WR-2 Hydrology
Interim Technical Memorandum

Kern River No. 3 Hydroelectric Project
FERC Project No. 2290

Prepared for:

Southern California Edison
Energy for What's Ahead®

Kernville, California

October 2023

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List of Acronyms and Abbreviations

CEFF	*California Environmental Flows Framework*
cfs	cubic feet per second
CNFD	California Natural Flows Database
COMID	COMmon IDentifier
EMG	ecological management goal
FERC	Federal Energy Regulatory Commission
KR3	Kern River No. 3
LOI	location of interest
NFKR	North Fork Kern River
NHD	National Hydrography Dataset
Project	Kern River No. 3 Hydroelectric Project (FERC Project No. 2290)
RM	River Mile
RSP	Revised Study Plan
SCE	Southern California Edison
SPD	Study Plan Determination
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WY	water year

1.0 INTRODUCTION

This interim Technical Memorandum provides the methods and findings of the *WR-2 Hydrology Study Plan* in support of Southern California Edison's (SCE) Kern River No. 3 (KR3) Hydroelectric Project (Project) relicensing, Federal Energy Regulatory Commission (FERC) Project No. 2290. The WR-2 Study Plan was included in SCE's Revised Study Plan (RSP) filed on July 1, 2022 (SCE, 2022). In the October 12, 2022, Study Plan Determination (SPD) (FERC, 2022), FERC approved the WR-2 Study Plan with modifications. Specifically, in addition to the compilation of hydrologic gage data and summarization of natural function flow, FERC specified that SCE describe flow travel times within the Fairview Dam Bypass Reach[1]. FERC also specified the inclusion of existing flow data from Salmon and Corral Creeks and the diversions.

This interim Technical Memorandum describes the hydrologic flow data in the Fairview Dam Bypass Reach and KR3 Water Conveyance and presents results from Section A of the *California Environmental Flows Framework* (CEFF) assessment (CEFWG, 2021a). Two additional items are in development and will be included as part of the Draft/Final License Application and Updated Study Report: (1) data collected for flow travel time analysis within the Fairview Dam Bypass Reach will be collected in fall 2023, and (2) flow data from Salmon and Corral Creeks will be collected and compiled in fall 2023.

2.0 STUDY GOALS AND OBJECTIVES

The objectives of the study, as outlined in *WR-2 Hydrology Study Plan* (SCE, 2022) and as amended by FERC in its SPD (FERC, 2022), include the following:

- Compile and summarize hydrologic gage data for use in other resource assessments.
- Determine, compile, and summarize natural functional flow ranges in wet, moderate, and dry years using existing unimpaired data.
- Describe flow travel times within the Fairview Dam Bypass Reach for a variety of flows, including minimum bypassed reach flows (40 to 130 cubic feet per second [cfs]) up to the existing maximum whitewater flow release target of 1,400 cfs.

The study objectives for the third bullet point are associated with outstanding/in-progress tasks and will be addressed in the final Technical Memorandum.

3.0 STUDY AREA AND STUDY SITES

The study area includes Project-affected stream reaches along the North Fork Kern River (NFKR) and Salmon and Corral Creeks for the purposes of characterization and data collection relevant to understanding potential effects of Project operation and maintenance activities on stream hydrology (Figure 3-1).

[1] The Fairview Dam Bypass Reach is defined as the approximatly 16-mile bypass reach of the North Fork Kern River between Fairview Dam and the KR3 Powerhouse trailrace.

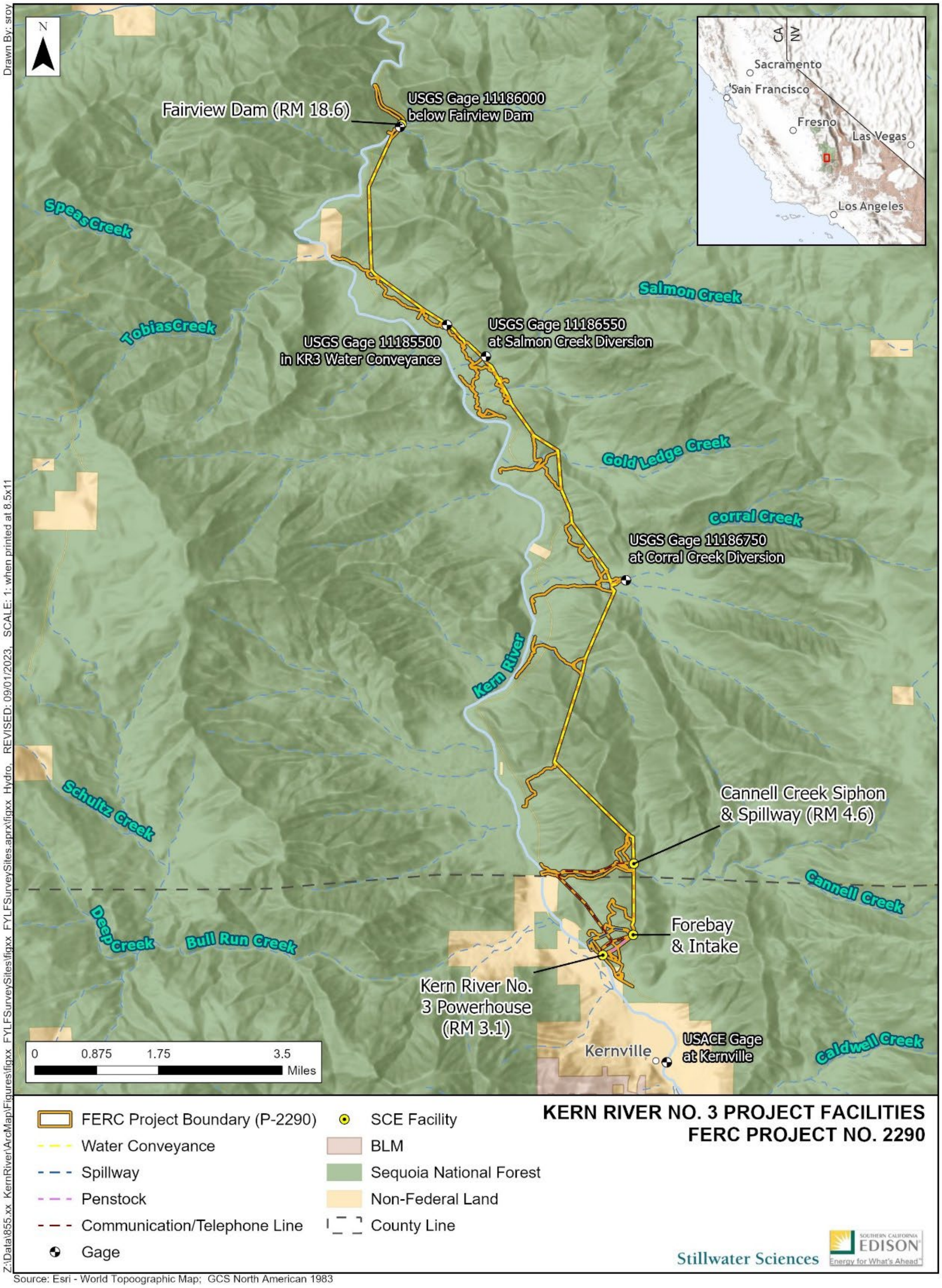


Figure 3-1. Hydrology Study Area.

Five streamflow gages are located within the study area (Table 3-1). SCE maintains four gages—two gaging stations that monitor and record water flow for KR3 Project compliance and two non-recording gaging stations. The recording gages measure flow in the Fairview Dam Bypass Reach (U.S. Geological Survey [USGS] gage 11186000) and the KR3 Water Conveyance system (USGS gage 11185500). The recorded gage data are published annually on the USGS website (USGS Water-Data Site Information for the Nation). The two other non-recording gaging stations are associated with the small diversions in Corral Creek (USGS gage 11186750) and Salmon Creek (USGS gage 11186550). These gages are inspected monthly by SCE to observe and log flow conditions at a fixed geometry orifice flow-release point (SCE, 2021).

Independent from the KR3 Project and as part of its water management system, the U.S. Army Corps of Engineers (USACE) maintains one gage on the NFKR at Kernville, approximately 2 river miles downstream of KR3 Powerhouse. USACE publishes daily flow gage data on its website (USACE, n.d.). Although the Kernville gage is not subject to USGS oversight, the Kernville USACE gage is operated to meet or exceed USGS data standards. USACE conducts monthly calibration inspections and compiles and reviews all streamflow data records prior to publication.

Table 3-1. Gages Within and Adjacent to Study Area

Name/ID	Location	Organization	Recorded Data
Gage 11186000	Fairview Bypass Reach	USGS/SCE	Yes
Gage 11185500	KR3 Water Conveyance	USGS/SCE	Yes
Gage 11186550	Salmon Creek Diversion	USGS/SCE	No
Gage 11186750	Corral Creek Diversion	USGS/SCE	No
Kernville Gage	Kernville Bridge	USACE	Yes

KR3 = Kern River No. 3; SCE = Southern California Edison; USGS = U. S. Geological Survey; USACE = U.S. Army Corps of Engineers

4.0 METHODS

Study implementation followed the methods described in SCE's RSP (SCE, 2022) and as amended by FERC in its SPD (FERC, 2022) with the following variance.

Study Plan Variances

The RSP specified that the hydrology analyses would be based on water years (WYs) 1997 through 2021. The study incorporated WY 2022 hydrology data into the analysis as the additional data was available at the time of the analysis.

4.1. HYDROLOGY

Flow data are available to assess watershed hydrology from the gages at the Fairview Dam Bypass Reach, the KR3 Project Water Conveyance, and the USACE gage in Kernville over the current license period (i.e., WY 1997, beginning October 1, 1996;

through WY 2022, ending September 30, 2022).[1] Although mean flow data were recorded at USGS gages 11185500 and 11186000 from October 1, 1996, to September 30, 2004, technological data storage limitations in the early portion of the current license period resulted in only daily mean flow data being available for this period. Hourly gage data at both USGS recording gages were compiled for the remainder of the current license period (i.e., WY 2005, beginning October 1, 2004, through WY 2022, ending September 30, 2022). The dataset from both USGS gages 11185500 and 11186000 was provided to Stakeholders via email on June 30, 2023, with a link to the public website (SCE, 2023a) and comprised WYs 1997 through 2021. The data from WYs 2022 and 2023 will be provided to Stakeholders after the data review process.

A preliminary quality assurance / quality control review of the recorded data was performed to identify anomalies (e.g., data gaps, outliers, or gage limitations).

For the purposes of this statistical analysis, hourly flow data were aggregated to daily data using an arithmetic mean calculation. To characterize the hydrology in the NFKR, the daily data were summarized monthly and annually using statistical parameters such as maximum/minimum flows and mean and median flows, and are displayed graphically using hydrographs and box and whisker plots in this Technical Memorandum. Annual and monthly flow duration curves were developed to display the flow characteristics of the NFKR without regard to the sequence of occurrence.

4.2. CALIFORNIA ENVIRONMENTAL FLOWS FRAMEWORK

The WR-2 Study Plan also includes the NFKR application of Section A of the CEFF, as detailed in the 2021 CEFF Technical Report (CEFWG, 2021a). CEFF is a framework that provides technical guidance to aid in the development of scientifically defensible environmental flow recommendations that balance human and ecosystem water needs. CEFF is a 12-step process divided into Sections A, B, and C. The outcome of Section A is a set of ecological flow criteria derived from natural functional flow metrics that characterize the natural variability in flow that supports essential ecosystem functions in the absence of human modification (CEFWG, 2021a). The four steps of CEFF Section A were applied to the NFKR, as described in the following sections.

4.2.1. STEP 1A: LOCATION OF INTEREST

The study area includes the section of NFKR between Fairview Diversion Dam and the KR3 Powerhouse. The locations of interest (LOIs) were selected based on the location of infrastructure features within the study area.

4.2.2. STEP 1B: ECOLOGICAL MANAGEMENT GOALS

For each LOI, ecological management goals (EMGs) associated with flow in the NFKR and applicable to the LOI were defined by conducting a literature review of federal, state, and local policies, programs, and plans.

[1] The USACE gage data are publicly available and are not summarized this memorandum.

4.2.3. Step 1c: Ecological Functions to Achieve Ecological Management Goals

The potential ecosystem functions listed in Table 1.2 of the CEFF Technical Report (CEFWG, 2021a) associated with each of the five functional flow components were reviewed (see Section 5.2.2, *Step 1b: Ecological Management Goals,* below, for a list of functional flow components). Next, the corresponding ecosystem functions that must be supported by the ecological flow criteria to achieve the EMGs identified in Step 1b were identified.

4.2.4. Step 2: Obtain Natural Ranges of Functional Flow Metrics

The CEFF analysis quantifies "natural flows" in streams using the natural functional flow metrics available from the California Natural Flows Database (CNFD) (CEFWG, 2021b), where natural flows are defined as the expected streamflow in the absence of human modification. The CNFD contains the natural functional flow metrics predicted for all stream reaches in California based on data from 1950 to approximately 2014. In the CNFD, predicted natural functional flow metrics were calculated using the functional flow metrics at USGS reference gages on California streams with minimal disturbance to natural hydrology and land cover (Falcone et al., 2010) using algorithms, which were described by Patterson et al. (2020) and based on the natural streamflow classification for California (Lane et al., 2018). Separate statistical models were then developed to predict the natural functional flow metrics at other stream reaches throughout California. Using machine-learning methods, functional flow metric values were related to watersheds and climactic characteristics following the approach described by Zimmerman et al. (2018). Natural functional flow metrics are used as ecological flow criteria in the CEFF based on the assumption that the range of natural functional flows would maintain the physical, chemical, and biological functions needed by native freshwater species (Escobar-Arias and Pasternack, 2010; Yarnell et al. 2015), and these functions would be broadly protective of ecosystem needs and achieve EMGs (Grantham et al., 2022).

