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ac-ft	acre-feet
CFR	Code of Federal Regulations
FERC	Federal Energy Regulatory Commission
Commission	Federal Energy Regulatory Commission
GSA	Geological Society of America
MODIS	moderate resolution imaging spectroradiometer
msl	mean sea level
NPS	National Park Service
NRR	Natural Resources Report
RESSED	reservoir sedimentation database
RM	river mile
SCE	Southern California Edison Company
SEKI	Sequoia and Kings Canyon National Parks
SIEN	Sierra Nevada Network of the National Park Service's Sierra Nevada Network Inventory and Monitoring Program
USACE	Unites States Army Corps of Engineers
USDA-FS	United States Department of Agriculture-Forest Service
USGS	United States Geological Survey

3.8 GEOMORPHOLOGY

This section summarizes existing information regarding channel geomorphology and associated fluvial processes in the river reaches (bypass reaches)[1] associated with the Kaweah Project (Project), and existing erosion, mass soil movement, slumping, or other forms of instability affecting these reaches. 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) Chapter I § 5.6(d)(3)(ii). Descriptions and maps showing the existing geology, topography, and soils in the Project vicinity and potential erosion at Project facilities are included in Section 3.7 Geology and Soils. Section 3.9 Riparian Resources includes a description of the vegetation cover along the streambanks and shorelines.

Channel geomorphology is a description of the channel form (morphology), including dimensions, gradient, planform, and pattern. Fluvial processes and hydrology refer to the flow, sediment supply, and sediment transport that create and maintain the channel morphology. Information directly related to channel morphology and sediment transport are not specifically required by the FERC regulations, however, this information is important to understanding channel maintenance processes and the aquatic and riparian habitat study reaches in relationship to the Project operations.

3.8.1 Information Sources

This section was prepared utilizing the following information sources:

- A National Resource Condition Assessment for Sequoia and Kings National Parks. Appendix 3 – Erosion and Mass Wasting (Austin 2013);
- Channel-reach morphology in mountain drainage basins (Montgomery and Buffington 1997);
- FERC Approval of Erosion Monitoring Filing (FERC 1999);
- Google Earth © imagery;
- Hydrology and Water Resources. Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options (Kattleman 1996);
- Hydrology of the Sierra Nevada Network National Parks: Status and Trends (Andrews 2012);
- Kaweah River Investigation, California, Final Feasibility Report (U.S. Army Corps of Engineers [USACE] 1996);
- MODIS Fire Detection GIS Data, 2005-2015 (United States Department of Agriculture- Forest Service [USDA-FS] 2015);

[1] 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 that reach.

- Recent visual assessment of channel conditions in the Project vicinity by Southern California Edison (SCE) in July 2015; and
- The Reservoir Sedimentation Database (RESSED). Reservoir Sediment Data for Lake Kaweah (United States Geological Survey [USGS] 2015).

3.8.2 Regional Setting

The Kaweah River Watershed (Watershed) is situated in the mountains and foothills of the western slope of the Sierra Nevada. The rivers in the Watershed flow generally westward, with elevations of ridges in the upper watersheds higher than 8,400 feet above mean sea level (msl) (Map 3.8-1). The Kaweah River from its headwater tributaries to Lake Kaweah is the steepest river in the United States dropping over 10,500 feet in 37.5 miles (280 feet per mile) (Austin 2013). This is the only river in the United States that drops 10,000 feet or more in less than 100 miles. In the vicinity of the Project, elevations range from approximately 2,585 feet above msl at the Kaweah No. 1 Diversion Dam on the East Fork Kaweah River to 921 feet above msl at the Kaweah No. 2 Powerhouse on the Kaweah River (Map 3.8-1; Figure 3.8-1).

The longitudinal profiles for the Kaweah River and its tributaries are shown in Figure 3.8-1. The Marble Fork Kaweah River has the overall steepest gradient of the Kaweah River tributaries (10%). The overall channel gradient of the East Fork and Middle Fork of the Kaweah River are 7% and 8%, respectively. The overall gradients of the North Fork and South Fork of the Kaweah River are 5% and 7%, respectively. Localized slopes in the upper tributaries can be much greater, up to 31%.

The upper Watershed is characterized by steep, deeply incised channels within rugged canyons. These channels have limited geomorphic landform development, and are confined by narrow V-shaped valley bottoms and steep-side slopes with a prevalence of bedrock and coarse substrate. Channels with these characteristics are generally not sensitive to changes in flow and sediment regimes. This includes all of the Marble Fork, Middle Fork, and East Fork Kaweah rivers.

The lower Watershed in the vicinity of the Kaweah River downstream of the East Fork Kaweah River confluence and in the lower reaches of the North Fork and South Fork of the Kaweah River is characterized by lower gradient and wider channels with floodplains. The channel surrounded by rolling foothills within a wider valley. These river segments are alluvial in nature. Information on geology and soils in the vicinity of the Project is provided in Section 3.7 Geology and Soils.

3.8.3 Channel Geomorphology in the Bypass Reaches Associated with the Project

The bypass reaches associated with the Project include:

- Kaweah River from the Kaweah No. 2 Diversion to the Kaweah No. 2 Powerhouse Tailrace (4.1 miles); and

- East Fork Kaweah River from the Kaweah No. 1 Diversion to the confluence with the Kaweah River (4.7 miles).

A visual geomorphology assessment was conducted of the bypass reaches and river reaches immediately upstream and downstream of the Project in July 2015 to classify the river into homogeneous reaches with similar fluvial geomorphic characteristics. The general classification approach was consistent with Montgomery-Buffington (1997) (Table 3.8-1). The river characteristics were mapped during a low-altitude helicopter flight, supplemented with ground-truthing and aerial photography review. Representative photographs were taken from the helicopter and during the ground-truthing. The visual assessment was then used to classify the bypass reaches. Locations of recent mass wasting were also noted during the helicopter flight.

Specific details regarding gradient and channel morphology are provided below and are summarized in Table 3.8-2. Sediment supply and transport, including hydrology, in the bypass reaches are provided in Section 3.8.4.

3.8.3.1 Kaweah River Bypass Reach

The Kaweah River Bypass Reach is comprised of two sub-reaches based on similar geomorphic and hydrologic characteristics: (1) from the Kaweah No. 2 Diversion Dam to the confluence with the East Fork Kaweah River; and (2) from the confluence with the East Fork Kaweah River to the Kaweah No. 2 Tailrace. The characteristics of each of the sub-reaches are described below. The channel upstream and downstream of the bypass reach is also described below.

Kaweah River from Kaweah No. 2 Diversion Dam to the East Fork Kaweah River Confluence

Gradient

The Kaweah River Bypass Reach immediately downstream of the Kaweah No. 2 Diversion Dam to the confluence of the East Fork Kaweah River has an overall 3% gradient (Figure 3.8-2).

