DEVIL CANYON PROJECT RELICENSING
FERC PROJECT NUMBER 14797

Draft License Application
Exhibit B – Project Operations and Resource Utilization

April 2019

State of California
California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES
Hydropower License Planning and Compliance Office

GAVIN NEWSOM	**WADE CROWFOOT**	**KARLA A. NEMETH**
Governor	Secretary for	Director
State of California	California Natural Resources	Department of Water Resources

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COMMONLY USED TERMS, ACRONYMS & ABBREVIATIONS

§	Section
°F	degrees Fahrenheit
Agreement Natural Inflow	Non-SWP inflow to Silverwood Lake, computed according to DWR's agreements with LFR and MWA
Agreement SWP Inflow	SWP inflow to Silverwood Lake, computed according to DWR's agreements with LFR and MWA
AF	acre-feet
CA	California
CAISO	California Independent System Operator
CDFW	California Department of Fish and Wildlife
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLAWA	Crestline-Lake Arrowhead Water Agency
CSD	Crestline Sanitary District
DWR	California Department of Water Resources
FERC	Federal Energy Regulatory Commission
Gaged Devil Canyon Powerhouse Outflow	Releases from the Devil Canyon Powerhouse, as measured by USGS gage 11063682
Gaged Natural Inflow	Non-SWP inflow to Silverwood Lake, computed using USGS gages 10260700 and 10260550 along with computed ungagged local inflow
Gaged Natural Outflow	Non-SWP releases from Silverwood Lake, computed using USGS gage 10260820
Gaged SWP Inflow	SWP inflow to Silverwood Lake, computed using USGS gage 10260780
GPM	gallons per minute
hp	horsepower
LFR	Los Flores Ranch
MW	megawatts
MWA	Mojave Water Agency
MWD	Metropolitan Water District of Southern California
NMWSE	Normal Maximum Water Surface Elevation

O&M	Operations and Maintenance
PCA	Pest Control Advisor
PM&E measures	protection, mitigation and enhancement measures
Project	Devil Canyon Project
Project area	The area within the FERC Project boundary and the area immediately surrounding the FERC Project boundary
Project region	The area within the FERC Project boundary and the area surrounding the Project on the order of a county or National Forest
Project vicinity	The area within the FERC Project boundary and the area surrounding the Project on the order of a USGS 1:24,000 quadrangle
rpm	revolutions per minute
SBNF	San Bernardino National Forest
SBCFD	San Bernardino County Fire Department
State	State of California
SWP	State Water Project
U.S.	United States
USACE	United States Army Corps of Engineers
USFS	U.S. Department of Agriculture, Forest Service
USGS	United States Geological Survey
vegetation	The total plant life or cover in an area; also used as a general term for plant life; the assemblage of plant species in a given area
WY	water year

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1.0 INTRODUCTION

The California Department of Water Resources (DWR) has prepared this Exhibit B, Project Operations and Resource Utilization, as part of its Application for a New License Major Project – Existing Dam (Application for New License) from the Federal Energy Regulatory Commission (FERC) for the Devil Canyon Project, FERC Project Number 14797. This exhibit has been prepared to conform with Title 18 of the Code of Federal Regulations (CFR), Subchapter B (Regulation under the Federal Power Act), Part 4, Subpart F (Application for License for Major Project – Existing Dam) (Traditional Licensing Process). In particular, this report complies with the regulations in 18 CFR Section (§) 4.51(c). For reference, 18 CFR § 4.51(c) states:

> Exhibit B is a statement of Project operation and resource utilization. If the project includes more than one dam with associated facilities, the information must be provided separately for each such discrete development. The exhibit must contain:
>
> (1) A statement whether operation of the powerplant will be manual or automatic, an estimate of the annual plant factor, and a statement of how the project will be operated during adverse, mean, and high water years,
>
> (2) An estimate of the dependable capacity and average annual energy production in kilowatt-hours (or a mechanical equivalent), supported by the following data:
>
> (i) The minimum, mean, and maximum recorded flows in cubic feet per second of the stream or other body of water at the powerplant intake or point of diversion, with a specification of any adjustment made for evaporation, leakage, minimum flow releases (including duration of releases), or other reductions in available flow, monthly flow duration curves indicating the period of record and the gauging stations used in deriving the curves, and a specification of the period of critical stream flow used to determine the dependable capacity,
>
> (ii) An area-capacity curve showing the gross storage capacity and usable storage capacity of the impoundment, with a rule curve showing the proposed operation of the impoundment and how the usable storage capacity is to be utilized;
>
> (iii) The estimated minimum and maximum hydraulic capacity of the powerplant (maximum flow through the powerplant) in cubic feet per second;

(iv) A tail water rating curve; and

(v) A curve showing powerplant capability versus head and specifying maximum, normal, and minimum heads.

(3) A statement, with load curves and tabular data, if necessary, of the manner in which the power generated at the project is to be utilized, including the amount of power to be used on-site, if any, the amount of power to be sold, and the identity of any proposed purchasers; and

(4) A statement of the applicant's plans, if any, for future development of the project or of any other existing or proposed water power project on the stream or other body of water, indicating the approximate location and estimated installed capacity of the proposed developments.

Excluding this introductory material, this exhibit includes eight sections. Section 2.0 gives a general description of the Project. Section 3.0 describes hydrology in the area within the proposed Project boundary and the area immediately surrounding the boundary (Project Area). Section 4.0 describes existing Project operations by Project facility, including regulatory and contractual operating constraints. Section 5.0 describes DWR's proposed Project operations. Section 6.0 describes the use of Project power. Section 7.0 discloses DWR's plans for future developments of the Project and DWR's plans for water projects in the watershed. Section 8.0 includes a list of references cited in this exhibit.

Refer to Exhibit A for a description of Project facilities and features, Exhibit C for a description of construction history and proposed construction schedule, Exhibit D for costs and financing information, and Exhibit E for a discussion of potential environmental effects and DWR's proposed resource management measures. Project design drawings are included in Exhibit F, and Project maps are included in Exhibit G. Exhibit H includes a detailed description of the need for the power generated by the Project, and other important miscellaneous information.

All elevation data in this exhibit are in United States (U.S.) Department of Commerce, National Oceanic and Atmospheric Association, National Geodetic Survey Vertical Datum of 1929, unless otherwise stated.

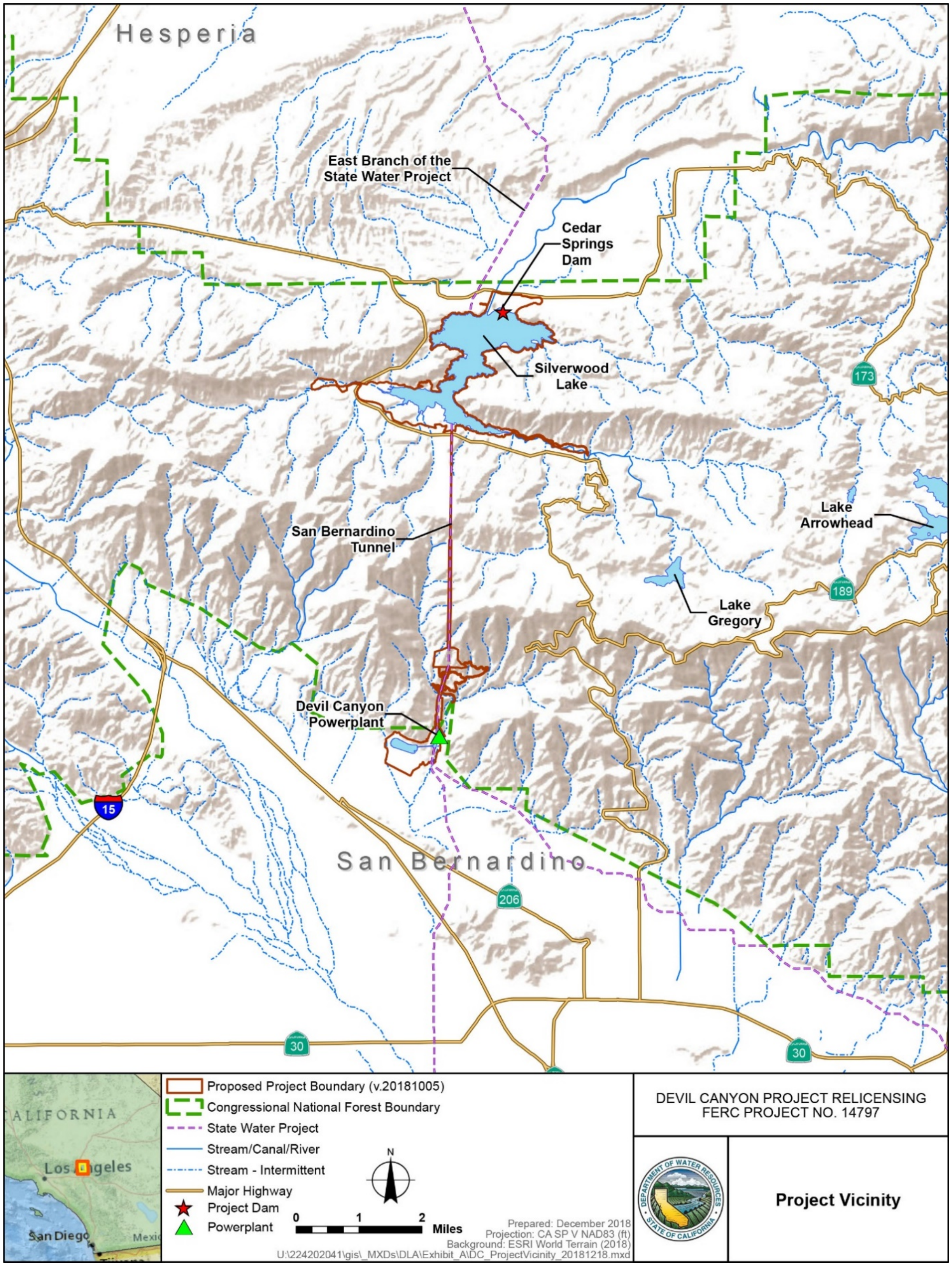
2.0 GENERAL DESCRIPTION OF THE PROJECT

The Project is part of a larger water storage and delivery system, the State Water Project (SWP), which is the largest state-owned and operated water supply project of its kind in the U.S. The SWP provides southern California with many benefits, including affordable water supply, reliable regional clean energy, opportunities to integrate green energy, accessible public recreation opportunities, and environmental benefits.

The existing Project, which is on the East Branch of the SWP in San Bernardino County, has a FERC-authorized installed capacity of 276,796 kilowatts (kW). Project facilities range in elevation from 5,377 feet to 1,778 feet, and include: Cedar Springs Dam and Silverwood Lake, which are located in the West Fork Mojave River drainage; the San Bernardino Tunnel; the Devil Canyon Powerplant; the Devil Canyon Powerplant Afterbay and adjacent Devil Canyon Second Afterbay; and the Devil Canyon Switchyard. The Project does not include any transmission lines or open water conduits, except for the short Cross Channel that connects the Devil Canyon Afterbay and Devil Canyon Second Afterbay and is described in Section 3.5. The Project's existing boundary includes 3,744.0 acres, of which 221.0 acres are National Forest System (NFS) lands managed by the U.S. Department of Agriculture, Forest Service (USFS), as part of the San Bernardino National Forest (SBNF). The Project generates electricity using SWP water as the water is delivered to downstream SWP water users.

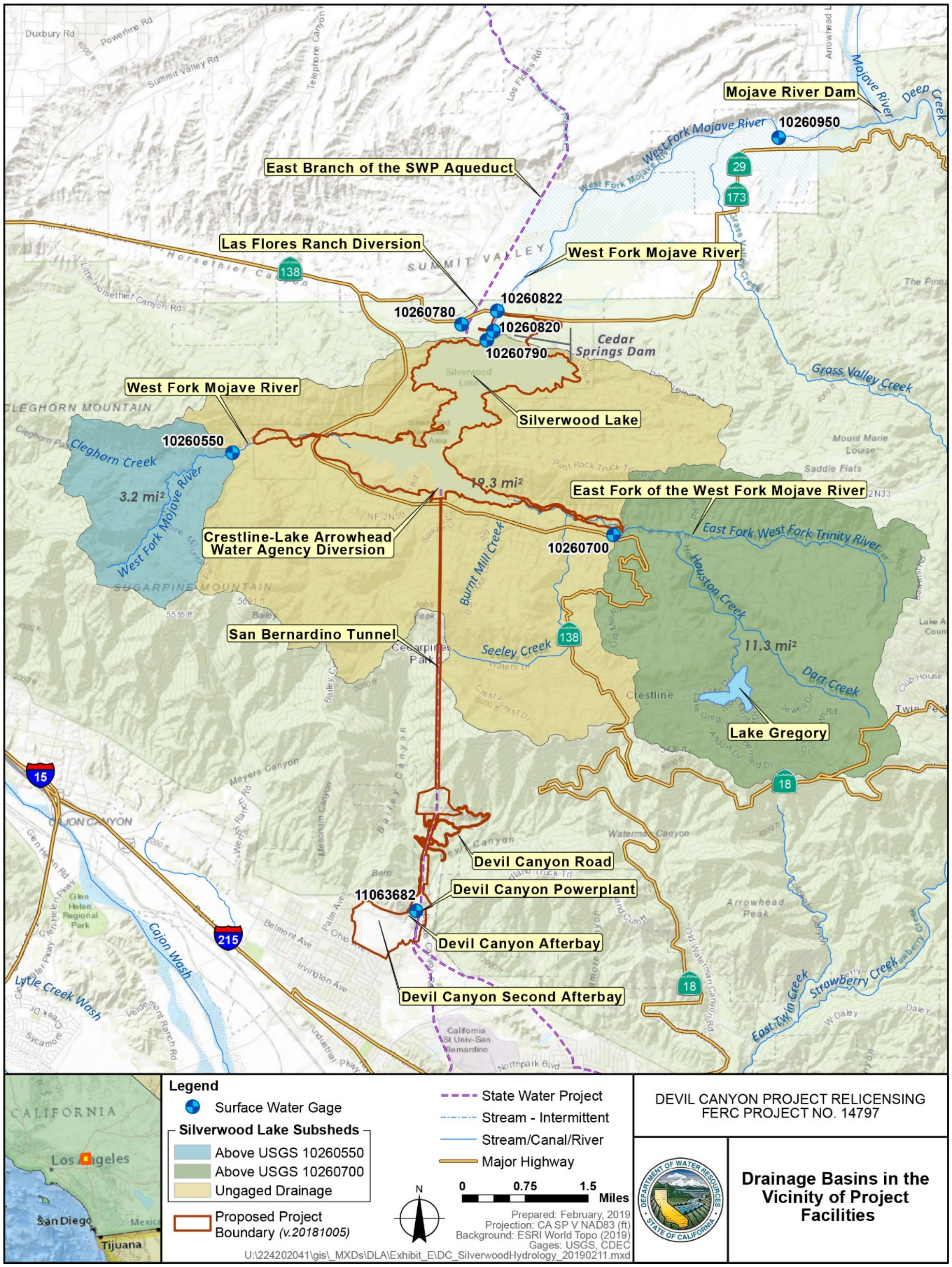
Under the new license, DWR proposes no modifications to existing Project facilities or operations but does propose adjusting the existing Project boundary. DWR proposes to continue to operate the Project as it has operated historically, with the addition of a number of operation and management activities to: (1) protect or mitigate impacts from continued operation and maintenance (O&M) of the Project; and (2) enhance resources affected by continued Project O&M. These activities are collectively referred to as protection, mitigation and enhancement (PM&E) measures in this exhibit.

Figure 2.0-1 shows the Project vicinity. Figure 2.0-2 shows Project facilities, including DWR's proposed Project boundary, pertinent drainage areas, and the location of reservoir stage and stream flow gages that are referenced in this exhibit.



Source: DWR, 2016.

