFS){WAFI QJ}

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	0.00	5.25	0.00	14.37	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	4.91	0.00	12.05	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	4.75	0.00	9.23	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	5.08	0.00	7.44	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	5.08	0.00	5.95	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	5.60	0.00	6.87	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	5.25	0.00	5.08	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	4.91	0.00	9.23	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.53	4.91	0.00	8.82	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	1.74	4.10	0.00	8.22	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	2.10	3.64	0.00	7.82	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	2.10	3.64	5.25	6.50	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	2.77	0.00	5.08	5.77	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	2.77	0.00	5.08	5.08	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	2.77	0.00	4.75	4.42	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	3.19	0.00	9.86	4.10	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	3.79	0.00	#N/A	3.49	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	5.08	0.00	9.86	2.91	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	6.13	0.00	13.19	2.91	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	5.42	0.00	#N/A	2.49	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	4.75	0.00	10.93	2.23	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	5.42	3.05	10.29	2.10	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	6.5	2.77	10.93	1.62	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	7.24	2.63	12.96	1.51	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	5.95	2.36	11.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	6.87	2.36	10.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	5.95	2.23	12.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	5.25	0.00	19.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	5.08	0.00	18.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00		5.25	0.00	18.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00		6.68		17.86		0.00	0.00		0.00		0.00
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	0.00	0.00	3.33	2.42	13.95	4.67	0.00	0.00	0.00	0.00	0.00	0.00

Lake Waha Feeder Canal Tables (CFS){WAFI QJ}

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.88	0.00	2.40	2.24	4.20	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.80	0.00	2.38	2.10	3.68	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.77	0.00	2.63	0.00	3.27	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.76	0.00	3.19	0.00	2.80	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.64		3.11	0.00	3.19	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.50		3.67	0.00	2.91	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.33	0	4.26	6.32	2.81	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.32	0.11	4.91	5.59	2.56	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.22	0.13	4.60	4.91	2.49	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.18	0.13	4.13	6.31	2.23	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.13	0.13	3.94	12.73	2.07	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.26		3.94	9.62	1.88	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.33		3.87	7.72	1.51	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.13		3.64	6.47	1.49	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.07	0.00	3.94	6.58	1.39	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	4.26	11.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00		0.00	7.44	18.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00		0.00	7.24	15.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00		0.00	7.24	13.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00		0.00	8.22	11.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00		0.00	7.04	9.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	1.77		0.00	6.11	10.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	1.74		0.00	5.41	11.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	1.62		0.00	4.84	10.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	1.44		0.00	4.26	9.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	1.39		0.00	3.86	7.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	1.30		0.00	3.64	6.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	1.29		0.00	3.19	5.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	1.13		3.19	2.79	4.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	1.08		2.77	2.50	4.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.98		0.00		3.79		0.00	0.00		0.00		0.00
MIN	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	.44	.40	.35	4.42	7.30	1.28	0.00	0.00	0.00	0.00	0.00	0.00

Lake Waha Feeder Canal Tables (CFS){WAFI QJ}

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	0.00	4.26	6.31	0.98	0.48	0.00	0.00	0.00	0.00	0.45
2	0.00	0.00	0.00	4.26	5.42	0.98	0.44	0.00	0.00	0.00	0.00	0.42
3	0.00	0.00	0.00	4.58	9.86	1.29	0.37	0.00	0.00	0.00	0.00	0.38
4	0.00	0.00	0.00	7.05	4.10	1.74	0.34	0.00	0.00	0.00	0.00	0.38
5	0.00	0.00	0.00	11.15	3.79	2.10	0.34	0.00	0.00	0.00	0.00	0.38
6	0.00	0.00	0.45	18.37	3.49	1.86	0.31	0.00	0.00	0.00	0.00	0.38
7	0.00	0.00	0.62	16.30	3.34	1.62	0.31	0.00	0.00	0.00	0.00	0.38
8	0.00	0.00	0.66	16.10	3.23	1.74	0.24	0.00	0.00	0.00	1.24	0.39
9	0.00	0.00	0.70	16.10	2.77	1.39	0.21	0.00	0.00	0.00	0.55	0.49
10	0.00	0.00	0.70	15.60	2.49	1.62	0.19	0.00	0.00	0.00	0.37	0.57
11	0.00	0.00	0.61	15.60	2.23	1.39	0.14	0.00	0.00	0.00	0.39	0.61
12	0.00	0.00	0.61	15.10	2.10	1.29	0.13	0.00	0.00	0.00	0.30	0.72
13	0.00	0.00	0.53	16.10	1.86	1.18	0.13	0.00	0.00	0.00	0.34	1.18
14	0.00	0.00	0.45	16.10	1.74	2.49	0.09	0.00	0.00	0.00	0.34	1.45
15	0.00	0.00	0.45	16.33	1.51	1.74	0.08	0.00	0.00	0.00	0.3	2.45
16	0.00	0.00	0.38	16.08	1.39	1.74	0.04	0.00	0.00	0.00	0.52	2.11
17	0.00	0.00	0.38	13.20	1.29	1.98	0.00	0.00	0.00	0.00	0.38	1.79
18	0.00	0.00	0.38	11.15	1.18	1.74	0.00	0.00	0.00	0.00	0.43	1.39
19	0.00	0.00	0.38	10.10	1.08	1.74	0.00	0.00	0.00	0.00	0.46	1.29
20	0.00	0.00	0.38	10.72	1.98	1.51	0.00	0.00	0.00	0.00	0.79	1.11
21	0.00	0.00	0.38	12.30	1.18	1.29	0.00	0.00	0.00	0.00	1.18	1.06
22	0.00	0.00	0.38	13.40	1.18	1.18	0.00	0.00	0.00	0.00	1.39	0.9
23	0.00	0.00	0.38	12.50	1.18	1.08	0.00	0.00	0.00	0.00	1.19	0.79
24	0.00	0.00	0.88	11.60	0.98	0.98	0.00	0.00	0.00	0.00	1.05	0.73
25	0.00	0.00	1.86	10.5	1.08	0.79	0.00	0.00	0.00	0.00	0.95	0.74
26	0.00	0.00	3.64	9.44	1.62	0.70	0.00	0.00	0.00	0.00	0.8	0.79
27	0.00	0.00	3.34	8.75	1.74	0.70	0.00	0.00	0.00	0.00	0.79	0.79
28	0.00	0.00	3.34	7.82	1.51	0.61	0.00	0.00	0.00	0.00	0.56	0.57
29	0.00		3.79	7.63	1.62	0.58	0.00	0.00	0.00	0.00	0.53	0.48
30	0.00		3.94	7.63	1.39	0.61	0.00	0.00	0.00	0.00	0.53	0.45
31	0.00		4.10		1.18		0.00	0.00	0.00	0.00		0.38
MIN	0.00	0.00	0.00	4.26	.98	.61	0.00	0.00	0.00	0.00	0.00	.38
AVG	0.00	0.00	1.09	11.86	2.45	1.36	.12	0.00	0.00	0.00	.51	.84

Lake Waha Feeder Canal Tables (CFS){WAFI QJ}

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.35		1.00	8.42	2.23	0.53	0.00	0.00	0.00	0.00	0.00	0.00
2	0.38		0.78	7.24	2.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.41		0.79	6.68	2.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.38	0.00	0.79	6.68	2.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.35	0.00	0.82	5.25	2.49	0.00	0.00	0.00	0.00	0.00	0.00	0.19
6	0.31	0.04	0.94	5.42	2.36	0.00	0.00	0.00	0.00	0.00	0.00	0.13
7	0.3	0.16	1.40	5.42	1.98	0.00	0.00	0.00	0.00	0.00	0.00	0.03
8	0.29	0.36	2.88	5.60	1.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.25	0.53	3.23	7.24	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.3	0.83	3.19	6.50	1.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.36	1.05	3.94	5.77	1.29	0.00	0.00	0.00	0.00	0.00	0.00	
12	0.52	1.39	9.77	4.91	1.18	0.00	0.00	0.00	0.00	0.00	0.00	
13	0.00	1.50	12.76	4.26	1.08	0.00	0.00	0.00	0.00	0.00	0.00	
14	0.00	1.36	11.40	3.79	0.98	0.00	0.00	0.00	0.00	0.00	0.00	
15	0.00	1.74	9.44	4.75	0.88	0.00	0.00	0.00	0.00	0.00	0.00	
16	0.00	2.36	7.82	4.42	0.79	0.00	0.00	0.00	0.00	0.00	0.00	
17	0.00	2.66	7.44	7.82	0.70	0.00	0.00	0.00	0.00	0.00	0.00	
18	0.00	2.95	8.22	8.22	0.61	0.00	0.00	0.00	0.00	0.00	0.00	
19	0.00	2.78	9.03	7.82	0.53	0.00	0.00	0.00	0.00	0.00	0.00	
20	0.00	2.52	10.30	7.05	0.45	0.00	0.00	0.00	0.00	0.00	0.00	
21	0.00	2.17	8.82	6.31	0.79	0.00	0.00	0.00	0.00	0.00	0.00	
22	0.00	2.63	7.82	5.60	1.74	0.00	0.00	0.00	0.00	0.00	0.00	
23	0.00	2.36	7.44	5.25	0.79	0.00	0.00	0.00	0.00	0.00	0.00	
24	0.00	1.50	7.63	4.42	0.79	0.00	0.00	0.00	0.00	0.00	0.00	
25	0.00	1.39	8.42	4.58	0.53	0.00	0.00	0.00	0.00	0.00	0.00	
26	0.00	1.86	16.33	3.94	0.45	0.00	0.00	0.00	0.00	0.00	0.00	
27	0.00	1.18	13.70	3.49	0.38	0.00	0.00	0.00	0.00	0.00	0.00	
28	0.00	1.62	11.60	3.19	0.38	0.00	0.00	0.00	0.00	0.00	0.00	
29	0.00		9.55	2.91	0.38	0.00	0.00	0.00	0.00	0.00	0.00	
30	0.00		8.42	2.63	0.31	0.00	0.00	0.00	0.00	0.00	0.00	
31	0.00		7.63		0.25		0.00	0.00		0.00		
MIN	0.00	0.00	.78	2.63	.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AVG	.14	1.48	6.88	5.52	1.19	.018	0.00	0.00	0.00	0.00	0.00	.035

Lake Waha Feeder Canal Tables (CFS){WAFI QJ}

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1			0.38	0.45	13.00	0.00	0.00	0.00	0.00			
2			0.31	0.38	10.90	0.00	0.00	0.00	0.00			
3			0.24	0.38	11.20	6.31	0.00	0.00	0.00			
4			0.31	0.38	14.40	7.63	0.00	0.00	0.00			
5	0.00		0.13	0.38	19.40	7.24	0.00	0.00	0.00			
6			0.02	0.38	17.30	7.44	0.00	0.00	0.00			
7			0.05	0.38	17.30	7.82	0.00	0.00	0.00			0.00
8			0.09	0.38	17.30	8.42	0.00	0.00	0.00			0.00
9			0.13	0.38	17.30	8.22	0.00	0.00	0.00			
10		0.01	0.13	0.38	16.30	7.63	0.00	0.00	0.00			
11		0.02	0.38	0.38	16.30	8.22	0.00	0.00	0.00			
12		0.02	1.08	1.16	16.30	8.82	0.00	0.00	0.00		0.00	
13		0.01	1.18	3.04	15.60	7.82	0.00	0.00	0.00		0.01	
14		0.00	1.18	8.82	15.80	7.05	0.00	0.00	0.00			
15		0.01	1.08	7.05	16.30	6.13	0.00	0.00	0.00			
16		0.00	0.98	5.95	16.10	5.25	0.00	0.00	0.00			
17		0.00	0.88	5.08	16.10	4.42	0.00	0.00	0.00			
18		0.01	0.79	7.44	16.10	3.94	0.00	0.00	0.00			
19		0.00	0.88	7.24	15.80	3.34	0.00	0.00	0.00			
20		0.02	0.88	7.05	14.10	2.91	0.00	0.00	0.00			
21		0.00	0.88	6.13	13.20	2.49	0.00	0.00	0.00			
22		0.00	0.79	5.08	10.70	2.63	0.00	0.00	0.00			
23		0.01	0.79	5.08	9.65	1.98	0.00	0.00	0.00			
24		0.01	1.08	4.75	7.82	0.00	0.00	0.00	0.00			
25		0.02	0.98	4.58	7.63	0.00	0.00	0.00	0.00			
26		0.01	0.98	4.75	6.13	0.00	0.00	0.00	0.00			
27		0.02	0.98	3.19	5.25	0.00	0.00	0.00	0.00			
28		0.02	0.88	10.50	0.00	0.00	0.00	0.00	0.00			
29		0.07	0.79	18.40	0.00	0.00	0.00	0.00	0.00			0.00
30			0.70	16.10	0.00	0.00	0.00	0.00	0.00			0.01
31			0.61		0.00		0.00	0.00	0.00			0.00
MIN	0.00	0.00	.02	.38	0.00	0.00	0.00	0.00	0.00		0.00	0.00
AVG	0.00	.013	.66	4.52	12.04	4.19	0.00	0.00	0.00		0.0033	.002

10. Sweetwater Canal
Daily Discharge Tables
(CFS) [SWCI QJ]

2003

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	14.70	0.00	19.40	18.30	18.50	28.90	30.80	8.0	0.00	0.00
2	0.00	0.00	14.70	0.00	19.40	0.00	23.40	30.30	30.80	6.70	0.00	0.00
3	0.00	0.00	15.40	0.00	19.40	0.00	21.60	30.80	30.30	6.40	0.00	0.00
4	0.00	0.00	14.90	0.00	0.00	0.00	21.60	30.80	30.30		0.00	0.00
5	0.00	0.00	14.50	0.00	0.00	18.30	21.60	30.80	30.30		0.00	0.00
6	0.00	0.00	14.90	0.00	0.00	17.30	21.20	30.30	30.30	5.90	0.00	0.00
7	0.00	0.00	15.70	0.00	0.00	16.80	21.20	30.30	30.30	5.90	0.00	0.00
8	0.00	0.00	15.70	0.00	0.00	16.60	22.10	29.80	31.50		0.00	0.00
9	0.00	0.00	15.80	0.00	0.00		24.20	29.80	31.50		0.00	0.00
10	0.00	0.00	16.00	0.00	0.00	13.50	23.90	29.30	25.80	5.60	0.00	0.00
11	0.00	8.60	16.20	0.00	0.00	13.50	23.90	30.50	24.80		0.00	0.00
12	0.00	12.90	16.60	0.00	0.00	13.50	23.50	30.50	24.60		0.00	0.00
13	0.00	16.00	16.80	0.00	0.00	12.70	23.50	30.50	24.40	5.70	0.00	0.00
14	0.00	16.00	16.80	0.00	0.00	15.60	23.50	8.90	24.40	5.70	0.00	
15	0.00	16.00	16.80	0.00	0.00	14.50	23.00	23.50	8.80		0.00	
16	0.00	16.00	16.80	0.00	0.00	13.90	23.00	30.80	24.20		0.00	
17	0.00	16.20	17.00	0.00	0.00	13.50	23.00	31.50	24.40		0.00	
18	0.00	16.20	16.60	0.00	0.00	13.30	22.60	31.50	24.40		0.00	
19	0.00	16.20	16.40	0.00	17.70	14.10	22.60	31.50	23.70	5.20	0.00	
20	0.00	16.20	16.20	0.00	18.30	14.50	22.60	31.50	23.70		0.00	
21	0.00	16.20	16.20	0.00	18.30	14.50	22.60	31.50	23.70		0.00	
22	0.00	16.20	16.20	0.00	18.30	13.50	22.60	31.50	23.50	4.90	0.00	
23	0.00	16.20	16.80	0.00	18.30	13.50	22.60	31.50	23.50	4.90	0.00	
24	0.00	11.90	16.60	0.00	18.30	13.10	22.60	31.50	23.20		0.00	
25	0.00	0.00	0.00	18.50	18.30	12.70	22.60	31.50	23.20		0.00	
26	0.00	0.00	0.00		18.30	12.30	21.20	31.50	23.00	4.90	0.00	
27	0.00	7.90	0.00		18.30	19.00	29.60	17.00	23.00		0.00	
28	0.00	8.80	0.00	19.20	18.30	19.00	29.60	31.00	23.00		0.00	
29	0.00		0.00	19.40	18.30	19.00	29.10	31.00	23.00	0.00	0.00	
30	0.00		0.00	19.40	18.30	18.50	29.10	31.00	23.00	0.00	0.00	
31	0.00		0.00		18.30		28.90	31.00		0.00		
MIN	0.00	0.00	0.00	0.00	0.00	0.00	21.20	8.90	8.80	0.00	0.00	0.00
AVG	0.00	8.13	12.40	2.73	9.53	13.62	23.58	29.41	25.38	4.65	0.00	0.00

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Sweetwater Canal
Daily Discharge Tables
(CFS) [SWCI QJ]