Channel Morphology

The channel has short alternating segments dominated by bedrock, step-pool formations, or boulder cascades (Map 3.8-2). The substrate is primarily comprised of large and small boulders (Table 3.8-3). A representative photograph of the channel is shown in Figure 3.8-3a.

Kaweah River from East Fork Kaweah River Confluence to the Kaweah No. 2 Tailrace

Gradient

Downstream of the confluence with the East Fork Kaweah River, the Kaweah River channel gradient is more moderate, approximately 2% (Figure 3.8-2).

Channel Morphology

Downstream of the confluence with the East Fork Kaweah River, the bypass channel is primarily comprised of pool-riffle and plane-bed segments (0.4 to greater than 1 mile in length) interspersed with short bedrock segments (typically 0.1-mile or less in length) (Map 3.8-2). Boulder-sized substrate dominates in the first 2.6 miles downstream from the East Fork Kaweah River confluence with the Kaweah River (River Mile [RM] 8.4 and RM 5.8), transitioning to cobble-dominated substrate downstream to the tailrace (Table 3.8-3). Representative photographs of this river channel at the top of the segment are provided in Figures 3.8-3b and c, and near the tailrace in Figure 3.8-3d.

Upstream and Downstream of the Bypass Reach

Upstream of the Kaweah No. 2 Diversion Dam (RM 9.5 to RM 9.0), the channel is similar to the 0.6-mile segment immediately downstream from the diversion, with a gradient of 3% (3.6 miles). Downstream from the Kaweah No. 2 Tailrace, the channel characteristics (gradient, channel morphology, and substrate) were similar to the downstream-most segment of the bypass reach (RM 5.8 to the tailrace). Gradients decrease to less than 0.5%. Representative photographs of the Kaweah River segment downstream of the bypass reach are shown in Figure 3.8-3e and f.

3.8.3.2 East Fork Kaweah River Bypass Reach

East Fork Kaweah River from Kaweah No. 1 Diversion Dam to Confluence with the Kaweah River

The gradient and channel morphology of East Fork Kaweah River is homogenous throughout the bypass reach as described below. The channel characteristics upstream of the diversion dam are also summarized.

Gradient

The channel gradient of the East Fork Kaweah River Bypass Reach is 5% (Figure 3.8-2).

Channel Morphology

The East Fork Kaweah River Bypass Reach has short alternating segments dominated by bedrock, step-pool formations, or boulder cascades (Map 3.8-2). The channel has frequent bedrock/large boulder exposures usually with coarse steps, with shorter channel segments where smaller sized material collects (cobble/gravel) or there is a shallow

mantling of alluvial material. These relatively small depositional features typically occurred at drainage confluences. The channel contains more cobble and gravel-sized material in the 0.4-mile segment immediately upstream of the confluence with the Kaweah River. Representative photographs of the channel are provided in Figure 3.8-4.

Upstream of the Bypass Reach

Upstream of the Kaweah No. 1 Diversion Dam (RM 5.2 to RM 4.7) the channel characteristics were similar to the bypass reach (gradient, channel morphology, and substrate) (Map 3.8-2). The channel gradient of the East Fork Kaweah River is 5% upstream of the Kaweah No. 1 Diversion Dam (Figure 3.8-2).

3.8.4 Sediment Supply and Transport

Each of the major tributaries to the Kaweah River provide increased hydrology (flow) and sediment supply. Typically, downstream of the confluence of each tributary the channel gradient decreases, the channel and valley floor becomes wider, and more sediment is present. Natural hydrology and sediment supply reaches in the vicinity of the Project include the following:

- Kaweah River from the Marble and Middle Fork Kaweah River confluence to the East Fork Kaweah River Confluence;
- Kaweah River from the East Fork Kaweah River Confluence to the North Fork Kaweah River Confluence;
- Kaweah River downstream of the North Fork Kaweah River to the South Fork Kaweah River;
- Kaweah River downstream of the South Fork Kaweah River; and
- East Fork Kaweah River.

The natural hydrology is modified at the Project diversions (Kaweah No. 1 and Kaweah No. 2 diversions). The diverted flow (with the exception of water delivered for consumptive purposes) reenters the natural river reaches in a downstream direction at the Kaweah No. 3, Kaweah No. 1, and Kaweah No. 2 powerhouses, respectively. The locations are labeled on Map 3.8-2.

This section describes potential sediment contribution to the bypass reaches from hillslope mass wasting and bank erosion and the relative capacity of the reaches to transport and store sediments.

3.8.4.1 Sediment Supply

Mass Wasting

Mass wasting (e.g., falls, slides, and flows) of valley walls can be a source of sediment, particularly in mountain streams and rivers. These sediments are re-worked and mobilized by subsequent high flows.

The National Park Service (NPS) conducted an assessment of mass wasting in the Watershed, including areas susceptive to large mass wasting events. Portions of the watersheds upstream of the bypass reaches (Marble, Middle, and East forks of the Kaweah River) were identified as areas where large mass wasting events have the potential to occur. Specifically, areas in the upper Watershed which are steep (>40% slope) with poor vegetative cover have the highest susceptibility for the occurrence of a large mass wasting event (Austin 2013).

Surveys completed by SCE in the Project vicinity in July 2015 did not identify evidence of any recent hillslope mass wasting events adjacent to the bypass reaches. The potential for large mass wasting events on the hillslopes adjacent to the bypass reaches is relatively low. Although the hillslopes are steep in some areas, there have been no recent fires (since 2005) (USDA-FS 2015) and the hillslopes are well-vegetated.

Streambank Erosion

Streambank erosion is a natural process, but acceleration of this process can lead to disproportionate increases in sediment supply, channel instability, adjacent land loss, and habitat loss/degradation. Excessive streambank erosion can be a large source of sediment in a watershed. Streambank erosion is driven by the characteristics of the bank (e.g., bank materials, vegetation, etc.) and hydraulic/gravitational forces. Accelerated bank erosion is often a response of the channel as it re-adjusts to a stable position from changes in the watershed that may have altered the flow and/or sediment regimes.

In the upper 3.2-mile portion of the Kaweah River Bypass Reach (RM 5.8 to RM 9.0) and in the entire East Fork Kaweah River Bypass Reach (RM 0.0 to RM 4.7), the potential for bank erosion is very low due to the presence of bedrock and coarse boulder substrates that stabilize the streambed and banks. In the lower 1-mile segment of the Kaweah River Bypass Reach (RM 5.8 to RM 4.85), the potential for excessive bank erosion is also generally low because the streambanks are well-vegetated with riparian trees and shrubs, and various grasses.

