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LIST OF ACRONYMS

CFR	Code of Federal Regulations
FERC or Commission	Federal Energy Regulatory Commission
PAD	Pre-Application Document
Project	Kaweah Project
SD	Supporting Document
TSP	Technical Study Plan
TSR	Technical Study Report

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7.0 AFFECTED ENVIRONMENT

This section follows the Federal Energy Regulatory Commission's (FERC or Commission) content requirements at Title 18 of the Code of Federal Regulations (CFR) §5.18(b)(5)(ii)(A) which specify that, "the applicant must provide a detailed description of the affected environment or area(s) to be affected by the proposed project by each resource area. This description must include the information on the affected environment filed in the Pre-Application Document (PAD) provided for in §5.6, developed under the applicant's approved study plan, and otherwise developed or obtained by the applicant. The section must include a general description of socio-economic conditions in the vicinity of the project including general land use patterns (e.g., urban, agricultural, forested), population patterns, and sources of employment in the project vicinity." In addition, as required under §5.18(b), this section follows the Commission's "Preparing Environmental Documents: Guidelines for Applicants, Contractors, and Staff" (FERC 2008).

The affected environment was developed from information included in Southern California Edison Company's PAD and collected during implementation of 17 FERC-approved Technical Study Plans (TSP) developed for the relicensing of the Kaweah Project (Project). Results of these studies are provided in Technical Study Reports (TSR) included in Supporting Document (SD) A. The affected environment descriptions identify existing resource conditions under current operations and maintenance of the Kaweah Project (baseline conditions).

This section is organized as follows:

- 7.1 – Description of the Kaweah River Basin
- 7.2 – Water Use and Hydrology Affected Environment
- 7.3 – Water Quality Affected Environment
- 7.4 – Fish and Aquatics Resources Affected Environment
- 7.5 – Botanical and Wildlife Resources Affected Environment
- 7.6 – Geology and Soils Affected Environment
- 7.7 – Geomorphology Affected Environment
- 7.8 – Riparian Resources Affected Environment
- 7.9 – Land Use Affected Environment
- 7.10 – Recreation Resources Affected Environment
- 7.11 – Aesthetic Resources Affected Environment
- 7.12 – Cultural Resources Affected Environment

- 7.13 – Tribal Resources Affected Environment
- 7.14 – Socioeconomics Affected Environment

LITERATURE CITED

FERC (Federal Energy Regulatory Commission). 2008. Preparing Environmental Documents: Guidelines for Applicants, Contractors, and Staff.

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LIST OF ACRONYMS

°F	degrees Fahrenheit
ac-ft	acre-feet
Basin or Watershed	Kaweah River Basin
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
cfs	cubic feet per second
CRWQCB	California Regional Water Quality Control Board
FERC or Commission	Federal Energy Regulatory Commission
ft	feet
mi	mile
mi ²	square mile
msl	mean sea level
NPS	National Park Service
POR	Period of record
Project	Kaweah Project
SCE	Southern California Edison Company
SNP	Sequoia National Park
SUP	Special Use Permit
USACE	United States Army Corps of Engineers
WY	water year

7.1 DESCRIPTION OF THE KAWEAH RIVER BASIN

This section describes the Kaweah River Basin (Basin or Watershed), which contains Southern California Edison Company's (SCE or Licensee) Kaweah Project (Project). The Federal Energy Regulatory Commission's (FERC or Commission) content requirements for this section are specified in Title 18 of the Code of Federal Regulations (CFR) §5.18(b)(1).

This section provides an overview of the Kaweah River Basin, including information on the overall watershed area and sub-watershed areas; rivers and streams affected by the Project; major land and water uses; and other dams and diversions in the Watershed.

7.1.1 Information Sources

This section was prepared utilizing the following information sources:

- California Regional Water Quality Control Board (CRWQCB) Central Valley Region's Water Quality Control Plan for the Tulare Lake Basin (CRWQCB 2018);
- FERC's Order Amending License for the Terminus Dam Project (FERC Project No. 3947) (FERC 2003a and b);
- FERC's SCE Kaweah Project Environmental Assessment, FERC Project No. 298-000 (FERC 1991);
- National Park Services' (NPS) Final General Management Plan and Comprehensive River Management Plan/Environmental Impact Statement for Sequoia and Kings National Parks (NPS 2006);
- SCE's Pre-Application Document for the Kaweah Project (SCE 2016);
- Southern Sierra Integrated Regional Water Management Plan (Provost & Prichard 2014);
- U.S. Army Corps of Engineers' (USACE) final feasibility investigation for providing increased flood protection and upstream storage for irrigation water supply (USACE 1996); and
- U.S. Bureau of Land Management (BLM) Bakersfield Field Office Resource Management Plan (BLM 2014).

These references are cited throughout the text and complete reference information is provided at the end of this section.

7.1.2 Overview of the Kaweah River Basin

The upper and lower watersheds of the Kaweah River are separated by the USACE's Terminus Dam, which impounds the Kaweah River forming Lake Kaweah. Lake Kaweah is situated where mountainous terrain transitions into a gentle foothill and valley environment. The Kaweah River Basin upstream of Lake Kaweah is comprised of five primary forks, including the Middle, Marble, East, North, and South forks of the Kaweah River (Map 7.1-1). The upper watersheds originate at elevations higher than 8,400 feet above mean sea level (msl) in the southern portion of the Sierra Nevada in lands administered by the NPS. The Marble and Middle forks of the Kaweah River are contained wholly within the Sequoia National Park (SNP). In the lower elevations, the East, North, and South forks of the Kaweah River flow through private lands and lands administered by the BLM. Land jurisdictions in the Project vicinity are shown on Map 7.1-2.

Together, the Watershed, including the local sub-basins surrounding Lake Kaweah, encompass a 561-square mile area. Table 7.1-1 provides a summary of the sub-basin areas, stream length, and elevations in the Project vicinity. The Middle, Marble, and East forks of the Kaweah River originate along the Great Western Divide at elevations higher than 8,400 feet above msl. The Middle Fork Kaweah River drains a 103.1-square mile area. It originates in a glacial U-shaped valley and intersects with the Marble Fork approximately 20.3 miles downstream forming the Kaweah River. The Marble Fork Kaweah River drains approximately 52.5 square miles and terminates at the confluence with the Middle Fork Kaweah River approximately 17.4 miles downstream from the headwater at the Kaweah River. The Kaweah River downstream from the confluence of the Middle and Marble forks of the Kaweah River drains approximately 36.6 square miles. The local watershed surrounding Lake Kaweah drains approximately 46.9 square miles.

The East Fork Kaweah River drains a 95-square mile area, flows through the U-shaped, glaciated Mineral King Valley before joining the Kaweah River 23.3 miles downstream. The East Fork Kaweah River joins the Kaweah River approximately 4 miles downstream from the confluence of the Middle and Marble forks of the Kaweah River. The North Fork Kaweah River, with a drainage area of 137.5 square miles, originates in several headwater streams along the Kings-Kaweah Divide and flows out of the Jennie Lakes Wilderness. The river joins the Kaweah River 26.4 miles downstream from its headwaters, approximately 5.3 miles downstream from the East Fork and Kaweah River confluence. The South Fork Kaweah River originates on the Hockett Plateau west of the Great Western Divide at approximately 9,500 feet above msl. It drains an 89.4-square mile area, and flows approximately 24.7 miles to the confluence with the Kaweah River, 2.7 miles downstream of the North Fork Kaweah River and Kaweah River confluence.

Downstream of Lake Kaweah, the Kaweah River flows southwest into the Central Valley near the town of Visalia where it splits into various creeks in which flows are depleted for irrigation purposes (non-FERC Project related diversion).

The Basin is characterized by hot, dry summers and mild, wet winters. Precipitation falls as rain in the lower elevations and primarily as snowfall at elevations greater than approximately 4,000 feet above msl. Snowpack in the high elevations within the Basin

can persist well into the summer months in wetter years. Mean annual precipitation in the lower elevations (near the town of Three Rivers) is approximately 24 inches and at higher elevations is about 45 inches (in the SNP).¹

Precipitation and snowfall accumulation are recorded in the vicinity of the Kaweah Project through a network of monitoring and recording stations operated by SCE, USACE, BLM, and Sequoia and Kings Canyon National Parks (Table 7.1-2). Measurements are collected at higher elevations in the headwaters near Mineral King (9,500 feet above msl) down to the lower elevations near Three Rivers (1,400 feet above msl) and Lake Kaweah (752 feet above msl). Real-time and historical rainfall and snowfall data are available on the California Data Exchange Center website (<http://cdec.water.ca.gov>).

Air temperatures in the Watershed can range from over 100 degrees Fahrenheit (°F) during the summer months in the lower elevations to below freezing during the winter in the headwaters. Average annual air temperatures near Three Rivers, CA, near the Project, range from 48°F to 76°F.

The amount of runoff derived from rainfall and snowmelt can vary greatly. The typical snowmelt period, when runoff and stream flows are high, starts in March, peaks in May or early June, and ends by July. Runoff peaks earlier in years with below average precipitation and lasts longer during wet years.

Total annual inflow into the Project (combined inflow at the Kaweah No. 1 and No. 2 diversions) between water years 1994–2018 ranged from approximately 78,000 acre-feet (ac-ft) (2015) to more than 668,000 ac-ft (2017). The median total annual inflow was approximately 229,000 ac-ft during this period (Figure 7.1-1).

The principal Kaweah Project facilities under FERC jurisdiction are shown on Map 7.1-3. A detailed description of the Project facilities and operations is presented in Section 3.0 – No-Action Alternative. The operation of the Project affects flows and potentially affects resources on the following river reaches:

- East Fork Kaweah River, from the Kaweah No. 1 Diversion to the confluence with the Kaweah River (4.7 miles); and
- Kaweah River, from the Kaweah No. 2 Diversion to the confluence of the Kaweah No. 2 Powerhouse Tailrace and the Kaweah River (4.1 miles).

7.1.3 Major Land Uses in the Project Vicinity

The Watershed, upstream of the community of Three Rivers, is mostly forested, rural in nature, and sparsely populated. The Watershed contains public and private lands. The upper watershed originates in the higher elevations of the SNP, with a portion of the watersheds managed as National Wilderness Areas (Sequoia-Kings Canyon and John Krebs Wilderness areas). The Middle, Marble, and East forks of the Kaweah River

¹ Climate data obtained from US weather data: <http://www.usclimatedata.com/climate/>

originate in the upper watershed. The upper watershed, is a popular wilderness recreation area for both summer and winter recreation activities.

Upstream of the Project, SCE operates several non-FERC Project facilities within the SNP. These facilities include Eagle, Lady Franklin, Crystal, and Upper Monarch lakes and their associated dams (referred to as the Mineral King Lakes); the Marble Fork Diversion Dam and Flowline; and the Middle Fork Diversion Dam and Flowline. SCE has a Special Use Permit (SUP) with the NPS for the continued operation and maintenance of the dams and diversions on the Marble and Middle forks of the Kaweah River and for the storage of water at the Mineral King Lakes to better facilitate the timing of generation.

The Project facilities within the FERC Project boundary are located on private lands and public lands administered by the BLM. Downstream of the Project, the Kaweah River flows through private property and lands managed by the USACE (Lake Kaweah and associated recreation areas). Land jurisdiction in the Watershed is shown in Map 7.1-2.

Residents in the vicinity of the FERC Project live in the community of Hammond along State Highway 198 near Kaweah No.1 Powerhouse; at Oakgrove along Mineral King Road near the Kaweah No. 2 Diversion Dam; in dispersed locations particularly in the vicinity of Washburn Cove near the Kaweah No. 2 Powerhouse; and in the community of Three Rivers (FERC 1991). Residences and businesses border the river corridor in the vicinity of the FERC Project. There are also several grazing leases in the Project vicinity (BLM 2014). Land uses within and adjacent to the FERC Project boundary include residential, commercial, agriculture, industrial, public/institutional, and open space/wilderness (Tulare County 2018).

In the Project vicinity, river access is very limited due to the rugged terrain, lack of access trails, and private property adjacent to the river corridor. Two main paved roads provide the primary access to the Kaweah Project vicinity. Mineral King Road parallels the East Fork Kaweah River from the confluence with the Kaweah River to the SNP upstream of the Project. State Highway 198 parallels the Kaweah River from the confluence with Lake Kaweah to areas upstream of the Project in the SNP. Because of the private land ownership, public access to the Kaweah River from State Highway 198 is restricted in the Project vicinity (FERC 1991). There are several other public paved roads that provide access in the Project vicinity, including Dinely Road, Kaweah River Drive, Craig Ranch Road, and North Fork Drive. Map 7.1-3 shows the principal Project facilities and primary access roads in the Project vicinity.

In the vicinity of Lake Kaweah, downstream of the Project, the USACE manages several recreation areas, including Slick Rock and Cobble Ridge, which provide public access to the river and floodplain areas. These recreation areas support a variety of activities, including fishing, hiking, picnicking, boating, sunning, and other water-based activities. Lake Kaweah is also a popular recreation attraction, supporting camping, boating, fishing, and various water sport activities.

7.1.4 Major Water Uses in the Project Vicinity

Existing and potential beneficial uses that apply to the surface waters within the Watershed are identified in the *Water Quality Control Plan for the Tulare Lake Basin* (Basin Plan) (CRWQCB 2018). Beneficial uses identified in the Basin Plan that pertain to the Kaweah River above Lake Kaweah include: (1) municipal and domestic water supply; (2) hydropower generation; (3) water contact and non-contact water recreation; (4) warm freshwater fisheries; (5) cold freshwater fisheries; (6) wildlife habitat; (7) rare, threatened, and endangered species; (8) spawning, reproduction, and/or early development for fisheries; and (9) freshwater replenishment.

SCE operates the FERC Project for hydroelectric generation and consumptive use. Consumptive water is delivered to local water users from the Kaweah No. 1 and Kaweah No. 2 flowlines, consistent with SCE's contractual obligations. The required flow to protect water users during low-runoff periods is up to 1.0 cubic foot per second (cfs) from the Kaweah No. 1 Diversion and 3.0 cfs from the Kaweah No. 2 Diversion. During low-runoff periods, no water is diverted for generation purposes. Refer to Section 3.0 – No-Action Alternative and Section 7.2 – Water Use and Hydrology for more detailed information on operations of the Project.

7.1.5 Other Dams and Diversions

Flows in the Kaweah River Basin upstream of the Project are influenced by several SCE-owned and operated non-FERC Project facilities located in the SNP that store and/or divert water. SCE operates two non-FERC Project diversions under the SUP on the Middle and Marble forks of the Kaweah River (Kaweah No. 3 diversions) that divert flow via the Kaweah No. 3 Flowline to the Kaweah No. 3 Powerhouse. The Kaweah No. 3 diversions (Marble and Middle Fork diversions) were constructed in 1907 and 1913, respectively. Both Kaweah No. 3 diversions are operated in run-of-the-river mode and have limited storage (less than one ac-ft total combined storage).

SCE also stores water in four small non-FERC Project lakes near Mineral King in the upper East Fork Kaweah River watershed (Eagle Lake, Lady Franklin Lake, Crystal Lake, and Upper Monarch Lake) (up to 1,152 ac-ft). The lakes were originally constructed in 1903 and 1905 and are operated under a SUP with the NPS (FERC 1991). SCE releases water from these reservoirs in the late summer and fall months to augment low flows in the East Fork Kaweah River. Flows are diverted from the East Fork Kaweah River to the Kaweah No. 1 Flowline via the Kaweah No. 1 Diversion Dam (FERC Project facilities).

Approximately 10 miles downstream of the FERC Project, the Kaweah River is impounded by USACE's Terminus Dam that forms Lake Kaweah. The Terminus Dam was constructed in 1962 for flood management and to provide river control for irrigation purposes. During the spring runoff season the reservoir stores up to 185,000 ac-ft of water. Water is released from the dam at the direction of the USACE for flood control and to meet irrigation needs. Downstream of Terminus Dam, the Kaweah River flows are diverted for irrigation of adjacent farmlands. Water releases serve multiple local water districts, including the Tulare Irrigation District and the Kaweah Delta Water Conservation

District, and urban areas, including the cities of Tulare and Visalia. The Terminus Power Plant, completed in 1992 by the Kaweah River Power Authority, generates hydroelectricity at the dam. The power plant is jointly managed by Tulare Irrigation District and the Kaweah Delta Water Conservation District, and the electricity is distributed by SCE. The power plant has a capacity of 20.09 megawatts (FERC 2003a and b).

7.1.6 Literature Cited

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TABLES

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Table 7.1-1. Information on Drainage Area and Stream Length of Waters in the Kaweah Watershed

Kaweah River Watershed Sub-Basin	Total Area (mi ²)	Sub-divided Areas (mi ²)	Stream Length (mi)	Elevation (ft)	
				Starting	Ending
Kaweah River Watershed					
Marble Fork Kaweah River Sub-Basin					
Marble Fork Kaweah River – Headwaters to confluence with Middle Fork Kaweah River	52.5		17.4	10,920	2,020
Middle Fork Kaweah River Sub-Basin					
Middle Fork Kaweah River – Headwaters to confluence with Marble Fork Kaweah River	103.1		20.3	11,005	2,020
East Fork Kaweah River Sub-Basin					
East Fork Kaweah River – Headwaters to confluence with Kaweah River	95		23.3	10,200	1,270
East Fork Kaweah River – Headwaters to Kaweah No. 1 Diversion Dam		85.7	18.6	10,200	2,585
East Fork Kaweah River – Kaweah No. 1 Diversion Dam to confluence with Kaweah River		9.3	4.7	2,585	1,270
Kaweah River Sub-Basin					
Kaweah River – Confluence of Middle Fork and Marble Fork to Lake Kaweah	36.6		12.6	2,020	720
Kaweah River – Confluence of Middle Fork and Marble Fork to Kaweah No. 2 Diversion Dam		10.3	3.6	2,020	1,360
Kaweah River – Kaweah No. 2 Diversion Dam to confluence with East Fork Kaweah River		2.1	0.6	1,360	1,260
Kaweah River – Confluence with East Fork Kaweah River to Lake Kaweah		24.2	8.4	1,260	720
North Fork Kaweah River Sub-Basin					
North Fork Kaweah River – Headwaters to confluence with Kaweah River	137.5		26.4	8,400	820

Kaweah River Watershed Sub-Basin	Total Area (mi ²)	Sub-divided Areas (mi ²)	Stream Length (mi)	Elevation (ft)	
				Starting	Ending
South Fork Kaweah River Sub-Basin					
South Fork Kaweah River – Headwaters to confluence with Kaweah River	89.4		24.7	9,480	750
Lake Kaweah Sub-Basin					
Lake Kaweah – Local Watershed	46.9		–	720	694
Kaweah River Watershed – Total Area	561.0				

Table 7.1-2. Snow Courses and Meteorological Stations Located in the Vicinity of the Kaweah Project

Name	Operator	Agency	Elevation (ft)	Location	
				Latitude	Longitude
Snow Courses					
Panther Meadow	PTM	SEKI NP	8600	36.588	-118.717
Mineral King	MNK	SEKI NP	8000	36.437	-118.587
Giant Forest	GFR	SEKI NP	6400	36.57	-118.768
Meteorological Stations					
Three Rivers PH No. 1	3RV	SCE	1140	36.467	-118.867
Lake Kaweah Weather	LKW	USACE	570	36.4153	-118.6975
Giant Forest	GFR	USACE	6650	36.562	-118.765
Atwell Camp	ATW	USACE	6400	36.464	-118.631
Lake Kaweah	KAWC1	USACE	540	36.41583	-119.00556
Three Rivers Museum	D0117	APRSWXNET/CWOP and MADIS	860	36.44829	-118.90016
Ash Mountain	TSHC1	BLM and NPS	1730	36.491389	-118.825278
Sequoia Natl Park-Lower Kaweah	CQ161	California Air Resources Board and Local Air District	6234	36.56611	-118.77778
WX6HNX-11 Sequoia NP	AT846	APRSWXNET/CWOP and MADIS	6690	36.60417	-118.73306
Case Mountain	CSWC1	BLM and National Interagency Fire Center	6450	36.410667	-118.809222
Pumpkin Hollow Bridge	CW4177	CWOP	1250	36.4775	-118.8445

APRSWXNET/

CWOP and MADIS = APRSWXNET/Citizen Weather Observer Program and Meteorological Assimilation Data Ingest System

BLM = Bureau of Land Management

NPS = National Park Service

SCE = Southern California Edison Company

SEKI NP = Sequoia and Kings Canyon National Parks

USACE = U.S. Army Corps of Engineers

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FIGURES

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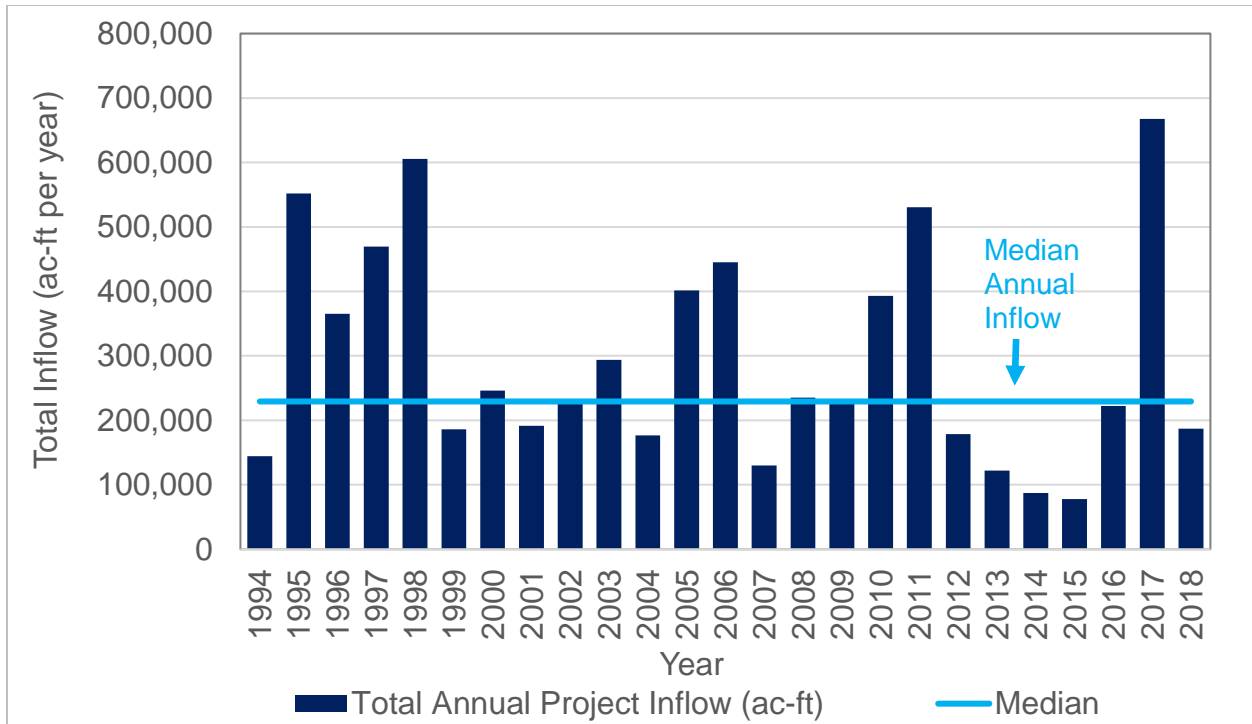


Figure 7.1-1. Annual Inflow to the Kaweah Project (WY 1994–2018)²

² The period of record (POR) used to characterize recent historical flows in the Kaweah River and East Fork Kaweah River extends from water year 1994 through 2018. This time period best represents Project operations since issuance of the FERC license and recent climatic conditions.

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MAPS

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Total Kaweah River Watershed Area = 561.0 mi²

North Fork = 137.5 mi²

Marble Fork = 52.5 mi²

Kaweah River = 36.6 mi²

Middle Fork = 103.1 mi²

East Fork = 95.0 mi²

Lake Kaweah = 46.9 mi²

South Fork = 89.4 mi²

SCE Facilities

- Powerhouse
- Diversion
- Dam
- Utility
- Forebay
- Flowline
- Penstock
- Transmission Line

Other Features

- Dam
- City/Town
- Highway/Road
- Watercourse
- Water Body
- Kaweah River Watershed Boundary

Watershed Sub-Basin Boundary

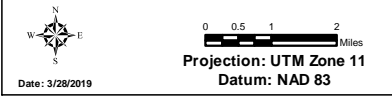
- Marble Fork Kaweah River
- Middle Fork Kaweah River
- East Fork Kaweah River
- Kaweah River
- North Fork Kaweah River
- South Fork Kaweah River
- Lake Kaweah



Kaweah Project - FERC Project No. 298

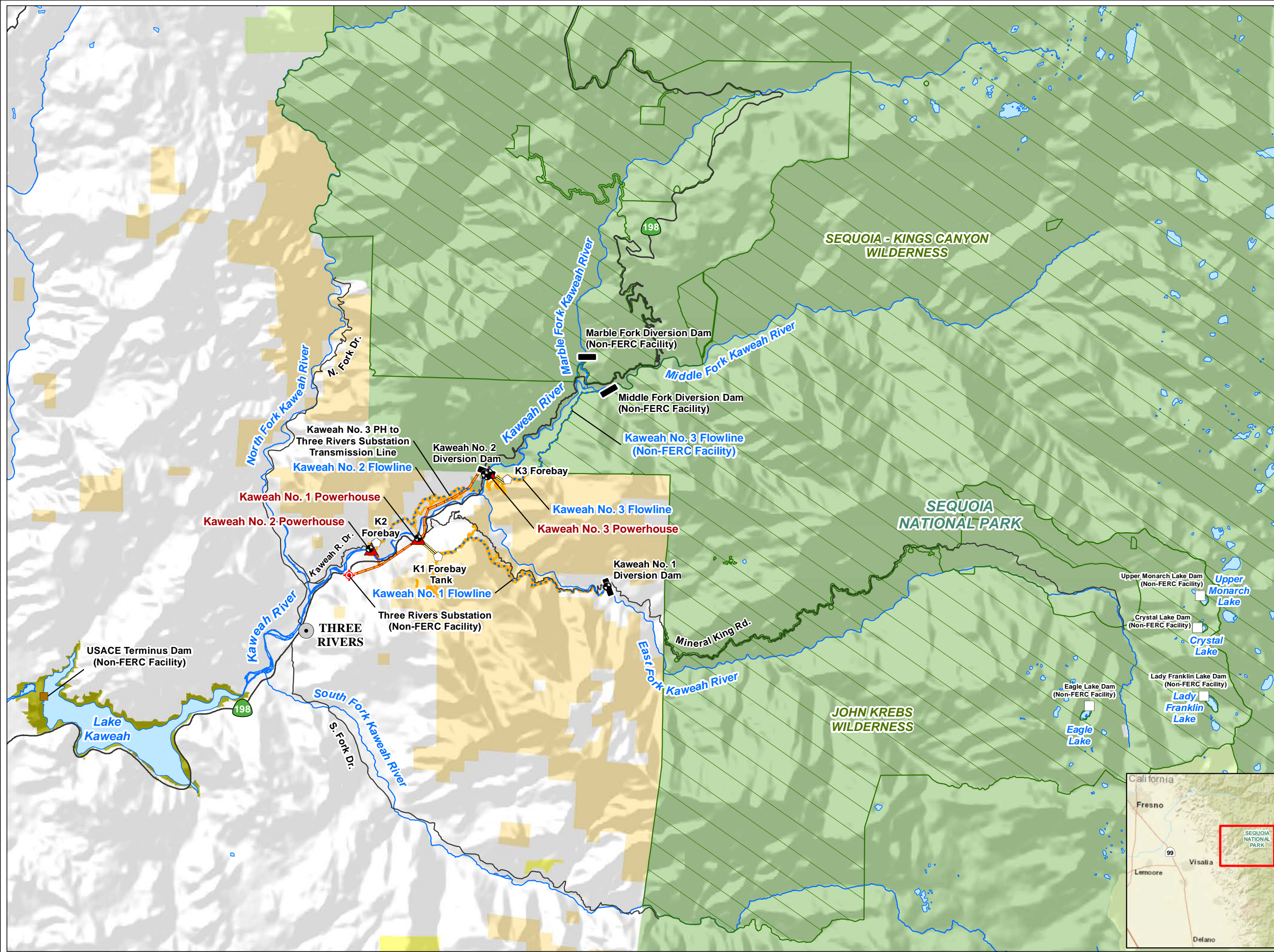
Map 7.1-1

Kaweah River Watershed and Sub-Basins




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- SCE Facilities**
- ▲ Powerhouse
 - Diversion
 - Dam
 - ⬢ Utility
 - ◊ Forebay
 - Gage
 - ⋯ Flowline
 - Penstock
 - Transmission Line
 - Project FERC Boundary
- NOTE: The Marble and Middle Fork Diversion Dams are not in designated Wilderness
- Other Features**
- Dam
 - City/Town
 - Highway/Road
 - Watercourse
 - Water Body
- Land Jurisdiction***
- Bureau of Land Management
 - U.S. Army Corps of Engineers
 - National Park Service
 - U. S. Forest Service
 - State Of California
 - Private (Blank)
- *SOURCE: BLM 2016
- Land Management**
- ▨ National Wilderness Area






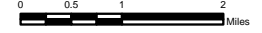
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Kaweah Project - FERC Project No. 298

Map 7.1-2
Land Jurisdictions and Other Dams and Diversions in the Vicinity of the Kaweah Project



Date: 4/25/2019

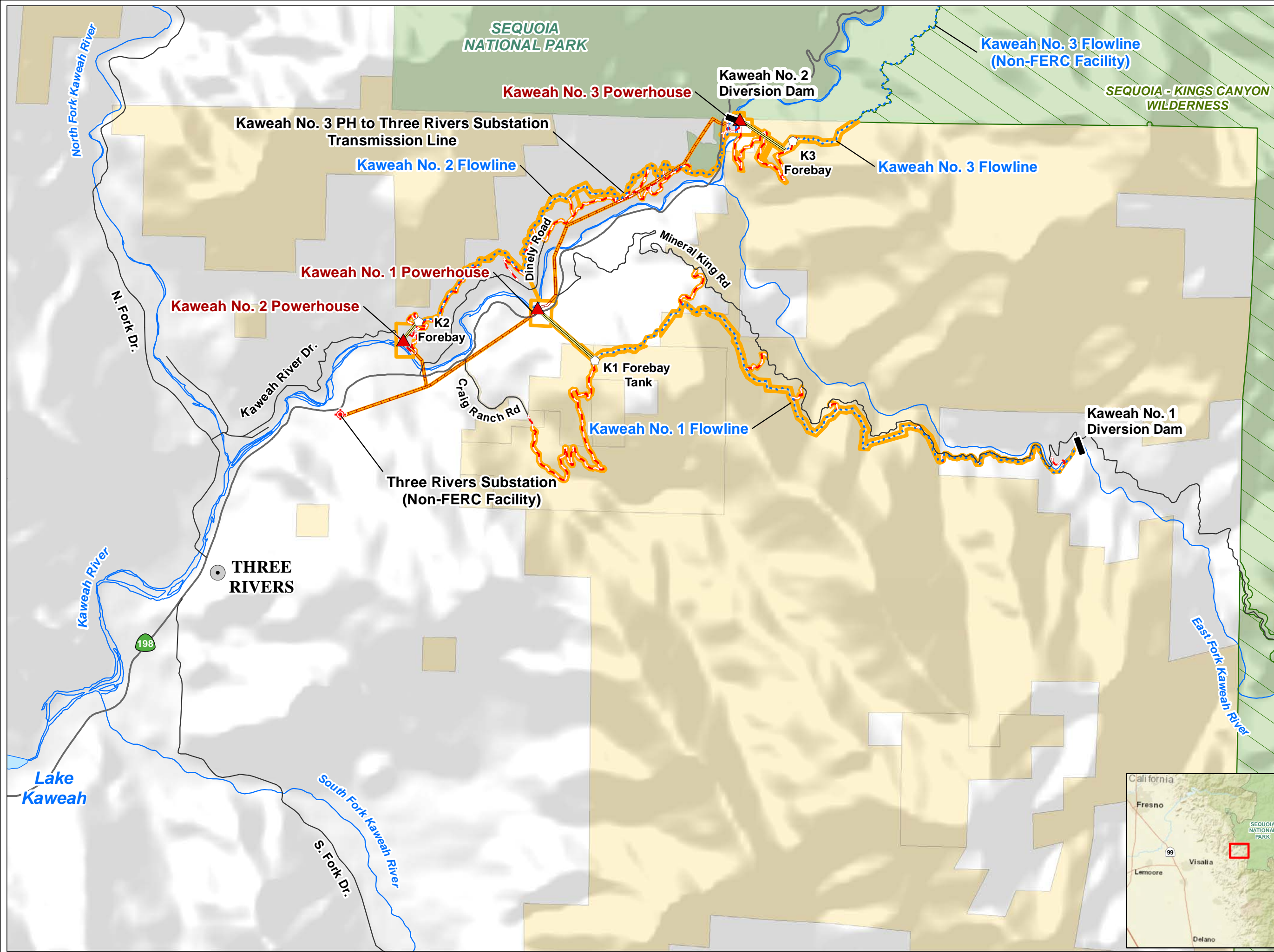


Projection: UTM Zone 11
Datum: NAD 83


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- Facilities**
- Powerhouse
 - Diversion
 - Utility
 - Forebay
 - Flowline
 - Penstock
 - Transmission Line
 - Project Road
 - FERC Boundary
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
- Land Jurisdiction***
- Bureau of Land Management
 - National Park Service
 - Private (Blank)
- *SOURCE: BLM 2016
- Land Management**
- National Wilderness Area




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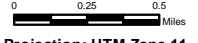
Kaweah Project - FERC Project No. 298

Map 7.1-3

Principal Kaweah Project Facilities



Date: 3/28/2019



Projection: UTM Zone 11
Datum: NAD 83

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LIST OF ACRONYMS

ac-ft	acre-feet
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
CRWQCB	California Regional Water Quality Control Board
DWR	Department of Water Resources
FERC or Commission	Federal Energy Regulatory Commission
MIF	minimum instream flow
NPS	National Park Service
POR	period of record
Project	Kaweah Project
SCE	Southern California Edison Company
SNP	Sequoia National Park
SUP	Special Use Permit
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Watershed	Kaweah River Watershed
WY	Water Year

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7.2 WATER USE AND HYDROLOGY

This section describes water use and hydrology associated with Southern California Edison Company's (SCE) Kaweah Project (Project). This section specifically addresses the water use and hydrology components of the Federal Energy Regulatory Commission (FERC or Commission) regulations. Information on water quality is addressed in Section 7.3 – Water Quality.

Information on (1) upstream and downstream requirements by other parties that may constrain operations of the Project; and (2) existing water rights and water rights applications that could potentially affect or be affected by the Project is also provided in Section 3.0 – No-Action Alternative and Section 7.1 – Description of the Kaweah River Basin.

7.2.1 Information Sources

Existing information regarding water use and hydrology associated with the Project was collected, compiled, and reviewed. Relevant information used to prepare this section was obtained from the following sources:

- Department of Water Resources (DWR) Bulletin 120 (DWR 2019);
- Environmental Assessment, Kaweah Project FERC Project No. 298-000 (FERC 1991);
- Order amending license re Kaweah River Power Authority's Terminus Dam Project under P-3947 (FERC 2003a);
- Errata notice to notice dated 12/17/03 Amending License re Kaweah River Power Authority under P-3947 (FERC 2003b);
- Kaweah River Investigation, California, Final Feasibility Report (USACE 1996);
- Order Amending Minimum Flow Release Requirements for Southern California Edison's Project No. 298 (FERC 1994);
- Order Issuing New License (Major) for Southern California Edison's Project No. 298 (FERC 1992);
- Special Use Permit (SUP) for Southern California Edison (NPS 2016);
- United States Geological Survey (USGS) Surface-Water Data for the Nation (USGS 2019); and
- Water Quality Control Plan for the Tulare Lake Basin (CRWQCB 2018).

7.2.2 Existing Water Uses

This section describes existing water uses associated with the Project and other water uses upstream and downstream of the Project.

7.2.2.1 Existing Project Water Uses

Existing and potential beneficial uses that apply to the surface waters within the Kaweah River Watershed (Watershed) are identified in the *Water Quality Control Plan for the Tulare Lake Basin* (Basin Plan) (CRWQCB 2018). Beneficial uses identified in the Basin Plan that pertain to the Kaweah River above Lake Kaweah include: (1) municipal and domestic water supply; (2) hydropower generation; (3) water contact and non-contact water recreation; (4) warm freshwater fisheries; (5) cold freshwater fisheries; (6) wildlife habitat; (7) rare, threatened, and endangered species; (8) spawning, reproduction, and/or early development for fisheries; and (9) freshwater replenishment.

SCE operates the Project for hydroelectric generation. Consumptive water is also delivered to local water users from the Kaweah No. 1 and Kaweah No. 2 flowlines, consistent with SCE's contractual obligations, and to the Hammond Fire Station near Hammond consistent with SCE's water rights and agreements.

The Project has three powerhouses: Kaweah No. 1 Powerhouse, Kaweah No. 2 Powerhouse, and Kaweah No. 3 Powerhouse. Water is diverted from the East Fork Kaweah River at the Kaweah No. 1 Diversion Dam and conveyed to the Kaweah No. 1 Powerhouse via the Kaweah No. 1 Flowline. Water is diverted from the Kaweah River at the Kaweah No. 2 Diversion Dam and conveyed to the Kaweah No. 2 Powerhouse via the Kaweah No. 2 Flowline. Water conveyed to Kaweah No. 3 Powerhouse is diverted at the Middle Fork and Marble Fork diversions (non-FERC facilities). The Project's annual net generation since issuance of the current license (1992–2018) and estimated dependable capacity is provided in Section 3.0 – No-Action Alternative.

The Project has two conflicting obligations (demands) associated with operation of the Project. These obligations include providing: (1) minimum instream flow (MIF) releases consistent with the flow schedule in License Article 405 of the existing FERC license (Table 7.2-1); and (2) domestic water to local users through the Project flowlines based on a prior contractual entitlement dating back to 1903. SCE must maintain a continuous flow up to a maximum of 1 cubic foot per second (cfs) from the Kaweah No. 1 Diversion and up to a maximum of 3 cfs from the Kaweah No. 2 Diversion to meet SCE's contractual obligations to local water users consistent with their pre-1914 water rights. During low-runoff periods, consumptive water is diverted and delivered to local water users, but no water is diverted for generation purposes. Figures 7.2-1 and 7.2-2 illustrate actual inflow compared to MIF release requirements and water supply obligations at the Kaweah No. 1 Diversion and Kaweah No. 2 Diversion, respectively.

Historically, SCE has requested and obtained approval from resource agencies (California Department of Fish and Wildlife [CDFW] and U.S. Fish and Wildlife Service [USFWS]) to temporarily modify (reduce) MIF releases below the Kaweah No. 1 and

Kaweah No. 2 diversions when forecasted inflows were approaching the combined flow necessary to meet both water supply and MIF release requirements. These temporary flow modifications from the resource agencies were necessary to ensure that SCE could comply with the license conditions based on uncertainty in actual runoff (magnitude and/or timing). SCE obtained agency approval for temporary modifications of MIFs below the Kaweah No. 1 Diversion in four Dry years and below Kaweah No. 2 Diversion in eight years (four Dry years and four Normal years) (Table 7.2-2 and Figure 7.2-3).¹

Although, SCE obtained agency approval for temporary modifications of MIFs when inflows were projected to not meet both the MIF requirements and the water supply commitments, the approved reductions in MIF were only implemented at the Kaweah No. 2 Diversion in 2002, 2012, 2015, and 2016 (Table 7.2-2). In 2002, SCE implemented the flow modifications, reducing the MIF release by 1.5 cfs on average for 13 days. In 2012, SCE reduced the MIF release by 1 cfs on average for three days. In 2015, SCE reduced the MIF release by 0.35 cfs on average for four days. In 2016, SCE reduced the MIF release by 0.35 cfs on average for four days. In 2016, SCE's original request for a temporary flow modification (through August 31) needed to be extended as runoff in the Kaweah Watershed was projected to remain low, due to drought conditions in the region. On August 30, 2016, SCE requested a temporary flow variance through December 31, 2016. SCE's temporary flow variance request was approved by FERC on September 8, 2016. During the entire flow modification period, SCE reduced the MIF release by 2.68 cfs on average for 25 days.

In the East Fork Kaweah River, stream flows were sufficient to meet both the MIF requirements and the water supply commitments in all years despite requests for flow modifications based on projected inflow.

7.2.2.2 Other Projects Upstream and Downstream of the Kaweah Project

Flows upstream of the Project are influenced by several SCE operated non-FERC facilities located in the Sequoia National Park (SNP). All non-FERC facilities are currently operated under a Special Use Permit (SUP) issued to SCE by the National Park Service (NPS). In the upper East Fork Kaweah River Watershed, SCE stores water in four small non-FERC reservoirs (Eagle Lake, Lady Franklin Lake, Crystal Lake, and Upper Monarch Lake). The reservoirs (collectively referred to as Mineral King Lakes) were originally constructed between 1903 and 1905 and have a combined storage capacity of approximately 1,152 acre-feet (ac-ft). SCE releases water from these reservoirs in the late summer and fall months to augment flows in the East Fork Kaweah River.

On the Middle and Marble forks of the Kaweah River, SCE operates two non-FERC diversions (Middle Fork Diversion and Marble Fork Diversion) and flowlines. The Middle Fork and Marble Fork diversions and associated flowlines were constructed between 1907 and 1913, respectively. Both diversions are operated in a run-of-river mode and have limited storage capacity (less than one ac-ft total combined storage). Flows from the Middle and Marble forks of the Kaweah River are diverted and conveyed through the

¹ See Table 7.2-1 for a definition of water year designations.

Kaweah No. 3 Flowline to the Kaweah No. 3 Powerhouse. All but the last 2,975 feet of the flowline is located in the SNP and is not part of the FERC License. The portion of the flowline outside the SNP and the Kaweah No. 3 Powerhouse are FERC Project facilities.

Approximately ten miles downstream of the Project, the Kaweah River is impounded by the United States Army Corps of Engineers' (USACE) Terminus Dam that forms Lake Kaweah. The Terminus Dam was constructed in 1962 for flood control and irrigation purposes. During the spring runoff season, the reservoir stores up to 185,000 ac-ft of water. Downstream of Terminus Dam, the Kaweah River flows are diverted for irrigation of adjacent farmlands. Water releases serve multiple local water districts, including the Tulare Irrigation District and the Kaweah Delta Water Conservation District, and urban areas, including the cities of Tulare and Visalia. The Terminus Power Plant (FERC Project No. 3947), completed in 1992 by the Kaweah River Power Authority, generates hydroelectricity at the dam. The power plant is jointly managed by Tulare Irrigation District and the Kaweah Delta Water Conservation District. The power plant has a capacity of 20.09 megawatts (FERC 2003a, 2003b).

7.2.3 Hydrology

This section describes existing FERC license flow requirements, flow gages, hydrology, and reservoir storage associated with operations of the Project.

7.2.3.1 Existing FERC License Flow Requirements

The MIF requirements, as specified in License Article 405 of the existing FERC License, for the bypass reaches² associated with the Project are presented in Table 7.2-1. MIF release requirements at the Project diversions are based on water year type. In the existing FERC license, water year types for the Project are defined as either "Normal" or "Dry" based on the April 1 through July 1 forecast of runoff in the Kaweah River at Terminus Reservoir as published by the DWR in its May 1 forecast. A Dry Year is defined as a year when the forecast is equal to or less than 172,000 ac-ft of runoff. A Normal Year is defined as a year when the forecast is greater than 172,000 ac-ft of runoff. The MIF release schedules take effect on May 10 following the May 1 forecast and extend through May 9 of the following calendar year (FERC 1994).

A summary of water year types from 1974–2018, based on the definition of Normal and Dry in the existing FERC license are provided in Table 7.2-3 (DWR 2018). This time period (1974–2018) is representative of long-term runoff patterns and climate conditions in the Watershed including wet and dry years in the 1970s and 1980s, prior to issuance of the existing FERC license in 1994. Water year types over a longer time period (1938 through 2018) are provided in Appendix 7.2-A for reference. Between 1974 and 2018, 67% of the years were classified as Normal and 33% were classified as "Dry". The distribution of DWR April–July and Water Year runoff forecasts in the Kaweah River at Terminus Reservoir from 1974–2018 and associated water year types is shown in Figure 7.2-3. In general, the pattern of each forecast type is similar and the exceedance

² A bypass reach is a segment of a river downstream of a diversion facility where Project operations result in the diversion of a portion of the water from the river.

ranks are comparable. Years where a flow modification was requested (Table 7.2-2) and years with critically low flow where forecasted inflows were approaching the combined flow necessary to meet both water supply and MIF release requirements (Figure 7.2-1 and 7.2-2) are depicted in Figure 7.2-3.

In addition to MIF requirements, License Article 404 specifies that the “Licensee shall operate the Project such that flows below diversion dams and Powerhouses Nos. 1 and 2 are not altered at a rate greater than 30 percent of the existing streamflow per hour” (i.e., ramping rates).

7.2.3.2 Existing Flow Gages

SCE currently maintains a network of flow gaging stations to monitor and record flows associated with operation of the Project. This network consists of eight stations that currently measure flow in bypass reaches, Project flowlines, and Project powerhouses (Table 7.2-4). Additional gages have historically recorded flows in the bypass reaches and flowlines associated with the Project and these are identified on Table 7.2-5. Additional Watershed gages are listed in Table 7.2-6. The location of current and historic flow gages in the bypass reaches and flowlines associated with the Kaweah Project, and other non-Project flow gages in the Kaweah Watershed are shown on Map 7.2-1.

7.2.3.3 Hydrology Associated with Project Operations

Flow data from existing and historic Project gages and other gages in the Watershed were collected and compiled into an Excel database (Tables 7.2-4 through 7.2-6). Data were reviewed to identify gages with data gaps or questionable data and those that only recorded low flows. Records with poor data were not included in the hydrology summaries.

The period of record (POR) used to characterize recent historical flows in the Kaweah River and East Fork Kaweah River extends from water year 1994 through 2018 (October 1, 1994 through September 30, 2018)³. As discussed above, this time period best represents Project operations since issuance of the FERC license and recent climatic conditions.

Hydrology

The Project is operated in a run-of-river mode. The Project diverts water from the East Fork Kaweah River at the Kaweah No. 1 Diversion and from the Kaweah River at the Kaweah No. 2 Diversion for power generation and to meet contractual obligations with pre-1914 water users. These diversions alter the volume of water in the rivers

³ A water year is defined as the period between October 1 of one year and September 30 of the following year. The water year is designated by the calendar year in which it ends, so that the 2013 water year started on October 1, 2012 and ended on September 30, 2013.

downstream of Project diversions (bypass reaches), with minimal to no change in the annual seasonal flow pattern. The bypass reaches associated with the Project include:

- East Fork Kaweah River, from the Kaweah No. 1 Diversion to the confluence with the Kaweah River (4.7 miles); and
- Kaweah River, from the Kaweah No. 2 Diversion to the confluence of the Kaweah No. 2 Powerhouse Tailrace and the Kaweah River (4.1 miles).

The amount and timing of flow diverted is a function of inflow (runoff), FERC License requirements for MIF and ramping rates, flowline capacities, and the minimum flow required to maintain sufficient head in the flowline to meet water delivery contractual obligations. Total annual inflow into the Project (combined inflow at the Kaweah No. 1 and No. 2 diversions) in water years 1994–2018 ranged from approximately 78,000 ac-ft (2015) to more than 668,000 ac-ft (2017). The median total annual inflow was approximately 229,000 ac-ft during this period (Figure 7.2-4).

The Kaweah No. 1 Flowline (East Fork Kaweah River) can divert up to 24 cfs, and the Kaweah No. 2 Flowline (Kaweah River) can divert up to 87 cfs. To maintain sufficient head pressure to meet water delivery contractual obligations along the flowlines, SCE must maintain a continuous flow up to a maximum of 1 cfs in the Kaweah No. 1 Flowline and up to a maximum of 3 cfs in the Kaweah No. 2 Flowline. Water diverted into the flowlines at Project diversions passes through Project powerhouses generating electricity prior to returning to the Kaweah River downstream of the Project tailraces (with the exception of water diverted for consumptive purposes). Additional information on consumptive water use, including water user diversion points, is provided in Section 3.0 – No-Action Alternative.

Figures 7.2-5a-c show monthly average flows in the bypass reaches (below the diversions), Project flowlines, and flow into the powerhouses for example water years that are representative of different runoff conditions into the Project diversions. The following example water years were selected to be representative of different water year types:

- Normal Water Year – 2006
- “Drier” Normal Year – 2009
- Dry – 2014

SCE typically diverts water throughout the year in wetter years, peaking in the winter and early summer months (Figures 7.2-5a-c). In drier years, low summer and winter flows (e.g., August to November) typically preclude diversion for generation. Diversions for generation in dry years typically only occur in spring (including Normal years with low runoff and Dry years) (Figures 7.2-5a-c). In “Drier” Normal years, inflows can be extremely low in the late summer/fall resulting in reductions in flow diversions (e.g., Figure 7.2-5, 2009). In all years, after runoff and during the driest months

(e.g., August through December), water withdrawals due to Project operation appreciably reduce flow exceedance in all Project reaches.

A detailed summary of the hydrology associated with the Project (river reaches, flowlines, and powerhouses) and at selected gages upstream and downstream of the Project is provided in the following appendices:

- Appendix 7.2-B – This appendix includes daily flow graphs in the bypass reaches and flowlines associated with the Project by location.
- Appendix 7.2-C – This appendix includes tables of monthly summary statistics (maximum, minimum, and average discharge) and exceedances (10%, 20%, 50%, 80%, and 90%) for the bypass reaches and flowlines associated with the Project.
- Appendix 7.2-D – This appendix includes monthly exceedance plots (10%, 20%, 50%, 80%, and 90%) bypass reaches and flowlines associated with the Kaweah Project from WY 1994–2018.
- Appendix 7.2-E – This appendix includes exceedance probability plots for existing and unimpaired daily discharge by month for bypass reaches associated with the Project.
- Appendix 7.2-F – This appendix includes tables summarizing monthly average flows in the bypass reaches and flowlines associated with the Project.
- Appendix 7.2-G – This appendix includes a table summarizing instantaneous peak annual flows for the bypass reaches and flowlines associated with the Project.
- Appendix 7.2-H – This appendix includes flows at selected gages upstream and downstream of the Project.

7.2.3.4 Reservoir Storage

The Project facilities have minimal water storage (approximately 11.93 ac-ft combined) in one forebay tank and two small forebays located at the terminus of the flowlines, above the powerhouses (Kaweah No. 1 Forebay Tank – 0.18 ac-ft; Kaweah No. 2 Forebay – 0.75 ac-ft; and Kaweah No. 3 Forebay – 11 ac-ft). Water levels in the forebays remain constant (full) during Project operations. The forebays may be drained during the Project's annual maintenance outage. The Project also includes diversion pools behind Kaweah No. 1 Diversion Dam and Kaweah No. 2 Diversion Dam (<0.03 ac-ft and 1 ac-ft of storage, respectively). Elevations of the diversion pools remain constant (full) year-round. The locations of these Project facilities are shown on Map 7.2-1.

Water stored in four small reservoirs (with combined storage capacity of 1,152 ac-ft) located on tributaries to the East Fork Kaweah River, upstream of the Kaweah No. 1 Diversion Dam within the SNP are also utilized by the Project. These reservoirs are operated under a SUP with the SNP and are, therefore, not under FERC

jurisdiction. However, the water rights associated with these reservoirs influence the operation of the Kaweah No. 1 Powerhouse, which is under FERC jurisdiction.

7.2.4 References

- CRWQCB (California Regional Water Quality Control Board) Central Valley Region. 2018. Water Quality Control Plan for the Tulare Lake Basin Second Edition. Revised May 2018. Available at: https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/tlbp_201805.pdf.
- DWR (Department of Water Resources). 2019. Department of Water Resources Bulletin 120. Available at: <http://cdec.water.ca.gov/snow/bulletin120/>.
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- USACE (U.S. Army Corps of Engineers). 1996. Kaweah River Investigation, California, Final Feasibility Report. United States Department of the Army, South Pacific Division, Sacramento District. September.
- USGS (U.S. Geological Survey). 2019. USGS Surface-Water Data for the Nation. Available at: <http://waterdata.usgs.gov/nwis/sw>.

TABLES

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Table 7.2-1. Minimum Instream Flow Requirements for Bypass Reaches Associated with the Kaweah Project.^{1,2}

Month	Kaweah No. 1 Diversion		Kaweah No. 2 Diversion	
	Normal Year (cfs)	Dry Year (cfs)	Normal Year (cfs)	Dry Year (cfs)
October	5	5	11	5
November	5	5	11	5
December	5	5	11	5
January	5	5	20	10
February	5	5	20	10
March	10	10	30	20
April	10	10	30	30
May	10	10	30	30
June	10	10	30	30
July	10	10	20	10
August	5	5	20	10
September	5	5	11	5

Source: FERC License Article 405, as amended on April 20, 1994.

¹ Runoff of Kaweah River at Terminus Reservoir for April 1 through July 31, for the current year, as estimated by the California Department of Water Resources (DWR) on or about May 1 of each such calendar year shall be used to distinguish between a normal water year and a dry water year for the purpose of this article. A "Normal Year" is defined as a forecasted runoff of 172,000 acre-feet or more. A "Dry Year" is defined as a forecasted runoff is equal to or less than 172,000 acre-feet. The determination of either a normal water year or a dry water year shall then be used in maintaining the appropriate minimum flow release for the period May 10 of each calendar year through May 9 of the succeeding calendar year.

² This flow schedule may be temporarily modified if required by operating emergencies beyond the control of the licensee or for short periods on mutual agreement between the licensee, the U.S. Fish and Wildlife Service, and the California Department of Fish and Wildlife. If the flow is so modified, the licensee shall notify the Commission as soon as possible, but no later than 10 days after each such incident.

Table 7.2-2. Recent History of Temporary Flow Modifications Requested by SCE and Approved by Resource Agencies (2002–2019).

SCE Modification Request	Resource Agency Approval	Water Year Type	Modification Implemented (yes/no)	Amount/ Duration of Offset Water (cfs/days)
Kaweah No. 1 Diversion				
June 29, 2015	CDFW: July 16, 2015 USFWS: August 26, 2015	Dry	No	N/A
August 8, 2014	CDFW: August 28, 2014 USFWS: September 2, 2014	Dry	No	N/A
September 5, 2013	CDFW: September 16, 2013 USFWS: September 11, 2013	Dry	No	N/A
September 10, 2007	CDFW: Approved USFWS: October 19, 2007	Dry	No	N/A
Kaweah No. 2 Diversion				
August 11, 2016 ¹	CDFW: August 17, 2016 USFWS: August 18, 2016	Normal	Yes	Average 2.68 cfs/25 days
June 29, 2015	CDFW: July 16, 2015 USFWS: August 26, 2015	Dry	Yes	Average 0.35 cfs/4 days
August 25, 2014	CDFW: August 28, 2014 USFWS: September 2, 2014	Dry	No	N/A
August 16, 19, 21, and 22, 2013	CDFW: August 27, 2013 USFWS: August 23, 2013	Dry	No	N/A
August 3, 2012	CDFW: August 8, 2012 USFWS: August 9, 2012	Normal	Yes	Average 1 cfs/3 days
September 25, 2009	CDFW: Approved USFWS: Approved	Normal	No	N/A
September 10, 2007	CDFW: Approved USFWS: October 19, 2007	Dry	No	N/A
August 16, 2002	CDFW: August 16, 2002 USFWS: August 16, 2002	Normal	Yes	Average 1.5 cfs/13 days

¹ In 2016, SCE's original request for a temporary flow modification (through August 31) needed to be extended as runoff in the Kaweah Watershed was projected to remain low, due to drought conditions in the region. On August 30, 2016, SCE requested a temporary flow variance through December 31, 2016. SCE's temporary flow variance request was approved by FERC on September 8, 2016 (156 FERC ¶62,183).

Table 7.2-3. Historic Water Year Types for the Kaweah River at Terminus Reservoir Based on Department of Water Resources Bulletin 120 May 1 Runoff Forecast (1974–2016).¹

Year	Apr-Jul Runoff Forecast (TAF)	Water Year Type Classification
1974	320	Normal
1975	290	Normal
1976	80	Dry
1977	40	Dry
1978	600	Normal
1979	250	Normal
1980	495	Normal
1981	255	Normal
1982	605	Normal
1983	720	Normal
1984	220	Normal
1985	220	Normal
1986	490	Normal
1987	110	Dry
1988	110	Dry
1989	150	Dry
1990	95	Dry
1991	210	Normal
1992	125	Dry
1993	360	Normal
1994	135	Dry
1995	500	Normal
1996	320	Normal
1997	320	Normal
1998	540	Normal
1999	160	Dry
2000	240	Normal
2001	190	Normal
2002	195	Normal
2003	225	Normal
2004	160	Dry
2005	380	Normal
2006	480	Normal
2007	95	Dry
2008	230	Normal

Year	Apr-Jul Runoff Forecast (TAF)	Water Year Type Classification
2009	195	Normal
2010	380	Normal
2011	490	Normal
2012	175	Normal
2013	83	Dry
2014	72	Dry
2015	38	Dry
2016	210	Normal
2017	550	Normal
2018	249	Normal

¹ Data obtained from: DWR Bulletin 120. Available at: <http://cdec.water.ca.gov/snow/bulletin120/>. Water Year Types for Apr 1 – Jul 1 Forecast of Runoff in the Kaweah River at Terminus Reservoir based on Bulletin 120 May 1 Forecast.

TAF = thousand acre-feet

Table 7.2-4. Current Project Flow Gages.

Gage Name	SCE Gage Number	USGS Station Number	Period of Record	Latitude, Longitude	Notes
East Fork Kaweah River					
East Fork Kaweah River near Three Rivers, CA	201	USGS 11208730	6/1/52-present	36°27'05", 118°47'15"	Traditional stage-discharge stream gage located on the south-west bank of the East Fork Kaweah River. Gage measures streamflow between the intake dam and the gage pool weir. Data gaps: 10/1/1955 - 9/30/1957; 10/1/1978 - 9/30/1993
	201a		10/1/95-present	36°27'05", 118°47'15"	Operational AVM on a release pipe that comes out of the sandbox used by SCE to measure minimum instream flow releases.
East Fork Kaweah River Conduit 1 near Three Rivers, CA	202		10/1/02-present	36°27'05", 118°47'19"	Operational AVM just downstream from the flowline intake that measures flow in the flowline.
East Fork Kaweah River Conduit 1 at Power Plant near Hammond, CA	200a	USGS 11208800	10/1/02-present	36°27'55", 118°51'43"	AVM located on the penstock to the Kaweah No. 1 Powerhouse that measures flow into the powerhouse.

Gage Name	SCE Gage Number	USGS Station Number	Period of Record	Latitude, Longitude	Notes
Kaweah River					
Kaweah River below Conduit No. 2 near Hammond, CA	203	USGS 11208600	10/1/93-present	36°29'04", 118°50'06"	Traditional stage-discharge stream gage located on the west bank of the Kaweah River that measures stream flow approximately 500 feet downstream of the Kaweah No. 2 Diversion Dam.
Kaweah River Conduit No. 2 near Hammond, CA	204a		12/8/05-present	36°29'10", 118°50'09"	Operational Acoustic Doppler Current Profiler (ADCP) located on the Kaweah No. 2 Flowline that measures flow from the Kaweah No. 2 Intake into the flowline.
Kaweah River Conduit No. 2 at Powerhouse near Hammond, CA	205a	USGS 11208818	10/1/02-present	36°27'42", 118°52'46"	This gage is an AVM located on the penstock to the Kaweah No. 2 Powerhouse that measures flow into the powerhouse.
Middle Fork Kaweah River Conduit No. 3 A Power Plant near Hammond, CA	206a	USGS 11208565	10/1/02-present	36°29'10", 118°50'08"	This gage is an AVM located on the penstock to the Kaweah No. 3 Powerhouse that measures flow into the powerhouse. This gage measures the combination of flows measured at SCE gage nos. 208 and 210.

Table 7.2-5. Historic Gages in the Project Vicinity.

Gage Name	SCE Gage Number	USGS Station Number	Period of Record	Lat, Long	Notes
East Fork Kaweah River					
Combined Flow East Fork Kaweah River near Three Rivers CA	--	USGS 11208731	6/1/52-9/30/02	36°27'05", 118°47'15"	Historic Calculated Flow Gage. Combined flow of USGS gage 11208730 and USGS gage 11208720. Data gaps: 10/1/1955 - 9/30/1957; 10/1/1978 - 9/30/1993
East Fork Kaweah River Conduit 1 near Three Rivers, CA	202	USGS 11208720	10/1/74 – 9/30/02	36°27'05", 118°47'19"	Historic Flow Gage. Measured flow in the Kaweah No. 1 Flowline. Data gaps: 10/1/1978 - 9/30/1993; 9/1/2005 - 9/9/2005; 8/26/2009 - 9/30/2009
Kaweah River					
Combined Flow of 11208570+ 11208600 CA	--	USGS 11208601	10/1/93-9/30/02	36°29'10", 118°50'09"	Historic Calculated Flow Gage. Combined flow of USGS gage 11208570 and USGS gage 11208600.
Kaweah River Conduit No. 2 near Hammond, CA	204	USGS 11208570	10/1/93-12/8/05	36°29'10", 118°50'09"	Traditional stage-discharge stream gage historically used by SCE to monitor flows in the flowline (replaced with SCE gage 204a).

Table 7.2-6. Other Flow Gages in the Kaweah River Watershed.

Gage Name	Gaging Station Number	Period of Record	Lat, Long	Notes
Kaweah River - downstream of Project				
Kaweah River at Three Rivers CA	USGS 11209900	10/1/58-9/30/90	36°26'38", 118°54'09"	Historic Flow Gage. Located 2.6 miles downstream from the East Fork Kaweah River and Kaweah River confluence.
Kaweah River at Three Rivers	USACE	2007-2015	36° 26' 37.9998, 118° 54' 15.997	Real-time Stage Gage. Located 2.6 miles downstream from the North Fork Kaweah River and Kaweah River confluence.
Middle Fork Kaweah River - upstream of Project				
Middle Fork Kaweah River No 3 Conduit near Potwisha Camp CA	USGS 11206000	10/1/75-9/30/02	36°30'41", 118°47'48"	Historic Flow Gage. Measured flow in the flowline near the point of diversion. Flow is currently measured at this location for operational purposes by SCE at gage no. 210.
Middle Fork Kaweah River near Potwisha Camp (river flow only) CA	USGS 11206500	7/12/49-9/30/14	36°30'47", 118°47'27"	Measured flow downstream of the diversion. Beginning October 2003, no records computed above 38 ft ³ /s. Incomplete data used in calculations made between 2003-2015.
Middle Fork Kaweah River near Potwisha Camp (total flow) CA	USGS 11206501	7/1/49-9/30/02	36°30'48", 118°47'27"	Historic Calculated Flow Gage. Computed combined flow USGS gage 11206000 and USGS gage 11206500.

Gage Name	Gaging Station Number	Period of Record	Lat, Long	Notes
Marble Fork Kaweah River - upstream of Project				
Marble Fork Kaweah River No 3 Conduit at Potwisha CA	USGS 11207500	10/1/75-9/30/02	36°31'10", 118°48'00"	Historic Flow Gage. Measured flow in the flowline near the point of diversion. Flow is currently measured at this location for operational purposes by SCE at gage no. 208.
Marble Fork Kaweah River (R only) at Potwisha Camp CA	USGS 11208000	4/1/50-9/30/14	36°31'19", 118°47'54"	Measures flow downstream of the diversion. Beginning October of 2003, no records recorded above 8 ft ³ /s. Incomplete data used in calculations.
Marble Fork Kaweah River (total flow) at Potwisha Camp CA	USGS 11208001	10/1/50-9/30/02	36°31'08", 118°48'03"	Historic Calculated Flow Gage. Computed combined flow USGS Gage 11207500 and 11208000.
Marble Fork Kaweah River above Horse Creek near Lodgepole CA	USGS 11206820	10/01/13-4/22/15	36°27'05", 118°37'04"	Located 11.0 of miles upstream of the Marble Fork Diversion Dam. Measures flow in the Marble Fork Kaweah River.
East Fork Kaweah River - upstream of Project				
East Fork Kaweah River below Mosquito Creek near Hammond CA	USGS 11208620	9/1/68-10/11/73	36°27'05", 118°37'04"	Historic Flow Gage. Located 11.1 miles upstream of the Kaweah No. 1 Diversion Dam. Measures flow in the East Fork Kaweah River.
East Fork Kaweah River at Sequoia National Park Boundary near Hammond CA	USGS 11208625	8/1/68-10/19/71	36°27'30", 118°39'11"	Historic Flow Gage. Located 9.5 miles upstream of the Kaweah No. 1 Diversion Dam. Measures flow in the East Fork Kaweah River.

Gage Name	Gaging Station Number	Period of Record	Lat, Long	Notes
Tributary to Kaweah River				
Middle Fork Kaweah Tributary near Hammond CA	USGS 11208500	6/1/67-9/30/73	36°29'35", 118°49'30"	Historic Flow Gage. Located on an unnamed tributary that flows into the Kaweah River approximately 1 mile upstream of the Kaweah No. 2 Diversion.
North Fork Kaweah River (above Confluence with Kaweah River)				
North Fork Kaweah River at Kaweah CA	USGS 11209500	10/1/1910-9/30/81	36°29'25", 118°55'12"	Historic Flow Gage. Located 3.5 miles upstream of the confluence with the Kaweah River. Measures flow in the North Fork Kaweah River.

FIGURES

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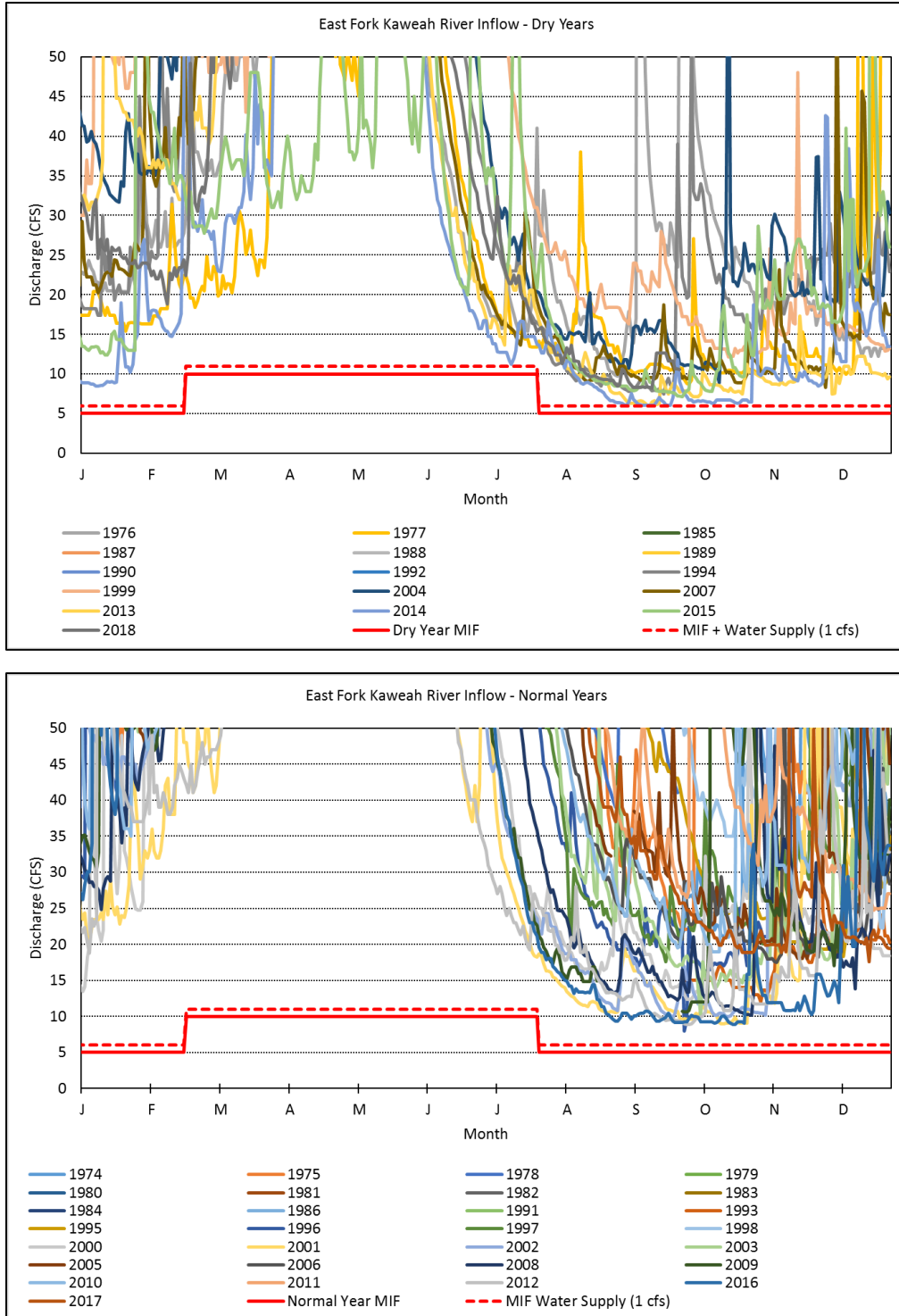


Figure 7.2-1. East Fork Kaweah River Inflow at Kaweah No. 1 Diversion Dam in Relation to Minimum Instream Flow Requirements and Water Supply Commitments in Dry (top) and Normal (bottom) Years (October 1974–September 2018)⁴

⁴ There is a data gap in the flow record of on USGS Gage 11208720 from WY 1979 to WY 1994.

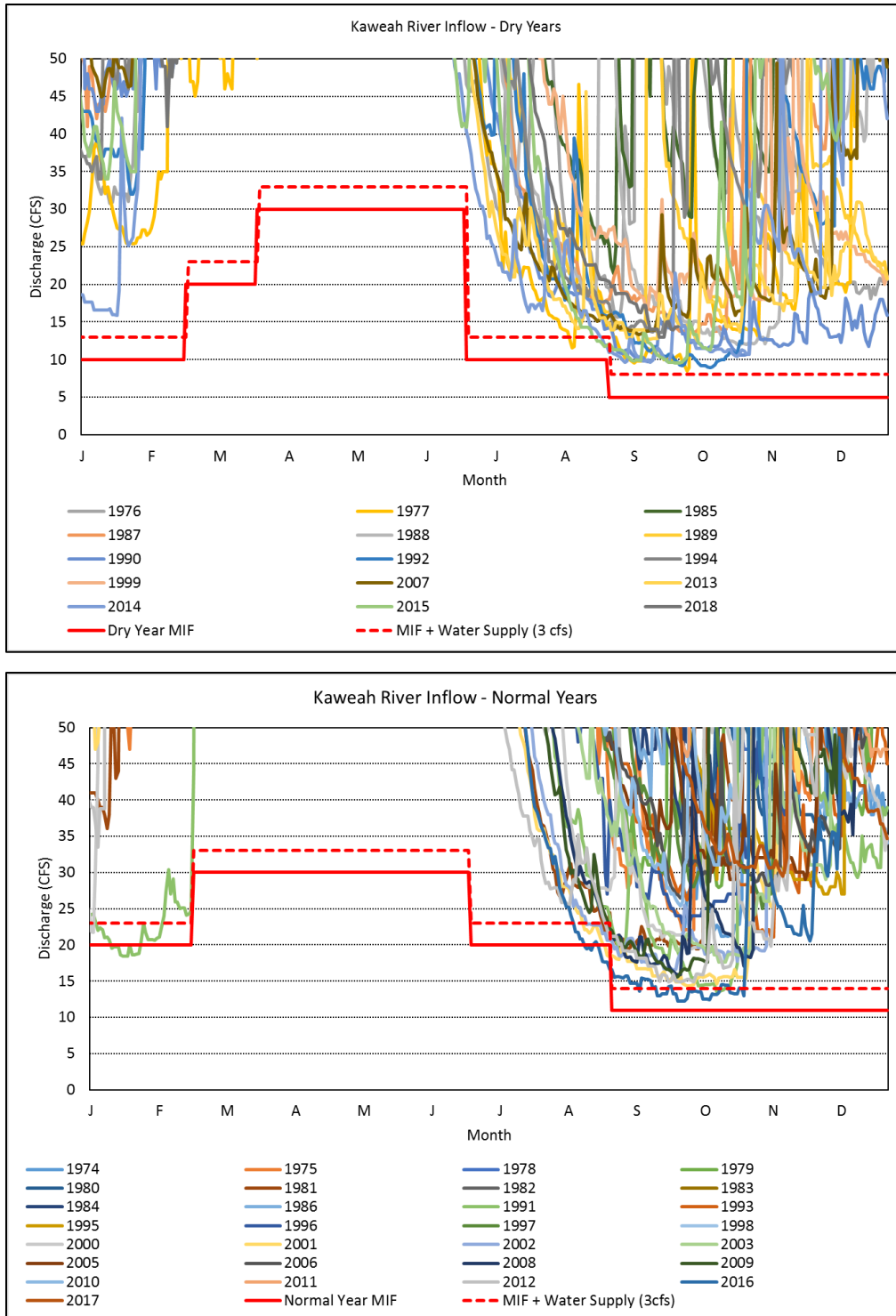


Figure 7.2-2. Kaweah River Inflow at Kaweah No. 2 Diversion Dam in Relation to Minimum Instream Flow Requirements and Water Supply Commitments in Dry (top) and Normal (bottom) Years (October 1974–September 2018)

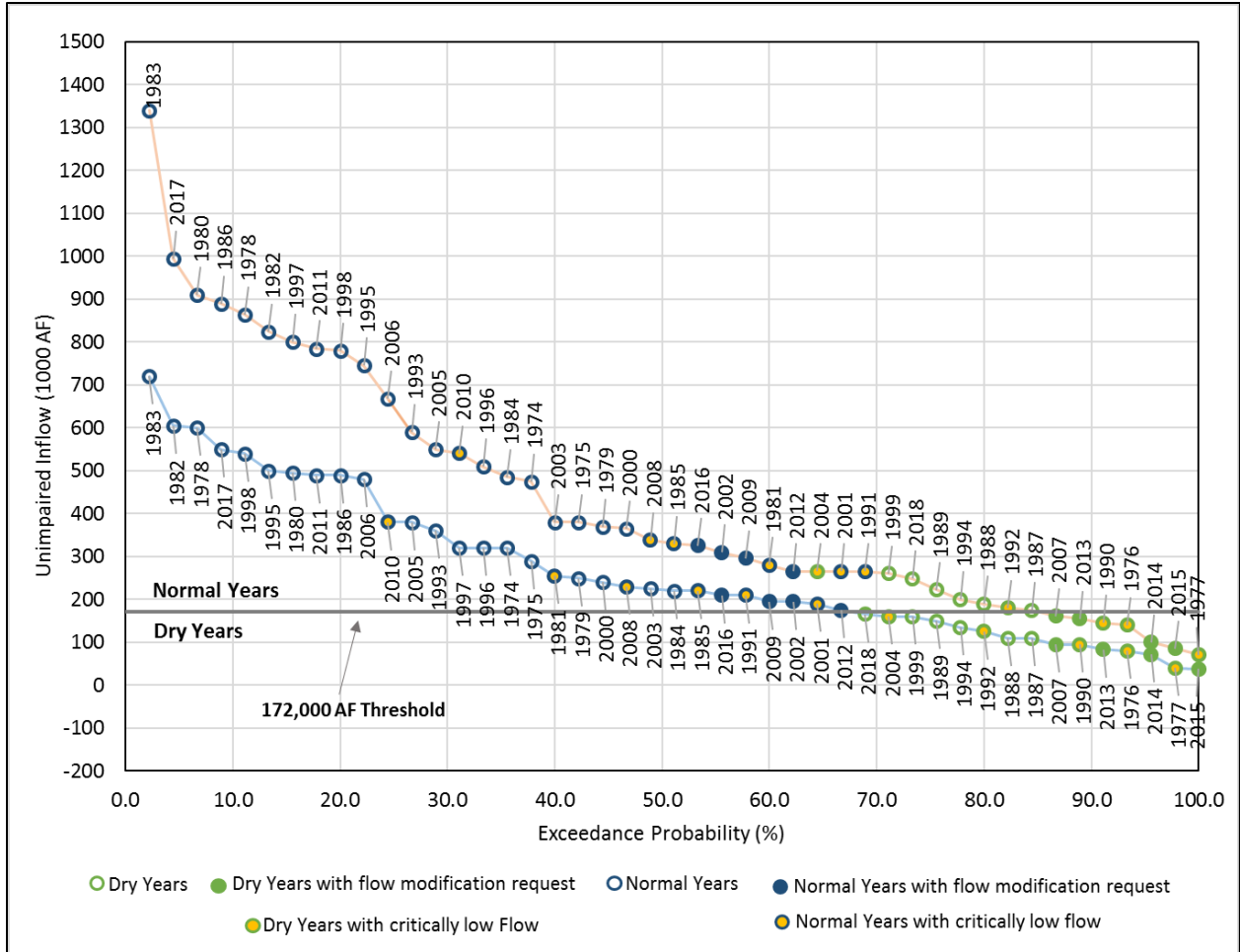


Figure 7.2-3. Distribution of the April 1 to July 1 Forecast of Runoff in the Kaweah River at Terminus Reservoir based on the Bulletin 120 May 1 Forecast (1974–2018).

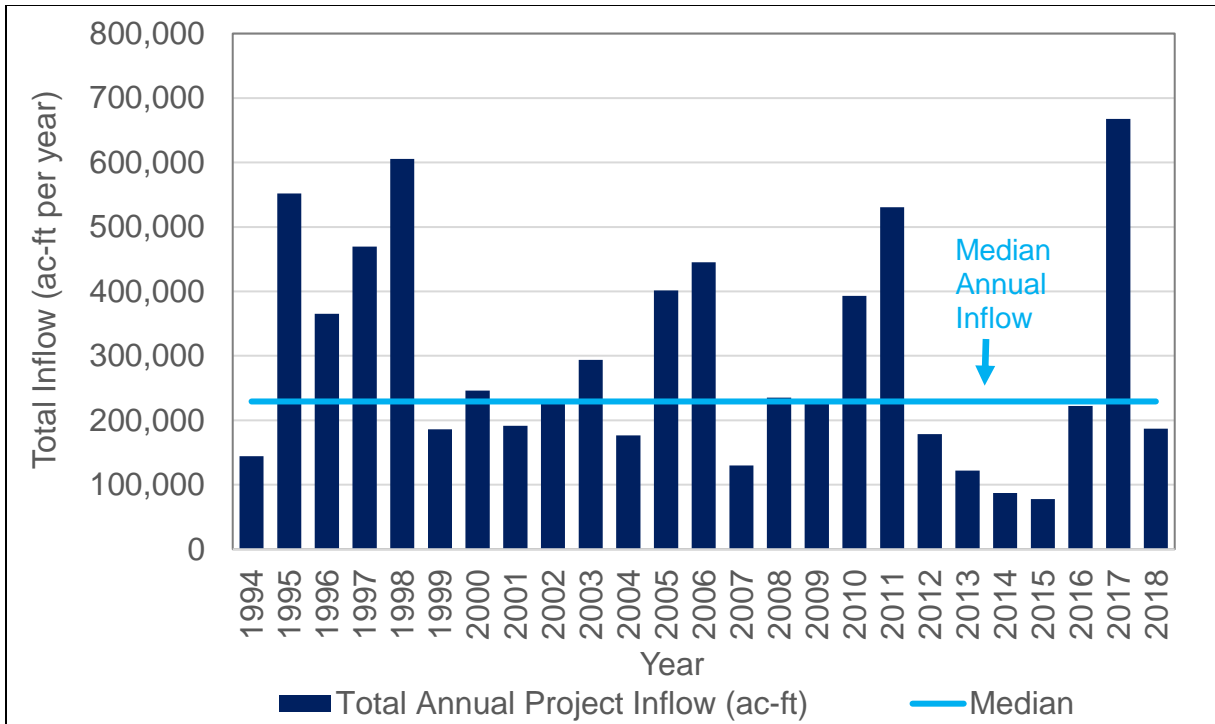


Figure 7.2-4. Annual Inflow to the Kaweah Project (WY 1994–2018)

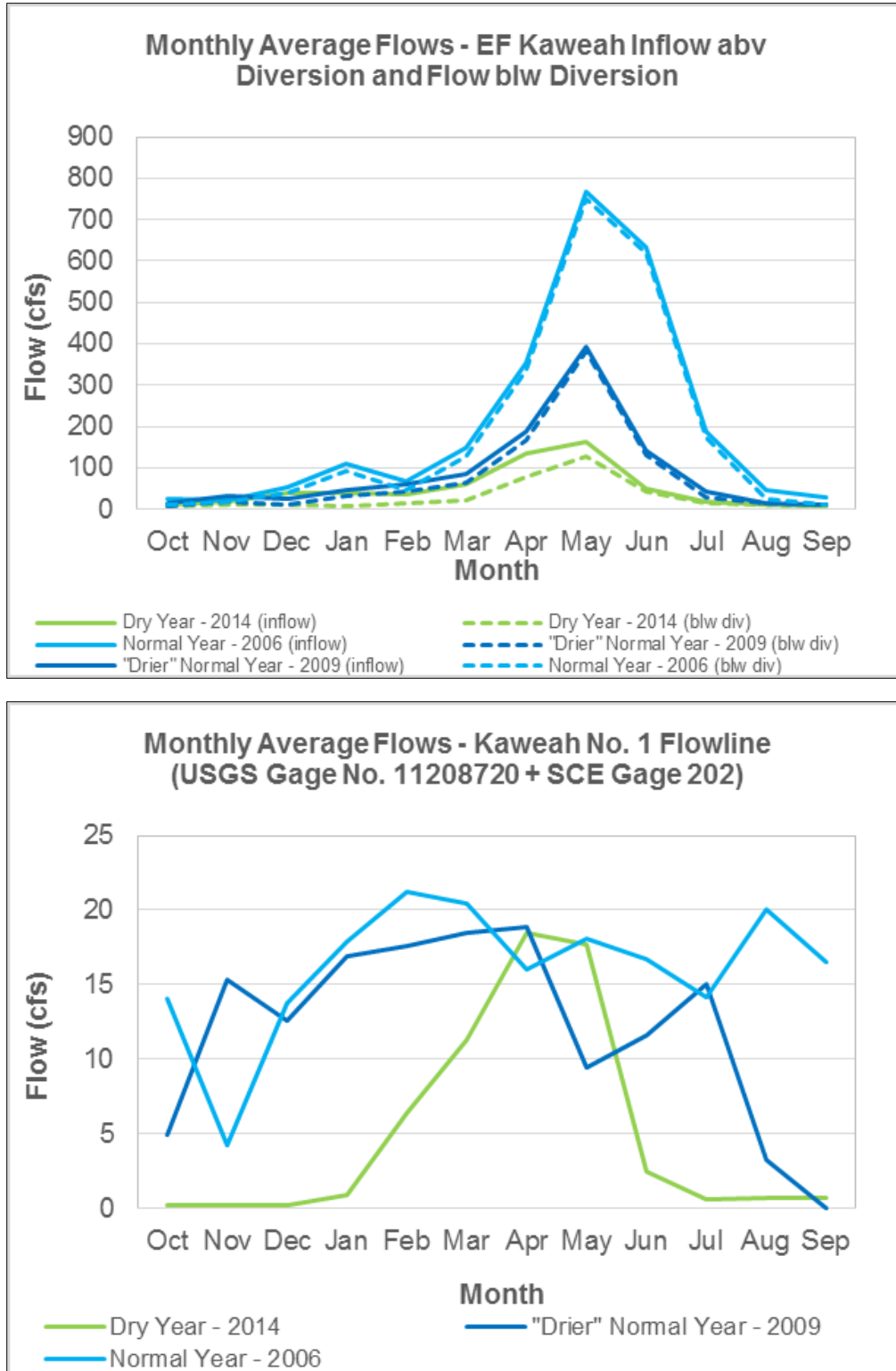


Figure 7.2-5a. Monthly Average Flows in a Representative Dry Year (2014), Normal Year (2006), and “Drier” Normal Year (2009) in the East Fork Kaweah River Bypass Reach and Kaweah No. 1 Flowline/Kaweah No. 1 Powerhouse

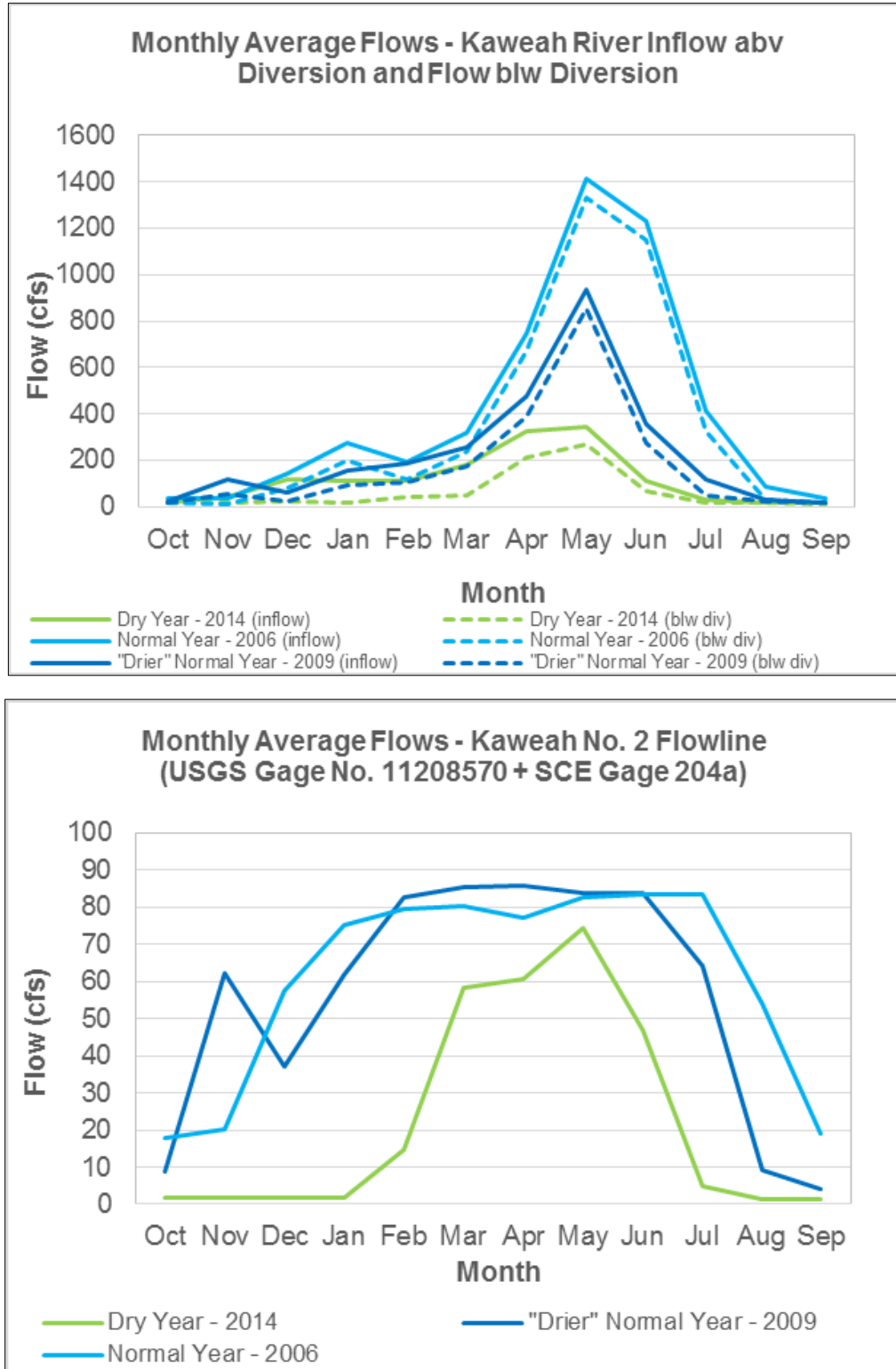


Figure 7.2-5b. Monthly Average Flows in a Representative Dry Year (2014), Normal Year (2006), and “Drier” Normal Year (2009) in the Kaweah River Bypass Reach and Kaweah No. 2 Flowline/Kaweah No. 2 Powerhouse

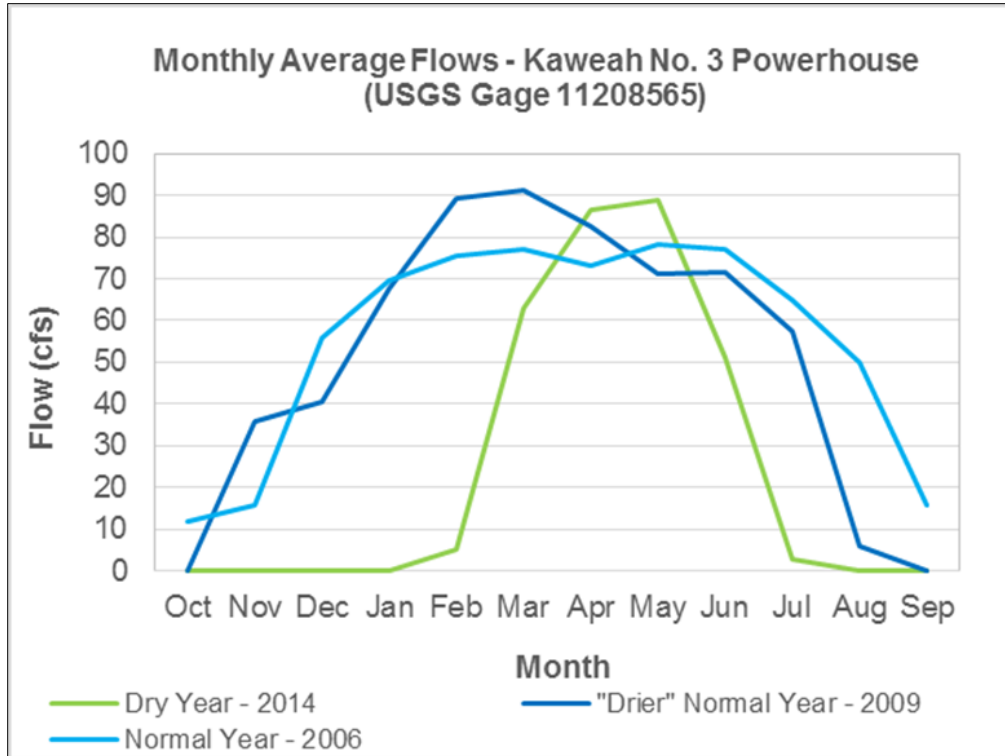
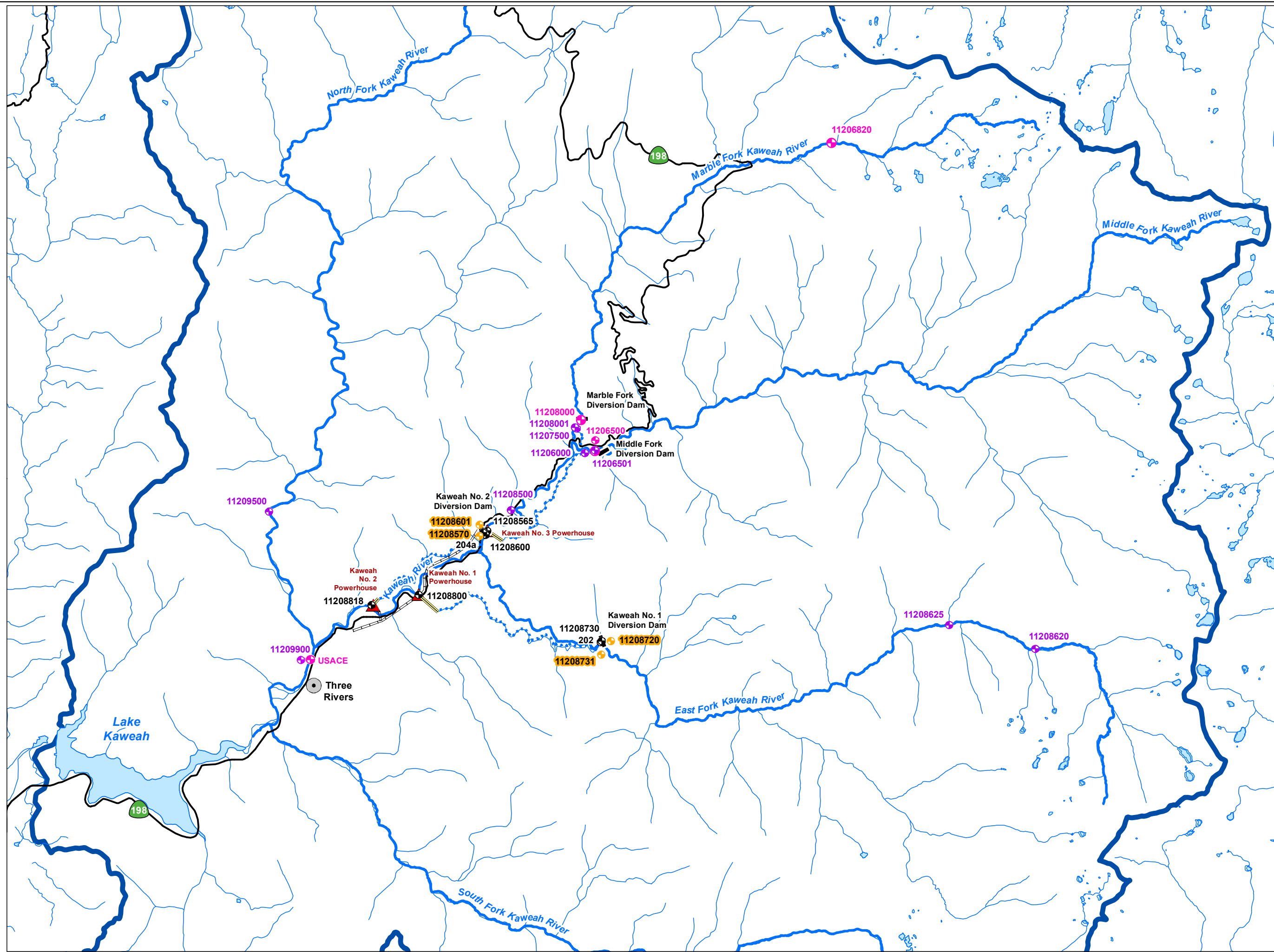


Figure 7.2-5c. Monthly Average Flows in a Representative Dry Year (2014), Normal Year (2006), and “Drier” Normal Year (2009) at the Kaweah No. 3 Powerhouse

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MAPS

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- Facilities**
- Powerhouse
 - Diversion
 - Flowline
 - Penstock
 - Transmission Line
 - Project Gage (current)
 - Project Gage (historic)
- Other Features**
- Highway
 - Watercourse
 - Water Body
 - Watershed Boundary
 - Non-Project Gage (current)
 - Non-Project Gage (historic)



Kaweah Project – FERC Project No. 298

Map 7.2-1

Current and Historic Flow Gages in the Vicinity of the Kaweah Project and Other Flow Gages in the Kaweah Watershed

Projection: UTM Zone 11
Datum: NAD 83

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APPENDIX 7.2-A

**Historic Water Year Types for the Kaweah River at Terminus Reservoir Based on
Department of Water Resources Bulletin 120 May 1 Runoff Forecast (1938-2015)**

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Table 7.2 A-1. Historic Water Year Types for the Kaweah River at Terminus Reservoir Based on Department of Water Resources Bulletin 120 May 1 Runoff Forecast (1938–2018).¹

Year	Apr-Jul Runoff Forecast (TAF)	Water Year Type Classification	Year	Apr-Jul Runoff Forecast (TAF)	Water Year Type Classification	Year	Apr-Jul Runoff Forecast (TAF)	Water Year Type Classification
1938	400	Normal	1973	440	Normal	2007	95	Dry
1939	120	Dry	1974	320	Normal	2008	230	Normal
1940	250	Normal	1975	190	Normal	2009	195	Normal
1941	440	Normal	1976	80	Dry	2010	380	Normal
1942	350	Normal	1977	40	Dry	2011	490	Normal
1943	320	Normal	1978	600	Normal	2012	175	Normal
1944	270	Normal	1979	250	Normal	2013	83	Dry
1945	340	Normal	1980	495	Normal	2014	72	Dry
1946	240	Normal	1981	255	Normal	2015	38	Dry
1947	145	Dry	1982	490	Normal	2016	210	Normal
1948	210	Normal	1983	720	Normal	2017	550	Normal
1949	170	Dry	1984	220	Normal	2018	249	Normal
1950	200	Normal	1985	220	Normal			
1951	90	Dry	1986	490	Normal			
1952	600	Normal	1987	110	Dry			
1953	170	Dry	1988	110	Dry			
1954	230	Normal	1989	150	Dry			
1955	180	Normal	1990	95	Dry			
1956	300	Normal	1991	210	Normal			
1957	170	Dry	1992	125	Dry			
1958	490	Normal	1993	360	Normal			
1959	75	Dry	1994	135	Dry			
1960	125	Dry	1995	500	Normal			

Year	Apr-Jul Runoff Forecast (TAF)	Water Year Type Classification	Year	Apr-Jul Runoff Forecast (TAF)	Water Year Type Classification	Year	Apr-Jul Runoff Forecast (TAF)	Water Year Type Classification
1961	55	Dry	1996	320	Normal			
1962	300	Normal	1997	320	Normal			
1963	235	Normal	1998	540	Normal			
1964	140	Dry	1999	160	Dry			
1965	250	Normal	2000	240	Normal			
1966	110	Dry	2001	190	Normal			
1967	610	Normal	2002	195	Normal			
1968	110	Dry	2003	225	Normal			
1969	800	Normal	2004	160	Dry			
1970	150	Dry	2005	380	Normal			
1971	170	Dry	2006	480	Normal			

¹ Data obtained from: DWR Bulletin 120. Available at: <http://cdec.water.ca.gov/snow/bulletin120/>. Water Year Types for Apr 1 - Jul 1 Forecast of Runoff in the Kaweah River at Terminus Reservoir based on Bulletin 120 May 1 Forecast.

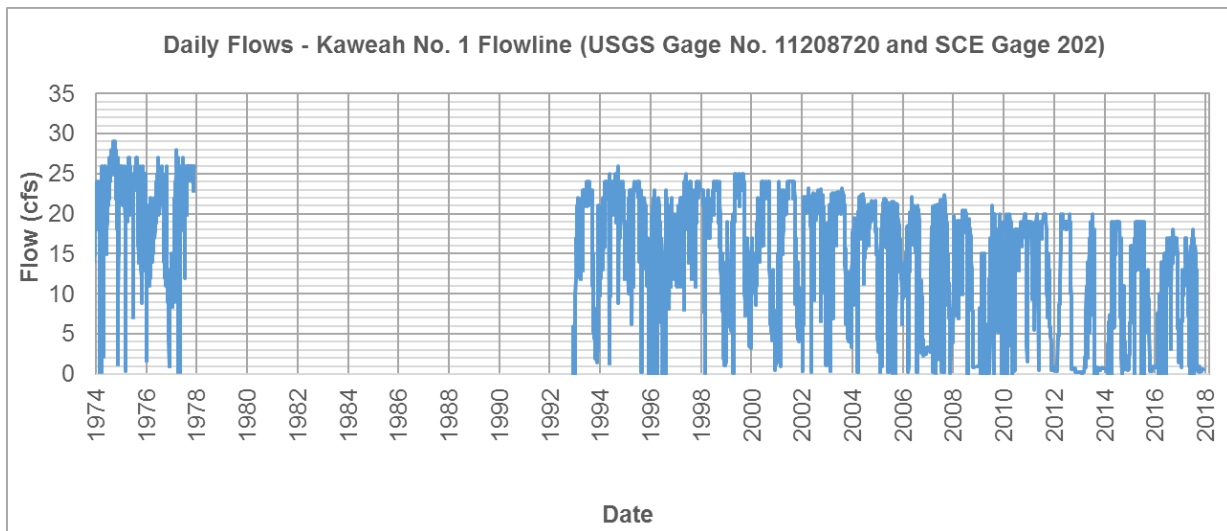
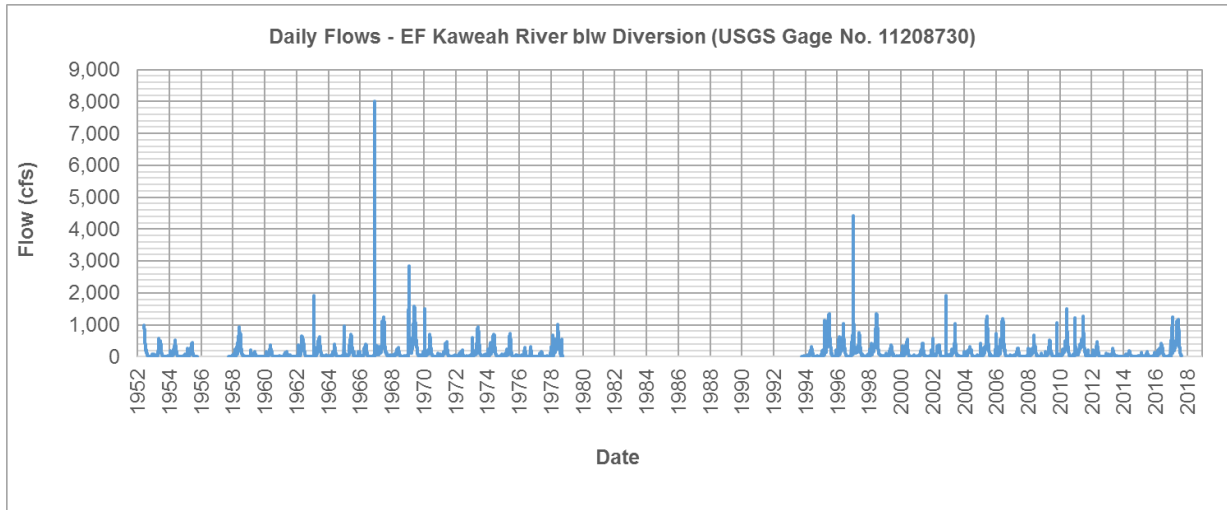
APPENDIX 7.2-B

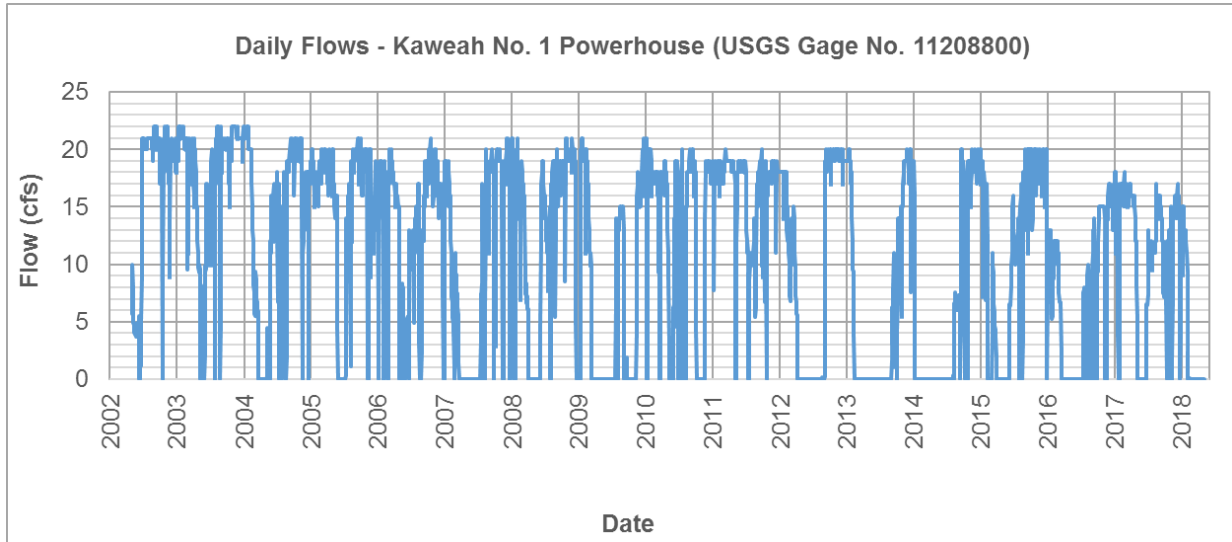
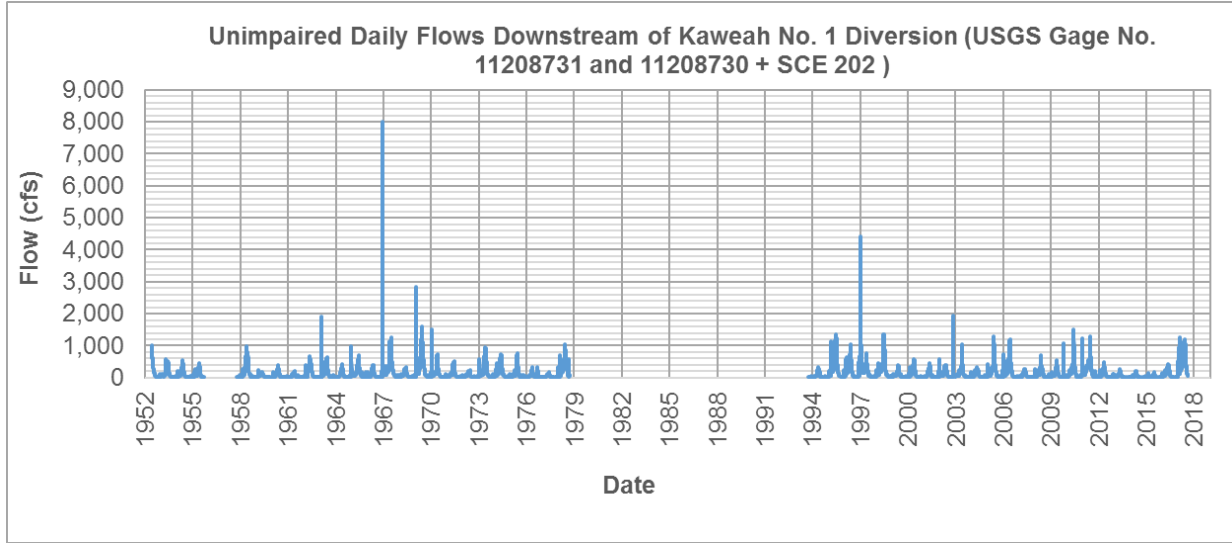
Daily Flow in Bypass Reaches and Flowlines Associated with the Kaweah Project

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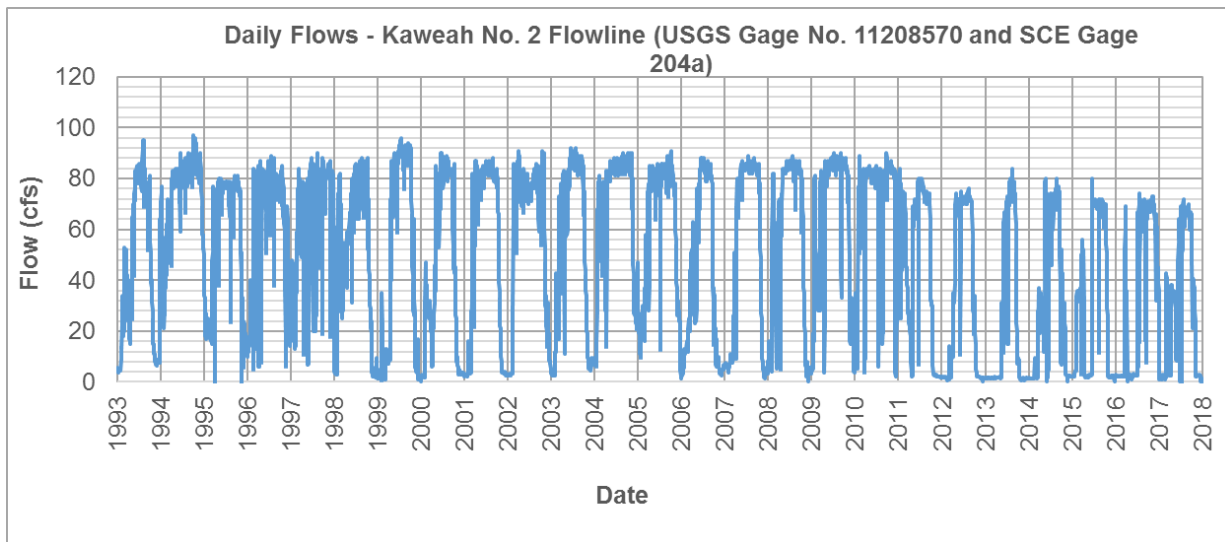
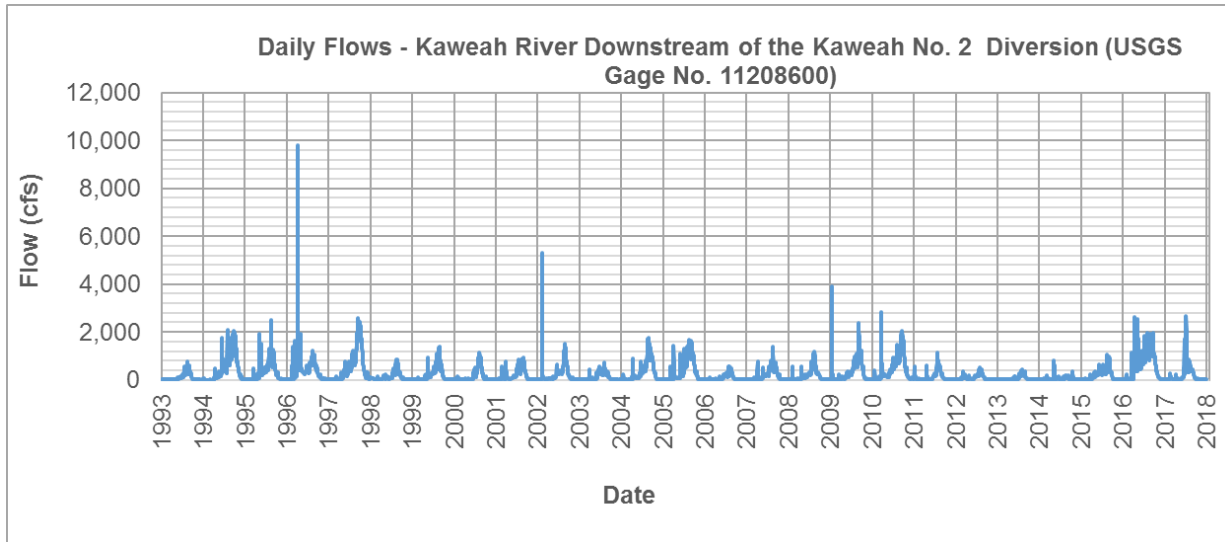
Data are presented for period of record available. Note, y-axis scales are different.