2004

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1		0.00	10.20	26.70	11.90	0.00	14.40	29.60	19.90	18.10	0.00	0.00
2		0.00	9.50	26.50	11.20	0.00	17.10	29.30	8.40	18.10	0.00	0.00
3		0.00	8.20	23.20	10.60	0.00	12.50	29.30	7.40	18.10	0.00	0.00
4		0.00	8.80	23.20	10.00	0.00	12.30	29.10	5.10	18.10	0.00	0.00
5		0.00	8.40	23.00	9.80	15.60	16.60	29.10	5.10	18.10	0.00	0.00
6		0.00	7.90	25.30	9.30	15.80	18.10	29.10	5.10	18.10	0.00	0.00
7		0.00	7.50	22.60	9.10	15.80	11.40	29.30	4.90	18.80	0.00	0.00
8		0.00	9.50	23.50	8.60	24.40	25.30	29.10	4.90	18.80	0.00	0.00
9		0.00	10.40	19.90	8.80	24.40	25.50	28.40	4.90	10.00	0.00	0.00
10		0.00	21.90	18.10	8.20	24.20	24.40	27.90	3.90	19.90	0.00	0.00
11		0.00	19.90	16.40	31.50	0.00	24.40	27.40		19.00	0.00	0.00
12		0.00	19.90	15.60	31.00	0.00	25.30	27.00		18.80	0.00	0.00
13		0.00	22.30	18.80	30.30	0.00	28.10	24.20	3.90	18.80	0.00	0.00
14		0.00	22.30	20.50	10.60	0.00	28.10	25.50	3.90	19.00	0.00	0.00
15		0.00	25.50	23.50	10.60	14.90	28.10	25.50	3.90	18.80	0.00	0.00
16		0.00	25.50	19.60	16.40	24.20	17.00	25.50	4.60	18.80	0.00	0.00
17		0.00	26.00	19.90	16.40	25.50	17.00	25.80	4.60	18.80	0.00	0.00
18		0.00	26.00	19.40	16.40	23.20	16.20	25.30			0.00	0.00
19		0.00	26.00	21.00	16.60	23.00	30.30	25.30	4.60	7.90	0.00	0.00
20		0.00	26.00	22.10	0.00	20.30	32.70	20.30		6.90	0.00	0.00
21		0.00	26.00	21.00	0.00	18.80	30.80	18.50	4.60	6.90	0.00	0.00
22		0.00	26.20	17.00	0.00	8.20	30.10	18.80	4.60	0.00	0.00	0.00
23		0.00	29.30	15.40	0.00	18.50	30.10	18.80	0.00	0.00	0.00	0.00
24		0.00	29.30	14.70	0.00	15.40	29.10	9.70	0.00	0.00	0.00	0.00
25		10.00	29.30	13.50	0.00	13.70	29.90	21.60	0.00	0.00	0.00	0.00
26		10.80	29.30	12.70	14.50	14.90	28.90	21.20	0.00	0.00	0.00	0.00
27		10.20	29.30	11.70	14.50	14.50	30.10	21.00	5.60	0.00	0.00	0.00
28		10.20	29.10	14.70	14.50	14.50	30.10	20.80	17.70	0.00	0.00	0.00
29		10.20	28.40	15.20	0.00	14.50	30.10	8.90	18.10	0.00	0.00	0.00
30			28.40	12.90	0.00	13.90	29.60	20.80	18.10	0.00	0.00	0.00
31			30.30		0.00		29.60	19.90		0.00	0.00	0.00
MIN		0.00	7.50	12.70	0.00	0.00	12.30	8.90	0.00	0.00	0.00	0.00
AVG		1.77	21.18	19.25	10.35	13.27	24.30	23.94	6.30	10.99	0.00	0.00

Sweetwater Canal
Daily Discharge Tables
(CFS) [SWCI QJ]

2005

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	6.20	19.00		24.40	12.10	30.30	28.10	12.70		
2	0.00	0.00	6.70	20.10	0.00	24.40	11.40	30.30	28.10	12.70		
3	0.00	0.00	7.00	21.60	17.00	24.40	10.20	30.30	28.10	12.70		
4	0.00	0.00	7.00	25.80	15.40	0.00	22.10	30.30	28.10	12.70	4.50	
5	0.00	0.00	7.00	24.60	15.80	0.00	22.80	30.30	28.10	3.60	0.00	
6	0.00	0.00	7.00	25.50	22.80	0.00	30.50	30.30	14.50	3.90		
7	0.00	0.00	7.40	30.00	0.00	20.30	29.10	29.60	13.10	3.50		
8	0.00	0.00	7.70	27.90	0.00	17.90	28.60	29.60	13.10			
9	0.00	0.00	7.70	26.70		16.80	26.70	29.60	5.70			
10	0.00	0.00	7.90	24.40	17.90	15.60	26.70	29.60	3.80			
11	0.00	0.00	7.40	23.50	0.00	15.60	26.70	29.60	3.40			
12	0.00	0.00	7.40	26.50	0.00	15.60	29.10	29.60	3.20	3.20		
13	0.00	0.00	6.90	27.90	0.00	14.30	28.40	16.80	3.20	3.00		
14	0.00	0.00	6.40	27.20	0.00	13.70	27.90	27.90	3.20	2.90		
15	0.00	0.00	6.20	27.70	0.00	13.30	25.80	27.90	3.50			
16	0.00	0.00	6.20	28.10	0.00	14.50	29.30	29.60	3.50			
17	0.00	0.00	6.20	30.10	0.00	15.40	28.90	28.90	3.50	3.40		
18	0.00	0.00	6.20	1.00	19.90	15.80	17.70	28.90	3.50	3.40		
19	0.00	0.00	6.20	7.90	19.90	16.00	28.90	28.90	3.40	14.10		
20	0.00	0.00	11.50	13.50	0.00	13.90	17.70	28.90	3.40	16.80		
21	0.00	0.00	9.10	13.50	0.00		27.90	28.90	13.90	16.80		
22	0.00	0.00	8.80	13.50	0.00	11.90	25.80	28.90	13.90	16.80		
23	0.00	0.00	10.20	0.00	0.00	11.20	25.80	28.90	13.90	16.80		
24	0.00	0.00	9.80	0.00	0.00	10.80	25.80	28.90	13.90	16.80		
25	0.00	0.00	9.30		19.00	10.40	8.20	28.90	13.90	16.80		
26	0.00	0.00	7.90	22.80	19.00	10.20	20.80	28.90	13.50	17.50		
27	0.00	0.00	10.20	20.80	19.00	12.50	23.90	28.90	12.70	5.20		
28	0.00	0.00	14.10	19.90	9.70	16.60	30.30	28.90	12.70	4.40		
29	0.00		24.40	17.50	9.70	17.30	30.30	28.10	12.70			
30	0.00		21.00	0.00	9.70	13.10	30.30	28.10	12.70			
31	0.00		14.30		17.70		30.30	28.10		4.80		
MIN	0.00	0.00	6.20	0.00	0.00	0.00	8.20	16.80	3.20	2.90	0.00	
AVG	0.00	0.00	9.07	19.55	8.02	14.00	24.52	28.80	11.94	9.76	2.25	

Sweetwater Canal
Daily Discharge Tables
(CFS) [SWCI QJ]

2006

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1		0.00	0.00	25.90	20.20	6.70	22.80	21.60	10.40		0.00	0.00
2		0.00	0.00	26.20	20.20	6.90	22.80	21.60	10.40		0.00	0.00
3		0.00	0.00	26.20	18.00	5.70	13.10	21.60	10.40		0.00	0.00
4		0.00	0.00	26.50	0.00	9.30	22.30	21.60	10.40		0.00	0.00
5		0.00	0.00	23.40	0.00	7.10	12.70	21.60	10.40		0.00	0.00
6		0.00	0.00	24.40	12.20	21.10	20.80	21.60	10.40	8.50	0.00	0.00
7		0.00	0.00	23.70	12.00	20.80	22.50	20.80	10.40	9.50	0.00	0.00
8		0.00	0.00	23.70	0.00	13.60	22.50	21.30	9.70	9.50	0.00	0.00
9		0.00	8.10	23.70	0.00	18.00	22.50	11.50	9.70	9.70	0.00	0.00
10		0.00	6.90	23.40	10.00	16.70	12.40	21.30	9.50	9.70	0.00	0.00
11		0.00	5.50	23.40	0.00	17.20	11.30	21.30	8.30		0.00	0.00
12		0.00	6.40	23.40	7.70	18.60	0.00	21.30	9.30	0.00	0.00	0.00
13		0.00	5.80	0.00	7.70	19.40	0.00	21.30	9.10	0.00	0.00	0.00
14		0.00	6.90	0.00	7.70	19.10	4.00	21.30	8.50	0.00	0.00	0.00
15		0.00	6.60	0.00	5.80	12.20	14.10	21.30	8.50	0.00	0.00	0.00
16		0.00	5.80	0.00	7.30	18.60	22.50	20.50	8.50	0.00	0.00	0.00
17		0.00	6.60	0.00	5.50	19.10	22.00	20.50	8.50	0.00	0.00	0.00
18		0.00	5.80	0.00	0.00	16.10	22.80	20.50	8.50	0.00	0.00	0.00
19		0.00	5.80	0.00	5.30	18.60	22.80	20.80	8.50	0.00	0.00	0.00
20		0.00	5.50	0.00	8.30	13.30	22.80	20.80	8.50	0.00	0.00	0.00
21		0.00	6.00	0.00	7.90	8.70	22.80	20.80	7.90	0.00	0.00	0.00
22		0.00	6.20	0.00	7.90	17.20	22.80	20.80	9.10	0.00	0.00	0.00
23		0.00	6.70	0.00	8.30	18.30	22.80	10.60	9.10	0.00	0.00	0.00
24		0.00	7.50	0.00	4.50	17.50	22.80	9.50	2.50	0.00	0.00	0.00
25		0.00	7.90	0.00	5.70	16.70	21.90	9.10		0.00	0.00	0.00
26		0.00	21.70	0.00	6.90	16.70	21.90	9.10		0.00	0.00	0.00
27		0.00	25.60	0.00	10.40	17.20	21.90	10.60		0.00	0.00	0.00
28		0.00	25.30	20.80	8.50	22.80	0.00	11.30		0.00	0.00	0.00
29			25.60	20.80	8.30	22.80	21.60	11.00		0.00	0.00	0.00
30			25.60	20.80	8.30	22.80	21.60	10.40		0.00	0.00	0.00
31			25.90		6.70		21.60	10.40		0.00	0.00	0.00
MIN		0.00	0.00	0.00	0.00	5.70	0.00	10.40	2.50	0.00	0.00	0.00
AVG		8.38	11.88	7.46	15.96	18.01	17.67	9.02	1.88	9.28	0.00	0.00

Sweetwater Canal
Daily Discharge Tables
(CFS) [SWCI QJ]

2007

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	7.10	18.80	10.02	6.17	21.82	19.89	7.37			0.00
2	0.00	0.00	4.00	19.11	8.97	6.64	21.46	19.58	7.12			0.00
3	0.00	0.00	4.00	18.97	7.59	6.44	23.26	19.48	7.01			0.00
4	0.00	0.00	6.20	18.93	7.23	8.28	23.29	19.41	6.96			0.00
5	0.00	0.00	5.10	18.79	7.51	18.14	22.19	19.31	7.46			0.00
.6	0.00	0.00	6.20	19.01	7.45	20.26	17.74	19.32	7.28			0.00
7	0.00	0.00	7.10	18.84	10.28	20.19	23.37	19.22	6.68			0.00
8	0.00	0.00	13.10	18.95	12.02	19.22	22.88	14.92	6.44			0.00
9	0.00	0.00	13.40	19.13	11.87	18.53	22.76	10.07	6.55			0.00
10	0.00	0.00	13.40	18.93	10.76	22.92	22.65	14.84	6.49			0.00
11	0.00	0.00	13.60	19.05	9.87	19.86	22.68	16.93	6.31			0.00
12	0.00	0.00	13.60	18.93	8.08	17.03	22.89	19.77	6.43			0.00
13	0.00	0.00	19.04	19.10	7.23	22.82	24.77	19.66	6.25			0.00
14	0.00	0.00	19.97	17.98	6.97	22.23	24.81	19.83	6.30			0.00
15	0.00	0.00	19.85	18.91	6.53	21.33	24.69	19.42	6.23			0.00
16	0.00	0.00	19.36	18.92	7.32	20.61	24.40	19.11	5.96			0.00
17	0.00	0.00	18.15	18.97	7.60	20.26	23.23	18.93	8.62			0.00
18	0.00	0.00	18.18	18.94	7.19	20.09	21.81	18.75	10.92			0.00
19	0.00	0.00	17.46	19.10	7.22	19.57	21.71	19.15	10.53			0.00
20	0.00	0.00	18.43	18.92	7.53	19.19	21.64	19.18	10.56			0.00
21	0.00	0.00	15.24	19.02	9.00	19.13	19.61	18.67	10.65			0.00
22	0.00	0.00	13.05	18.91	11.32	23.77	21.42	18.27	10.72			0.00
23	0.00	10.10	13.68	18.97	6.56	23.63	21.05	18.06	10.82			0.00
24	0.00	10.10	11.74	18.99	0.83	23.48	19.71	18.08	6.77			0.00
25	0.00	10.10	15.73	18.96	6.48	22.14	20.83	17.73	0.47			0.00
26	0.00	9.90	18.98	18.91	5.80	17.52	20.76	17.39	0.00			0.00
27	0.00	8.90	18.84	18.96	5.88	22.84	20.60	16.41	0.00			0.00
28	0.00	7.30	18.76	18.17	6.20	22.61	20.42	9.19	0.00			0.00
29	0.00		18.89	16.11	5.70	22.67	14.24	7.74	0.00			0.00
30	0.00		18.88	12.37	5.17	22.61	20.16	7.33	0.00			0.00
31	0.00		18.90		5.17		19.97	7.33				
MIN	0.00	0.00	4.00	12.37	5.17	6.17	14.24	7.33	0.00			0.00
AVG	0.00	2.01	14.19	18.59	7.66	19.01	21.70	16.87	6.23			0.00

Sweetwater Canal
Daily Discharge Tables
(CFS) [SWCI QJ]

2008

DATE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
1	0.00	0.00	5.61	2.87	22.22	26.34	22.42	18.74	15.74		0.00	0.00
2	0.00	0.00	5.18	3.20	21.99	26.05	20.53	16.18	15.44	0.00	0.00	0.00
3	0.00	0.00	4.66	2.59	22.15	26.17	20.57	16.09	15.39	0.00	0.00	0.00
4	0.00	0.00	4.62	3.11	22.08	26.39	20.08	12.68	15.14	0.00	0.00	0.00
5	0.00	0.00	3.96	3.08	21.84	26.29	20.00	7.39	14.90	0.00	0.00	0.00
6	0.00	0.00	2.34	3.30	21.85	26.35	19.75	16.42	13.97	0.00	0.00	0.00
7	0.00	0.00	3.73	3.68	21.83	26.38	19.54	20.38	14.12	0.00	0.00	0.00
8	0.00	0.00	3.33	3.89	22.00	26.52	17.81	18.70	14.44	0.00	0.00	0.00
9	0.00	0.00	2.78	5.46	22.08	24.86	18.39	10.24	14.28	0.00	0.00	0.00
10	0.00	0.00	2.94	5.53	22.12	0.00	18.17	22.47	14.05	0.00	0.00	0.00
11	0.00	0.00	4.05	6.26	22.01	10.59	17.13	20.08	13.18	0.00	0.00	0.00
12	0.00	0.00	6.74	7.98	21.94	13.82	17.44	22.40	12.66	0.00	0.00	0.00
13	0.00	0.00	8.08	14.37	21.95	17.82	17.45	20.04	12.52	0.00	0.00	0.00
14	0.00	0.00	6.12	20.18	22.15	21.24	17.24	22.02	12.76	0.00	0.00	0.00
15	0.00	0.00	6.22	19.88	22.83	21.08	16.68	21.25	12.62	0.00	0.00	0.00
16	0.00	0.00	5.51	18.29	24.54	22.77	10.96	20.60	12.08	0.00	0.00	0.00
17	0.00	0.00	4.59	17.01	25.23	25.27	16.69	20.62	12.76	0.00	0.00	0.00
18	0.00	0.00	4.13	21.03	24.89	26.2	21.78	18.90	13.22	0.00	0.00	0.00
19	0.00	0.00	5.20	22.17	24.74	26.73	25.27	15.46	11.65	0.00	0.00	0.00
20	0.00	0.00	6.37	22.00	25.06	26.00	24.82	23.02	19.51	0.00	0.00	0.00
21	0.00	0.00	5.45	21.96	25.11	23.98	25.12	24.34	20.63	0.00	0.00	0.00
22	0.00	0.00	4.00	22.21	24.95	24.19	26.65	22.67	16.77	0.00	0.00	0.00
23	0.00	0.00	3.69	22.07	25.03	21.37	26.81	22.30	19.78	0.00	0.00	0.00
24	0.00	0.00	4.75	21.97	25.05	21.75	25.75	22.05	19.54	0.00	0.00	0.00
25	0.00	0.00	4.61	22.18	25.07	20.43	23.26	18.62	18.73	0.00	0.00	0.00
26	0.00	0.00	4.86	22.01	24.67	19.83	17.84	22.82	17.72	0.00	0.00	0.00
27	0.00	0.00	4.98	19.52	22.91	19.09	14.38	22.21		0.00	0.00	0.00
28	0.00	0.00	5.01	21.85	22.96	18.11	23.96	18.98	0.00	0.00	0.00	0.00
29	0.00	3.68	4.71	22.07	25.4	18.35	24.40	16.56		0.00	0.00	0.00
30	0.00		4.56	22.16	25.37	21.95	23.40	16.40		0.00	0.00	0.00
31	0.00		3.46		26.06		23.15	16.16		0.00		0.00
MIN	0.00	0.00	2.34	2.87	21.83	0.00	10.96	7.39	0.00	0.00	0.00	0.00
AVG	0.00	0.13	4.72	14.13	23.49	21.86	20.56	18.93	14.58	0.00	0.00	0.00

Appendix C

Derivation of 2003 to 2008 Unregulated Flows in Sweetwater Creek near Lewiston Orchards, Idaho

APPENDIX C

DRAFT--- TECHNICAL MEMORANDUM

Derivation of 2003-2008 Unregulated Flows in Sweetwater Creek near Lewiston Orchards, Idaho

PREPARED BY: Ted Day - Hydraulic Engineer
PN6200 - River and Reservoir Operations Group

PREPARED FOR: Snake River Area Office, Boise Idaho

DATE: February 23, 2009 (Revised May 1, 2009 and June 19,2009)

Introduction

A dataset of mean daily unregulated flows for 3 locations within the Sweetwater Creek drainage has been created for the 2003–2008 period (water years). These locations are: Webb Creek at Mouth, Sweetwater Creek below Sweetwater Diversion, and Sweetwater Creek at Mouth. The 2003-2008 period was chosen to correspond with the availability of daily flow records following the installation of automated stream gaging stations in 2003 on Webb and Sweetwater Creeks. In addition to the stream gaging data, a great deal of canal diversion and irrigation delivery data was required for this effort, most of which was provided by Lewiston Orchards Irrigation District (LOID). Unfortunately this data was not always complete, and some data was of insufficient quality; both of these factors required a substantial amount of estimation to build a complete data set. A discussion of sensitivity to data error is included in a later section of this report.