3.8.4.2 Sediment Transport

Most of the sediment in the Watershed is transported during large flood events (USACE 1996; Andrews 2012; Austin 2013). High gradient streams, like the East Fork Kaweah River and the upper Kaweah River bypass sub-reach, are typically considered to be supply limited. These types of channels are able to transport considerably more material than is delivered to them from the Watershed, resulting in either bedrock or mixed bedrock-alluvial channels. The lower Kaweah River bypass sub-reach, is considered to be transitional between supply-limited and transport-limited. This segment of the bypass reach was classified as a pool-riffle/plane-bed channel type, dominated with cobble and smaller substrate size classes. These types of channels adjust over long periods of time so that sediment provided to them is transported under the existing flow regime. As such, the channel is neither aggrading nor degrading, and the channel dimensions are stable.

There is minimal sediment data available in the Watershed, with the exception of a short period of record available on the East Fork Kaweah River. In the East Fork Kaweah River, suspended sediment was monitored at three USGS gage locations between 1968 and 1971 (Table 3.8-4)[2]. Two of the USGS gages (gage nos. 11208620 and 11208625) are located upstream of Kaweah No. 1 Diversion Dam. The third location (gage no. 11208730) is located at the diversion dam. Figure 3.8-5 provides suspended sediment concentrations measured at the three gage locations on the East Fork Kaweah River in relation to flow.

Sediment accumulation has been measured and reported in Lake Kaweah from 1961-1987 (USGS 2015). Based on these data, the annual sediment yield into Lake Kaweah has averaged 0.31 acre-feet (ac-ft) per year per square mile[3]. The USACE estimates that the average annual sediment inflow into Lake Kaweah is about 100 ac-ft (USACE 1996)

Sediment (typically sandy decomposed granite and small organic debris) is trapped in the Kaweah No. 1 Diversion Sandbox. In general, the trapped sediments are remobilized and released from the sandbox into the river channel during subsequent high-flow events.

During high-flow events, large sediments (gravels, cobbles and boulders) originating upstream of the Project are trapped behind the Kaweah No. 2 Diversion Dam in the diversion pool. The Kaweah No. 2 Diversion Pool is currently full of sediment; however, SCE is not authorized to conduct sediment management at this facility in the existing FERC License.

3.8.5 References

Andrews, E. D. 2012. Hydrology of the Sierra Nevada Network National Parks: Status and Trends. Natural Resource Report NPS/SIEN/NRR—2012/500. National Park Service, Fort Collins, Colorado.

Austin, J.T. 2013. A National Resource Condition Assessment for Sequoia and Kings National Parks. Appendix 3 – Erosion and Mass Wasting. Natural Resource Report NPS/SEKI/NRR-2013/665.3. June 2013.

Federal Energy Regulatory Commission (FERC). 1999. FERC Approval of Erosion Monitoring Filing. Dated August 13, 1999.

Kattleman, R. 1996. Hydrology and Water Resources. Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options. University of California, Davis, Centers for Water and Wildland Resources.

[2] The locations of these gages are shown on Map 3.4-1a in Section 3.4 Water Quality.

[3] Note, other reports (e.g., Austin 2013; Kattleman 1996; Andrews 2012) have reported higher annual sediment yields for the Kaweah Watershed (0.8 ac-ft per year per square mile). This yield (0.8 ac ft) is substantially higher than other Sierra watersheds as reported in Kattleman 1996. However, the estimate of 0.8 ac-ft was derived from a short time period (1961-1967) that was influenced by several large events that occurred during that time period, thereby, substantially influencing the results (i.e., making the estimate of annual sediment yield to be very high).

Montgomery, D. R. and J. M. Buffington. 1997. Channel-reach morphology in mountain drainage basins. GSA Bulletin May 1997, v.109, no.5. pp.

U.S. Army Corps of Engineers (USACE). 1996. Kaweah River Investigation, California, Final Feasibility Report. United States Department of the Army, South Pacific Division, Sacramento District. September. Available at: http://elibrary.ferc.gov/idmws/File_list.asp?document_id=13759225.

United States Geological Survey. 2015. The Reservoir Sedimentation Database (RESSED). Reservoir Sediment Data for Lake Kaweah, Available at: http://water.usgs.gov/osw/ressed/datasheets/71-43.pdf.

United States Department of Agriculture-Forest Service (USDA-FS). 2015. MODIS Fire Detection GIS Data, 2005-2015, Available at: http://activefiremaps.fs.fed.us/gisdata.php.

TABLES

Table 3.8-1. Physical Characteristics of Montgomery-Buffington (1997) Channel Morphology Types.

Channel Types	Pool-Riffle	Plane-Bed	Step-Pool	Cascade	Bedrock
General Description	*Channel with exposed bars, turbulent flow over riffles, and more tranquil flow through pools*	*Channel with isolated boulders protruding through otherwise uniform flow*	*Sequential turbulent flow over temps and more tranquil flows through intervening pools*	*Nearly continuous turbulent flow around large particles*	*Dominated by bedrock*
Typical Bed Material	Gravel	Gravel, cobble	Cobble, boulder	Boulder	Not applicable
Reach Type	Response	Response	Transport	Transport	Transport
Dominant Roughness Elements	Bedforms (bars, pools), grains, LWD, sinuosity, banks	Grains, banks	Bedforms (steps, pools), grains, LWD, banks	Grains, banks	Boundaries (bed and banks)
Dominant Sediment Sources	Fluvial, bank failure, inactive channel, debris flows	Fluvial, bank failure, debris flows	Fluvial, hillslope, debris flows	Fluvial, hillslope, debris flows	Fluvial, hillslope, debris flows
Sediment Storage Elements	Overbank, bedforms, inactive channel	Overbank, inactive channel	Bedforms	Lee and stoss sides of flow obstructions	–
Typical Slope (ft/ft)	0.2%< S<2%	1%< S<3%	3%< S<7.5%	S>7.5%	Variable
Typical Confinement	Unconfined	Variable	Confined	Confined	Confined

Abbreviations: LWD: large woody debris; S: slope; ft: feet

Table 3.8-2. Geomorphic Characteristics of the Bypass Reaches Associated with the Kaweah Project.

Bypass Reaches	River Mile	Reach Length (miles)	Gradient	Channel Morphology and Substrate
Kaweah River Bypass Reach				
Kaweah River from Kaweah No. 2 Diversion Dam to East Kaweah River Confluence	9.0-8.4	0.6	3%	Alternating bedrock, step-pool, and cascade channel types. Channel has frequent bedrock/large boulder exposures with coarse steps.
Kaweah River from East Fork Kaweah River Confluence to Kaweah No. 2 Powerhouse Tailrace	8.4-4.85	3.55	1.9%	Alternating sections of plane-bed and pool-riffle channel types with short bedrock sections interspersed. Channel substrate is small boulders with cobbles and gravels and short bedrock and large boulder segments.
East Fork Kaweah River Bypass Reach				
East Fork Kaweah River from Kaweah No. 1 Diversion Dam to Kaweah River Confluence	4.7-0	4.7	5%	Alternating bedrock, step-pool, and cascade channel types. Channel has frequent bedrock/large boulder exposures with coarse steps.