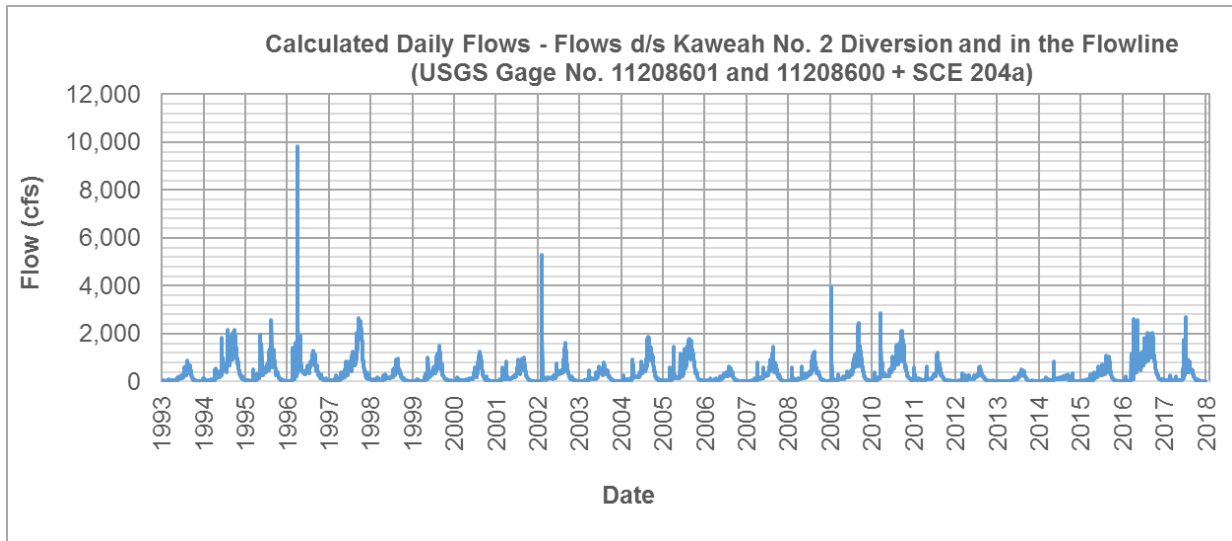
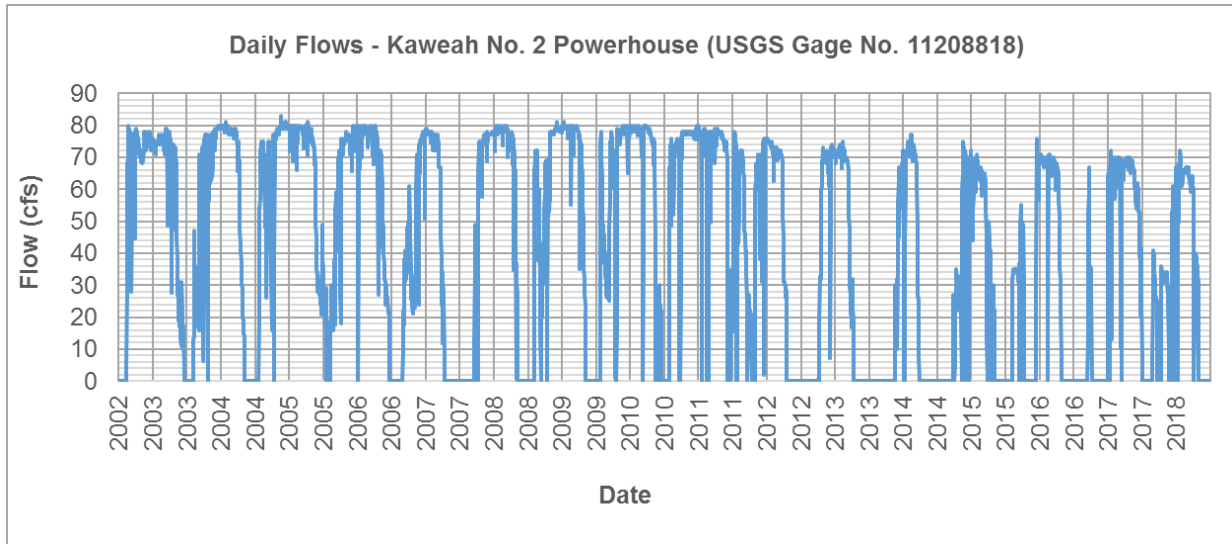
East Fork Kaweah River

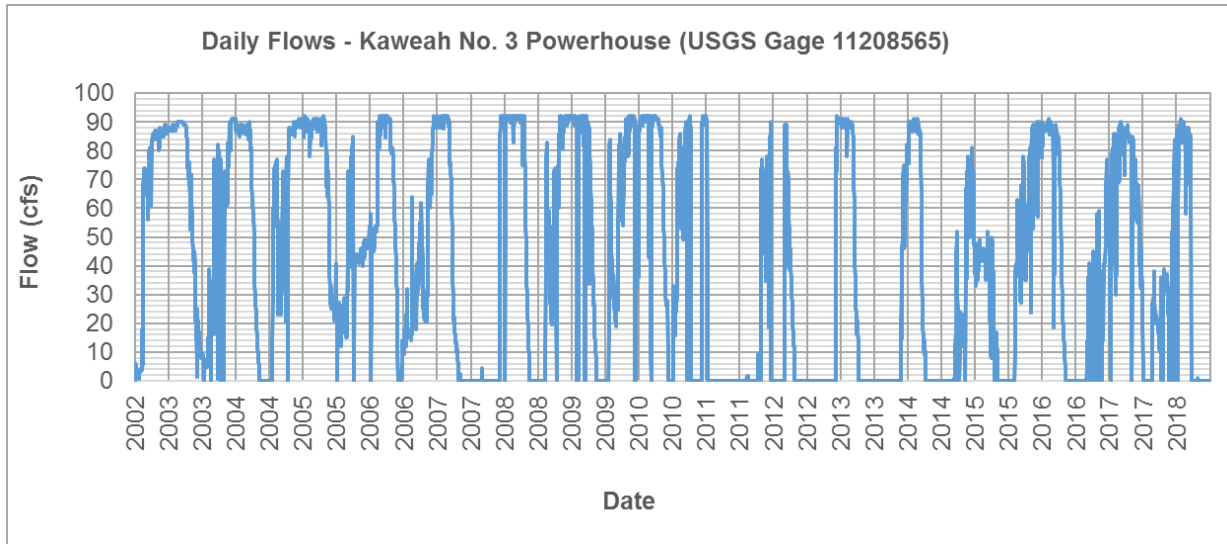




Kaweah River







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APPENDIX 7.2-C

Tables of Monthly Summary Statistics (maximum, minimum, average discharge) and Exceedances for Gaging Stations in Bypass Reaches and Flowlines Associated with the Kaweah Project

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Table 7.2 C-1. Flow Statistics for Stream Gages and Flowlines Associated with the Kaweah Project for the Available Flow Data Period of Record.

Month	Daily Exceedance Flows by Month (cfs)					Maximum, Minimum, and Average Daily Flows (cfs)		
	10%	20%	50%	80%	90%	Max	Min	Average
Flow to Kaweah No. 3 Powerhouse (USGS Gage 11208565) (WY 2002-2018)								
Oct	24.0	15.0	0.0	0.0	0.0	84.0	0.0	7.9
Nov	66.1	44.0	14.5	0.0	0.0	86.0	0.0	21.4
Dec	78.0	65.0	29.5	0.0	0.0	91.0	0.0	32.7
Jan	86.0	77.0	25.0	0.0	0.0	92.0	0.0	34.9
Feb	89.0	87.0	51.5	0.0	0.0	92.0	0.0	47.4
Mar	91.0	91.0	85.0	48.0	34.0	92.0	0.0	69.8
Apr	91.0	90.2	88.0	47.0	0.0	92.0	0.0	70.6
May	92.0	90.0	88.0	45.0	0.0	92.0	0.0	71.4
Jun	92.0	90.0	86.0	37.8	1.4	92.0	0.0	67.0
Jul	91.0	88.0	36.0	0.0	0.0	92.0	0.0	43.4
Aug	69.5	45.0	0.0	0.0	0.0	88.0	0.0	18.1
Sep	27.0	9.2	0.0	0.0	0.0	68.0	0.0	6.0
Calculated Unimpaired Flow Upstream of Kaweah No. 2 Diversion¹ (WY 1994-2018)								
Oct	142.0	60.8	32.7	19.9	18.3	260.4	16.4	51.4
Nov	189.9	96.1	55.3	33.4	24.0	377.4	20.6	80.8
Dec	329.0	135.8	90.3	49.7	26.8	409.6	24.2	109.8
Jan	275.2	245.0	136.8	77.8	52.0	1292.7	18.9	197.0
Feb	436.4	234.2	184.9	102.6	91.2	514.1	57.5	199.3
Mar	458.4	417.8	291.9	188.1	159.7	600.2	109.6	307.0
Apr	741.8	632.5	491.4	339.9	306.0	771.5	273.5	502.1
May	1213.9	1052.5	905.0	486.7	355.9	1413.8	345.6	832.0
Jun	1612.1	1442.5	555.2	179.6	116.8	2075.0	114.0	726.2
Jul	1188.5	513.6	133.9	50.8	31.1	1647.5	24.6	331.0
Aug	320.3	93.7	37.0	22.2	18.6	334.2	17.9	81.4
Sep	92.0	44.0	24.5	16.5	14.6	161.8	11.3	36.9
Kaweah No. 2 Flowline (USGS Gage No. 11208570 + SCE Gage 204a) (1994-2002 and 2002-2018)								
Oct	35.0	22.0	4.4	2.1	1.6	97.0	0.3	13.1
Nov	74.0	58.0	21.0	2.5	1.6	89.0	0.7	29.2
Dec	78.0	70.0	40.0	14.0	3.6	91.0	0.8	41.4
Jan	82.0	79.0	52.0	13.0	2.6	90.0	0.0	47.2
Feb	84.0	82.4	74.0	40.0	5.0	90.0	1.0	63.1
Mar	87.0	85.0	79.0	67.0	30.4	92.0	0.1	70.8
Apr	87.5	85.5	81.0	70.0	63.0	96.0	0.2	75.8

Month	Daily Exceedance Flows by Month (cfs)					Maximum, Minimum, and Average Daily Flows (cfs)		
	10%	20%	50%	80%	90%	Max	Min	Average
May	87.0	85.5	81.0	72.0	69.0	95.0	12.0	78.1
Jun	87.0	85.0	79.0	68.0	56.0	94.0	6.9	73.9
Jul	86.0	83.0	69.0	28.0	8.9	97.0	0.7	56.8
Aug	82.0	70.0	9.7	2.6	2.1	90.0	0.0	27.7
Sep	53.0	26.9	4.8	2.2	1.8	90.0	0.0	15.8
Kaweah River Downstream Kaweah No. 2 Diversion (USGS Gage No. 11208600) (WY 1994-2018)								
Oct	50.0	28.0	16.0	12.0	10.0	3910.0	5.6	32.9
Nov	65.0	31.2	18.0	12.1	11.0	5300.0	5.6	43.8
Dec	112.2	60.4	19.0	12.9	9.4	2830.0	5.5	60.5
Jan	323.2	147.2	49.0	21.0	15.3	9800.0	10.0	151.3
Feb	326.0	200.0	80.3	30.0	24.4	2550.0	11.0	158.0
Mar	474.6	337.6	188.0	95.0	59.0	1760.0	24.0	240.8
Apr	780.7	606.9	374.5	219.6	151.6	2680.0	34.0	433.3
May	1290.0	1070.0	668.0	350.0	238.8	2500.0	40.0	725.6
Jun	1620.6	1159.3	355.5	95.0	39.9	2590.0	29.8	622.9
Jul	764.6	364.6	37.0	20.0	14.0	2440.0	11.0	246.0
Aug	97.4	37.0	22.4	16.0	12.6	602.0	9.5	47.4
Sep	25.3	18.0	13.7	11.0	8.5	322.0	5.8	19.1
Flow to Kaweah No. 1 Powerhouse (USGS Gage No. 11208800) (WY 2002-2018)								
Oct	13.0	5.9	0.0	0.0	0.0	19.0	0.0	3.0
Nov	18.0	14.0	0.0	0.0	0.0	21.0	0.0	6.2
Dec	18.0	14.0	10.0	0.0	0.0	21.0	0.0	7.9
Jan	20.0	19.0	15.0	0.0	0.0	22.0	0.0	11.8
Feb	20.0	20.0	18.0	8.7	2.0	22.0	0.0	15.2
Mar	20.0	20.0	18.0	5.0	0.0	22.0	0.0	14.0
Apr	21.0	20.0	18.0	14.0	0.0	22.0	0.0	15.8
May	20.0	20.0	18.0	15.0	12.0	22.0	0.0	16.6
Jun	21.0	20.0	18.0	11.0	0.0	22.0	0.0	15.0
Jul	19.0	18.0	14.0	0.0	0.0	22.0	0.0	11.5
Aug	19.0	18.0	7.5	0.0	0.0	21.0	0.0	8.8
Sep	18.0	16.0	0.0	0.0	0.0	21.0	0.0	6.0

Month	Daily Exceedance Flows by Month (cfs)					Maximum, Minimum, and Average Daily Flows (cfs)		
	10%	20%	50%	80%	90%	Max	Min	Average
Flow to Kaweah No. 2 Powerhouse (USGS Gage No. 11208818) (WY 2002-2018)								
Oct	30.0	0.0	0.0	0.0	0.0	78.0	0	7.3
Nov	72.0	63.0	13.0	0.0	0.0	80.0	0	25.2
Dec	74.0	62.0	34.0	0.0	0.0	79.0	0	33.8
Jan	77.0	76.0	41.0	0.0	0.0	79.0	0	41.8
Feb	78.0	78.0	71.0	24.0	0.0	83.0	0	55.1
Mar	80.0	79.0	76.0	53.0	0.0	81.0	0	61.9
Apr	80.0	79.0	75.0	69.0	61.0	81.0	0	70.5
May	79.0	79.0	74.0	68.0	66.0	80.0	0	71.8
Jun	79.0	79.0	72.0	62.0	35.9	80.0	0	65.9
Jul	78.0	77.0	51.5	0.0	0.0	81.0	0	45.7
Aug	72.0	63.0	0.0	0.0	0.0	78.0	0	20.3
Sep	31.0	22.0	0.0	0.0	0.0	70.0	0	8.1
Calculated Unimpaired Flow Upstream of Kaweah No. 1 Diversion² (WY 1994-2018)								
Oct	Oct	53.3	28.1	20.8	11.8	10.9	80.4	8.4
Oct	36.9	26.0	16.4	10.2	9.0	1061.0	6.3	22.1
Nov	41.9	32.1	21.1	14.8	10.8	1933.8	8.5	31.8
Dec	58.6	42.9	27.0	19.1	15.2	1220.0	7.5	42.7
Jan	137.5	80.0	39.7	23.1	17.2	4424.8	8.5	82.1
Feb	174.8	94.0	54.2	36.0	24.7	1260.0	10.2	83.5
Mar	229.6	178.0	97.8	53.9	41.7	1144.4	22.9	119.1
Apr	350.0	303.8	190.7	117.9	84.7	1246.7	31.0	208.9
May	624.2	477.2	338.0	199.8	152.8	1300.0	36.0	372.8
Jun	922.9	539.2	197.2	70.2	45.9	1503.7	19.0	343.7
Jul	355.1	197.4	52.3	23.6	19.2	1341.5	11.2	139.6
Aug	78.3	51.0	19.4	12.1	10.3	333.0	6.6	37.5
Kaweah No. 1 Flowline (USGS Gage No. 11208720 and SCE Gage 202) (WY 1994-2002 and 2002-2018)								
Oct	18.9	13.8	4.0	0.8	0.2	26.0	0	6.8
Nov	19.0	16.6	11.0	1.0	0.7	23.3	0	10.0
Dec	21.2	19.6	13.0	4.7	0.5	24.0	0	12.3
Jan	22.0	21.2	16.0	6.2	0.8	24.0	0	14.0
Feb	22.3	21.5	19.0	13.0	5.7	24.0	0	16.6
Mar	23.0	22.0	19.0	13.0	4.3	25.0	0	16.9
Apr	23.5	22.9	19.0	16.0	8.1	24.4	0	18.1
May	23.8	23.0	19.0	16.0	13.4	24.7	0	18.4

Month	Daily Exceedance Flows by Month (cfs)					Maximum, Minimum, and Average Daily Flows (cfs)		
	10%	20%	50%	80%	90%	Max	Min	Average
Jun	23.6	23.0	19.1	12.0	3.3	25.1	0	17.2
Jul	22.8	21.0	17.0	7.6	0.7	26.0	0	14.7
Aug	21.0	20.0	11.0	2.5	0.7	24.0	0	11.6
Sep	20.7	18.3	6.8	0.6	0.4	24.0	0	9.1
East Fork Kaweah River downstream Kaweah No. 1 Diversion (USGS Gage No. 11208730) (1993-2018)								
Oct	22.0	16.9	9.8	6.9	6.0	4420.0	5.2	15.3
Nov	26.3	19.0	10.4	7.3	6.4	1930.0	2.7	21.8
Dec	45.0	28.0	13.0	7.4	6.5	1220.0	3.1	30.4
Jan	126.6	61.2	23.0	9.0	7.4	4420.0	5.2	68.1
Feb	156.9	78.9	35.0	17.0	10.9	1260.0	5.2	66.9
Mar	214.0	161.1	79.5	34.0	26.0	1140.0	12.0	102.1
Apr	338.0	288.0	170.2	97.3	64.3	1240.0	13.0	190.8
May	610.1	458.7	317.4	181.8	132.4	1281.0	18.0	354.4
Jun	910.3	519.8	181.3	52.4	30.0	1500.0	11.9	326.5
Jul	338.6	181.3	33.2	13.8	12.0	1319.2	10.9	124.9
Aug	61.0	32.0	9.9	6.9	6.3	311.0	5.0	25.9
Sep	21.0	15.0	8.4	6.3	6.1	87.7	4.8	11.8

¹ 1994-2002: Sum of Kaweah No. 2 Flowline (USGS 11208570 [SCE 204a]), the main Kaweah River downstream of the Kaweah No. 2 Diversion (USGS 11208600 [SCE 203]), and the discharge of the Kaweah No. 3 Powerhouse (Sum of SCE 210 & SCE 208 gages). 2002-2018: Sum of Kaweah No. 2 Flowline (USGS 11208570 [SCE 204a]), the main Kaweah River downstream of the Kaweah No. 2 Diversion (USGS 11208600 [SCE 203]), and the discharge of the Kaweah No. 3 Powerhouse (SCE 206a).

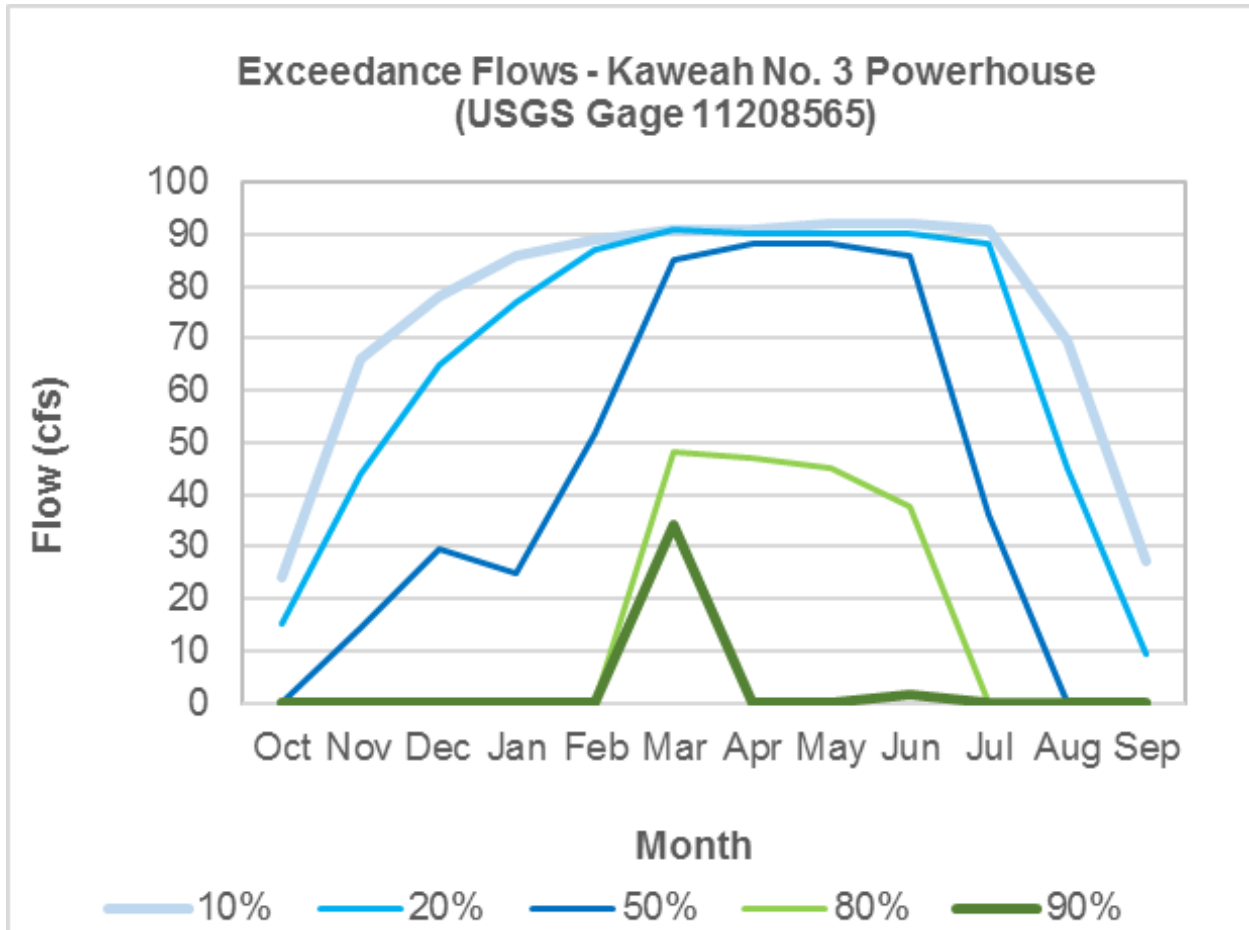
² 1994-2002: Sum of East Fork Kaweah River downstream of the Kaweah No. 1 Diversion (11208730 [SCE 201]) and the Kaweah No. 1 Flowline (USGS 11208720 [SCE 202]). 2002-2018: Sum of East Fork Kaweah River downstream of the Kaweah No. 1 Diversion (11208730 [SCE 201]) and the Kaweah No. 1 Flowline (USGS 11208720 [SCE 202]).

APPENDIX 7.2-D

Monthly Exceedance Flows (10%, 20%, 50%, 80%, and 90%) in Bypass Reaches and Flowlines Associated with the Kaweah Project from WY 1994-2018

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Figure 7.2 D-1. Monthly Exceedance Flows (10%, 20%, 50%, 80%, and 90%) at the Kaweah No. 3 Powerhouse (USGS Gage 11208565).¹



¹ Kaweah No. 3 Powerhouse period of record is from 2002-2018.

Figure 7.2 D-2. Monthly Exceedance Flows (10%, 20%, 50%, 80%, and 90%) in the Kaweah River Bypass Reach and Kaweah No. 2 Flowline (WY 1994-2018).

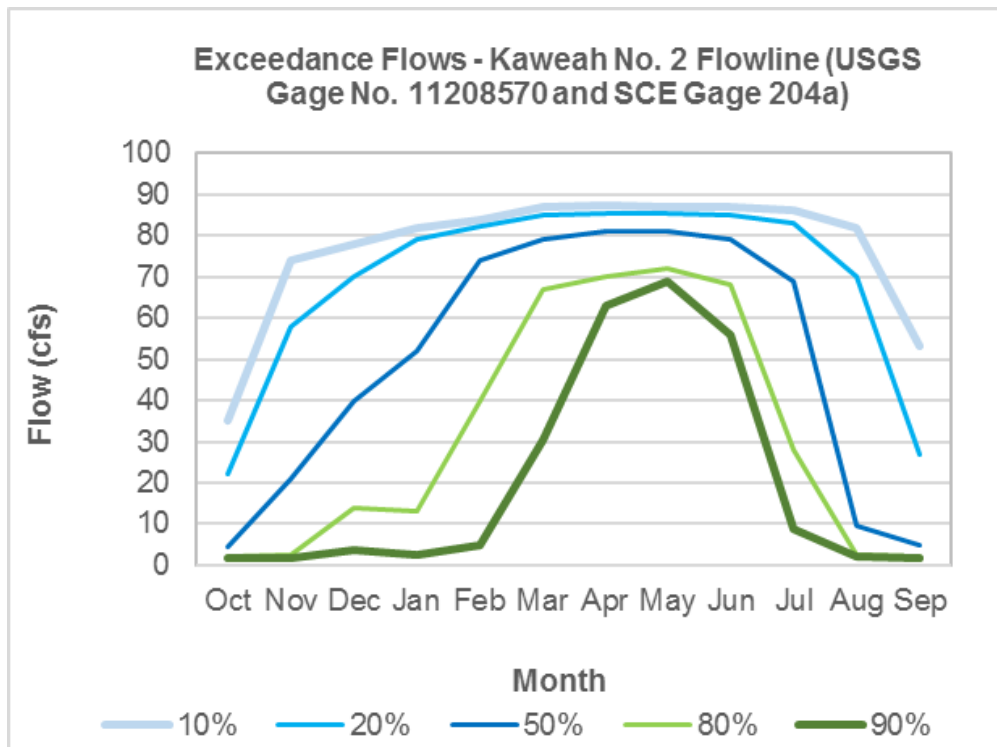
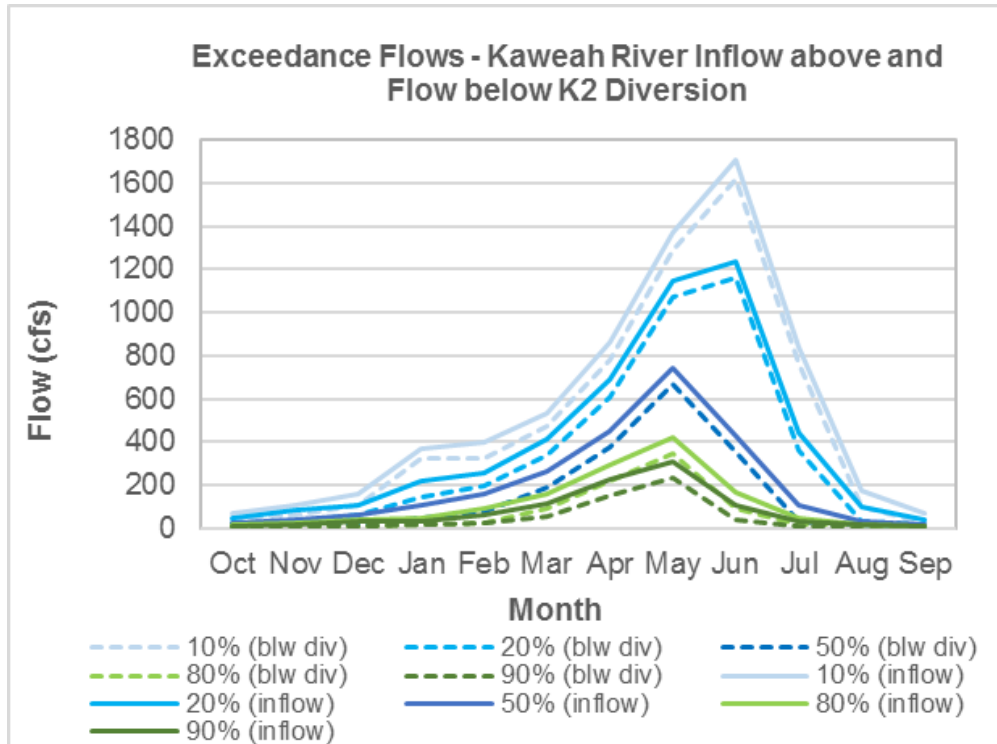


Figure 7.25 D-3. Monthly Exceedance Flows (10%, 20%, 50%, 80%, and 90%) in the East Fork Kaweah River Bypass Reach and Kaweah No. 1 Flowline (WY 1994-2018).

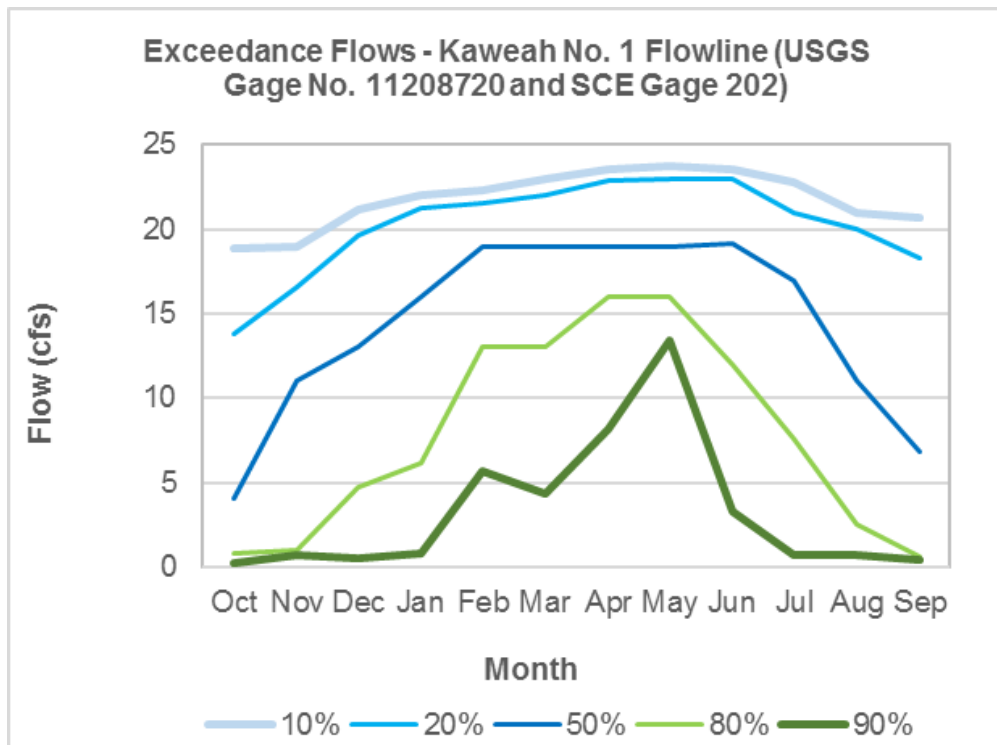
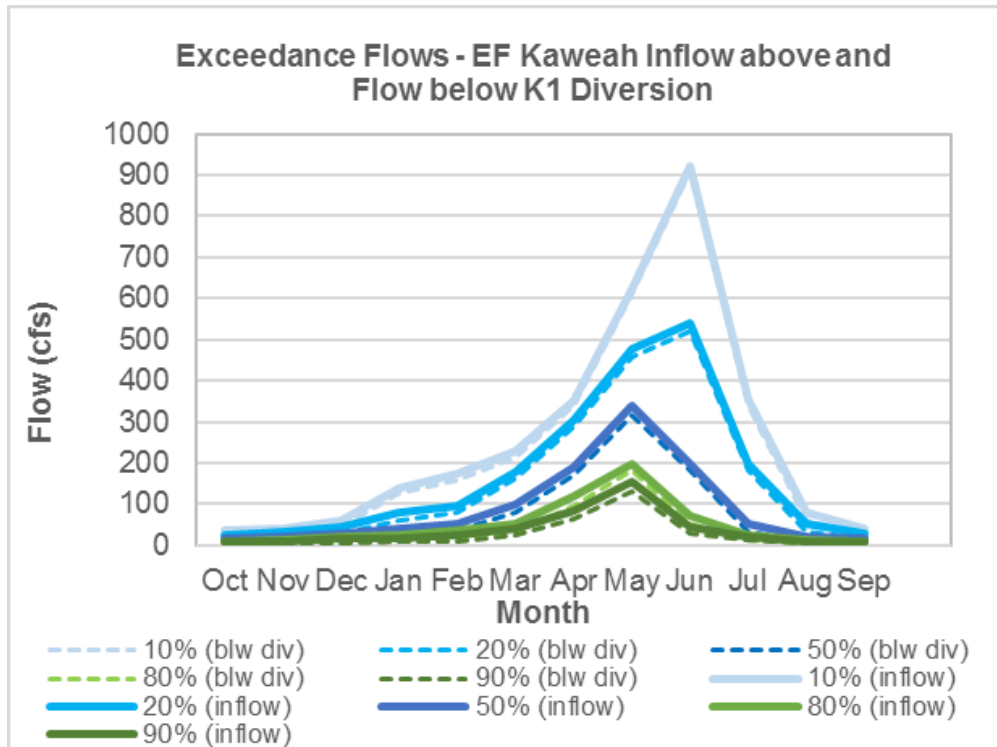
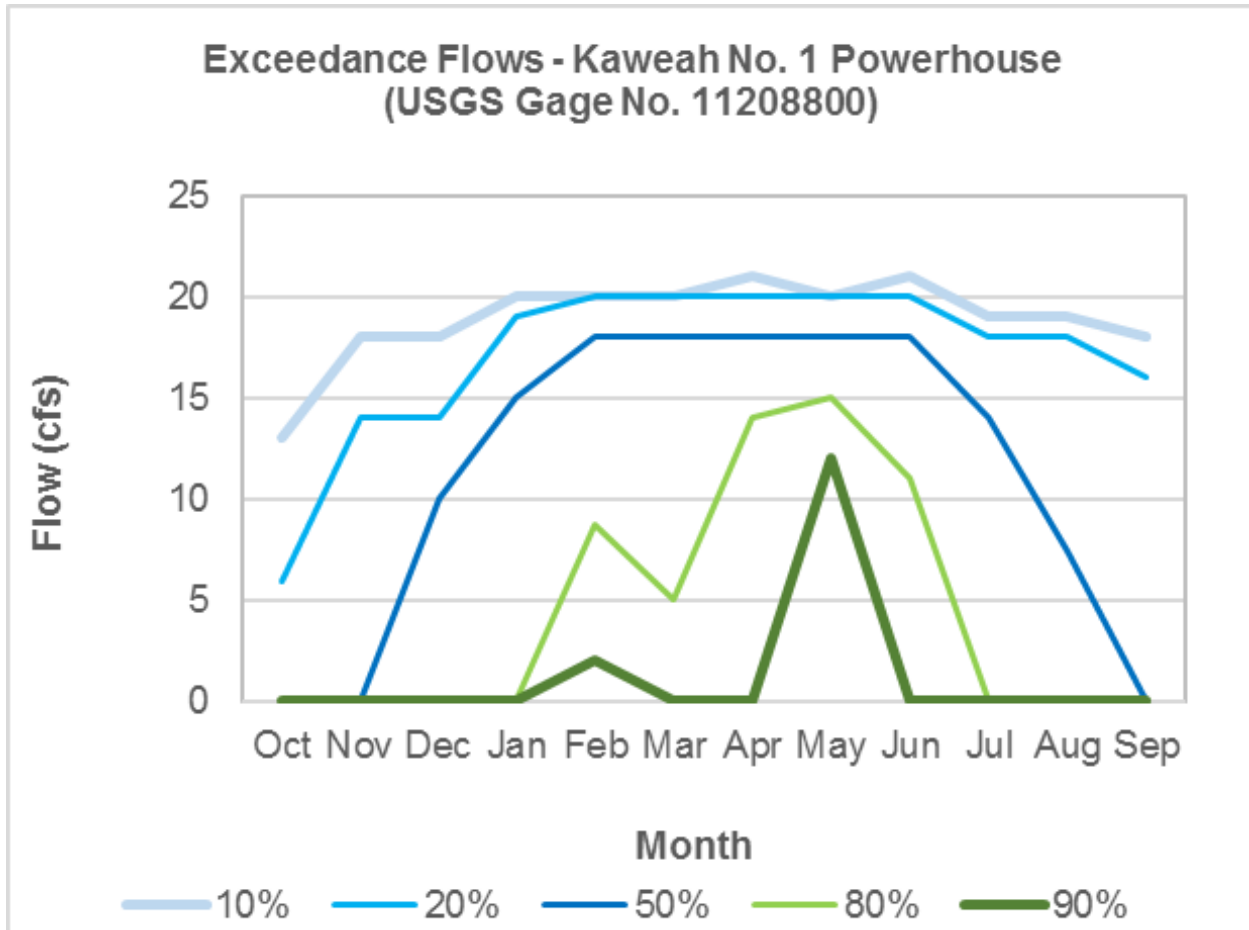
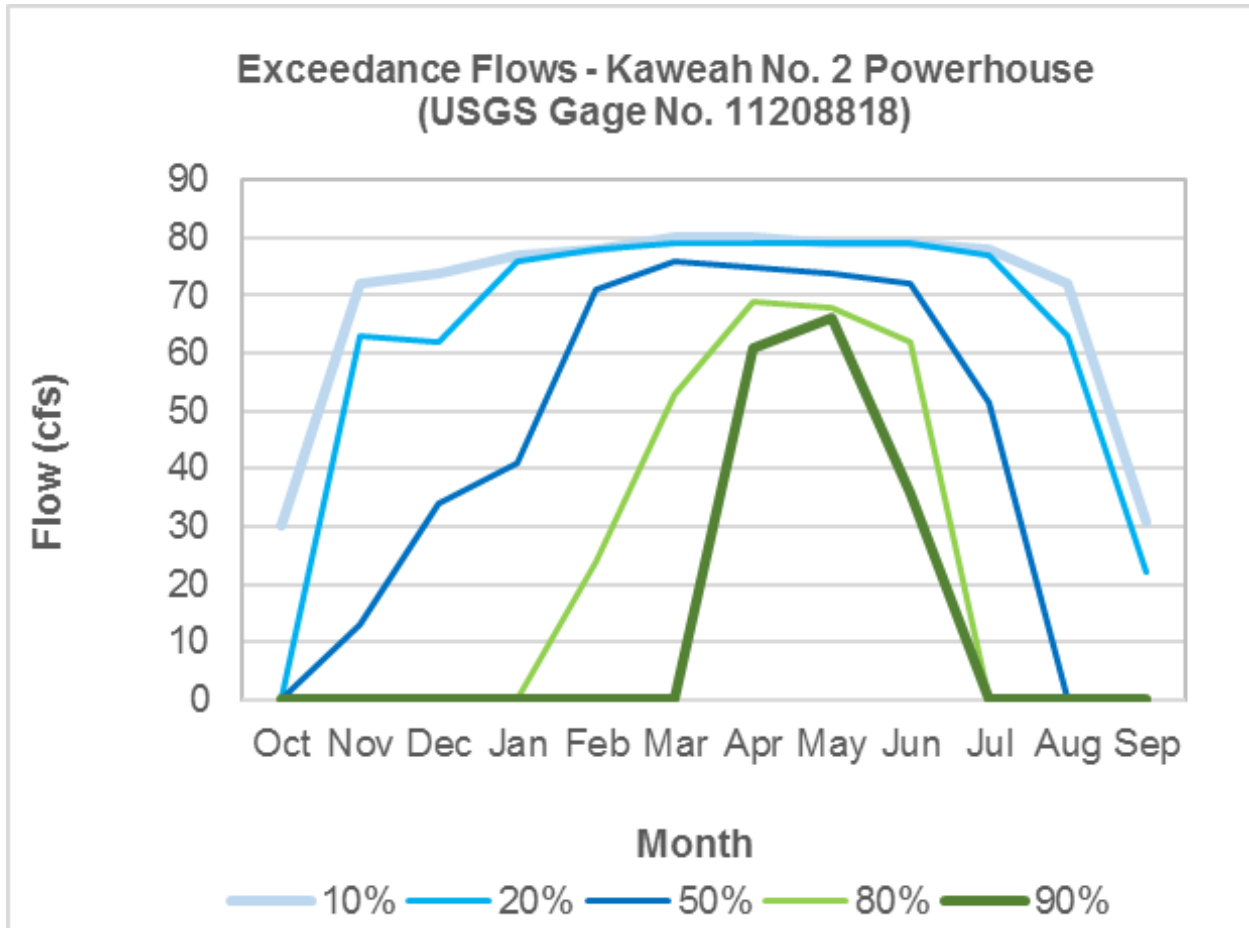


Figure 7.2 D-4. Monthly Exceedance Flows (10%, 20%, 50%, 80%, and 90%) at the Kaweah No. 1 Powerhouse (WY 1994-2018) (continued).¹



¹ Kaweah No. 1 Powerhouse period of record is from 2002-2018.

Figure 7.2 D-5. Monthly Exceedance Flows (10%, 20%, 50%, 80%, and 90%) at the Kaweah No. 2 Powerhouse (USGS Gage No. 11208818).¹



¹ Kaweah No. 2 Powerhouse period of record is from 2002-2018.

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APPENDIX 7.2-E

Daily Discharge Exceedance Plots by Month for Selected Bypass Reaches

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Figure 7.2 E-1a-I. Exceedance probability for existing and unimpaired daily discharge (WY 1994 to WY 2018) for each month of the year, downstream of the Kaweah No. 3 Powerhouse and upstream of the East Fork Kaweah.

Figure 7.2 E-1a.

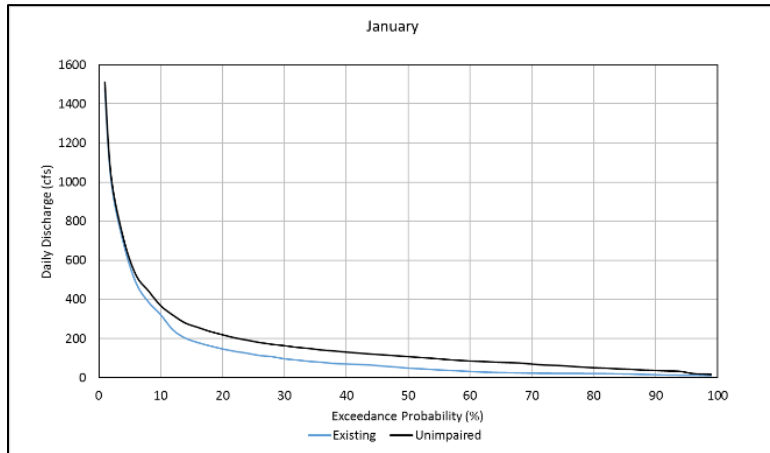


Figure 7.2 E-1b.

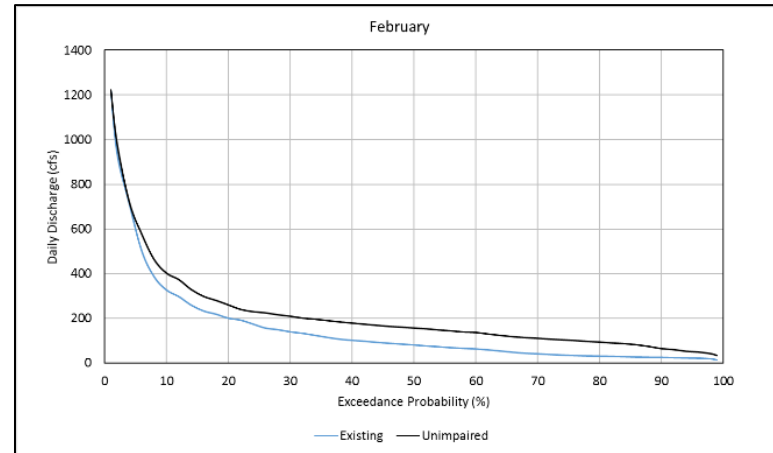


Figure 7.2 E-1c.

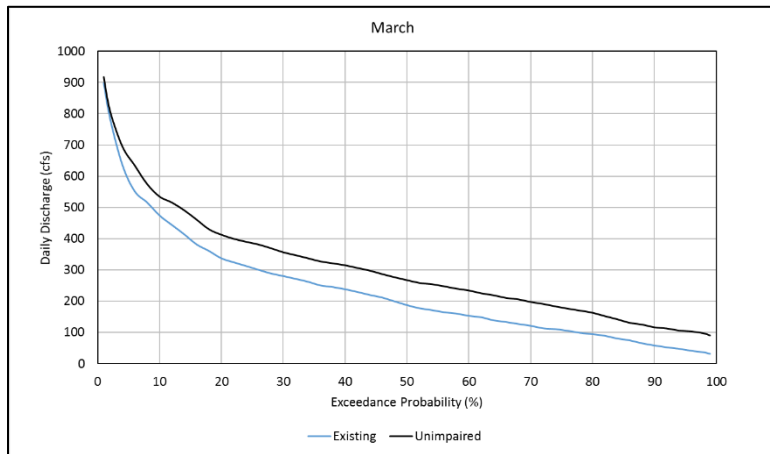


Figure 7.2 E-1d.

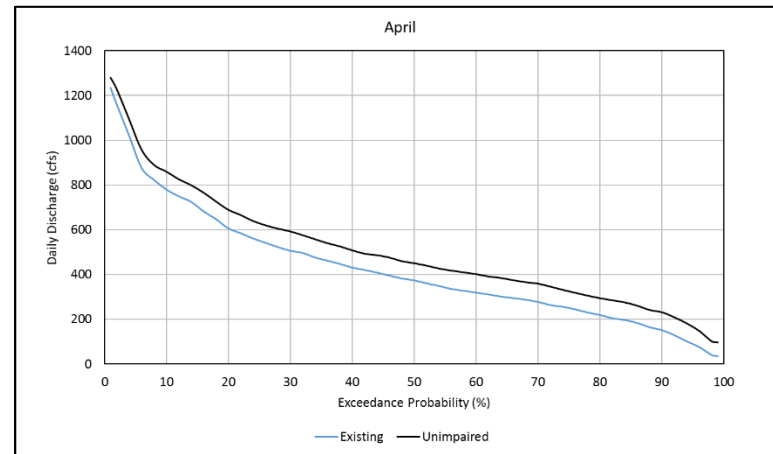


Figure 7.2 E-1e.

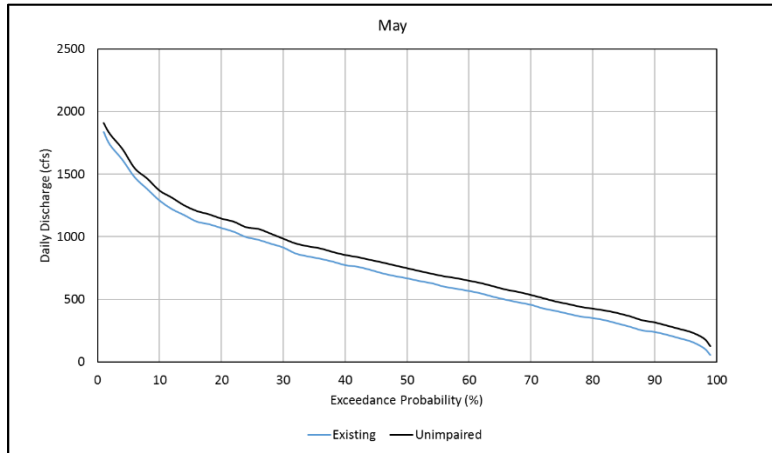


Figure 7.2 E-1f.

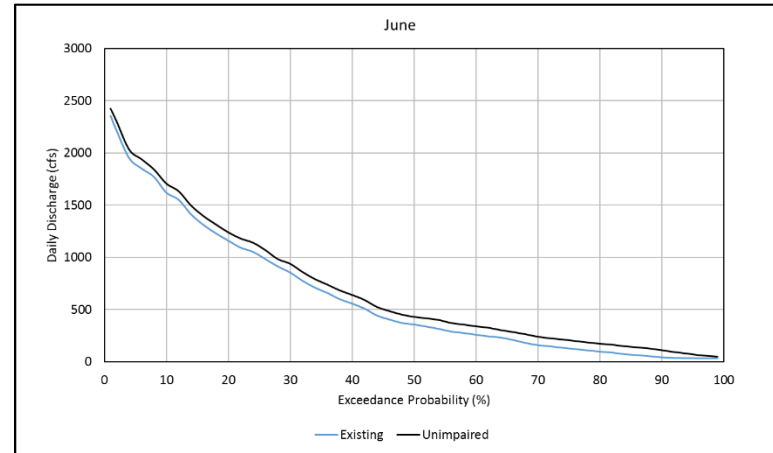


Figure 7.2 E-1g.

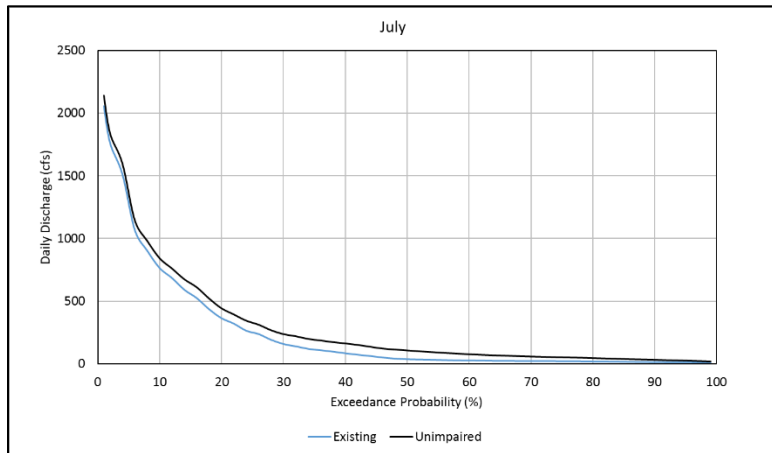


Figure 7.2 E-1h.

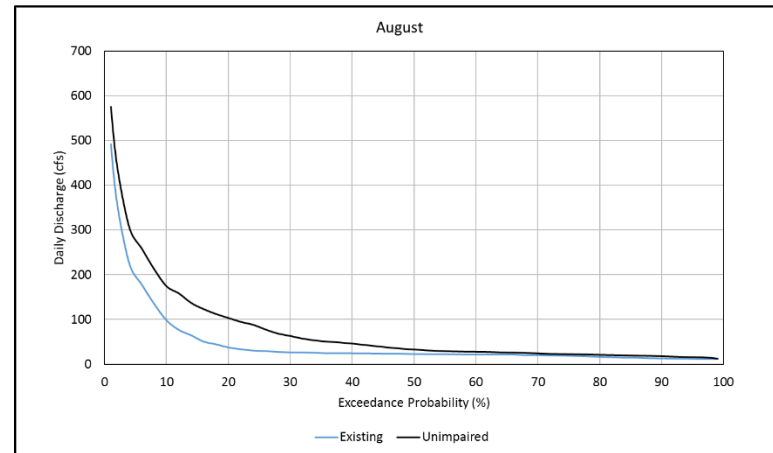


Figure 7.2 E-1i.

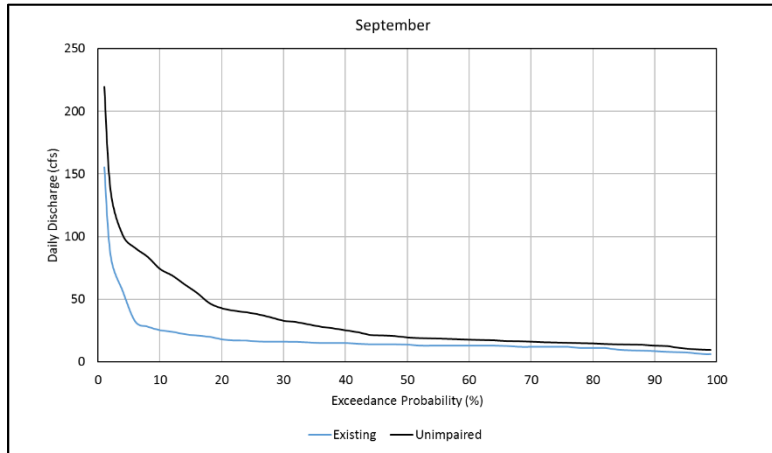


Figure 7.2 E-1j.

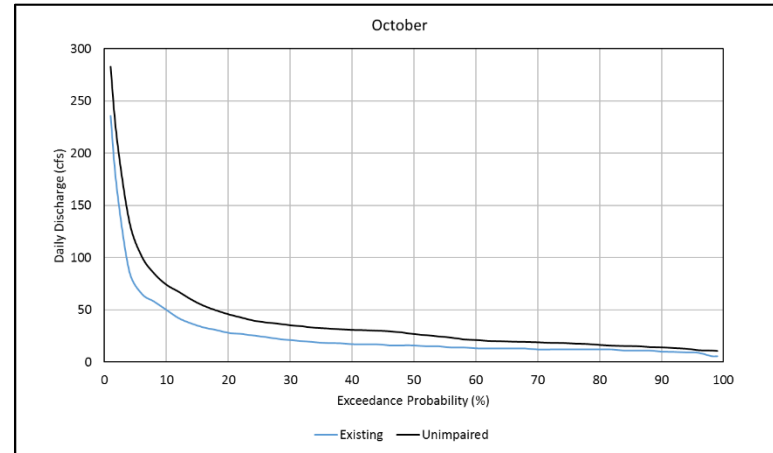


Figure 7.2 E-1k.

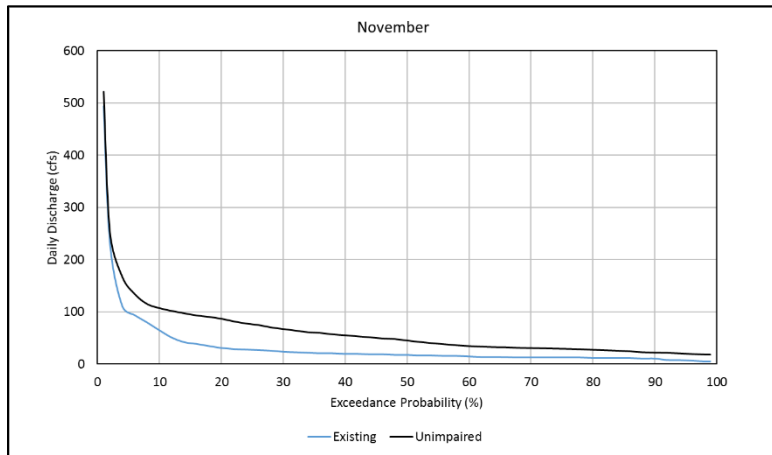


Figure 7.2 E-1l.

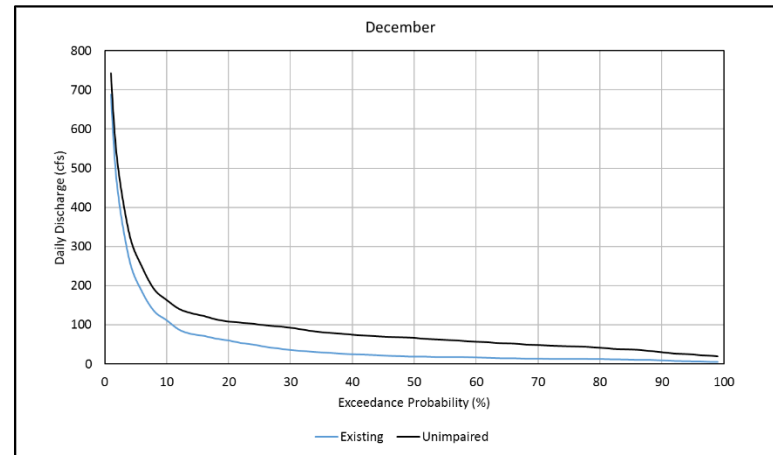


Figure 7.2 E-2a-I. Exceedance probability for existing and unimpaired daily discharge (WY 1994 to WY 2018) for each month of the year, downstream of the East Fork Kaweah and upstream of the Kaweah No.1 Powerhouse.

Figure 7.2 E-2a.

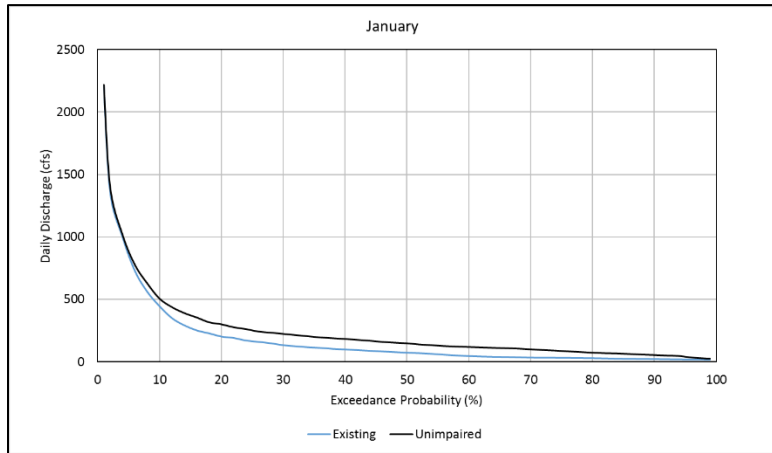


Figure 7.2 E-2b.

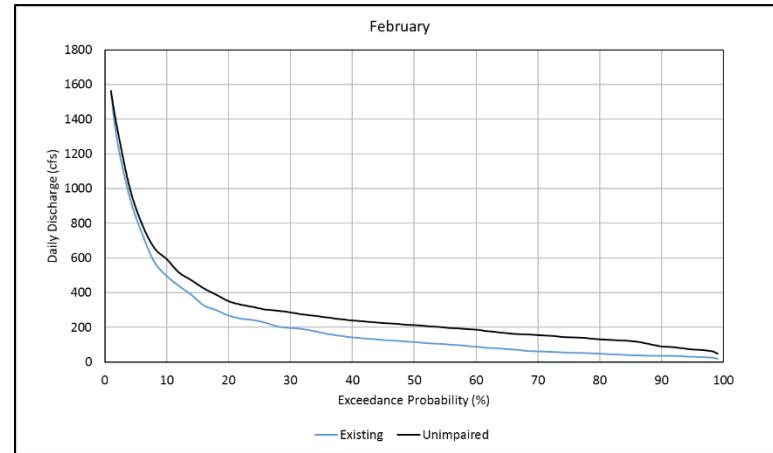


Figure 7.2 E-2c.

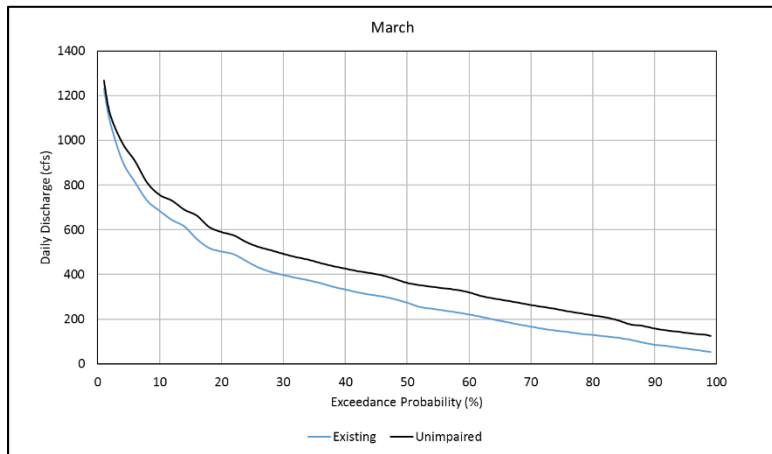


Figure 7.2 E-2d.

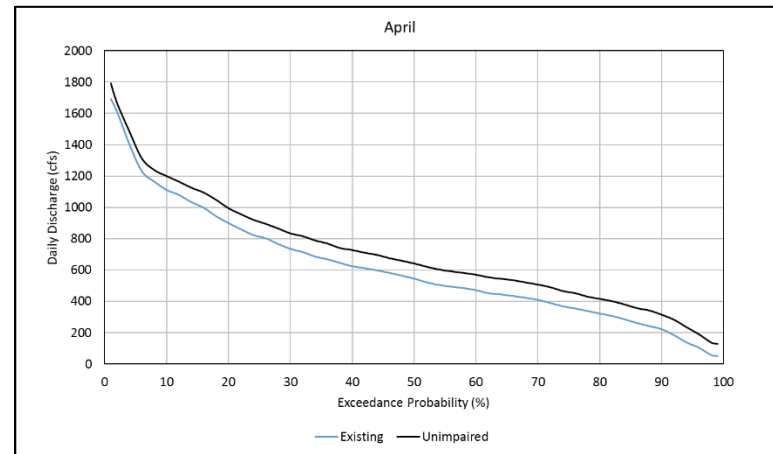


Figure 7.2 E-2e.

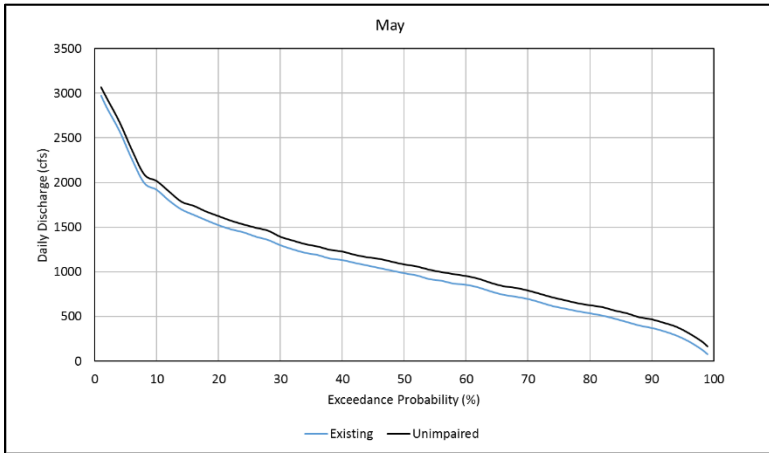


Figure 7.2 E-2f.

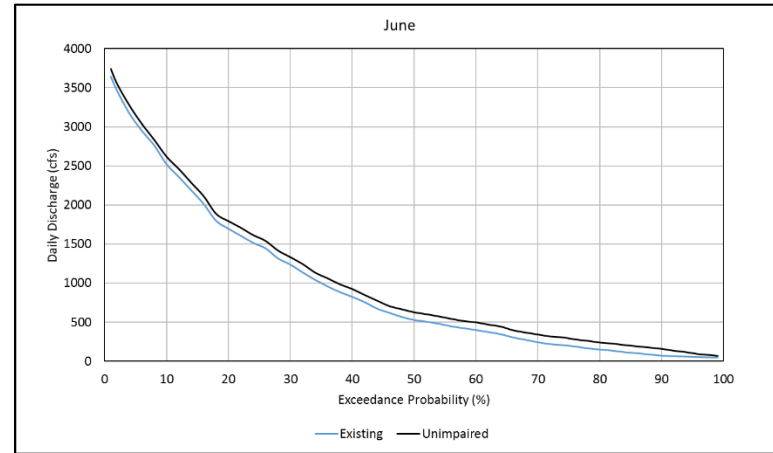


Figure 7.2 E-2g.

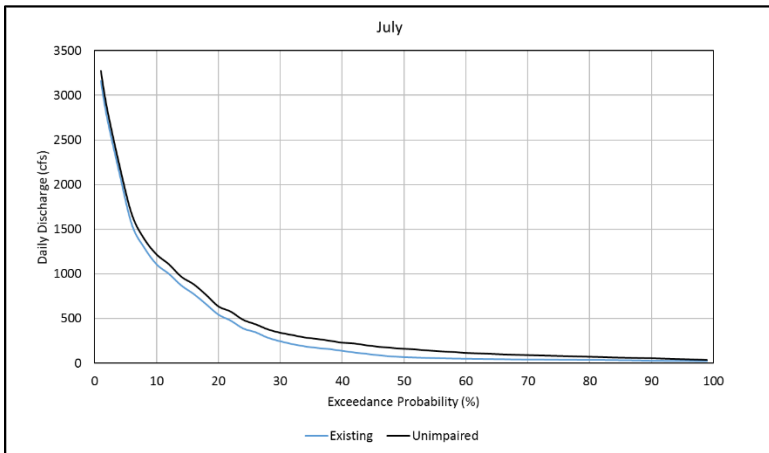


Figure 7.2 E-2h.

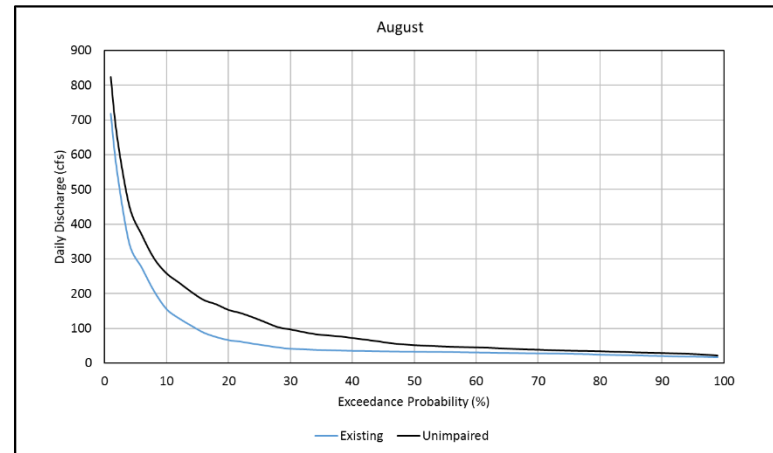


Figure 7.2 E-2i.

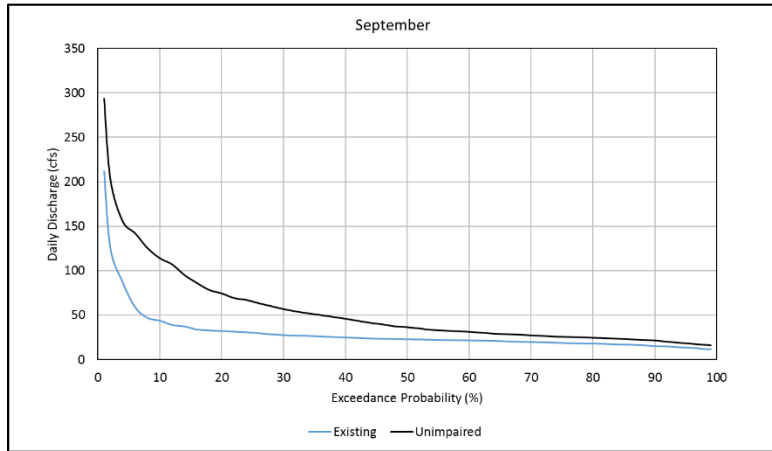


Figure 7.2 E-2j.

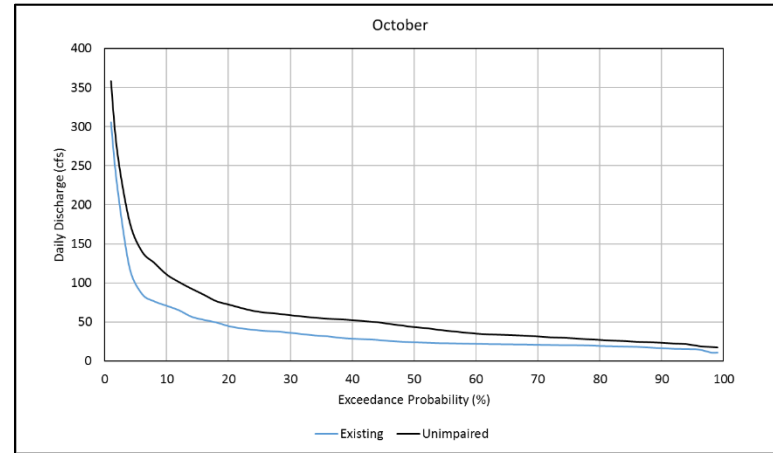


Figure 7.2 E-2k.

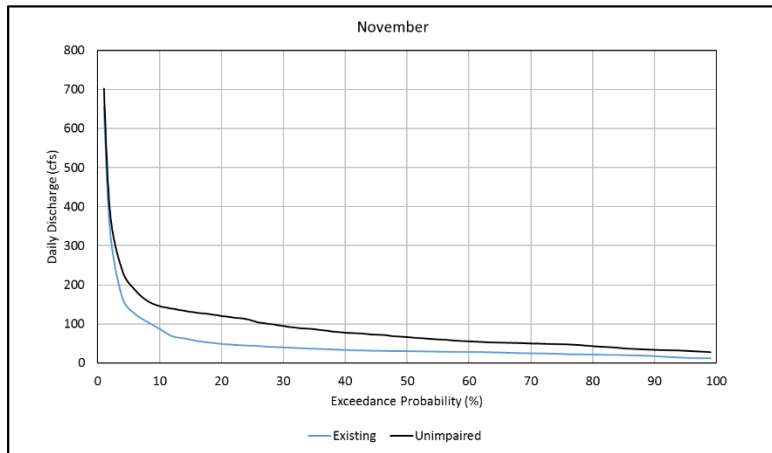


Figure 7.2 E-2l.

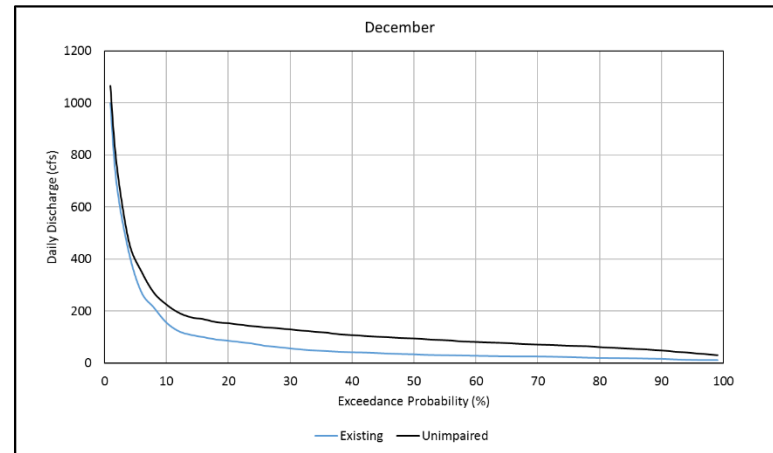


Figure 7.2 E-3a-I. Exceedance probability for existing and unimpaired daily discharge (WY 1994 to WY 2018) for each month of the year, downstream of the Kaweah No. 1 Powerhouse and upstream of the Kaweah No. 2 Powerhouse.

Figure 7.2 E-3a.

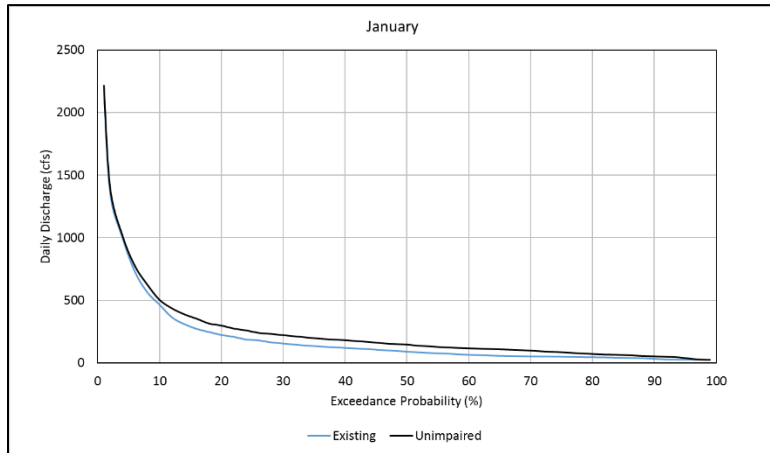


Figure 7.2 E-3b.

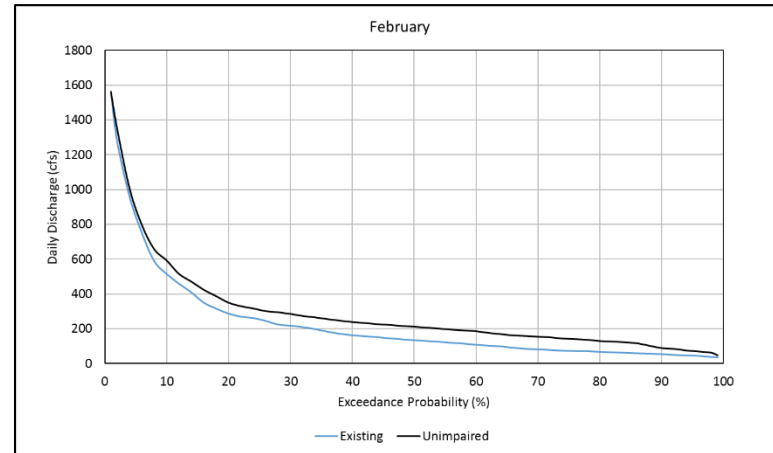


Figure 7.2 E-3c.

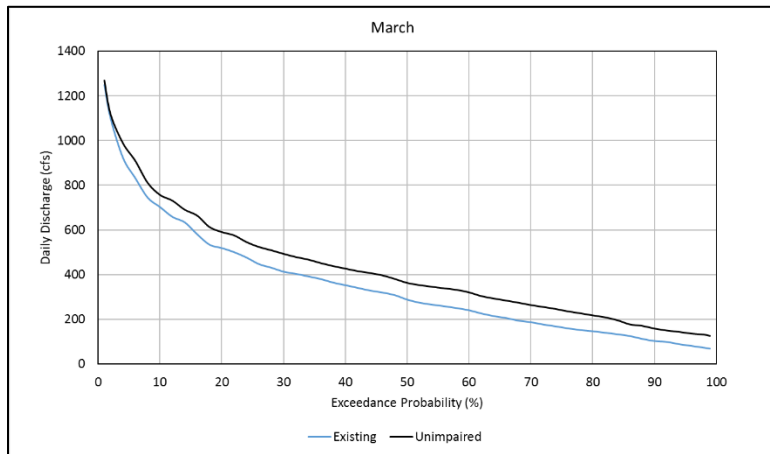


Figure 7.2 E-3d.

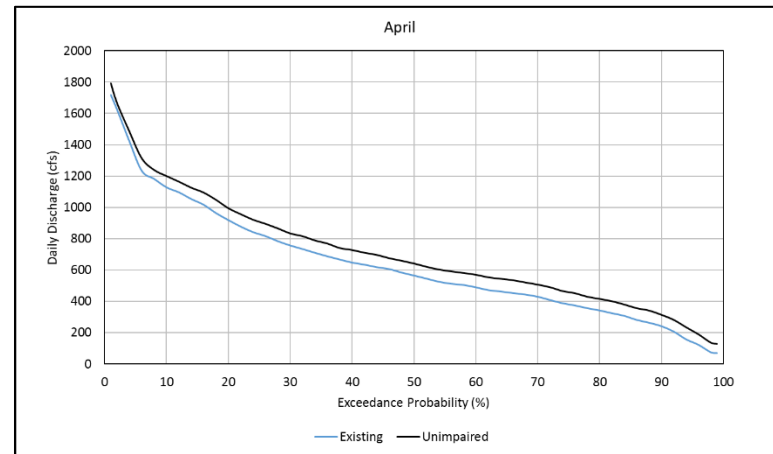


Figure 7.2 E-3e.

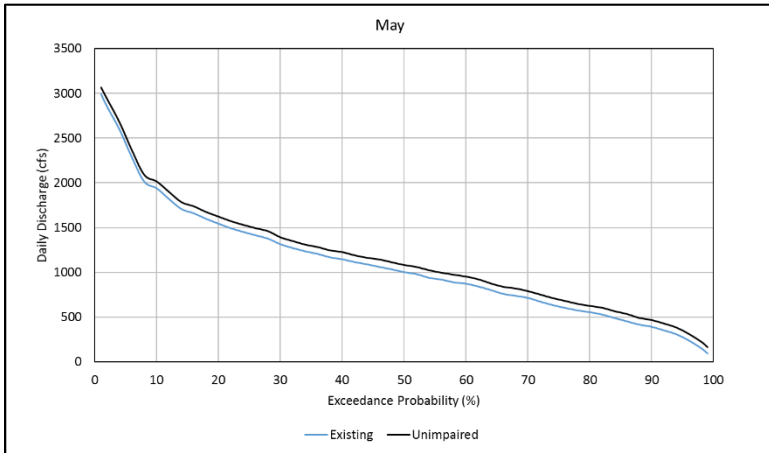


Figure 7.2 E-3f.

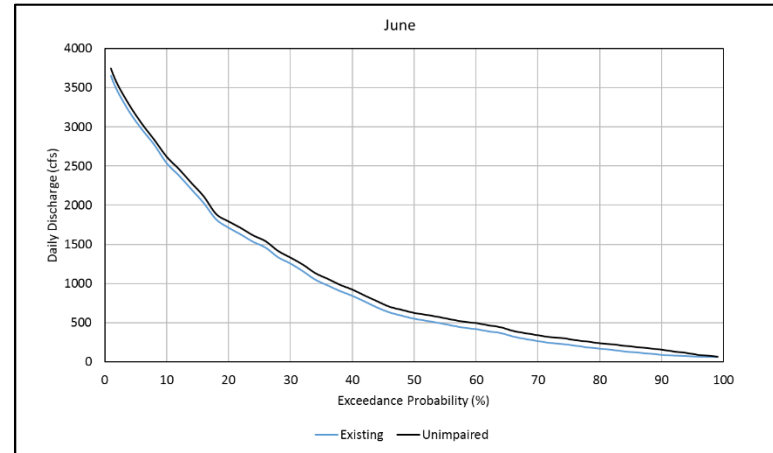


Figure 7.2 E-3g.

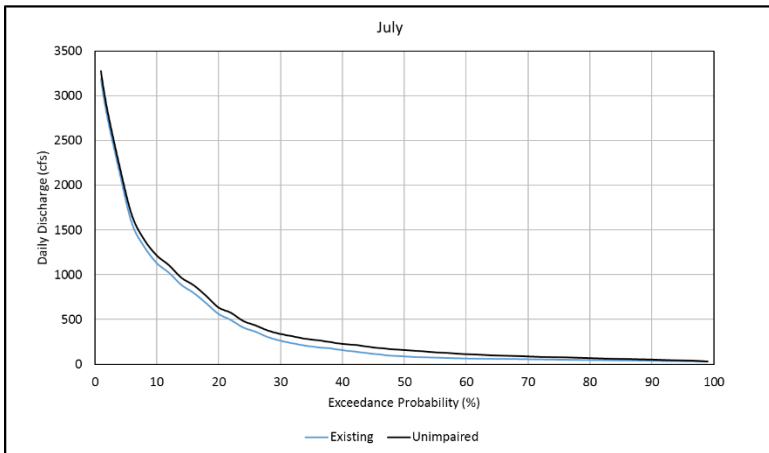


Figure 7.2 E-3h.

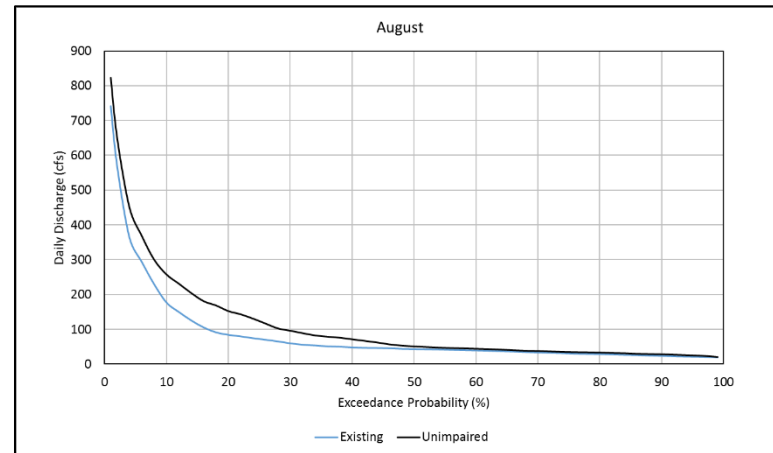


Figure 7.2 E-3i.

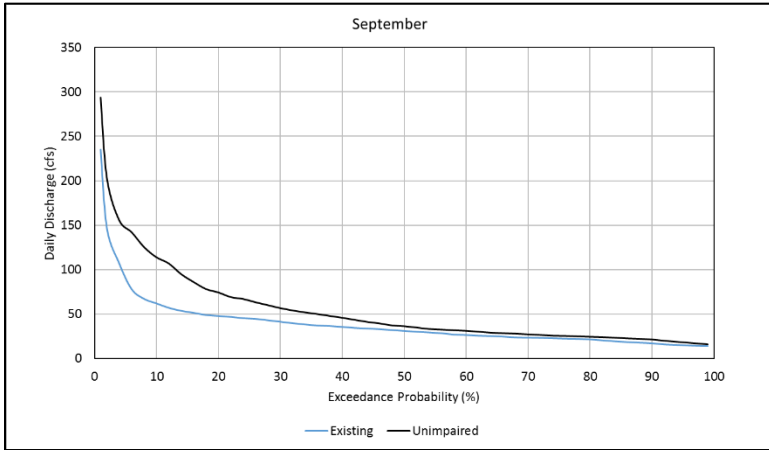


Figure 7.2 E-3j.

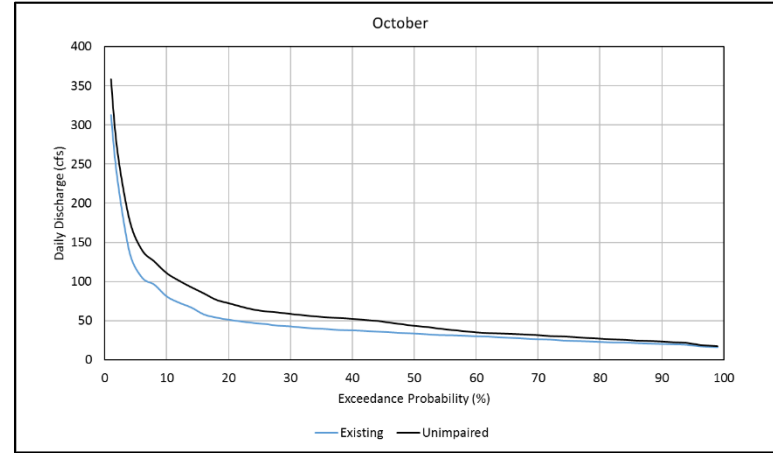


Figure 7.2 E-3k.

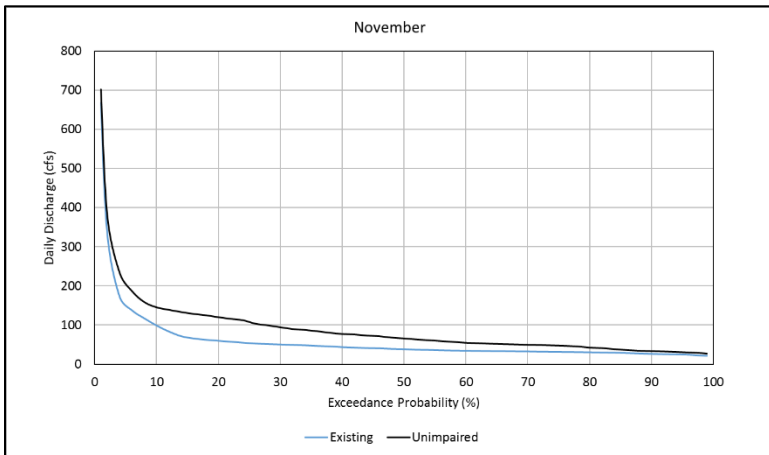


Figure 7.2 E-3l.

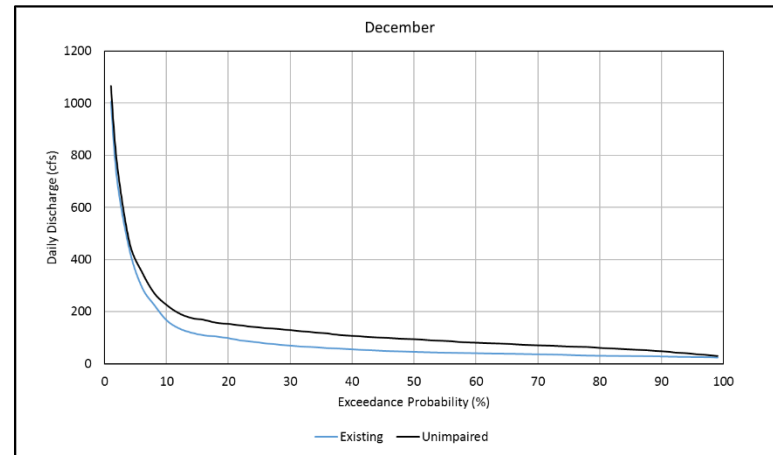


Figure 7.7 E-4a-l. Exceedance probability for daily discharge (WY 1994 to WY 2018) for each month of the year, upstream of the East Fork Kaweah River confluence.

Figure 7.7 E-4a.

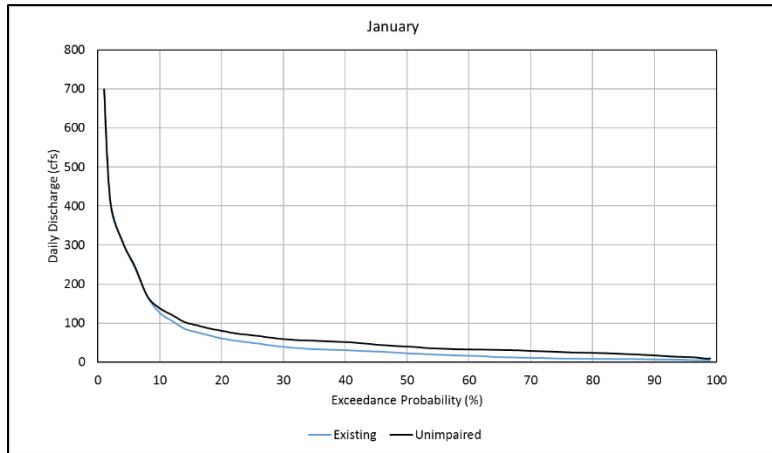


Figure 7.7 E-4b.

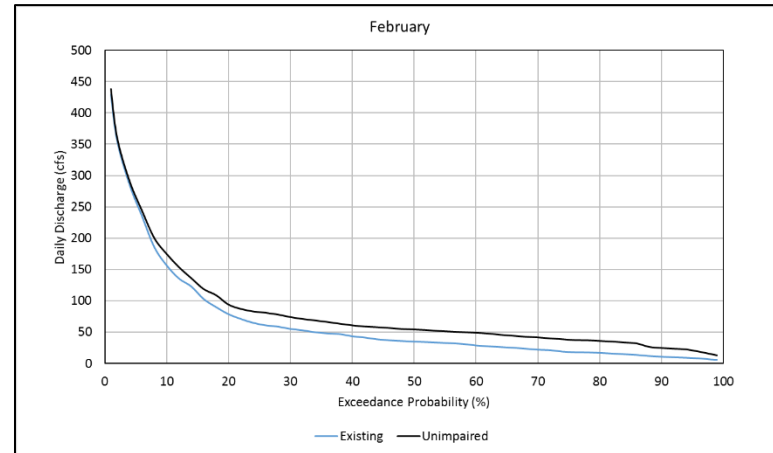


Figure 7.7 E-4c.

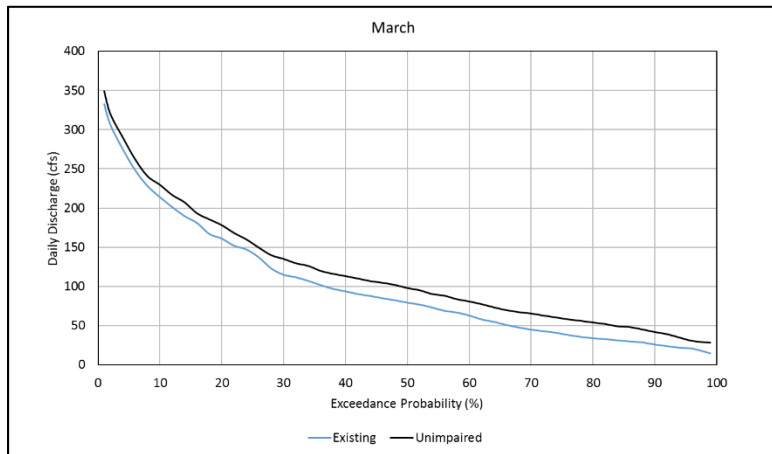


Figure 7.7 E-4d.

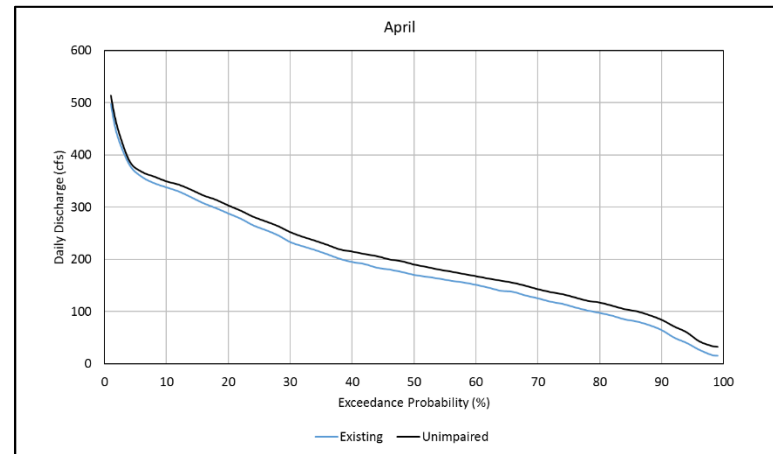


Figure 7.7 E-4e.

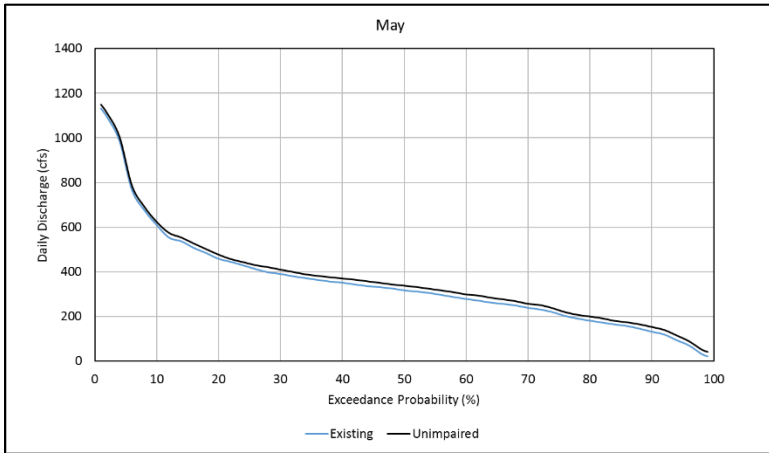


Figure 7.7 E-4f.

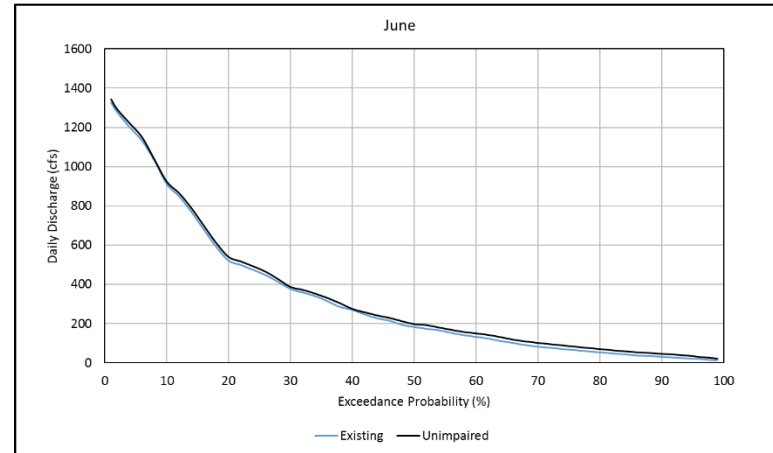


Figure 7.7 E-4g.

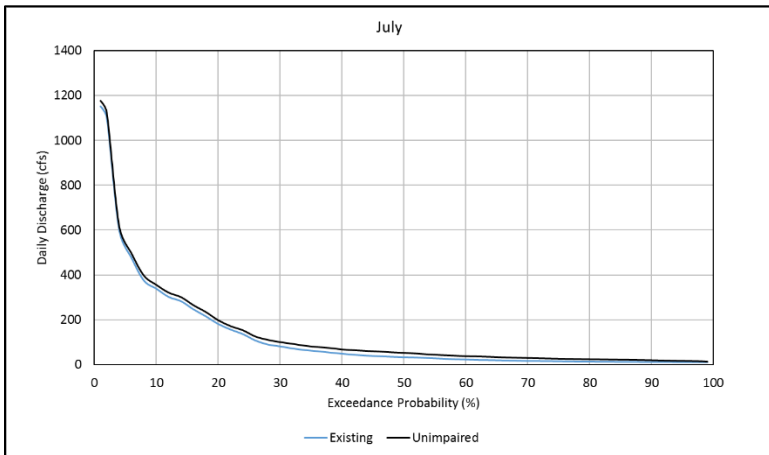


Figure 7.7 E-4h.

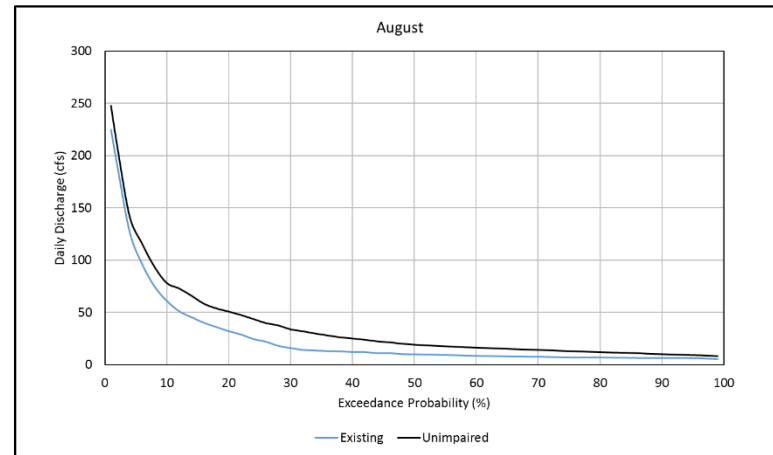


Figure 7.7 E-4i.

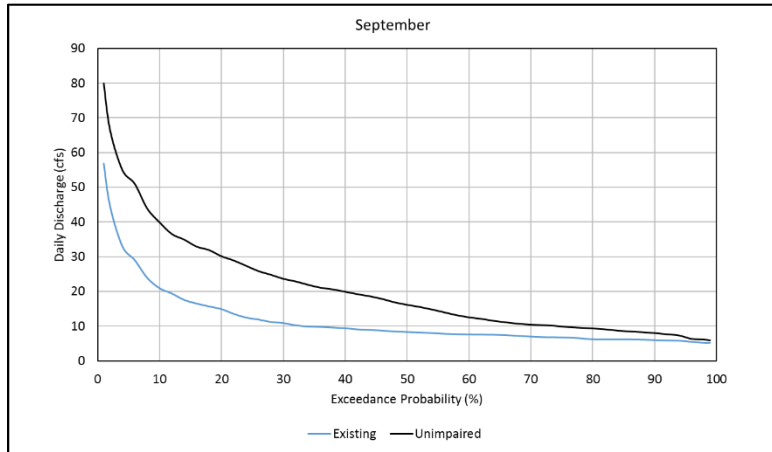


Figure 7.7 E-4j.

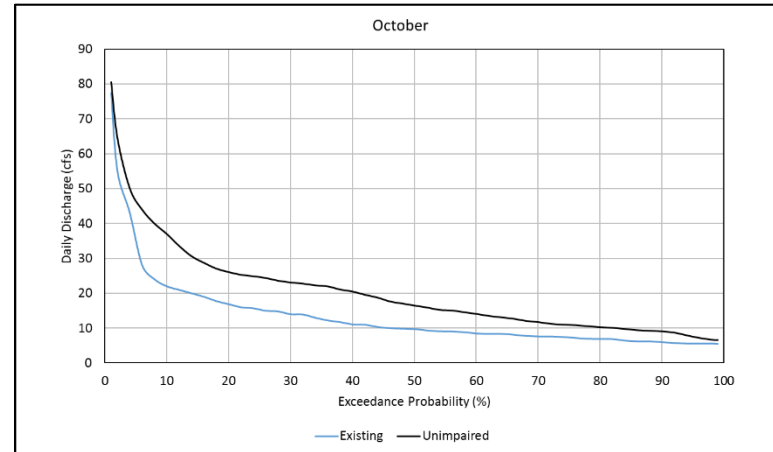


Figure 7.7 E-4k.

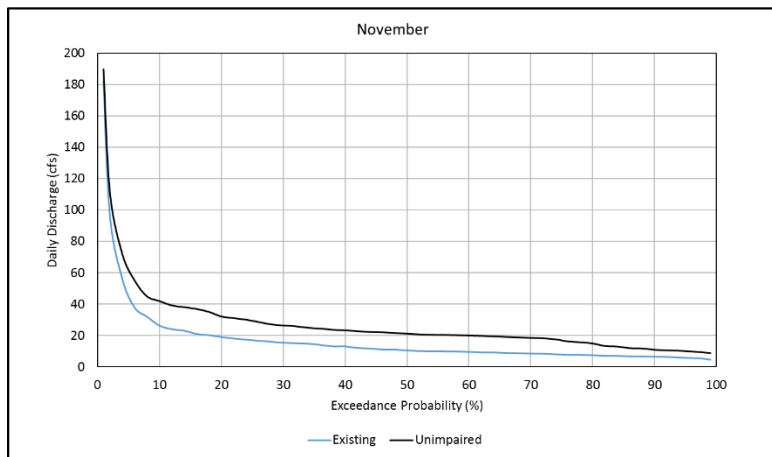
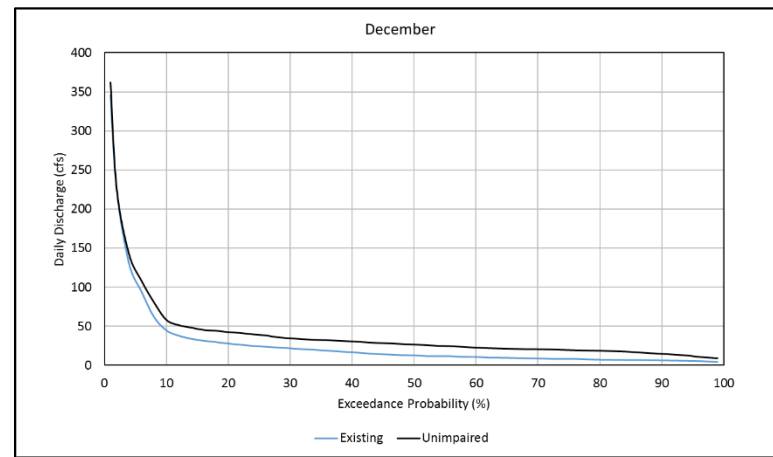


Figure 7.7 E-4l.



APPENDIX 7.2-F

Monthly Average Flows by Year in Bypass Reaches and Flowlines Associated with the Kaweah Project over the Available Flow Data Period of Record

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Table 7.2-F-1. Monthly Average Flows by Year in Bypass Reaches and Flowlines Associated with the Kaweah Project over the Available Flow Data Period of Record.⁵

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Flow to Kaweah No. 3 Powerhouse (USGS Gage 11208565)												
2002										2.89	42.60	71.87
2003	85.61	85.43	87.03	87.87	88.87	89.60	76.39	43.97	13.47	6.15	19.27	53.32
2004	32.71	72.34	89.13	87.83	87.71	81.97	33.52	1.49	0.00	25.71	54.03	49.35
2005	74.81	87.86	89.74	89.57	88.19	89.77	89.61	60.52	27.60	17.88	19.37	64.48
2006	36.73	44.00	48.23	46.99	76.42	91.20	87.74	48.59	3.49	17.07	24.53	33.90
2007	32.29	54.82	86.23	90.17	90.61	62.27	10.10	0.07	0.0	0.0	0.18	0.0
2008	0.0	0.0	76.03	86.23	91.06	91.60	76.16	7.82	0.0	0.0	35.80	40.71
2009	67.68	89.29	91.29	82.60	71.29	71.43	57.45	5.85	0.0	25.87	31.40	60.39
2010	76.39	88.50	58.48	90.33	87.90	76.69	89.35	50.97	4.77	30.84	69.30	57.97
2011	24.78	0.0	67.77	22.63	0.0	0.0	0.0	0.00	0.00	0.00	0.17	0.0
2012	18.74	60.90	36.16	0.00	0.0	61.20	21.38	88.9	54.4	4.4	0.0	0.0
2013	0.0	0.0	72.00	89.93	88.94	54.43	4.45	88.9	51.2	2.8	0.0	0.0
2014	0.0	5.35	63.13	86.63	88.94	51.17	2.82	43.8	34.9	18.0	0.7	0.0
2015	0.0	0.0	15.5	12.9	43.1	63.1	41.3	88.3	74.9	42.7	1.0	0.0
2016	0.0	37.5	44.5	59.5	81.8	85.1	87.9	68.2	84.5	85.0	68.8	47.1
2017	0.0	0.2	10.4	17.6	22.5	58.9	64.0	82.9	56.2	0.1	0.0	0.0
2018	0.2	8.2	20.2	18.3	21.1	45.0	75.0	88.9	54.4	4.4	0.0	0.0

⁵ Note: See Tables 7.2-4 and 7.2-5 for data gaps/ time periods with missing data.