Methodology

The unregulated dataset was developed essentially by “turning off” all LOID storage and diversions in both Webb Creek and Sweetwater Creek; the resulting flow changes (positive or negative) are routed downstream and added to the observed data at the streamflow gages. Specifically, the following features of the LOID system were turned off:

<u>Webb Creek</u>:

- Storage operations at Soldiers Meadow reservoir (by allowing calculated inflows to be passed downstream). Trans-basin diversions from Captain John Creek were included in the inflow calculation, since no data is available to quantify the amount and timing of this diversion.
- Webb Creek canal, which diverts water from Webb Creek over to Sweetwater Creek above Sweetwater Diversion. This water instead stays in Webb Creek.

Sweetwater Creek:

- Waha Feeder canal, which diverts from West Fork Sweetwater Creek into Lake Waha; this water remains in the West Fork and is routed downstream.
- Irrigation pumping from Lake Waha; this water instead would remain in the lake and not artificially add to streamflows downstream. (See following discussion of Lake Waha).
- Webb Creek canal (as noted above) does not operate and add water above Sweetwater Diversion.
- Sweetwater Diversion canal; the main diversion to Reservoir A is instead routed downstream in Sweetwater Creek.

One area where adequate information is lacking to fully unregulate the system is Lake Waha, where little data exists to document inflows to the lake, how the lake level fluctuates under natural conditions, and a clearly defined elevation/spring discharge relationship. Given this situation, the approach was to simply eliminate LOID's diversion of water from West Fork Sweetwater Creek into Lake Waha via the Waha Feeder canal, and eliminate pumping from the lake to Sweetwater Creek downstream (i.e. known quantities). This leaves the discharge from Big Springs and reach gains downstream of the lake (including tributary inflows) as the unregulated flow reaching Sweetwater diversion dam. It is recognized that, under natural conditions (i.e. no man-made manipulations), lake levels would likely vary from those in the 2003-2008 record, and would fluctuate on an annual basis depending on water supply. Prolonged droughts or wet periods would likely create downward or upward trends in the lake level, but the annual variations in lake levels would be smaller than current operations. Historic data suggests the lake would reach an equilibrium point higher than with current practices, and discharge from Big Springs would thus also be higher than reflected in the 2003-2008 record, particularly the minimum discharges. No effort was made to modify the spring discharges, due to the uncertainties involved. To be noted, however, is that during the 2003-2008 period LOID pumping from the lake has generally corresponded to the amount of water diverted into the lake, potentially minimizing the impact to spring flows when only viewing this snapshot in time.

Unregulating the storage operations at Soldiers Meadow Reservoir also merits further discussion. Measured inflow data does not exist; therefore it was necessary to calculate a daily inflow using change in reservoir storage plus outflow. These "calculated inflow" results can jump around on a daily basis, reflecting sensitivity to the daily reservoir elevation data. For example, a minor jump of .01 feet up or down in the forebay reading can cause big jumps in the calculated inflows. These 'jumps' usually correct themselves, in that an upward jump one day is typically followed by a corresponding downward jump the next, thus maintaining a mass balance. These up and down spikes were minimized by using a running 3 day average approach, which smooths the dataset.

Another problem with calculated inflow values is that all evaporation and reservoir losses are included in the calculation; this can lead to negative inflow values during the low flow summer period, which is obviously not a realistic situation. The only reliable means to establish inflow during these lowest flow times would be by field measurement. Lacking this, anecdotal information based on observations by LOID staff and other local residents suggested very low flows (approaching zero) in most summers. LOID described it as “pools of standing water, but not flowing”. It was therefore assumed that inflows would not drop below 0.25 cfs and the calculated data set was modified to reflect this convention. Field measurements should be taken to confirm this assumption.

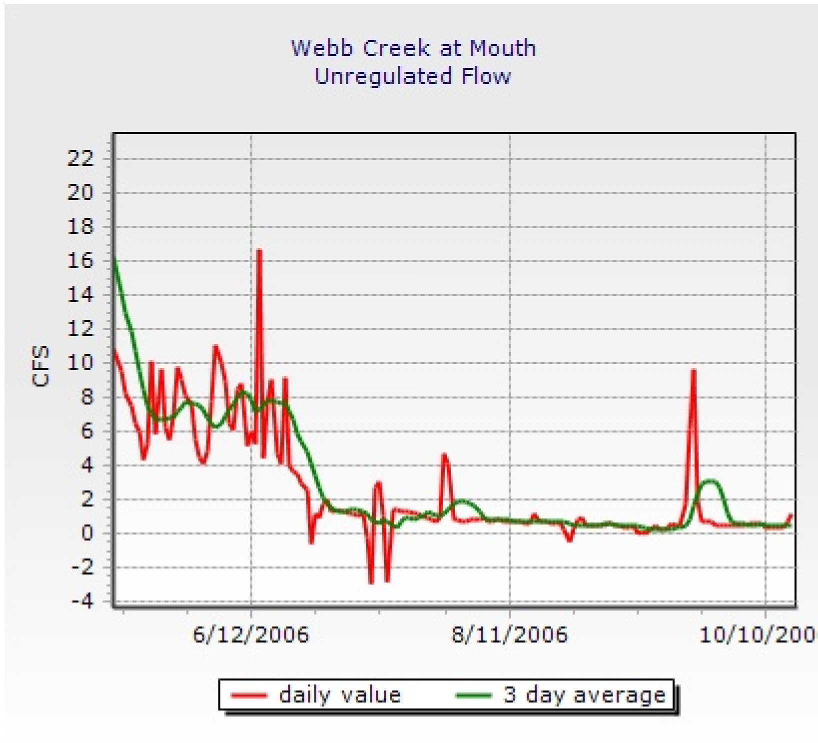
Sensitivity to Data Error

While the 3 main stream gages have been automated since 2003, most of the canal data was collected via manual readings taken once a day by LOID staff; not all days were measured which meant some data had to be estimated. For use in the dataset, it had to be assumed that the measured instantaneous value represented the mean daily value, but in reality the flow likely fluctuated throughout the day and the true mean daily value differed at least slightly. In addition, problems with gaging equipment (weirs, staff gages, etc) and human error in the readings could also lead to potential errors in the data. One area of particular concern was Sweetwater Diversion canal data prior to automation in 2006. USGS spot measurements taken in 2003 and 2004 indicated that the weir used by LOID over-reported the diversions by about 20%. It was necessary to correct for this and other data inconsistencies found in the dataset. Included in an appendix will be a list of the individual data points that went into the dataset, the source of the data, and discussion of the data quality and estimation techniques as warranted.

In terms of sensitivity, even the smallest errors in the data can be significant when trying to quantify natural flows at such small scales, such as those in the 0 to 2 cfs range. For example, an overestimate of canal diversion by only 1 cfs can have a dramatic affect on the natural flow calculation, when those natural flows may only be .5 cfs to begin with. In other words, the magnitude of the data “noise” can exceed the calculated flow value. This reveals itself in a plot (Figure 1, red line) of the daily unregulated flow as a sudden spike (up or down) in the data that has no hydrological explanation. To help alleviate the impact of these spikes, a 3-day moving average (Figure 1, green line) was adopted to help “smooth” the data (as was done for calculated inflows to Soldiers Meadow).

With the above caveats in mind, the unregulated dataset should be viewed in terms of general flow ranges and trends, rather than relying on an individual day’s data to establish a discreet absolute value.

Figure 1. Example of data error effect on daily flow calculation.



Discussion of Water Year Types

Due to the lack of long term streamflow data on Sweetwater Creek, it is difficult to provide exact analysis of the water year types (ie, wet, dry, average) during the 2003 to 2008 period. However, other gaged streams in the area can be used as a surrogate and provide qualitative information. The preferred gage to use is Lapwai Creek since it is geographically the closest and Sweetwater Creek is within the Lapwai Creek drainage. Data for Lapwai Creek was available from 1975 through 2008; unfortunately no data exists for 2005 and 2006. Total flow volume (acre feet) at Lapwai Creek for the January through June period was summed up for each year, and individual years were compared to the long term (32 year) average. Figure 2 shows a ranked listing of these years and their comparison to average. This analysis indicates that 2003 (132%) was likely a wet year, and that 2008, 2004, and 2007 (69%, 60%, 55%, respectively) would be considered dry years. The ranked data shows that much wetter and much drier years are likely possible, perhaps by a factor of 2 or more. The ranked values also indicate a high degree of variability in the drainage, ranging from 17% on the low end to 280% on the biggest year. This variability would also apply to Sweetwater Creek due to its relatively low elevation headwaters and reliance on rainfall as well as snow to provide its runoff.

For 2005 and 2006 (years of missing Lapwai Creek data), Lolo Creek near Greer was used as a general indicator of the water year type. Lolo Creek's period of record was 1980 to 2008. The range of January-June volume for Lolo Creek is less variable than for Lapwai Creek, ranging from 51% to 183%. Based on the 29 year average for Lolo Creek, 2005 was 75% of average, and 2006 was 96% of average. 2005 was ranked in the bottom six years, indicating that it was likely a dry year on Sweetwater Creek.

Based on the above analysis, the water year types for Sweetwater Creek can likely be summed up as follows:

2003: Wet
2004: Dry
2005: Dry
2006: Near Average
2007: Dry
2008: Dry (but timing of runoff was very important, see following discussion.)

Runoff conditions in 2008 were rather unique; a very cold spring prevented early season snowmelt, and delayed the freshet at least one month later than typical. Runoff did not begin in earnest until May, peaked in mid May, and continued strong into late June. Drafting of reservoirs did not begin until July after the flows receded. So despite a below average runoff, the timing of it was very positive for water supply and 2008 was the best year in the six year set. In contrast, 2003 was a wet year but the runoff occurred early (March and April) and could not be utilized, with subsequent early drafting of the reservoirs.

Figure 2. Ranked January – June Runoff Volumes for Lapwai Creek (1975 – 2008)

Lapwai Creek
Accumulated Volume (Acre-feet)
Jan 01 - Jun 30

Year	Volume	%avg
1996	124629	280
1997	114385	257
1982	95034	214
1979	89704	202
1976	75592	170
1984	71171	160
1978	68118	153
1999	62079	140
2003	58751	132
1989	55567	125
1986	49577	112
1995	47770	107
1975	47629	107
1985	41903	94
1980	41169	93
2002	35111	79
1993	34718	78
2001	33962	76
1983	33822	76
2000	33039	74
1991	32521	73
1990	31375	71
2008	30756	69
1998	29810	67
1981	29157	66
1987	28179	63
2004	26735	60
2007	24448	55
1988	15175	34
1994	11647	26
1977	9022	20
1992	7354	17

Results

The results are best summed up with the following series of graphs. Figure 3 shows the unregulated flow on a moving 3 day average basis for Webb Creek at mouth on a year round basis, and Figure 4 shows this same data zoomed in to the July through September period. Figures 5 and 6, and Figures 7 and 8, display this same data for Sweetwater Creek below Diversion and Sweetwater Creek at Mouth, respectively. Much attention has been focused on the low flow period, and it is illustrative to note that the calculated unregulated data suggests that Webb Creek approaches (or may even reach) no-flow conditions during the summer in the years studied. Minimum flows in Sweetwater Creek are typically at least a few cfs higher, as would be expected given the spring discharge component below Lake Waha.