Table 3.8-3. Substrate Sizes Classes Observed during Helicopter Overflight of the Bypass Reaches Associated with the Kaweah Project and Reaches Upstream and Downstream of the Project Facilities.

River Mile[1]		Substrate Size Classes Observed[2]					
Begin	End	Bedrock	Large Boulder	Small Boulder	Large Cobble	Small Cobble	Gravels
Kaweah River							
0.5 Mile Upstream of the Kaweah No. 2 Diversion Dam							
9.5	9		x	x	x	x	x
Kaweah No. 2 Diversion Dam to Kaweah No. 2 Tailrace							
9	8.2		x	x	x	x	x
8.2	7.1			x	x		
7.1	7	x					
7	6.6			x	x	x	x
6.6	6.5	x			x		
6.5	5.9		x	x	x		x
5.9	5.8	x					
5.8	5.5				x	x	x
5.5	5	x			x	x	x
5	4.9			x	x		
4.9	4.85	x	x				
Kaweah No. 2 Tailrace to Lake Kaweah							
4.85	4.45			x	x	x	x
4.45	4.2				x		
4.2	4.15	x			x		
4.15	3.9				x	x	x
3.9	3.8		x	x	x		
3.8	3.2				x	x	x
3.2	3.15	x			x		
3.15	2.9				x	x	x
2.9	2.8	x	x				
2.8	1.42				x	x	x
1.42	1.37			x	x		
1.37	1.1				x	x	x
1.1	0			x	x	x	x

Table 3.8-3. Substrate Sizes Classes Observed during Helicopter Overflight of the Bypass Reaches Associated with the Kaweah Project and Reaches Upstream and Downstream of the Project Facilities (continued).

River Mile[1]		Substrate Size Classes Observed[2]					
Begin	End	Bedrock	Large Boulder	Small Boulder	Large Cobble	Small Cobble	Gravels
East Fork Kaweah River							
0.5 Mile Upstream of the Kaweah No. 1 Diversion Dam							
5.2	4.7	x	x	x	x		
Kaweah No. 1 Diversion Dam to Confluence with the Kaweah River							
4.7	3.4	x	x	x	x		
3.4	3.35		x	x	x	x	x
3.35	3.2	x	x	x	x		
3.2	0.4	x	x	x	x	x	x
0.4	0.35			x	x	x	x
0.35	0.3	x	x				
0.3	0		x		x		x

[1]Substrate were mapped during a low-level helicopter flight and are presented at a scale to show general trends in substrate along the river reaches in the vicinity of the Project, and does not show detailed bed or bank substrate that would be generated during on-the-ground reach scale or mesohabitat mapping.

[2]Sands are generally present throughout

Table 3.8-4. Summary of USGS Existing Suspended Sediment Data on the East Fork Kaweah River (1968-1971).

Measurement Date and Time	Suspended Sediment Concentration (mg/L)	Daily Mean Flow (cfs)	Sediment Discharge (mg/s)
EF KAWEAH R BL MOSQUITO C NR HAMMOND CA (upstream of Kaweah No. 1 Diversion Dam) (USGS Gage. No. 11208620) (lat. 36.451389/long. -118.61777) (Drainage Area: 16 sq. mi.)			
8/2/1968 9:05	1	10	283
8/27/1968 13:45	10	9.6	2718
10/1/1968 11:00	6	4.4	748
10/15/1968 15:00	1	8	227
10/29/1968 11:00	1	5.4	153
12/7/1968 13:30	2	7.4	419
1/18/1969 11:15	1	10	283
3/25/1969 14:00	11	17	5295
4/22/1969 12:00	24	96	65242
5/21/1969 13:30	32	280	253719
6/18/1969 14:50	9	205	52245
7/29/1969 16:00	3	116	9854
8/25/1969 17:00	2	41	2322
10/14/1969 16:40	2	9.4	532
12/8/1969 14:00	2	8.9	504
1/20/1970 14:30	3	23	1954
3/11/1970 13:00	1	12	340
4/28/1970 10:30	2	31	1756
5/20/1970 12:00	10	140	39644
6/30/1970 8:35	0	60	0
8/3/1970 16:00	1	18	510
8/28/1970 16:30	1	9.9	280
9/21/1970 17:15	1	5.6	159
11/2/1970 10:45	0	5.4	0
2/1/1971 14:30	1	13	368
3/16/1971 15:30	1	22	623
5/11/1971 15:30	1	43	1218
6/24/1971 11:30	9	86	21917
9/21/1971 11:30	2	6.7	379

Table 3.8-4 Summary of USGS Existing Suspended Sediment Data on the East Fork Kaweah River (1968-1971) (continued).

