



January 2026
Study of Physical Data Gaps to Inform the Implementation
of Nur Rematriation Upstream of Shasta Dam
(AB 211 Drought Grant Agreement Number – Q2396040)



Appendix G

Existing Water Infrastructure, Barriers, and Water Rights Data

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Existing Water Infrastructure, Barriers, and Water Rights Data

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ABBREVIATIONS

ac-ft	acre-feet
ACID	Anderson-Cottonwood Irrigation District
Background Compendium	<i>Background Compendium and Design Criteria Report for the Feasibility of Volitional Fish Passage Above Keswick and Shasta Dams</i>
BIOS	Biogeographic Information and Observation System
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
CDFG	CDFG
cfs	cubic feet per second
Consultant Team	Anchor QEA; HDR Engineering, Inc.; U.S. Geological Survey; and QEDA Consulting, LLC
CP	comprehensive plan
CSA	County Service Area
CVP	Central Valley Project
DWR	California Department of Water Resources
EIS	Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
ft	foot/feet
ft msl	feet above mean sea level
HDR	HDR Engineering, Inc.
hp	horsepower
I-5	Interstate-5
kW	kilowatt(s)
MOA	Memorandum of Agreement
MW	megawatt(s)
NFH	National Fish Hatchery
NGVD29	National Geodetic Vertical Datum of 1929
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
Nomtipom Waywaket	Winnemem Wintu words for Sacramento River
Nur	Winnemem Wintu word for Chinook Salmon
PAD	Passage Assessment Database
PG&E	Pacific Gas & Electric Company
QEDA	QEDA Consulting, LLC
Regional Boards	Regional Water Quality Control Boards
RM	river mile

SLWRI	Shasta Lake Water Resources Investigation
SGMA	Sustainable Groundwater Management Act
State Water Board	California State Water Resources Control Board
TCD	temperature control device
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
Study waterbodies	Winnemem Waywaket, Nomtipom Waywaket, Dry Creek, Little Cow Creek, and Cow Creek
Winnemem Waywaket	Winnemem Wintu words for McCloud River

1 Introduction

A team of engineering and fisheries science consultants consisting of Anchor QEA; HDR Engineering, Inc. (HDR); U.S. Geological Survey (USGS); and QEDA Consulting, LLC (QEDA) known herein as the “Consultant Team,” has received funding from the California Department of Fish and Wildlife (CDFW) to implement studies to gather data, compile information, and identify data gaps related to physical and biological conditions in the Study Area. These studies will be referred to within this document as the “Project.” The results of the Project will support an investigation of the feasibility of providing volitional passage for fish, particularly Chinook Salmon (*Oncorhynchus tshawytscha*), above Keswick and Shasta dams on the Nomtipom Waywaket (also known as the Sacramento River) and into the Winnemem Waywaket (also known as the McCloud River) in northern California. In this document, Chinook Salmon is used to generally describe the species because once connectivity is re-established through reintroduction, fish will adapt to the new environments and could display run timing consistent with multiple runs. It is inclusive of Nur, which the Winnemem Wintu Tribe uses for Chinook Salmon that have been raised by the Tribe. The formal, Evolutionarily Significant Unit (ESU)-specific name (e.g., Sacramento River winter-run Chinook Salmon) is used when discussing federal Endangered Species Act (ESA)-listed Chinook Salmon or steelhead (*O. mykiss*). This document is an appendix to the overarching report documenting the results of the Project, which is called the *Background Compendium and Design Criteria Report for the Feasibility of Volitional Fish Passage Above Keswick and Shasta Dams* (Background Compendium). This larger report contains additional background information for the Project and this document should be considered within this context.

The Project Study Area extends from the confluence of Cow Creek and the Nomtipom Waywaket and includes the Winnemem Waywaket from Shasta Reservoir to the McCloud Dam (Figure 1). It includes portions of the Winnemem Waywaket; the Nomtipom Waywaket, including Keswick and Shasta dams and reservoirs; Cow Creek; Little Cow Creek; and Dry Creek. These water bodies vary in hydrology, geomorphology, and water quality, with seasonal fluctuations in temperature and flow; these parameters are being measured during this Project to evaluate habitat suitability and passage for salmonids. Understanding these physical conditions is essential to evaluating the feasibility of restoring fish passage to historical spawning and rearing areas upstream of the dams.

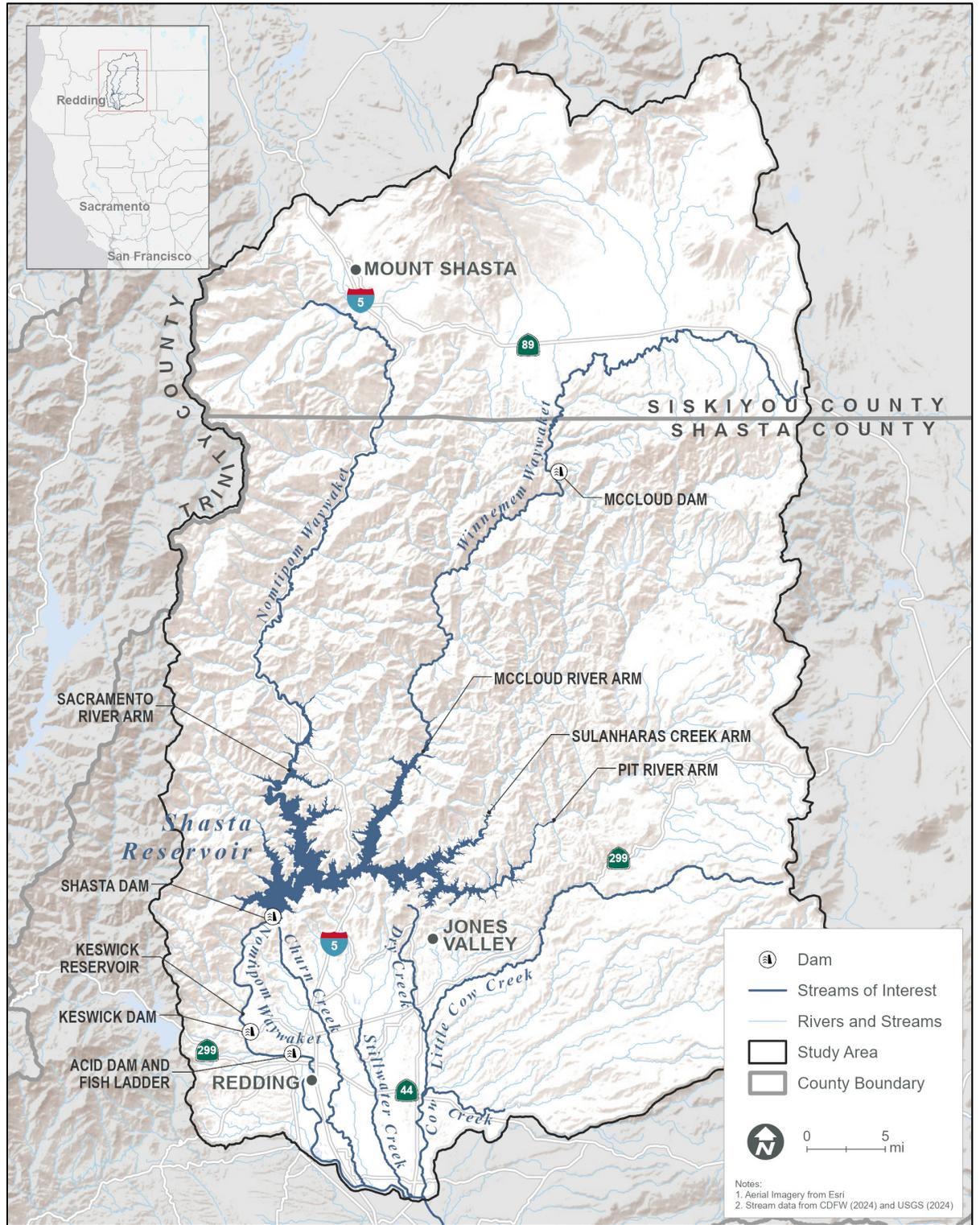
This document includes descriptions of available water infrastructure, barriers, and water rights information. The information informs potential limitations for the construction and operation of fish passage facilities within the Study Area. Information collected and compiled during the Project will be used to support a volitional passage feasibility study that will be reviewed by the salmon co-managers (Winnemem Wintu Tribe, CDFW, and National Marine Fisheries Service (NMFS) and used to inform fish passage decisions. The objectives of this document are to:

- Summarize the Consultant Team’s approach and methods of gathering information

- Synthesize and summarize readily available information on infrastructure and barriers (such as dams, diversion structures, and water crossings), and water rights in the Study Area
- Identify information data gaps and key findings that will be used to inform the development of fish passage alternatives.

Readers should understand that on December 12, 2025, the Consultant Team received an email stating that the Winnemem Wintu Tribe does not endorse these reports (referring to the Background Compendium and appendices and *Alternatives Formulation and Evaluation Report* [Anchor QEA and HDR 2026]).

Figure 1
Study Area, Key Features, and Vicinity



2 Information Sources

The Consultant Team conducted a desktop analysis of existing information to assess water infrastructure, barriers, and water rights. Sources of relevant data and a summary of the information each source contains are included in Table 1. Note that multiple datums were used throughout the references obtained. The datums are reported as described in their references.

Table 1
Summary of Key Data Sources used in Document Preparation

Data Source	Citation	Summary
CalFish Webpage - FAQ	CalFish 2018	Provides information on the CalFish cooperative program, including agency partners and the Passage Assessment Database (PAD).
CDFW BIOS Online Database - CalFish PAD	CDFW 2024	The CalFish PAD layer on BIOS provides the location of and information about road crossings, natural barriers, diversions, etc. within the Study waterbodies.
California Department of Water Resources (DWR) Webpage – Watermaster Services	DWR 2024a	Provides general information on the watermaster services program administered by the DWR.
California Data Exchange Center Query Tools	DWR 2024b	Provides stage-duration information at McCloud, Shasta, and Keswick reservoirs.
State Water Board License for Diversion and Use of Water	State Water Board 1968a	Pacific Gas and Electric Company License 10216 for diversion and use of water from the Winnemem Waywaket.
State Water Board License for Diversion and Use of Water	State Water Board 1968b	Pacific Gas and Electric Company License 10216 for diversion and use of water from the Winnemem Waywaket.
Division of Water Rights Judgment and Decree No. 38577: Cow Creek Stream System	State Water Board 1969	Provides detailed water right decree for a portion of the Cow Creek system, including a summary of irrigated lands, irrigation schedule, diversions, and water users.
State Water Board Water Rights Determination Map of California	State Water Board 2002	Provides map of California detailing surface water and ground water basin statutory adjudication and court reference areas.
State Water Board Water Quality Certification for McCloud-Pit Hydroelectric Project	State Water Board 2019	Provides detailed information about the three developments and two regulating reservoirs that comprise the McCloud-Pit Hydroelectric Project: the James B. Black, the Pit 6, and the Pit 7, and the McCloud and Iron Canyon reservoirs.
State Water Board Notice of Preparation and Scoping Meetings for a Subsequent Environmental Impact Report for the McCloud-Pit Hydroelectric Project	State Water Board 2022	Provides an overview of information about the three developments that comprise the McCloud-Pit Hydroelectric Project: the James B. Black, the Pit 6, and the Pit 7.

Data Source	Citation	Summary
State Water Board Webpage	State Water Board 2024a	Provides an overview of information about the State Water Board, including their mission statement, structure, and history. Provides detailed information about water rights law history and present day, including registrations, permits, and licenses.
State Water Board Webpage – Water Rights Fiscal Year 2024-2025 Fee Schedule Summary.	State Water Board 2024b	Provides a summary of the fiscal year 2024-2025 fee schedule for California water rights, including one-time and annual fees.
State Water Board Webpage – Electronic Water Rights Information Management System (eWRIMS)	State Water Board 2024c	Provides an electronic portal for searching state water rights records, complaints, web mapping, decisions and orders, progress reports, application processing summaries, and petitions information.
Sustainable Groundwater Management Act Webpage	State Water Board 2025	Provides information about the history, purpose, and implementation of the Sustainable Groundwater Management Act in California.
PG&E (Pacific Gas & Electric Company) McCloud-Pit Hydroelectric Project Water Quality Certification – Final Initial Study	Cardno 2019	Provides information on the McCloud-Pit Hydroelectric Project, including information about dam, powerhouse, and water diversion operations.
Notice of Applicability; General Waste Discharge Requirements for Cold Water Concentrated Aquatic Animal Production (CAAP) Facility Discharges to Surface Waters	Central Valley Regional Water Quality Control Board 2023	Provides summary on purpose and infrastructure of the Livingston Stone National Fish Hatchery at the base of Shasta Dam.
Keswick Dam Fish Trap video on Facebook	Coleman National Fish Hatchery 2018	Provides insight on operations at the Keswick Dam fish trap, specifically how fish move through the tailrace and into the trap.
Keswick Dam Fish Trap reel on Facebook	Coleman National Fish Hatchery 2024	Provides insight on operations at the Keswick Dam fish trap, specifically how fish are transported from trap to truck and truck to Coleman National Fish Hatchery.
Assessment and Prioritization of Anadromous Fish Passage at Barriers and Diversions in the Cow Creek Watershed Report	H.T. Harvey & Associates 2015	Provides a detailed assessment and ranking of water diversions and other types of fish passage barriers in the Cow Creek watershed.
Aboriginal Water Rights – Natural Resources Journal	Merrill 1980	Provides the definition of an Aboriginal water right.
2014 NMFS Recovery Plan	NOAA 2014	Provides information about requirements of introducing Chinook Salmon to habitats above Shasta Dam for meeting objectives for redundancy and spatial distribution described in 2014 Recovery Plan.
Hatchery and Genetic Management Plan: Livingston Stone National Fish Hatchery	NOAA 2016	Summarizes purpose and operations of the Livingston Stone National Fish Hatchery at the base of Shasta Dam.

Data Source	Citation	Summary
NOAA Fisheries Webpage	NOAA 2022	Provides watershed information related to development and habitat for the Nomtipom Waywaket and its major tributaries.
Plan and Profile Engineering Drawing of the Jones Valley Emergency Water Supply Project Pump Station Intake Extension	Pace Engineering 2022	Engineering drawing details Jones Valley CSA No. 6 Shasta Reservoir water intake structures, pumps, and respective elevations.
Sacramento River Watershed Program Webpage – Cow Creek Watershed	Sacramento River Watershed Program 2024a	Provides an overview of watershed statistics, hydrology, water quality, vegetation, fish and wildlife, and management objectives for the Cow Creek watershed.
Sacramento River Watershed Program Webpage – McCloud River Watershed	Sacramento River Watershed Program 2024b	Provides an overview of watershed statistics, hydrology, water quality, vegetation, fish and wildlife, and management objectives for the Winnemem Waywaket watershed.
Grand Jury Report: Ensuring Anderson-Cottonwood Irrigation District Agricultural Water for the Next Century	Shasta County Grand Jury 2024	Summarizes an investigation conducted on fish passage criteria at the Anderson-Cottonwood Irrigation District Diversion Dam.
Shasta County Department of Public Works Webpage – Shasta County Water Agency	Shasta County Department of Public Works 2024a	Provides background information on the Shasta County Water Agency development.
Email Communication with Shasta County Department of Public Works Deputy County Surveyor and Supervising Engineer	Shasta County Department of Public Works 2024b	Provides history, operation, water rights, and water infrastructure related to the Jones Valley County Service Area No. 6 of Shasta County.
Municipal Service Review & Sphere of Influence Update for County Service Area – No. 6 Jones Valley document	Shasta LAFCO 2017	Provides history, operation, water rights, and water infrastructure related to the Jones Valley County Service Area No. 6 of Shasta County.
SHN Consulting Engineers & Geologists, Inc. (SHN) Cow Creek Watershed Assessment	SHN 2001	Provides detailed information on water right adjudication and watermaster service areas for the entirety of the Cow Creek watershed.
Stillwater Sciences Webpage – McCloud-Pit Hydroelectric Project Relicensing	Stillwater Sciences 2024	Aerial photo of McCloud Dam.
2025 Salmonid Restoration Federation Conference Brochure	Trout Unlimited 2025	A Guide to California Water Rights for Small Water Users
U.S. Army Corps of Engineers (USACE) <i>Report on Reservoir Regulation for Flood Control, Shasta Dam and Lake</i>	USACE 1962	Describes Shasta Dam and Reservoir operations and prescribed regulations for flood control operations.
USACE National Inventory of Dams – McCloud	USACE 2024a	General, dimensions, and hydraulics and hydrology information on McCloud Dam.
USACE National Inventory of Dams – Shasta	USACE 2024b	General, dimensions, and hydraulics and hydrology information on Shasta Dam.
USACE National Inventory of Dams – Keswick	USACE 2024c	General, dimensions, and hydraulics and hydrology information on Keswick Dam.

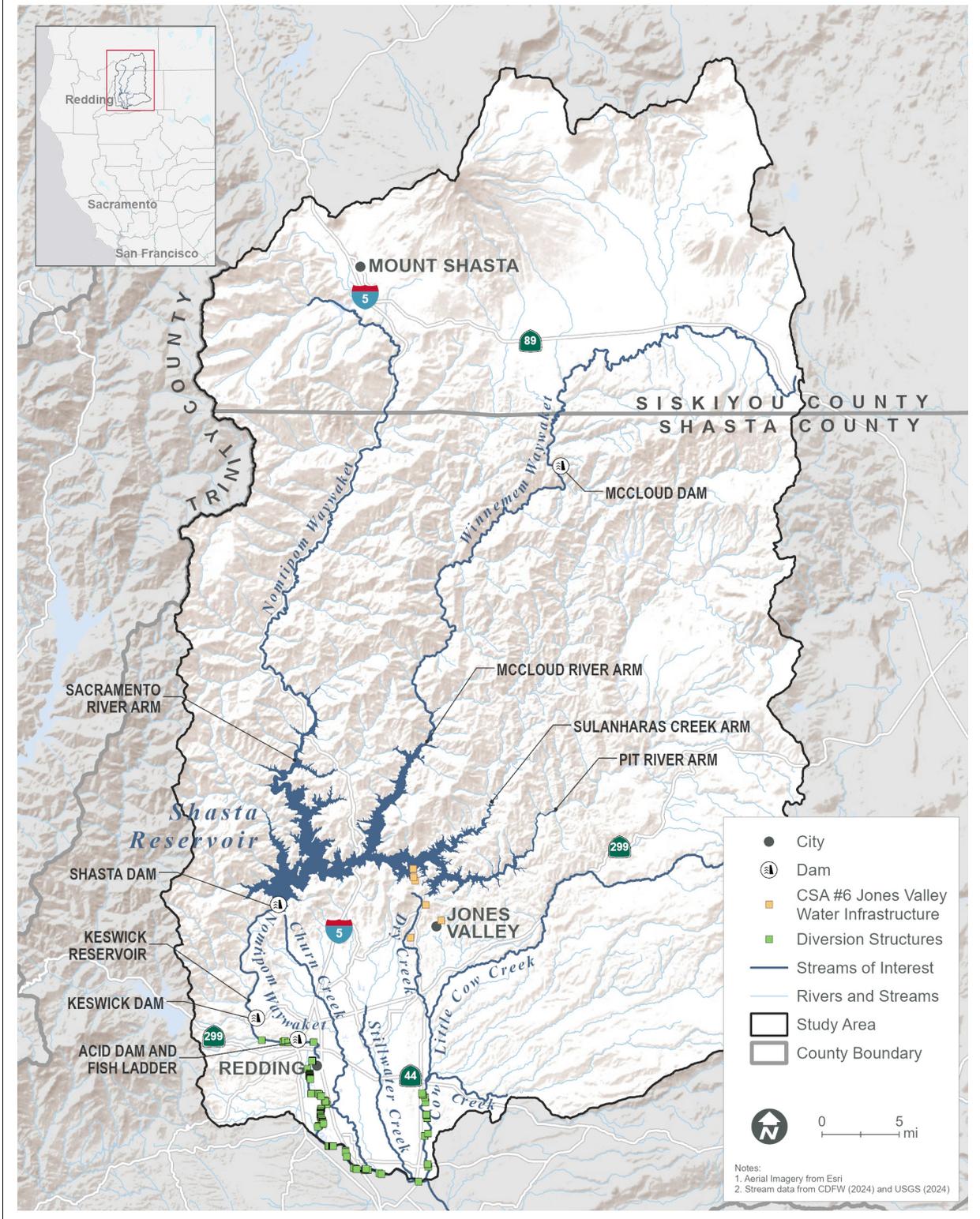
Data Source	Citation	Summary
USACE National Inventory of Dams – Anderson Cottonwood	USACE 2024d	General, dimensions, and hydraulics and hydrology information on Anderson-Cottonwood Irrigation District Dam.
U.S. Bureau of Reclamation (USBR) Central Valley Project Operations Criteria and Plan	USBR 1992	Describes Central Valley Project facilities, components, goals, and operational theory.
Shasta Lake Water Resources Investigation, California, Office Report: Ecosystem Restoration Opportunities in the Upper Sacramento River Region	USBR 2003	Describes impact of McCloud Dam on lower Winnemem Waywaket hydrology.
USBR Long-Term Central Valley Project: Operations Criteria and Plan	USBR 2004	Provides description of facilities and operations updates since the 1992 release of the Central Valley Project Operations Criteria and Plan.
Anderson-Cottonwood Irrigation District Integrated Regional Water Management Program – Groundwater Production Element Project. <i>Draft Environmental Assessment/Initial Study and Finding of No Significant Impact/Mitigated Negative Declaration</i>	USBR 2011	Describes Anderson-Cottonwood Irrigation District Dam facility components and provides brief description of facility operations.
Shasta Dam: A Tour Through Time presentation	USBR 2012	Summarizes Shasta Dam and facility components, including facility anatomy and operations.
Final Environmental Impact Statement Executive Summary	USBR 2014	Summarizes No-Action and Action Alternatives for enlarging Shasta Dam and primary and secondary objectives.
Shasta Lake Water Resources Investigation (SLWRI) – Feasibility Report	USBR 2015	Provides quantitative information and a map for inundation of the Winnemem Waywaket under all SLWRI project Action Alternatives.
USBR flickr Webpage	USBR 2019	Provides an aerial photo of a Keswick Dam water release from 2019.
Final Supplemental Environmental Impact Statement	USBR 2020	Provides new and updated information that has come available since the publication of the Final and Draft Environmental Impact Statements.
USBR Shasta Dam and Reservoir Enlargement Project Webpage	USBR 2022	Provides background information, resources, and status updates on the Shasta Dam and Reservoir Enlargement Project.
USBR Projects and Facilities Webpage on Keswick Dam	USBR 2024a	Provides a brief overview of Keswick Dam history, location, and owner and contact information. USBR also provides general details related to dam dimensions and hydraulics and hydrology of Keswick Dam.
USBR Projects and Facilities Webpage on Shasta Dam	USBR 2024b	Provides a brief overview of Shasta Dam history, location, and owner and contact information. USBR also provides general details related to dam dimensions and hydraulics and hydrology of Shasta Dam.