Figure 3. Unregulated Flow of Webb Creek at Mouth

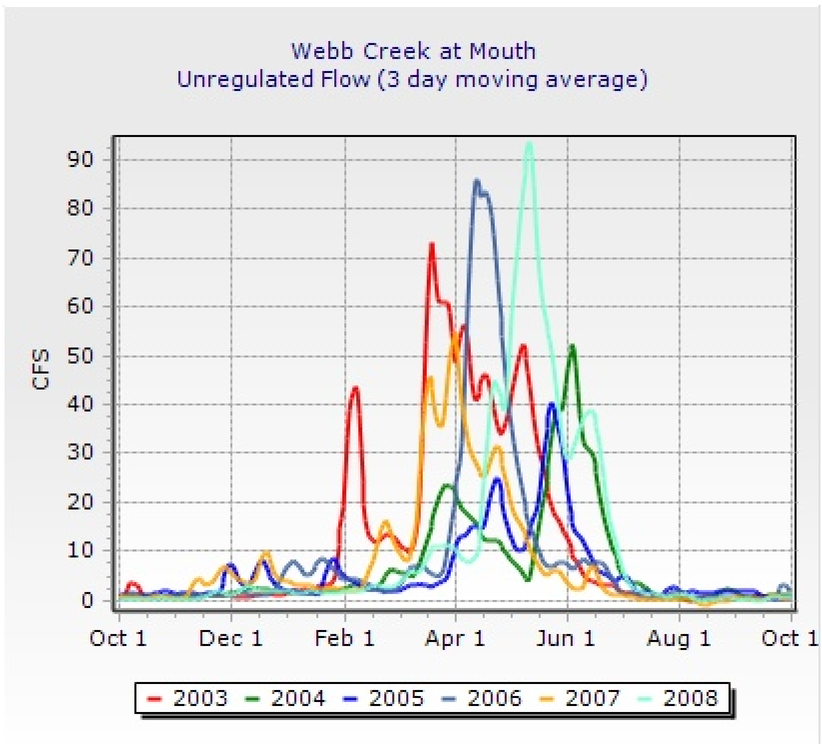


Figure 4. Unregulated Flow of Webb Creek at Mouth

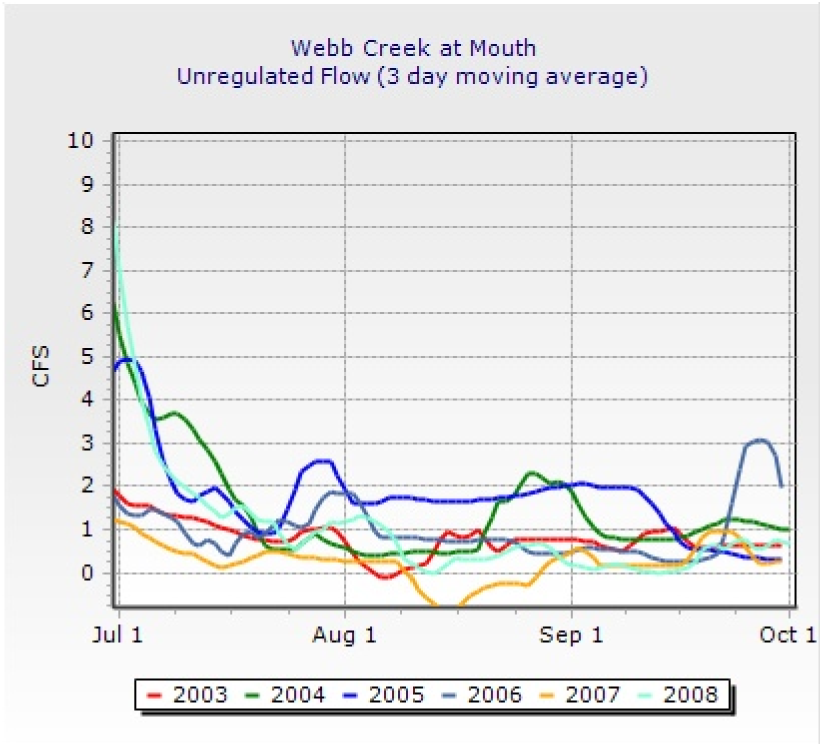


Figure 5. Unregulated Flow of Sweetwater Creek below Diversion

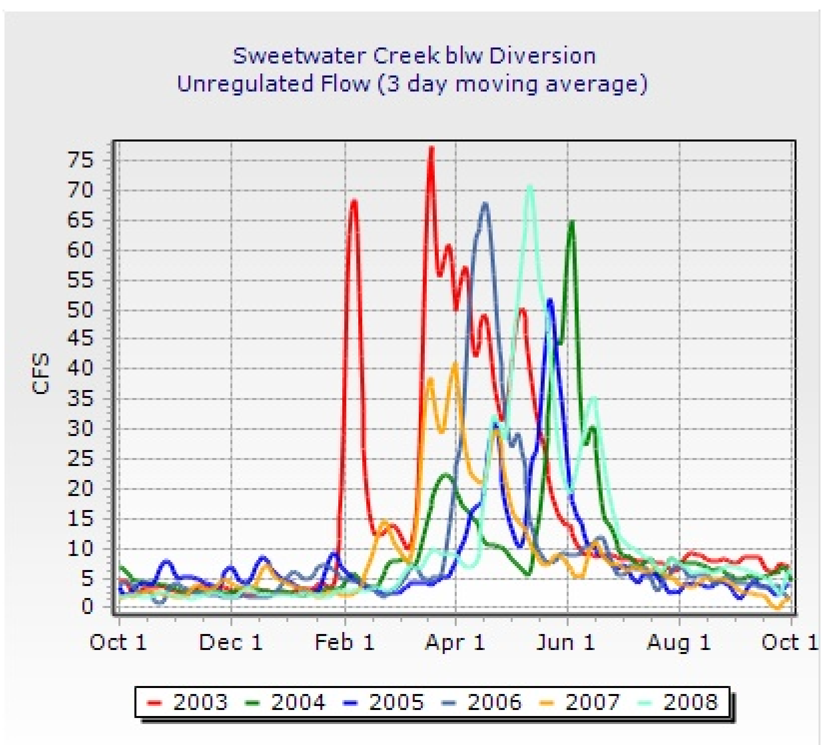


Figure 6. Unregulated Flow of Sweetwater Creek below Diversion

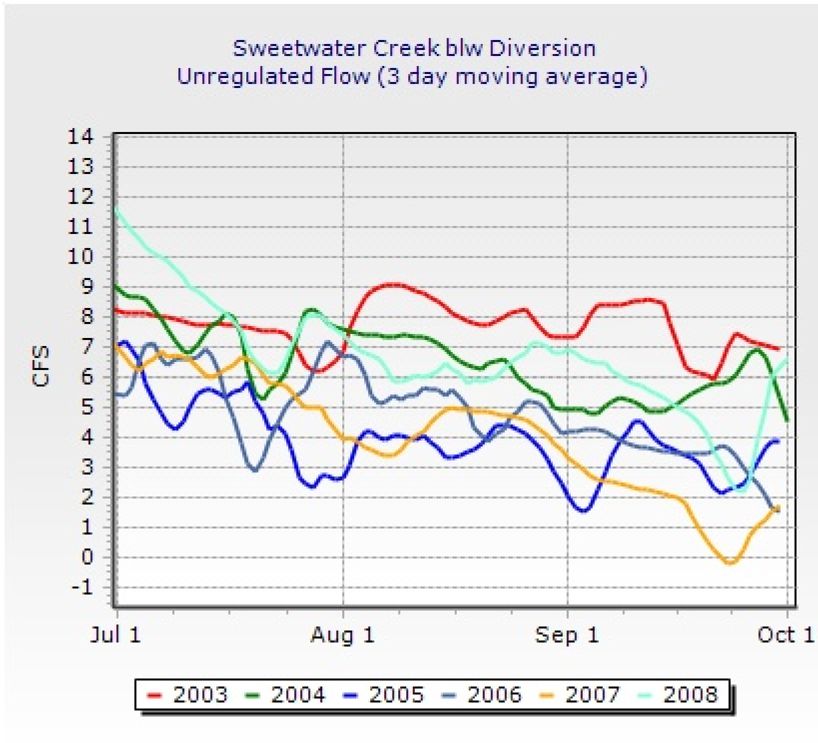


Figure 7. Unregulated Flow of Sweetwater Creek at Mouth

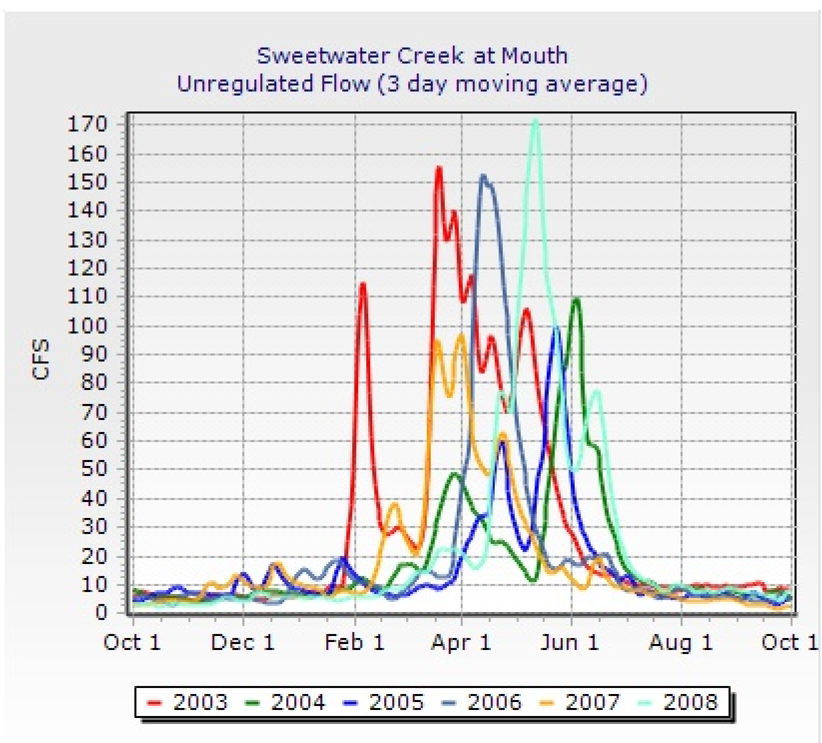
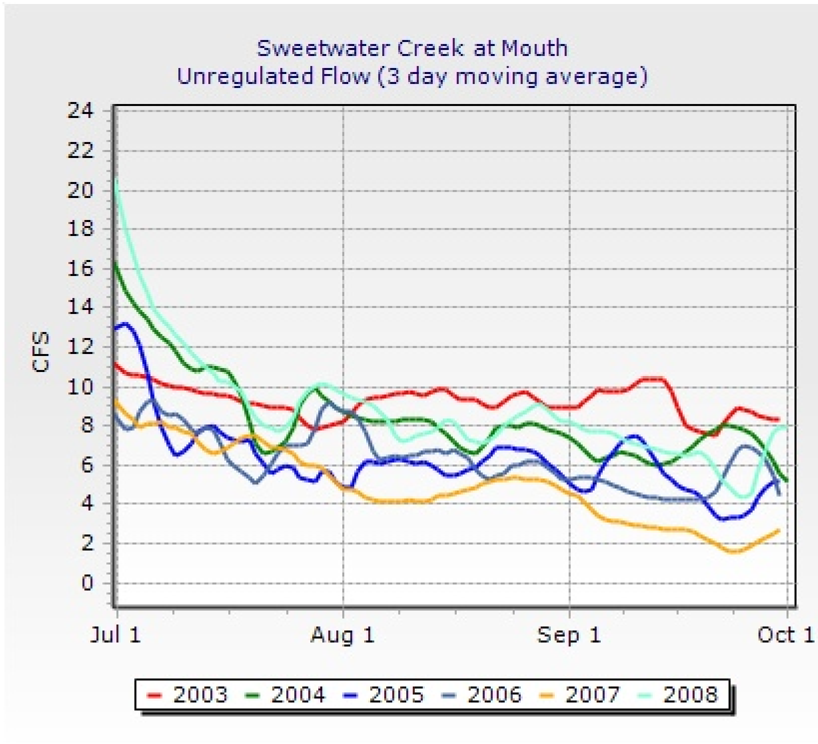


Figure 8. Unregulated Flow of Sweetwater Creek at Mouth



APPENDIX

Miscellaneous Data Notes

<u>Soldiers Meadow Storage and Outflow:</u>

From cleaned up Hydromet database

<u>Soldiers Meadow Inflow:</u>

Calculated daily inflow from Hydromet data, cleaned up by using 3 day averaging, with minimum values limited to dropping no lower than .25.

<u>Waha Feeder Canal:</u>

From LOID daily readings; very complete with only a few values missing during operating season; estimated as needed using interpolation. No known quality problems.

<u>Pump Release from Lake Waha:</u>

From LOID; data consisted of reported hours of pump operation, which had to be converted to cfs. Daily storage data (Hydromet) was available for Lake Waha starting 9/8/2004. The draft rate of the reservoir during times of pumping was compared to the draft rate just prior and just after pumping to establish an approximate pump discharge. Pumping only occurred late in the summer when very little water was entering the Lake via natural sources, and no water was being run in the Waha Feeder canal. Hence, the lake level was relatively stable (typically drafting by 1 to 3 cfs per day via the springs) prior to the pumping, allowing for a reasonably accurate segregation of pumped releases. This daily pumped discharge was then divided by the hours of pump operation (typically a 24 hr/day basis once up and running) to establish an average hourly discharge rate of 0.93 af/hour. This hourly discharge rate was then used to estimate pumped discharge prior 9/8/2004, when the only data available were hours pumped (daily discharge= hours pumped X 0.93, converted to cfs). Some data inconsistencies were noted on startup and ending dates of pumping, most likely due to over-reporting of the hours pumped on those days. Therefore, these days were not used to establish the average hourly pumping rate. The 0.93 af/hour rate was consistent across all Lake Waha elevations experienced when the pumps were in operation.

<u>Webb Creek Transfer Canal:</u>

From LOID daily readings. Data was fairly complete during operating season, with some missing values but typically not more than several days in a row, allowing for easy interpolation. The exception was 2005 data, which often only had one or two values per week; interpolation was used to fill in missing data, along with examination of Soldiers Meadows releases to confirm trends. Data quality assumed to be good based on conversations with LOID and on spot measurements from USGS in 2003 and 2004. Data on start-up and ending days subject to possible error due to under or over reporting (ie, the daily reported value assumes the canal operated at that flow all day, which was likely not the case.)

Webb Creek at Mouth:

From USGS data. 2008 is provisional USGS data, except for Jan. 17 to Feb.3 which uses Hydromet data (USGS data not available due to icing). Data from Apr. 28 to May 5 (high flow period) was deemed unreliable and was estimated instead by using flow ratios with Sweetwater below Diversion and Sweetwater at Mouth.

Sweetwater Diversion Canal:

LOID data through Mar. 12, 2007, and Hydromet data after that. In a January 27, 2005 memo from Greg Clark (USGS) to Dana Weigel (BOR), the USGS reported that spot measurements found the LOID data to be overmeasured by about 20%, consistent across a wide range of diversion rates. The error was most likely caused by submergence of the LOID measuring weir due to channel constrictions downstream. This situation was remedied with installation of a new measuring weir and Hydromet data collection equipment in March of 2007. LOID data for the 2003 to 2005 period was therefore modified by multiplying by 80%. LOID data for 2006 measured at the headworks of the canal is inconsistent with other years and very questionable. LOID also recorded measurements at the end of the canal before it flows into Reservoir A, and this data can be used to determine approximate canal losses. As measured by LOID, these losses consistently ranged in the 25% to 35% range for 2003 to 2005; for 2006 the measured losses dropped to 0% to 10%, and in some cases actually showed more inflow to Res. A than was diverted. Discussion with LOID could not determine the reason for the inconsistencies, although LOID believed the Res. A inflow readings were probably the more accurate data. Based on this, for 2006 data only, the measured inflow at Res. A was used with an assumed canal loss factor of 20% to estimate canal diversion. The assumed loss factor was the calculated average loss for 2007 and 2008, after installation of the new Hydromet equipment. The resulting data for 2006 is consistent with other years, but nonetheless likely contains errors that could affect other calculations.

Reservoir A Inflow:

As measured by LOID. Used to determine canal losses, and to estimate 2006 canal diversion data (see discussion for Sweetwater Diversion Canal).

Sweetwater Creek below Diversion:

USGS data through Dec. 31, 2006; LOID data Jan. 1 through March 12, 2007; Hydromet data after that. Missing data (1/11/2007 – 1/20/2007, 3/8/2007 – 3/12/2007, 10/30/2007 –

11/1/2007, 1/31/2008 – 2/11/2008) estimated by using ratios with other gages and/or interpolation.

<u>Sweetwater Creek at Mouth:</u>

USGS data (provisional for 2008); with missing values for 2008 filled in from Hydromet (12/31 – 1/3, 1/17 – 2/12, 9/12, 9/21 – 9/22, 9/24).

Appendix D

Snake River Steelhead Recovery Planning, Objectives, and Status in the Lower Clearwater

APPENDIX D: SNAKE RIVER STEELHEAD RECOVERY PLANNING, OBJECTIVES, AND STATUS IN THE LOWER CLEARWATER

D.1 Introduction

This appendix briefly describes recovery of listed fish species in the context of the ESA, what recovery might look like for the Snake River steelhead DPS, particularly for the Clearwater River MPG, criteria that the ICTRT considers when assessing a population's viability, and other pertinent information. Some of the information presented is based on a NMFS (2008b) revised "Recovery Framework for Snake River Steelhead and Relation to Section 7 Consultation" handout presented at the Project's remand collaborative process meeting held in December 2008.

Recovery in the context of the ESA means improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act" (ESA Regs.). The criteria in section 4(a)(1) are as follows:

(a) the present or threatened destruction, modification, or curtailment of its habitat or range;

(b) overutilization for commercial, recreational, scientific, or educational purposes;

(c) disease or predation;

(d) the inadequacy of existing regulatory mechanisms; or

(e) other natural or manmade factors affecting its continued existence.

In practice, a species is "recovered" when criteria specified in an approved recovery plan are achieved. Recovery plans are required for listed species and are generally developed collaboratively by local entities such as watershed councils, state, federal and local agencies, non-governmental organizations (NGOs), etc., with final review and approval by NMFS. Recovery plans provide some general guidelines for actions that would improve viability of populations, but implementation of actions is not mandatory. Because of this approach, recovery plans are likely to differ across various ESUs/DPSs based on their geographical distribution, abundance, limiting factors and threats to their survival, etc. Recovery plans rely in part on population viability criteria that are based on the VSP framework of McElhany et al. (2000).

Threats to a species existence and the species' status are evaluated periodically in status reviews or status review updates. Recovery planning for the Snake River steelhead DPS is in progress (NMFS 2009a). Several draft chapters dated 2006 are available.

ESA-listed steelhead in Idaho belong to the Snake River Basin steelhead DPS, which is considered a "species" under the ESA. The hierarchical structure of the listed Snake River steelhead is the DPS, MPGs, component populations, followed by major and minor spawning areas (which could be considered "subpopulations"). An MPG is a set of populations that share genetic, geographic (hydrographic), and habitat characteristics within an ESU or DPS (ICTRT 2007a). The Snake River steelhead DPS has six MPGs with 25 extant component populations. This hierarchical level of organization is intended to reflect geographic differences in genetic traits, habitat conditions, and fish productivity that vary throughout the Snake River Basin. Other Columbia Basin salmon ESUs and steelhead DPSs are structured similarly. The Snake River steelhead DPS hierarchical structure relative to the consultation on the Lewiston Orchards Project is shown in Figure D-1 (see also Figure 7-3, in Chapter 7: "Proportion of major (MaSAs) and minor (MiSAs) spawning areas that make up the Clearwater River Lower Mainstem steelhead population").