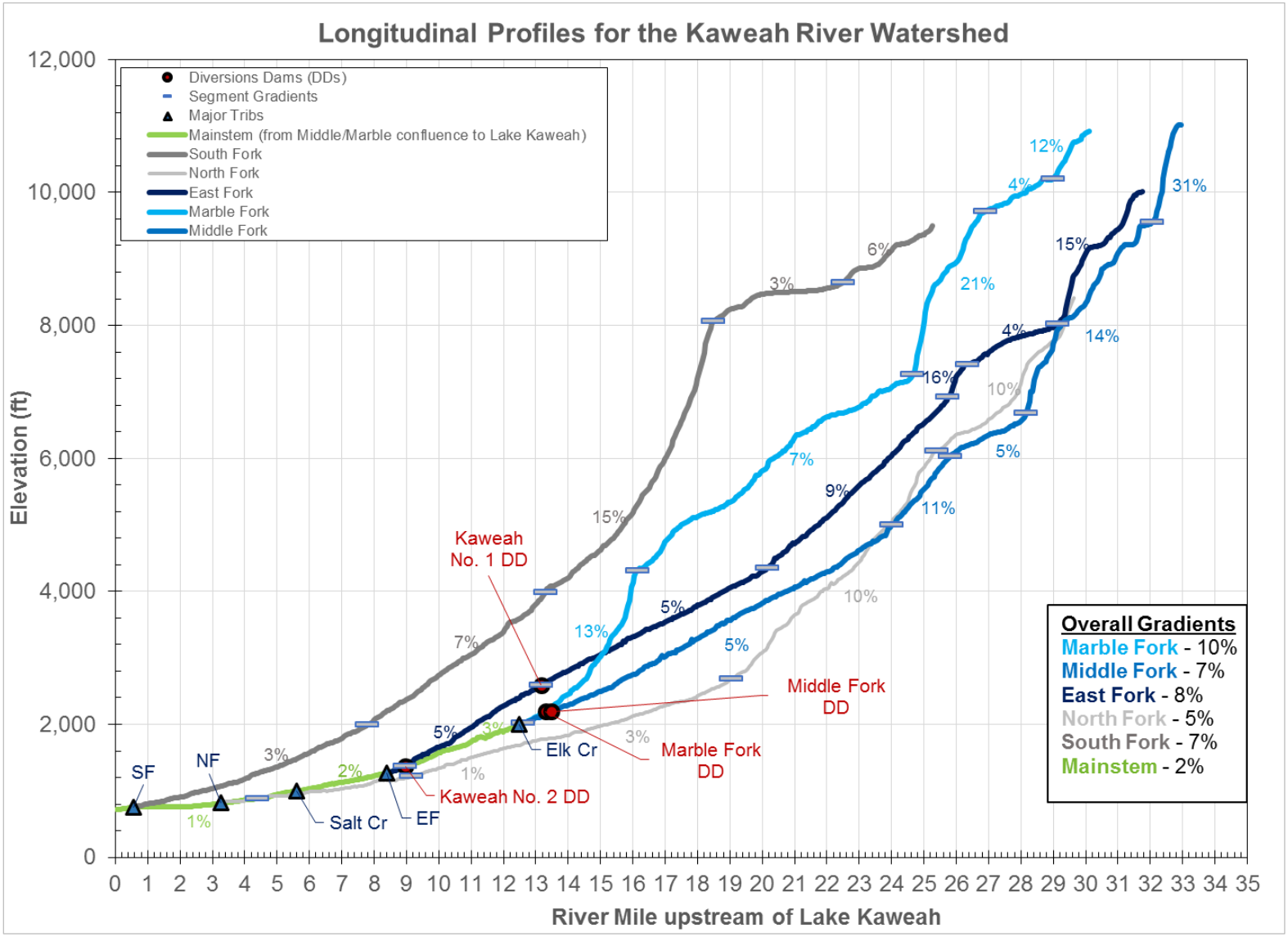
Measurement Date and Time	Suspended Sediment Concentration (mg/L)	Daily Mean Flow (cfs)	Sediment Discharge (mg/s)
EF KAWEAH R A SEQ NATL P BNDRY NR HAMMOND CA (USGS Gage No. 11208625) (upstream of Kaweah No. 1 Diversion Dam) (lat. 36.458333/long. -118.653056) (Drainage Area: 23.7 sq. mi.)			
8/2/1968 10:50	1	10	283
8/27/1968 16:15	1	6.9	195
10/1/1968 14:00	2	5.7	323
10/29/1968 12:30	1	6.5	184
3/26/1969 10:30	14	30	11893
5/29/1969 16:15	88	528	1315713
7/30/1969 9:00	4	155	17556
8/25/1969 10:45	4	39	4417
10/15/1969 8:30	2	13	736
12/8/1969 11:00	1	9.2	261
1/19/1970 12:00	7	39	7730
3/9/1970 14:10	1	22	623
4/21/1970 11:00	1	39	1104
5/19/1970 14:00	13	232	85404
6/29/1970 17:00	0	69	0
8/4/1970 9:00	1	20	566
8/29/1970 8:30	0	12	0
9/22/1970 8:30	1	9.2	261
11/2/1970 13:00	0	7.4	0
12/15/1970 12:50	0	12	0
2/2/1971 12:05	2	22	1246
4/2/1971 10:00	2	45	2549
5/12/1971 9:00	1	60	1699
6/24/1971 15:00	8	118	26731
7/20/1971 12:45	2	36	2039
9/21/1971 12:45	1	8.4	238

Table 3.8-4 Summary of USGS Existing Suspended Sediment Data on the East Fork Kaweah River (1968-1971) (continued).

Measurement Date and Time	Suspended Sediment Concentration (mg/L)	Daily Mean Flow (cfs)	Sediment Discharge (mg/s)
EF KAWEAH R NR THREE RIVERS CA (USGS Gage No. 11208730) (at Kaweah No. 1 Diversion Dam) (lat. 36.451389/long. -118.7875) (Drainage Area: 85.8 sq. mi.)			
8/2/1968 13:20	1	3.8	108
8/26/1968 15:26	1	0.4	11
8/26/1968 15:30	1	16	453
9/30/1968 8:45	1	0.68	19
10/31/1968 10:00	2	20	1133
12/11/1968 14:30	9	31	7900
1/14/1969 11:30	14	88	34886
1/20/1969 12:00	50	433	613059
5/1/1969 9:50	24	516	350675
5/29/1969 10:45	83	1170	2749846
6/19/1969 15:00	14	745	295344
7/30/1969 15:00	2	266	15065
8/26/1969 10:40	2	79	4474
10/15/1969 14:30	1	38	1076
1/19/1970 15:30	6	181	30752
3/10/1970 10:00	1	101	2860
4/22/1970 10:00	3	104	8835
5/18/1970 10:00	19	615	330882
7/1/1970 11:20	1	118	3341
8/4/1970 14:30	2	33	1869
8/28/1970 9:20	1	21	595
9/22/1970 12:15	0	15	0
11/2/1970 16:05	0	16	0
12/14/1970 9:30	0	30	0
12/18/1970 11:00	2	30	1699
2/2/1971 17:20	2	53	3002
3/17/1971 10:30	2	57	3228
5/3/1971 11:00	2	170	9628
6/22/1971 17:10	9	300	76455
7/21/1971 12:00	5	65	9203
9/22/1971 11:30	3	15	1274