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Calculated Unimpaired Flow Upstream of Kaweah No. 2 Diversion¹ (WY 1994 - 2018)												
1994	31.4	30.8	46.6	44.6	86.4	188.2	329.6	531.6	323.9	55.5	20.8	19.7
1995	55.6	51.1	64.3	216.5	236.4	600.2	590.5	1038.0	1583.0	1220.4	334.1	94.2
1996	39.8	31.0	89.5	136.4	514.1	419.5	709.9	1123.9	782.5	243.6	60.7	29.0
1997	28.3	197.8	347.4	1292.7	445.7	460.5	566.0	971.5	586.3	210.5	75.0	44.9
1998	37.2	56.8	94.5	155.8	352.6	411.1	643.1	923.4	2075.0	1647.5	334.2	161.8
1999	70.8	82.8	91.0	97.2	152.8	157.8	304.1	687.5	345.5	95.9	35.4	21.8
2000	20.6	33.3	25.0	73.6	221.1	300.3	547.6	1009.1	531.0	100.3	38.6	27.1
2001	50.5	64.4	42.8	51.2	100.9	251.0	424.5	917.5	227.8	76.1	25.6	16.7
2002	18.2	92.9	163.6	159.2	148.0	220.1	547.3	670.5	470.2	89.5	27.4	18.4
2003	19.8	377.4	104.8	145.8	156.2	283.6	380.5	892.5	711.8	152.6	67.8	27.7
2004	19.2	34.5	96.7	107.3	116.9	392.6	401.5	467.8	236.7	59.6	21.3	16.4
2005	49.9	77.2	72.4	252.1	184.9	341.5	475.5	1223.9	1159.7	523.5	96.2	40.6
2006	33.5	33.7	140.3	275.2	195.0	319.3	745.2	1413.0	1232.6	410.3	83.7	37.9
2007	31.9	38.4	52.6	59.4	90.4	228.8	329.8	440.0	138.1	34.0	18.0	15.8
2008	20.0	23.2	48.8	137.3	195.0	282.4	475.3	757.8	579.3	161.6	33.9	18.3
2009	24.1	118.5	62.8	157.1	184.8	256.7	474.7	936.8	358.0	115.1	32.5	18.6
2010	260.4	53.8	94.9	122.9	201.3	309.6	507.3	856.1	1494.9	474.0	82.4	34.6
2011	62.1	97.0	409.6	274.8	225.3	438.7	771.5	1056.1	1615.3	901.5	196.1	71.7
2012	149.9	89.5	53.8	94.4	98.3	177.0	550.6	561.9	167.5	48.5	27.2	17.3
2013	20.4	41.2	117.6	112.4	109.6	180.1	323.7	346.6	114.5	30.7	18.6	14.5
2014	16.4	20.6	24.2	18.9	57.5	109.6	273.5	345.6	114.0	24.6	19.2	11.3
2015	11.7	27.9	64.0	40.3	183.5	120.1	113.1	180.4	124.8	75.8	18.9	10.7
2016	17.8	56.2	74.2	126.1	207.1	326.4	468.1	620.0	545.5	83.7	23.1	14.3

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2017	25.8	30.2	120.4	728.6	1004.4	703.2	1031.4	1603.4	1638.8	665.9	158.3	73.2
2018	35.6	67.3	46.9	82.0	56.5	309.8	743.8	517.8	262.1	70.6	27.0	16.2
Kaweah No. 2 Flowline (USGS Gage No. 11208570 and SCE Gage 204a) (1994-2002 and 2002-2018)												
1994	4.4	20.6	37.2	24.5	54.3	80.3	80.6	80.3	73.8	43.8	9.6	11.6
1995	42.6	45.4	58.4	75.3	81.6	79.0	83.0	82.1	82.9	89.7	82.1	68.0
1996	28.0	19.6	45.9	63.5	74.9	77.6	76.6	73.0	76.8	77.2	36.6	17.0
1997	16.2	45.4	75.9	42.4	81.6	72.4	82.3	76.0	75.9	77.3	40.2	28.8
1998	25.4	39.6	68.0	63.9	58.4	79.5	44.7	73.4	66.3	76.4	80.5	71.7
1999	8.7	66.1	42.8	48.1	65.1	76.6	74.4	82.9	83.1	62.1	12.6	3.7
2000	2.1	3.6	8.6	36.6	81.1	87.5	90.9	88.3	89.3	64.3	14.4	3.3
2001	2.0	29.9	24.7	23.9	68.8	79.3	83.2	83.8	77.8	42.5	4.6	3.5
2002	3.0	6.8	66.5	76.3	79.1	82.2	84.0	84.4	80.7	54.6	6.8	3.0
2003	3.0	42.6	75.8	78.4	75.4	75.3	75.6	79.9	79.1	78.6	39.6	13.3
2004	2.8	20.5	53.9	66.5	70.8	87.1	87.3	85.5	83.0	46.4	7.7	8.1
2005	25.5	65.8	56.9	69.8	83.1	84.3	84.6	86.4	86.8	86.6	63.1	27.5
2006	18.0	20.2	57.6	75.3	79.6	80.4	77.1	82.7	83.3	83.3	54.0	19.0
2007	6.3	13.2	36.3	35.6	54.8	83.8	84.4	82.4	65.7	17.9	5.6	5.2
2008	6.4	7.5	26.9	62.1	82.1	84.4	85.0	84.7	84.9	73.5	11.5	3.9
2009	8.6	62.2	37.2	62.0	82.7	85.3	86.1	83.6	84.0	64.3	9.3	4.1
2010	27.0	40.5	61.3	59.0	83.7	85.7	86.2	86.7	79.9	84.8	44.2	16.6
2011	26.6	71.0	59.8	82.5	81.9	81.1	77.1	65.4	82.8	84.1	83.2	25.1
2012	58.8	67.8	37.1	16.9	68.0	70.2	78.2	73.2	67.6	16.7	2.5	2.1
2013	1.9	1.7	8.2	47.0	69.4	65.9	71.9	72.4	49.8	11.3	1.9	1.8
2014	1.6	1.6	1.6	1.7	14.7	58.3	60.7	74.5	46.9	4.7	1.3	1.5
2015	1.5	1.5	11.4	27.2	56.1	30.7	62.9	72.9	51.8	27.4	4.6	2.4

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2016	2.9	29.6	36.7	10.7	2.5	42.3	69.9	64.0	68.5	43.1	2.3	2.2
2017	2.4	2.4	24.6	6.3	2.2	3.3	53.9	68.1	60.8	69.7	68.2	49.9
2018	2.1	6.0	22.2	24.5	24.7	36.2	53.9	66.7	65.4	39.8	5.1	1.5
Kaweah River Downstream Kaweah No. 2 Diversion (USGS Gage No. 11208600) WY 1994-2018)												
1994	27.0	10.2	9.4	20.1	32.1	107.9	249.0	451.3	250.1	11.7	11.2	8.0
1995	13.0	5.7	5.9	141.2	154.8	521.2	507.4	955.9	1500.1	1130.6	252.0	26.3
1996	11.8	11.4	43.6	72.9	439.2	341.9	633.3	1050.9	705.7	166.5	24.1	12.0
1997	12.1	152.4	271.5	1250.3	364.1	388.1	483.7	895.5	510.3	133.1	34.9	16.1
1998	11.8	17.2	26.4	91.8	294.1	331.5	598.4	850.0	2008.7	1571.1	253.6	90.1
1999	62.2	16.6	48.2	49.1	87.6	81.1	229.7	604.7	262.4	33.9	22.8	18.2
2000	18.5	29.7	16.4	37.0	140.0	212.7	456.7	920.9	441.7	36.0	24.2	23.8
2001	48.6	34.6	18.1	27.3	32.1	171.8	341.3	833.6	150.0	33.6	21.0	13.3
2002	15.2	86.1	97.1	82.9	68.9	137.8	463.3	586.1	389.5	34.9	20.5	15.3
2003	16.9	334.8	29.0	67.5	80.8	208.3	304.9	812.6	632.7	74.0	28.2	14.4
2004	16.4	14.0	42.8	40.7	46.2	305.5	314.2	382.4	153.6	13.3	13.6	8.3
2005	24.4	11.4	15.5	182.2	101.8	257.2	390.9	1137.5	1072.9	436.9	33.1	13.1
2006	15.5	13.4	82.7	199.9	115.4	238.9	668.3	1331.1	1149.8	326.8	29.7	19.0
2007	25.6	25.3	16.3	23.7	35.6	145.0	245.4	357.6	72.5	16.2	12.4	10.7
2008	13.6	15.7	22.0	75.1	112.8	198.0	390.3	673.0	494.4	88.1	22.4	14.5
2009	15.5	56.3	25.6	95.1	102.2	171.4	388.7	853.5	274.0	50.8	23.3	14.4
2010	233.5	13.3	33.6	63.9	117.6	223.9	421.1	769.4	1415.0	389.2	38.2	18.0
2011	35.5	26.0	349.7	192.3	143.4	357.6	694.4	990.7	1532.5	817.4	112.8	46.5
2012	91.2	21.7	16.7	77.5	30.4	106.8	472.4	488.7	100.0	31.8	24.8	15.3
2013	18.4	39.5	109.4	65.4	40.2	114.2	251.7	274.2	64.6	19.4	16.7	12.6
2014	14.8	19.0	22.6	17.2	42.8	51.3	212.9	271.0	67.0	19.8	17.9	9.8

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2015	10.3	26.3	55.2	13.1	127.5	89.4	50.2	107.5	72.9	48.4	14.3	8.4
2016	14.8	26.7	37.5	115.4	204.6	284.1	398.2	556.0	477.0	40.6	20.9	12.1
2017	23.4	27.8	95.8	722.2	1002.2	700.0	977.5	1535.3	1578.0	596.2	90.1	23.3
2018	33.4	61.3	24.7	57.5	31.8	273.5	689.9	451.2	196.8	30.8	21.9	14.7
Flow to Kaweah No. 1 Powerhouse (USGS Gage No. 11208800)												
2003	5.0	8.2	20.6	20.8	21.2	15.9	18.6	19.9	20.9	20.4	19.2	15.0
2004	6.1	11.9	15.9	18.1	20.1	20.0	21.7	21.1	21.3	13.9	3.6	0.0
2005	5.4	13.4	9.3	11.6	20.0	20.0	15.9	16.8	17.9	17.9	18.8	18.0
2006	11.3	0.0	11.2	17.2	19.9	19.0	12.8	15.0	14.7	12.0	18.5	13.0
2007	3.6	7.9	11.8	8.8	16.6	18.8	17.7	11.8	17.6	6.5	3.1	0.0
2008	0.0	0.0	6.0	14.4	17.8	18.2	13.7	17.1	12.6	16.1	9.3	0.0
2009	0.0	14.7	11.3	17.3	17.9	18.9	19.2	9.4	13.0	16.3	1.8	0.0
2010	0.0	0.0	2.1	14.1	0.1	0.0	10.7	18.2	16.5	17.9	13.8	16.8
2011	1.8	11.5	5.6	14.9	18.5	0.6	6.7	18.3	17.6	17.9	19.0	18.3
2012	14.7	18.6	9.0	11.9	17.4	13.9	18.3	18.0	17.9	13.0	10.5	0.6
2013	0.0	0.0	0.0	0.3	19.0	19.5	19.8	19.0	18.1	2.3	0.0	0.0
2014	0.0	0.0	0.0	0.2	6.3	11.3	18.6	18.3	2.5	0.0	0.0	0.0
2015	0.0	0.0	0.0	5.4	13.8	6.7	18.5	19.1	15.0	1.9	4.6	0.0
2016	0.0	9.8	11.1	15.3	17.7	18.3	18.4	15.9	11.1	11.4	2.2	0.0
2017	0.0	0.0	1.7	3.8	5.6	14.7	9.6	15.4	10.8	16.6	16.1	13.5
2018	0.1	3.2	10.9	14.5	11.2	8.2	12.5	13.1	12.7	0.1	0.0	0.0
Flow to Kaweah No. 2 Powerhouse (USGS Gage No. 11208818) (WY 2003 - 2018)												
2003	0.0	40.7	68.7	74.0	72.8	75.3	74.1	75.5	75.5	68.8	34.5	9.1
2004	0.0	23.8	52.5	62.7	71.3	79.1	79.6	78.7	76.9	43.8	2.1	0.0
2005	19.7	64.3	55.4	65.3	79.2	79.9	79.0	78.6	78.9	78.6	60.0	28.7

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2006	11.7	16.0	55.7	69.5	75.5	77.1	73.2	78.2	77.0	65.0	49.9	15.6
2007	0.0	0.3	33.8	33.5	50.7	75.1	77.5	74.2	58.7	8.5	0.0	0.0
2008	0.0	0.0	16.5	60.4	76.0	77.3	78.4	78.8	75.6	62.8	5.7	0.0
2009	0.0	55.5	34.3	60.2	78.1	79.0	79.5	78.0	78.3	58.7	2.7	0.0
2010	19.6	38.6	57.6	54.7	78.2	78.5	79.0	78.2	76.0	77.3	28.6	10.3
2011	11.1	68.2	71.6	77.2	77.9	77.7	74.0	70.3	76.0	77.9	74.7	19.0
2012	57.4	66.2	33.1	14.0	65.1	66.4	74.7	71.3	66.1	14.6	0.0	0.0
2013	0.0	0.0	0.0	40.7	68.9	65.4	71.5	71.4	47.8	7.2	0.0	0.0
2014	0.0	0.0	0.0	0.0	13.4	58.3	56.2	72.4	43.6	0.0	0.0	0.0
2015	0.0	0.0	5.9	26.2	53.0	27.2	61.4	65.6	44.4	23.3	1.6	0.0
2016	0.0	27.7	33.0	8.7	0.0	39.8	69.3	61.9	67.2	40.1	0.0	0.0
2017	0.0	0.0	22.4	4.2	0.0	0.6	52.2	66.6	59.0	68.3	64.3	47.2
2018	0.2	3.8	20.2	21.5	21.1	33.2	52.3	65.2	63.3	36.7	0.2	0.0
Calculated Unimpaired Flow Upstream of Kaweah No. 1 Diversion² (WY 1994 - 2018)												
1994	20.4	33.1	58.7	113.8	216.8	131.0	26.9	10.8	10.2	15.0	18.8	22.2
1995	75.8	80.6	270.1	251.8	439.2	946.0	683.0	168.7	53.0	23.4	20.5	23.5
1996	54.0	202.8	189.6	311.8	554.6	339.8	89.4	31.0	21.0	28.3	21.7	37.9
1997	674.4	204.5	192.6	248.7	486.4	292.0	81.8	33.3	24.3	18.1	98.2	180.4
1998	72.0	161.7	159.0	247.8	366.1	1035.5	794.2	143.0	67.6	25.8	30.5	43.6
1999	44.6	58.7	52.1	111.2	298.7	160.9	51.1	22.1	20.8	41.2	42.0	38.8
2000	30.9	71.2	96.3	192.6	417.7	207.8	45.8	19.4	18.8	14.4	17.8	15.0
2001	22.8	37.5	89.5	164.1	362.9	106.8	34.5	13.1	13.8	23.3	24.8	20.3
2002	61.5	51.2	77.9	230.4	305.5	203.7	41.5	17.6	13.9	10.9	31.5	68.4
2003	55.7	65.1	102.6	162.9	448.2	359.1	69.8	41.9	25.1	11.7	158.7	50.7
2004	40.0	51.5	148.6	191.1	252.5	125.1	31.7	15.2	14.0	15.7	21.0	39.5

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2005	88.4	60.3	119.8	203.8	666.1	623.1	227.6	56.4	28.3	18.4	24.2	26.5
2006	111.1	67.8	148.9	353.0	768.5	634.9	186.2	46.3	27.0	25.0	20.9	53.7
2007	25.9	36.0	78.5	137.6	213.8	63.9	20.0	12.4	10.8	23.3	22.4	25.5
2008	45.9	68.3	100.8	183.6	351.6	265.6	67.3	20.6	16.2	10.9	12.2	20.0
2009	47.8	60.4	84.0	186.5	393.3	143.4	44.3	16.1	10.4	12.8	32.3	23.8
2010	43.1	77.4	128.0	208.9	362.0	766.2	232.4	44.5	26.5	80.4	25.3	34.1
2011	103.7	88.1	205.1	331.4	427.3	831.5	343.1	83.5	36.6	27.2	32.7	151.2
2012	43.6	40.3	68.3	213.9	289.5	80.8	27.6	18.5	11.3	54.6	38.6	28.1
2013	39.7	37.1	59.6	134.5	164.1	51.4	19.2	11.2	7.2	12.4	17.5	38.3
2014	9.6	20.3	31.3	97.3	145.5	43.6	14.7	10.4	6.7	8.4	9.9	10.3
2015	13.7	45.3	35.3	37.6	50.0	44.3	44.1	12.6	8.2	6.7	10.3	18.6
2016	47.9	70.5	112.3	216.6	300.7	238.2	44.1	14.1	9.9	10.6	21.6	30.9
2017	249.0	375.0	278.5	394.1	822.3	810.7	244.5	62.5	33.3	11.3	12.5	45.0
2018	30.4	23.0	89.7	296.6	216.1	86.2	24.4	11.5	9.9	21.6	28.2	21.7
Kaweah No. 1 Flowline (USGS Gage No. 11208720 + SCE Gage 202)												
1975	17.2	21.5	19.8	20.5	22.6	24.9	19.2	25.5	27.3	28.2	26.1	18.9
1976	23.4	24.7	24.3	18.0	23.3	23.5	21.0	25.3	26.1	18.2	15.6	19.8
1977	22.7	15.7	12.9	16.6	16.8	20.6	23.0	24.6	25.1	16.6	14.6	9.1
1978	7.8	11.2	15.8	26.6	22.8	23.2	24.0	24.7	25.6	26.0	25.9	25.6
1979-93	no data											
1994	0.2	12.0	17.2	14.7	19.6	23.0	22.9	22.8	22.9	14.3	4.3	3.4
1995	15.7	14.5	17.3	21.9	23.0	19.1	23.2	23.2	22.8	22.3	21.1	22.9
1996	19.4	15.2	17.7	22.4	21.1	23.1	23.4	20.5	9.8	19.2	18.9	13.8
1997	7.7	14.2	20.1	0.9	11.0	17.8	5.5	0.0	13.1	19.3	19.6	17.0
1998	15.4	15.4	19.5	20.7	17.8	22.3	22.5	22.4	17.9	19.2	20.6	22.6

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1999	23.1	23.2	17.4	20.2	18.5	19.3	22.0	23.4	23.5	21.2	14.8	8.1
2000	1.8	9.5	7.9	10.9	15.4	22.8	23.7	23.9	23.9	19.3	10.5	10.8
2001	3.7	14.6	11.9	13.8	18.4	18.5	21.2	23.2	23.3	16.8	6.8	7.5
2002	2.3	9.4	20.2	20.6	21.3	21.6	23.5	23.9	23.6	19.7	10.8	7.5
2003	5.8	9.0	21.3	21.7	22.0	16.8	19.6	20.7	21.9	22.4	20.5	16.0
2004	7.9	13.1	16.7	19.9	21.3	21.1	22.5	22.2	22.1	15.3	7.6	5.2
2005	8.2	14.5	13.3	12.6	21.2	21.1	17.4	18.8	19.6	19.9	20.7	20.1
2006	14.1	4.3	13.8	17.9	21.2	20.4	16.0	18.1	16.7	14.1	20.0	16.5
2007	10.4	11.1	13.2	9.6	17.8	19.9	18.9	13.4	19.2	7.8	5.2	2.6
2008	3.1	3.1	8.3	15.5	18.2	19.8	17.1	18.4	13.9	17.9	12.7	3.9
2009	4.9	15.3	12.6	17.0	17.5	18.5	18.9	9.5	11.6	15.1	3.3	0.0
2010	1.0	2.8	6.2	13.8	0.4	0.1	10.7	17.8	16.7	17.5	15.6	17.4
2011	1.9	11.6	6.8	15.5	18.1	1.1	6.9	17.8	17.3	17.6	19.0	19.2
2012	15.6	19.0	15.4	13.3	18.9	16.0	18.5	19.0	19.2	14.1	10.9	3.1
2013	0.7	0.7	2.0	7.0	18.4	19.1	19.0	19.0	18.2	2.9	0.7	0.3
2014	0.2	0.3	0.2	0.9	6.4	11.3	18.5	17.7	2.5	0.6	0.7	0.7
2015	0.7	0.7	2.3	6.3	13.6	10.4	18.0	18.9	14.6	2.4	4.9	0.6
2016	1.2	9.9	11.9	14.9	17.3	17.7	17.5	15.4	10.8	11.5	2.7	0.6
2017	0.8	0.9	3.4	3.7	5.5	14.4	10.4	15.4	11.8	16.4	16.4	14.1
2018	4.2	5.8	11.3	14.7	11.6	8.5	13.9	14.0	13.4	0.6	0.5	0.6
East Fork Kaweah River below Kaweah No. 1 Diversion (USGS Gage No. 11208730)												
1952									632.3	229.7	50.1	6.2
1953	1.5	3.7	9.7	33.1	19.4	28.6	130.8	177.2	323.9	87.1	4.9	0.2
1954	0.4	0.6	2.9	11.6	23.5	48.6	190.9	369.2	142.4	21.1	0.8	0.5
1955	0.9	2.6	2.5	5.2	30.3	29.8	68.8	232.5	209.9	27.0	0.3	0.3

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1956-57	no data											
1958	0.5	1.2	7.4	11.6	35.1	78.1	203.4	663.0	614.2	189.3	34.0	5.9
1959	0.3	7.6	0.2	1.2	16.7	26.5	79.2	84.9	38.4	0.8	0.6	0.7
1960	0.7	0.8	0.6	1.1	15.9	29.0	115.1	206.1	112.6	4.8	0.6	0.8
1961	0.8	1.4	2.0	0.5	0.4	6.8	62.2	119.2	48.2	0.9	4.8	1.0
1962	1.2	0.9	1.6	2.7	71.3	25.1	249.9	377.3	362.1	83.5	5.3	0.6
1963	1.4	0.5	0.4	59.3	169.4	46.3	122.4	411.6	415.6	115.3	16.5	5.5
1964	4.2	16.5	10.0	16.6	2.2	15.3	79.5	231.2	149.3	17.8	1.1	0.8
1965	3.5	5.2	109.9	68.6	41.0	45.0	151.4	342.8	420.6	147.1	55.4	9.9
1966	1.7	26.3	25.3	19.5	13.9	55.2	219.8	312.2	69.0	6.9	1.1	0.6
1967	0.5	13.6	593.9	114.4	103.6	131.3	157.1	582.1	820.1	552.4	148.3	48.6
1968	13.6	12.8	23.8	19.3	41.1	62.2	114.4	224.1	129.0	13.5	1.4	0.7
1969	2.9	5.2	20.0	358.6	219.1	160.4	350.1	943.8	965.7	451.3	96.5	22.8
1970	22.4	10.2	30.8	137.5	51.5	85.3	127.5	451.2	279.0	45.3	3.7	1.1
1971	1.0	12.7	17.4	30.1	31.6	54.8	120.1	255.6	338.0	64.7	8.4	2.5
1972	1.2	3.6	13.2	12.8	10.6	58.4	55.1	130.3	77.7	2.4	1.9	2.9
1973	0.8	4.6	17.6	80.9	50.4	78.7	181.5	662.9	654.1	138.6	25.0	1.9
1974	10.1	12.3	20.8	73.4	37.9	113.1	200.7	494.8	430.6	87.9	15.1	4.5
1975	2.3	2.6	8.6	7.0	22.9	52.0	72.9	404.3	472.2	80.3	7.1	3.2
1976	12.6	5.5	6.9	4.3	4.1	24.2	67.7	166.2	21.3	1.8	1.4	26.1
1977	12.6	4.0	1.3	1.9	2.1	2.3	45.2	54.8	60.9	2.0	2.1	2.0
1978	3.5	1.3	29.7	38.5	103.3	191.2	222.9	466.5	713.8	306.6	63.3	73.9
1979-93	no data											
1994	14.8	6.8	5.1	5.7	13.5	35.7	90.9	194.0	108.2	12.7	6.6	6.8
1995	7.7	6.0	6.2	53.9	57.7	251.0	228.6	415.9	923.2	660.7	147.7	30.1

Water Year and Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1996	8.9	6.5	20.2	31.7	181.7	166.6	288.4	534.1	330.0	70.2	12.1	7.2
1997	10.2	83.9	160.6	673.5	193.5	174.8	243.2	486.4	278.9	62.5	13.7	7.3
1998	10.4	15.1	24.0	51.1	144.0	136.7	225.3	343.6	1017.0	774.7	122.4	45.1
1999	18.3	19.1	21.4	24.3	40.2	32.9	89.2	275.3	137.6	30.0	7.3	12.9
2000	12.4	8.2	7.1	20.1	55.9	73.5	169.0	393.8	183.9	26.5	8.8	7.9
2001	19.5	10.1	8.4	9.0	19.1	71.1	142.9	339.7	83.5	17.6	6.4	6.3
2002	8.6	22.1	48.2	40.8	29.9	56.3	206.9	281.6	180.1	21.9	6.8	6.4
2003	5.9	149.7	29.4	34.1	43.2	85.8	143.4	427.5	337.2	47.4	21.4	9.1
2004	7.8	8.0	22.8	20.1	30.3	127.6	168.6	230.2	102.9	16.4	7.6	8.9
2005	10.2	9.7	13.1	75.9	39.1	98.9	186.4	647.6	603.3	207.8	35.7	14.1
2006	10.9	16.6	39.9	93.2	46.6	128.5	336.9	750.1	618.2	172.1	26.3	10.5
2007	12.9	11.3	12.4	16.3	18.2	58.6	118.6	200.5	44.7	12.0	7.3	8.1
2008	7.8	9.0	11.7	30.4	50.2	80.9	166.5	333.3	251.7	49.5	8.0	12.3
2009	7.9	17.0	11.3	30.7	42.8	65.6	167.6	383.8	131.8	29.2	12.7	10.4
2010	79.4	22.5	27.9	29.2	77.4	127.9	200.3	387.8	775.3	208.7	28.8	9.1
2011	25.4	21.2	144.4	88.2	70.0	204.0	324.5	409.4	814.3	325.4	64.5	17.4
2012	39.0	19.6	12.7	30.3	21.4	52.4	195.4	270.6	61.6	13.4	7.6	8.2
2013	11.6	16.8	36.3	32.7	18.7	40.5	115.6	145.1	33.2	16.3	10.4	6.9
2014	8.2	9.6	10.2	8.6	14.0	19.9	78.9	127.8	41.1	14.1	9.7	6.0
2015	6.0	9.6	16.3	7.5	31.7	24.9	19.6	31.1	29.7	41.7	7.7	7.6
2016	9.5	11.7	19.0	33.0	53.2	94.6	199.2	285.3	227.4	32.6	11.3	9.3
2017	10.5	11.7	41.6	245.2	369.5	264.1	383.7	806.9	798.9	228.1	46.1	19.2
2018	17.5	22.4	10.3	15.7	11.5	81.2	282.7	202.1	72.8	23.7	11.0	9.3

APPENDIX 7.2-G

Annual Maximum Instantaneous Peak Flows (cfs) for Bypass Reaches and Flowlines Associated with the Kaweah Project

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Table 7.2 G-1. Annual Maximum Instantaneous Peak Flows (cfs) for Waters Associated with the Kaweah Project.

Water Year	EF Kaweah River blw Diversion		Kaweah River blw Diversion	
	USGS Gage 11208730		USGS Gage 11208600	
	Flow (cfs)	Date	Flow (cfs)	Date
1953	1050	4/27/53		
1954	630	1/24/54		
1955	1090	2/16/55		
1956				
1957				
1958	1070	5/22/58		
1959	541	2/16/59		
1960	855	2/1/60		
1961	231	5/17/61		
1962	755	5/5/62		
1963	2850	2/1/63		
1964	480	5/20/64		
1965	1510	12/23/64		
1966	541	12/29/65		
1967	13000	12/6/66		
1968	424	5/29/68		
1969	4700	1/25/69		
1970	3220	1/16/70		
1971	632	6/15/71		
1972	428	6/8/72		
1973	1220	5/28/73		
1974	876	6/6/74		
1975	1050	6/1/75		
1976	522	9/11/76		
1977	276	5/31/77		
1978	1160	6/8/78		
1979				
1980				
1981				
1982				
1983				
1984				
1985				
1986				
1987				

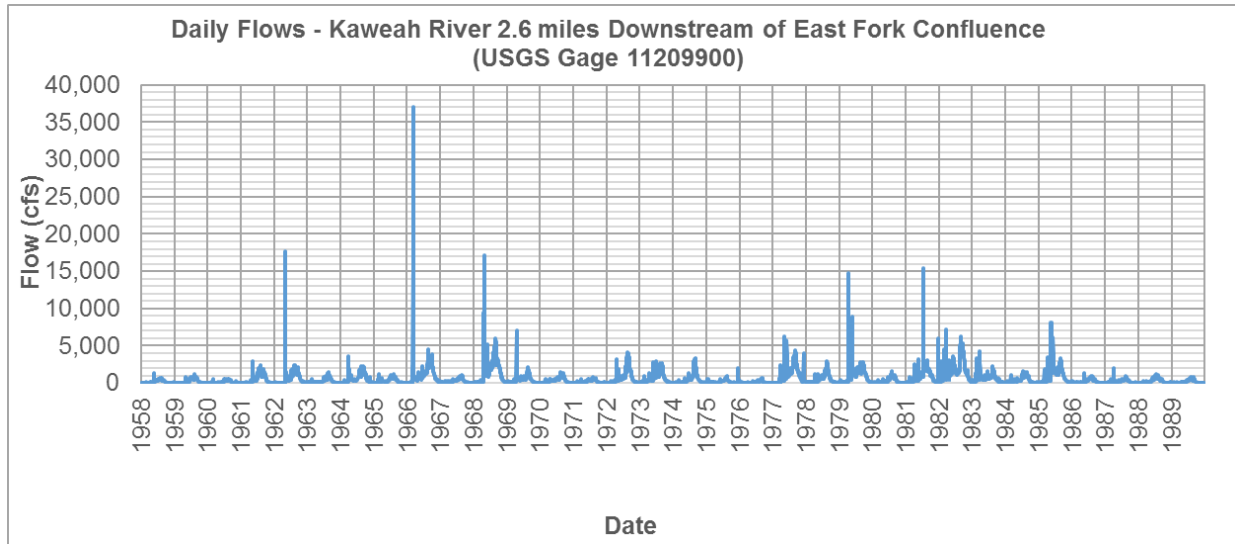
Water Year	EF Kaweah River blw Diversion		Kaweah River blw Diversion	
	USGS Gage 11208730		USGS Gage 11208600	
	Flow (cfs)	Date	Flow (cfs)	Date
1988				
1989				
1990				
1991				
1992				
1993				
1994	427	5/14/94	1140	5/14/94
1995	1690	3/10/95	3000	4/30/95
1996	1700	2/19/96	3780	2/19/96
1997	11300	1/2/97	29000	1/2/97
1998	1530	7/1/98	3170	7/2/98
1999	466	5/25/99	1260	5/25/99
2000	910	2/14/00	1940	5/23/00
2001	544	5/10/01	1640	5/8/01
2002	1070	12/29/01	2330	11/24/01
2003	5680	11/8/02	15700	11/8/02
2004	476	12/24/03	1000	12/24/03
2005	1540	5/27/05	2440	5/16/05
2006	1500	6/4/06	2420	12/31/05
2007	318	5/12/07	783	4/29/07
2008	1250	1/5/08	2510	1/5/08
2009	687	5/11/09	1520	5/9/09
2010	2600	10/14/09	9000	10/14/09
2011	2250	12/19/10	5170	12/19/10
2012	878	10/5/11	1930	10/5/11
2013	331	4/29/13	889	12/2/12
2014	249	5/17/14	638	5/3/14
2015	1220	2/7/15	1880	2/7/15
2016	522	5/13/16	1480	5/13/16
2017	2240	2/7/17	4660	2/7/17
2018	2420	4/7/18	4820	4/7/18

APPENDIX 7.2-H

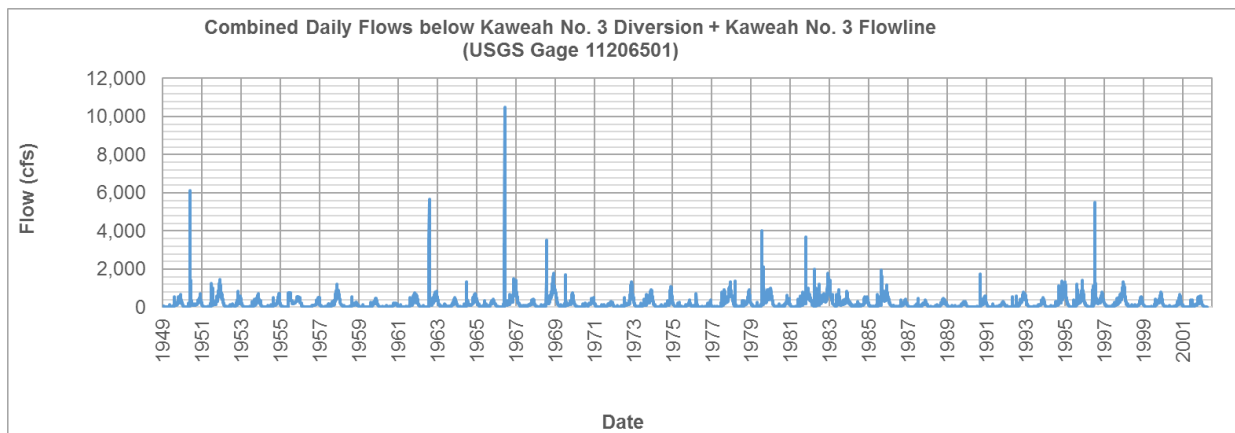
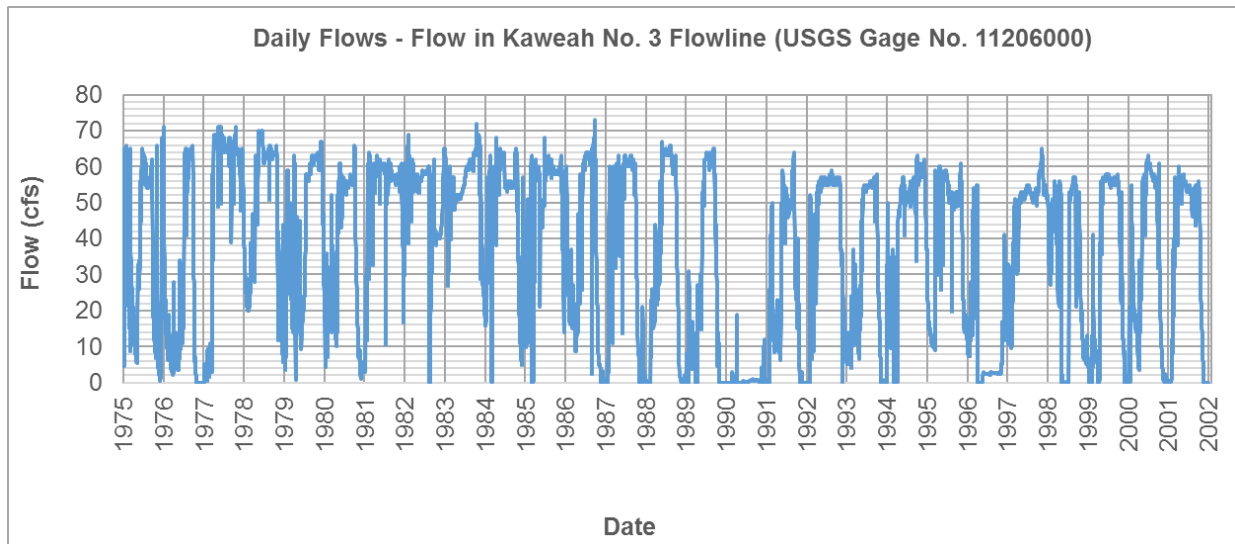
Hydrology for Other River Reaches in the Watershed – Daily Flows and Annual Maximum Instantaneous Peak Flows

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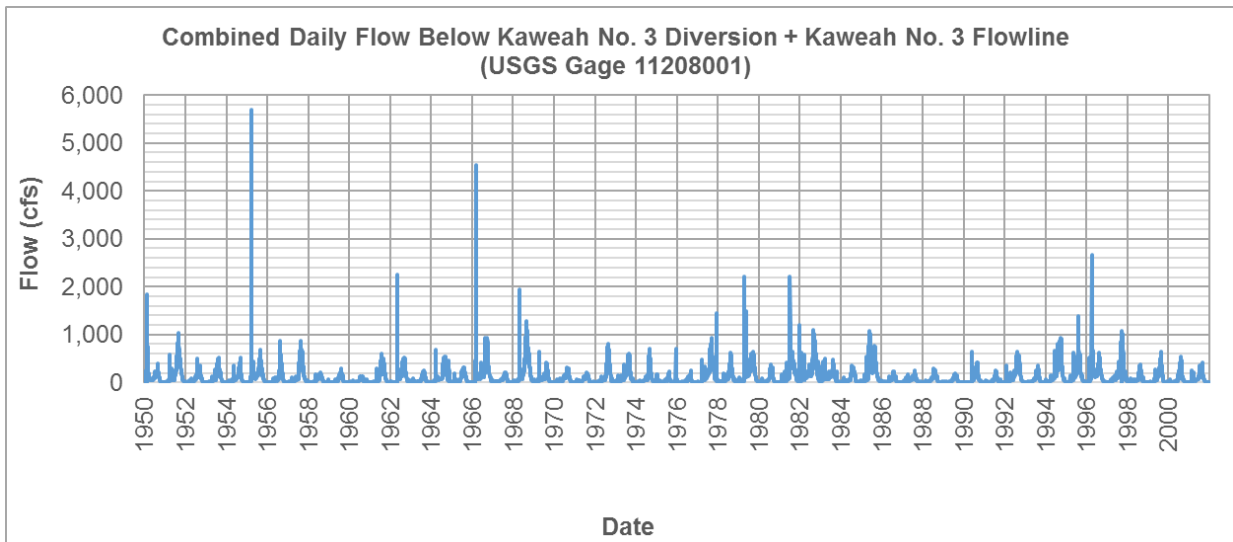
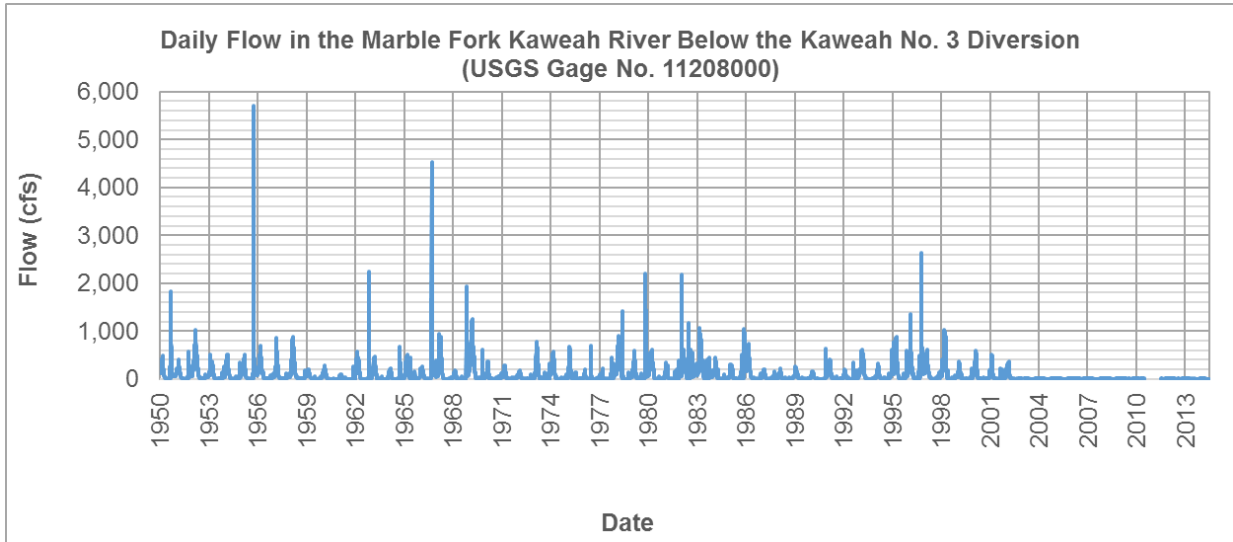
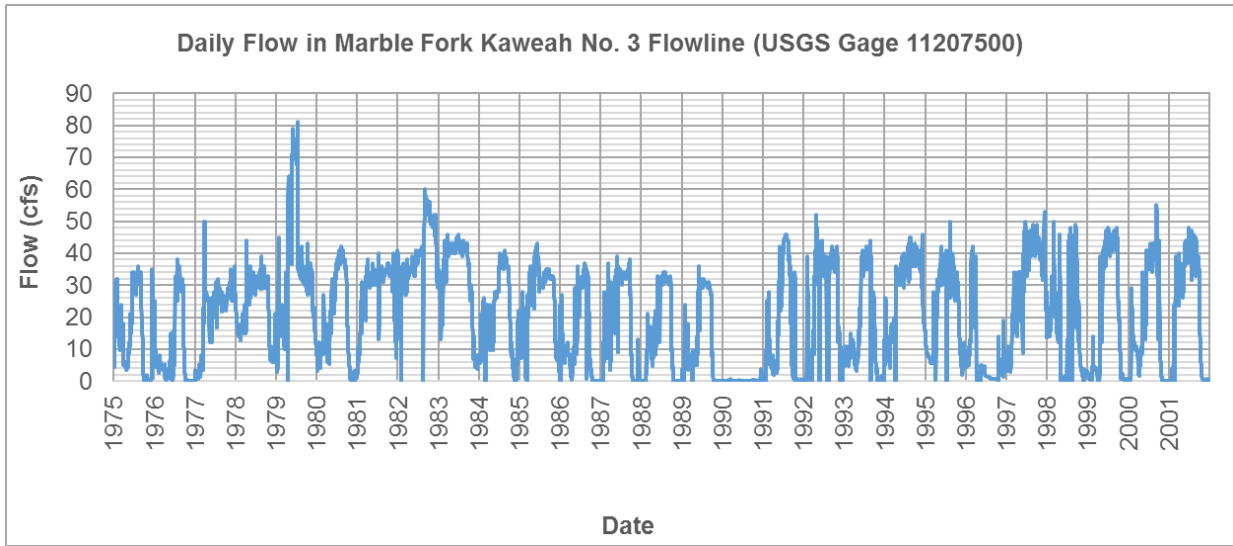
Kaweah River – Downstream of the Kaweah River Bypass Reach



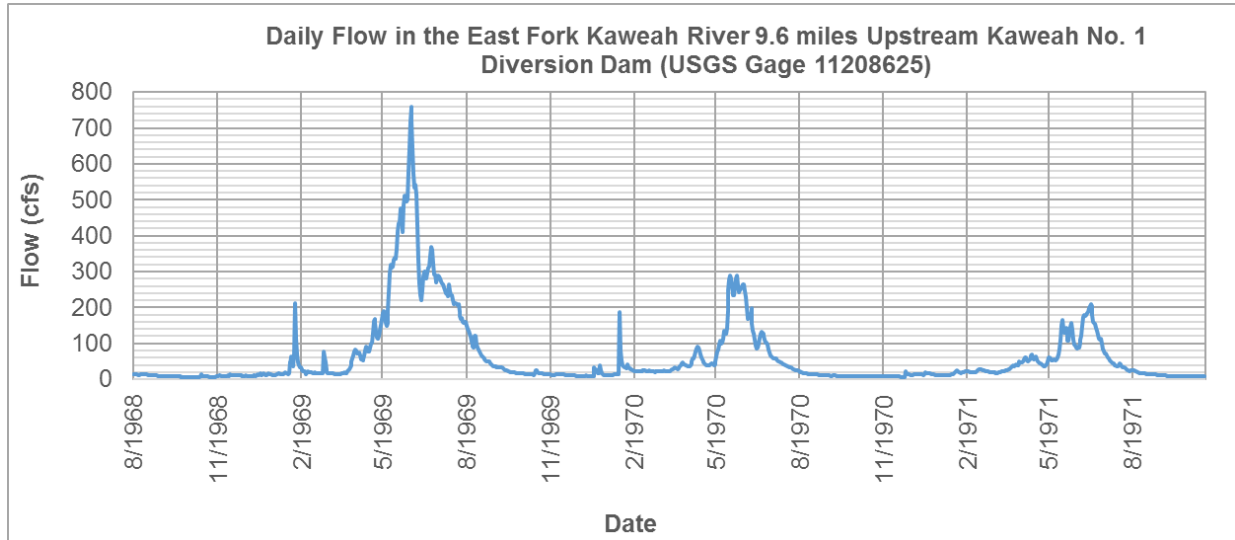
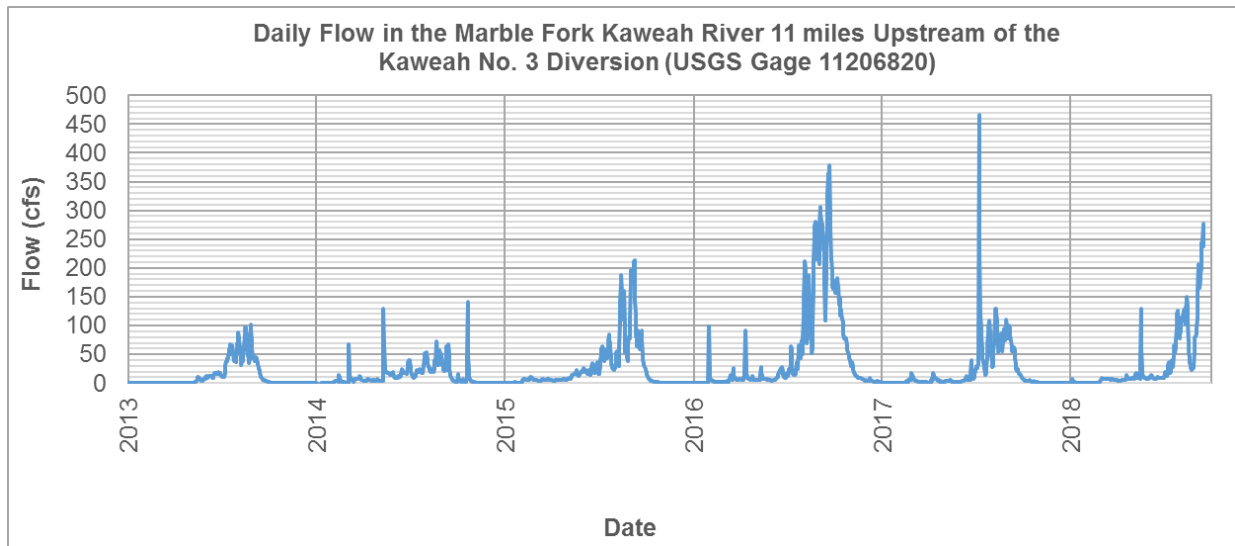
Middle Fork Kaweah River upstream of the Bypass Reaches Associated with the Project



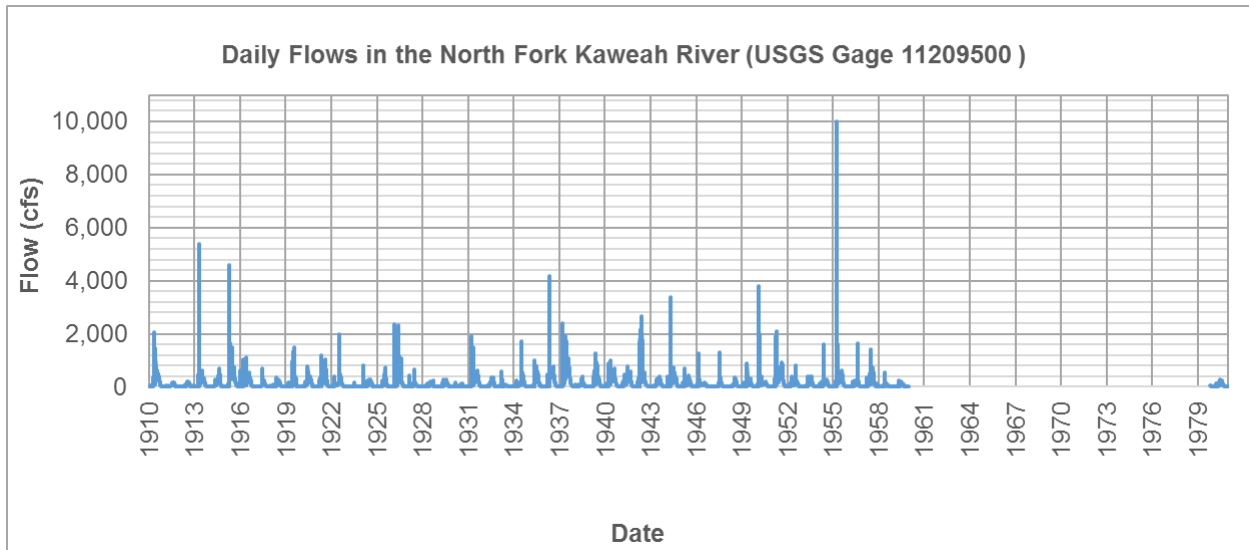
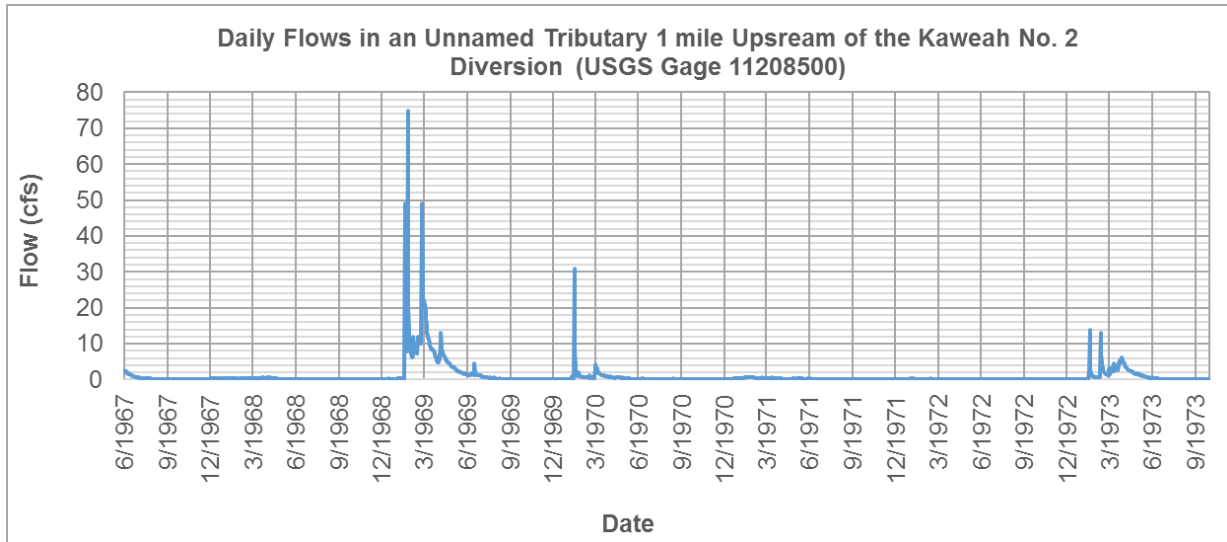
Marble Fork Kaweah River upstream of the Bypass Reaches Associated with the Project



East Fork Kaweah River upstream of Kaweah No. 1 Diversion Dam



Tributaries to Kaweah River



Annual Maximum Instantaneous Peak Flows (cfs) for Other Reaches in the Watershed.

Water Year	MF Kaweah Flow blw Diversion		Marble Fork Kaweah River blw Diversion		EF Kaweah River 9.6 miles u/s Kaweah No. 1 Diversion Dam		Kaweah River Unnamed Tributary 1 mile u/s Kaweah No. 2 Diversion		North Fork Kaweah River		Kaweah River 2.6 miles d/s from EF Confluence	
	USGS Gage 11206500		USGS Gage 11208000		USGS Gage 11208625		USGS Gage 11208500		USGS Gage 11209500		USGS Gage 1209900	
	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Flow (cfs)	Date	Date	Flow (cfs)	Date	Flow (cfs)	Date
1911									2710	1/31/11		
1912									178	4/11/12		
1913									196	4/1/13		
1914									7400	1/25/14		
1915									940	4/30/15		
1916									5380	1/17/16		
1917									3050	2/21/17		
1918									900	3/18/18		
1919									360	2/11/19		
1920									1500	4/17/20		
1921									1040	3/13/21		
1922									1740	2/11/22		
1923									2860	4/6/23		
1924									182	4/11/24		
1925									1080	11/9/24		
1926									730	4/8/26		
1927									4650	2/16/27		
1928									915	3/27/28		
1929									780	6/16/29		

Water Year	MF Kaweah Flow blw Diversion		Marble Fork Kaweah River blw Diversion		EF Kaweah River 9.6 miles u/s Kaweah No. 1 Diversion Dam		Kaweah River Unnamed Tributary 1 mile u/s Kaweah No. 2 Diversion		North Fork Kaweah River		Kaweah River 2.6 miles d/s from EF Confluence	
	USGS Gage 11206500		USGS Gage 11208000		USGS Gage 11208625		USGS Gage 11208500		USGS Gage 11209500		USGS Gage 1209900	
	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Flow (cfs)	Date	Date	Flow (cfs)	Date	Flow (cfs)	Date
1930									326	5/3/30		
1931									250	11/17/30		
1932									4200	12/28/31		
1933									340	5/29/33		
1934									1220	12/13/33		
1935									3240	4/8/35		
1936									2430	2/2/36		
1937									6200	2/6/37		
1938									11200	12/11/37		
1939									700	4/2/39		
1940									2550	2/26/40		
1941									2260	2/11/41		
1942									1580	4/4/42		
1943									5870	1/21/43		
1944									1220	3/4/44		
1945									5550	2/1/45		
1946									1070	12/22/45		
1947									2680	11/23/46		
1948									2460	4/10/48		
1949									469	4/21/49		

Water Year	MF Kaweah Flow blw Diversion		Marble Fork Kaweah River blw Diversion		EF Kaweah River 9.6 miles u/s Kaweah No. 1 Diversion Dam		Kaweah River Unnamed Tributary 1 mile u/s Kaweah No. 2 Diversion		North Fork Kaweah River		Kaweah River 2.6 miles d/s from EF Confluence	
	USGS Gage 11206500		USGS Gage 11208000		USGS Gage 11208625		USGS Gage 11208500		USGS Gage 11209500		USGS Gage 1209900	
	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Flow (cfs)	Date	Date	Flow (cfs)	Date	Flow (cfs)	Date
1950	894	2/6/50	677	5/29/50					1670	2/6/50		
1951	17500	11/19/50	4000	11/18/50					10800	11/19/50		
1952	1680	12/29/51	1150	5/27/52					2890	1/25/52		
1953	1500	4/27/53	1080	4/27/53					2490	4/27/53		
1954	870	5/19/54	651	5/19/54					1430	1/24/54		
1955	1160	2/16/55	715	6/7/55					2860	2/16/55		
1956	46800	12/23/55	12500	12/23/55					21500	12/23/55	60000	12/23/55
1957			1900	5/19/57					3790	5/19/57		
1958	1350	5/1958	1220	5/22/58					2160	4/3/58		
1959	999	2/16/59	339	2/16/59					1280	2/16/59	3400	2/16/59
1960	1060	2/1/60	414	5/11/60			8.7	2/1/60	778	2/1/60	3030	2/1/60
1961	262	8/11/61	160	5/24/61			17	12/1/60			1160	12/2/60
1962	860	5/5/62	748	5/5/62							6180	2/9/62
1963	11800	2/1/63	3830	2/1/63			152	2/1/63			30900	2/1/63
1964	636	5/20/64	355	5/20/64							1970	5/20/64
1965	2370	12/23/64	2370	8/15/65			57	12/27/64			6050	12/23/64
1966	549	11/22/65	402	5/6/66			2.9	12/30/65			1680	11/23/65
1967	23300	12/6/66	6400	12/6/66			879	12/6/66	23900	12/6/66	73000	12/5/66
1968	610	5/28/68	278	5/28/68			0.9	3/16/68			1520	5/29/68
1969	6580	1/25/69	2610	1/25/69	934	5/31/69	203	1/25/69			24200	1/25/69

Water Year	MF Kaweah Flow blw Diversion		Marble Fork Kaweah River blw Diversion		EF Kaweah River 9.6 miles u/s Kaweah No. 1 Diversion Dam		Kaweah River Unnamed Tributary 1 mile u/s Kaweah No. 2 Diversion		North Fork Kaweah River		Kaweah River 2.6 miles d/s from EF Confluence	
	USGS Gage 11206500		USGS Gage 11208000		USGS Gage 11208625		USGS Gage 11208500		USGS Gage 11209500		USGS Gage 1209900	
	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Flow (cfs)	Date	Date	Flow (cfs)	Date	Flow (cfs)	Date
1970	2890	1/16/70	1310	1/16/70	450	1/16/70	80	1/16/70			13400	1/16/70
1971	638	6/15/71	392	6/8/71	266	6/15/71	1.4	3/13/71			1830	5/16/71
1972	526	6/8/72	283	6/5/72	14.5	7/13/72	1.2	1/4/72			1120	6/8/72
1973	1550	5/28/73	1010	5/28/73			37	1/18/73			8070	1/18/73
1974	1200	4/1/74	797	5/27/74							6330	4/2/74
1975	1370	6/1/75	954	6/1/75							4250	6/1/75
1976	1220	9/11/76	1740	9/11/76							4400	9/11/76
1977	549	6/9/77	406	6/9/77							1240	6/9/77
1978	2030	9/5/78	2790	9/5/78							9460	3/4/78
1979	1120	5/21/79	806	5/21/79							3620	5/21/79
1980	7740	1/12/80	3040	1/13/80							23600	1/12/80
1981	711	5/1/1981	430	5/1/81					421	3/20/81	1970	5/2/81
1982	5610	4/11/82	3140	4/11/82							23700	4/11/82
1983	2290	10/26/82	1590	10/26/82							14300	12/22/82
1984	2700	11/24/83	1360	11/24/83							11500	11/24/83
1985	623	5/23/85	405	4/14/85							2030	11/28/84
1986	1910	2/19/86	1040	2/19/86							15800	2/13/86
1987	774	5/15/87	464	5/12/87							3220	2/13/87
1988	691	1/5/88	355	5/15/88							3530	1/5/88
1989	494	5/7/89	365	5/7/89							1420	4/11/89

Water Year	MF Kaweah Flow blw Diversion		Marble Fork Kaweah River blw Diversion		EF Kaweah River 9.6 miles u/s Kaweah No. 1 Diversion Dam		Kaweah River Unnamed Tributary 1 mile u/s Kaweah No. 2 Diversion		North Fork Kaweah River		Kaweah River 2.6 miles d/s from EF Confluence	
	USGS Gage 11206500		USGS Gage 11208000		USGS Gage 11208625		USGS Gage 11208500		USGS Gage 11209500		USGS Gage 1209900	
	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Flow (cfs)	Date	Date	Flow (cfs)	Date	Flow (cfs)	Date
1990	361	5/6/90	253	4/27/90							1010	5/7/90
1991	5110	3/4/91	1940	3/4/91								
1992	625	10/26/91	310	4/29/92								
1993	974	1/7/93	1710	10/30/92								
1994	666	5/14/94	511	5/14/94								
1995	1930	4/30/95	1410	7/8/95								
1996	2460	2/5/96	2170	5/16/96								
1997	18400	1/2/97	6760	1/2/97							54900	1/2/97
1998	1470	6/15/98	2100	9/3/98								
1999	706	5/25/99	755	7/13/99								
2000	983	5/23/00	869	5/23/00								
2001	773	5/8/01	755	5/8/01								
2002	1610	11/24/01										
2003	10800	11/8/02										
2004												
2005												
2006												
2007												
2008												
2009												

Water Year	MF Kaweah Flow blw Diversion		Marble Fork Kaweah River blw Diversion		EF Kaweah River 9.6 miles u/s Kaweah No. 1 Diversion Dam		Kaweah River Unnamed Tributary 1 mile u/s Kaweah No. 2 Diversion		North Fork Kaweah River		Kaweah River 2.6 miles d/s from EF Confluence	
	USGS Gage 11206500		USGS Gage 11208000		USGS Gage 11208625		USGS Gage 11208500		USGS Gage 11209500		USGS Gage 1209900	
	Flow (cfs)	Date	Flow (cfs)	Date	Flow (cfs)	Flow (cfs)	Date	Date	Flow (cfs)	Date	Flow (cfs)	Date
2010												
2011												
2012												
2013												
2014												

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Appendix 7.3-A Summary of Historical Water Quality Data

LIST OF ACRONYMS

Basin Plan	Water Quality Control Plan for the Tulare Lake Basin
CEDEN	California Environmental Data Exchange Network
CTR	California Toxics Rule
DO	dissolved oxygen
DWR	California Department of Water Resources
<i>E. coli</i>	<i>Escherichia coli</i>
EPA	Environmental Protection Agency
NPS	National Park Service
PAD	Pre-Application Document
Project	Kaweah Project
STORET	EPA Storage and Retrieval
SD	Supporting Document
TRCSD	Three Rivers Community Service District
TSR	Technical Study Report
USGS	U.S. Geological Survey
Watershed	Kaweah River Watershed

7.3 WATER QUALITY AFFECTED ENVIRONMENT

This section describes the water quality in the vicinity of the Kaweah Project (Project), including an overview of applicable water quality standards and objectives, historical water quality data in the vicinity of the Project, and recent water quality data collected during Project relicensing studies. Water temperature and dissolved oxygen are discussed in Section 7.4 – Fish and Aquatics Resources. Hydrologic conditions associated with the Project are summarized in Section 7.2 – Water Use and Hydrology.

7.3.1 Information Sources

This section was prepared using the following information sources:

- Water quality standards
 - Water Quality Control Plan for the Tulare Lake Basin (Basin Plan) (CRWQCB 2018).
 - Environmental Protection Agency (EPA) National Water Quality Criteria (EPA 1986, 2012, 2013, 2016, 2019).
 - California Toxics Rule (CTR) (65 Federal Register [FR] 31682).
- Historical study reports and data
 - The U.S. Geological Survey's (USGS) National Water Information System (USGS 2015) and EPA Storage and Retrieval (STORET) (EPA 2015) online databases provided water quality information that was collected by the USGS and other agencies (California Department of Water Resources [DWR], California Environmental Data Exchange Network [CEDEN], and the National Park Service [NPS]).
 - Three Rivers Community Services District (TRCSD) has bacteria test results for 2014 for total coliform and *Escherichia coli* (*E. coli*) at several locations along the Kaweah River¹ (TRCSD 2014).
- Recent reports and data
 - Pre-Application Document (PAD) for the Project (SCE 2016). The PAD includes a general description of water quality conditions within the vicinity of the Project, including historical water quality information.
 - AQ 6 – Water Quality Technical Study Report (SCE 2019) (AQ 6 – TSR), which is included in Supporting Document A (SD A).

¹ The TRCSD monitors surface water quality at various locations along the bypass reaches associated with the Project and in the surrounding watershed (RMA 2009, SSRWVG 2014).

7.3.2 Water Quality Standards

The State of California is responsible for maintaining water quality standards through implementation of the Federal Clean Water Act. The Central Valley Regional Water Quality Control Board has established water quality objectives for specific beneficial water uses in the Basin Plan. The water quality objectives include both numeric and narrative standards for surface water that are based on criteria that protect both human health and aquatic life. If water quality is maintained at levels consistent with these objectives, beneficial uses are considered to be protected. Applicable water quality objectives and standards in the Basin Plan are provided in Table 7.3-1.

The Basin Plan provides water quality objectives that are derived from various sources. These objectives include references to maximum contaminant levels that are provided in Title 22 of the California Code of Regulations which sets standards for waters designated for domestic or municipal use. Additional, and often more stringent, criteria are provided by the CTR (65 FR 31682) and by various EPA sources (EPA 1986, 2012, 2013, 2016, 2019) to protect aquatic life, and human health. The CTR and pertinent EPA standards are provided in Table 7.3-1.

7.3.3 Historical Water Quality Information

The USGS, CEDEN, DWR, NPS, and TRCSD water quality measurements are provided in Appendix 7.3-A. Historic water quality sampling locations are shown on Map 7.3-1 and Map 7.3-2. Map 7.3-1 shows the measurement locations in the Kaweah River Watershed (Watershed), including locations outside of the Project area. Map 7.3-2 shows the measurement locations in the vicinity of the Project (the locations on the bypass reaches and in the Watershed downstream of the bypass reaches).

Historical water quality data indicates that the physical and water chemistry conditions in the streams and rivers associated with the Project are of high quality and conform to regulatory water quality objectives and standards. No persistent, widespread water quality issues were found. There are no agriculture or water treatment plants that discharge into the bypass reaches. Several grazing allotments are present in the vicinity of the bypass reaches. Similarly, physical and water chemistry conditions in the Watershed upstream of the bypass reaches are of high quality.

Review of the water quality data from sample locations in the bypass reaches and on the Kaweah River downstream of the Project indicate that generally all of the constituents analyzed have complied with current regulatory standards, with the exception of two pH measurements in 2002 at the upstream end of the Kaweah River Bypass Reach downstream from the Kaweah No. 2 Diversion Dam and at the downstream end of the bypass reach immediately upstream of Kaweah No. 2 Powerhouse (Appendix 7.3-A, Table 2). In addition, surface water measurements by the TRCSD exceeded regulatory standards for fecal coliform in 2014 downstream of the Kaweah River Bypass Reach near the North Fork Kaweah River confluence (Appendix 7.3-A, Table 5).

Water quality samples in the Watershed upstream of the Project and on other tributaries to the Kaweah River have also generally complied with current regulatory standards, based on data collected by the USGS, DWR, CEDEN, and NPS, with a few exceptions. Samples at several locations upstream of the Project or on tributaries to the Kaweah River have not complied with regulatory standards for pH, alkalinity, and fecal coliform in the 1980s and more recently in 2014 (Appendix 7.3-A, Tables 1 and 4). However, measurements of pH and alkalinity in the bypass reaches and overall Watershed, although in some instances not consistent with Basin Plan objectives, are a natural characteristic of the granitic watershed and typical of most west-slope Sierra Nevada streams and rivers.

7.3.4 Recent Water Quality Data Collected During Project Relicensing Studies

As part of the AQ 6 – TSR (SCE 2019), a comprehensive water quality monitoring program was conducted on the Kaweah River and East Fork Kaweah River in spring and summer 2018 (Table 7.3-2, Map 7.3-3). Sampling timing was designed to capture water quality during the spring runoff (May) and summer low-flow or base-flow period (August). Sixteen sites were sampled in the bypass river reaches associated with the Project and comparison river reaches upstream and downstream of the bypass reaches. A total of 33 parameters were measured, including a suite of *in-situ* field measurements, general parameters, dissolved metals, and total mercury. In addition, total coliform and *E. coli* sampling was conducted upstream and downstream of the river access area near Kaweah No. 2 Powerhouse (referred to by locals as “Edison Beach”) where contact recreation (e.g., swimming) occurs. Results of these sampling efforts are summarized below. A detailed description of the study methods and results are available in AQ 6 – TSR included in SD A (SCE 2019).

7.3.4.1 *In-Situ* Field Measurements

In-situ water quality measurements consisted of water temperature, dissolved oxygen [DO], turbidity, conductivity, and pH. Water temperature, DO, turbidity, and conductivity measurements met the applicable water quality standards at all sampling sites (Table 7.3-3 and Table 7.3-4). A single pH measurement taken in the Kaweah No. 2 Flowline in August exceeded the Basin Plan criterion, likely due to a combination of low flow, daytime photosynthesis by attached algae in the flowline, and the general low alkalinity in the Watershed.

7.3.4.2 General Water Quality Sampling

Results of the general water quality sampling are presented in Table 7.3-5 for spring and in Table 7.3-6 for summer. Table 7.3-7 and Table 7.3-8 contain the calculated criteria and results for ammonia, which has criteria based on temperature and pH and therefore must be calculated on a location-by-location basis. Table 7.3-9 and Table 7.3-10 contain calculated criteria and results for cadmium, copper, lead, and nickel, which have hardness-based criteria. All general water quality sampling parameters were within the Basin Plan water quality objectives and the CTR and EPA national water quality criteria. Four of the 29 ammonia samples were greater than the Basin Plan ammonia “waste

discharge” objective; however, Project operations do not produce any waste discharge. Project operations only divert water from the river into the flowlines, then into powerhouses, and back into the river. There are no known Project-related activities, facilities, or operations that have the potential to affect ammonia concentrations. Ammonia can be produced from septic systems (decomposing organic matter) and there are many homes and the Sequoia National Park Visitor Center that are adjacent to the Kaweah River and could potentially be a source for ammonia. Nine of the 29 alkalinity samples were below the EPA total alkalinity criterion; however the EPA criterion also states that this minimum value does not apply “where alkalinity is naturally lower.” Low alkalinity is a natural condition of the Watershed during spring high flow conditions when snowmelt and rainfall runoff have little opportunity to pick up calcium carbonate from the basin geology.

7.3.4.3 Coliform Sampling

The results of the total coliform and *E. coli* analysis are presented in Table 7.3-11. The *E. coli* samples were less than the EPA criteria for human health risk for contact recreation. There is no contact recreation criteria for total coliform because much of total coliform can be from natural sources.

7.3.5 Literature Cited

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TABLES

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Table 7.3-1. Summary of Water Quality Analytical Tests, Including Laboratory Methods and Detection Limits, and Chemical Water Quality Objectives.

Analyte	Units ¹	Analysis Method ²	Method Detection Limit (MDL)	Practical Quantitation Limit (PQL)/ Method Reporting Limit (MRL)	Water Quality Criteria			Sample Container	Hold Time	Preservative/ Comment
					Basin Plan ³	CA Toxics Rule (CTR) ⁴	EPA Criteria ⁵			
In-Situ Measurements				PQL/MRL						
Water Temperature	Celsius (°C)	Water Quality Meter	Not Applicable	Not Applicable	≤ +5°F ⁶	NS	NS	Not Applicable	Not Applicable	None
Dissolved Oxygen (DO)	mg/L	Water Quality Meter	Not Applicable	Not Applicable	5.0 - 7.0 ⁷	NS	3.0 - 8.0 ⁸	Not Applicable	Not Applicable	None
Turbidity	NTU	Water Quality Meter	Not Applicable	Not Applicable	Depends on natural turbidity ⁹	NS	NS	Not Applicable	Not Applicable	None
Conductivity	µS/cm at 25°C	Water Quality Meter	Not Applicable	Not Applicable	175	NS	NS	Not Applicable	Not Applicable	None
pH	unitless	Water Quality Meter	Not Applicable	Not Applicable	6.5 – 8.3 ¹⁰	NS	6.5 – 9.0	Not Applicable	Not Applicable	None
General Parameters				PQL/MRL						
Calcium	µg/L	EPA 200.7	10.79	50.0	NS	NS	NS	500mL plastic	180 days	HNO ₃ , maintain at ≤6°C
Chloride	mg/L	EPA 300.0	0.08	1.0	250 ¹¹	NS	230/860 ¹²	250mL plastic	28 days	Maintain at ≤6°C
Hardness (as CaCO ₃)	mg/L	EPA 200.7/SM 2340B	1.00	1.0	NS	NS	NS	500mL plastic	180 days	HNO ₃ , maintain at ≤6°C
Magnesium	µg/L	EPA 200.7	3.48	25.0	NS	NS	NS	500mL plastic	180 days	HNO ₃ , maintain at ≤6°C
Nitrate	mg/L	EPA 300.0	0.01	0.2	10	NS	NS	500mL plastic	48 hours	H ₂ SO ₄ , maintain at ≤6°C
Nitrite	mg/L	EPA 300.0	0.01	0.1	1	NS	NS	500mL plastic	48 hours	H ₂ SO ₄ , maintain at ≤6°C
Nitrate/Nitrite (NO ₃)	mg/L	EPA 353.2	0.028	0.10	10	NS	NS	500mL plastic	48 hours	H ₂ SO ₄ , maintain at ≤6°C
Ammonia as N	mg/L	EPA 350.1	0.012	0.5	0.025	NS	Depends on pH & temperature	500mL plastic	28 days	H ₂ SO ₄ , maintain at ≤6°C
Total Kjeldahl Nitrogen (TKN)	mg/L	EPA 351.2	0.267	0.50	NS	NS	NS	500mL plastic	28 days	H ₂ SO ₄ , maintain at ≤6°C
Total Phosphorus	µg/L	SM 4500	24.0	100	NS	NS	NS	500mL plastic	28 days	H ₂ SO ₄ , maintain at ≤6°C
Ortho-phosphate	mg/L	SM 4500-P E	0.016	0.05	NS	NS	NS	500mL amber glass	48 hours	Maintain at ≤6°C
Potassium	µg/L	EPA 200.7	93.9	500	NS	NS	NS	500mL plastic	180 days	HNO ₃ , maintain at ≤6°C
Sodium	µg/L	EPA 200.7	82.9	500	NS	NS	NS	500mL plastic	180 days	HNO ₃ , maintain at ≤6°C
Sulfate (SO ₄)	mg/L	EPA 300.0	0.09	1.0	250 ¹¹	NS	NS	250mL plastic	180 days	Maintain at ≤6°C
Total Dissolved Solids	mg/L	SM 2540C	4.4	10	500 ¹¹	NS	NS	500mL plastic	7 days	Maintain at ≤6°C
Total Suspended Solids	mg/L	SM 2540D	5.6	10	NS	NS	NS	500mL plastic	7 days	Maintain at ≤6°C
Turbidity	NTU	EPA 180.1/SM 2130B	0.035	0.10	Depends on natural turbidity ⁹	NS	NS	1L amber glass	Not Applicable	Maintain at ≤6°C
Organic Carbon, Total (TOC)	mg/L	SM 5310C	Not Applicable	0.2	NS	NS	NS	250mL amber glass	28 days	H ₂ SO ₄ , maintain at ≤6°C
Total Alkalinity	mg/L	SM 2320B	0.85	2.0	NS	NS	>20 ¹³	250mL plastic	14 days	Maintain at ≤6°C
Metals-Dissolved				MRL						
Arsenic	µg/L	EPA 1638	0.056	0.204	10	150/340 ¹²	150/340 ¹² , 0.018 ¹⁴ , 0.14 ¹⁵	125mL plastic	48 hours	Maintain at ≤6°C
Cadmium	µg/L	EPA 1638	0.031	0.092	5	2.2/4.3 ^{12, 16}	0.72/1.8 ^{12, 16}	125mL plastic	48 hours	Maintain at ≤6°C
Copper	µg/L	EPA 1638	0.112	0.337	1,000 ¹¹	9.0/13 ^{12, 16} , 1,300 ¹⁴	9.0/13 ^{12, 16, 17}	125mL plastic	48 hours	Maintain at ≤6°C

Analyte	Units ¹	Analysis Method ²	Method Detection Limit (MDL)	Practical Quantitation Limit (PQL)/ Method Reporting Limit (MRL)	Water Quality Criteria			Sample Container	Hold Time	Preservative/ Comment	
					Basin Plan ³	CA Toxics Rule (CTR) ⁴	EPA Criteria ⁵				
Iron	µg/L	EPA 1638	1.43	4.34	300 ¹¹	NS	1,000 ¹⁸ , 300 ¹⁹	125mL plastic	48 hours	Maintain at ≤6°C	
Lead	µg/L	EPA 1638	0.026	0.077	15	2.5/65 ^{12, 16}	2.5/65 ^{12, 16}	125mL plastic	48 hours	Maintain at ≤6°C	
Manganese	µg/L	EPA 1638	0.107	0.321	50 ¹¹	NS	50 ²⁰	125mL plastic	48 hours	Maintain at ≤6°C	
Nickel	µg/L	EPA 1638	0.117	0.352	100	52/470 ^{12, 16} , 610 ¹⁴ , 4,600 ¹⁵	52/470 ^{12, 16} , 610 ¹⁴ , 4,600 ¹⁵	125mL plastic	48 hours	Maintain at ≤6°C	
Chromium-Total	µg/L	EPA 1638	0.128	0.383	50	NS	NS	125mL plastic	48 hours	Maintain at ≤6°C	
Metals-Total				MRL							
Mercury	ng/L	EPA 1631E	0.13	0.40	2,000	50 ¹⁴ , 51 ¹⁵	770/1,400 ¹²	125mL plastic	48 hours	Maintain at ≤6°C	
Bacteria				MRL							
Total Coliform	MPN/100 mL	EPA SM9223B	Not Applicable	1	NS	NS	NS	100 mL plastic	24 hours	Maintain at ≤6°C	
<i>E. coli</i>	MPN/100 mL	EPA SM9223B	Not Applicable	1	NS	NS	126	100 mL plastic	24 hours	Maintain at ≤6°C	

Notes:

- MDL - Method Detection Limit: The minimum measured concentration of a substance that can be reported with 99 percent confidence that the measured concentration is distinguishable from method blank results.
- MPN - Most probable number of bacterial colonies per 100 mL of water.
- MRL - Method Reporting Limit: The lowest concentration of a substance that can be reliably reported under current laboratory operating conditions.
- NS - no standard available
- PQL - Practical Quantitation Limit: The concentration that can be reliably measured within specified limits and accuracy during routine laboratory operating conditions.

Footnotes:

- ¹ Units follow listed criterion standards. If standards were not available, laboratory supplied units were used. (Note: µg/L=ppb and mg/L=ppm)
- ² Analysis methods are periodically updated by the EPA. The most recent methods available were used for the water quality analysis.
- ³ The Water Quality Control Plan for the Tulare Lake Basin Second Edition relies on California primary and secondary Maximum Concentration Level objectives as criteria for water quality to be used as a municipal and domestic supply for human consumption.
- ⁴ California Toxics Rule (CTR) criteria are based primarily on EPA standards developed under the Clean Water Act for human consumption of water and aquatic organisms with an adult risk for carcinogens estimated to be one in one million as contained in the Integrated Risk Information System (IRIS) as of October 1, 1996.
- ⁵ Federal water quality criteria are from the EPA's website unless otherwise noted in the footnotes.
Aquatic Life Criteria: <https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table#table>
Human Health Criteria: <https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table>
- ⁶ Elevated temperature wastes shall not cause the temperature of waters designated COLD or WARM to increase by more than 5°F above natural receiving water temperature.
- ⁷ 5.0 mg/L for waters designated WARM, 7.0 mg/L for waters designated COLD or SPWN.
- ⁸ The 1-day minimum warmwater criteria are 5.0 mg/L for early life stages, which includes all embryonic and larval stages and all juveniles forms to 30 days following hatching, and 3.0 mg/L for other life stages. The 1-day minimum coldwater criteria are 8.0 mg/L to achieve required intergravel DO concentrations for early life stages, 5.0 mg/L for early life stages exposed directly to the water column, and 4.0 mg/L for other life stages (EPA's 1986 'Gold Book').
- ⁹ Where natural turbidity is between 0 and 5 NTUs, increases shall not exceed 1 NTU. Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent. Where natural turbidity is equal to or between 50 and 100 NTUs, increases shall not exceed 10 NTUs. Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.
- ¹⁰ pH shall not be depressed below 6.5, raised above 8.3, or changed at any time more than 0.3 units from normal ambient pH.
- ¹¹ The criteria listed are secondary Maximum Concentration Levels for California drinking water quality objectives that do not necessarily indicate a toxic amount of contaminate. Rather these standards dictate water quality objectives designed to preserve taste, odor, or appearance of drinking water.
- ¹² Freshwater aquatic life protection, continuous concentration (4-day average)/maximum concentration (1-hour average).
- ¹³ The CCC of 20 mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25 percent of the natural level.
- ¹⁴ Human health criterion (30-day average) for drinking water sources (consumption of water and aquatic organisms).
- ¹⁵ Human health criterion (30-day average) for other waters (consumption of aquatic organisms only).
- ¹⁶ Criterion is hardness dependent which is expressed as a function of hardness and decreases as hardness decreases. The actual criteria are calculated based on the hardness (as CaCO₃) of the sample water. Values displayed above correspond to a total hardness of 100mg/L.
- ¹⁷ Criteria values are from the EPA's 2004 National Recommended Water Quality Criteria.
- ¹⁸ Criterion for freshwater aquatic life protection (EPA's 1986 'Gold Book').
- ¹⁹ Criterion for domestic water supplies (EPA's 1986 'Gold Book').

Table 7.3-2. Water Quality Monitoring and Sampling Locations.

Sampling Location	Sampling Location Description	Sample ID	GPS Coordinates		Sampled in Spring? (May 7 – 31, 2018)	Sampled in Summer? (Aug 20 – 23, 2018)
			UTM11_ NAD 83 E	UTM11_ NAD 83 N		
Kaweah River						
K3 Flowline Above PH3	Kaweah No. 3 Flowline Upstream of the Kaweah No. 3 Powerhouse	6, 19	336315	4039197	Y	N ¹
KR Upstream of PH3	Kaweah River Upstream of the Kaweah No. 3 Powerhouse	8, 25	335524	4039460	Y	Y
K2 Flowline Below PH3	Kaweah No. 2 Flowline Downstream of the Kaweah No. 3 Powerhouse	9	335446	4039333	Y	N ¹
KR Downstream of PH3	Kaweah River Downstream of the Kaweah No. 3 Powerhouse	7, 26	335549	4039215	Y	Y
KR Upstream of the Conf. with EF	Kaweah River Upstream of the East Fork Kaweah River Confluence	10, 27	335382	4038784	Y	Y
KR Downstream of the Conf. with EF	Kaweah River Downstream of the East Fork Kaweah Confluence	11, 32	335161	4038695	Y	Y
KR Upstream of PH1	Kaweah River Upstream of the Kaweah No. 1 Powerhouse	14, 23, 34	333144	4037224	Y	Y
K1 Flowline Above PH1	Kaweah No. 1 Flowline Upstream of the Kaweah No. 1 Powerhouse	12, 16	333867	4036565	Y	N ²
KR Downstream of PH1	Kaweah River Downstream of the Kaweah No. 1 Powerhouse	13, 22, 33	333049	4037206	Y	Y
K2 Flowline Above PH2	Kaweah No. 2 Flowline Upstream of the Kaweah No. 2 Powerhouse	5, 18, 36	331832	4037037	Y	Y
KR Upstream of PH2	Kaweah River Downstream of the Kaweah No. 1 Powerhouse and Upstream of the Kaweah No. 2 Powerhouse	4, 17, 35	331593	4036687	Y	Y
KR Downstream of PH2	Kaweah River Downstream of the Kaweah No. 2 Powerhouse	15, 24, 37	331240	4036770	Y	Y
East Fork Kaweah River						
EF Upstream of K1 Div.	East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion	2, 28	339661	4035539	Y	Y
EF Downstream of K1 Div.	East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion	3, 20, 29	339590	4035507	Y	Y
K1 Flowline Below K1 Div.	Kaweah No. 1 Flowline Downstream of the Kaweah No. 1 Diversion	1, 30	339450	4035266	Y	Y
EF Upstream of the Conf. with KR	East Fork Kaweah River Upstream of the Confluence with Kaweah River	21, 31	335383	4038647	Y	Y

Notes:

¹ The water level in the K3 Flowline above PH3 and the K2 Flowline below PH3 was so low during the summer sampling period that it could not be reached without entering the flowlines. Since entering the flowlines is prohibited, water quality samples could not be collected.

² The K1 Flowline above PH1 was dry during the summer sampling period and therefore water quality samples could not be collected.

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Table 7.3-3. Summary of *In-Situ* Water Quality Measurements, Spring 2018.

Sampling Location	Sample ID	Date	Time	Flow (cfs)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Conductivity (µS/cm)	pH
K3 Flowline Above PH3	6	5/8/2018	825	90	10.82	9.33	3.7	15	7.32
	19	5/30/2018	1145	88	13.53	10.05	1.8	17	7.68
KR Upstream of PH3	8	5/8/2018	1000	841	11.88	9.44	2.0	16	7.35
K2 Flowline Below PH3	9	5/8/2018	1045	68	12.16	9.31	3.1	16	7.36
KR Downstream of PH3	7	5/8/2018	930	773	11.75	9.46	2.2	15	7.35
KR Upstream of the Conf. with EF	10	5/8/2018	1200	773	12.75	9.1	2.3	16	7.4
KR Downstream of the Conf. with EF	11	5/8/2018	1310	1073	13.49	9.21	2.9	23	7.55
KR Upstream of PH1	14	5/9/2018	1110	1088	12.1	9.48	3.6	22	7.51
	23	5/31/2018	845	531	13.56	9.77	0.9	28	7.64
K1 Flowline Above PH1	12	5/9/2018	830	16	9.38	9.3	5.5	38	7.69
	16	5/30/2018	835	16	14.02	9.22	0.5	49	7.46
KR Downstream of PH1	13	5/9/2018	1000	1104	12.05	9.26	3.9	23	7.5
	22	5/31/2018	820	547	13.51	10.04	0.1	29	7.51
K2 Flowline Above PH2	5	5/7/2018	1405	65	14.78	9.35	1.7	19	7.75
	18	5/30/2018	1035	69	15.37	9.87	0.8	18	7.75
KR Upstream of PH2	4	5/7/2018	1250	880	14.05	9.27	2.5	26	7.56
	17	5/30/2018	1015	627	15.37	9.55	1.1	27	7.6
KR Downstream of PH2	15	5/9/2018	1150	1171	13.12	9.15	3.8	23	7.51
	24	5/31/2018	930	616	13.95	9.9	2.8	29	7.76
EF Upstream of K1 Div.	2	5/7/2018	1015	276	9.34	9.57	1.5	41	7.74
EF Downstream of K1 Div.	3	5/7/2018	1100	258	9.59	9.8	2.0	40	7.7
	20	5/30/2018	1300	158	13.63	9.39	0.8	50	7.88
K1 Flowline Below K1 Div.	1	5/7/2018	840	18	9.31	9.71	2.1	40	7.7
EF Upstream of the Conf. with KR	21	5/30/2018	1430	158	16.56	9.31	0.6	50	7.84

Table 7.3-4. Summary of *In-Situ* Water Quality Measurements, Summer 2018.

Sampling Location	Sample ID	Date	Time	Flow (cfs)	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Conductivity (µS/cm)	pH
KR Upstream of PH3	25	8/20/2018	1100	23.6	23.07	8.51	4.0	93	7.86
KR Downstream of PH3	26	8/20/2018	1315	21	24.03	8.43	3.5	92	8.07
KR Upstream of the Conf. with EF	27	8/20/2018	1400	21	25.03	8.44	2.5	92	8.16
KR Downstream of the Conf. with EF	32	8/23/2018	1031	29.2	21.93	8.9	2.2	110	8.04
KR Upstream of PH1	34	8/23/2018	1155	29.2	23.03	8.9	2.4	110	8.14
KR Downstream of PH1	33	8/23/2018	1123	29.68	22.42	8.71	2.3	110	8.12
K2 Flowline Above PH2	36	8/23/2018	1254	2.6	26.9	9.61	2.1	95	8.57
KR Upstream of PH2	35	8/23/2018	1325	29.68	23.8	8.3	1.3	113	8.21
KR Downstream of PH2	37	8/23/2018	1400	32.28	24.64	8.69	1.2	113	8.17
EF Downstream of K1 Div.	29	8/22/2018	900	9.1	18.19	8.97	3.2	136	7.84
EF Upstream of the Conf. with KR	31	8/23/2018	938*	9.2	21.04	8.85	1.9	139	7.82

Notes:

* *In-situ* water quality measurements were taken in the morning and water quality samples were collected in the afternoon.

Table 7.3-5. Summary of Analytical Results for Water Quality Samples Collected during the Spring 2018 Sampling Event.

					Sample ID	6, 19	8	9	7	10	11	14, 23	12, 16	13, 22	5, 18	4, 17	15, 24	2	3, 20	1	21
					Sample Location	K3 Flowline Above PH3	KR Upstream of PH3	K2 Flowline Below PH3	KR Downstream of PH3	KR Upstream of the Conf. with EF	KR Downstream of the Conf. with EF	KR Upstream of PH1	K1 Flowline Above PH1	KR Downstream of PH1	K2 Flowline Above PH2	KR Upstream of PH2	KR Downstream of PH2	EF Upstream of K1 Div.	EF Downstream of K1 Div.	K1 Flowline Below K1 Div.	EF Upstream of the Conf. with KR
					Date	5/8/2018 ¹ , 5/30/2018 ¹	5/8/2018	5/8/2018	5/8/2018	5/8/2018	5/8/2018	5/9/2018 ¹ , 5/31/2018 ¹	5/9/2018 ¹ , 5/30/2018 ¹	5/9/2018 ¹ , 5/31/2018 ¹	5/7/2018 ¹ , 5/30/2018 ¹	5/7/2018 ¹ , 5/30/2018 ¹	5/9/2018 ¹ , 5/31/2018 ¹	5/7/2018	5/7/2018 ¹ , 5/30/2018 ¹	5/7/2018	5/30/2018
					Time	0825, 1145	1000	1045	0930	1200	1310	1110, 0845	0830, 0835	1000, 0820	1405, 1035	1250, 1015	1150, 0930	1015	1100, 1300	0840	1430
General Parameters	Units	MDL	PQL/MRL	WQ Criteria																	
Calcium	µg/L	10.79	50.0	NS	1740	2040	2010	1930	2040	3120	3300	6410	3260	2850	3660	3190	6660	6270	6590	7350	
Chloride	mg/L	0.08	1.0	250 ²	0.6 ^J	0.7 ^J	0.7 ^J	0.7 ^J	0.7 ^J	0.7 ^J	<MDL	0.7 ^J	<MDL	0.7 ^J	0.8 ^J	<MDL	0.8 ^J	0.7 ^J	0.7 ^J	0.8 ^J	
Hardness (as CaCO ₃)	mg/L	1.00	1.0	NS	5.4	6.4	6.4	6.1	6.3	9.2	9.7	17.9	9.6	8.6	10.8	9.4	18.6	17.5	18.5	20.5	
Magnesium	µg/L	3.48	25.0	NS	266	316	341	303	298	334	346	468	343	366	400	346	487	456	485	519	
Nitrate	mg/L	0.01	0.2	10 ²	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Nitrite	mg/L	0.01	0.1	1 ²	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Nitrate/Nitrite (NO ₃)	mg/L	0.028	0.10	10 ²	<MDL	<MDL	<MDL	<MDL	<MDL	0.16	0.34	0.36	0.24	<MDL	<MDL	0.08 ^J	<MDL	<MDL	<MDL	1.50	
Ammonia as N	mg/L	0.012	0.5	0.025 ³	<MDL	<MDL	1.6	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Total Kjeldahl Nitrogen (TKN)	mg/L	0.267	0.50	NS	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	0.41 ^{B,J}
Total Phosphorus	µg/L	24.0	100	NS	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	39 ^J	<MDL	<MDL	49 ^J	<MDL	<MDL	<MDL	<MDL	53 ^J	<MDL	
Ortho-phosphate	mg/L	0.016	0.05	NS	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Potassium	µg/L	93.9	500	NS	370 ^J	413 ^J	418 ^J	401 ^J	401 ^J	420 ^J	415 ^J	493 ^J	434 ^J	419 ^J	463 ^J	408 ^J	504	468 ^J	484 ^J	473 ^J	
Sodium	µg/L	82.9	500	NS	884	1060	1020	999	1050	1120	1230	1420	1200	1220	1390	1200	1570	1490	1570	1740	
Sulfate (SO ₄)	mg/L	0.09	1.0	250 ²	0.7 ^J	0.7 ^J	0.8 ^J	0.7 ^J	0.8 ^J	1.0	1.1	1.7	1.1	0.8 ^J	1.1	1.1	1.9	1.8	1.8	2.0	
Total Dissolved Solids	mg/L	4.4	10	500 ²	30	33	34	25	26	35	33	49	41	36	40	35	51	49	48	58	
Total Suspended Solids	mg/L	5.6	10	NS	9 ^J	11	10	14	11	10	<MDL	<MDL	<MDL	7 ^J	7 ^J	<MDL	11	8 ^J	16	<MDL	
Turbidity	NTU	0.035	0.10	Depends on natural turbidity ⁴	1.30	1.40	1.40	1.10	0.80	1.00	2.10	2.70	2.10	0.42	0.60	1.40	1.10	0.77	0.72	0.61 ^{H,T}	
Organic Carbon, Total (TOC)	mg/L	Not Applicable	0.2	NS	1.6	1.5	1.5	1.5	1.6	1.7	1.6	2.1	1.7	1.5 ^B	1.8 ^B	1.6	2.2 ^B	2.1 ^B	2.1 ^B	1.6	
Total Alkalinity	mg/L	0.85	2.0	>20 ⁵	5.9	6.6	1.0 ^J	6.5	2.8	369	9.4	22.4 ^B	11.6	7.8	20.3	9.7	23.6	23.7	24.1	20.4	

					Sample ID	6, 19	8	9	7	10	11	14, 23	12, 16	13, 22	5, 18	4, 17	15, 24	2	3, 20	1	21
					Sample Location	K3 Flowline Above PH3	KR Upstream of PH3	K2 Flowline Below PH3	KR Downstream of PH3	KR Upstream of the Conf. with EF	KR Downstream of the Conf. with EF	KR Upstream of PH1	K1 Flowline Above PH1	KR Downstream of PH1	K2 Flowline Above PH2	KR Upstream of PH2	KR Downstream of PH2	EF Upstream of K1 Div.	EF Downstream of K1 Div.	K1 Flowline Below K1 Div.	EF Upstream of the Conf. with KR
					Date	5/8/2018 ¹ , 5/30/2018 ¹	5/8/2018	5/8/2018	5/8/2018	5/8/2018	5/8/2018	5/9/2018 ¹ , 5/31/2018 ¹	5/9/2018 ¹ , 5/30/2018 ¹	5/9/2018 ¹ , 5/31/2018 ¹	5/7/2018 ¹ , 5/30/2018 ¹	5/7/2018 ¹ , 5/30/2018 ¹	5/9/2018 ¹ , 5/31/2018 ¹	5/7/2018	5/7/2018 ¹ , 5/30/2018 ¹	5/7/2018	5/30/2018
					Time	0825, 1145	1000	1045	0930	1200	1310	1110, 0845	0830, 0835	1000, 0820	1405, 1035	1250, 1015	1150, 0930	1015	1100, 1300	0840	1430
Metals-Dissolved	Units	MDL	MRL	WQ Criteria																	
Arsenic	µg/L	0.056	0.204	10 ²	0.124 ^J	0.223 ^J	0.210	0.215	0.233	0.435	0.564	1.250	0.589	0.269, 0.305	0.566	0.585	0.894	1.200	0.951	1.365	
Cadmium	µg/L	0.031	0.092	Hardness dependent ⁶	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Copper	µg/L	0.112	0.337	Hardness dependent ⁶	0.239 ^J	0.261 ^J	0.290 ^J	0.299 ^J	0.283 ^J	0.383	0.260 ^J	0.573	0.228 ^J	0.268 ^J , 0.271 ^J	0.254 ^J	0.236 ^J	0.224 ^J	0.192 ^J	0.322 ^J	0.233 ^J	
Iron	µg/L	1.43	4.34	300 ²	65.5	50.7	47.1	45.4	48.2	55.5	37.7	44.0	47.2	166.7, 29.3	48.1	38.6	40.1	47.3	38.4	71.1	
Lead	µg/L	0.026	0.077	Hardness dependent ⁶	0.041 ^J	0.044 ^J	0.031 ^J	0.028 ^J	0.027 ^J	0.046 ^J	<MDL	0.032 ^J	0.029 ^J	<MDL	0.028 ^J	<MDL	<MDL	0.037 ^J	<MDL	0.062 ^J	
Manganese	µg/L	0.107	0.321	50 ²	2.30	1.74	1.74	1.65	1.95	2.32	1.60	2.05	1.96	3.29, 1.19	2.06	1.80	1.57	2.21	1.65	3.21	
Nickel	µg/L	0.117	0.352	Hardness dependent ⁶	<MDL	<MDL	<MDL	<MDL	<MDL	0.133 ^J	<MDL	0.120 ^J	<MDL	<MDL, 0.236 ^J	<MDL	<MDL	0.206 ^J	<MDL	0.187 ^J	<MDL	
Chromium-Total	µg/L	0.128	0.383	50 ²	<MDL	0.132 ^J	<MDL	0.134 ^J	<MDL	0.136 ^J	<MDL	0.151 ^J	<MDL	<MDL, 0.464	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Metals-Total	Units	MDL	MRL	WQ Criteria																	
Mercury	ng/L	0.13	0.40	1,400 ⁷	0.66	0.97	1.12	1.04	0.94	0.94	0.65	0.81	0.70	0.84, 0.72	0.95	0.67	1.29	1.29	1.35	1.28	

Note: Bold results do not meet the listed criteria

Acronyms

MRL (Method Reporting Limit): The lowest concentration of a substance that can be reliably reported under current laboratory operating conditions.
 PQL (Practical Quantitation Limit): The concentration that can be reliably measured within specified limits and accuracy during routine laboratory operating conditions.
 <MDL: Analyte was not detected above the method detection limit and is therefore considered a non-detect.
 NS: No standard

Footnotes

- ^B The analyte was found in a method blank, as well as in the sample.
- ^J Detected by the instrument, the result is greater than the method detection limit but less than or equal to the method reporting limit. Result is reported and considered an estimate.
- ^H Holding time exceeded. Due to equipment failure at the primary lab, the sample was subcontracted to another lab and the analysis was completed one day past holding time.
- ^T Sample was received above the mandated temperature. Due to equipment failure at the primary lab, the sample was subcontracted to another lab and was received above the mandated temperature. The lab did not indicate by how much temperature was exceeded.
- ¹ Some locations were sampled twice because samples were missed or because holding times were exceeded during the first sampling effort. Sample results where holding times were exceeded were omitted from this results table except one instance (see "H" flag) where holding time was exceeded due to lab equipment failure.
- ² Water quality objective from the 2015 Water Quality Control Plan for the Tulare Lake Basin Second Edition.
- ³ Basin Plan water quality objective is 0.025 mg/L. EPA criterion is pH, temperature, and life cycle dependent. See Table AQ 6-9 for EPA criteria and results.
- ⁴ Where natural turbidity is between 0 and 5 NTUs, increases shall not exceed 1 NTU. Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent. Where natural turbidity is equal to or between 50 and 100 NTUs, increases shall not exceed 10 NTUs. Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.
- ⁵ EPA criterion. The CCC of 20 mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25 percent of the natural level.
- ⁶ Criterion is hardness dependent which is expressed as a function of hardness and decreases as hardness decreases. The actual criterion is calculated based on the hardness (as CaCO₃) of the sample water. Refer to Table AQ 6-11 for sample site criteria and results.
- ⁷ EPA maximum concentration (1-hour average) criterion for freshwater aquatic life protection. Basin Plan water quality objective is less stringent (2,000 ng/L).

Table 7.3-6. Summary of Analytical Results for Water Quality Samples Collected during the Summer 2018 Sampling Event.

					Sample ID	25	26	27	32	34	33	36	35	37	28	29	30	31
					Sample Location	KR Upstream of PH3	KR Downstream of PH3	KR Upstream of the Conf. with EF	KR Downstream of the Conf. with EF	KR Upstream of PH1	KR Downstream of PH1	K2 Flowline Above PH2	KR Upstream of PH2	KR Downstream of PH2	EF Upstream of K1 Div.	EF Downstream of K1 Div.	K1 Flowline Below K1 Div.	EF Upstream of the Conf. with KR
					Date	8/20/2018	8/20/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/21/2018	8/21/2018	8/21/2018	8/23/2018
					Time	1100	1315	1400	1031	1155	1123	1254	1325	1400	1250	0900	1415	0938
General Parameters	Units	MDL	PQL	WQ Criteria														
Calcium	µg/L	10.79	50.0	NS	8350	8690	9670	13700	13100	14200	10000	14100	13500	21200	21000	20800	21100	
Chloride	mg/L	0.08	1.0	250 ¹	3.0	3.0	3.0	2.8	2.9	2.7	3.2	3.3	3.4	1.4	1.4	1.3	1.8	
Hardness (as CaCO ₃)	mg/L	1.00	1.0	NS	26.7	27.9	31.0	41.2	39.3	42.6	32.0	42.2	40.7	59.2	58.9	58.2	59.5	
Magnesium	µg/L	3.48	25.0	NS	1430	1500	1670	1680	1620	1730	1690	1730	1680	1540	1540	1550	1650	
Nitrate	mg/L	0.01	0.2	10 ¹	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Nitrite	mg/L	0.01	0.1	1 ¹	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Nitrate/Nitrite (NO ₃)	mg/L	0.028	0.10	10 ¹	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Ammonia as N	mg/L	0.012	0.5	0.025 ²	<MDL	<MDL	<MDL	<MDL	0.3^J	<MDL	<MDL	0.1^J	0.9	<MDL	<MDL	<MDL	<MDL	
Total Kjeldahl Nitrogen (TKN)	mg/L	0.267	0.50	NS	<MDL	<MDL	<MDL	0.50	<MDL	0.27 ^J	0.44 ^J	0.72	<MDL	<MDL	<MDL	<MDL	<MDL	
Total Phosphorus	µg/L	24.0	100	NS	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Ortho-phosphate	mg/L	0.016	0.05	NS	<MDL	<MDL	0.03 ^J	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Potassium	µg/L	93.9	500	NS	1180	1210	1360	1320	1310	1430	1410	1470	1400	1230	1270	1270	1350	
Sodium	µg/L	82.9	500	NS	5340	5580	6160	6280	6030	6520	6400	6830	6650	5240	5200	5180	6220	
Sulfate (SO ₄)	mg/L	0.09	1.0	250 ¹	2.0	2.0	2.0	3.0	3.0	3.0	2.1	2.9	2.9	4.6	4.7	4.6	4.7	
Total Dissolved Solids	mg/L	4.4	10	500 ¹	66	66	70	83	87	77	66	78	75	89	90	91	105	
Total Suspended Solids	mg/L	5.6	10	NS	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Turbidity	NTU	0.035	0.10	Depends on natural turbidity ³	0.37	0.39	0.36	0.32	0.31	0.35	0.38	0.40	0.33	0.37	0.41	0.34	0.53	
Organic Carbon, Total (TOC)	mg/L	Not Applicable	0.2	NS	1.2	1.3	1.3	1.2	1.2	1.2	1.5	1.2	1.2	0.9 ^C	0.9	1.1	1.2	
Total Alkalinity	mg/L	0.85	2.0	>20 ⁴	38.8	40.5	41.0	49.4	49.1	49.6	39.2	49.2	48.8	645	62.9	63.2	63.5	
Metals-Dissolved	Units	MDL	MRL	WQ Criteria														
Arsenic	µg/L	0.056	0.204	10 ¹	3.265	3.190	3.210	3.340	3.120	3.215	3.330	2.950	2.995	2.442	2.450	2.465	3.475	
Cadmium	µg/L	0.031	0.092	Hardness dependent ⁵	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Copper	µg/L	0.112	0.337	Hardness dependent ⁵	0.150 ^J	0.174 ^J	0.182 ^J	0.171 ^J	0.280 ^J	0.154 ^J	0.208 ^J	0.141 ^J	0.137 ^J	0.120 ^J	0.125 ^J	0.125 ^J	0.137 ^J	
Iron	µg/L	1.43	4.34	300 ¹	26.7	27.2	28.1	35.1	36.0	37.0	35.7	47.4	48.8	30.2	33.5	30.7	40.7	
Lead	µg/L	0.026	0.077	Hardness dependent ⁵	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	

					Sample ID	25	26	27	32	34	33	36	35	37	28	29	30	31	
					Sample Location	KR Upstream of PH3	KR Downstream of PH3	KR Upstream of the Conf. with EF	KR Downstream of the Conf. with EF	KR Upstream of PH1	KR Downstream of PH1	K2 Flowline Above PH2	KR Upstream of PH2	KR Downstream of PH2	EF Upstream of K1 Div.	EF Downstream of K1 Div.	K1 Flowline Below K1 Div.	EF Upstream of the Conf. with KR	
					Date	8/20/2018	8/20/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/21/2018	8/21/2018	8/21/2018	8/23/2018	
					Time	1100	1315	1400	1031	1155	1123	1254	1325	1400	1250	0900	1415	0938	
Manganese	µg/L	0.107	0.321	50 ¹		1.34	1.2	1.10	1.82	1.51	1.55	1.36	2.245	2.25	3.415	3.75	3.26	2.92	
Nickel	µg/L	0.117	0.352	Hardness dependent ⁵		0.140 ^J	<MDL	0.123 ^J	0.121 ^J	0.121 ^J	<MDL	0.120 ^J	0.121 ^J	0.119 ^J	0.122 ^J	0.138 ^J	0.142 ^J	0.124 ^J	
Chromium-Total	µg/L	0.128	0.383	50 ¹		<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	
Metals-Total	Units	MDL	MRL	WQ Criteria															
Mercury	ng/L	0.13	0.40	1,400 ⁶		0.30 ^J	0.26 ^J	0.31 ^J	0.30 ^J	0.31 ^J	0.30 ^J	0.33 ^J	0.25 ^J	0.28 ^J	0.43	0.45	0.46	0.50	

Notes: Bold results do not meet the listed criteria

Acronyms:

<MDL: Analyte was not detected above the method detection limit and is therefore considered a non-detect.

MRL (Method Reporting Limit): The lowest concentration of a substance that can be reliably reported under current laboratory operating conditions.

NS: No standard

PQL (Practical Quantitation Limit): The concentration that can be reliably measured within specified limits and accuracy during routine laboratory operating conditions.

Footnotes:

^C Sample was received without chemical preservation.

^J Detected by the instrument, the result is greater than the method detection limit but less than or equal to the method reporting limit. Result is reported and considered an estimate.

¹ Water quality objective from the 2015 Water Quality Control Plan for the Tulare Lake Basin Second Edition.

² Basin Plan water quality objective is 0.025 mg/L. EPA criterion is pH, temperature, and life cycle dependent. See Table AQ 6-10 for EPA criteria and results.

³ Where natural turbidity is between 0 and 5 NTUs, increases shall not exceed 1 NTU. Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent. Where natural turbidity is equal to or between 50 and 100 NTUs, increases shall not exceed 10 NTUs. Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

⁴ EPA criterion. The CCC of 20 mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25 percent of the natural level.

⁵ Criterion is hardness dependent which is expressed as a function of hardness and decreases as hardness decreases. The actual criterion is calculated based on the hardness (as CaCO₃) of the sample water. Refer to Table AQ 6-12 for sample site criteria and results.

⁶ EPA maximum concentration (1-hour average) criterion for freshwater aquatic life protection. Basin Plan water quality objective is less stringent (2,000 ng/L).

Table 7.3-7. Basin Plan Ammonia Waste Discharge Exceedance Criteria and Calculated Ammonia Concentration Criteria for the Spring 2018 Sampling Event.

Sample Site, Date, Time, and Parameters						Basin Plan Waste Discharge Exceedance Criteria mg/L	EPA Ammonia Chronic Criteria ¹ mg/L	EPA Ammonia Acute Criteria ¹ mg/L	Ammonia Concentration mg/L
Sample ID	Location Name	Date	Time	pH	Temperature (°C)				
6	K3 Flowline Above PH3	5/08/2018	0825	7.3	10.82	0.025	2.89	17.07	<MDL
8	KR Upstream of PH3	5/08/2018	1000	7.4	11.88	0.025	2.65	16.41	<MDL
9	K2 Flowline Below PH3	5/08/2018	1045	7.4	12.16	0.025	2.58	16.20	1.6
7	KR Downstream of PH3	5/08/2018	0930	7.4	11.75	0.025	2.67	16.41	<MDL
10	KR Upstream of the Conf. with EF	5/08/2018	1200	7.4	12.75	0.025	2.41	15.34	<MDL
11	KR Downstream of the Conf. with EF	5/08/2018	1310	7.6	13.49	0.025	2.03	12.31	<MDL
14	KR Upstream of PH1	5/09/2018	1110	7.5	12.1	0.025	2.30	13.09	<MDL
12	K1 Flowline Above PH1	5/09/2018	0830	7.7	9.38	0.025	2.29	9.81	<MDL
13	KR Downstream of PH1	5/09/2018	1000	7.5	12.05	0.025	2.33	13.28	<MDL
5	K2 Flowline Above PH2	5/07/2018	1405	7.8	14.78	0.025	1.51	8.85	<MDL
4	KR Upstream of PH2	5/07/2018	1250	7.6	14.05	0.025	1.94	12.12	<MDL
15	KR Downstream of PH2	5/09/2018	1150	7.5	13.12	0.025	2.15	13.09	<MDL
2	EF Upstream of K1 Div.	5/07/2018	1015	7.7	9.34	0.025	2.17	9.01	<MDL
3	EF Downstream of K1 Div.	5/07/2018	1100	7.7	9.59	0.025	2.24	9.64	<MDL
1	K1 Flowline Below K1 Div.	5/07/2018	0840	7.7	9.31	0.025	2.28	9.64	<MDL
21	EF Upstream of the Conf. with KR	5/30/2018	1430	7.8	16.56	0.025	1.21	6.98	<MDL

Notes: Bold results do not meet the listed criterion.

<MDL: Analyte was not detected above the method detection limit (MDL) and is therefore considered a non-detect. The MDL for ammonia is 0.012 mg/L.

¹ Ammonia criterion calculated using guidelines from the EPA's 2013 Aquatic Life Ambient Water Quality Criteria for Ammonia - Freshwater, which is based on ambient pH and temperature conditions.

Table 7.3-8. Basin Plan Ammonia Waste Discharge Exceedance Criteria and Calculated EPA Ammonia Concentration Criteria for the Summer 2018 Sampling Event.

Sample Site, Date, and Parameters						Basin Plan Waste Discharge Exceedance Criteria mg/L	EPA Ammonia Chronic Criteria ¹ mg/L	EPA Ammonia Acute Criteria ¹ mg/L	Ammonia Concentration mg/L
Sample ID	Location Name	Date	Time	pH	Temperature (°C)				
25	KR Upstream of PH3	8/20/2018	1100	7.86	23.07	0.025	0.77	3.92	<MDL
26	KR Downstream of PH3	8/20/2018	1315	8.07	24.03	0.025	0.54	2.45	<MDL
27	KR Upstream of the Conf. with EF	8/20/2018	1400	8.16	25.03	0.025	0.44	1.89	<MDL
32	KR Downstream of the Conf. with EF	8/23/2018	1031	8.04	21.93	0.025	0.65	3.08	<MDL
34	KR Upstream of PH1	8/23/2018	1155	8.14	23.03	0.025	0.52	2.32	0.3 ^J
33	KR Downstream of PH1	8/23/2018	1123	8.12	22.42	0.025	0.56	2.54	<MDL
36	K2 Flowline Above PH2	8/23/2018	1254	8.57	26.9	0.025	0.20	0.74	<MDL
35	KR Upstream of PH2	8/23/2018	1325	8.21	23.8	0.025	0.44	1.90	0.1 ^J
37	KR Downstream of PH2	8/23/2018	1400	8.17	24.64	0.025	0.45	1.92	0.9
28	EF Upstream of K1 Div.	8/22/2018	0900	7.83 ²	18.08 ³	0.025	1.11	6.26	<MDL
29	EF Downstream of K1 Div.	8/22/2018	0900	7.84	18.19	0.025	1.09	6.10	<MDL
30	K1 Flowline Below K1 Div.	8/22/2018	0900	7.83 ²	18.15 ³	0.025	1.10	6.23	<MDL
31	EF Upstream of the Conf. with KR	8/23/2018	0938	7.82	21.04	0.025	0.93	4.99	<MDL

Notes: Bold results do not meet the listed criterion.

<MDL: Analyte was not detected above the method detection limit (MDL) and is therefore considered a non-detect. The MDL for ammonia is 0.012 mg/L.

¹ Ammonia criterion calculated using guidelines from the EPA's 2013 Aquatic Life Ambient Water Quality Criteria for Ammonia - Freshwater, which is based on ambient pH and temperature conditions.

² pH was not measured at this site on this date. The pH value was estimated by averaging the pH values at the other sites on the East Fork Kaweah River (EF Downstream of K1 Div. and EF Upstream of the Conf with KR).

³ Temperature was not measured with a YSI at this site on this date. Temperature values were obtained from the temperature logger reading at this site at 0900 on 8/22/2018.

^J Detected by the instrument, the result is greater than the method detection limit but less than or equal to the reporting limit (RL). Result is reported and considered an estimate. The RL for ammonia is 0.5 mg/L.

Table 7.3-9. Hardness-based Water Quality Criteria for Cadmium, Copper, Lead, and Nickel for the Spring 2018 Sampling Event.

Sample ID	6, 19	8	9	7	10	11	14, 23	12, 16	13, 22	5, 18	4, 17	15, 24	2	3, 20	1	21
Sample Location	K3 Flowline Above PH3	KR Upstream of PH3	K2 Flowline Below PH3	KR Downstream of PH3	KR Upstream of the Conf. with EF	KR Downstream of the Conf. with EF	KR Upstream of PH1	K1 Flowline Above PH1	KR Downstream of PH1	K2 Flowline Above PH2	KR Upstream of PH2	KR Downstream of PH2	EF Upstream of K1 Div.	EF Downstream of K1 Div.	K1 Flowline Below K1 Div.	EF Upstream of the Conf. with KR
Date Sampled	5/08/2018 5/30/2018	5/08/2018	5/08/2018	5/08/2018	5/08/2018	5/08/2018	5/09/2018 5/31/2018	5/09/2018 5/30/2018	5/09/2018 5/31/2018	5/07/2018 5/30/2018	5/07/2018 5/30/2018	5/09/2018 5/31/2018	5/07/2018	5/07/2018 5/30/2018	5/07/2018	5/30/2018
Time Sampled	0825, 1145	1000	1045	0930	1200	1310	1110, 0845	0830, 0835	1000, 0820	1405, 1035	1250, 1015	1150, 0930	1015	1100, 1300	0840	1430
Hardness (CaCO ₃) (mg/L)	5.4	6.4	6.4	6.1	6.3	9.2	9.7	17.9	9.6	8.6	10.8	9.4	18.6	17.5	18.5	20.5
Cadmium (Cd)																
Laboratory Result (µg/L)	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
Maximum Criterion (µg/L)	0.12	0.14	0.14	0.13	0.13	0.19	0.20	0.36	0.20	0.18	0.22	0.20	0.37	0.35	0.37	0.41
Continuous Criterion (µg/L)	0.08	0.09	0.09	0.09	0.09	0.12	0.12	0.20	0.12	0.11	0.13	0.12	0.20	0.19	0.20	0.22
Copper (Cu)																
Laboratory Result (µg/L)	0.239 ^J	0.261 ^J	0.290 ^J	0.299 ^J	0.283 ^J	0.383	0.260 ^J	0.573	0.228 ^J	0.268 ^J , 0.271 ^J	0.254 ^J	0.236 ^J	0.224 ^J	0.192 ^J	0.322 ^J	0.233 ^J
Maximum Criterion (µg/L)	0.86	1.01	1.01	0.96	0.99	1.42	1.49	2.66	1.48	1.33	1.65	1.45	2.75	2.60	2.74	3.02
Continuous Criterion (µg/L)	0.74	0.86	0.86	0.82	0.84	1.17	1.22	2.06	1.21	1.10	1.34	1.19	2.13	2.02	2.12	2.31
Lead (Pb)																
Laboratory Result (µg/L)	0.041 ^J	0.044 ^J	0.031 ^J	0.028 ^J	0.027 ^J	0.046 ^J	<MDL	0.032 ^J	0.029 ^J	<MDL	0.028 ^J	<MDL	<MDL	0.037 ^J	<MDL	0.062 ^J
Maximum Criterion (µg/L)	2.42	2.94	2.94	2.78	2.89	4.46	4.74	9.52	4.68	4.13	5.36	4.57	9.94	9.28	9.88	11.10
Continuous Criterion (µg/L)	0.09	0.11	0.11	0.11	0.11	0.17	0.18	0.37	0.18	0.16	0.21	0.18	0.39	0.36	0.39	0.43
Nickel (Ni)																
Laboratory Result (µg/L)	<MDL	<MDL	<MDL	<MDL	<MDL	0.133 ^J	<MDL	0.120 ^J	<MDL	<MDL, 0.236 ^J	<MDL	<MDL	0.206 ^J	<MDL	0.187 ^J	<MDL
Maximum Criterion (µg/L)	39.63	45.76	45.76	43.94	45.16	62.21	65.05	109.24	64.49	58.76	71.24	63.35	112.84	107.17	112.33	122.52
Continuous Criterion (µg/L)	4.40	5.08	5.08	4.88	5.02	6.91	7.23	12.13	7.16	6.53	7.91	7.04	12.53	11.90	12.48	13.61

Notes: Bold results do not meet the calculated criteria

<MDL: Analyte was not detected above the method detection limit (MDL) and is therefore considered a non-detect. The MDL for cadmium is 0.031 µg/L, the MDL for lead is 0.026 µg/L, and the MDL for nickel is 0.117 µg/L.

^J Detected by the instrument, the result is greater than the MDL but less than or equal to the method reporting limit (MRL). Result is reported and considered an estimate. The MRL for copper is 0.337 µg/L, the MRL for lead is 0.077 µg/L, and the MRL for nickel is 0.352 µg/L.

California Toxics Rule (CTR) and EPA standard was used for Cu, Pb, and Ni. EPA standard was used for Cd as it is more stringent than the CTR standard.

Formulas used are provided in Appendix B.

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Table 7.3-10. Hardness-based Water Quality Criteria for Cadmium, Copper, Lead, and Nickel for the Summer 2018 Sampling Event.

Sample ID	25	26	27	32	34	33	36	35	37	28	29	30	31
Sample Location	KR Upstream of PH3	KR Downstream of PH3	KR Upstream of the Conf. with EF	KR Downstream of the Conf. with EF	KR Upstream of PH1	KR Downstream of PH1	K2 Flowline Above PH2	KR Upstream of PH2	KR Downstream of PH2	EF Upstream of K1 Div.	EF Downstream of K1 Div.	K1 Flowline Below K1 Div.	EF Upstream of the Conf. with KR
Date Sampled	8/20/2018	8/20/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/23/2018	8/21/2018	8/21/2018	8/21/2018	8/23/2018
Time Sampled	1100	1315	1400	1031	1155	1123	1254	1325	1400	1250	0900	1415	0938
Hardness (CaCO ₃) (mg/L)	26.7	27.9	31	41.2	39.3	42.6	32	42.2	40.7	59.2	58.9	58.2	59.5
Cadmium (Cd)													
Laboratory Result (µg/L)	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
Maximum Criterion (µg/L)	0.52	0.54	0.60	0.78	0.75	0.81	0.62	0.80	0.77	1.10	1.09	1.08	1.10
Continuous Criterion (µg/L)	0.27	0.27	0.30	0.37	0.36	0.38	0.30	0.38	0.37	0.48	0.48	0.48	0.49
Copper (Cu)													
Laboratory Result (µg/L)	0.150 ^J	0.174 ^J	0.182 ^J	0.171 ^J	0.280 ^J	0.154 ^J	0.208 ^J	0.141 ^J	0.137 ^J	0.120 ^J	0.125 ^J	0.125 ^J	0.137 ^J
Maximum Criterion (µg/L)	3.87	4.04	4.46	5.83	5.57	6.01	4.59	5.96	5.76	8.20	8.16	8.07	8.24
Continuous Criterion (µg/L)	2.90	3.01	3.29	4.20	4.03	4.32	3.38	4.28	4.15	5.72	5.70	5.64	5.75
Lead (Pb)													
Laboratory Result (µg/L)	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL	<MDL
Maximum Criterion (µg/L)	14.95	15.71	17.68	24.30	23.05	25.22	18.32	24.96	23.97	36.33	36.13	35.66	36.54
Continuous Criterion (µg/L)	0.58	0.61	0.69	0.95	0.90	0.98	0.71	0.97	0.93	1.42	1.41	1.39	1.42
Nickel (Ni)													
Laboratory Result (µg/L)	0.140 ^J	<MDL	0.123 ^J	0.121 ^J	0.121 ^J	<MDL	0.120 ^J	0.121 ^J	0.119 ^J	0.122 ^J	0.138 ^J	0.142 ^J	0.124 ^J
Maximum Criterion (µg/L)	153.21	159.02	173.84	221.14	212.48	227.48	178.58	225.67	218.87	300.50	299.21	296.20	301.79
Continuous Criterion (µg/L)	17.02	17.66	19.31	24.56	23.60	25.27	19.83	25.07	24.31	33.38	33.23	32.90	33.52

Notes: Bold results do not meet the calculated criteria

<MDL: Analyte was not detected above the method detection limit (MDL) and is therefore considered a non-detect. The MDL for cadmium is 0.031 µg/L, the MDL for lead is 0.026 µg/L, and the MDL for nickel is 0.117 µg/L.

^J Detected by the instrument, the result is greater than the MDL but less than or equal to the method reporting limit (MRL). Result is reported and considered an estimate. The MRL for copper is 0.337 µg/L and the MRL for nickel is 0.352 µg/L.

California Toxics Rule (CTR) and EPA standard was used for Cu, Pb, and Ni. EPA standard was used for Cd as it is more stringent than the CTR standard.

Formulas used are provided in Appendix B.

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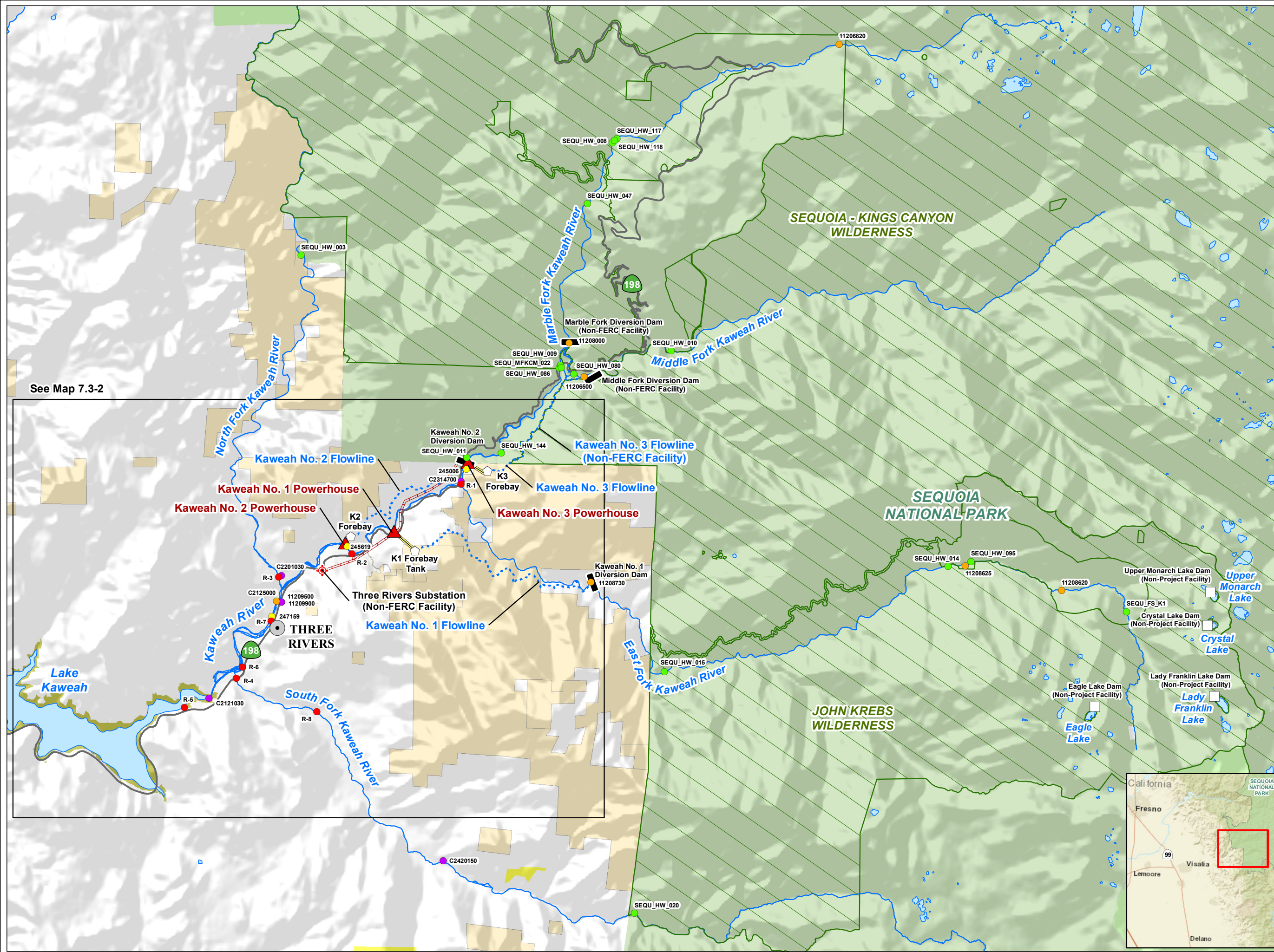
Table 7.3-11. Edison Beach Coliform Sampling Upstream/Downstream Comparison.