CNFD flow metric predictions are provided by stream reaches defined in the NHDPlus, Version 2, dataset (USGS, 2019); each stream reach is uniquely identified with a COMmon IDentifier (COMID). A single stream reach (COMID) within the LOI was selected as representative of conditions in the LOI. The natural functional flows in the LOI were characterized using predicted metrics downloaded from the CNFD for the selected COMID (CEFWG, 2021b).

4.2.5. Step 3: Evaluate whether the Natural Ranges of Functional Flow Metrics Supports Ecosystem Functions Needed to Achieve Ecological Management Goals

Step 3 entailed the identification of potential non-flow limiting factors on the NFKR (i.e., physical channel, biogeochemical, and biological alterations) that would likely limit whether the natural ranges of the functional flow metrics would support the ecosystem functions and the EMGs identified in Step 1b. The non-flow limiting factors were assessed through an evaluation of high-resolution aerial photographs, Google Earth satellite imagery, and visual inspection of the stream channel. Per the CEFF guidelines (CEFWG, 2021a), this identification of potential non-flow limiting factors is a high-level qualitative appraisal of conditions rather than a rigorous quantification of the physical, biogeochemical, and biological alterations to the streams.

4.2.6. Step 4: Select Ecological Flow Criteria

Step 4 is predicated on the results from Step 3; if no non-flow limiting factors were identified for a functional flow component in Step 3, the CNFD-predicted natural functional flow metrics compiled in Step 2 were selected as ecological flow criteria for those functional flow components. If potential non-flow limiting factors were identified for a functional flow component, no ecological flow criteria were selected from the CNFD-predicted natural functional flow metrics and additional analysis were recommended to determine appropriate ecological flow criteria. CNFD-predicted natural functional flow metrics selected as ecological flow criteria values are expected to support the EMGs identified in Step 1b.

5.0 DATA SUMMARY

5.1. Hydrology

The available gage data for both USGS gages 11185500 and 11186000 were determined as complete with no data gaps. Within the current license period through September 30, 2022, 1,621 zero flow days in the KR3 Water Conveyance were recorded by the USGS 11185500 gage. The zero flow days are the result of outages for KR3 Project maintenance and repairs to the KR3 Water Conveyance, which led to extended periods where full flows were released in WYs 2013, 2014, and 2022.

5.1.1. Monthly Flow in North Fork Kern River

The NFKR hydrograph (seasonal streamflow pattern) for the Fairview Dam Bypass Reach and the KR3 Water Conveyance depicts that the wetter period occurs primarily during spring (April through June) when streamflow typically peaks as snow that accumulated during winter melts and increases streamflow. The NFKR streamflow begins to decrease at the beginning of summer in July, and then the NFKR usually enters a drier period for the remainder of the summer through the end of fall in December. Monthly mean, minimum, and maximum daily flows for the Fairview Dam Bypass Reach and the KR3 Water Conveyance are presented in Table 5.1-1 and Table 5.1-2, respectively. Figure 5.1-1 is a box and whisker plot summarizing the distribution and variability of the monthly data for the Fairview Dam Bypass Reach. The lower and upper whiskers are annual minimum and maximum flows, respectively, and shaded boxes represent lower quartile (Q1) through upper quartile (Q2) with the annual median at the center bar in the shaded box. Although flows on the Fairview Dam Bypass Reach are typically relatively low during winter, winter storms can cause temporary and infrequent very high peaks. Flows are most consistently high during spring (May through June), and the maximum annual flow most often occurs during the spring runoff (see Figure 5.1-2). Figure 5.1-3 is a box and whisker plot that shows the variability in KR3 Water Conveyance where higher flows are diverted during spring (May through June). Figure 5.1-4 presents the comparison between the monthly mean flow for both the Fairview Dam Bypass Reach and the KR3 Water Conveyance for the current license period.

Table 5.1-1. Monthly Flow for the Fairview Dam Bypass Reach, Water Years 1997–2022 (USGS Gage 11186000)

Month	Monthly Mean Daily Flow (cfs)	Monthly Maximum Daily Flow (cfs)	Monthly Minimum Daily Flow (cfs)
October	133	1,752	27
November	133	6,030	40
December	136	6,245	40
January	268	25,100[a]	41
February	212	5,997	42
March	370	3,048	72
April	693	4,552	102
May	1,449	6,350	101
June	1,427	7,120	88
July	620	5,370	71
August	188	1,486	29
September	126	596	26

Source: SCE, 2023b; USGS, 2023b

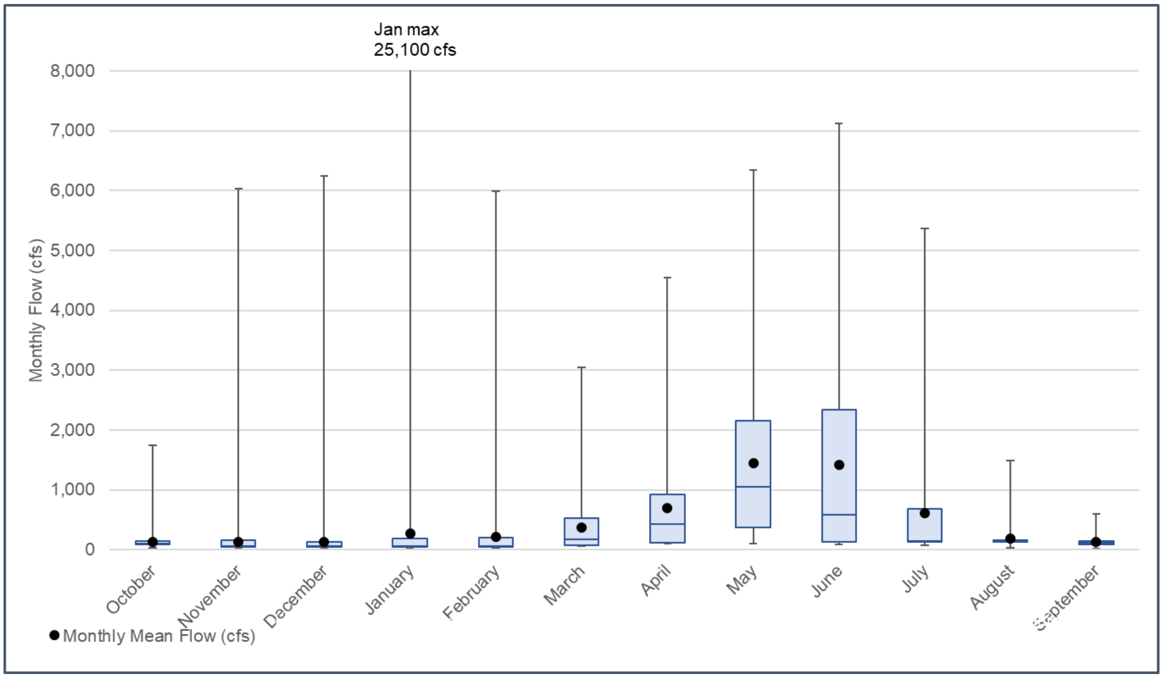
cfs = cubic feet per second
Notes:
[a] Maximum daily flow recorded on January 3, 1997.

Table 5.1-2. Monthly Flow for the Kern River No. 3 Project Water Conveyance, Water Years 1997–2022 (USGS Gage 11185500)

Month	Mean Monthly Flow (cfs)	Maximum Mean Daily Flow (cfs)	Minimum Mean Daily Flow (cfs)
October	81	525	0
November	115	574	0
December	151	591	0
January	189	594[a]	0
February	253	589	0
March	287	593	0
April	406	591	0
May	432	590	0
June	390	588	0
July	272	588	0
August	167	584	0
September	93	586	0

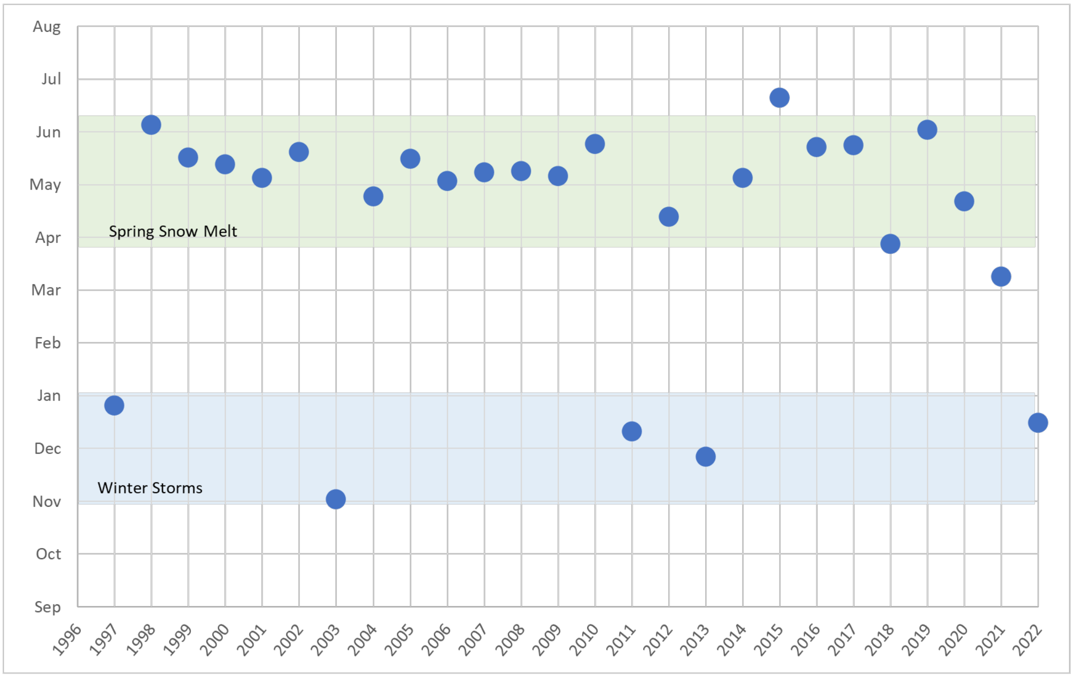
Source: SCE, 2023b; USGS, 2023a

cfs = cubic feet per second
Notes:
[a] Maximum daily flow recorded on January 3, 1997.



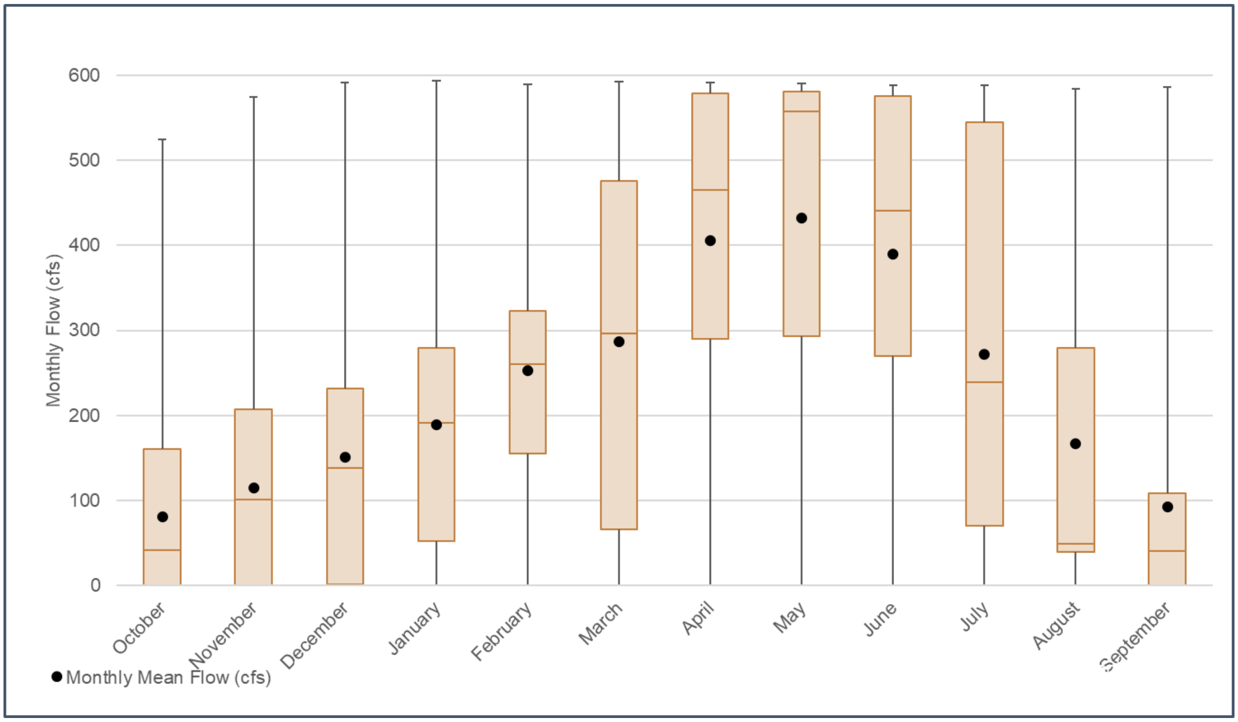
Source: SCE, 2023b; USGS, 2023b

Figure 5.1-1. Monthly Flow for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



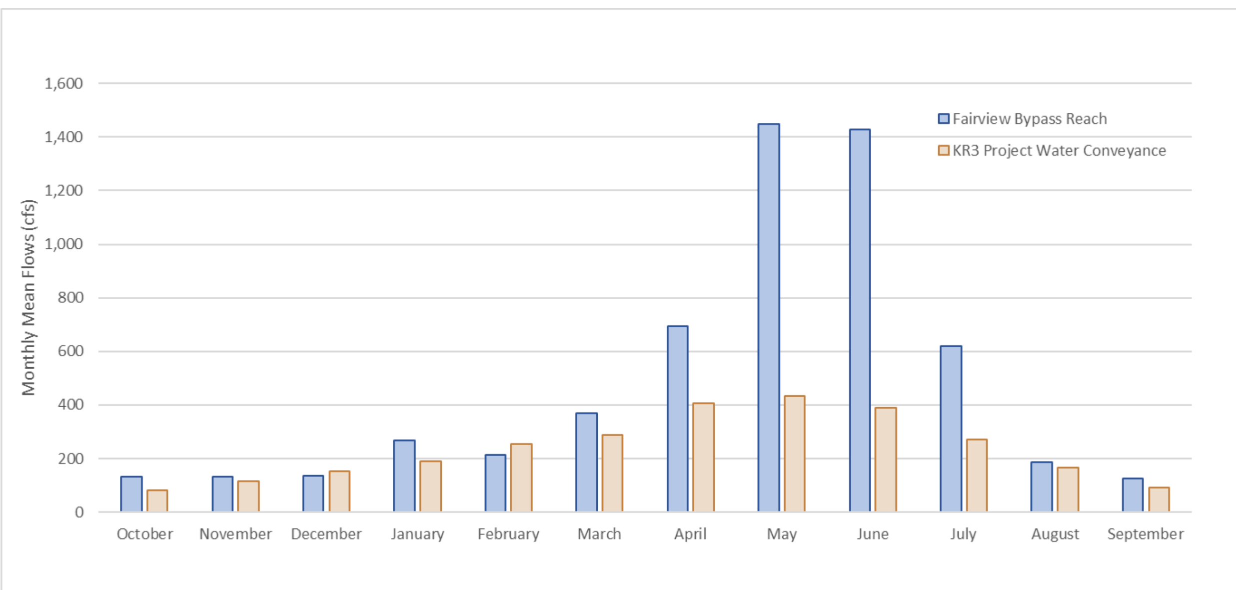
Source: SCE, 2023b; USGS, 2023b

Figure 5.1-2. Date of Maximum Flow for the North Fork Kern River Fairview Dam Bypass Reach.