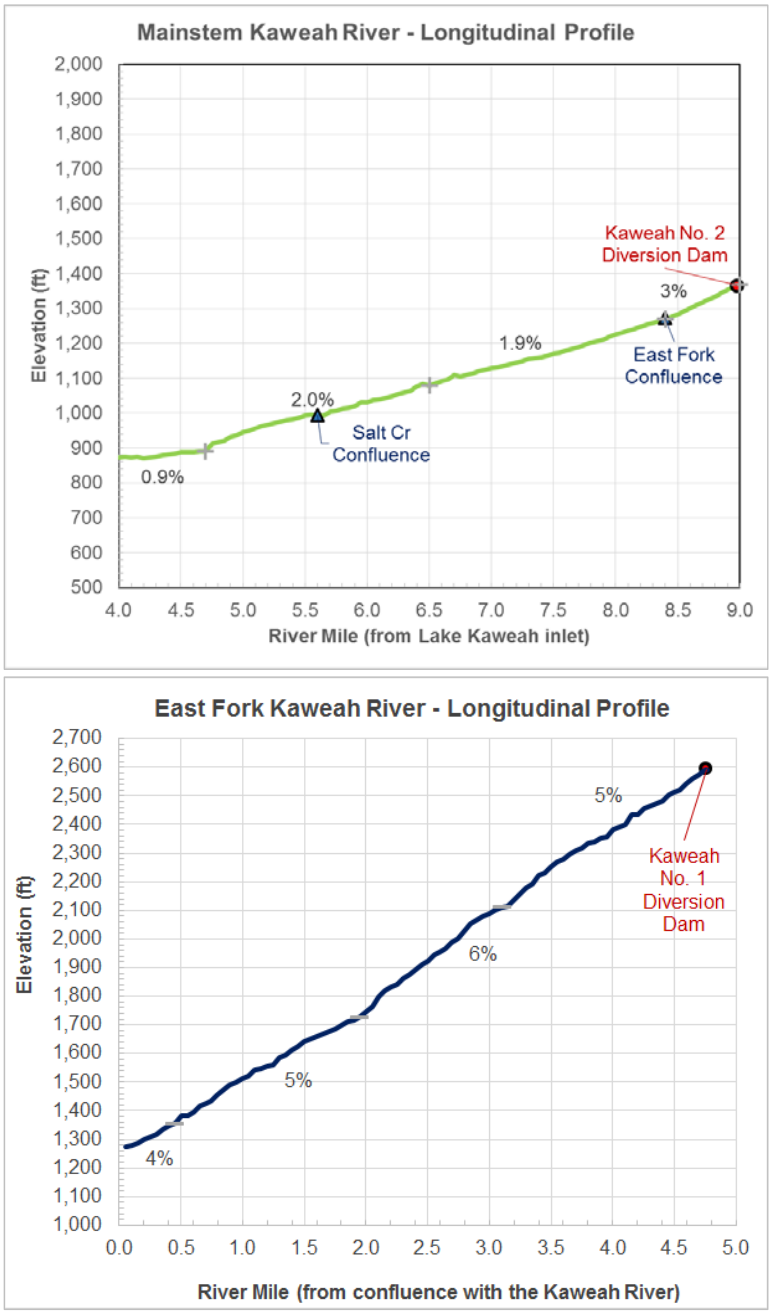
FIGURES

Figure 3.8-1. Longitudinal Profiles of Rivers in the Kaweah River Watershed (Marble, Middle, East, North, South, and Mainstem).



Longitudinal profiles developed from 10 m DEM data. Blue lines indicate gradient breaks.

Figure 3.8-2. Longitudinal Profiles for the Kaweah River (top) and East Fork Kaweah River (bottom) Bypass Reaches.



Longitudinal profiles developed from 10 m DEM data. Gray lines indicate gradient breaks.

Figure 3.8-3a-f. Representative Photographs of the Kaweah River Channel Morphology in the Vicinity of the Project.

a. Near RM 8.35

b. Near RM 7.6, facing upstream

Figure 3.8-3a-f. Representative Photographs of the Kaweah River Channel Morphology in the Vicinity of the Project (continued).

c. Near RM 6.7, facing upstream

d. At tailrace outflow, RM 4.87, facing downstream

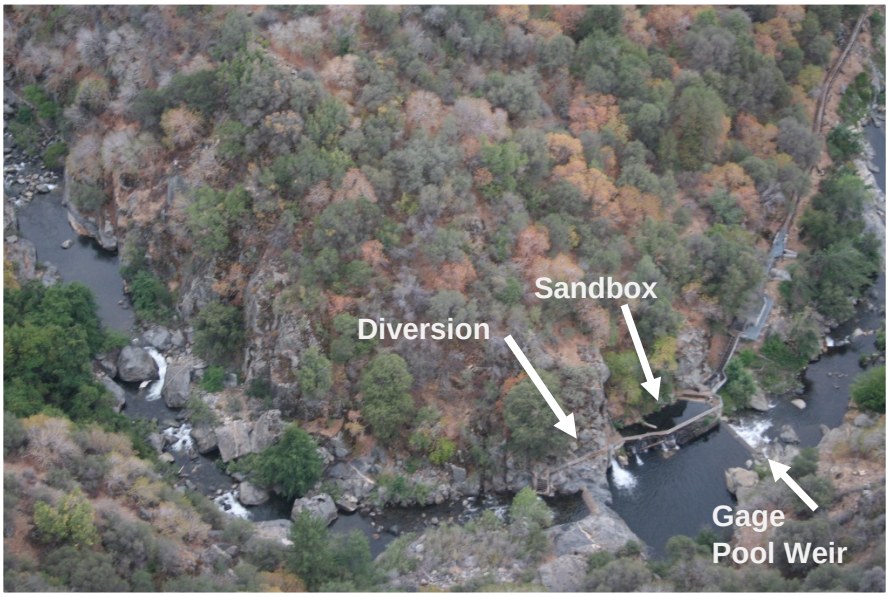
Figure 3.8-3a-f. Representative Photographs of the Kaweah River Channel Morphology in the Vicinity of the Project (continued).

e. Near RM 4.6, facing upstream

f. Near RM 2.9

Figure 3.8-4. Representative Photographs of the East Fork Kaweah River Channel Morphology in the Vicinity of the Project.

At Diversion



Near RM 3.3

Near RM 2.4

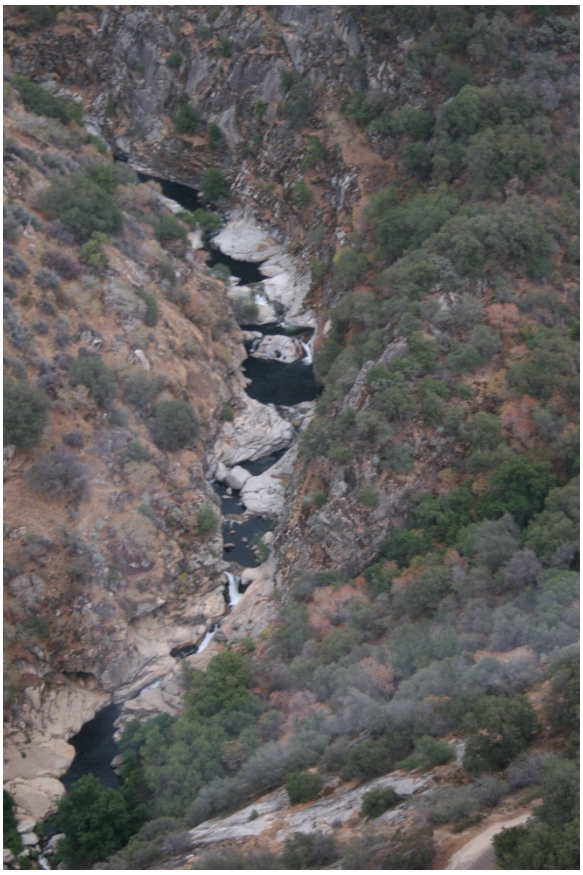
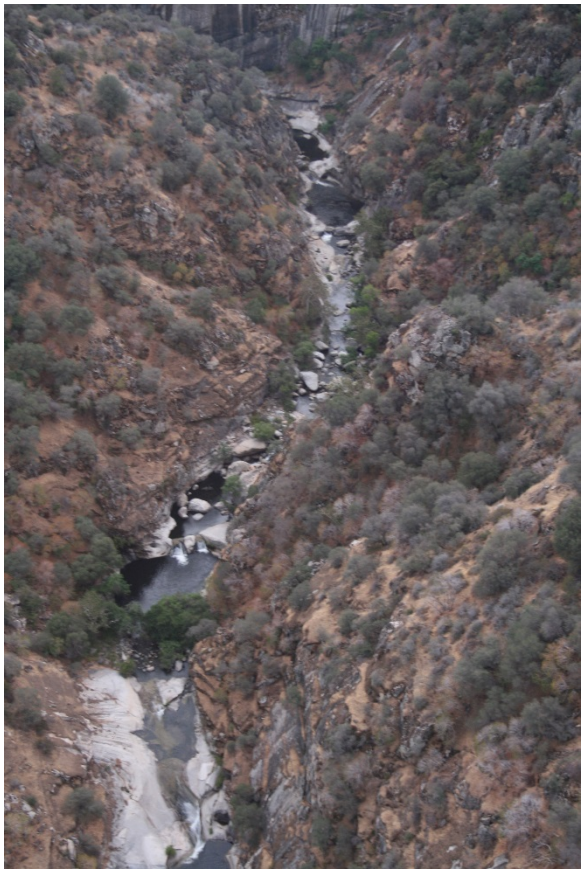