Data Source	Citation	Summary
U.S. Department of Agriculture (USDA) Lower McCloud Watershed Analysis	USDA 2011	Provides a watershed analysis for the lower Winnemem Waywaket to obtain a scientifically based understanding of the ecological processes and interactions occurring within the watershed. This analysis enables the Forest Service to plan long-term management.
11370000 Shasta Lake near Redding, CA: Surface-Water Records	USGS 2025a	Provides dead pool elevation at Shasta Reservoir.
11370500 Sacramento River at Keswick, CA: Surface-Water Records	USGS 2025b	Provides daily stage elevations within the Nomtipom Waywaket below Keswick Dam.
Water Education Foundation Webpage on Shasta Dam	Water Education Foundation 2024	Provides an overview of information on Shasta Dam, its operations, and future considerations.
Western Shasta Resource Conversation District Webpage – North Cow Creek, Bella Vista Water District Fish Passage Project	Western Shasta Resource Conservation District 2023	Provides an overview of the September 2023 implementation of the demolition and removal of the Bella Vista Water District Pipe Crossing for restoration of fish passage in the waterbody.

3 Existing Water Infrastructure and Barriers

This section summarizes information regarding existing water infrastructure and barriers on waterbodies in the Study Area including the Winnemem Waywaket, Nomtipom Waywaket, Dry Creek, Little Cow Creek, and Cow Creek (herein referred to as study waterbodies). Existing water infrastructure identified at the time of this analysis includes dams, release structures, water pipelines, open channel distributaries, diversion structures, storage tanks, water intake structures, and water crossings. Figure 2 shows the relative locations of identified water infrastructure and barriers.

Figure 2
Relative Locations of Identified Water Infrastructure and Barriers



3.1 Dams

Several dams are located in the Study Area that influence river conditions and flood events. Subsequent sections describe the location, purpose and intent, facility anatomy, and operational theory of McCloud, Shasta, Keswick, and Anderson-Cottonwood Irrigation District (ACID) dams. Refer to Figure 2 for the location of each dam.

3.1.1 *McCloud Dam*

McCloud Dam (Figure 3), located at RM 24 of the Winnemem Waywaket, is a 241-foot-high and 630-foot-long earth- and rock-filled dam built to divert up to 1,400 cfs via McCloud Tunnel to Iron Canyon Reservoir and subsequently the Pit River for hydroelectric generation (State Water Board 2019). This facility is a part of Pacific Gas & Electric Company's (PG&E's) James B. Black Development, a major component of the McCloud-Pit Hydroelectric Project, which includes an area totaling over 3,700 acres and three separate developments with several powerhouses. These three hydroelectric developments have a combined capacity of 386 megawatts (MW). The McCloud Dam facility has a drainage area of 398 square miles (USACE 2024a) and includes McCloud Tunnel, a 7.2-mile-long tunnel used to convey water from the McCloud Reservoir to Iron Canyon Reservoir on the Lower Pit River Basin. Water that is not conveyed to the Iron Canyon Reservoir is impounded in McCloud Reservoir or passed downstream to the Winnemem Waywaket via a spillway or regulating outlet. The Winnemem Waywaket and Pit River flow into Shasta Reservoir (Cardno 2019).

McCloud Dam can be accessed from Redding, California via Interstate 5 (I-5) and Highway 89. Turn right onto Squaw Valley Road and continue until a fork in the road appears with a sign for the McCloud-Pit Hydroelectric Project. Take a right at the fork and follow the road until a second fork appears. Take a left and continue along McCloud Reservoir to the dam.

Figure 3
Aerial View of McCloud Dam



Source: Stillwater Sciences 2024

3.1.1.1 Facility Anatomy

McCloud Reservoir has a surface area of 520 acres and a maximum storage capacity of 31,197 acre-feet (ac-ft). Along the spillway crest, there are three, 27- by 24.5-foot (ft) radial gates used to discharge water via the spillway to the Winnemem Waywaket below the dam. A gate at the base of the dam is connected to an 84-inch diameter pipe, which bifurcates into a pipe that releases instream flows to the Winnemem Waywaket and an emergency valve to control reservoir water surface elevations. The 17-foot-diameter intake tower located in the middle of the reservoir collects water from the McCloud Reservoir and routes it to Iron Canyon Reservoir (Cardno 2019). Table 2 summarizes pertinent data for McCloud Dam.

Table 2
McCloud Dam Summary

Parameter	McCloud Dam	Data Source
General		
Owner	PG&E	(Cardno 2019)

Parameter	McCloud Dam	Data Source
Latitude, Longitude	41.131367, -122.070891	(USACE 2024a)
Construction Completed	1965	(Cardno 2019)
River	Winnemem Waywaket	(USACE 2024a)
National Identification Number	CA00416	(USACE 2024a)
Dimensions		
Structural Height (ft)	241	(Cardno 2019)
Crest Length (ft)	630	(Cardno 2019)
Spillway Width (ft)	81	(USACE 2024a)
Spillway Elevation (ft msl ¹)	2,696	(Cardno 2019)
Hydraulics and Hydrology		
Maximum Reservoir Storage Capacity (ac-ft)	31,197	(Cardno 2019)
Reservoir surface area (ac)	520	(Cardno 2019)
Maximum Spillway Capacity (cfs)	50,000	(USACE 2024a)
Drainage Area (square miles)	398	(USACE 2024a)
Normal Maximum Water Surface Elevation (ft msl)	2,680	(Cardno 2019)
Normal Minimum Operating Pool Elevation (ft msl)	2,634	(Cardno 2019)
Maximum power generation capacity (MW) ³	172	(Cardno 2019)

Notes:

1. Ft above mean sea level (ft msl)
2. Generated at the James B. Black Powerhouse

3.1.1.2 Facility Operations

The McCloud-Pit Project operates as both a peaking system and load-following system, with operations coordinated between McCloud Dam and Reservoir and Iron Canyon Reservoir to minimize spills and optimize use of water after satisfying minimum instream flow requirements. Hydropower operations range from minimum or no load during the off-peak periods to maximum powerhouse output during peak demand periods (Cardno 2019).

The intake structure takes water from the reservoir and conveys it through the McCloud Tunnel to the Iron Canyon Reservoir. The water surface differential between McCloud and Iron Canyon reservoirs controls the discharge through the tunnel. Flows are conveyed from Iron Canyon Reservoir through Iron Canyon Tunnel to James B. Black Powerhouse, which subsequently discharges to the Pit River, through Pit 6 and Pit 7, and ultimately discharges to Shasta Reservoir. Operation of the McCloud-Pit Hydroelectric Project are planned specifically to avoid and prevent the spilling of water

at McCloud Dam; the dam spills approximately four out of every ten years. When high inflows are expected to result in water being spilled at McCloud Dam, Iron Canyon Reservoir and McCloud Reservoir are drawn down to create storage space (Cardno 2019).

Flood Control

Although not expressly operated for flood control, the coordinated operation of McCloud and Iron Canyon dams limits the amount of water spilled at McCloud Dam.

Water Supply

Since McCloud Dam was constructed, PG&E has been authorized to directly divert 1,870 cfs from Winnemem Waywaket into McCloud Reservoir, up to 1,400 cfs of which is diverted to Iron Canyon Reservoir for power generation (State Water Board 2019). This diversion does not significantly influence the larger peak flow events in the watershed; the tributaries immediately below McCloud Reservoir supply over three times more runoff to the Winnemem Waywaket than is supplied by the entire upper watershed of the Winnemem Waywaket (USDA 2011). However, the hydrology of the Winnemem Waywaket has changed substantially due to McCloud Dam (USBR 2003).

Stage-Duration

Sixteen USGS stream gauges in the Study Area are used to monitor flows and storage within the McCloud-Pit Hydroelectric Project, two of which are located just downstream of McCloud Dam (Cardno 2019). There are also several California Data Exchange Center (CDEC) stations in the Study Area, and Station MCO was used to develop the stage-duration data presented in Table 3.

**Table 3
McCloud Reservoir Stage-Duration Summary**

Percent of Time Exceeded (%)	Mean Daily Reservoir Stage Elevation (ft)
Max	2,678.0
0.1	2,677.3
1	2,676.3
5.0	2,666.9
10.0	2,665.0
50.0	2,650.3
90.0	2,640.9
95.0	2,639.9
99.0	2,638.5
99.9	2,636.5
Min	2,636.0

Notes:
Datum: NAVD88
CDEC Mean Daily Water Level at McCloud Reservoir (Station MCO)
Data Range: 01/13/2020 – 11/17/2024
Source: DWR 2024b

Hydropower

No hydropower generation occurs at McCloud Dam, and water sent to Iron Canyon Reservoir is conveyed to the James B. Black Powerhouse for power generation. The James B. Black Powerhouse contains two vertical shaft impulse turbines, each rated at 104,000 horsepower (hp), with a total combined maximum capacity of 172 MW (Cardno 2019).

Fish Conservation

Minimum instream flows were set during the Federal Energy Regulatory Commission (FERC) licensing for McCloud-Pit Hydropower Project in 1961 based on flows required to sustain salmonid (trout) spawning runs from Shasta Reservoir. A minimum flow rate of 40 cubic feet per second (cfs) from December 1 – April 30, and 50 cfs from March 1 – November 30 must be maintained below McCloud Dam, but flows typically remain above 100 cfs. Additionally, minimum instream flows of 160 to 210 cfs must be maintained year-round at the Ah-Di-Na USGS stream gauge located below the confluence of Hawkins Creek with the Winnemem Waywaket (Cardno 2019).

Navigation

The McCloud-Pit Hydroelectric Project does not operate based upon navigational requirements.

Recreation

McCloud Dam and Reservoir are within the Shasta-Trinity National Forest, and as such, must accommodate recreation activities year-round. While there are no National Forest trails identified at McCloud Reservoir, the McCloud Reservoir Boat Ramp operates on the northern end of McCloud Reservoir when the appropriate water level is available.

3.1.2 Shasta Dam

Shasta Dam (Figure 4) is a 602-foot-high concrete gravity dam located at RM 311 of the Nomtipom Waywaket, approximately nine miles northwest of Redding, California. The facility has a drainage area of 6,665 square miles and is owned and operated by the Bureau of Reclamation (USBR; USBR 2024b). The dam was commissioned in 1945 to provide flood control, power, and water supply benefits to the region. Shasta Reservoir is fed by the Nomtipom Waywaket, the Pit River, and the Winnemem Waywaket, with additional water coming from Sulanharas Creek. Shasta Dam can be accessed via CA 299 and Co Highway 18 / Lake Boulevard.

The Livingston Stone National Fish Hatchery (NFH) is located at the base of Shasta Dam and was established in 1997 to partially offset habitat and fish losses resulting from the construction of the dam and assist in recovery of winter-run Chinook Salmon in the upper Nontipom Waywaket (NOAA 2016). The facility is operated by the U.S. Fish and Wildlife Service (USFWS) and raises endangered winter-run Chinook Salmon and maintains a reserve population of Delta Smelt (*Hypomesus transpacificus*) population (Central Valley Regional Water Quality Control Board 2023).

Figure 4
Aerial View of Shasta Dam



Source: USBR 2024b

3.1.2.1 Facility Anatomy

Shasta Dam consists of the dam itself, Shasta Reservoir, and the Shasta Powerplant. Shasta Reservoir has a surface area of 30,210 acres and a maximum storage capacity of 4,661,860 ac-ft (USACE 2024b). The spillway face has 18 valves used to manage reservoir level and provide flood control downstream of the dam. The spillway crest has three steel drum gates also used to manage reservoir level (USBR 2012). Five penstocks connected to the reservoir deliver water to the seven generators in the powerplant, two of which are used for station power (USBR 2004). A temperature control device (TCD) located on the upstream face of the dam adjacent to the spillway crest has multiple gate

openings at several depths to allow water withdrawal from a variety of temperatures within the reservoir (USBR 2012).

Table 4 summarizes pertinent data for Shasta Dam.

**Table 4
Shasta Dam Summary**

Parameter	Shasta Dam	Data Source
General		
Owner	USBR	(USBR 2024b)
Latitude, Longitude	40.7186, -122.4192	(USACE 2024b)
Original Construction	1938-1945	(USBR 2024b)
Modified Construction	1995-1996	(USBR 2024b)
River	Nomtipom Waywaket	(USBR 2024b)
National Identification Number	CA10186	(USBR 2024b)
Base Width (ft)	543	(USBR 2024b)
Dimensions		
Hydraulic Height (Normal Operating Depth at Dam) (ft)	522.5	(USBR 2024b)
Crest Elevation (ft)	1,077.5	(USBR 2024b)
Structural Height (ft)	602.0	(USBR 2024b)
Crest Length (ft)	3,460	(USBR 2024b)
Crest Width (ft)	30	(USBR 2024b)
TCD Upper Gate(s) Inlet Elevation (ft)	1,000	(USBR 2004)
TCD Middle Gate(s) Inlet Elevation (ft)	950	(USBR 2004)
TCD Pressure Relief Gate(s) Inlet Elevation (ft)	815	(USBR 2004)
Hydraulics And Hydrology		
Total Water Storage at Elevation 1067 (ac-ft)	4,522,000	(USBR 2024b)
Spillway Capacity at Elevation 1065 cubic feet per second (cfs)	186,000	(USBR 2024b)
Outlet Works Capacity at Elevation 1065 (cfs)	81,800	(USBR 2024b)
Drainage Area (square miles)	6,665	(USBR 2024b)
Maximum Water Surface Elevation (ft)	1,076.2	(USBR 2024b)
Normal Pool Elevation (ft)	1,067	(USBR 1992)
Low Operating Pool Elevation (ft)	840	(USGS 2025a)

Parameter	Shasta Dam	Data Source
Dead Pool Elevation (ft)	737.75	(USGS 2025a)
Net Generation (kilowatts-hour)	1,806,476,000	(USBR 2024b)
Maximum Powerplant Operating Capability (kilowatt)	584,000	(USBR 2004)
Livingston Stone NFH design flow (million gallons per day)	7.2	(Central Valley Regional Water Quality Control Board 2023)

Notes:

Elevations listed in Table 4 are in the National Geodetic Vertical Datum of 1929.

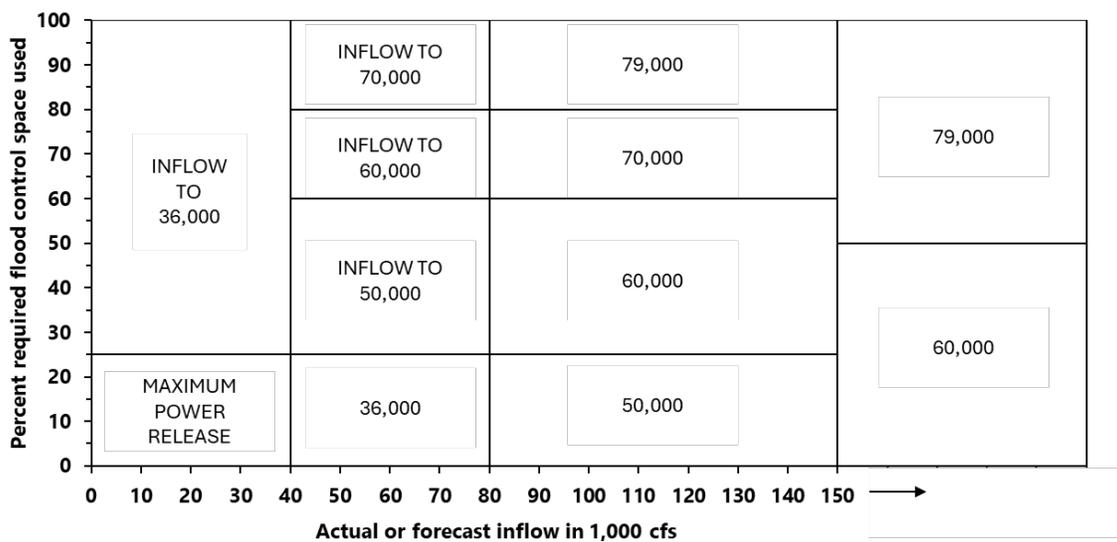
3.1.2.2 Facility Operations

Shasta Dam is operated as part of the Central Valley Project (CVP), a major water conservation development under the supervision of USBR. The CVP functions as a multi-purpose network of dams, reservoirs, canals, hydroelectric powerplants, and other facilities extending 400 miles through central California. The authorized purposes of the CVP in order of priority are to provide river regulation for improvement of navigation and flood control, irrigation and domestic use, and power generation. The Shasta Division of the CVP includes both the Shasta Dam and Reservoir and the Keswick Dam and Reservoir and provides storage for flood control and irrigation of the Sacramento and San Joaquin valleys. The Shasta Division is also responsible for maintenance of navigation and fish conservation in the Nomtipom Waywaket, providing protection from saltwater intrusion in the Sacramento-San Joaquin Delta, water for municipal and industrial uses, and generation of hydroelectric energy (USBR 1992). Details of the CVP and operations of facilities as they relate to the CVP are discussed in Section 4. The following paragraphs describe operation of Shasta Dam and associated facilities.

Flood Control

According to the 1992 CVP Operational Criteria and Plan, “Shasta Dam and Shasta [Reservoir] on the [Nomtipom Waywaket] serve to control floodwater and store surplus winter runoff for irrigation use in the Sacramento and San Joaquin Valleys” (USBR 1992). Flood control releases at Shasta Dam are dependent on forecasted or measured storm flows and available reservoir storage prior to and during flood flows. Powerplant capacities are used to the extent practicable during flood control operations (USACE 1962). Flood control releases from Shasta Dam follow the schedule shown in Figure 5.

**Figure 5
Shasta Dam Flood Control Release Schedule**



Adapted from USBR 1992

Water Supply

Shasta Reservoir is part of the CVP’s extensive network of surface water reservoirs, which are operated to ensure water is available during dry years for urban, agricultural, and environmental purposes. Specific water supply allocations are based upon runoff and operations forecasting, as well as reservoir carryover storage needs (USBR 1992). Assessments are performed to “determine the amount of CVP water needed to balance a contractor’s water demands with its available surface water and groundwater supplies” (USBR 2004).

Stage-Duration

At Shasta Reservoir, 1,300,00 ac-ft below the elevation of 1,067 ft are reserved for flood storage, with varying storage based on the anticipated flood hazard (USBR 1992). A CDEC Station at the dam (Station SHA) monitors reservoir elevation, inflow, outflow, and storage, as well as discharge, power generation, and precipitation. Table 5 summarizes Shasta Reservoir stage-duration, developed using the CDEC Station SHA daily reservoir elevation data.

Table 5
Shasta Reservoir Stage-Duration Summary

Percent of Time Exceeded (%)	Mean Daily Reservoir Stage Elevation (ft)
Max	1066.5
0.1	1065.4
1	1064.1
5.0	1060.4
10.0	1054.1
50.0	1014.2
90.0	936.9
95.0	918.2
99.0	894.8
99.9	885.2
Min	882.24

Notes:
 Datum: NAVD88
 CDEC Mean Daily Water Level at Shasta Dam (Station SHA)
 Data Range: 02/04/2000 – 08/06/2024
 Source: DWR 2024b

Reservoir storage typically peaks in May and generally does not experience significant drawdown until July and August. Maximum reservoir drawdown rates typically coincide with peak irrigation demands in July. The region’s winter rain generally fills the reservoir close to capacity each spring. The water is sent downstream during the summer months, allowing for flood control to occur during the winter months. During dry years, the reservoir’s surplus is vitally important as it helps meet obligations that would normally be fulfilled by annual rainfall (USBR 1992).

Hydropower

The generating units within Shasta Powerplant have a maximum operating capability of 710,000 kilowatts (kW), with a maximum release of approximately 18,000 cfs (USBR 2012). The maximum installed generation capacity is 625,000 kW (USBR 2004). Power generated is transmitted and sold by the Western Area Power Administration throughout 15 western states (USBR 2012). Shasta generates enough power to meet the needs of anywhere from 300,000 to 700,000 homes (Water Education Foundation 2024).