Source: SCE, 2023b; USGS, 2023a

Figure 5.1-3. Monthly Flow for the Kern River No. 3 Project Water Conveyance, Water Years 1997–2022.



Source: SCE, 2023b; USGS, 2023a; USGS, 2023b

Figure 5.1-4. Monthly Mean Flow in the North Fork Kern River for the Fairview Bypass Reach and the Kern River No. 3 Water Conveyance, Water Years 1997–2022.

5.1.2. ANNUAL FLOW IN NORTH FORK KERN RIVER

Annual mean, minimum, and maximum daily flows for the Fairview Dam Bypass Reach and the KR3 Water Conveyance are presented in Table 5.1-3 and Table 5.1-4, respectively. Figures 5.1-5 and 5.1-6 are box and whisker plots summarizing the distribution of the annual data for the Fairview Dam Bypass Reach and the KR3 Water Conveyance, respectively. The lower and upper whiskers in these figures show annual minimum and maximum, respectively. Figure 5.1-7 shows the hydrograph of daily flows over the current license period (1997–2022).

Table 5.1-3. Annual Flow for the Fairview Dam Bypass Reach, Water Years 1997–2022

Water Year	Mean Annual Flow (cfs)	Maximum Mean Daily Flow (cfs)	Minimum Mean Daily Flow (cfs)
1997	930	25,100	45
1998	1,105	7,120	47
1999	188	1,300	42
2000	294	2,490	45
2001	210	1,960	43
2002	179	1,230	41
2003	377	6,030	41
2004	385	2,000	44
2005	945	6,041	49
2006	863	5,063	51
2007	185	701	47
2008	498	3,418	108
2009	305	2,403	51
2010	784	6,354	46
2011	1,236	6,245	110
2012	168	1,248	47
2013	134	499	49
2014	239	903	89
2015	91	277	26
2016	210	1,560	27
2017	1,607	6,352	44
2018	202	4,552	44
2019	1,002	5,909	41
2020	152	1,163	46
2021	96	298	39
2022	108	901	42

Source: SCE; 2023b; USGS, 2023b

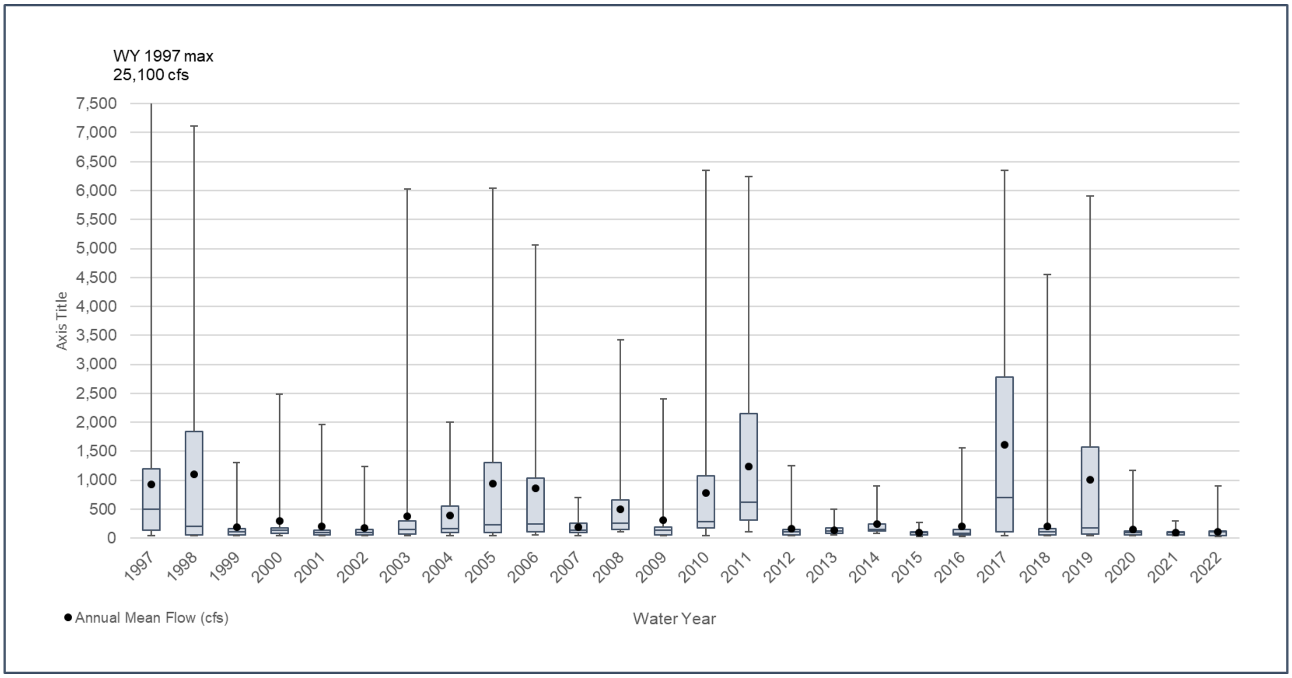
cfs = cubic feet per second

Table 5.1-4. Annual Flow for the Kern River No. 3 Project Water Conveyance, Water Years 1997–2022

Water Year	Mean Annual Flow (cfs)	Maximum Mean Daily Flow (cfs)	Minimum Mean Daily Flow (cfs)
1997	457	594	3
1998	464	591	3
1999	314	587	0
2000	251	589	0
2001	228	590	35
2002	256	588	1
2003	270	590	2
2004	125	553	0
2005	259	590	2
2006	359	593	2
2007	150	585	0
2008	115	313	0
2009	265	590	0
2010	183	324	0
2011	270	587	0
2012	283	591	0
2013	153	584	0
2014	0	0	0
2015	75	280	0
2016	246	587	0
2017	379	586	0
2018	282	580	20
2019	380	583	0
2020	265	582	42
2021	113	570	0
2022	0	0	0

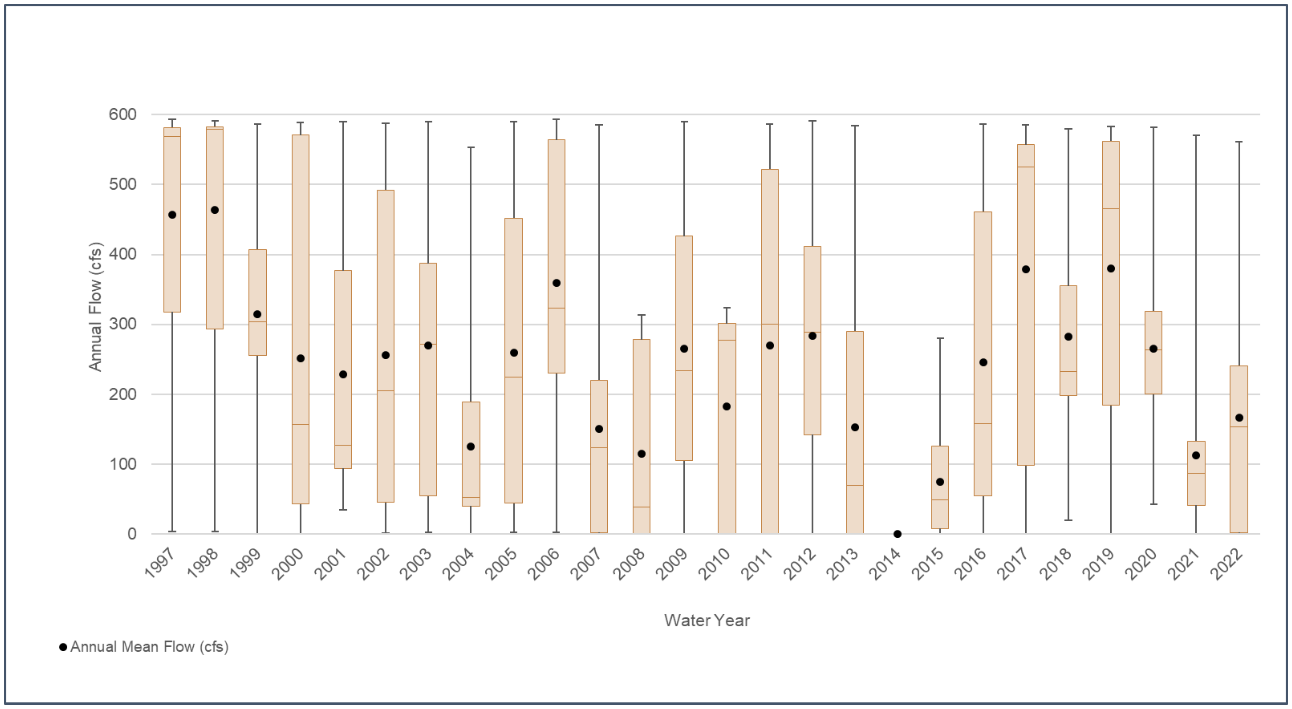
Source: SCE, 2023b; USGS, 2023a

cfs = cubic feet per second



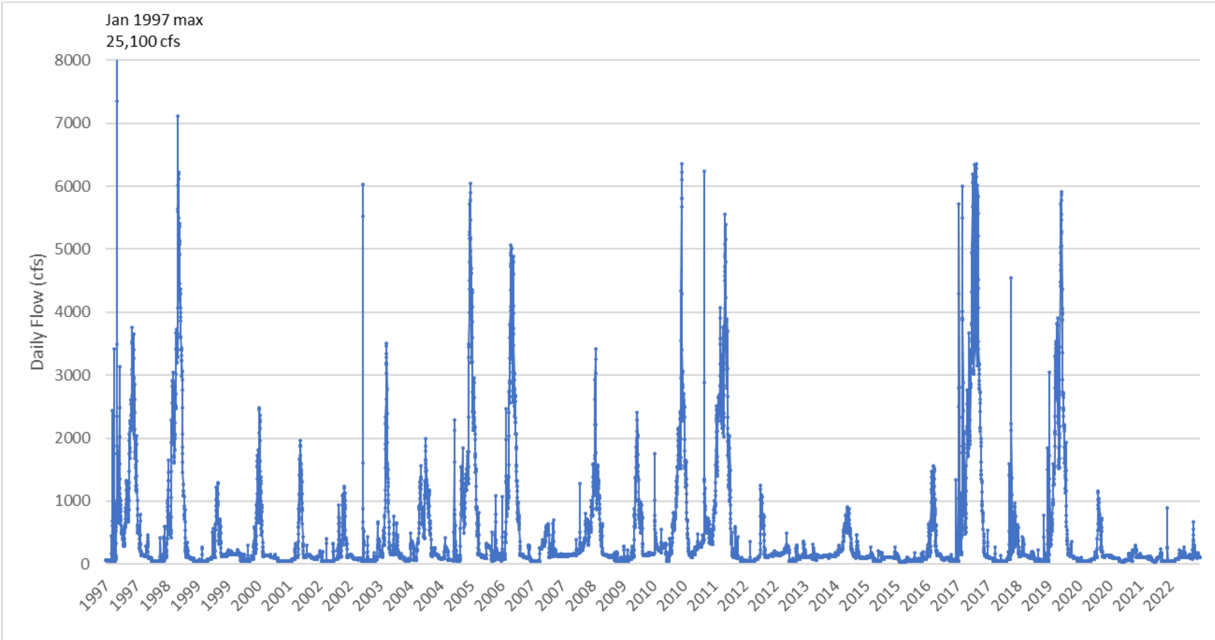
Source: SCE, 2023b; USGS, 2023b

Figure 5.1-5. Annual Flow for the Fairview Dam Bypass Reach, Water Years 1997–2022.



Source: SCE, 2023b; USGS, 2023a

Figure 5.1-6. Annual Flow for the Kern River No. 3 Project Water Conveyance, Water Years 1997–2022.



Source: SCE, 2023b; USGS, 2023b

Figure 5.1-7. Daily Flow for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.

5.1.3. Flow Duration Curves

Monthly flow duration curves for the Fairview Diversion Dam Bypass Reach (USGS gage 11186000) are in Appendix A, Figures A-1 through Figure A-12. Annual flow duration curves for the Fairview Diversion Dam Bypass Reach (USGS gage 11186000) and the KR3 Water Conveyance (USGS gage 11185500) are shown in Appendix A, Figure A-13 and Figure A-14.