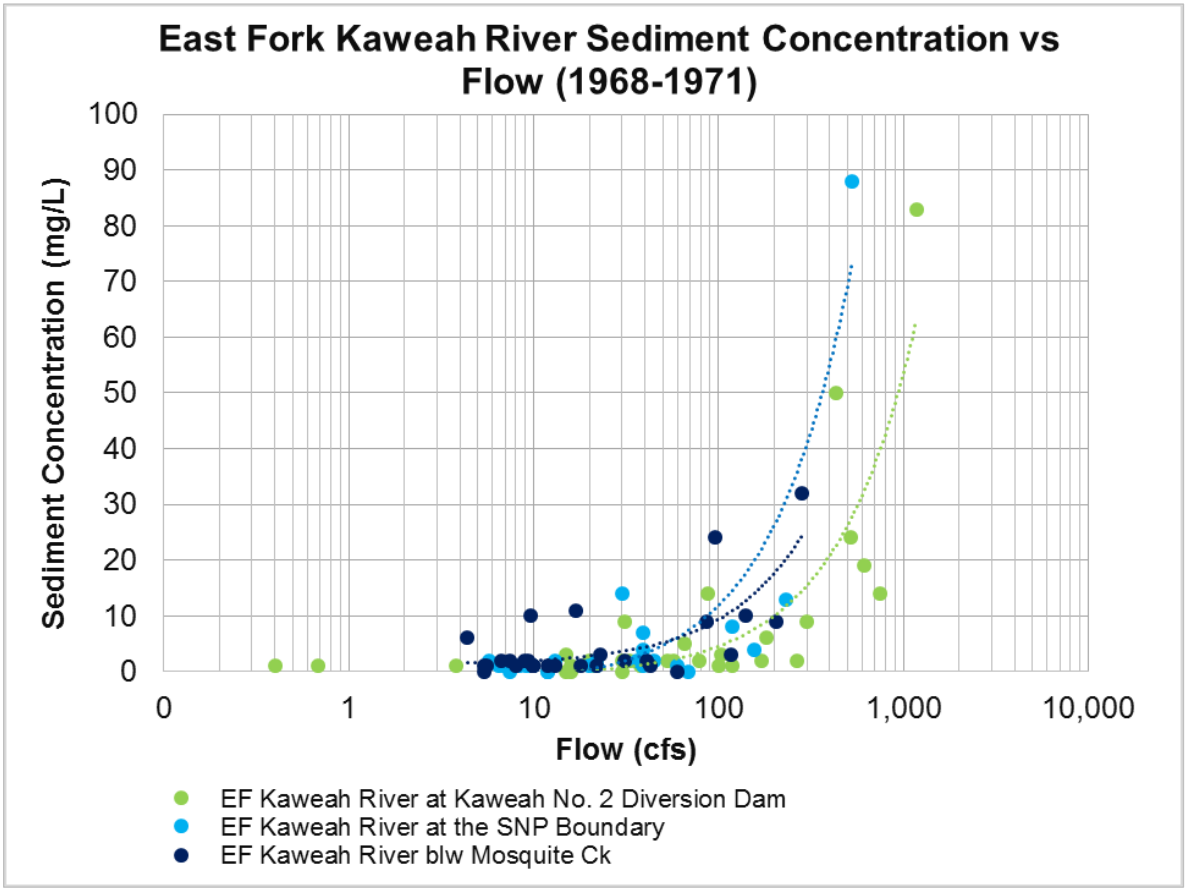
Figure 3.8-4. Representative Photographs of the East Fork Kaweah River Channel Morphology in the Vicinity of the Project (continued).