Figure 2.0-1. Devil Canyon Project Vicinity



Source: DWR, 2017.

Note: Drainages for the Devil Canyon Afterbay and Devil Canyon Second Afterbay are not shown since the Afterbays do not intercept any surface drainages.

Figure 2.0-2. DWR's Proposed Devil Canyon Project and Local Drainage Areas

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3.0 RELICENSING SYSTEM HYDROLOGY

DWR developed a 12-year long hydrology dataset for relicensing using publicly available data. The relicensing period of record (POR) extends from Water Year (WY) 2006 through WY 2017 (i.e., October 1, 2005 through September 30, 2017). Reservoir data are end-of-day stage and storage for Silverwood Lake, Devil Canyon Afterbay and Devil Canyon Second Afterbay. Flow data are average daily flow, unless otherwise stated. Appendix A to this exhibit includes the hydrology dataset for the relicensing POR in Microsoft™ Excel format and in U.S. Army Corps of Engineers (USACE), Hydrologic Engineering Center Data Storage System file format.

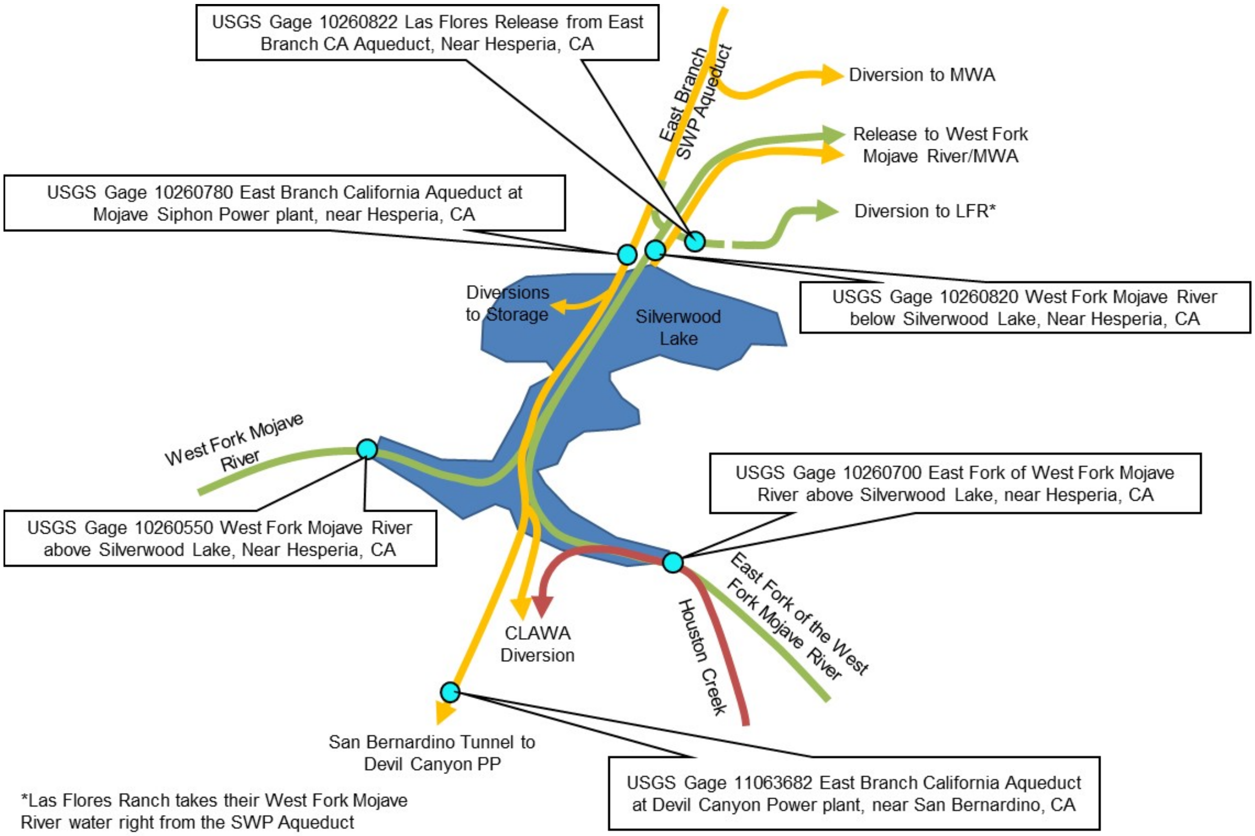
The gages and other information used to compile the relicensing hydrology dataset are described below.

3.1 INFLOW INTO SILVERWOOD LAKE

The Project does not use natural flow into Silverwood Lake for electricity generation, nor does the Project have discretion over releases from Silverwood Lake into the West Fork Mojave River. Electricity is generated using SWP water, and releases from Silverwood Lake into the West Fork Mojave River are made in accordance with existing water rights and water delivery agreements that are not related to electricity generation. Figure 3.1-1 depicts the Silverwood Lake hydrologic balance, which is discussed in detail below.

Silverwood Lake receives natural inflow in the drainage and imported water (Figure 3.1-1). Each of these is described below:

- Natural Inflow:
    - West Fork Mojave River
    - East Fork of the West Fork Mojave River
    - Local ungaged drainage
- Imported Water:
    - East Branch of the SWP Aqueduct



Key:
CA = California
CLAWA = Crestline-Lake Arrowhead Water Agency
LFR= Los Flores Ranch
MWA = Mojave Water Agency
PP= Powerplant
SWP = State Water Project
USGS = United States Geologcial Survey

Figure 3.1-1. Schematic of Silverwood Lake Hydrologic Balance

3.1.1 Natural Inflow

The following section describes the natural inflows to Silverwood Lake.

3.1.1.1 West Fork Mojave River

The primary source of data for inflow from the West Fork Mojave River is U.S. Geological Survey (USGS) Gage 10260550, West Fork Mojave River above Silverwood Lake, Near Hesperia, California (CA) (Figures 2.0-2 and 3.1-1). The gage is a water stage recorder with a concrete control weir, located on the left bank of the West Fork Mojave River, 1.5 miles upstream from Silverwood Lake. The West Fork Mojave River gage measures a drainage of 3.2 square miles. Average daily flow data are available for the entire relicensing POR and are included in Appendix A.

3.1.1.2 East Fork of the West Fork Mojave River

The primary source of data for inflow from the East Fork of the West Fork Mojave River is USGS Gage 10260700, East Fork of West Fork Mojave River above Silverwood Lake, near Hesperia, CA (Figures 2.0-2 and 3.1-1). The gage is a water stage recorder with a concrete control weir, located on the left bank of the East Fork of the West Fork Mojave River, 1.5 miles upstream from Silverwood Lake. The East Fork of the West Fork Mojave River gage has a drainage area of 11.3 square miles. Average daily flow data are available for the entire relicensing POR and are included in Appendix A.

3.1.1.3 Local Ungaged Drainage

The ungaged portion of the watershed upstream from Cedar Springs Dam is 19.3 square miles. The total watershed upstream of Cedar Springs Dam is 33.8 square miles and, as described above, only two gages measure inflow to Silverwood Lake: USGS gages 10260550 and 10260700, which together account for 14.5 square miles of the watershed (Figure 2.0-2). Agreements between DWR and each of the Mojave Water Agency (MWA) and Las Flores Ranch (LFR) include an agreed upon method for determining natural inflow into Silverwood Lake, which incorporates a table (see Table 4.1.1 in Section 4.1.4.3) relating measured inflow at the two USGS gages to total inflow to Silverwood Lake. The flow in the local ungaged drainage is the difference between the calculated total natural inflow and the measured flow at the two upstream gages. Using the Table from the agreements, DWR calculates the ungaged flow for each day in the POR and are included in Appendix A.

3.1.2 <u>Imported Water</u>

The following section describes the imported water to Silverwood Lake.

3.1.2.1 East Branch of the SWP Aqueduct

The primary source of data for inflow from the East Branch of the SWP Aqueduct is USGS Gage 10260780, East Branch California Aqueduct at Mojave Siphon Powerplant, near Hesperia, CA (Figures 2.0-2 and 3.1-1). The gage is located on the Aqueduct 0.2 miles upstream from Silverwood Lake. Flow at this site has two components that are combined by USGS for publication: (1) flow through the non-Project Mojave Siphon Powerplant as measured by an acoustic velocity meter on the intake pipes; and (2) bypass flow through the SWP flume as measured by a water stage recorder in a stilling well on the flume. Average daily flow data are available for the entire relicensing POR and are included in Appendix A.

3.2 SILVERWOOD LAKE STORAGE

The primary source of data for Silverwood Lake stage and storage is USGS Gage 10260790, Silverwood Lake, Near Hesperia, CA (Figures 2.0-2 and 3.1-1). The gage is a water stage recorder located on Silverwood Lake near Cedar Springs Dam. End-of-day stage and storage data are available for the entire relicensing POR and are included in Appendix A.

3.3 OUTFLOW FROM SILVERWOOD LAKE

Releases from Silverwood Lake are governed by two primary operational categories, deliveries to SWP contractors and deliveries of natural inflow to the users identified in the Mojave River Adjudication Decree issued by the Riverside County Superior Court in 1996. Outflow releases are made in the following four ways (Figure 3.1-1), each of which is further described below:

- Crestline-Lake Arrowhead Water Agency
- West Fork Mojave River:
  - Cedar Springs Dam low-level outlet works and Spillway
  - Cedar Springs Dam seepage
- San Bernardino Tunnel
- Las Flores Ranch Diversion

3.3.1 Crestline-Lake Arrowhead Water Agency

Direct releases from Silverwood Lake to the Crestline-Lake Arrowhead Water Agency (CLAWA) occur on the south shore of Silverwood Lake via an intake near CLAWA’s water treatment plant, off of CA138, near the Silverwood Lake Marina (Figures 2.0-2 and 3.1-1). This section provides a discussion of CLAWA’s diversions.

CLAWA has the right to divert water from Houston Creek, a tributary to Silverwood Lake, under water rights held by DWR and delivered to CLAWA per the 1989 agreement between both agencies. CLAWA also has a contract with DWR for additional water from the SWP. CLAWA measures its diversions from Silverwood Lake and reports the diversion volumes to DWR. DWR reports CLAWA’s total daily diversions from Silverwood Lake in Table 29 of DWR’s monthly operations reports. Monthly Operations Reports’ Table 29 including daily volumes of total CLAWA diversions are available for the full relicensing POR. These data are included in Appendix A as daily volumes and average daily flow rates.

3.3.2 West Fork Mojave River

The following sections describe releases from Cedar Springs Dam to the West Fork Mojave River.

3.3.2.1 Cedar Springs Dam Low-Level Outlet and Spillway

The primary source of data for outflow from the Cedar Springs Dam's low-level outlet and spillway into the West Fork Mojave River is USGS Gage 10260820, West Fork Mojave River below Silverwood Lake, Near Hesperia, CA (Figures 2.0-2 and 3.1-1). Flows through the low-level outlet are measured by a flow meter on the release valve, and flows over the spillway are computed based on a theoretical rating on the two slide gates on the spillway. USGS reports the combination of these releases. Average daily flow data are available for the entire POR and are included in Appendix A.

3.3.2.2 Cedar Springs Dam Seepage

DWR monitors on a daily basis seepage from Cedar Springs Dam at seven locations. Total seepage varies considerably over the WY, and from 1972 through 2017, ranged from 0 to 2.28 cubic feet per second (cfs) with a long-term average daily seepage of 0.24 cfs. Daily seepage rates are monitored and recorded in DWR's monthly water accounting reports for Silverwood Lake and are available for the POR and included in Appendix A. Table 3.3-1 shows the long-term average seepage for each location.

Table 3.3-1. Long-Term Average Daily Seepage for Cedar Springs Dam Seepage Monitoring Sites from 1972 through 2017

Seepage Point	Maximum (GPM)	Minimum (GPM)	Average (GPM)
Site A (includes G & H)	11.0	0.2	3.9
Site B	49.4	0.1	23.7
Site G	100.7	0.1	3.1
Site H (Includes G)	76.2	0	4.2
Site C	76.3	0.2	33.9
Site D	11.0	0.2	3.9
Site F	876.8	1.0	43.9
Total Seepage			
Total (GPM)	**1,024.5**	**1.7**	**109.3**
Total (cfs)	**2.28**	**0**	**0.24**

Source: DWR Operations Records
Key:
Cfs = Cubic Feet per Second
GPM = gallons per minute

3.3.3 <u>San Bernardino Tunnel</u>

The primary source of data for flow through the San Bernardino Tunnel is USGS Gage 11063682, East Branch California Aqueduct at Devil Canyon Powerplant, near San Bernardino, CA (Figures 2.0-2 and 3.1-1). Flow at this location is recorded using acoustic-velocity meters on five pipes (i.e., the Devil Canyon Powerhouse penstocks), and the components are combined by USGS for publication. Average daily flow data are available for the entire relicensing POR and are included in Appendix A.

3.3.4 Las Flores Ranch

DWR and LFR entered into an agreement to deliver SWP water to LFR directly from the East Branch of the SWP Aqueduct near the non-Project Mojave Siphon. The original LFR diversion was lost with the construction of Cedar Springs Dam and the creation of Silverwood Lake. LFR has held an appropriative right to water dating back to the 1800's and it is included in the Mojave River Decree. Due to its water right seniority, LFR is to receive the first 23 cfs of natural inflow before any other releases of natural inflow are made. DWR tracks the natural inflow and provides a like amount to LFR from the Aqueduct per the agreement. Accordingly, LFR's diversions are considered an outflow from Silverwood Lake for the purposes of this Application for New License. LFR diversions are measured by USGS Gage 10260822, Las Flores Ranch Release from the East Branch Aqueduct, near Hesperia, CA. Average daily flow records are available for the entire period of record and are included in Appendix A.

3.4 INFLOW TO DEVIL CANYON AFTERBAY

The only inflow to the Devil Canyon Afterbay is water that passes through the San Bernardino Tunnel (Section 3.3.3) and the Devil Canyon Powerplant. The Devil Canyon Afterbay is an engineered water body and collects negligible surface runoff; there is a system of drainage ditches around the Devil Canyon Afterbay that diverts local runoff around the Devil Canyon Afterbay.

3.5 OUTFLOW FROM DEVIL CANYON AFTERBAY

The Devil Canyon Afterbay conveys Project water to the Devil Canyon Second Afterbay via a 1,100-foot-long, 40-foot-wide, 27-foot-deep concrete-lined Cross Channel with an approximately 13-foot-high uncontrolled weir structure at the inlet to the Cross Channel. Flow from the Devil Canyon Afterbay to the Devil Canyon Second Afterbay is not gaged and recorded by DWR.

No Project water is directly released to State of California surface waters. While the Devil Canyon Afterbay includes a spillway structure designed for emergency purposes, the structure has never been used and is now obsolete due to the construction of the Devil Canyon Second Afterbay.

Some SWP water is released for consumptive use from the Afterbay into one of the following pipelines: San Bernardino Pipeline, Santa Ana Pipeline, Azusa Pipeline, and Rialto Pipeline. Each of the pipelines' intakes are all part of the same intake structure in the Afterbay. The San Gabriel Valley Municipal Water District's Azusa pipeline is about 38 miles long and runs west from the Devil Canyon Afterbay to the San Gabriel Canyon Spreading Grounds in Azusa. The pipeline's capacity is 55 cfs. The San Bernardino Valley Municipal Water District's San Bernardino Pipeline is a 72-inch pipeline that conveys water 17 miles eastward to various spreading grounds, agricultural, and wholesale domestic delivery points in the San Bernardino basin. The SWP's Santa Ana Valley Pipeline carries water supply from a 9-foot diameter turnout in the Devil Canyon Afterbay and a 9-foot diameter turnout from the Second Afterbay through a 12-foot diameter high-pressure pipeline approximately 27 miles to the Lake Perris inlet in Riverside County. The Metropolitan Water District of Southern California's (MWD) 30-mile Rialto Pipeline carries water supply from both the Devil Canyon Afterbay and Second Afterbay to MWD's San Dimas Powerplant, with a capacity of 1,000 cfs. The valves, turnouts, meters, and connections for all these SWP delivery pipes are not part of the Project facilities. Since releases to these pipes are not Project-related, flow through them is not reported for the POR in this exhibit or discussed further in this exhibit.