Fish Conservation

Water is supplied to the Livingston Stone NFH via a pipe tapped into multiple penstocks of the powerplant for redundant water supply to the hatchery, including during times of low flow (Central Valley Regional Water Quality Control Board 2023). Wastewater from the hatchery is discharged to

the Nomtipom Waywaket at three distinct locations adjacent to the facility. Effluent at these points is in compliance with the effluent limitations outlined in the Water Quality Control Board's General Order (Central Valley Regional Water Quality Control Board 2023).

The TCD was installed in 1997 and is operated to manage water temperatures in the Nomtipom Waywaket downstream of Keswick Dam. During mid-winter and early spring, "the highest elevation gates possible are used to draw from the upper portions of the reservoir to conserve deeper colder resources" (USBR 2004). In the late spring and summer, deeper gates begin to open in the TCD to provide cold water downstream as reservoir elevation decreases. In the late summer and fall, side gates are opened to provide remaining cold water resources. "The seasonal progression of Shasta TCD operation is designed to maximize the conservation of cold-water resources deep in Shasta [Reservoir] until the time the resource is of greatest management value to fishery management purposes" (USBR 2004). Water from the TCD is sent through the powerplant to maximize power generation while providing cool water downstream. The 2004 CVP Operations Criteria and Plan (USBR 2004) suggests that significant improvements need to be made to the TCD and TCD operations to ensure their success.

TCD improvements and monitoring of its operation have been ongoing to comply with requirements in the 2009, 2019, and the 2024 Biological Opinion for the Long-Term Operations of the Central Valley Project and the State Water Project, including operation of Shasta Dam. The 2024 Biological Opinion for the Long-Term Operations of the Central Valley Project and the State Water Project also includes expectations that specific temperature requirements downstream of Keswick Dam consisting of daily average water temperature of 53.5°F from May 15 through October 31 at or downstream of the Nomtipom Waywaket above Clear Creek gauge will occur with varying levels of achievement to protect incubating salmon eggs.

In 1990, prior to implementation of the TCD, operations at Shasta and Keswick dams, along with other facilities in the CVP outside of the Study Area, were modified to maintain a daily average temperature of 56 degrees Fahrenheit at Red Bluff Diversion Dam as mandated by the State Water Resources Control Board (WR 90-5 and 91-01). Without the TCD, temperature control releases bypassed the Shasta Powerplant, resulting in a decrease in power generation. Under WR 90-5, outside of flood control and emergency operations, release rates were not permitted to decrease by more than 15 percent and 2.5 percent in 12-hour and 1-hour periods, respectively (USBR 1992).

Navigation

USBR does not allocate storage at Shasta Reservoir to navigation uses but is obligated by the Rivers and Harbors Act of 1937 to operate in a way that improves navigation of the Nomtipom Waywaket (USBR 1992).

Recreation

Shasta Reservoir is used extensively for recreation (Water Education Foundation 2024). No legal or contractual obligations exist for maintaining reservoir levels or river flows to accommodate recreation; however, USBR considers recreational uses when making operational decisions. While typical reservoir levels during peak recreation (between Memorial Day and Labor Day) range from full to 50 feet below the normal pool, prioritization of other CVP uses has resulted in unsatisfactory recreational reservoir levels during drought (USBR 2004).

Other

Shasta and Keswick dams regulate a considerable portion of Nomtipom Waywaket flow, affecting seepage potential under the levees downstream. Although the dams are not expressly authorized for seepage control, they can be operated to assist with seepage control provided that operations do not interfere with authorized CVP functions. Allowance for seepage control would only occur during periods of non-extreme weather when available flood control storage is determined to be sufficient to reduce releases from the dams, which would limit water on the downstream levees and reduce seepage potential (USBR 1992).

3.1.2.3 Potential Future Facility Changes

To increase water supply and water supply reliability, USBR evaluated the potential of raising Shasta Dam in an investigation called the "Shasta Lake Water Resources Investigation" (SLWRI). USBR transmitted to Congress the Final Feasibility Report and Environmental Impact Statement (EIS) for the SLWRI in July 2015 that investigate the potential effects of raising Shasta Dam by 6.5 feet, 12.5 feet, and 18.5 feet and describe potential technical, environmental, economic, and financial evaluations associated with raising the dam. The SLWRI is intended to increase water supply and water supply reliability for agricultural, municipal and industrial, and environmental purposes and increase survival of anadromous fish populations in the upper Nomtipom Waywaket (USBR 2020). Specific objectives for the SLWRI are summarized in the following bullets; primary objectives are those for which specific alternatives are formulated to address and secondary objectives are considered to the extent possible through pursuit of the primary objectives (USBR 2014).

- Primary Objectives:
 - Increase the survival of anadromous fish populations in the Nomtipom Waywaket, primarily upstream from the Red Bluff Pumping Plant.
 - Increase water supply and water supply reliability for agricultural, municipal and industrial, and environmental purposes, to help meet current and future water demands, with a focus on enlarging Shasta Dam and Reservoir.
- Secondary Objectives:

- Conserve, restore, and enhance ecosystem resources in the Shasta Reservoir area and along the upper Nomtipom Waywaket
- Reduce flood damage along the Nomtipom Waywaket
- Develop additional hydropower generation capabilities at Shasta Dam
- Maintain and increase recreation opportunities at Shasta Reservoir
- Maintain or improve water quality conditions in the Nomtipom Waywaket downstream from Shasta Dam and in the Sacramento-San Joaquin Delta.

Five comprehensive plans (CP) and a No-Action Alternative were developed as part of the SLWRI (Table 6). Each of the CPs includes enlarging Shasta Dam and Reservoir and a variety of management measures to address SLWRI objectives to varying degrees

**Table 6
Summary of SLWRI Plan Alternatives**

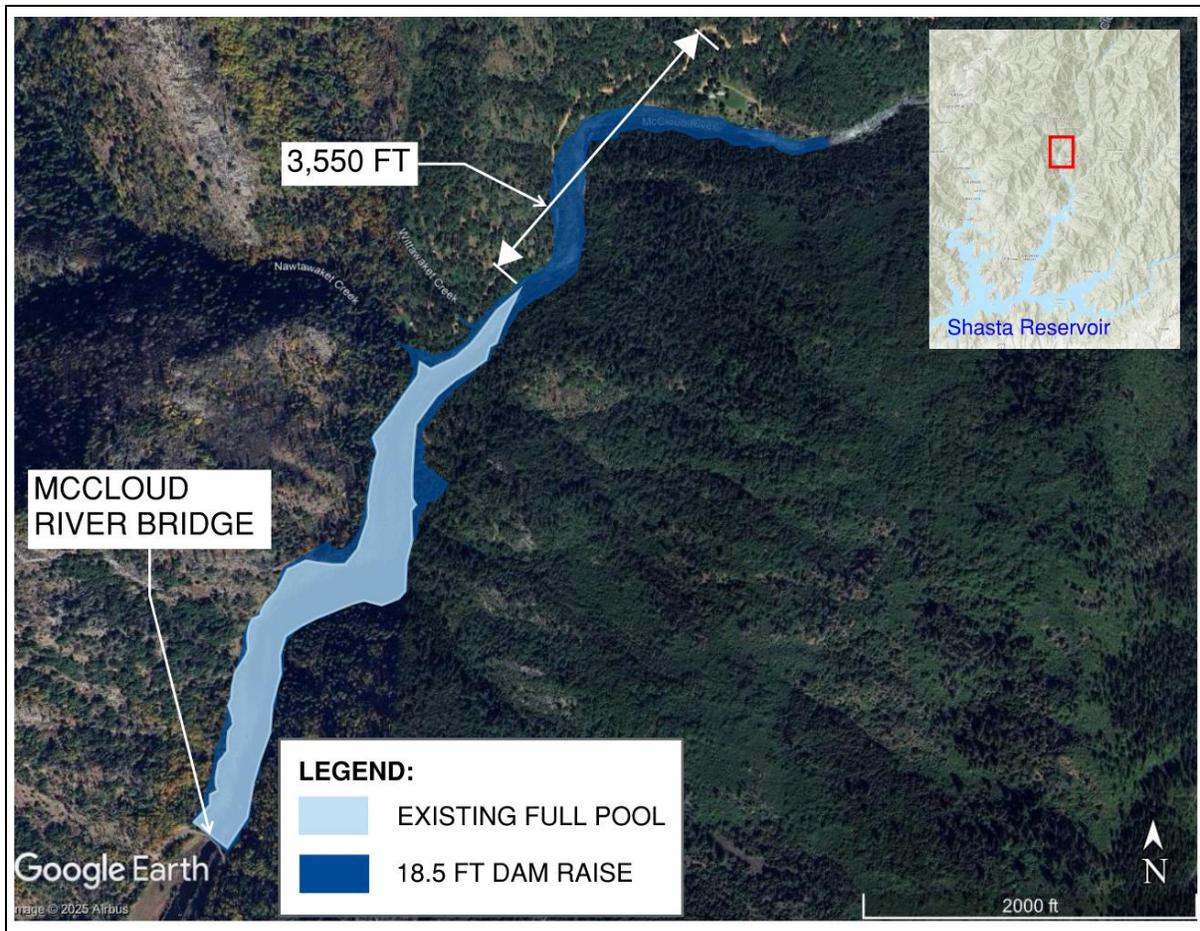
Plan	Dam Raise	Description
Comprehensive Plan 1 (CP1)	6.5-ft dam raise, new crest elevation: 1,084 National Geodetic Vertical Datum of 1929 (NGVD29)	CP1 consists of enlarging Shasta Dam and Reservoir by raising the crest 6.5 ft from Elevation 1,077.5 NGVD29 to Elevation 1,084 NGVD29. By raising the crest elevation, in combination with spillway modifications, this alternative would increase the height of the reservoir's full pool by 8.5 ft, adding approximately 256,000 ac-ft of additional storage capacity (increasing the full pool storage from 4.55 million ac-ft to 4.81 million ac-ft).
Comprehensive Plan 2 (CP2)	12.5-ft dam raise, new crest elevation: 1,090 NGVD29	CP2 consists of enlarging Shasta Dam and Reservoir by raising the crest 12.5 ft from Elevation 1,077.5 NGVD29 to Elevation 1,090 NGVD29. By raising the crest elevation, in combination with spillway modifications, this alternative would increase the height of the reservoir's full pool by 14.5 ft, adding approximately 443,000 ac-ft of additional storage capacity (increasing the full pool storage from 4.55 million ac-ft to 5.0 million ac-ft).
Comprehensive Plan 3 (CP3)	18.5-ft dam raise, new crest elevation: 1,096 NGVD29	CP3 consists of enlarging Shasta Dam and Reservoir by raising the crest 18.5 ft from Elevation 1,077.5 NGVD29 to Elevation 1,096 NGVD29. By raising the crest elevation, in combination with spillway modifications, this alternative would increase the height of the reservoir's full pool by 20.5 ft, adding approximately 634,000 ac-ft of additional storage capacity (increasing the full pool storage from 4.55 million ac-ft to 5.19 million ac-ft).
Comprehensive Plan 4, 4A, and 5 (CP4, CP4A, and CP5)	18.5-ft dam raise, new crest elevation: 1,096 NGVD29	CP4, CP4A, and CP5 all consist of the same proposed water elevation and storage capacity increases as CP3 to address the primary objective of enlarging Shasta Dam and Reservoir. Differences in CP4, CP4A, and CP5 in comparison to CP3 are related to proposed measures to address other Primary and secondary objectives.

Source: USBR 2014

The SLWRI found that overall benefits of an 18.5-ft Shasta Dam raise for meeting identified primary and secondary objectives were greater than those for either a 6.5-ft raise or a 12.5-ft raise. However, neither CP4 nor CP5 formulations performed satisfactorily in addressing both anadromous fish survival and water supply reliability (the two primary objectives), making CP4A the selected preferred alternative. CP4A would have relatively high increases in water supply reliability and the second highest increase in anadromous fish survival of all CPs. Additionally, CP4A would have the ability to meet secondary objectives (USBR 2014).

If any CPs of the SLWRI are implemented, additional areas within the Winnemem Waywaket basin may periodically be inundated. Figure 6 illustrates the estimated increase in area of inundation in the lower Winnemem Waywaket for the 18.5-foot dam raise CPs. Implementation of the preferred alternative, CP4A, would result in an inundation area that extends approximately 3,550 linear feet upstream from the existing full pool extent (USBR 2015).

Figure 6
Winnemem Waywaket Extent of Maximum Inundation for 18.5-ft Raise



Source: Adapted from USBR 2015

In March 2018, Congress approved \$20 million in grant funding to support preconstruction and design work for the SLWRI. Specific activities completed between 2018 and 2020 through support from this funding included: data collection (environmental, cultural, design), consultation and coordination (with tribal interests, landowners, government and non-government agencies), real estate planning, and arranging for a non-federal cost share partner. During the 2014 Final Feasibility Report and EIS activities, the total project cost was estimated at \$1.4 billion (2014 dollars) (USBR 2022).

During preconstruction and design work, USBR identified the need to supplement the SLWRI Final EIS. The Supplemental EIS includes updated information on the potential impacts to waters of the U.S., a revision of the wild and scenic river considerations for the Winnemem Waywaket that refocuses on federal requirements, and updated modeling to reflect the operational changes to Shasta Dam in the 2019 Biological Opinions issued by the USFWS and the NMFS (USBR 2020). The Final Supplemental EIS was released in November 2020. Currently, Congress has not appropriated funds or authorized construction of Shasta Dam raise (USBR 2022).

3.1.3 Keswick Dam

Keswick Dam, located at RM 302 on the Nomtipom Waywaket approximately nine miles downstream of Shasta Dam (Figure 7), is a 157-foot-high concrete gravity dam with a crest length of 1,046 feet. The facility has a drainage area of 6,380 square miles and is owned and operated by USBR (USBR 2024a). Keswick Dam was constructed from 1941 to 1950 as an afterbay dam to control river fluctuations due to releases from the Shasta Dam and Powerplant and the Trinity River Diversion of the CVP (USBR 2004). Keswick Dam is operated to regulate flows of the Nomtipom Waywaket downstream of the facility (USBR 2024a). The dam and powerplant can be accessed via Quartz Hill road and Keswick Dam Road.

Figure 7
Aerial View of Keswick Dam



Source: USBR 2019

3.1.3.1 Facility Anatomy

Keswick Dam has a 200-foot-wide spillway containing four 50-foot by 50-foot slide gates (USACE 2024c). The powerplant located on the west side of the dam has three generators with a rated capacity of 105 MW (USBR 2024a). A fish trap is located at the base of Keswick Dam to capture upstream-migrating Chinook Salmon and steelhead. Table 7 summarizes pertinent data for Keswick Dam.

Table 7
Keswick Dam Summary

Parameter	Keswick Dam	Data Source
General		
Owner	USBR	(USBR 2024a)
Latitude, Longitude	40.6150, -122.4528	(USACE 2024c)
Original Construction	1941-1950	(USBR 2024a)
River	Nomtipom Waywaket	(USBR 2024a)
National Identification Number	CA10160	(USBR 2024a)

Parameter	Keswick Dam	Data Source
Dimensions		
Base Width (ft)	110.6	(USBR 2024a)
Hydraulic Height (Normal Operating Depth at Dam) (ft)	118.0	(USBR 2024a)
Crest Elevation (ft)	595.5	(USBR 2024a)
Structural Height (ft)	157.0	(USBR 2024a)
Crest Length (ft)	1,046	(USBR 2024a)
Crest Width (ft)	20	(USBR 2024a)
Hydraulics and Hydrology		
Total Water Storage at Elevation 587 (ac-ft)	23,800	(USBR 2024a)
Spillway Capacity at Elevation 587 (cfs)	250,000	(USBR 2024a)
Drainage Area (square miles)	6,380	(USBR 2024a)
Maximum Water Surface Elevation (ft)	601.6	(USBR 2024a)
Normal Pool Elevation (ft)	Data not available	--
Low Operating Pool Elevation (ft)	Data not available	--
Net Generation (kWh)	383,010,000	(USBR 2024a)

Note:
Elevations listed in Table 7 are in the National Geodetic Vertical Datum of 1929.

3.1.3.2 Facility Operations

Keswick Dam operations related to the CVP are discussed in Section 4. Information provided in this section describes operations specific to Keswick Dam.

Flood Control

Flood control releases at Keswick Dam are dependent on forecasted or measured storm flows and available reservoir storage prior to and during flood flows. Powerplant capacities are used to the extent practicable during flood control operations (USACE 1962). During flood events, Keswick Dam is operated in coordination with Shasta Dam so that flows do not exceed 79,000 cfs at the tailwater of Keswick Dam, and/or stage of the Nontipom Waywaket does not exceed 39.2 feet (approximated as a flow of 100,000 cfs) at the Bend Bridge gauging station approximately 40 RMs downstream. Releases from Keswick Dam are modulated to meet these requirements, decreasing release rates as flow and/or stage approaches the allowable maximum, and increasing release rates as tailwater flows/stage recede to allow for evacuation of flood control space at Shasta Reservoir. Since the City of Redding begins to flood at flows greater than 36,000 cfs, flood control releases from Keswick Dam are maintained below this rate for as long as the release schedule permits. Releases are not

permitted to increase or decrease by more than 15,000 cfs and 4,000 cfs, respectively, within a 2-hour period, except where necessary to meet the aforementioned downstream criteria. Flood control operations at Keswick Dam must also consider inflows from Spring Creek Powerplant, Spring Creek Debris Dam, and additional runoff and streamflow into Keswick Reservoir (USBR 1962).

Water Supply

All releases from Keswick Reservoir are made to the Nomtipom Waywaket at Keswick Dam (USBR 2004).

Stage-Duration

A CDEC Station at Keswick Dam (Station KES) monitors reservoir elevation, inflow, and outflow, as well as storage, discharge, and power generation discharge and was used to develop the Stage-Duration data within Keswick Reservoir (Table 8).

**Table 8
Keswick Reservoir Stage-Duration Summary**

Percent of Time Exceeded (%)	Mean Daily Reservoir Stage Elevation (ft)
Max	586.9
0.1	586.5
1	586.1
5.0	585.6
10.0	585.2
50.0	583.6
90.0	581.0
95.0	580.1
99.0	578.5
99.9	576.2
Min	552.44

Notes:

Datum: NAVD88

CDEC Mean Daily Water Level at Keswick Dam (Station KES)

Data Range: 2/10/1985 – 11/18/2024

Source: DWR 2024b

Water surface elevations in the Nomtipom Waywaket below Keswick Dam were also evaluated given their importance for fish passage efforts past the dam. The closest gauge to the Keswick Dam tailrace is USGS Gage ID 11370500 SACRAMENTO R A KESWICK CA, located approximately 5,000 feet downstream of the dam. While data within the tailrace is most ideal for this analysis, these values

provide an order of magnitude estimate for conservative design. Table 9 summarizes the stage-duration data at USGS ID 11370500.

**Table 9
Nomtipom Waywaket Stage-Duration Summary downstream of Keswick Dam**

Percent of Time Exceeded (%)	Mean Daily Reservoir Stage Elevation (ft)
Max	512.6
0.1	512.5
1	507.6
5.0	499.4
10.0	498.0
50.0	492.6
90.0	490.7
95.0	490.6
99.0	490.5
99.9	490.4
Min	490.43

Notes:

USGS Mean Daily Water Level in Sacramento River at Keswick (Gage ID 11370500)

Data Range: 5/19/2022 – 5/6/2025

Source: USGS 2025b

Hydropower

The Keswick Powerplant has three generating units, with a maximum operating capability of 105,000 kW and a maximum installed generation capacity of 117,000 kW. Maximum releases through the powerplant are approximately 16,000 cfs (USBR 2004). Because Keswick operates as an afterbay dam, regulating releases from both Shasta and Trinity River diversions, its hydropower operation is mainly dependent on discharges from those facilities.

Fish Conservation

The fish trap at Keswick Dam operates in conjunction with both Livingston Stone NFH and Coleman NFH on Battle Creek (USBR 2004; Coleman National Fish Hatchery 2024). Fish enter a trap at the base of Keswick Dam and are raised to the top of the dam via a fish elevator. A truck at the top of the dam collects fish weekly from the elevator and transports them to Livingston Stone NFH where they are sorted for spawning (at Coleman NFH) or released back into the Nomtipom Waywaket (Coleman National Fish Hatchery 2018, 2024).

Seasonal minimum releases from Keswick Dam as required by the 1960 Memorandum of Agreement (MOA) between USBR and the California Department of Fish and Game (CDFG), as well as the State Water Board Order 90-5 (WR 90-05), and the NOAA 1993 winter-run Chinook Salmon Biological Opinion are provided in Table 10. The MOA was executed in an effort to protect natural resources of the Nomtipom Waywaket from the adverse effects of operations of the Shasta Division of the CVP (USBR 1992). Values associated with the WR 90-5 represent 1981 release agreements between USBR and CDFG. Additional flow requirements were introduced as part of the 1993 NMFS Biological Opinion (USBR 2004).