5.2. California Environmental Flows Framework Results

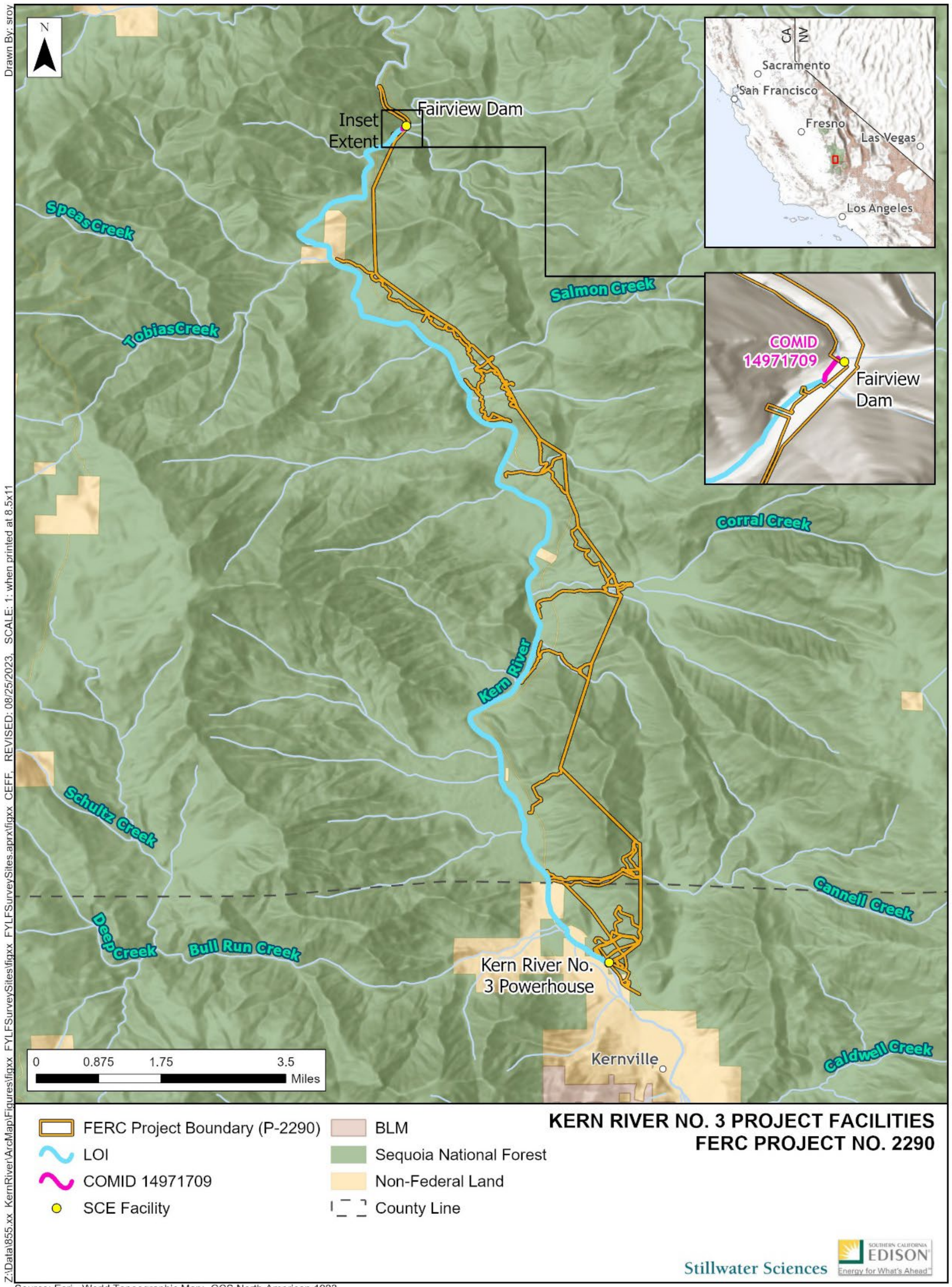
5.2.1. Step 1a: Location of Interest

Given the intent of the data to inform discussions related to instream flow releases downstream of Fairview Dam, a single LOI (NFKR LOI 1) downstream of Fairview Diversion Dam was selected for CEFF Section A evaluation. NFKR LOI 1 extends from immediately downstream of Fairview Dam (RM 18.6) to the KR3 Powerhouse (RM 3.1) (Table 5.2-1 and Figure 5.2-1).

Table 5.2-1. Summary of North Fork Kern River Location of Interest for California Environmental Flows Framework Section A Analysis

Location of Interest	From	To	Description
NFKR LOI 1	RM 3.1	RM 18.6	NFKR immediately downstream of Fairview Dam

LOI = location of interest; NFKR = North Fork Kern River; RM = River Mile



Source: Esri - World Topoographic Map; GCS North American 1983

COMID = COMmon IDentifier (to uniquely identify stream reaches in the NHDPlus, Version 2, dataset [USGS, 2019]); LOI = location of interest

Figure 5.2-1. North Fork Kern River, California Environmental Flows Framework Location of Interest, Immediately Downstream of Fairview Dam.

5.2.2. Step 1b: Ecological Management Goals

Six EMGs were identified for the LOI from a literature review of federal, state, and local policies, programs, and plans. The six EMGs range from very broad to species-specific. Table 5.2-2 summarizes these six EMGs, sorted chronologically by planning source.

Table 5.2-2. Ecological Management Goals for the North Fork Kern River California Environmental Flows Framework Section A Analysis

EMG #	Ecological Management Goal	Planning Document Source
EMG 1	Restore the structure and composition of riparian areas	Sequoia National Forest Land and Management Plan (USFS, 2023)
EMG 2	Abundance and Richness: Maintain and increase ecosystem and native species distributions in California, while sustaining and enhancing species abundance and richness	California State Wildlife Action Plan (CDFW, 2015) [a]
EMG 3	Enhance Ecosystem Conditions: Maintain and improve ecological conditions vital for sustaining ecosystems in California	
EMG 4	Enhance Ecosystem Functions and Processes: Maintain and improve ecosystem functions and processes vital for sustaining ecosystems in California	
EMG 5	Protect and restore cold-water ecosystems	*Strategic Plan for Trout Management: A Plan for 2004 and Beyond* (CDFW, 2003) [a]
EMG 6	Protect and enhance native fish populations and their habitats	*Upper Kern Basin Fishery Management Plan* (CDFG, 1995)

CDFW= California Department of Fish and Wildlife; CEFF = California Environmental Flows Framework; EMG = Ecological Management Goal

Notes:

[a] State-wide plan

5.2.3. Step 1c: Ecological Functions to Achieve Ecological Management Goals

Ecosystem functions identified as essential for achieving the six EMGs in NFKR LOI 1 are summarized in Table 5.2-3. Ecosystem functions not identified as essential for NRKR EMGs may still be important for the overall NFKR ecosystem health but were less critical to achieving the NRKR EMGs.

Table 5.2-3. Ecosystem Functions for the North Fork Kern River California Location of Interest 1, Environmental Flows Framework, Section A Analysis

Functional Flow Component	Ecosystem Function	EMG 1	EMG 2	EMG 3	EMG 4	EMG 5	EMG 6
Fall Pulse Flow	Flush fine sediment and organic material from substrate		●	●	●	●	●
	Increase longitudinal connectivity						
	Increase riparian soil moisture	●	●	●	●	●	●
	Flush organic material downstream and increase nutrient cycling	●	●	●	●	●	●
	Modify salinity conditions in the estuary/tidally influenced river						
	Reactivate exchanges/connectivity with hyporheic zone	●	●	●	●	●	●
	Decrease water temperature and increase dissolved oxygen	●	●	●	●	●	●
	Support fish migration to spawning areas						
Wet-season baseflow	Increase longitudinal connectivity	●	●	●	●	●	●
	Increase shallow groundwater (riparian)	●	●	●	●	●	
	Support hyporheic exchange	●	●	●	●	●	●
	Support migration, spawning, and residency of aquatic organisms		●	●	●	●	●
	Support channel margin riparian habitat	●	●	●	●	●	●
Wet-season peak flow	Scour and deposit sediments and large wood in channel and floodplains and overbank areas	●	●	●	●	●	●
	Encompasses maintenance and rejuvenation of physical habitat	●	●	●	●	●	●
	Increase lateral connectivity, recharge groundwater (floodplains)	●	●	●	●	●	●
	Increase nutrient cycling on floodplains	●	●	●	●	●	●
	Increase exchange of nutrients and organic matter between floodplains and channel	●	●	●	●	●	●
	Support fish spawning and rearing in floodplains and overbank areas		●	●	●	●	●

Functional Flow Component	Ecosystem Function	EMG 1	EMG 2	EMG 3	EMG 4	EMG 5	EMG 6
	Support plant biodiversity via disturbance, riparian succession, and extended inundation in floodplains and overbank areas	●	●	●	●	●	●
	Limit vegetation encroachment and non-native aquatic species via disturbance	●	●	●	●	●	●
Spring recession flow	Sorting of sediments via increased sediment transport and size selective deposition	●	●	●	●	●	●
	Recharge groundwater (floodplains)	●	●	●	●	●	●
	Increase lateral and longitudinal connectivity	●	●	●	●	●	●
	Decrease water temperatures and increase turbidity		●	●	●	●	●
	Increase export of nutrients and primary producers from floodplain to channel	●	●	●	●	●	●
	Provide hydrologic cues for fish outmigration and amphibian spawning; support juvenile fish rearing		●	●	●	●	●
	Increase hydraulic habitat diversity and habitat availability resulting in increased algal productivity, macroinvertebrate diversity, arthropod diversity, fish diversity, and general biodiversity	●	●	●	●	●	●
	Provide hydrologic conditions for riparian species recruitment	●	●	●	●	●	●
	Limit riparian vegetation encroachment into channel	●	●	●	●	●	●
Dry season baseflow	Maintain riparian soil moisture	●	●	●	●	●	
	Limit longitudinal connectivity in ephemeral streams; limit lateral connectivity to disconnect floodplains	●	●	●	●	●	●
	Maintain longitudinal connectivity in perennial streams	●	●	●	●	●	●
	Maintain water temperature and dissolved oxygen	●	●	●	●	●	●
	Maintain habitat availability for native aquatic species (broadly)	●	●	●	●	●	●
	Condense aquatic habitat to limit non-native species and support for native predators	●	●	●	●	●	●
	Support primary and secondary producers	●	●	●	●	●	●

COMID = COMmon IDentifier; EMG = ecological management goal (see Table 5.2-2)

5.2.4. Step 2: Obtain Natural Ranges of Functional Flow Metrics

The NHDPlus COMID 14971709 was selected as representative of NFKR LOI 1 because it is the upstream-most stream reach within the LOI (Table 5.2-1 and Figure 5.2-1). In the CEFF context, the range (10th percentile, median, and 90th percentile) of natural functional flows for each metric at COMID 14971709 characterize the predicted (modeled) flow metrics for the study LOI. The natural functional flow metrics are compiled in Table 5.2-4.

Table 5.2-4. Functional Flow Metrics from the California Natural Flows Database for the North Fork Kern River Location of Interest 1, California Environmental Flows Framework, Section A Analysis

Functional Flow Component	Flow Metric	Unit	Predicted Range at NFKR LOI 1 COMID 14971709		
			10th percentile	Median	90th percentile
Fall pulse flow	Fall pulse magnitude	cfs	202	506	1,069
	Fall pulse start	day of WY	3	42	64
	Fall-pulse duration	days	2	3	7
Wet-season baseflow	Wet-season baseflow	cfs	177	335	516
	Wet-season median baseflow	cfs	636	1,001	1,810
	Wet-season start	day of WY	120	158	185
	Wet-season duration	days	60	92	143
Wet-season peak flow	2-year flood magnitude	cfs	2,150	3,890	8,410
	2-year flood duration	days	1	13	47
	2-year flood frequency	occurrences	1	2	5
	5-year flood magnitude	cfs	4,580	7,310	16,800
	5-year flood duration	days	1	2	12
	5-year flood frequency	occurrences	1	1	3
	10-year flood magnitude	cfs	3,530	11,400	30,000
	10-year flood duration	days	1	1	4
	10-year flood frequency	occurrences	1	1	1

Functional Flow Component	**Flow Metric**	**Unit**	**Predicted Range at NFKR LOI 1 COMID 14971709**		
			10th percentile	**Median**	**90th percentile**
Spring recession flow	Spring recession magnitude	cfs	1,375	2,679	4,625
	Spring start	day of WY	236	255	273
	Spring duration	days	49	73	104
	Spring rate of change	%	4.3%	6.1%	8.9%
Dry-season baseflow	Dry-season baseflow	cfs	66	195	366
	Dry-season high baseflow	cfs	144	398	930
	Dry-season start	day of WY	296	326	353
	Dry-season duration	days	150	198	236

cfs = cubic feet per second; LOI = location of interest; NFKR = North Fork Kern River; WY = water year
Note:
WYs extend from October 1 to September 30, so October 1 is the first day of the WY.

5.2.5. Step 3: Evaluate Whether the Natural Ranges of Functional Flow Metrics Supports Ecosystem Functions Needed to Achieve Ecological Management Goals

There were no physical, biogeochemical, or biological modifications identified in the NFKR LOI 1 that would constitute a non-flow limiting factor and influence whether the range of natural functional flows would support the ecosystem functions needed to achieve the established EMGs of the NFKR.

5.2.6. Step 4: Select Ecological Flow Criteria

The natural range of functional flow metrics specified in Step 2 (Table 5.2-4) were selected as the ecological flow criteria for NFKR LOI 1 because there were no non-flow limiting factors identified in Step 3 and the range of natural functional flow metrics were expected to support the ecosystem functions required to achieve the six EMGs for NFKR LOI 1 (Table 5.2-2).

6.0 STUDY SPECIFIC CONSULTATION

- The hydrology dataset from both USGS gages 11185500 and 11186000 beginning October 1, 1996, through September 30, 2021, was provided to Stakeholders via email on June 30, 2023, with a link to the Project website (SCE, 2023a).
- Compiled hydrology data from WYs 2022 and 2023 will also be provided to Stakeholders after the annual data review process.