3.6 INFLOW TO DEVIL CANYON SECOND AFTERBAY

The only inflow to the Devil Canyon Second Afterbay occurs from the Devil Canyon Afterbay, as discussed in Section 3.5. Like the Devil Canyon Afterbay, the Devil Canyon Second Afterbay is an engineered water body and collects negligible surface runoff; there is a system of drainage ditches around the Devil Canyon Second Afterbay that diverts local runoff around the Devil Canyon Second Afterbay.

3.7 OUTFLOW FROM DEVIL CANYON SECOND AFTERBAY

The Devil Canyon Second Afterbay, the most downstream Project facility, includes an emergency overflow spillway discharge outlet and a low-level emergency outlet. The overflow spillway is incorporated into the Outlet Structure. The spillway was designed to pass the maximum discharge capacity of 2,960 cfs at an impoundment water surface elevation of 1,934 feet. The spillway crest elevation is 1,931 feet and configured in a sawtooth pattern. Discharge from the overflow spillway enters the Wasteway pipeline, which serves as a low-level emergency outlet. The 144-inch Wasteway pipeline is regulated by two slide gates measuring 96 inches x 120 inches. One gate is capable of dewatering the entire Second Afterbay within six hours. The Second Afterbay spillway has never been used, and the low-level outlet slide gates are exercised every three years to comply with dam safety regulations, but have not otherwise been used. Approximately 0.5 AF are discharged each time the slide gates are exercised.

In addition, SWP water is released for consumptive use from the Second Afterbay into the Rialto Pipeline and Santa Ana Pipeline, both of which are described above, and the Inland Feeder. The Inland Feeder is a 44-mile-long conveyance system that connects the SWP to Diamond Valley Lake and the Colorado River Aqueduct. The pipeline is a 12-foot diameter, reinforced concrete pipe with a conveyance capacity of 1,000 cfs. The system increases the operational flexibility necessary to store water in wet years, facilitates power generation, delivers water into the system by gravity, and provides SWP supplies to the Colorado River Aqueduct when needed. The Inland Feeder is designed to take advantage of wet years when it can move large amounts of water from the SWP into Diamond Valley Lake. The valves, turnouts, meters, and connections for these SWP delivery pipes are not part of the Project facilities. Since releases to these pipes are not Project-related, flow through them is not reported for the POR in this exhibit or discussed further in this exhibit.

3.8 OVERVIEW OF THE BASIN HYDROLOGY

The Project's Silverwood Lake collects water from two named drainages: the West Fork Mojave River and the East Fork of the West Fork Mojave River. Flow in both rivers is seasonal (intermittent) in that each river flows during certain times of the year when smaller upstream waters are flowing and when groundwater provides enough water for river flow. Runoff from rainfall or other precipitation supplements the flow.

The West Fork Mojave River originates at an elevation of 4,960 feet on the north side of a saddle between summits on a ridge running west northwest of Sugarpine Mountain. The West Fork has no significant diversions or withdrawals upstream of Silverwood Lake. As described in Section 3.1.1.1, at its inflow into Silverwood Lake, the West Fork Mojave River drains an area of 3.2 square miles.

The East Fork of the West Fork Mojave River (East Fork) originates at an elevation of 5,500 feet in Twin Peaks, California. Prior to construction of Cedar Springs Dam, the East Fork was a tributary to the West Fork Mojave River. However today, the East Fork flows directly into Silverwood Lake and drains an area of 11.3 square miles (Section 3.1.1.2). Upstream of Silverwood Lake, the East Fork collects water from Houston Creek, which has a small reservoir called Lake Gregory at its headwaters. Lake Gregory Dam was built in 1938 by the Crest Forest County Water District. Today, Lake Gregory primarily serves as a recreation destination and includes a San Bernardino County Regional Park.

Several un-named tributaries enter Silverwood Lake. However, none of these tributaries are gaged. Collectively, they drain an area of 19.3 square miles (Section 3.1.1.3).

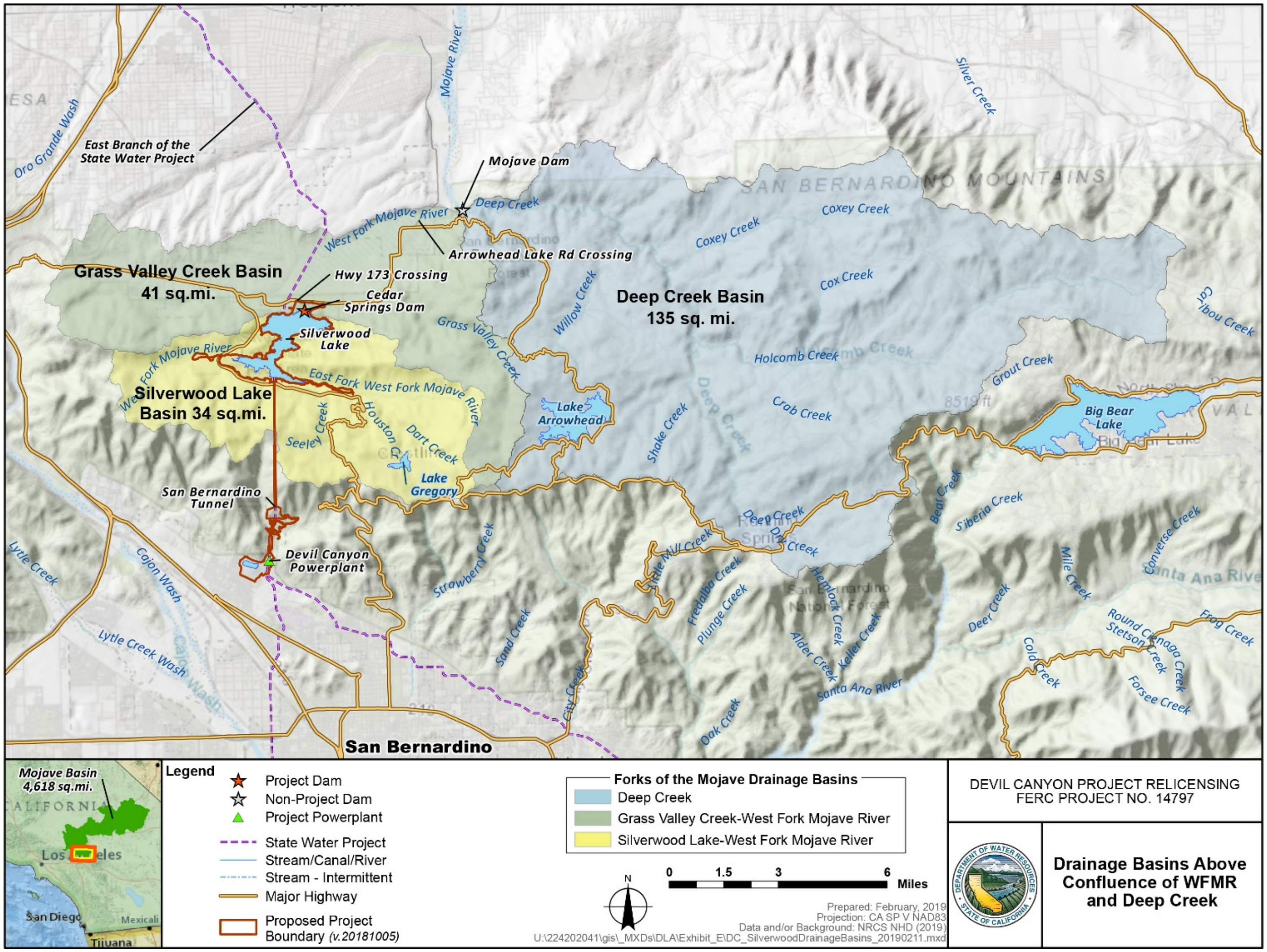
Cedar Springs Dam discharges into the West Fork Mojave River, which flows downstream from the dam approximately 4.3 miles to where Grass Valley Creek enters the West Fork. Grass Valley Creek has a small private reservoir called Grass Valley Lake, which is located near its headwaters.

From its confluence with Grass Valley Creek, the West Fork Mojave River flows another 2.1 miles to join with Deep Creek to form the Mojave River. The area drained by Grass Valley Creek and the 6.4 miles of West Fork Mojave River downstream from Cedar Springs Dam to Deep Creek is approximately 41 square miles and consists of both steep mountainous terrain, with elevations that range from 3,000 feet to 6,000 feet, and a long narrow valley to the west of the West Fork Mojave River.

The sub-basin that is drained by Deep Creek is 135 square miles of rugged mountainous terrain, with elevations that range from 3,000 feet to 8,200 feet. Deep Creek collects water from several tributaries, including Coxey, Holcomb, Willow, and

Little Bear Creeks. The privately-owned Lake Arrowhead, formed by Lake Arrowhead Dam, is located near the headwaters of Little Bear Creek. The dam was completed in 1922 by Arrowhead Lake Company to create Lake Arrowhead as a resort destination. Figure 3.8-1 shows the basins contributing to Mojave River flow at the confluence of the West Fork Mojave River and Deep Creek. The Mojave Forks Dam, which is also known as the Mojave River Dam or West Fork Dam is located just downstream of the West Fork Mojave River and Deep Creek confluence. The dam is a USACE flood-control structure completed in 1974 to provide flood protection to the cities located downstream on the Mojave River and can store approximately 179,400 AF of water. Because the dam serves strictly for flood control, the reservoir is usually dry; however, it can fill quickly following heavy winter storms. Flood waters are released as quickly as possible without exceeding the capacity of downstream levees. The reservoir is generally drained within 2–3 days of a flooding event. Because the dam reduces the sharp peaks of flash floods in the Mojave River channel, it also provides incidental groundwater recharge benefits in the Victor Valley area.

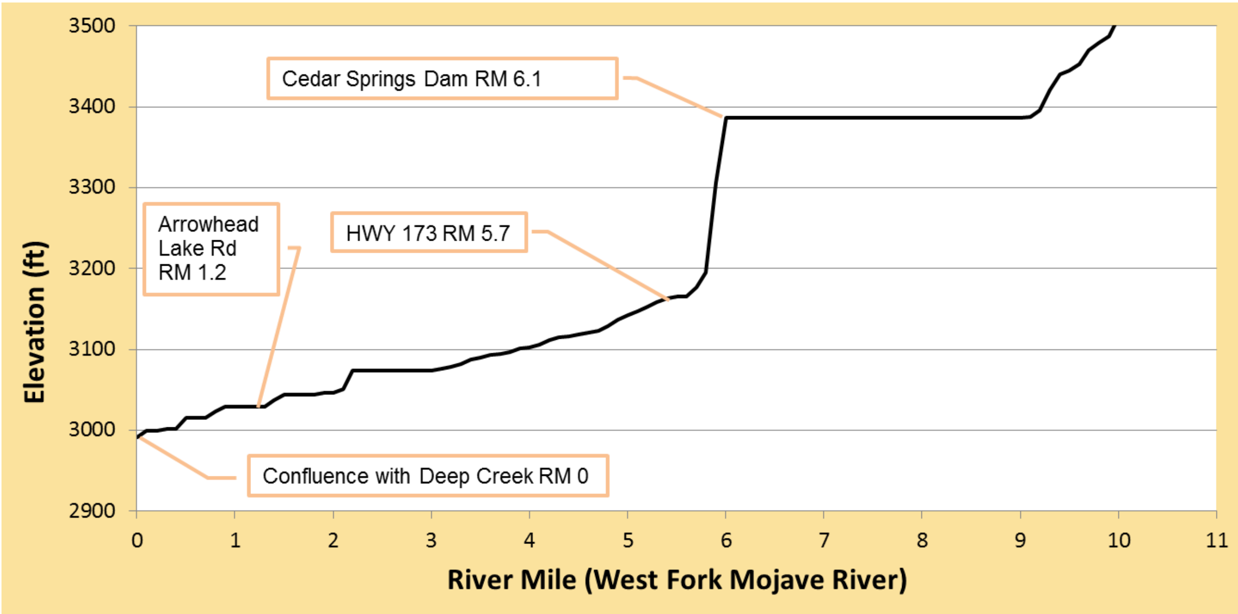
From the Mojave Forks Dam, the Mojave River flows north and east through the California cities of Hesperia, Victorville, and Barstow and through the Mojave Desert for approximately 100 miles before terminating into the Mojave River Wash on the western edge of the Mojave National Preserve. River flow is seasonal, with much of the flow subsurface. The Mojave River basin covers approximately 4,600 square miles. Figure 3.8-1 shows the basins that contribute to the Mojave River at Mojave Dam, along with key watershed features.



Key:
Hwy = highway
sq. mi. = square miles

Figure 3.8-1. Drainage Basins Above the Confluence of the West Fork Mojave River and Deep Creek

Figure 3.8-2 shows the gradient in the West Fork Mojave River, with notable features identified by river mile.



Key:
ft. = feet
HWY = Highway
Rd = Road
RM = river mile

Figure 3.8-2. West Fork Mojave River Profile

3.9 CLIMATE IN THE BASIN

The climate in the basin is classified as arid or Cold Desert Climate. The area loses more water via evapotranspiration than falls as precipitation. Average annual precipitation is approximately 6 inches, with rare snowfalls, and the average annual evapotranspiration rate is 57 inches. Air temperatures range from approximately 100 degrees Fahrenheit (°F) in July to about 30°F in January.

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4.0 EXISTING OPERATIONS

4.1 REGULATORY AND CONTRACTUAL OPERATING CONSTRAINTS

This section discusses existing regulatory and contractual operating constraints on the Project.

4.1.1 Conditions in Existing FERC License

The existing FERC license includes 80 articles, only one of which affects operations: Article 58 requires DWR to maintain Silverwood Lake surface elevations at the highest, most practicable level commensurate with other Project purposes during the summer recreation season.

4.1.2 Water Rights for Power

Under SWP water rights for power generation, DWR has water rights to store SWP water in Silverwood Lake; the point of use is Devil Canyon Powerplant. Note that in this Application for New License, “store” means hold water in storage for 30 days or more.

4.1.3 Water Rights for Beneficial Use or Other Purposes

DWR holds water rights for diversion from the West Fork Mojave River. The Mojave River watershed was declared fully appropriated by the SWRCB in its Decision 1619 issued in 1988. The water rights issued to CLAWA, and transferred to DWR per the 1989 agreement, were the last surface water rights issued for the Mojave River basin. These water rights were issued with the understanding that there would be no net effect to the watershed from CLAWA’s diversion due to the fact that the Crestline Sanitary District (CSD) essentially returns all water diverted back to the watershed through the discharge of treated effluent downstream of Cedar Springs Dam. The water rights held by DWR for CLAWA’s use allow for the diversion and storage of water from Houston Creek in Silverwood Lake as long as the amount diverted does not exceed the amount of return flows for that year, up to a maximum of 1,302 acre-feet.

4.1.4 The Mojave River Decree and Its Effect on Natural Inflow to Silverwood Lake

The Mojave River basin has been known to be in a state of significant overdraft since the 1950’s. State laws passed in 1959 to help facilitate development of the SWP also allowed regions around the State to form water agencies to responsibly manage their water supplies and make use of SWP water. Because of this, the MWA was formed to help bring SWP water to the Mojave River basin to help supplement what was naturally available. As management of water supplies in the basin expanded, the need to determine the water rights of users in the basin became necessary. An initial attempt to adjudicate the basin was made in 1964. A second, more successful attempt was made in 1990 when many parties filed lawsuits in Riverside County seeking guaranteed amounts of water. The result of the court proceedings was the Mojave River Decree, which adjudicated the rights of all users of water within the Mojave River basin. Due to the statutory authority granted to MWA by the California Legislature in 1959, the Court decided that MWA should be the Watermaster in charge of administering the Decree. In its role as watermaster, MWA is responsible for managing the water supplies released from Silverwood Lake for use downstream. DWR manages releases from Silverwood lake per its agreements with MWA and LFR, which assist with Decree management. The Project has no discretion on releases of natural flow from Silverwood Lake and currently the Watermaster notes that it is critical that DWR's current management of natural inflow and releases from Silverwood Lake remains unchanged in order to meet the needs of downstream water right holders identified in the Decree.