Table 10
Seasonal Minimum Releases from Keswick Dam

Time Period	Minimum Release (cfs)			
	MOA Normal Year	WR 90-5 Normal Year	MOA Critically Dry	1993 NMFS winter-run Biological Opinion All Years
January 1 – February 28 (29)	2,600	3,250	2,000	3,250
March 1 – March 31	2,300	2,300	2,300	3,250
April 1 – April 30	2,300	2,300	2,300	-- ¹
May 1 – August 31	2,300	2,300	2,300	-- ¹
September 1 – September 30	3,900	3,250	2,800	-- ¹
October 1 – November 30	3,900	3,250	2,800	3,250
December 1 – December 31	2,600	3,250	2,000	3,250

Notes:

1. No regulation

Source: Adapted from USBR 2004

Navigation

The Rivers and Harbors Act of 1937 requires USBR to operate Keswick Dam in a way that improves navigation of the Nomtipom Waywaket; USBR does not allocate storage at Keswick Reservoir to navigation uses (USBR 1992).

Recreation

There are no legal obligations for accommodating recreation within Keswick Reservoir, but USBR considers recreation when making operational decisions (USBR 1992).

Other

Similar to Shasta Dam, Keswick Dam can be operated to assist with levee seepage control provided that operations do not interfere with authorized CVP functions (USBR 1992).

Keswick Dam operations also consider impacts of Spring Creek Reservoir discharge on water quality. Spring Creek Reservoir receives acid mine drainage from Iron Mountain Mine and is operated to meet water quality criteria for copper and zinc, as outlined in a Memorandum of Understanding between USBR, CDFW, and the State Water Board. Releases from Keswick Dam are sometimes used to dilute metal concentrations in spill from Spring Creek Debris Dam; however, authorized CVP operations take priority to stipulations in the Memorandum of Understanding (USBR 2004).

3.1.4 Anderson-Cottonwood Irrigation District Diversion Dam

The ACID Diversion Dam is located at RM 298.6 of the Nomtipom Waywaket, just upstream of the Highway 273 bridge crossing and downstream of the Union Pacific Redding Trestle (railroad truss bridge) (Figure 8). The facility is owned and operated by the ACID, a Sacramento River Settlement Contractor which holds a water right to divert water from the Nomtipom Waywaket (USBR 2011). The ACID Diversion Dam can be accessed via Caldwell Park to the north, or a private road off of Benton Drive to the south.

Figure 8
ACID Diversion Dam and Fish Ladder



3.1.4.1 Facility Anatomy

The ACID Diversion Dam includes a 450-foot-long flashboard dam installed during the irrigation season, a screened diversion that typically diverts up to 300 cfs (maximum capacity 450 cfs), and two fish ladders (a pool-and-chute fish ladder on the south side adjacent to the diversion and a vertical slot fishway on the north side) to provide upstream passage through the facility (CDFW 2024). The dam “consists of boards supported by a pinned steel superstructure anchored to a concrete foundation” (USBR 2004). The specific number of boards pinned to the structure varies based upon river flow and diversion needs. Table 11 summarizes pertinent data for the ACID Diversion Dam.

**Table 11
Pertinent Data for ACID Diversion Dam**

Parameter	ACID Diversion Dam	Data Source
General		
Owner	ACID	(USACE 2024d)
Latitude, Longitude	40.5922, -122.3944	(USACE 2024d)
Original Construction	1917	(USACE 2024d)
River	Nomtipom Waywaket	(USACE 2024d)
National Identification Number	CA00226	(USACE 2024d)
Dimensions		
Hydraulic Height (ft)	15	(USACE 2024d)
Structural Height (ft)	24	(USACE 2024d)
Crest Width (ft)	455	(USACE 2024d)
Hydraulics and Hydrology		
Reservoir Capacity (ac-ft)	1,240	(USACE 2024d)
Drainage Area (square miles)	6,860	(USACE 2024d)

3.1.4.2 Facility Operations

The ACID Diversion Dam is erected yearly to provide water to ACID customers during the irrigation season (April through October) with specific dates of operation varying depending on hydrology and river conditions (USBR 2004). To build the dam, the steel superstructure is raised, the walkway is installed, and flashboards are placed manually on the downstream side of the structure, which takes roughly two weeks. Once the dam is erected, water is diverted from the dam via gravity to ACID’s distribution system and customers (USBR 2011). At the end of the irrigation season, flashboards are removed, the walkway is disassembled, and the steel superstructure is lowered (USBR 2004).

Flood Control

There are no provisions for flood control at the ACID Diversion Dam.

Water Supply

The ACID Diversion Dam's sole purpose is to divert water from the Nomtipom Waywaket for irrigation use. The system has a diversion capacity of up to 450 cfs (CDFW 2024). Additional information regarding the dam's diversion efforts is provided in Section 3.2.2.

Stage-Duration

Stage-duration data is not available at the ACID Diversion Dam.

Hydropower

Hydropower generation is not associated with the ACID Diversion Dam.

Fish Conservation

According to an investigation conducted in May of 2024, the ACID Diversion Dam's fish ladders do not provide safe and timely passage for upstream migrating fish (Shasta County Grand Jury 2024). It is possible that this diversion dam remains a fish passage impediment despite the pool-and-chute fish ladder located on the south side of the diversion dam and the vertical slot fishway located on the north side of the diversion dam. Additional information regarding fish passability was not available at the time of this document development.

Navigation

Navigational requirement data was not available at the time of this analysis.

Recreation

Recreational requirement data was not available at the time of this analysis.

3.2 Diversion Structures

A number of diversion structures are located within the Study Area that may act as potential barriers to fish passage. Subsequent sections provide details on identified diversion structures (excluding major dams identified in Section 3.1) including locations, prior assessments, status, and key features.

3.2.1 *Winnemem Waywaket*

No diversion structures were identified within the Study Area portion of Winnemem Waywaket at the time of this analysis.

3.2.2 *Nomtipom Waywaket*

A number of diversion structures were identified within the Study Area portion of the Nomtipom Waywaket using the CalFish managed California Fish Passage Assessment Database (PAD) layer of

the CDFW Biogeographic Information and Observation System (BIOS) online tool. CalFish is a cooperative program that compiles and provides access to California fisheries data. The program's agency partners include CDFW, DWR, and NOAA, among others (CalFish 2018). The PAD compiles numerous data sources to provide an inventory of barrier assessments of known and potential barriers to anadromous fish in California (CDFW 2024). Information derived from the PAD can be used for identification of barriers suitable for removal or modification. BIOS is a system designed to enable the management, visualization, and analysis of biogeographic data collected by CDFW and its partner organizations (CDFW 2024). BIOS integrates geographic information system, relational database management, and Environmental Systems Research Institute's ArcGIS Server technology to create a statewide, integrated online information management tool (CDFW 2024).

Diversion structures identified on the Nomtipom Waywaket within the Study Area utilizing the PAD (CDFW 2024) are summarized in Table 12 and shown in Figure 9. Information provided by this layer on the BIOS tool includes location, site name, and most recent assessment or survey of the site and by whom the assessment or survey was performed. A description of the site from the most recent assessment or survey, whether the diversion is screened or unscreened, if the diversion is located on the left or right riverbank, the associated pump size, and other site notes are available for some sites. Ninety-nine diversion structures (mainly pump diversions) were identified, 13 of which are screened. A large majority of diversion structures were most recently surveyed in 2014 by CDFW. A significant gap in time exists between when some sites were assessed or surveyed and present day, making the BIOS tool useful for potential diversion identification with the caveat that changes in site status are possible.

Three unscreened pump diversions are associated with the ACID (ACID Bonnyview Pumps – Vertical Pump); all three were most recently surveyed in 2014. These three pump diversions are separate diversions for the ACID and are not associated with ACID Diversion Dam. ACID Diversion Dam is located at RM 298.6 of the Nomtipom Waywaket and is installed and operated during the irrigation season (typically between April through October) by the ACID. Water is conveyed to ACID customers through the ACID distribution system (a system of canals) after being diverted from the dam via gravity (see Section 3.1.4 for more information).

Four screened pump diversions are associated with the Bella Vista Water District (Bella Vista Water District – Wintu Plant Vertical Pump); three were most recently assessed in 2006 and one was most recently assessed in 1996.

Table 12
Nomtipom Waywaket Diversions Identified within Study Area

Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description	Assessor / Date Surveyed ¹
Sierra Pacific – Centrifugal Pump	Pump diversion	Unscreened	Right bank	40.4745965, -122.319836	One centrifugal pump with 75 hp. Intake size is 9 inches in diameter, water is discharged to sprinklers and operates for fire protection and dust control purposes for a lumber mill.	CDFW / 9/4/2014
H. Daniell – Vertical Pump	Pump diversion	Unscreened	Left bank	40.53431799, -122.3535279	One vertical pump with 75 hp. Intake size is 9 inches in diameter. Water is discharged to sprinklers and operates for agricultural purposes. Diverts up to 0.15 cfs.	CDFW / 9/26/1996
Unknown	Pump diversion	Unknown	Left bank	40.53709574, -122.3548647	One rusted and broken 6-8-inch-diameter pipe with a straight pump 6-8 inches in diameter at intake that is no longer in use.	CDFW / 9/4/2014
ACID Bonnyview Pumps – Vertical Pump	Pump diversion	Unscreened	Left bank	40.53792907, -122.3556763	Vertical pumps measuring 12 inches in diameter at intake. The pipes have a profile bar, slotted rotary drum, or cylindrical screen. These diversion pumps are associated with the ACID, but not the ACID Diversion Dam (gravity).	CDFW / 9/4/2014
	Pump diversion	Unscreened	Left bank	40.53765129, -122.355683	Vertical pumps measuring 12 inches in diameter at intake. The pipes have a profile bar, slotted rotary drum, or cylindrical screen. These diversion pumps are associated with the ACID, but not the ACID Diversion Dam (gravity).	CDFW / 9/4/2014
	Pump diversion	Unscreened	Left bank	40.53765129, -122.3556197	Vertical pumps measuring 12 inches in diameter at intake. The pipes have a profile bar, slotted rotary drum, or cylindrical screen. These diversion pumps are associated with the ACID, but not the ACID Diversion Dam (gravity).	CDFW / 9/4/2014
ACID Diversion Dam	Flashboard dam with pool and weir fish ladder (gravity fed)	Screened	Seasonally spanning river	40.59209505, -122.3943766	450-ft-long flashboard dam installed during irrigation season (typically between April and October). Screened diversion and pool and weir fish ladder. Diverts up to 450 cfs.	CDFW / 2000
Bella Vista Water District – Wintu Plant Vertical Pump	Pump diversion	Screened	Left bank	40.59265078, -122.3699473	One vertical pump with vertical traveling screen behind baffles.	USFWS / 9/26/1996
	Pump diversion	Screened	Left bank	40.59265078, -122.369989	One vertical pump with vertical traveling screen behind baffles.	USFWS / 2006
	Pump diversion	Screened	Left bank	40.59265078, -122.3699373	One vertical pump with vertical traveling screen behind baffles.	USFWS / 2006
	Pump diversion	Screened	Left bank	40.59265078, -122.3698857	One vertical pump with vertical traveling screen behind baffles.	USFWS / 2006
City of Redding Station 1	Unknown	Screened	Unknown	40.59290893, -122.4073573	A positive barrier fish screen structure was installed on the intake structure.	USFWS / 2006
City of Redding Station 1 – Vertical Pump	Pump diversion	Screened	Right bank	40.59237273, -122.4073438	A positive barrier fish screen structure on the intake structure with 1 by 1.5-inch-square openings in the metal grating. One vertical pump with 700 hp that operates for municipal purposes.	CDFW / 2006
City of Redding Station 1 – Vertical Pump	Pump diversion	Screened	Right bank	40.59237273, -122.4073172	A positive barrier fish screen structure on the intake structure with 1 by 1.5-inch-square openings in the metal grating. One vertical pump with 700 hp that operates for municipal purposes.	CDFW / 2006
Centrifugal Pump	Pump diversion	Unscreened	Left Bank	40.59376163, -122.4051687	10-inch-diameter pipe and centrifugal pump operated for domestic purposes.	CDFW / 9/4/2014
Centrifugal Pump	Pump diversion	Unscreened	Left Bank	40.59376163, -122.4051887	One centrifugal pump with 10 hp. Intake size is 3 inches in diameter, water is discharged to sprinklers and operates for domestic purposes.	CDFW / 9/4/2014

Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description	Assessor / Date Surveyed ¹
City of Redding – Vertical Pump	Pump diversion	Unscreened	Right Bank	40.59237278, -122.4011552	One vertical pump with 15 hp. Intake size is 10 inches in diameter, water is discharged underground and operates for agricultural purposes.	CDFW / 8/2/2000
William L. & Gloria S. Pedretti – Unknown	Unknown	Unscreened	Right Bank	40.46189, -122.24015	Intake size is 1 inch in diameter. Operation is for domestic purposes.	CDFW / 9/4/2014
Sacramento River Diversion #1	Pipe diversion	Unknown	Right Bank	40.53041317, -122.3600298	One 5-inch-diameter pipe.	CDFW / 9/4/2014
Sacramento River Diversion #2	Pump diversion	Unscreened	Right Bank	40.52948294, -122.3605264	Two 4-inch-diameter pipes and pumps with 2 hp.	CDFW / 9/4/2014
Sacramento River Diversion #3	Pump diversion	Unscreened	Right Bank	40.52773188, -122.3609642	Two PVC pipes and pumps with intake sizes of 2 inches and 3 inches in diameter, respectively.	CDFW / 9/4/2014
Sacramento River Diversion #4	Pump diversion	Unknown	Right Bank	40.52724497, -122.361093	One 4-inch diameter PVC pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #5	Pump diversion	Screened	Right Bank	40.52717448, -122.3610859	One 3-inch-diameter PVC pipe and a pump with a perforated plate and screen.	CDFW / 9/4/2014
Sacramento River Diversion #6	Pump diversion	Unknown	Right Bank	40.52619481, -122.3613647	One 2-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #7	Pump diversion	Unknown	Right Bank	40.52603588, -122.3614266	One 2.5-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #8	Pump diversion	Unknown	Right Bank	40.52583019, -122.3613833	One 3-inch-diameter pipe and pump.	CDFW / 9/4/2014
Sacramento River Diversion #9	Pump diversion	Screened	Right Bank	40.52553532, -122.3613729	One 2-inch-diameter pipe and pump with a perforated plate and screen.	CDFW / 9/4/2014
Sacramento River Diversion #10	Pump diversion	Unknown	Right Bank	40.5253054, -122.3614187	Two 3-inch-diameter fire hoses and pumps.	CDFW / 9/4/2014
Sacramento River Diversion #11	Pump diversion	Unknown	Right Bank	40.52470886, -122.3614166	One 2-inch-diameter PVC pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #12	Pump diversion	Unscreened	Right Bank	40.52286409, -122.3609099	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #13	Pump diversion	Unscreened	Right Bank	40.52267374, -122.3608513	One 2-inch-diameter pipe with a pump. The screen on the diversion has unsuitably sized holes.	CDFW / 9/4/2014
Sacramento River Diversion #14	Pump diversion	Unknown	Unknown	40.52183915, -122.3603279	Two 2-inch-diameter steel pipes with wire and pumps.	CDFW / 9/4/2014
Sacramento River Diversion #15	Pump diversion	Unscreened	Unknown	40.52107992, -122.3601585	One 11-inch-diameter pipe and one 3-inch-diameter pipe, both with pumps.	CDFW / 9/4/2014
Sacramento River Diversion #16	Pump diversion	Unscreened	Unknown	40.5193716, -122.3589322	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #17	Pump diversion	Unscreened	Unknown	40.51855168, -122.3585714	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #18	Pump diversion	Unknown	Unknown	40.51784316, -122.3583341	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014

Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description	Assessor / Date Surveyed ¹
Sacramento River Diversion #19	Pump diversion	Unscreened	Right Bank	40.5174353, -122.3583054	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #20	Pump diversion	Unknown	Right Bank	40.51644715, -122.3587697	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #21	Pump diversion	Unknown	Right Bank	40.51625588, -122.3588445	One 2-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #22	Pump diversion	Unscreened	Unknown	40.51578381, -122.3588692	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #23	Pump diversion	Unknown	Unknown	40.51549681, -122.3590507	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #24	Pump diversion	Unknown	Unknown	40.51426291, -122.3628084	One 11-inch and one 2-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #25	Pump diversion	Unscreened	Unknown	40.51393552, -122.3633259	One 2-inch-diameter pipe and a pump with a large perforated tank.	CDFW / 9/4/2014
Sacramento River Diversion #26	Pump diversion	Unscreened	Unknown	40.51307738, -122.3642864	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #27	Pump diversion	Unscreened	Unknown	40.49515955, -122.3513351	One 1.5-inch-diameter pipe and one 3-inch diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #28	Pump diversion	Unscreened	Unknown	40.4950593, -122.3498757	One 2-inch pipe diameter with a pump. The diversion has a screen made of mesh wire bag.	CDFW / 9/4/2014
Sacramento River Diversion #29	Pump diversion	Unscreened	Unknown	40.49495168, -122.3470016	One 5-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #30	Pump diversion	Unscreened	Unknown	40.49491203, -122.3465688	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #31	Pump diversion	Unscreened	Unknown	40.49499091, -122.3460761	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #32	Pump diversion	Unscreened	Unknown	40.49500608, -122.3458699	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #33	Pump diversion	Unscreened	Unknown	40.49501966, -122.345383	One 3-inch-diameter pipe with a pump.	CDFW / 9/4/2014
Sacramento River Diversion #34	Pump diversion	Unscreened	Unknown	40.49501731, -122.3451581	One 3-inch-diameter pipe with a pump. The pump is in a loading dock area.	CDFW / 9/4/2014
Centrifugal Pump	Pump diversion	Unscreened	Unknown	40.46984, -122.2886	One 3-inch-diameter pipe with a centrifugal pump. At the pipe inlet there is a small plastic mesh.	CDFW / 9/4/2014
Sacramento River Diversion #36	Unknown	Unscreened	Unknown	40.47253713, -122.3064534	No description available.	CDFW / 9/4/2014
Sacramento River Diversion #37	Pump diversion	Unscreened	Unknown	40.47262439, -122.3048085	One 3-inch-diameter pipe and a pump.	CDFW / 9/4/2014
Sacramento River Diversion #38	Pump diversion	Unscreened	Unknown	40.47275565, -122.3040505	One 3-inch-diameter pipe with a permanent pump.	CDFW / 9/4/2014

Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description	Assessor / Date Surveyed ¹
Sacramento River Diversion #39	Unknown	Unscreened	Unknown	40.4728678, -122.3024475	No description available.	CDFW / 9/4/2014
Sacramento River Diversion #40	Pump diversion	Unscreened	Right bank	40.594181, -122.433626	One 6-inch-diameter plastic corrugated pipe and a pump coiled on hillside.	USFWS / 9/4/2014
Sacramento River Diversion #42	Unknown	Unscreened	Right bank	40.574849, -122.371159	No description available.	USFWS / 9/4/2014
Sacramento River Diversion #43	Culvert	Unscreened	Right bank	40.575497, -122.371059	8-inch concrete culvert. The structure is located on the side of a lagoon.	USFWS / 9/4/2014
Diversion behind Beadman Store	Pipe diversion	Unscreened	Right bank	40.574965, -122.371624	5-inch long PVC pipes span across lagoon into bushes.	USFWS / 9/4/2014
Sacramento River Diversion #45	Culvert	Unscreened	Unknown	40.56754, -122.377276	12-inch culvert full of rocks downstream of Cypress Bridge.	USFWS / 9/4/2014
Sacramento River Diversion #46	Unknown	Unscreened	Right bank	40.560693, -122.375556	No description available.	USFWS / 9/4/2014
Sacramento River Diversion #47	Unknown	Unscreened	Right bank	40.544263, -122.372544	No description available.	USFWS / 9/4/2014
Sacramento River Diversion #48	Unknown	Unscreened	Left bank	40.542097, -122.36046	No description available.	USFWS / 9/4/2014
Slant Pump	Pump diversion	Unscreened	Right bank	40.46893, -122.2857	Slant pump measuring 2 inches in diameter at intake.	CDFW / 9/4/2014
Concrete Pipe/Possible Diversion	Pipe diversion	Unscreened	Left bank	40.536796, -122.354769	Unscreened concrete slant pipe, likely a drain measuring 6 inches in diameter at intake. During the survey, a large permanent diversion and three pipes in the vicinity were observed but not surveyed.	CDFW / 9/4/2014
Sacramento River Diversion #53	Pump diversion	Unscreened	Unknown	40.516272, -122.357283	Long rusty slant pump and pipe measuring 4 inches in diameter at intake. Likely no longer in use.	CDFW / 9/4/2014
Sacramento River Diversion #54	Pump diversion	Unknown	Left bank	40.489785, -122.330048	Two vertical pumps measuring 2 inches in diameter at intake.	CDFW / 9/4/2014
Sacramento River Diversion #55	Pump diversion	Unknown	Left bank	40.490953, -122.330057	One pump measuring 2 inches in diameter at intake with large mesh size mesh bag on end of intake.	CDFW / 9/4/2014
Pipe/Possible Diversion	Pipe diversion	Unscreened	Left bank	40.489593, -122.330026	Pipe measuring 6 inches in diameter at intake. It is likely a concrete drain.	CDFW / 9/4/2014
Sacramento River Diversion #57	Pump diversion	Unknown	Left bank	40.485175, -122.328591	Siphon/slant pump 8 inches in diameter with a permanent power source.	CDFW / 9/4/2014
Unknown Box Structure with Screen/Possible Diversion	Unknown	Screened	Left bank	40.473861, -122.317226	Structure is located across from Sierra Pacific Crane.	CDFW / 9/4/2014
Sacramento River Diversion #59	Pipe diversion	Unknown	Left bank	40.473376, -122.316207	PVC pipe measuring 1-2 inches in diameter at intake.	CDFW / 9/4/2014
Sacramento River Diversion #60	Pump diversion	Unknown	Left bank	40.473687, -122.305742	One slant pump measuring 6 inches in diameter at intake.	CDFW / 9/4/2014
Sacramento River Diversion #61	Pump diversion	Unknown	Left bank	40.473821, -122.304893	One 3 inch pump at intake. Inlet is buried in the sand.	CDFW / 9/4/2014

Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description	Assessor / Date Surveyed ¹
Possible Diversion	Unknown	Unknown	Left bank	40.56345723, -122.374446	Possible diversion, but unable to locate inlet pipe in river.	CDFW / 10/8/2014
Sacramento River Diversion #67	Pump diversion	Unscreened	Left bank	40.56268158, -122.3746558	One 2-inch pump with hose on end of intake.	CDFW / 10/8/2014
Sacramento River Diversion #68	Pump diversion	Unknown	Left bank	40.56194384, -122.3743152	One 3-inch pump.	CDFW / 10/8/2014
Sacramento River Diversion #69	Pump diversion	Unscreened	Left bank	40.56189057, -122.3743449	One 5-inch pump that is possibly no longer in use.	CDFW / 10/8/2014
Sacramento River Diversion #70	Pump diversion	Screened	Left bank	40.56184315, -122.374337	One 3-inch pump with a slotted, wire round screen.	CDFW / 10/8/2014
Sacramento River Diversion #71	Pump diversion	Screened	Left bank	40.56139968, -122.3743094	One 2-inch portable pump with a slotted, round screen. The diversion has a water tank.	CDFW / 10/8/2014
Sacramento River Diversion #72	Pump diversion	Unknown	Left bank	40.56109597, -122.3741314	One 1.5-inch-diameter pipe with a pump.	CDFW / 10/8/2014
Sacramento River Diversion #73	Pipe diversion	Unknown	Left bank	40.5610842, -122.3741534	One 2-inch-diameter pipe.	CDFW / 10/8/2014
Sacramento River Diversion #74	Pipe diversion	Unknown	Left bank	40.56079609, -122.3741084	One 2-inch diameter pipe with rusty pipe screen.	CDFW / 10/8/2014
Sacramento River Diversion #75	Pipe diversion	Screened	Left bank	40.55999577, -122.3739672	One 2-inch-diameter pipe with large metal cylindrical screen.	CDFW / 10/8/2014
Sacramento River Diversion #76	Pipe diversion	Unscreened	Left bank	40.55993165, -122.3739862	One 2-inch-diameter pipe with a cylindrical screen.	CDFW / 10/8/2014
Sacramento River Diversion #77	Pump diversion	Unscreened	Left bank	40.55960545, -122.3739653	One 3-inch-diameter pipe with a pump and a permanent power source.	CDFW / 10/8/2014
Sacramento River Diversion #78	Pipe diversion	Unscreened	Left bank	40.55917772, -122.3738737	One 3-inch-diameter pipe and one 5-inch pipe.	CDFW / 10/8/2014
Sacramento River Diversion #79	Pump diversion	Unknown	Left bank	40.55895655, -122.373737	One 3-inch-diameter pipe with a pump. Diversion is located off main river channel in a small backwater channel.	CDFW / 10/8/2014
Sacramento River Diversion #80	Pipe diversion	Unscreened	Left bank	40.55835278, -122.3737224	One 3-inch-diameter pipe and one 1.5-inch pipe connecting to a 7-inch PVC pipe.	CDFW / 10/8/2014
Sacramento River Diversion #81	Pipe diversion	Unknown	Left bank	40.55805295, -122.3736549	One 4-inch-diameter steel / PVC pipe with rusty steel cylindrical screen.	CDFW / 10/8/2014
Sacramento River Diversion #82	Pipe diversion	Unknown	Left bank	40.55799351, -122.3736772	One 1-inch-diameter PVC pipe, one 1.5-inch diameter PVC pipe, and one 3-inch diameter PVC pipe.	CDFW / 10/8/2014
Sacramento River Diversion #83	Pipe diversion	Unknown	Left bank	40.55782896, -122.3735845	One 3-inch-diameter pipe within a 7-inch diameter steel pipe.	CDFW / 10/8/2014
Golf Course Site #1	Pipe diversion	Unknown	Left bank	40.54438622, -122.3641417	One 12-inch-diameter steel pipe cover over a 5-inch diameter steel pipe.	CDFW / 10/8/2014
Golf Course Site #2	Unknown	Unknown	Left bank	40.54436501, -122.3641544	No description available.	CDFW / 10/8/2014

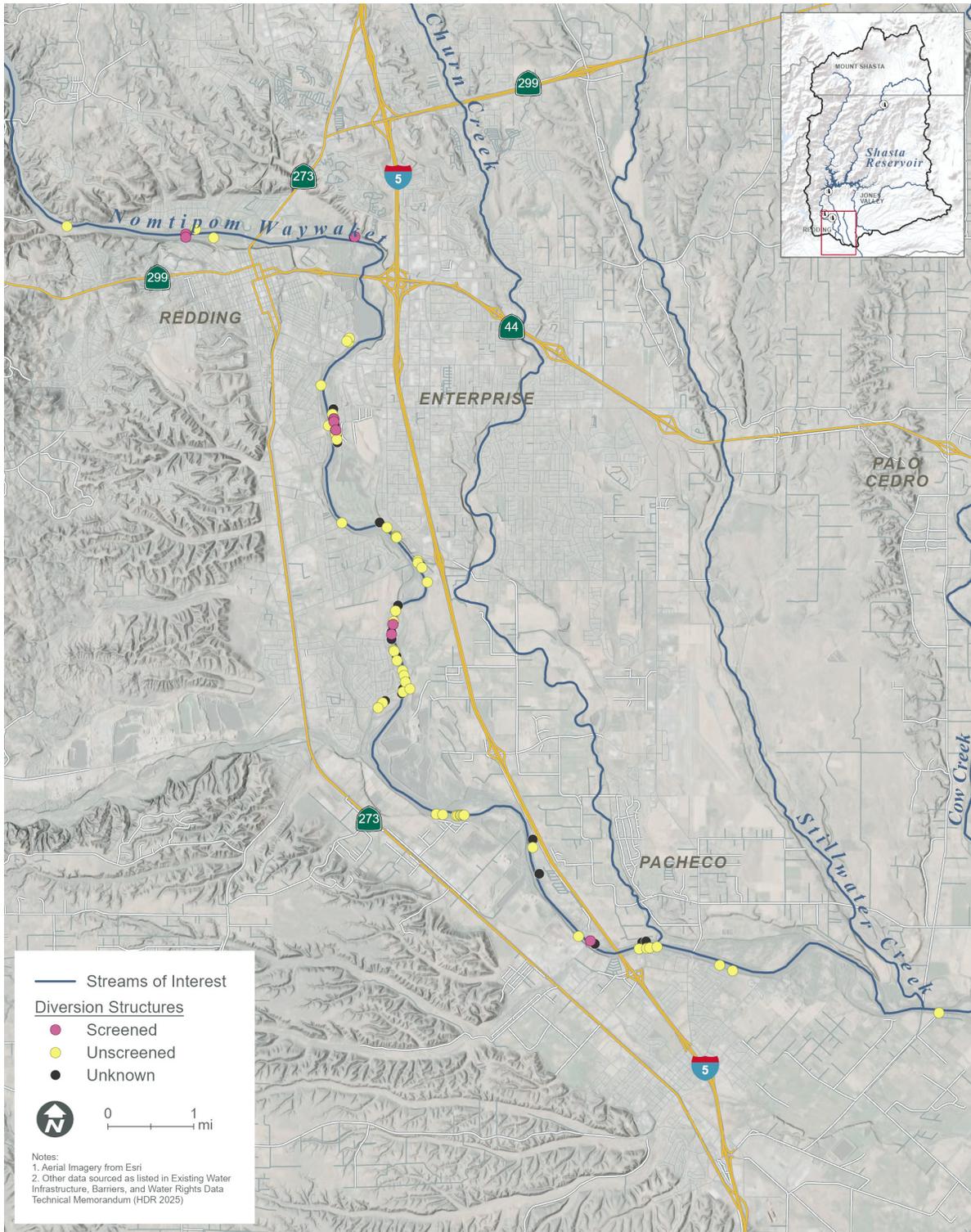
Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description	Assessor / Date Surveyed ¹
Sacramento River Diversion #86	Pump diversion	Unscreened	Left bank	40.54359257, -122.3625011	One 3-inch-diameter pump with a cylindrical screen equipped with 3-mm openings.	CDFW / 10/8/2014
Sacramento River Diversion #87	Pipe diversion	Unscreened	Left bank	40.54196046, -122.3605249	One 2-inch-diameter broken end pipe.	CDFW / 10/8/2014
Sacramento River Diversion #88	Pump diversion	Unscreened	Left bank	40.54187612, -122.3604181	One out-of-water 2-inch-diameter pipe with a pump. There is a broken end and no screen.	CDFW / 10/8/2014

Notes:

1. Status of diversion is as of date noted under "Assessor / Date Surveyed" column

Source: CDFW 2024

Figure 9
Nontipom Waywaket Diversion Structures Identified within Study Area



3.2.3 Cow Creek Watershed

Several diversion structures were identified within the Cow Creek watershed based on a 2015 report prepared by H.T. Harvey & Associates. The report was prepared for the USFWS to document the results of an assessment and prioritization of anadromous fish passage at barriers and diversions in the Cow Creek watershed. The report included an assessment of the Cow Creek and Little Cow Creek portions of the Study Area but did not include an assessment of Dry Creek.

In order to identify barriers and diversions present in the Cow Creek watershed, the H.T. Harvey & Associates (2015) assessment first utilized analysis of desktop aerial imagery and publicly available information, followed by field visual survey or survey following methodology described in the Washington Department of Fish and Wildlife Fish Passage and Surface Water Diversion Screen and Prioritization Manual. Permission to access Cow Creek below Dersch Road Bridge was not obtained by H.T. Harvey & Associates, so this portion of the creek was not included in field survey. Up to a half dozen barriers potentially exist in Little Cow Creek that were not surveyed due to a combination of owners affirming that reported barriers do not exist, or access not being provided by owners for reported barriers.

The summarized findings of the H.T. Harvey & Associates (2015) assessment concluded that no major natural or manmade barriers affecting fish passage were identified on Cow Creek. Barriers and diversions were categorized as “major” or “minor” according to their potential impact on fish and/or fish habitat (H.T. Harvey & Associates 2015). One major manmade barrier affecting fish passage, the Bella Vista Water District Pipe Crossing, was identified on Little Cow Creek within the Study Area but was since removed (2023) with the intent of restoring unimpeded fish passage for Chinook Salmon and steelhead (Western Shasta Resource Conversation District 2023). As summarized in Table 13, twelve minor barriers, consisting mainly of pump diversions and one pushup dam, were identified along Cow Creek. The Cow Creek watershed diversion structures identified within the Study Area are displayed in Figure 10. H.T. Harvey & Associates (2015) noted that minor barriers present in the Cow Creek “likely have relatively minor impacts on migrating salmonids.”

It is important to note that diversions identified by H.T. Harvey & Associates were cross-checked with the previously mentioned PAD layer of the CDFW BIOS tool utilized for diversion identification on the Nomtipom Waywaket. The PAD cited H.T. Harvey & Associates (2015) for all diversions identified on the Cow Creek watershed, confirming that the below table accounts for all previously identified diversions within this waterbody. No diversions were identified within the Study Area portion of Dry Creek at this time.

Table 13
Cow Creek Watershed Diversions Identified within Study Area

Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description ¹	Status ²
M. Hawes Pump	Pump diversion	Screened	Right bank	40.475931, -122.228283	Intake Size: 12 inches Material: Metal Screened: Yes Screen Material: Metal, diamond-shaped screen Screen Shape: Cylinder Mesh Size: 3/4 inch Screen Length: 4.1 ft Screen Diameter: 1.3 ft Pump Size: 30 hp Pump Type: Electric	Active
R. Hawes East Pump	Pump diversion	Unscreened (Partially Screened)	Left bank	40.478444, -122.228944	Intake Size: 4 inches Material: Flexible plastic Screen Material: Stainless steel perforated plate Screen Shape: Cylinder Mesh Size: 5/64 inch Screen Length: 36 inches Screen Diameter: 20 inches Pump Type: Gas	Active
Undocumented Pump Diversion 1	Pump diversion	Unscreened	Right bank	40.504861, -122.232889	Intake Size: 1.5 inches Material: Metal	Not active

Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description ¹	Status ²
Pearson Pump	Pushup dam and pump diversion	Unscreened (Partially Screened)	Left bank	40.50725, -122.228861	Intake Size: 8 inches Material: Metal Screen Material: Galvanized, corrugated metal Screen Shape: Vertical cylinder Mesh Size: 3/4 inch Screen Diameter: 36 inches Pump Type: Electric	Active
Undocumented Pump Diversion 2	Pump diversion	Screened	Right bank	40.521528, -122.229861	Intake Size: 2.5 inches Material: Rubber/plastic Screen Material: Stainless steel, perforated Screen Shape: Cone/cylinder Mesh Size: 1/8 inch Screen Length: 6 inches Screen Diameter: Tapered to 2 inches	Active
Stone-Fitzpatrick Pump	Pump diversion	Screened	Left bank	40.524425, -122.229836	Intake Size: 8 inches Material: PVC Screen Material: Metal Screen Shape: Cylinder Mesh Size: 5/32 inch Screen Length: 30 inches Screen Diameter: 16 inches Pump Size: 10 hp Pump Type: Electric	Active
Undocumented Pump Diversion 3	Pump diversion	Unknown	Right bank	40.524639, -122.230722	No description available.	Unknown

Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description ¹	Status ²
Undocumented Pump Diversion 4	Pump diversion	Screened	Left bank	40.525083, -122.230972	Intake Size: 2 inches Material: PVC Screen Material: PVC Screen Shape: Cylinder Mesh Size: 1/8 inch x 5 inches Screen Diameter: 8-10 inches	Active
Undocumented Pump Diversion 5	Pump diversion	Unknown	Left bank	40.536417, -122.231944	Intake Size: 3.5 inches Material: Metal	Not active
Fraser Pump	Pump diversion	Screened	Left bank	40.541083, -122.232611	Intake Size: 2 inches Material: PVC Screen Material: Wood frame with nylon screen Screen Shape: Box Mesh Size: 1/16 inch Screen Length: 13 inches Screen Diameter: 13 inches Pump Size: 3 hp Pump Type: Electric	Active
Undocumented Pump Diversion 6	Pump diversion	Screened	Right bank	40.543444, -122.235306	Intake Size: 2 inches Material: Plastic Screen Material: PVC Screen Shape: Cylinder Mesh Size: 1/16 inch x 4 inches Screen Length: 8 ft Screen Diameter: 6-8 inches	Active

Site	Diversion Type	Screening Status	River Bank Location	Latitude, Longitude	Description ¹	Status ²
Undocumented Pump Diversion 7	Pump diversion	Screened	Right bank	40.544917, -122.236278	Intake Size: 2.5 inches Material: Plastic Screen Material: Perforated stainless steel Screen Shape: Cone Mesh Size: 7/64 inch Screen Length: 5 inches Screen Diameter: 1.5-2 inches	Active

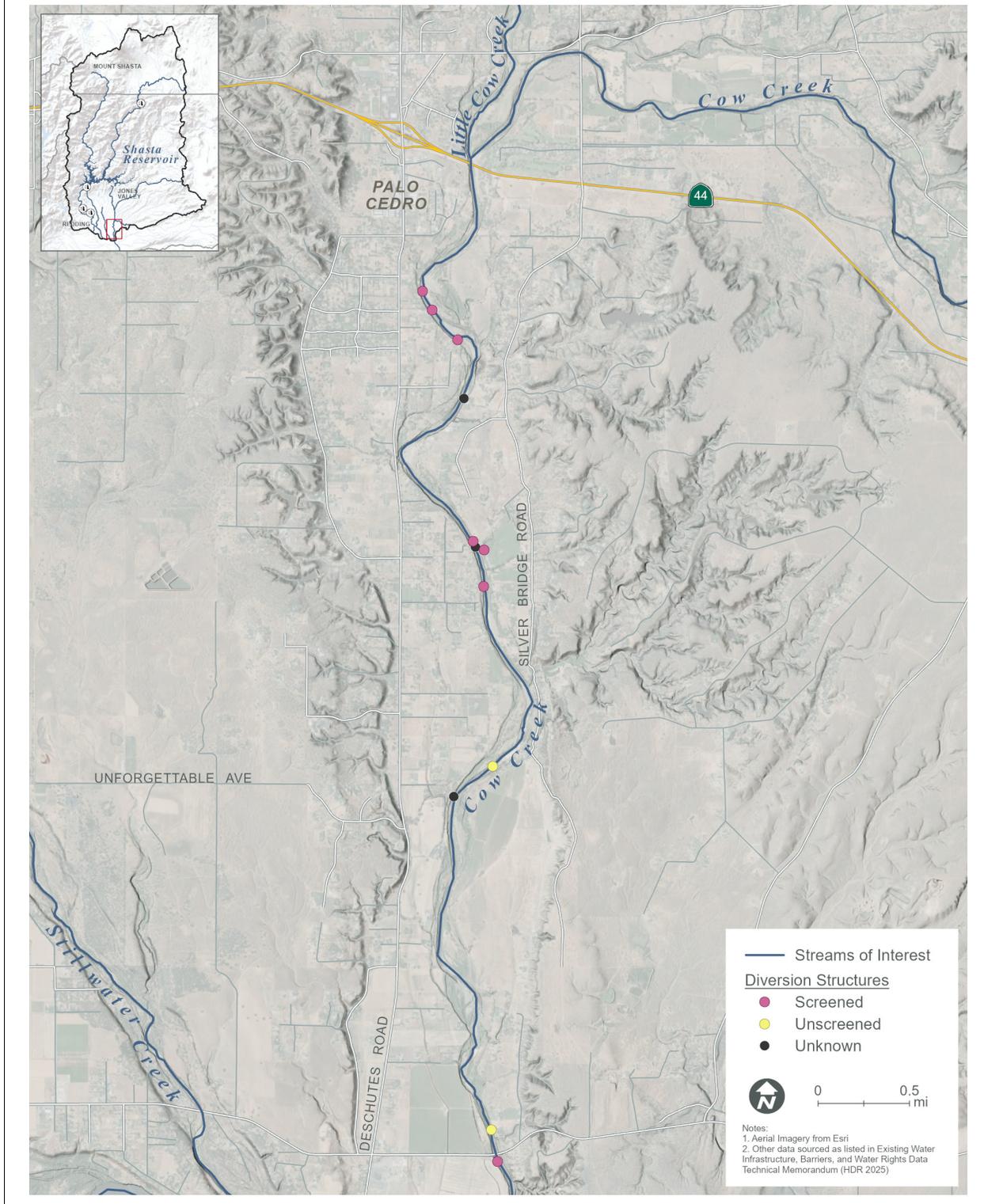
Notes:

1. Measurements are approximate

2. Status of diversions as of 2012

Source: H.T. Harvey & Associates 2015

Figure 10
Cow Creek Watershed Diversion Structures Identified within Study Area



The H.T. Harvey & Associates (2015) assessment implemented a priority ranking system for identified diversions affecting fish passage. Each identified diversion affecting fish passage was assigned a “low,” “moderate,” or “high” priority for improvement (H.T. Harvey & Associates 2015). Pump diversions surveyed within the Cow Creek watershed have a relatively low priority because they are seasonally operated during periods when juvenile salmonids are unlikely to occupy this reach. The criteria for the priority categories for Cow Creek diversions included the following:

- Low priority: diversions with small-diameter intakes (approximately 2-4 inches), which pose little risk to migrating fish;
- Moderate priority: diversions with larger-diameter intakes (approximately 4-6 inches), which pose a greater threat than the low-priority diversions; and
- High priority: diversions with large-diameter intakes (approximately 6-12 inches), which are associated with dead-end channels or unscreened pushup diversion dams.

During the survey field survey portion of the assessment, H.T. Harvey & Associates evaluated diversion screens to determine whether they met current CDFW and NMFS criteria for approach flow velocities, sweeping flow velocities, and screen openings, as well as juvenile bypass requirements (H.T. Harvey & Associates 2015). The assessment made site-specific recommendations for improvement of identified diversions, as summarized in Table 14. A common recommendation the H.T. Harvey & Associates (2015) assessment documented for improvement was to “screen the pump intake to meet CDFW criteria in order to prevent entrainment and impingement of juvenile salmonids.”