Figure D-1. Snake River Steelhead DPS Hierarchical Structure

Snake River Steelhead **DPS**
Clearwater River **MPG** (one of six total MPGs in the DPS)
Clearwater River Lower Mainstem Population (**CRLMA-s**) (five additional populations: Lolo, Lochsa, Selway, South Fork Clearwater, North Fork Clearwater [extirpated])
Major Spawning Areas (based on area): Upper Potlatch, **Lapwai Creek**, Big Canyon Creek, Clear Creek, and Lawyer Creek
Minor Spawning Areas (based on area): Jim Ford, Bedrock, Orofino, Butcher, Rabbit, Cottonwood (Clearwater), Middle Potlatch, Little Potlatch, Maggie, Cottonwood (SF Clearwater), Howard Gulch, Hatwai, Sixmile (Clearwater), Lindsay, Beardy Gulch, and Suttler.

D.2 Recovery Criteria

Since development of recovery plans rely heavily on viability assessments of component populations, we include in this section a brief discussion of viability analyses. Recovery planning for an ESU or DPS is closely linked to population viability analyses conducted by technical recovery teams (TRTs) established by NMFS. TRTs such as the Interior Columbia TRT conduct rigorous analyses of populations of ESA-listed species and generally adhere to the VSP framework of McElhany et al. (2000), although the several coast-wide TRTs have the flexibility to develop their own approach and viability criteria for ESA-listed salmon and steelhead in their particular domain (Busch et al. 2008).

In recent determinations for proposed listings for 27 West Coast salmonid ESUs, NMFS (69 FR 33101) used in part the four components of the VSP framework (McElhany et al. 2000) in their assessment of ESU status and condition. The four components of VSP are abundance, productivity/population growth rate, spatial structure, and diversity, which includes genetic diversity. McElhany et al. (2000) provide detailed explanations of the components of VSP. For analytical purposes, abundance and productivity are usually considered together, as are spatial structure and diversity. If data are available, abundance and productivity can be estimated, while spatial structure and diversity are somewhat more qualitatively assessed. The ICTRT has conducted extensive analyses on several steelhead DPSs and salmon ESUs to assess population size, productivity, risk of extinction and abundance thresholds expected to reduce the risk of extinction over the long term.

Also relevant to a status (recovery) assessment and determination, in addition to the biological criteria elucidated by the abundance, productivity, spatial structure and diversity parameters of the VSP framework, are “limiting factors or threats,” which are the physical habitat conditions, or other impacts resulting in the depressed population. Biological criteria are met by addressing the limiting factors or threats; however, meeting the biological criteria may not be sufficient for recovery if threats may undermine biological performance once ESA protections are removed.

Although the several TRTs may use different metrics when addressing the four VSP parameters, they all agree that for evaluating viability at the ESU/DPS-level, important considerations include the risk of catastrophic events, long-term demographic processes, and long-term evolutionary processes (Busch et al. 2008). The ICTRT ESU/DPS viability criterion is that all extant MPGs and any extirpated MPGs critical for proper functioning of the ESU/DPS should be at low risk (in other words, viable) (ICTRT 2007a). If all MPGs are viable, the ESU/DPS is considered to be viable.

D.3 Viability Criteria for MPGs

The viability of an MPG is determined by the attributes of the component populations that form that MPG. The ICTRT used the following criteria to assess MPG viability:

- *Highly Viable*—a composite rating based on achieving less than 1 percent chance of extinction in the next century and structural/diversity risk categorized as low or very low (ICTRT 2007a).
- *Viable*—a composite rating based on achieving 1-5 percent chance of extinction in the next century and structural/diversity risk categorized as very low, low, or moderate (ICTRT 2007a).
- *Maintained*—sufficient productivity so that these areas do not serve as significant population sinks, and to provide a conduit for connectivity within and among other populations. This is generally met by achieving a 1:1 replacement rate.

A composite rating for the MPG is derived from a combination of abundance and spatial structure attributes as shown in Figure D-2.

Figure D-2. Matrix of possible Abundance/Productivity and Spatial Structure/Diversity scores for application at the population level. Percentages for abundance and productivity scores represent the probability of extinction over a 100-year time period. Cells that contain a "V" are considered Viable combinations. "HV" indicates Highly Viable combinations. Shaded cells do not meet criteria for Viable status—darkest cells indicate populations that would be at greater risk. Cells designated as "M*" are candidates for maintained status.

		Spatial Structure/ Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	HV	HV	V	M*
	Low (1-5%)	V	V	V	M*
	Moderate (6-25%)	M*	M*	M*	
	High (>25%)				

Viability Key: HV – Highly Viable; V – Viable; shaded cells do not meet viability criteria

The ICTRT's Snake River steelhead DPS level viability criterion is that all extant MPGs and any extirpated MPGs critical for proper functioning of the ESU should be at low risk.

Generally, according to the ICTRT approach, an MPG meeting the following five criteria would be considered to be at low risk:

1. At least one-half of the populations historically within the MPG (with a minimum of two populations) should meet viability standards.
2. At least one population should be classified as "Highly Viable."
3. Viable populations within an MPG should include some populations classified (based on historical intrinsic potential) as "Very Large," "Large," or "Intermediate" generally reflecting the proportions historically present within the MPG. In particular, Very Large and Large populations should be at or above their composite historical fraction within each MPG.
4. All major life history strategies (e.g., spring and summer run-timing, or A-run and B-run fish) that were present historically within the MPG should be represented in populations meeting viability requirements.
5. Populations not meeting viability standards should be "maintained" with a) sufficient productivity so the overall MPG productivity does not fall below replacement (i.e., these areas should not serve as significant population sinks), and b) sufficient spatial structure and diversity demonstrated by achieving Maintained standards.

D.4 Viability Assessment

The ICTRT developed recommendations for recovery criteria based on the spatial structure of the populations in the Clearwater River Basin. The size categories and life history types for the five extant and one extirpated component populations of the Clearwater River MPG are shown in Table D-1. The focus of the Lewiston Orchards Project ESA consultation is steelhead in the Lapwai Creek drainage, a major spawning area for the CRLMA-s population. Following general ICTRT recommendations, at least two of these MPG populations listed in Table D-1 must be viable, and one additional population must be highly viable. The criteria for viable and highly viable component populations are explained above.

Table D-1. Six component populations in the Clearwater River steelhead MPG, along with their ICTRT threshold size category and life history type. (ICTRT 2007a).

Independent populations	Size Category		Life History Type
Clearwater River Lower Mainstem	Large	1,500	A-run
South Fork Clearwater	Intermediate	1,000	B-run
North Fork Clearwater (extirpated)	Large		B-run
Lolo Creek	Basic	500	A- & B-run
Selway River	Intermediate	1,000	B-run
Lochsa River	Intermediate	1,000	B-run

Because of the unique attributes of the component populations in the Clearwater River MPG, and applying the five criteria described above, the ICTRT stated that at the MPG level for Snake River steelhead, the Clearwater River MPG would be at low risk if it met the following criteria:

- Three populations must meet viability criteria, one of which must meet high viability criteria.
- Lolo Creek has the only A-run and B-run life history, and must meet viability criteria.
- Two Large or Very Large populations must meet viability criteria; however, there are no Very Large populations in this MPG, and the Lower Clearwater is the only extant Large population.
- One additional Intermediate or larger population must meet viability criteria.
- At least one A-run and one B-run population must meet viability criteria.

Because of the uniqueness of the Clearwater River steelhead MPG, the ICTRT determined that:

- ICTRT criteria for size and life history cannot be met with three populations; four viable populations are necessary.
- Lochsa River is more accessible than the Selway River for data collection.
- North Fork population is extirpated.
- A/B life history (as seen in Lolo) may be less important than ensuring that both A-run and B-run fish are present.

A draft viability assessment was prepared by NMFS (2006c) for the Lower Clearwater and other component populations in the Clearwater River MPG. Viability criteria for a component population such as the Lower Clearwater population are specified for a variety of population, genetic, and spatial attributes. Based on these attributes, NMFS (2006c) determined that the CRLMA-s has a low or very low risk for the number and spatial arrangement of spawning areas, spatial extent of the population, continuities or gaps between spawning areas, presence of major life history strategies, phenotypic variation, genetic variation, distribution of population across habitat types, and changes in natural processes due to hydropower, hatcheries, and habitat. The population has a moderate risk for spawner composition and impacts from size-selective harvest. The population abundance and productivity risks are unknown due to insufficient information specific to steelhead in the Clearwater River Basin. Since the abundance and productivity of this population are unknown, as are those of many other steelhead populations in the DPS, there is insufficient information to calculate the returns needed to achieve 5 percent or lower extinction risk. The ICTRT classified the CRLMA-s as “Large,” which requires a minimum mean abundance of 1500 spawners (750 pairs) and sufficient intrinsic productivity (ratio of future spawning returns to present number of spawners) to achieve a 100-year extinction risk of 5 percent or less (ICTRT 2007a).

Because there is insufficient information on abundance and productivity, the CRLMA-s is assigned, by default, a high risk (Figure D-3), and therefore, again by default, the Clearwater River MPG is given a non-viable rating. The population at present may actually fall into any one of the viable or non-viable categories, but the best available information from smolts and adult steelhead counted at Lower Granite Dam indicates that abundance is likely to be insufficient to meet viability criteria.

Figure D-3. Viable salmonid population risk matrix for five steelhead populations in the Clearwater River MPG, as determined from viability assessments.

		Spatial Structure/ Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	HV	HV	V	
	Low (1-5%)	V	V	V	
	Moderate (6-25%)				
	High (>25%)		Clearwater River lower mainstem, Lolo Creek, Lochsa, Selway	South Fork Clearwater	

Viability Key: HV – Highly Viable; V – Viable; shaded cells do not meet viability criteria

Little information exists for local returns of steelhead in the lower Clearwater Basin due, in part, to challenges of monitoring and sampling during the peak spring runoff when adult steelhead return to spawn in natal streams. The Potlatch Basin is expected to contribute about 20 percent of the CRLMA-s population which would be about 300 spawners (Figure 6-3). Currently, the adult return population estimate for Big Bear and Little Bear creeks in the Potlatch Basin was 266, 77, and 174 in 2005, 2006, and 2007, respectively (IDFG 2006a, 2006b, 2007). When considering additional contributions from known spawning areas located in this basin, it is possible that the Potlatch Basin is a substantial way toward meeting these recovery goals. Lapwai Creek is expected to contribute about 14 percent of the CRLMA-s population which would be about 202 spawners (Figure 6-3). Monitoring or sampling of adult escapement into this basin has not been attempted, but it is necessary eventually to quantify the numbers of adult returns to the basin.

D.5 Current Status of Recovery Planning Goals and Objectives

Recovery planning for ESA-listed salmonids is the purview of NMFS and local or regional entities. Reclamation defers development of a recovery plan for Snake River steelhead to those agencies. However, since the ICTRT recommended that the CRLMA-s be at least viable, the purpose of the recovery plan, when it is completed, is to describe goals and objectives to achieve a viable population. As of July 2009, the recovery plan for this population is still in progress. The lack of abundance and productivity data is problematic since these are the only factors identified by the ICTRT within the geographic region that present a risk to the viability of the CRLMA-s. In spite of this limitation, NMFS (2008b) believes that the primary focus of recovery actions for the Clearwater River lower mainstem should be based on improving abundance and productivity. Since there is insufficient information to identify where specific problems exist, a general default strategy will be used until better information is available.

Appendix E

Habitat Transect Plots

APPENDIX E: HABITAT TRANSECT PLOTS

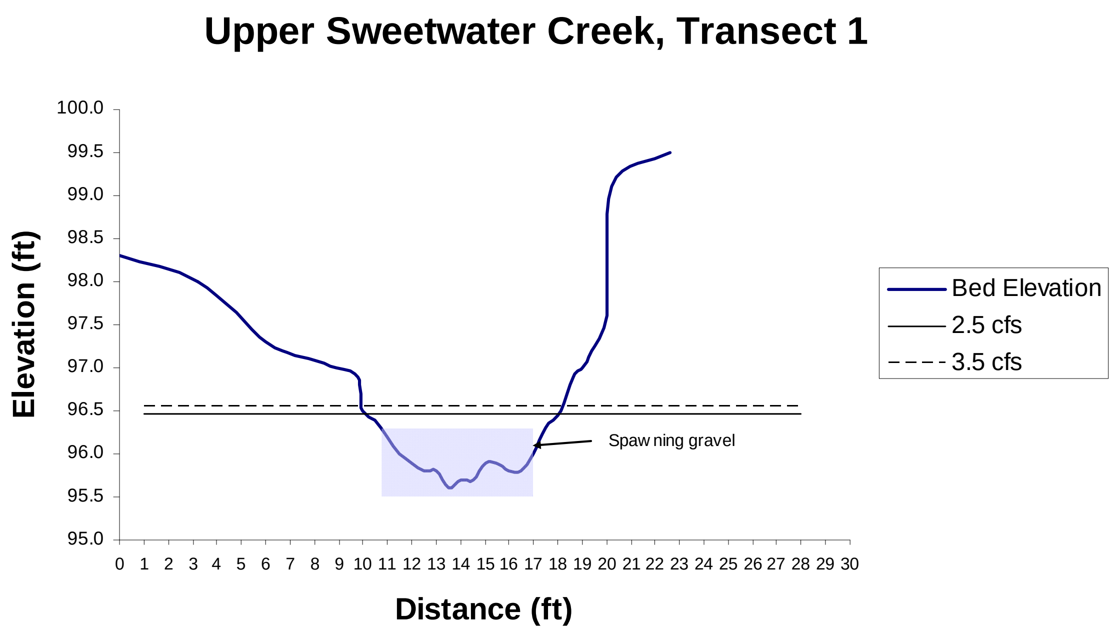


Figure E-1. Water surface elevation at 2.5 cfs (96.47 feet) and 3.5 cfs (96.56 feet) in upper Sweetwater Creek, transect 1 (spawning habitat at distances 11 to 17 feet).

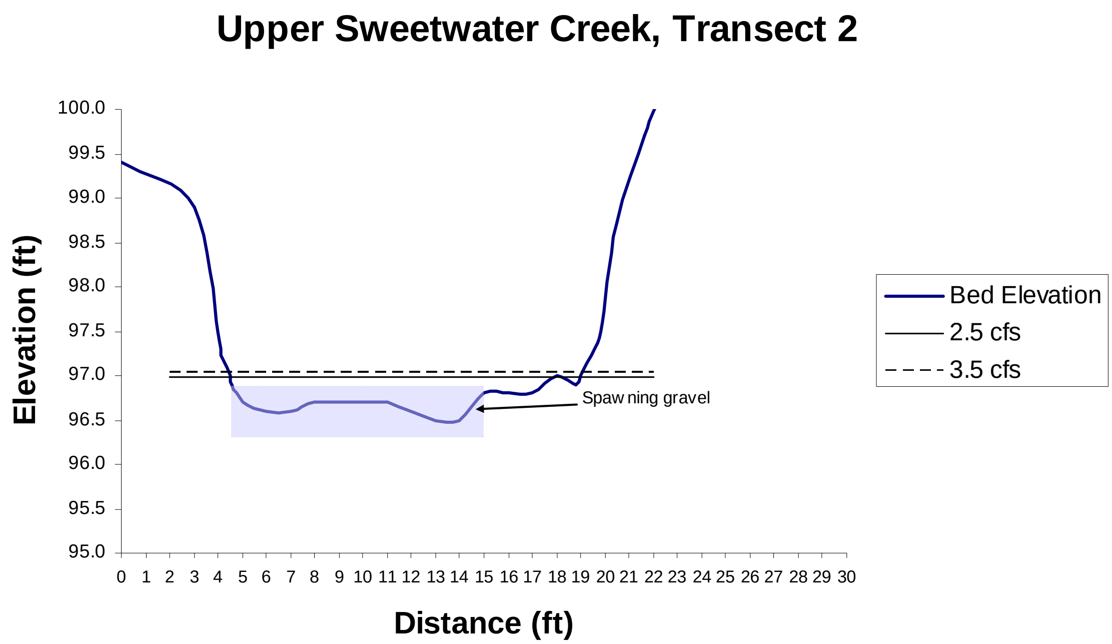


Figure E-2. Water surface elevation at 2.5 cfs (96.98 feet) and 3.5 cfs (97.04 feet) in upper Sweetwater Creek, transect 2 (spawning habitat at distances 4.6 to 15 feet).