4.1.5 Measures in Other Agreements and Contracts That Affect Project Operations

This section describes six agreements that affect DWR's operations of Silverwood Lake. Upon construction of Cedar Springs Dam, DWR entered into two operational agreements with CLAWA, and one each with LFR and MWA to satisfy existing consumptive use water rights as identified in the Mojave River Decree that had been affected by Cedar Springs Dam. None of these parties held water rights for power generation and, with the exception of CLAWA's Houston Creek water rights, none transferred its existing consumptive use water rights to DWR. The other two agreements were entered into by DWR with SBNF and California Department of Fish and Wildlife (CDFW), and pertain to Silverwood Lake water surface elevation. Each of these agreements is described below.

4.1.5.1 CLAWA and DWR 1989 Agreement

As mentioned above, CLAWA was issued two water rights permits, with issuance dates of 1990, for Houston Creek, a tributary to the East Fork of the West Fork Mojave River, with a combined diversion limitation of up to 3.37 cfs and a total annual volume of up to 1,302 AF of storage in Silverwood Lake. Per the decision by the SWRCB that issued permits to CLAWA, return flows discharged from the waste water treatment plants in the CSD system are released via a pipeline that follows State Highway 138 and discharges downstream from Cedar Springs Dam onto LFR's land where they contribute to the recharge of the Mojave groundwater basin.

Per the 1989 agreement between DWR and CLAWA, CLAWA assigned to DWR its combined water rights for Houston Creek. Actual diversion quantities vary depending upon annual amounts of precipitation and are limited according to the amount of return flow to the Mojave watershed each WY.

As outlined in the agreement, in exchange for CLAWA's assignment of Houston Creek water rights to DWR, CLAWA is able to take a like amount of water from Silverwood Lake via CLAWA's diversion structure. The diversion structure is located on the south shore of Silverwood Lake, near CLAWA's water treatment plant, off of State Highway138, near the Silverwood Lake Marina. CLAWA is responsible for reporting

Houston Creek flows to DWR, measured at a gaging station below Crest Forest County Water District's Gregory Lake spillway. DWR adjusts the reported Houston Creek flow measurements to account for losses such as evapotranspiration and percolation between the gaging station and Silverwood Lake, for concurrence by CLAWA. In the event that the Lake Gregory gaging station (Figure 2.0-1) becomes inoperable, the Houston Creek flow is determined by records of Lake Gregory storage change plus measured Lake Gregory inflow. Both DWR and CLAWA record and share their respective operations at Silverwood Lake and their measurements and computations of local water flowing into, stored in, released, and pumped from Silverwood Lake.

4.1.5.2 CLAWA and DWR Water Supply Contract

In addition to the local water from Houston Creek appropriated by DWR for CLAWA, CLAWA has a separate SWP water supply contract for 5,800 AF per WY taken from CLAWA's intake on the south shore of Silverwood Lake. CLAWA diverts its supplies from Silverwood Lake via an intake near CLAWA's water treatment plant, off of State Highway 138, near the Silverwood Lake Marina. All of CLAWA's diversions from Silverwood Lake are measured together, and the portion of its diversion representing its Houston Creek supplies is computed based on CLAWA's agreement with DWR. Daily volumes and average daily flow records are available for the entire period of record and are included in Appendix A. CLAWA's diversions are prioritized as follows:

- Non-Project water (i.e., per its 1989 Houston Creek agreement)
- Non-Project water previously held in Silverwood Lake
- Project water (i.e., SWP contract supplies)

These three categories of supplies are tracked individually and reported by CLAWA to DWR each month. The CLAWA water data, which were used in this report, are available at: http://www.water.ca.gov/swp/operationscontrol/monthly.cfm.

Since the accounting of CLAWA's deliveries between Non-Project and Project supplies are accounted at a monthly level, for purposes of this Application for New License, CLAWA's total daily deliveries from Silverwood Lake are split between SWP and water rights (Non-Project) volumes according to the monthly distribution of delivery volumes of SWP and Non-Project deliveries. For example, if the monthly CLAWA deliveries were 90% SWP supplies and 10% Non-Project supplies, each day's total deliveries would be split according to the same percentages. Available historical data includes total CLAWA diversions from Table 29 (combined SWP and Non-Project), of DWR's monthly operations reports, and monthly volumes for Non-Project CLAWA deliveries. The data set of daily SWP and Non-Project deliveries is available for the entire relicensing period of record and is included in Appendix A.

4.1.5.3 Los Flores Ranch and DWR 1980 Agreement

LFR has a pre-1914 (1882) water right to divert from the West Fork Mojave River as confirmed by the Mojave River Decree. During the construction of Cedar Springs Dam, DWR removed stream diversion works owned and operated by LFR. As a replacement for the removed LFR diversions, DWR built new diversion works within the DWR right-of-way of the non-Project Mojave Siphon, located upstream from the Mojave Siphon's discharge to Silverwood Lake. The new diversion works includes a 30-inch cone valve with a 23 cfs capacity, the maximum amount LFR can divert under its water right. Diversions to LFR do not come from Silverwood Lake storage; instead, LFR diverts SWP water in exchange for West Fork Mojave River supplies. Since LFR diverted from the West Fork Mojave River prior to the construction of Silverwood Lake, LFR's diversions off the Mojave Siphon are based on computed Silverwood Lake inflow. Since LFR has one of the most senior water rights in the basin, DWR's agreement with LFR requires all inflow to Silverwood Lake that is less than or equal to 23 cfs to be delivered through exchange off the Mojave Siphon to LFR prior to any other releases of natural inflow. Any flow not used by LFR is returned to the Mojave River. LFR diversions are measured by USGS gage 10260822, Las Flores Ranch Release from the East Branch Aqueduct, near Hesperia, CA, which is described in Section 3.3.4.

The 1980 agreement between DWR and LFR outlines the methodology for determining the amount of flow that would have been available for LFR diversion. This computation is based on the combined gaged inflow at the two USGS gaging stations above Cedar Springs Dam (USGS Gages 10260700 [see Section 3.1.1.2] and 10260550 [see Section 3.1.1.1]). Exhibit A of the 1980 agreement provides a synthetic flow based on the inflow at these two gaging stations. When the combined gaged inflow is more than 300 cfs, Exhibit A of the 1980 agreement stipulates that the change in storage method for determining natural outflow will be used. Table 4.1-1 shows Exhibit A of the agreement between DWR and LFR to compute the theoretical synthetic inflow in cfs, which accounts for ungaged runoff to Silverwood Lake.

Within the relicensing POR, there were outages of the LFR diversion for necessary repairs between August 26, 2010 and November 20, 2012, and between February 7, 2013 and May 10, 2013. During this time, DWR stored LFR's supplies in Silverwood Lake per the 1980 agreement, and released the water to LFR in 2013 and 2014.

Table 4.1-1. Relationship between Gaged Inflow and Synthetic Inflow, as Described in Exhibit A of Agreements between DWR, LFR, and MWA

Gaged Inflow (AF/Mo)	Synthetic Inflow (AF/Mo)	Gaged Inflow (AF/Mo)	Synthetic Inflow (AF/Mo)	Gaged Inflow (AF/Mo)	Synthetic Inflow (AF/Mo)	Gaged Inflow (AF/Mo)	Synthetic Inflow (AF/Mo)
1	1.7	4.2	7.7	12	23.2	46	94
1.1	1.9	4.4	8	13	25.2	48	98
1.2	2.1	4.6	8.40	14	27.3	50	103
1.3	2.2	4.8	8.8	15	29.3	52	107
1.4	2.4	5	9.2	16	31.3	54	111
1.5	2.6	5.2	9.6	17	33.4	56	116
1.6	2.8	5.4	10	18	35.4	58	120
1.7	3	5.6	10.3	19	37.5	60	125
1.8	3.2	5.8	10.7	20	39.5	62	129
1.9	3.3	6	11.1	21	41.6	64	133
2	3.5	6.2	11.5	22	43.7	66	137
2.1	3.7	6.4	11.9	23	45.8	68	142
2.2	3.9	6.6	12.3	24	47.9	70	147
2.3	4.1	6.8	12.7	25	50	72	151
2.4	4.3	7	13.1	26	52	74	155
2.5	4.5	7.2	13.5	27	54	76	160
2.6	4.6	7.4	13.9	28	56	78	164
2.7	4.8	7.6	14.3	29	58	80	168
2.8	5	7.8	14.7	30	60	82	172
2.9	5.2	8	15.1	31	62	84	178
3	5.4	8.2	15.5	32	64	86	182
3.1	5.6	8.4	15.9	33	66	88	186
3.2	5.8	8.6	16.3	34	68	90	190
3.3	5.9	8.8	16.7	35	70	92	195
3.4	6.1	9	17.1	36	72	94	200
3.5	6.3	9.2	17.5	37	75	96	204
3.6	6.5	9.4	17.9	38	77	98	209
3.7	6.7	9.6	18.3	39	79	100	214
3.8	6.9	9.8	18.7	40	81	110	235
3.9	7.1	10	19.1	42	86	120	257
	7.3	11	21.2	44	90	130	279
140	300	250	532	360	760	540	1130

Table 4.1-1. Relationship between Gaged Inflow and Synthetic Inflow, as Described in Exhibit A of Agreements between DWR, LFR, and MWA (continued)

Gaged Inflow (AF/Mo)	Synthetic Inflow (AF/Mo)	Gaged Inflow (AF/Mo)	Synthetic Inflow (AF/Mo)	Gaged Inflow (AF/Mo)	Synthetic Inflow (AF/Mo)	Gaged Inflow (AF/Mo)	Synthetic Inflow (AF/Mo)
150	321	260	554	370	780	560	1170
160	342	270	575	380	800	580	1220
170	363	280	595	390	820	600	1260
180	384	290	617	400	840	620	1300
190	405	300	639	420	880	640	1340
200	426	310	660	440	920	660	1390
210	448	320	680	460	970	680	1430
220	469	330	700	480	1010	--	--
230	490	340	720	500	1050	--	--
240	511	350	740	520	1090	--	--

Source: Los Flores Ranch and DWR 1980 Agreement
Key:
-- = no data available
AF/Mo = acre-feet per month

4.1.5.4 MWA and DWR 1982 Water Agreement

As discussed in Section 4.1.4 above, the Mojave Basin water rights were adjudicated per a 1996 Court Decree issued by Riverside County which names MWA the Watermaster responsible for the administration of the decree. As Watermaster, MWA is authorized to manage natural flows from the West Fork Mojave River and its agreement with DWR aides in management of the Decree.

MWA's 1982 agreement with DWR states:

> Current operation of Cedar Springs Dam provides for the release of water, which originates in the watershed tributary thereto, from the dam at the same rate as the inflow to Silverwood Lake.

MWA's agreement allows MWA to hold inflow to Silverwood Lake for subsequent release (within 30 days of inflow) at MWA's request. The agreement outlines the relationship for determining the amount of natural outflow from Cedar Springs Dam that would otherwise have occurred if DWR had not held the water in Silverwood Lake and the corresponding volume of water held in Silverwood Lake. The relationship and computation method for the total combined inflow are identical to those in DWR's 1980 agreement with the LFR, and is reflected in Table 4.1-1 above. DWR maintains an accounting of water held in Silverwood Lake at MWA's request.

MWA also has a SWP Water Supply Contract with DWR and typically takes delivery of SWP water from the East Branch of the SWP Aqueduct upstream from the Mojave Siphon. However, in the case of an outage of the East Branch of the SWP Aqueduct, or other restrictions on deliveries, MWA could receive SWP supplies by release from Silverwood Lake. DWR also facilitates exchanges of SWP water between the Metropolitan Water District of Southern California (MWD) and MWA. These exchanges of SWP water can occur either from turnouts on the East Branch of the Aqueduct or by release from Silverwood Lake. Though rare, two such exchanges occurred via release from Silverwood Lake during the relicensing POR. The first was an exchange of 14,141 acre-feet of SWP water from September through December 2011, and the other was an exchange of 2,994 acre-feet of SWP water in November of 2012.

DWR tracks releases from Silverwood Lake made for MWA's SWP contract deliveries in DWR's monthly operations reports in addition to releases for natural Mojave River flows. USGS gage 10260820, West Fork Mojave River below Silverwood Lake, CA, reflects releases for these combined purposes. Average daily flows are available for the entire POR for both USGS gage 10260820 and releases of natural flow and contract deliveries to MWA (monthly operations reports Table 29) and are included in Appendix A.

4.1.5.5 USFS and DWR 1968 Agreement, as Amended

The USFS agreement was signed in 1968 and amended in 1971. It established operating goals to maintain a water surface elevation in Silverwood Lake from March 1 to September 15 of each year, within a range of not more than 30 inches during each seven-day period, beginning at midnight Sunday, and within a range of not more than 11 inches each day. However, the agreement also recognized that the weekend water level recovery pattern may result in a daily rise of up to 18 inches during the weekend cycle, and there may be periods of reservoir operations where the fluctuations have to exceed the 11-inches-per-day fluctuation limit to economically meet DWR's commitments for SWP water supply delivery. Therefore, DWR may exceed the 11-inches-per-day fluctuation limit by 3 inches, for a total of 15 days between March 1 and September 15. A consultation process is also provided if there is a need to exceed the 11-inches-per-day limit beyond 15 days.

4.1.5.6 CDFW and DWR 2003 Agreement

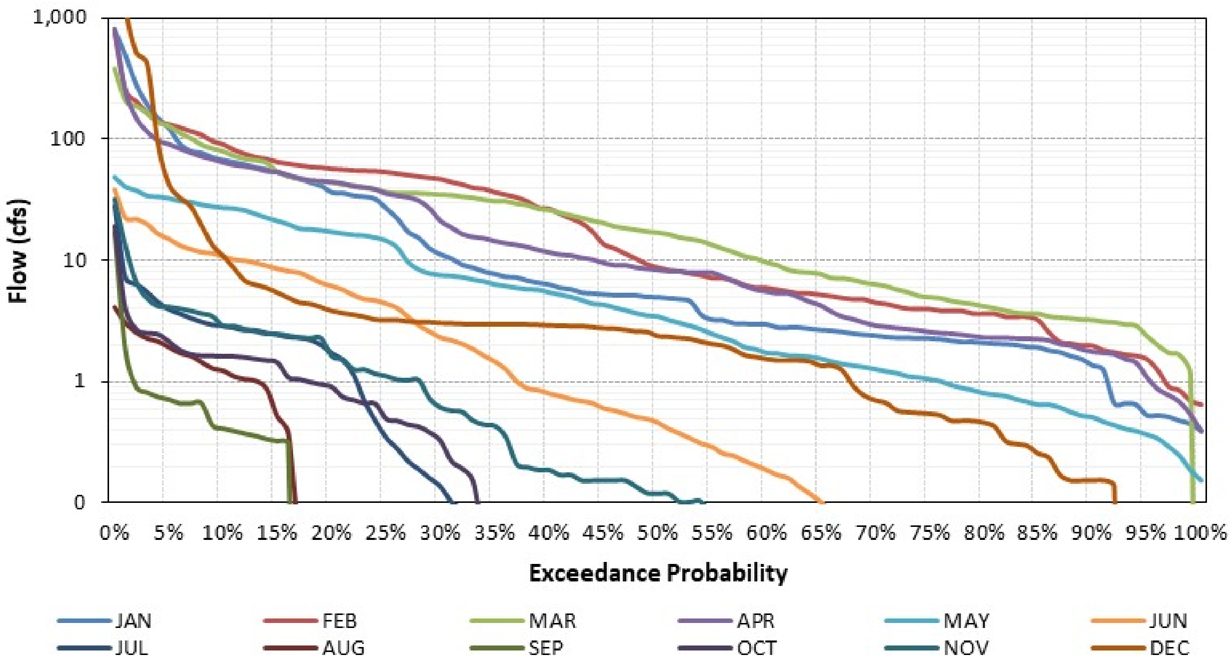
The 2003 agreement with CDFW (formerly California Department of Fish and Game) stipulates operations constraints to help protect bass spawning. On April 1 each year, DWR reports the Silverwood Lake water level to CDFW; and during the period of April 1 to June 30 each year, DWR manages the lake, such that the lake is not lowered more than three feet from the April 1 reported level. A consultation process was established in the agreement in the event DWR needs to lower the lake level by more than three feet during this period.