7.0 OUTSTANDING STUDY PLAN ELEMENTS

The anticipated schedule to complete the remaining tasks associated are identified in Table 7-1.

Table 7-1. Schedule

Date	Activity
Winter 2023—Summer 2024	Compile additional flow data to inform the flow travel time calculations. Summarize existing flow data from Salmon and Corral Creeks. Review and disseminate hourly gage data for WYs 2022 and 2023.
Summer-Fall 2024	Analyze data and prepare final Technical Memorandum.

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APPENDIX A
FLOW DURATION CURVES

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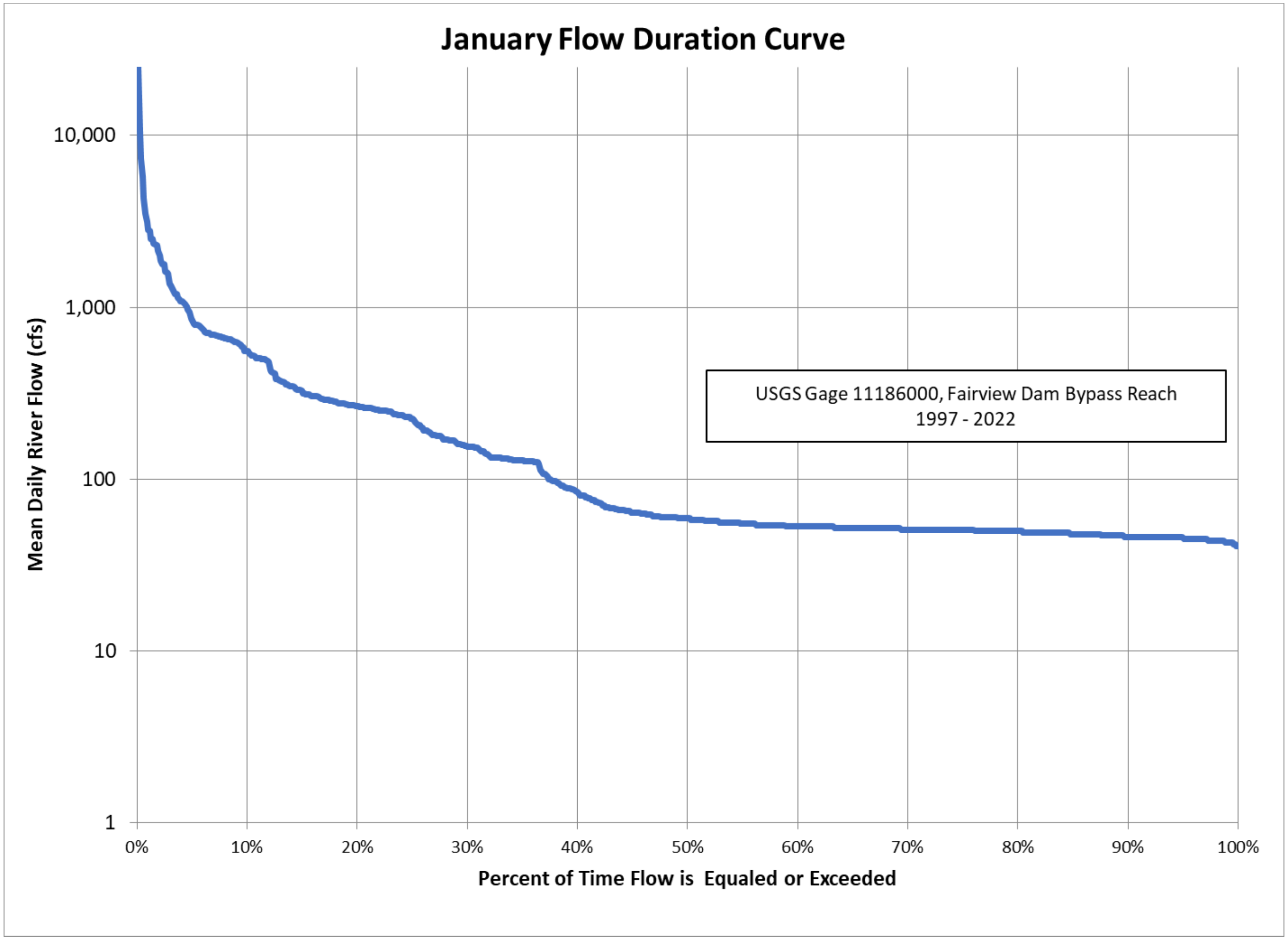
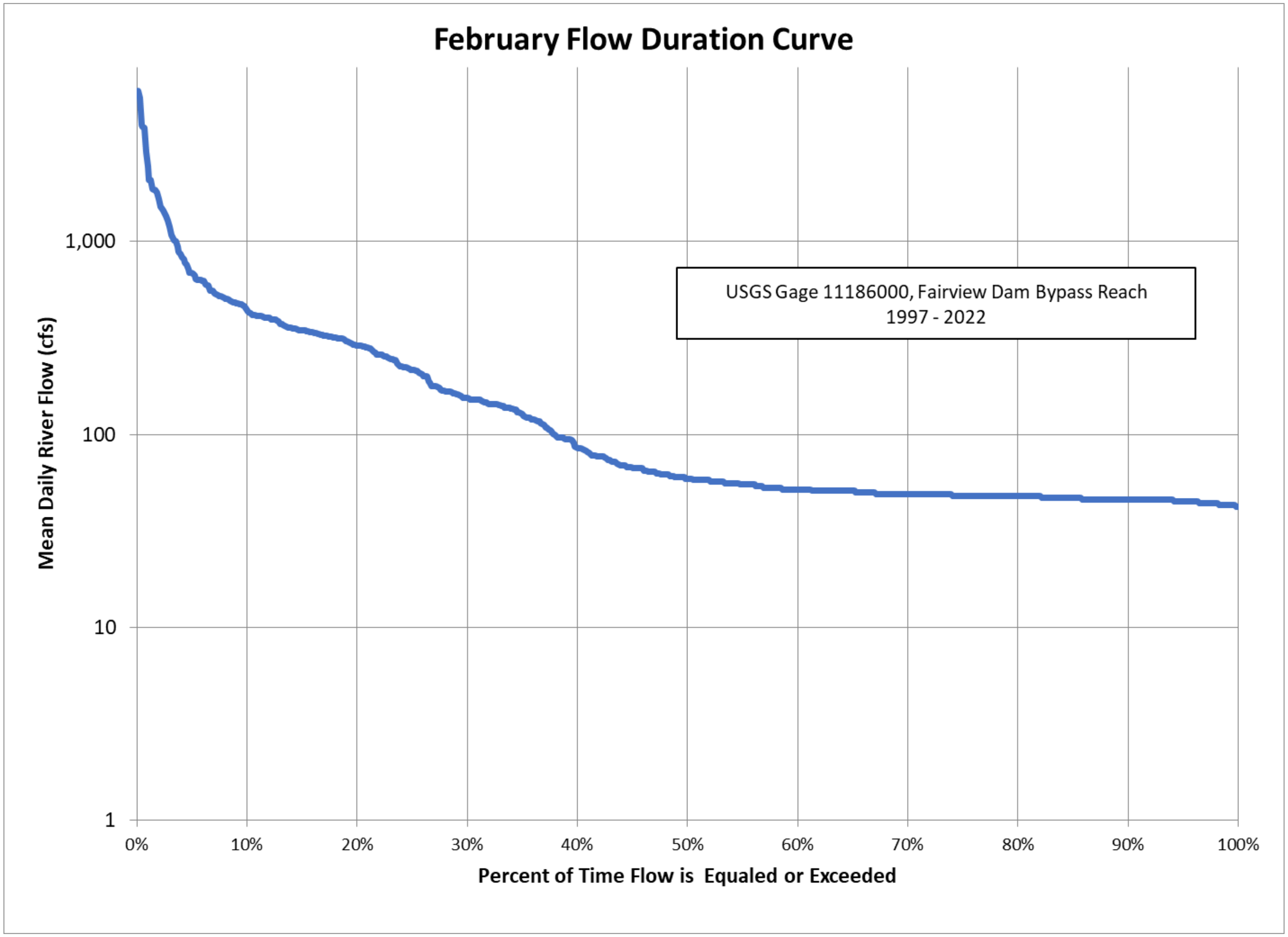