Near RM 1.7



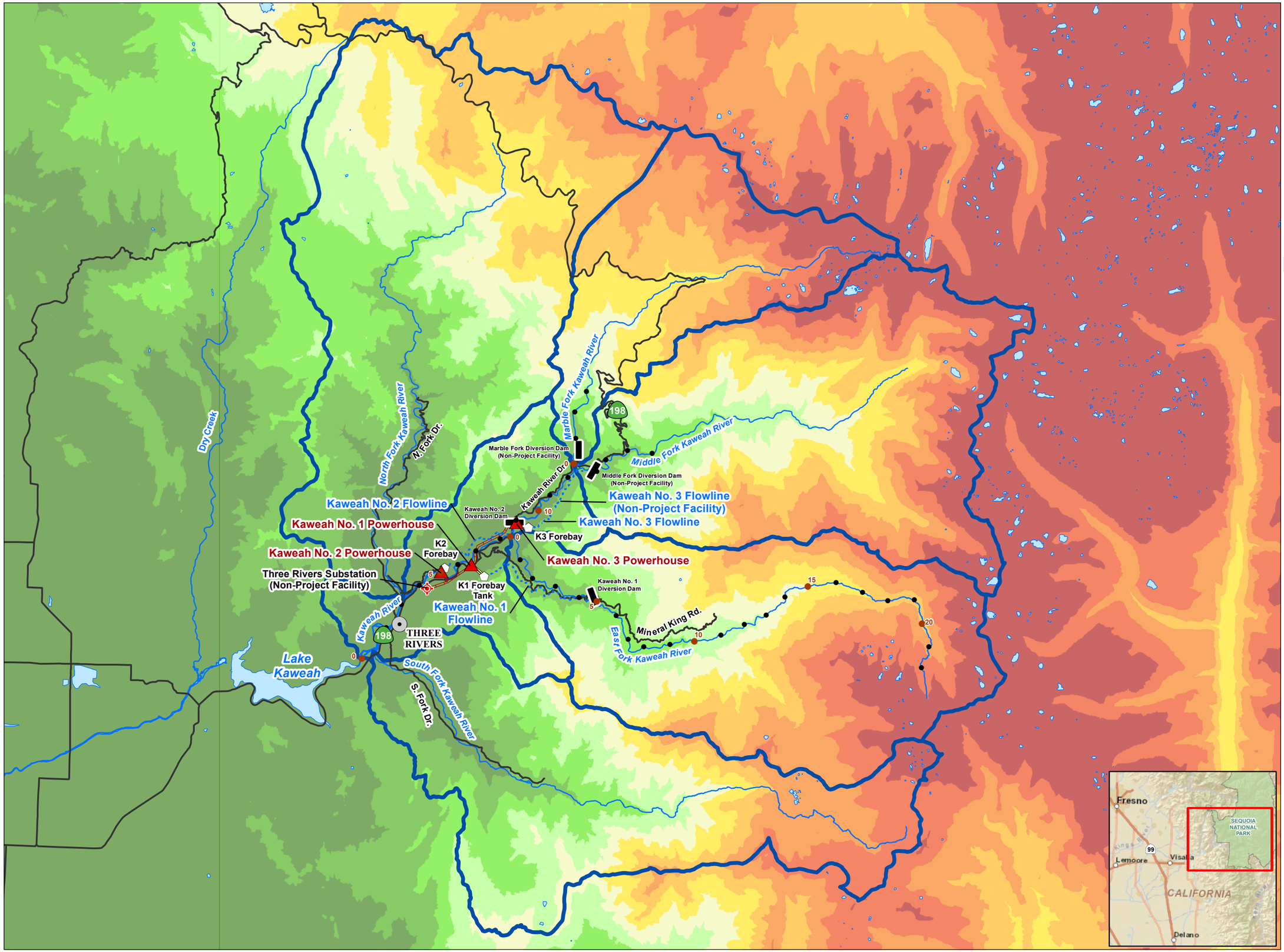
At the Confluence with the Kaweah River

Figure 3.8-5. Sediment Concentration versus Flow on the East Fork Kaweah River (1968-1971).



Data sources: see Table 3.8-4.

MAPS



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Map 3.8-1

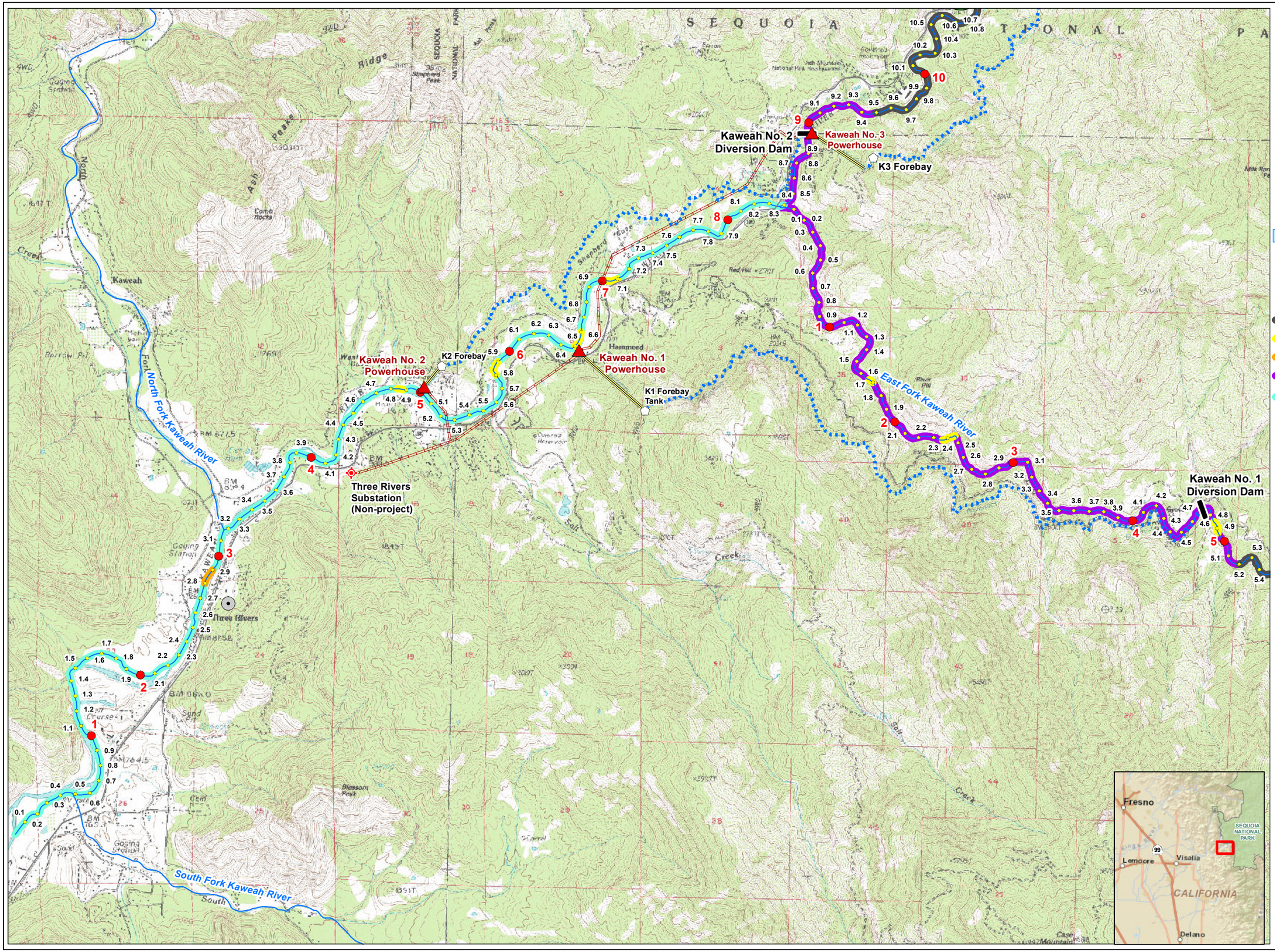
Topography in the Kaweah River Watershed

0 0.5 1 Miles

Projection: UTM Zone 11
Datum: NAD 83

Date: 7/24/2015

C:\Users\clare\Documents\Edited\EntireProject\30735240_SCE_EasternProject\map\Kaweah\SCE_Eastern_KAWEAH_Topo_17i11i_01.mxd



Facilities

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

Other Features

- City/Town
- Highway/Road
- Watercourse
- Water Body
- River Mile
- River Mile (1/10th)

Channel Characterization

- NA
- bedrock
- bedrock/cascade
- bedrock/step-pool/cascade
- pool-riffle/plane-bed

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Map 3.8-2

Channel Morphology in the Bypass Reaches in the Vicinity of the Project

0 500 1,000 2,000 Feet

Projection: UTM Zone 11
Datum: NAD 83

Date: 8/6/2015

C:\GIS\ENTRIX\30735240_SCE_EasternHydro\map\Kaweah\SCE_Eastern_KAWEAH_Geomorph_17i11i_01.mxd