4.2 OPERATIONS IN TYPICAL DRY, NORMAL AND WET YEARS

The existing Project is operated as a power recovery project using SWP water. For that reason, Project operations do not vary based on changes in local hydrological conditions.

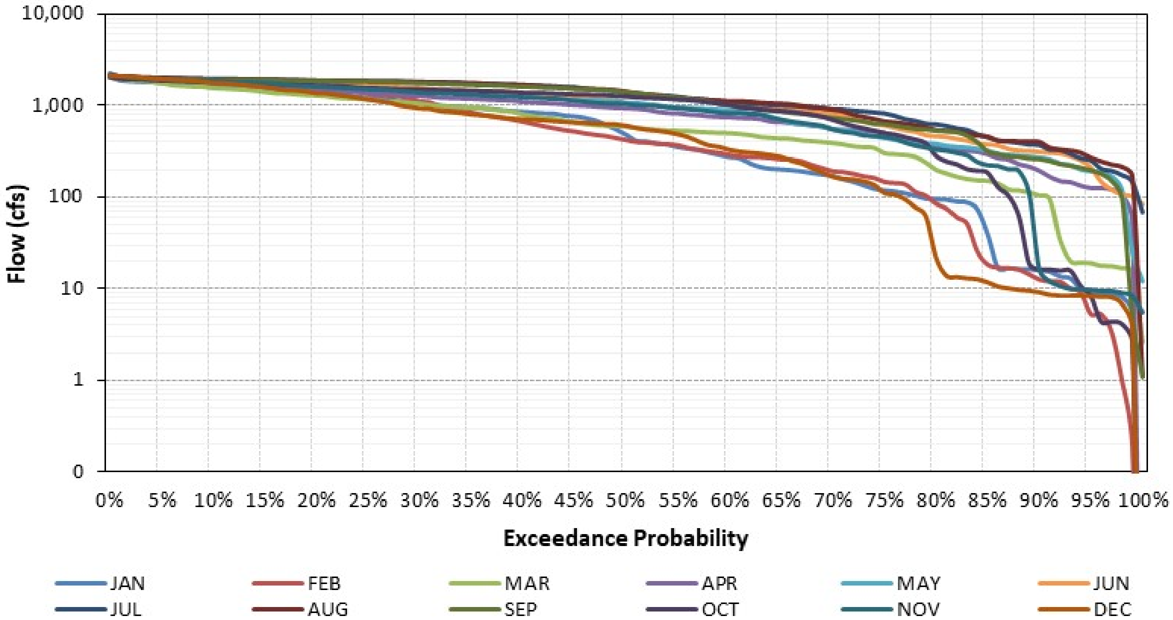
4.2.1 Inflow into Silverwood Lake

Figures 4.2-1, 4.2-2 and 4.2-3 provide monthly flow duration curves for inflow into Silverwood Lake from: (1) SWP; (2) natural flow; and (3) the combination SWP and natural inflow. The natural inflow includes the sum of USGS Gage 10260550 as described in Section 3.1.1.1, USGS Gage 10260700, as described in Section 3.1.1.2, and the agreement-derived ungaged flow, as described in Section 3.1.1.3. The SWP inflow is the sum of SWP Aqueduct inflow measured by USGS gage 10260780, as described in Section 3.1.2, and a volume of West Fork Mojave River inflow equivalent to the amount exchanged with LFR, computed as the first 23 cfs of natural inflow to Silverwood Lake according to LFR's water rights, as described in Section 3.3.4. In the POR, the peak natural inflow was 5,712 cfs on Dec 22, 2010, the peak SWP inflow was 2,263 cfs on Apr 17, 2007, and the peak total inflow was 7,692 cfs on Dec 22, 2010.



Source: USGS gages 10260550 and 10260700
Key:
% = Percent
cfs = cubic feet per second

Figure 4.2-1. Monthly Flow Duration Curves for Natural Inflow to Silverwood Lake for the Relicensing Period of Record



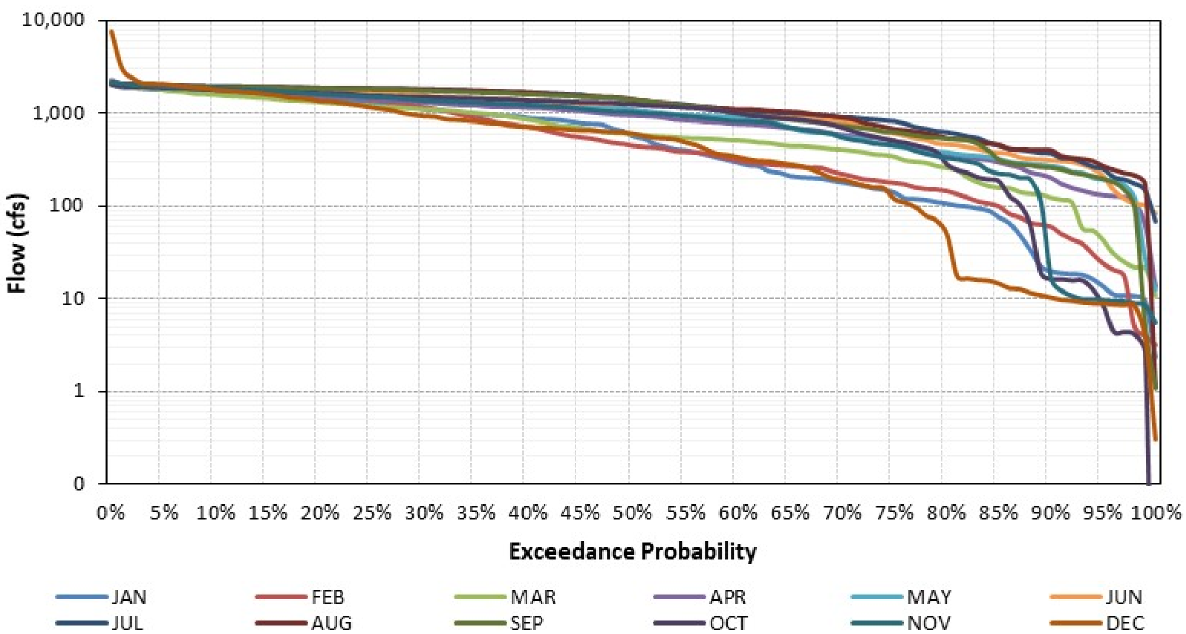
Source: USGS gage 10260780

Key:

% = Percent

cfs = cubic feet per second

Figure 4.2-2. Monthly Flow Duration Curves for SWP Inflow to Silverwood Lake for the Relicensing Period of Record



Source: USGS gages 10260550, 10260700, and 10260780

Key:

% = Percent

cfs = cubic feet per second

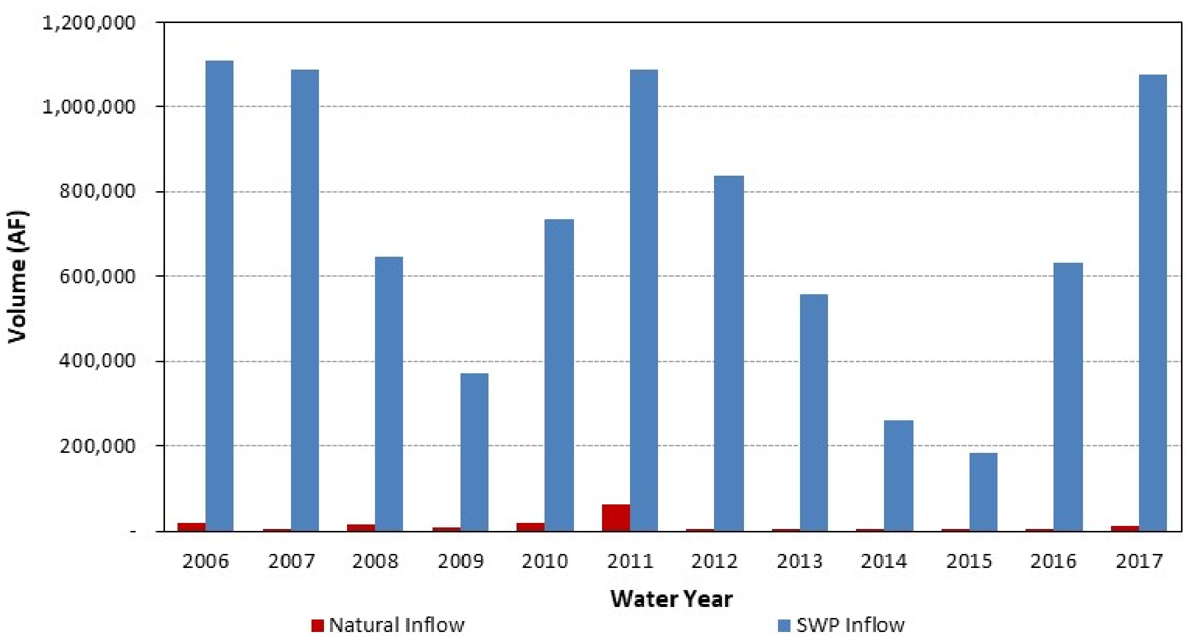
Figure 4.2-3. Monthly Flow Duration Curves for Total Inflow to Silverwood Lake for the Relicensing Period of Record

Figure 4.2-4 shows the relative contribution of the natural inflow and SWP inflow for each year of the POR. Annual volume of natural inflow is rarely noticeable compared to the volume of SWP inflow to Silverwood Lake. The greatest difference between the two volumes of 1,091,276 AF occurred in WY 2006, and the smallest difference between the two volumes of 182,423 AF occurred in WY 2015.

4.2.2 Silverwood Lake Storage

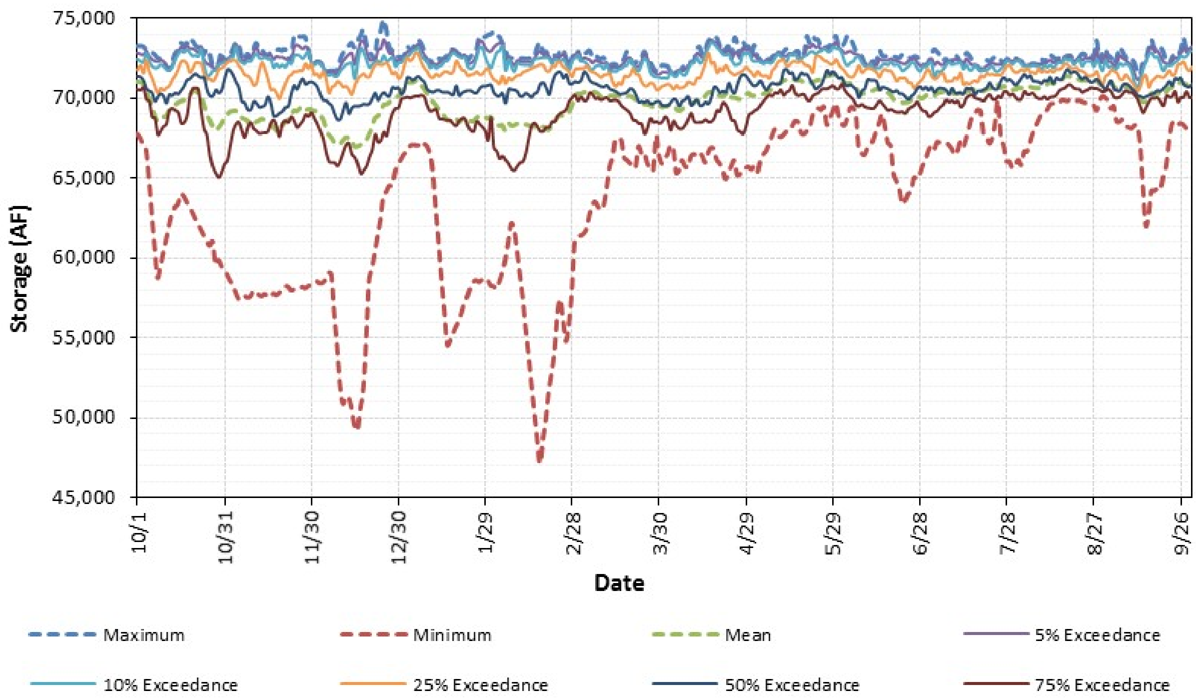
Silverwood Lake is the principal storage facility for the Project. The reservoir has a gross storage capacity of 75,000 AF (i.e., storage at the normal maximum water surface elevation [NMWSE] of 3,355 feet) and dead storage at the invert of the Cedar Springs Dam outlet structure at elevation 3,250 feet corresponding to 8,234 AF. The minimum operating pool for the Devil Canyon Powerhouse is 39,211 AF, corresponding to a minimum operating pool elevation of 3,312 feet. The reservoir does not have a regulatory minimum pool requirement or any flood pool restrictions. Article 58 in the existing FERC license (Section 4.1.1) and the existing DWR agreements with USFS (Section 4.1.3.5) and CDFW (Section 4.1.3.6) set some limits on reservoir fluctuations from around March through mid-September.

Figure 4.2-5 shows average daily storage in Silverwood Lake, as well as the maximum daily storage and minimum daily storage for the POR and various percent exceedance levels of daily storage over the POR.



Source: USGS gages 10260550, 10260700, and 10260780
Key:
AF = acre-feet
SWP = State Water Project

Figure 4.2-4. Relative Contribution of Natural Inflow and SWP Inflow to Silverwood Lake

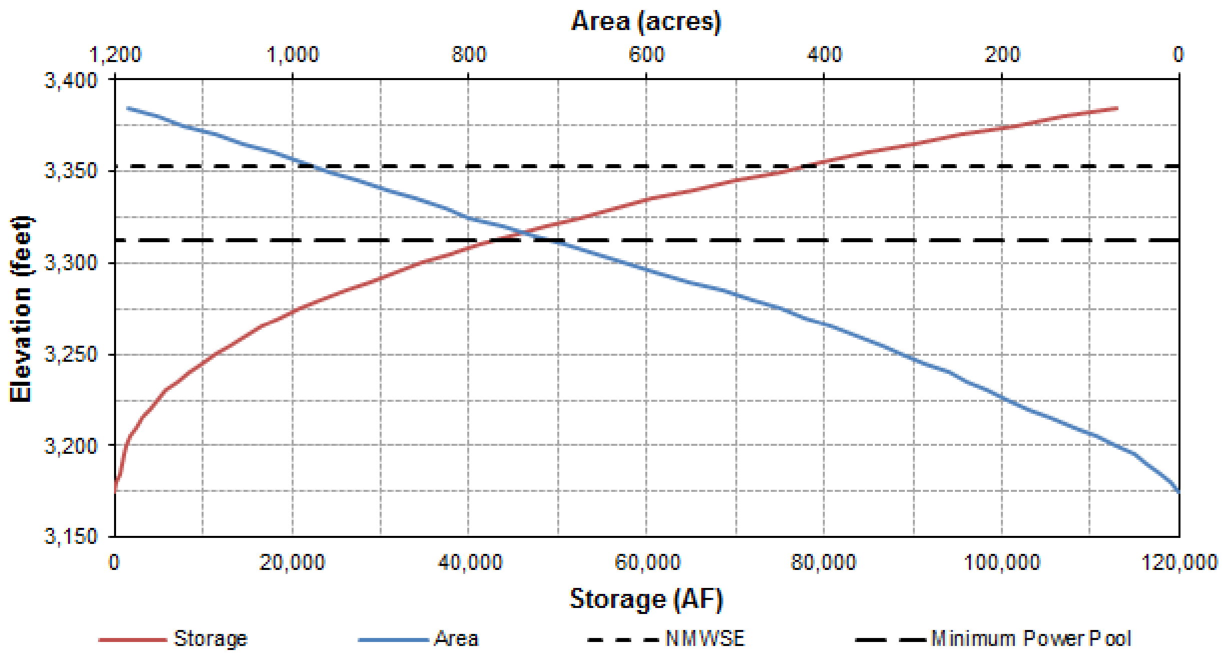


Source: USGS gage 10260790
Key:
% = Percent
AF = acre-feet

Figure 4.2-5. Daily Storage Statistics for Silverwood Lake for the Relicensing Period of Record

Figure 4.2-5 shows that for most times in the relicensing POR, storage is consistently kept in the range of 65,000 AF to 75,000 AF. Of the 4,383 days in the relicensing POR, 3,724 (85 percent of days) are within this range. However, there are a few instances of low storage. In 4 of the 12 WYs (i.e., 2007, 2010, 2011 and 2016), storage drops below 55,000 AF. The lowest storage value of 47,100 AF occurred on February 17, 2007. Over the span of about eight days, the reservoir experienced no inflow from the East Branch of the SWP Aqueduct, while the Devil Canyon Powerplant was still operating at a daily average of approximately 800 cfs.