Sample Location	Test	Sample Date				
		7/05/2018	7/12/2018	7/19/2018	7/26/2018	7/31/2018
Upstream of Edison Beach	Total Coliform (MPN/100mL)	>2419.6	>2419.6	>2419.6	>2419.6	>2419.6
	<i>E. coli</i> (MPN/100mL)	69.7	52.9	41.4	14.5	14.5
Downstream of Edison Beach	Total Coliform (MPN/100mL)	>2419.6	>2419.6	>2419.6	>2419.6	>2419.6
	<i>E. coli</i> (MPN/100mL)	30.1	76.9	45.7	18.7	14.8

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MAPS


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See Map 7.3-2

- SCE Facilities**
- Powerhouse
 - Diversion
 - Dam
 - Utility
 - Forebay
 - Flowline
 - Penstock
 - Transmission Line
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
- Land Jurisdiction***
- Bureau of Land Management
 - National Park Service
 - U.S. Army Corps of Engineers
 - State of California
 - Private (Blank)
- *SOURCE: BLM 2012

- Land Management**
- National Wilderness Area
- Water Quality Sample Locations**
- CEDEN
 - California Dept. of Water Resources
 - National Park Service Water Resources Division
 - USGS
 - Three Rivers CSD




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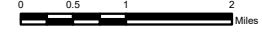
Kaweah Project – FERC Project No. 298

Map 7.3-1

Water Quality Sample Locations in the Kaweah Watershed



Date: 7/3/2019

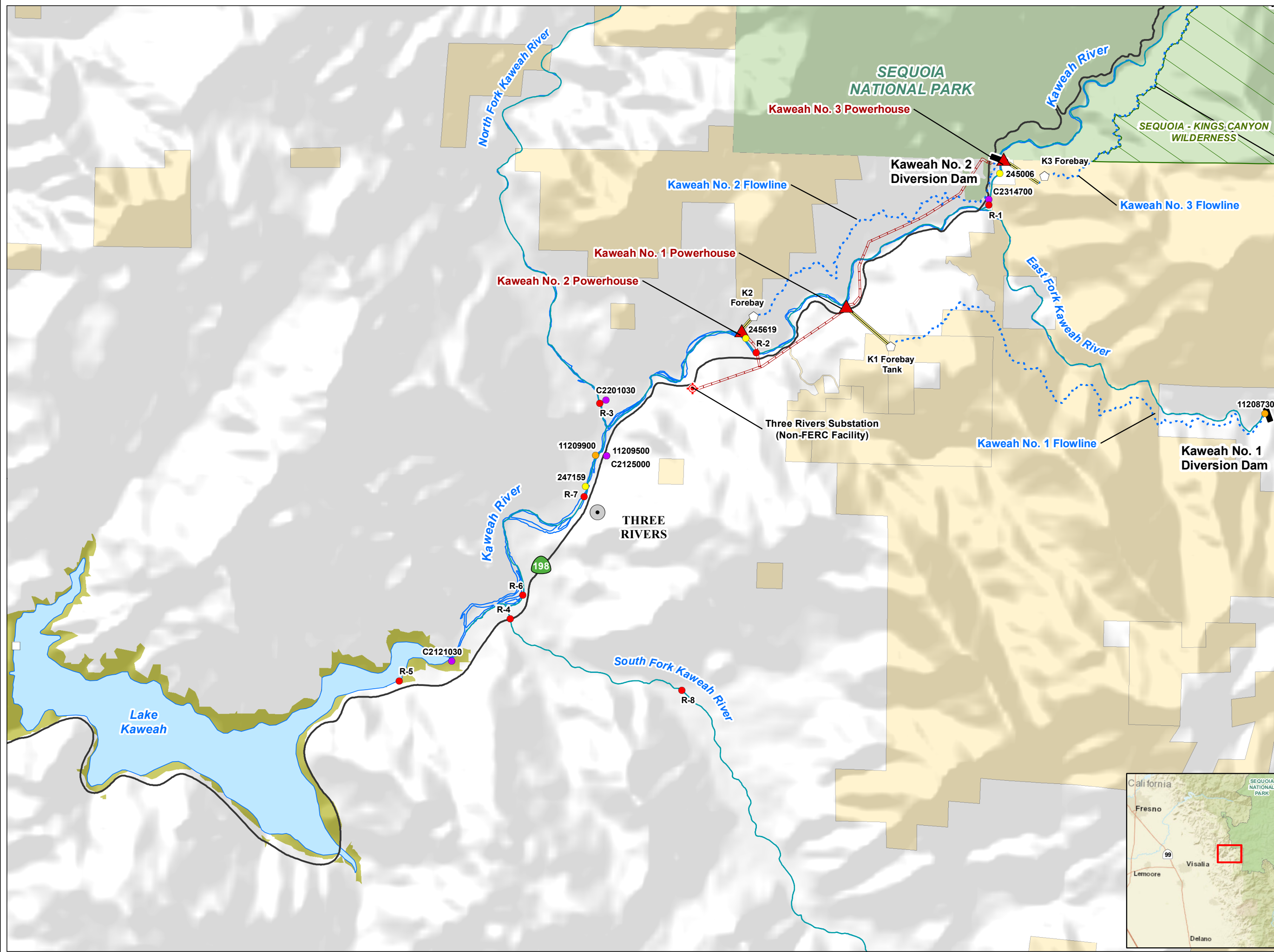


0 0.5 1 2 Miles


Projection: UTM Zone 11
Datum: NAD 83

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- SCE Facilities**
- Powerhouse
 - Diversion
 - Dam
 - Utility
 - Forebay
 - Flowline
 - Penstock
 - Transmission Line
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
- Land Jurisdiction***
- Bureau of Land Management
 - National Park Service
 - U.S. Army Corps of Engineers
 - State of California
 - Private (Blank)
- *SOURCE: BLM 2012
- Land Management**
- National Wilderness Area
- Water Quality Sample Locations**
- CEDEN
 - California Dept. of Water Resources
 - National Park Service Water Resources Division
 - USGS
 - Three Rivers CSD




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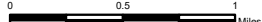
Kaweah Project – FERC Project No. 298

Map 7.3-2

Water Quality Sample Locations in the Vicinity of the Kaweah Project



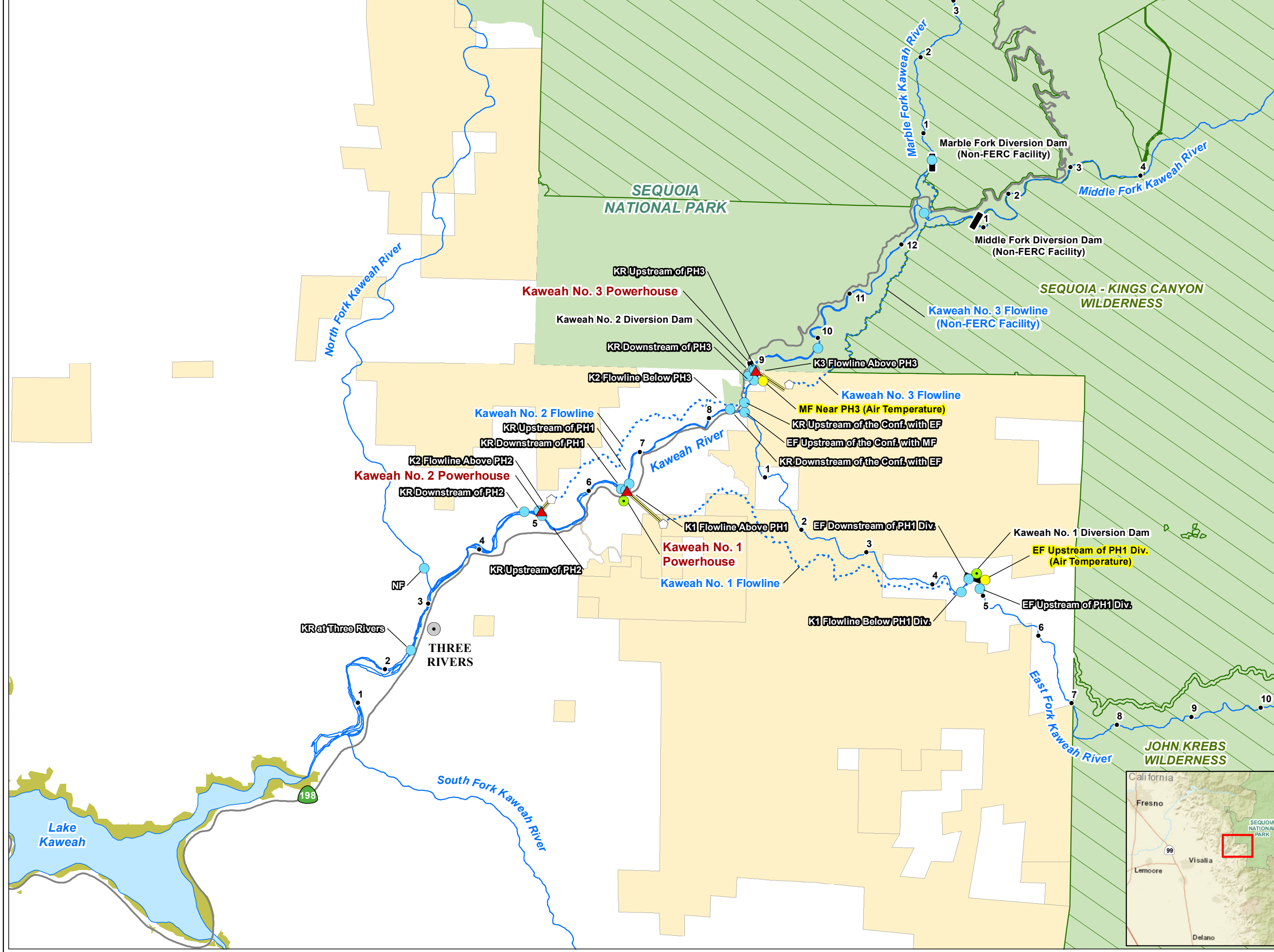
Date: 7/3/2019



Projection: UTM Zone 11
Datum: NAD 83

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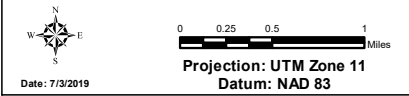
- SCE Facilities**
- Powerhouse
 - Diversion
 - Forebay
 - Flowline
 - Penstock
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
 - River Mile
- Land Jurisdiction***
- Bureau of Land Management
 - U.S. Army Corps of Engineers
 - National Park Service
 - Private
- *SOURCE: BLM 2012
- Land Management**
- National Wilderness Area
- Monitoring Locations**
- Water Quality and Water Temperature Monitoring (existing water temperature data site)
 - Water Quality and Water Temperature Monitoring
 - Water Temperature Monitoring (only)
 - Meteorological Monitoring Location
 - Air Temperature Monitoring Location



Kaweah Project – FERC Project No. 298

Map 7.3-3

**Kaweah Project
Water Quality Monitoring
and Sampling Locations**



Date: 7/3/2019

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APPENDIX 7.3-A

Summary of Historical Water Quality Data

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Table 7.3-A1. USGS Water Quality Monitoring in the Vicinity of the Kaweah Project

Sample Date	Temperature (deg C)	Discharge, cubic feet per second	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field,	Dissolved oxygen, water, unfiltered, milligrams per liter	General Parameters																	Trace Elements			Bacteria			
							Ammonia, water, filtered, milligrams per liter as NH4	Calcium, water, filtered, milligrams per liter	Chloride, water, filtered, milligrams per liter	Fluoride, water, filtered, milligrams per liter	Hardness, water, milligrams per liter as calcium carbonate	Magnesium, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Orthophosphate, water, filtered, milligrams per liter	Phosphorus, water, filtered, milligrams per liter as phosphorus	Potassium, water, filtered, milligrams per liter	Silica, water, filtered, milligrams per liter as SiO2	Sodium, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Dissolved solids, water, filtered, sum of constituents, milligrams per liter	Suspended sediment concentration, milligrams per liter	Organic carbon, water, filtered, milligrams per liter	Alkalinity, water, filtered, inflection, milligrams per liter as calcium carbonate	Boron, water, filtered, micrograms per liter	Iron, water, filtered, micrograms per liter	Manganese, water, filtered, micrograms per liter	Total coliforms, M	Fecal coliforms, M	
Applicable Water Quality Objective or Standard	NS	NS	6.5-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	250	2	NS	NS	45	1	NS	NS	NS	NS	NS	250	500	NS	NS	>20	NS	300	50	NS	200	
Station 11208730 EF Kaweah R nr Three Rivers CA																														
7/25/1968	18	3.4	7.5	98	52	8.4	0	15	1	0.1	41	1	0.8	0.181	0		1.1	12	3	5	65					0	0			
8/2/1968	20.6	3.8																				1								
8/26/1968	27.2	0.4																				1								
8/26/1968	16	16																				1								
8/26/1968	16	16	7.7	111	60	8.9	1.2	17	0.7	0.1	48	1.2	0.2	0.045	0.03		1.2	12	3.9	5	71				60	10		400		
9/30/1968	12.6	0.68																				1								
9/30/1968	15	10	7.5	121	66	9.9	0.01	18	1.3	0	50	1.3	0.7	0.158	0.07		1.6	13	5	6	80				0	0		88		
10/31/1968	10	20	7.7	102	56	9		14	1.5	0.1	40	1.3	0.3	0.068			1.1	15	4.7	3	69	2			0	10		210		
12/11/1968	5	31																				9								
1/14/1969	6	88	7.3	58	32	12.2	0.01	7.3	0.6	0.2	20	0.5	0.1	0.023	0.07		0.9	14	3.4	3	46	14			30	40		14		
1/20/1969	6	433																				50								
5/1/1969	7	516																				24								
5/29/1969	10	1170	6.6	33	16	12.3	0	4.6	0.3	0	13	0.4	0.2	0.045	0.03		0.6	7.7	1.3	2	25	83			40	20				
6/19/1969	12	745	6.8	35	17	11.5	0.03	4.5	0.5	0.1	12	0.4	0.1	0.023	0.04		0.5	9.3	1.4	2	27	14			20	20		14		
7/30/1969	18	266	6.5	46	24	10.2	0.04	6.5	0.4	0	18	0.5	0		0		0.6	9.1	1.2	1	31	2			0	30		20		
8/26/1969	15	79	7.4	73	37	8.9	0.04	10	0.4	0	28	0.8	0.1	0.023	0.03		0.8	13	2.6	3	49	2			0	10		18		
10/15/1969	10	38																				1								
10/15/1969	8.5	38	7.8	90	48	11.9	0.03	12	1.3	0.1	34	1	0.1	0.023	0.07		1	17	4	3	63				0	20				
12/9/1969	3.5	28	7.5	93	47		0	12	1.4	0.1	34	1.1	0.1	0.023	0.06		1	18	4.9	3	65				30	40		17		
1/19/1970	6	181	6.9	54	28		0.03	6.5	0.8	0.2	20	0.8	0.2	0.045	0.05		0.9	15	3.2	2	43	6			0	40		10		
3/10/1970	4	101	7.9	73	38	11.9	0	8.4	1.6	0	28	1.8	0		0.08		1	20	4.4	3	60	1			0	60		14		
4/22/1970	3	104	7.5	67	34	12.7	0	9.4	0.6	0	26	0.7	0		0.06		0.7	14	3.1	2	48	3			0	10		10		
5/18/1970	7	615																				19								
5/18/1970	9.5	532	6.6	38	18	10.5	0	5.8	0.4	0	16	0.3	0.2	0.045	0.06		0.5	6.6	1.2	4	28				70	0		180		
7/1/1970	14	118	7.1	59	28		0.04	8.7	0.4	0.2	24	0.5	0		0.12		0.6	8.7	2	3	38	1			0	40				

Sample Date	Temperature (deg C)	Discharge, cubic feet per second	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field,	Dissolved oxygen, water, unfiltered, milligrams per liter	General Parameters																	Trace Elements			Bacteria									
							Ammonia, water, filtered, milligrams per liter as NH4	Calcium, water, filtered, milligrams per liter	Chloride, water, filtered, milligrams per liter	Fluoride, water, filtered, milligrams per liter	Hardness, water, milligrams per liter as calcium carbonate	Magnesium, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Orthophosphate, water, filtered, milligrams per liter	Phosphorus, water, filtered, milligrams per liter as phosphorus	Potassium, water, filtered, milligrams per liter	Silica, water, filtered, milligrams per liter as SiO2	Sodium, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Dissolved solids, water, filtered, sum of constituents, milligrams per liter	Suspended sediment concentration, milligrams per liter	Organic carbon, water, filtered, milligrams per liter	Alkalinity, water, filtered, inflection, milligrams per liter as calcium carbonate	Boron, water, filtered, micrograms per liter	Iron, water, filtered, micrograms per liter	Manganese, water, filtered, micrograms per liter	Total coliforms, M	Fecal coliforms, M							
Applicable Water Quality Objective or Standard	NS	NS	6.5-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	250	2	NS	NS	45	1	NS	NS	NS	NS	NS	NS	250	500	NS	NS	>20	NS	300	50	NS	200						
8/4/1970	19	33	7.1	91	46	8.7	0.04	13	0.7	0.2	36	0.9	0		0.14		1	12	3.2	4	58	2														
8/28/1970	19.5	21	7.2	111	59	9.2	0.04	16	1	0	45	1.2	0		0		1.1	13	4.5	3	69															
8/28/1970	19.5	21																				1														
9/22/1970	14.5	15																				0								400						
9/22/1970	14	15	7.3	114	61	9.5	0.06	16	1.1	0.1	45	1.2	0.3	0.068	0.03		1.3	12	4.5	5	71															
11/2/1970	9	15	7.6	117	62	10.9	0	17	1.8	0.2	47	1.1	0	0	0.05		1.2	16	5	4	77															
11/2/1970	9	16																				0														
12/14/1970	3	30	7.4	90	44	12.7	0.01	10	1.2	0.2	30	1.1	0.1	0.02	0.12		1	17	4.4	3	60															
12/14/1970	3	30																				0														
12/14/1970	3	30																																		
12/18/1970	1.5	30																				2														
2/2/1971	4	53	7.4	79	40		0.15	11	1	0.2	28		0	0	0.01		0.9	16	4.1	3	56	2														
3/17/1971	4	57	7.3	76	40	12	0.06	11	1.3	0	32	1	0		0.03		1.4	18	4.5	3.5	61															
3/17/1971	4	57																				2														
5/3/1971	7	170																				2														
5/4/1971	5.5	154	7.3	60	36	11.9	0.17	8.9	1.2	0	26	1			0		0.7	13	2.5	2	48															
6/22/1971	16	300	7.8		27	9.6	0	6.1	2.5	0	17	0.4			0		0.5	7.8	4.3	2.5	38															
6/22/1971	16	300																				9														
7/21/1971	18.5	65	8	70	44	8.5	0.1	11	0.4	0.2	30	0.7			0		0.7	11	2.4	3	51															
7/21/1971	18.5	65																				5														
9/22/1971	15.5	15	7.7	119	67	9.3	0.13	17	1.4	0.4	46	0.8			0.09		1.2	14	4.5	3.5	76															
9/22/1971	14.5	15																				3														
Station 11209900 Kaweah R a Three Rivers CA																																				
11/4/1963		81	7.8	121	63				5.8		47																									
8/10/1977	27	20	8	115		8.4																														
9/27/1977	18	19	7.1	132		9.5																														

Sample Date	Temperature (deg C)	Discharge, cubic feet per second	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field,	Dissolved oxygen, water, unfiltered, milligrams per liter	General Parameters																	Trace Elements			Bacteria				
							Ammonia, water, filtered, milligrams per liter as NH4	Calcium, water, filtered, milligrams per liter	Chloride, water, filtered, milligrams per liter	Fluoride, water, filtered, milligrams per liter	Hardness, water, milligrams per liter as calcium carbonate	Magnesium, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Orthophosphate, water, filtered, milligrams per liter	Phosphorus, water, filtered, milligrams per liter as phosphorus	Potassium, water, filtered, milligrams per liter	Silica, water, filtered, milligrams per liter as SiO2	Sodium, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Dissolved solids, water, filtered, sum of constituents, milligrams per liter	Suspended sediment concentration, milligrams per liter	Organic carbon, water, filtered, milligrams per liter	Alkalinity, water, filtered, inflection, milligrams per liter as calcium carbonate	Boron, water, filtered, micrograms per liter	Iron, water, filtered, micrograms per liter	Manganese, water, filtered, micrograms per liter	Total coliforms, M	Fecal coliforms, M		
Applicable Water Quality Objective or Standard	NS	NS	6.5-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	250	2	NS	NS	45	1	NS	NS	NS	NS	NS	NS	250	500	NS	NS	>20	NS	300	50	NS	200	
Station 11208620 EF Kaweah R bl Mosquito C nr Hammond CA																															
7/26/1968	10	14	7.5	135	74	8.5	0.09	24	0.6	0.1	64	1.1	1	0.226	0.04		0.5	7.3	1.6	7	79					0	0				
8/2/1968	10	10																					1								
8/27/1968	12	9.6	7.7	152	80	7.9	0	27	0.8	0.1	73	1.3	0.1	0.023	0.01		0.7	8.3	2.1	11	90	10			40	10		24			
10/1/1968	7	4.4	7.8	182	104	9.8		31	0.8	0.1	85	1.8	0.8	0.181			0.9	27	2.8	8	124	6			0	0		4			
10/15/1968	8	8																				1									
10/29/1968	6	5.4																				1									
12/7/1968	2	7.4																				2									
1/18/1969	2	10																				1									
3/25/1969	4	17																				11									
4/22/1969	4	96																				24									
5/21/1969	5	280																				32									
6/18/1969	7	205																				9									
7/29/1969	10	116																				3									
8/25/1969	15	41																				2									
10/14/1969	5	9.4	7.9	149	84	10.8	0.01	27	0.6	0.2	73	1.3	0		0		0.6	8.8	2	6	88	2			0	20					
12/8/1969	1	8.9	7.9	168	92		0	30	0.8	0.1	82	1.6	0.1	0.023	0.04		0.7	9.2	2.4	7	97	2			30	10					
1/20/1970	4	23	7.4	126	70		0.09	22	0.5	0.2	60	1.2	0.5	0.113	0.02		0.8	8	1.8	7	76	3			0	10		5			
3/11/1970	2	12	7.7	145	78	10.3	0	25	1.2	0	68	1.3	0.1	0.023	0.06		0.7	9.3	2.2	9	87	1			0	50		2			
4/28/1970	1	31	7.9	123	68	10.9	0.01	22	0.4	0	59	1	0		0.19		0.5	7.9	1.8	5	72	2			0	10		1			
5/20/1970	5	144	6.9	68	32	9.8	0	12	0.6	0	32	0.4	0.7	0.158	0.1		0.4	5	1	5	41				30	0		2			
5/20/1970	5	140																				10									
6/30/1970	6	62	7.6	77	38		0.04	13	0.4	0.2	35	0.6	0.2	0.045	0.07		0.4	5	1.1	5	45				0	20		8	2		
6/30/1970	6	60																				0									
8/3/1970	13	18	7.2	124	65	8.6	0.01	21	0.3	0.2	56	1	0.1	0.023	0.01		0.6	7.3	1.7	6	70	1			70	0		56			
8/28/1970	12.5	9.9	7.4	150	83			26	0.6	0.1	70	1.3					0.7	9.6	2.2	5	87	1			90	10					
8/29/1970	12			150			0.01							0.2	0.045	0												118	13		

Sample Date	Temperature (deg C)	Discharge, cubic feet per second	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field,	Dissolved oxygen, water, unfiltered, milligrams per liter	General Parameters																		Trace Elements			Bacteria			
							Ammonia, water, filtered, milligrams per liter as NH4	Calcium, water, filtered, milligrams per liter	Chloride, water, filtered, milligrams per liter	Fluoride, water, filtered, milligrams per liter	Hardness, water, milligrams per liter as calcium carbonate	Magnesium, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Orthophosphate, water, filtered, milligrams per liter	Phosphorus, water, filtered, milligrams per liter as phosphorus	Potassium, water, filtered, milligrams per liter	Silica, water, filtered, milligrams per liter as SiO2	Sodium, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Dissolved solids, water, filtered, sum of constituents, milligrams per liter	Suspended sediment concentration, milligrams per liter	Organic carbon, water, filtered, milligrams per liter	Alkalinity, water, filtered, inflection, milligrams per liter as calcium carbonate	Boron, water, filtered, micrograms per liter	Iron, water, filtered, micrograms per liter	Manganese, water, filtered, micrograms per liter	Total coliforms, M	Fecal coliforms, M		
Applicable Water Quality Objective or Standard	NS	NS	6.5-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	250	2	NS	NS	45	1	NS	NS	NS	NS	NS	NS	250	500	NS	NS	>20	NS	300	50	NS	200	
8/29/1970	13		8.3	152			0.22						0.1	0.023	0															13	1
8/29/1970	14.5		8	151		7.8	0.18						0		0															111	3
8/30/1970	12.5		8.3	154		8.8	0						0.2	0.045	0.12															107	10
8/30/1970	12.5		8.3	152		8.2	0						0.1	0.023	0															50	1
8/30/1970	14.5		8.3	156		7.6	0						0.8	0.181	0.17															73	1
8/31/1970	11.5			156			0						0.2	0.045	1.3															98	9
8/31/1970	11.5			153			0						0.2	0.045	0															121	3
9/21/1970	11	5.6	7.6	197	112	8.6	0	36	0.7	0.1	96	1.6	0.1	0.023	0.01		0.8	7.5	2.4	8	112							50	0	140	
9/21/1970	11	5.6																				1									
11/2/1970	5.5	5.4	8	190	104	10.2	0.03	33	1	0	90	1.7	0.1	0.02	0.03		0.8	9.7	2.8	8	108	0					0	0	15		
12/29/1970	0.5	7.7	7.6	163	88	10.2	0	26	0.6	0.1	71	1.5	0.2	0.05	0.01		0.7	8.7	2.5	8	91						140	0	6		
12/29/1970	0.5	7.7																													
2/1/1971	4	13	7.7	141	72	11.2	0.13	25	0.8	0.1	62		0.4	0.09	0.01		0.6	8.2	2.6	7	79						90	0			
2/1/1971	4	13																				1									
3/16/1971	5	22	7.6	133	68	9.7	0.15	25	0.7	0	68	1.4	0.885	0.2	0		0.9	9.5	2.4	6.3	81					0	20	8			
3/16/1971	5.5	22																				1									
5/11/1971	7	43	8.3	116	70	9.6	0.17	20	0.9	0	56	1.5			0.03		0.7	8.8	1.6	6	75					0	20	24			
5/11/1971	7	43																				1									
6/24/1971	8	86	7.8	65	31	9.6	0	11	2	0	30	0.5			0.03		0.4	5.2	0.8	4.5	40					10	10				
6/24/1971	8	86																				9									
7/7/1971	8		7.2	85	39	9.1	0.08								0.03																
8/9/1971	14.5		6.7	135	58	8	0.14								0.15																
9/7/1971	8		7.1	130	76	9	0.01								0.06																
9/21/1971	8	6.7																				2									
9/28/1971	4.5		7.4	185	85	9.7	0.03								0.03																
10/27/1971	5.5		7	170	84	9.7																									
10/27/1971	5.5						0.17								0.15																

Sample Date	Temperature (deg C)	Discharge, cubic feet per second	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field,	Dissolved oxygen, water, unfiltered, milligrams per liter	General Parameters																			Trace Elements			Bacteria	
							Ammonia, water, filtered, milligrams per liter as NH4	Calcium, water, filtered, milligrams per liter	Chloride, water, filtered, milligrams per liter	Fluoride, water, filtered, milligrams per liter	Hardness, water, milligrams per liter as calcium carbonate	Magnesium, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Orthophosphate, water, filtered, milligrams per liter	Phosphorus, water, filtered, milligrams per liter as phosphorus	Potassium, water, filtered, milligrams per liter	Silica, water, filtered, milligrams per liter as SiO2	Sodium, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Dissolved solids, water, filtered, sum of constituents, milligrams per liter	Suspended sediment concentration, milligrams per liter	Organic carbon, water, filtered, milligrams per liter	Alkalinity, water, filtered, inflection, milligrams per liter as calcium carbonate	Boron, water, filtered, micrograms per liter	Iron, water, filtered, micrograms per liter	Manganese, water, filtered, micrograms per liter	Total coliforms, M	Fecal coliforms, M	
Applicable Water Quality Objective or Standard	NS	NS	6.5-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	250	2	NS	NS	45	1	NS	NS	NS	NS	NS	NS	250	500	NS	NS	>20	NS	300	50	NS	200
1/5/1972	0		7.4	175	80	11.2																								
1/5/1972	0						0.05							0																
3/1/1972	2		7.4	150	72	11					72																			
3/1/1972	2						0.1							0.03																
5/1/1972	7		7.1	88	42	8.7					46																			
5/1/1972	7						0.01							0																
6/21/1972	7.5	20	6.2	95	41	9.5					45																			
6/21/1972	7.5		8.1	95	53		0.13	16	0.4	0	43	0.8		0		0.3	6	0.9	5.3	56					20	30				
7/25/1972	15		6.8	150	68	7.9					74																			
7/25/1972	15						0.06							0.03																
9/6/1972	13		8.2	125	64	8.6					62																			
9/6/1972	13						1.7							0.03																
10/17/1972	7		7.7	180	90	10					90																			
10/17/1972	7						0.05							0																
5/8/1973	5													0																
6/19/1973														0																
9/24/1973	10													0.09																
Station 11208625 EF Kaweah R a Seq Natl P Bndry nr Hammond CA																														
8/2/1968	14	10																				1								
8/27/1968	15	6.9	7.7	138	74	8.7	0	24	0.3	0.1	65	1.2	0.1	0.023	0		0.7	9.5	2.4	7	81	1			40	10		60		
10/1/1968	8	5.7	7.7	162	90	9.9	0	26	0.8	0.1	72	1.6	0.7	0.158	0.05		1	11	3.3	7	96	2			20	0		44		
10/29/1968	6	6.5																				1								
10/29/1968	6.2	6.4	7.9	169	98	10.7	0.02	30	0.8	0.1	82	1.6	0.3	0.068	0.08		0.8	11	3.3	5	101				0	0		27		
3/26/1969	2	30																				14								
5/29/1969	9	528	6.8	49	23	11.4	0.05	8.2	0.3	0	22	0.4	0.4	0.09	0.03		0.5	5.4	0.9	3	30	88			10	10		1		
7/30/1969	10	155	6.5	56	28	10.8	0.04	9.1	0.2	0.1	24	0.5	0.1	0.023	0		0.4	5.4	0.5	3	33	4			0	20		7		
8/25/1969	13	39																				4								

Sample Date	Temperature (deg C)	Discharge, cubic feet per second	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field,	Dissolved oxygen, water, unfiltered, milligrams per liter	General Parameters																		Trace Elements			Bacteria		
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Applicable Water Quality Objective or Standard	NS	NS	6.5-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	250	2	NS	NS	45	1	NS	NS	NS	NS	NS	NS	250	500	NS	NS	>20	NS	300	50	NS	200
8/25/1969	13	40	7.5	85	44	9.9	0.04	14	0.2	0	38	0.8	0.1	0.023	0.04		0.5	7.2	1.3	4	50					0	0		26	
10/15/1969	5	13	7.9	125	70	11.7	0.05	22	0.7	0.1	60	1.2	0.1	0.023	0.56		0.7	10	2.3	5	76	2				0	20			
12/8/1969	1	9.2	7.6	138	74	12.5	0	23	0.8	0.1	64	1.4	0.1	0.023	0.05		0.8	11	2.8	6	82	1				10	40		2	
1/19/1970	3	39	7.1	86	43			14	1.8	0.2	38	0.9	0				0.7	9.7	2	5	55	7				0	20		7	
3/9/1970	2	22	7.5	112	62	11.1	0.18	19	1.2	0	52	1	0		0.45		0.8	11	2.4	6	73	1				0	40		2	
4/21/1970	1	39	7.6	97	50		0	16	0.4	0	44	0.8	0.3	0.068	0.02		0.5	10	2	5	60	1				0	10		1	
5/19/1970	8	232	6.8	57	26	10.2	0	9.9	0.3	0	26	0.4	0.5	0.113	0.05		0.4	5.7	1	4	35	13				0	10		3	
6/29/1970	11	69																				0								
6/29/1970	11	67	7	69	34		0.04	12	0.4	0.2	32	0.5	0.2	0.045	0.07		0.4	6.2	1.2	4	42					0	20			
8/4/1970	12	20	7.5	113	60		0.01	19	0.4	0.1	52	1	0.2	0.045	0		0.7	8.6	1.9	5	67	1				80	0		74	
8/29/1970	12	12	7.1	135	74		0.04	23	0.6	0.1	62	1.2	0		0		0.8	10	2.3	5	79	0				40	10		22	
9/22/1970	8	7.2	7.9	147	82	10	0.03	25	0.7	0	68	1.4	0		0.01		0.8	8.3	2.7	6	85					50	0		100	
9/22/1970	8	9.2																				1								
11/2/1970	5	7.4	7.8	164	88	10.9	0.06	28	1	0.2	76	1.5	0.1	0.02	0.03		0.8	11	3	7	96	0				0	0		13	
12/15/1970	1	12																												
12/15/1970	1	12	7.5	136	72	12.2	0.04	21	0.6	0.1	58	1.3	0.3	0.07	0.01		0.7	11	2.5	7	79					120	20		25	
12/15/1970	1	12																				0								
2/2/1971	2	22	7.5	109	56	13.1	0.13	19	0.8	0.2	48		0.3	0.07	0.01		0.8	10	2.6	5	66					110	10			
2/2/1971	2	22																				2								
4/2/1971	3	45	7.8	100	56	11.9	0.1	17	0.8	0	46	0.9	0.885	0.2	0		0.9	10	2.2	4.3	65	2				10	20		2	
5/12/1971	5	60	7.7	90	51	10.9	0.23	15	1	0	42	1.2			0		0.6	10	1.6	3.8	59	1				10	20		16	
6/24/1971	14	118	8	60	31	9.3	0	9.3	1.5	0	26	0.7			0		0.4	6	1	5.8	40					0	20		0	
6/24/1971	14	118																				8								
7/20/1971	13.5	36																				2								
7/20/1971	13.5	36	8.4	84	53	8.9	0.06	14	0.9	0.3	38	0.7			0.03		0.1	7.9	1.4	1.3	53					10	10		180	
9/21/1971	9	8.4	7.8	152	89	9.6	0.17	26	1.1	0.3	69	1			0.09		0.7	11	2.7	5.5	93					30	10		4300	
9/21/1971	9	8.4																				1								

Sample Date	Temperature (deg C)	Discharge, cubic feet per second	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field,	Dissolved oxygen, water, unfiltered, milligrams per liter	General Parameters																	Trace Elements			Bacteria			
							Ammonia, water, filtered, milligrams per liter as NH4	Calcium, water, filtered, milligrams per liter	Chloride, water, filtered, milligrams per liter	Fluoride, water, filtered, milligrams per liter	Hardness, water, milligrams per liter as calcium carbonate	Magnesium, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Orthophosphate, water, filtered, milligrams per liter	Phosphorus, water, filtered, milligrams per liter as phosphorus	Potassium, water, filtered, milligrams per liter	Silica, water, filtered, milligrams per liter as SiO2	Sodium, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Dissolved solids, water, filtered, sum of constituents, milligrams per liter	Suspended sediment concentration, milligrams per liter	Organic carbon, water, filtered, milligrams per liter	Alkalinity, water, filtered, inflection, milligrams per liter as calcium carbonate	Boron, water, filtered, micrograms per liter	Iron, water, filtered, micrograms per liter	Manganese, water, filtered, micrograms per liter	Total coliforms, M	Fecal coliforms, M	
Applicable Water Quality Objective or Standard	NS	NS	6.5-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	250	2	NS	NS	45	1	NS	NS	NS	NS	NS	250	500	NS	NS	>20	NS	300	50	NS	200	
Station 11209500 NF Kaweah R a Kaweah CA																														
6/12/1980	12.8		7.2	46		9.9		6.2	0.5	0	19	0.9				0.011	0.7	13	2.4	0.2	39					0	30	M		
7/10/1980	17		7.6	89		9		13	1	0.2	39	1.7				0.005	1	19	4	1.1	66						50	M		
8/6/1980	23.5	37	8	121		7.6		16	1.5	0.2	49	2.1				0.014	1.2	21	4.8	1.1	85						20	M		
9/10/1980	23	27	8.1	157		7.7		19	3.4	0.1	58	2.5				0.002	1.5	21	5.2	7.3	95						10	M		
10/8/1980	20.9	14	8.1	151		8.2		22	2.8	0.1	68	3.1				0.007	1.9	21	5.8	2.6	108						80	M		
Station 11206500 MF Kaweah R nr Potwish Camp (river flow only) CA																														
6/12/1980	11.5	700	7.3	18		10.6		2.1	0.3	0	7	0.4				0.01	0.4	6.2	1	0.5	16				M	10	M			
7/10/1980	12.5	435	7.3	19		10		2.1	0.2	0.1	7	0.4				0.003	0.4	6.1	1.3	1.4	18						20	M		
8/6/1980	17.5	155	7.1	23		9		2.4	0.3	0.3	7	0.3				0.01	0.5	6.4	1.3	0.3	17						< 10	M		
9/11/1980	14	6.6	7	48		8.9		4.8	0.9	0.1	14	0.6				0.001	1.1	12	2.7	6.1	38						< 10	M		
10/8/1980	13.6	28	7.1	60		9.3		6.4	1.5	0.1	20	1				0	1.2	14	3.8	0.8	47						10	M		
Station 11206820 Marble Fork Kaweah R ab Horse C nr Lodgepole CA																														
12/20/2012			6.9					1.17	0.35		3.34	0.099				0.234	4.53	0.83	0.62	10			1.33	3						
1/17/2013	1.7		6.9					0.988	0.21		2.81	0.084				0.194	4.43	0.86	0.58	9			0.95	3						
2/14/2013	1.5		6.8					0.926	0.15		2.65	0.081				0.195	4.5	0.7	0.57	9			1.05	3						
3/13/2013			6.8					0.772	0.11		2.19	0.063				0.179	4.2	0.51	0.42	8			1.45	2.7						
4/3/2013	5		6.8					0.753	0.09		2.14	0.063				0.167	3.89	0.54	0.34	8			1.26	2.5						
4/18/2013	2		6.7					0.698	0.08		1.99	0.061				0.156	3.6	0.46	0.33	7			1.23	2.4						
5/2/2013	9		6.5					0.579	0.06		1.66	0.051				0.14	2.74	0.37	0.25	6			1.04	1.8						
5/9/2013	6		6.6					0.666	0.08		1.91	0.059				0.147	3.23	0.46	0.26	6			1.28	2.3						
5/16/2013	3		6.6					0.531	0.06		1.52	0.048				0.124	2.55	0.36	0.24	5			0.92	1.9						
5/22/2013			6.6					0.564	0.05		1.61	0.05				0.124	2.72	0.35	0.23	5			0.82	2						
6/6/2013	11		6.6					0.647	0.04		1.84	0.054				0.138	2.73	0.38	0.27	6			0.69	2.5						
6/20/2013	12		6.8					1.3	0.06		3.81	0.139				0.186	3.76	0.68	0.39	9			0.69	3.6						
7/11/2013			6.7					1.57	0.14		4.45	0.13				0.277	5.27	1.04	0.49	13			0.53	6						

Sample Date	Temperature (deg C)	Discharge, cubic feet per second	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field,	Dissolved oxygen, water, unfiltered, milligrams per liter	General Parameters																			Trace Elements			Bacteria			
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Applicable Water Quality Objective or Standard	NS	NS	6.5-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	250	2	NS	NS	45	1	NS	NS	NS	NS	NS	250	500	NS	NS	>20	NS	300	50	NS	200			
7/29/2013	14.5		7.1					1.83	0.17			5.17	0.149					0.358	5.96	1.16	0.67	15		0.59	6.9							
8/22/2013	12		7.3					2.35	0.21			6.64	0.19					0.454	6.88	1.7	0.84	18		0.53	8.7							
9/10/2013	11		7.2					2.29	0.2			6.45	0.18					0.443	7.26	1.63	0.91	19		0.58	9.3							
10/22/2013	4		7.1					2.17	0.34			6.12	0.174					0.449	6.66	1.58	0.87	18		0.62	8.5							
11/19/2013	3		6.9					2.23	0.48			6.31	0.18					0.409	6.07	1.52	0.88	17		0.23	7.4							
12/17/2013	5		6.8					1.95	0.57			5.52	0.158					0.376	5.14	1.3	0.89	16		0.49	5.6							
1/16/2014			6.8					1.94	0.38			5.51	0.162					0.329	6.02	1.45	0.91	16		0.37	6.9							
2/11/2014	1		6.5					1.18	0.32			3.35	0.096					0.224	4.93	1.03	0.94	11		1.3	2.6							
3/11/2014	8		6.9					1	0.23			2.82	0.077					0.23	5.02	0.81	0.61	10		1.68	2.7							
4/1/2014	0		6.1					0.782	0.16			2.22	0.065					0.168	4.14	0.65	0.49	8		1.41	2.5							
4/15/2014	6		6.4					0.64	0.13			1.8	0.049					0.175	3.46	0.48	0.37	7		1.6	2							
5/1/2014	9		6.6					0.576	0.09			1.64	0.05					0.161	3.31	0.44	0.31	6		1.39	2							
5/7/2014	5		6.2					0.566	0.1			1.62	0.051					0.136	3.06	0.4	0.3	6		1.34	2							
5/13/2014	9		6.3					0.531	0.12			1.51	0.045					0.133	2.87	0.36	0.29	5		1.31	1.6							
5/22/2014			6.8					0.562	0.1			1.61	0.049					0.131	2.78	0.38	0.27	6		1.61	2.2							
6/3/2014	9		6.3					0.604	0.1			1.71	0.049					0.136	2.54	0.37	0.26	5		1.02	2.1							
6/23/2014	12		6.4					1	0.13			2.81	0.075					0.178	4.02	0.69	0.41	9		0.52	3.7							
7/17/2014	15.5		7.1					1.59	0.15			4.47	0.123					0.314	5.25	1.06	0.66	13		0.44	6.3							
7/29/2014	10		6.9					1.86	0.19			5.24	0.146					0.369	5.7	1.25	0.71	15		0.46	7.1							
8/20/2014																																
8/21/2014	12		7.1					2.1	0.24			5.92	0.164					0.36	5.37	1.43	0.74	15		0.6	7.6							
9/10/2014	10		7.1					2.41	0.27			6.83	0.198					0.461	7.18	1.84	1	18		0.63	7.2							
10/14/2014	7							2.36	0.33			6.71	0.199					0.469	7.21	1.76	1.02			0.23								
11/13/2014	6							1.7	0.45			4.78	0.131					0.313	5.07	1.11	0.69			1.39								
12/13/2014	0.5							1.05	0.41			2.96	0.083					0.206	4.58	0.84	0.66			1.5								
1/13/2015	1							1.08	0.24			3.06	0.088					0.198	5.1	0.87	0.62			0.93								
2/17/2015																								1.52								

Sample Date	Temperature (deg C)	Discharge, cubic feet per second	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per	Bicarbonate, water, unfiltered, fixed endpoint (pH 4.5) titration, field,	Dissolved oxygen, water, unfiltered, milligrams per liter	General Parameters																	Trace Elements			Bacteria			
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Applicable Water Quality Objective or Standard	NS	NS	6.5-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	250	2	NS	NS	45	1	NS	NS	NS	NS	NS	250	500	NS	NS	>20	NS	300	50	NS	200	
3/17/2015	5							0.76	0.11		2.14	0.059					0.153	3.93	0.72	0.35										
3/31/2015	7																													
6/12/1980	10	445	7.2	15		10.8		2	0.7	0	7	0.4				0.006	0.4	6.3	1.1	1	17				M	20				
Station 11208000 Marble F Kaweah R (R only) a Potwisha Camp CA																														
7/10/1980	10.5	243	7.1	19		10.1		1.9	0.1	0.1	6	0.4				0	0.3	5.7	1	0.9	16					20	M			
8/6/1980	17	65	7.2	30		8.6		3.2	0.5	0.2	10	0.6				0.01	0.4	6.6	1.1	2	20					10	M			
9/10/1980	15	1.6	7.5	68		9.1		8.6	0.6	0.1	28	1.7				0.001	1	14	2.4	3.3	47					< 10	M			
10/8/1980	15.2		7.6	109		9.3		13	0.7	0	44	2.8				0	1.2	17	3.2	0.8	71					< 10	M			

Measurements that exceed the applicable water quality objective or standard are highlighted in green.

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Table 7.3-A2. Water Quality Data Collected by the California Environmental Data Exchange Network (CEDEN) in the Vicinity of the Kaweah Project.

Station ID	Activity Start	Temperature, deg C	pH	Specific Conductance, uS/cm	Dissolved Oxygen, µg/l	General Parameters			Bacteria		
						Ammonia as N, mg/l	Kjeldahl nitrogen, mg/L	Secchi Depth, m	E. coli, MPN/100ml	Fecal Coliform, MPN/100 ml	Total Coliform, MPN/100 ml
Applicable Water Quality Objective or Standard		NS	6.5-8.5	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	1.5	NS	NS	NS	200	NS
Kaweah River - Ash Mountain											
245006	4/16/2002 13:47	7.8							2	2	110
245006	6/11/2002 11:30	13.4	8.3	21.5	10.65				8		50
245006	9/9/2002 12:50	20.3	8.3	91.7	9.09	0.0234					
245006	12/17/2002 11:25	5.8	8.6	38.7	10.2	ND	0.17				
245006	3/25/2003 12:00	9.6	8	43.3	11.28	0.0044	0.12				
Kaweah River - Dinely Rd.											
245619	4/16/2002 13:19	8.3	7.8	35.9	11.4				30	2	
245619	6/11/2002 12:00	15.2	8.3	31.5	10.6				4	4	50
245619	9/9/2002 12:15	19.8	8.3	107.4	8.56	0.0052	0.15				
245619	12/17/2002 12:00	7.5	8.6	46	10.09	0.0053	0.37				
245619	3/25/2003 12:21	30	8.2	53	11.1	0.0096	0.11				
Kaweah River - North Fork											
247159	4/16/2002 12:54	9.1	8	38	11.54				23	23	70
247159	6/11/2002 12:25	16.2		34.7	10.52				4	4	22
247159	9/9/2002 11:50	20.6	8.3	112.1	9.25	0.0041	0.14		4	13	30
247159	12/17/2002 13:00					0.011	0.3				
247159	12/17/2002 13:00	12.9	8.3	58.7	10.7	0.0216	0.12		13	50	80

NS: No standard; ND: no detection

Measurements that exceed the applicable water quality objective or standard are highlighted in green.

Table 7.3-A3. Water Quality Data Collected by the Department of Water Resources in the Vicinity of the Kaweah Project.

Station ID	Activity Start	General Parameters		
		pH	Temperature, water, deg C	Specific conductance, $\mu\text{S}/\text{cm}$
Applicable Water Quality Objective or Standard		6.8-8.5	NS	NS
KAWEAH R A THREE RIVERS				
C2125000	5/6/1998 14:45	7.2	10	62
C2125000	5/14/2003 10:30	7.3	12	47
C2125000	10/22/2003 10:15	7.9	17	135
KAWEAH R AB LK KAWEAH				
C2121030	5/6/1998 12:00	7.5	18	105
C2121030	5/14/2003 12:00	7.2	14	59
C2121030	10/22/2003 14:15	8.1	20	143
KAWEAH R MF BL NO 2 IT NR THREE R				
C2314700	5/6/1998 14:00	7	10	53
C2314700	5/13/2003 15:30	7.3	13	45
C2314700	10/22/2003 8:15	7.5	16	117
KAWEAH R SF AB GROUSE C				
C2420150	5/6/1998 13:15	7.2	10	66
C2420150	5/14/2003 9:00	7.3	9	52
C2420150	10/22/2003 11:30	7.9	16	180
KAWEAH R,NF,NR MOUTH				
C2201030	5/6/1998 15:30	7.7	0.1	84
C2201030	5/13/2003 16:30	7.6	16	71
C2201030	10/22/2003 9:30	7.6	16	193

NS: No standard

Measurements that exceed the applicable water quality objective or standard are highlighted in green.

Table 7.3-A4. Water Quality Data Collected by the National Park Service Water Resources Division in the Vicinity of the Kaweah Project and in the Kaweah Watershed.

Station ID	Visit Start	Temperature, air, deg C	Temperature, water, deg C	pH	Specific conductance, umho/cm	Bicarbonate, mg/l	Dissolved oxygen (DO), mg/l	General Parameters																Trace Elements												Bacteria						
								Ammonia as NH3	Calcium, mg/l	Carbonate, mg/l	Chloride, mg/l	Fluoride, mg/l	Hardness, Ca + Mg, mg/l	Kjeldahl nitrogen, mg/l	Magnesium, mg/l	Nitrite as N, mg/l	Orthophosphate as PO4, mg/l	Potassium, mg/l	Silica, mg/l	Sodium, mg/l	Sulfur, sulfate (SO4) as SO4, mg/l	Turbidity, FTU	Alkalinity, Total (total hydroxide+carbonate+bicarbonate), mg/l	Aluminum, ug/l	Antimony, ug/l	Arsenic, ug/l	Beryllium, ug/l	Cadmium, ug/l	Chromium, ug/l	Copper, ug/l	Iron, mg/l	Lead, ug/l	Manganese, ug/l	Mercury, ug/l	Nickel, ug/l	Thallium, ug/l	Zinc, ug/l	Fecal Coliform, cfu/100ml	Fecal Streptococcus Group Bacteria, cfu/100ml	Total Coliform, cfu/100ml		
Applicable Water Quality Objective or Standard		NS	NS	6.8-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	0.025	NS	>20	250	2	NS	NS	NS	1	NS	NS	NS	NS	250	Narr	>20	0.2	5.6	10	4	5	50	1	0.3	15	50	0.05	100	0.24	5	200	NS	NS		
EAST FORK AT ATWELL TRAIL CROSSING																																										
SEQU_HW_014	6/29/1981 0:00	22.6	13.9		73				38		ND	36		0.84		ND	0.52	8	1.44	ND	ND	38																				
SEQU_HW_014	7/27/1981 0:00	27.7	15.2	8.13	92				53.5		ND	57		1.3			0.7		2.15	4	ND	58																				
SEQU_HW_014	8/11/1981 0:00	27	18.5	8.28	125				72		ND	65		1.52		0.025	0.83	9.45	2.42	5	ND	67							0.006													
SEQU_HW_014	8/19/1981 0:00				69																																					
SEQU_HW_014	5/19/1982 12:00	13.5	4.9	8.4	43				27		ND					ND		8.6		1	1	29																				
SEQU_HW_014	6/26/1982 0:00	18.9	12.6	8.59	40				18		0.5					0.008				ND	1.2	31																				
SEQU_HW_014	7/20/1982 12:00	16.8	10.1	8.3	43											0.013					0.62	20															3	1				
SEQU_HW_014	8/19/1982 0:00		10.9		69											0.017					1.15	40														40	6	0				
SEQU_HW_014	8/18/1983 12:00		10		41											0.01					2.6														50	0						
SEQU_HW_014	10/11/1983 0:00		5		72											0.017					0.72														2	0						
EAST FORK AT KAWEAH HAN																																										
SEQU_HW_095	6/28/1983 0:00		7.8		35											0.008					10.08																2	6				
EAST FORK KAWEAH AT BOUNDARY																																										
SEQU_HW_015	6/29/1981 0:00	26.8	16.1	8.15	60				25		ND	27		0.77		ND	0.65	10	2.24		ND	32																				
SEQU_HW_015	7/27/1981 0:00	28.5		8.14	92				31		ND	37		1.17		ND	0.97		3.18	1	ND	45.5																				
SEQU_HW_015	8/26/1981 0:00	23.9	18.3	8.21	108				48		0.5			1.49		0.017	1.13	16.4	3.63	1	ND	54.5						0.018														
SEQU_HW_015	5/19/1982 0:00	17.8	7.6	8.2	30				19		ND					ND				1	1	20																				
SEQU_HW_015	8/19/1982 0:00	14	14		63											0.023					0.52	34															170	27	0			
SEQU_HW_015	9/12/1985 0:00		7	10.2	82																																					
SEQU_HW_015	3/17/1987 0:00		2.1		50											ND						14.66																10				
SEQU_HW_015	5/27/1987 0:00		8	7.9	47				3.27		0.845	ND		0.273		0.021	0.5		1.764	0.84		8.88			0.2	ND	ND		3		ND						1	16				
SEQU_HW_015	7/15/1987 0:00		16.8	8.23	73											0.014						15															14	23				
SEQU_HW_015	8/17/1987 0:00		15.4	8.29	99.5				13.89		1.089	ND		1.083		0.03	1.2		5.53	3.632		21.04			ND	ND	ND		ND		ND					24	42					
SEQU_HW_015	10/29/1987 0:00		11.6	8.1	93											0.018						19.24			ND	ND	ND		ND		ND						20	1254				
SEQU_HW_015	6/28/1988 0:00	15.4		8.06	74											0.017					0.4	11.7														5	121					
SEQU_HW_015	7/25/1988 0:00	24.9		8.41	97											0.035					0.2	15.84														606	90					
SEQU_HW_015	8/23/1988 0:00	17.9		8.46	127											0.017					0.2	20.2														18	55					

Station ID	Visit Start	Temperature, air, deg C	Temperature, water, deg C	pH	Specific conductance, umho/cm	Bicarbonate, mg/l	Dissolved oxygen (DO), mg/l	General Parameters														Trace Elements										Bacteria										
								Ammonia as NH3	Calcium, mg/l	Carbonate, mg/l	Chloride, mg/l	Fluoride, mg/l	Hardness, Ca + Mg, mg/l	Kjeldahl nitrogen, mg/l	Magnesium, mg/l	Nitrite as N, mg/l	Orthophosphate as PO4, mg/l	Potassium, mg/l	Silica, mg/l	Sodium, mg/l	Sulfur, sulfate (SO4) as SO4, mg/l	Turbidity, FTU	Alkalinity, Total (total hydroxide+carbonate+bicarbonate), mg/l	Aluminum, ug/l	Antimony, ug/l	Arsenic, ug/l	Beryllium, ug/l	Cadmium, ug/l	Chromium, ug/l	Copper, ug/l	Iron, mg/l	Lead, ug/l	Manganese, ug/l	Mercury, ug/l	Nickel, ug/l	Thallium, ug/l	Zinc, ug/l	Fecal Coliform, cfu/100ml	Fecal Streptococcus Group Bacteria, cfu/100ml	Total Coliform, cfu/100ml		
Applicable Water Quality Objective or Standard		NS	NS	6.8-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	0.025	NS	>20	250	2	NS	NS	NS	1	NS	NS	NS	NS	NS	NS	250	Narr	>20	0.2	5.6	10	4	5	50	1	0.3	15	50	0.05	100	0.24	5	200	NS	NS
EAST FORK KAWEAH RIVER BELOW EAGLE CREEK																																										
SEQU_FS_K1	10/27/1971 12:40							0.1606					0.25			0.09								0.4															0	27		
SEQU_FS_K1	1/5/1972 9:45			7.5	180	72	10.9						74											0.2															0	8		
SEQU_FS_K1	2/29/1972 14:00							0.3683 3								0																							0	1		
SEQU_FS_K1	5/1/1972 14:45			7	130	50	9						54											0.3															0	16		
SEQU_FS_K1	6/20/1972 11:30					50	8.7																	0.65															0	4		
SEQU_FS_K1	7/25/1972 15:30							0.0094 4					0.09			0								0.3															0	16		
SEQU_FS_K1	9/5/1972 14:00			7.3	165	74	8.3						74											0.4													1	12 0				
MAIN FORK KAWEAH BELOW MARBLE FORK																																										
SEQU_HW_086	7/6/1983 0:00	25.8	14.8	6.75	14											ND							8.4	4.98														43	38			
MAIN STEM KAWEAH AT BOUNDARY																																										
SEQU_HW_011	6/11/1981 0:00	27.7	17.5	7.66	22								9			ND		4.92		1	1	10																				
SEQU_HW_011	7/6/1981 0:00	36.2	25.6	8.26	81								26	1.49	0.006	1.16	10	3.79	ND			29																				
SEQU_HW_011	7/31/1981 12:00	38.7	24.1	8.77	95							3																														
SEQU_HW_011	8/2/1981 0:00	33.9	23	8.53	90								27	1.82		1.26	24	3.87	ND	ND	41																					
SEQU_HW_011	10/17/1981 0:00	29.8	21.1	8.27	103																																					
SEQU_HW_011	3/19/1982 12:00	9.5	10.2	7.7	65																																					
SEQU_HW_011	4/11/1982 0:00		2.9	8.8	30																																					
SEQU_HW_011	5/10/1982 12:00		6.6	7.25	21											ND																										
SEQU_HW_011	6/22/1982 0:00																																					1	0	10		
SEQU_HW_011	6/30/1982 12:00	25.2	10.1	7.82	19											0.023	7.82																							2		
SEQU_HW_011	7/28/1982 12:00	42	19.3	7.58	12											0.007																						1	3	10 0		
SEQU_HW_011	5/5/1983 0:00		7	5.4	42																																		9	9		
SEQU_HW_011	5/17/1983 0:00																																						2	3		
SEQU_HW_011	6/7/1983 0:00	26.5	10.7	7.02	13											0.009																							1	5		
SEQU_HW_011	8/15/1983 0:00	31.5	17.4	6.87	21											0.021																							75	25		
SEQU_HW_011	10/4/1983 0:00		13.4		49											0.018																							9	0		
SEQU_HW_011	7/18/1984 0:00				22											ND																							106	166		

Station ID	Visit Start	Temperature, air, deg C	Temperature, water, deg C	pH	Specific conductance, umho/cm	Bicarbonate, mg/l	Dissolved oxygen (DO), mg/l	General Parameters													Trace Elements											Bacteria												
								Ammonia as NH3	Calcium, mg/l	Carbonate, mg/l	Chloride, mg/l	Fluoride, mg/l	Hardness, Ca + Mg, mg/l	Kjeldahl nitrogen, mg/l	Magnesium, mg/l	Nitrite as N, mg/l	Orthophosphate as PO4, mg/l	Potassium, mg/l	Silica, mg/l	Sodium, mg/l	Sulfur, sulfate (SO4) as SO4, mg/l	Turbidity, FTU	Alkalinity, Total (total hydroxide+carbonate+bicarbonate), mg/l	Aluminum, ug/l	Antimony, ug/l	Arsenic, ug/l	Beryllium, ug/l	Cadmium, ug/l	Chromium, ug/l	Copper, ug/l	Iron, mg/l	Lead, ug/l	Manganese, ug/l	Mercury, ug/l	Nickel, ug/l	Thallium, ug/l	Zinc, ug/l	Fecal Coliform, cfu/100ml	Fecal Streptococcus Group Bacteria, cfu/100ml	Total Coliform, cfu/100ml				
Applicable Water Quality Objective or Standard		NS	NS	6.8-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	0.025	NS	>20	250	2	NS	NS	NS	1	NS	NS	NS	NS	NS	NS	NS	250	Narr	>20	0.2	5.6	10	4	5	50	1	0.3	15	50	0.05	100	0.24	5	200	NS	NS	
SEQU_HW_011	9/18/1984 0:00															0.029																									10	13		
SEQU_HW_011	10/31/1984 0:00		10		71											ND																								3	168			
SEQU_HW_011	7/31/1985 0:00		23.1	8.2	116																																							
SEQU_HW_011	9/9/1985 0:00		18.8	9.4	110																																							
SEQU_HW_011	11/4/1985 0:00		12.9	7.2	93											ND																									9	4		
SEQU_HW_011	3/17/1987 0:00		12		66											ND										11.46																8		
SEQU_HW_011	5/27/1987 0:00		11.8	7.9	32				8.3	0.414	ND			0.26	0.013	0.5	1.974	1.705							5.2		0.13	ND	ND			8		ND						1	4			
SEQU_HW_011	7/15/1987 0:00		24.7	8.31	75										0.018											13.1														13	71			
SEQU_HW_011	8/17/1987 0:00		22.8	8.37	92				9.1	2.155	ND		9.531	0.029	0.95	3.84	1.837								15.06			ND	ND			ND		ND					8	35				
SEQU_HW_011	10/29/1987 0:00	16.8		8	113									0.022												18.54		ND	ND	ND		ND		ND						256	532			
SEQU_HW_011	6/28/1988 0:00		19.9	7.96	55										0.017										0.3	7.22														3	53			
SEQU_HW_011	7/25/1988 0:00		25.8	8.45	80										0.038										0.3	12.4														260	67			
SEQU_HW_011	8/23/1988 0:00		24.4	8.56	86										0.014									0.2	15.9														3	120				
MAIN STEM KAWEAH BELOW HEADQUARTERS																																												
SEQU_HW_144	7/30/1982 0:00		19.9	7.91	21										0.019																										92	37	0	
SEQU_HW_144	7/31/1982 0:00		19.5	7.78	24										0.008																										6	0	0	
SEQU_HW_119	10/16/1984 0:00		9		49																																							
SEQU_HW_119	10/17/1984 0:00								ND						0.026																										253	608		
MARBLE FORK ABOVE HALSTEAD CREEK																																												
SEQU_HW_117	9/28/1983 0:00		8.8		30										0.023																											1	0	
SEQU_HW_117	7/10/1984 0:00				15																																				3			
SEQU_HW_117	7/26/1984 0:00				15																																				5	10		
SEQU_HW_117	9/27/1984 0:00																																								3	17		
SEQU_HW_117	7/19/1988 0:00		24.6	7.82	33										0.029									0.1	3.74																17	95		
MARBLE FORK ABOVE SUWANNEE CREEK																																												
SEQU_HW_008	6/26/1981 0:00	23.7	14.7	7.48	15					1.73	ND	ND	0.22			0.47	14.5	1.34	ND	ND	7																							
SEQU_HW_008	7/22/1981 0:00	23.7	12.9	6.65	37					8	ND	4	0.6	0.023	0.98		4.15	ND	ND	18							0.037																	
SEQU_HW_008	8/24/1981 0:00	23.2	17.1	7.58	35					6	2		0.48	0.015	0.96	14.9	3.09		ND	18																								
SEQU_HW_008	6/23/1982 12:00	15.3	7.8	7.23	9					3	4			0.011				ND	0.52	13																				16	0	26		
SEQU_HW_008	7/15/1982 0:00	10.8	9.3	7.3	9																			0.48																	7	2	3	
SEQU_HW_008	8/17/1982 0:00		11.5		30										0.025									2	21																5	38	0	

Station ID	Visit Start	Temperature, air, deg C	Temperature, water, deg C	pH	Specific conductance, umho/cm	Bicarbonate, mg/l	Dissolved oxygen (DO), mg/l	General Parameters														Trace Elements											Bacteria										
								Ammonia as NH3	Calcium, mg/l	Carbonate, mg/l	Chloride, mg/l	Fluoride, mg/l	Hardness, Ca + Mg, mg/l	Kjeldahl nitrogen, mg/l	Magnesium, mg/l	Nitrite as N, mg/l	Orthophosphate as PO4, mg/l	Potassium, mg/l	Silica, mg/l	Sodium, mg/l	Sulfur, sulfate (SO4) as SO4, mg/l	Turbidity, FTU	Alkalinity, Total (total hydroxide+carbonate+bicarbonate), mg/l	Aluminum, ug/l	Antimony, ug/l	Arsenic, ug/l	Beryllium, ug/l	Cadmium, ug/l	Chromium, ug/l	Copper, ug/l	Iron, mg/l	Lead, ug/l	Manganese, ug/l	Mercury, ug/l	Nickel, ug/l	Thallium, ug/l	Zinc, ug/l	Fecal Coliform, cfu/100ml	Fecal Streptococcus Group Bacteria, cfu/100ml	Total Coliform, cfu/100ml			
Applicable Water Quality Objective or Standard		NS	NS	6.8-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	0.025	NS	>20	250	2	NS	NS	NS	1	NS	NS	NS	NS	NS	250	Narr	>20	0.2	5.6	10	4	5	50	1	0.3	15	50	0.05	100	0.24	5	200	NS	NS		
SEQU_HW_009	10/4/1983 0:00		11.9		32																																		4	0			
SEQU_HW_009	7/18/1984 0:00				23																			4.3																158	198		
SEQU_HW_009	9/18/1984 12:00																																								24		
SEQU_HW_009	9/19/1984 12:00																																								13		
SEQU_HW_009	10/31/1984 0:00		9		85																																			2	314		
SEQU_HW_009	7/31/1985 0:00		19.9	7.8	101																																						
SEQU_HW_009	9/9/1985 0:00		16.5	9.5	140																																						
SEQU_HW_009	11/4/1985 0:00																																							1	8		
SEQU_HW_009	5/19/1987 0:00		10	7.6	18																																		0	9			
MIDDLE FORK AT POTWISHA ABOVE CONTROL																																											
SEQU_HW_082	3/19/1982 0:00				37																																						
SEQU_HW_081	7/6/1983 0:00	23	15.3	6.49	14																																				0	4	
SEQU_HW_081	8/7/1983 0:00				20																																						
SEQU_HW_080	8/11/1983 12:00		14.5		20																																					3	0
SEQU_HW_080	9/22/1983 0:00		17.2	7.03	36																																					7	0
MIDDLE FORK KAWEAH ABOVE BUCKEYE BRIDGE																																											
SEQU_HW_010	6/15/1981 0:00	24.9	12.6	7.45	21																																						
SEQU_HW_010	7/6/1981 0:00	30.8	20	7.63	29																																						
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								Ammonia as NH3	Calcium, mg/l	Carbonate, mg/l	Chloride, mg/l	Fluoride, mg/l	Hardness, Ca + Mg, mg/l	Kjeldahl nitrogen, mg/l	Magnesium, mg/l	Nitrite as N, mg/l	Orthophosphate as PO4, mg/l	Potassium, mg/l	Silica, mg/l	Sodium, mg/l	Sulfur, sulfate (SO4) as SO4, mg/l	Turbidity, FTU	Alkalinity, Total (total hydroxide+carbonate+bicarbonate), mg/l	Aluminum, ug/l	Antimony, ug/l	Arsenic, ug/l	Beryllium, ug/l	Cadmium, ug/l	Chromium, ug/l	Copper, ug/l	Iron, mg/l	Lead, ug/l	Manganese, ug/l	Mercury, ug/l	Nickel, ug/l	Thallium, ug/l	Zinc, ug/l	Fecal Coliform, cfu/100ml	Fecal Streptococcus Group Bacteria, cfu/100ml	Total Coliform, cfu/100ml							
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								Ammonia as NH3	Calcium, mg/l	Carbonate, mg/l	Chloride, mg/l	Fluoride, mg/l	Hardness, Ca + Mg, mg/l	Kjeldahl nitrogen, mg/l	Magnesium, mg/l	Nitrite as N, mg/l	Orthophosphate as PO4, mg/l	Potassium, mg/l	Silica, mg/l	Sodium, mg/l	Sulfur, sulfate (SO4) as SO4, mg/l	Turbidity, FTU	Alkalinity, Total (total hydroxide+carbonate+bicarbonate), mg/l	Aluminum, ug/l	Antimony, ug/l	Arsenic, ug/l	Beryllium, ug/l	Cadmium, ug/l	Chromium, ug/l	Copper, ug/l	Iron, mg/l	Lead, ug/l	Manganese, ug/l	Mercury, ug/l	Nickel, ug/l	Thallium, ug/l	Zinc, ug/l	Fecal Coliform, cfu/100ml	Fecal Streptococcus Group Bacteria, cfu/100ml	Total Coliform, cfu/100ml								
Applicable Water Quality Objective or Standard		NS	NS	6.8-8.5	NS	NS	Meet or exceed 5.0 for WARM; 7.0 for COLD	0.025	NS	>20	250	2	NS	NS	NS	1	NS	NS	NS	NS	NS	NS	NS	250	Narr	>20	0.2	5.6	10	4	5	50	1	0.3	15	50	0.05	100	0.24	5	200	NS	NS					
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NS: no standard; ND: no detection

Measurements that exceed the applicable water quality objective or standard are highlighted in green.

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Table 7.3-A5. Water Quality Data Collected by Three Rivers Community Services District in the Vicinity of the Kaweah Project.

Month	Date	Sampling Location and Parameter Sampled															
		R1 - Buckeye/ Gateway		R2 - Dinely Bridge		R3 - North Fork (airport bridge)		R4 - South Fork (198 bridge)		R5 - Slick Rock		R6 - Main Fork		R7 - Hwy 198/ NF Bridge		R8 - South Fork/District Boundary	
		Total Coliform ¹	Fecal Coliform ¹	Total Coliform	Fecal Coliform	Total Coliform	Fecal Coliform	Total Coliform	Fecal Coliform	Total Coliform	Fecal Coliform	Total Coliform	Fecal Coliform	Total Coliform	Fecal Coliform	Total Coliform	Fecal Coliform
Jan	1/27/14	>200.5	<1.1	>200.5	4.4	>200.5	200.5	>200.5	15.0	>200.5	16.8	>200.5	8.4	>200.5	17.4	>200.5	16.8
Feb	2/24/14	>200.5	3.1	>200.5	2.0	>200.5	47.8	>200.5	56.0	>200.5	19.2	>200.5	28.8	>200.5	17.8	>200.5	56.0
Mar	3/24/14	2.1	1.1	17.8	11.4	94.5	200.5	144.5	36.4	30.6	3.1	>200.5	13.7	>200.5	19.7	>200.5	32.4
Apr	4/21/14	69.7	6.4	>200.5	9.0	>200.5	25.4	>200.5	27.1	>200.5	11.1	>200.5	8.7	>200.5	15.0	>200.5	8.7
May	5/26/14	>200.5	9.9	>200.5	16.4	>200.5	40.6	>200.5	45.3	>200.5	23.8	>200.5	28.8	>200.5	19.2	>200.5	47.8
Jun	6/23/14	149.5	1.0	144.5	8.7	>200.5	53.1	>200.5	30.6	>200.5	21.7	>200.5	12.4	>200.5	9.9	>200.5	17.8
Jul	7/28/14	>200.5	22.2	>200.5	25.4	>200.5	45.3	>200.5	118.4	>200.5	13.7	>200.5	17.8	>200.5	47.8	>200.5	12.7
Aug	8/25/14	165.0	9.9	>200.5	12.4	>200.5	27.1	>200.5	109.1	>200.5	12.2	>200.5	13.7	>200.5	22.2	>200.5	9.4
Sept	9/22/14	>200.5	20.7	>200.5	3.1	>200.5	11.1	>200.5	73.8	>200.5	12.4	>200.5	8.7	>200.5	3.0	>200.5	62.4
Oct	10/27/14	>200.5	36.4	>200.5	25.4	>200.5	73.8	>200.5	69.7	>200.5	15.0	>200.5	12.4	>200.5	22.2	>200.5	114.2
Nov	11/24/14	>200.5	25.4	>200.5	155.2	>200.5	53.1	>200.5	101.3	>200.5	62.4	>200.5	78.2	>200.5	62.4	>200.5	118.2
Dec	12/22/14	129.8	2.0	>200.5	22.2	>200.5	17.8	>200.5	144.5	>200.5	69.7	>200.5	38.4	>200.5	28.8	>200.5	165.2

Applicable Water Quality Objective or Standard: Fecal coliform: 200 MPN/100 ml; Total coliform: no standard

Green shading indicates that the water quality objective is exceeded.

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LIST OF ACRONYMS

BLM	Bureau of Land Management
BLMS	Bureau of Land Management Sensitive Species
°C	degrees Celsius
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CFP	California Fully Protected
cfs	cubic feet per second
CNDDDB	California Natural Diversity Database
COLD	Cold Freshwater Habitat
CSC	California Species of Special Concern
CT	Candidate Threatened
CVRWQCB	Central Valley Regional Water Quality Control Board
DWR	Department of Water Resources
EPA	Environmental Protection Agency
ESA	Endangered Species Act
°F	degrees Fahrenheit
FC	Federal Candidate
FE	Federal Endangered
FERC or Commission	Federal Energy Regulatory Commission
FPD	Federal Proposed Delisted
FPE	Federal Proposed Endangered
FPT	Federal Proposed Threatened
FT	Federal Threatened
FYLF	foothill yellow-legged frog
GIS	Geographic Information System
HSC	Habitat suitability criteria
IBI	Index of Biotic Integrity
lbs	pounds
m	meter
m ³	cubic meter
mg/L	milligrams per liter
mm	millimeter
msl	mean sea level
MVZ	Museum of Vertebrate Zoology
NPS	National Park Service
PCB	Polychlorinated biphenyl
Project	Kaweah Project

RARE	Rare, Threatened, or Endangered
RM	River Mile
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SCE	Southern California Edison Company
SD	Supporting Document
SE	State Endangered
SOP	Standard operating procedures
SPWN	Spawning, Reproduction and/or Early Development
ST	State Threatened
STORET	EPA Storage and Retrieval
SWAMP	Surface Water Ambient Monitoring Program
TL	total length
TSR	Technical Study Report
USGS	U.S. Geological Survey
WARM	Warm Freshwater Habitat
Watershed	Kaweah River Watershed
WPT	western pond turtle
WUA	weighted usable area
YOY	young-of-year

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7.4 FISH AND AQUATICS RESOURCES AFFECTED ENVIRONMENT

This section describes the fish and aquatic resources in the vicinity of the Kaweah River Watershed (Watershed), including the river segments (bypass reaches) associated with the Kaweah Project (Project). Physical resource information pertinent to the discussion of fish and aquatic resources (hydrology, water quality, geomorphology, and riparian) is also summarized in this section. Detailed information on hydrology (Section 7.2), water quality (Section 7.3), geomorphology (Section 7.7), and riparian resources (Section 7.8) can be found in the respective sections for each of these topics.

The description of the fish and aquatic resources affected environment is organized based on the following categories:

- Information Sources
- Project Study Area Overview
- Fish and Special-status Aquatic Species Overview
- Resource Management Objectives
- Riverine Physical Environment
 - Hydrology
 - Water Temperature and Water Quality
 - Channel Geomorphology and Sediment
 - Riparian Vegetation
- Instream Flow Habitat Modeling
- Riverine Aquatic Community
 - Benthic Algae
 - Benthic Macroinvertebrates
 - Wetted Perimeter Productivity
- Fish Passage Barriers
- Riverine Fish
 - Distribution and Diversity
 - Growth and Condition

- Emergence/Spawning Timing
- Abundance (Standing Crop)
- Fish Stocking
- Bypass Reach Habitat
- Foothill Yellow-legged Frogs and Western Pond Turtles
 - Distribution and Abundance
 - Habitat
- Fish Entrainment
- Special-status Species
 - Hardhead
 - Foothill Yellow-legged Frog
 - Western Pond Turtle

7.4.1 Information Sources

The aquatic resources information is based on a review of existing literature, agency, and stakeholder consultation, and studies conducted as part of the Kaweah relicensing process. A summary of agency and stakeholder consultation is provided in Section 14.0. The studies included early information gathering of water temperature data and nine aquatic technical studies that were developed in consultation with agencies and other interested relicensing participants. The studies were approved by the Federal Energy Regulatory Commission (FERC or Commission) and were completed in 2018 and 2019.

Key information sources are summarized below.

- Aquatic Species and Habitat Study (SCE 2007);
- Benthic Macroinvertebrates below Hydropower Dams (Rehn 2009);
- Bureau of Land Management (BLM) Designated Sensitive Species;
- California Department of Fish and Wildlife (CDFW) website (www.wildlife.ca.gov);
- CDFW California Wildlife website (www.dfg.ca.gov/biogeodata);
- CDFW California Natural Diversity Database (CNDDDB) (CDFW 2019);

- Early Water Temperature Data Collection by Southern California Edison Company (SCE) 2014–2015 (SCE 2016);
- FERC website (www.ferc.gov);
- Fish Population and Water Temperature Studies – 1986 and 1987 (FERC 1991);
- Impact study of the Kaweah No. 3 Hydroelectric Facility on Sequoia National Park (Jordan/Avent et al. 1983, as cited in SCE 2007);
- Periodic point measurements of water temperature data at various locations available from Environmental Protection Agency STORage and RETrieval (EPA STORET) on-line databases;
- Characterization of the hydrology in the study area in Section 7.2 Water Use and Hydrology;
- Quantification and evaluation of aquatic habitat as a function of flow. Identification of time periods, flow conditions, and life stages when habitat may be a limiting factor for aquatic species in AQ 1 – Instream Flow Technical Study Report (TSR) (SCE 2019a; Supporting Document [SD] A) (AQ 1 – TSR);
- Documentation of fish species composition, distribution, and abundance; and characterization of fish growth and population age structure in the bypass reaches (AQ 2 – Fish Population TSR [SCE 2019b; SD A]) (AQ 2 – TSR);
- Documentation of the benthic macroinvertebrate community in the bypass reaches (AQ 3 – Macroinvertebrate TSR [SCE 2019c; SD A]) (AQ 3 – TSR);
- Characterization of the relationship between flow and water temperature in the bypass reaches using models supported by existing water temperature data (AQ 4 – Water Temperature TSR [SCE 2019d; SD A]) (AQ 4 – TSR);
- Characterization of the river geomorphology physical environment and geology in in Section 7.6 Geology and Soils and Section 7.7 Geomorphology and AQ 5 – Geomorphology TSR (SCE 2019e; SD A) (AQ 5 – TSR);
- Characterization of physical, chemical, and bacterial water quality conditions in the bypass reaches (AQ 6 – Water Quality TSR [SCE 2019f; SD A]) (AQ 6 – TSR);
- Identification of foothill yellow-legged frog (FYLF) presence/absence and habitat in the bypass reaches and documentation of western pond turtle (WPT) habitat (AQ 7 – Special-status Amphibians and Aquatic Reptiles TSR [SCE 2019g; SD A]) (AQ 7 – TSR);
- Documentation of the location, nature, and characteristics of fish barriers in the bypass reaches (AQ 8 – Fish Passage TSR [SCE 2019h; SD A]) (AQ 8 – TSR);

- Evaluation of potential fish entrainment associated with flow diversion intake structures (AQ 9 – Draft Entrainment TSR [SCE 2019i; SD A]) (AQ 9 – TSR);
- Characterization of riparian resources along the bypass reaches (Section 7.8 Riparian Resources); and
- Water quality objectives and water and standards in the Water Quality Control Plan for the Tulare Lake Basin (Basin Plan; CVRWQCB 2018).

7.4.2 Project Study Area Overview

Detailed descriptions of the Kaweah River Basin and the Kaweah Project Water Use and Hydrology are provided in Sections 7.1 and 7.2, respectively. The Project Study Area includes five river bypass reaches, two diversions, and three powerhouse inflows (Figure 7.4-1 and Map 7.4-1). Field studies to characterize aquatic resources were conducted in the five bypass reaches and in three nearby comparison reaches (Table 7.4-1). The comparison reaches were located upstream or downstream of the bypass reaches. The reaches (bypass and comparison) were delineated by selecting sections of river that were homogeneous with respect to geomorphology and hydrology (i.e., reaches that have similar channel types and flow regimes).

7.4.3 Fish and Special-Status Aquatic Species Overview

No anadromous, catadromous, or other migratory fish species are present in the vicinity of the Project. The study reaches associated with the Project are located within the Sacramento-San Joaquin Province and the Central Valley subprovince (Moyle 2002). These river reaches support primarily warmwater fishes (pikeminnow-hardhead-sucker assemblage; Moyle 2002) with trout present in some areas. The warmwater fish assemblage is characteristic of lower elevation west slope Sierra Nevada river habitat that exhibits low summer/fall streamflows and high water temperatures. The AQ 2 – TSR (SCE 2019b; SD A) sampling confirmed that Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychocheilus grandis*), and hardhead (*Mylopharodon conocephalus*) (including young-of-year [YOY] mixed minnows), were the dominant fish species. Some rainbow trout were present (*Onchorynchus mykiss*) and other native species, Central California roach [*Lavinia symmetricus symmetricus*] and sculpin (*Cottus* spp.). Non-native fish species observed were smallmouth bass (*Micropterus dolomieu*) and brown trout (*Salmo trutta*). Table 7.4-2 shows the fish species observed in the study reaches.

Special-status aquatic species are those granted status by federal and state agencies. Federally listed species under the Endangered Species Act (ESA) include threatened (FT), endangered (FE), proposed threatened (FPT), proposed endangered (FPE), candidate (FC), or listed species proposed for delisting (FPD). BLM also has a list of wildlife species that are not federally listed under the ESA, but are designated by the BLM State Director for special management consideration (BLMS). State-listed aquatic species, which are granted status by the CDFW under the California Endangered Species Act (CESA), include state threatened (ST), state endangered (SE), California Fully

Protected Species (CFP), California Species of Special Concern (CSC), and Candidate Threatened (CT).

There are potentially three sensitive aquatic species in the vicinity of the Project including:

- Foothill yellow-legged frog (FYLF) (*Rana boylei*) – CSC, CT, BLMS
- Hardhead (*Mylopharodon conocephalus*) – CSC
- Western pond turtle (WPT) (*Actinemys marmorata*) – CSC

Where: CSC = CDFW Species of Special Concern; CT = CDFW Candidate Threatened; and BLMS = BLM Special Management Consideration.

Of these three species, FYLF were not found during surveys and are not known to be extant in the Watershed; hardhead are common in select reaches associated with the Project; and WPT are known to be extant in the Watershed, but no WPT were observed during aquatic studies in the Project study area.

7.4.4 Resource Management Objectives

For the Kaweah River and East Fork Kaweah River in the vicinity of the Project, resource management objectives focus on providing suitable habitat conditions to support warmwater (e.g., hardhead) and coldwater fish populations (rainbow trout) and other aquatic species. Management plans that apply to aquatic resources in the Project study area are listed below.

- California Department of Fish and Wildlife (CDFW) – No CDFW trout management plans/programs (e.g., stocking) apply specifically to the Project study area. None of the rivers in the Watershed are designated as Wild or Heritage Trout Waters. The Kaweah River from the Kaweah No. 1 Powerhouse to Lake Kaweah is designated as a Central Valley drainage hardhead/pikeminnow stream and a California Natural Diversity Database (CNDDDB) rare natural community (CDFW 2019). Although this segment has been designated as a rare natural community, it is still under review by the state to be assigned a rank (S1-S3; status levels of imperilment). Hardhead have a global rank of G3 (at moderate risk of extinction due to a restricted range, relatively few populations [often 80 or fewer], recent and widespread declines, or other factors) and a state rank S3 (vulnerable in the state due to a restricted range, relatively few populations [often 80 or fewer], recent and widespread declines, or other factors making it vulnerable to extirpation from the state).
- State or Federal Wild and Scenic Rivers – None of the rivers in the Watershed are included in the California Wild and Scenic River System and none of the rivers in the Watershed are designated as National Wild and Scenic Rivers.

- Bakersfield Office Resource Management Plan (BLM) – The management plan provides broad-scale direction for the future management of BLM-administered public lands and resources including lands within the Watershed.
- Water Quality Control Plan for the Tulare Lake Basin by the California Regional Water Quality Control Board Central Valley Region (CVRWQCB) includes the following beneficial uses for the Kaweah River and tributaries upstream of Lake Kaweah:
 - Warm Freshwater Habitat (WARM): Uses of water that support warm water ecosystems, including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates. WARM includes support for reproduction and early development of warm water fish.
 - Cold Freshwater Habitat (COLD): Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
 - Rare, Threatened, or Endangered Species (RARE): Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.
 - Spawning, Reproduction and/or Early Development (SPWN): Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish. SPWN shall be limited to cold water fisheries.
- National Park Service Nationwide Rivers Inventory (NPS) – The NPS lists two river segments upstream of the Project and within the Sequoia National Park, Marble Fork of the Kaweah River and Middle Fork of the Kaweah River, as recreationally important rivers with wild and scenic values.
- Final General Management Plan and Comprehensive River Management Plan / Environmental Impact Statement (NPS 2006) – The River Management Plan provides direction and overall guidance on the management of lands and uses within the river corridors in Sequoia National Park upstream of the Project.
- No essential fish habitat as defined under the Magnuson-Stevens Fishery Conservation and Management Act is present in the vicinity of the Project.

7.4.5 Riverine Physical Environment

The riverine physical environment associated with the Project is described below. The physical environment includes: (1) hydrology; (2) water temperature and water quality (3) channel geomorphology and sediment; and (4) riparian vegetation.

7.4.5.1 Hydrology

A detailed description of Kaweah hydrology is included in Section 7.3 Water Quality. Overviews of FERC License minimum instream flows/pre-1914 water rights and typical Project operations in the bypass reaches are discussed below.

FERC License Minimum Instream Flows / Pre-1914 Water Delivery Requirements

The minimum instream flow requirements for the Project are shown in Table 7.4-3. The existing minimum instream flows in the Kaweah River are based on dry and normal water year type designations. In the hydrologic period of record (1975–2018) 34% of the years were dry and the remainder were normal. In the Kaweah River minimum instream flows are lower in dry years and higher in normal years. In the East Fork Kaweah River the minimum instream flows are the same for both dry and normal years.

Local water user pre-1914 consumptive water rights exist on both the Kaweah No. 2 Flowline and the Kaweah No. 1 Flowline consequently SCE must maintain water in the flowlines to deliver water to local water users (see Section 3.5.2.2). Flows of 3 cubic feet per second (cfs) in the Kaweah No. 2 Flowline and 1 cfs in the Kaweah No. 1 Flowline must be maintained for local water users.

Figures 7.2-1 and 7.2-2 show both the minimum instream flows and the pre-1914 consumptive water rights requirements for normal and dry years overlaid with the unimpaired flows at the Kaweah No. 2 Diversion and Kaweah No. 1 Diversion. With respect to the bypass reach flows downstream of the diversions, the minimum instream flows in practice are only approached during the dry season months (July to December; sometimes January and February). During the wetter season months (March through June), natural flow minus diverted flow is far in excess of the minimum flows and pre-1914 consumptive water rights requirements (Figures 7.2-1 and 7.2-2).

During dry years in the East Fork Kaweah River there are a few years when unimpaired inflows at the Kaweah No. 1 Diversion are barely equal to or greater than the required minimum flow combined with the pre-1914 consumptive water right diversion requirement. During both normal and dry years at Kaweah No. 2 Diversion, there are a number of years when unimpaired flows are less than the minimum instream flow and pre-1914 diversion requirement (Figure 7.2-2) (see Section 7.2.2.1).

FERC Ramping Rate Requirements

The existing FERC license for the Project requires the Licensee to operate such that flows below the Kaweah No. 1 and No. 2 diversion dams and Kaweah No. 1 and No. 2 powerhouses are not altered at a rate greater than 30 percent of the existing streamflow

per hour. In the four bypass reaches this results in average stage changes as shown in Figures 7.4-2, 7.4-3, 7.4-4, and 7.4-5. The up-ramping rates are extremely conservative. Typically, up-ramping rates are used to protect recreationists and often a 1.0 foot/hour ramping rate is used. Under the current FERC license, the up-ramping rates are on the order of <0.1 to <0.3 foot/hour. The down-ramping rates are approximately <0.1 to 0.3 foot/hour in the range of flows that the Project can operate (87 cfs at Kaweah No. 2 Diversion and 24 cfs at Kaweah No. 1 Diversion).

Typical Project Operations in the Bypass Reaches

In the river bypass reaches (Kaweah River and East Fork Kaweah River) flows are potentially altered year-round. Up to 87 cfs can be diverted at Kaweah No. 2 Diversion on the Kaweah River and up to 24 cfs can be diverted at the Kaweah No. 1 Diversion on the East Fork Kaweah River. These are run-of-river diversions that have minimum flow requirements downstream of the diversions (see Section 7.4.5.1). Project operations and flows in the bypass reaches and diversions/flowlines are discussed in Section 7.2 Water Use. Figures 7.2-5a and b show that during the wetter months (April, May, June) the natural river flows are relatively large and the Project diversions have minimal effect on flows in the bypass reaches. During the drier months (August, September, October, November and sometimes December, January and February), the Project diversions can have a larger effect on flow in the bypass reaches. Figures 7.2 E1-4 in Section 7.2 Appendix E shows monthly flow exceedances for both existing and unimpaired flows. During drier water year types, diversions do not operate during many of the drier months.

The effects of flow diversion on flows in the bypass reaches are analyzed extensively in AQ 1 – TSR (SCE 2019a; SD A). The effects of flow reductions on wetted perimeter are discussed in Section 7.4.7.3 Wetted Perimeter / Productivity. The effects on fish habitat are discussed in Section 7.4.9.6 Bypass Reach Habitat Modeling

7.4.5.2 Water Temperature and Water Quality

The distribution of aquatic species is directly related to water temperature. Water temperature in the Kaweah River and in the East Fork Kaweah River varies with elevation and season. Water temperature is cooler in the upper elevation portions of the Watershed and transitions to warm, particularly in the summer, in the lower elevation portions of the Watershed where the Project is located.

The sources for water temperature data in the Watershed include periodic point measurement water temperature data at various locations recorded in the EPA STORET on-line databases; water temperature studies conducted in 1989 in the Kaweah River and East Fork Kaweah rivers in the vicinity of the Kaweah No. 1 and No. 2 diversions (FERC 1991); water temperature data loggers installed by SCE July 2014 to May 2015 at seven locations in the vicinity of the Project (Table 7.4-4; Map 7.4-2); and 13 water temperature loggers installed February 2018 to December 2018, including two air temperature stations, as part of the AQ 4 – TSR (SCE 2019d; SD A) (Table 7.4-5; Map 7.4-3).

Water quality data (e.g., turbidity, dissolved oxygen) for the Project study area are discussed in AQ 6 – TSR (SCE 2019f; SD A) and Section 7.3 Water Quality and briefly summarized below.

Kaweah River Water Temperature

Water temperature studies conducted in 1989 (in the vicinity of the Kaweah No. 1 and No. 2 diversions) (FERC 1991) found that water temperatures were relatively warm during the summer ≥ 70 degrees Fahrenheit ($^{\circ}\text{F}$) (21 degrees Celsius [$^{\circ}\text{C}$]). The highest water temperatures were observed during the late summer low-flow period when air temperatures were warmest (FERC 1991). The warm temperatures occurred naturally during the late summer when water diversion for power generation was not occurring due to low inflows. As fall air temperatures cooled, river water temperatures also decreased.

Water temperature data collected in 2014/2015 (very dry years) and 2018 (dry year / normal year transition), in the vicinity of the Project show that at the upstream boundary of the Project, near river mile (RM) 8.8 (1,390 feet above mean sea level [msl]) monthly average water temperature in 2014 exceeded 70°F during July, August, and September and in 2018 exceeded 70°F during July and August (Figure 7.4-6). Farther downstream, average monthly water temperature exceeded approximately 75°F in the Kaweah River bypass reaches in July and August and 70°F in September. Summer 2018 was slightly cooler than 2014 (Figure 7.4-6). Figure 7.4-7 shows the 15-min diel and daily average temporal distribution, respectively, of water temperature at several sites between the periods of late July 2014 to April 2015 and February to December 2018. Water temperatures in the bypass reaches typically did not fall below 70°F from early July to early September. The warm summer temperature period (both 2014 and 2018) corresponded to a time when air temperatures were high, stream flows were very low, and no generation was occurring (see Figure 7.4-7). In 2018, for example, the Kaweah No. 2 Flowline was not diverting from early August to December and the Kaweah No. 3 Flowline (located upstream in Sequoia National Park) was not diverting from late June through early December.

East Fork Kaweah River Water Temperature

Water temperature data collected in 2014/2015 (very dry years) and 2018 (dry year / normal year transition), in the East Fork Kaweah River were slightly cooler than water temperature in the main stem Kaweah River due in part to the elevation and likely the orientation of the river with respect to solar shading. As shown in Figure 7.4-8, at the upstream temperature monitoring location above the Kaweah No.1 Diversion Dam (2,600 feet above msl), average monthly water temperature in 2014 was between about 65°F and 70°F during July, August, and September and in 2018 it was warmer in July (above 70°F) and cooler in September $< 65^{\circ}\text{F}$. However, the downstream sampling station (1,300 feet above msl), located near the confluence of the East Fork Kaweah River and Kaweah River, followed a warmer water temperature pattern similar to that in the Kaweah River in the vicinity of the confluence. Water temperatures were approximately 70°F , or greater, July, August, and September and did not fall below 70°F until late September in 2014. Figure 7.4-9 shows

the daily average and 15-minute temperature data. In 2018, water temperature cooled to below 70°F in early September (Figure 7.4-9).

The warm summer temperature period in both 2014 and 2018 corresponded to a time when air temperatures were high, stream flows were very low, and no generation was occurring (see Figure 7.4-9). In 2018, for example, diversions at the East Fork Kaweah No. 1 Diversion ceased at the beginning of July through the remainder of the year, except for the 1 cfs pre-1914 consumptive water right delivery. The high temperatures observed in July, August, and September were a natural consequence of the watershed.

Water Quality

Historical water quality data and recent data collected in 2018 during the spring runoff (May) and during the summer low-flow period (August) (see Section 7.3 Water Quality) indicate that the physical and water chemistry conditions in the bypass reaches are of high quality and conform to regulatory water quality objectives and standards related to aquatic species. All in-situ measurements in the bypass reaches (dissolved oxygen, turbidity, conductivity, and pH) met applicable standards. General water quality parameters (e.g., metals, nutrients) were typically high quality. During the high-flow season, several samples in the Kaweah River bypass reaches and comparison reaches exhibited low alkalinity (<20 milligrams/liter [mg/L]). This appears to be a natural condition of the Watershed during spring high-flow conditions when snowmelt and rainfall runoff have little opportunity to pick up calcium carbonate from the basin geology. Also, there were three ammonia samples in bypass reaches during the summer low-flow sampling that exceeded water quality criteria. Because the Project does not have operations that would typically affect ammonia, the source could potentially be septic systems from homes along the river (see Section 7.3 Water Quality).

7.4.5.3 Channel Geomorphology and Sediment

Details of the Project study area geomorphology are included in Section 7.7 Geomorphology. Overviews of the river channels, fine sediment, spawning gravel abundance, and channel maintenance flows are discussed below.

River Channels

The Kaweah and East Fork Kaweah rivers in the study area are steep, coarse substrate rivers (e.g., abundant large cobbles, boulders, very large boulders, and bedrock) (Figure 7.4-1). Very little gravel exists in the system and finer substrate (sand/decomposed granite) exists in the pools or in the velocity shadow of large substrate. Sediment transport and deposition dynamics in boulder, bedrock-dominated systems are mediated by the resistant channel boundary. The bypass reach downstream of the Kaweah No. 2 Diversion (KR DS PH3) has a 3.3% gradient and consists of boulder and cobble step pool sequences punctuated by bedrock pools. The bypass reaches in the Kaweah River downstream of the confluence with the East Fork River (KR US PH1 and KR US PH2) have a somewhat lower gradient (1.7% to 1.9%) and exhibit plane-bed and pool-riffle morphology with abundant large substrates. The bypass reach in the East

Fork Kaweah downstream of the Kaweah No. 1 Diversion (EF DS K1 Div) is predominately a steep (5.4% gradient) bedrock, plunge pool channel punctuated by coarse sediment aggregations in lower gradient sections. The exception is the lower 0.5-mile river reach (EF US Confl) stream near the confluence with the Middle Fork Kaweah (4.2% gradient), which includes large boulder substrates in combination with lower-gradient pools and runs with expansive sand deposits.

Fine Sediment

Fine sediment in the Project study reaches primarily consisted of sand/decomposed granite and generally fine sediment abundance was low (local areas had higher fine sediment abundance). Fine sediment in pools was limited to a small proportion of the residual pool volume. In 48 of the 60 sampling sites, V^* values were less than 0.10. Twelve sampling sites had V^* values greater than 0.10, with the highest V^* value being 0.18 (see Section 7.7 Geomorphology; and AQ 5 – TSR [SCE 2019e; SD A]). Fine sediment within potential spawning gravels was generally within the criteria to support high reproductive success; however, spawning gravels were generally very limited in the river due to the high gradient of the rivers (see Section 7.7 Geomorphology; AQ 5 – TSR [SCE 2019e; SD A]).

Spawning Gravel Abundance

Spawning gravel is limited in the study area. Of the 61 instream flow transects in the four bypass reaches, only 18 included spawning gravels (typically a small amount). During selection of transects, transect placement emphasized locations with the most spawning gravel. In particular transects in pool tailouts and riffles were located where spawning gravel was present, if it was present in the channel (AQ 1 – TSR [SCE 2019a; SD A]). For the 18 transects with spawning gravel, the average number of cells (substrate measurement locations) across each transect was 48 (range 35 to 62 cells) and the average number of cells with spawning gravel was 8 cells per transect (range 1 to 20 cells per transect). On average, 17% of substrate on the 18 “spawning” transects was spawning gravel.

Channel Maintenance

Sediment/channel conditions in the bypass reaches are being maintained by the current flow regime. High flows continue to exist in each of the four bypass reaches. There was no berm development, channel narrowing, channelization, or aggradation / degradation observed in the bypass reaches (see Section 7.7 Geomorphology and Section 7.8 Riparian Resources). The high-flow events that move sediment and maintain the channels were relatively unchanged between existing and unimpaired flow regimes. Annual instantaneous peak flow exceedance plots for each bypass reach show that the existing and unimpaired instantaneous peak stream flows are similar. The peak flood frequency analysis for recurrence intervals from 1.005 year up to 100 years have been altered only 0.6% to 3.5% by Project operations in the bypass reaches (AQ 5 – TSR [SCE 2019e; SD A]). The difference in the frequency (duration) of days when existing daily

flows exceeded the 1.5-year unimpaired flow event was 87% to 93% of what would occur under unimpaired flows.

7.4.5.4 Riparian Vegetation

Details of the riparian resources are discussed in the Section 7.8 Riparian Resources. Riparian vegetation was sparse and patchily distributed along the majority of the four bypass reaches due to the confined valley walls and bedrock/coarse substrate. Riparian habitat occurred along approximately 3.5 linear miles or 51% of the total river miles along the bypass reaches, occurring primarily in discontinuous narrow corridors along the channel (2.7 miles) (see Section 7.8 Riparian Resources). The remaining 49% of the bypass reaches were sparsely vegetated with scattered riparian trees and shrubs. Wide corridors of riparian vegetation were relatively uncommon.

The riparian community in the bypass reaches was primarily comprised of native species. The common woody riparian species included various willow species, white alder, cottonwoods, and California sycamores. Willows and alder were the dominant woody riparian species. Fremont cottonwood and California sycamore trees were common associates within the community. A diversity of age classes, including seedlings and young individuals, was present within the bypass reaches. In general, riparian vegetation distribution and abundance along the channel and community composition/age structure were similar between the bypass reaches and the appropriate comparison reaches (see Section 7.8 Riparian Resources).

7.4.6 Instream Flow Habitat Modeling

Instream flow physical habitat modeling was conducted for each of the four bypass reaches in the Project study area using 1D hydraulics and habitat models (AQ 1 – TSR [SCE 2019a; SD A]) (Map 7.4-4). The modeling was used to develop wetted perimeter versus flow and habitat area versus flow relationships (weighted usable area [WUA] vs flow) and habitat time series habitat analyses (WUA each day).

The following habitat analyses were completed for the bypass reaches:

Bypass Reach	Method	Species/Life Stage	Months
KR US CONF EF KR US PH1 KR US PH2 EF US CONF KR	Habitat (WUA) vs. Flow and Habitat (WUA) Time Series (1994–2018)	Rainbow Trout	All
		• Spawning	March-May
		• Adult	All
		• Juvenile	All
		• Fry	May-Aug
		Hardhead / Sacramento Pikeminnow	All
		• Adult	All
		• Juvenile	All
		Sacramento Sucker	All
		• Adult	All

		• Juvenile	All
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The priority management species and life stages were selected in collaboration with the Aquatic Technical Working Group (AQ 1 – TSR [SCE 2019a; SD A]). The primary species and life stages selected for instream flow modeling included hardhead and Sacramento pikeminnow (juvenile and adult rearing), Sacramento Sucker (juvenile and adult rearing), and rainbow trout (adult, juvenile, and fry rearing and adult spawning). Habitat suitability criteria (HSC) were developed for these species and life stages (AQ 1 – TSR [SCE 2019a; SD A]). A life-stage periodicity chart (i.e., season of occurrence) for the aquatic species in the study area (Figure 7.4.10) was developed from existing information (e.g., Moyle 2002) and biologist input.

Habitat versus flow relationships were modeled over a wide range of flows (low base flows up to approximately the 5–15% exceedance unimpaired flow). The habitat versus flow relationships were combined with hydrology (impaired and unimpaired daily mean flows) over the 1994–2018 period of record to create habitat time series and habitat exceedance plots. The habitat time series were used to compare the amount of habitat during the different biologically sensitive time periods (reproduction and rearing) and identify potential habitat limiting factors/time periods. Habitat exceedance plots were created for the two Project water year types (normal and dry).

The aquatic species habitat modeling analyses were applicable either to the summer/fall rearing period or spring spawning period. Habitat suitability criteria were not developed for the winter or early spring periods (cold water periods). Typically, fish utilize comparatively low velocity water habitats during cold weather periods (Baltz et al. 1991; Vondracek et al. 1992). As a result, habitat modeling of winter habitat typically indicates that low flows provide suitable habitat.

The wetted perimeter versus flow results are provided in Section 7.4.7 Riverine Aquatic Community and the modeling results for fish species are found in the Section 7.4.8 Riverine Fish.

7.4.7 Riverine Aquatic Community

7.4.7.1 Benthic Algae

Benthic algae sampling was conducted twice historically (Jordan/Avent et al. 1983; SCE 2007) in the vicinity of the Project and algae area coverage was sampled during the 2018 AQ 3 – TSR (SCE 2019c; SD A) sampling. Jordan/Avent et al. (1983) sampled upstream of the Project in the Kaweah River, as well as in the Marble and Middle forks of the Kaweah River. At the time, high concentrations of algae were observed. The SCE (2007) study included sampling locations that overlapped the Jordan/Avent et al. (1983) sampling site and additional sampling near the Kaweah No. 2 Diversion. In the SCE (2007) study algae cover was light, typically less than 25%, in all sampling locations and there were no instances of “nuisance” algae in the sampling areas (dense growths). Didymo (*Didymosphenia geminata*), a well know nuisance algae, was not observed.

Cladophora (sp.), which can produce heavy coverages of algae, was observed only at one sampling location and abundance was low at that location.

During the AQ 3 – TSR (SCE 2019c; SD A) sampling in the bypass reaches in 2018, the percent coverage of macro algae ranged from 9% to 99% depending on the site location and dominate substrate present at the site. In general, algae abundance was moderate and nuisance algae were not observed (nor were high abundance algae locations observed). There was no obvious difference between algae coverage in the bypass reaches and the comparison reaches.

7.4.7.2 Benthic Macroinvertebrates

Drifting Macroinvertebrates

Macroinvertebrate drift sampling was conducted at eight sampling sites in August (summer) and October (fall) 2018 to document the seasonal density and size distribution of drifting macroinvertebrates in the bypass and comparison reaches of the Project (Table 7.4-6 and Map AQ 7.4-5) (AQ 3 – TSR [SCE 2019c; SD A]). General aquatic invertebrate length versus weight relationships (Cummins and Wuycheck 1971; Smock 1980) were used to convert macroinvertebrate drift to energy equivalents (joules/cubic meter [m^3]) for each size class (0–1, >1–3, >3–5, >5–7, and >7 millimeter [mm]) for potential use in bioenergetics analysis, if appropriate, to assist in the identification of limiting factors related to fish growth (food and water temperature) (AQ 3 – TSR [SCE 2019c; SD A]).

The average of the summer/fall drift density for all sites was 0.28 number/ m^3 (range 0.18 to 0.41 number/ m^3) (Table 7.4-7, Figure 7.4-11), which is on the low end of the typical drift density range reported by Allan (1995) of 0.01 to 5.0 number/ m^3 . This drift density was 19 to 30% of drift densities found in the American River Watershed (PCWA 2011) and 18% of Klamath River drift densities (Addley 2005) (Table 7.4-8, Figure 7.4-12).

Average summer/fall drift densities were similar between comparison and bypass reaches (Table 7.4-8, Figure 7.4-12). For Kaweah River comparison reaches, drift densities were 0.21 and 0.41 number/ m^3 . Kaweah River bypass reaches ranged from 0.18 to 0.30 number/ m^3 . The East Fork Kaweah River comparison reach had a drift density of 0.18 number/ m^3 while bypass reaches had drift densities of 0.32 and 0.41 number/ m^3 .

Average summer/fall prey energy at all sites was 1.7 joules/ m^3 and ranged from 0.4 joules/ m^3 to 3.3 joules/ m^3 (Table 7.4-9a and b, Figure 7.4-13). Average prey energy in the Kaweah River was 47% of the average prey energy calculated in the American River Watershed (North Fork and Middle Fork American Rivers and Rubicon River) in 2008 spring, summer, and fall sampling events (PCWA 2011).

Benthic Macroinvertebrates

Benthic macroinvertebrates were collected in the bypass and comparison reaches using the Surface Water Ambient Monitoring Program (SWAMP) RWB protocol (Ode 2016) (AQ 3 – TSR [SCE 2019c; SD A]). The samples collected from each sampling site were a

composite of 11 sub-samples, each taken from one of 11 equally spaced transects. The transects were spaced 15 meters (m) apart, or 25 m if the wetted width of the channel was greater than 10 m wide. Sub-sampling alternated between left-center, center, and right-center locations on each sequential transect. Sampling sites for benthic macroinvertebrates are identified in Table 7.4-6 and Map 7.4-5.

Macroinvertebrate taxonomy was processed according to the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) level 2 (Richards and Rogers 2006). The processed 600 organism count data was used to calculate the hydropower Index of Biotic Integrity (IBI) metrics as outlined in Rehn et al. (2007).

Benthic macroinvertebrate sampling metric results and IBI scores are presented in Table 7.4-10. Physical habitat data from sampling reaches are presented in Table 7.4-11. Kaweah River comparison reaches had IBI scores of 35 and 37 and Kaweah River bypass reaches had similar scores that ranged from 31 to 40. The East Fork Kaweah River comparison reach had an IBI score of 36 and East Fork Kaweah River bypass reaches had similar IBI scores of 40 and 42.

A literature search for comparable benthic macroinvertebrate data and metrics found that one site sampled in 2007 (ENTRIX 2007) (site F2) was in a similar location to K9.5 sampled in 2018. Taxonomic richness was slightly higher in 2018 (IBI score of 36) compared to 2007 (IBI 31). EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa richness and percentage were lower in 2018 (13 and 37.5%, respectively) compared to 2007 (16 and 51.1%, respectively). The percent of intolerant individuals was lower in 2018 (2.7%) compared to 2007 (10%).

7.4.7.3 Wetted Perimeter / Productivity

Wetted perimeter versus flow relationships for each of the four bypass reaches were modeled as part of the AQ 1 – TSR (SCE 2019a; SD A). Wetted perimeter versus flow relationships, useful for evaluating potential effects of flow regimes on wetted surface area and, therefore, productivity of algae and benthic macroinvertebrates, were relatively monotonic in their rate of increase in wetted perimeter with flow in the bypass reaches. The rate of increase in wetted perimeter with increased flow was greatest at the lowest flows and least at the highest flows. However, the relationships typically did not have distinct inflection points (distinct breaks) where an increase in flow exhibited an obvious change in the wetted perimeter relationship. Plots showing these relationships are shown in Figure 7.4-14 (also see AQ 1 – TSR [SCE 2019a; SD A]).

Comparison of wetted perimeter under existing and unimpaired hydrology conditions show that, in general, the existing wetted perimeter is approximately $\geq 80\%$ of the unimpaired wetted perimeter. Figures 7.4-15 to 7.4-18 show the existing wetted perimeter percent of unimpaired wetted perimeter for each month for both dry and normal water year types. The warm water temperature months (June–October) and cooler water temperature months (all other months) are separated in the plots. The bypass reaches on the Kaweah River (Figures 7.4-1 to 7.4-17) have existing wetted perimeter exceedance values well above 80% except for parts of December and January in the

farthest upstream reach, KR DS PH3, which are at or slightly below 80% during a small part of the exceedance. The East Fork Kaweah River is similar, except there are a few months in normal water years and dry water years (cooler months) that have a small part of the exceedance plot between 70% and 80% of unimpaired.

7.4.8 Fish Passage Barriers

Map 7.4-6 shows the barriers documented in the fish passage study (AQ 8 – TSR [SCE 2019h; SD A]) and barriers that were previously documented upstream of Kaweah RM 9.5 in the Sequoia National Park as part of another study (SCE 2007). Details and pictures of barriers surveyed in 2018 are summarized in Table 7.4-12 and AQ 8 – TSR, Appendix C (SCE 2019h; SD A).

7.4.8.1 Kaweah River

In the Kaweah River there were two Project-related barriers identified. These include the Kaweah No. 2 Diversion Dam (RM 8.9) and Kaweah No. 2 Diversion Dam Gage Pool Weir (RM 8.8). The Kaweah No. 2 Diversion Dam was identified as an impassable barrier and the Kaweah No. 2 Diversion Dam Gage Pool Weir was identified as a partial barrier to fish passage (Map 7.4-6; Table 7.4-12; AQ 8 – TSR, Appendix C (SCE 2019h; SD A)). Additionally, one natural partial barrier was documented on the Kaweah River below Kaweah No. 2 Powerhouse at RM 3.8, downstream of the bypass reaches, and an impassable natural barrier was identified upstream of the bypass reaches within the Sequoia National Park at RM 9.5 approximately 0.6 mile upstream of the Kaweah No. 2 Diversion Dam.

The Kaweah No. 2 Diversion Dam at RM 8.9 precludes upstream fish passage into the river reach from RM 8.9 upstream to the impassable natural barrier at RM 9.5 (numerous partial and impassable barriers exist upstream of RM 9.5, both natural and manmade).

7.4.8.2 East Fork Kaweah River

In the East Fork Kaweah River, there were two Project-related barriers, including the Kaweah No. 1 Diversion Dam and Kaweah No. 1 Diversion Dam Gage Pool Weir (Map 7.4-6; Table 7.4-12; AQ 8 – TSR, Appendix C (SCE 2019h; SD A)). Both structures create impassable fish barriers at approximately RM 4.7. Downstream of the Project-related barriers there were two natural barriers that were surveyed – an impassable natural barrier on the East Fork Kaweah River near the confluence at RM 0.2 and an impassable natural barrier at RM 4.4 below the Kaweah River Bridge. Analysis of aerial photographs of the river stretch between these natural barriers suggest the existence of many similar impassable natural barriers in this section of river, however, ground surveys were unsafe due to steep terrain.

7.4.9 Riverine Fish

Fish sampling was conducted in each of the five bypass reaches and three comparison reaches (Table 7.4-1) and is reported in the AQ 2 – TSR (SCE 2019b; SD A). The sampling was designed to identify the spatial distribution and the abundance of fish

species in the Project study area. Quantitative sampling was conducted during the late summer/early fall base flow period using a combination of electrofishing (shallow water) and snorkeling (deep water) at each representative reach study site. At the snorkeling locations, juvenile hardhead and Sacramento pikeminnow less than approximately 3 inches were recorded as a single category, “unidentified juvenile mixed minnow”, due to the difficulty of distinguishing these two species during snorkeling.

Qualitative sampling using single pass electrofishing and/or seining gear was also used to collect seasonal information on emergence of fry. The purpose of this sampling was to identify the timing and abundance of fry in the vicinity of Project diversions (Kaweah No. 1 and Kaweah No. 2 diversions) and diversions within the Sequoia National Park (Marble Fork and Middle Fork diversions) with respect to potential entrainment into the diversions.

Information discussed below in relation to riverine fish includes: (1) distribution and diversity; (2) growth and condition; (3) emergence/spawning timing; (4) abundance (standing crop); (5) fish stocking; and (6) bypass reach habitat.

7.4.9.1 Distribution and Diversity

The results of the quantitative and qualitative fish population sampling (AQ 2 – TSR [SCE 2019b; SD A]) are summarized in a sampling site by species matrix, Table 7.4-1, to show the distribution and diversity of each fish species observed in the Kaweah River and in the East Fork Kaweah River. Hardhead and Sacramento pikeminnow were captured at all sampling sites in the Kaweah River and only the lowest elevation site on the East Fork Kaweah River. Sacramento suckers were found throughout the Kaweah and East Fork Kaweah River sampling sites. Rainbow trout were found in the upper three sampling sites on the Kaweah River, but not the lower two sites and at all of the East Fork Kaweah River study sites. Smallmouth bass were found in the lower three Kaweah River sites and lower East Fork Kaweah River. California roach were found at the two upper sites on the Kaweah River and the two lower sites on the East Fork Kaweah River.

7.4.9.2 Growth and Condition

Length Frequency Histograms and Age Structure

Length frequency histograms were created for rainbow trout as well as for all other fish species captured during river sampling and special-purpose qualitative sampling at all of the fish sampling locations (Figure 7.4-19). Note that electrofishing and snorkeling data are presented in different size categories. In general, most of the fish captured or observed were YOY and juvenile, with some adults. Rainbow trout included juvenile fish up to about 100 mm (0+ and 1+) and adults from about 130–220 mm, with one adult observed greater than 260 mm (Figure 7.4-19; Figure 7.4-20; and AQ 2 – TSR, Appendix B, Table B-2 (SCE 2019b; SD A). The largest/oldest rainbow trout collected were 3+ years old (approximately 200+ mm) (Figure 7.4-20). Length frequency histograms for rainbow trout at each sampling site where they were observed are provided in AQ 2 – TSR, Appendix C (SCE 2019b; SD A). A length versus weight relationship for rainbow

trout is also provided in Figure 7.4-21. Pikeminnow, Sacramento sucker, and California roach were dominated by juvenile fish with a few larger adults captured/observed. Hardhead and smallmouth bass were an exception to the general pattern, with approximately equal numbers of juvenile and larger adult fish observed. Hardhead were particularly bimodal, with equal numbers of small (<80 mm) and larger (>260 mm) fish captured/observed (Figure 7.4-19).