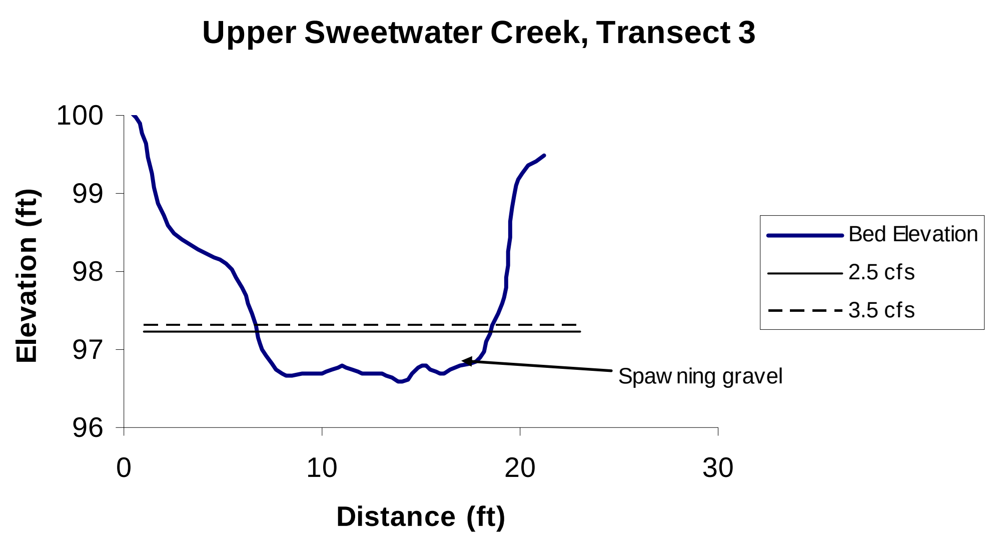


Figure E-3. Water surface elevation at 2.5 cfs (97.23 feet) and 3.5 cfs (97.30 feet) in upper Sweetwater Creek, transect 3 (spawning habitat at distances 8 to 17 feet).

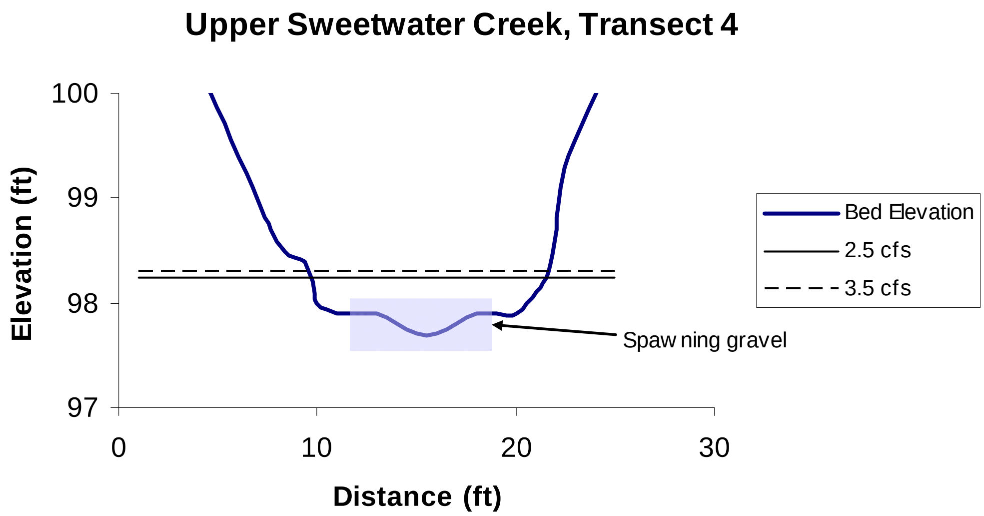


Figure E-4. Water surface elevation at 2.5 cfs (98.25 feet) and 3.5 cfs (98.30 feet) in upper Sweetwater Creek, transect 4 (spawning habitat at distances 12 to 18 feet).

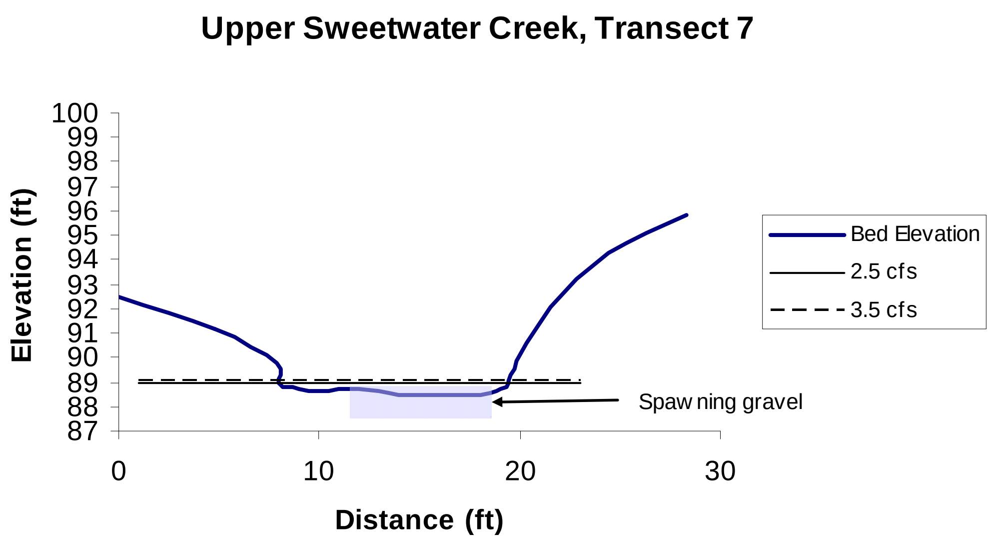


Figure E-5. Water surface elevation at 2.5 cfs (88.99 feet) and 3.5 cfs (89.06 feet) in upper Sweetwater Creek, transect 7 (spawning habitat at distances 12 to 18 feet).

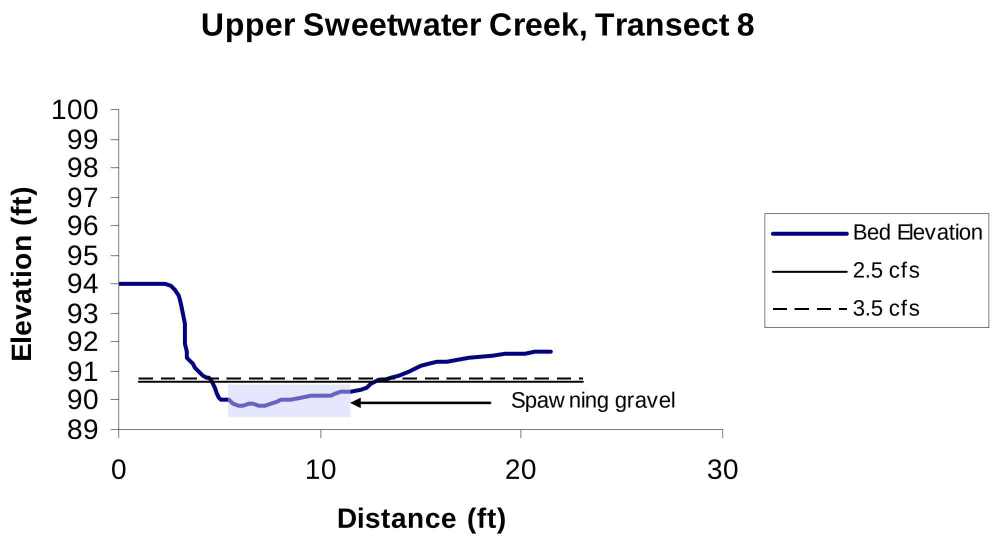


Figure E-6. Water surface elevation at 2.5 cfs (90.63 feet) and 3.5 cfs (90.71 feet) in upper Sweetwater Creek, transect 8 (spawning habitat at distances 5.5 to 11.5 feet).

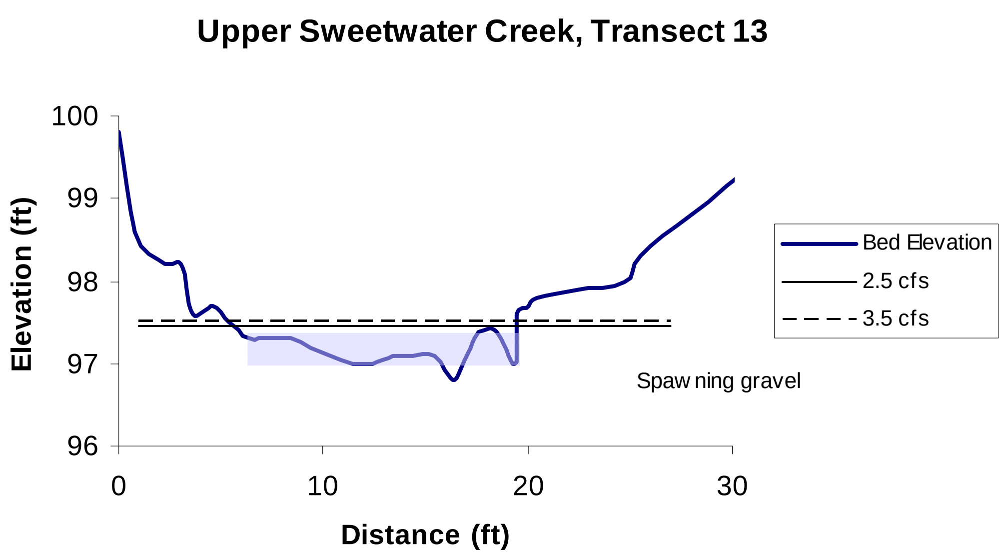


Figure E-7. Water surface elevation at 2.5 cfs (97.46 feet) and 3.5 cfs (97.51 feet) in upper Sweetwater Creek, transect 13 (spawning habitat at distances 5.4 to 19.3 feet).

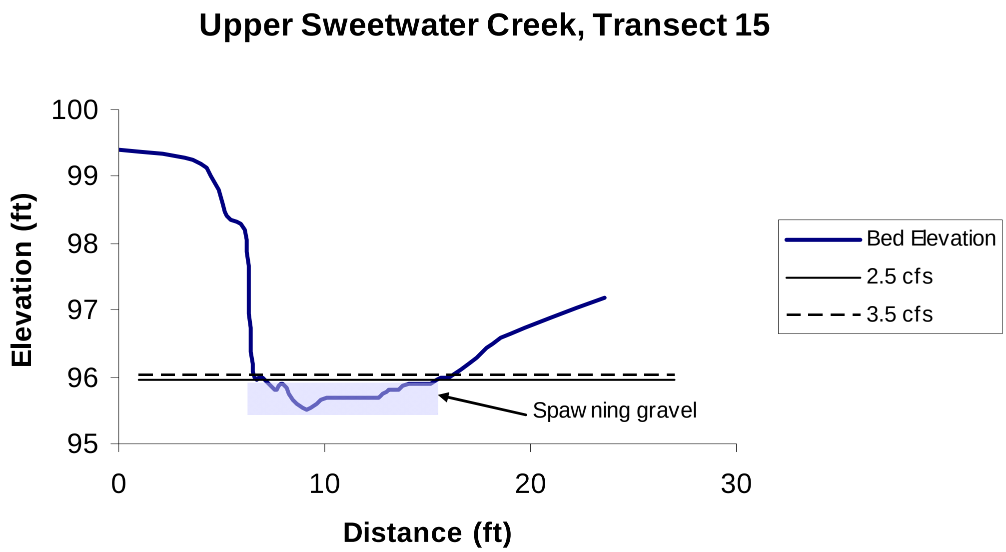


Figure E-8. Water surface elevation at 2.5 cfs (95.95 feet) and 3.5 cfs (96.02 feet) in upper Sweetwater Creek, transect 15 (spawning habitat at distances 6.6 to 14.6 feet).

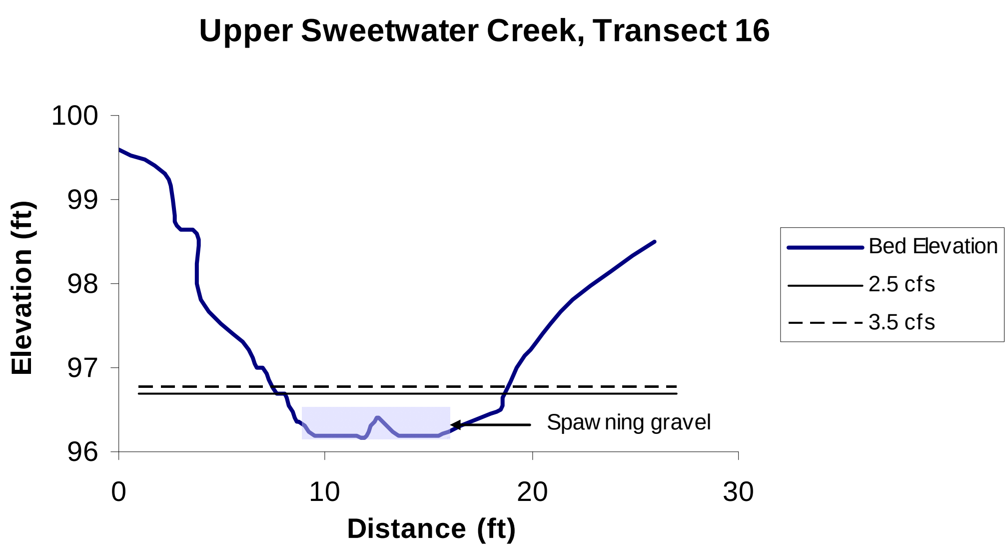


Figure E-9. Water surface elevation at 2.5 cfs (96.69 feet) and 3.5 cfs (96.76 feet) in upper Sweetwater Creek, transect 16 (spawning habitat at distances 9 to 15.5 feet).

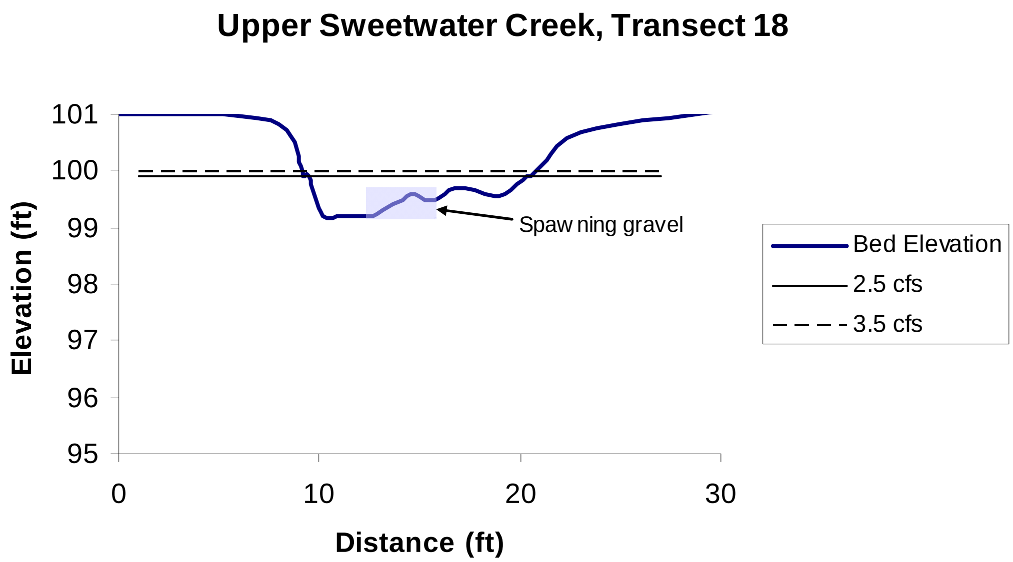


Figure E-10. Water surface elevation at 2.5 cfs (99.91 feet) and 3.5 cfs (99.96 feet) in upper Sweetwater Creek, transect 18 (spawning habitat at distances 12.2 to 16.2 feet).

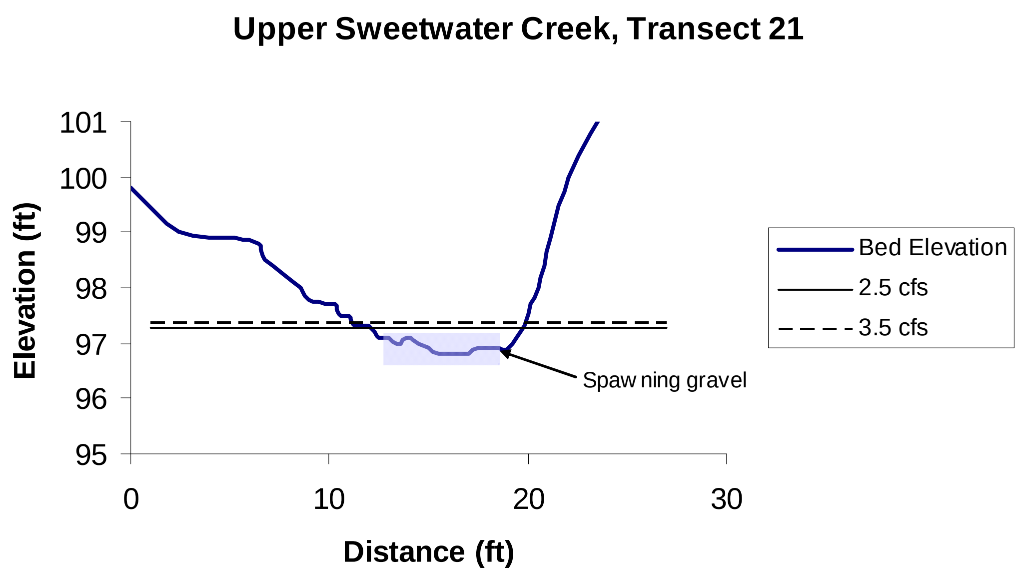


Figure E-11. Water surface elevation at 2.5 cfs (97.28 feet) and 3.5 cfs (97.36 feet) in upper Sweetwater Creek, transect 21 (spawning habitat at distances 12 to 19 feet).