The storage-capacity curve showing the usable and gross storage capacities of Silverwood Lake is shown on Figure 4.2-6. The surface area at the maximum operating pool of 3,353 feet is 962.0 acres, with a storage volume of 73,032 AF. The minimum operating pool for the Devil Canyon Powerplant is at 3,312 feet, corresponding to 690.0 acres of surface area, and 39,211 AF of storage.

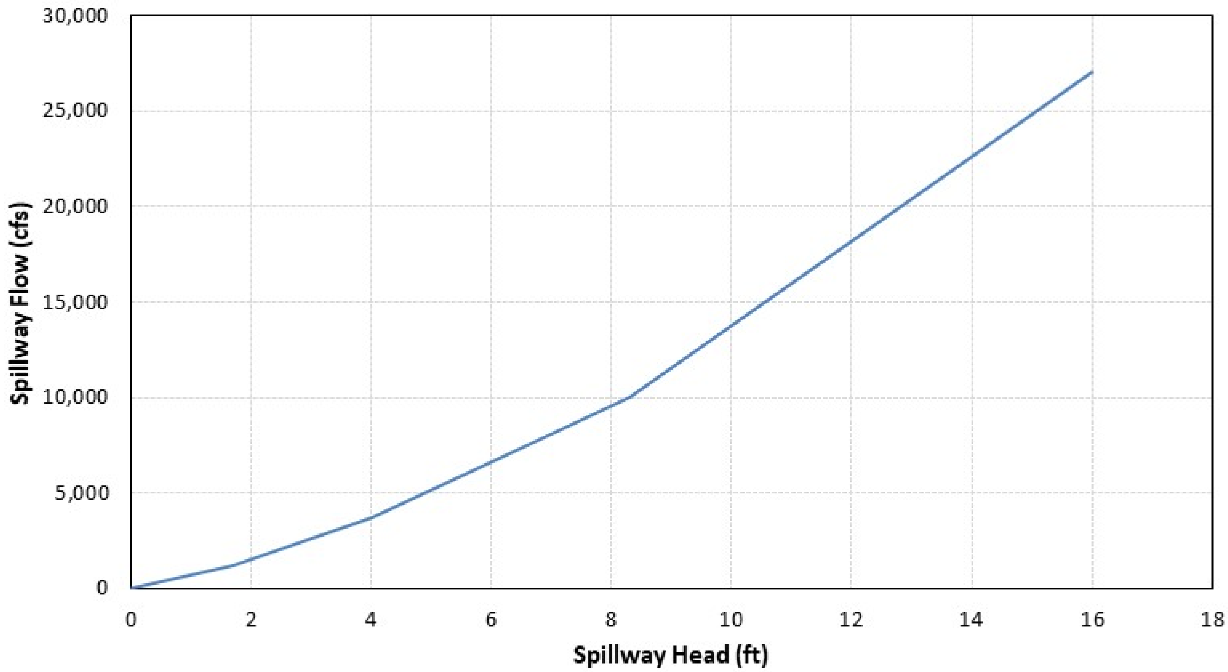


Source: DWR Exhibit L-1-C
Key:
AF = acre-feet
NMWSE = Normal Maximum Water Surface Elevation

Figure 4.2-6. Silverwood Lake Storage-Capacity Curve

There are no rule curves pertinent to Silverwood Lake. In general, the reservoir is maintained as full as possible.

The Cedar Springs Dam spillway is located on the left abutment of the dam and consists of a 120-foot long, un-gated crest with a rectangular, lined concrete channel. The elevation of the spillway crest is 3,355 feet, and the maximum capacity of the spillway is 78,000 cfs. The spillway and low-level outlet discharge into a rock-lined stilling basin. The spillway rating curve is presented on Figure 4.2-7.

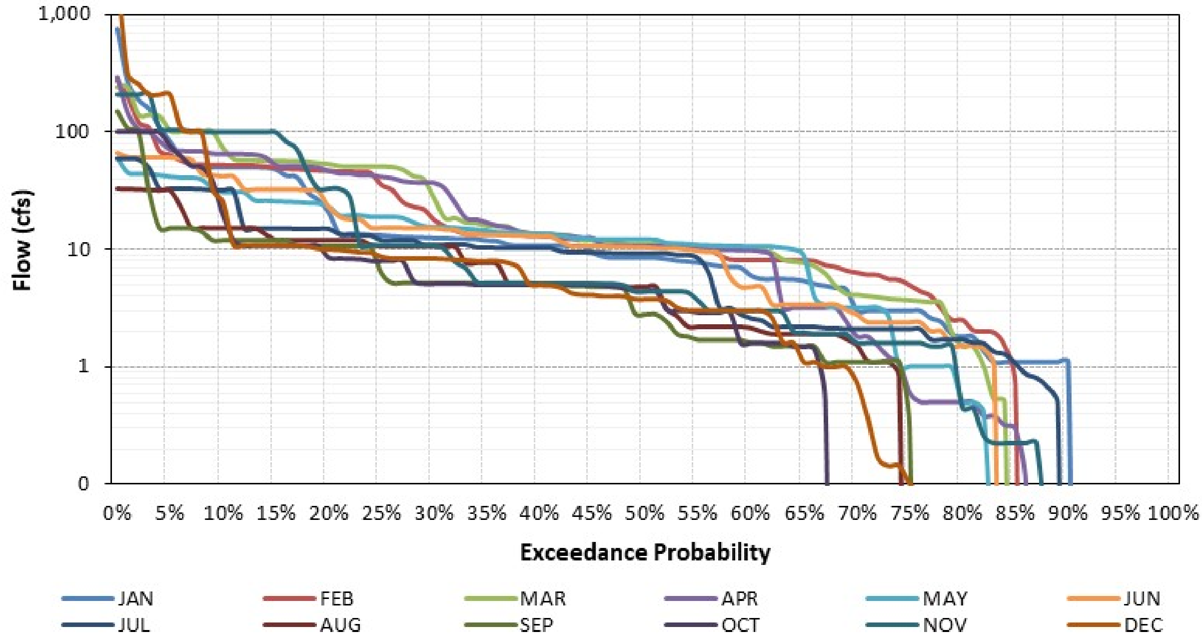


Source: DWR Department of Engineering Cedar Springs Dam Breach and Innundation Study Report (2007)
Key:
cfs = cubic feet per second
ft = feet

Figure 4.2-7. Cedar Springs Dam Spillway Rating Curve

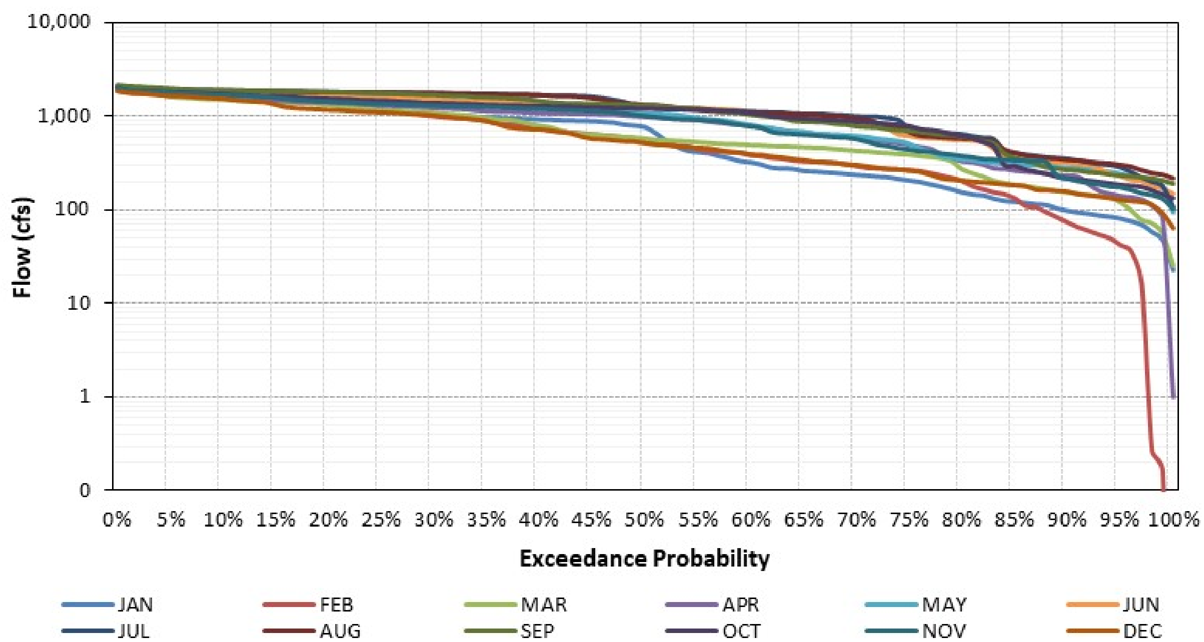
4.2.3 <u>Outflow from Silverwood Lake</u>

Figures 4.2-8, 4.2-9 and 4.2-10 provide monthly flow duration curves for outflow from Silverwood Lake from: (1) SWP; (2) natural flow; and (3) the combination SWP and natural outflow. The natural outflow includes the sum of USGS Gage 10260820 as described in Section 3.3.2.1, USGS Gage 10260822, as described in Section 3.3.4, and the CLAWA's water rights diversions, as described in Section 3.3.1. The SWP outflow is the sum of San Bernardino Tunnel outflow measured by USGS gage 11063682, as described in Section 3.3.3 and CLAWA SWP diversions, as described in Section 3.3.1. In the POR, the peak natural outflow was 2,140 cfs on Dec 22, 2010, the peak SWP outflow was 2,164 cfs on Sep 23, 2017, and the peak total outflow was 3,300 cfs on Dec 22, 2010.



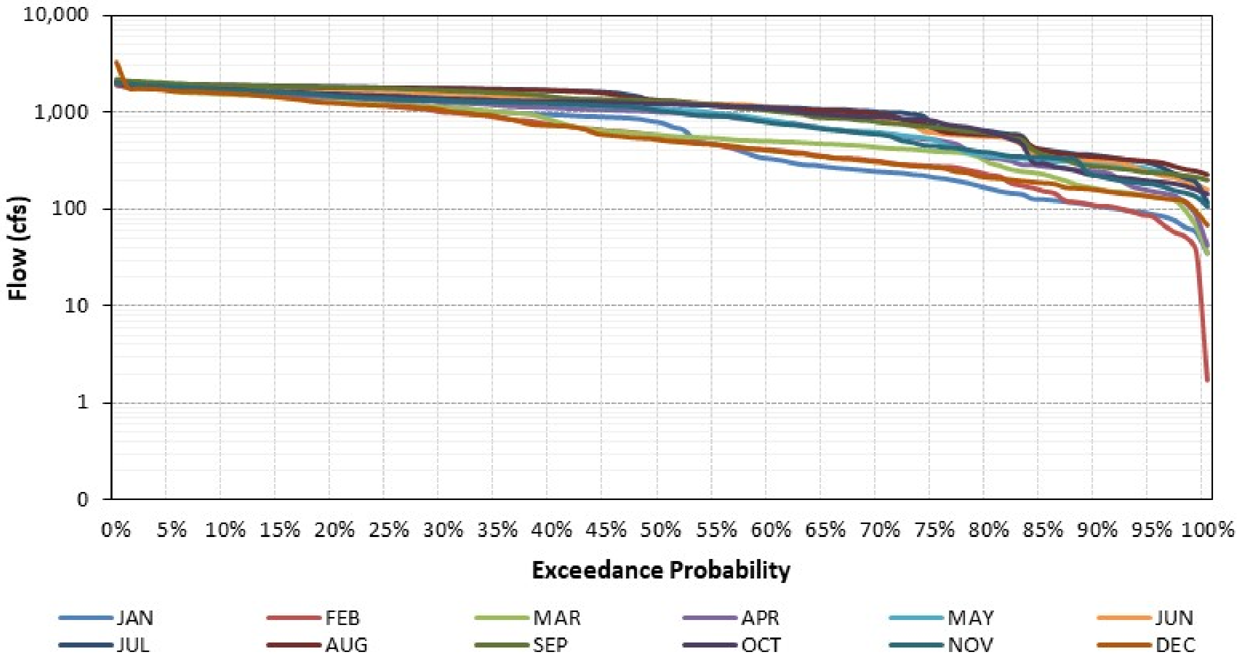
Source: USGS Gages 10260820 and 10260822
Key:
% = Percent
cfs = cubic feet per second

Figure 4.2-8. Monthly Flow Duration Curves for Natural Outflow from Silverwood Lake for the Relicensing Period of Record



Source: USGS gage 11063682
Key:
% = Percent
cfs = cubic feet per second

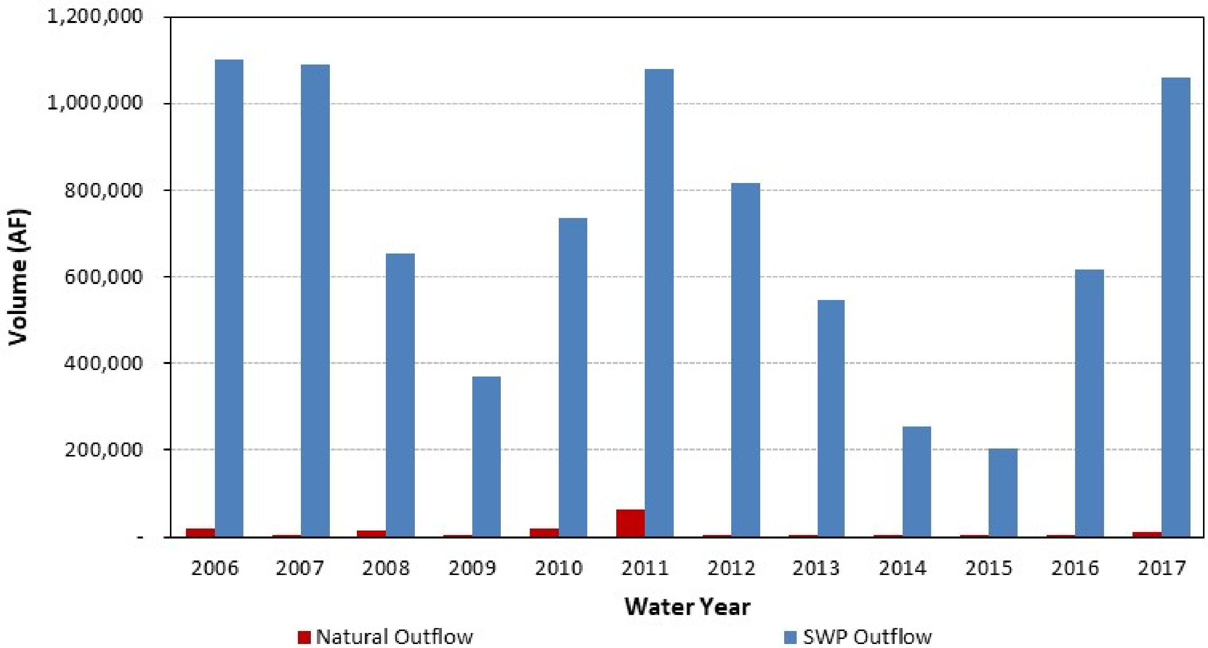
Figure 4.2-9. Monthly Flow Duration Curves for SWP Outflow from Silverwood Lake for the Relicensing Period of Record



Source: USGS Gages 10260820, 10260822, and 11063682
Key:
% = Percent
cfs = cubic feet per second

Figure 4.2-10. Monthly Flow Duration Curves for Total Outflow from Silverwood Lake for the Relicensing Period of Record

Figure 4.2-11 shows the relative contribution of the natural outflow and SWP outflow for each year of the POR. The annual volume of natural outflow is rarely noticeable compared to the volume of SWP outflow. The greatest difference between the two volumes of 1,088,818 AF occurred in WY 2007, and the smallest difference between the two volumes of 202,317 AF occurred in WY 2015.