Condition Factor

Fulton's fish condition factor provides a relative index of the nutritional state (e.g., storage of muscle and lipids) of the fish, but the values of calculated condition factor that represent good or poor nutritional state vary by species, depending on their body shape, and can vary depending on the size (length) of fish within a species. The average condition factor of rainbow trout in the Project study area was 1.17 (Table 7.4-14). Condition factors for trout can range from <0.6 to >2.0 (Carlander 1969), where starving fish often have condition <0.7 (Reimers 1963; Carlander 1969) and exceptional fish have high condition factors (e.g., >1.5). The condition factor for rainbow trout in the Project area appears to be good, but is not exceptional. Similar rainbow trout condition factors to those observed in the Project vicinity were found in the Kings River downstream of Pine Flat Dam (Hanson and Bajjaliya 2005) and represent fish in good condition. Detailed information for condition factors at individual sampling locations and for rainbow trout YOY versus older fish is shown in Table 7.4-15. There were no remarkable differences between sampling sites or fish sizes. For all other fish species (hardhead, Sacramento pikeminnow, Sacramento sucker, sculpin, California roach, and smallmouth bass) average condition factors are shown in Table 7.4-14. Reference data for the condition factors for these species were not available.

7.4.9.3 Emergence/Spawning Timing

The total number of fry sampled or observed in the vicinity of each diversion during the June 13-14 and July 6-7, 2018, emergence sampling was relatively small. The results of the qualitative fry emergence surveys are shown in Table 7.4-16. Rainbow trout, brown trout, Sacramento pikeminnow, hardhead, unidentified juvenile mixed minnows, Sacramento sucker, and California roach were captured or observed during the sampling. No rainbow trout YOY were captured in the June 13-14 sampling. During the July 6-7 sampling, one rainbow trout was captured near the Middle Fork Diversion (total length [TL] = 46 mm) and eight rainbow/brown trout were captured or observed near the Marble Fork Diversion (RBT TL = 40 to 50 mm; BRT TL = 72 to 82 mm). Based on lack of rainbow trout fry observed in mid-June and the size of rainbow trout fry captured in early July (TL = 40 to 50 mm), rainbow trout emergence likely occurred sometime in early or mid-June. For example, emergence size for rainbow trout fry is approximately ≥ 26 mm (Reclamation 2010). Potential growth at 15°C to 20°C (59°F to 68°F) from early June to early July when rainbow trout fry were captured would be approximately 20 mm in length (calculated from observed laboratory growth rates in Hokanson et al. 1977); therefore, emergence of fry in early June would result in fry in the size range observed in early July (40 to 50 mm).

Minnow species and Sacramento sucker hatching also likely occurred sometime in mid-to late-June. The number and size of larval minnow species observed in mid-June was very small and more larval/fry minnows were observed in the early July sampling.

A fish life stage periodicity chart (or life history chronology chart by month) for each species in the study reaches was developed based on available literature (Moyle 2002), discussion with qualified fisheries biologists, and review of the results of the 2018 fish population sampling (backpack e-fishing, snorkeling, and YOY sampling; Table 7.4-17).

7.4.9.4 Abundance (Standing Crop)

Sacramento pikeminnow, hardhead (including YOY mixed minnows), and Sacramento sucker were the dominant fish species in the study reaches (Tables 7.4-18 and 7.4-19). The study reaches on the Kaweah River and the lower East Fork Kaweah River are situated directly within the pikeminnow-hardhead-sucker assemblage elevation zone (100–1,500 feet above msl) of the Sacramento-San Joaquin Province / Sierra Nevada foothills (Moyle 2002). Along the Sierra Nevada mountain range, the foothill streams in this elevation band are dominated by pikeminnow-hardhead-sucker species, primarily due to water temperature. Figure 7.4-22 shows the elevation of the fish sampling locations. The only sampling locations that were above the 100–1,500 feet above msl elevation band are two sites on the upper East Fork Kaweah River (>2,500 feet above msl). Water temperature at the fish sampling locations generally ranged from 68–86°F (20–30°C) during the summer months (Figure 7.4-23).

Rainbow trout numbers in the reaches were relatively low, ranging from 0–707 fish/mile (25.6 pounds [lbs]/mile), with the highest numbers in the upper East Fork Kaweah River where the water temperature was cooler (Table 7.4-19 and Figure 7.4-24). Conversely, smallmouth bass were present in the lower Kaweah River and lower East Fork Kaweah River (lowest elevation sites) where the warmest summer water temperature occurred (Table 7.4-18).

Fish densities by mesohabitat type within each sample reach are shown in Table 7.4-20 (fish/mile) and Table 7.4-21 (fish/acre) for all species captured. Rainbow trout biomass (lbs/mile and lbs/acre) for each mesohabitat type within each sample reach is shown in Table 7.4-22.

For comparison purposes, the rainbow trout fish density and biomass results from the sampling effort in the bypass reaches associated with the Kaweah Project were compared to density and biomass data from other Sierra Nevada stream systems in the same elevation range (Figure 7.4-25). Rainbow trout density and biomass in the bypass reaches and reference reaches upstream of the Project are lower than most of the Sierra Nevada fish density data in Figure 7.4-25. The Sierra Nevada fish density data were summarized from the Yuba and American Rivers (PCWA 2010) as well as the Middle Fork San Joaquin River, Clark Fork Stanislaus River, Clavey River, Merced River, Kings River, Kaweah River (1984 and 1985 surveys), and Tule River (CDFW 2017). The dataset was limited to elevations between 500 and 3,000 feet above msl. Water temperature may be a confounding factor in the Sierra Nevada data sets as many of the

data sets are derived from streams with colder water temperature downstream of reservoirs, whereas the bypass reach data sets are not influenced by cold/cool reservoir flow releases.

7.4.9.5 Fish Stocking

Fish species in the bypass and comparison reaches are naturally reproducing populations and no stocking currently occurs. Historically fish stocking of trout did occur in the Project study area.

7.4.9.6 Bypass Reach Habitat Modeling

The habitat versus flow relationships and habitat time series analyses for hardhead (juvenile and adult) (including Sacramento pikeminnow), Sacramento sucker (juvenile and adult), and rainbow trout (spawning, adult, juvenile, fry) and fish species are summarized below. Tables of WUA and percent of maximum WUA are presented for each study site in AQ1 – TSR, Appendix E (SCE 2019a; SD A).

Habitat versus Flow Modeling

Habitat versus flow relationships in the bypass reaches indicated that relatively large flows (in comparison to the natural unimpaired summer flow) provide the maximum habitat for species and life stages that use deep and relatively faster water, such as adult hardhead/pikeminnow, adult Sacramento sucker, and adult rainbow trout. That is, the channels in the bypass reaches are relatively large, presumably because of frequent high magnitude winter and spring flow events, and are capable of providing habitat for deep/fast water species/life stages at much higher flows than the natural summer/fall base flows that occur in these rivers (very low summer/fall baseflows compared to other times of the year). Table 7.4-23 (also see AQ 1 – TSR [SCE 2019a; SD A]) provides information on existing and unimpaired flows for the streams/rivers associated with the Project. The existing flow exceedances are slightly lower than the unimpaired flow exceedances.

The hardhead/pikeminnow adult, Sacramento sucker adult, and rainbow trout adult habitat versus flow relationships were very similar and typically reached a maximum at the highest discharges (approximately 150 cfs to 200 cfs in the Kaweah River and 100 cfs to 150 cfs in the East Fork Kaweah River) compared to other species/life stages (Figures 7.4-25 to 7.4-28). Juvenile and fry life stages reached a maximum habitat at much lower flows. The amount of rainbow trout spawning habitat in the bypass reaches was very low due to the very limited amount of spawning gravel.

In the East Fork Kaweah River, habitat versus flow relationships are typically only applicable to the accessible lower 0.5 miles of channel where the instream flow modeling was conducted (EF US Confl). Upstream in the inaccessible bypass reach (EF DS K1 Div), the channel is much narrower and steeper and too dangerous to measure/model. Presumably, in the upstream bypass reach (EF DS K1 Div), habitat would reach a maximum at a much lower flow than occurs at the wider, lower gradient EF US Confl site where the modeling was conducted.

Habitat Time Series Modeling

A time series analyses (1994 to 2018) of existing and unimpaired flow conditions was used to provide an estimate of the difference between existing habitat and the natural habitat potential (unimpaired habitat) in the bypass reaches associated with the Project. The data and detailed discussion are presented in AQ 1 – TSR (SCE 2019a; SD A). A summary of the results is provided below.

KAWEAH RIVER

The lower Kaweah River from the Kaweah No. 1 Powerhouse to Lake Kaweah is designated as a Central Valley drainage hardhead/pikeminnow stream and a CNDDDB rare natural community (CDFW 2019). In addition, adult hardhead/pikeminnow typically require some of the highest flow needed among fish species/life stages in the Kaweah River to achieve maximum habitat (similar to adult Sacramento sucker and adult rainbow trout). The individual monthly exceedance plots of existing and unimpaired habitat are shown in AQ 1 – TSR, Appendix G (SCE 2019a; SD A) for each bypass reach. A summary of the difference between the existing and unimpaired habitat each month is shown in Figures 7.4-29 to 7.4-32. Existing habitat in all months is $\geq 80\%$ of unimpaired habitat in the lowest reach, KR US PH2, and approximately $\geq 70\%$ (typically $\geq 80\%$) in all months in the upper two reaches (KR US PH1 and KR DS PH3). The lowest months (months where part of the exceedance plot is $< 80\%$) are the drier months in the fall and early winter before snowmelt occurs (October, November, December, January and February). Figure 7.4-32 shows the existing percent of unimpaired habitat for all three of the Kaweah River bypass reaches combined (weighted by length of the reaches).

Adult rainbow trout habitat is similar to the adult hardhead habitat, but with slightly lower existing percentages of unimpaired habitat (see AQ 1 – TSR [SCE 2019a; SD A]). Typically, however, the water temperature in these reaches is naturally too high for quality rainbow trout habitat (e.g., $> 70^{\circ}\text{F}$) and more conducive to hardhead, Sacramento pikeminnow, Sacramento sucker, and other warmer water species.

Juvenile habitat (hardhead/pikeminnow, Sacramento sucker, rainbow trout) and rainbow trout spawning habitat, in general, was higher under existing compared to unimpaired habitat (see AQ1 – TSR, Appendix G [SCE 2019a; SD A]). This occurs because during many months unimpaired flow is too high to provide optimum habitat for juvenile life stages or spring spawning and the reduction of flows in the bypass reaches from the Project diversion actually enhances habitat.

EAST FORK KAWEAH RIVER

LOWEST REACH (EF US CONFL)

In the lower East Fork Kaweah River bypass reach (EF US Confl), adult hardhead/pikeminnow required some of the highest flow needed among fish species/life stages to achieve maximum habitat (similar to adult Sacramento sucker and adult rainbow trout). The individual monthly exceedance plots of existing and unimpaired habitat are shown in AQ1 – TSR, Appendix G (SCE 2019a; SD A) for each bypass reach. A summary

of the difference between the existing and unimpaired habitat each month is shown in Figure 7.4-33. Existing habitat in all months is $\geq 70\%$ and typically $\geq 80\%$ in the wetter months (March to July).

Adult rainbow trout habitat is similar to adult hardhead/pikeminnow habitat, but with slightly lower existing versus unimpaired habitat percentages (see AQ 1 – TSR [SCE 2019a; SD A]). Typically, however, the water temperature is too high for quality rainbow trout summer rearing habitat (e.g., $>70^{\circ}\text{F}$) in the lower reach (EF US Confl) and more conducive to hardhead, Sacramento pikeminnow, Sacramento sucker, and other warmer water species.

Juvenile habitat (hardhead/pikeminnow, Sacramento sucker, rainbow trout, in general, was lower under existing compared to unimpaired habitat (see AQ1 – TSR, Appendix G [SCE 2019a; SD A]). Juvenile WUA tends to have a maximum habitat at flows of 50 cfs. Once flow exceed this the habitat decreases. Habitat at lower flows (10–25 cfs) increases rapidly as flow increase, as a result if water is diverted at these lower flows the habitat can decrease quickly. Rainbow trout spawning tends to decrease under existing conditions when compared to unimpaired.

UPPER REACH (EF DS K1 DIV)

The upper reach, EF DS K1 DIV, was not modeled due to the narrow, steep, and dangerous terrain. We assume that because of the narrower channel, diversion of flow from the bypass channel would have less negative impact on adult habitat than in the downstream, wider channel bypass reach (EF US Confl) (see discussion above) and more beneficial impacts on juvenile habitat and spring rainbow trout spawning habitat.

7.4.10 Foothill Yellow-Legged Frogs

7.4.10.1 Distribution and Abundance

Surveys for FYLF were conducted in spring and/or late summer and early fall along the bypass and comparison reaches (and their tributaries) to document the distribution and abundance of FYLF (Map 7.4-7; Figure 7.4-33). The surveys followed the Visual Encounter Protocol described in Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians (Heyer et. al. 1994). The study sites and survey methods are described in the AQ 7 –TSR (SCE 2019g; SD A).

FYLF were not observed in the surveyed reaches. In the reaches where FYLF might have been expected to be present based on physical habitat, bullfrogs were found (competitors/predators of FYLF). It is highly unlikely that FYLF persist in the study area, given the dominance of bullfrogs in the lower elevation reaches, the absence of permanently flowing tributaries in the higher elevation study reaches, and the position of the Watershed downwind of areas in the Central Valley where pesticide use is heavy (Davidson et al. 2004, Sparling et al. 2015). Pacific treefrogs in the area have long shown the negative effects of pesticides (Datta et al. 1998) and FYLF is particularly sensitive to contaminant exposure (Sparling and Fellers 2015, Kerby and Sih 2015).

The possibility that a small remnant FYLF population may exist somewhere in the greater Kaweah Watershed cannot be completely ruled out because frog populations that have gone undetected for decades are occasionally re-discovered (Backlin et al. 2018). However, there are no recent observations of FYLF in the Watershed. The most recent records date back to 1970, almost 50 years ago (Moyle 1973). At that point in time, FYLF were already uncommon in the region according to the Conservation Assessment for FYLF (Hayes et al. 2016). No collections or sightings of FYLF exist from Sequoia National Park in the interval from 1980 to present.

The only other relatively recent (i.e., within the last few decades) sightings in the vicinity, were outside the Watershed, in two unnamed tributaries of the North Fork Kern River in Sequoia National Forest (Lind et al. 2003). The creeks were surveyed multiple times from 1998 to 2002. The last observation of FYLF from one creek was of three adults found by Patrick Kleeman of the U.S. Geological Survey (USGS) on September 12, 1998 (Lind et al. 2003). No frogs were observed at that locality during three subsequent surveys conducted 2002–2003. At least two adult FYLF were observed per survey at the other creek between 1998 and 2002 (Lind et al. 2003).

7.4.10.2 Habitat

Based on longitudinal profile, topography, and geomorphology, the sections of river with the greatest proportion of wide channel cross sections, low gradients, and close proximity to tributaries should offer the best habitat for FYLF (Kupferberg 1996, Rice 2017). Upstream of the Project (KR US PH3 and EF US K1 DIV), there was little indication of habitat suitable for FYLF. There were only small isolated locations in the river channels with slow velocity habitat and the off-channel tributaries were ephemeral. Similarly, the bypass study reaches in the upstream portion of the study area (KR US CONF EF, EF DS K1 DIV) provided limited FYLF habitat. The channels are generally narrow and steep gradient with limited depositional area suitable for breeding and perennial off-channel tributaries are not present. The lower portion of the Kaweah River study area (KR US PH1, KR US PH2, and KR DS PH2), provides pockets of suitable FYLF breeding habitat, including side channels, however, the presence of abundant bullfrogs and other predators such as signal crayfish, likely precludes the possibility of FYLF occupying the habitat.

7.4.11 Fish Entrainment

The Project locations where fish entrainment could result in fish translocation or mortality (e.g., into flowlines or through Project powerhouses) include: (1) Kaweah No. 1 Diversion, flowline, forebay, and powerhouse (2) the Kaweah No. 2 diversion, flowline, forebay, and powerhouse and (3) the Kaweah No. 3 flowline, forebay, and powerhouse. The timing of YOY fish emergence, abundance of fish in the river reaches upstream of the Project diversions, empirical fish entrainment sampling, and diversion/powerhouse characteristics related to fish translocation or mortality are discussed below.

7.4.11.1 Emergence Timing

The timing of emergence in river reaches upstream of Project diversions, could influence the entrainment of YOY fishes. The AQ 9 – TSR (SCE 2019i; SD A) included emergence sampling near diversions and emergence sampling is also discussed in Section 7.4.9.3. The number of fry sampled or observed in the vicinity of each diversion during the June 13-14 and July 6-7, 2018, emergence sampling was relatively small. In total, at the four upstream of diversion sampling sites (Marble Fork Diversion, Middle Fork Diversion, Kaweah No. 2 Diversion, Kaweah No. 1 Diversion), there were only 45 YOY and 139 YOY fish captured, June and July, respectively. Rainbow trout, brown trout, Sacramento pikeminnow, hardhead, unidentified juvenile mixed minnows, Sacramento sucker, and California roach were captured during the sampling. Based on lack of rainbow trout fry observed in mid-June and the size of rainbow trout fry captured in early July (TL = 40 to 50 mm), rainbow trout emergence likely occurred sometime in early or mid-June. Minnow species and Sacramento sucker hatching also likely occurred sometime in June. The number and size of larval minnow species observed in mid-June was very small and more larval/fry minnows were observed in the early July sampling. The data suggest that hatching was occurring primarily in June.

Section 7.2.3.3 shows the hydrology related to each individual diversion. During the driest years the diversions quit diverting flow in late June or early July and, therefore, the diversion pattern would minimize the potential for YOY entrainment. During wetter years, the diversions continue to divert later into the summer and/or fall and there would be more opportunity for YOY entrainment.

7.4.11.2 Fish Abundance

Entrainment potential is likely related to fish abundance in the river reaches upstream of the Project diversions. Section 7.4.9.4 discusses fish abundance in the bypass and comparison reaches. Sacramento sucker, Sacramento pikeminnow, and hardhead (including YOY mixed minnows), in general, were the dominant fish species in the study reaches, with California roach being relatively abundant in the upper reaches of both the Kaweah River and East Fork Kaweah River (KR US PH3, KR DS PH3, EF US Confl). Rainbow trout numbers in the reaches were relatively low compared to other Sierra Nevada trout rivers, ranging from 0–707 fish/mile (25.6 lbs/mile), with the highest numbers in the upper East Fork Kaweah River where the water temperature was cooler.

7.4.11.3 Entrainment Sampling

Entrainment sampling (fyke net and drift net) is being conducted as part of the revised AQ 9 – Entrainment Technical Study Plan (TSP) filed with FERC on December 11, 2018¹. Because entrainment sampling will not be completed prior to filing of the Kaweah Project Application for New License (December 2019), SCE and key resource agencies met to collaborate on a modified schedule and approach for completing and reporting the AQ 9 – TSP. On December 3 and December 10, 2019, SCE met with the California Department of Fish and Wildlife (CDFW) and the State Water Resources Control Board (State Water

¹ FERC Accession No.: 20181212-5130; Available online at: <https://www.ferc.gov/docs-filing/elibrary.asp>.

Board) and reached agreement on a proposed approach. Consistent with direction from FERC staff, SCE filed the proposed approach in a letter to FERC (Comments on Updated Study Report Meeting Summary, December 20, 2019) and included the Entrainment Study Measure in Exhibit E, Section 4, Appendix 4-A of the Application for New License. Details of the AQ 9 – TSP components completed to date and the modified schedule and approach are provided below.

Table 7.4-24 shows the sampling that has occurred and the schedule for future sampling. Both drift net sampling and fyke net sampling are being conducted for a three day/night period during four seasons. Due to dangers of overtopping the Kaweah No. 3 Flowline, only drift net sampling is proposed, not fyke net sampling. The Revised AQ 9 – Entrainment TSP proposes to use fyke net entrainment monitoring in the Kaweah No. 1 and 2 flowlines to approximate entrainment in Kaweah No. 3 Flowline. The Revised AQ 9 – Entrainment TSP also allows for additional entrainment sampling based on consultation with agency biologists/staff.

Kaweah No. 1 Flowline

Direct entrainment sampling (fyke and drift nets) occurred at the top of the Kaweah No. 1 Flowline for one day on May 14, 2019 (Table 7.4-24), however, due to conflicts with the landowner who has a home on the other side of the river near the sampling location, the sampling was cancelled. The sampling for two 4-hour time windows during the day and a 0.8-hour time window at night before the sampling was discontinued, resulted in no fish (adult, juvenile, or fry) being captured. In addition, no fish were visually observed in the sandbox or flume (SCE 2019i; SD A). Completion of the entrainment sampling in the Kaweah No. 1 Flowline is included as a proposed license measure and will be completed within 18 months of issuance of the new license (Table 7.4-24) (refer to Appendix 4-A, Section 4.1.5 – Entrainment Study Measure).

Kaweah No. 2 Flowline

Direct entrainment sampling in the Kaweah No. 2 Flowline (fyke and drift nets) occurred during two time periods, May 7-9, 2019 and July 9-11, 2019 (Table 7.4-24). During the three days of sampling (three 4-hour periods each day), only one fish was captured in the fyke net (35 millimeter Sacramento pikeminnow) and no fry were captured in the drift nets. In addition, no fish were visually observed in the approximately 1,000 feet of flowline upstream of the sampling location (SCE 2019i; SD A). Completion of the entrainment sampling in the Kaweah No. 2 Flowline will be completed by April 2020 (Table 7.4-24) (refer to Appendix 4-A, Section 4.1.5 – Entrainment Study Measure).

Kaweah No. 3 Flowline

Drift net entrainment sampling at the Kaweah No. 3 Flowline was conducted May 21-23, 2019 and July 23-25, 2019 (Table 7.4-24). No fry were captured in the drift nets (SCE 2019i; SD A). Based on collaboration between SCE and key resource agencies with respect to entrainment sampling (CDFW and the State Water Board) on December 3 and December 10, 2019, drift net sampling in the Kaweah No. 3 Flowline was deemed

complete at this time and the need for any additional drift net sampling in the Kaweah No. 3 Flowline will be determined based on interpretation of drift net sampling results from the Kaweah No. 2 Flowline (Table 7.4-24) (refer to Appendix 4-A, Section 4.1.5 – Entrainment Study Measure).

7.4.11.4 Diversion/Powerhouse Characteristics

Kaweah No. 1 Diversion, Flowline, Forebay, and Powerhouse

Any potential entrainment of fish at the Kaweah No. 1 Diversion would result in translocation of fish into the Kaweah No. 1 flowline, forebay tank, and powerhouse. The annual number of fish that potentially are entrained into the Kaweah No. 1 Diversion/Flowline is currently unknown, however, direct sampling to date (Section 7.4.11.3) and incidental observations by maintenance workers and field biologists suggest the number may be very low. Presently the Kaweah No. 1 Flowline is out of service due to a rockslide.

Generally, fish entrained into the flowline would have high survival, until at some point the flowline was dewatered or the fish were entrained into the powerhouse. The Kaweah No. 1 Powerhouse is an impulse turbine with 1,260 feet of head and a capacity of 24 cfs. It is assumed that entrained fish passing through an impulse turbine will sustain high mortality (nearly 100%). Translocation of fish from the diversion, into the flowline, into the powerhouse and back into the Kaweah River below the powerhouse would be associated with a high percentage mortality risk (SCE 2019i; SD A).

Kaweah No. 2 Diversion, Flowline, Forebay, and Powerhouse

Any potential entrainment of fish at the Kaweah No. 2 Diversion would result in translocation of fish into the Kaweah No. 2 flowline, forebay, and powerhouse. The annual number of fish that potentially are entrained into the Kaweah No. 2 Diversion/Flowline is currently unknown, however, direct sampling to date (Section 7.4.11.3) and Incidental observations by maintenance workers and field biologists suggest the number may be very low.

Generally, fish entrained into the flowline would experience high survival, until at some point the flowline was dewatered or the fish were entrained into the powerhouse. Typically, the flowline maintains a few cfs of flow to provide consumptive water-rights conveyance and fish may not experience complete dewatering very frequently. The Kaweah No. 2 Powerhouse is a Francis-type turbine with 344 feet of head and a capacity of 82 cfs. Francis-type turbines typically have moderate to high average survival rates of 67-90% for fish <250 millimeter (mm) passing through them (Winchell et al. 2000). Translocation of fish from the diversion, into the flowline/forebay, into the powerhouse, and back into the Kaweah River below the powerhouse would likely be associated with a low to moderate percentage mortality risk (SCE 2019i; SD A).

Kaweah No. 3 Flowline, Forebay, and Powerhouse

Any potential entrainment of fish at the Kaweah No. 3 diversions (Marble Fork and Middle Fork Kaweah River) would result in translocation of fish into the Kaweah No. 3 flowline, forebay, and powerhouse. The annual number of fish that potentially are entrained into the Kaweah No. 3 Diversion/Flowline is currently unknown, however, direct sampling to date (Section 7.4.11.3) and incidental observations by maintenance workers during maintenance outages and draining of the Kaweah No. 3 Forebay, suggest the number may be relatively low (SCE 2019i; SD A).

Generally, fish entrained into the flowline would experience high survival in the flowline and/or the forebay, until at some point the flowline/forebay was dewatered or the fish were entrained into the powerhouse. The Kaweah No. 3 Powerhouse is an impulse turbine with 750 feet of head and a capacity of 92 cfs. It is assumed that entrained fish that pass through an impulse turbine will sustain high mortality (nearly 100%). Translocation of fish from the diversion, into the flowline, into the powerhouse and back into the Kaweah River below the powerhouse would be associated with a high percentage mortality risk (SCE 2019i; SD A).

7.4.12 Special-Status Species

Table 7.4-25 provides a list of special-status species identified by resources agencies as potentially occurring in the Project area. Of these, only three – hardhead, FYLF, and WPT, may potentially occur in the study area. These species are discussed below.

7.4.12.1 Hardhead

Hardhead distribution and abundance in the Project study area was discussed above in Sections 7.4.9.1 and 7.4.9.4, respectively. Hardhead, were present in low to moderate abundance in all of the bypass and comparison reaches on the Kaweah River (KR US PH3, KR DS PH3, KR US PH1, KR US PH2, KR DS PH2) and in the lowest reach of the East Fork Kaweah River (EF US Confl). Hardhead were not found in the upper reaches of the East Fork Kaweah River (EF DS K1 Div or EF US K1 Div) likely due to the extensive number of natural upstream migration barriers in the narrow, steep, confined channel. It is unlikely hardhead have ever existed in these reaches. A total of 36 hardhead were captured or observed during the AQ 2 – TSR (SCE 2019b; SD A) sampling. The hardhead size distribution was bimodal with approximately half of the fish being juvenile fish and half being adult fish. A large number of mixed minnows were observed during the snorkel sampling in the Kaweah River study reaches and it is unknown how many of these were hardhead (AQ 2 – TSR [SCE 2019b; SD A]).

7.4.12.2 Foothill Yellow-legged Frog

Historical data and extensive FYLF sampling as part of AQ 7 – TSR (SCE 2019g; SD A) are discussed in Section 7.4.10. FYLF were not observed during the surveys conducted in the Project study area. In the reaches where FYLF might have been expected to be present based on physical habitat, bullfrogs were found (competitors/predators of FYLF). It is highly unlikely that FYLF persist in the study area, given the dominance of bullfrogs

in the lower elevation reaches, the absence of permanently flowing tributaries in the higher elevation study reaches, and the position of the Watershed downwind of areas in the Central Valley where pesticide use is heavy (Davidson et al. 2004, Sparling et al. 2015). Pacific treefrogs in the area have long shown the negative effects of pesticides (Datta et al. 1998) and FYLF is particularly sensitive to contaminant exposure (Sparling and Fellers 2015, Kerby and Sih 2015).

The possibility that a small remnant FYLF population may exist somewhere in the greater Kaweah Watershed cannot be completely ruled out because frog populations that have gone undetected for decades are occasionally re-discovered (Backlin et al. 2018). However, there are no recent observations of FYLF in the Watershed. The most recent records date back to 1970, almost 50 years ago (Moyle 1973). At that point in time, FYLF were already uncommon in the region according to the Conservation Assessment for FYLF (Hayes et al. 2016). No collections or sightings of FYLF exist from Sequoia National Park in the interval from 1980 to present.

The only other relatively recent (i.e., within the last few decades) sightings in the vicinity, were outside the watershed, in two unnamed tributaries of the North Fork Kern River in Sequoia National Forest (Lind et al. 2003). The creeks were surveyed multiple times from 1998 to 2002. The last observation of FYLF from one creek was of three adults found by Patrick Kleeman of the USGS on September 12, 1998 (Lind et al. 2003). No frogs were observed at that locality during three subsequent surveys conducted 2002–2003. At least two adult FYLF were observed per survey at the other creek between 1998 and 2002 (Lind et al. 2003).

7.4.12.3 Western Pond Turtle

The FYLF study sites (AQ 7 – TSR [SCE 2019g; SD A]) and Section 7.4.10 were surveyed for WPT during the FYLF surveys. In particular, surveyors visually inspected pools and backwaters for WPT at each study site during the FYLF surveys. Additionally, potential sightings of WPT during implementation of other aquatic technical studies were recorded, if they occurred. In particular, these included the AQ 1 – Instream Flow Study mesohabitat mapping and field data collection (SCE 2019a; SD A), the AQ 2 – Fish Population study (SCE 2019b; SD A), and the AQ 3 – Macroinvertebrate study (SCE 2019c; SD A).

No WPT were encountered either in the water or on land during the three surveys conducted by the amphibian/reptile surveyors. No incidental observations of WPT occurred during the other aquatic studies. There was one incidental observation of an unidentified turtle on July 25, 2018 in the KR US PH2 reach (i.e., downstream of Kaweah No.1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse); however, the unidentified turtle was in the vicinity (200 m and 380 m east-southeast) of a pair of ponds where many bullfrogs, known predators of hatchling WPT, were observed (Jancowski and Orchard 2013), and there is a high potential that non-native turtles could be present and the observed turtle; therefore, may have been non-native.

Similar to the findings for FYLF, the upstream survey reaches in both the Kaweah and the East Fork Kaweah River where cascades and narrow bedrock canyons were common, provide limited instream habitat for turtles and no large woody debris for basking. Side pools and side channels in the downstream lower gradient reaches (KR US PH1, KR US PH2, KR DS PH2) would provide refuge during high flows for WPT, but again, most suitable habitat was occupied by bullfrogs.

There are recent observations of WPT near the study area from two locations in Sequoia National Park that have been the focus of either population monitoring (Jeffcoack 2014), thermal behavior research (Ruso et al. 2017) or ecotoxicological studies (Datta et al. 1998; Meyer et al. 2013, 2014, 2016). One population occupies pools in the permanently flowing reaches of the North Fork Kaweah near the confluence with Yucca Creek approximately 12 kilometers (km) upstream of the study area. The other is in Sycamore Creek, an intermittent tributary of the Middle Fork Kaweah approximately 1 km from the study area (see Map 7.4-7). These sites have long histories of being occupied by WPT as there are collections records from the University of California's Museum of Vertebrate Zoology (MVZ) for both of these sites dating from 1935 (record Nos. MVZ: Herp:19334, 18277, 21910). Turtles in the Kaweah Watershed show evidence of high loads of agricultural pesticides and immunological impairment due to windborne contaminants that drift into the study area from the Central Valley (Datta et al. 1998; Meyer et al. 2013, 2014, 2016).

Geographic Information System (GIS) analysis indicates that potential nesting habitat exists in a narrow patchy corridor along the Kaweah River and East Fork Kaweah River corridors and along some of the small tributaries / ponds that may maintain permanent water (Map 7.4-8). During field work no evidence of nesting activity in the Project area was observed. During reconnaissance surveys at potential nesting locations identified in the GIS map near Project facilities (e.g., powerhouses, diversion pools, and Project roads), we found that a large amount of the GIS-identified habitat included substrate (e.g., large cobble/boulders, roadways) and/or dense vegetation that was not suitable for nesting. Potential nesting habitat with suitable substrate on the north side of the river upstream of the Kaweah No. 2 Diversion and on the north side of the river near the Kaweah No. 2 Powerhouse was identified.

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TABLES

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Table 7.4-1. Bypass and Comparison Reaches in the Project Study Area.

Study Reach	Site ID	Bypass Reaches	Comparison Reaches¹
Kaweah River Upstream of Kaweah No. 3 Powerhouse	KR US PH3		X
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence	KR DS PH3	X	
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse	KR US PH1	X	
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse	KR US PH2	X	
Kaweah River Downstream of Kaweah No. 2 Powerhouse	KR DS PH2		X
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion	EF US K1 Div		X
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion	EF DS K1 Div	X	
East Fork Kaweah River Upstream of Confluence with Kaweah River	EF US Confl	X	

¹ upstream or downstream of the Project

Table 7.4-2. Summary of Fish Species Observed in the Kaweah River and East Fork Kaweah River Study Reaches during 2018 Quantitative Sampling.

Study Site	Date	Fish Species ¹								
		RBT	BNT	HH	SPM	MXD	SS	SC	CAR	SMB
Kaweah River										
Kaweah River Upstream of Kaweah No. 3 Powerhouse (KR US PH3)	10/02/2018 10/18/2018	•	• ²	• ³	• ³	•	•		•	
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence (KR DS PH3)	10/01/2018 10/06/2018	•		•	•	•	•		•	
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse (KR US PH1)	10/01/2018 10/17/2018 10/19/2018	•		•	•		•			•
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse (KR US PH2)	10/01/2018 10/08/2018			•	•	•	•	•		•
Kaweah River Downstream of Kaweah No. 2 Powerhouse (KR DS PH2)	10/01/2018 10/03/2018 10/19/2018			•	•		•	•		•
East Fork Kaweah River										
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion (EF US K1 Div)	10/02/2018 10/05/2018	•					•			
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion (EF DS K1 Div)	10/02/2018	•					•		•	
East Fork Kaweah River Upstream of Confluence with Kaweah River (EF US Confl)	10/02/2018 10/09/2018 10/19/2018	•		•	•	•	•		•	•

Notes:

¹ Species: RBT = Rainbow Trout; BNT = Brown Trout; HH = Hardhead; SPM = Sacramento Pikeminnow; MXD = Unidentified Juvenile Mixed Minnow; SS = Sacramento Sucker; SC = Sculpin spp.; CAR = California Roach; SMB = Smallmouth Bass

² Brown trout were only captured during qualitative sampling upstream of the Middle Fork Kaweah Diversion within Sequoia National Park.

³ Hardhead and Sacramento Pikeminnow were captured during the qualitative sampling but not during the quantitative sampling.

Table 7.4-3. Minimum Instream Flow Requirements for the Bypass Reaches Associated with the Kaweah Project.^{1,2}

Month	Kaweah No. 1 Diversion		Kaweah No. 2 Diversion	
	Normal Year (cfs)	Dry Year (cfs)	Normal Year (cfs)	Dry Year (cfs)
October	5	5	11	5
November	5	5	11	5
December	5	5	11	5
January	5	5	20	10
February	5	5	20	10
March	10	10	30	20
April	10	10	30	30
May	10	10	30	30
June	10	10	30	30
July	10	10	20	10
August	5	5	20	10
September	5	5	11	5

Source: FERC License Article 405, as amended on April 20, 1994.

¹ Runoff of Kaweah River at Terminus Reservoir for April 1 through July 31, for the current year, as estimated by the California Department of Water Resources (DWR) on or about May 1 of each such calendar year shall be used to distinguish between a normal water year and a dry water year for the purpose of this article. A "Normal Year" is defined as a forecasted runoff of 172,000 acre-feet or more. A "Dry Year" is defined as a forecasted runoff is equal to or less than 172,000 acre-feet. The determination of either a normal water year or a dry water year shall then be used in maintaining the appropriate minimum flow release for the period May 10 of each calendar year through May 9 of the succeeding calendar year.

² This flow schedule may be temporarily modified if required by operating emergencies beyond the control of the licensee or for short periods on mutual agreement between the licensee, the U.S. Fish and Wildlife Service, and the California Department of Fish and Wildlife. If the flow is so modified, the licensee shall notify the Commission as soon as possible, but no later than 10 days after each such incident.

Table 7.4-4. Water Temperature Monitoring Locations 2014-2015.

Temperature Monitoring Location	River Mile
Kaweah River	
Three Rivers	2.4
Downstream of Kaweah No. 2 PH	4.8
Downstream of Kaweah No. 1 PH	6.5
Downstream of the Conf. with East Fork Kaweah River	8.3
Near Kaweah No. 3 PH	8.8
East Fork Kaweah River	
Upstream of the Conf. with Kaweah River	0.1
Upstream of Kaweah No. 1 Diversion	4.8

Table 7.4-5. Water Temperature Monitoring Locations 2018.

Monitoring Sites	Site ID	Sampling Location		Bypass or Comparison Reach (B or C)
		River Mile	GPS Location	
Water Temperature Monitoring Sites				
Kaweah River Upstream of Kaweah No. 3 Powerhouse	KR US PH3	8.96	36.48635136, -118.8361886	C
Kaweah River Downstream of Kaweah No. 3 Powerhouse	KR DS PH3	8.79 8.82	36.48439526, -118.8357774 36.48405746, -118.8359942	B
Kaweah No. 3 Powerhouse Tailrace	No. 3 Flowline	8.95	36.48620181, -118.8357265	B
Kaweah River Upstream of the Confluence with East Fork Kaweah River	KR US Conf EF	8.44	36.47956494, -118.8380172	B
Kaweah River Downstream of the Confluence with East Fork Kaweah River	KR DS Conf EF	8.3	36.4794382, -118.8402536	X
Kaweah River Upstream of Kaweah No. 1 Powerhouse	KR US PH1	6.51 6.52	36.46579943, -118.862146 36.46593544, -118.8620571	X
Kaweah River Downstream of Kaweah No. 1 Powerhouse	KR DS PH1	6.45	36.46562639, -118.863133	X
Kaweah No. 1 Powerhouse Tailrace	No. 1 Flowline	6.49	36.4653658, -118.8620713	X
Kaweah River Upstream of Kaweah No. 2 Powerhouse	KR US PH2	5.04	36.46071055, -118.8796395	X
Kaweah River Downstream of Kaweah No. 2 Powerhouse	KR DS PH2	4.81	36.4613941, -118.8834057	C
Kaweah No. 2 Powerhouse Tailrace	No. 2 Flowline	4.95	36.46186337, -118.8806466	X
East Fork Kaweah River				
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion Dam	EF DS K1 Div	4.68	36.45138042, -118.7899557	X
East Fork Kaweah River Upstream of the Confluence with Kaweah River	EF US Conf KR	0.09	36.47896325, -118.8374857	X
Air Temperature Monitoring Sites				
Kaweah No. 3 Powerhouse Air Temp	NA	8.93	36.48592359, -118.8364717	NA
Kaweah No. 1 Diversion Dam Air Temp	NA	4.48	36.44906467, -118.7916033	NA
Weather Station Monitoring Sites				
Kaweah No. 1 Powerhouse Weather Station	NA	6.49	36.465126, -118.861466	NA

Table 7.4-6. Macroinvertebrate River Sampling Reaches.

Study Reach	Site ID	Bypass Reaches	Reaches Upstream of Project Facilities or Comparison Reaches	Number of SWAMP Benthic Macroinvertebrate Sample Locations	Number of Drift Macroinvertebrate Sample Locations
Kaweah River					
Kaweah River Upstream of Kaweah No. 3 Powerhouse	US PH3 (K9.5)		X	1	1
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence	DS PH3 (K8.7)	X		1	1
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse	US PH1 (K7.3)	X		1	1
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse	US PH2 (K6.9)	X		1	1
Kaweah River Downstream of Kaweah No. 2 Powerhouse	DS PH2 (K4.3)		X	1	1
East Fork Kaweah River					
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion	EF Ref (EFK5.2)		X	1	1
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion	EF DS K1 (EFK3.8)	X		1	1
East Fork Kaweah River Upstream of Confluence with Kaweah River	EF US Confl (EFK0.7)	X		1	1

Table 7.4-7. Average Macroinvertebrate Drift Density (Summer and Fall) by Site (number/m³).

Length (mm)	Site								Average
	K9.5	K8.7	K7.3	K6.9	K4.3	EFK5.2	EFK3.8	EFK0.7	
0-1	0.018	0.017	0.013	0.008	0.018	0.009	0.015	0.027	0.016
>1-3	0.132	0.095	0.136	0.113	0.168	0.083	0.160	0.189	0.135
>3-5	0.050	0.050	0.096	0.091	0.144	0.063	0.105	0.133	0.092
>5-7	0.007	0.012	0.035	0.030	0.049	0.019	0.033	0.038	0.028
>7	0.004	0.008	0.017	0.013	0.026	0.004	0.009	0.018	0.012
Total	0.211	0.182	0.296	0.256	0.405	0.178	0.323	0.406	0.282

Table 7.4-8. Average Macroinvertebrate Drift Density (Summer and Fall) at the Kaweah River Study Locations and Comparison Locations.

River/Site	Comparison Type	Location	Elevation (ft)	Season	Avg. Drift Density (number/m ³)
Kaweah Project Study Reaches					
Kaweah River Upstream of Kaweah No. 3 Powerhouse	Kaweah River Comparison Reach	California	1,380	Summer/Fall	0.21
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence	Bypass Reach	California	1,320	Summer/Fall	0.18
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse	Bypass Reach	California	1,160	Summer/Fall	0.30
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse	Bypass Reach	California	1,135	Summer/Fall	0.26
Kaweah River Downstream of Kaweah No. 2 Powerhouse	Kaweah River Comparison Reach	California	910	Summer/Fall	0.41
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion	East Fork Kaweah River Comparison Reach	California	2,574	Summer/Fall	0.18
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion	Bypass Reach	California	2,600	Summer/Fall	0.32
East Fork Kaweah River Upstream of Confluence with Kaweah River	Bypass Reach	California	1,420	Summer/Fall	0.41
Comparison River Sites					
American River (MF)	Literature Reference (Cardno 2011)	California	1,200	Summer/Fall	0.82
American River (NF)	Literature Reference (Cardno 2011)	California	800	Summer/Fall	1.19
American River (NFMF)	Literature Reference (Cardno 2011)	California	1,200	Summer/Fall	1.06
Rubicon River	Literature Reference (Cardno 2011)	California	3,800	Summer/Fall	0.77
Klamath River	Literature Reference (Addley 2005)	Oregon	3,415	Summer/Fall	1.52

Table 7.4-9a. Average Macroinvertebrate Drift Total Prey Energy (Summer and Fall) (joules/m³).

Length (mm)	Site								Average
	K9.5	K8.7	K7.3	K6.9	K4.3	EFK5.2	EFK3.8	EFK0.7	
0-1	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000
>1-3	0.278	0.273	0.702	0.363	0.687	0.152	0.464	0.877	0.474
>3-5	0.140	0.305	1.278	0.859	1.914	0.316	0.807	1.534	0.894
>5-7	0.006	0.035	0.379	0.207	0.459	0.064	0.175	0.293	0.202
>7	0.004	0.037	0.233	0.092	0.278	0.007	0.028	0.172	0.106
Total	0.429	0.651	2.592	1.521	3.339	0.538	1.474	2.878	1.678

Table 7.4-9b. Average Macroinvertebrate Drift Total Prey Energy Percent by Size (Summer and Fall) (joules/m³).

Length (mm)	Site								Average
	K9.5	K8.7	K7.3	K6.9	K4.3	EFK5.2	EFK3.8	EFK0.7	
0-1	8.8%	8.7%	4.2%	3.4%	4.4%	5.3%	4.8%	6.4%	5.8%
>1-3	62.5%	51.3%	45.9%	44.6%	41.7%	47.0%	50.8%	46.2%	48.7%
>3-5	23.7%	29.2%	32.5%	34.7%	34.9%	34.7%	31.5%	33.4%	31.8%
>5-7	3.2%	6.6%	11.8%	11.9%	12.3%	10.6%	10.0%	9.7%	9.5%
>7	1.9%	4.2%	5.6%	5.5%	6.7%	2.3%	2.9%	4.3%	4.2%

Table 7.4-10. Benthic Macroinvertebrate SWAMP Sampling Results.

Metric / IBI Score Components	Kaweah River Site										East Fork Kaweah River Site					
	K9.5 Comparison Reach		K8.7 Bypass Reach		K7.3 Bypass Reach		K6.9 Bypass Reach		K4.3 Comparison Reach		EFK5.2 Comparison Reach		EFK3.8 Bypass Reach		EFK0.7 Bypass Reach	
	# / %	IBI Score	# / %	IBI Score	# / %	IBI Score	# / %	IBI Score	# / %	IBI Score	# / %	IBI Score	# / %	IBI Score	# / %	IBI Score
ET Taxa	12	5	13	5	13	5	17	7	18	8	12	5	15	6	17	7
Percent Non-Insect Taxa	19	6	15	8	16	7	18	6	20	6	19	6	15	8	20	6
Percent Intolerant Individuals (0-2)	1	0	6	1	4	0	8	1	9	1	17	3	20	4	8	1
Percent Tolerant Individuals (8-10)	3	7	4	6	8	2	4	6	9	1	5	5	1	9	4	6
Percent Predator Individuals	22	10	17	10	18	10	12	6	20	10	21	10	8	2	16	10
Percent Scraper Individuals	28	7	28	7	13	3	28	7	19	4	21	5	35	8	29	7
Shannon Diversity	2.23	0	2.61	3	2.83	4	3.00	6	3.11	7	2.56	2	2.70	3	2.92	5
IBI Score*		35		40		31		39		37		36		40		42

* IBI Score is the sum of all IBI Components

Table 7.4-11. SWAMP Physical Habitat Data.

Site ID	Date	Water Temp (°F)	Average Velocity (ft/sec)	Average Width (ft)	Average Depth (in)	Dominant Substrate	Subdominant Substrate	Average Cobble % Embeddedness	% with CPOM	Predominate Microalgae Thickness	% Attached Macroalgae	% Unattached Macroalgae	% Macrophytes
K9.5	8/20/18	73.5	1.8	59.4	15.9	Boulder, Small	Boulder, Large	48%	31%	>20mm	99%	21%	88%
K8.7	8/20/18	73.4	6.8	25.2	16.0	Bedrock, Smooth	Cobble	32%	87%	>20mm	85%	0%	0%
K7.3	8/22/18	76.4	1.8	52.6	18.1	Cobble	Boulder, Small	55%	5%	>20mm	99%	30%	0%
K6.9	8/21/18	75.2	1.4	63.3	8.9	Cobble	Sand	37%	63%	<1mm	47%	0%	0%
K4.3	8/21/18	76.5	0.6	51.9	12.2	Cobble	Sand	47%	76%	<1mm	9%	0%	0%
EFK5.2	8/21/18	70.5	1.9	27.6	21.1	Boulder, Small	Boulder, Large	29%	4%	Not Present	66%	5%	0%
EFK3.8	8/22/18	64.7	1.2	39.4	15.6	Cobble; Bedrock, Smooth	Sand	50%	61%	Not Present	29%	-	-
EFK0.7	8/21/18	72.9	3.3	27.7	13.3	Boulder, Small	Cobble	46%	8%	>20mm	88%	2%	4%

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Table 7.4-12. Potential Fish Passage Barriers.

	River Mile	Barrier Type	Barrier Class	Physical Characteristics					Passable at Low / High Flows		Barrier Limitation
				Height of Barrier (ft)	Horizontal Distance or Length (ft) (Measured or Calculated) ²	Plunge Pool / Chute Depth (ft)	Water Velocity ³ (ft/s)	Flow at Visit (cfs)	Trout	Minnows ⁴	
Kaweah River											
Downstream of National Park Foothills Visitor Center	9.5	Natural	Falls	10.0 ¹	12.0 ¹	-	-	-	NO / NO	NO / NO	Fall Height
Kaweah No. 2 Diversion Dam	8.9	Project	Falls	9.2	16.0	5.0	2.2	338	NO / NO	NO / NO	Fall Height
Kaweah No. 2 Diversion Dam Gage Pool Weir	8.8	Project	Falls	1.0	3.0	5.2	2.2	315	NO ⁵ / YES	NO ⁵ / YES	Fall Height
Downstream of Kaweah No. 2 Powerhouse	3.8	Natural	Falls	1.8	20.0	2.3	0.6	169	NO / YES	NO / YES	Fall Height
East Fork Kaweah River											
Kaweah No. 1 Diversion Dam	4.7	Project	Falls	11.5	15.0	8.0	2.5	188	NO / NO	NO / NO	Fall Height
Kaweah No. 1 Diversion Dam Gage Pool Weir	4.7	Project	Falls/ Chute	7.2	11.2 / 17.0	2.5/0.5	3 / >12	122	NO / NO	NO / NO	Fall Height, Chute Velocity, and Length
East Fork Kaweah Downstream of Kaweah River Bridge	4.4	Natural	Falls	9.0	20.0	6.0	4.0	195	NO / NO	NO / NO	Fall Height
East Fork Kaweah above Confluence with Kaweah River	0.2	Natural	Falls/ Chute	5.7/9.7	15.0 / 35.8	4.0/0.5	3.8 / 12.2	47	NO / NO	NO / NO	Fall Height, Chute Velocity, and Length

¹ Measurement estimated from online kayaker video.² Horizontal leap distance required to clear falls and/or swimming length of chutes.³ Velocity at crest of falls / Velocity in chute.⁴ "Minnows" include hardhead, Sacramento pikeminnow, and Sacramento sucker.⁵ Passable at measured flow, but not at low flow.

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Table 7.4-13. Summary of Fish Species Observed in the Kaweah River and East Fork Kaweah River Study Reaches during 2018 Quantitative Sampling.

Study Site	Date	Fish Species ¹							
		RBT	HH	SPM	MXD	SS	SC	CAR	SMB
Kaweah River									
Kaweah River Upstream of Kaweah No. 3 Powerhouse (US PH3)	10/02/2018 10/18/2018	•	• ²	• ²	•	•		•	
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence (DS PH3)	10/01/2018 10/06/2018	•	•	•	•	•		•	
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse (US PH1)	10/01/2018 10/17/2018 10/19/2018	•	•	•		•			•
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse (US PH2)	10/01/2018 10/08/2018		•	•	•	•	•		•
Kaweah River Downstream of Kaweah No. 2 Powerhouse (DS PH2)	10/01/2018 10/03/2018 10/19/2018		•	•		•	•		•
East Fork Kaweah River									
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion (EF US K1 Div)	10/02/2018 10/05/2018	•				•			
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion (EF DS K1 Div)	10/02/2018	•				•		•	
East Fork Kaweah River Upstream of Confluence with Kaweah River (EF US Confl)	10/02/2018 10/09/2018 10/19/2018	•	•	•	•	•		•	•

Notes:

¹ Species: RBT = Rainbow Trout; BNT = Brown Trout; HH = Hardhead; SPM = Sacramento Pikeminnow; MXD = Unidentified Juvenile Mixed Minnow; SS = Sacramento Sucker; SC = Sculpin spp.; CAR = California Roach; SMB = Smallmouth Bass

² Hardhead and Sacramento Pikeminnow were captured during the qualitative sampling but not during the quantitative sampling.

Table 7.4-14. Average Condition Factors, Standard Deviation, and Sample Size by Species Collected during Electrofishing in the Study Area in 2018.

Species	Average Condition Factor	Standard Deviation	Sample Size
Rainbow Trout	1.17	0.17	68
Hardhead	1.15	0.31	5
Sacramento Pikeminnow	0.81	0.21	135
Sacramento Sucker	1.14	0.24	117
Sculpin	1.30	0.21	12
California Roach	1.10	0.28	160
Smallmouth Bass	1.37	0.15	73

Table 7.4-15. Rainbow Trout Condition Factors by Site.

Study Reach	Age Class	Average Condition Factor	n
Kaweah River			
Kaweah River Upstream of Kaweah No. 3 Powerhouse (US PH3)	YOY	1.23	4
	1+	1.14	6
	COMBINED	1.18	10
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence (DS PH3)	YOY	1.22	5
	1+	1.04	1
	COMBINED	1.19	6
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse (US PH1)	YOY	1.1	1
	1+	1.06	1
	COMBINED	1.08	2
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse (US PH2)	YOY	--	Not Observed
	1+	--	Not Observed
	COMBINED	--	Not Observed
Kaweah River Downstream of Kaweah No. 2 Powerhouse (DS PH2)	YOY	--	Not Observed
	1+	--	Not Observed
	COMBINED	--	Not Observed
East Fork Kaweah River			
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion (EF US K1 Div)	YOY	1.18	29
	1+	1.14	6
	COMBINED	1.17	35
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion (EF DS K1 Div)	YOY	1.18	4
	1+	1.27	4
	COMBINED	1.22	8
East Fork Kaweah River Upstream of Confluence with Kaweah River (EF US Confl)	YOY	1.12	4
	1+	1.2	3
	COMBINED	1.15	7

Table 7.4-16. Qualitative Fry Sampling in the Vicinity of the Project Diversions and the Sequoia National Park Diversions. (note: sampling generally consisted of 0.5 to 2.5 hours of sampling with seines and/or electrofishing gear).

Sample Location	Type of Observation	June 13-14 Sampling ¹					July 6-7 Sampling ¹						
		RBT	SPM	MXD	SS	CAR	RBT	BRT	HH	SPM	MXD	SS	CAR
Project Diversions													
Kaweah No. 1 Diversion	Captured (size mm)	0	0	0	0	0	0	0	0	0	26 (larval)	0	0
	Visually Observed	--	--	--	--	--	--	--	--	--	--	--	--
Kaweah No. 2 Diversion	Captured (size mm)	0	1 (24)	1 (20)	1 (no size)	1 (80)	0	0	6 (26, 35, 39, 42, 42, 46)	3 (36, 42, 51)	32 (larval)	20 (25, 25, 26, 26, 27, 27, 27, 27, 28, 29, 29, 30, 30, 31, 32, 32, 32, 33, 34, 35)	1 (75)
	Visually Observed (size)	--	>20 (larval)	> 100 (larval)	--	--	--	--	--	--	--	--	--
Sequoia National Park Diversions													
Middle Fork Diversion	Captured (size mm)	0	0	1 (15)	0	0	1 (46)	0	0	0	40 (larval)	0	0
	Visually Observed	--	--	40 (larval)	--	--	--	--	--	--	--	--	--
Marble Fork Diversion	Captured (size mm)	0	0	0	0	0	2 (42, 50)	2 (75, 82)	0	0	0	2 (51, 57)	0
	Visually Observed	--	--	--	--	--	4 (40-50 mm) ²	--	--	--	--	--	--

¹Species: RBT = Rainbow Trout; BRT = Brown Trout; HH = Hardhead; SPM = Sacramento Pikeminnow; MXD = Unidentified Juvenile Mixed Minnow; SS = Sacramento Sucker; CAR = California Roach

² Unidentified salmonids (i.e. Brown Trout or Rainbow Trout).

Table 7.4-17. Fish Species Life Stage Periodicity.

Month	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Rainbow Trout												
Spawning				■	■	■	■	■	■			
Incubation				■	■	■	■	■	■	■	■	
Fry								■	■	■	■	■
Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
Adult	■	■	■	■	■	■	■	■	■	■	■	■
Brown Trout												
Spawning	■	■	■									
Incubation		■	■	■	■	■	■					
Fry				■	■	■	■	■	■			
Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
Adult	■	■	■	■	■	■	■	■	■	■	■	■
Sacramento Pikeminnow												
Spawning							■	■	■	■		
Larval											■	
Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
Adult	■	■	■	■	■	■	■	■	■	■	■	■
Hardhead												
Spawning							■	■	■			
Larval										■		
Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
Adult	■	■	■	■	■	■	■	■	■	■	■	■
California Roach												
Spawning						■	■	■	■	■		
Larval											■	
Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
Adult	■	■	■	■	■	■	■	■	■	■	■	■
Sacramento Sucker												
Spawning					■	■	■	■	■			
Larval					■	■	■	■	■	■		
Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
Adult	■	■	■	■	■	■	■	■	■	■	■	■
Smallmouth Bass												
Spawning								■	■	■		
Incubation										■		
Fry								■	■	■	■	■
Juvenile	■	■	■	■	■	■	■	■	■	■	■	■
Adult	■	■	■	■	■	■	■	■	■	■	■	■

Table 7.4-18. Summary of Reach Density for All Captured Species excluding Rainbow Trout.

Study Reach	Species ¹ Reach Density (Fish per Mile)							Species ¹ Reach Density (Fish per Acre)						
	HH	SPM	MXD	SS	SC	CAR	SMB	HH	SPM	MXD	SS	SC	CAR	SMB
Kaweah River														
Kaweah River Upstream of Kaweah No. 3 Powerhouse (US PH3)	0	0	15389	5345	0	1993	0	0	0	1414	532	0	419	0
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence (DS PH3)	26	3400	12645	2079	0	850	0	5	652	2192	373	0	171	0
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse (US PH1)	6	104	0	684	0	0	611	1	14	0	140	0	0	95
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse (US PH2)	19	2	5	237	54	0	622	2	0	1	42	10	0	109
Kaweah River Downstream of Kaweah No. 2 Powerhouse (DS PH2)	116	45	0	299	209	0	644	15	5	0	36	22	0	73

Study Reach	Species ¹ Reach Density (Fish per Mile)							Species ¹ Reach Density (Fish per Acre)						
	HH	SPM	MXD	SS	SC	CAR	SMB	HH	SPM	MXD	SS	SC	CAR	SMB
East Fork Kaweah River														
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion (EF US K1 Div)	0	0	0	1725	0	0	0	0	0	0	360	0	0	0
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion (EF DS K1 Div)	0	0	0	2486	0	13	0	0	0	0	627	0	3	0
East Fork Kaweah River Upstream of Confluence with Kaweah River (EF US Confl)	26	377	1341	255	0	409	137	4	107	217	86	0	120	33

Notes:

¹ Species: RBT = Rainbow Trout; HH = Hardhead; SPM = Sacramento Pikeminnow; MXD = Unidentified Juvenile Mixed Minnow; SS = Sacramento Sucker; SC = Sculpin spp.; CAR = California Roach; SMB = Smallmouth Bass

Table 7.4-19. Reach Density and Reach Biomass of Rainbow Trout.

Study Reach	Reach Density (Adult; YOY)		Reach Biomass	
	Fish per Mile	Fish per Acre	Pounds per Mile	Pounds per Acre
Kaweah River Upstream of Kaweah No. 3 Powerhouse (US PH3)	102 (61; 41)	17 (10; 7)	11.3	1.8
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence (DS PH3)	142 (24; 118)	26 (4; 22)	0.8	0.2
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse (US PH1)	84 (42; 42)	19 (9.3; 9.3)	0.8	0.2
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse (US PH2)	0	0	0.0	0.0
Kaweah River Downstream of Kaweah No. 2 Powerhouse (DS PH2)	0	0	0.0	0.0
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion (EF US K1 Div)	707 (120; 587)	184 (31; 153)	25.6	6.7
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion (EF DS K1 Div)	196 (98; 98)	37 (18.5; 18.5)	20.6	4.2
East Fork Kaweah River Upstream of Confluence with Kaweah River (EF US Confl)	177 (76; 101)	72 (31; 41)	4.9	2.1

Table 7.4-20. Density of Species, Fish per Mile and Percent of Young-of-Year, at Quantitative Sampling Sites.

Study Site	Species Density (fish per mile)							
	RBT (% YOY)	HH	SPM	MXD	SS	SC	CAR	SMB
Kaweah River Upstream of Kaweah No. 3 Powerhouse (US PH3)								
HGR	271 (40%)	0	0	0	1489	0	3790	0
LGR	770 (40%)	0	0	0	550	0	6050	0
RUN	127 (40%)	0	0	0	1143	0	16644	0
MCP ¹	0	0	0	24046	7565	0	108	0
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence (DS PH3)								
HGR	230 (83%)	0	5518	0	613	0	0	0
LGR	284 (83%)	189	4165	0	852	0	2083	0
RUN	0	0	6008	0	1073	0	2468	0
MCP ¹	176 (83%)	35	458	11158	1901	0	0	0
RUN ¹	0	0	143	26450	2569	0	48	0
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse (US PH1)								
HGR	0	0	703	0	938	0	0	2814
LGR	176 (50%)	0	0	0	1144	0	0	352
MCP ¹	0	26	35	0	52	0	0	250
RUN ¹	0	0	0	0	0	0	0	0
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse (US PH2)								
LGR	0	0	0	0	671	168	0	1676
MCP ¹	0	72	9	18	81	0	0	316
Kaweah River Downstream of Kaweah No. 2 Powerhouse (DS PH2)								
HGR	0	153	153	0	307	460	0	307
LGR	0	147	73	0	733	440	0	1026
RUN	0	0	0	0	62	62	0	928
MCP ¹	0	187	0	0	150	0	0	212
RUN ¹	0	0	0	0	0	0	0	0

Study Site	Species Density (fish per mile)							
	RBT (% YOY)	HH	SPM	MXD	SS	SC	CAR	SMB
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion (EF US K1 Div)								
HGR	1863 (83%)	0	0	0	254	0	0	0
RUN	1101 (83%)	0	0	0	2372	0	0	0
MCP ¹	0	0	0	0	2624	0	0	0
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion (EF DS K1 Div)								
HGR	268 (50%)	0	0	0	358	0	0	0
RUN	367 (50%)	0	0	0	1026	0	73	0
MCP ¹	18 (50%)	0	0	0	5920	0	0	0
East Fork Kaweah River Upstream of Confluence with Kaweah River (EF US Confl)								
HGR	1173 (57%)	0	0	0	978	0	0	391
LGR	220 (57%)	0	1319	0	440	0	1539	0
MCP ¹	0	47	47	2134	62	0	0	171
RUN ¹	0	0	0	1998	57	0	0	29

Notes:

CAR = California Roach
 HGR = high gradient riffle
 HH = Hardhead
 LGR = low gradient riffle
 MCP = mid-channel pool
 MXD = Unidentified Juvenile Mixed Minnow
 RBT = Rainbow Trout
 SC = Sculpin spp.
 SMB = Smallmouth Bass
 SPM = Sacramento Pikeminnow
 SS = Sacramento Sucker
 YOY = young-of-year

¹ These sites were sampled by snorkeling. All other sites were sampled by electrofishing.

Table 7.4-21. Density of Species, Fish per Acre and Percent of Young-of-Year, at Quantitative Sampling Sites.

Study Site	Species Density (fish per acre)							
	RBT (% YOY)	HH	SPM	MXD	SS	SC	CAR	SMB
Kaweah River Upstream of Kaweah No. 3 Powerhouse (US PH3)								
HGR	43 (40%)	0	0	0	236	0	601	0
LGR	144 (40%)	0	0	0	103	0	1134	0
RUN	40 (40%)	0	0	0	359	0	5232	0
MCP ¹	0	0	0	2210	695	0	11	0
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence (DS PH3)								
HGR	41 (83%)	0	991	0	110	0	0	0
LGR	74 (83%)	49	1084	0	222	0	542	0
RUN	0	0	1162	0	208	0	477	0
MCP ¹	31 (83%)	6	80	1959	334	0	0	0
RUN ¹	0	0	25	4546	442	0	8	0
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse (US PH1)								
HGR	0	0	92	0	123	0	0	369
LGR	39 (50%)	0	0	0	255	0	0	78
MCP ¹	0	3	5	0	7	0	0	34
RUN ¹	0	0	0	0	0	0	0	0
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse (US PH2)								
LGR	0	0	0	0	123	31	0	307
MCP ¹	0	8	1	2	9	0	0	37
Kaweah River Downstream of Kaweah No. 2 Powerhouse (DS PH2)								
HGR	0	13	13	0	26	39	0	26
LGR	0	18	9	0	92	55	0	128
RUN	0	0	0	0	6	6	0	91
MCP ¹	0	29	0	0	23	0	0	33
RUN ¹	0	0	0	0	0	0	0	0

Study Site	Species Density (fish per acre)							
	RBT (% YOY)	HH	SPM	MXD	SS	SC	CAR	SMB
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion (EF US K1 Div)								
HGR	485 (83%)	0	0	0	66	0	0	0
RUN	396 (83%)	0	0	0	852	0	0	0
MCP ¹	0	0	0	0	540	0	0	0
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion (EF DS K1 Div)								
HGR	46 (50%)	0	0	0	62	0	0	0
RUN	78 (50%)	0	0	0	217	0	16	0
MCP ¹	5 (50%)	0	0	0	1550	0	0	0
East Fork Kaweah River Upstream of Confluence with Kaweah River (EF US Confl)								
HGR	538 (57%)	0	0	0	448	0	0	179
LGR	65 (57%)	0	389	0	130	0	453	0
MCP ¹	0	7	7	327	10	0	0	26
RUN ¹	0	0	0	466	13	0	0	7

Notes:

CAR = California Roach
 HGR = high gradient riffle
 HH = Hardhead
 LGR = low gradient riffle
 MCP = mid-channel pool
 MXD = Unidentified Juvenile Mixed Minnow
 RBT = Rainbow Trout
 SC = Sculpin spp.
 SMB = Smallmouth Bass
 SPM = Sacramento Pikeminnow
 SS = Sacramento Sucker
 YOY = young-of-year

¹ These sites were sampled by snorkeling. All other sites were sampled by electrofishing.

Table 7.4-22. Rainbow Trout Biomass at the Quantitative Sampling Sites.

Study Site	Pounds per Mile	Pounds per Acre
Kaweah River Upstream of Kaweah No. 3 Powerhouse (US PH3)		
HGR	35.2	5.6
LGR	30.4	5.7
RUN	2.5	0.8
MCP ¹	0	0
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence (DS PH3)		
HGR	2.5	0.4
LGR	3.2	0.8
RUN	0	0
MCP ¹	0.2	0.04
RUN ¹	0	0
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse (US PH1)		
HGR	0	0
LGR	1.6	0.4
MCP ¹	0	0
RUN ¹	0	0
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse (US PH2)		
LGR	0	0
MCP ¹	0	0
Kaweah River Downstream of Kaweah No. 2 Powerhouse (DS PH2)		
HGR	0	0
LGR	0	0
RUN	0	0
MCP ¹	0	0
RUN ¹	0	0
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion (EF US K1 Div)		
HGR	67.5	17.6
RUN	12.5	4.5
MCP ¹	0	0
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion (EF DS K1 Div)		
HGR	30.3	5.2
RUN	6.0	1.3
MCP ¹	15.5	4.3

Study Site	Pounds per Mile	Pounds per Acre
East Fork Kaweah River Upstream of Confluence with Kaweah River (EF US Confl)		
HGR	40.3	18.5
LGR	3.2	0.9
MCP ¹	0	0
RUN ¹	0	0

Notes:

HGR = high gradient riffle

LGR = low gradient riffle

MCP = mid-channel pool

¹ These sites were sampled by snorkeling. All other sites were sampled by electrofishing.

Table 7.4-23. Impaired and Unimpaired Hydrology Summary for each Instream Flow Study Site.

Instream Flow Study Reaches	Impaired or Unimpaired	Minimum Flow (cfs)	Exceedance Flows (cfs)					Current FERC License Instream Flow Requirement
			10%	20%	50%	80%	90%	
Kaweah River								
Kaweah River Upstream of Kaweah No. 3 Powerhouse	Impaired	0.8	775.9	471.0	113.0	33.1	21.0	
	Unimpaired	9.5	847.0	534.0	179.5	46.7	23.9	
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence	Impaired	5.5	772.0	458.0	112.5	32.0	19.2	Dry: 5 – 30 cfs Wet: 11 – 30 cfs
	Unimpaired	9.5	847.0	534.0	179.5	46.7	23.9	
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse	Impaired	10.9	1065.0	664.0	156.0	43.7	28.7	Dry: 5 – 30 cfs* Wet: 11 – 30 cfs*
	Unimpaired	15.6	1156.0	749.5	239.0	68.5	37.6	
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse	Impaired	13.6	1080.3	682.0	171.4	53.3	33.9	Dry: 5 – 30 cfs* Wet: 11 – 30 cfs*
	Unimpaired	15.6	1156.0	749.5	239.0	68.5	37.6	
Kaweah River Downstream of Kaweah No. 2 Powerhouse	Impaired	15.6	1156.0	749.5	239.0	68.5	37.6	
	Unimpaired	15.6	1156.0	749.5	239.0	68.5	37.6	
East Fork Kaweah River								
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion	Impaired	6.0	336.3	194.0	44.8	18.8	12.5	
	Unimpaired	6.0	336.3	194.0	44.8	18.8	12.5	
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion	Impaired	2.7	319.4	176.8	28.0	9.1	7.0	5 – 10 cfs All Water Year Types
	Unimpaired	6.0	336.3	194.0	44.8	18.8	12.5	

* Note: Minimum flow requirements are implemented at a compliance location upstream.

Table 7.4-24. Proposed Entrainment Sampling Schedule (also see Section 4, Appendix 4-A, Section 4.1.5 – Entrainment Study Measure).

Location	Representative Time Periods	Sampling Dates	Sampling Type	
			Drift Netting	Fyke Trapping
Kaweah No. 1 Flowline	January/February within 18 months of license issuance*	TBD	Pending	Pending
	March/April within 18 months of license issuance*	TBD	Pending	Pending
	May/June within 18 months of license issuance*	TBD	Pending	Pending
	July within 18 months of license issuance*	TBD	Pending	Pending
Kaweah No. 2 Flowline	May/June 2019	May 7-9, 2019	Completed	Completed
	July 2019	July 9-11, 2019	Completed	Completed
	January/February 2020	TBD	Pending	Pending
	March/April 2020	TBD	Pending	Pending
Kaweah No. 3 Flowline	May/June 2019	May 21-23, 2019	Completed	NA**
	July 2019	July 23-25, 2019	Completed	NA**
	January/February 2020	NA	Sampling was deemed complete at the present time***	NA**
	March/April 2020	NA	Sampling was deemed complete at the present time***	NA**

* Monitoring will be completed within 18 months of license issuance consistent with the Application for New License Section 4, Appendix 4-A Entrainment Study Measure.

** Due to high risk at the Kaweah No. 3 Flowline, the revised study plan proposed to use entrainment monitoring in the Kaweah No. 1 and No. 2 flowlines to approximate entrainment in Kaweah No. 3 Flowline. The revised study plan allowed for additional entrainment sampling based on consultation with agency biologists/staff.

*** Based on collaboration between SCE and key resource agencies with respect to entrainment sampling (CDFW and the State Water Board) on December 3 and December 10, 2019, drift net sampling in the Kaweah No. 3 Flowline was deemed complete at this time and the need for any additional drift net sampling in the Kaweah No. 3 Flowline will be determined based on interpretation of drift net sampling results from the Kaweah No. 2 Flowline (see Application for New License Section 4, Appendix 4-A Entrainment Study Measure).

NA = Not Applicable

TBD = To Be Determined

Table 7.4-25. Special-Status Aquatic Species Known to Occur or Potentially Occurring in the Study Area

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
Known to Occur in the Study Area				
Fish				
<i>Mylopharodon conocephalus</i> hardhead	—	SSC	Undisturbed larger middle- and low-elevation streams with summer temperatures in excess of 20°C at elevations ranging from 30 to 4,750 feet. Most commonly found in clear, deep (>3 feet) pools with sand-gravel-boulder substrates and slow water velocities (<0.8 feet per second).	<ul style="list-style-type: none"> Known to occur in the study area. Observed in low to moderate abundance in the bypass and comparison reaches on the Kaweah River, and in the lowest reach of the East Fork Kaweah River. Refer to AQ 2 - TSR for more detailed information about occurrence of this species.
May Potentially Occur in the Study Area				
Amphibians				
<i>Rana boylei</i> foothill yellow-legged frog	BLMS	SCT, SSC	Perennial rocky (pebble or cobble) streams with cool, clear water in a variety of habitats from valley and foothill oak woodland, riparian forest, ponderosa pine, mixed conifer, coastal scrub, and mixed chaparral at elevations ranging from 0 to 6,370 feet.	<ul style="list-style-type: none"> This species is not known to be extant in the Kaweah River Watershed. This species was not observed during extensive surveys conducted in support of relicensing (AQ 7 – TSR). The most recent observations in the Kaweah River Watershed date to 1970. Refer to AQ 7 - TSR for more detailed information about occurrence of this species.
Reptiles				
<i>Actinemys marmorata</i> western pond turtle		SSC	Perennial wetlands and slow-moving creeks and ponds, from sea level to 6,000 ft in elevation, with overhanging vegetation and suitable basking sites such as logs and rocks above the waterline.	<ul style="list-style-type: none"> May potentially occur in appropriate habitat and is known to be present in the Kaweah watershed; however, this species was not observed during surveys conducted in support of relicensing. Refer to AQ 7 - TSR for more detailed information about occurrence of this species.
Unlikely to Occur in the Study Area				
Fish				
<i>Entosphenus tridentatus</i> Pacific lamprey	BLMS	SSC	An anadromous fish requiring stream and river reaches with natural flow regimes, deep pools with adequate cover, low velocity rearing areas with fine sand or silt, and silt-free cobble areas upstream of rearing areas. Temperatures must not exceed 20°C.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
<i>Oncorhynchus mykiss whitei</i> Little Kern golden trout	FT	—	Known only from the Little Kern River and tributaries in Tulare County, mostly within Sequoia National Forest and Sequoia National Park. High altitude freshwater lakes and river from elevations ranging from 9,000 to 12,000 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation and geographic range of this species.
<i>Hypomesus transpacificus</i> delta smelt	FT	SE	Tidally influenced backwater sloughs and channel edgewater of brackish and freshwater marshes.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species and does not contain suitable habitat.

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Siphateles bicolor snyderi</i> Owens tui chub	FE	SE	Standing waters and low gradient reaches of the Owens River and larger tributaries. Found in springs, ponds, lakes, large sluggish streams, and shelter of small swiftwater streams. Prefers reaches with abundant aquatic vegetation and summer temperatures in excess of 20°C.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
<i>Gasterosteus aculeatus williamsoni</i> unarmored threespine stickleback	FE	SE	Slow, continuous flows of water in isolated headwater streams that experience intermittent flows to the ocean and lack turbidity. Restricted to the Santa Clara River watershed in Los Angeles County.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.

Sources:

- Bureau of Land Management (BLMS). 2014. BLMS Species Status Animal Species by Field Office, Bakersfield Office.
- California Natural Diversity Database (CNDDDB). 2018. Rare Find 5.0. California Department of Fish and Wildlife, Habitat Planning and Conservation Branch. Accessed August 2018. Electronic Database.
- U.S. Fish and Wildlife Service (USFWS). 1994. Endangered and Threatened Wildlife and Plants; Critical Habitat Determination for the Delta Smelt. Federal Register, Vol. 59, No. 242.
- USFWS. 2018. Information for Planning and Consultation (IPaC) – Powered by the Environmental Conservation Online System (ECOS). Accessed August 2018. Electronic Database.

LEGEND:Federal Status

BCC = Birds of Conservation Concern

BLMS = Bureau of Land Management Sensitive (Bakersfield Office)

FC = Federal Candidate

FD = Delisted Species

FE = Federal Endangered

FPD = Federal Proposed for Delisting

FT = Federal Threatened

State Status

CFP = State of California Fully Protected

SCT = State Candidate Threatened

SCE = State Candidate Endangered

SD = State Delisted

SE = State Endangered

SSC = State Species of Special Concern

ST = State Threatened

WL = Watch List

FIGURES

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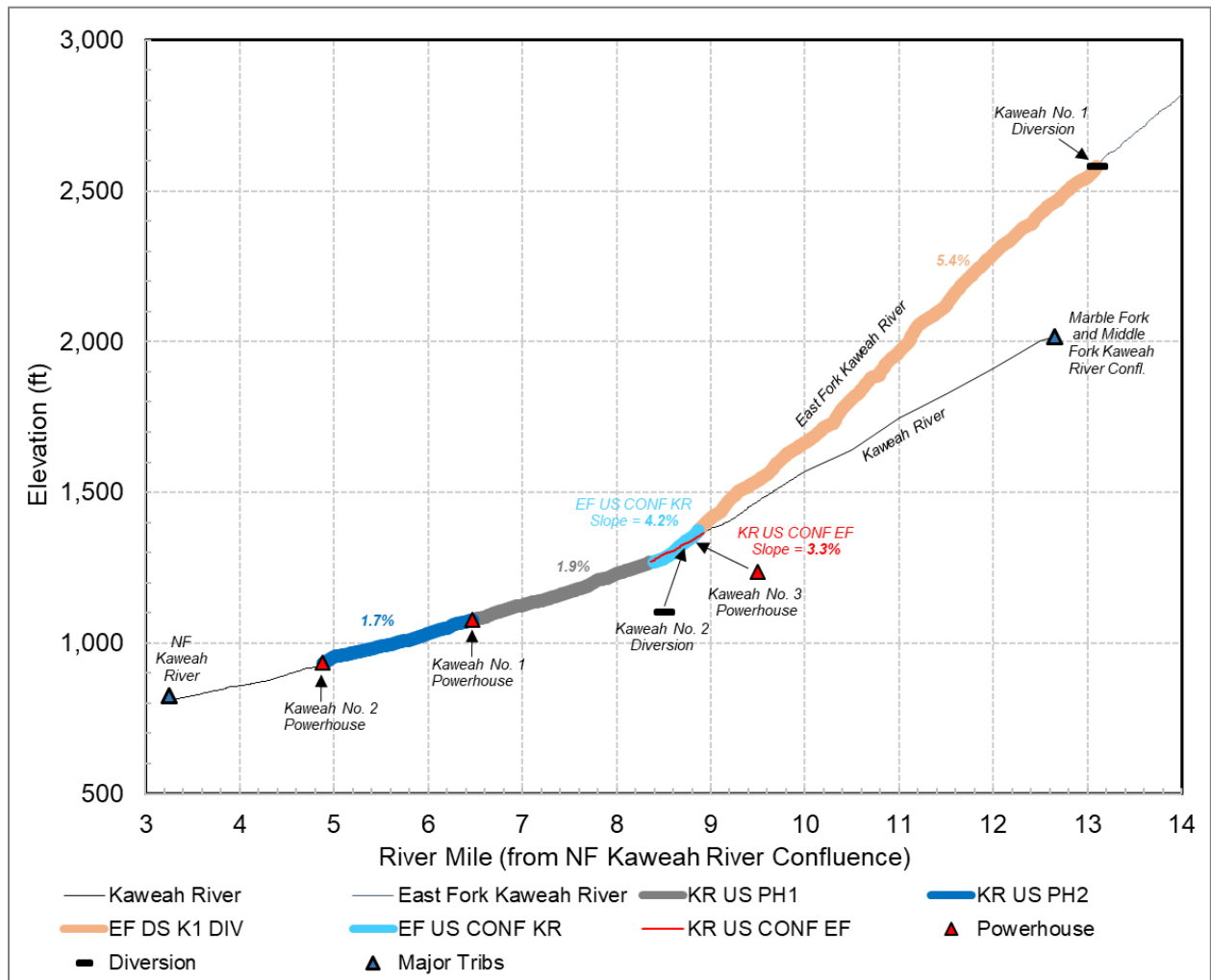


Figure 7.4-1. Gradient map of the Kaweah River and East Fork Kaweah River Showing Project Diversions and Powerhouses.

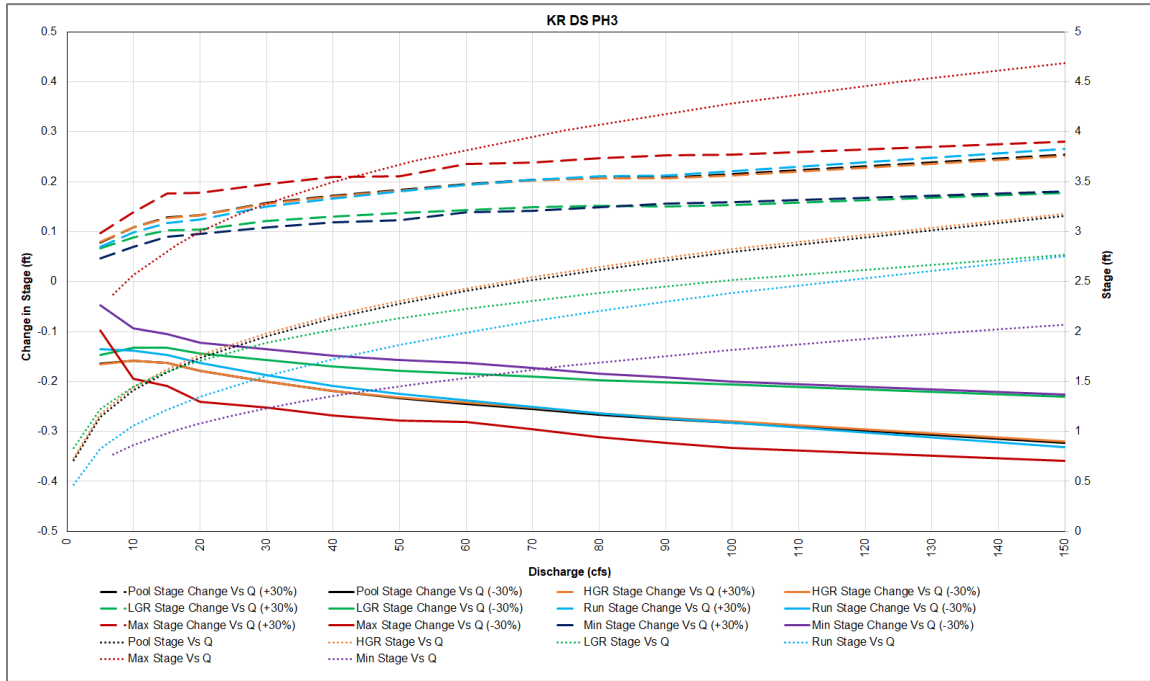


Figure 7.4-2. Stage Changes in the Kaweah River Downstream of Powerhouse No. 3 (KR DS PH3) Bypass Reach Based on a 30% of Existing Streamflow up or Down Ramp per Hour.

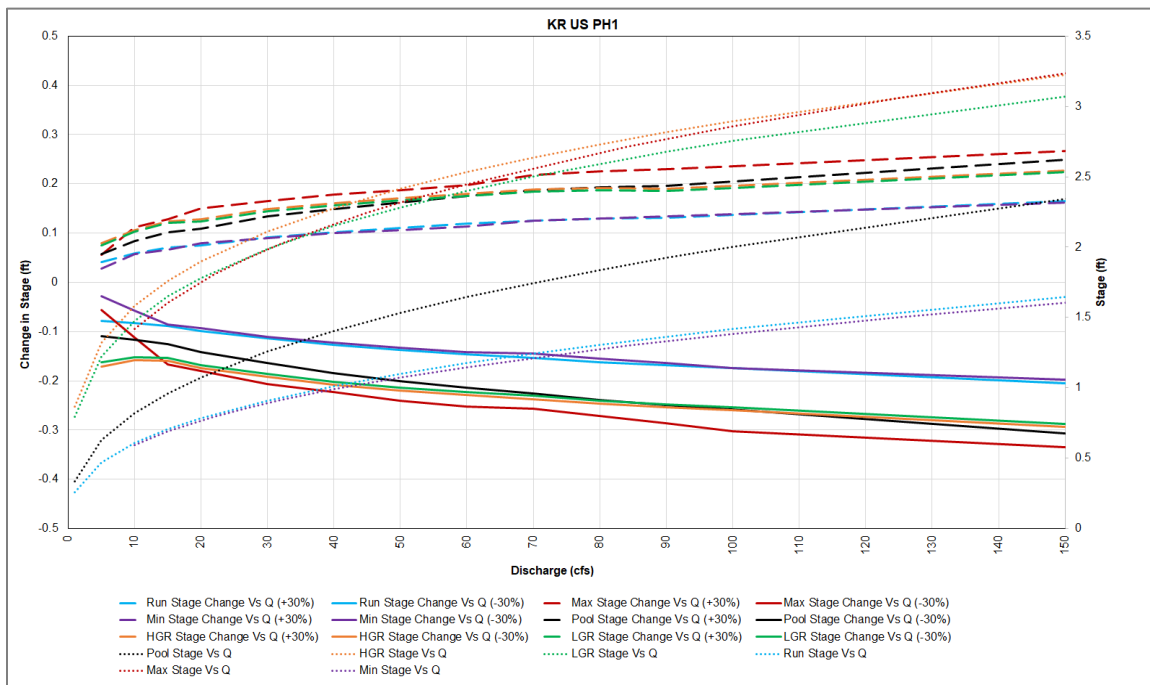


Figure 7.4-3. Stage Changes in the Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse (KR US PH1) Bypass Reach Based on a 30% of Existing Streamflow up or Down Ramp per Hour.

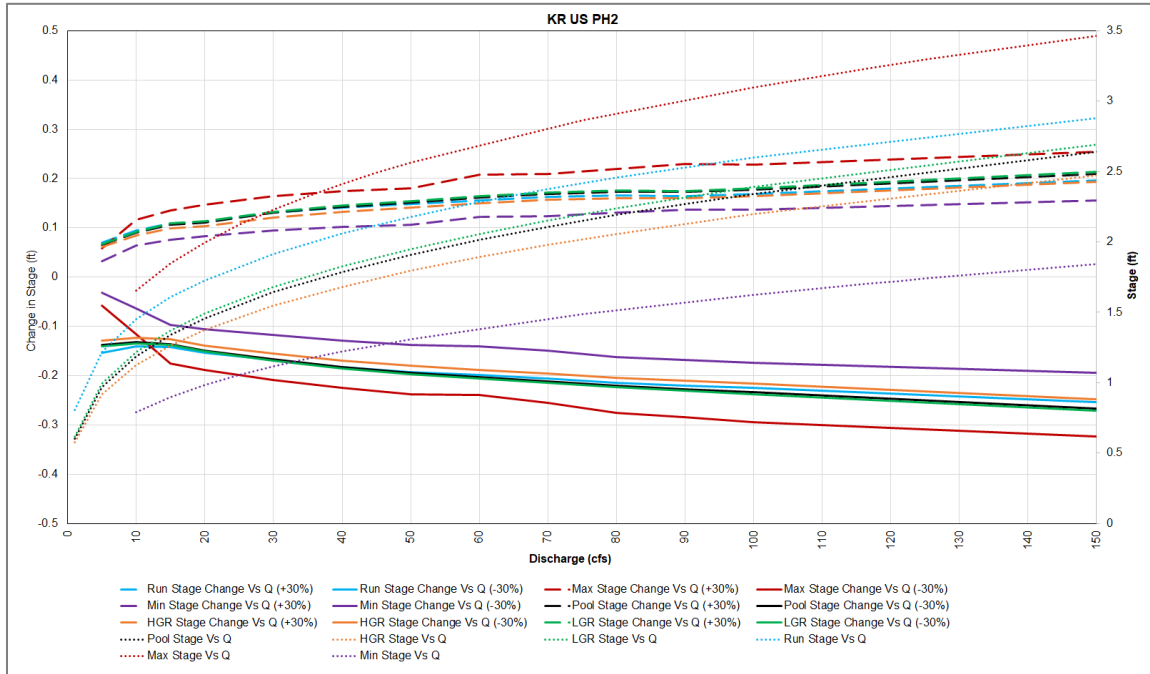


Figure 7.4-4. Stage changes in the Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse (KR US PH2) Bypass Reach Based on a 30% of Existing Streamflow up or Down Ramp per Hour.

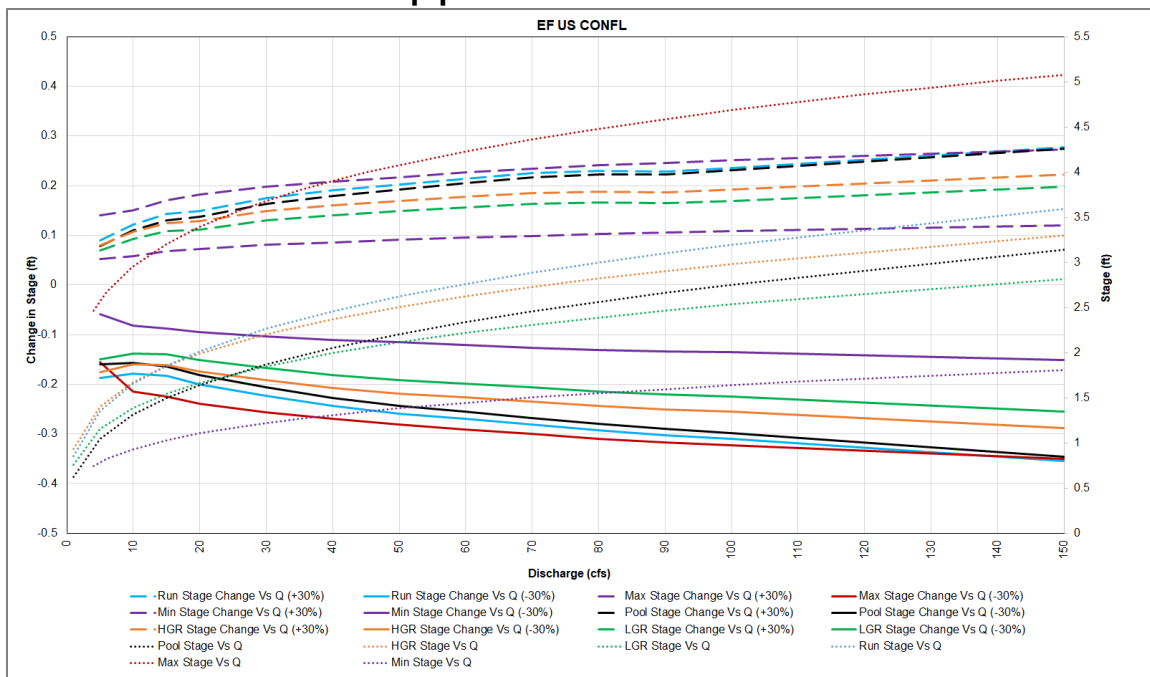


Figure 7.4-5. Stage Changes in the East Fork Kaweah River Upstream of Confluence with Kaweah River (EF US Confl) Bypass Reach Based on a 30% of Existing Streamflow up or Down Ramp per Hour.

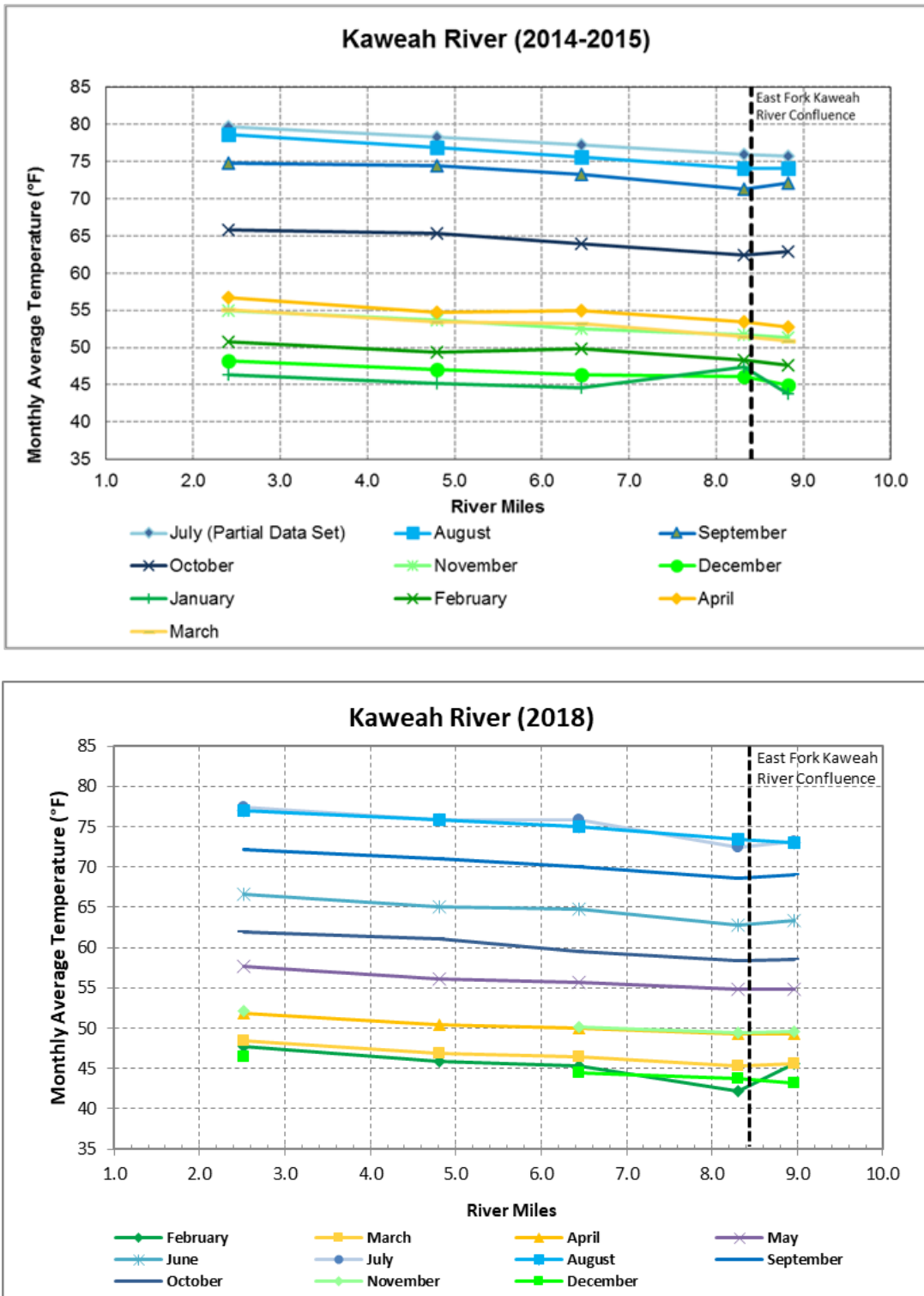


Figure 7.4-6. Longitudinal trends in Average Monthly Water Temperature along the Kaweah River July 2014 through April 2015 (top) and 2018 (bottom).

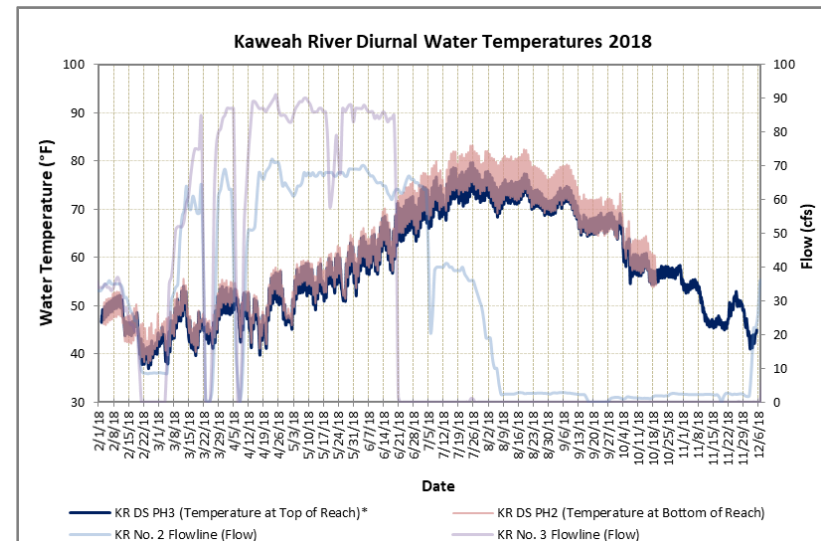
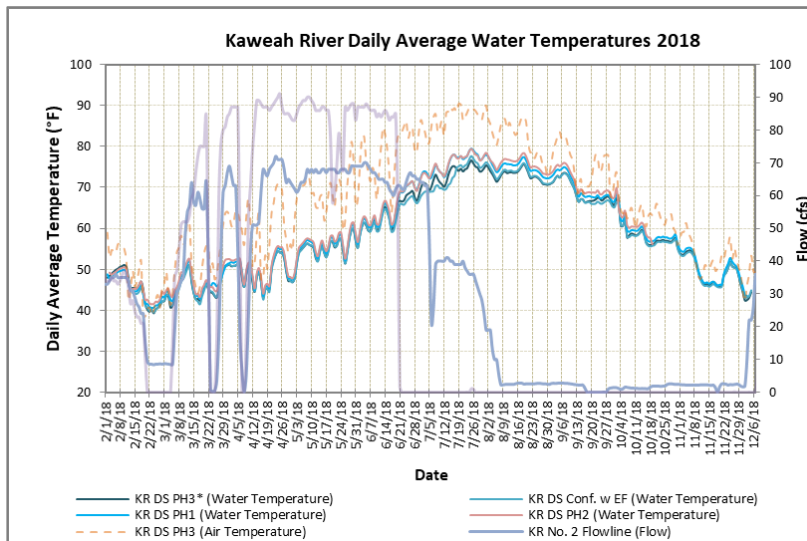
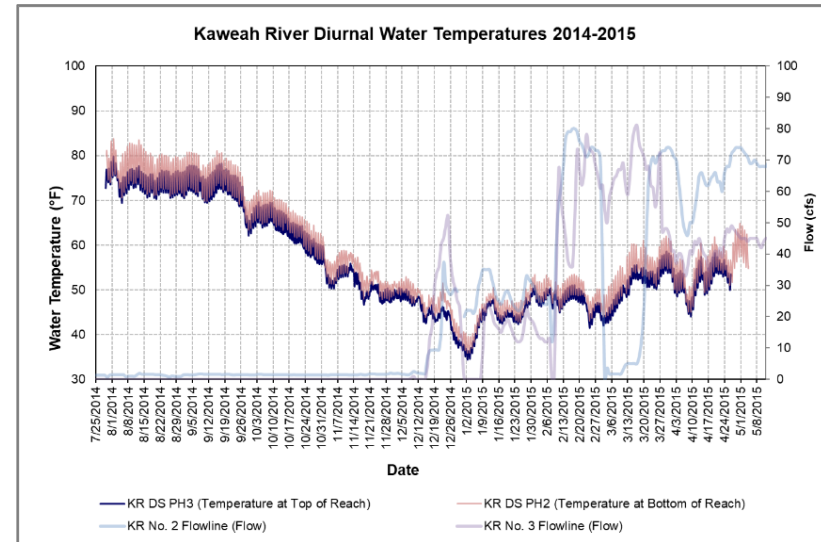
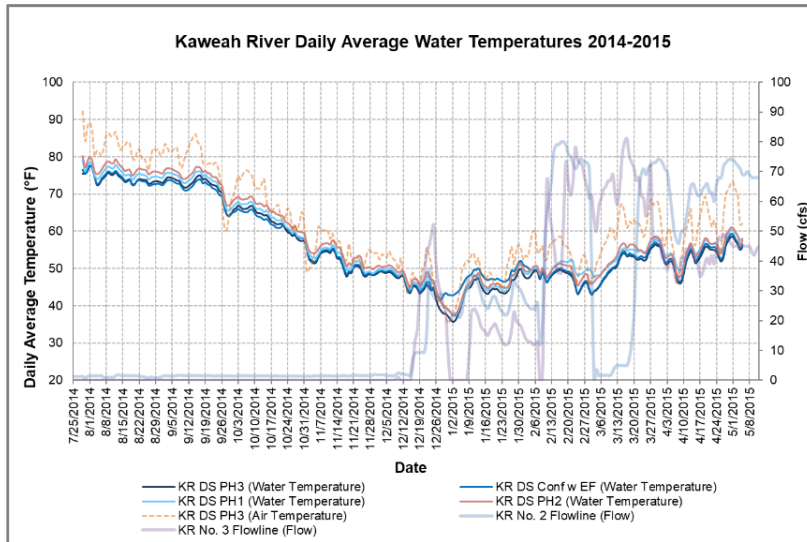


Figure 7.4-7. Kaweah River Average Daily and 15-min Water Temperature July 2014 through April 2015 (top) and 2018 (bottom).

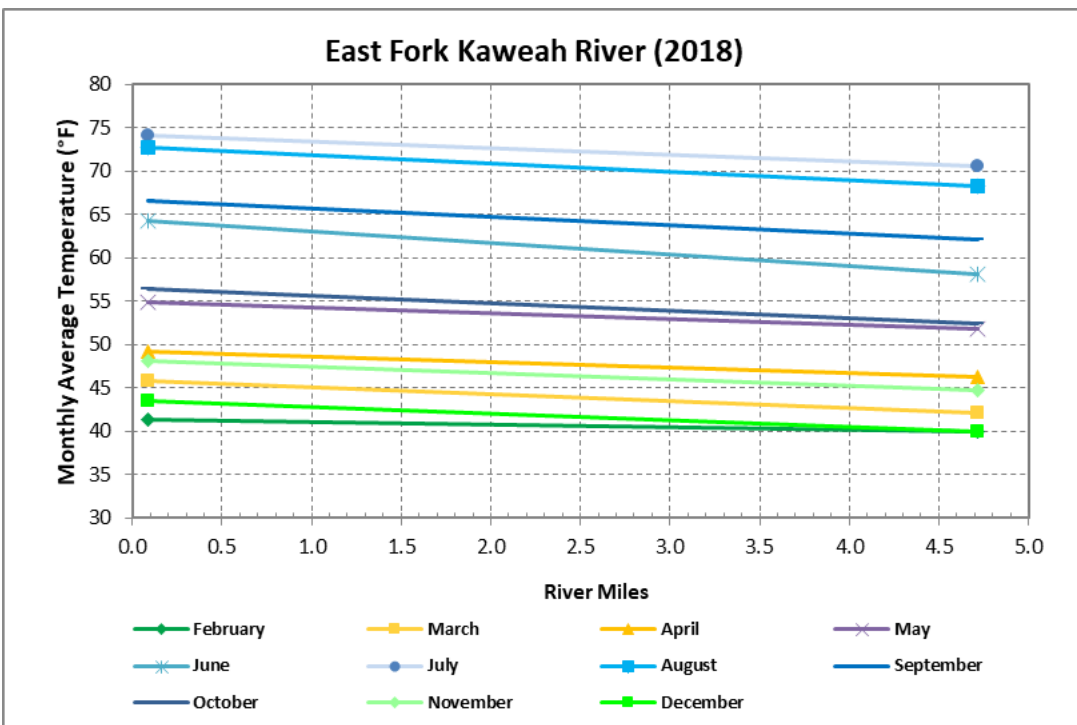
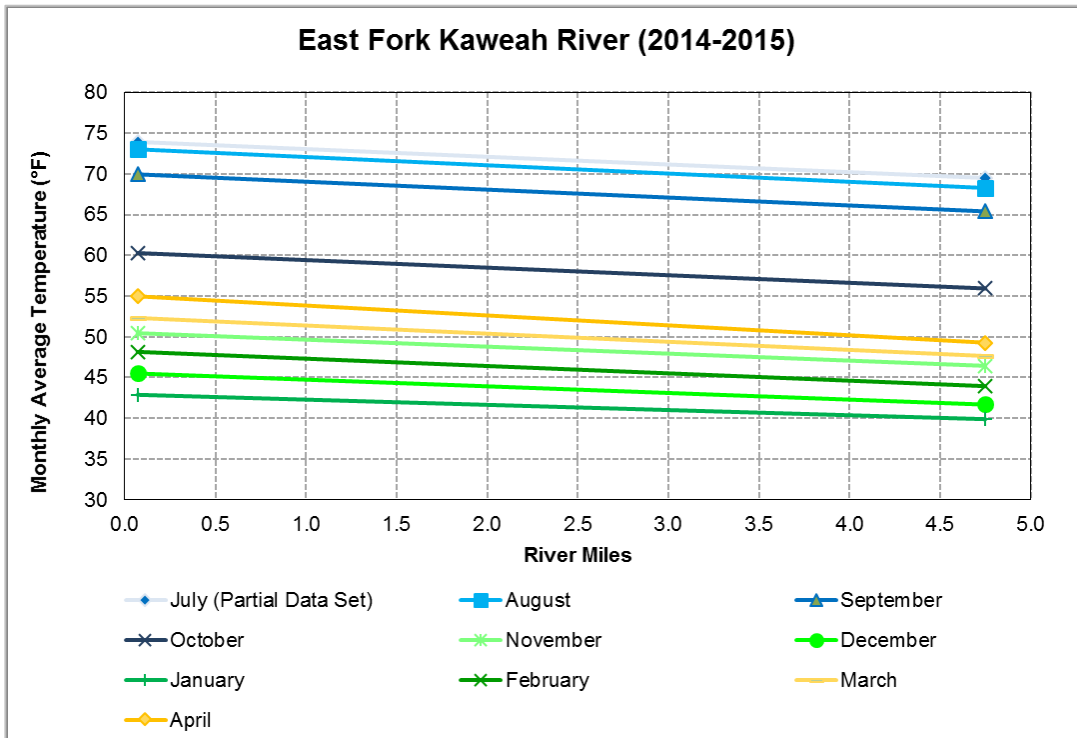


Figure 7.4-8. Longitudinal Trends in Average Monthly Water Temperature along the East Fork Kaweah River July 2014 through April 2015 (top) and 2018 (bottom).

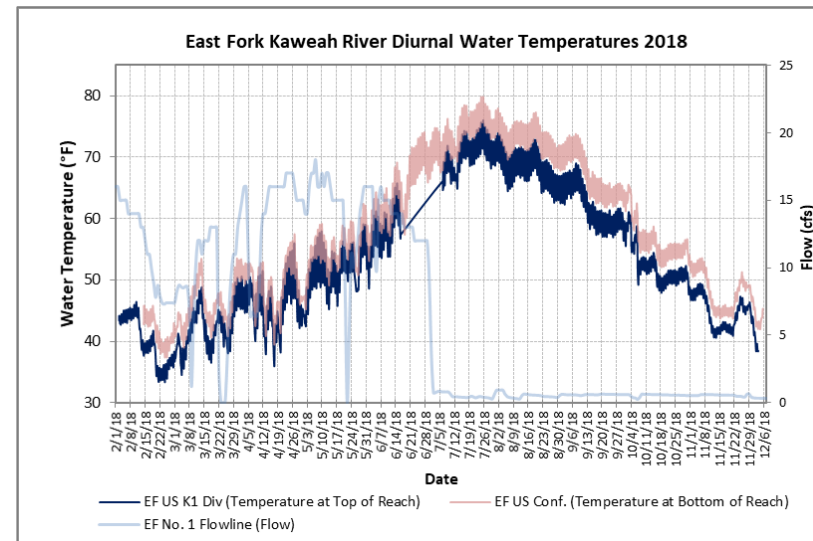
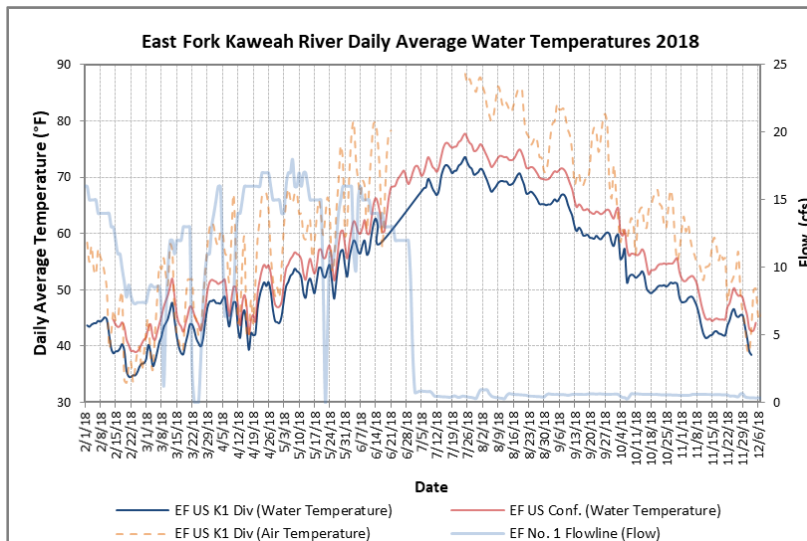
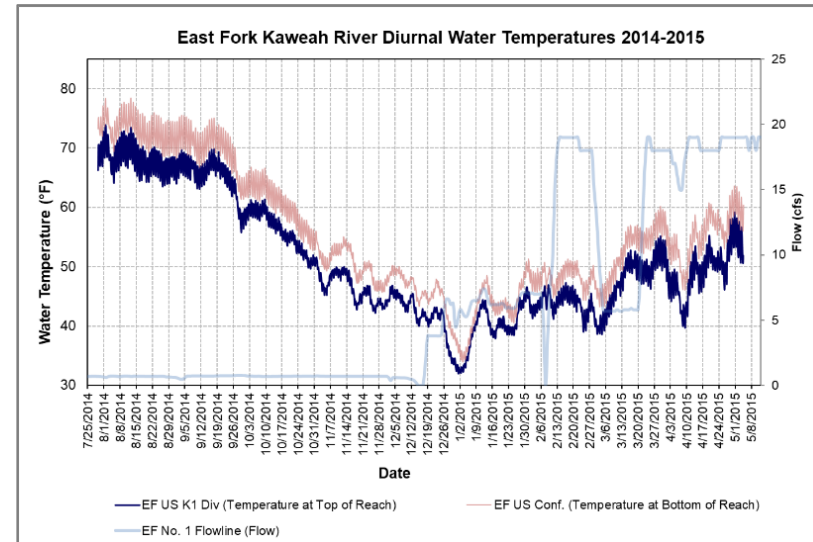
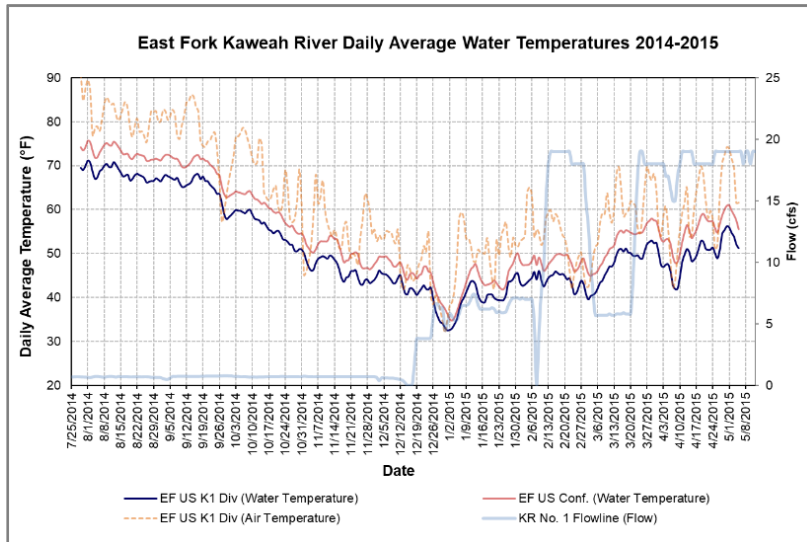


Figure 7.4-9. East Fork Kaweah River Average Daily and 15-min Water Temperature July 2014 through April 2015 (top) and 2018 (bottom).

Month	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Hardhead												
Juvenile												
Adult												
Sacramento Pikeminnow												
Juvenile												
Adult												
Sacramento Sucker												
Juvenile												
Adult												
Rainbow Trout												
Spawning												
Fry												
Juvenile												
Adult												

Figure 7.4-10. Periodicity Chart for Modeled Fish Species and Life Stages in the Kaweah Project.