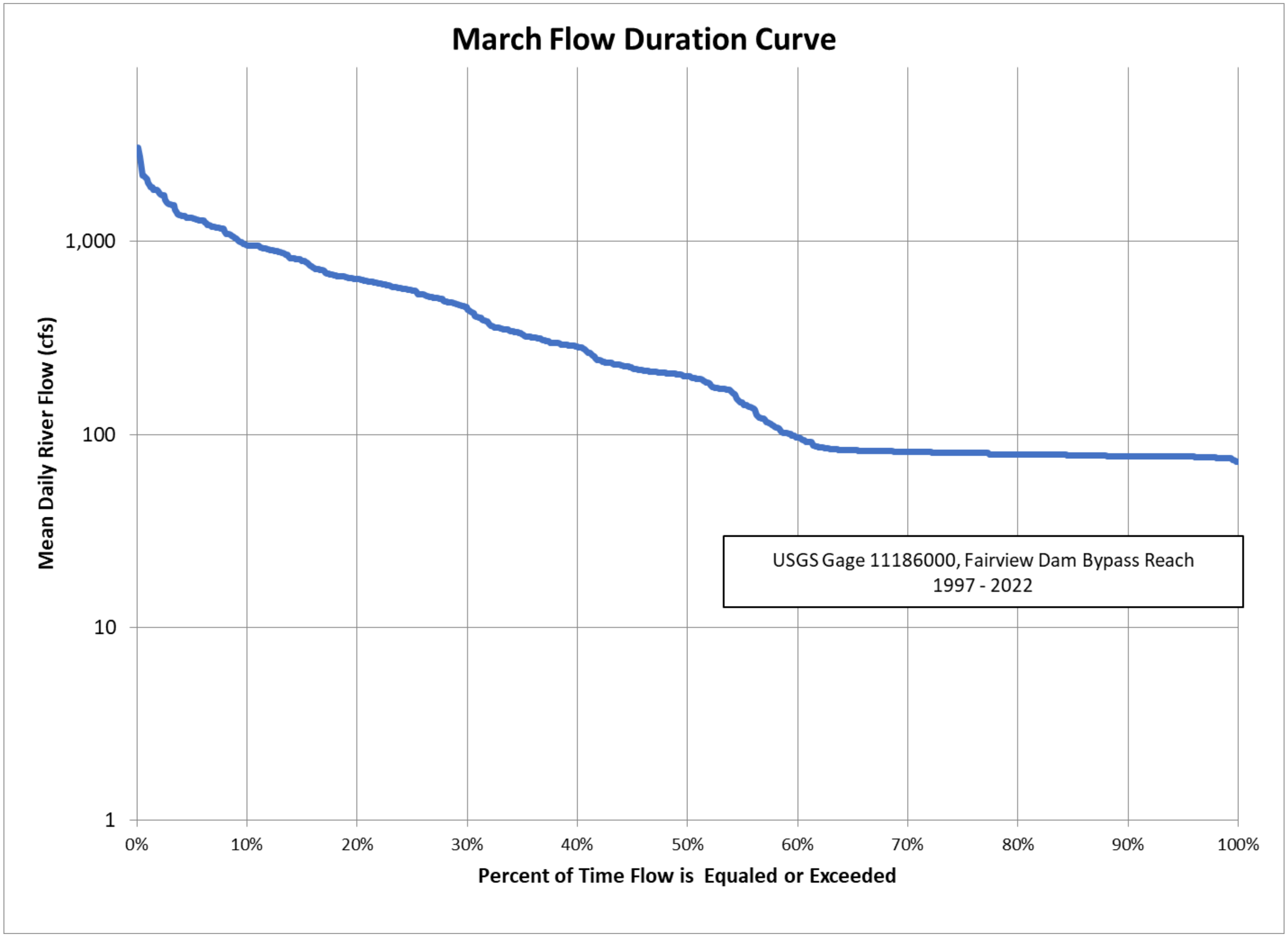
Source: SCE, 2023b; USGS, 2023b

Figure A-1. January Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



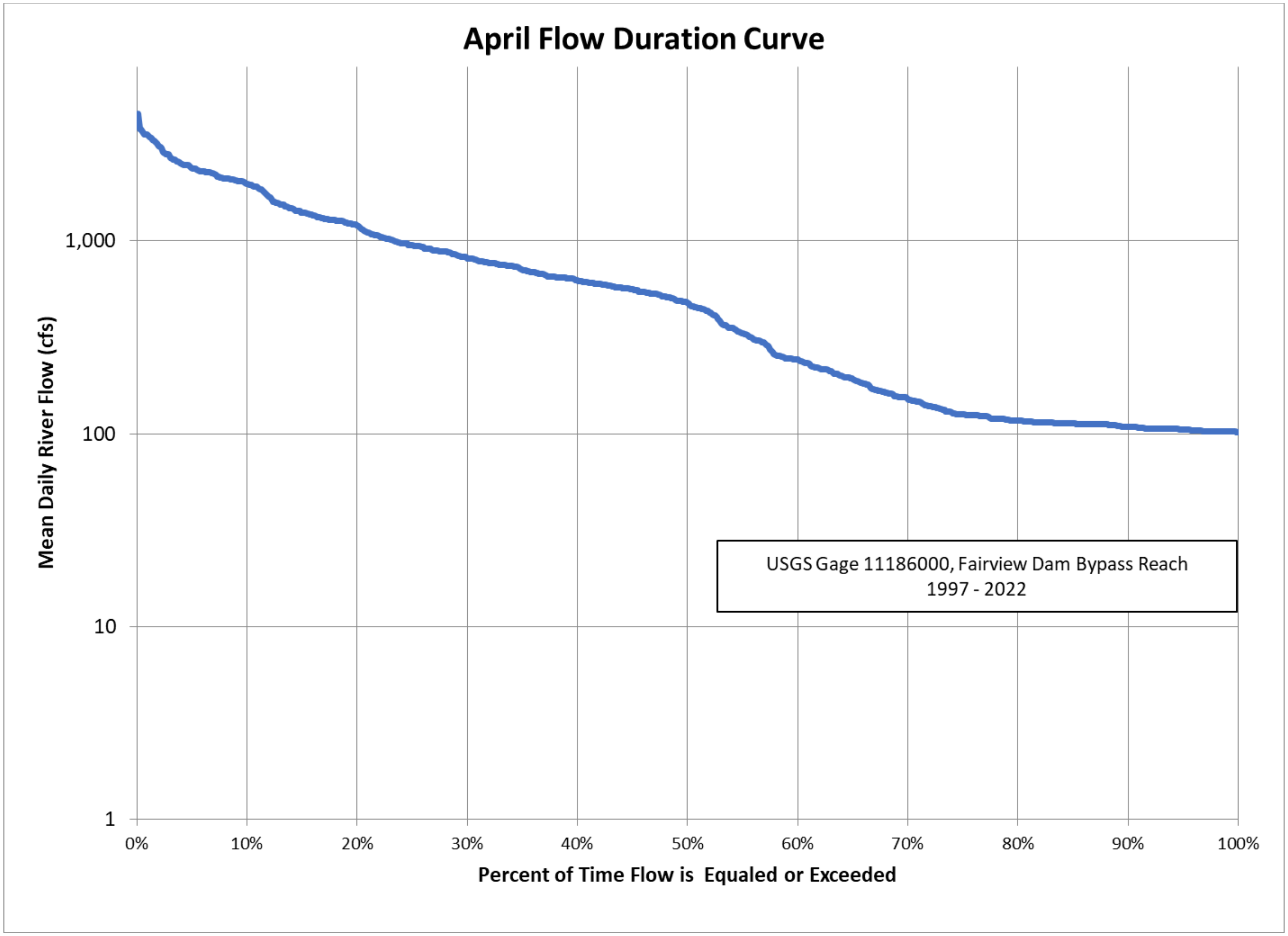
Source: SCE, 2023b; USGS, 2023b

Figure A-2. February Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



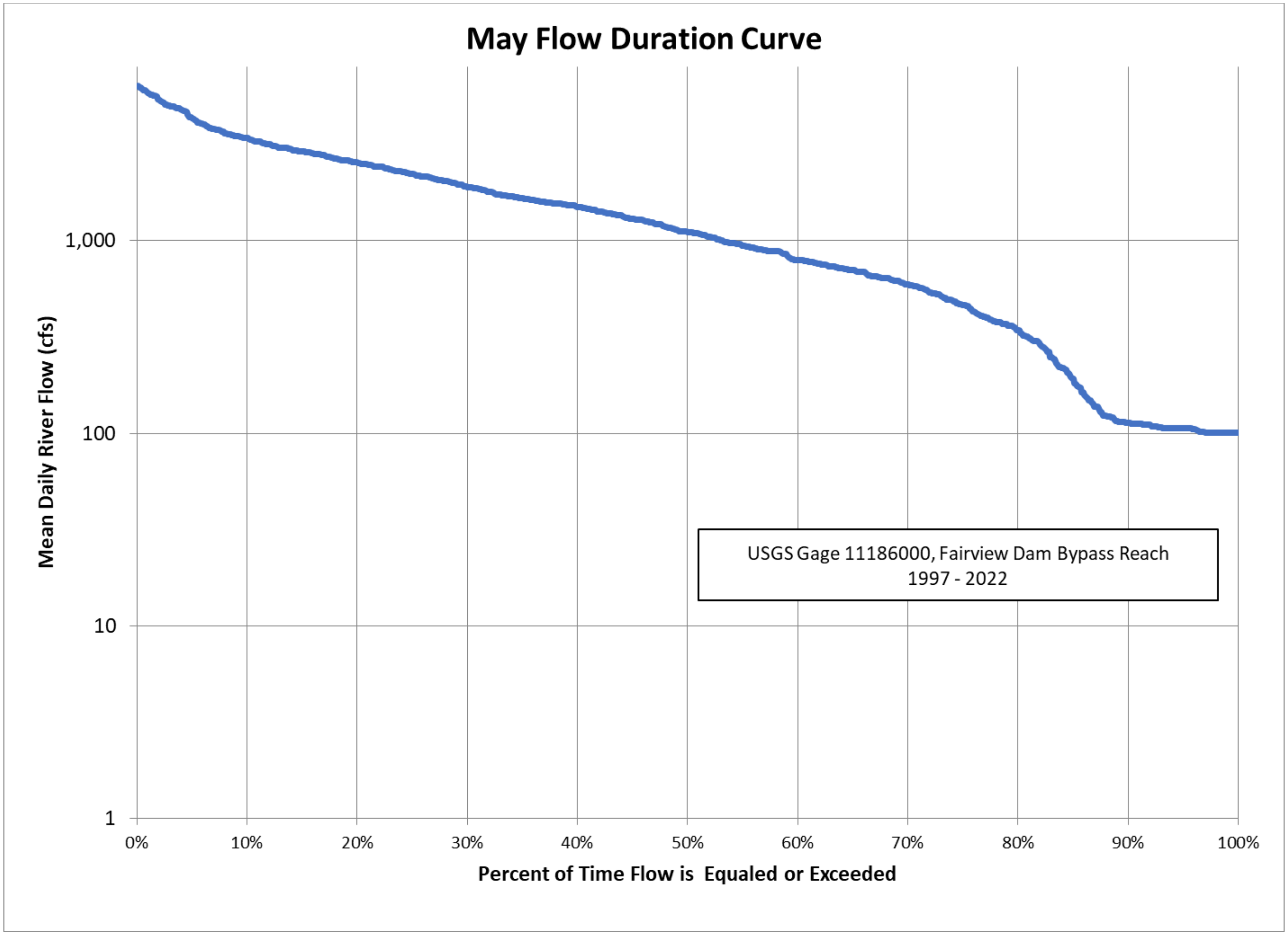
Source: SCE, 2023b; USGS, 2023b

Figure A-3. March Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



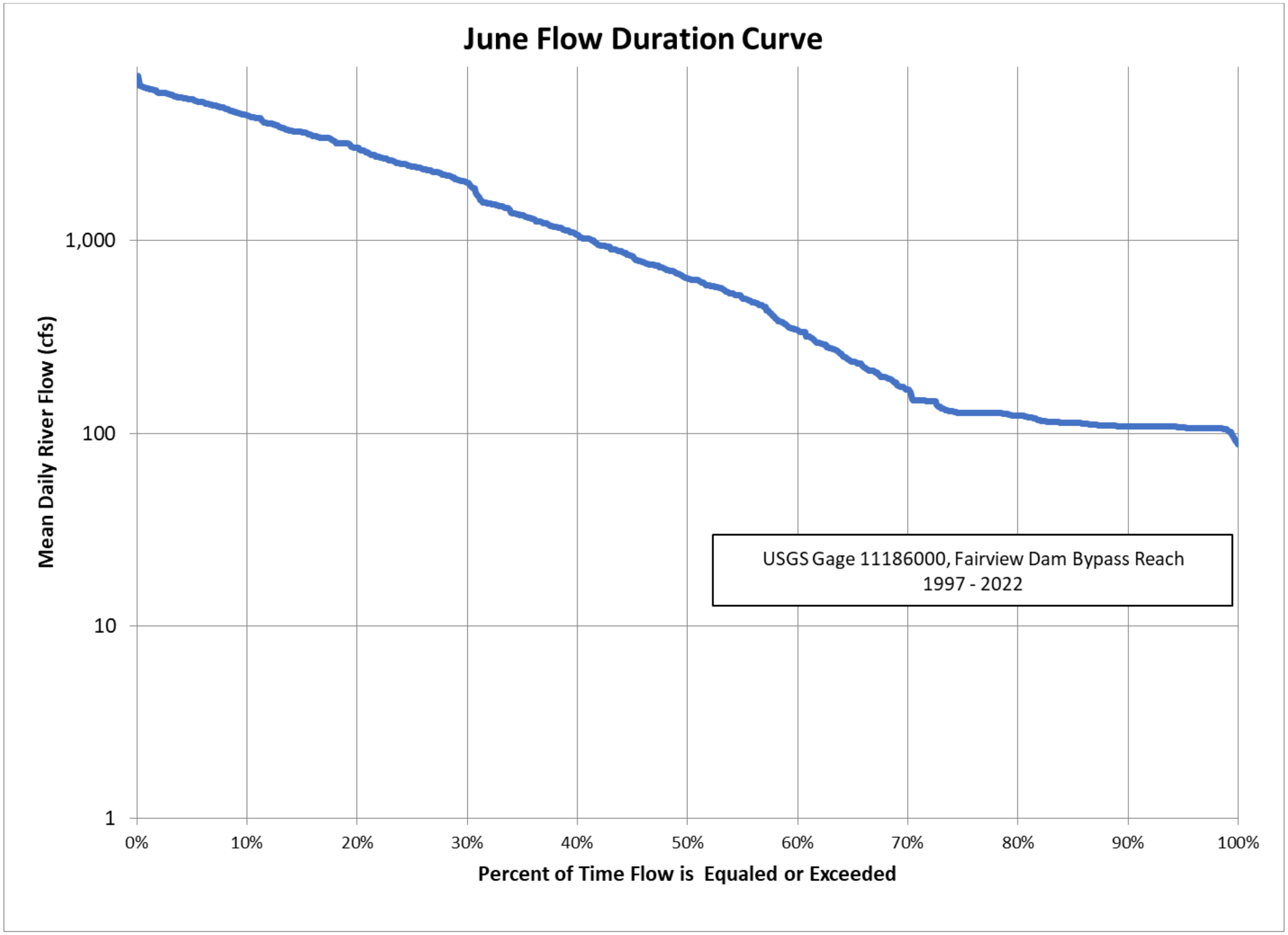
Source: SCE, 2023b; USGS, 2023b

Figure A-4. April Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



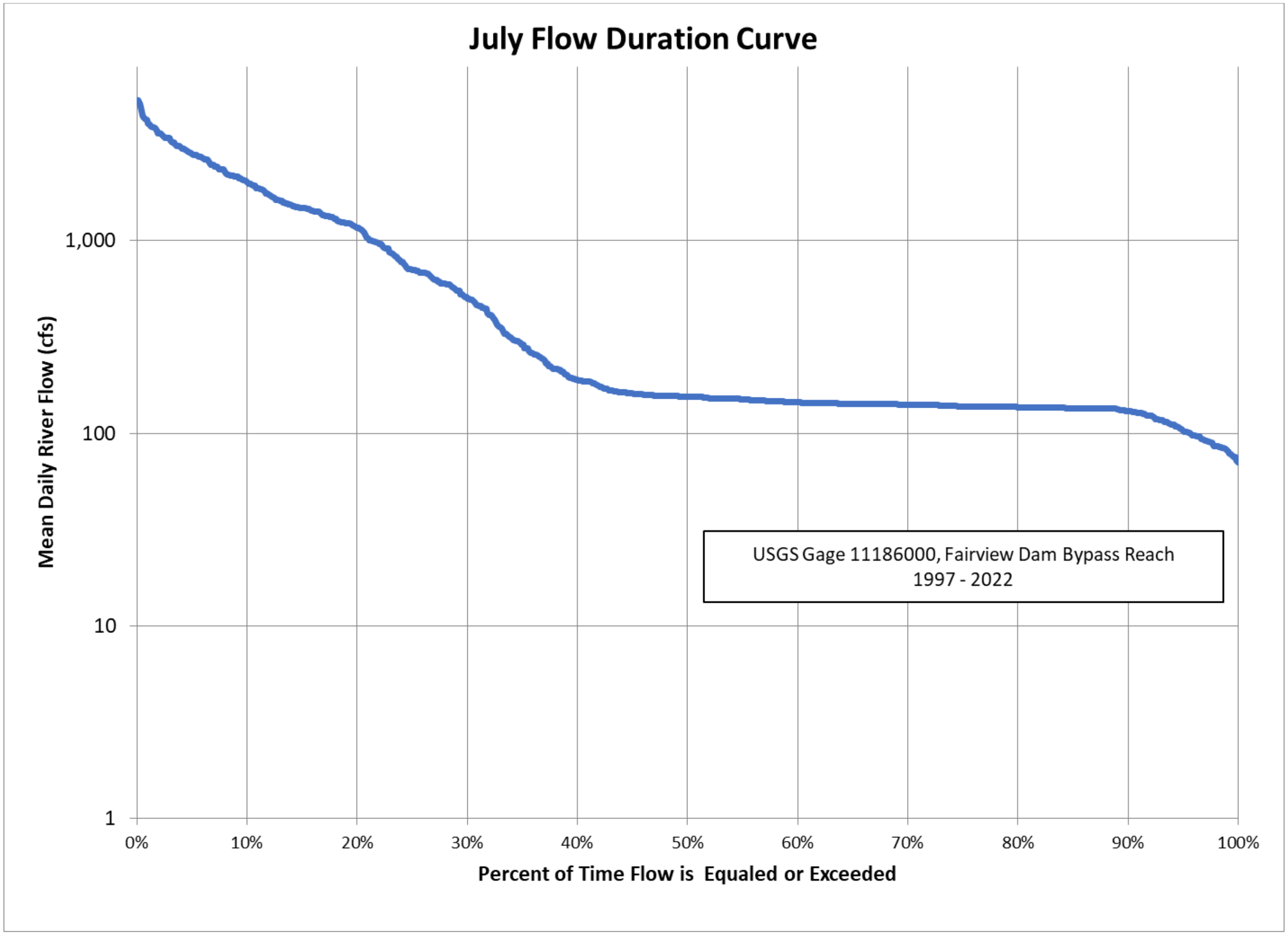
Source: SCE, 2023b; USGS, 2023b