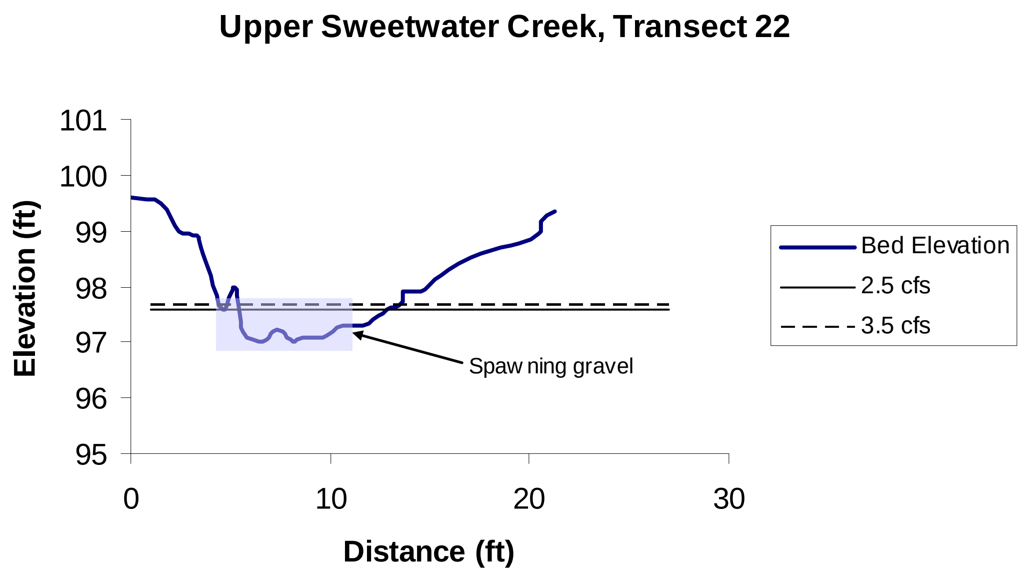


Figure E-12. Water surface elevation at 2.5 cfs (97.57 feet)and 3.5 cfs (97.65 feet) in upper Sweetwater Creek, transect 21 (spawning habitat at distances 4.6 to 11.6 feet).

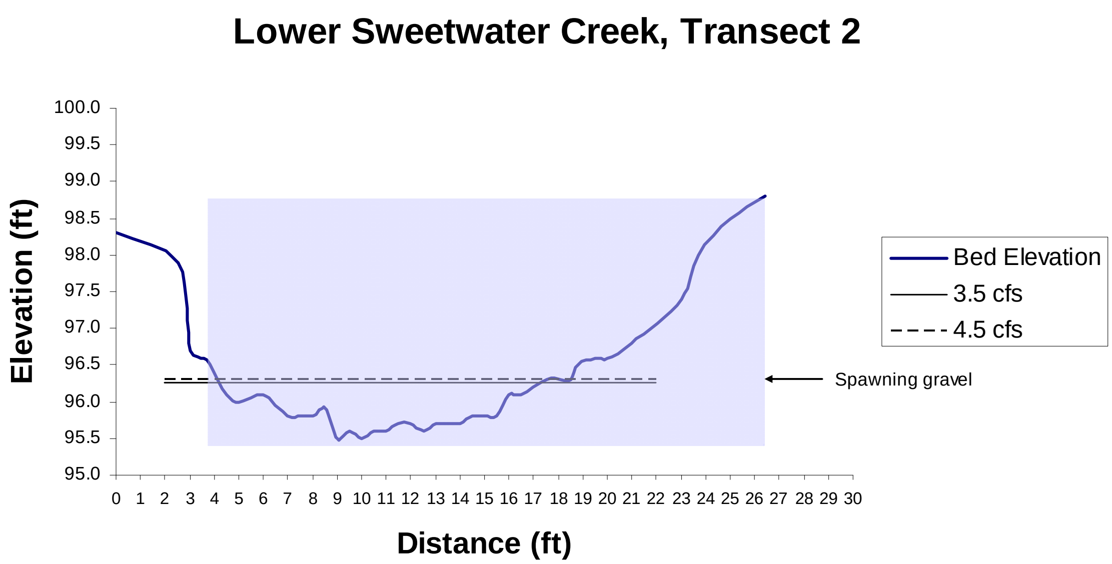


Figure E-13. Water surface elevation at 3.5 cfs (96.26 feet) and 4.5 cfs (96.30 feet) in lower Sweetwater Creek, transect 2 (spawning habitat at distances 3.8 to 26.4 feet).

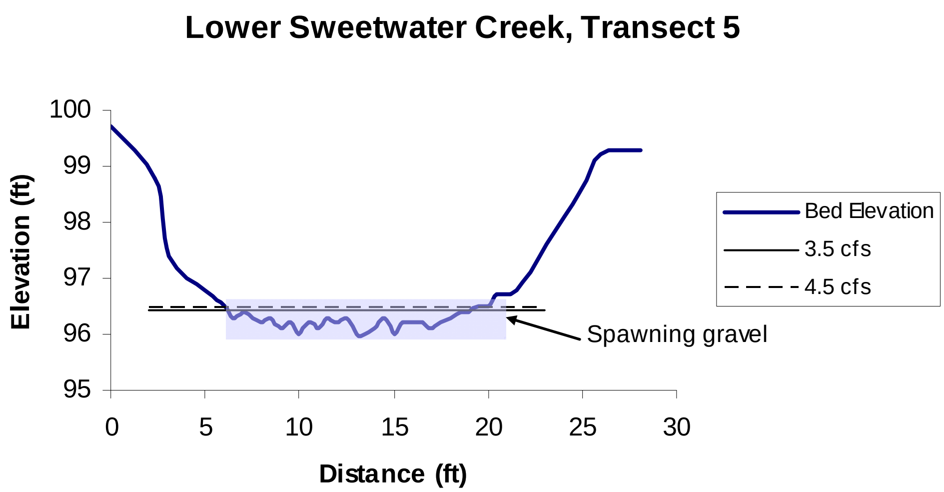


Figure E-14. Water surface elevation at 3.5 cfs (96.42 feet) and 4.5cfs (96.46 feet) in lower Sweetwater Creek, transect 5 (spawning habitat at distances 5.6 to 21.5 feet).

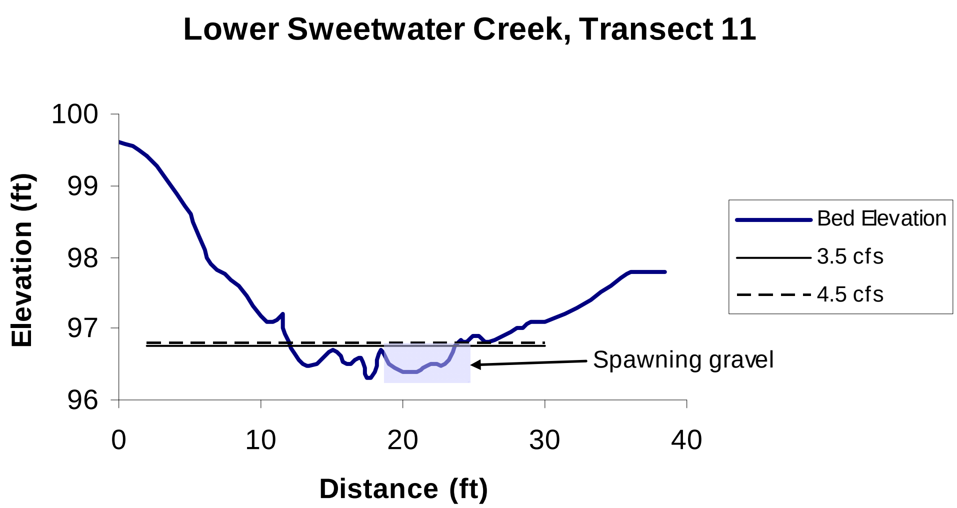


Figure E-15. Water surface elevation at 3.5 cfs (96.75 feet) and 4.5cfs (96.79 feet) in lower Sweetwater Creek, transect 11 (spawning habitat at distances 19 to 24 feet).

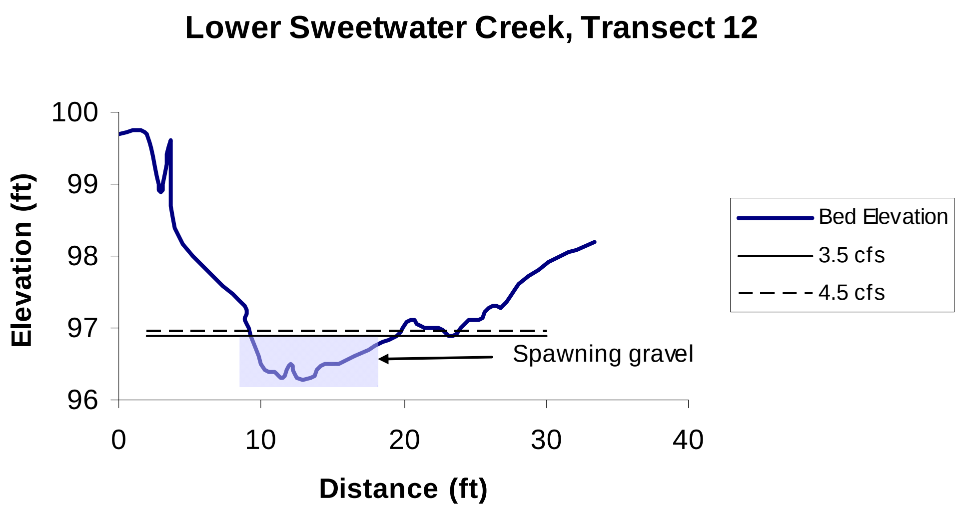


Figure E-16. Water surface elevation at 3.5 cfs (96.89 feet) and 4.5cfs (96.94 feet) in lower Sweetwater Creek, transect 12 (spawning habitat at distances 9.1 to 18.5 feet).

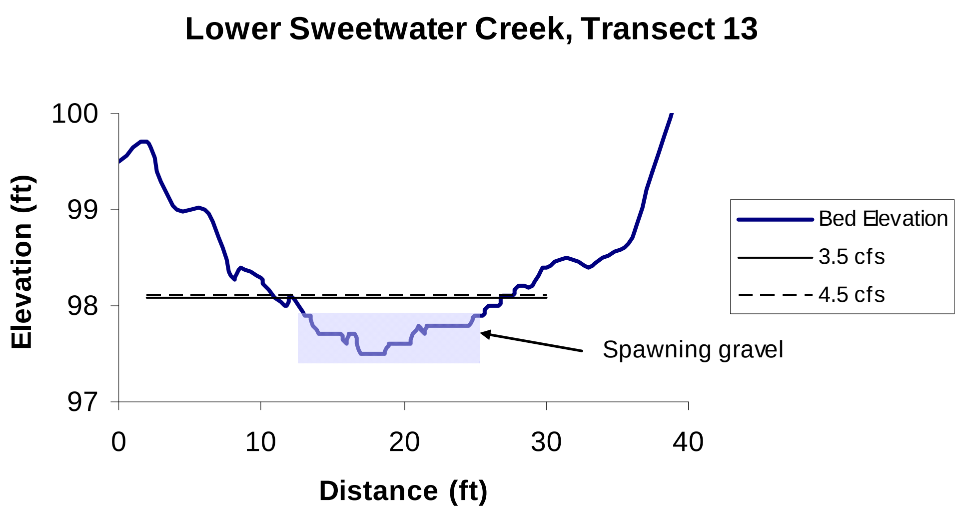


Figure E-17. Water surface elevation at 3.5 cfs (98.07 feet) and 4.5cfs (98.11 feet) in lower Sweetwater Creek, transect 13 (spawning habitat at distances 12.6 to 25.5 feet).

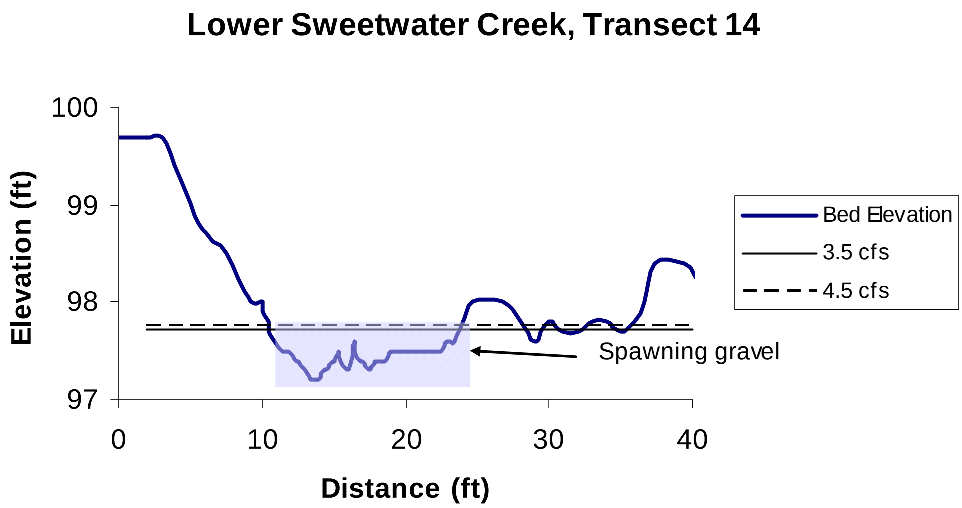


Figure E-18. Water surface elevation at 3.5 cfs (97.72 feet) and 4.5cfs (97.76 feet) in lower Sweetwater Creek, transect 14 (spawning habitat at distances 10.4 to 24.2 feet).

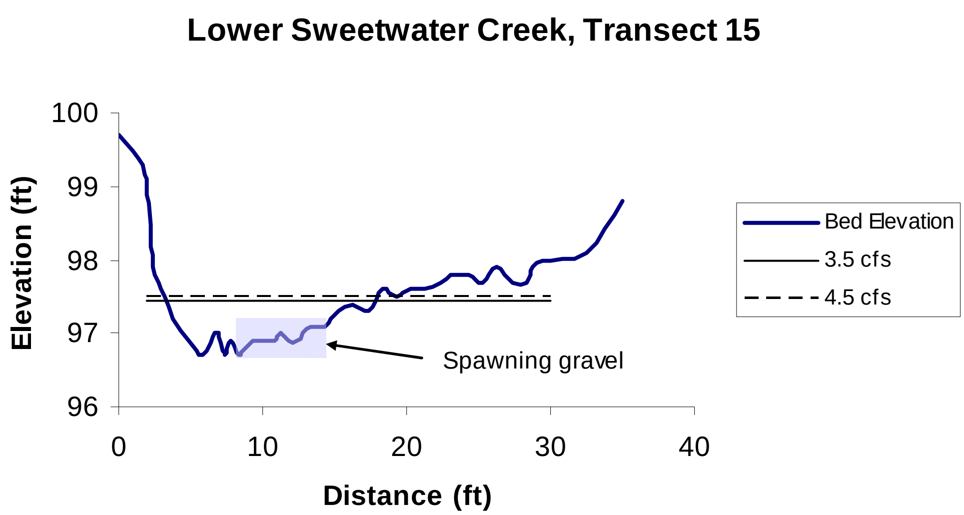


Figure E-19. Water surface elevation at 3.5 cfs (97.45 feet) and 4.5cfs (97.50 feet) in lower Sweetwater Creek, transect 15 (spawning habitat at distances 8.3 to 14.3 feet).

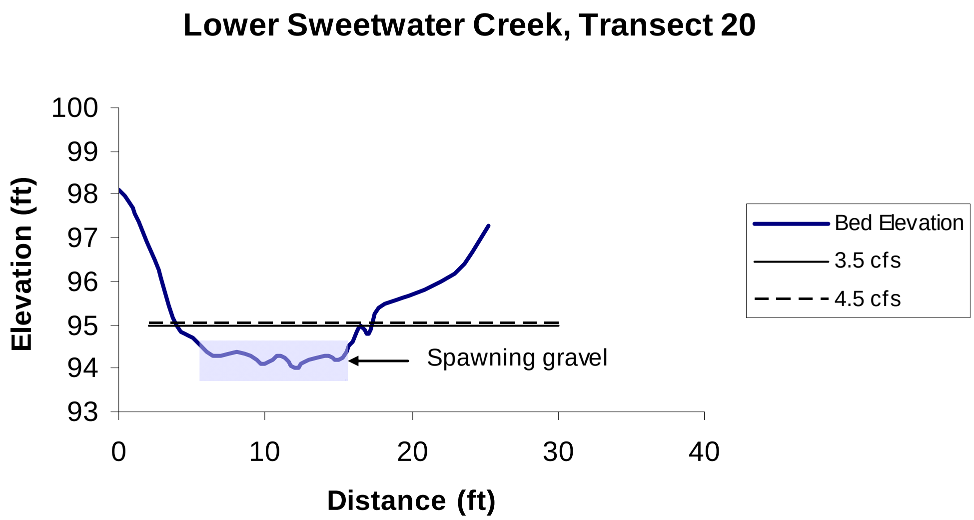


Figure E-20. Water surface elevation at 3.5 cfs (94.97 feet) and 4.5cfs (95.02 feet) in lower Sweetwater Creek, transect 20 (spawning habitat at distances 5 to 16 feet).