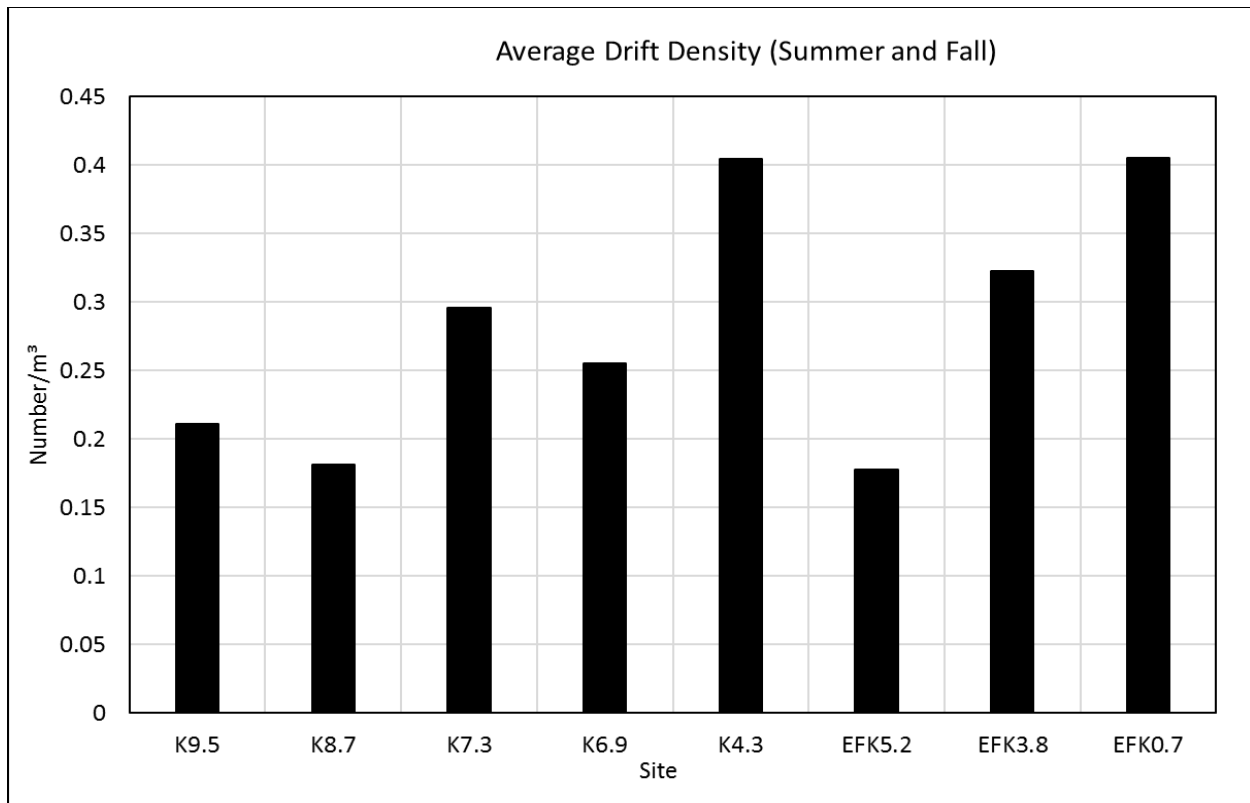


Figure 7.4-11. Average Macroinvertebrate Drift Density (Summer and Fall) (number/m³) by Location.

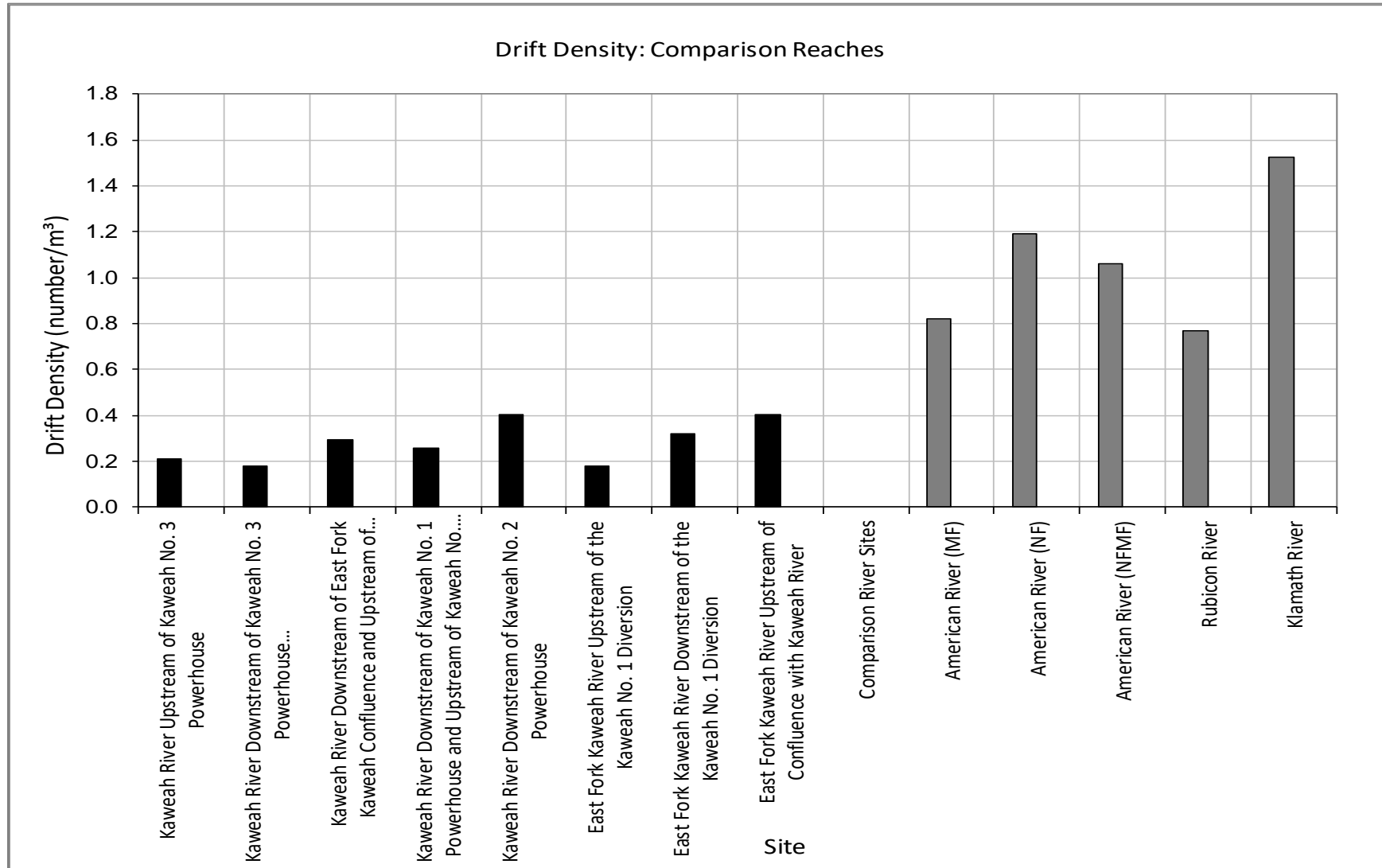


Figure 7.4-12. Average Drift Density (Summer and Fall) at Kaweah River Study Locations (black) and Comparable Locations (grey).

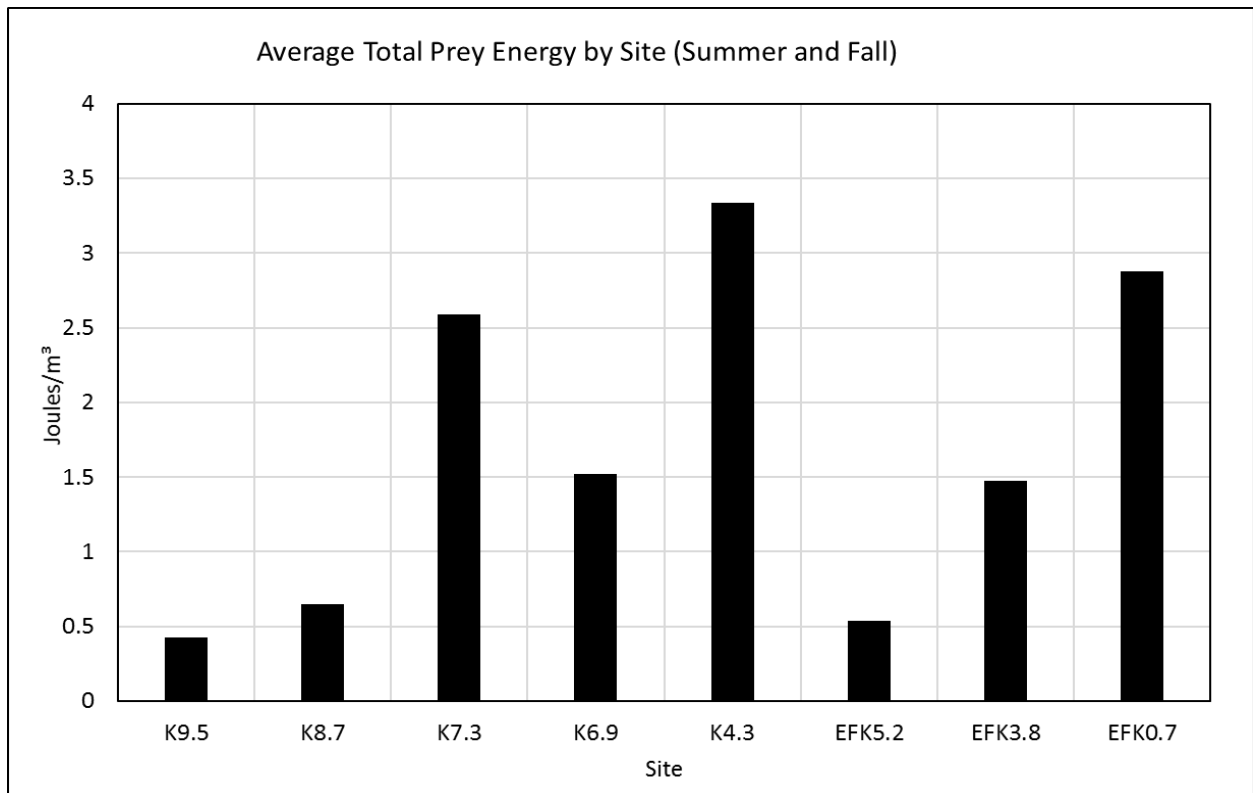


Figure 7.4-13. Average Total Prey Energy (Summer and Fall) by Site.

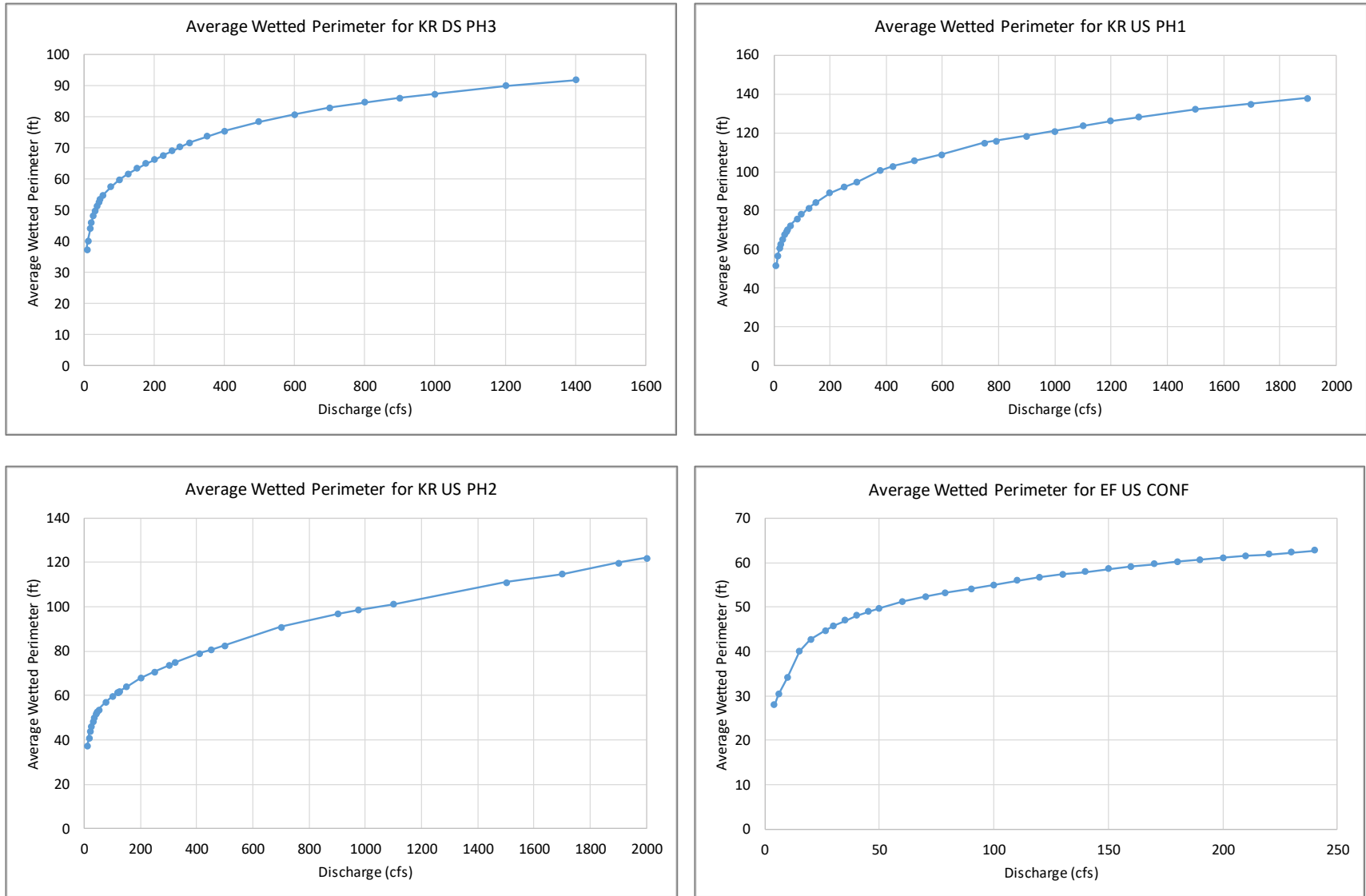


Figure 7.4-14. Wetted Perimeter Versus Flow in each Bypass Reach.

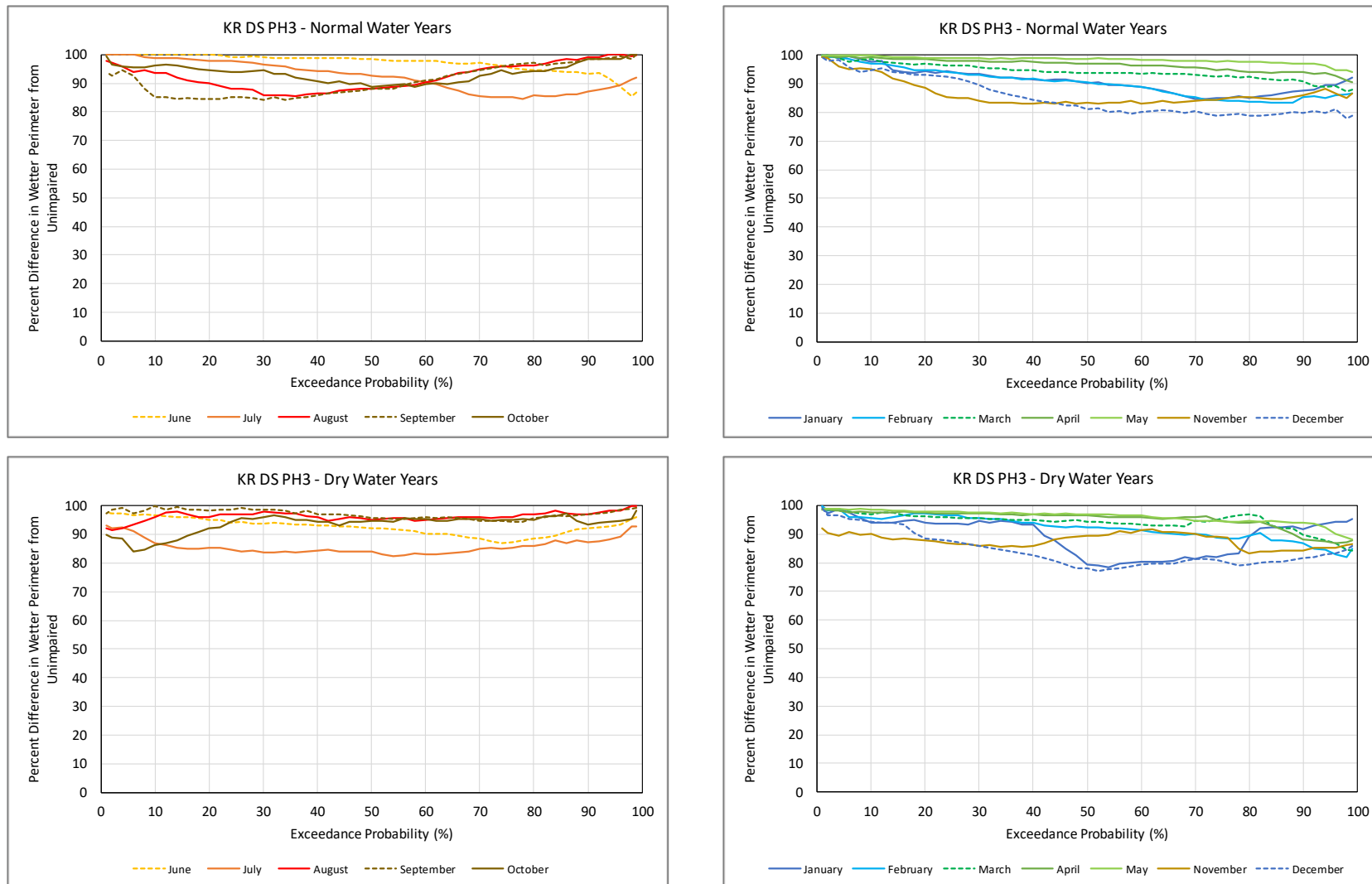


Figure 7.4-15. Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence Wetted Perimeter Percent of Unimpaired Exceedance Plots (1994-2018) for Normal (top) and Dry Water Year Types (bottom) (warm water temperature months, left, cool water temperature months, right).

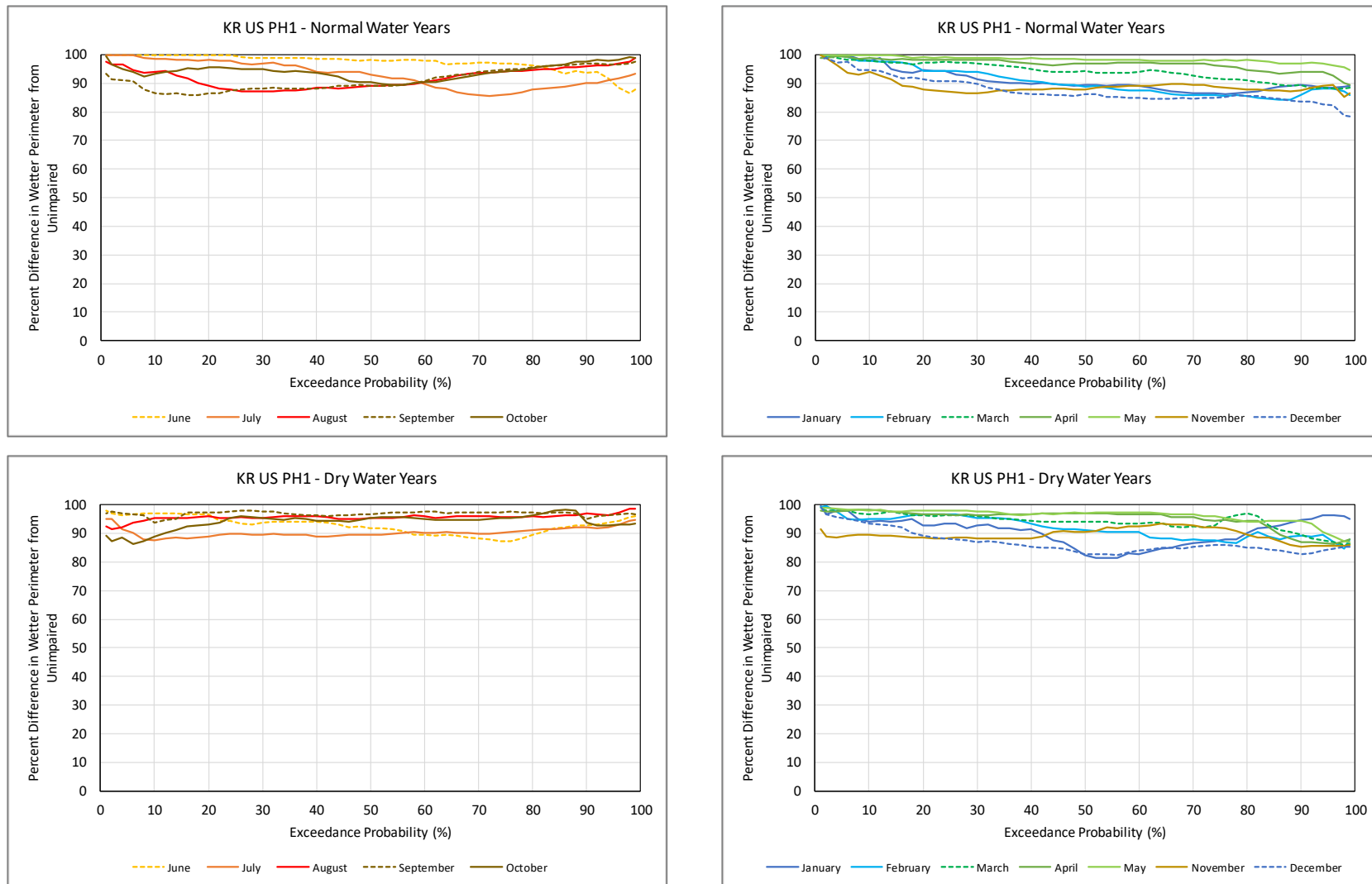


Figure 7.4-16. Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse Wetted Perimeter Percent of Unimpaired Exceedance Plots (1994-2018) for Normal (top) and Dry Water Year Types (bottom) (warm water temperature months, left, cool water temperature months, right).

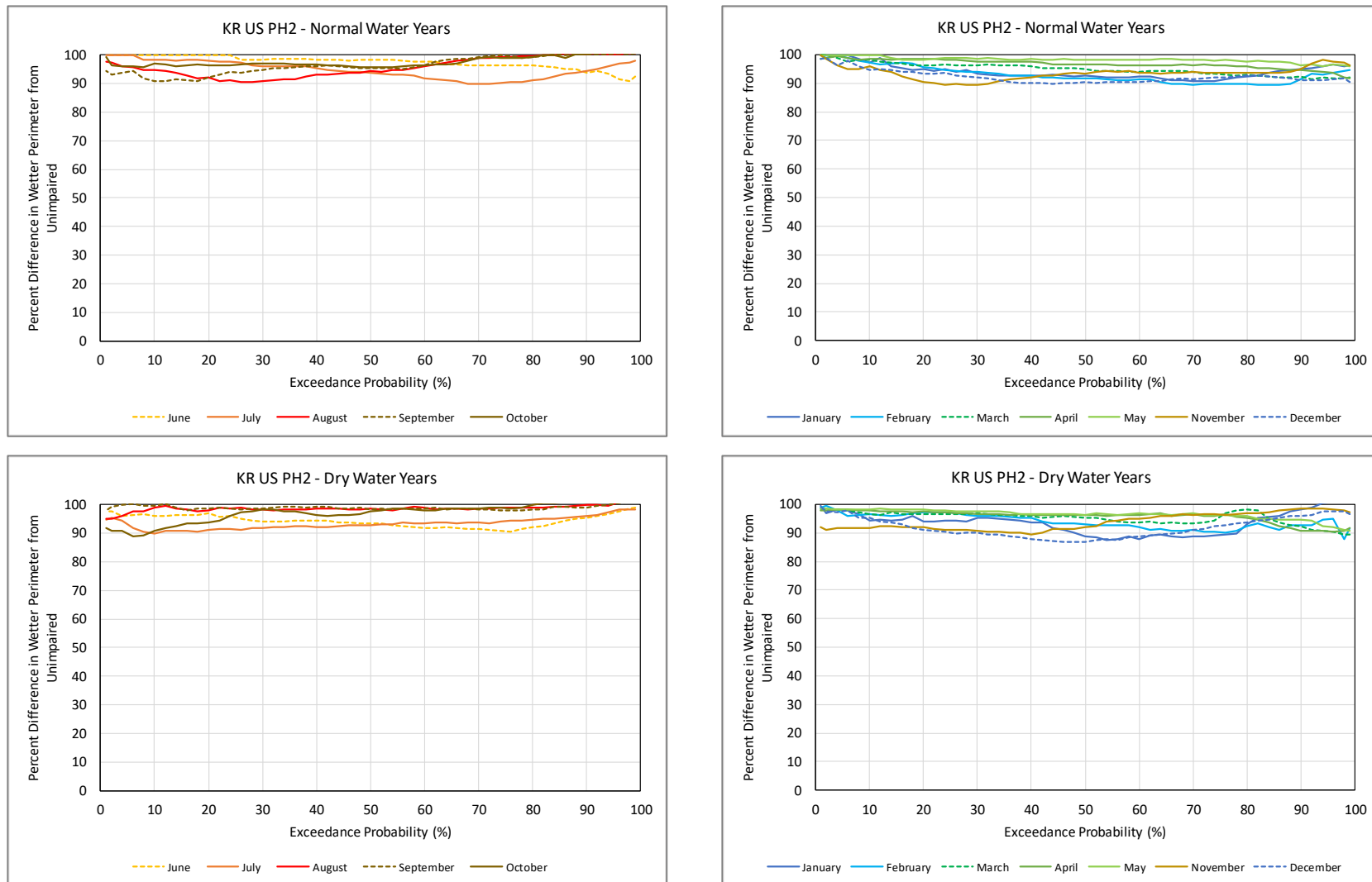


Figure 7.4-17. Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse Wetted Perimeter Habitat Percent of Unimpaired Exceedance Plots (1994-2018) for Normal (top) and Dry Water Year Types (bottom) (warm water temperature months, left, cool water temperature months, right).

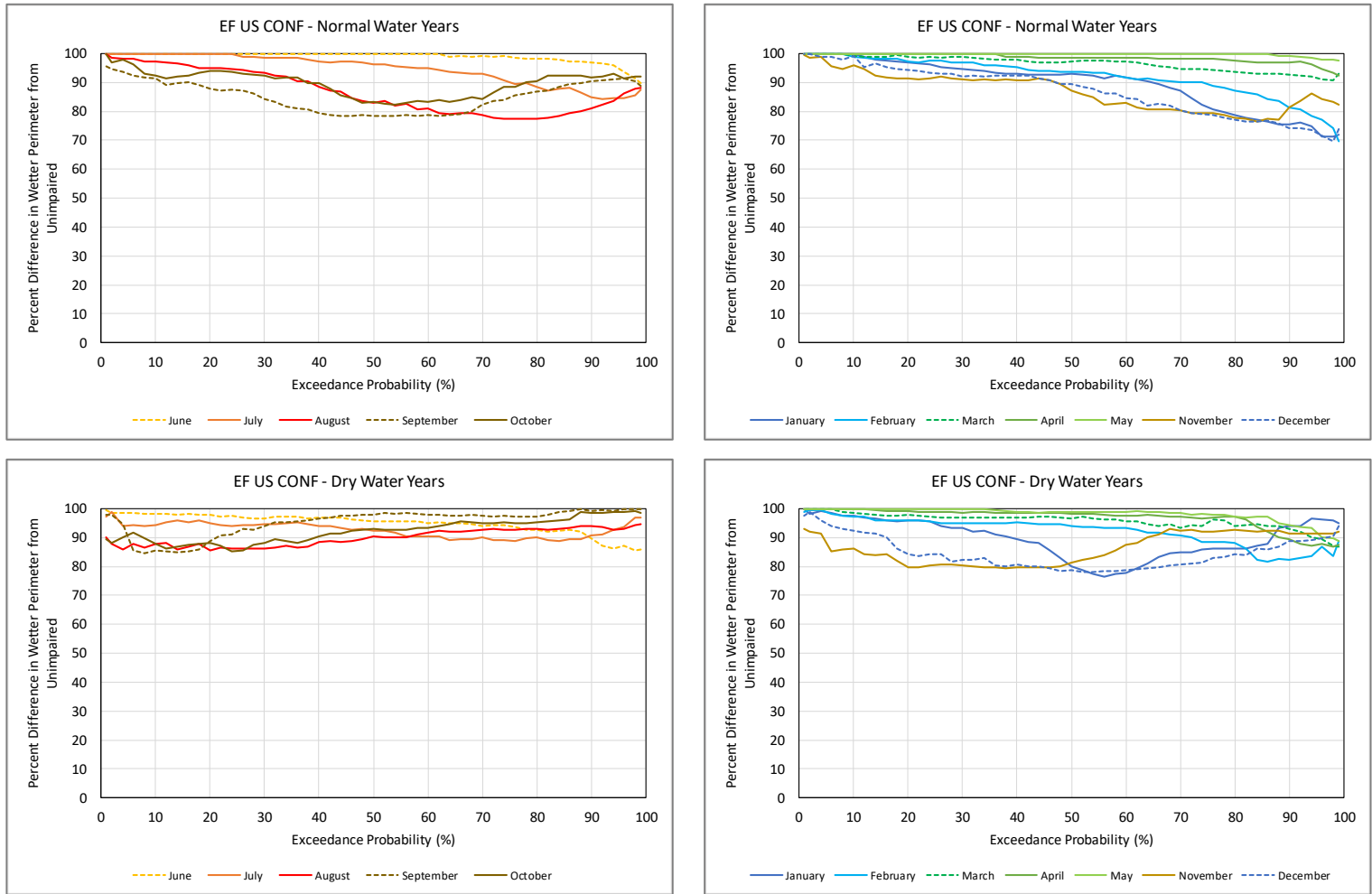


Figure 7.4-18. East Fork Kaweah River Upstream of the Confluence with Kaweah River Wetted Perimeter Percent of Unimpaired Exceedance Plots (1994-2018) for Normal (top) and Dry Water Year Types (bottom) (warm water temperature months, left, cool water temperature months, right).

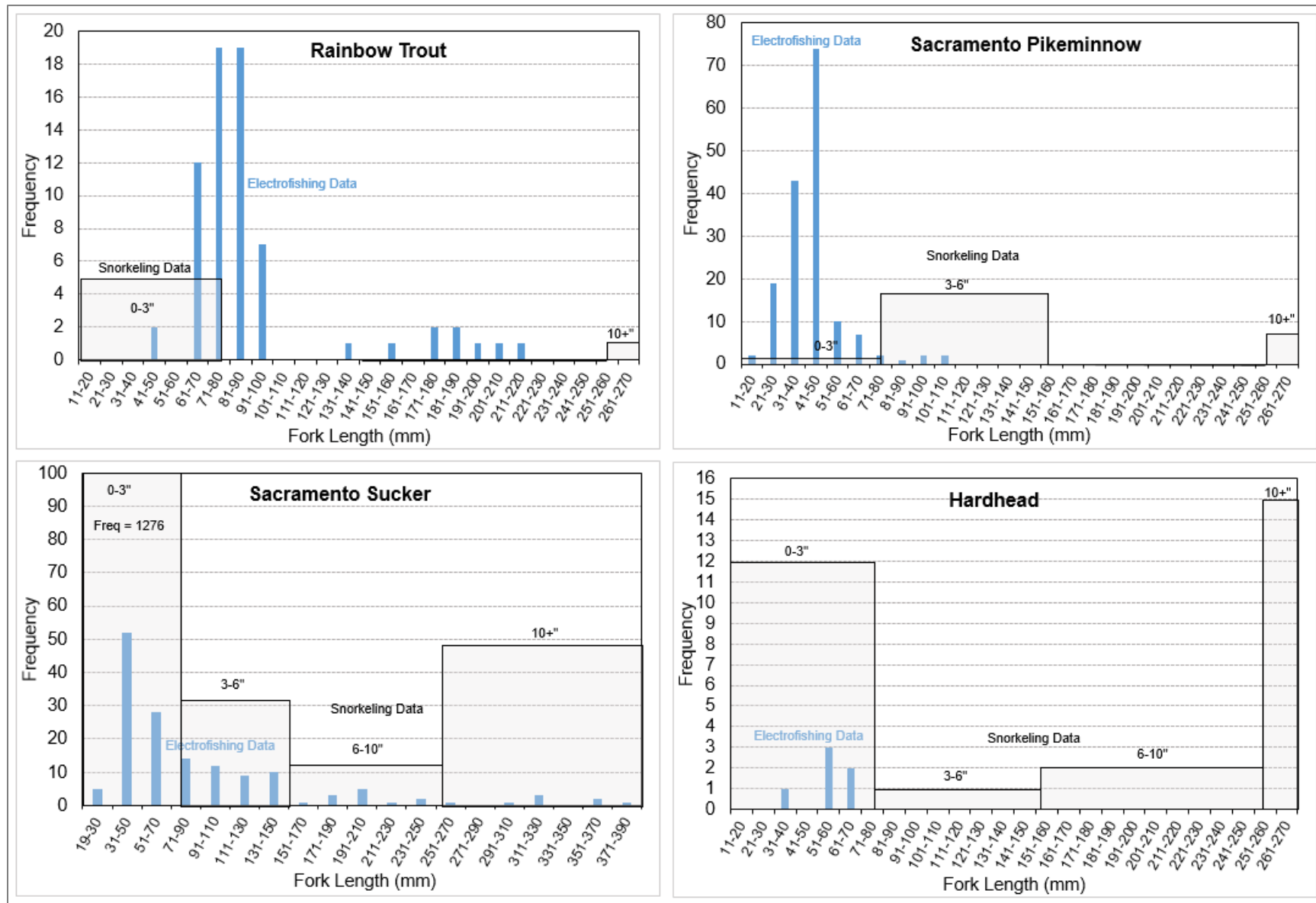


Figure 7.4-19. Length Frequency Histograms for Each Fish Species Captured at All Sites.

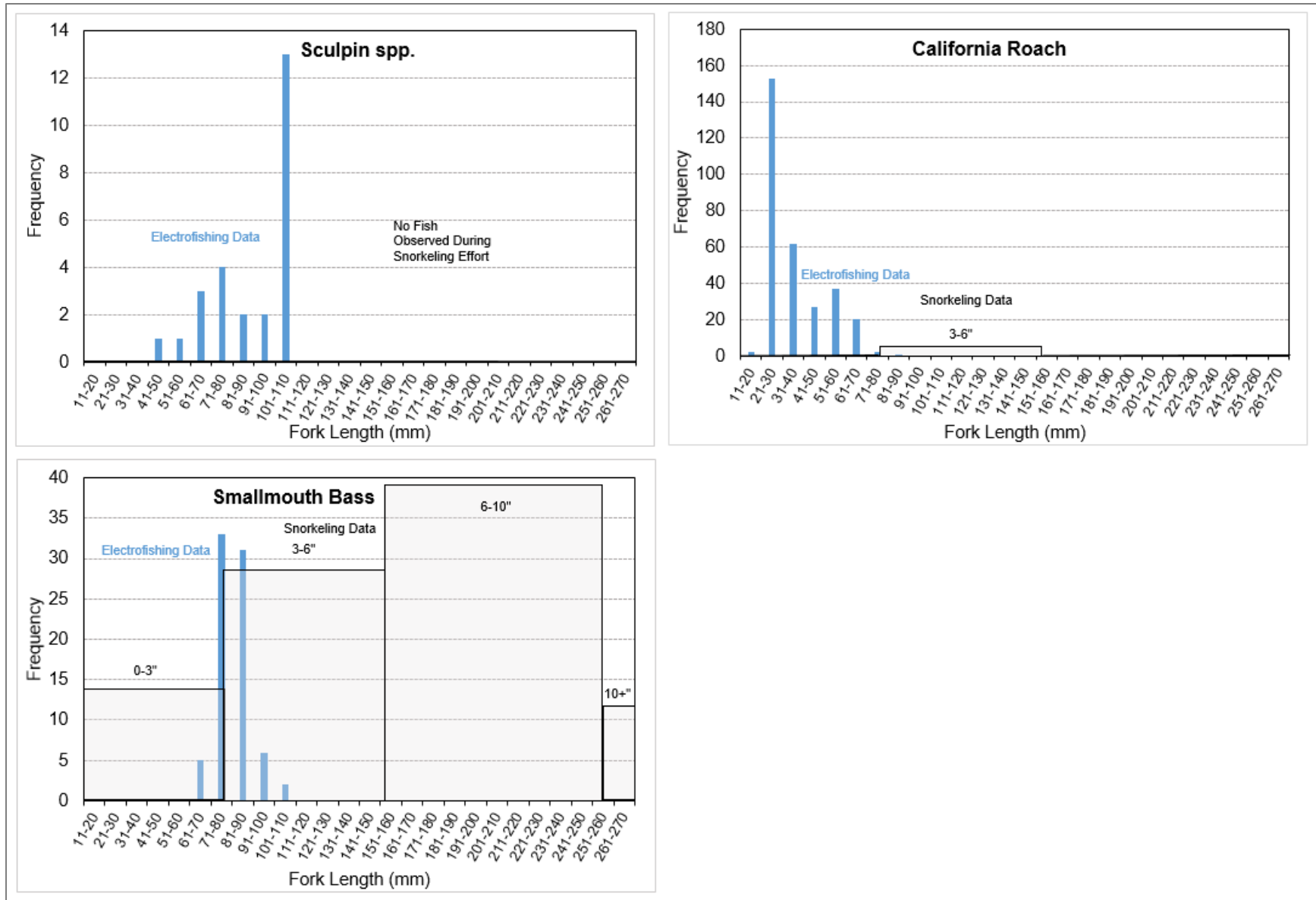


Figure 7.4-19. (cont'd) Length Frequency Histograms for Each Fish Species Captured Across All Sites.

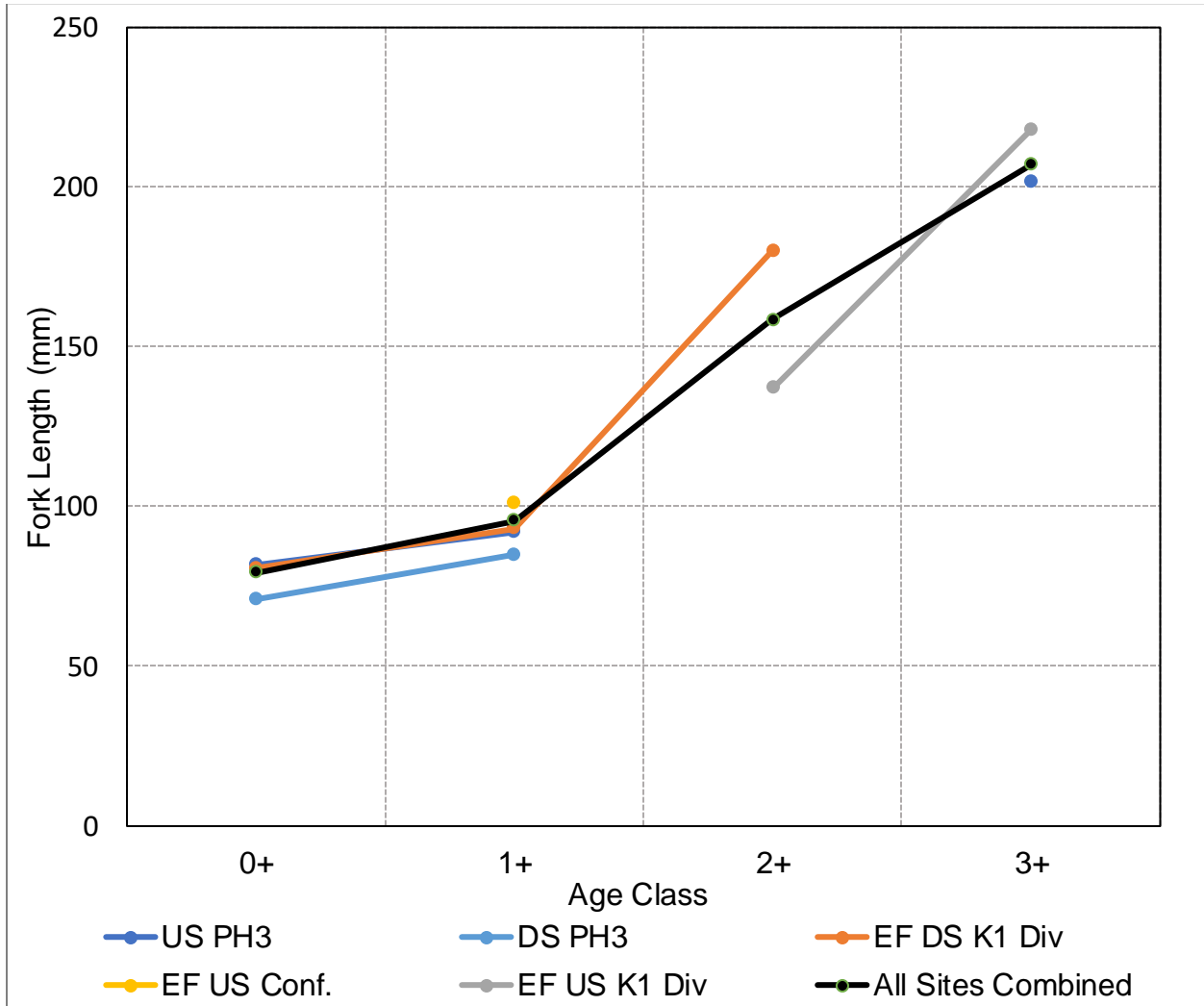


Figure 7.4-20. 2018 Age and Growth Rates of Rainbow Trout for All Study Sites Combined Based on Scale Analysis (n=30).

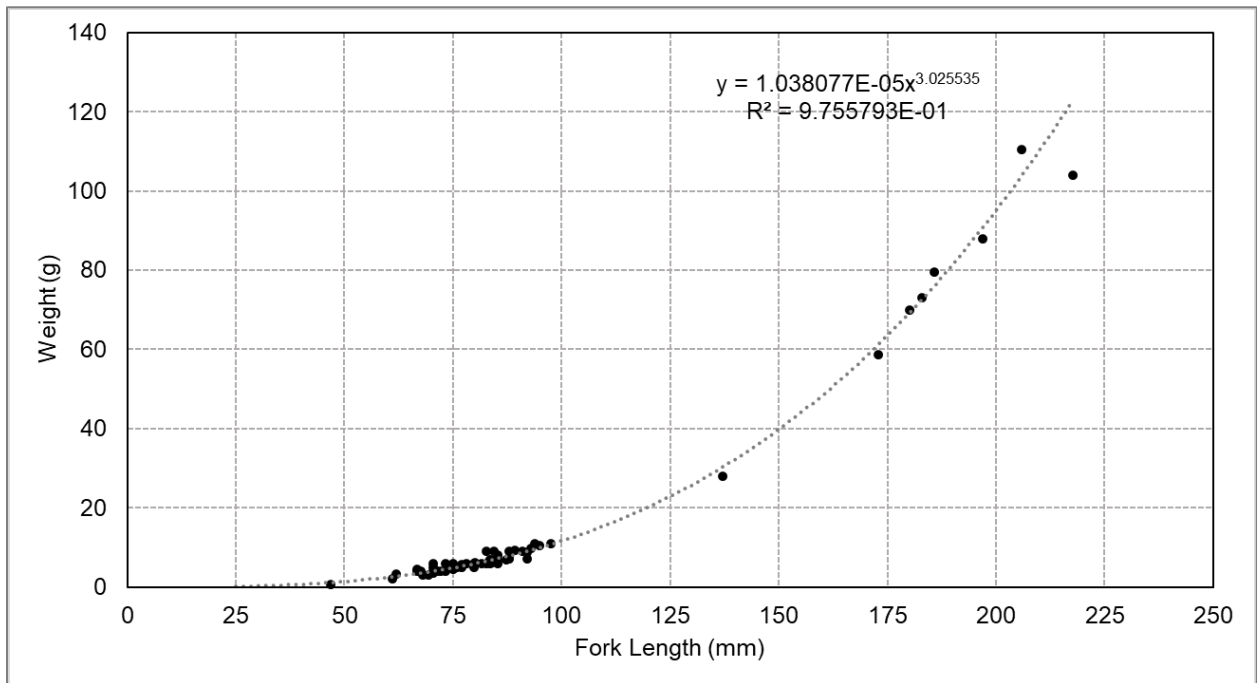


Figure 7.4-21. Length and Weight Relationship for Rainbow Trout for All Study Sites Combined.

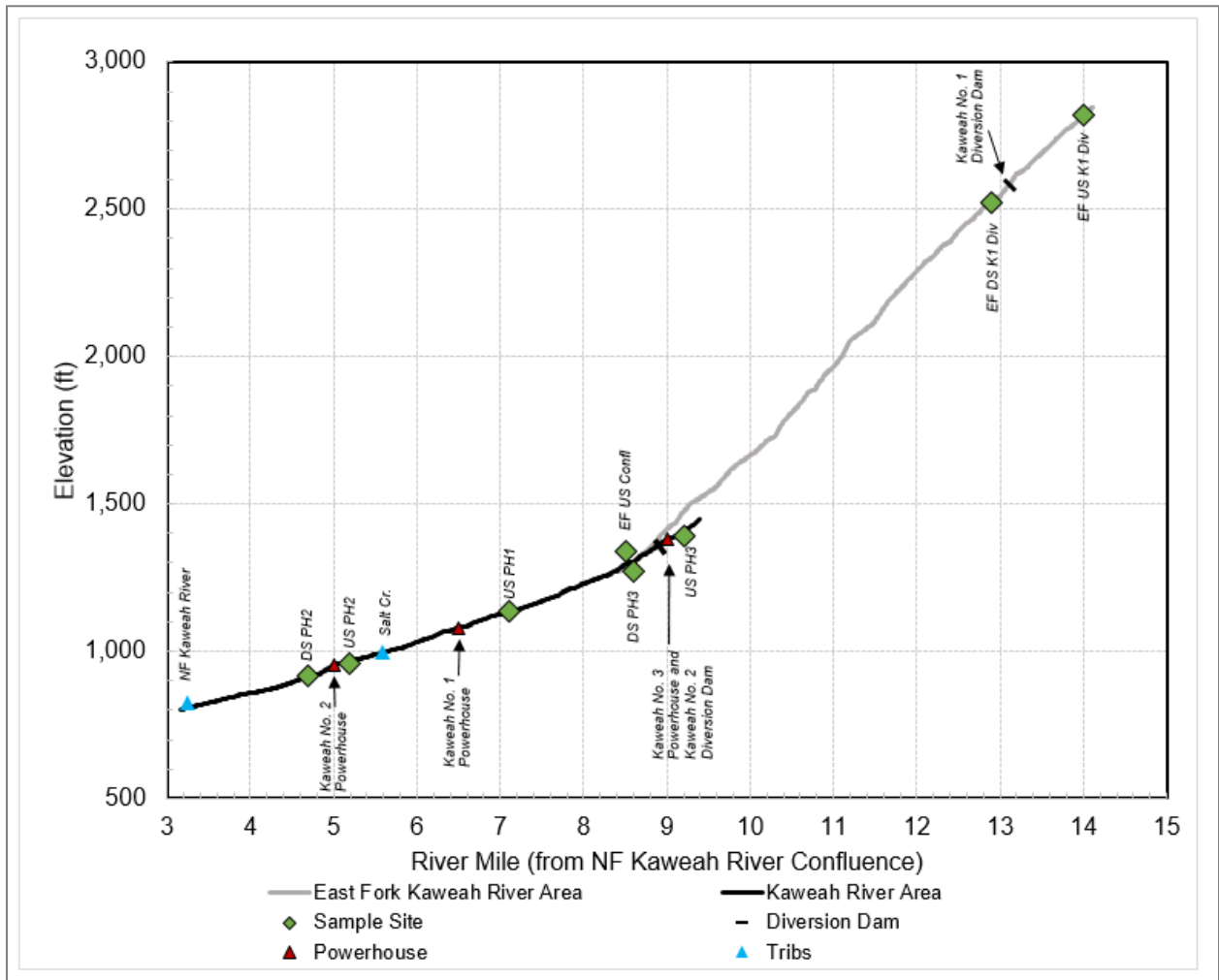


Figure 7.4-22. Elevation of Fish Sampling Sites on the Kaweah River and East Fork Kaweah River.

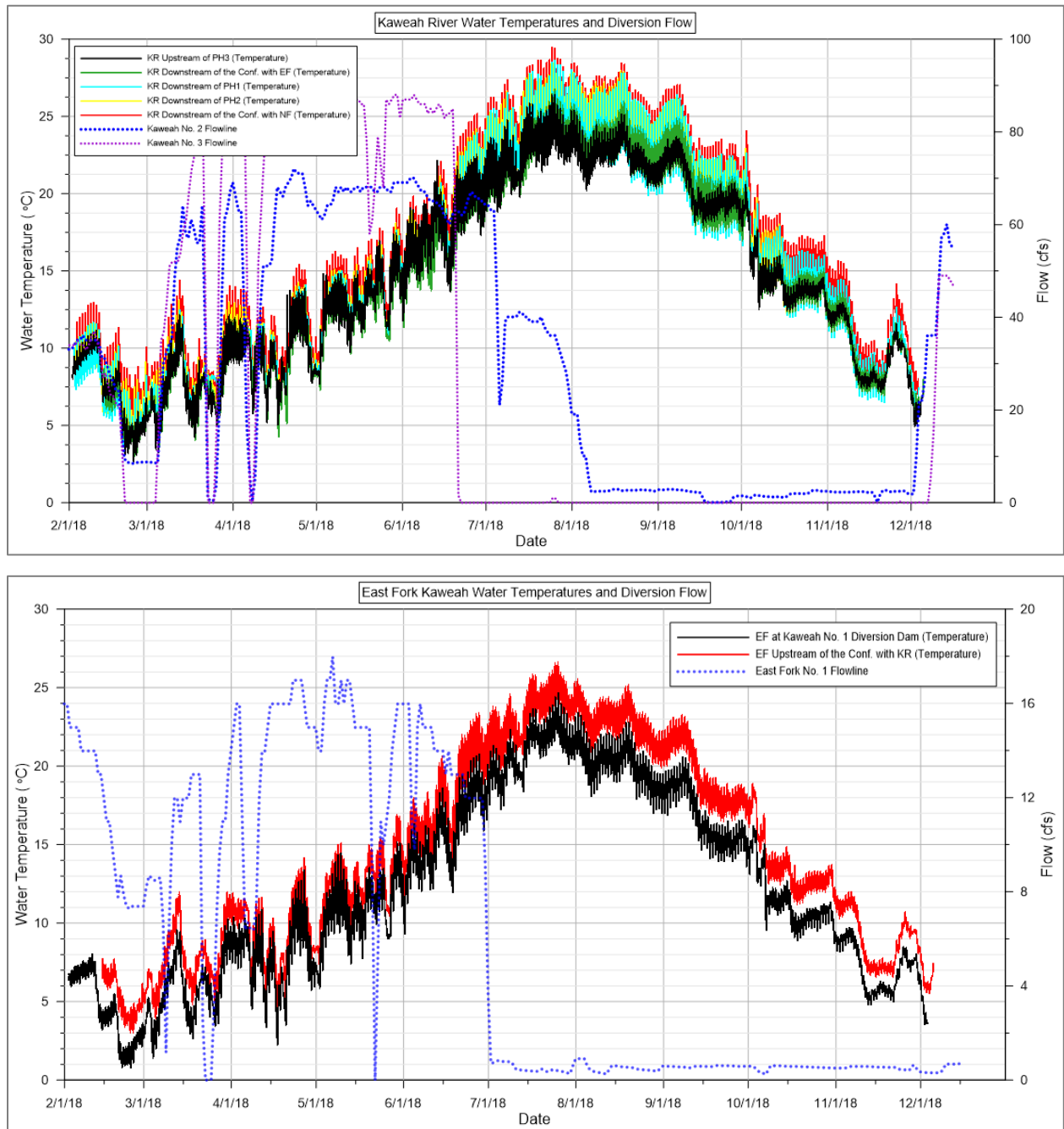


Figure 7.4-23. Water Temperature (2018) in the Vicinity of the Kaweah River and East Fork Kaweah River Fish Sampling Sites.

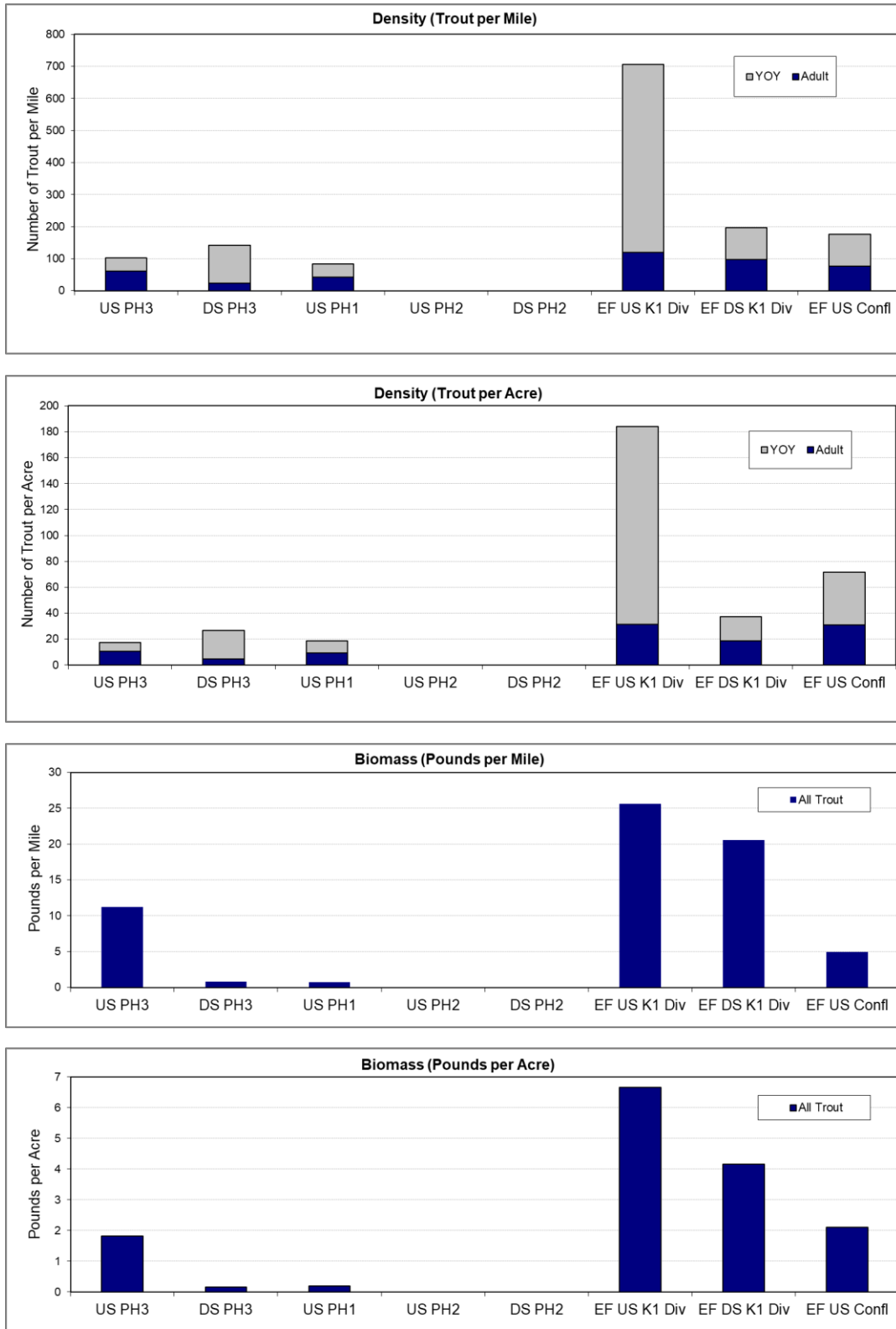


Figure 7.4-24. The Density and Biomass of Rainbow Trout in Study Reaches.

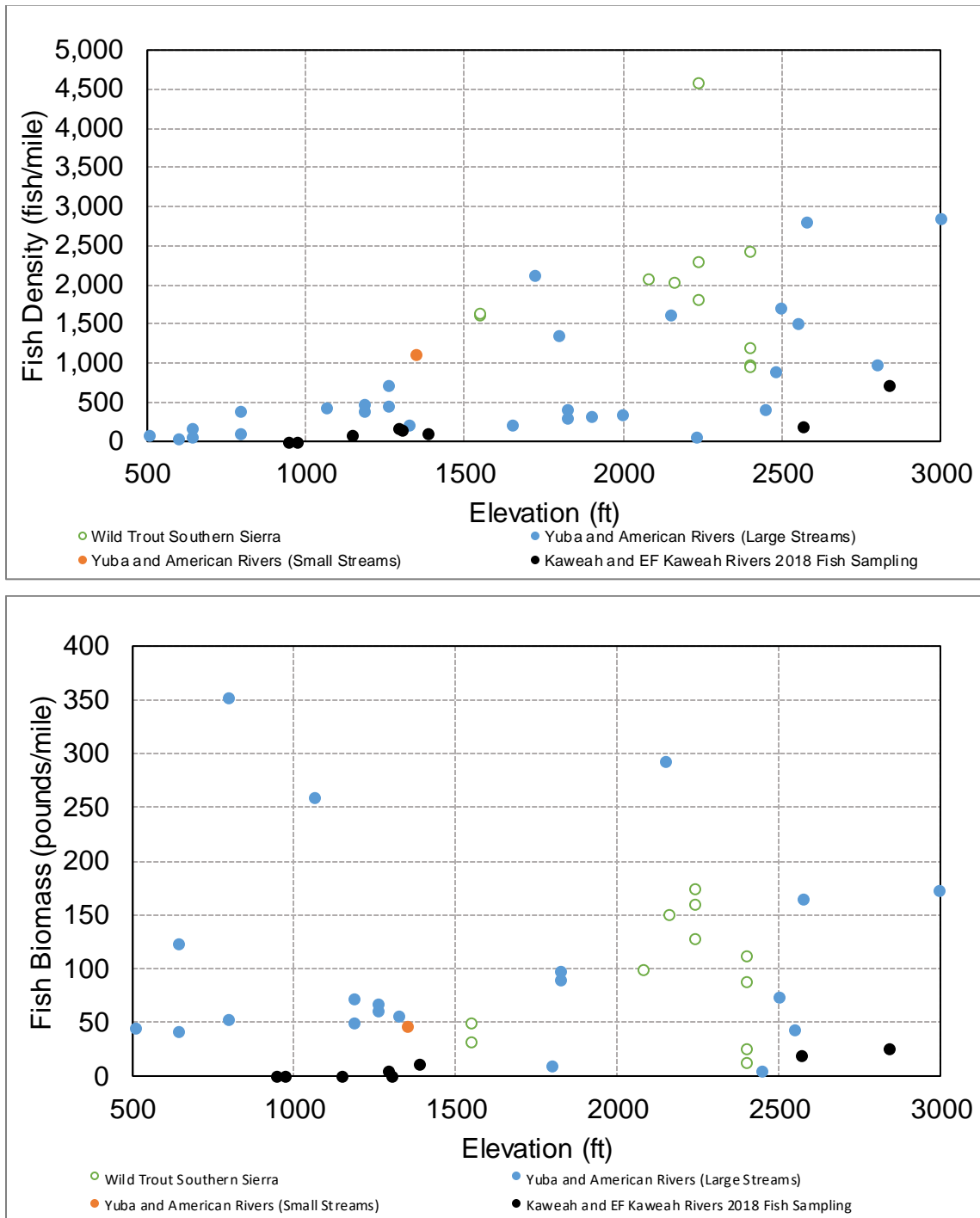


Figure 7.4-25. Rainbow Trout - Elevation vs. Fish per Mile (top) and Elevation vs. Pounds per Mile (bottom).

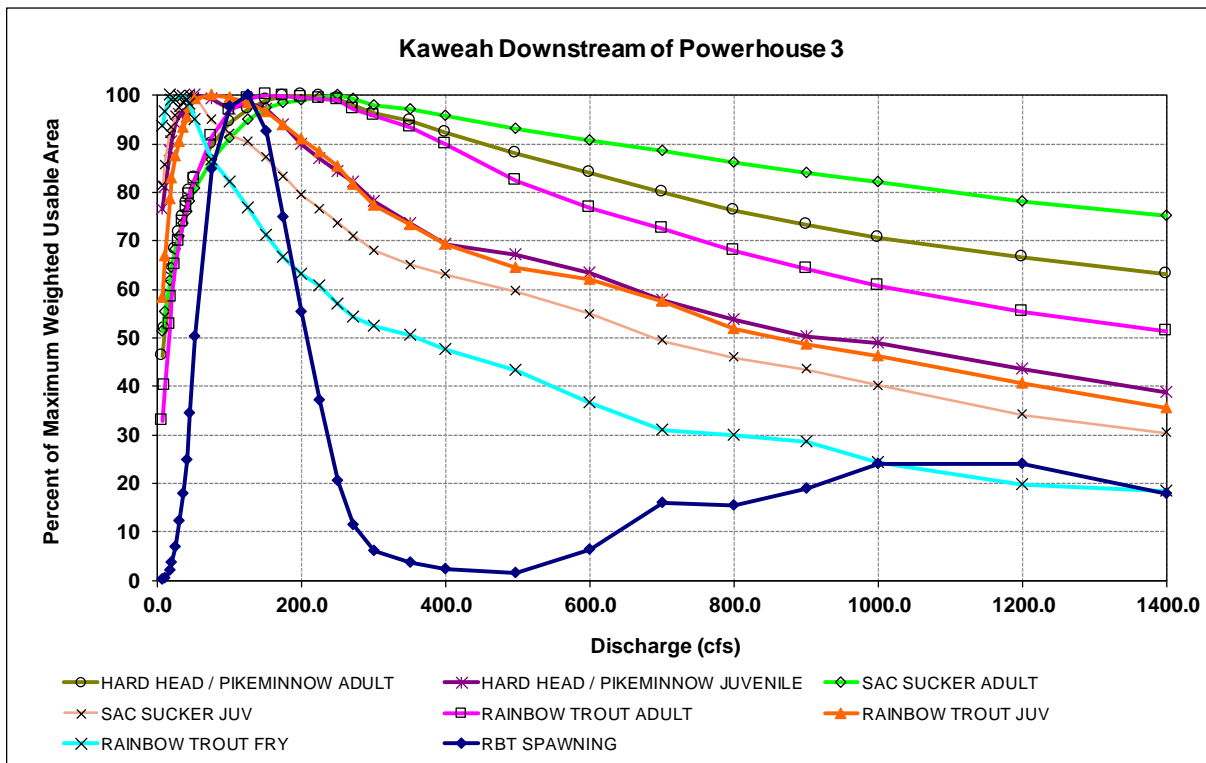
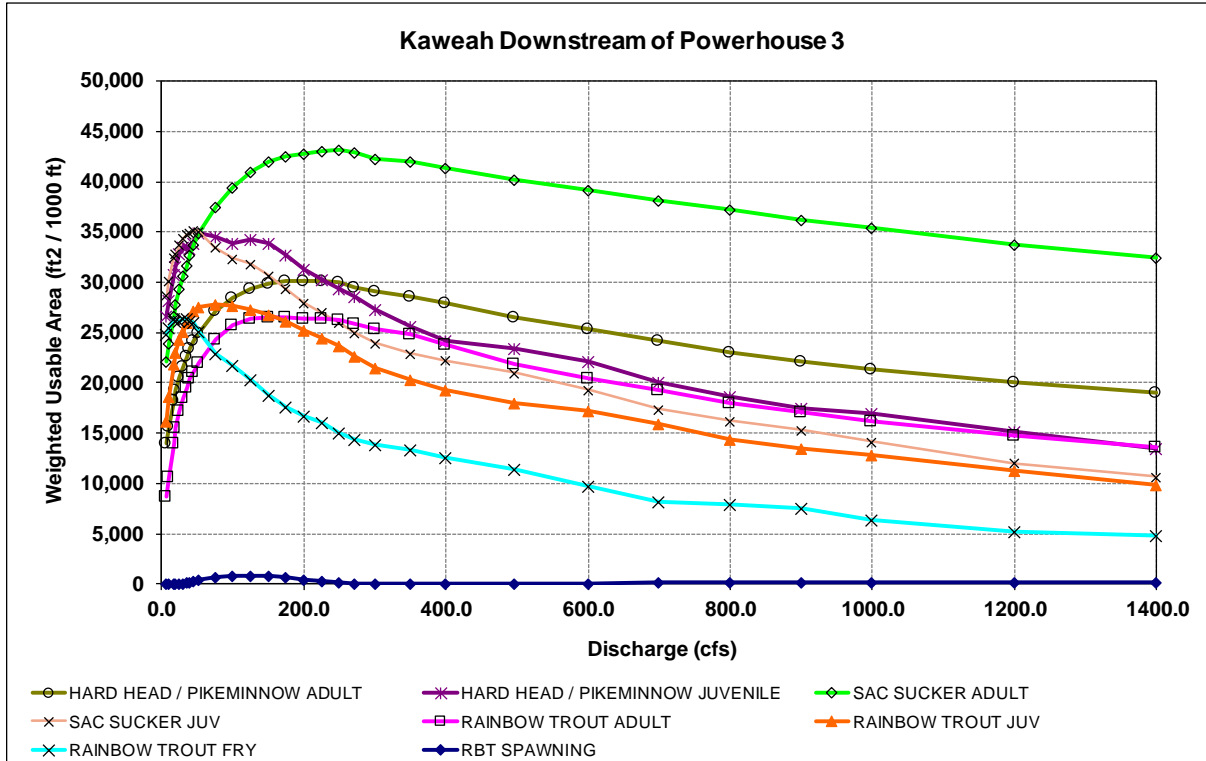


Figure 7.4-26. Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence Weighted Usable Area (top) and Percent of Maximum Weighted Usable Area (bottom).

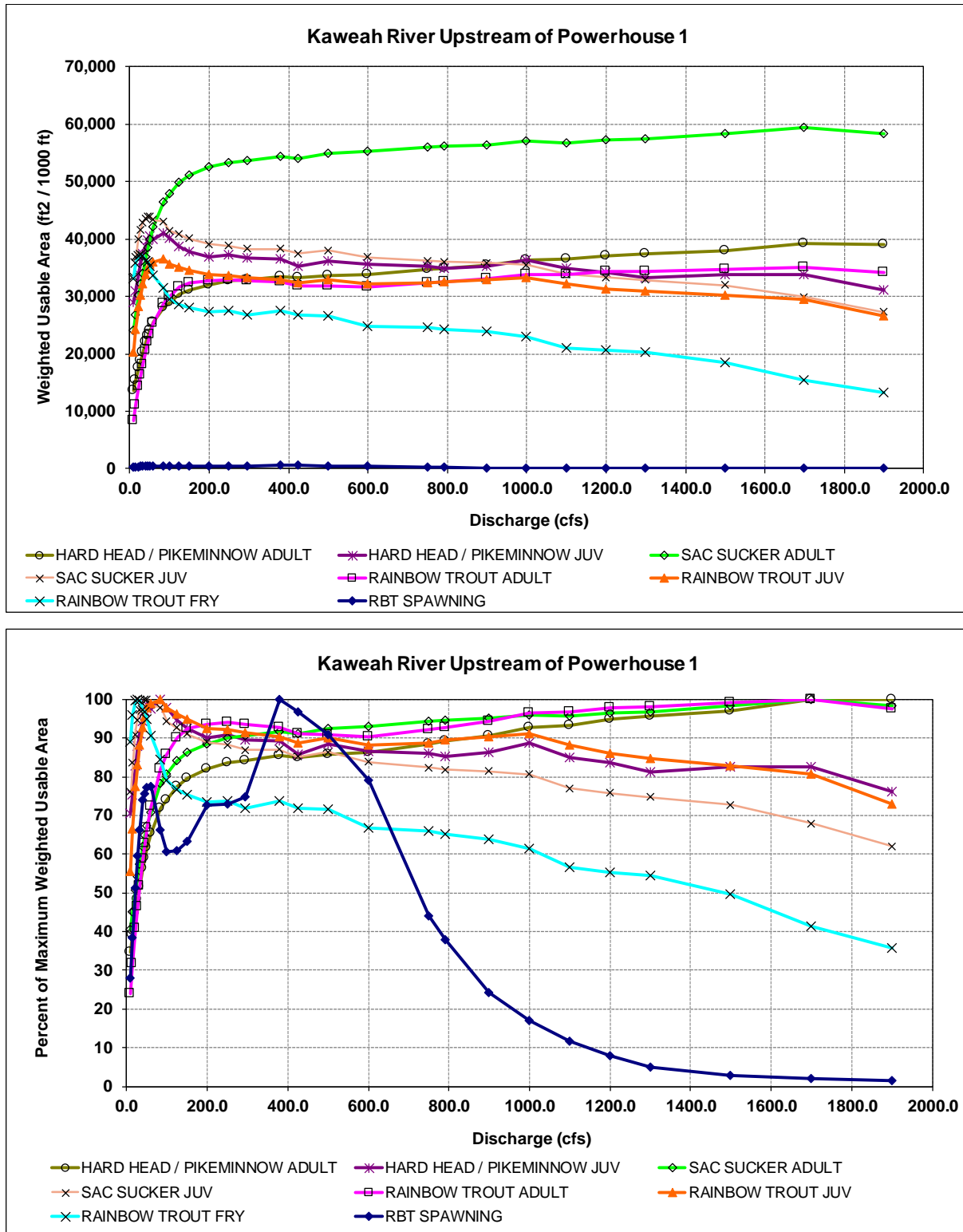


Figure 7.4-27. Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse Weighted Usable Area (top) and Percent of Maximum Weighted Usable Area (bottom).

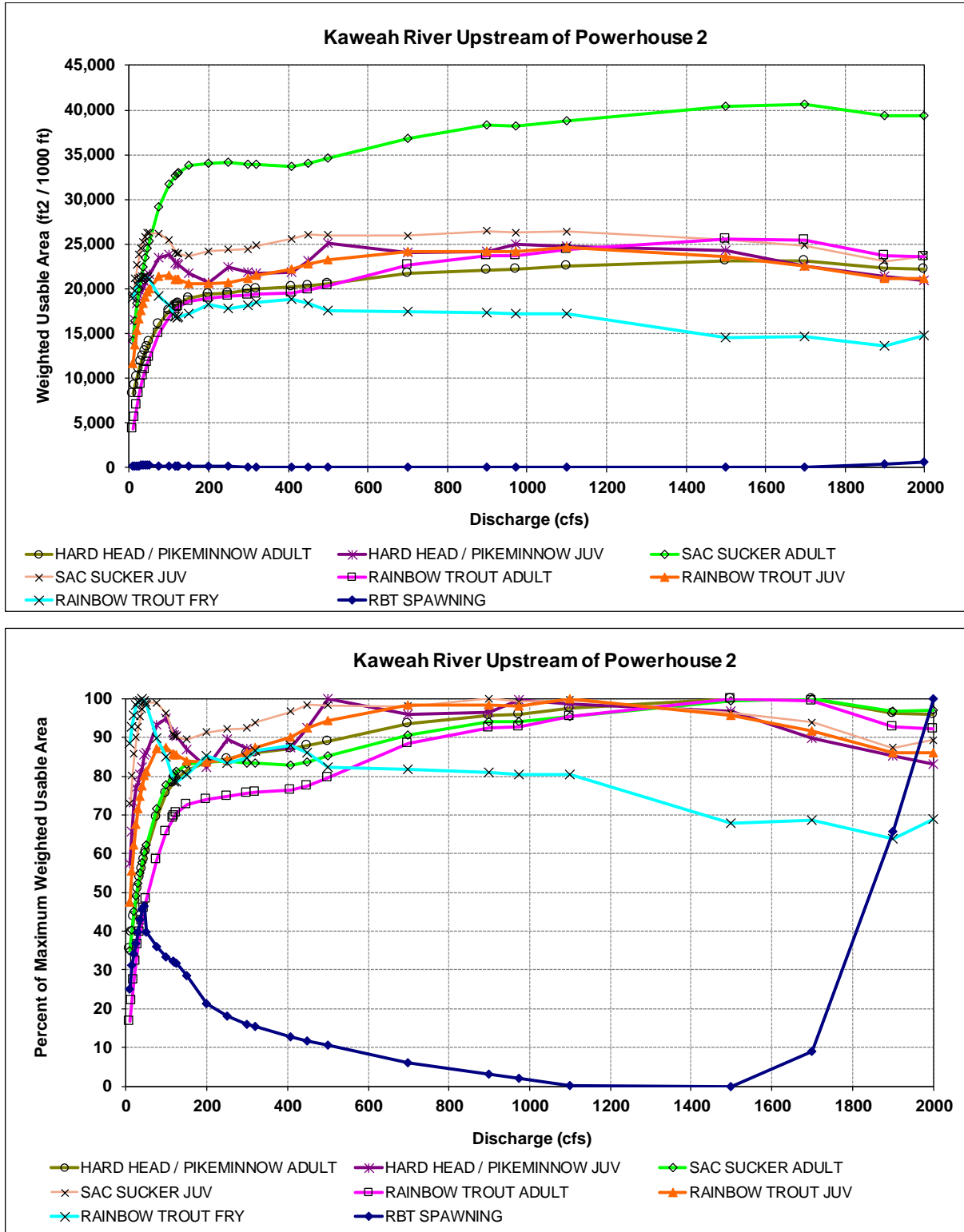


Figure 7.4-28. Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse Weighted Usable Area (top) and Percent of Maximum Weighted Usable Area (bottom).

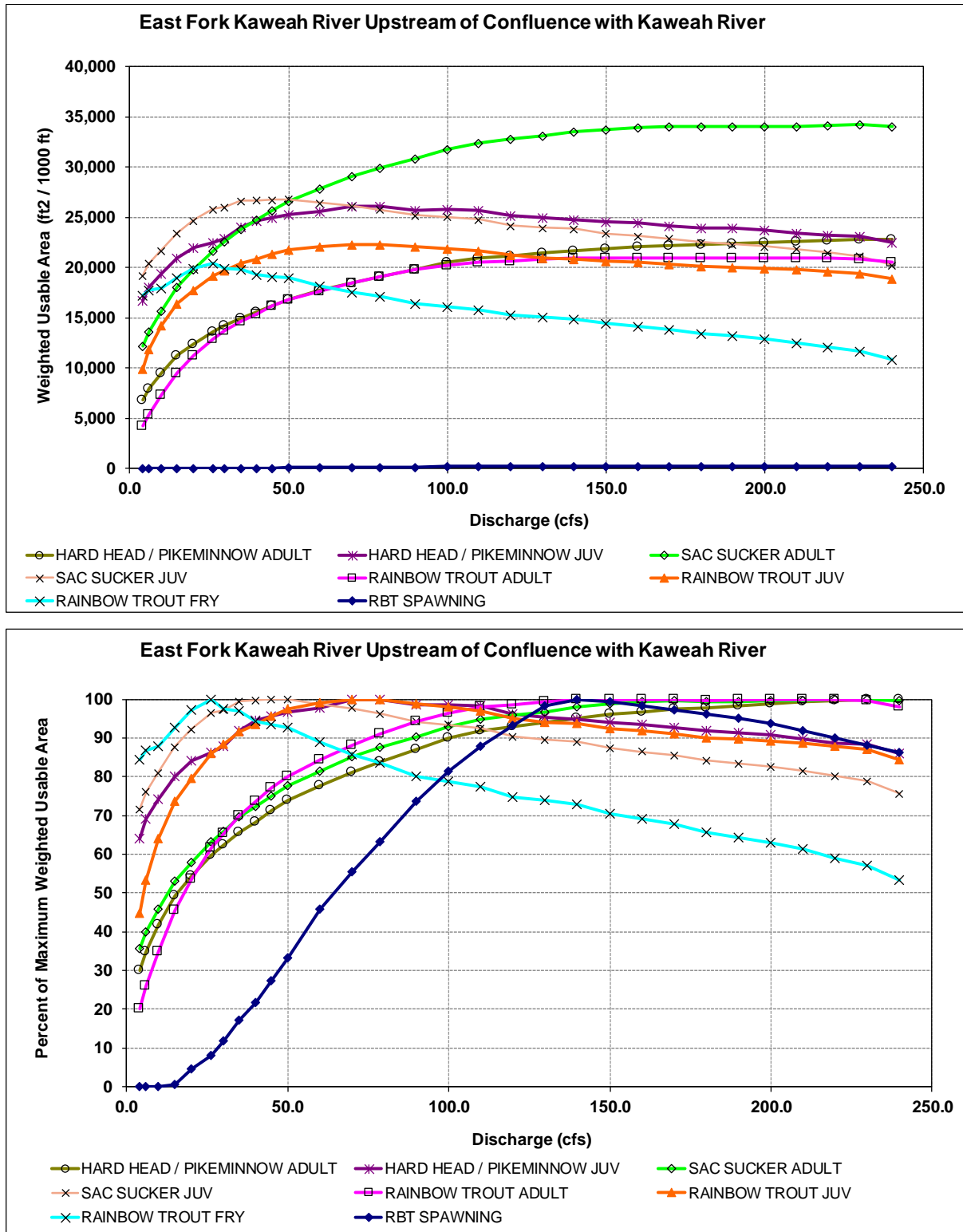


Figure 7.4-29. East Fork Kaweah River Upstream of the Confluence with Kaweah River Weighted Usable Area (top) and Percent of Maximum Weighted Usable Area (bottom).

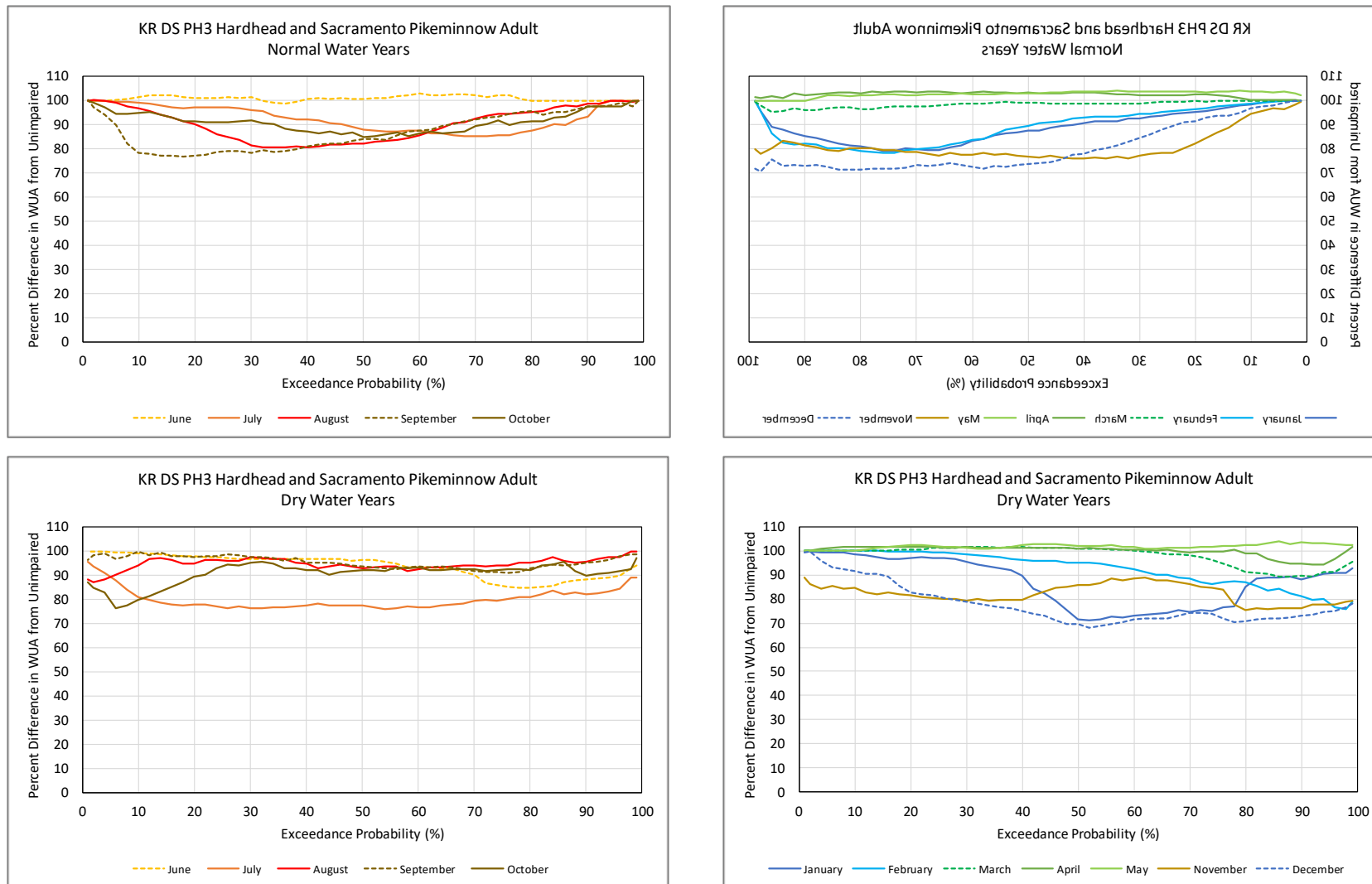


Figure 7.4-30. Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence Hardhead and Sacramento Pikeminnow Adult Habitat Percent of Unimpaired Habitat Exceedance Plots (1994-2018) for Normal (top) and Dry Water Year Types (bottom) (warm water temperature months, left, cool water temperature months, right).

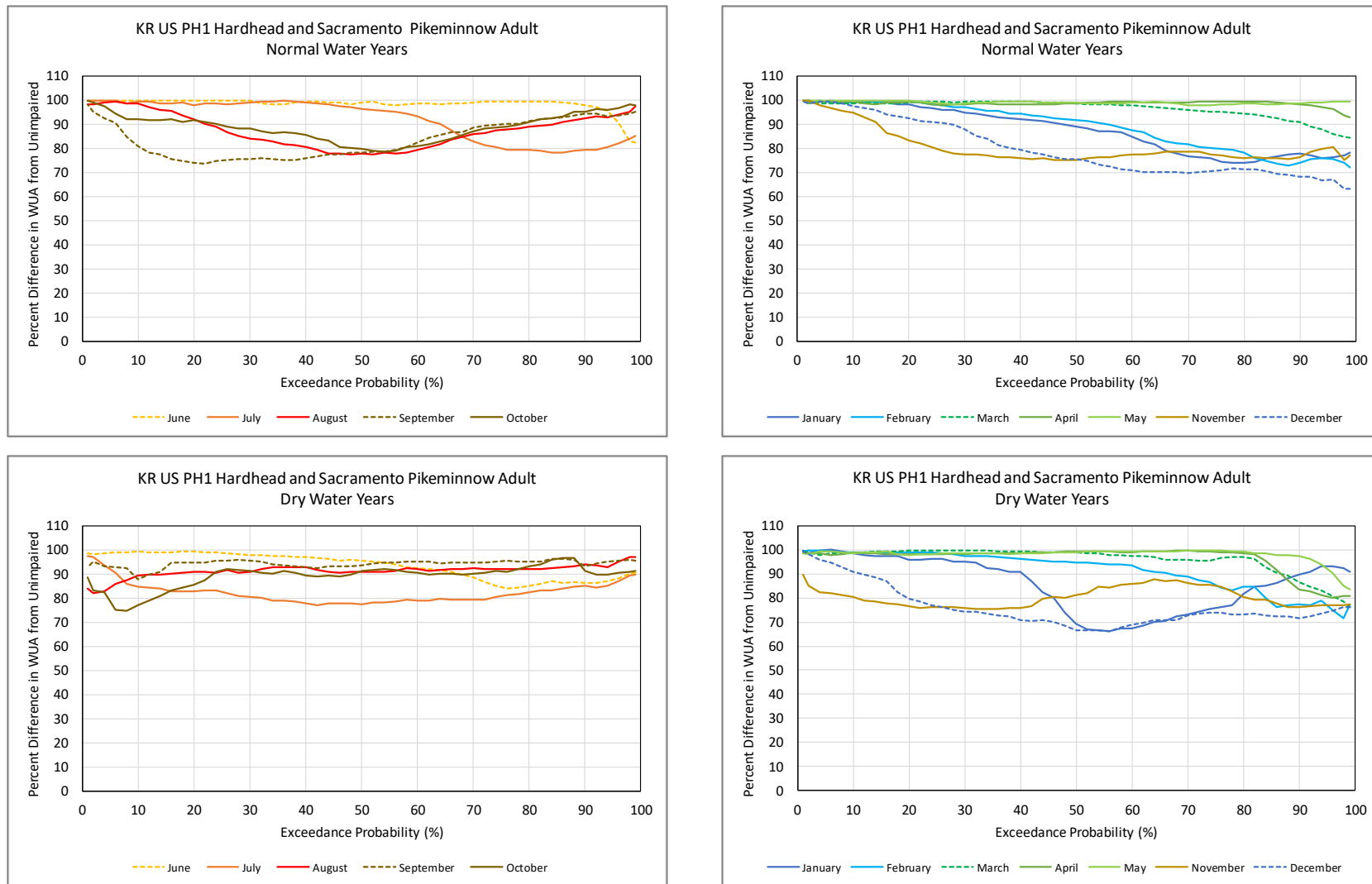


Figure 7.4-31. Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse Hardhead and Sacramento Pikeminnow Adult Habitat Percent of Unimpaired Exceedance Plots (1994-2018) for Normal (top) and Dry Water Year Types (bottom) (warm water temperature months, left, cool water temperature months, right).

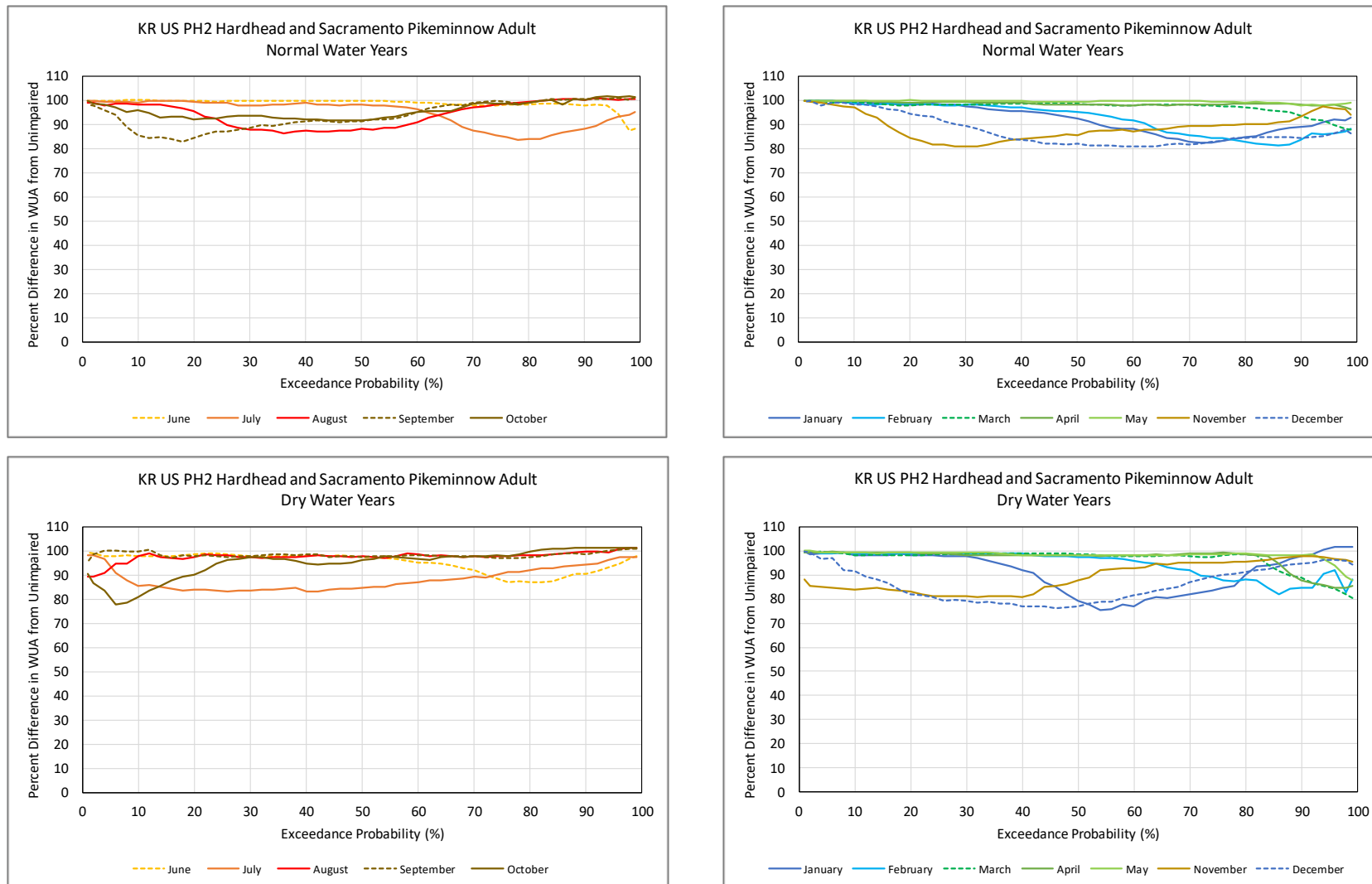


Figure 7.4-32. Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse Hardhead and Sacramento Pikeminnow Adult Habitat Percent of Unimpaired Exceedance Plots (1994-2018) for Normal (top) and Dry Water Year Types (bottom) (warm water temperature months, left, cool water temperature months, right).

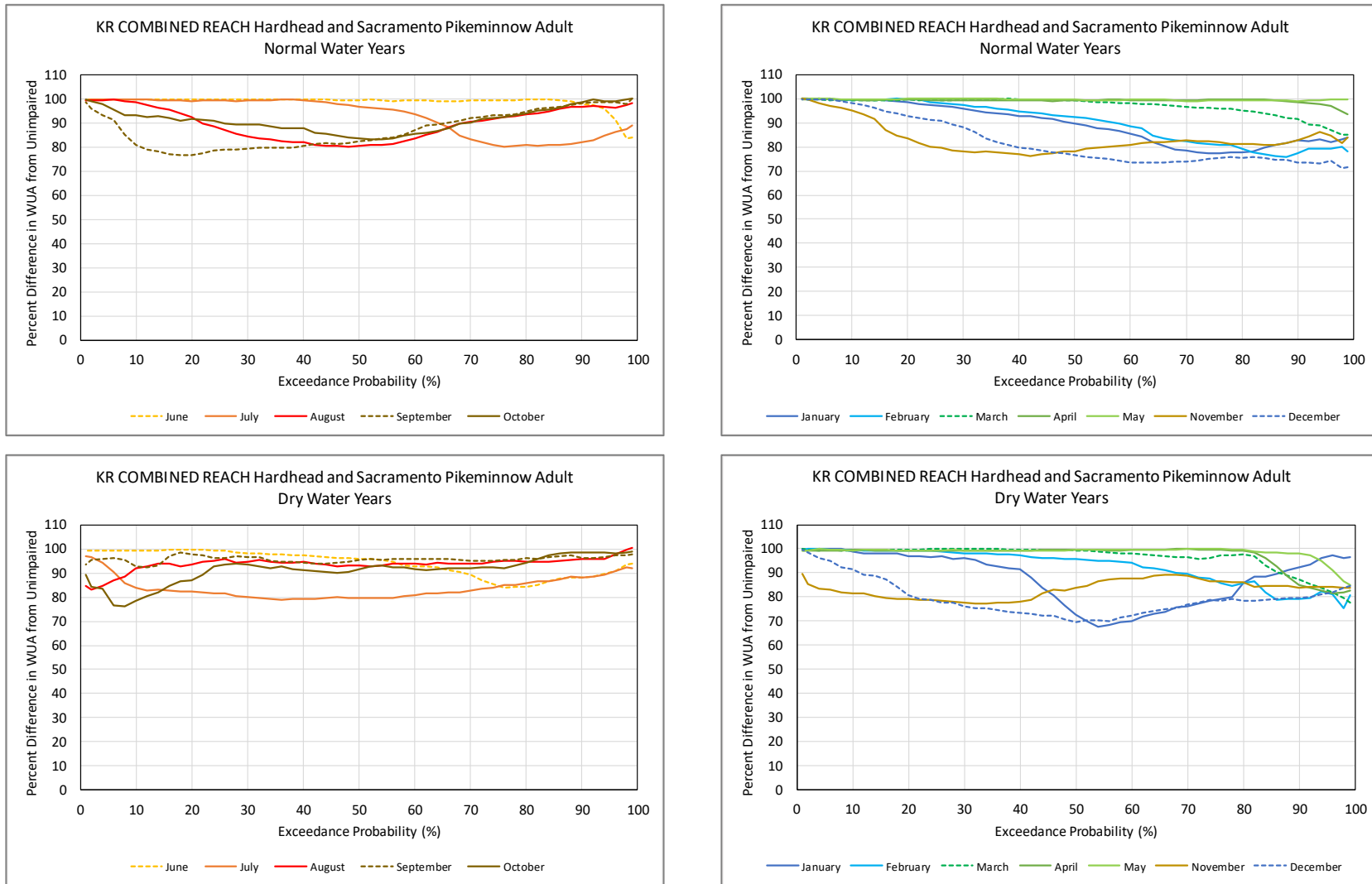


Figure 7.4-33. Kaweah River Combined Reaches Hardhead and Sacramento Pikeminnow Adult Habitat Percent of Unimpaired Exceedance Plots (1994-2018) for Normal (top) and Dry Water Year Types (bottom) (warm water temperature months, left, cool water temperature months, right).

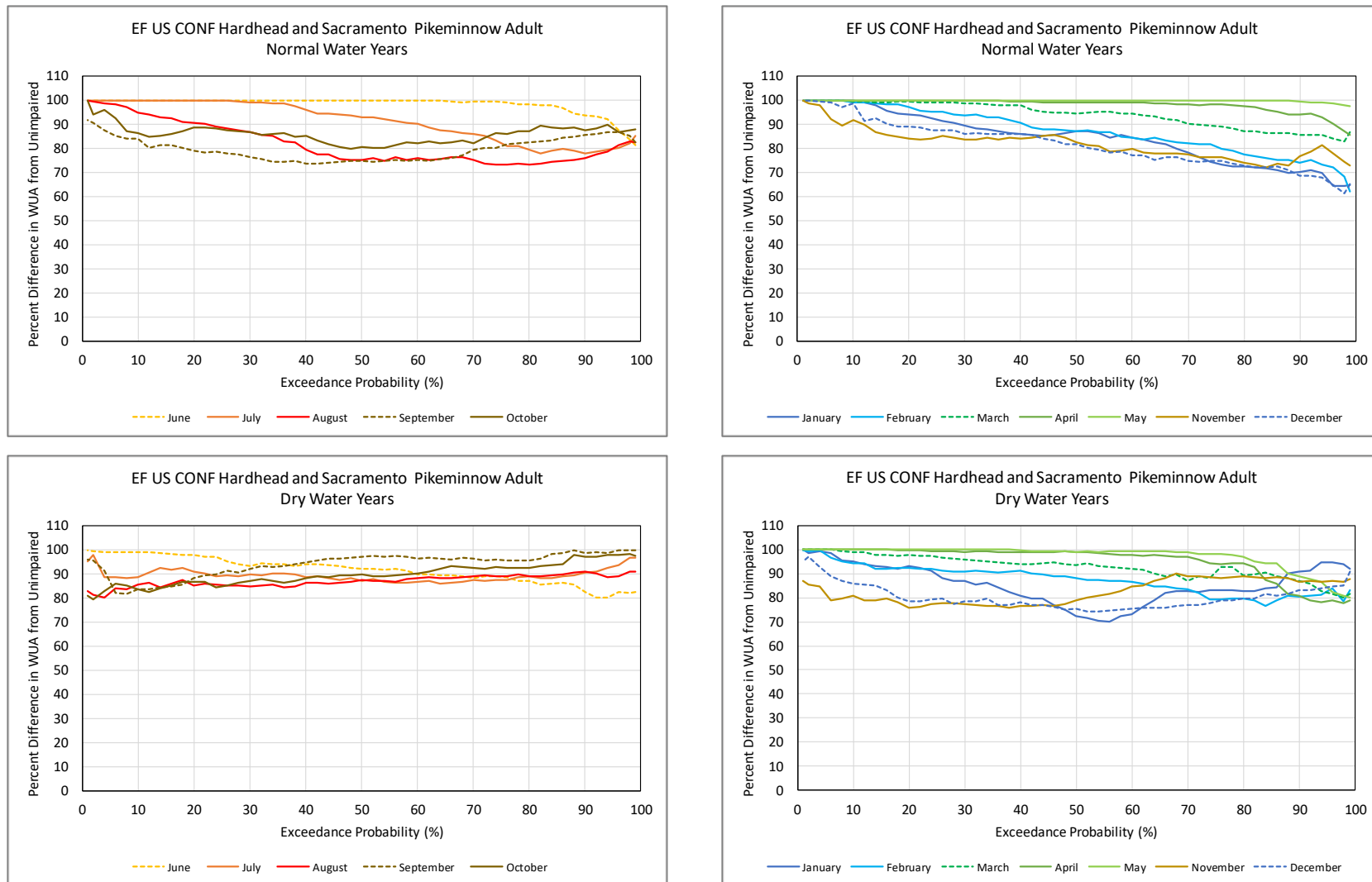


Figure 7.4-34. East Fork Kaweah River Upstream of the Confluence with Kaweah River Hardhead and Sacramento Pikeminnow Adult Habitat Percent of Unimpaired Exceedance Plots (1994-2018) for Normal (top) and Dry Water Year Types (bottom) (warm water temperature months, left, cool water temperature months, right).

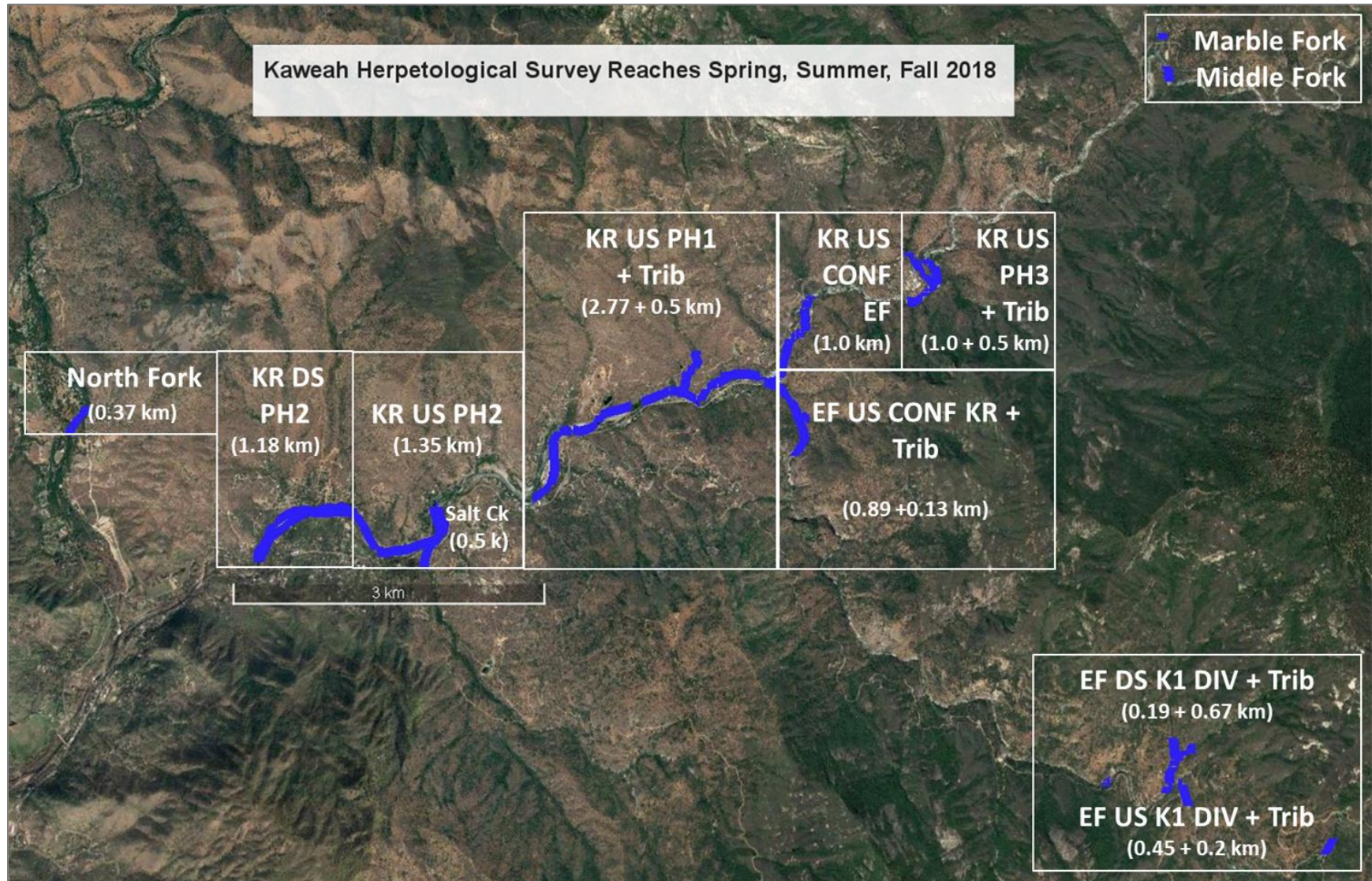
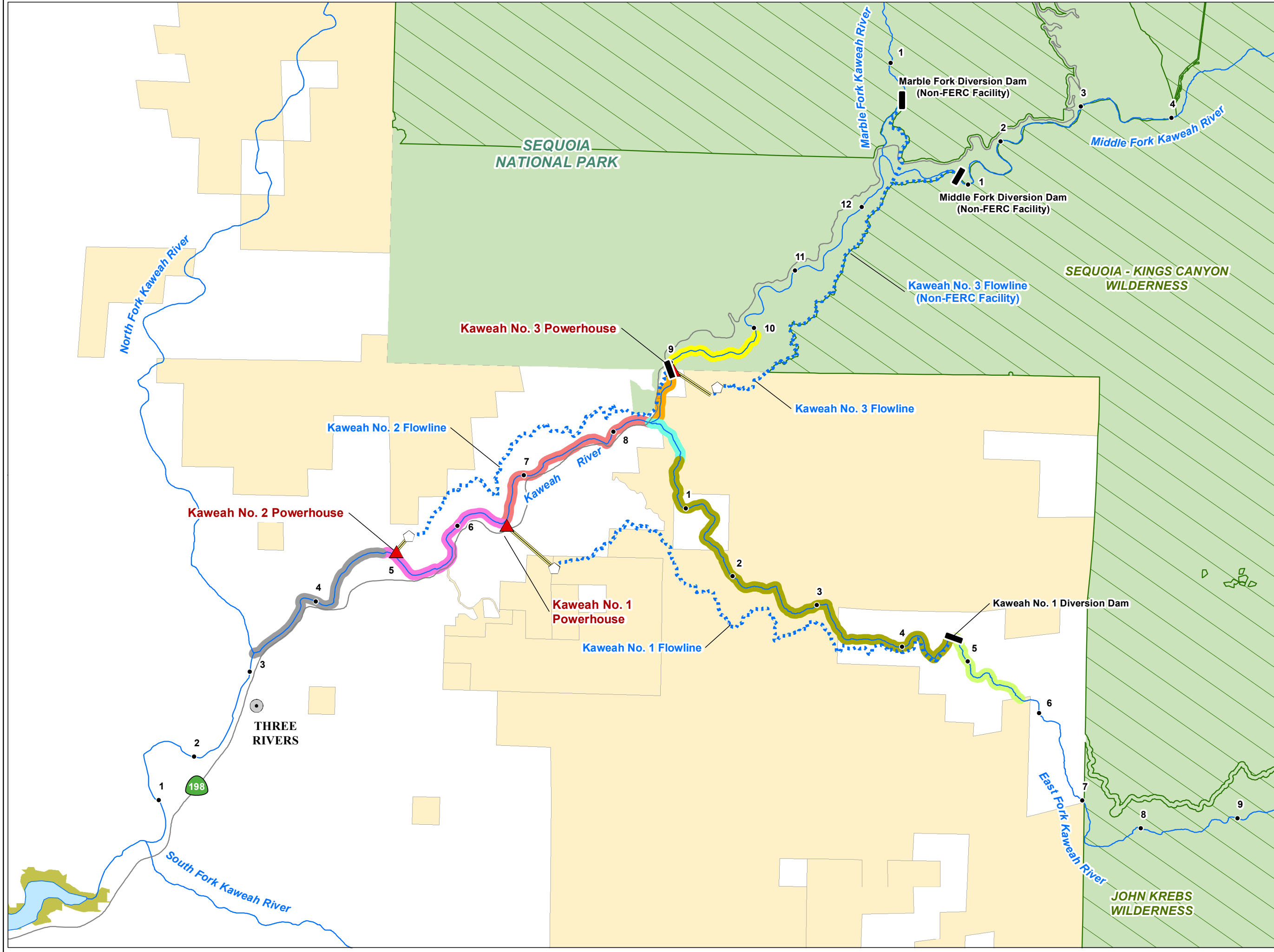



Figure 7.4-35. 2018 Survey Reaches for Amphibians, Reptiles, and Other Aquatic Species (Blue Lines=Field Survey Locations).