Source: USGS gages 10260820, 10260822, and 11063682
Key:
AF = acre-feet
SWP = State Water Project

Figure 4.2-11. Relative Contribution of Natural Outflow and SWP Outflow

4.2.4 <u>San Bernardino Tunnel and Penstocks</u>

Releases of SWP water from Silverwood Lake are made through the San Bernardino Tunnel. The tunnel intake is a vertical reinforced concrete tower on the south end of Silverwood Lake at an invert elevation of 3,265 feet. The San Bernardino Tunnel is 3.81 miles long, concrete-lined, 12.75 feet in diameter, and has a design capacity of 2,811 cfs. The tunnel delivers water to two above-ground penstocks that run parallel, generally following the ground slope from the south portal, or end, of the San Bernardino Tunnel to the Devil Canyon Powerplant. The maximum capacities of the two penstocks are approximately 1,200 cfs and 1,600 cfs. Flow through the tunnel and penstocks is discussed in the next section.

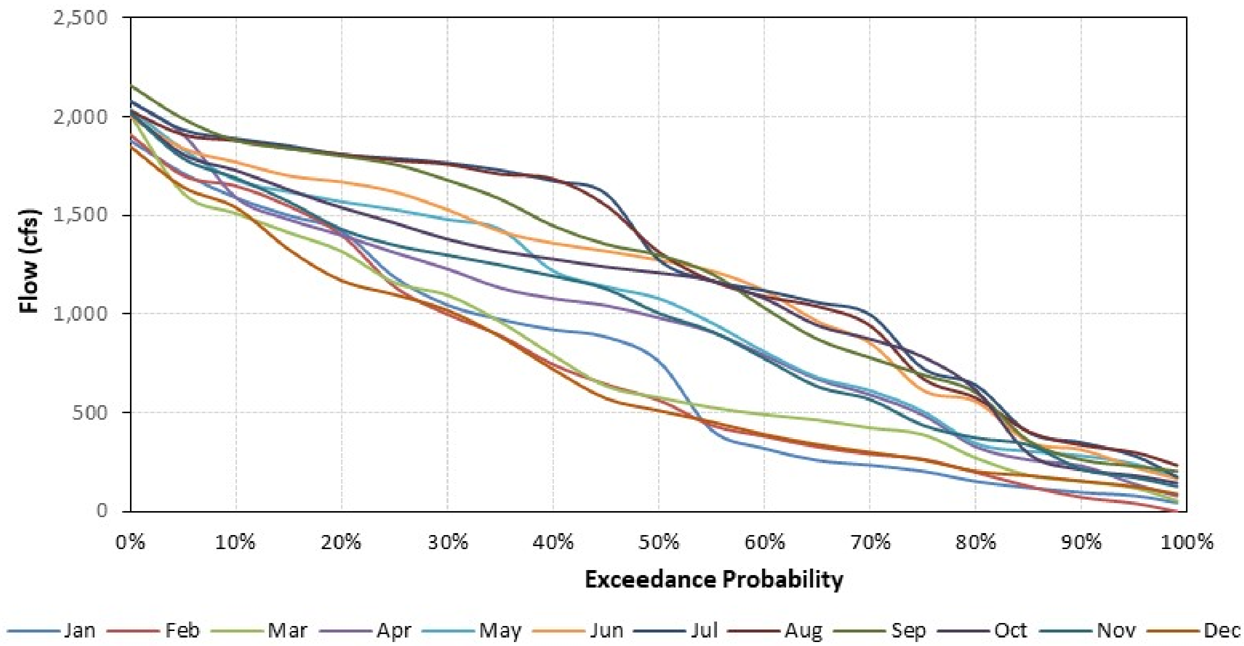
4.2.5 <u>Devil Canyon Powerplant</u>

The Devil Canyon Powerplant generates power using SWP water released for downstream water users. As a general rule, weekly water demands are established, and DWR in coordination with CAISO manages that water on a daily and hourly basis to maximize peaking power, and to provide regulation-up, regulation-down and spinning reserve ancillary services in support of the California electric grid. The powerplant is manually operated, with DWR staff on site seven days per week, 24 hours per day.

Minimum-, maximum- and mean-daily average flows through the powerplant over the relicensing POR are 0 cfs, 2,160 cfs and 980 cfs, respectively.

The Devil Canyon Powerplant contains four generation units with a centerline elevation of 1,942 feet. These include one Baldwin-Lima-Hamilton Pelton-type turbine and one Sulzer Escher Wyss Pelton-type turbine, each with 1,357 feet rated head, 277 revolutions per minute (rpm) runner speed, 81,000 horsepower (hp) rated output, 670 cfs approximate rated discharge, and a licensed capacity of 59,850 kW. The other two are Voith Pelton-type turbines each with 1,250 feet rated head, 277 rpm runner speed, 102,064 hp rated output, 800 cfs approximate rated discharge, and licensed capacity of 76,548 kW.

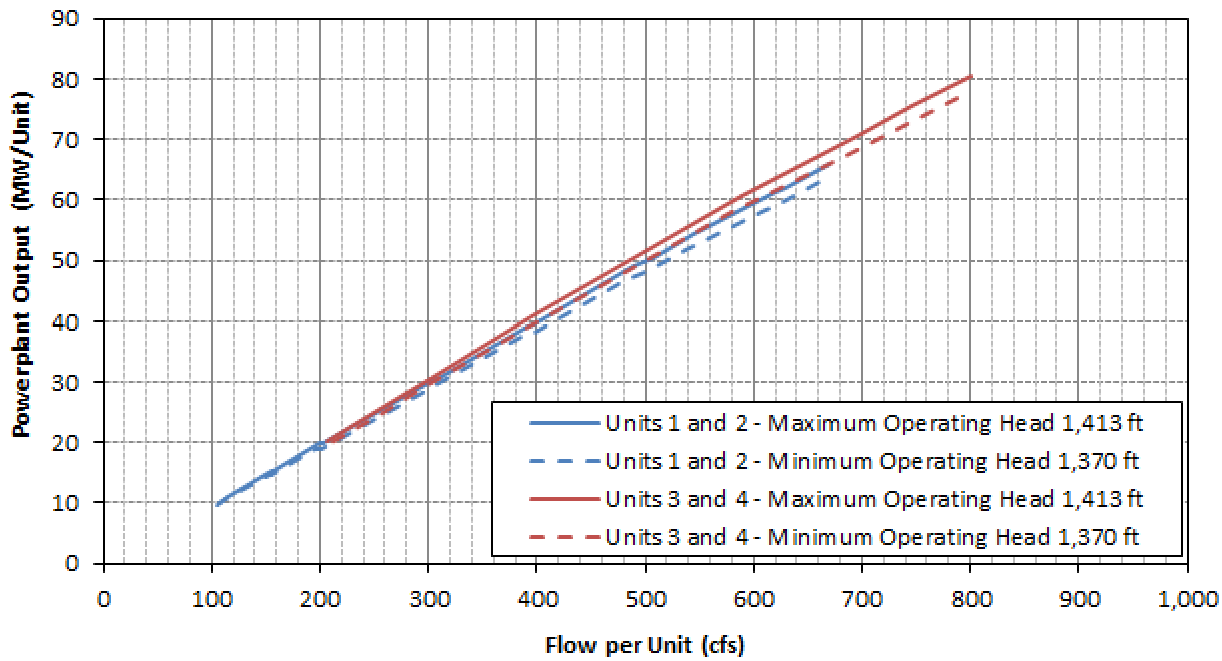
Monthly flow duration curves for releases from Devil Canyon Powerplant over the relicensing POR are provided on Figure 4.2-12.



Source: USGS gage 11063682
Key:
% = Percent
cfs = cubic feet per second

Figure 4.2-12. Monthly Flow Duration Curves for Devil Canyon Powerplant for the Relicensing Period of Record Using Gaged Data

Powerhouse capability versus flow is shown on Figure 4.2-13. Normal, minimum- and maximum-operating heads for Devil Canyon Powerplant are 1,411 feet (corresponding to a Silverwood Lake surface elevation of 3,353 feet and 73,032 AF of storage); 1,370 feet (corresponding to a Silverwood Lake surface elevation of 3,312 feet and 39,211 AF of storage); and 1,413 feet (corresponding to a reservoir surface elevation of 3,355 feet and 75,000 AF of storage), respectively.



Source: Devil Canyon Powerplant Efficiency Test, performed June 15-16 2011
Notes:
[1]Curves for normal operating head (1,411 feet) are not shown; they would be indistinguishable from maximum head curves.
[2]Reported operating head is for gross head (elevation drop between Silverwood Reservoir WSE and Devil Canyon Powerplant turbine.)
Key:
cfs = cubic feet per second
ft. = feet
MW = megawatt

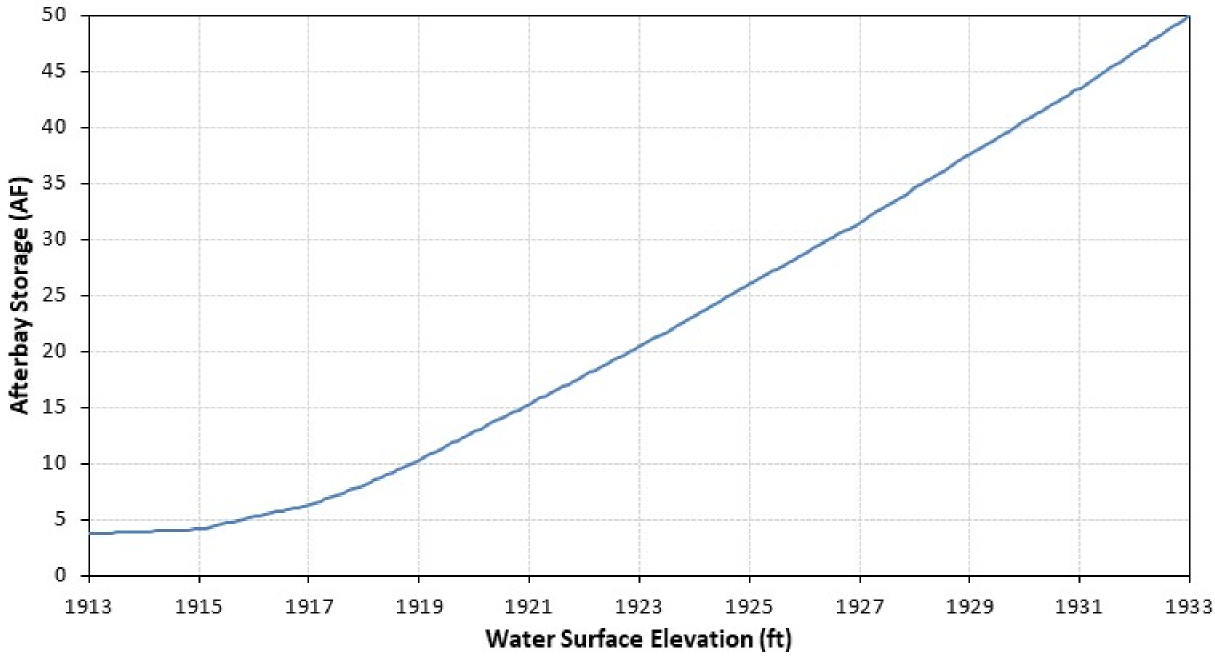
Figure 4.2-13. Devil Canyon Powerplant Capability Curve

The Devil Canyon Powerplant units use Pelton turbines, and are not dependent on tail water elevation. The turbine elevation for the Devil Canyon Powerplant is 1938 feet. The Devil Canyon Powerplant is operated for participation in both energy and ancillary services markets with the California Independent System Operator (CAISO). Its daily and weekly operations are driven by energy market demands, so there is no standard load curve.

The Devil Canyon Powerplant has a nameplate capacity of 272,796 kW and a dependable capacity of 250,100 kW, and generates an annual average of 836,000 megawatt-hours per year (refer to Exhibit D).

4.2.6 Devil Canyon Afterbay

The Devil Canyon Afterbay provides a minimal amount of regulatory capacity for matching the Devil Canyon Powerplant's inflow and outflow to different pipelines for SWP water deliveries. At an NMWSE of 1,932 feet, the Devil Canyon Afterbay has a capacity of 49 AF and a surface area of 13.8 acres. The storage capacity curve showing the storage capacities of the Devil Canyon Afterbay is shown on Figure 4.2-14.



Source: DWR
Key:
AF = acre-feet
ft. = feet

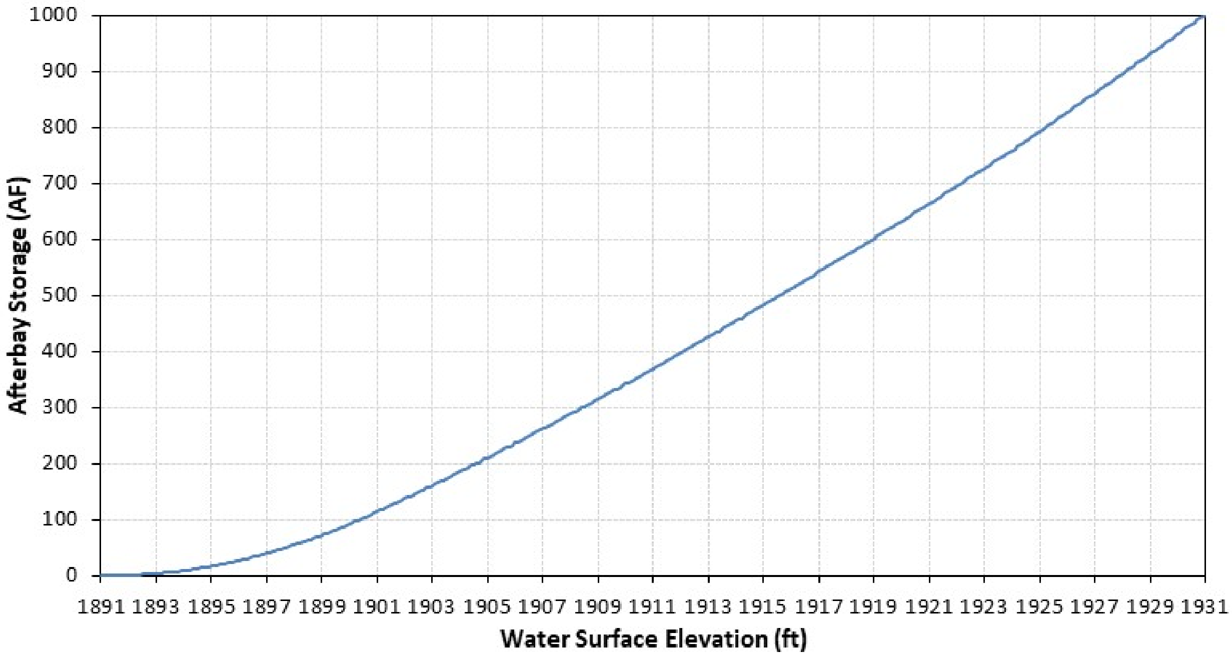
Figure 4.2-14. Devil Canyon Afterbay Elevation-Storage Curve

The Devil Canyon Afterbay includes a spillway structure designed for emergency purposes but has never been used, and is obsolete due to the construction of the Second Afterbay. The Afterbay does not include facilities for releases to surface waters, other than the second Afterbay.