Table 14**Prioritization and Site-specific Recommendations for Surveyed Diversions in the Cow Creek Watershed within Study Area**

Site	Recommendation	Priority	Assessment Status
M. Hawes Pump	Screen the pump intake to meet CDFW criteria in order to prevent entrainment and impingement of juvenile salmonids.	Moderate	Surveyed
R. Hawes East Pump	Screen the pump intake to meet CDFW criteria in order to prevent entrainment and impingement of juvenile salmonids. If possible, reposition the pump, store fuel away from the channel, and implement spill containment and prevention measures.	Low	Visual Survey Conducted
Undocumented Pump Diversion 1	Contact the diversion owner to determine the status of the diversion.	Moderate	Visual Survey Conducted
Pearson Pump	Contact the diversion owner to determine the timing and method of pushup dam construction and to document pump capacity. Screen the diversion to meet CDFW criteria. Maintain the bypass channel.	High ¹	Visual Survey Conducted
Undocumented Pump Diversion 2	Contact the diversion owner to document pump capacity. Position the diversion intake away from large wood. Screen the intake to meet CDFW criteria.	Low	Visual Survey Conducted
Stone-Fitzpatrick Pump	Clean the trash screen regularly so that it does not create a velocity refuge. Remove the trash screen or move the screen upstream so that migrating fish do not seek refuge close to the pump intake. Screen the diversion to meet CDFW criteria.	Moderate	Surveyed
Undocumented Pump Diversion 3	Contact the diversion owner to determine the status of the diversion.	Low	Visual Survey Conducted
Undocumented Pump Diversion 4	Contact the diversion owner to document pump capacity. Screen the diversion to meet CDFW criteria.	Low	Visual Survey Conducted
Undocumented Pump Diversion 5	Contact the diversion owner to verify that the diversion is no longer active.	Low	Visual Survey Conducted
Fraser Pump	Contact the diversion owner to determine the schedule of operation and pump size. Conduct a full screen evaluation.	Low	Visual Survey Conducted
Undocumented Pump Diversion 6	Contact the diversion owner to determine the schedule operation and pump size. Conduct a full screen evaluation.	Low	Visual Survey Conducted
Undocumented Pump Diversion 7	Contact the diversion owner to determine the schedule operation and pump size. Screen the diversion to meet CDFW criteria.	Low	Visual Survey Conducted

Notes:

1. The Pearson Pump intake identified was located in a dead-end channel and was not screened to CDFW criteria, resulting in a higher risk of entraining fish than low- or moderate-priority diversions. Therefore, the Pearson Pump was assigned a high priority for improvement.

Source: H.T. Harvey & Associates 2015

3.3 Water Crossings

The barrier study, which includes evaluation of water crossings and other barrier structures (culverts, natural barriers, critical riffles, etc.) as they relate to fish passability, is occurring concurrently and is described in *Physical Barriers to Fish Passage Evaluation* (Appendix L of the Background Compendium).

3.4 Existing Water Supply Systems: Jones Valley

Numerous water supply systems exist and operate within the Study Area. The Shasta County Water Agency's special district County Service Area (CSA) No. 6, Jones Valley, was reviewed due to its potential role related to Project alternatives development and evaluation. No other water supply systems within the Study Area were reviewed at this time.

In 1957, the Shasta County Water Agency was established by the Shasta County Department of Public Works to develop water resources for the beneficial use of the people of Shasta County (Shasta County Department of Public Works 2024a). The agency currently manages eight dependent special districts under CSA law. CSAs provide water, sewer, and other services to unincorporated county areas (Shasta LAFCO 2017).

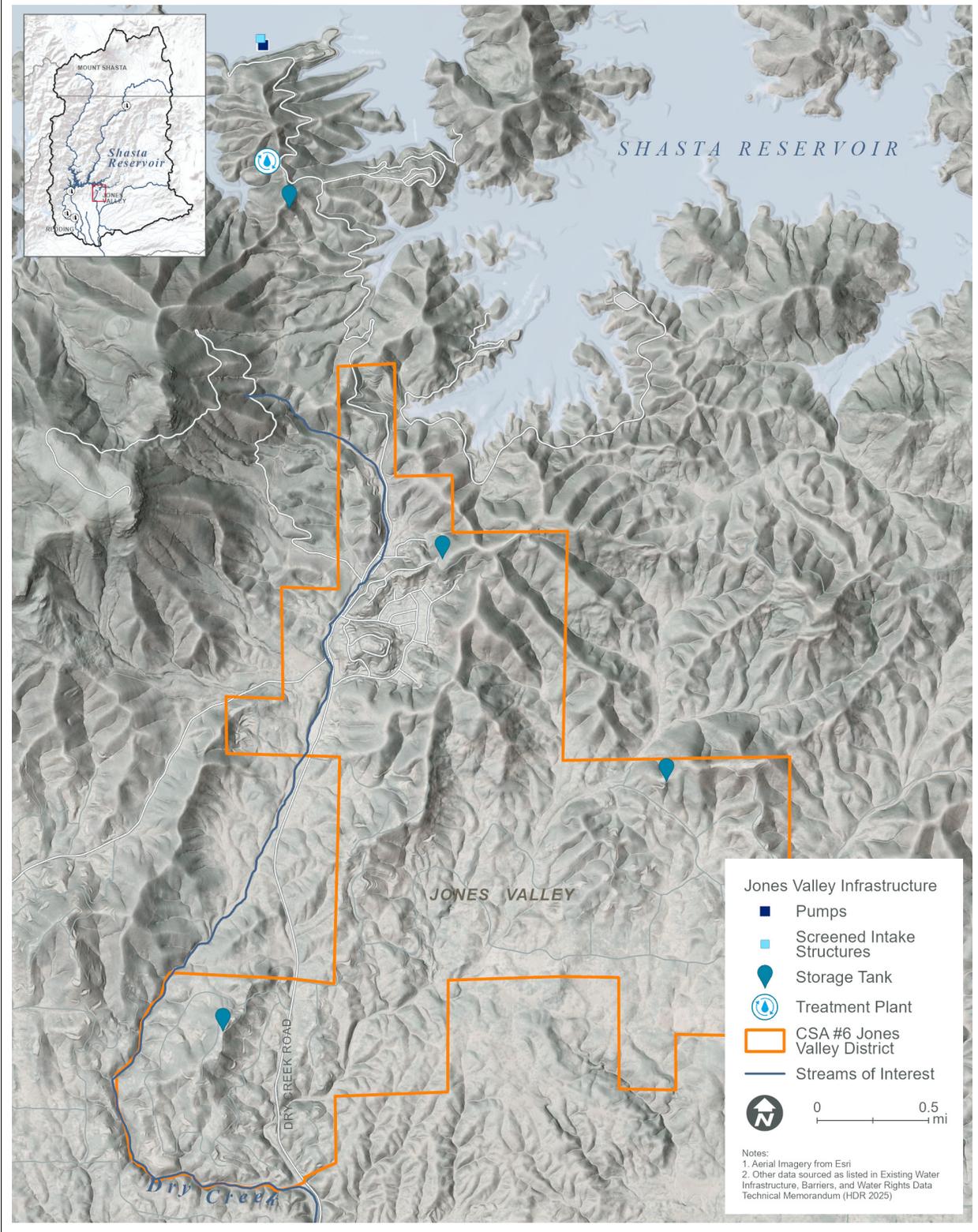
The Jones Valley CSA provides domestic and commercial water to approximately 500 parcels in the unincorporated area of Jones Valley located in central Shasta County, approximately 14 miles northeast of Redding, and south of Shasta Reservoir (Shasta LAFCO 2017). The current service area of CSA No. 6 is approximately 3,034 acres, and the majority are located along Dry Creek Road. The CSA was formed in 1980 to implement major facility improvements from the current water system that withdrew water supply from on-site wells. At that time, grants and loans were secured to design and construct water intake structures within Shasta Reservoir, water pipelines, a treatment plant, and water storage tanks (Shasta LAFCO 2017).

The current conveyance system relies on two screened water intake structures each equipped with a 60-hp submersible pump (Shasta County Department of Public Works 2024b). The intake structures are located at approximately 794 ft North American Vertical Datum of 1988 (272 ft below maximum elevation of Shasta Reservoir), and the pumps are located at approximately 842 ft North American Vertical Datum of 1988 (224 ft below maximum elevation of Shasta Reservoir) (Pace Engineering 2022). Raw water is pumped from the reservoir to a water treatment plant and then into a 225,000-gallon storage tank (Shasta County Department of Public Works 2024b). From this storage tank, treated water is distributed to three storage tanks of varying capacities throughout the district to serve customers at different elevations via approximately 25 miles of water pipeline (Shasta County Department of Public Works 2024b). Figure 11 details water infrastructure locations within the

boundaries of the CSA, from the water intake structures within Shasta Reservoir, to the storage tanks located throughout the service area.

Water rights pertaining to water withdrawn via the Jones Valley intake structures in Shasta Reservoir are summarized in Section 5.5.

Figure 11
Shasta County Service Area No. 6 – Jones Valley Water Infrastructure Locations



3.5 Data Gaps

This section summarizes information that was not obtained during this exercise but is important or recommended for alternative formulation, development, evaluation, and determination of feasibility.

3.5.1 Dams

Several data gaps were identified for the four dams discussed in Section 3.1 and are described in the following paragraphs.

In their application for a new FERC license at McCloud Dam, PG&E proposed new minimum instream flow requirements within the Winnemem Waywaket below McCloud Dam. At the time of document development, it is unclear if those stipulations have been put in place. These values may influence water availability within the Winnemem Waywaket for fish passage facilities.

Specific water supply allocations as part of the CVP are determined based upon hydrologic conditions and water demand for a specific year. Future year allocations are unknown, and as such, potential impacts to Shasta and Keswick reservoir storage are unknown. Likewise, how water would be allocated under a potential future 18.5-foot dam raise at Shasta Dam and impacts to Shasta Reservoir storage are unknown.

Specific elevations at the ACID Diversion Dam are unknown. As-built information, if available, may be useful in understanding potential elevation differentials for alternatives that may be located near the ACID Diversion Dam.

3.5.2 Diversion Structures

The following data gaps identified and described from Section 3.2 are important for project completion, as they influence the total number of points of diversions to navigate when addressing passage and can impact water supply needs during design. Section 3.2 cites the Assessment and Prioritization of Anadromous Fish Passage at Barriers and Diversions in the Cow Creek watershed report by H.T. Harvey & Associates (2015) to identify barriers and diversions to fish passage in the Study Area portion of the Cow Creek watershed. It is important to note that the assessment of barriers and diversions in the Cow Creek watershed conducted by H.T. Harvey & Associates and cited in Section 3.2.3 did not assess Dry Creek. Also, the report documented data gaps related to visual surveys for barrier and diversion identification primarily related to the inability to access privately owned land. Thus, there may be additional diversions in the Cow Creek watershed that were not identified (H.T. Harvey & Associates 2015). Obtaining landowner permission for field visual survey or conducting boat-based surveys of reaches previously inaccessible (Cow Creek and Little Cow Creek) and previously unassessed (Dry Creek) to identify additional undocumented diversions would fill this identified data gap.

The PAD (introduced in Section 3.2) was used to identify diversions in the Study Area, but it is possible that additional undocumented diversions exist, or changes in site status since the most recent assessment or survey dates listed have occurred. Field assessments and surveys of the Nomtipom Waywaket and Winnemem Waywaket within the Study Area would be needed to identify additional diversions to fill this data gap.

The final data gap identified for the Diversion Structure Section (Section 3.2) relates to data identified within the Water Rights Section (Section 5) later in the report. When comparing identified diversion data against water rights data for all study waterbodies, an incongruence exists between the two datasets. For instance, nearly 100 diversions were identified in the Study Area portion of the Nomtipom Waywaket, but only 23 water rights representing 26 total diversions were identified within the same geographical area. The inconsistencies among these two data sets for the Winnemem Waywaket, Nomtipom Waywaket, and Cow Creek watershed constitute a data gap. It is possible that since pre-2014 appropriative water rights and riparian water rights did not require approval by the State Water Board and are subject to a lesser degree of scrutiny, they have not been filed with the State Water Board. This would potentially account for the increased number of identified diversions compared to identified water rights on all study waterbodies. Field assessment and survey to confirm the existence, status, and location of diversions within the Study Area would be necessary to close this data gap.

3.5.3 Existing Water Supply Systems: Jones Valley

Figure 11 identifies the existing infrastructure in the Jones Valley CSA water supply system. However, only approximate locations of infrastructure were available, and it is possible that discrepancies exist between the representation in Figure 11 and the actual infrastructure location. Obtaining as-built drawings for all described water infrastructure in the Jones Valley CSA would fill this identified data gap. Closing this data gap is important for Project completion; the location of the infrastructure could impact the design of future fish passage route alternatives via Jones Valley.

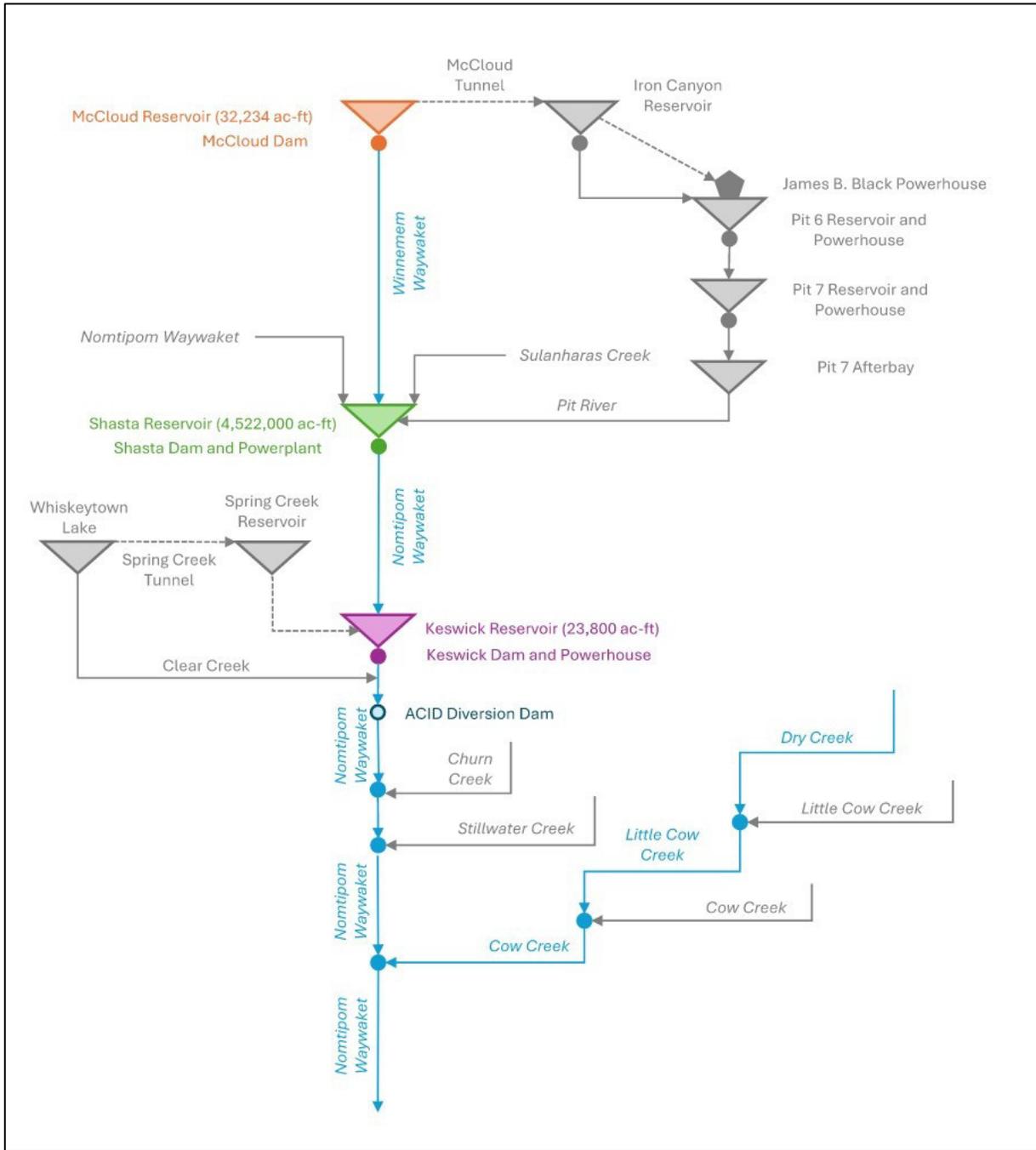
4 Study Area Operational Theory

This section summarizes operations of the water infrastructure and barriers identified in Section 3. It describes the operational theory of the Study Area as a whole to understand how each facility or barrier influences one another. Operational theory is a description of how the system is operated per documented operation plans and demands but may differ from actual operations depending on real-time information, forecasts, or user/agency needs.

4.1 System Overview

Flows within the Study Area are impacted by the system of dams and diversions extending from McCloud Dam at the upstream limit of the Study Area to the confluence of Cow Creek with the Nontipom Waywaket at the downstream limit of the Study Area. The Winnemem Waywaket begins at Colby Meadows, approximately 85 miles northeast of the City of Redding (Sacramento River Watershed Program 2024b). The river flows for approximately 24 miles before reaching the McCloud Reservoir and the McCloud-Pit Hydroelectric Project. Water stored in McCloud Reservoir is primarily diverted to Iron Canyon Reservoir and subsequently conveyed to James B. Black Powerhouse on the Pit River, and the downstream Pit 6 and Pit 7 hydropower facilities. Flows that are not diverted to the Pit River reenter the Winnemem Waywaket downstream of McCloud Dam. Both the Winnemem Waywaket and the Pit River outlet into Shasta Reservoir, which provides storage for flood control, water supply, fish conservation, navigation, and recreation. Flows released from Shasta Dam via the powerplant or spillway/outlets go directly into Keswick Reservoir, as do releases from Whiskeytown Reservoir to the Spring Creek Tunnel and releases from Spring Creek Reservoir. Keswick Reservoir and Dam, in addition to hydropower generation, serve to regulate flow releases from the upper basin for beneficial uses in the Nontipom Waywaket downstream. Downstream of Keswick Dam, ACID has three pump diversions (ACID Bonnyview Vertical Pumps) at the Bonnyview Pumpstation and ACID Diversion Dam near Redding, at which flows are diverted for water supply and irrigation. The confluence of Cow Creek with the Nontipom Waywaket marks the downstream end of the Study Area. Figure 12 provides an overview of how water moves through the Study Area.

Figure 12
Study Area Process Diagram



Note: Diversion structures identified in Section 3.2 are not shown.

4.2 Operations and Coordination

The dams and diversions within the system are operated in consideration of a range of objectives, including flood control, water supply, hydropower, fish conservation, navigation, and recreation. Table 15 summarizes operational considerations for each of the identified facilities, including whether hydropower or fish conservation are a part of the operational decision-making process. This table also provides a summary of where water moves once it passes through each facility. Operational considerations as they relate to coordination between facilities within the system, in order from upstream to downstream, are discussed below. Refer to Section 3.1 for details of the specific operational strategy used at each of the facilities.

Table 15
Summary of Operational Considerations throughout the Study Area

Facility	Operational Considerations						Flow outlets to
	Flood Control	Water Supply	Hydropower	Fish Conservation	Navigation	Recreation	
McCloud Dam		•	•	•		•	Winnemem Waywaket, Iron Canyon Reservoir/Pit River
Shasta Dam	•	•	•	•	•	•	Shasta Powerplant, Nontipom Waywaket
Keswick Dam			•	•	•		Keswick Powerplant, Nontipom Waywaket
ACID Diversion Dam		•		•			Nontipom Waywaket

Note:
Diversion structures identified in Section 3.2 not included.

McCloud Reservoir and Dam are operated as part of McCloud-Pit Hydropower Project, the primary objective of which is hydropower generation. Base flows in the Winnemem Waywaket downstream of McCloud Dam are completely regulated by the McCloud-Pit Hydroelectric Project, as almost all flows entering McCloud Reservoir are diverted to Iron Canyon Reservoir via McCloud Tunnel, and subsequently conveyed to the James B. Black Powerhouse on the Pit River for hydroelectric power (Cardno 2019). Flow through McCloud Tunnel is driven by the water surface differential between the reservoirs; when large inflows are expected, Iron Canyon Reservoir is drawn down to evacuate

storage space in both reservoirs. Minimum discharges of 40 cfs to 50 cfs are released from McCloud Dam to Winnemem Waywaket for fish conservation. Outflows from the McCloud-Pit Hydroelectric Project are ultimately conveyed to Shasta Reservoir (Cardno 2019). When the water surface elevation at Shasta Reservoir is below the invert of the powerplant draft tubes (1,055 ft mean sea level), a minimum of 150 cfs must be released from the McCloud-Pit Hydroelectric Project through the Pit River to Shasta Reservoir (Cardno 2019).

As part of the CVP's Shasta Division, Shasta and Keswick dams are operated in tandem; operations are driven by flood control requirements, irrigation requirements, water quality/ecological requirements, navigation requirements, and recreational use of the reservoirs and Nomtipom Waywaket. Shasta Reservoir generally provides storage for the aforementioned purposes, while Keswick Reservoir and Dam help regulate the delivery of flows to the Nomtipom Waywaket and downstream.

Minimum releases from the Shasta Division are generally governed by ecological requirements, while maximum releases are generally governed by flood control needs. Apart from the navigational flow requirement of 5,000 cfs at Wilkins Slough near Sacramento, more than 170 RMs downstream of Keswick Dam, there are no stipulations for navigation for the Shasta and Sacramento Divisions of the CVP (USBR 2004).

Historically, USBR has used Shasta Division reservoirs to moderate temperatures for fish survival in the Nomtipom Waywaket, releasing flows from the low level outlets and upper reservoir levels to lower and raise the average river temperature, respectively. Temperature objectives and minimum flow release are described in Section 3.1.2 and Section 3.1.3. Releases from Shasta and Keswick dams are gradually reduced in September and early October as operational goals shift from meeting export and water quality demands to flood control. Releases may increase as required to achieve authorized CVP purposes (USBR 1992).