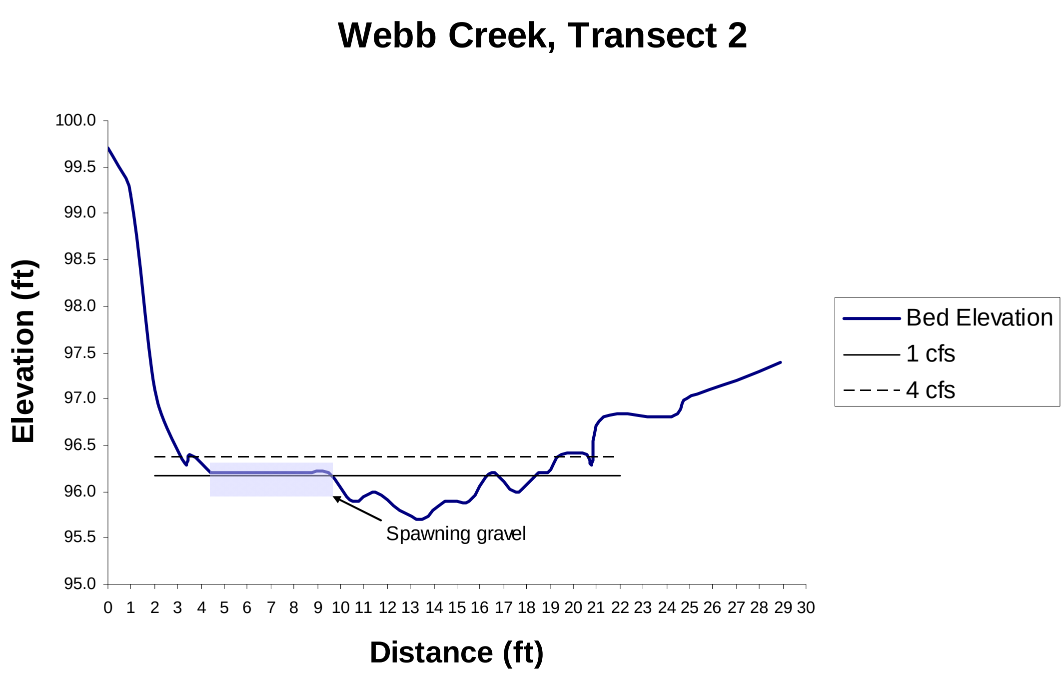


Figure E-21. Water surface elevation at 1 cfs (96.17 feet) and 4 cfs (96.37 feet) in lower Webb Creek, transect 2 (spawning habitat at distances 4.4 to 9.5 feet).

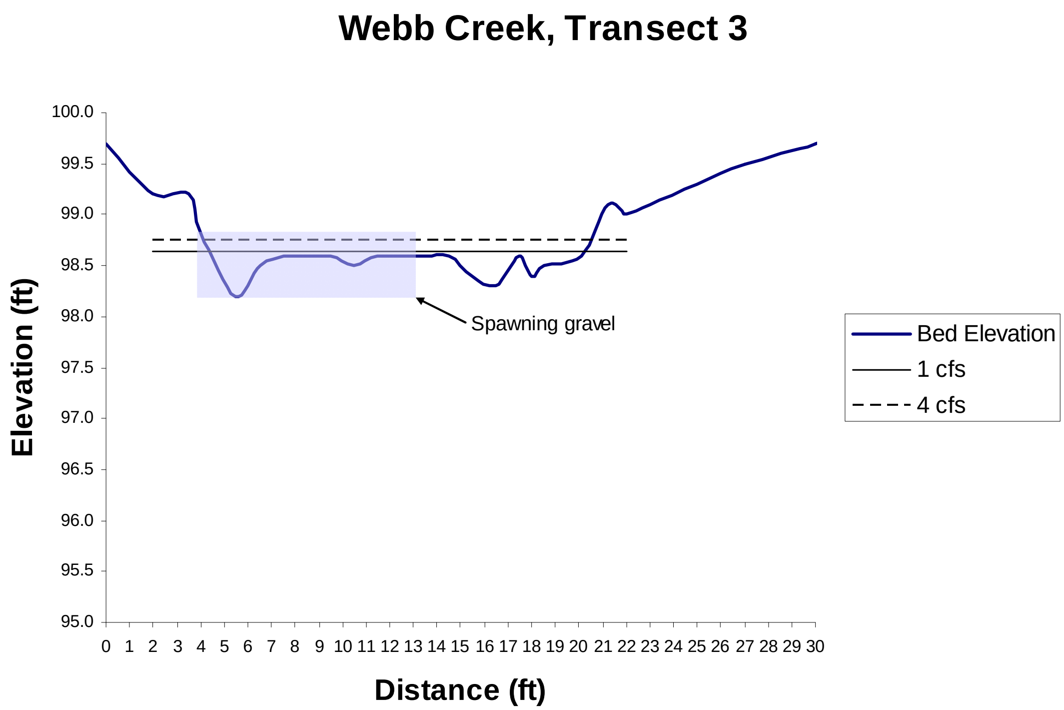


Figure E-22. Water surface elevation at 1 cfs (98.63 feet) and 4 cfs (98.75 feet) in lower Webb Creek, transect 3 (spawning habitat at distances 4.0 to 13.5 feet).

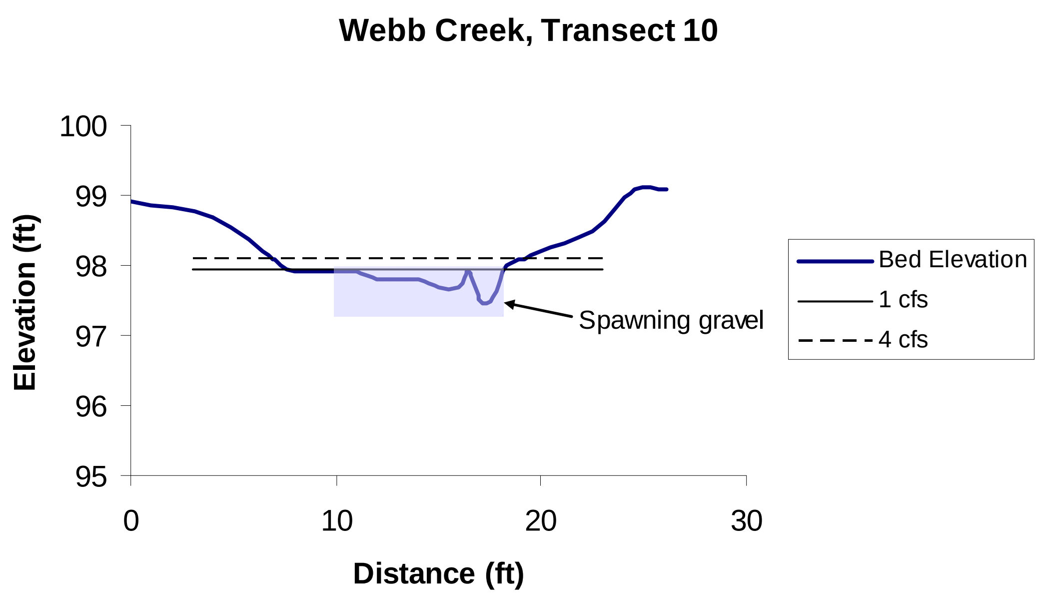


Figure E-23. Water surface elevation at 1 cfs (97.95 feet) and 4 cfs (98.08 feet) in lower Webb Creek, transect 10 (spawning habitat at distances 10 to 18 feet).

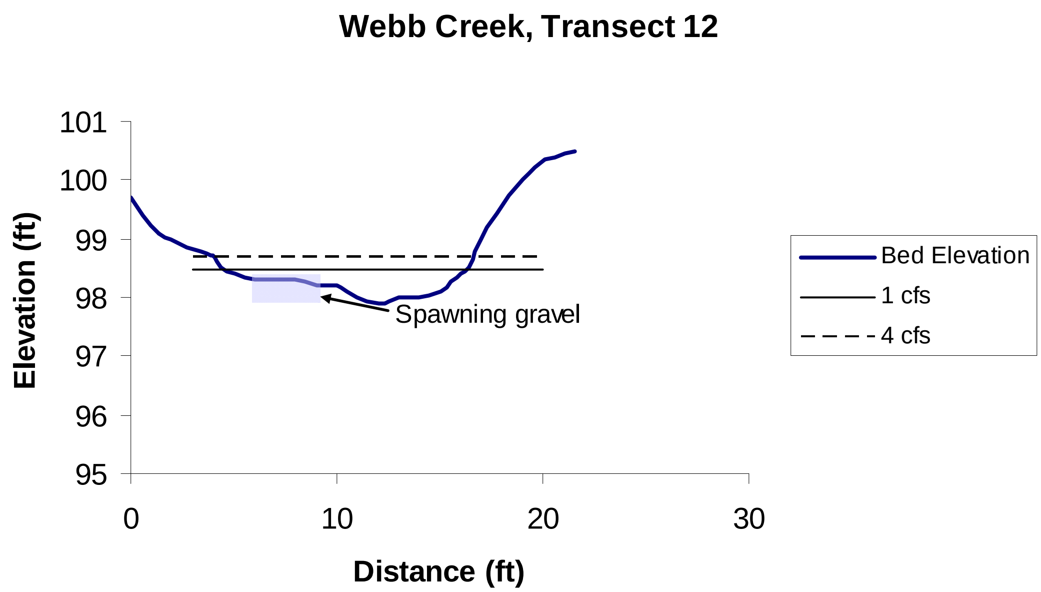


Figure E-24. Water surface elevation at 1 cfs (98.46 feet) and 4 cfs (98.68 feet) in lower Webb Creek, transect 12 (spawning habitat at distances 6 to 9 feet).

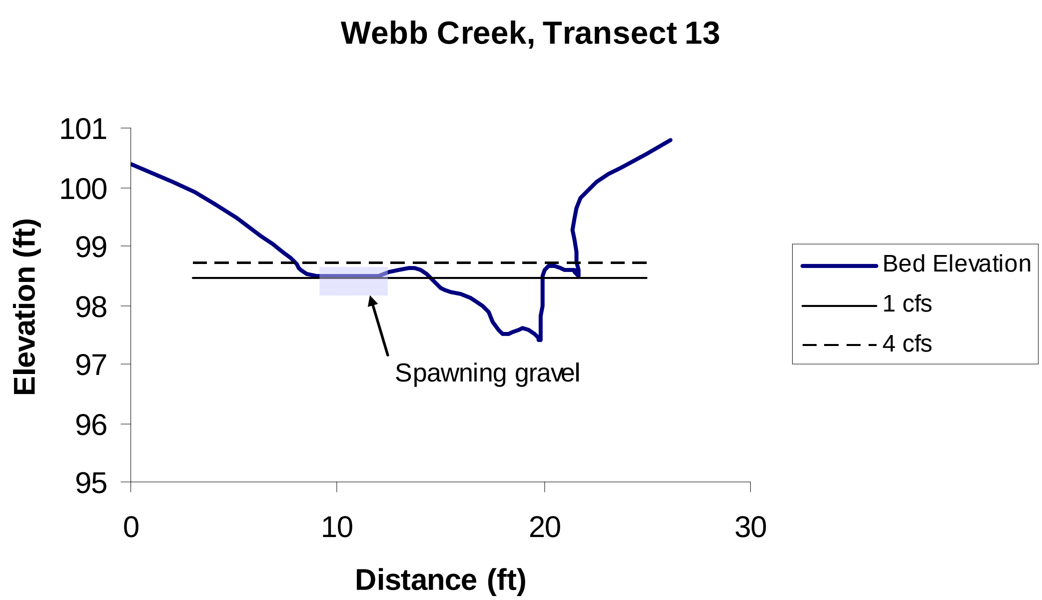


Figure E-25. Water surface elevation at 1 cfs (98.47 feet) and 4 cfs (98.68 feet) in lower Webb Creek, transect 13 (spawning habitat at distances 9 to 13 feet).

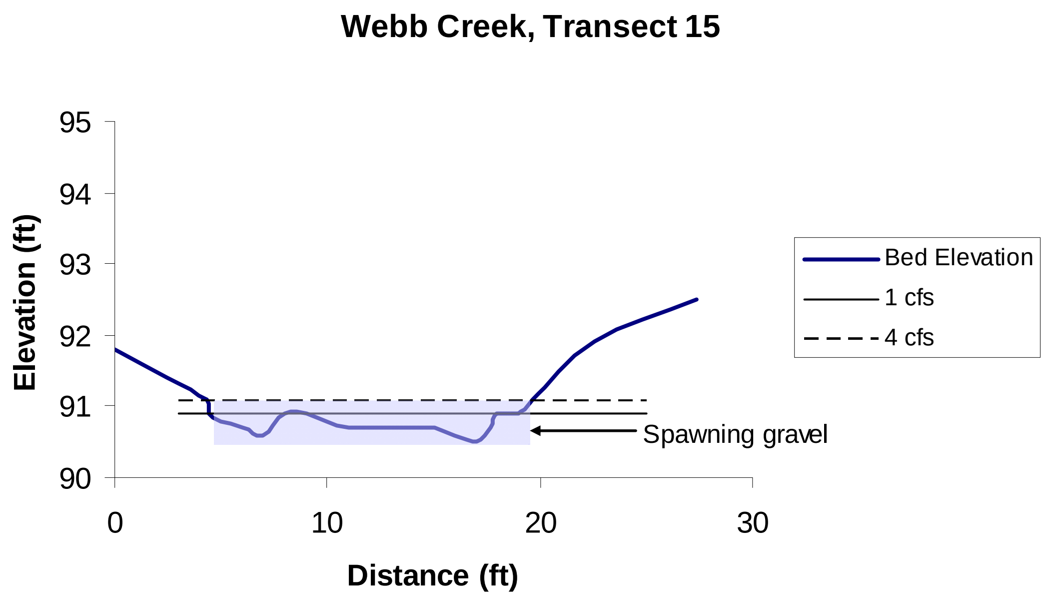


Figure E-26. Water surface elevation at 1 cfs (90.90 feet) and 4 cfs (91.06 feet) in lower Webb Creek, transect 15 (spawning habitat at distances 4.3 to 19.7 feet).

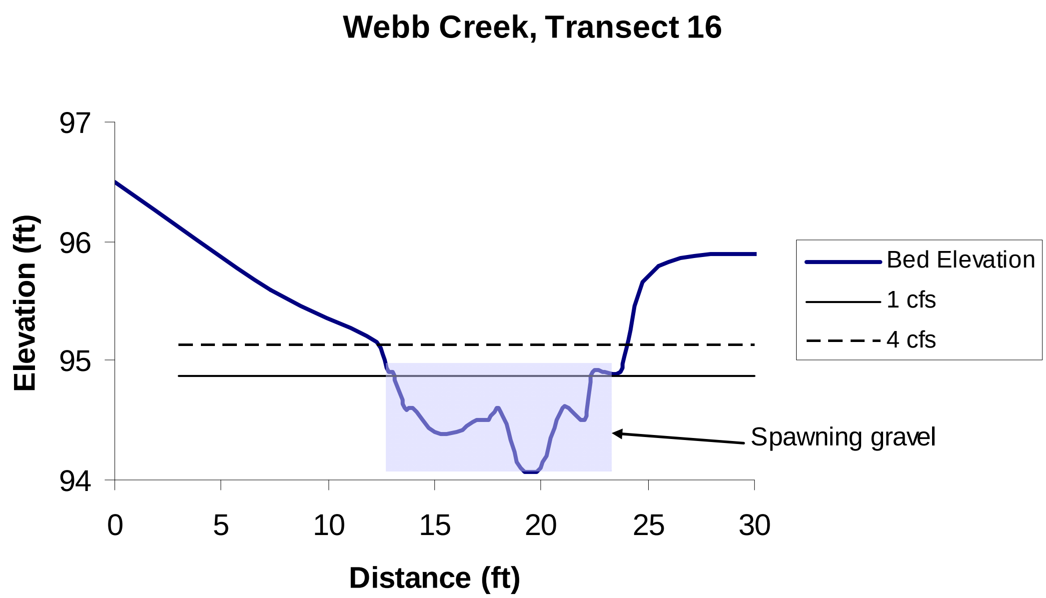


Figure E-27. Water surface elevation at 1 cfs (94.87 feet) and 4 cfs (95.13 feet) in lower Webb Creek, transect 16 (spawning habitat at distances 12.8 to 23.7 feet).