Figure A-5. May Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



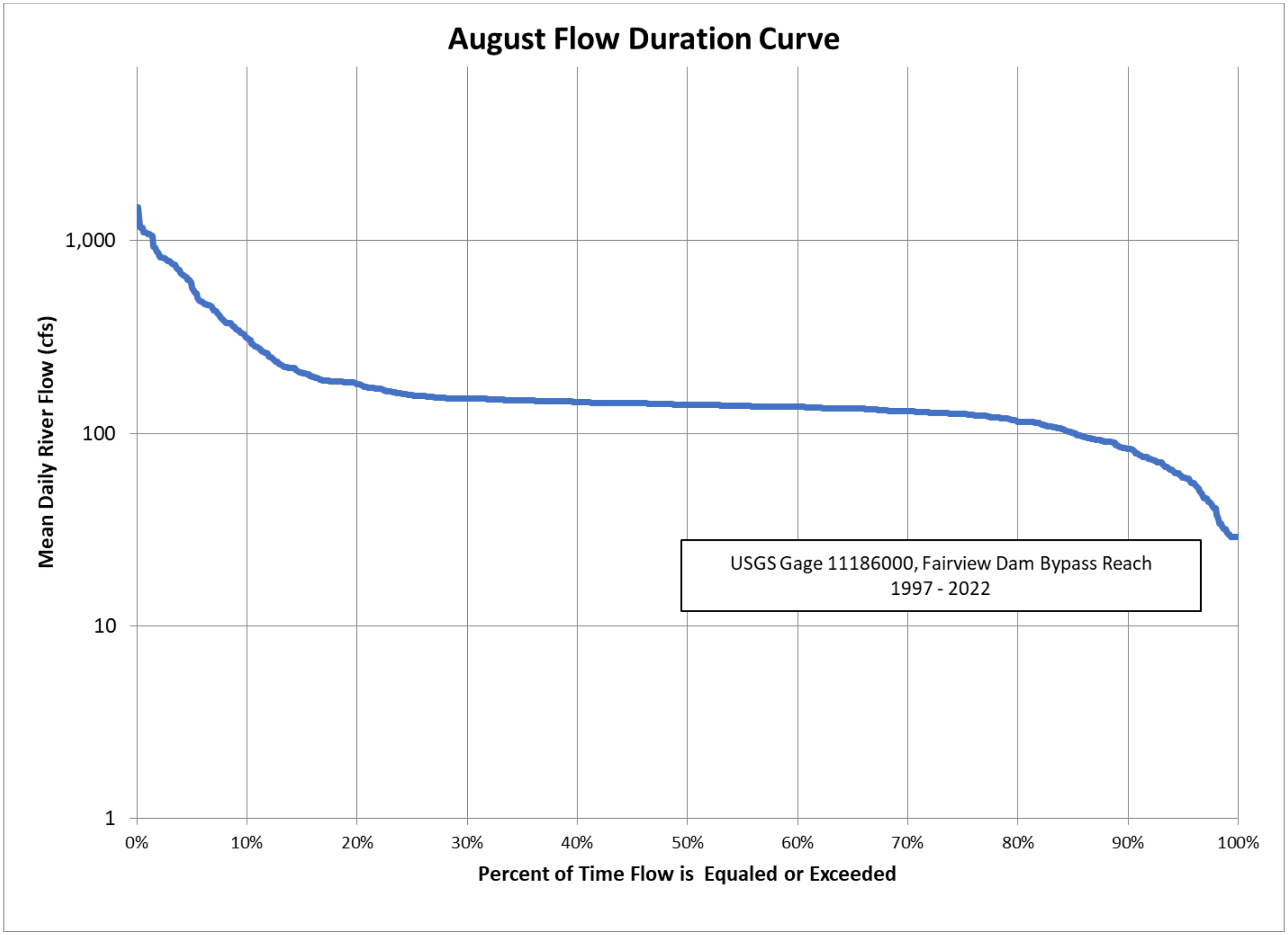
Source: SCE, 2023b; USGS, 2023b

Figure A-6. June Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



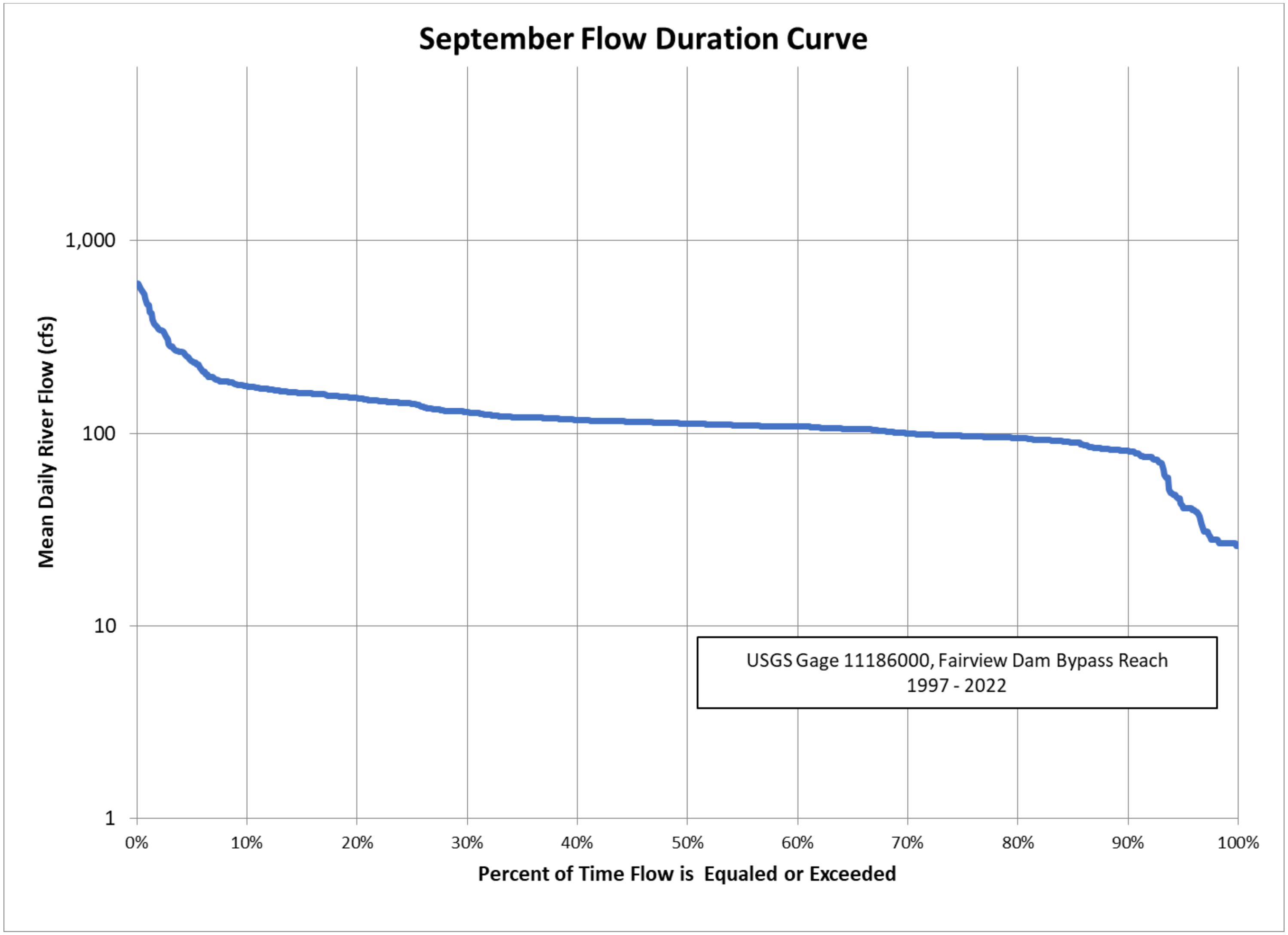
Source: SCE, 2023b; USGS, 2023b

Figure A-7. July Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



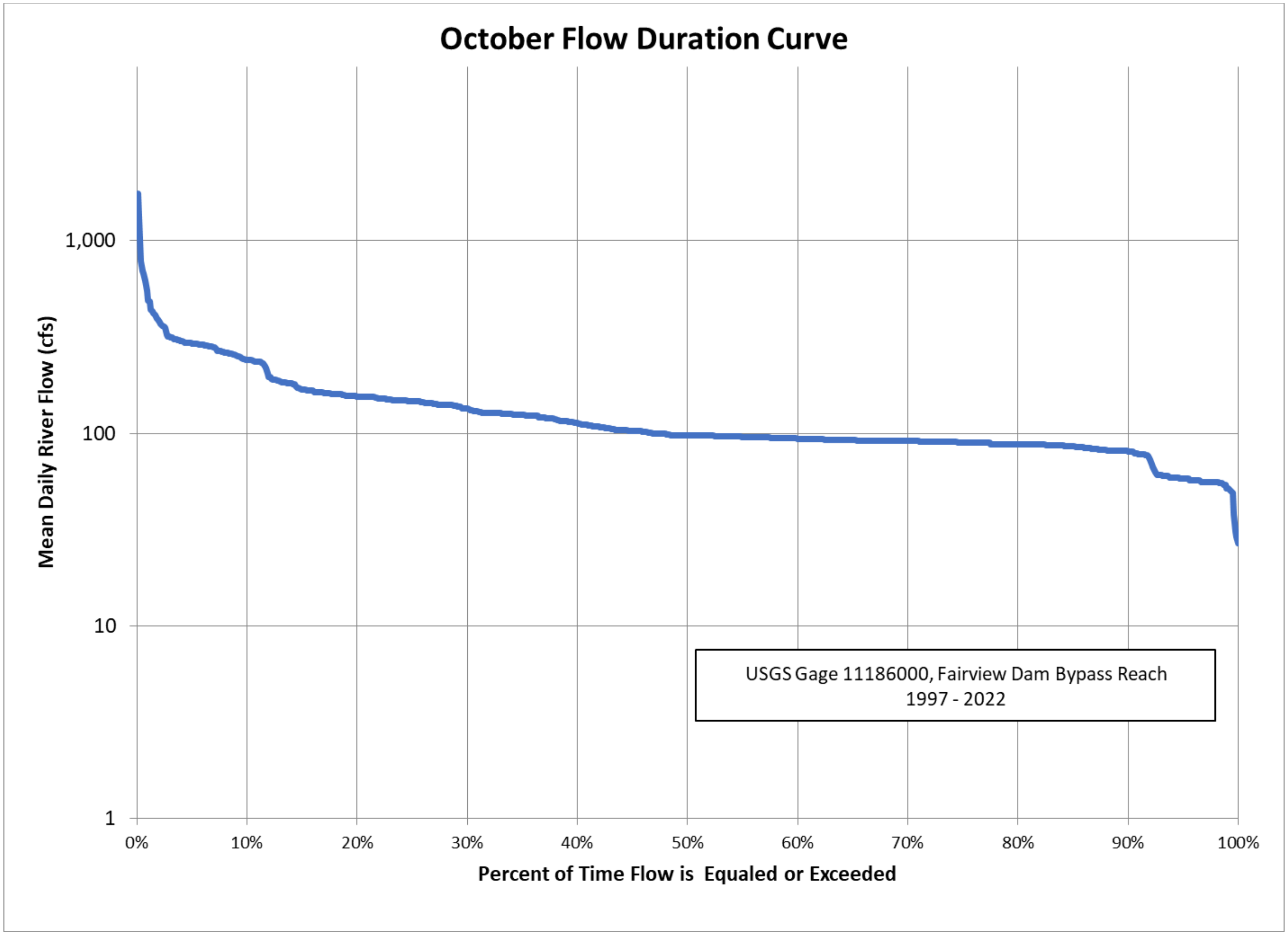
Source: SCE, 2023b; USGS, 2023b

Figure A-8. August Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



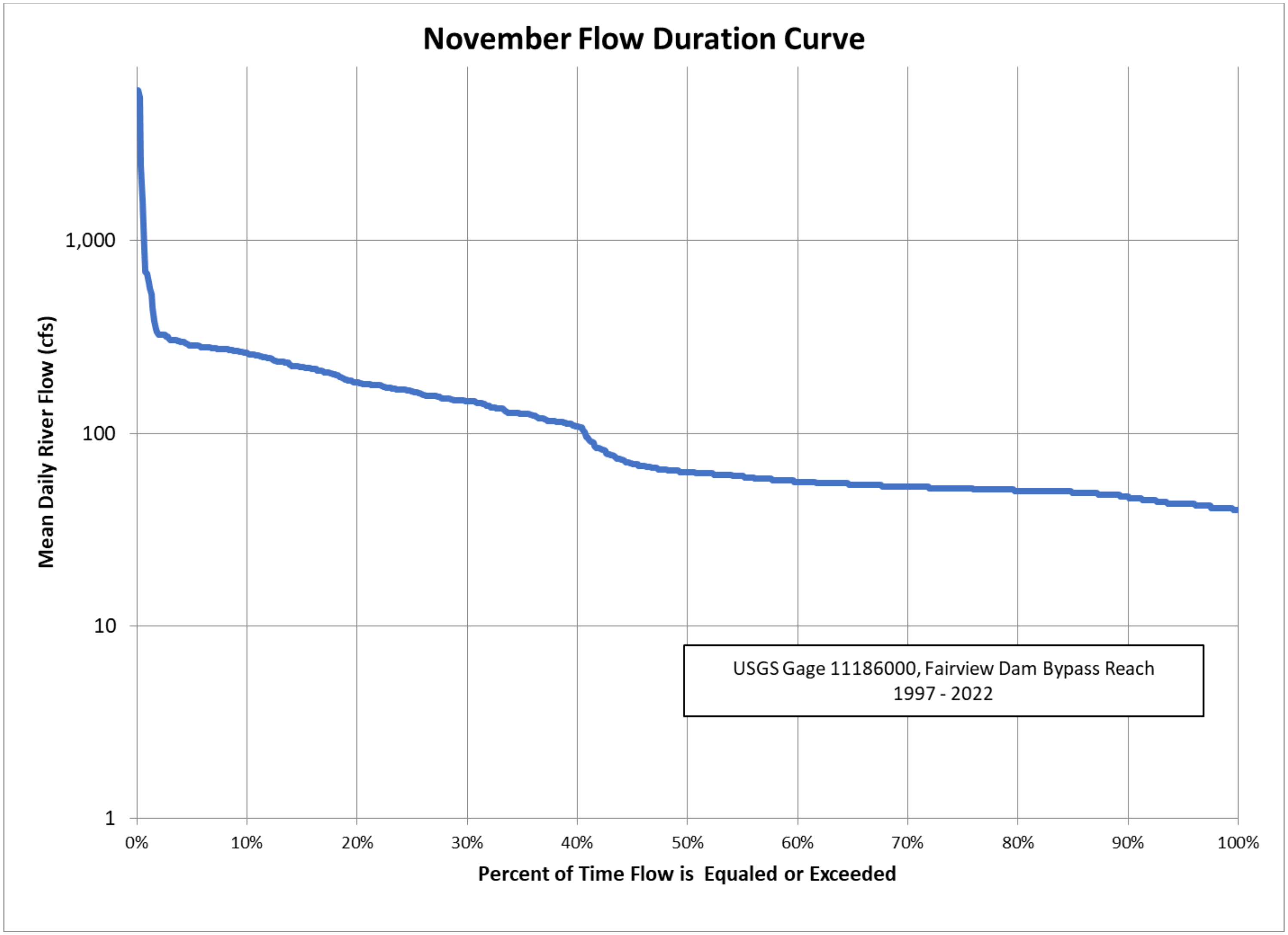
Source: SCE, 2023b; USGS, 2023b

Figure A-9. September Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



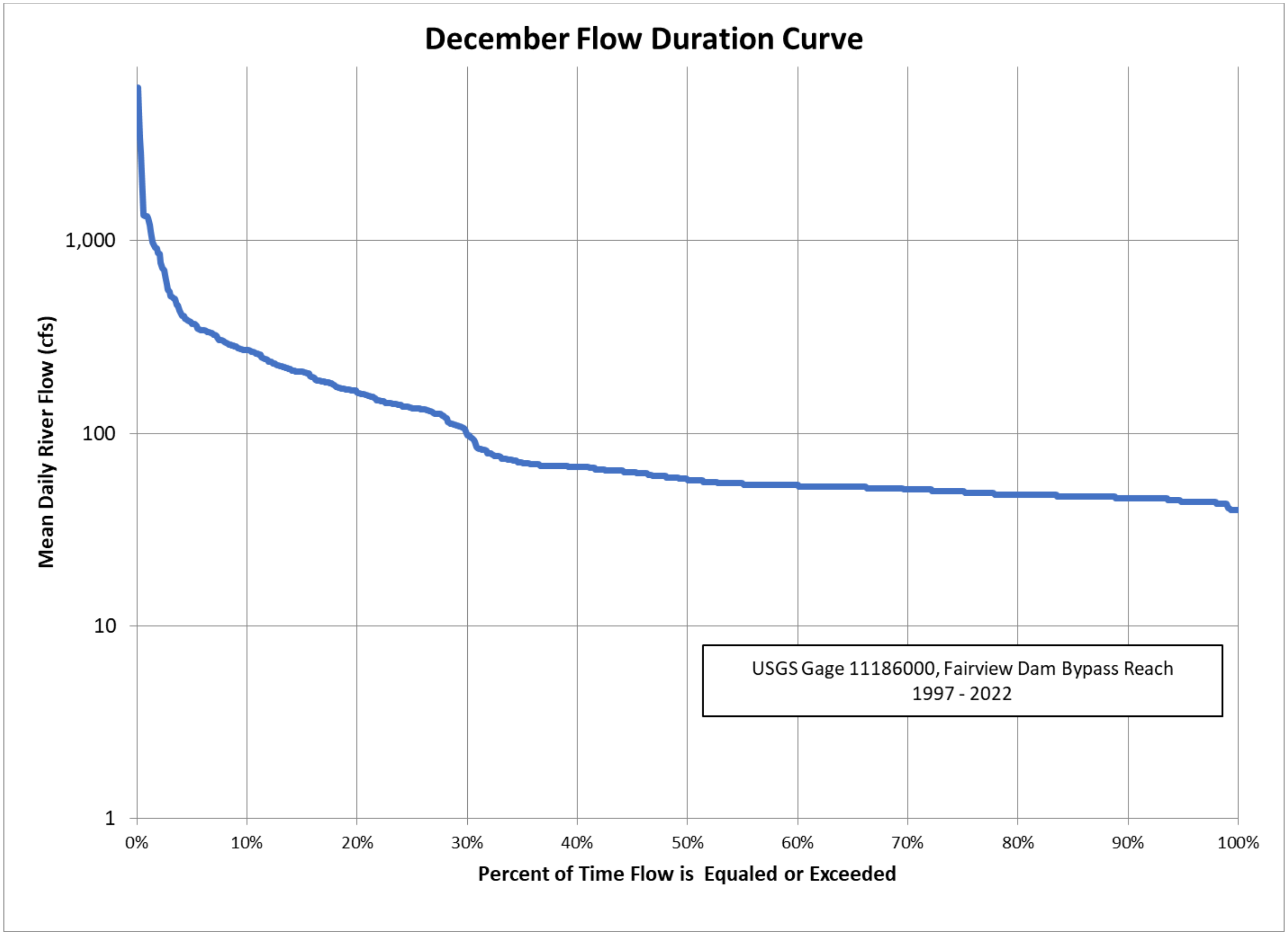