There are no rule curves pertinent to the Afterbay. In general, the Afterbay is maintained at full pool.

4.2.7 Devil Canyon Second Afterbay

The Devil Canyon Second Afterbay, at an NMWSE of 1,930 feet, has a gross storage capacity of 967 AF and a surface area of approximately 36.0 acres. The minimum Devil Canyon Second Afterbay elevation is 1,910 feet, corresponding to 342 AF of storage. The storage capacity curve showing the usable and gross storage capacities of the Devil Canyon Second Afterbay is shown on Figure 4.2-15.



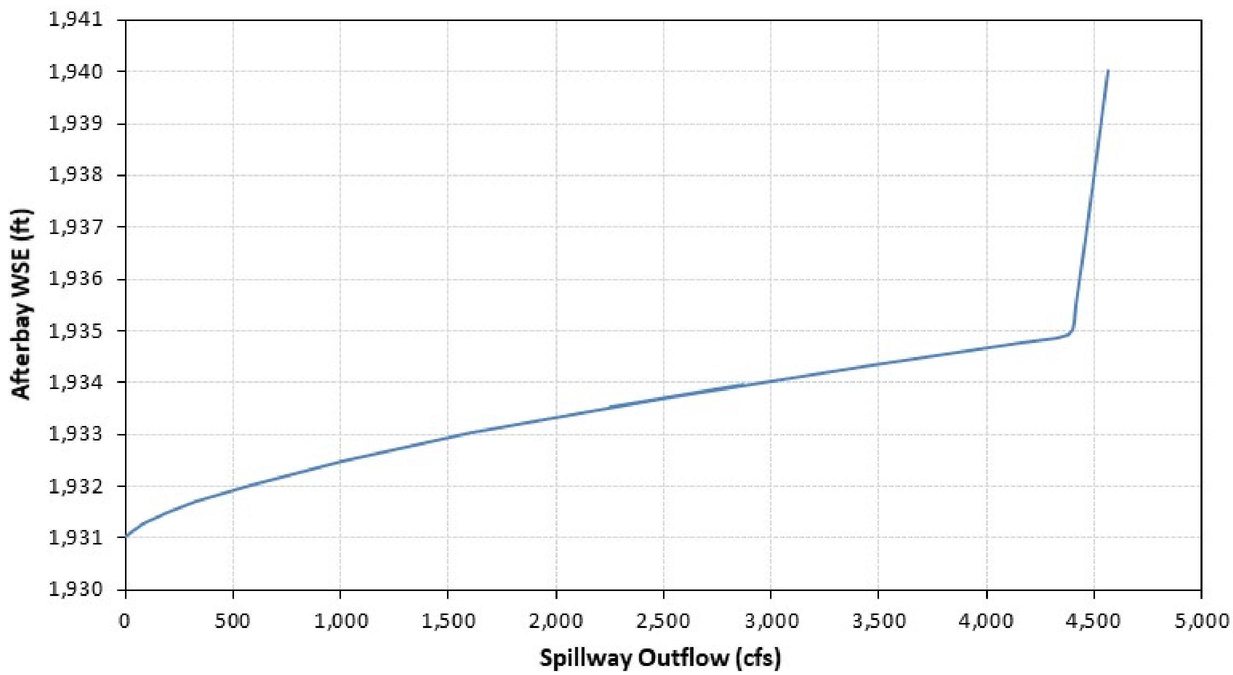
Source: DWR As-Built drawing (Spec. NO. 92-16)
Key:
AF = acre-feet
ft. = feet

Figure 4.2-15. Devil Canyon Second Afterbay Storage-Capacity Curve

Like the Devil Canyon Afterbay, the Second Afterbay provides a minimal amount of regulatory capacity for matching the Devil Canyon Powerplant's inflow and outflow to different pipelines for SWP water deliveries.

The Devil Canyon Second Afterbay also has an emergency overflow spillway discharge outlet: the Wasteway Pipe (Exhibit F-8A), which releases to Devil Canyon Creek. Flows from the Devil Canyon Second Afterbay can be discharged to the Wasteway Pipe either through two low-level outlet gates, over a spillway with an elevation of 1,931.0 feet. The Devil Canyon Second Afterbay spillway has never been used; the low-level outlet gates are exercised every three years for dam safety purposes.

There are two components to the Devil Canyon Second Afterbay's spillway outflow rating curve: the discharging capacity over the spillway, and the flow carrying capacity of the Wasteway Pipe. The minimum of the above two is the controlling factor for the combined outflow rating. Depending on the water surface elevation within the Second Afterbay, the spillway and Wasteway Pipe can function as two independent outlets or one outlet. Figure 4.2-16 shows the final rating curve for the Second Afterbay Spillway. When the water surface elevation within the Second Afterbay is less than 1,934.8 feet, the outflow from the spillway is less than the capacity of the Wasteway Pipe. When the Second Afterbay water surface elevation is above 1,934.8 feet, the outflow is limited by the capacity of the Wasteway Pipe inlet.



Source: DWR Devil Canyon Powerplant Second Afterbay, Determination of Spillway Length, Jan 2017
Key:
cfs = cubic feet per second
ft. = feet

Figure 4.2-16. Devil Canyon Second Afterbay Dam Spillway Rating Curve

There are no rule curves pertinent to the Devil Canyon Second Afterbay. In general, the Afterbay is maintained at full pool.

4.3 PROJECT FACILITY MAINTENANCE

4.3.1 San Bernardino Tunnel

The San Bernardino Tunnel is always pressurized, except for one to two periods approximately once every five years when the tunnel is dewatered for inspection.

4.3.2 Devil Canyon Powerplant Maintenance

DWR conducts annual mechanical and electrical inspections and maintenance at the Devil Canyon Powerhouse to verify the structural and/or functional integrity of the facilities and to identify conditions that might disrupt operations. The annual mechanical and electrical inspections and maintenance of the generation units is typically done one unit at a time and occurs in the spring and fall time frame while keeping other units available for water delivery. These annual inspections typically run about 25 days each. In the fall, half of the powerplant is out at a time for 3 days for switchyard inspections and maintenance. Penstock inspections are done individually and usually happen in the late fall or early winter, again affecting half the powerplant at a time and leaving two units available for power generation and water delivery.

4.3.3 Other Facility Maintenance

Routine maintenance activities conducted in the vicinity of Project facilities include vegetation management, pest management, road and trail maintenance, maintenance of communication facilities, debris management, and facility painting. Each of these activities is described below.

4.3.4 Vegetation Maintenance

Vegetation management is implemented by DWR at Project facilities. Vegetation management is completed throughout the Project area as necessary to reduce fire hazard, to provide for adequate Project facility access and inspection, to protect Project facilities, and to provide for worker and public health and safety. In general, vegetation management is implemented within approximately 75 feet of the powerhouse and switchyard; within approximately 15 feet on either side of roads and trails to Project facilities; and within and adjacent to recreation areas.

Vegetation management is conducted manually (hand trimming) and chemically (with the use of herbicides). Hand trimming includes cutting grasses and forbs using string trimmers, and removing or trimming overhanging shrubs and tree limbs using a chain saw or other handheld saw or clippers. These management activities are conducted as needed in conjunction with facility inspections.

Herbicides, in combination with surfactants, are used in combination with hand trimming vegetation management activities on an annual basis at Project facilities located on DWR-owned property. All herbicide applications are supervised by a Qualified Applicator under the direction of a licensed Pest Control Advisor (PCA). The PCA prepares pest control recommendations consistent with the specific herbicide label(s) for each site, prescribing specific application direction and associated precautions that must be strictly followed. All-terrain vehicles, other vehicles (e.g., pick-up trucks), backpack sprayers, or small hand-held sprayers are used to apply herbicides. Herbicide application occurs twice annually, at a minimum. These applications occur between December 1 and March 31, as determined by the PCA for pre-emergents. Follow-up visits to apply post-emergent herbicides and/or additional treatments (as needed) are seasonally dependent, and typically occur between April 1 and June 30. A third cycle, if required, would be completed between July 1 and October 14.

4.3.5 Hazard Trees

Hazard trees – generally defined as dead or dying trees or trees with defects that may result in failure and have the potential to cause property damage, personal injury, or death – are removed as needed. Removal is conducted with a chainsaw, handheld saw, or other equipment. Smaller diameter debris from felled hazard trees is either chipped or lopped and scattered. Downed logs are typically left on-site and are moved only if needed for safety. If moving logs is necessary, it may be completed by hand or machine, depending on the situation.

4.3.5.1 Vertebrate Pest Management

DWR implements rodent control as needed in facility interiors using non-restricted rodenticides, which are applied in accordance with the label instructions. Rodent control occurs within the Devil Canyon Powerhouse.

4.3.5.2 Road Maintenance

Regular inspection of the Project access roads occurs during the course of day-to-day Project activities. Road maintenance on Project and shared roads occurs as needed. Maintenance generally includes, but is not limited to, the following types of activities: debris removal; filling potholes; grading, sealing, and surfacing; maintenance or replacement of erosion control features (e.g., culverts, drains, ditches, and water bars); repair, replacement, or installation of access control structures such as posts, cables, rails, gates, and barrier rock; and repair and replacement of signage. Vegetation management may be conducted concurrently with road maintenance.

4.3.5.3 Facility Painting

DWR paints the exterior of Project facilities, including the powerhouse and ancillary facilities as needed.

4.3.5.4 Recreation Facilities Maintenance

Maintenance of recreation facilities is conducted by both DWR and the California Department of Parks and Recreation. Maintenance activities include activities to support recreation development and use and include maintaining parking areas, lawns, restrooms, lights, water, power, shelters, and picnic/campground equipment.

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5.0 DWR'S PROPOSED PROJECT OPERATIONS

DWR proposes to continue to operate the Project as it has operated historically.

DWR proposes for inclusion in the new license the following 11 environmental measures to protect or enhance environmental resources at the Project:

Geology and Soils

- Measure GS1 - Implement the Erosion and Sediment Control Plan included in Appendix A of Exhibit E, that includes measures to control sedimentation and erosion when stabilizing slopes affected by the Project. DWR developed this plan in collaboration with interested parties and understands USFS supports this plan.

Water Resources

- Measure WR1 - Maintain Silverwood Lake minimum pool and limit Silverwood Lake water surface elevations for the benefit of recreation and reservoir fishery. This measure, which is included in Appendix A of Exhibit E, incorporates into the new license the Silverwood Lake minimum pool and water surface elevation restrictions in the DWR and USFS 1968 MOU and the DWR and CDFW 2003 MOU, and is substantially consistent with Article 58 in the existing Project license.

- Measure WR2 - Implement the Hazardous Materials Management Plan included in Appendix A of Exhibit E, that includes measures to manage hazardous materials, including response and clean-up of hazardous materials spills. DWR developed this plan in collaboration with interested parties and understands USFS and San Bernardino County Fire Department (SBCFD) supports this plan.

Aquatic Resources

- Measure AR1 - Implement the Silverwood Lake Fish Stocking condition Plan included in Appendix A of Exhibit E, that includes measures to maintain the rainbow trout recreational fishery, including periodic angler surveys. This measure is similar to Article 51 in the existing Project license. DWR developed this measure in collaboration with interested parties and understands CDFW supports this measure.

- Measure AR2 - Implement the Aquatic Invasive Species Management Plan included in Appendix A of Exhibit E, that includes measures to prevent the introduction and spread of aquatic invasive species.

Terrestrial Resources

- Measure TR1 - Implement the Integrated Vegetation Management Plan included in Appendix A of Exhibit E, that includes measures for controlling non-native plant species, protecting special-status species, and re-vegetating disturbed areas.

Land Use

- Measure LU1 - Implement the Transportation System Management Plan included in Appendix A of Exhibit E, that provides guidance for the maintenance of Primary Project Roads and Trails. DWR developed this plan in collaboration with interested parties and understands USFS supports this plan.

- Measure LU2 - Implement the Fire Prevention and Response Plan included in Appendix A of Exhibit E, that provides measures for preventing, reporting, and investigating Project-related wildfires. DWR developed this plan in collaboration with interested parties and understands USFS and SBCFD support this plan.

- Measure LU3 - Develop and Implement a Project Safety Plan that provides measures for installing and maintaining signs, lights, sirens and other devices below Cedar Springs Dam needed to protect the public. This measure is similar to Articles 60 and 402 in the existing license.

Aesthetics

- Measure VR1 - Implement the Visual Resources Management Plan included in Appendix A of Exhibit E, that includes measures to reduce the visual contrast of some Project facilities.

Cultural Resources

- Measure CR1 - Implement the Historic Properties Management Plan (Privileged) included in Appendix A of Exhibit E, that provides specific actions and processes to manage historic properties.

DWR also intends to include a recreation management plan for the Project in its FLA.

See Appendix A of Exhibit E, for a detailed description of each of the above measures.

6.0 USE OF POWER

DWR is required to schedule all energy through the Cal-ISO for pumping requirements and available resources to meet the SWP load, including energy from the Devil Canyon powerplant. DWR considers power from the Devil Canyon powerplant as used for SWP pumping load requirements. However, Cal-ISO considers all electrical energy received as a power purchase and all energy supplied as a sale.

Table 6.0-1 shows energy used each year on-site for the Devil Canyon powerplant station service.

Table 6.0-1. Consumed Power for the Devil Canyon Powerplant over the Relicensing Period of Record

Year	Devil Canyon Powerplant Consumed Power (kWh)
2006	81,312
2007	7,995
2008	158,505
2009	919,116
2010	381,988
2011	47,491
2012	32,825
2013	138,281
2014	1,693,287
2015	1,151,405
2016	531,180
2017	91,073
Average	436,205

Source: DWR
Key:
kWh = Kilowatt-hour

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7.0 PLANS FOR FUTURE DEVELOPMENT OF THE PROJECT AND IN THE WATERSHED

At this time, DWR has no plans, other than those described in the application for a new license, to expand the Project or to develop other water projects in the West Fork Mojave River watershed.

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8.0 REFERENCES CITED

None.

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Appendix A

HYDROLOGY DATASET FOR THE RELICENSING PERIOD OF RECORD

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APPENDIX A

HYDROLOGY DATASET FOR THE RELICENSING PERIOD OF RECORD

Appendix A includes the historical hydrological data. Specifically, the material in Appendix A includes:

- HEC-DSS files of historical hydrology from USGS gages and DWR records.
- Microsoft Excel file with summaries of historical hydrology data as shown in Exhibit B.

Table A-1 lists the contents of this appendix, including file type and total file size.

Table A-1. Contents of Appendix A

Name	File Type(s) on Disc	Total File Size
Hydrology Data		
Silverwood Hydrology	1 DSS files	400 KB
Exhibit B Hydrology Figures (07132018)	1 Microsoft Excel files	2.8 MB
Total Size		**3.17 MB on CD**

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