MAPS

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- SCE Facilities**
- Powerhouse
 - Diversion
 - Forebay
 - Flowline
 - Penstock
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
 - River Mile
- Land Jurisdiction***
- Bureau of Land Management
 - U.S. Army Corps of Engineers
 - National Park Service
 - Private
- *SOURCE: BLM 2016
- Land Management**
- National Wilderness Area
- Study Reaches and Sampling Locations**
- KR US PH3
 - KR US CONF EF
 - KR US PH1
 - KR US PH2
 - KR DS PH2
 - EF US K1 DIV
 - EF DS K1 DIV
 - EF US CONF KR




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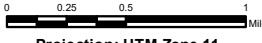
Kaweah Project - FERC Project No. 298

Map 7.4-1

Fish and Aquatics Reaches



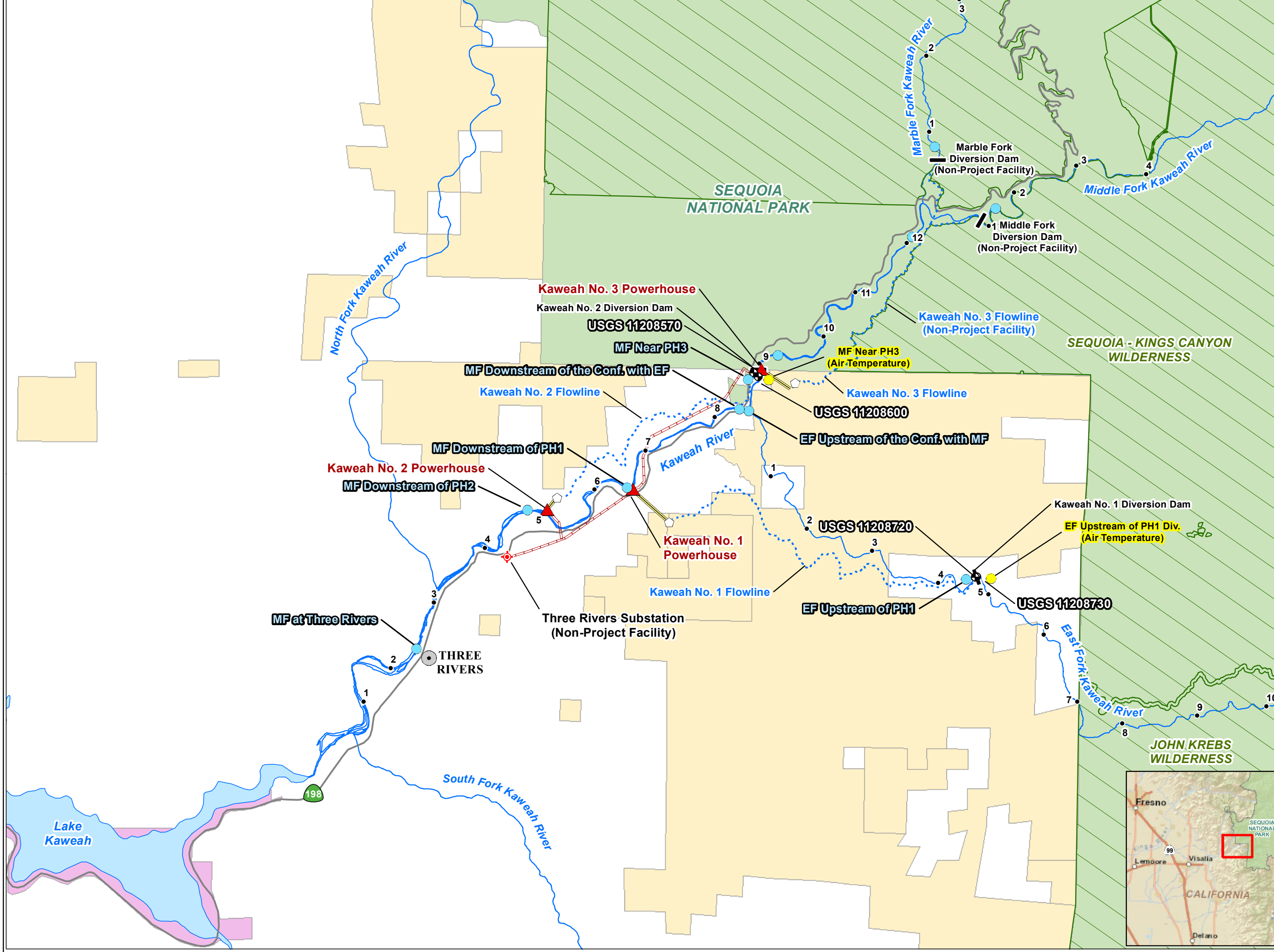
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Datum: NAD 83

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- ### Facilities
- Powerhouse
 - Diversion
 - Utility
 - Forebay
 - Flowline
 - Penstock
 - Transmission Line
- ### Other Features
- Major City/Town
 - Highway
 - Watercourse
 - Water Body
 - Flow Gage Locations
 - Water Temperature Monitoring Locations
 - Air Temperature Monitoring Locations
 - River Mile
- ### Land Jurisdiction*
- Bureau of Land Management
 - U.S. Army Corps of Engineers
 - National Park Service
 - Private
- *SOURCE: BLM 2012
- ### Land Management
- National Wilderness Area




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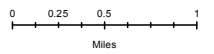
Eastern Hydro Generation

Map 7.4-2

Kaweah Project 2014-15
Temperature Monitoring and
Flow Gage Locations



Date: 8/11/2015

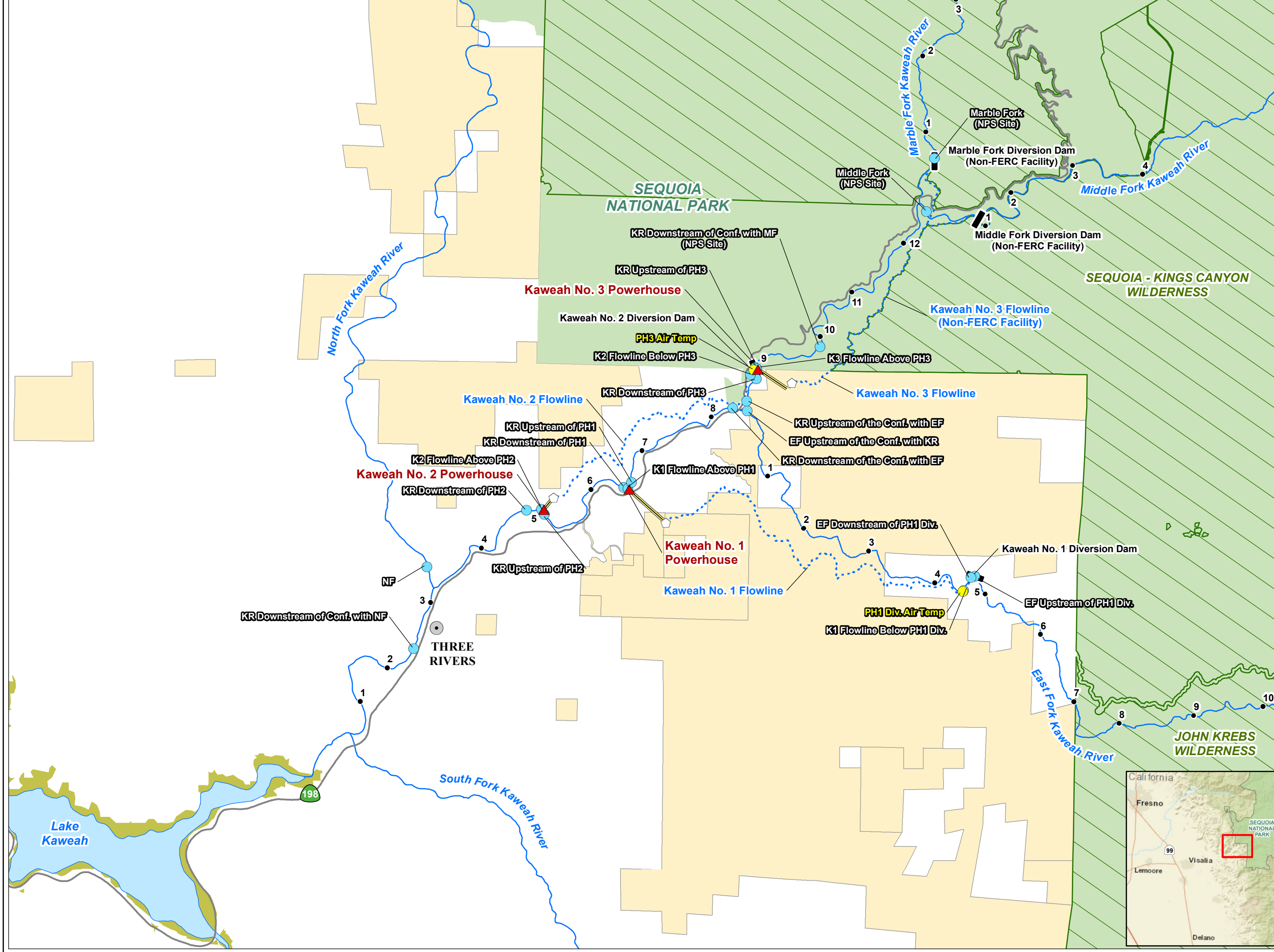


Miles

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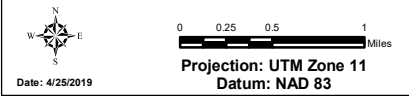


- SCE Facilities**
- Powerhouse
 - Diversion
 - Forebay
 - Flowline
 - Penstock
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
 - River Mile
- Land Jurisdiction***
- Bureau of Land Management
 - U.S. Army Corps of Engineers
 - National Park Service
 - Private
- *SOURCE: BLM 2016
- Land Management**
- National Wilderness Area
- Monitoring Locations**
- Water Temperature Monitoring Location
 - Air Temperature Monitoring Location



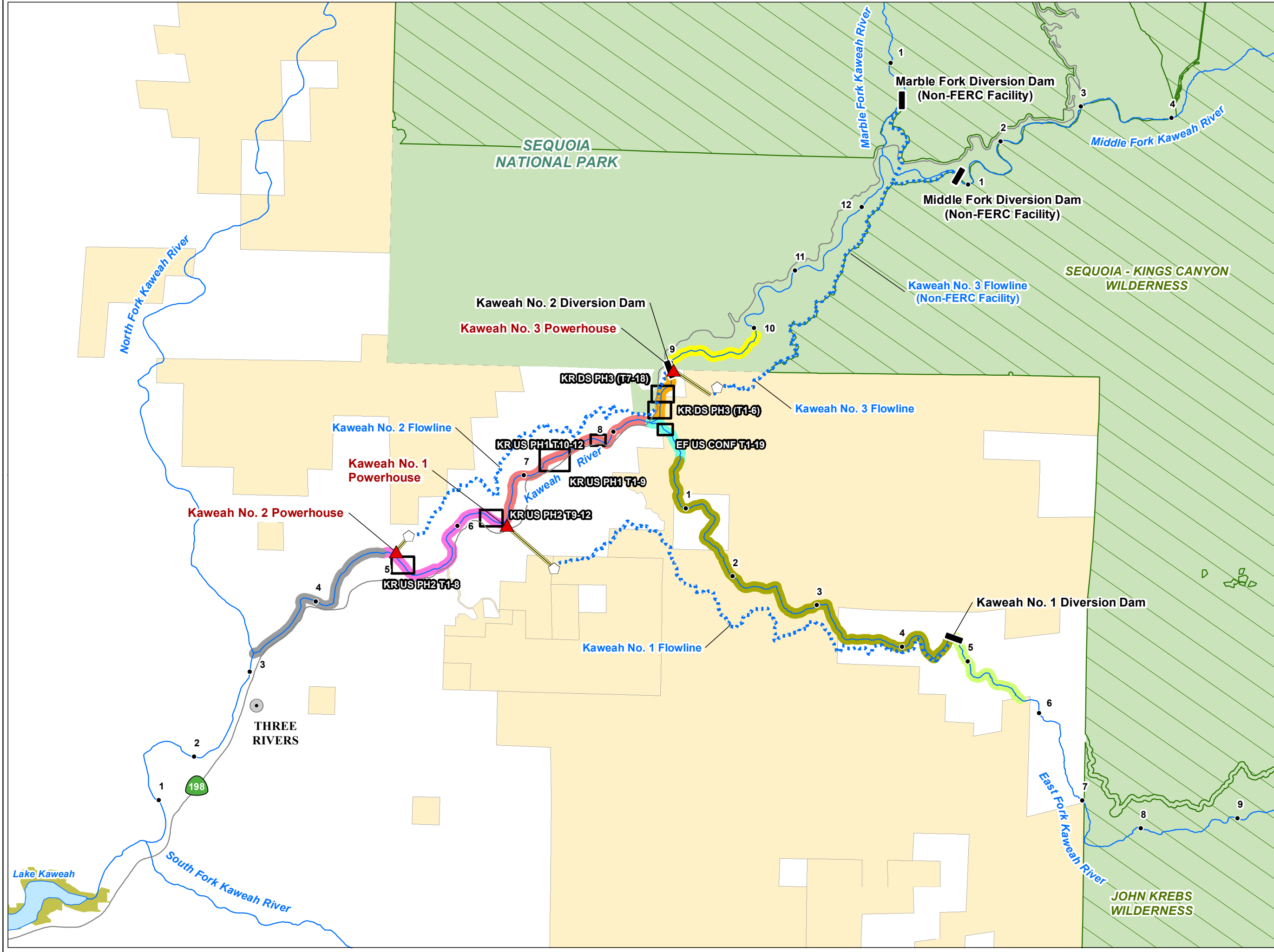
FERC Project No. 298

**Map 7.4-3
Kaweah Project 2018
Water Temperature Monitoring
Locations**




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- SCE Facilities**
- Powerhouse
 - Diversion
 - Forebay
 - Flowline
 - Penstock
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
 - River Mile
- Land Jurisdiction***
- Bureau of Land Management
 - U.S. Army Corps of Engineers
 - National Park Service
 - Private
- *SOURCE: BLM 2016
- Land Management**
- National Wilderness Area
- Study Reaches and Sampling Locations**
- KR US PH3
 - KR DS PH3
 - KR US PH1
 - KR US PH2
 - KR DS PH2
 - EF US K1 Div
 - EF DS K1 Div
 - EF US Confl
 - Instream Flow Site




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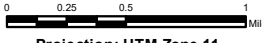
Kaweah Project - FERC Project No. 298

Map 7.4-4

Instream Flow Sites



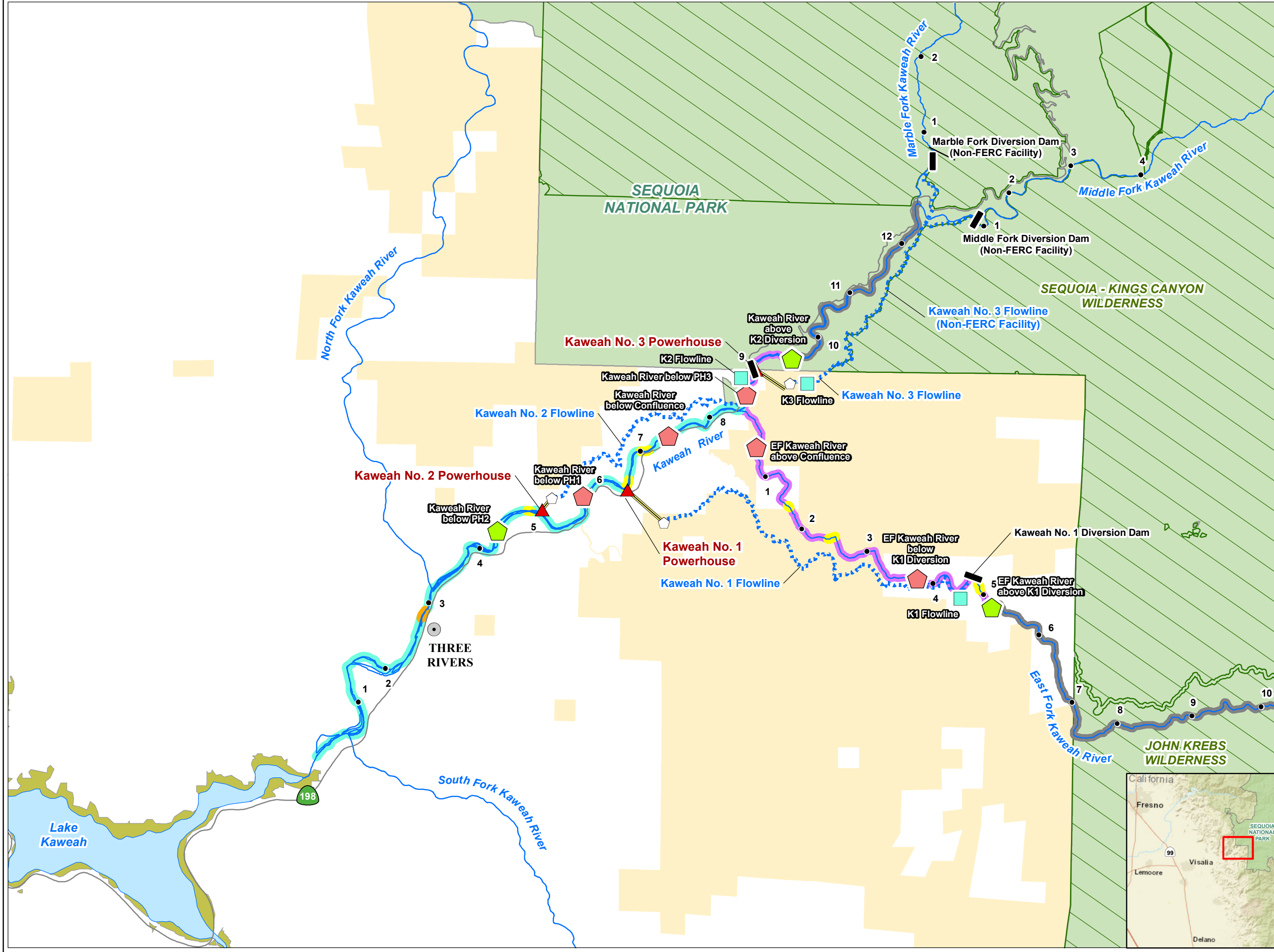
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- SCE Facilities**
- ▲ Powerhouse
 - ▬ Diversion
 - Dam
 - ⊕ Utility
 - ◻ Forebay
 - ⊙ Gage
 - ⋯ Flowline
 - ▬ Penstock
 - ▬ Project FERC Boundary
- Other Features**
- Dam
 - ⊙ City/Town
 - ▬ Highway/Road
 - ▬ Watercourse
 - ▬ Water Body
- Land Jurisdiction***
- Bureau of Land Management
 - National Park Service
 - U.S. Army Corps of Engineers
 - U.S. Forest Service
 - State
 - Private
- *SOURCE: BLM 2016
- Channel Characterization**
- ▬ NA
 - ▬ bedrock
 - ▬ bedrock/cascade
 - ▬ bedrock/step-pool/cascade
 - ▬ pool-riffle/plane-bed
- Sampling Locations**
- Entrainment Monitoring (flowlines)
 - ◊ Fish, BMI, FYLF, Riparian
 - ◊ Fish, BMI, FYLF, Riparian, Instream Flow




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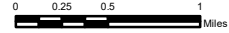
Kaweah Project - FERC Project No. 298

Map 7.4-5

**Kaweah Project
Aquatic and Riparian Sampling Locations**



Date: 4/25/2019

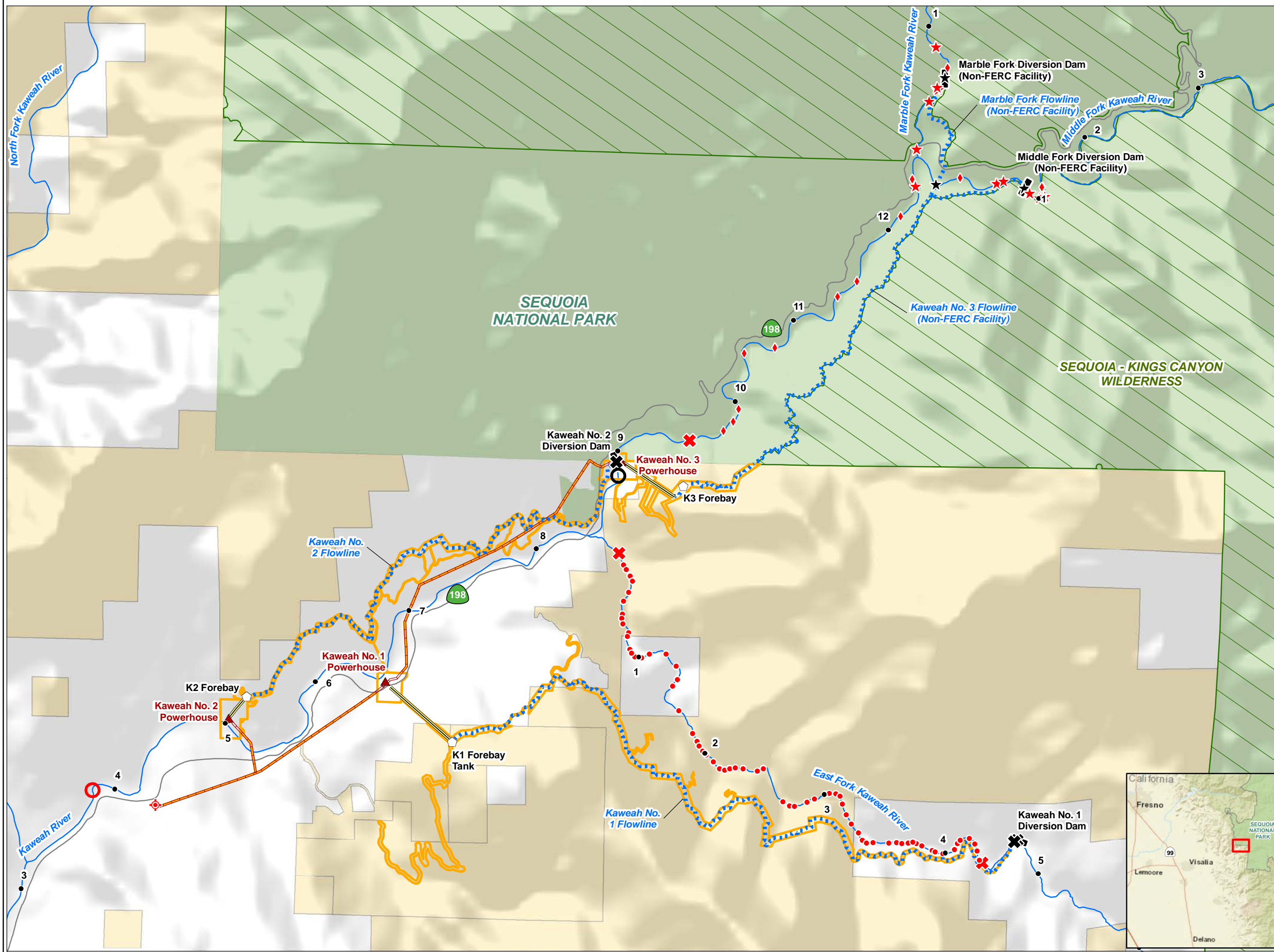


0 0.25 0.5 1 Miles


Projection: UTM Zone 11
Datum: NAD 83

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- SCE Facilities**
- ▲ Powerhouse
 - Diversion
 - ◻ Forebay
 - ⋯ Flowline
 - Penstock
 - Transmission Line
 - FERC Boundary
- Other Features**
- Highway/Road
 - Watercourse
 - Water Body
 - River Mile
- Land Jurisdiction***
- Bureau of Land Management
 - National Park Service
 - Private (Blank)
- *SOURCE: BLM 2016
- Land Management**
- ▨ National Wilderness Area
- 2018 Fish Passage Barriers**
- ✘ Impassable Project Barrier
 - ✘ Impassable Natural Barrier
 - Partial Project Barrier
 - Partial Natural Barrier
 - Potential Impassable Barriers ¹
- ¹ Not visited due to inaccessibility
- 2007 Fish Passage Barriers ²**
- ★ Impassable Man-made Barrier
 - ★ Impassable Natural Barrier
 - ◆ Partial Natural Barrier
- ² Barriers from SCE 2007 Report



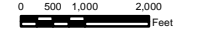
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FERC Project No. 298

Map 7.4-6
Kaweah Project
Fish Passage Barrier
Locations and Category



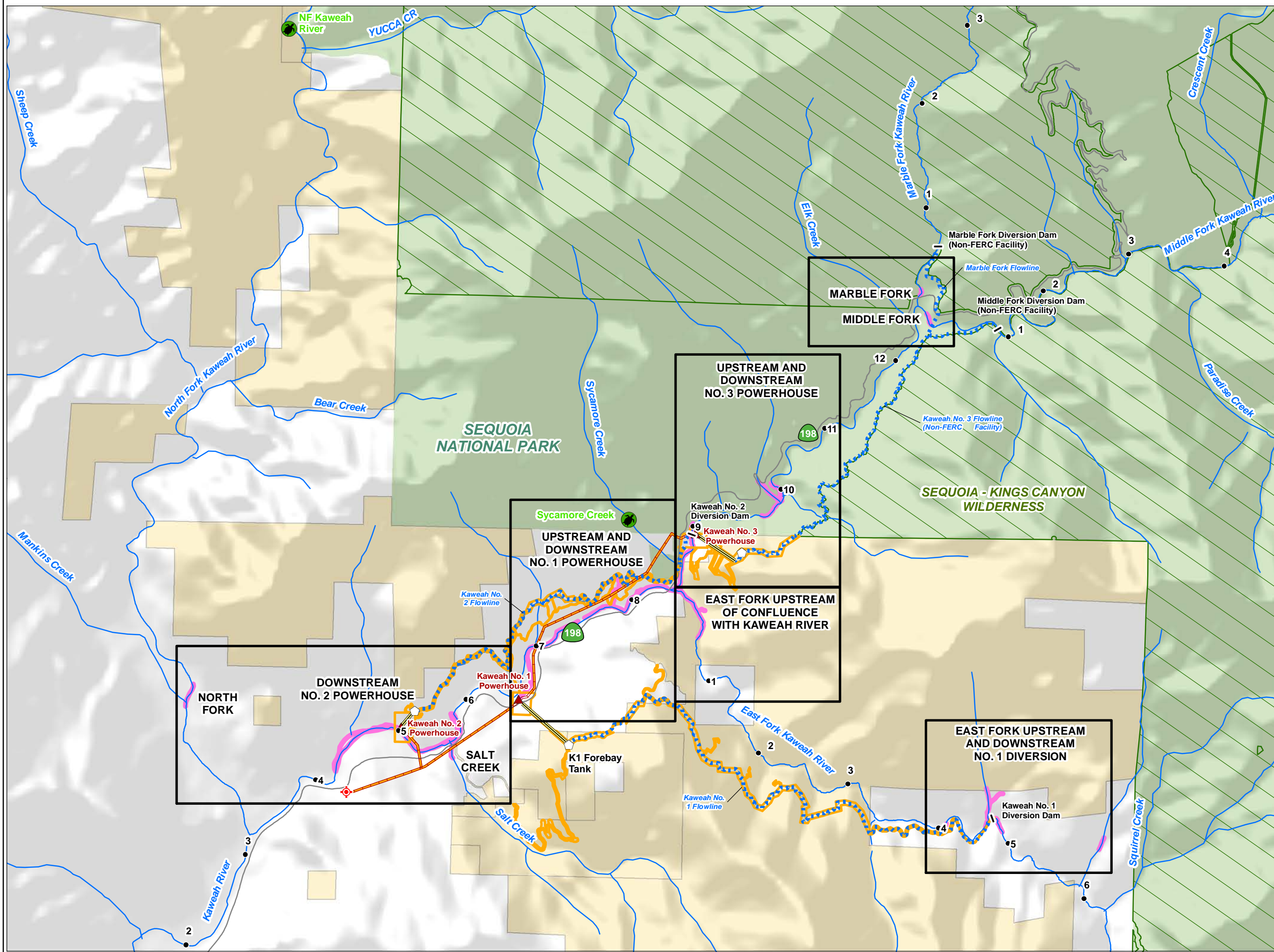
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 - Diversion
 - Forebay
 - Flowline
 - Penstock
 - Transmission Line
 - FERC Boundary
- Other Features**
- Highway/Road
 - Watercourse
 - Water Body
 - River Mile
- Land Jurisdiction***
- Bureau of Land Management
 - National Park Service
 - Private (Blank)
- *SOURCE: BLM 2016
- Land Management**
- National Wilderness Area
- Western Pond Turtle Data**
- FYLF (No Known Locations)
 - Western Pond Turtle**
- ** SOURCE: Ruso et al. 2017
- AQ7 Survey**
- Herpetological Survey Reaches



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FERC Project No. 298

Map 7.4-7
Kaweah Project
Herpetological Survey Reaches
Spring, Summer, Fall 2018

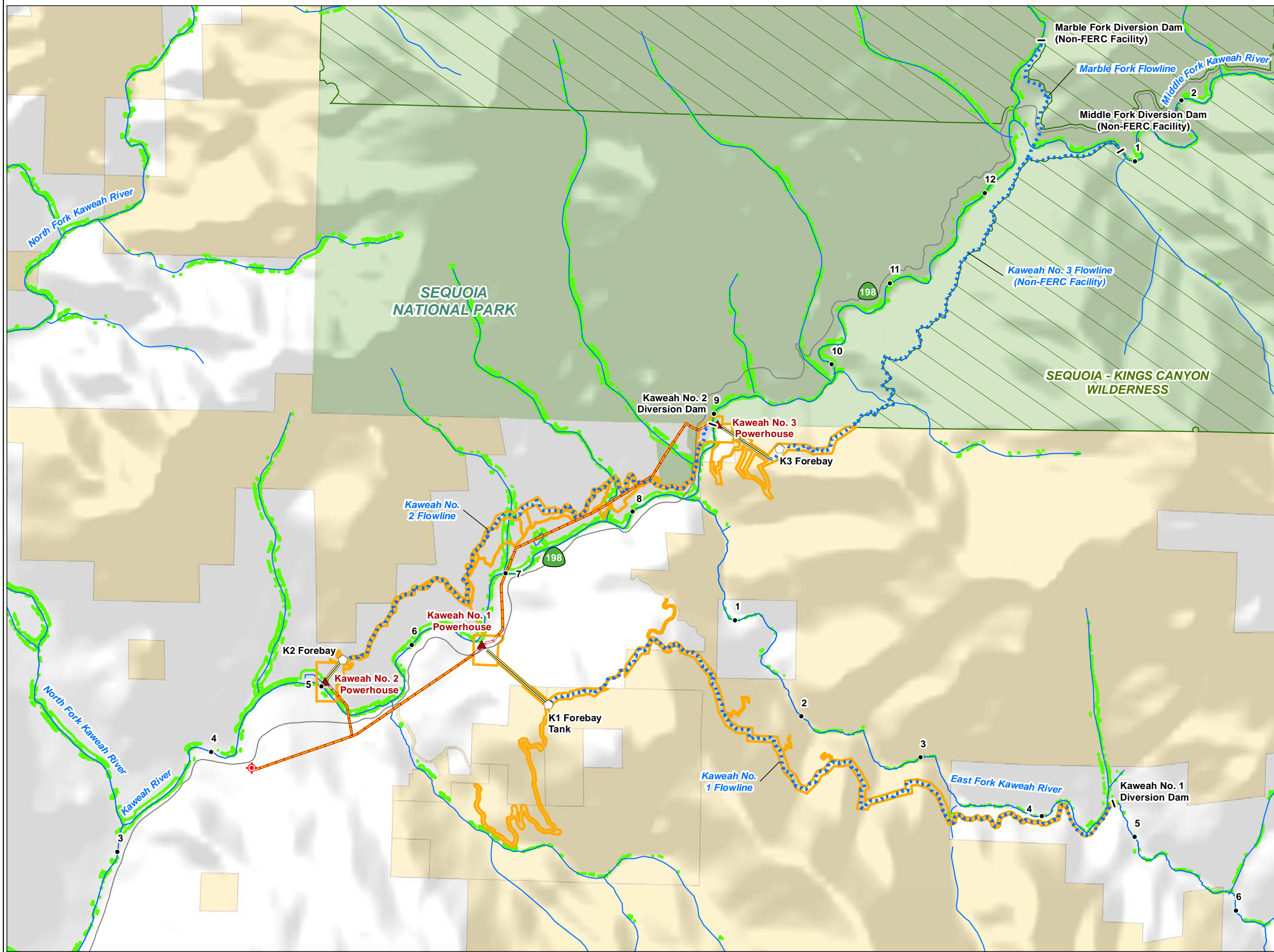
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 - Diversion
 - ◻ Forebay
 - ⋯ Flowline
 - Penstock
 - Transmission Line
 - FERC Boundary
- Other Features**
- Highway/Road
 - Watercourse
 - Water Body
 - River Mile
- Land Jurisdiction***
- Bureau of Land Management
 - National Park Service
 - Private (Blank)
- *SOURCE: BLM 2016
- Land Management**
- ▨ National Wilderness Area
- Western Pond Turtle Data**
- ▭ Western Pond Turtle Habitat




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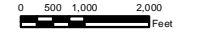
FERC Project No. 298

Map 7.4-8

Western Pond Turtle Habitat



Date: 5/9/2019



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LIST OF ACRONYMS

APLIC	Avian Power Line Interaction Committee
BCC	Birds of Conservation Concern
BLM	Bureau of Land Management
BLMS	Bureau of Land Management Sensitive Species
CALVEG	Classification and Assessment with LANDSAT of Visible Ecological Groupings
CDFA	California Department of Food and Agriculture
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFP	California Fully Protected
CNPS	California Native Plant Society
CRPR	California Rare Plant Rank
CWHR	California Wildlife Habitat Relationships
ESA	Endangered Species Act
FC	Federal Candidate for Listing
FE	Federal Endangered
FERC or Commission	Federal Energy Regulatory Commission
FPD	Federal Proposed Delisted
FPE	Federal Proposed Endangered
FPT	Federal Proposed Threatened
FT	Federal Threatened
NNIP	Non-native Invasive Plant
PAD	Pre-Application Document
Project	Kaweah Project
SCE	Southern California Edison Company
SD	Supporting Document
SE	State Endangered
SR	State Rare
SSC	Species of Special Concern
ST	State Threatened
TSR	Technical Study Report
USDA-FS	U.S. Department of Agriculture – Forest Service
USFWS	U.S. Fish and Wildlife Service
WL	Watch List

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7.5 BOTANICAL AND WILDLIFE RESOURCES AFFECTED ENVIRONMENT

This section describes botanical and wildlife resources in the vicinity of the Kaweah Project (Project), including identification of vegetation alliances and wildlife habitats; federally listed rare, threatened, and endangered plant or wildlife species; other special-status plants and wildlife; non-native invasive plants (NNIP); game species; wildlife use of wildlife bridges; and wildlife mortality in flowlines. Information on special-status aquatic species is included in Section 7.4 – Fish and Aquatic Resources.

7.5.1 Information Sources

Information on botanical and wildlife resources is based on data from resource agency files and reports; Southern California Edison Company's (SCE) Pre-Application Document (PAD); and botanical and wildlife resources technical studies completed in 2018 for the Kaweah Project relicensing. A summary of agency and stakeholder consultation is provided in Section 14.0 – Consultation Documentation. Detailed descriptions of the study methods and results are provided in the following Technical Study Reports (TSR):

- TERR 1 – Botanical Resources TSR (TERR 1 – TSR) (SCE 2019a; Supporting Document [SD] A)
- TERR 2 – Wildlife Resources TSR (TERR 2 – TSR) (SCE 2019b; SD A)

Extensive field surveys were conducted as part of the TERR 1 and TERR 2 – TSRs to document the location of botanical and wildlife resources and their habitats in the vicinity of the Project. Field surveys included:

- Vegetation Alliances and Wildlife Habitat Mapping;
- Special-status Plant Surveys;
- NNIP Surveys;
- Wildlife Reconnaissance Surveys;
- Evaluation of Transmission and Power Lines for Consistency with Avian Power Line Interaction Committee (APLIC) Guidelines;
- Special-status Bat Reproductive and Seasonal Use Surveys;
- Evaluation of Wildlife Use of Wildlife Bridges; and
- Evaluation of Wildlife Mortality in Project Flowlines.

Information on the relationship between flow and riparian vegetation in the bypass reaches associated with the Project is provided in AQ 1 – Instream Flow TSR (AQ 1 – TSR) (SCE 2019c; SD A).

7.5.2 Botanical Resources

This section describes botanical resources including vegetation alliances; special-status plants; and NNIPs.

7.5.2.1 Vegetation Alliances

The study area for vegetation alliances includes areas within 1 mile of the Federal Energy Regulatory Commission (FERC or Commission) Project boundary. Vegetation alliances are classified based on the Classification and Assessment with LANDSAT of Visible Ecological Groupings (CALVEG) mapping and vegetation alliance descriptions developed by the United States Department of Agriculture – Forest Service (USDA-FS) Region 5 (USDA-FS 2014).

Twenty-five vegetation alliances are present within the study area. Vegetation alliances in the study area vary with increases in elevation. The higher elevations of the Project along the East Fork Kaweah River are composed primarily of chamise (*Adenostoma fasciculatum*), lower montane mixed chaparral and interior mixed hardwood alliances, while the lower elevations near the Kaweah River are composed primarily of blue oak (*Quercus douglasii*), annual grasses/forbs, and riparian mixed hardwood alliances. Refer to Table 7.5-1 for a complete list of vegetation alliances present within the study area. Detailed information and vegetation alliance maps are provided in TERR 1 – TSR (SCE 2019a). Additional information on the location of riparian habitat is described in Section 7.8 – Riparian Resources.

7.5.2.2 Upland Special-Status Plants

For the purposes of this document, special-status plants are defined as any plant granted protection by a federal, state, or local agency, including:

- Federally listed plant species granted status by the United States Fish and Wildlife Service (USFWS) under the Federal Endangered Species Act (ESA) include threatened (FT), endangered (FE), proposed threatened or endangered (FPT, FPE), candidate (FC), or listed species proposed for delisting (FPD).
- State of California listed plant species granted status by the California Department of Fish and Wildlife (CDFW) under the California Endangered Species Act (CESA) include state threatened (ST), endangered (SE), rare (SR), and California Species of Special Concern (SSC).
- California Native Plant Society (CNPS) listed plant species, which uses the California Rare Plant Rank (CRPR) system for rare, threatened, or endangered plants in California. Under the California Environmental Quality Act (CEQA), special-status plants include the following CRPR:
 - 1A (presumed extirpated in California and either rare or extinct elsewhere);
 - 1B (rare, threatened, or endangered in California and elsewhere);

- 2A (presumed extirpated in California, but common elsewhere); and
- 2B (rare, threatened, or endangered in California, but common elsewhere).
- Bureau of Land Management (BLM) list of sensitive plant species, which are designated by the BLM State Director for special management consideration. In California, this includes all plants on BLM lands that are listed as FC, ST, SE, and SR; all plants that have a CRPR of 1B, and any other plants that the State Director has determined to warrant status.

The study area for special-status plants is defined to include public lands within the FERC Project boundary where operations and/or maintenance activities are conducted, plus a protective buffer. Refer to Table 7.5-2 for the survey area by facility type. Based on database queries and literature searches conducted for the TERR 1 – TSR, 28 upland special-status plant and moss species were determined to have the potential to occur within the study area. Refer to Table 7.5-3 for the status of each species, a summary of life history requirements, and information on their presence in the study area.

One special-status plant species, Munz's iris (*Iris munzii* [BLMS, CRPR 1B.3]) was observed during botanical surveys (a total of 29 populations) in the vicinity of the Kaweah No. 1 Flowline and associated access roads. No other special-status plants were observed. Refer to Map 7.5-1 (a–t) (CONFIDENTIAL) for the location of these plants in the study area. Refer to Table 7.5-4 for a list of each Munz's iris population identified in the study area and the estimated size and number of individuals in each population.

7.5.2.3 Riparian Associated Special-Status Plants

Three special-status plants and mosses may potentially occur in riparian habitats along bypass reaches associated with the Project. Refer to Table 7.5-3 for the status of each species, a summary of life history requirements, and information on their presence in the study area. The special-status plants and mosses include:

- Watershield (*Brasenia schreberi* [CRPR 2B.3]);
- American manna grass (*Glyceria glandis* [CRPR 2B.3]); and
- Holzinger's orthotrichum moss (*Orthotrichum holzingeri* [CRPR 1B.3]).

Portions of riparian habitats along bypass reaches associated with the Project were surveyed as part of the AQ 1 – TSR (SCE 2019c). No special-status riparian plants were observed during these surveys.

7.5.2.4 Non-native Invasive Plants

The study area for NNIPs is defined to include public lands within the FERC Project boundary where operations and/or maintenance activities are conducted, plus a protective buffer. Refer to Table 7.5-2 for the survey area by facility type. A list of target NNIPs in the study area was developed in consultation with BLM and includes species

from the California Department of Food and Agriculture's (CDFA) list, edited to include only those found in Tulare County (Arbogast, pers. comm., 2018). Five NNIP species were identified during botanical surveys, including:

- Two populations of tree-of-heaven (*Ailanthus altissima*);
- Seventy-three populations of tocalote (also known as Malta starthistle) (*Centaurea melitensis*);
- One population of bull thistle (*Cirsium vulgare*);
- One population of French broom (*Genista monspessulana*); and
- Twenty-five populations of puncture vine (*Tribulus terrestris*).

Refer to Table 7.5-5 for a summary of each NNIP population and to Map 7.5-1 (a–t) (CONFIDENTIAL) for the location of these populations in the study area. The full extent of each population was mapped, with the exception of tocalote. This species was widespread in grasslands and woodlands throughout the study area; therefore, with the exception of five populations, mapping for this species was not extended beyond the study area.

7.5.3 Wildlife Resources

This section describes wildlife resources in the Project vicinity, including wildlife habitats and common wildlife species; special-status wildlife; and game species.

7.5.3.1 Wildlife Habitats

The study area for wildlife habitats includes areas within 1 mile of the FERC Project boundary. Information on wildlife habitats was obtained to characterize habitat conditions and identify common wildlife species in the study area. Vegetation alliances described in Section 7.5.2.1 were cross-walked with the California Wildlife Habitat Relationships (CWHR) habitats using a CALVEG–CWHR Crosswalk for California (USDA-FS 2004). This crosswalk was developed by USDA-FS and CDFW as a method to determine which wildlife habitats are likely to be present based on existing vegetation alliances and forest structural characteristics.

Fourteen wildlife habitats were identified in study area. Dominant habitats in the study area include montane hardwood and chamise-redshank chaparral at higher elevations along the East Fork Kaweah River, and blue oak woodland, valley oak woodland, and annual grassland at lower elevations along the Kaweah River. Refer to Table 7.5-1 for a list of the wildlife habitats that occur within 1 mile of the Project. Detailed maps and descriptions of wildlife habitats are provided in TERR 2 – TSR (SCE 2019b). Additional information on the location of riparian habitat is described in Section 7.8 – Riparian Resources.

7.5.3.2 Special-Status Wildlife

This section describes special-status wildlife that occur or may potentially occur in the study area. This section addresses only special-status terrestrial wildlife species. Aquatic species, including fish, amphibians, and aquatic reptiles, are addressed in Section 7.4 – Fish and Aquatic Resources.

For the purposes of this document, a special-status wildlife species is defined as any animal species that is granted status by a federal, state, or local agency, including:

- Federally listed species granted status by USFWS under the ESA include FT, FE, FPT, FPE, FC, or FPD. Also included are those species listed by USFWS as Birds of Conservation Concern (BCC) which include “species, subspecies, and populations of all migratory nongame birds that, without additional conservation action, are likely to become candidates for listing under the ESA of 1973” (USFWS 2008).
- State of California listed wildlife species that are granted status by the CDFW under the CESA include ST, SE, Fully Protected species (CFP), and CSC.
- BLM list of wildlife species that are not federally listed under the ESA, but are designated by the BLM State Director for special management consideration.
- One additional species, the osprey (*Pandion haliaetus* [CDFW Watch List (WL)]), although not a special-status species, is included in this analysis because it is commonly associated with hydroelectric facilities in the state of California.

The study area for special-status wildlife (excluding bats) includes public lands within the FERC Project boundary where operations and/or maintenance activities are conducted, plus a protective buffer. Refer to Table 7.5-2 for the survey area by facility type. The study area for special-status bats includes facilities listed on Table 7.5-6.

Thirteen special-status wildlife species were observed in the study area during reconnaissance surveys conducted as part of the TERR 2 – TSR or observed incidentally during other studies. Twenty additional special-status wildlife may potentially occur in the study area based on a literature and data review. Refer to Table 7.5-7 and Map 7.5-2 for a comprehensive list of special-status wildlife species evaluated for their potential to occur in the study area, including the status of each species, a summary of life history requirements, and information on their presence in the study area. Detailed information is provided in the TERR 2 – TSR (SCE 2019b).

Special-Status Terrestrial Reptile Species

Three terrestrial reptiles may potentially occur in the study area: coast horned lizard (*Phrynosoma blainvillii* [BLMS, SSC]), northern California legless lizard (*Anniella pulchra* [SSC]), and California mountain kingsnake (*Lampropeltis zonata* [BLMS, WL]). Refer to Table 7.5-7 for a summary of each species’ status, habitat requirements, and potential for occurrence in the study area.

Special-Status Bird Species

RAPTORS

Special-status raptors known to occur in the study area include golden eagle (*Aquila chrysaetos* [BLMS, BCC, CFP, WL]) and osprey. Refer to the TERR 2 – TSR for detailed survey methods and results.

An adult golden eagle was observed in flight over the Kaweah No. 1 Flowline near the Summit Access Road during reconnaissance surveys conducted as part of the TERR 2 – TSR. Large cliffs and rocky structures in the study area provide suitable golden eagle nesting habitat, though no suitable nesting habitat is present within the study area. Suitable grassland foraging habitat is present in the study area.

An adult osprey was observed in flight over a small pond adjacent to the Kaweah No. 2 Flowline Access Road – Canal 5. There is no suitable nesting habitat within the study area, though osprey may forage along riverine and lacustrine habitats in the study area.

Ten additional special-status raptor species may potentially occur in the study area. These include seven diurnal raptors—California condor (*Gymnogyps californianus* [FE, SE, CFP]); northern goshawk (*Accipiter gentilis* [BLMS, SSC]); Swainson’s hawk (*Buteo swainsoni* [BLMS, BCC, ST]); northern harrier (*Circus cyaneus* [SSC]); white-tailed kite (*Elanus leucurus* [BLMS, CFP]); bald eagle (*Haliaeetus leucocephalus* [FD, BCC, BLMS, SE, CFP]); and American peregrine falcon (*Falco peregrinus anatum* [FD, BCC, SD, CFP])—and three owl species—short-eared owl (*Asio flammeus* [SSC]); burrowing owl (*Athene cunicularia* [BLMS, BCC, SSC]); and California spotted owl (*Strix occidentalis occidentalis* [BCC, SSC]). Refer to Table 7.5-7 for a summary of each species’ status, habitat requirements, and potential for occurrence in the study area.

OTHER BIRDS

One special-status songbird, the yellow warbler (*Dendroica petechia* [BCC, SSC]) is known to occur in the study area. An adult male was observed singing in riparian vegetation between the Kaweah No. 1 Flowline and the East Fork Kaweah River during reconnaissance surveys. Suitable breeding habitat for this species occurs along the East Fork Kaweah River and Kaweah River in brushy valley and montane riparian woodlands. Refer to TERR 2 – TSR for detailed information on survey methods and results.

Four additional non-raptorial special-status bird species may potentially occur in the study area, including black swift (*Cypseloides niger* [BCC, SSC]); Lewis’ woodpecker (*Melanerpes lewis* [BCC]); willow flycatcher (*Empidonax traillii* [BCC, SE]); and southwestern willow flycatcher (*Empidonax traillii extimus* [FE, SE]). Refer to Table 7.5-7 for a summary of each species’ status habitat requirements, and potential for occurrence in the study area.

Special-Status Mammal Species

BATS

Nine special-status bat species were detected during surveys conducted for TERR 2 – TSR (SCE 2019b). These include:

- Pallid bat (*Antrozous pallidus* [BLMS, SSC]);
- Townsend’s big-eared bat (*Corynorhinus townsendii* [BLMS, SSC]);
- Spotted bat (*Euderma maculatum* [BLMS, SSC]);
- Western red bat (*Lasiurus blossevillii* [SSC]);
- Western small-footed myotis (*Myotis ciliolabrum* [BLMS]);
- Long-eared myotis (*Myotis evotis* [BLMS]);
- Fringed myotis (*Myotis thysanodes* [BLMS]);
- Yuma myotis (*Myotis yumanensis* [BLMS]); and
- Western mastiff bat (*Eumops perotis californicus* [BLMS, SSC]).

Pallid bats, spotted bats, and western mastiff bats roost primarily in cliffs, caves, and rock crevices. Western red bats roost solitarily under tree foliage. Townsend’s big-eared bats prefer man-made structures, such as mines and buildings. Western small-footed myotis, fringed myotis, long-eared myotis, and Yuma myotis roost in buildings, mines, caves, crevices, and underneath bark. The fringed myotis is commonly associated with ponderosa pine (*Pinus ponderosa*) snags and live trees with extensive shingle bark.

Yuma myotis were detected roosting inside the Kaweah No. 2 Powerhouse and on the exterior of a maintenance building near the Kaweah No. 3 Powerhouse. No other special-status bat species were confirmed roosting on Project facilities.

Open water habitats in the study area (i.e., forebays, diversion pools, and river reaches) provide aquatic foraging habitat and a drinking resource for special-status bat species. Grassland and oak woodland habitats provide additional open foraging habitat for special-status bats in the study area. Foraging special-status bats were detected during acoustic sampling and mist net sampling conducted for the TERR 2 – TSR. Refer to TERR 2 – TSR for more detailed information on the location, season, and number of bats detected in the study area.

Refer to Table 7.5-8 for a detailed list of each special-status bat species known to occur in the study area and the facilities where they were detected.

OTHER MAMMALS

One special-status mammal, ringtail (*Bassariscus astutus* [CFP]), is known to occur in the study area. Ringtail sign (i.e., scat and pawprints) was observed near the Kaweah No. 1 Diversion Dam and Pool and near the Kaweah No. 3 Powerhouse and Switchyard during reconnaissance surveys. Refer to TERR 2 – TSR for more detailed information on the location of these observations. Suitable habitat for ringtail occurs near rocky outcrops along the Kaweah No. 1 Flowline and the riparian corridors along the Kaweah River.

Two additional special-status species, the fisher (*Pekania pennanti* [FPT, BLMS, ST, SSC]) and American badger (*Taxidea taxus* [SSC]), may potentially occur in the study area. Fisher may occur in montane hardwood or riparian habitats within the study area. American badger may occur in open habitats within the study area where there are dry, friable soils for burrowing.

7.5.3.3 Game Species

A game species is an animal that is hunted for sport. Information on game species known to occur or potentially present in the study area is provided in this section because of their commercial and recreational value. Game species are regulated by CDFW and are defined under the California Fish and Game Code as follows:

- Resident and migratory game birds are defined in California Fish and Game Code §3500.
- Game mammals are defined in California Fish and Game Code §3950.
- Furbearing mammals are defined in California Fish and Game Code §4000.

Game species described in the California Fish and Game Code were evaluated for their likelihood to occur based on the geographic and elevation range of the Project and wildlife habitats present. Fourteen species of game were observed during wildlife reconnaissance surveys in the study area. Table 7.5-9 lists the resident and migratory game birds and game mammals that are known or have the potential to occur in the study area, including their habitat requirements and a summary of state hunting regulations for each species. Hunting of game species is permitted during seasons regulated by the CDFW.

A brief summary of the game species known to occur in the study area, including resident game birds, migratory game birds, and game mammals, is provided below.

Resident and Migratory Game Birds

Eight species of game birds were observed in the study area during reconnaissance surveys. Upland birds known to occur in the study area that meet the definition of resident game birds include: wild turkey (*Meleagris gallopavo*), mountain quail (*Oreotyx pictus*), and California quail (*Callipepla californica*). Birds that meet the definition of migratory game birds include mallard (*Anas platyrhynchos*), common merganser (*Mergus*

merganser), American coot (*Fulica americana*), mourning dove (*Zenaida macroura*), and Eurasian-collared dove (*Streptopelia decaocto*).

Four species of game birds were identified as potentially occurring in the study area, including ring-necked pheasant (*Phasianus colchicus*), sooty grouse (*Dendragapus fuliginosus*), common snipe (*Gallinago gallinago*), and band-tailed pigeon (*Columba fasciata*).

Game Mammals

A summary of game mammals known to occur in the study area is provided below. Table 7.5-9 provides the status, habitat requirements, and a summary of state hunting regulations for each of these species.

MULE DEER

Mule deer (*Odocoileus hemionus*) are among the most visible and widespread wildlife species in California. The study area is within Deer Management Unit 460 and Deer Hunt Zone D8 (CDFW 2018). Deer hunting is regulated by California state law through CDFW. A hunting license and a hunting tag are required to take mule deer, and only bucks with antlers with demonstrable forks (or greater) may be taken, except during special hunts.

Two herds, the Kaweah Herd and the Southern Sierra Foothill Herd are present in the study area (CDFW 2018). The Kaweah Herd is migratory, spending the majority of the year in higher-elevation areas within the Sequoia National Park. Winter conditions drive the deer into lower elevation areas. Map 7.5-3 provides the location of the Kaweah mule deer herd key areas, winter range, and migratory routes. The Southern Sierra Foothill Herd is a resident, non-migratory herd that occupies the western Sierra Nevada foothills across multiple Deer Management Units. The populations of these herds are stable to declining, although there is an overall decline in population numbers in California (CDFW 2018). Survival rates of fawns have been low in the past few years, which can be attributed to weather conditions that affect forage production (CDFW 2018).

OTHER GAME MAMMALS

In addition, to mule deer, five game species were detected in the study area, including the small game mammals desert cottontail (*Sylvilagus audubonii*) and western gray squirrel (*Sciurus griseus*); the furbearers gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), and raccoon (*Procyon lotor*); and large game mammal: black bear (*Ursus americanus*).

One other furbearer, American mink (*Mustela vison*), may potentially occur in the study area. In addition, one large game mammal, wild pig (*Sus scrofa*), may also potentially occur in the study area.

7.5.3.4 Wildlife Bridges

Wildlife drownings, primarily of mule deer, were identified by agencies as a resource issue during the previous relicensing for the Kaweah Project (SCE 1989, FERC 1991). The current FERC license included measures (Articles 408 and 409) to minimize wildlife drowning in the Kaweah No. 2 and Kaweah No. 3 flowlines¹. The measures included modification, relocation, and/or rebuilding of existing foot and wildlife bridges, constructing new wildlife bridges, and installation of hazers and flashers at existing escape ramps. These improvements were implemented between 1994 and 1996.

Monitoring of wildlife bridges along the Kaweah No.2 and Kaweah No. 3 was conducted in the spring and fall of 2018 to evaluate whether mule deer and other species were successfully using the wildlife bridges. Refer to Table 7.5-10 for a list of all species and the number observed during flowline monitoring.

Out of 299 total mule deer observations, 254 were observed making a complete crossing of the wildlife bridges. Seven other species were also observed crossing wildlife bridges, including bobcat, coyote (*Canis latrans*), gray fox, black bear, striped skunk (*Mephitis mephitis*), western spotted skunk (*Spilogale gracilis*), and raccoon. No special-status wildlife species were observed during monitoring.

Refer to the TERR 2 – TSR for more detailed information on wildlife species observed during monitoring of wildlife bridges (SCE 2019b).

7.5.3.5 Wildlife Mortality in Flowlines

The current FERC license includes a measure (Article 410) for annual monitoring of wildlife mortality in the Kaweah No. 2 and Kaweah No. 3 flowlines.¹ Since 1991, there have been a total of 52 wildlife mortalities in these flowlines. The majority of these mortalities have been mule deer (41 observations), but seven foxes, a coyote, a black bear, a golden eagle, and an unknown owl species were also recorded.

Since implementation of the measures in Articles 408 and 409 (described in the previous section) there has been a decline in wildlife mortality in the flowlines, particularly in the last 10 years of monitoring (refer to Figure 7.5-1). Refer to the TERR 2 – TSR for more detailed information on wildlife mortalities in Project flowlines (SCE 2019b).

¹ Monitoring of wildlife bridges and documentation of mortalities was not conducted for the Kaweah No. 1 Flowline because wildlife drownings in flowline are rare. The structure is an elevated flume along its entire length, rather than a canal, and is covered by a planked walkway that prevents large wildlife from accessing the water.

7.5.4 Literature Cited

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TABLES

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Table 7.5-1. Vegetation Alliances and Wildlife Habitats Within 1 Mile of the FERC Project Boundary

Vegetation Community¹	Wildlife Habitat²	Acreage of Wildlife Habitat within 1 Mile of the Kaweah Project
Annual Grasses/Forbs	Annual Grassland	985
Barren	Barren	172
Blue Oak	Blue Oak Woodland	3,469
Chamise	Chamise-Redshank Chaparral	2,387
Water	Lacustrine	40
Birchleaf Mountain Mahogany	Mixed Chaparral	780
Ceanothus Chaparral		
Chaparral Yucca		
Lower Montane Mixed Chaparral		
Wedgeleaf Ceanothus		
Whiteleaf Manzanita		
Ceanothus Chaparral	Montane Chaparral	23
Upper Montane Mixed Chaparral		
Wedgeleaf Ceanothus		
Whiteleaf Manzanita		
Black Oak	Montane Hardwood	2,458
California Buckeye		
Canyon Live Oak		
Interior Live Oak		
Interior Mixed Hardwood		
Riparian Mixed Hardwood	Montane Riparian	363
Shrub Willow		
White Alder		
Perennial Grasses/Forbs	Perennial Grassland	2
Incense Cedar	Sierran Mixed Conifer	2
Mixed Conifer-Pine		
Urban/Developed	Urban	32
California Sycamore	Valley Foothill Riparian	103
Riparian Mixed Hardwood		
Interior Live Oak	Valley Oak Woodland	4,314
TOTAL ACREAGE		15,130

¹ Vegetation alliance classification is based on the Classification and Assessment with LANDSAT of Visible Ecological Groupings (CALVEG) (USDA-FS 2014).

² Wildlife habitat classification is based on California Wildlife Habitat Relationships (CWHR) (CDFW 2018).

Table 7.5-2. Survey Area for Special-Status Plants, Non-Native Invasive Plants, and Wildlife Reconnaissance, by Facility Type

Project Facility	Survey Area¹
Diversion Dams and Pools	15 feet around the perimeter
Flowlines ²	20 feet on either side
Forebays/Forebay Tank	20 feet around the perimeter
Penstocks	15 feet on either side
Powerhouses and Switchyards	Within and up to 15 feet around the perimeter fence
Transmission, Power, and Communication Lines	25 feet on either side
Gages	10 feet around gages
Project Access Roads	20 feet on either side
Project Trails	15 feet on either side
Kaweah No. 1 Powerhouse Campus	Within the developed campus
Repeaters and Solar Panels	15 feet around the perimeter
River Access Parking	10 feet around parking area and beach

¹ Survey areas represent locations where potential operation and maintenance activities occur.

² Footbridges, wildlife bridges, and wildlife escape ramps are located on Project flowlines and will be surveyed concurrently with the flowlines.

Table 7.5-3. Special-Status Plant Species Known to Occur or Potentially Occurring in the Study Area

Scientific/Common Name	Federal Status	State Status and CRPR Rank	Blooming Period/Fertile	Habitat	Likelihood for Occurrence/Occurrence Notes
Known to Occur in the Study Area					
<i>Iris munzii</i> Munz's iris	BLMS	CRPR 1B.3	April	Wet, grassy sites, open to part shade in foothill woodland habitat from 1,000 to 2,700 feet.	<ul style="list-style-type: none"> Observed in 2018 during special-status plant surveys conducted as part of relicensing. Twenty-nine populations were observed along the Kaweah No. 1 Flowline and associated access roads. SCE notes in their 1989 report that the population along the Kaweah No. 1 flowline responds favorably to SCE maintenance (periodically clearing away woody species near plants) (SCE 1989).
May Potentially Occur in the Study Area					
<i>Astragalus hornii</i> var. <i>hornii</i> Horn's milk-vetch	BLMS	CRPR 1B.1	May – Oct	Lake margins, with alkaline substrate including meadows and seeps, and playas. 196 to 2,888 feet elevation.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Atriplex cordulata</i> var. <i>cordulata</i> heart-leaved saltbush	BLMS	CRPR 1B.2	April – Oct	Chenopod scrub, meadows and seeps, and valley and foothill grassland with sandy, aline, or alkaline substrate. Up to 1,837 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Atriplex coronata</i> var. <i>vallicola</i> Lost Hills crownscale	BLMS	CRPR 1B.2	April – Aug	Chenopod scrub, valley and foothill grassland, and vernal pools with alkaline substrate. 164 to 2,083 feet elevation.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Brasenia schreberi</i> watershield	–	CRPR 2B.3	June – Sept	Ponds and slow streams below 7,200 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Brodiaea insignis</i> Kaweah brodiaea	BLMS	SE, CRPR 1B.2	April – June	Known only from blue oak woodlands in the Kaweah and Tule River drainages in Tulare County (approx. 400 to 5,000 feet). Associated with reddish-brown clay loam soils underlain by granitic rock substrates.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Calochortus striatus</i> alkali mariposa lily	BLMS	CRPR 1B.2	April – June	Chaparral, chenopod scrub, mojavean desert scrub, and meadows and seeps with alkaline and mesic substrate. 229 to 5,232 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Carex praticola</i> northern meadow sedge	–	CRPR 2B.2	May – July	Perennial herb. Meadows and seeps. To 10,500 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>California macrophylla</i> round-leaved filaree	BLMS	CRPR 1B.1.2	March – May	Open sites, grassland, scrub, vertic clay, occasionally serpentine. 50 to 3,935 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.

Scientific/Common Name	Federal Status	State Status and CRPR Rank	Blooming Period/Fertile	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Caulanthus californicus</i> California jewelflower	FE	SE, CRPR 1B.1	Feb – May	Grasslands in the southern San Joaquin valley. 250 to 3,300 feet. USFWS has not designated critical habitat for this species.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Clarkia springvillensis</i> Springville clarkia	FT, BLMS	SE, CRPR 1B.2	May – July	Chaparral, grasslands, and woodlands from 800 to 4,000 feet. USFWS has not designated critical habitat for this species. Known only from the Tulare River Drainage.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Deinandra mohavensis</i> Mojave tarplant	BLMS	SE, CRPR 1B.3	(May)Jun – Oct(Jan)	Chaparral, Coastal and Riparian scrub with mesic substrate. 2,100 to 5,250 feet elevation.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Delphinium purpusii</i> rose-flowered larkspur/ Kern County larkspur	BLMS	CRPR 1B.3	March – May	Talus areas and cliffs among chaparral, foothill woodland, and pinyon-juniper woodland 900 to 4,400 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Delphinium recurvatum</i> recurved larkspur	BLMS	CRPR 1B.2	March – June	Poorly drained, fine, alkaline soils in grassland scrub, and foothill woodland below 2,600 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Eremalche (=Malvastrum) kernensis</i> Kern mallow	FE, BLMS	CRPR 1B.1	March – May	Found on dry, open sandy to clay soils, often at the edge of balds. In valley and foothill grasslands. USFWS has not designated critical habitat for this species.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Eriogonum nudum</i> var. <i>murinum</i> mouse buckwheat	BLMS	CRPR 1B.2	June – Nov	Sandy soils in chaparral, grassland, or foothill woodland 1,100 to 3,800 feet. Known only from the Kaweah River drainage. Restricted to marble outcrops, although it may colonize disturbed sites.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Eryngium spinosepalum</i> spiny-sepaled button-celery	–	CRPR 1B.2	April – June	Vernal pools, swales, and roadside ditches in lower foothills and grasslands of Fresno, Stanislaus, and Tulare counties from 200 to 2,100 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Mimulus norrisii/Erythranthe norrisii</i> Kaweah monkeyflower	BLMS	CRPR 1B.3	March – May	Marble crevices in chaparral and cismontane woodlands. Known only from the Kaweah and Kings River drainages. 1,100 to 4,300 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Fritillaria striata</i> striped adobe-lily	BLMS	ST, CRPR 1B.1	Feb – April	Clay soil in valley grassland and foothill woodland below 3,300 feet. Known to occur at one remaining site in Tulare County (Lewis Hill east of Porterville).	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Glyceria grandis</i> American manna grass	–	CRPR 2B.3	June – Aug	Freshwater emergent wetlands, streambanks, and lake margins below 6,500 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.

Scientific/Common Name	Federal Status	State Status and CRPR Rank	Blooming Period/Fertile	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Helianthus winteri</i> Winter's sunflower	BLMS	CRPR 1B.2	Jan – Dec	Cismontane woodland and valley and foothill grassland. Grows in openings on relatively steep south-facing slopes, with granitic and often rocky substrate, often roadsides. 410 to 1,510 feet elevation.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Hesperocyparis nevadensis</i> Piute cypress	BLMS	CRPR 1B.2	–	Closed-cone coniferous forest, chaparral, and cismontane, pinyon, and juniper woodland. 2,360 to 6,005 feet elevation.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Leptosiphon serrulatus</i> Madera leptosiphon	–	CRPR 1B.2	April – May	Dry slopes in cismontane oak woodland and lower montane coniferous forest. Usually in decomposed granite, one instance on serpentine. 900 to 4,300 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Mimulus pictus/Diplacus pictus</i> calico monkeyflower	BLMS	CRPR 1B.2	March – May	Bare, sunny, shrubby areas, around granite outcrops. 443 to 4,101 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Monolopia congdonii</i> San Joaquin woollythreads	FE	CRPR 1B.2	Feb – May	Chenopod scrub and valley and foothill grassland. 190 to 2,625 feet elevation.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Navarretia setiloba</i> Piute Mountains navarretia	BLMS	CRPR 1B.1	April – July	Cismontane, pinyon, and juniper woodland and valley and foothill grassland with clay or gravelly loam substrate. 935 to 6,890 feet elevation.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Orthotrichum holzingeri</i> Holzinger's orthotrichum moss	–	CRPR 1B.3	N/A	Periodically inundated rock surfaces near streams in dry, montane forests from 2,300 to 5,900 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Phacelia nashiana</i> Charlotte's phacelia	BLMS	CRPR 1B.2	March – June	Joshua tree woodland, Mojavean desert scrub, and pinyon and juniper woodland with usually granitic and sandy substrate. 1,960 to 7,220 feet elevation.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Pseudobahia peirsonii</i> San Joaquin adobe sunburst/ Tulare Pseudobahia	FT	SE, CRPR 1B.1	Feb – April	Clay (Cibo, Porterville, or Centerville) soils in grassland and foothill woodland from 200 to 2,700 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Ribes menziesii</i> var. <i>ixoderme</i> aromatic canyon gooseberry	–	CRPR 1B.2	April	Chaparral and montane woodlands to 3,900 feet.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.
<i>Sidalcea keckii</i> Keck's checker-mallow/ Keck's checkerbloom	FE	CRPR 1B.1	April – May	Cismontane woodland and valley and foothill grassland with serpentinite and clay substrates from 300 to 2,200 feet. USFWS has designated critical habitat for this species.	<ul style="list-style-type: none"> The study area is within the known geographic and elevation range of this species. This species was not observed during the TERR 1 special-status plant surveys.

Scientific/Common Name	Federal Status	State Status and CRPR Rank	Blooming Period/Fertile	Habitat	Likelihood for Occurrence/Occurrence Notes
Unlikely to Occur in the Study Area					
<i>Agrostis humilis</i> mountain bent grass	–	CRPR 2B.3	July – Sept	Grows in moist to dry locations in subalpine to alpine meadows or slopes at elevations from 8,700 to 10,500 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Allium abramsii</i> Abram's onion	–	CRPR 1B.2	May – July	Granitic sand in lower and upper montane coniferous forest. 2,900 to 10,100 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Asplenium septentrionale</i> northern spleenwort	–	CRPR 2B.3	N/A	Crevices in granite within chaparral or conifer forests from 5,200 to 11,000 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Astragalus lentiginosus</i> var. <i>kernensis</i> Kern Plateau milk-vetch	–	CRPR 1B.2	June – July	Sandy areas and meadows in subalpine forests 7,300 to 9,100 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Astragalus shevockii</i> Shevock's milk-vetch	BLMS	CRPR 1B.3	June – July	Upper montane coniferous forest with granitic and sandy substrates. 6,200 to 6,446 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Atriplex cordulata</i> var. <i>erecticaulis</i> Earlimart orache	BLMS	CRPR 1B.2	Aug – Sept (Nov)	Valley and foothill grassland. 130 to 330 feet elevation.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Atriplex subtilis</i> subtle orache	BLMS	CRPR 1B.2	June, Aug, Sept, (Oct)	Valley and foothill grassland with alkaline substrate. 131 to 328 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Boechea tularensis</i> Tulare rockcress	–	CRPR 1B.3	June – July	Rocky slopes in montane, subalpine habitats. 5,900 to 11,000 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Botrychium minganense</i> Mingan moonwort	–	CRPR 2B.2	July – Sept	Meadows, marshes, bogs, and fens in lower and upper montane conifer forest. 4,500 to 7,200 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Calochortus westonii</i> Shirley Meadows star-tulip	BLMS	CRPR 1B.2	May – June	Meadows and open areas among conifer woodlands above 4,900 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Calyptidium pygmaeum</i> pygmy pussypaws	–	CRPR 1B.2	June – Aug	Lodgepole, subalpine coniferous forest, and upper montane coniferous forest, in sandy or gravelly soils. 6,400 to 11,500 feet in elevation.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Carlquistia muirii</i> Muir's tarplant (=Muir's raillardella)	BLMS	CRPR 1B.3	July – Aug	Chaparral (montane), lower montane coniferous forest, upper montane coniferous forest. Northern distributional limit is in the vicinity of the Wishon Reservoir in the Kings River drainage. 3,000 to 8,200 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Cinna bolanderi</i> Bolander's woodreed	–	CRPR 1B.2	July – Sept	Meadows and seeps and along stream banks in upper montane coniferous forests. 5,400 to 8,000 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Cryptantha circumscissa</i> var. <i>rosulata</i> rosette cushion cryptantha	–	CRPR 1B.2	July – Aug	Barren areas of decomposed granite at elevations from 9,600 to 12,000 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Cuscuta jepsonii</i> Jepson's dodder	–	CRPR 1B.2	July – Sept	Possibly extinct, grows on <i>Ceanothus diversifolius</i> and <i>C. prostratus</i> from 3,900 to 7,600 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Draba cruciata</i> Mineral King draba	–	CRPR 1B.3	June – Aug	Gravelly soils in subalpine areas from 8,200 to 11,000 feet. Known primarily from the slopes surrounding Mineral King Valley.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Dudleya cymosa</i> ssp. <i>costatifolia</i> Pierpoint Springs dudleya	–	CRPR 1B.2	May – July	Limestone outcrops from 4,700 to 5,300 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Erigeron aequifolius</i> Hall's daisy	BLMS	CRPR 1B.3	June – Aug	Broad-leaved upland forest, lower and upper montane coniferous forest, pinyon-juniper woodland, rocky soils. 4,900 to 8,100 feet.	• Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.

Scientific/Common Name	Federal Status	State Status and CRPR Rank	Blooming Period/Fertile	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Erigeron multiceps</i> Kern River daisy	BLMS	CRPR 1B.2	June – Sept	Meadows, riverbanks, sandy flats, and openings in Joshua tree or aspen woodlands and conifer forest from 4,900 to 8,300 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Erythronium pusaterii</i> Kaweah fawn lily	–	CRPR 1B.3	May – July	Meadows and rocky ledges from 6,800 to 9,200 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Galium angustifolium</i> subsp. <i>onycense</i> Onyx Peak bedstraw	BLMS	CRPR 1B.3	April – July	Cismontane, Pinyon and juniper woodland with granitic and rocky substrate. 2,820 to 7,545 feet elevation.	<ul style="list-style-type: none"> The study area is outside the elevation range of and does not support appropriate habitat for this species. Known to occur on BLM lands managed by the Bakersfield field office.
<i>Hosackia oblongifolia</i> var. <i>cuprea</i> copper-flowered bird's-foot trefoil	–	CRPR 1B.3	June – Aug	Meadows and openings in conifer woodlands from 7,800 to 9,100 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Hulsea vestita</i> ssp. <i>pygmaea</i> pygmy hulsea	–	CRPR 1B.3	June – Oct	Gravel soils in alpine barrens and open slopes within subalpine forest from 9,300 to 13,000 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Ivesia campestris</i> field ivesia	–	CRPR 1B.2	May – Aug	Meadow edges from 6,400 to 11,200 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Lasthenia glabrata</i> subsp. <i>coulteri</i> Coulter's goldfields	BLMS	CRPR 1B.1	Feb – June	Marshes and swamps (coastal salt), playas, and vernal pools. 3 to 4,005 feet elevation.	<ul style="list-style-type: none"> Unlikely to occur. The study area does not support appropriate habitat for this species.
<i>Lupinus lepidus</i> var. <i>culbertsonii</i> Hockett Meadows lupine	–	CRPR 1B.3	July – Aug	Meadows and rocky slopes among conifer forests from 8,000 to 9,900 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Mimulus shevockii</i> Kelso Creek monkeyflower	BLMS	CRPR 1B.2	March – May	Alluvial fans, dry streamlets, generally granitic soils. 2,953 to 4,265 feet elevation.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.
<i>Minuartia stricta</i> bog sandwort	–	CRPR 2B.3	July – Sept	Wet areas of decomposed granite or sandy soils in meadows or alpine areas from 8,000 to 13,000 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Myurella julacea</i> small mousetail moss	–	CRPR 2B.3	N/A	Rich soil among rocks or in crevices from 8,800 to 9,900 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Nemacladus twisselmannii</i> Twisselmann's nemacladus	BLMS	SR, CRPR 1B.2	July	Upper montane coniferous forest. 7,350 to 8,040 feet elevation.	<ul style="list-style-type: none"> The study area is outside the elevation range of and does not support appropriate habitat for this species. Suspected to occur on BLM lands managed by the Bakersfield field office.
<i>Oreonana purpurascens</i> purple mountain-parsley	–	CRPR 1B.2	May – June	Ridgetops, usually metamorphic rocks in conifer forests from 7,800 to 9,400 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Orcuttia inaequalis</i> San Joaquin Valley Orcutt grass	FT	SE, CRPR 1B.1	April – Sept	Vernal pools. Below 2,700 feet. USFWS has designated critical habitat for this species.	<ul style="list-style-type: none"> Unlikely to occur. The study area does not support vernal pool habitat.
<i>Petrophytum caespitosum</i> ssp. <i>acuminatum</i> marble rockmat	–	CRPR 1B.3	Aug – Sept	Limestone cliffs from 3,900 to 7,600 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Phacelia novemmillensis</i> Nine Mile Canyon phacelia	BLMS	CRPR 1B.2	(Feb) May – June	Broadleafed upland forest, cismontane, pinyon, and juniper woodland, and upper montane coniferous forest with sandy or gravelly substrate. Often in leaf litter under canyon live oak (<i>Quercus chrysolepsis</i>). 5,390 to 8,665 feet elevation.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Phacelia orogenes</i> mountain phacelia	–	CRPR 4.3	June – Aug	Rock moist slopes in subalpine forests from 9,250 to 9,400 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Ribes tulareense</i> Sequoia gooseberry	BLMS	CRPR 1B.3	May	Conifer forests from 5,400 to 5,800 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Sidalcea multifida</i> cut-leaf checkerbloom	–	CRPR 2B.3	May – Sept	Dry areas among sagebrush scrub and conifer forest from 5,700 to 9,200 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.

Scientific/Common Name	Federal Status	State Status and CRPR Rank	Blooming Period/Fertile	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Streptanthus gracilis</i> alpine jewelflower	–	CRPR 1B.3	July – Aug	Rocky slopes in subalpine conifer forests from 9,100 to 11,500 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Trifolium kingii</i> subsp. <i>dedeckerae</i> DeDecker's clover	BLMS	CRPR 1B.3	May – July	Lower montane coniferous forest, pinyon and juniper woodland, and Subalpine and upper montane coniferous forest with granitic or rocky substrate. 6,890 to 11,485 feet elevation.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Triglochin palustris</i> marsh arrow-grass	–	CRPR 2B.3	July – Aug	Wet areas in subalpine to alpine habitats from 7,400 to 12,200 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Tuctoria (=Orcuttia) greenei</i> Greene's tuctoria	FE	SR, CRPR 1B.1	May – July	Vernal pools below 3,600 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area does not support vernal pool habitat.
<i>Utricularia intermedia</i> flat-leaved bladderwort	–	CRPR 2B.2	July – Aug	Annual aquatic herb. Shallow waters within bogs, fens, swamps, and wet meadows. 3,900 to 8,900 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.
<i>Viola pinetorum</i> var. <i>grisea</i> grey-leaved violet	–	CRPR 1B.3	April – July	Dry peaks and slopes in subalpine conifer forest and upper montane conifer forest. 4,500 to 12,100 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of and does not support appropriate habitat for this species.

LEGEND:

Federal Status

FT = Federal Threatened

FE = Federal Endangered

BLMS = BLM Sensitive

State Status

ST = California Threatened

SE = California Endangered

SR = California Rare

CRPR = California Native Plant Society Rare Plant Rank

CRPR 1B = rare, threatened or endangered in California and elsewhere

CRPR 2B = rare in California but more common elsewhere

3 = need more information

4 = plants of limited distribution; a watch list

_.1 = Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)

_.2 = Moderately threatened in California (20–80% occurrences threatened)

_.3 = Not very threatened in California (<20% of occurrences threatened or no current threats known)

Table 7.5-4. Munz's Iris Populations Identified in the Study Area

Scientific Name	Common Name	Unique Population/ Map ID ¹	Facility	Total # of Individuals	Population Size (Square Feet)	Survey Date
Iris munzii	Munz's iris	IRMU001	Kaweah No. 1 Flowline	3	135	6/17/2018
Iris munzii	Munz's iris	IRMU002	Kaweah No. 1 Flowline	7	2,177	6/17/2018
Iris munzii	Munz's iris	IRMU003	Kaweah No. 1 Flowline	7	7,925	6/17/2018
Iris munzii	Munz's iris	IRMU004	Kaweah No. 1 Flowline	45	16,413	6/17/2018
Iris munzii	Munz's iris	IRMU005	Kaweah No. 1 Flowline Access Road – Slick Rock	1	3	6/17/2018
Iris munzii	Munz's iris	IRMU006	Kaweah No. 1 Flowline	2	10	6/17/2018
Iris munzii	Munz's iris	IRMU007	Kaweah No. 1 Flowline	2	150	6/18/2018
Iris munzii	Munz's iris	IRMU008	Kaweah No. 1 Flowline	58	8,258	6/18/2018
Iris munzii	Munz's iris	IRMU009	Kaweah No. 1 Flowline	21	17,829	6/18/2018
Iris munzii	Munz's iris	IRMU010	Kaweah No. 1 Flowline	1	4	6/18/2018
Iris munzii	Munz's iris	IRMU011	Kaweah No. 1 Flowline	1	4	6/18/2018
Iris munzii	Munz's iris	IRMU012	Kaweah No. 1 Flowline	14	3,285	6/18/2018
Iris munzii	Munz's iris	IRMU013	Kaweah No. 1 Flowline	29	9,479	6/18/2018
Iris munzii	Munz's iris	IRMU014	Kaweah No. 1 Flowline	94	21,828	6/18/2018
Iris munzii	Munz's iris	IRMU015	Kaweah No. 1 Flowline	10	1,873	6/18/2018
Iris munzii	Munz's iris	IRMU016	Kaweah No. 1 Flowline	2	471	6/18/2018
Iris munzii	Munz's iris	IRMU017	Kaweah No. 1 Flowline	2	503	6/18/2018
Iris munzii	Munz's iris	IRMU018	Kaweah No. 1 Flowline	4	1,396	6/18/2018
Iris munzii	Munz's iris	IRMU019	Kaweah No. 1 Flowline	1	36	6/18/2018
Iris munzii	Munz's iris	IRMU020	Kaweah No. 1 Flowline	3	412	6/18/2018
Iris munzii	Munz's iris	IRMU021	Kaweah No. 1 Flowline	5	932	6/18/2018
Iris munzii	Munz's iris	IRMU022	Kaweah No. 1 Flowline	4	2,474	6/19/2018
Iris munzii	Munz's iris	IRMU023	Kaweah No. 1 Flowline	1	9	6/19/2018

Scientific Name	Common Name	Unique Population/ Map ID¹	Facility	Total # of Individuals	Population Size (Square Feet)	Survey Date
Iris munzii	Munz's iris	IRMU024	Kaweah No. 1 Flowline	4	5,889	6/19/2018
Iris munzii	Munz's iris	IRMU025	Kaweah No. 1 Flowline	11	12,512	6/19/2018
Iris munzii	Munz's iris	IRMU026	Kaweah No. 1 Flowline	5	7,761	6/19/2018
Iris munzii	Munz's iris	IRMU027	Kaweah No. 1 Flowline	1	8	6/19/2018
Iris munzii	Munz's iris	IRMU028	Kaweah No. 1 Flowline	6	4,159	6/19/2018
Iris munzii	Munz's iris	IRMU029	Kaweah No. 1 Flowline	2	4,264	6/19/2018

¹Refer to Map 7.5-1 (a-t) (CONFIDENTIAL) for the location of each individual/population in the Study area.

Table 7.5-5. Non-Native Invasive Plant Populations Identified in the Study Area

Scientific Name	Common Name	Unique Population/Map ID ¹	Facility	Level of Infestation ²	Population Size (Square Feet)	Survey Date
<i>Ailanthus altissima</i>	Tree-of-Heaven	AIAL001	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	MOD	8,752	6/23/2018
<i>Ailanthus altissima</i>	Tree of Heaven	AIAL002	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	HIGH	16,718	4/26/2018
<i>Centaurea melitensis</i>	Tocalote	CEME001 ³	Kaweah No. 3 Forebay Road	LOW	6,836	6/14/2018
<i>Centaurea melitensis</i>	Tocalote	CEME002	Kaweah No. 3 Forebay Road	LOW	129,704	6/14/2018
<i>Centaurea melitensis</i>	Tocalote	CEME003	Kaweah No. 3 Forebay Road, Kaweah No. 3 Penstock	LOW	200,760	6/14/2018, 6/23/2018
<i>Centaurea melitensis</i>	Tocalote	CEME004	Kaweah No. 3 Powerhouse and Switchyard	MOD	4	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME005	Kaweah No. 3 Powerhouse Road	LOW	320	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME006	Kaweah No. 3 Powerhouse Road	LOW	1,730	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME007	Kaweah No. 2 Intake Road	LOW	25	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME008	Kaweah No. 2 Intake Road	MOD	100	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME009	Kaweah No. 2 Intake Road	LOW	100	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME010	Kaweah No. 2 Flowline Access Road - Open Siphon Grids, Kaweah No. 2 Flowline	LOW	18,756	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME011	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	30,994	4/27/2018

Scientific Name	Common Name	Unique Population/Map ID ¹	Facility	Level of Infestation ²	Population Size (Square Feet)	Survey Date
<i>Centaurea melitensis</i>	Tocalote	CEME012	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	13,540	4/27/2018
<i>Centaurea melitensis</i>	Tocalote	CEME013	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	4,799	4/27/2018
<i>Centaurea melitensis</i>	Tocalote	CEME014	Kaweah No. 2 Flowline (Canal 2 to Forebay)	LOW	980,963	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME015	Kaweah No. 2 Flowline East Access Road	LOW	212,577	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME016	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	67,108	6/16/2018
<i>Centaurea melitensis</i>	Tocalote	CEME017	Kaweah No. 2 Flowline Access Trail - Canal 4 West, Kaweah No. 2 Flowline Access Road - Canal 4 East	LOW	19,558	6/15/2018
<i>Centaurea melitensis</i>	Tocalote	CEME018	Kaweah No. 2 Flowline Access Road - Canal 4 West	LOW	31,371	6/16/2018
<i>Centaurea melitensis</i>	Tocalote	CEME019	Kaweah No. 2 Flowline Access Road - Canal 5	LOW	38,427	6/16/2018
<i>Centaurea melitensis</i>	Tocalote	CEME020	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	12,245	6/16/2018
<i>Centaurea melitensis</i>	Tocalote	CEME021	Kaweah No. 2 Flowline Access Road - Canal 6 East	LOW	12,981	6/16/2018
<i>Centaurea melitensis</i>	Tocalote	CEME022	Kaweah No. 2 Flowline Access Road - Canal 6 West	LOW	5,968	6/16/2018
<i>Centaurea melitensis</i>	Tocalote	CEME023	Kaweah No. 2 Flowline East Access Road	LOW	29,603	6/16/2018

Scientific Name	Common Name	Unique Population/Map ID ¹	Facility	Level of Infestation ²	Population Size (Square Feet)	Survey Date
<i>Centaurea melitensis</i>	Tocalote	CEME024	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	400	4/27/2018
<i>Centaurea melitensis</i>	Tocalote	CEME025	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	12,163	4/27/2018
<i>Centaurea melitensis</i>	Tocalote	CEME026	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	900	4/27/2018
<i>Centaurea melitensis</i>	Tocalote	CEME027	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	HIGH	15,273	6/16/2018
<i>Centaurea melitensis</i>	Tocalote	CEME028	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	MOD	900	4/27/2018
<i>Centaurea melitensis</i>	Tocalote	CEME029 ³	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	MOD	3,001	4/27/2018
<i>Centaurea melitensis</i>	Tocalote	CEME030	Kaweah No. 2 Flowline Access Road - Flume 8	LOW	43,422	6/21/2018
<i>Centaurea melitensis</i>	Tocalote	CEME031	Kaweah No. 2 Flowline Center Access Road	LOW	212,844	6/21/2018
<i>Centaurea melitensis</i>	Tocalote	CEME032	Kaweah No. 2 Flowline West Access Road	LOW	226,414	6/21/2018
<i>Centaurea melitensis</i>	Tocalote	CEME033	Kaweah No. 2 Spillways	LOW	14,505	6/21/2018
<i>Centaurea melitensis</i>	Tocalote	CEME034	Kaweah No. 2 Forebay Road	LOW	87,801	6/21/2018
<i>Centaurea melitensis</i>	Tocalote	CEME035	Kaweah No. 2 Penstock	LOW	88,032	6/22/2018
<i>Centaurea melitensis</i>	Tocalote	CEME036	Kaweah No. 2 Penstock Road	LOW	96,300	6/22/2018

Scientific Name	Common Name	Unique Population/Map ID ¹	Facility	Level of Infestation ²	Population Size (Square Feet)	Survey Date
Centaurea melitensis	Tocalote	CEME037	Kaweah No. 2 Powerhouse Transmission Tap Line	LOW	29,897	6/22/2018
Centaurea melitensis	Tocalote	CEME038	Kaweah No. 2 Powerhouse Transmission Tap Line	LOW	300	6/22/2018
Centaurea melitensis	Tocalote	CEME039	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	35,389	6/24/2018
Centaurea melitensis	Tocalote	CEME040	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	13,197	6/23/2018
Centaurea melitensis	Tocalote	CEME041	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	9,146	6/24/2018
Centaurea melitensis	Tocalote	CEME042 ³	Kaweah No. 1 Penstock	LOW	10,170	6/18/2018
Centaurea melitensis	Tocalote	CEME043	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	72,630	6/23/2018
Centaurea melitensis	Tocalote	CEME044	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	6,791	6/23/2018
Centaurea melitensis	Tocalote	CEME045	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	25	6/23/2018
Centaurea melitensis	Tocalote	CEME046	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	5,524	6/23/2018
Centaurea melitensis	Tocalote	CEME047	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	3,929	4/26/2018

Scientific Name	Common Name	Unique Population/Map ID ¹	Facility	Level of Infestation ²	Population Size (Square Feet)	Survey Date
<i>Centaurea melitensis</i>	Tocalote	CEME048	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	5,069	4/26/2018
<i>Centaurea melitensis</i>	Tocalote	CEME049	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	LOW	400	6/23/2018
<i>Centaurea melitensis</i>	Tocalote	CEME050	Kaweah No. 1 Solar Yard Satellite Repeater	HIGH	2,807	6/17/2018
<i>Centaurea melitensis</i>	Tocalote	CEME051	Kaweah No. 1 Solar Yard Satellite Repeater	LOW	8,479	6/17/2018
<i>Centaurea melitensis</i>	Tocalote	CEME052	Kaweah No. 1 Intake Road	LOW	40,782	6/17/2018
<i>Centaurea melitensis</i>	Tocalote	CEME053	Kaweah No. 1 Flowline	LOW	36,632	6/17/2018
<i>Centaurea melitensis</i>	Tocalote	CEME054	Kaweah No. 1 Flowline	LOW	3,998	6/17/2018
<i>Centaurea melitensis</i>	Tocalote	CEME055	Kaweah No. 1 Flowline	LOW	44,893	6/17/2018
<i>Centaurea melitensis</i>	Tocalote	CEME056	Kaweah No. 1 Access Road - Lumberyard	MOD	3,293	6/18/2018
<i>Centaurea melitensis</i>	Tocalote	CEME057	Kaweah No. 1 Flowline	LOW	28,067	6/18/2018
<i>Centaurea melitensis</i>	Tocalote	CEME058	Kaweah No. 1 Flowline	LOW	21,880	6/18/2018
<i>Centaurea melitensis</i>	Tocalote	CEME059 ³	Kaweah No. 1 Access Road - Upper Pine	LOW	40,693	6/22/2018
<i>Centaurea melitensis</i>	Tocalote	CEME060	Kaweah No. 1 Flowline	LOW	2,370	6/18/2018
<i>Centaurea melitensis</i>	Tocalote	CEME061	Kaweah No. 1 Flowline	LOW	33,653	6/18/2018
<i>Centaurea melitensis</i>	Tocalote	CEME062	Kaweah No. 1 Flowline Access Road - Lower Pine	LOW	32,447	6/22/2018
<i>Centaurea melitensis</i>	Tocalote	CEME063	Kaweah No. 1 Flowline	LOW	8,126	6/18/2018
<i>Centaurea melitensis</i>	Tocalote	CEME064	Kaweah No. 1 Flowline	LOW	15,948	6/19/2018
<i>Centaurea melitensis</i>	Tocalote	CEME065	Kaweah No. 1 Flowline Access Road - Grapevine	LOW	39,555	6/19/2018

Scientific Name	Common Name	Unique Population/Map ID ¹	Facility	Level of Infestation ²	Population Size (Square Feet)	Survey Date
<i>Centaurea melitensis</i>	Tocalote	CEME066	Kaweah No. 1 Flowline	LOW	13,736	6/19/2018
<i>Centaurea melitensis</i>	Tocalote	CEME067	Kaweah No. 1 Flowline	LOW	2,691	6/19/2018
<i>Centaurea melitensis</i>	Tocalote	CEME068	Kaweah No. 1 Flowline	LOW	19,794	6/19/2018
<i>Centaurea melitensis</i>	Tocalote	CEME069	Kaweah No. 1 Flowline Access Road - Summit	MOD	2,430	6/22/2018
<i>Centaurea melitensis</i>	Tocalote	CEME070 ³	Kaweah No. 1 Forebay Tank and Spillway Channel	LOW	1,048	6/19/2018
<i>Centaurea melitensis</i>	Tocalote	CEME071	Kaweah No. 1 Forebay Road	LOW	91,443	6/19/2018
<i>Centaurea melitensis</i>	Tocalote	CEME072	Kaweah No. 1 Forebay Road	LOW	66,683	6/19/2018
<i>Centaurea melitensis</i>	Tocalote	CEME073	Kaweah No. 1 Forebay Road	LOW/MOD/HIGH	23,390	6/19/2018
<i>Cirsium vulgare</i>	Bull thistle	CIVU001	Kaweah No. 2 Flowline at Flume 4	LOW	150	6/16/2018
<i>Genista monspessulana</i>	French broom	GEMO001	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	HIGH	2,042	4/26/2018
<i>Tribulus terrestris</i>	Puncture vine	TRTE001	Kaweah No. 3 Forebay and Spillway Channel	LOW	14,766	6/14/2018
<i>Tribulus terrestris</i>	Puncture vine	TRTE002	Kaweah No. 3 Powerhouse and Switchyard	LOW	954	6/15/2018
<i>Tribulus terrestris</i>	Puncture vine	TRTE003	Kaweah No. 3 Powerhouse and Switchyard	LOW	20	6/15/2018
<i>Tribulus terrestris</i>	Puncture vine	TRTE004	Kaweah No. 3 Powerhouse and Switchyard	LOW	3,319	6/15/2018
<i>Tribulus terrestris</i>	Puncture vine	TRTE005 ⁴	Kaweah No. 3 Powerhouse and Switchyard	LOW	100	6/15/2018
<i>Tribulus terrestris</i>	Puncture vine	TRTE006	Kaweah No. 3 Powerhouse Road	LOW	2,815	6/15/2018

Scientific Name	Common Name	Unique Population/Map ID ¹	Facility	Level of Infestation ²	Population Size (Square Feet)	Survey Date
Tribulus terrestris	Puncture vine	TRTE007	Kaweah No. 3 Powerhouse Road	LOW	1,227	6/15/2018
Tribulus terrestris	Puncture vine	TRTE008	Kaweah No. 3 Powerhouse Road	LOW	9,193	6/15/2018
Tribulus terrestris	Puncture vine	TRTE009	Kaweah No. 2 Intake Road	LOW	19,590	6/15/2018
Tribulus terrestris	Puncture vine	TRTE010	Kaweah No. 2 Intake Road, Kaweah No. 2 Flowline Access Road - Open Siphon Grids	LOW	28,862	6/15/2018
Tribulus terrestris	Puncture vine	TRTE011	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	MOD	225	6/16/2018
Tribulus terrestris	Puncture vine	TRTE012	Kaweah No. 2 Access Road - Red Barn	LOW	30,828	6/21/2018
Tribulus terrestris	Puncture vine	TRTE013	Kaweah No. 2 Flowline West Access Road	MOD	16	6/21/2018
Tribulus terrestris	Puncture vine	TRTE014	Kaweah No. 2 Flowline Access Trail - Canal 15	LOW	1,062	6/21/2018
Tribulus terrestris	Puncture vine	TRTE015	Kaweah No. 2 Flowline Access Trail - Canal 15	LOW	587	6/21/2018
Tribulus terrestris	Puncture vine	TRTE016	Kaweah No. 2 Forebay Road	LOW	73,683	6/22/2018
Tribulus terrestris	Puncture vine	TRTE017	Kaweah No. 2 Powerhouse Road, Kaweah River Drive, Kaweah No. 2 Powerhouse	MOD	3,352	6/22/2018
Tribulus terrestris	Puncture vine	TRTE018	Kaweah No. 2 Powerhouse Road, Kaweah River Drive, Kaweah No. 2 Switchyard	LOW	10,207	6/22/2018

Scientific Name	Common Name	Unique Population/Map ID ¹	Facility	Level of Infestation ²	Population Size (Square Feet)	Survey Date
Tribulus terrestris	Puncture vine	TRTE019	Kaweah No. 2 Powerhouse Road, Kaweah River Drive, Kaweah No. 2 Powerhouse	LOW	10,102	6/22/2018
Tribulus terrestris	Puncture vine	TRTE020	Kaweah No. 2 Powerhouse Transmission Tap Line	LOW	4	6/22/2018
Tribulus terrestris	Puncture vine	TRTE021	Kaweah No. 2 Powerhouse Transmission Tap Line	LOW	300	6/22/2018
Tribulus terrestris	Puncture vine	TRTE022	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line, Kaweah No. 1 Powerhouse Campus	LOW/MOD	32,905	6/18/2018
Tribulus terrestris	Puncture vine	TRTE023	Kaweah No. 1 Powerhouse Campus	LOW	2,198	6/18/2018
Tribulus terrestris	Puncture vine	TRTE024	Kaweah No. 1 Penstock	LOW	23,005	6/18/2018
Tribulus terrestris	Puncture vine	TRTE025	Kaweah No. 3 Powerhouse to Three Rivers Substation Transmission Line	MOD	400	6/23/2018

Notes:

LOW = <5% cover

MOD = 6–25% cover

HIGH = >25% cover

¹ Refer to Map 7.5-1 (a–t) (CONFIDENTIAL) for the location of each individual/population in the Study Area.

² Level of Infestation.

³ Tocalote is widespread in the Study area. Therefore, with the exception of populations CEME001, CEME029, CEME042, CEME059, and CEME070, the full extent of tocalote populations were not fully mapped and extend beyond the study area boundaries.

⁴ After review, TRTE005 was removed from the map because it falls outside of the Project boundary. It is included in this table for reference.

Table 7.5-6. Survey Locations for Special-Status Bats

Diversion Dams and Pools
• Kaweah No. 1 Diversion Dam and Pool (East Fork Kaweah River) ^{1,2}
• Kaweah No. 2 Diversion Dam and Pool (Kaweah River) ¹
Flowlines
• Kaweah No. 1 Flowline (flume section only) ¹
• Kaweah No. 2 Flowline (flume section only) ¹
Powerhouses and Switchyards
• Kaweah No. 1 Powerhouse and Switchyard ^{1,2}
• Kaweah No. 2 Powerhouse and Switchyard ^{1,2}
• Kaweah No. 3 Powerhouse and Switchyard ^{1,2}
Stream Gages
• East Fork Kaweah River Conduit 1 at Power Plant near Hammond CA (USGS Gage No. 11208800) (SCE Gage No. 200a) ¹
• East Fork Kaweah River near Three Rivers CA (USGS Gage No. 11208730) (SCE Gage No. 201) ¹
• Kaweah No. 1 Minimum Instream Flow Release (SCE Gage No. 201a) ¹
• East Fork Kaweah River Conduit 1 near Three Rivers CA (SCE Gage No. 202) ¹
• Kaweah River below Conduit No. 2 near Hammond CA (USGS Gage No. 11208600) (SCE Gage No. 203) ¹
• Kaweah River Conduit No. 2 near Hammond CA (SCE Gage No. 204a) ¹
• Kaweah River Conduit No. 2 at Power Plant near Hammond CA (USGS Gage No. 11208818) (SCE Gage No. 205a) ¹
• Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a) ¹
Ancillary and Support Facilities
• Kaweah No. 1 Powerhouse Campus ¹
• Kaweah No. 2 Wildlife Bridges ¹
• Kaweah No. 2 Wildlife Escape Ramps ¹
• Kaweah No. 2 Footbridges ¹
• Kaweah No. 3 Wildlife Bridges ¹
• Kaweah No. 3 Wildlife Escape Ramps ¹
• Kaweah No. 3 Footbridges ¹

¹Bat roost and reproductive survey location²Acoustic and mist nest survey location

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Table 7.5-7. Special-Status Wildlife Species Known to Occur or Potentially Occurring in the Study Area

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
Known to Occur in the Study Area				
Birds				
<i>Pandion haliaetus</i> osprey	—	WL	Uncommon migratory raptor that builds large perennial nests in dead trees or other prominent supports near open water. Foraging areas include regulated and unregulated rivers, reservoirs, lakes, estuaries, and coastal marine ecosystems.	<ul style="list-style-type: none"> Known to occur in the study area. An individual was observed April 2018 foraging in a pond adjacent to the Kaweah No. 2 Flowline Access Trail – Canal 5 during technical studies conducted in 2018. However, there is no appropriate breeding habitat within the FERC Project boundary. Refer to TERR 2 – TSR for more detailed information about occurrence of this species.
<i>Aquila chrysaetos</i> golden eagle	Eagle Act, BLMS, BCC	CFP, WL (nesting and wintering)	Forages in grasslands and early successional stages of forest and shrub habitats at elevations up to 11,500 feet. Nests on secluded cliffs with overhanging ledges or large trees in open areas with unobstructed view.	<ul style="list-style-type: none"> Known to occur in the study area. A mortality was recorded by SCE in the Kaweah No. 2 Forebay in 1994. An individual was observed flying over Kaweah No. 1 Flowline during reconnaissance surveys conducted in May 2018. Refer to TERR 2 – TSR for more detailed information about occurrence of this species.
<i>Dendroica petechia</i> yellow warbler	BCC	SSC (nesting)	Breeds in riparian woodlands from coastal and desert lowlands at elevations up to 8,000 feet in the Sierra Nevada. Also breeds in montane chaparral, open ponderosa pine, and mixed conifer habitats with substantial amounts of brush.	<ul style="list-style-type: none"> Known to occur in the study area. One singing male was observed near the Kaweah No. 1 Flowline just downstream of the Kaweah No. 1 Diversion Dam during reconnaissance surveys conducted in May 2018. Refer to TERR 2 – TSR for more detailed information about occurrence of this species.
Mammals				
<i>Antrozous pallidus</i> pallid bat	BLMS	SSC	Occurs in grasslands, shrublands, woodlands, and forests from sea level to 10,000 feet in elevation. Typically roosts in caves, crevices, or mines. Requires open habitat for foraging.	<ul style="list-style-type: none"> Known to occur in the study area. Observed during bat surveys conducted for relicensing studies in 2018. Refer to Table TERR 2-8 in the TERR 2 – TSR for specific facilities where this species was observed.
<i>Corynorhinus townsendii</i> Townsend's big-eared bat	BLMS	SSC	Found in all but alpine and subalpine habitats; most abundant in mesic habitats up to 6,000 feet in elevation. Requires caves, mines, tunnels, buildings, or other man-made structures for roosting. Extremely sensitive to disturbance and may abandon a roost if disturbed.	<ul style="list-style-type: none"> Known to occur in the study area. Observed during bat surveys conducted for relicensing studies in 2018. Refer to Table TERR 2-8 in the TERR 2 – TSR for specific facilities where this species was observed. The CNDDDB query yielded one record for this species 2.5 miles northeast of Sycamore Drive at Generals Highway (HWY 198).
<i>Euderma maculatum</i> spotted bat	BLMS	SSC	Ranges from arid deserts and grasslands through mixed conifer forests up to elevations of 10,600 feet in southern California. Prefers sites with adequate roosting habitat, such as cliffs. Often limited by the availability of cliff habitat. Feeds over water and along marshes.	<ul style="list-style-type: none"> Known to occur in the study area. Observed during bat surveys conducted for relicensing studies in 2018. Refer to Table TERR 2-8 in the TERR 2 – TSR for specific facilities where this species was observed.
<i>Lasiurus blossevillii</i> western red bat	—	SSC	Roosts in forests and woodlands from sea level up through mixed mesic conifer forests in coastal ranges and the Sierra Nevada. Forages in a variety of habitats including croplands, grasslands, shrublands, and open woodlands and forests. Prefers solitary roosts in trees and occasionally shrubs.	<ul style="list-style-type: none"> Known to occur in the study area. Observed during bat surveys conducted for relicensing studies in 2018. Refer to Table TERR 2-8 in the TERR 2 – TSR for specific facilities where this species was observed.
<i>Myotis ciliolabrum</i> western small-footed myotis	BLMS	—	Found in a wide variety of habitats, primarily in relatively arid wooded and brushy uplands near water. Elevation range is from 0 to 8,900 feet.	<ul style="list-style-type: none"> Known to occur in the study area. Observed during bat surveys conducted for relicensing studies in 2018. Refer to Table TERR 2-8 in the TERR 2 – TSR for specific facilities where this species was observed.
<i>Myotis evotis</i> long-eared myotis	BLMS	—	Found predominantly in coniferous forests, typically only at higher elevations in southern areas (between 7,000 and 8,500 feet). They roost in tree cavities and beneath exfoliating bark in both living trees and dead snags.	<ul style="list-style-type: none"> Known to occur in the study area. Observed during bat surveys conducted for relicensing studies in 2018. Refer to Table TERR 2-8 in the TERR 2 – TSR for specific facilities where this species was observed.

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Myotis thysanodes</i> fringed myotis	BLMS	—	Optimal habitats are pinyon-juniper, valley foothill hardwood, and hardwood-conifer, generally at 4,000 to 7,000 feet. Roosts in caves, mines, buildings, and crevices. Separate day and night roosts may be used. Uses open habitats, early successional stages, streams, lakes, and ponds as foraging areas. This species is migratory, making relatively short, local movements to suitable hibernacula.	<ul style="list-style-type: none"> Known to occur in the study area. Observed during bat surveys conducted for relicensing studies in 2018. Refer to Table TERR 2-8 in the TERR 2 – TSR for specific facilities where this species was observed.
<i>Myotis yumanensis</i> Yuma myotis	BLMS	—	Occasionally roosting in mines or caves, these bats are most often found in buildings or bridges. Bachelors also sometimes roost in abandoned cliff swallow nests, but tree cavities are probably the original sites for most nursery roosts. These bats typically forage over water in forested areas.	<ul style="list-style-type: none"> Known to occur in the study area. Observed during bat surveys conducted for relicensing studies in 2018. Refer to Table TERR 2-8 in the TERR 2 – TSR for specific facilities where this species was observed.
<i>Eumops perotis californicus</i> western mastiff bat	BLMS	SSC	Found in variety of habitats including desert scrub, chaparral, oak woodland, ponderosa pine, meadows, and mixed conifer forests up to 4,600 feet in elevation. Distribution is likely limited by availability of significant rock features offering suitable roosting habitat.	<ul style="list-style-type: none"> Known to occur in the study area. Observed during bat surveys conducted for relicensing studies in 2018. Refer to Table TERR 2-8 in the TERR 2 – TSR for specific facilities where this species was observed. The CNDDDB query yielded two records for this species adjacent to Project facilities: A 1994 detection approximately 0.5 mile to the north of the Kaweah No. 3 Powerhouse and Switchyard; A 1994 detection approximately 0.5 mile to the south of the Kaweah No. 3 Powerhouse and Switchyard.
<i>Bassariscus astutus</i> ringtail	—	CFP	Found in most forest and shrub habitats in close association with rocky and/or riparian areas, usually not more than 0.6 miles from water. Dens in hollow trees, snags, or other cavities.	<ul style="list-style-type: none"> Known to occur in the study area. Sign was observed incidentally during surveys conducted for relicensing studies in October 2018: Scat found at the Kaweah No. 1 Diversion Dam and Pool (East Fork Kaweah River); Tracks found by the river behind the Kaweah No. 3 Powerhouse and Switchyard. Refer to TERR 2 – TSR for more detailed information about occurrence of this species.
May Potentially Occur in the Study Area				
Reptiles				
<i>Phrynosoma blainvillii</i> coast horned lizard	BLMS	SSC	Occurs in valley foothill hardwood, conifer and riparian habitats, as well as in pine-cypress, juniper, and annual grassland habitats. The elevational range extends up to 4,000 feet in the Sierra Nevada foothills and up to 6,000 feet in the mountains of southern California.	<ul style="list-style-type: none"> May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
<i>Anniella pulchra</i> northern California legless lizard	—	SSC	Occurs in moist warm loose soil with plant cover. Moisture is essential. Occurs in sparsely vegetated areas of beach dunes, chaparral, pine-oak woodlands, desert scrub, sandy washes, and stream terraces with sycamores, cottonwoods, or oaks. Often can be found under surface objects such as rocks, boards, driftwood, leaf litter, and logs. Elevation range is from sea level to 5,900 feet.	<ul style="list-style-type: none"> May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing. The CNDDDB query yielded one record for this species from 1907 with the general location as Kaweah.
<i>Lampropeltis zonata</i> California mountain kingsnake	BLMS	WL	A habitat generalist, found in diverse habitats including coniferous forest, oak-pine woodlands, riparian woodland, chaparral, manzanita, and coastal sage scrub. Wooded areas near a stream with rock outcrops, talus, or rotting logs that are exposed to the sun are good places to find this snake. Elevation range is from 1,500 to 8,000 feet.	<ul style="list-style-type: none"> May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
Birds				
<i>Gymnogyps californianus</i> California condor	FE	SE, CFP	Found mostly below 9,000 feet in open rangelands in the mountain ranges surrounding the southern San Joaquin Valley. Nests in caves, crevices, or sandstone ledges, typically at elevations below 6,500 feet. USFWS has designated critical habitat for this species.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing. • The CNDDDB query yielded one record outside the Study area, which documents a condor roosting area located at Blue Ridge, approximately 4.5 miles to the southwest of the Kaweah No. 2 Powerhouse. Condors typically roost here between April and September. • The closest critical habitat is located along the Kaweah River downstream of the study area, including a portion of Kaweah Lake.
<i>Accipiter gentilis</i> northern goshawk	BLMS	SSC (nesting)	Forages and nests in middle to high elevation, mature, dense conifer forests. Wintering habitat includes foothills, northern deserts in pinyon-juniper woodland, and low elevation riparian habitats.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
<i>Buteo swainsoni</i> Swainson's hawk	BLMS, BCC	ST (nesting)	Uncommon breeding resident and migrant in the Central Valley, Klamath Basin, Northeastern Plateau, Lassen County, and Mojave Desert. Nests in riparian woodlands, juniper-sage flats, and oak woodlands. Forages in grasslands and agricultural areas.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
<i>Circus cyaneus</i> northern harrier	—	SSC (nesting)	Occurs in a variety of habitats at elevations up to 10,000 feet. Forages in open areas such as meadows, wetlands, and grasslands. Breeding habitat is up to 5,700 feet in the Sierra Nevada, in areas with shrubby vegetation near foraging habitat.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
<i>Elanus leucurus</i> white-tailed kite	BLMS	CFP	Prefers coastal and lowland valleys; often associated with farmlands, meadows with emergent vegetation, and grasslands.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
<i>Haliaeetus leucocephalus</i> bald eagle	FD (Former FT, delisted on 7/09/07), Eagle Act, BCC, BLMS	SE, CFP	Year-round resident in ice-free regions of California. Foraging areas include regulated and unregulated rivers, reservoirs, lakes, estuaries, and coastal marine ecosystems. The majority of bald eagles in California breed near reservoirs and nests are usually located within 1 mile of foraging habitat.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing. • This species could potentially forage along the Kaweah River. There is no appropriate breeding habitat within the FERC Project boundary.
<i>Falco peregrinus anatum</i> American peregrine falcon	FD (Former FE, delisted on 8/25/99) (nesting), BCC	SD (Former SE, delisted on 8/6/09), CFP	Very uncommon breeding resident and uncommon as a migrant. Breeds in woodlands, forests, coastal habitats, and riparian areas near wetlands, lakes, rivers, or other water on high cliffs, banks, dunes, or mounds. Active nesting sites are known along the coast, in the Sierra Nevada, and in the mountains of northern California. Migrants occur along the coast and the western Sierra Nevada in spring and fall.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
<i>Asio flammeus</i> short-eared owl	—	SSC (nesting)	Open areas with few trees, such as annual and perennial grasslands, prairies, dunes, meadows, irrigated lands, saline and fresh emergent wetlands. Needs elevated sites for perching and dense vegetation for roosting.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
<i>Athene cunicularia</i> burrowing owl	BLMS, BCC	SSC	Suitable habitat throughout their breeding range typically includes open, treeless areas within grassland, steppe, and desert biomes. They generally inhabit gently-sloping areas, characterized by low, sparse vegetation.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
<i>Strix occidentalis occidentalis</i> California spotted owl	BLMS, BCC	SSC	Nests and forages in dense, old growth, multi-layered mixed conifer, redwood, Douglas-fir, and oak woodland habitats, from sea level to elevations of approximately 7,600 feet.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
<i>Cypseloides niger</i> black swift	BCC	SSC (nesting)	Nests in moist crevices or caves, or on cliffs near waterfalls in deep canyons at elevations ranging from 6,000 to 11,000 feet. Forages widely over many habitats; seems to avoid arid regions. Known from the high elevations of the Sierra National Forest.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing. The CNDDDB query yielded one historic (1935) record for this species outside the Study area along the Marble Fork, approximately 3 miles upstream of the Kaweah No. 3 Powerhouse.
<i>Melanerpes lewis</i> Lewis' woodpecker	BCC	—	Breeds east of the Sierra Nevada crest in cavities excavated in sycamore, cottonwood, oak, or conifer trees. Winter resident in open oak savannas, broken deciduous, and coniferous habitats with a sufficient supply of acorns and insects.	<ul style="list-style-type: none"> • May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Empidonax traillii</i> willow flycatcher	BCC	SE	Summer resident in wet meadow and montane riparian habitats at 2,000 to 8,000 feet in the Sierra Nevada. Most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows.	<ul style="list-style-type: none"> May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing. The Kaweah Project is located outside the breeding range for this species. However, individuals may be present during the non-breeding season.
<i>Empidonax traillii extimus</i> southwestern willow flycatcher	FE	SE (nesting)	Wet meadow and montane riparian habitats at elevations ranging from 2,000 to 8,500 feet in elevation. Most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows. USFWS has designated critical habitat for this species.	<ul style="list-style-type: none"> May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing. The Kaweah Project is located outside the breeding range for this species. However, individuals may be present during the non-breeding season. The closest designated critical habitat is in Kern County.
Mammals				
<i>Pekania pennanti</i> fisher – West Coast DPS	FPT, BLMS	ST, SSC	Found in large areas of mature, dense forest red fir, lodgepole pine, ponderosa pine, mixed conifer, and Jeffery pine forests with snags and greater than 50% canopy closure. Historically known from elevations of sea level to 8,000 feet.	<ul style="list-style-type: none"> May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing and suitable habitat is limited in the study area. The CNDDDB query yielded three historical records for this species in the study area: <ul style="list-style-type: none"> A 1937 circular (non-specific) record in the mountains between the Kaweah River and East Fork Kaweah River, approximately 3.5 miles east of the Kaweah No. 3 Powerhouse; A record from 1968 and is a circular (non-specific) record which covers the Kaweah No. 2 facilities including the powerhouse and the diversion; A 2003 detection at a mesocarnivore photo station, 1 mile south of Oak Grove and the East Fork Kaweah River (approximately 1 mile south of the Kaweah No. 1 diversion). There are seven other CNDDDB records within 5 miles of the study area.
<i>Taxidea taxus</i> American badger	—	SSC	Occurs throughout most of the state in areas with dry, friable soils. It is most abundant in drier open stages of most shrub, forest, and herbaceous habitats up to 12,000 feet in elevation.	<ul style="list-style-type: none"> May potentially occur in appropriate habitat; however, this species was not observed during surveys conducted in support of relicensing.
Unlikely to Occur in the Study Area				
Invertebrates				
<i>Coelus gracilis</i> San Joaquin dune beetle	BLMS	—	This beetle inhabits inland sand dunes along the western edge of the San Joaquin Valley.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
<i>Desmocerus californicus dimorphus</i> valley elderberry longhorn beetle	FT	—	Central valley riparian forests and adjacent upland vegetation along river corridors, in close association with elderberry (<i>Sambucus</i> spp.) plants.	<ul style="list-style-type: none"> Unlikely to occur. Two CNDDDB records exist within the Study Area. However, the study area is outside the geographic range of this species. In 2014, the USFWS revised their description of the life history, population distribution, range, and occupancy. As part of the revised range, several counties were removed from the species' range. The study area is located within Tulare County, which is no longer within the species' range.
Amphibians				
<i>Ambystoma californiense</i> California tiger salamander	FT	ST, WL	Found in grassland, oak savanna, edges of mixed woodland, and lower elevation coniferous forest. The USFWS has designated critical habitat for this species. Critical habitat consists of vernal pools, permanent or ephemeral standing water bodies, as well as upland habitat with small mammal burrows adjacent to the water bodies.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species. The closest critical habitat in Tulare County is northeast of Visalia in the Central Valley. The study area does not meet the Primary Constituent Elements (PCEs) of critical habitat.
<i>Batrachoseps stebbinsi</i> Tehachapi slender salamander	BLMS	ST	Inhabits north-facing moist canyons and ravines in oak and mixed woodlands in arid to semi-arid locations. Found under rocks, logs, bark, and other debris in moist areas, especially in areas with a lot of leaf litter, often near talus slopes. Only recorded from the Tehachapi mountains in Kern County.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Ensatina eschscholtzii</i> <i>croceator</i> yellow-blotched salamander	BLMS	WL	Found in evergreen and deciduous forests, under rocks, logs, and other surface debris, especially bark that has peeled off and fallen beside decaying logs. Shaded north-facing areas seem to be favored, especially near creeks or streams. Subspecies and intergrades only recorded from Kern County.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
Reptiles				
<i>Gambelia (=Crotaphytus) sila</i> blunt-nosed leopard lizard	FE	SE, CFP	Found in sparsely vegetated alkali scrub and desert habitats below 2,400 feet in the San Joaquin Valley and adjacent foothills. USFWS has not designated critical habitat for this species.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
<i>Thamnophis gigas</i> giant garter snake	FT	ST	Uses a wide variety of habitats including forests, mixed woodlands, grasslands, chaparral, and agricultural lands in the Central and San Joaquin Valleys. The species often occurs near aquatic habitat including ponds, marshes, and streams where it freely enters and retreats to when alarmed.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
<i>Thamnophis hammondi</i> two-striped garter snake	BLMS	SSC	Associated with permanent or semi-permanent bodies of water in rocky areas, woodland, shrubland, and coniferous forest from sea level to 8,000 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
Birds				
<i>Pelecanus occidentalis californicus</i> California brown pelican	FD, BLMS	SD, CFP	Brown Pelicans live year-round in estuaries and coastal marine habitats along both the east and west coasts. On the west coast they breed on dry, rocky offshore islands. When not feeding or nesting, they rest on sandbars, pilings, jetties, breakwaters, mangrove islets, and offshore rocks.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
<i>Charadrius montanus</i> mountain plover	BLMS	SSC	Breeds on open plains at moderate elevations in the Intermountain West. Winters in short-grass plains and fields, plowed fields, and sandy deserts in the western United States.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
<i>Laterallus jamaicensis coturniculus</i> California black rail	BLMS, BCC	ST, CFP	Year-round resident of the western slope foothills of the Sierra Nevada range in California. Nests in high portions of salt marshes, shallow freshwater marshes, wet meadows, and flooded grassy vegetation.	<ul style="list-style-type: none"> Unlikely to occur. Study area lacks large freshwater marshes or wet meadow required by this species.
<i>Coccyzus americanus occidentalis</i> western yellow-billed cuckoo	FT, BLMS	SE	Breeds and forages in riparian areas with low woody vegetation in lowland California, especially willow-cottonwood habitat. Critical habitat has been proposed for this species.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species. The closest population is located Southwest of the study area near the town of Lindsay.
<i>Otus flammeolus</i> flamulated owl	BCC	—	Summer resident in coniferous habitats from ponderosa pine to red fir forests from 6,000 to 10,000 feet in elevation; prefers low to intermediate canopy closure. Breeds in the North Coast and Klamath Ranges, Sierra Nevada, and in suitable habitats in mountains of southern California.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.
<i>Strix nebulosa</i> great gray owl	—	SE (nesting)	Nests in old-growth coniferous forests and forages in montane meadows. Distribution includes high elevations of the Sierra Nevada and Cascade ranges, from 4,500 to 7,500 feet in elevation.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.
<i>Stellula calliope</i> calliope hummingbird	BCC	—	Prefers coniferous forests and mountain meadow habitats for breeding. In the Sierra Nevada, it typically nests above 4,000 feet in elevation. Nests almost always in a lodgepole pine or aspen, immediately beneath live branches, and typically in riparian areas. Migrates and spends winter in central and southern Mexico.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.
<i>Sphyrapicus thyroideus</i> Williamson's sapsucker	BCC	—	Uncommon to fairly common summer resident in coniferous forests from approximately 5,500 to 9,500 feet in elevation throughout California. Preferred nesting habitat is lodgepole pine forests.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Contopus borealis</i> olive-sided flycatcher	BCC	SSC (nesting)	Uncommon to common summer resident in a wide variety of forest and woodland habitats. Nesting habitats include mixed conifer, montane hardwood-conifer, Douglas-fir, redwood, red fir, and lodgepole pine forests from 3,000 to 7,000 feet in elevation.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.
<i>Vireo bellii pusillus</i> least Bell's vireo	FE	SE	Breeds in riparian habitats (typically in dense willows) in the southwestern U. S. Winters in Baja California. Its distribution includes cismontane southern California (most breeding pairs occur in San Diego county) extending north up to the Owens Valley and east into Death Valley National Park. USFWS has designated critical habitat for this species.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of the species, and outside of designated critical habitat for this species.
<i>Vireo vicinior</i> gray vireo	BLMS, BCC	SSC	Found in hot, arid mountains and high plains scrubland habitats, including desert scrub, mixed juniper or pinyon pine and oak scrub associations, and chaparral. Found in desert habitats on the eastern slope of the Sierra Nevada and eastern slopes of San Bernardino mountains.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside of the geographic range for this species.
<i>Riparia riparia</i> bank swallow	BLMS	ST	Nests in riparian, lacustrine, and coastal areas with vertical banks, bluffs and cliffs with sandy soils; found in open country near water during migration.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside of the geographic range for this species.
<i>Toxostoma lecontei macmillanorum</i> San Joaquin Le Conte's thrasher	BLMS	SSC	Le Conte's thrashers are generally found in open desert scrub, alkali desert scrub, and desert succulent scrub. In the San Joaquin Valley, the species is found primarily in habitats dominated by saltbush, and often frequents desert washes and flats with scattered saltbush. Elevation range is between sea level and 3,800 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of the species.
<i>Agelaius tricolor</i> tricolored blackbird	BLMS, BCC	SCE, SSC (Nesting colony)	Nests near fresh water, emergent wetland with cattails or tules, and Himalayan blackberry; forages in grasslands, woodland, and agriculture in the Central Valley and coastal ranges.	<ul style="list-style-type: none"> Unlikely to occur. Suitable habitat for this species is not abundant within the study area and the study area is higher in elevation than preferred valley habitats.
<i>Carpodacus cassinii</i> Cassin's finch	BCC	—	A common montane resident from 4,200 to 8,000 feet in elevation. Prefers tall, open coniferous forests, in lodgepole pine, red fir, and subalpine conifer habitats, especially for breeding. Most numerous near wet meadows and grassy openings; also frequents semi-arid forests.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.
Mammals				
<i>Macrotus californicus</i> California leaf-nosed bat	BLMS	SSC	Occupied habitats include desert riparian, desert wash, desert scrub, desert succulent shrub, and alkali desert scrub. Their preferred roosting habitats are caves, mines, and rock shelters near palm oases. In California, they are generally recorded below 2,000 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of the species, and the study area does not contain appropriate habitat.
<i>Aplodontia rufa</i> Sierra Nevada mountain beaver	—	SSC	Dense riparian and open brushy stages of most forest types at elevations ranging from 3,900 to 10,100 feet in elevation. Deep, friable soils are required for burrowing along cool, moist microclimates. Burrows are typically located in or near deep soils near streams and springs. Found in Sierra montane riparian habitats.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.
<i>Ammospermophilus nelson</i> Nelson's antelope squirrel	BLMS	ST	Habitat consists of dry, flat, or rolling terrain with grassy, sparsely shrubby ground; requires soils with sandy or gravelly texture, or fine-grained soils that are nearly brick-hard when dry. They also occur in areas lacking shrubs where giant kangaroo rats are present. The range of this species is restricted to the central and western San Joaquin Valley and neighboring areas to the west in the inner Coast Ranges of California. Elevation range is between 165 to 3,610 feet.	<ul style="list-style-type: none"> Unlikely to occur, The study area is outside of the geographic range for this species.
<i>Dipodomys ingens</i> giant kangaroo rat	FE	SE	Large (6-inch) kangaroo rat that lives in dry, sandy grasslands. It currently is found only in isolated areas west of the San Joaquin Valley, including the Carrizo Plain, Elkhorn Plain, and Kettleman Hills. No critical habitat rules have been published for this species.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the known geographic range of the species.