Source: SCE, 2023b; USGS, 2023b

Figure 18. October Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



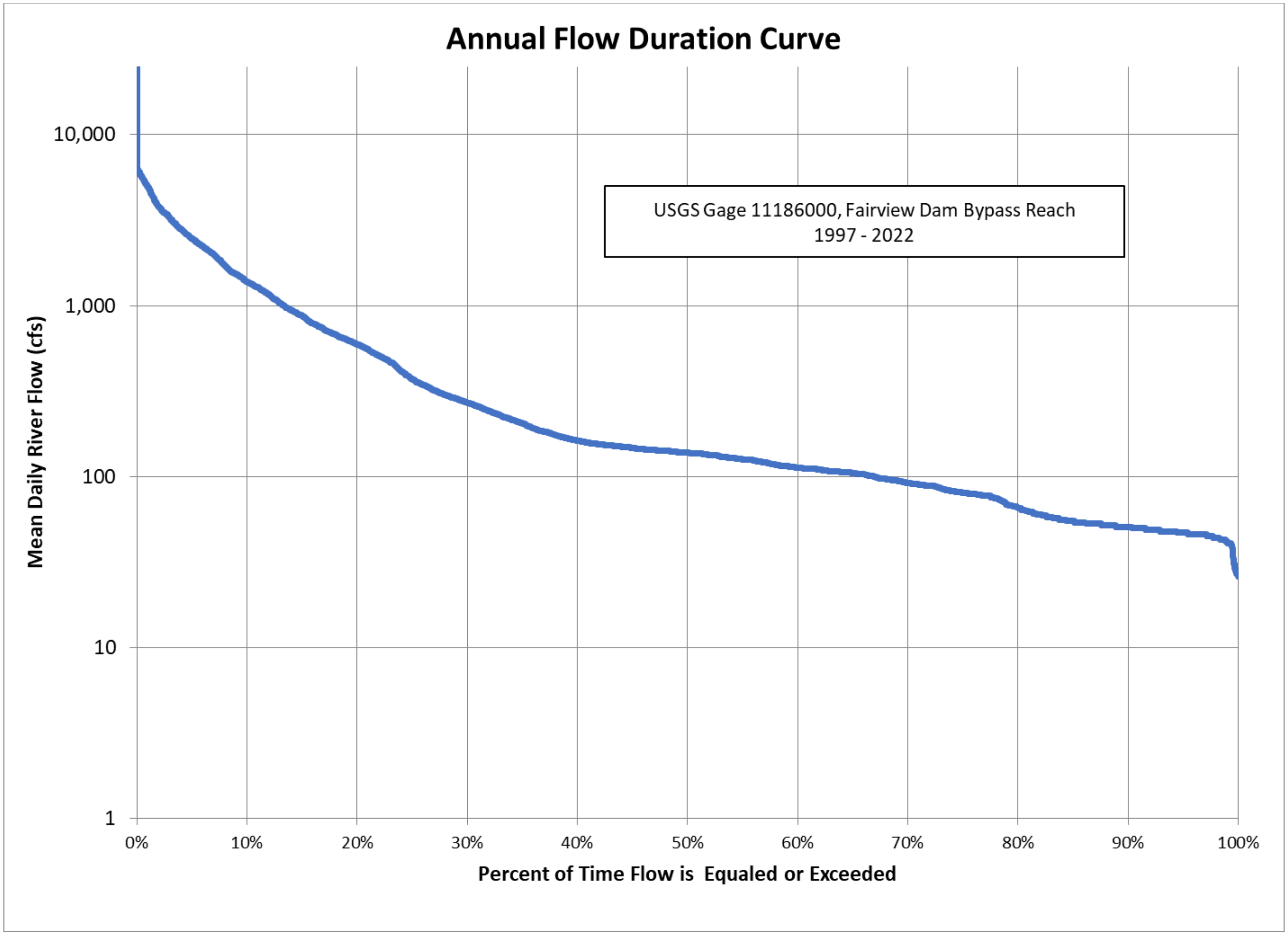
Source: SCE, 2023b; USGS, 2023b

Figure A-11. November Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



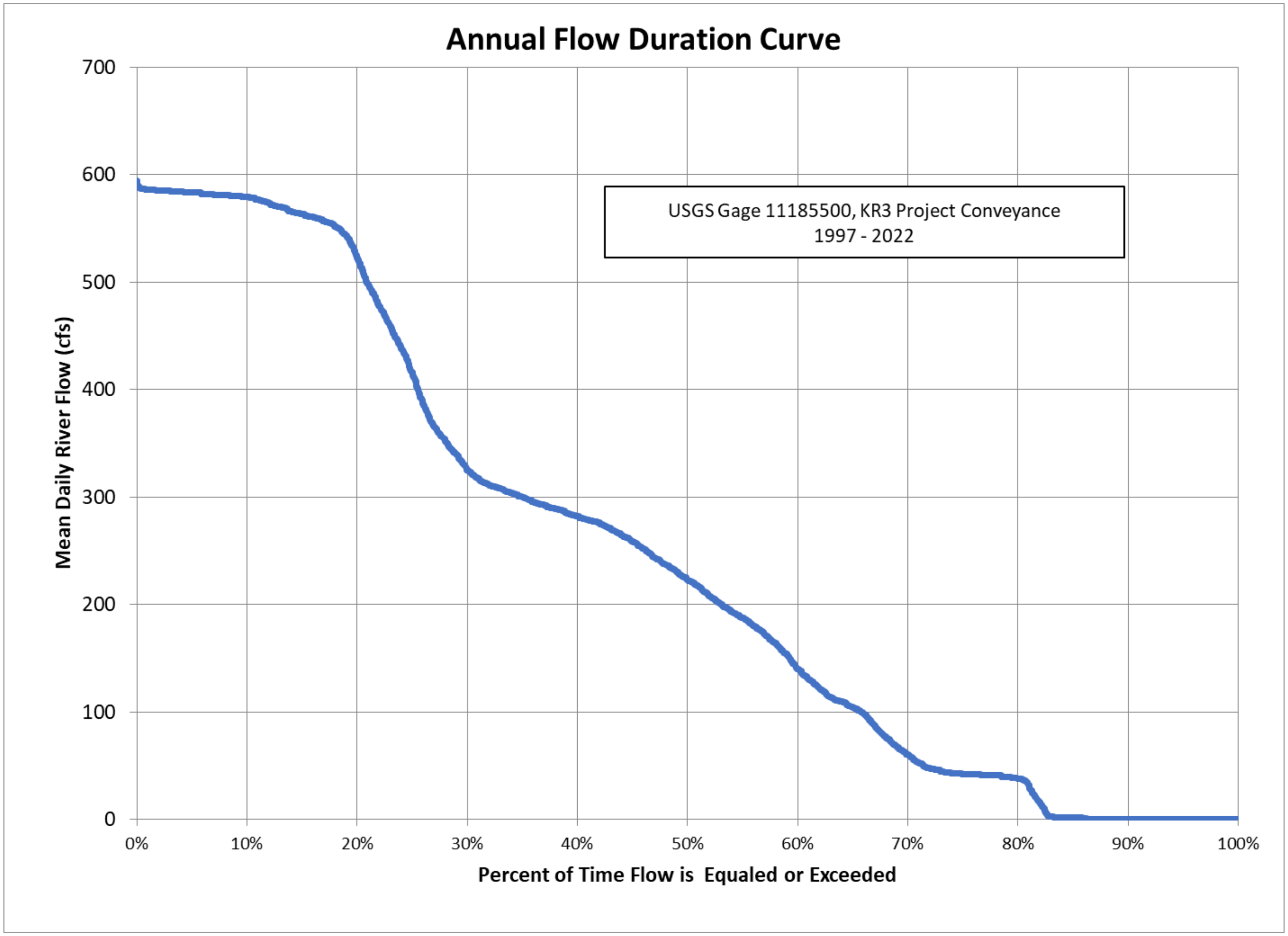
Source: SCE, 2023b; USGS, 2023b

Figure A-12. December Monthly Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



Source: SCE, 2023b; USGS, 2023b

Figure A-13. Annual Flow Duration Curve for the North Fork Kern River Fairview Dam Bypass Reach, Water Years 1997–2022.



Source: SCE, 2023b; USGS, 2023a

Figure A-14. Annual Flow Duration Curve for Kern River No. 3 Project Water Conveyance, Water Years–2022.