Refer to Section 3.1.3 for details about flow and stage criteria that guide flood control operations at Keswick Dam. Releases from Keswick Dam are modulated to meet these requirements, decreasing release rates as flow and/or stage approaches the allowable maximum, and increasing release rates as tailwater flows/stage recede to allow for evacuation of flood control space at Shasta Reservoir. Although Clair Engle Lake and Trinity Dam, Whiskeytown Reservoir and Dam, and Spring Creek Reservoir and Dam and associated power generating facilities are part of the Trinity Division, releases from these locations ultimately discharge to Keswick Reservoir or Nomtipom Waywaket downstream of Keswick Dam. Thus, operations at Shasta and Keswick dams also require close coordination with the Trinity Division (USBR 1992).

The Shasta Division of the CVP also provides water supply storage, and supplies flows for ACID and the Bella Vista Water District, as well as other diversions not associated with a water or irrigation

district (i.e. City of Redding, personal diversions, and unknown sites). Based on State Water Board records, the ACID vertical pumps have allocated diversion rates of 54, 60, and 50 cfs, which is roughly 8 percent of the minimum flow release from Keswick Dam during critical water years. ACID Diversion Dam has an allocated diversion rate of 400 cfs, roughly 20 percent of the minimum release from Keswick Dam during a critical water year (State Water Board 2024c). Releases from Keswick Dam must be coordinated during installation and removal of ACID Diversion Dam to ensure safe flow conditions below 6,000 cfs are met. Since ACID Diversion Dam cannot withstand high flows, the stoplogs must be removed prior to major releases from Keswick Dam (USBR 1992). The Bella Vista Water District has four diversions downstream of Keswick Dam.

At the downstream limit of the Study Area, Cow Creek flows into the Nomtipom Waywaket. Based on current State Water Board records, there are 12 known diversion locations on the main stem of Cow Creek, including the upstream portion where Dry Creek transitions into Little Cow Creek, which subsequently transitions into Cow Creek. The allotted diversion rates throughout this reach add up to approximately 12.4 cfs and are detailed in Table 19 (State Water Board 2024c). The cumulative diversion rate is insignificant relative to minimum flow releases from Keswick Dam of approximately 2,000 – 3,600 cfs (see Table 10). It should be noted that there are an additional 22 diversions located on the tributaries to Cow Creek that may impact the available flow in Cow Creek; however, diversion rates in these tributaries have not been quantified (H.T. Harvey and Associates 2015) and there is insufficient information to assess the impact of these diversions on flows in the Nomtipom Waywaket and upstream operations.

The CVP continues downstream of Keswick Dam and ACID Diversion Dam with the Sacramento River Division, American River Division, Delta Division, and West San Joaquin Division. Information regarding coordination with divisions downstream of the Study Area is not included in this document.

4.3 Data Gaps

Potential unknown diversions on the Nomtipom Waywaket and Cow/Little Cow/Dry Creeks may influence overall flows and the number of potential barriers in the Nomtipom Waywaket. This data gap could affect fish passage alternative formulation, development, evaluation, and determination of feasibility.

5 Water Rights

Of note, this section does not provide detail on Aboriginal water rights; however, a definition is provided due to the concept's importance, Project relevance, and unresolved nature in the Study Area. An Aboriginal water right is one which was the first of its kind in a region, and is based on the use of water from the earliest days (Merrill 1980).

This remainder of this section provides a summary of historical and present-day water right law in California as it pertains to surface and ground water. As defined by the State Water Board (2024a), "a water right is a legal entitlement authorizing water to be diverted from a specific source and put to beneficial, nonwasteful use." This section describes the different processes for obtaining water rights, including permitting, licensure, and registration, as well as water rights court decrees and adjudication. Finally, this section provides a summary of water rights within the Study Area encompassing the Winnemem Waywaket, the Nomtipom Waywaket, the Cow Creek watershed, and the Jones Valley CSA.

5.1 Water Right Law

In California, water rights law is administered solely by the State Water Board Division of Water Rights. Local governments and water districts do not administer water rights, but instead assist in governance. The State Water Board shares the authority to enforce water right laws with the state courts (State Water Board 2024a). The State Water Board is separate from and has different responsibilities than the DWR, which manages state-owned water infrastructure, such as dams, reservoirs, and aqueducts. The Study Area is geographically located within Regional Board 5 (Central Valley Region) (State Water Board 2024a).

The California Constitution requires all use of water to be reasonable, beneficial, and in accordance with the public trust doctrine. The use of water (the amount diverted and the manner of diversion) must be reasonable and correspond with its desired beneficial use (Trout Unlimited 2025). Beneficial uses are legally recognized and include municipal and industrial uses, irrigation, hydroelectric generation, livestock watering, recreational use, fish and wildlife protection, enhancement and aesthetic enjoyment, among others (State Water Board 2024a). The State Water Board can implement minimum flow standards to ensure there is sufficient instream flow for public trust uses of water, such as navigation, fish and wildlife, and recreation, in accordance with the public trust doctrine (Trout Unlimited 2025). The State Water Board must keep three major goals in mind when making water rights decisions, including "developing water resources in an orderly manner, preventing waste and unreasonable use of water, and protecting the environment" (State Water Board 2024a).

5.1.1 *Surface Water Rights*

Based on California’s seasonal, geographic, and quantitative differences in precipitation compared to other states in the West, the water right law system utilizes both riparian and appropriative rights, a system called the California Doctrine. Riparian rights are typically associated with owning a parcel of land adjacent to a source of water and remain with the property through changes in ownership. These rights entitle the landowner to use a share of the water flowing past their property for one or more of the approved beneficial uses described above. These rights do not require permits, licenses, or government approval, and they apply solely to water which would naturally flow in the stream. Riparian right holders are prohibited from diverting water for storage purposes and also from using this water on land outside of the watershed.

The Water Commission Act of 1914 is responsible for establishing the current permit process for California’s post-1914 appropriative surface water rights. In accordance with the “first in time, first in right” principle, the most recent right holder must be the first to discontinue water use during shortages. A water right’s priority concurs with when the permit application was filed with the State Water Board (State Water Board 2024a). Post-1914 rights are subject to a greater degree of scrutiny by the State Water Board. Pre-1914 appropriative water rights and riparian water rights do not require approval by the State Water Board, but should be claimed and filed for consideration when making decisions on new water right applications. Riparian rights have a higher priority than appropriative rights, and priorities among riparian right holders are equal (State Water Board 2024a).

5.1.2 *Groundwater Rights*

Groundwater may be removed and put to beneficial use in many areas of California by overlying landowners without approval from the State Water Board or a court and can be appropriated for use outside of the basin. Overlying landowners have superior rights to other appropriators. No permit process for regulation of groundwater use exists, but in some basins (outside of the Study Area) its use is subject to regulation in accordance with court adjudications (State Water Board 2024a, 2002). Additionally, use of ground water in high- and medium-priority groundwater basins is subject to the Sustainable Groundwater Management Act (SGMA) that California adopted in 2014. SGMA is overseen by the DWR and its goal is to achieve balanced levels of groundwater for long-term sustainability through local management (State Water Board 2025). In order to determine the priority level of a groundwater basin, a technical evaluation considering components such as overlying population, projected population growth, total number of wells, quantity of overlying irrigated acreage, reliance on groundwater use, and existing impacts to groundwater in a given basin was completed for each of California’s basins (State Water Board 2025). Under SGMA, high- and medium-priority basins must be managed by groundwater sustainability agencies formed by local agencies. These groundwater sustainability agencies must then develop and implement groundwater

sustainability plans to address overuse and excessive groundwater pumping for the protection of groundwater resources (State Water Board 2025).

5.1.3 *The Permit and Licensing Process*

The State Water Board takes into account all prior rights, the availability of water in the basin, and necessary flows for preservation of instream uses such as recreation and fish and wildlife habitat before issuing a permit. A series of steps must be taken for a prospective appropriator to obtain a water right permit, including filing an application detailing the proposed project, environmental review, and public notice. If it is found that unappropriated water is available to supply the applicant and that the appropriation is in the public's interest, a water right permit is issued. After the permitted project is complete, a water right license can be issued to the appropriator if the terms of the permit have been met. The water right license remains effective as long as its conditions are fulfilled and beneficial use continues (State Water Board 2024a).

The State Water Board requires that water right holders report the quantities of diverted water on an annual basis in addition to paying one-time application fees and annual fees associated with maintaining a permit or license. The annual fee for maintaining a permit or license is \$350 plus \$0.12 per each ac-ft diverted greater than 10 ac-ft as per the (fiscal year) 2024-2025 fee schedule (State Water Board 2024b). Additional one-time or annual fees may apply to certain water right holders depending on the nature of the water right held or on a case-by-case basis. For example, holders of small domestic and livestock stock pond water rights are subject to an annual fee of \$100 per the (fiscal year) 2024-2025 fee schedule (State Water Board 2024b). One-time application fees are determined by the annual quantity of water proposed for diversion in ac-ft. Water right holders applying to divert less than 10 ac-ft/year are responsible for a one-time \$5,000 fee, while water right holders applying to divert more than 200,000 ac-ft/year are responsible for a one-time \$811,000 fee per the (fiscal year) 2024-2025 fee schedule (State Water Board 2024b).

The State Water Board maintains an Electronic Water Rights Information Management System (eWRIMS) to provide the public with water rights records, complaints, web mapping, decisions and orders, progress reports, application processing summaries, and petitions information (State Water Board 2024c). The eWRIMS portal is a comprehensive resource for understanding how water rights are adjudicated among water users who have applied for rights. Information provided by the eWRIMS portal water right records include application number, water right type, status, primary owner, point of diversion location, point of diversion type (direct or storage), quantity of diversion, seasonal duration of direct diversion, source waterbody, and associated beneficial use. The eWRIMS portal was used for identification of water right records for all study waterbodies.

5.1.4 *Water Rights Registrations*

Since 1989, the State Water Board has offered water right registrations for expedited acquisition of appropriative water rights for small projects. These registrations must fall into one of the following categories: small domestic use, small irrigation use, or livestock stock pond. According to State Water Board 2024a, criteria that must be met for qualification as a small project for each of these registration types are as follows:

- “Small domestic use registrations: direct diversion at a rate not to exceed 4,500 gallons per day or diversion to storage of an amount not to exceed 10 ac-ft/year”
- “Small irrigation use registrations: diversion to off-stream storage not to exceed 20 ac-ft/year where the storage is either existing or proposed for construction within cultivated lands”
- “Livestock stock pond: direct diversion at a rate not to exceed 4,500 gallons per day or diversion to storage of an amount not to exceed 10 ac-ft/year.”

Upon receipt of a registration, the State Water Board completes a review to ensure the submittal meets criteria for the water rights registration program. A certificate is then issued for a completed registration that details the conditions under which water may be diverted and used (State Water Board 2024a).

5.1.5 *Water Transfers*

Temporary or long-term transfers of water for post-1914 water rights are initiated by petition to the State Water Board. If it is found that the proposed transfer will not injure any other legal user of water and will not unreasonably affect fish, wildlife or other instream users, then the transfer is approved. Temporary transfers are defined to be for a period of one year or less, and long-term transfers are defined as being in excess of one year (State Water Board 2024a).

5.1.6 *Adjudication and the Watermaster Program*

Water rights in California for some waterbodies or portions of those waterbodies, and for some ground water basins have been adjudicated through court decrees. Courts can issue rulings known as adjudications when water users are in dispute over legal rights to water.

The State Water Board is responsible for statutory adjudication, which is a “process by which the comprehensive determination of all water rights in a stream system is made” (State Water Board 2024a). Statutory adjudication occurs when a claimant petitions the State Water Board for an adjudication, and it is found both necessary and in the public interest. After investigation, the Superior Court issues a court decree that determines all water rights within the disputed system is issued (State Water Board 2024a).

As previously mentioned, the State Water Board shares the authority to enforce water right laws with the state courts. The courts typically appoint a watermaster to administer court decrees for adjudications concerning surface or ground water. California established the Watermaster Program in 1924 to provide for general public welfare and safety after injuries and deaths resulting from disputes over adjudicated water rights. Watermaster services throughout the state of California are delivered by state, federal, and private watermasters. The DWR, among many other entities that serve an official watermaster role, administers a state Watermaster Program for implementation and enforcement of established water right allocations in accordance with court adjudications. This program aids in reducing water rights court litigation, civil lawsuits, and law enforcement workload, and helps prevent the waste or unreasonable use of water. The DWR watermaster service areas are created either at the request of water users or by order of the Superior Court (DWR 2024a).

5.2 Winnemem Waywaket Water Rights

Water rights on the Winnemem Waywaket were identified utilizing the eWRIMS portal and are summarized in Table 16. Water rights that are categorized as “Canceled,” “Inactive,” “Rejected,” or “Revoked” are not included in the table. As detailed below, approximately 2,720 cfs of direct diversion water and 39,300 ac-ft/year of stored water make up water right applications in the Winnemem Waywaket. Most water right applications are subject to a seasonal duration in which direct diversion or diversion to storage can occur. Beneficial uses of direct diversions and stored water include dust control, domestic, industrial, stock watering, fire protection, power, and irrigation. Water right types in the Winnemem Waywaket consist of appropriative (post-1914) and unspecific statement of diversion and use rights (State Water Board 2024c). Statement of diversion and use water rights are typically specified as pre-1914, court decree, or riparian rights, but this information was not included for the Winnemem Waywaket in eWRIMS.

Table 16**Winnemem Waywaket Water Rights Identified within Study Area**

Application Number	Water Right Type	Status	Primary Owner	Point of Diversion Latitude / Longitude	Point of Diversion Type	Point of Diversion: Direct Diversion	Point of Diversion: Storage ¹	Direct Diversion and/or Storage Seasonal Duration ²	Beneficial Use
S018965	Statement of Diversion and Use	Claimed	Bascom-Pacific, LLC	41.2554, -121.8364	Point of Direct Diversion, Point of Storage – Unspecified	0.78 cfs	4,000 ac-ft/year	-	Dust Control
A016161	Appropriative	Licensed	McCloud Partners, LLC	41.23223694, -122.00929135	Point of Direct Diversion	6.78 cfs	-	DD: 1/1 – 12/31	Domestic, Industrial
S004076	Statement of Diversion and Use	Claimed	Sierra Pacific Industries	41.20130202, -121.78869561	Point of Storage – Unspecified	-	0.0 ac-ft/year	S: 5/1 – 11/30	Industrial, Stock watering, Dust Control, Fire Protection
A014785	Appropriative	Licensed	Pacific Gas and Electric Company	41.13134189, -122.07099417	Point of Direct Diversion	1,870 cfs	-	DD: 1/1 – 12/31	Power, Domestic
S000668	Statement of Diversion and Use	Claimed	Robert B McIntosh	41.23757608, -121.81348716	Point of Direct Diversion	1.25 cfs	-	-	Stock watering, Irrigation
S017294	Statement of Diversion and Use	Claimed	Wyntoon Timberlands, LLC	41.2053, -122.0609	Point of Direct Diversion	835 cfs	-	-	Dust Control, Fire Protection
A015717	Appropriative	Licensed	Pacific Gas and Electric Company	41.13134189, -122.07099417	Point of Storage – Unspecified	-	35,300 ac-ft/year	S: 1/1 – 12/31	Power, Domestic
A004561	Appropriative	Licensed	McCloud Partners, LLC	41.23223694, -122.00929135	Point of Direct Diversion	5.57 cfs	-	DD: 1/1 – 12/31	Domestic, Industrial
S015394	Statement of Diversion and Use	Claimed	Wyntoon Estate, LLC	41.19914001, -122.07070253	Point of Direct Diversion	0.13 cfs	-	DD: 5/15 – 10/15 DD: 1/1 – 12/31	Irrigation, Recreational

Application Number	Water Right Type	Status	Primary Owner	Point of Diversion Latitude / Longitude	Point of Diversion Type	Point of Diversion: Direct Diversion	Point of Diversion: Storage ¹	Direct Diversion and/or Storage Seasonal Duration ²	Beneficial Use
S015393	Statement of Diversion and Use	Claimed	Wyntoon Estate, LLC	41.1994146, -122.07052112	Point of Direct Diversion	0.13 cfs	-	DD: 5/15 – 10/15 DD: 1/1 – 12/31	Irrigation, Recreational
S015395	Statement of Diversion and Use	Claimed	Wyntoon Estate, LLC	41.19872828, -122.0707021	Point of Direct Diversion	0.13 cfs	-	DD: 5/15 – 10/15 DD: 1/1 – 12/31	Irrigation, Recreational
S015392	Statement of Diversion and Use	Claimed	Wyntoon Estate, LLC	41.19996368, -122.07033999	Point of Direct Diversion	0.13 cfs	-	DD: 5/15 – 10/15 DD: 1/1 – 12/31	Irrigation, Recreational
S017390	Statement of Diversion and Use	Claimed	Wyntoon Estate, LLC	41.1908, -122.0643	Point of Storage – Unspecified	-	0.2 ac-ft/year	-	Irrigation, Domestic, Fire Protection
S015391	Statement of Diversion and Use	Claimed	Wyntoon Estate, LLC	41.20051276, -122.07015886	Point of Direct Diversion	0.13 cfs	-	DD: 5/15 – 10/15 DD: 1/1 – 12/31	Irrigation, Recreational
S015396	Statement of Diversion and Use	Claimed	Wyntoon Estate, LLC	41.1984538, -122.07070181	Point of Direct Diversion	0.13 cfs	-	DD: 5/15 – 10/15 DD: 1/1 – 12/31	Irrigation, Recreational
S001238	Statement of Diversion and Use	Claimed	Wyntoon Estate, LLC	41.19296771, -122.06470041	Point of Direct Diversion	0.076 cfs	-	DD:1/1 – 12/31	Irrigation, Domestic, Fire Protection
S015390	Statement of Diversion and Use	Claimed	Wyntoon Estate, LLC	41.20092482, -122.06961417	Point of Direct Diversion	0.13 cfs	-	DD: 5/15 – 10/15 DD: 1/1 – 12/31	Irrigation, Recreational

Notes:

1. Water storage quantities reported as “0.0” in the “Point of Diversion: Storage” column are assumed to be rounded and greater-than-zero values. It is assumed that quantities reported in the “Point of Diversion: Storage” column are in ac-ft/year units.
2. DD = Direct Diversion, S = Storage

Source: State Water Board 2024c

Of note among water right applications on the Winnemem Waywaket are two primarily owned by PG&E. PG&E's identified water right applications account for the diversion of 1,870 cfs and the storage of approximately 35,300 ac-ft/year from the Winnemem Waywaket for power and domestic beneficial uses. The licenses associated with these water rights include provisions for ensuring minimum flow requirements are maintained downstream during normal and dry water years. The license defines a dry water year as, "one in which the California Department of Water Resources April forecast of the April-July runoff of the McCloud River into Shasta Reservoir is 300,000 ac-ft or less, except that not more than 2 years in succession shall be considered dry regardless of forecast" (State Water Board 1968a, 1968b). PG&E is required to make additional releases of water from the McCloud Dam to the Winnemem Waywaket to the extent necessary to maintain the minimum flows at the Ah-Di-Na stream gaging station as described in Table 17, below.

Table 17
Minimum Downstream Flows Required by PG&E Water Right Licenses

Month	Minimum Flows below Normal Year (cfs)	Minimum Flows below Dry Year (cfs)
January	160	160
February	160	160
March	170	170
April	170	170
May 1-15	170	160
May 16-31	200	160
June	200	160
July	200	160
August	200	160
September	210	180
October	210	180
November	210	180
December 1-15	210	180
December 16-31	170	170

Source: State Water Board 1968a, 1968b

The primary owner with the most water right applications within the Study Area portion of the Winnemem Waywaket is Wyntoon Estate, LLC, with nine water right applications. These water right applications account for the diversion of approximately 0.99 cfs and the storage of approximately 0.2 ac-ft/year from the Winnemem Waywaket for irrigation, recreational, domestic, and fire protection beneficial uses.

5.3 Nomtipom Waywaket Water Rights

Utilizing the eWRIMS portal, water rights within the Study Area portion of the Nomtipom Waywaket were identified and are summarized in Table 18, below. Water rights that are categorized as “Canceled,” “Inactive,” “Rejected,” or “Revoked” are not included in the table. Approximately 63,725 cfs of direct diversion water and approximately 45,299,103 ac-ft/year of stored water constitute water right applications in the Nomtipom Waywaket. Most water right applications are subject to a seasonal duration in which direct diversion or diversion to storage can occur. Beneficial uses of direct diversions and stored water include power, stock watering, irrigation, recreational, municipal, industrial, fish and wildlife preservation and enhancement, domestic, fire protection, and milling. Water right types in the Nomtipom Waywaket vary but consist of both riparian and appropriative (pre- and post-1914) rights.

USBR is the primary owner of six water right applications within the Study Area portion of the Nomtipom Waywaket. These water right applications account for the diversion of approximately 63,075 cfs and the storage of approximately 14,099,000 ac-ft/year from the Nomtipom Waywaket for power, stock watering, irrigation, recreational, municipal, industrial, fish and wildlife preservation and enhancement, and domestic beneficial uses.

The ACID is the primary owner of four water right applications that account for a total of approximately 564 cfs of diversion water from the Nomtipom Waywaket for irrigation, and municipal and domestic beneficial uses. These water right applications are likely associated with the four diversions identified by the PAD and discussed in Section 3.2.2.

The State Water Board is the primary owner of two pending water right applications. When approved, these water right applications will account for the storage of 15,600,000 ac-ft/year each from the Nomtipom Waywaket for power, irrigation, fish and wildlife preservation and enhancement, domestic, and recreational beneficial uses.