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Dipodomys nitratooides brevinasus</i> short-nosed kangaroo rat	BLMS	SSC	Short-nosed kangaroo rats generally occupy grassland with scattered shrubs and desert-shrub associations on friable soils. Historically this species occurred on the western, southern, and extreme southeastern side of the San Joaquin Valley. Museum records for this species range from 148-2,411 feet. The current range is approximately 1.5-3.7% of the historic range. Restricted and disjunct populations are known to occur or potentially occur in the following areas (listed from north to south): Panoche and San Joaquin valleys, Kettleman Hills, Antelope and Carrizo plains, and Cuyama Valley.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside of the geographic range for this species.
<i>Dipodomys nitratooides exilis</i> Fresno kangaroo rat	FE	SE	The range of this species encompasses arid grasslands (with friable, sandy soils) in the San Joaquin and adjacent valleys, from the valley floor in Merced County, south of the Merced and San Joaquin rivers, to the southern edge of the valley, and the Panoche Valley (eastern San Benito County), the Carrizo Plain (San Luis Obispo County), and the upper Cuyama Valley (San Luis Obispo and Santa Barbara counties), at elevations of 100 to 2,700 feet. USFWS has designated critical habitat for this species.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of the species. The closest critical habitat designated for this species is in western Fresno County.
<i>Dipodomys nitratooides nitratooides</i> Tipton kangaroo rat	FE	SE	Tipton kangaroo rats are limited to arid-land communities occupying the Valley floor of the Tulare Basin in level or nearly level terrain. They are currently found in scattered, isolated areas clustered in low elevation valleys of Tulare and Kern County. USFWS has not designated critical habitat for this species.	<ul style="list-style-type: none"> Unlikely to occur. The study area is (just) outside the geographic range of the species.
<i>Microtus californicus vallicola</i> Owens Valley vole	BLMS	SSC	Occurs in mesic habitats including riparian corridors and montane riparian, meadows, dense annual grassland, and agricultural lands. This species is limited to the Owen's Valley of California.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range for this species.
<i>Onychomys torridus tularensis</i> Tulare grasshopper mouse	BLMS	SSC	Habitats include compact soils with a sparse growth of perennial grasses; blue oak savannas; desert scrub associations composed of grasses and shrubs; valley sink and saltbush scrub communities on the valley floor; and valley grassland. The historic range of the Tulare grasshopper mouse extended along the foothills and floor of the southern San Joaquin Valley from western Merced and eastern San Benito counties, east to Madera County, and south to the foothills of the Tehachapi and San Emigdio mountains. It also occurs on the Carrizo Plain in eastern San Luis Obispo County, Cuyama Valley, Caliente Creek Wash in southern Kern County, Weldon and Kelso Valley in northeastern Kern County, the Tulare Basin, and the Panoche Valley. Elevation range is between 279 to 2,650 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside of the geographic range for this species.
<i>Perognathus inornatus</i> San Joaquin pocket mouse	BLMS	—	Occurs in dry, open grasslands with fine-textured soils in the Central and Salinas Valleys from elevation 1,000 to 2,000 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside of the geographic range for this species.
<i>Perognathus xanthonotus</i> yellow-eared pocket mouse	BLMS	—	The species is found in Joshua tree woodland, desert scrub, pinyon-juniper, mixed and montane chaparral, sagebrush and bunchgrass habitats. Occurs primarily in sandy soils with sparse to moderate shrub cover. Elevations of known localities range between 3,380 and 5,300 feet.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.
<i>Vulpes macrotis mutica</i> San Joaquin kit fox	FE	ST	Grasslands and shrubland areas in the San Joaquin Valley with friable soils for building underground dens. Denning begins around September, mating occurs from December to March, and pups are born February through April. No critical habitat rules have been published for this species.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species.
<i>Vulpes vulpes necator</i> Sierra Nevada red fox	FC	ST	Occurs throughout the Sierra Nevada in forests interspersed with meadows or alpine forests at elevations above 7,000 feet. Open areas are used for hunting, forested habitats for cover and reproduction.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.

Scientific/ Common Name	Federal Status	State Status	Habitat	Likelihood for Occurrence/Occurrence Notes
<i>Gulo gulo luscus</i> California wolverine	FPT	ST, CFP	Mixed conifer, red fir, and lodgepole habitats, and probably subalpine conifer, alpine dwarf shrub, wet meadow, and montane riparian habitats. Occurs in Sierra Nevada at elevations ranging from 4,300 to 10,800 feet. Majority of recorded sightings are found above 8,000 feet in elevation.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the elevation range of this species.
<i>Ovis canadensis sierrae</i> Sierra Nevada bighorn sheep	FE	SE, CFP	Lives on steep, rugged slopes in the high Sierra Nevada and Great Basin in shrub, grassland, montane chaparral, subalpine conifer, or riparian habitats. The USFWS has designated critical habitat for this species.	<ul style="list-style-type: none"> Unlikely to occur. The study area is outside the geographic range of this species, and outside the designated critical habitat for this species.

LEGEND:

Federal Status

BCC = Birds of Conservation Concern

BLMS = Bureau of Land Management Sensitive (Bakersfield Office)

FC = Federal Candidate

FD = Delisted Species

FE = Federal Endangered

FPD = Federal Proposed for Delisting

FT = Federal Threatened

State Status

CFP = State of California Fully Protected

SCT = State Candidate Threatened

SCE = State Candidate Endangered

SD = State Delisted

SE = State Endangered

SSC = State Species of Special Concern

ST = State Threatened

WL = Watch List

Table 7.5-8. Special-Status Bat Species Known to Occur in the Study Area

Common Name	Scientific Name	Status	Facility Where Bat was Detected ¹
pallid bat	<i>Antrozous pallidus</i>	BLMS, SSC	<ul style="list-style-type: none"> • Kaweah No. 1 Flowline • Kaweah No. 1 Powerhouse and Switchyard • Kaweah No. 1 Powerhouse Campus • East Fork Kaweah River Conduit 1 at Power Plant near Hammond CA (USGS Gage No. 11208800) (SCE Gage No. 200a) • Kaweah No. 2 Powerhouse and Switchyard • Kaweah No. 3 Powerhouse and Switchyard • Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a) • Kaweah No. 1 Diversion Dam and Pool (East Fork Kaweah River) • East Fork Kaweah River near Three Rivers CA (USGS Gage No. 11208730) (SCE Gage No. 201)
Townsend's big-eared bat	<i>Corynorhinus townsendii</i>	BLMS, SSC	<ul style="list-style-type: none"> • Kaweah No. 1 Flowline • Kaweah No. 1 Powerhouse and Switchyard • Kaweah No. 1 Powerhouse Campus • East Fork Kaweah River Conduit 1 at Power Plant near Hammond CA (USGS Gage No. 11208800) (SCE Gage No. 200a) • Kaweah No. 2 Powerhouse and Switchyard • Kaweah No. 3 Powerhouse and Switchyard • Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a) • Kaweah No. 1 Diversion Dam and Pool (East Fork Kaweah River) • East Fork Kaweah River near Three Rivers CA (USGS Gage No. 11208730) (SCE Gage No. 201)

Common Name	Scientific Name	Status	Facility Where Bat was Detected ¹
spotted bat	<i>Euderma maculatum</i>	BLMS, SSC	<ul style="list-style-type: none"> • Kaweah No. 1 Flowline • Kaweah No. 1 Powerhouse and Switchyard • Kaweah No. 1 Powerhouse Campus • East Fork Kaweah River Conduit 1 at Power Plant near Hammond CA (USGS Gage No. 11208800) (SCE Gage No. 200a) • Kaweah No. 2 Powerhouse and Switchyard • Kaweah No. 3 Powerhouse and Switchyard • Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a)
western red bat	<i>Lasiurus blossevillii</i>	SSC	<ul style="list-style-type: none"> • Kaweah No. 1 Flowline • Kaweah No. 3 Powerhouse and Switchyard • Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a)
western small-footed myotis	<i>Myotis ciliolabrum</i>	BLMS	<ul style="list-style-type: none"> • Kaweah No. 3 Powerhouse and Switchyard • Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a)
long-eared myotis	<i>Myotis evotis</i>	BLMS	<ul style="list-style-type: none"> • Kaweah No. 1 Flowline • Kaweah No. 3 Powerhouse and Switchyard • Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a) • Kaweah No. 1 Diversion Dam and Pool (East Fork Kaweah River) • East Fork Kaweah River near Three Rivers CA (USGS Gage No. 11208730) (SCE Gage No. 201)
fringed myotis	<i>Myotis thysanodes</i>	BLMS	<ul style="list-style-type: none"> • Kaweah No. 3 Powerhouse and Switchyard • Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a) • Kaweah No. 1 Diversion Dam and Pool (East Fork Kaweah River) • East Fork Kaweah River near Three Rivers CA (USGS Gage No. 11208730) (SCE Gage No. 201)

Common Name	Scientific Name	Status	Facility Where Bat was Detected ¹
Yuma Myotis	<i>Myotis yumanensis</i>	BLMS	<ul style="list-style-type: none"> • Kaweah No. 1 Flowline • Kaweah No. 1 Powerhouse and Switchyard • Kaweah No. 1 Powerhouse Campus • East Fork Kaweah River Conduit 1 at Power Plant near Hammond CA (USGS Gage No. 11208800) (SCE Gage No. 200a) • Kaweah No. 2 Powerhouse and Switchyard* • Kaweah No. 3 Powerhouse and Switchyard* • Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a) • Kaweah No. 1 Diversion Dam and Pool (East Fork Kaweah River) • East Fork Kaweah River near Three Rivers CA (USGS Gage No. 11208730) (SCE Gage No. 201)
western mastiff bat	<i>Eumops perotis</i>	BLMS, SSC	<ul style="list-style-type: none"> • Kaweah No. 1 Flowline • Kaweah No. 1 Powerhouse and Switchyard • Kaweah No. 1 Powerhouse Campus • East Fork Kaweah River Conduit 1 at Power Plant near Hammond CA (USGS Gage No. 11208800) (SCE Gage No. 200a) • Kaweah No. 2 Powerhouse and Switchyard • Kaweah No. 3 Powerhouse and Switchyard • Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a) • Kaweah No. 1 Diversion Dam and Pool (East Fork Kaweah River) • East Fork Kaweah River near Three Rivers CA (USGS Gage No. 11208730) (SCE Gage No. 201)

Common Name	Scientific Name	Status	Facility Where Bat was Detected ¹
Bat Groups			
California myotis/western small-footed myotis ²	<i>Myotis californicus</i> / <i>Myotis ciliolabrum</i>	BLMS	<ul style="list-style-type: none"> • Kaweah No. 1 Powerhouse Campus* • Kaweah No. 2 Powerhouse and Switchyard*

¹ Some facilities are geographically co-located and therefore acoustic and mist net surveys covered both facility types. The following facilities are geographically co-located: Kaweah No. 1 Powerhouse and Switchyard, Kaweah No. 1 Powerhouse Campus, and East Fork Kaweah River Conduit 1 at Power Plant near Hammond CA (USGS Gage No. 11208800) (SCE Gage No. 200a); Kaweah No. 3 Powerhouse and Switchyard and Middle Fork Kaweah River Conduit No. 3 at Power Plant near Hammond CA (USGS Gage No. 11208565) (SCE Gage No. 206a); Kaweah No. 1 Diversion Dam and Pool and East Fork Kaweah River near Three Rivers CA (USGS Gage No. 11208730) (SCE Gage No. 201).

² Currently, there are no unique genetic markers that can distinguish California myotis/western small-footed myotis species from guano samples. Therefore, these roosts could consist of either or both species.

* Indicates that roost for this species was detected at this location.

Table 7.5-9. Game Species Known to Occur or Potentially Occurring in the Study Area

Species	Habitat	General Season	Bag Limit	Possession Limit	Hunting Restrictions
Resident Game Birds					
wild turkey (<i>Meleagris gallopavo</i>)	<ul style="list-style-type: none"> Found mostly in deciduous riparian, oak, and conifer-oak woodlands. Prefers rugged, hilly terrain with low to intermediate canopy, interspersed with numerous grass/forb openings, near water. 	<ul style="list-style-type: none"> Fall Season – November 8 – December 7 Spring Season – the last Saturday in March extending for 37 consecutive days 	<ul style="list-style-type: none"> Fall Season: 1 either-sex turkey per day. Spring Season: 1 bearded turkey per day 	<ul style="list-style-type: none"> Fall Season: 2 per season Spring Season: 3 per season 	<ul style="list-style-type: none"> Hunting license is required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use of practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than No. 2. On July 1, 2019 nonlead ammunition required.
mountain quail (<i>Oreotyx pictus</i>)	<ul style="list-style-type: none"> Common to uncommon resident, found typically in most major montane habitats of the state. Found seasonally in open, brushy stands of conifer and deciduous forest, woodland, and chaparral. 	<ul style="list-style-type: none"> Zones Q1 and Q3: October 18 – January 25 	<ul style="list-style-type: none"> 10 per day 	<ul style="list-style-type: none"> Triple the daily bag limit 	<ul style="list-style-type: none"> Hunting license is required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use of practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB. On July 1, 2019 nonlead ammunition required.
California quail (<i>Callipepla californica</i>)	<ul style="list-style-type: none"> Common, permanent resident of low and middle elevations. Found in shrub, scrub, and brush, open stages of conifer and deciduous habitats, and margins of grasslands and croplands. 				
ring-necked pheasant (<i>Phasianus colchicus</i>)	<ul style="list-style-type: none"> Common to uncommon introduced species. Occurs in scattered locations throughout the state, centered in the Central Valley. Dependent on croplands with adjacent herbaceous and woody cover; also in perennial grasslands with sufficient cover. 	<ul style="list-style-type: none"> November 8 – December 21 	<ul style="list-style-type: none"> 2 males per day for first two days of the season; 3 males per day after the first two days of the season 	<ul style="list-style-type: none"> Triple the daily bag limit 	<ul style="list-style-type: none"> Hunting license is required. On July 1, 2019 nonlead ammunition required.
sooty grouse (<i>Dendragapus fuliginosus</i>)	<ul style="list-style-type: none"> Uncommon to common permanent resident at middle to high elevations. Occurs in open, medium to mature aged stands of fir, Douglas-fir, and other conifer habitats, interspersed with medium to large openings, and available water. 	<ul style="list-style-type: none"> The second Saturday in September extending for 31 consecutive days 	<ul style="list-style-type: none"> 2 sooty grouse per day 	<ul style="list-style-type: none"> Triple the daily bag limit 	<ul style="list-style-type: none"> Hunting license is required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use of practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB. On July 1, 2019 nonlead ammunition required.
Migratory Game Birds					
mallard (<i>Anas platyrhynchos</i>)	<ul style="list-style-type: none"> Common resident and migrant, found throughout the state in fresh emergent wetlands, estuarine, lacustrine, and riverine habitats, ponds, pastures, croplands, and urban parks. 	<ul style="list-style-type: none"> South San Joaquin Valley Zone: October 20 – January 27 	<ul style="list-style-type: none"> 7 per day, not more than 2 females 	<ul style="list-style-type: none"> Triple the daily bag limit 	<ul style="list-style-type: none"> Hunting license and state duck tag are required. Must use ten-gauge shotgun or smaller, and shot must be nonlead and non-toxic. Electronically-operated calling or sound-reproducing devices are prohibited. No use of practice dogs on birds outside of season. No take of nests or eggs. On July 1, 2019 nonlead ammunition required.
common merganser (<i>Mergus merganser</i>)	<ul style="list-style-type: none"> Uncommon to locally common resident and migrant on lakes, ponds, and large streams of the Coast, Klamath, Cascade, and Sierra Nevada Ranges. 		<ul style="list-style-type: none"> 7 per day 		
American coot (<i>Fulica americana</i>)	<ul style="list-style-type: none"> Common resident throughout most of the state below 7,000 feet in elevation. Found in fresh and saline emergent wetlands, wet grasslands, pastures, lacustrine, estuarine, cropland, and urban habitats. 		<ul style="list-style-type: none"> 25 per day 		

Species	Habitat	General Season	Bag Limit	Possession Limit	Hunting Restrictions
common snipe (<i>Gallinago gallinago</i>)	<ul style="list-style-type: none"> Fairly common winter visitor from October to April on wet meadow and short, emergent wetland habitats throughout much of California. 	<ul style="list-style-type: none"> The third Saturday in October extending for 107 days 	<ul style="list-style-type: none"> 8 per day 	<ul style="list-style-type: none"> Triple the daily bag limit 	<ul style="list-style-type: none"> Hunting license and state duck tag are required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use of practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB. On July 1, 2019 nonlead ammunition required.
band-tailed pigeon (<i>Columba fasciata</i>)	<ul style="list-style-type: none"> Common resident in hardwood and hardwood-conifer habitats. Inhabits lower slopes of major mountain ranges of the state. 	<ul style="list-style-type: none"> The third Saturday in December extending for 9 consecutive days 	<ul style="list-style-type: none"> 2 per day 	<ul style="list-style-type: none"> Triple the daily bag limit 	<ul style="list-style-type: none"> Hunting license and state duck tag are required. No use of motor vehicles to drive birds toward target. No use of mammal (or imitation) as blind. No take of nests or eggs. No use of practice dogs on birds outside of season. Must use ten-gauge shotgun or smaller, and no shot size larger than BB. On July 1, 2019 nonlead ammunition required.
mourning dove (<i>Zenaidura macroura</i>)	<ul style="list-style-type: none"> Open woodlands, grasslands, croplands, open hardwood, hardwood-conifer, riparian, low elevation conifer, and deserts all provide adequate habitat. Requires and nearby water source. 	<ul style="list-style-type: none"> September 1-15 and from the second Saturday in November extending for an additional 45 days 	<ul style="list-style-type: none"> 15 doves, up to 10 may be white winged 	<ul style="list-style-type: none"> Triple the daily bag limit 	<ul style="list-style-type: none"> On July 1, 2019 nonlead ammunition required.
Eurasian-collared Dove (<i>Streptopelia decaocto</i>)	<ul style="list-style-type: none"> Introduced species to California. Found throughout California in urban and suburban settings with access to bird feeders or other seed sources. In agricultural areas they seek open sites where grain is available, including farmyards, fields, and areas around silos. 	<ul style="list-style-type: none"> All year 	<ul style="list-style-type: none"> no limit 	<ul style="list-style-type: none"> no limit 	
Mammals					
desert cottontail (<i>Sylvilagus audubonii</i>)	<ul style="list-style-type: none"> This species is considered resident small game under the California Fish and Wildlife Code. Commonly found in grasslands, open forests, and desert-shrub habitats of southern deserts, Central Valley, and surrounding foothills. 	<ul style="list-style-type: none"> July 1 – January 27 Falconry only (January 28-March 17) 	<ul style="list-style-type: none"> 5 per day 	<ul style="list-style-type: none"> 10 in possession 	<ul style="list-style-type: none"> Hunting license is required. Must use ten-gauge shotgun or smaller, and no shot size larger than BB. On July 1, 2019 nonlead ammunition required.
western gray squirrel (<i>Sciurus griseus</i>)	<ul style="list-style-type: none"> This species is considered resident small game under the California Fish and Wildlife Code. Fairly common locally in mature stands of most conifer, hardwood, and mixed hardwood-conifer habitats in the Klamath, Cascade, Transverse, Peninsular, and Sierra Nevada Ranges. Dependent upon mature stands of mixed conifer and oak habitats. Closely associated with oaks. Requires large trees, mast, and snags. 	<ul style="list-style-type: none"> The second Saturday in September through the last Sunday in January. 	<ul style="list-style-type: none"> 4 per day 	<ul style="list-style-type: none"> 4 in possession 	<ul style="list-style-type: none"> Hunting license is required. Must use ten-gauge shotgun or smaller, and no shot size larger than BB. On July 1, 2019 nonlead ammunition required.
gray fox (<i>Urocyon cinereoargenteus</i>)	<ul style="list-style-type: none"> This species is considered a furbearing mammal under the California Fish and Wildlife Code. Uncommon to common permanent resident of low to middle elevations throughout most of the state. Frequents most shrublands, valley foothill riparian, montane riparian, and brush stages of many deciduous and conifer forest and woodland habitats. Also found in meadows and cropland areas. Suitable habitat consists of shrublands, brushy and open-canopied forests, interspersed with riparian areas, providing water. 	<ul style="list-style-type: none"> November 24 – the last day of February 	<ul style="list-style-type: none"> no limit 	<ul style="list-style-type: none"> no limit 	<ul style="list-style-type: none"> Hunting license is required. May use firearms, bow and arrow, poison under special permit, and approved traps with trapping permit. Dogs permitted. On July 1, 2019 nonlead ammunition required.

Species	Habitat	General Season	Bag Limit	Possession Limit	Hunting Restrictions
black bear (<i>Ursus americanus</i>)	<ul style="list-style-type: none"> This species is considered a big game mammal under the California Fish and Wildlife Code. Widespread, common to uncommon resident occurring from sea level to high mountain regions. Occurs in fairly dense, mature stands of many forest habitats, and feeds in a variety of habitats including brushy stands of forest, valley foothill riparian, and wet meadow. 	<ul style="list-style-type: none"> Opening day of deer season through the last Sunday in December. 	<ul style="list-style-type: none"> 1 adult/season/tag 	<ul style="list-style-type: none"> 1 adult/season/tag 	<ul style="list-style-type: none"> Requires hunting license and hunting tags. May use approved rifles, bow and arrow, and approved shotguns. Cubs and females accompanied by cubs may not be taken. On July 1, 2019 nonlead ammunition required.
American mink (<i>Mustela vison</i>)	<ul style="list-style-type: none"> This species is considered a furbearing mammal under the California Fish and Wildlife Code. Uncommon permanent resident, generally occurring in the northern half of the state. Semiaquatic, inhabiting most aquatic habitats, including some coastal areas. Occurs at elevation up to about 9,000 feet. 	<ul style="list-style-type: none"> November 16 – March 31 	<ul style="list-style-type: none"> no limit 	<ul style="list-style-type: none"> no limit 	<ul style="list-style-type: none"> Hunting license is required. May use firearms, bow and arrow, poison under special permit, and approved traps with trapping permit. Dogs permitted. On July 1, 2019 nonlead ammunition required.
Raccoon (<i>Procyon lotor</i>)	<ul style="list-style-type: none"> This species is considered a furbearing mammal under the California Fish and Wildlife Code. Widespread, common to uncommon permanent resident throughout most of the state. Occurs in all habitats except alpine and desert types without water; marginal in Great Basin shrub types. Most abundant in riparian and wetland areas at low to middle elevations. 	<ul style="list-style-type: none"> November 16 – March 31 	<ul style="list-style-type: none"> no limit 	<ul style="list-style-type: none"> no limit 	<ul style="list-style-type: none"> Hunting license is required. May use firearms, bow and arrow, poison under special permit, and approved traps with trapping permit. Dogs permitted. When taking raccoon after dark, pistols and rifles not large than .22 caliber rimfire and shotguns using shot no larger than BB may be used. On July 1, 2019 nonlead ammunition required.
Bobcat (<i>Lynx rufus</i>)	<ul style="list-style-type: none"> Common throughout the state, except at higher elevations. Abundant at lower elevations in herbaceous and desert-shrub areas and open, early stages of forest and chaparral habitats. 	<ul style="list-style-type: none"> October 15 – February 28 	<ul style="list-style-type: none"> 5 bobcats per season 	<ul style="list-style-type: none"> 5 bobcats per season 	<ul style="list-style-type: none"> Hunting license is required. Bobcat Hunting Tags also required. Dogs are not permitted. It is unlawful to trap any bobcat, or attempt to do so, or sell or export any bobcat from the State of California. Any holder of a trapping license who traps a bobcat shall immediately release the bobcat to the wild unharmed.
Mule deer (<i>Odocoileus hemionus</i>)	<ul style="list-style-type: none"> This species is considered a big game mammal under the California Fish and Wildlife Code. 	<ul style="list-style-type: none"> The season in Zone D-8 shall open on the fourth Saturday in September and extend for 30 consecutive days. 	<ul style="list-style-type: none"> 1 buck/tag 	<ul style="list-style-type: none"> 1 buck/tag 	<ul style="list-style-type: none"> Requires hunting license and hunting tags. May use approved rifles, bow and arrow, approved shotguns, and crossbows. Only bucks with antlers with demonstrable forks (or greater) may be taken. On July 1, 2019 nonlead ammunition required.
Wild pig (<i>Sus scrofa</i>)	<ul style="list-style-type: none"> This species is considered a big game mammal under the California Fish and Wildlife Code. Wild pigs currently exist in 56 of the state's 58 counties and can be found in a variety of habitats ranging from woodland, chaparral, meadow and grasslands. Wild pigs are omnivorous, consuming both plant and animal matter. In general, wild pigs feed on: grasses and forbs in the spring; mast and fruits in the summer and fall; and roots, tubers and invertebrates throughout the year. 	<ul style="list-style-type: none"> All Year 	<ul style="list-style-type: none"> no limit 	<ul style="list-style-type: none"> no limit 	<ul style="list-style-type: none"> Requires a hunting license and a wild pig tag. On July 1, 2019 nonlead ammunition required. Dogs permitted, but only 3 dogs per hunter are allowed.

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Table 7.5-10. Species Observed Using Wildlife Bridges and Escape Ramps During 2018 Monitoring

Species ¹	Number of Observations								Total No. Observations
	Spring				Fall				
	Kaweah No. 2 Flowline		Kaweah No. 3 Flowline		Kaweah No. 2 Flowline		Kaweah No. 3 Flowline		
	Wildlife Bridges	Escape Ramps	Wildlife Bridges	Escape Ramps	Wildlife Bridges	Escape Ramps	Wildlife Bridges	Escape Ramps	
mule deer (<i>Odocoileus hemionus</i>)	93	0	1	0	203	0	2	0	299
gray fox (<i>Urocyon cinereoargenteus</i>)	42	0	0	0	55	0	26	0	123
bobcat (<i>Lynx rufus</i>)	48	0	7	0	30	0	7	0	92
coyote (<i>Canis latrans</i>)	17	0	0	0	65	0	1	0	83
striped skunk (<i>Mephitis mephitis</i>)	5	0	0	0	2	0	12	0	19
cow (<i>Bos taurus</i>)	0	0	3	0	0	0	11	0	14
raccoon (<i>Procyon lotor</i>)	7	0	0	0	4	0	0	0	11
black bear (<i>Ursus americanus</i>)	0	0	1	0	0	0	3	0	4
mountain lion (<i>Puma concolor</i>)	3	0	0	0	0	0	0	0	3
western spotted skunk (<i>Spilogale gracilis</i>)	0	0	0	0	0	0	3	0	3
Virginia opossum (<i>Didelphis virginiana</i>)	0	0	0	0	0	0	1	0	1

¹ Species are listed in order of most commonly observed to least commonly observed species.

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FIGURES

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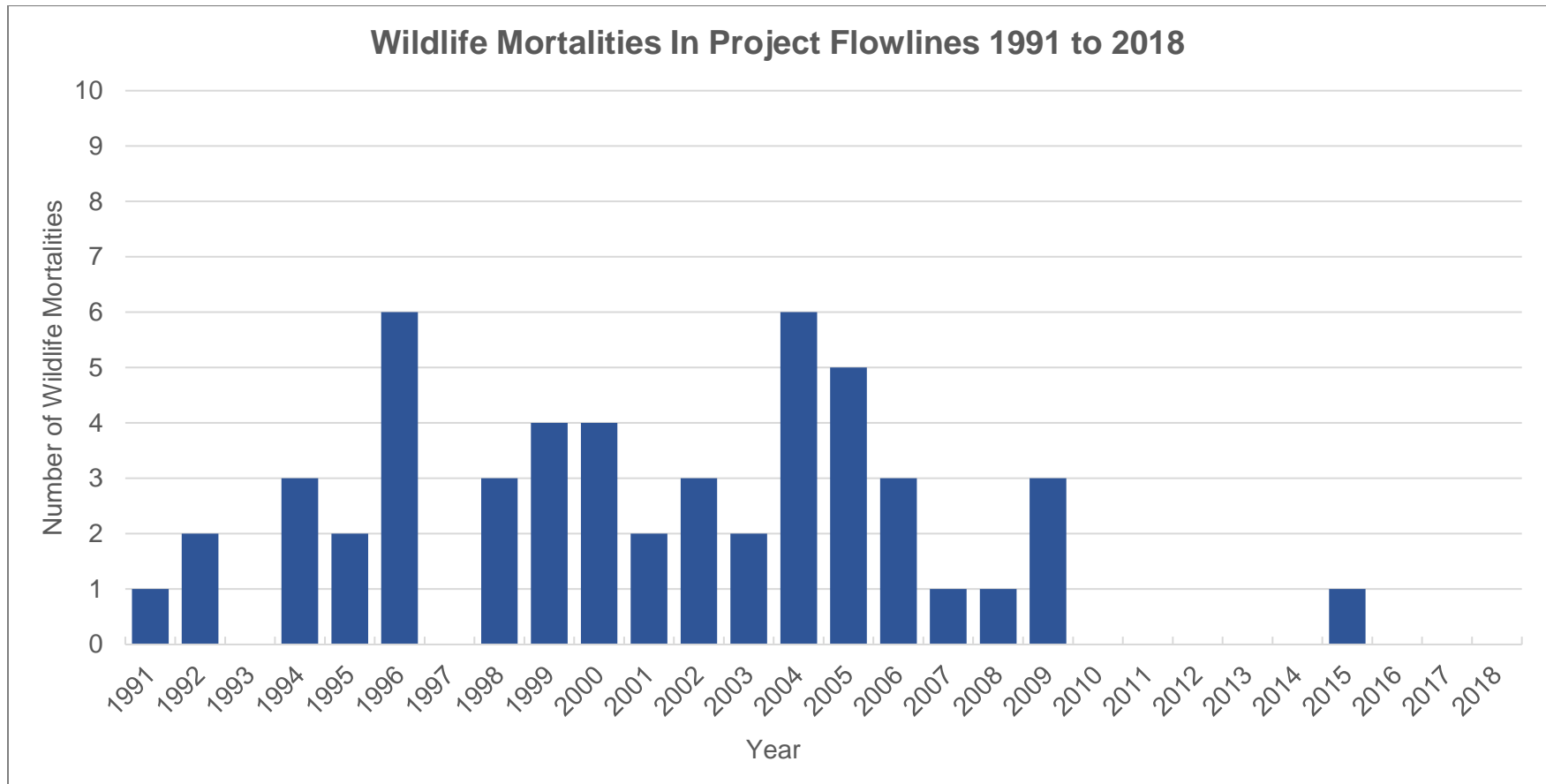


Figure 7.5-1. Wildlife Mortalities in Project Flowlines 1991 to 2018

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MAPS

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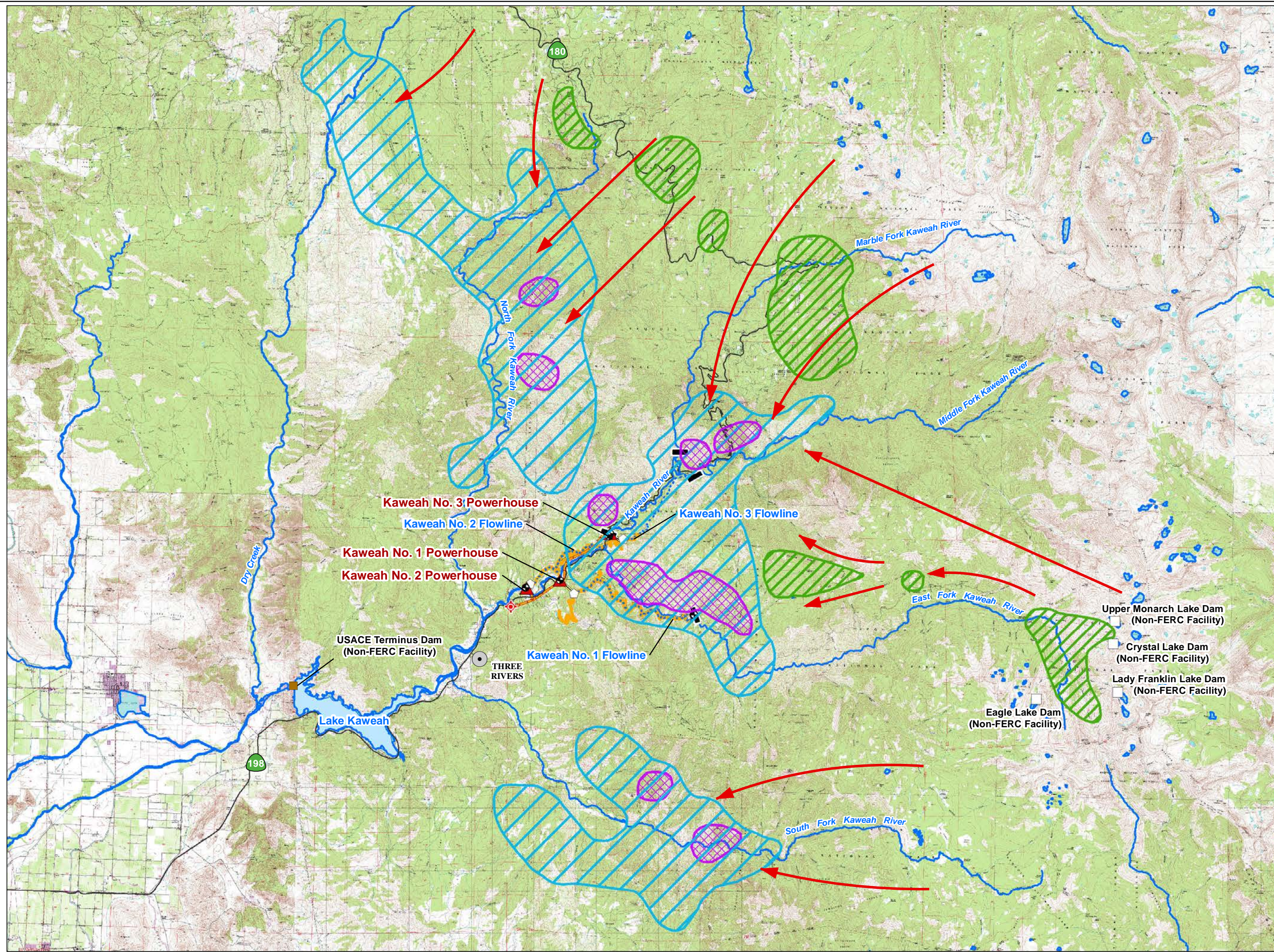
CONFIDENTIAL

The following maps is being withheld from public disclosure in accordance with applicable regulations. These maps contains details on the locations of special-status biological resources and qualifies as Confidential Information [18 CFR §385.1112]. Disclosure of such information could be harmful to these resources. To further understand FERC's regulations regarding confidential filings visit <https://www.ferc.gov/legal/ceii-foia/foia.asp>

- Map 7.5-1 (a-t). CONFIDENTIAL Location of Special-Status Plant and Non-Native Invasive Plant Populations at Kaweah Project Facilities**
- Map 7.5-2. CONFIDENTIAL Special-status Wildlife in the Vicinity of the Kaweah Project**


These maps will not be distributed to the general public. Documents containing Confidential Information may be requested by entities and organizations with jurisdiction over these resources. To request copies, please contact David Moore, SCE Relicensing Project Manager at (626) 302-9494, or david.moore@sce.com.

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- SCE Facilities**
- ▲ Powerhouse
 - Diversion
 - Dam
 - ◆ Utility
 - ◊ Forebay
 - Gage
 - ⋯ Flowline
 - Penstock
 - Transmission Line
 - Project FERC Boundary
- Other Features**
- Dam
 - City/Town
 - Highway/Road
 - Watercourse
 - Water Body
- Mule Deer Data***
- ▨ Important Winter Range
 - ▩ Key Winter Range
 - ▨ Key Areas
 - Migratory Routes

*Source: Southern California Edison Company, November 1989.




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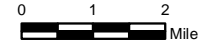
Kaweah Project - FERC Project No. 298

Map 7.5-3

Kaweah Mule Deer Herd Key Areas, Winter Range, and Migratory Routes



Date: 4/25/2019



0 1 2 Miles

Projection: UTM Zone 11
Datum: NAD 83

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LIST OF ACRONYMS

ac-ft	acre-foot/feet
BLM	Bureau of Land Management
CDC	California Department of Conservation
cfs	cubic feet per second
FERC or Commission	Federal Energy Regulatory Commission
msl	mean sea level
NRCS	Natural Resource Conservation Service
Project	Kaweah Project
SCE	Southern California Edison Company
SD	Supporting Document
SNP	Sequoia National Park
TSR	Technical Study Report
USACE	U.S. Army Corps of Engineers
Watershed	Kaweah River Watershed

7.6 GEOLOGY AND SOILS

This section describes the geology and soils in the vicinity of the Kaweah Project (Project). Specifically, this section describes: (1) the geologic setting in the vicinity of the Project, including the bedrock lithology, seismicity, structural features, glacial features, unconsolidated sediments, and mineral resources; (2) the soils in the vicinity of the Project, including factors pertaining to soil movement and erodibility; (3) the shorelines associated with the Project; (4) potential erosion associated with Project operations or maintenance activities, including Southern California Edison Company's (SCE) current Erosion Protection and Remediation Plan; and (5) sediment management practices at Project diversions, flowlines, and forebays. Additional information related to stream condition in the bypass reaches is included in Section 7.7 – Geomorphology.

7.6.1 Information Sources

This section was prepared utilizing existing information available in the following maps and documents:

- Environmental Assessment, Kaweah Project Federal Energy Regulatory Commission (FERC or Commission) Project No. 298-000 (FERC 1991);
- Evaluation of Geologic and Soils Conditions, Kaweah Hydroelectric Project, (Sholes 1989);
- Fault Activity Map of California, California Department of Conservation (CDC) (CDC 2010a);
- Geology of California (Norris R. and Webb, R. 1990);
- Geologic Map of California (CDC 2010b);
- Glacial Reconnaissance of Sequoia National Park (SNP) California (Matthes 1959);
- Limits of Tahoe glaciation in Sequoia and Kings Canyon National Parks, California (Moore and Mack 2008);
- Pre-Application Document for the Kaweah Project (SCE 2016);
- Terminus Reservoir Geology, Paleontology, Flora & Fauna, Archaeology, History (Berryman, et al. 1966);
- U.S. Department of Agriculture – Natural Resource Conservation Service (NRCS) for soils information (NRCS 2019);
- U.S. Army Corps of Engineers (USACE) Kaweah River Investigation (USACE 1996);

- AQ 5 – Geomorphology Technical Study Report (TSR) (SCE 2019a) (AQ 5 – TSR), which is included in Supporting Document A (SD A); and
- LAND 1 – Transportation TSR (SCE 2019b) (LAND 1 – TSR), which is included in SD A.

7.6.2 Geologic Setting

The Project is situated along the western slope of the Sierra Nevada, at elevations ranging from about 2,585 feet above mean sea level (msl) at the Kaweah No. 1 Diversion Dam to 921 feet above msl at the Kaweah No. 2 Powerhouse. The upper Kaweah River Watershed (Watershed) is characterized by steep canyons with narrow “V-shaped” valley bottoms and steep, deeply-incised channels. The lower Watershed is characterized by rolling foothills with wider “U-shaped” valley bottoms and lower gradient and wider channels (floodplains). Topography in the Watershed is shown on Map 7.6-1.

7.6.2.1 Bedrock Lithology

The Watershed primarily consists of mixed Cretaceous (Upper Mesozoic) granites and granodiorites of the Sierra Nevada batholith that intruded coherent older masses of Mesozoic metasedimentary and metavolcanic rocks. Quaternary till and talus and recent alluvium are the principal surficial deposits. A basic geologic time scale is provided in Table 7.6-1 for reference.

As shown on Map 7.6-2, the Cretaceous granites underlying the Project facilities primarily consist of granodiorite. Small bodies of mafic intrusive igneous rocks, mainly gabbro, are also present. The Mesozoic metasedimentary and metavolcanic rocks are expressed as large generally elongated roof pendants, mapped as peridotite. Contacts between the granitic and metamorphic rocks are deeply dipping. The roof pendants trend northwest, reflecting the orientation of bedding and foliation within the metamorphic bodies (Sholes 1989).

The Project facilities are situated on granitic rock. Bedrock outcrops occur in scattered locations; in a few areas, outcrops comprise up to 50% or more of the ground surface. Weathering of the granitic rock is variable; in some areas, the bedrock is completely decomposed to depths of 20 feet or more (FERC 1991).

7.6.2.2 Seismicity

The Project is situated in an area with low historic seismicity. There are no known active faults¹ or fault zones in the immediate vicinity of the Project. In addition, there are no Alquist-Priolo Earthquake Fault Zones² identified in the Project vicinity (CDC 2015).

The nearest known active fault is the Kern Canyon Fault, a northeast-southwest trending fault that extends from the mouth of the Kern River Canyon, through Lake Isabella and Kernville, through the SNP, terminating near Harrison Pass, approximately 32 miles east of the community of Three Rivers. Recent USACE field studies determined that the Kern Canyon Fault is active and capable of producing a 7.5-magnitude earthquake. The last movement on the Kern Canyon Fault appears to have occurred during the past 2,500 to 4,000 years, with an average interval between large earthquakes of about 3,200 years (USACE 2012). A moderate to large earthquake on this fault would likely produce ground shaking in the Project vicinity.

7.6.2.3 Structural Features

There are very few structural features in the vicinity of the Project, primarily because the area is relatively inactive. The most prominent structural features are the roof pendants that occur in the Watershed. These features consist of older rocks stratigraphically positioned on top of younger intrusive rocks.

Massive, rounded, granitic domes that are typical of the Sierra Nevada occur in the Watershed. The most prominent of these is Moro Rock, which is located in the SNP between the Marble and Middle forks of the Kaweah River.

At least four caverns have been formed in the marble and limestone deposits in the Watershed. None are large, but all contain limestone cave features such as stalactites, stalagmites, and pillars (Norris and Webb 1990). The largest and most popular is Crystal Cove near the Giant Forest in the SNP.

7.6.2.4 Glacial Features

The Sierra Nevada was glaciated several times during the Pleistocene Period. Glacial events modified the topography of the Watershed by forming wider, U-shaped valleys, particularly in the upper portions of the Watershed. Glaciers in the Watershed were not extensive and terminated at approximately 6,100 feet, 5,100 feet, and 6,200 feet in the Marble, Middle, and East forks of the Kaweah River, respectively (Moore and Mack 2008).

Glacial deposits (moraines and till) have been mapped in the upper portions of the Watershed. The most prominent glacial deposit is located on the Marble Fork Kaweah

¹ The California Department of Conservation (CDC) defines an "Active Fault Zone" as an area of related faults that have exhibited surface displacement within the last 11,000 years.

² The Alquist-Priolo Earthquake Fault Zoning Act was passed into law following the 1971 San Fernando earthquake. The intent of the Act is to ensure public safety by prohibiting the siting of most structures for human occupancy across traces of active faults that constitute a potential hazard to structures from surface faulting or fault creep.

River upstream of the Marble Fork Diversion Dam, where Highway 198 crosses the river (Map 7.6-2). Erosion of glacial deposits, such as till and moraines tend to contribute gravel-sized sediment to the streambeds downstream.

7.6.2.5 Unconsolidated Sediments

Aside from glacial deposits, unconsolidated sediments in the Watershed are generally limited to surface soils, and recent alluvium deposited in the stream and river courses and associated terraces. As shown on Map 7.6-2, a relatively large deposit of unconsolidated and semi-consolidated Quaternary alluvium is present in the vicinity of Three Rivers, extending along the North Fork Kaweah River and the Kaweah River to the upper end of Lake Kaweah.

7.6.2.6 Mineral Resources

Historic and current mining activity in the Watershed is shown on Map 7.6-3. As indicated, with the exception of one uranium prospect located near the Kaweah No. 1 Diversion Dam, there are no known historic or active mines located within the FERC Project boundary or the immediate vicinity. The only active mine in the vicinity of the Project is a crushed stone mining operation located due south of the community of Three Rivers (Map 7.6-3).

As indicated by the absence of productive mines, mineral resources in the Watershed are relatively limited, which is typical in areas dominated by granitic rock. As shown on Map 7.6-3, a variety of minerals have been identified in the Watershed, but only a few deposits have produced active mines. Deposits of lead were identified on the divide between the North Fork Kaweah River and the Middle Fork Kaweah River, but not in concentrations that could be economically mined. Tungsten was historically mined along the North Fork Kaweah River and the South Fork Kaweah River, southeast of Three Rivers. These northwest-southeast trending lead deposits appear to occur along or near the contact between the younger granitic and older metamorphic rocks (Map 7.6-2).

Silver and galena (a lead ore) were historically mined in the Mineral King Valley, which is located in the SNP at the headwaters of the East Fork Kaweah River, approximately 20 miles southeast of the community of Three Rivers. Silver was first discovered in the Mineral King Valley in 1872. Mining continued between 1873 and 1882, but these operations ceased when the ore was found to be difficult to smelt profitably (SCE 1992a).

Extensive deposits of limestone occur near Three Rivers along the South Fork Kaweah River, and on the Middle, Marble and East forks of the Kaweah River in the SNP. These deposits were mined historically but are not currently active.

7.6.3 Soils

Soils found within 0.5 mile of Project facilities and bypass reaches are shown on Map 7.6-4. Descriptions of each soil shown on the map, including taxonomy, parent rock, vegetation and erodibility (K Factor) are summarized in Table 7.6-2. Table 7.6-3 summarizes the soil types that underlie each Project facility, organized by development. The information is based entirely on detailed soil information developed by the NRCS (NRCS 2015).

In general, the soils shown on Map 7.6-4 can be classified into two categories as follows, based primarily on factors that pertain to the parent material from which the soil is derived:

- Soils formed on granitic bedrock are moderately deep and moderately coarse-grained. These soils are subject to erosion, particularly when devoid of vegetated cover (USACE 1996).
- Soils formed on metamorphic and volcanic bedrock are shallow, well drained, slightly acidic, rocky, and medium-textured. These soils are relatively stable and well vegetated.

As indicated on the map and tables, most of soils within 0.5 mile of the East Fork Kaweah River and within 0.5 mile of the Kaweah River, including the soils underlying the Project facilities, were formed on granitic bedrock, meaning they are moderately deep and moderately coarse-grained and are subject to erosion, particularly when devoid of vegetated cover. The excessively well-drained nature of the soils can make revegetation difficult, especially on steeper slopes. Soils derived from metasedimentary rocks do not occur in the immediate vicinity of the Project or within 0.5 mile of a Project facility, but they do occur downstream near Three Rivers. Minor deposits of alluvium (stream deposits) and colluvium (material moved by gravity) occur at scattered locations throughout the area, primarily within the active stream channels and terraces.

One of the parameters used by the NRCS in assessing the susceptibility of a soil to erosion is the K factor. This factor assesses the susceptibility of the soil to sheet and rill erosion and is dependent upon the percentages of clay, silt, sand, and organic matter in the soil. In general, soils with low K factors are less susceptible to erosion and soils with high K factors are more susceptible to erosion. The K factor for each of the soil types in the vicinity of the Project are provided on Tables 7.6-2 and 7.6-3. As indicated, K values for the soils underlying Project facilities range from 0.15 to 0.37, meaning they have low to moderate susceptibility to erosion when there is minimal vegetative cover. Areas with good vegetative cover would have a lower overall potential for erosion.

7.6.4 Shorelines

This section describes the shorelines associated with the Project, including potential erosion issues. A description of the streambank/channel conditions in the river reaches downstream of the Project diversion dams (bypass reaches) is provided in Section 7.7 – Geomorphology.

The Project under FERC jurisdiction does not have any impoundments/reservoirs. The Project is operated in a run-of-river mode with water diverted from the Kaweah River and East Fork Kaweah River at the Kaweah No. 2 Diversion Dam/Pool and the Kaweah No. 1 Diversion Dam/Pool, respectively. The Kaweah No. 1 Diversion Dam is a 6-foot high overflow concrete gravity dam, with a crest length of 20 feet at an elevation of 2,583 feet. The Kaweah No. 1 Diversion Pool has a design and current capacity of approximately 0.03 acre-feet (ac-ft). The Kaweah No. 2 Diversion Dam is a 7-foot high masonry overflow gravity dam, with an overall crest length of 161 feet at an elevation of 1,365 feet. The Kaweah No. 2 Diversion Pool has a design capacity of approximately 1–2 ac-ft. Over time, this diversion pool has filled in with sediment and it currently has a capacity of approximately 0.2 ac-ft.

The Kaweah No. 1 and Kaweah No. 2 diversion dams/pools are situated in granitic bedrock. Therefore, there is very minimal potential for erosion in the immediate vicinity of the dams or along the perimeters of small pools formed behind the diversion pools. In addition, the bedrock/large boulder channels upstream of the diversion pools have little potential for erosion. The Project also includes three small concrete-lined forebays which are not subject to erosion. A description of each forebay is provided in in Section 3.2.3.

7.6.5 Potential Erosion Associated with Project Operation and Maintenance Activities

The Project facilities are well-maintained and the surrounding landscape is relatively stable. Minimal erosion is present on the slopes surrounding the Project facilities. As discussed in the following subsections, potential erosion issues are primarily limited to: (1) operation and maintenance of the Project flowlines and forebays; and (2) use and maintenance of the Project access roads and trails.

7.6.5.1 Flowlines

The flowlines are narrow and contour the hillsides, so there are limited areas of cut and fill that could be subject to erosion or slope instability (FERC 1991). Runoff from the slopes above the flowlines is directed through culverts and overflow chutes, which helps minimize erosion.

Breaks in the flowlines could potentially cause erosion. Historically, these breaks caused substantial erosion, creating gullies and channels up to 40 feet wide and 10 to 15 feet deep. These channels have since been revegetated by native grasses and scattered brush. In accordance with License Article 401, SCE prepared an Erosion Protection and Remediation Plan in 1992 to address Project-related erosion, including potential erosion from flowline breaks. The plan was subsequently revised and FERC approved the revised plan in an Order issued January 29, 1993. In addition to addressing specific erosion issues that were identified during the previous relicensing effort, the plan includes erosion protection measures that SCE is required to implement in the event of a future flowline break. The plan specified actions that were to be implemented in the event of a break, including shutting off the flow within two hours (Sholes 1989; SCE 1992b).

Implementation of the measures outlined in this plan has substantially reduced the potential for erosion and other forms of instability associated with the Project.

7.6.5.2 Forebays

In the event of an unplanned powerhouse outage (i.e., unit trips), water in the flowlines continues to flow (drain) into the forebays until the diversion is turned out (closed). Water entering the forebay can either be: (1) passed through the generating units at the powerhouse (if operational); (2) released through the powerhouse bypass valve (if present); or (3) released from each forebay/tank via Project spillways/spillway chutes that direct the overflow into natural channels for conveyance to the Kaweah River.

Periodic spills from the forebays (due to powerhouse outages) have occurred into natural channels via the spillways/spillway chutes for decades. These spills generally last for less than a day. A description and the location of the forebay spillways/spillway chutes and associated natural channels are described below and shown on Maps 7.6-5 through 7.6-7.

Kaweah No. 1 Forebay Tank Spillway Flume and Natural Channel

The Kaweah No. 1 Forebay consists of a 24-foot diameter steel tank with a capacity of 0.18 ac-ft. Overflow from the Kaweah No. 1 Forebay Tank is directed through a short spillway flume into a natural channel located adjacent to the penstock (Map 7.6-5). There is also a drain and pipe from the bottom of the tank directed approximately 50 feet downslope adjacent to the penstock. Once in the natural channel, the water travels approximately 0.72 mile downslope before flowing into the Kaweah River just south of the Kaweah No. 1 Powerhouse Campus. This channel is very steep and heavily vegetated. In aerial photographs of the area there is extensive bedrock in the vicinity of the channel and there is no evidence of extensive erosion, rather the channel appears similar to adjacent natural channels on the hillside. Field verification of the upper portion of the channel has not been attempted due to safety concerns. The bottom 0.25 mile of channel, near the river, is dominated by coarse boulders, cobbles, and bedrock and there is no evidence of excessive erosion due spills (Figure 7.6-1a-c).

Kaweah No. 2 Forebay Spillways and Natural Channels

The Kaweah No. 2 Forebay is an enlargement of the Kaweah No. 2 Flowline that extends approximately 180 feet and has a cross section 13-feet wide by 14-feet deep and a capacity of 0.75 ac-ft. At the Kaweah No. 2 Forebay, up to 87 cubic feet per second (cfs) can spill into three concrete-lined spillway chutes, which discharge into natural channels (Map 7.6-6). The primary spillway chute is located adjacent to the forebay and receives spill flows up to 40 cfs. Water from the spillway chute enters a natural channel approximately 0.23-mile long that flows into the Kaweah River. The two smaller natural channels receive water from the smaller spillway chutes and converge approximately 220 feet downslope and then continue downslope to the Kaweah River, discharging approximately 0.16 mile upstream of the Kaweah No. 2 Powerhouse. The upper sections of the three natural channels are very steep, with slopes exceeding 50%. Figure 7.6-2a shows the primary channel with approximately 10 cfs of water.

The three natural channels receiving water from the spillway chutes show evidence of historical incision through the decomposed granite to the underlying granitic bedrock (Figure 7.6-2b). Most of the vertical erosion occurred several decades ago based on the size of the trees currently established along the channel margins. The side slopes of the upper sections of the channels are generally comprised of bedrock or coarse boulders or decomposed granite, with relatively minimal vegetative cover. Some ongoing instability occurs in the upper portion of the primary channel where the decomposed granite/soil horizon overlays the bedrock (Figure 7.6-2c). The other bedrock or large boulder sections are stable (Figure 7.6-2d). The lower portions of the channels are lower gradient and well vegetated, which reduces the erosion potential.

Kaweah No. 3 Forebay Spillway Chute and Natural Channels

The Kaweah No. 3 Forebay is an embankment concrete forebay with a capacity of approximately 11 ac-ft. At Kaweah No. 3 Forebay, up to 97 cfs of flow can spill into an approximate 75-foot long concrete-lined spillway chute that begins at the upstream end of the forebay (Map 7.6-7). The chute discharges into an adjacent natural channel that flows approximately 0.3 mile downslope into the Kaweah River. Spills occur periodically and generally last for less than a day. The channel is very narrow and steep (approximately 38% gradient), and is primarily comprised of large boulders and bedrock and is well vegetated (Figure 7.6-3a-d). The large substrate / bedrock acts as rip-rap and well-vegetated side slopes limit the potential for down cutting and erosion of the side slopes. At the confluence with the Kaweah River, the channel is vegetated, with no large sediment deposits at the margins of the channel. There is no evidence of excessive erosion due spills (Figure 7.6-3e).

There is also a natural channel on the downstream side of the forebay. During sediment removal activities (see below), or other activities where the forebay is drained, water is released from the low-level outlet and enters a short concrete chute. The chute discharges into a natural channel that flows approximately 0.5 mile downslope into the Kaweah River within the SNP (Map 7.6-7). From aerial photographs, the channel is very narrow and steep, well vegetated, and appears to be primarily comprised of large boulders and bedrock. There is no evidence of excessive erosion due spills.

7.6.5.3 Project Roads and Trails

The Project includes various Project roads and trails that are used to access the Project facilities for operation and maintenance purposes. A list of the Project access roads and trails is provided in the Table 3-5.

A detailed assessment of the Project roads and trails, and all associated drainage and erosion control features (e.g., culverts, water bars, and drainage channels) was conducted in 2018 using the methods identified in the LAND 1 – Transportation System TSP. The assessment results are documented in the LAND 1 – TSR, included in SD-A. A characterization of each Project road and trail, including overall length, width, surface treatment, and overall condition is provided in Table LAND 1-3 (included in the LAND 1 – TSR). In addition, detailed descriptions of all of the features that occur along

the Project roads and trails, including erosion control features, are provided in Appendix C of the LAND 1 – TSR.

All of the Project trails and most of the Project roads are unpaved and therefore susceptible to erosion. Erosion of the roads and trails is controlled by directing runoff along the road through drainage features such as ditches or water bars, or under the road via culverts and downdrains. However, erosion of the trail or road surface can occur when the amount of runoff exceeds the capacity of the erosion control features, or when these features are damaged or blocked by debris. In addition, erosion can occur where concentrated runoff has been directed down natural slopes.

To minimize the potential for erosion, SCE regularly inspects the Project access roads and trails, including erosion control features, during normal Project activities, and makes repairs, as necessary. Minor repairs are conducted on an as-needed basis and major repairs are implemented annually in consultation with the appropriate resource agencies. In general, SCE regrades the Project roads and maintains the adjacent ditches annually (FERC 1991).

During the previous relicensing effort, active erosion was identified along specific sections of the Mineral King Road that had the potential to undercut the support legs of the adjacent Kaweah No. 1 Flowline (SCE 1992b; FERC 1999). SCE has since addressed this issue as outlined in the Erosion Protection and Remediation Plan and associated monitoring, which are required by License Articles 401 and 402, respectively (refer to Section 7.6.5.1).

7.6.6 Sediment Management

SCE conducts routine sediment management activities at the following locations:

- Kaweah No. 1 Intake Structure
 - The low-level outlet at the sandbox is routinely opened during high flows to flush sand and gravel into the active stream channel. If larger substrate becomes trapped in the sandbox, it is typically removed and placed back into the active channel during the fall maintenance outage.
- Kaweah No. 1 Forebay Tank
 - A low-level outlet in the forebay tank is routinely opened during normal operations to flush sand and fine sediment from the bottom of the tank into an adjacent natural channel. Any large material remaining in the bottom of the tank is removed during the fall maintenance outage.
- Kaweah No. 2 Diversion Pool/Intake
 - The Kaweah No. 2 Diversion Pool has a design capacity of approximately 1–2 ac-ft. Over time, the diversion pool has filled in with sediment and it currently has a capacity of approximately 0.2 ac-ft. No sediment management activities

have occurred since issuance of the current license other than removal of a small amount of sediment blocking the intake structure.

- Kaweah No. 2 Forebay
 - The forebay has several low-level outlets which are routinely opened during normal operations to flush small accumulation of sand and fine sediment from the bottom of the forebay into natural channels. Any large build-up of material is removed during the fall maintenance outage.
- Kaweah No. 3 Forebay
 - Active sediment removal in the forebay occurs approximately every five years. Heavy equipment is used to remove the sediment. The majority of the sediment removed is composed of sand. Prior to sediment removal, water in the forebay is lowered, first by passing water via the penstock through the Kaweah No. 3 Powerhouse. As the forebay water level approaches the elevation of the intake structure, diversion through the powerhouse is discontinued and the remainder of the water is released through the forebay's low-level outlet. Water released from the low-level outlet enters a short concrete chute. The chute discharges into a natural channel that flows approximately 0.5 mile downslope into the Kaweah River within the SNP (Map 7.6-7). Sediment removal with heavy equipment occurs once the sediment in the bottom of the forebay dries. Most recently, in the summer of 2018, approximately 2,500 cubic yards of sediment was removed from the forebay. The forebay is located on lands managed by the U.S. Bureau of Land Management (BLM). SCE consults with BLM on the disposition of the material prior to initiation of sediment removal activities.

7.6.7 Literature Cited

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TABLES

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Table 7.6-1. Simplified Geologic Time Scale

Eon	Era	Period	Years Before Present (MYA = Million Years Ago)
Phanerozoic (542.0 mya to present)	Cenozoic (65.5 mya to present)	Quaternary	2.6 mya to present
		Holocene	11,700 yrs to present
		Pleistocene	2.588 mya to 11,700 yrs
		Tertiary	65.5 to 2.6 mya
	Mesozoic (251.0 to 65.5 mya)	Cretaceous	145.5 to 65.5 mya
		Jurassic	199.6 to 145.5 mya
		Triassic	251.0 to 199.6 mya
	Paleozoic (542.0 to 251.0 mya)	Permian	299.0 to 251.0 mya
		Carboniferous	359.2 to 299.0 mya
		Devonian	416.0 to 359.2 mya
		Silurian	443.7 to 416.0 mya
		Ordovician	488.3 to 443.7 mya
		Cambrian	542.0 to 488.3 mya
	Precambrian		

Source: Adapted from Geologic Time Scale, University of California Museum of Paleontology (<http://www.ucmp.berkeley.edu/help/timeform.php>).

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Table 7.6-2. Description of Soils Within 0.5 Mile of the Kaweah Project Facilities, Organized by Soil Code

Code (Corresponds to Map 7.6-4)	Association	Soil Description	Slope	Taxonomy	Parent Rock	Erosion K Factor ¹	Vegetation
102	Auberry sandy loam	deep, well drained soils that formed in material weathered from intrusive, acid igneous rocks	15 to 30% slope	Fine-loamy, mixed, semiactive, thermic Ultic Haploxeralfs	intrusive acid igneous rocks, principally quartz diorite or grandiorite	0.24	woodland grass, annual grasses and forbes, and brush
103	Auberry sandy loam	deep, well drained soils that formed in material weathered from intrusive, acid igneous rocks	30 to 50% slope	Fine-loamy, mixed, semiactive, thermic Ultic Haploxeralfs	intrusive acid igneous rocks, principally quartz diorite or grandiorite	0.24	woodland grass, annual grasses and forbes, and brush
105	Blasingame sandy loam	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	9 to 15% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	gabrodiorite and other basic igneous rocks	0.24	annual grasses and forbs with some shrubs and blue oak trees
106	Blasingame sandy loam	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	15 to 30% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	gabrodiorite and other basic igneous rocks	0.24	annual grasses and forbs with some shrubs and blue oak trees
107	Blasingame sandy loam	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	30 to 50% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	gabrodiorite and other basic igneous rocks	0.24	annual grasses and forbs with some shrubs and blue oak trees
108	Blasingame rock outcrop complex	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	9 to 50% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	gabrodiorite and other basic igneous rocks	0.24	annual grasses and forbs with some shrubs and blue oak trees
116	Cieneba-Rock	very shallow and shallow, somewhat excessively drained soils that formed in material weathered from granitic rock	15 to 75% slope	Loamy, mixed, superactive, nonacid, thermic, shallow Typic Xerorthents	granite and other rocks of similar texture and composition	0.24	chaparral and chemise with widely spread foothill pine or oak tree, small area of thin annual grasses and weeds
118	Coarsegold loam	moderately deep, well drained soils that formed from weathered schist	15 to 30% slope	Fine-loamy, mixed, superactive, thermic Mollic Haploxeralfs	metasedimentary rocks of mica schist, quartz, gneiss or quartzite	0.28	chaparral composed of chamise, scrub oak, birchleaf mountain mahogany, eastern manzanita, cupleaf ceanothus, and yucca Open Area: ground cover of cheatgrass, wild oats and other annual grasses and weeds
119	Coarsegold loam	moderately deep, well drained soils that formed from weathered schist	30 to 50% slope	Fine-loamy, mixed, superactive, thermic Mollic Haploxeralfs	metasedimentary rocks of mica schist, quartz, gneiss or quartzite	0.28	chaparral composed of chamise, scrub oak, birchleaf mountain mahogany, eastern manzanita, cupleaf ceanothus, and yucca Open Area: ground cover of cheatgrass, wild oats and other annual grasses and weeds
123	Crouch-Rock outcrop complex	deep, well drained soils that formed in material weathered from granitic rock	15 to 50% slope	Coarse-loamy, mixed, superactive, mesic Ultic Haploxerolls	igneous (granitic) rocks	-	annual grasses and forbs with open stands of timber at higher elevations
128	Fallbrook sandy loam	deep, well drained soils that formed in material weathered from granitic rocks	30 to 50% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	material weathered from granite and closely related granitic rocks	0.28	annual grasses and forbs with considerable chaparral, chamise, flattop buckwheat and other shrubs
130	Friant-Rock outcrop complex	shallow, well drained soils that formed in material weathered from mica schist, quartz schist and gneiss	15 to 75% slope	Loamy, mixed, superactive, thermic Lithic Haploxerolls	residuum weathered from mica schist, quartz schist, and gneiss	0.28	buckwheat, chaparral, and naturalized grasses and forbs

Code (Corresponds to Map 7.6-4)	Association	Soil Description	Slope	Taxonomy	Parent Rock	Erosion K Factor ¹	Vegetation
136	Holland loam	very deep, well drained soils that formed in material weathered from granitic rock	15 to 30% slope	Fine-loamy, mixed, semiactive, mesic Ultic Haploxeralfs	granitic rocks	0.24	semi-dense stands of ponderosa pine and incense cedar with some white fir, sugar pine, black or canyon live oak with an understory of bear clover and manzanita
137	Holland loam	very deep, well drained soils that formed in material weathered from granitic rock	30 to 50% slope	Fine-loamy, mixed, semiactive, mesic Ultic Haploxeralfs	granitic rocks	0.24	semi-dense stands of ponderosa pine and incense cedar with some white fir, sugar pine, black or canyon live oak with an understory of bear clover and manzanita
138	Holland-Rock outcrop complex	very deep, well drained soils that formed in material weathered from granitic rock	15 to 50% slope	Fine-loamy, mixed, semiactive, mesic Ultic Haploxeralfs	granitic rocks		semi-dense stands of ponderosa pine and incense cedar with some white fir, sugar pine, black or canyon live oak with an understory of bear clover and manzanita
140	Honcut sandy loam	very deep, well drained soils that formed in moderately coarse textured alluvium from basic igneous and granitic rocks	2 to 5% slope	Coarse-loamy, mixed, superactive, nonacid, thermic Typic Xerorthents	alluvium dominantly from basic rocks but are derived from acid igneous rocks in some places	0.2	open parklike areas of annual grasses, herbs and scattered oaks
142	Las Posas loam	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	15 to 30% slope	Fine, smectitic, thermic Typic Rhodoxeralfs	material weathered from basic igneous rocks	0.37	annual grasses, forbs, and broadleaf chaparral
143	Las Posas loam	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	30 to 50% slope	Fine, smectitic, thermic Typic Rhodoxeralfs	material weathered from basic igneous rocks	0.37	annual grasses, forbs, and broadleaf chaparral
151	Riverwash	-	-	-	-	-	-
152	Rock outcrop	-	-	-	-	-	-
160	Sheephead-Rock outcrop complex	shallow, somewhat excessively drained soils that formed in material weathered from mica, schist, gneiss, or granite	15 to 75% slope	Loamy, mixed, superactive, mesic, shallow Entic Ultic Haploxerolls	material weathered from granitic rocks	0.17	mainly chaparral but in the lower rainfall area it is scrub oak, pinyon pine, and digger pine
164	Tujunga sand	very deep, somewhat excessively drained soils that formed in alluvium from granitic sources		Mixed, thermic Typic Xeropsammets	alluvium weathered from granitic sources or similar	0.02	Uncultivated areas have a cover of shrubs, annual grasses, and forbs. In urban areas ornamentals and turf-grass are common
165	Vista coarse sandy loam	moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks	9 to 15% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerepts	material weathered from decomposed granite and other closely related rocks	0.15	annual grasses and forbs and such shrubs as California sagebrush, scrub oak, lilac, chamise, sumac, and flattop buckwheat
166	Vista coarse sandy loam	moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks	15 to 30% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerepts	material weathered from decomposed granite and other closely related rocks	0.15	annual grasses and forbs and such shrubs as California sagebrush, scrub oak, lilac, chamise, sumac, and flattop buckwheat
167	Vista coarse sandy loam	moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks	30 to 50% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerepts	material weathered from decomposed granite and other closely related rocks	0.15	annual grasses and forbs and such shrubs as California sagebrush, scrub oak, lilac, chamise, sumac, and flattop buckwheat

Code (Corresponds to Map 7.6-4)	Association	Soil Description	Slope	Taxonomy	Parent Rock	Erosion K Factor ¹	Vegetation
168	Vista-Rock outcrop complex	moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks, 9 to 15% slope	9 to 50% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerepts	material weathered from decomposed granite and other closely related rocks	0.15	annual grasses and forbs and such shrubs as California sagebrush, scrub oak, lilac, chamise, sumac, and flattop buckwheat
169	Walong sandy loam	moderately deep, well drained soils that formed in material weathered from granitic rocks	15 to 30% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerolls	material weathered from granite	0.2	annual grasses, blue oaks, and live oaks
171	Walong-Rock outcrop complex	moderately deep, well drained soils that formed in material weathered from granitic rocks	15 to 50% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerolls	material weathered from granite	0.15	annual grasses, blue oaks, and live oaks
173	Wyman loam	deep, well drained soils that formed in alluvium from andesitic and basaltic rocks	2 to 5% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	alluvium originating from andesitic and basaltic rocks	0.37	annual grasses and herbs with a few scattered oaks
175	Xerofluvents	-	-	-	-	-	-
178	Water	-	-	-	-	-	-

Source: USDA NRCS Official Soil Series Descriptions (OSDs) (NRCS 2019)

¹ The K factor assesses the susceptibility of soil to sheet and rill erosion and is dependent upon the percentages of clay, silt, sand, and organic matter in the soil. In general, soils with low K factors are less susceptible to erosion and soils with high K factors are more susceptible to erosion.

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Table 7.6-3. Description of Soils Underlying the Kaweah Project Facilities, Organized by Development

Project Facility	Code (Corresponds to Map 7.6-4)	Association	Soil Description	Slope	Taxonomy	Parent Rock	Erosion K Factor ¹	Vegetation
Kaweah No. 1 Development								
Kaweah No 1 Diversion Dam Kaweah No. 1 Flowline	128	Fallbrook sandy loam	deep, well drained soils that formed in material weathered from granitic rocks	30 to 50% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	material weathered from granite and closely related granitic rocks	0.28	annual grasses and forbs with considerable chaparral, chamise, flattop buckwheat and other shrubs
Kaweah No. 1 Flowline	152	Rock outcrop	-	-	-	-	-	-
Kaweah No. 1 Flowline Kaweah No. 1 Forebay Tank Kaweah No. 1 Penstock Kaweah No. 1 Powerhouse	171	Walong-Rock outcrop complex	moderately deep, well drained soils that formed in material weathered from granitic rocks	15 to 50% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerolls	material weathered from granite	0.15	annual grasses, blue oaks, and live oaks
Kaweah No. 2 Development								
Kaweah No. 2 Diversion Dam	107	Blasingame sandy loam	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	30 to 50% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	gabbrodiorite and other basic igneous rocks	0.24	annual grasses and forbs with some shrubs and blue oak trees
Kaweah No. 2 Powerhouse	108	Blasingame rock outcrop complex	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	9 to 50% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	gabbrodiorite and other basic igneous rocks	0.24	annual grasses and forbs with some shrubs and blue oak trees
Kaweah No. 2 Flowline	116	Cieneba-Rock	very shallow and shallow, somewhat excessively drained soils that formed in material weathered from granitic rock	15 to 75% slope	Loamy, mixed, superactive, nonacid, thermic, shallow Typic Xerorthents	granite and other rocks of similar texture and composition	0.24	chaparral and chemise with widely spread foothill pine or oak tree, small area of thin annual grasses and weeds
Kaweah No. 2 Flowline	166	Vista coarse sandy loam	moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks	15 to 30% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerepts	material weathered from decomposed granite and other closely related rocks	0.15	annual grasses and forbs and such shrubs as California sagebrush, scrub oak, lilac, chamise, sumac, and flattop buckwheat
Kaweah No. 2 Flowline Kaweah No. 2 Forebay Kaweah No. 2 Powerhouse	168	Vista-Rock outcrop complex	moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks	9 to 50% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerepts	material weathered from decomposed granite and other closely related rocks	0.15	annual grasses and forbs and such shrubs as California sagebrush, scrub oak, lilac, chamise, sumac, and flattop buckwheat
Kaweah No. 3 Development								
Kaweah No. 3 Flowline Kaweah No. 3 Forebay	160	Sheephead-Rock outcrop complex	shallow, somewhat excessively drained soils that formed in material weathered from mica, schist, gneiss, or granite	15 to 75% slope	Loamy, mixed, superactive, mesic, shallow Entic Ultic Haploxerolls	material weathered from granitic rocks	0.17	mainly chaparral but in the lower rainfall area it is scrub oak, pinyon pine, and digger pine
Kaweah No. 3 Powerhouse	107	Blasingame sandy loam	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	30 to 50% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	gabbrodiorite and other basic igneous rocks	0.24	annual grasses and forbs with some shrubs and blue oak trees

Project Facility	Code (Corresponds to Map 7.6-4)	Association	Soil Description	Slope	Taxonomy	Parent Rock	Erosion K Factor ¹	Vegetation
Transmission Line								
Transmission Line	108	Blasingame rock outcrop complex	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	9 to 50% slope	Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs	gabbrodiorite and other basic igneous rocks	0.24	annual grasses and forbs with some shrubs and blue oak trees
Transmission Line	116	Cieneba-Rock	very shallow and shallow, somewhat excessively drained soils that formed in material weathered from granitic rock	15 to 75% slope	Loamy, mixed, superactive, nonacid, thermic, shallow Typic Xerorthents	granite and other rocks of similar texture and composition	0.24	chaparral and chemise with widely spread foothill pine or oak tree, small area of thin annual grasses and weeds
Transmission Line	143	Las Posas loam	moderately deep, well drained soils that formed in material weathered from basic igneous rocks	30 to 50% slope	Fine, smectitic, thermic Typic Rhodoxeralfs	material weathered from basic igneous rocks	0.37	annual grasses, forbs, and broadleaf chaparral
Transmission Line	166	Vista coarse sandy loam	moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks	15 to 30% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerepts	material weathered from decomposed granite and other closely related rocks	0.15	annual grasses and forbs and such shrubs as California sagebrush, scrub oak, lilac, chamise, sumac, and flattop buckwheat
Transmission Line	168	Vista-Rock outcrop complex	moderately deep, well drained soils that formed in material weathered from decomposed granitic rocks	9 to 50% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerepts	material weathered from decomposed granite and other closely related rocks	0.15	annual grasses and forbs and such shrubs as California sagebrush, scrub oak, lilac, chamise, sumac, and flattop buckwheat
Transmission Line	171	Walong-Rock outcrop complex	moderately deep, well drained soils that formed in material weathered from granitic rock	15 to 50% slope	Coarse-loamy, mixed, superactive, thermic Typic Haploxerolls	material weathered from granite	0.2	annual grasses, blue oaks, and live oaks

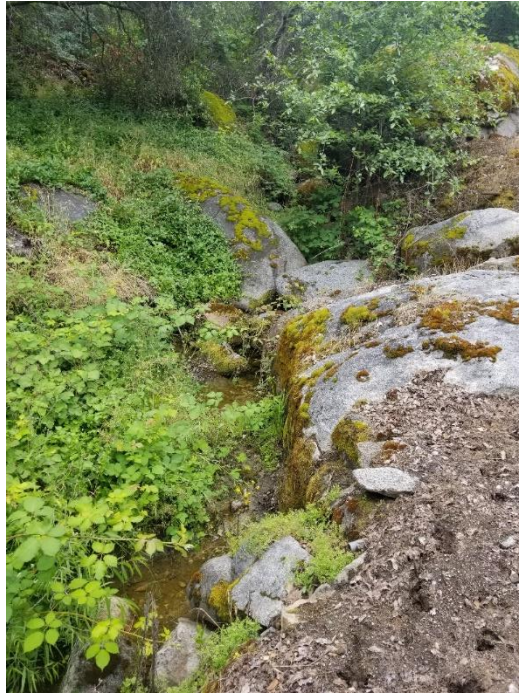
Source: USDA NRCS Official Soil Series Descriptions (OSDs) (NRCS 2019)

¹ The K factor assesses the susceptibility of soil to sheet and rill erosion and is dependent upon the percentages of clay, silt, sand, and organic matter in the soil. In general, soils with low K factors are less susceptible to erosion and soils with high K factors are more susceptible to erosion.

FIGURES

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Figure 7.6-1a-c. Representative Photographs of the Natural Channels Associated with the Kaweah No. 1 Forebay



(a) Representative photograph of the portion of the Kaweah No. 1 natural channel upstream of the Kaweah No. 1 Powerhouse.

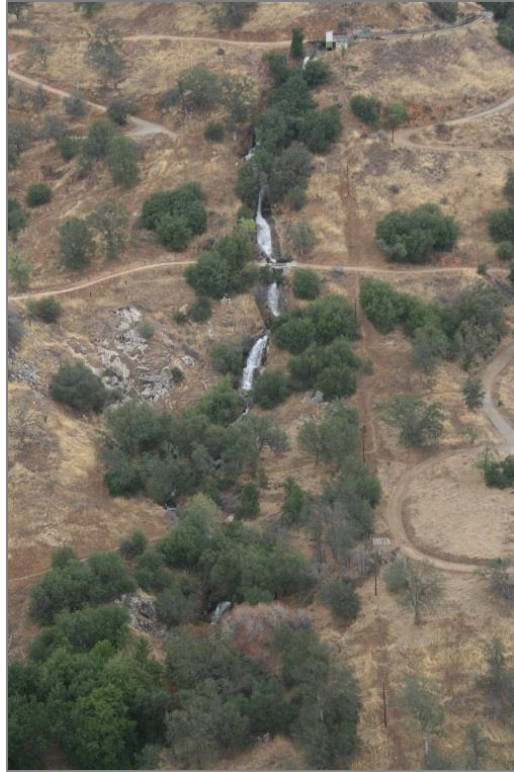


(b) Representative section of the Kaweah No. 1 natural channel, illustrating the steep, bedrock/boulder nature of this channel.



(c) Representative section of the Kaweah No. 1 natural channel just west of the Kaweah No. 1 Powerhouse and immediately upstream of its confluence with the Kaweah River.

Figure 7.6-2a-d. Representative Photographs of the Natural Channels Associated with the Kaweah No. 2 Forebay



(a) View of the Kaweah No. 2 spillway and natural channel (#1, primary) (flow is approximately 10 cfs).



(b) Representative photograph of a down cut section in the Kaweah No. 2 natural channel (#1, primary).



(c) Recent erosion on the side slope of the Kaweah No. 2 natural channel (#1, primary), near the top of the channel.



(d) Representative photograph of a stable section of the Kaweah No. 2 natural channel (#2).

Figure 7.6-3a-e. Representative Photographs of the Natural Channels Associated with the Kaweah No. 3 Forebay



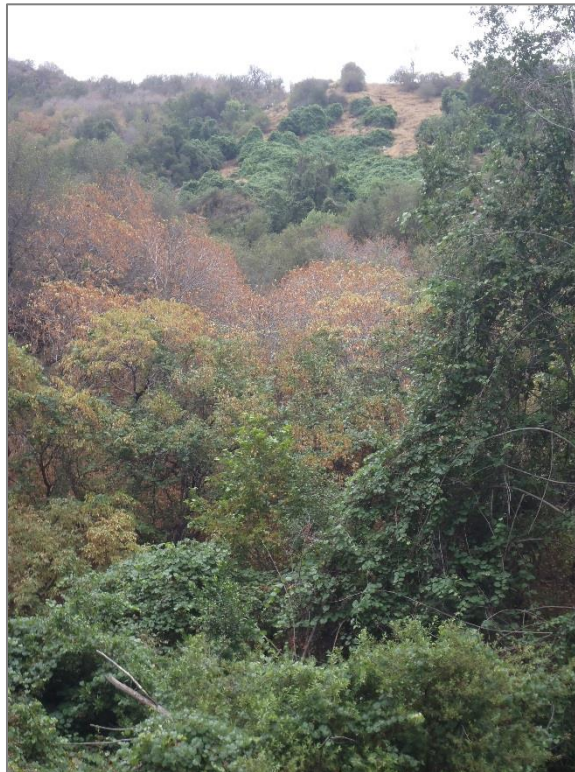
(a) Representative photograph of the upper portion of the Kaweah No. 3 natural channel, showing the end of the spill chute.



(b) Representative section of the Kaweah No. 3 natural channel, illustrating the steep, bedrock/boulder nature of this channel.



(c) Representative section of the Kaweah No. 3 natural channel showing boulders along the side slopes of the channel.



(d) View of the Kaweah No. 3 natural channel from the bottom.

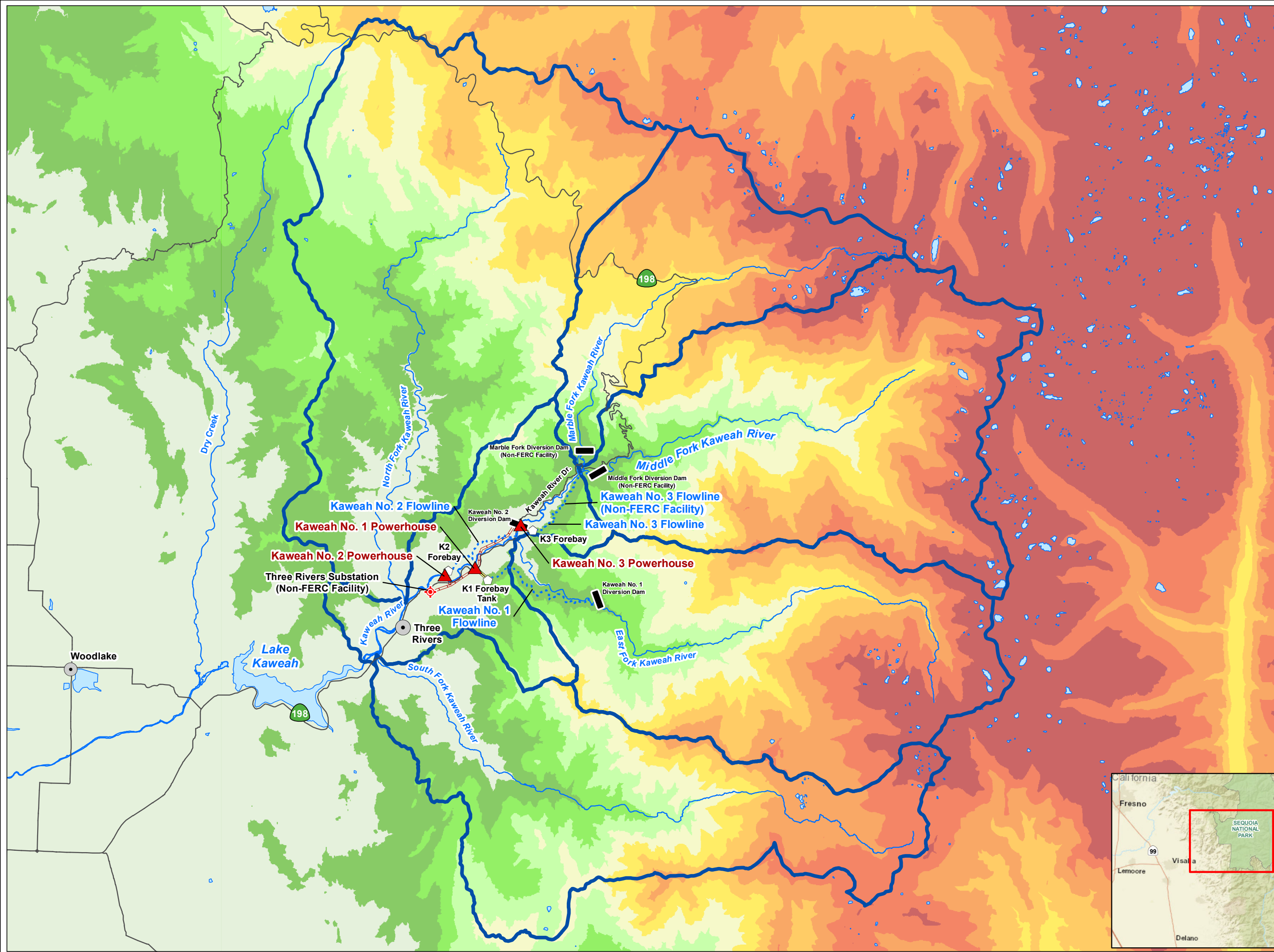


(e) Outlet of the Kaweah No. 3 natural channel at the Kaweah River.

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MAPS

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- SCE Facilities**
- Powerhouse
 - Diversion
 - Utility
 - Forebay
 - Flowline
 - Penstock
 - Transmission Line
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
 - Watershed Boundary

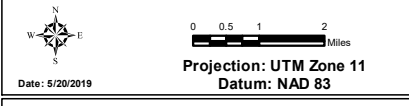
- Elevations**
- <2000'
 - 2000'-3000'
 - 3000'-4000'
 - 4000'-5000'
 - 5000'-6000'
 - 6000'-7000'
 - 7000'-8000'
 - 8000'-9000'
 - 9000'-10,000'
 - >10,000'



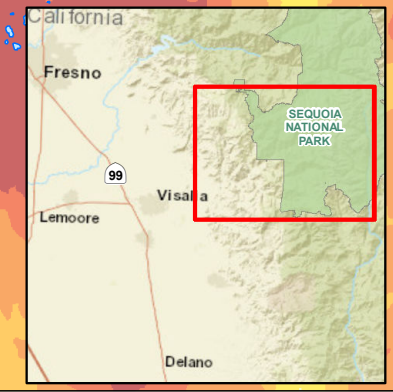
Kaweah Project - FERC Project No. 298

Map 7.6-1

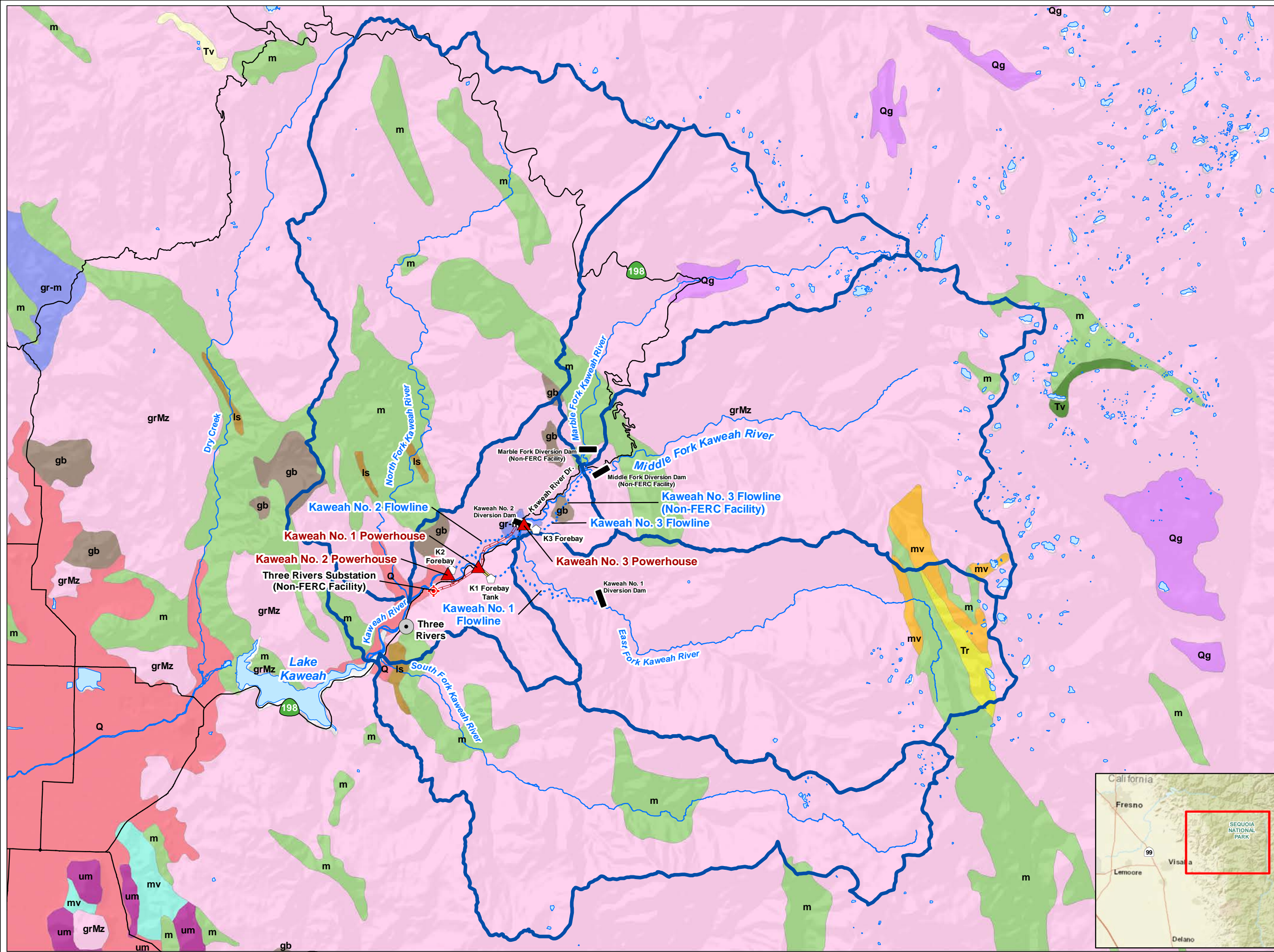
Topography in the Kaweah River Watershed



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 - Utility
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 - Flowline
 - Penstock
 - Transmission Line
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
 - Watershed Boundary
- Geologic Rock Types***
- Cenozoic**
- Q alluvium
 - Qg glacial drift
 - Tr sandstone
 - Tv rhyolite
 - Tv tephrite (basanite)
- Mesozoic**
- grMz granodiorite
 - gb gabbro
 - gr-m plutonic rock (phaneritic)
 - ls limestone
 - m peridotite
- Paleozoic**
- mv schist
 - mv basalt
 - um intermediate volcanic rock

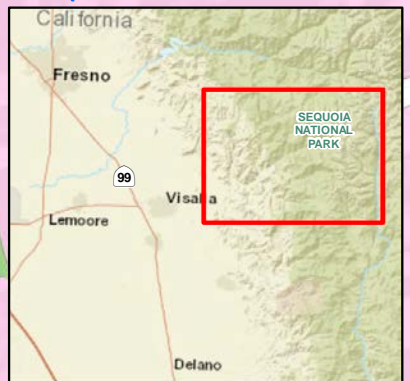
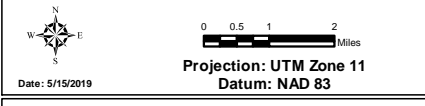
*Source: California Geologic Survey Data, 2005



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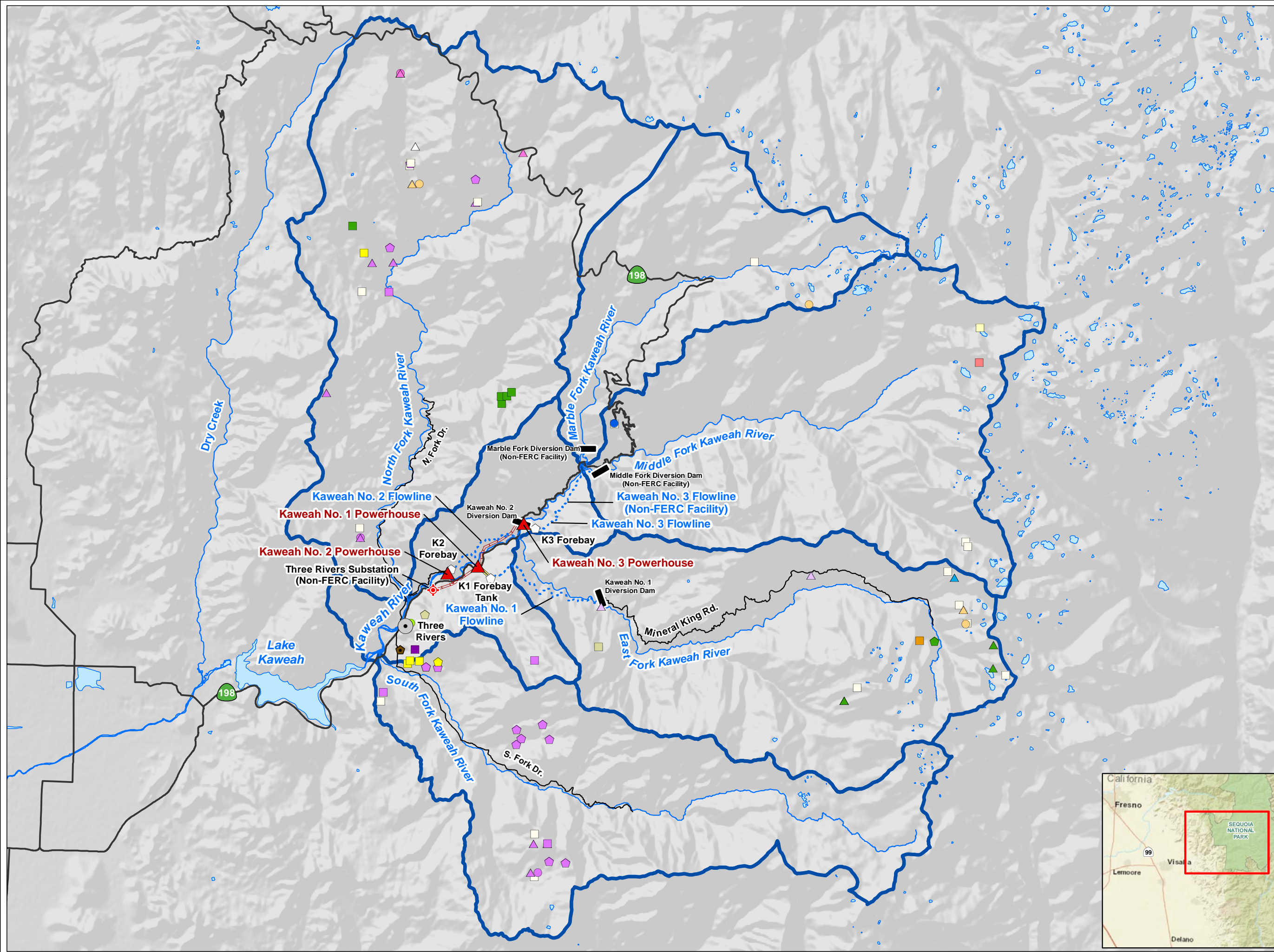
Map 7.6-2

Geologic Formations in the Kaweah River Watershed



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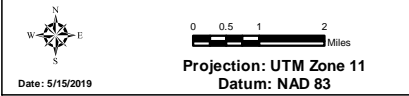
- SCE Facilities**
- ▲ Powerhouse
 - Diversion
 - ⬢ Utility
 - ◻ Forebay
 - ⋯ Flowline
 - Penstock
 - Transmission Line
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body
 - ▭ Watershed Boundary
- Mining**
- Material Mined**
- ◻ Unknown
 - Calcium
 - Copper
 - Feldspar
 - Gold
 - Lead
 - Lead, Zinc, Silver
 - Limestone, General
 - Mercury
 - Molybdenum
 - Molybdenum, Tungsten
 - Sand and Gravel, Construction
 - Stone, Crushed/Broken
 - Tungsten
 - Tungsten, Molybdenum
 - Uranium
 - Zinc
- Mine Status**
- ◻ Occurrence
 - ◻ Past Producer
 - ◻ Producer
 - △ Prospect
 - Unknown



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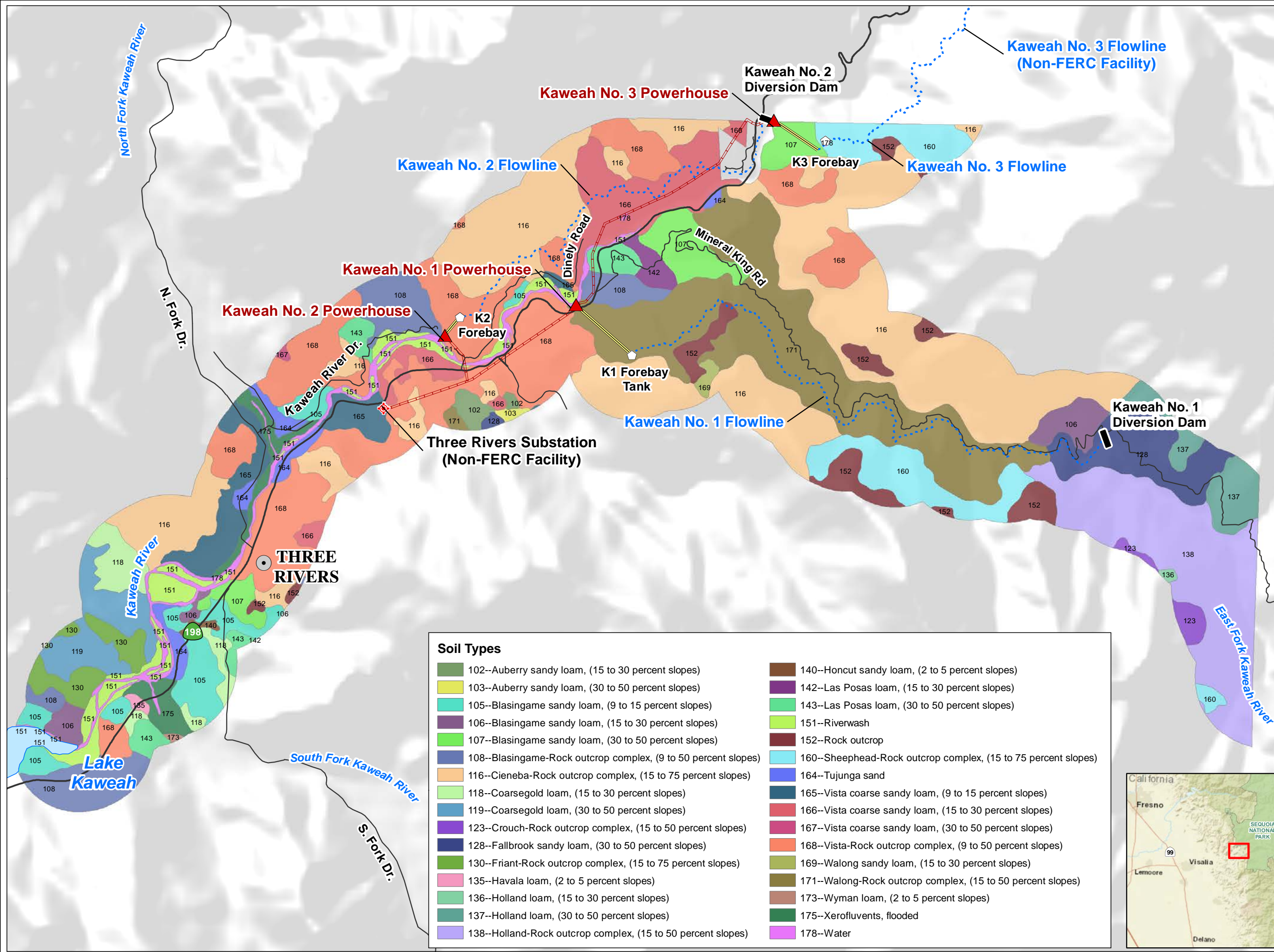
Map 7.6-3

Mining Activity in the Kaweah River Watershed



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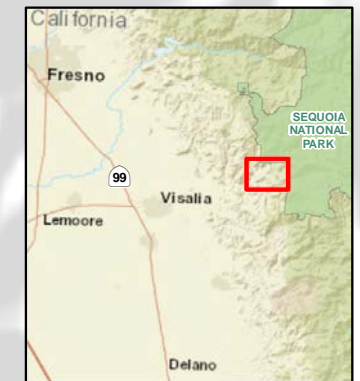
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- SCE Facilities**
- Powerhouse
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 - Utility
 - Forebay
 - Flowline
 - Penstock
 - Transmission Line
- Other Features**
- City/Town
 - Highway/Road
 - Watercourse
 - Water Body

Soil Types

102--Auberry sandy loam, (15 to 30 percent slopes)	140--Honcut sandy loam, (2 to 5 percent slopes)
103--Auberry sandy loam, (30 to 50 percent slopes)	142--Las Posas loam, (15 to 30 percent slopes)
105--Blasingame sandy loam, (9 to 15 percent slopes)	143--Las Posas loam, (30 to 50 percent slopes)
106--Blasingame sandy loam, (15 to 30 percent slopes)	151--Riverwash
107--Blasingame sandy loam, (30 to 50 percent slopes)	152--Rock outcrop
108--Blasingame-Rock outcrop complex, (9 to 50 percent slopes)	160--Sheephead-Rock outcrop complex, (15 to 75 percent slopes)
116--Cieneba-Rock outcrop complex, (15 to 75 percent slopes)	164--Tujunga sand
118--Coarsegold loam, (15 to 30 percent slopes)	165--Vista coarse sandy loam, (9 to 15 percent slopes)
119--Coarsegold loam, (30 to 50 percent slopes)	166--Vista coarse sandy loam, (15 to 30 percent slopes)
123--Crouch-Rock outcrop complex, (15 to 50 percent slopes)	167--Vista coarse sandy loam, (30 to 50 percent slopes)
128--Fallbrook sandy loam, (30 to 50 percent slopes)	168--Vista-Rock outcrop complex, (9 to 50 percent slopes)
130--Friant-Rock outcrop complex, (15 to 75 percent slopes)	169--Walong sandy loam, (15 to 30 percent slopes)
135--Havala loam, (2 to 5 percent slopes)	171--Walong-Rock outcrop complex, (15 to 50 percent slopes)
136--Holland loam, (15 to 30 percent slopes)	173--Wyman loam, (2 to 5 percent slopes)
137--Holland loam, (30 to 50 percent slopes)	175--Xerofluvents, flooded
138--Holland-Rock outcrop complex, (15 to 50 percent slopes)	178--Water



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Map 7.6-4

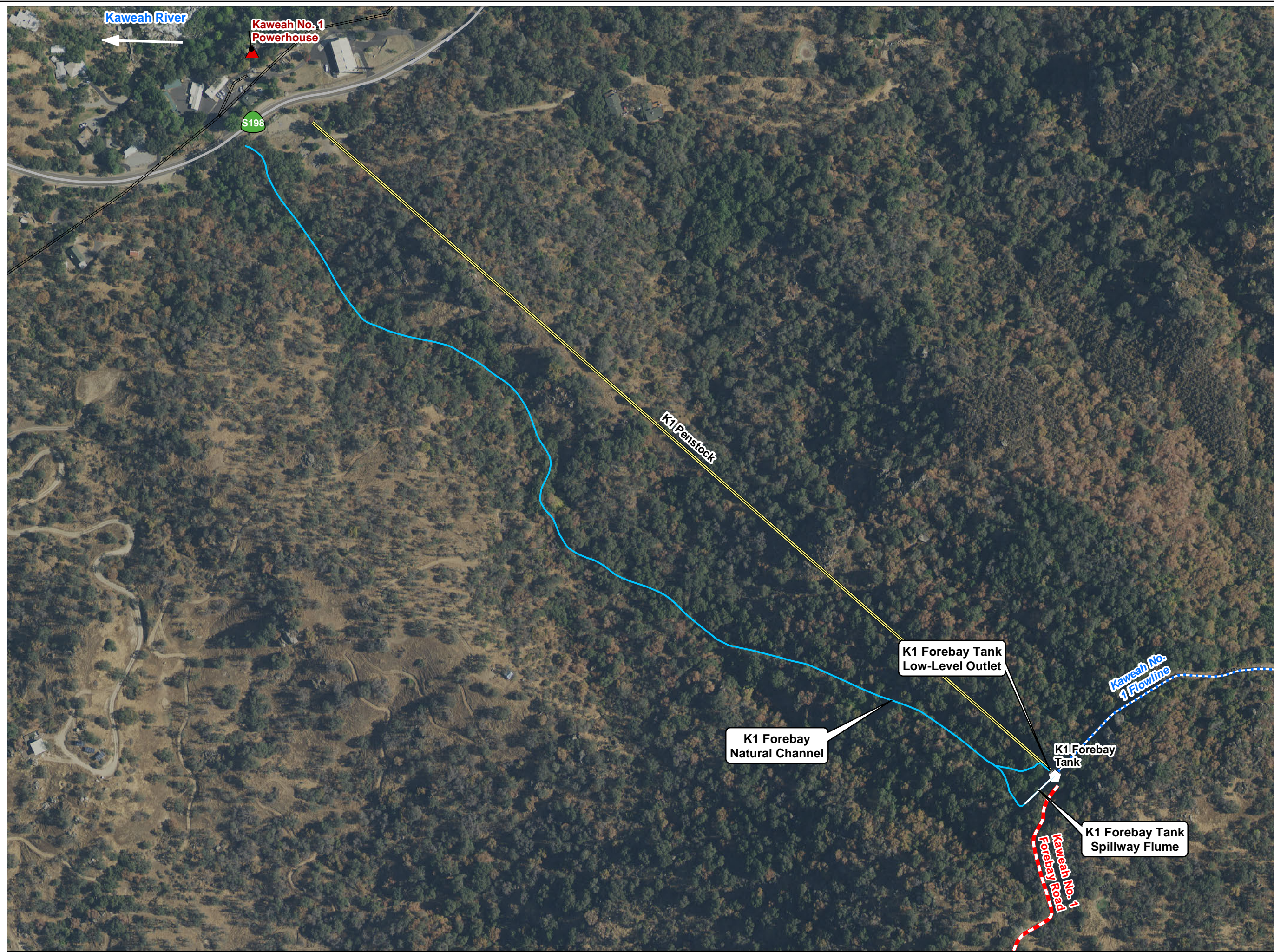
Soil Types within 0.5 miles of the Kaweah Project Facilities

Date: 5/15/2019


Projection: UTM Zone 11
Datum: NAD 83

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- SCE Facilities**
- Powerhouse
 - Diversion
 - Utility
 - Forebay
 - Flowline
 - Penstock
 - Transmission Line
- Other Features**
- Project Road
 - Non-Project General Access Road
 - River/Stream
- Survey Features**
- K1 Forebay Tank Spill Channel*
- *NOTE: Location of natural channels are approximate based on topography




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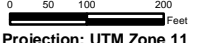
FERC Project No. 298

Map 7.6-5

Kaweah No. 1 Forebay Tank and Associated Natural Channels



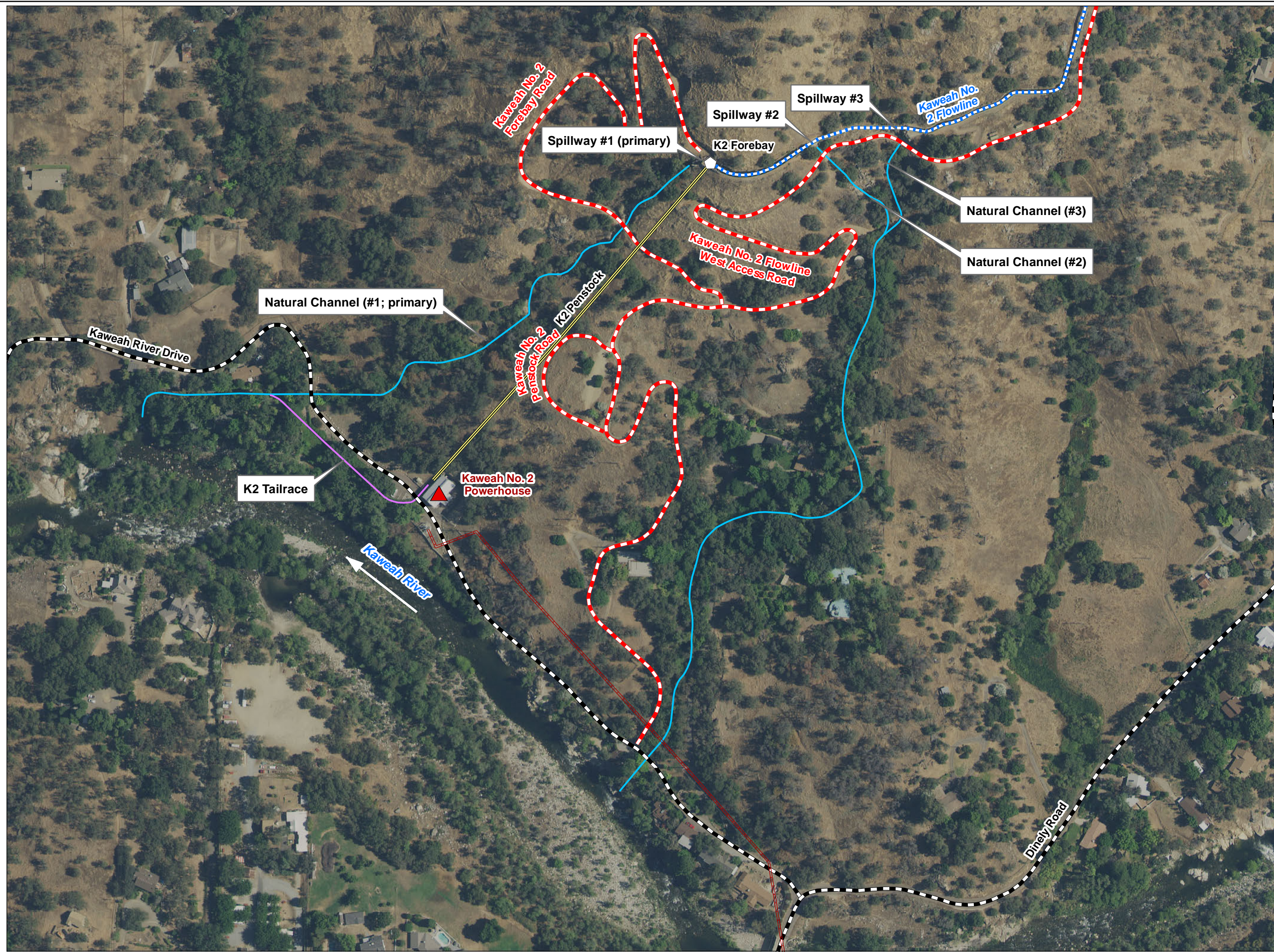
Date: 11/26/2019



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 - Forebay
 - Flowline
 - Tailrace
 - Penstock
 - Transmission Line
- Other Features**
- Project Road
 - Non-Project General Access Road
 - River/Stream
- Survey Features**
- K2 Forebay Spill Channel*

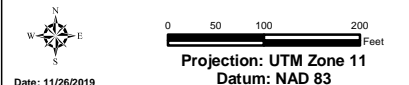
*NOTE: Location of natural channels are approximate based on topography



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Map 7.6-6

Kaweah No. 2 Forebay and Associated Natural Channels




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- SCE Facilities**
- Powerhouse
 - Diversion
 - Utility
 - Forebay
 - Flowline
 - Steel Pipe
 - Penstock
 - Transmission Line
- Other Features**
- Project Road
 - Non-Project General Access Road
 - River/Stream
- Survey Features**
- K3 Forebay Spill Channel*
- *NOTE: Location of natural channels are approximate based on topography
- Land Jurisdiction**
- National Park Service Boundary




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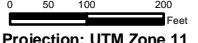
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Map 7.6-7

Kaweah No. 3 Forebay and Associated Natural Channels



Date: 12/13/2019



Projection: UTM Zone 11
Datum: NAD 83

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