Table 18
Nomtipom Waywaket Water Rights Identified within Study Area

Application Number	Water Right Type	Status	Primary Owner	Point of Diversion Latitude / Longitude	Point of Diversion Type	Point of Diversion: Direct Diversion	Point of Diversion: Storage ¹	Direct Diversion and/or Storage Seasonal Durations ²	Beneficial Use
A005625	Appropriative	Permitted	USBR	40.71761076, -122.42033593	Point of Direct Diversion, Point of Storage - Unspecified	11,000 cfs	3,190,000 ac-ft/year	DD: 1/1 – 12/31, S: 10/1 – 6/30	Power
A005626	Appropriative	Permitted	USBR	40.61223925, -122.44596938 40.71761599, -122.42034947	Point of Direct Diversion Point of Storage – Unspecified	8,000 cfs 8,000 cfs	3,190,000 ac-ft/year 3,190,000 ac-ft/year	DD: 9/1 – 6/30, S: 10/1 – 6/30	Stock watering, Irrigation, Recreational, Municipal, Industrial, Fish and Wildlife Preservation and Enhancement, Domestic, Other
A006716	Appropriative	Licensed	City of Redding	40.59248043, -122.4073058	Point of Direct Diversion	0.11 cfs	-	DD: 3/1 – 11/1	Municipal, Industrial
A008884	Appropriative	Licensed	City of Redding	40.59248043, -122.4073058	Point of Direct Diversion	5.0 cfs	-	DD: 1/1 – 12/31	Municipal

Application Number	Water Right Type	Status	Primary Owner	Point of Diversion Latitude / Longitude	Point of Diversion Type	Point of Diversion: Direct Diversion	Point of Diversion: Storage ¹	Direct Diversion and/or Storage Seasonal Durations ²	Beneficial Use
A009363	Appropriative	Permitted	USBR	40.71761599, -122.42034947 40.61224447, -122.44598291	Point of Storage – Unspecified Point of Direct Diversion	1,000 cfs 1,000 cfs	310,000 ac-ft/year 310,000 ac-ft/year	DD: 9/1 – 6/30, 7/1 – 8/31 S: 10/1 – 6/30,	Industrial, Municipal
A009364	Appropriative	Permitted	USBR	40.61224447, -122.44598291 40.71761599, -122.42034947	Point of Direct Diversion – Point of Re-diversion Point of Storage – Unspecified	9,000 cfs 9,000 cfs	1,303,000 ac-ft/year 1,303,000 ac-ft/year	DD: 9/1 – 6/30, 7/1 – 8/31 S: 10/1 – 6/30	Municipal, Domestic, Recreational, Stock watering, Industrial
A009365	Appropriative	Permitted	USBR	40.71761076, -122.42033593	Point of Direct Diversion, Point of Storage – Unspecified	2,275 cfs	1,303,000 ac-ft/year	DD: 1/1 – 12/31 S: 10/1 – 6/30	Power
A010320	Appropriative	Licensed	City of Redding	40.59388449, -122.39831141	Point of Direct Diversion	0.45 cfs	-	DD: 1/1 – 12/31	Industrial, Fire Protection, Domestic
A010588	Appropriative	Licensed	USBR	40.61223925, -122.44596938	Point of Direct Diversion	13,800 cfs	-	DD: 1/1 – 12/31	Power, Domestic
A015197	Appropriative	Licensed	City of Redding	40.59248043, -122.4073058	Point of Direct Diversion	0.58 cfs	-	DD: 5/1 – 10/31	Municipal, Industrial
A026928SF	Appropriative (State Filing)	Pending	State Water Board	40.71761076, -122.42033593	Point of Storage - Unspecified	-	15,600,000 ac-ft/year	S:10/1 – 7/1	Power

Application Number	Water Right Type	Status	Primary Owner	Point of Diversion Latitude / Longitude	Point of Diversion Type	Point of Diversion: Direct Diversion	Point of Diversion: Storage ¹	Direct Diversion and/or Storage Seasonal Durations ²	Beneficial Use
A026929SF	Appropriative (State Filing)	Pending	State Water Board	40.71761076, -122.42033593	Point of Storage - Unspecified	-	15,600,000 ac-ft/year	S: 10/1 – 7/1	Irrigation, Fish and Wildlife Preservation and Enhancement, Domestic, Recreational, Other
D033141	Registration Domestic	Registered	Milton Wilson	40.59666787, -122.43962257	Point of Direct Diversion	0.09 cfs	-	DD: 9/1 – 6/14	Domestic
S000597	Statement of Diversion and Use – Riparian	Claimed	Sierra Pacific Industries	40.47197563, -122.31814592	Point of Storage – Unspecified	-	0.0 ac-ft/year	S: 1/1 – 12/31, 5/1 – 9/30	Fire Protection, Milling, Irrigation
S012208	Statement of Diversion and Use – Pre-1914	Claimed	ACID	40.59170208, -122.39433726	Point of Direct Diversion	50.0 cfs	-	-	Irrigation
S016818	Statement of Diversion and Use – Pre-1914	Claimed	ACID	40.5378, -122.3556	Point of Direct Diversion	60.0 cfs	-	-	Irrigation
S022757	Statement of Diversion and Use - Riparian	Claimed	Hawes River Acres	40.4629, -122.2415	Point of Direct Diversion	3.34 cfs	-	-	Irrigation
S023710	Statement of Diversion and Use – Pre-1914	Claimed	ACID	40.5923, -122.4073	Point of Direct Diversion	54.0 cfs	-	-	Municipal

Application Number	Water Right Type	Status	Primary Owner	Point of Diversion Latitude / Longitude	Point of Diversion Type	Point of Diversion: Direct Diversion	Point of Diversion: Storage ¹	Direct Diversion and/or Storage Seasonal Durations ²	Beneficial Use
S024700	Statement of Diversion and Use - Riparian	Claimed	Redding Memorial Park (courtesy of Joshua Gulick)	40.5911, -122.3829	Point of Direct Diversion	0.90 cfs	-	-	Irrigation
S025373	Statement of Diversion and Use - Riparian	Claimed	Todd Ratley	40.5535, -122.372	-	0.004 cfs	-	-	Irrigation
S028949	Statement of Diversion and Use - Riparian	Claimed	Sean Baxter	40.56055, -122.3731	-	-	-	-	Domestic, Irrigation
S028970	Statement of Diversion and Use – Pre-2014	Claimed	City of Redding	40.592301, -122.407319	Point of Direct Diversion, Point of Diversion to Off-stream Storage	75.0 cfs	102.81 ac-ft/year	-	Municipal, Industrial, Domestic, Fire Protection
Z000916	Section 12 File	Claimed	ACID	40.59170208, -122.39433726	Point of Direct Diversion	400 cfs	-	DD: 1/1 – 12/31	Irrigation, Domestic

Notes:

1. Water storage quantities reported as “0.0” in the “Point of Diversion: Storage” column are assumed to be rounded and greater-than-zero values. It is assumed that quantities reported in the “Point of Diversion: Storage” column are in ac-ft/year units.
2. DD = Direct Diversion, S = Storage

Source: State Water Board 2024c

5.4 Cow Creek Watershed Water Rights

The Cow Creek watershed has been adjudicated by multiple court decrees. Large portions of the tributaries that feed Cow Creek upstream of the Study Area, including the upstream portion of Little Cow Creek, Oak Run Creek, and Clover Creek were established as watermaster service areas. Old Cow Creek and its tributaries and South Cow Creek and its tributaries, which are also outside of the Study Area, are not regulated by watermaster service. Finally, the main stem Cow Creek, which is included in the Study Area, is also not regulated by watermaster service.

Water rights on the Old Cow Creek, South Cow Creek, and mainstem Cow Creek were established under Decree No. 38577, dated August 25, 1969 (State Water Board 1969). Water rights governed under this decree are divided into four separate groups designated as the Independent Tributary Group, the Old Cow Creek Group, and South Cow Creek Group, and the Lower Cow Creek Group (main stem Cow Creek) (SHN 2001). The allotments in each group are broken into four priority classes (first, second, third, and fourth priorities), as well as a surplus class and a special class (SHN 2001). The priority classes were established so that in the event of insufficient water supply, the available supply would be prorated in accordance with allotments in that priority class (SHN 2001). No priority class is entitled to use water until all the rights with lower numbers have been supplied (SHN 2001). Surplus class rights rank below third-class rights, but above fourth-class rights (SHN 2001). Allotments for irrigation are from March 1 through October 31 of each year (SHN 2001). All allotments in the first priority class are for domestic and stock watering purposes which are entitled to the first priority class allotments during the non-irrigation season, from November 1 until March 1¹ (SHN 2001).

Utilizing the eWRIMS portal, water rights within the Study Area portion of the Cow Creek watershed were identified and are summarized in Table 19, below. Water rights that are categorized as “Canceled,” “Inactive,” “Rejected,” or “Revoked” are not included in the table. Additionally, no water rights applications were identified via the portal for either Little Cow Creek or Dry Creek (State Water Board 2024c). Approximately 12.3 cfs of direct diversion water and a small but unknown² quantity of stored water constitute water right applications in the Study Area portion of the Cow Creek. Some water right applications are subject to a seasonal duration in which direct diversion or diversion to storage can occur. Beneficial uses of direct diversions and stored water include irrigation, stock watering and fish and wildlife preservation and enhancement. Water right types in the Study Area

¹ It is important to note that despite water right allotments described herein, most adjudications require bypass or minimum flows (SHN 2001).

² As noted below, water storage quantities reported as “0.0” in the “Point of Diversion: Storage” column in Table 19 are assumed to be rounded and greater-than-zero values.

portion of the Cow Creek vary but consist of both riparian and appropriative (pre- and post-1914) rights.

Table 19
Cow Creek Watershed Water Rights Identified within Study Area

Application Number	Water Right Type	Status	Primary Owner	Point of Diversion Latitude / Longitude	Point of Diversion Type	Point of Diversion: Direct Diversion	Point of Diversion: Storage ¹	Direct Diversion and/or Storage Seasonal Duration ²	Beneficial Use
S017018	Statement of Diversion and Use - Riparian	Claimed	David Bjerke	40.5258, -122.2312	Point of Direct Diversion	0.89 cfs	-	-	Irrigation, Stock watering
S021772	Statement of Diversion and Use – Pre-2014 and Court Decree #38577	Claimed	Harry J Hawes	40.4764, -122.2284	Point of Direct Diversion	5.57 cfs	-	-	Irrigation
S017132	Statement of Diversion and Use - Riparian	Claimed	Joyce Jackson	40.5255, -122.2311	Point of Direct Diversion	0.223 cfs	-	-	Stock watering
A012138A	Appropriative	Licensed	Shane Tatom	40.5197, -122.2293	Point of Direct Diversion	0.06 cfs	-	DD: 5/1 – 11/1	Irrigation
A012138B	Appropriative	Licensed	Laura L Redwine - Cuenca	40.5197, -122.2293	Point of Direct Diversion	0.06 cfs	-	DD: 5/1 – 11/1	Irrigation
S017448	Statement of Diversion and Use - Riparian	Claimed	Joyce Jackson	40.5254, -122.2309	Point of Direct Diversion	0.891 cfs	-	-	Stock watering

Application Number	Water Right Type	Status	Primary Owner	Point of Diversion Latitude / Longitude	Point of Diversion Type	Point of Diversion: Direct Diversion	Point of Diversion: Storage ¹	Direct Diversion and/or Storage Seasonal Duration ²	Beneficial Use
S020121	Statement of Diversion and Use - Riparian	Claimed	Lawrence E King	40.5279, -122.233	Point of Direct Diversion	0.89 cfs	-	-	Irrigation
S017129	Statement of Diversion and Use - Riparian	Claimed	Robert M Pas	40.5239, -122.2301	Point of Storage – Unspecified	-	0.0 ac-ft/year	-	Stock watering
S020309	Statement of Diversion and Use – Court Decree #38577	Claimed	Bob Moller	40.5077, -122.2281	Point of Direct Diversion	2.22 cfs	-	-	Irrigation, Fish and Wildlife Preservation and Enhancement
S023194	Statement of Diversion and Use – Riparian and Pre-2014	Claimed	The Wilderness Land Trust	40.5431, -122.236	Point of Direct Diversion: Pump	0.22 cfs	-	-	Irrigation
S018390	Statement of Diversion and Use – Court Decree #38577	Claimed	Salvatore V. Alberti	40.5239, -122.2301	Point of Direct Diversion	1.114 cfs	-	-	Irrigation
S016991	Statement of Diversion and Use - Riparian	Claimed	David Bjerke	40.5268, -122.2319	Point of Direct Diversion	0.223 cfs	-	-	Stock watering
S017810	Statement of Diversion and Use - Other	Claimed	Bob Moller	40.5483, -122.232	Point of Storage – Unspecified	-	0.0 acre-ft/year	-	Irrigation, Stock watering

Notes:

1. Water storage quantities reported as “0.0” in the “Point of Diversion: Storage” column are assumed to be rounded and greater-than-zero values.

2. DD = Direct Diversion

Source: State Water Board 2024c

5.5 Jones Valley CSA Water Rights

The Shasta County Water Agency initially entered into a contract with the USBR for CVP water on June 30, 1967. In December 1980, the Shasta County Water Agency entered into a subcontract with Shasta County that would provide water for the Jones Valley CSA through the USBR CVP. Due to limitations of CVP water, water allocations pursuant to the CSA's water right have been limited. For instance, in 2014, water allocation to the CSA was cut by nearly half, and in 2015, water allocation was cut by nearly a quarter. Supplemental water was purchased from another entity to meet the CSA's water demands in these years, and it is anticipated that future drought conditions will again necessitate supplemental water purchase. (Shasta LAFCO 2017). The Shasta County Water Agency currently administers 1,022 ac-ft of CVP water that is subcontracted to private parties and other water purveyors in Shasta County (Shasta County Department of Public Works 2024a).

The water right licensed to Shasta County for use by the Shasta County Water Agency with the California State Water Resources Control Board (State Water Board) under Application Number 26671 and Permit Number 18569 (Shasta County Department of Public Works 2024b). This license provides water delivery at a rate of approximately \$45/ac-ft and specifies that the diversion shall not exceed 0.7 cfs and 350 ac-ft/year (Shasta County Department of Public Works 2024b).

Table 20 details the Shasta County water right license for the Jones Valley CSA (State Water Board 2024c).

Table 20
Shasta County Service Area No. 6 Jones Valley Water Rights Identified

Application Number	Water Right Type	Status	Primary Owner	Point of Diversion Latitude / Longitude	Point of Diversion Type	Point of Diversion: Direct Diversion	Point of Diversion: Storage	Source	Beneficial Use
A026671	Appropriative	Permitted	County of Shasta – CSA 6	40.7554465, -122.24657717	Point of Direct Diversion	0.7 cfs	-	Pit River Arm Shasta Reservoir	Municipal

Source: State Water Board 2024c

5.6 Data Gaps

As described in Section 3.5.2, nearly 100 diversions were identified on the Study Area stretch of the Nomtipom Waywaket, but only 23 water rights representing 26 total diversions identified within the same geographical area. The inconsistencies among these two data sets for the Winnemem Waywaket, Nomtipom Waywaket, and Cow Creek watershed constitute a data gap. It is possible that since pre-2014 appropriative water rights and riparian water rights do not require approval by the State Water Board and are subject to less scrutiny, they have not been filed with the State Water Board. This would potentially account for the increased number of identified diversions compared to identified water rights on all study waterbodies. The utilization of field assessment and surveys to confirm the existence, status, and location of diversions within the Study Area would be necessary for filling this data gap. This information is important for Project completion, as it influences the total number of points of diversions to navigate when addressing fish passage and can impact water supply needs during design of fish passage facilities.

6 Summary of Findings

The purpose of this document is to synthesize and summarize readily available information on existing water infrastructure, barriers, and water rights in the Study Area. Existing water infrastructure and barriers identified on the Winnemem Waywaket, Nomtipom Waywaket, Dry Creek, Little Cow Creek, and Cow Creek at the time of this analysis included dams, release structures, water pipelines, open channel distributaries, diversion structures, storage tanks, water intake structures, and water crossings. Operational theory of water infrastructure and barriers identified throughout the Study Area was summarized to understand how each facility or barrier influences one another. Finally, a summary of water rights for the study waterbodies was compiled. Detailed information about sources utilized in this document can be found in Section 2.

In addition to summarized data on existing water infrastructure and barriers and water rights within the Study Area, findings for this document include identifying and summarizing information data gaps and key findings for use in informing future fish passage alternatives evaluation. Data gaps identified and summarized throughout this document are evaluated in Section 6.1, below, based on their importance for completion of the Project.

Information provided in this document and other documents created as part of this Project will be used as a basis for developing and evaluating alternatives. The information contained within this document represents the current basis of knowledge available for the Project which will be developed further as this and other studies progress forward.

6.1 Data Gaps Summary

Table 21 provides a summary of the data gaps identified in Section 3.5, Section 4.3, and Section 5.6, and indicates its importance for completing the Project, along with recommendation on how the data gaps can be resolved and the difficulty of each recommendation. All the data gaps identified in Table 21 are judged to be significant and a high priority to resolve to continue the development of fish passage alternatives and designs. The lack of resolution could impact design considerations of future fish passage alternatives evaluation, such as water availability, infrastructure operational changes, and fish passage navigational unknowns.

As described in Table 21, both agency collaboration and field studies are recommended to resolve identified data gaps to inform alternatives development, evaluation, and decisions in upcoming steps of this Project. Resolution of identified data gaps via agency collaboration has an anticipated difficulty of "Low" and "Medium", while recommendations for field assessments and surveys has an anticipated difficulty of "High."

Table 21
Summary of Identified Data Gaps

Pertinent Section	Data Gap	Importance of Data Gap	Recommended Data Gap Resolution	Anticipated Difficulty of Resolution (Low, Medium, High)
Section 3.5.1 Dams	Minimum Instream Flow Requirements at McCloud Dam	Influences water availability within the Winnemem Waywaket (upper end of Study Area) and may impact additional water supply needs in design.	Reach out to PG&E and/or FERC to determine if any minimum instream flow requirements have been set.	Medium
Section 3.5.1 Dams	Specific water supply allocations of the CVP in future years and under a potential future 18.5 ft Shasta Dam raise	Unknown future impact to Shasta and Keswick reservoir storage.	Reach out to USBR to determine if any forecasts are available for water supply allocation that consider climate change and anticipated future supply and demand.	Medium
Section 3.5.1 Dams	Specific crest and infrastructure elevations at the ACID Diversion Dam	Influences range of operational water surface differentials at ACID Diversion Dam.	Obtain as-built information for ACID Diversion Dam.	Low
Section 3.5.2 Diversion Structures	Inability to access portions of privately owned land on the Cow Creek and Little Cow Creek. Lack of assessment on the Dry Creek.	There may be additional diversions within the Study Area in the Cow Creek watershed that have not yet been identified. Influences total number of points of diversions to navigate when addressing passage and can impact water supply needs in design.	Obtain landowner permission for field survey or conducting boat survey of waterbody reaches previously inaccessible (Cow Creek and Little Cow Creek) and previously unassessed (Dry Creek) to identify and confirm existence, status, and location of potential diversions	High

Pertinent Section	Data Gap	Importance of Data Gap	Recommended Data Gap Resolution	Anticipated Difficulty of Resolution (Low, Medium, High)
Section 3.5.2 Diversion Structures	Potentially outdated diversion status reported by the PAD layer of the CDFW BIOS online tool.	There may be additional diversions within the Study Area in the Nomtipom Waywaket that are not accurately represented in the PAD. Influences total number of points of diversions to navigate when addressing passage and can impact water supply needs in design.	Conduct field assessments and surveys within the Study Area stretches of Nomtipom Waywaket and Winnemem Waywaket to identify and confirm existence, status, and location of potential diversions.	High
Section 3.5.2 Diversion Structures	Discrepancy between PAD layer of the CDFW BIOS online tool and eWRIMS portal related to total number of diversions within Study Area portions of the Winnemem Waywaket, the Nomtipom Waywaket, and the Cow Creek watershed.	There may be additional diversions within the Study Area that are not accurately represented in the PAD. Influences total number of points of diversions to navigate when addressing passage and can impact water supply needs in design.	Field assessment and survey to identify and confirm the existence, status, and location of diversions on study waterbodies.	High
Section 3.5.3 Existing Water Supply Systems	Lack of precise as-built drawings that describe the location of infrastructure in the Jones Valley CSA	Could impact design of future fish passage route alternative via Jones Valley area if precise locations of existing water infrastructure are unknown.	Agency collaboration to obtain as-built drawings from the Jones Valley CSA for water infrastructure.	Low
Section 4.3 Study Area Operational Theory	Potential unknown diversions on Nomtipom Waywaket and Cow/Little Cow/Dry Creeks	May influence overall flows in Cow Creek watershed and/or Nomtipom Waywaket; may be additional diversions on these reaches not already identified.	Collaborate with CalFish on any updates to the PAD within our Study Area, which is largely incomplete and relies on volunteered information.	High

Pertinent Section	Data Gap	Importance of Data Gap	Recommended Data Gap Resolution	Anticipated Difficulty of Resolution (Low, Medium, High)
Section 5.6 Water Rights	Discrepancy between PAD layer of the CDFW BIOS online tool and eWRIMS portal related to total number of diversions within Study Area portions of the Winnemem Waywaket, the Nomtipom Waywaket, and the Cow Creek watershed.	There may be additional diversions within the Study Area that are not accurately represented in the PAD. Influences total number of points of diversions to navigate when addressing passage and can impact water supply needs in design.	Field assessment and survey to identify and confirm the existence, status, and location of diversions on study waterbodies.	High

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