Streamflow and Reservoir Elevation Gaging Plan

Sacramento Municipal Utility District

Hydro License Implementation • Revision 1
January 2023
Upper American River Project

Powering forward. Together.

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1.0 Background and Introduction

This revised Streamflow and Reservoir Elevation Gaging Plan (Gaging Plan or Plan) was prepared by the Sacramento Municipal Utility District (SMUD) in response to the Federal Energy Regulatory Commission's (FERC) Order Modifying and Approving the original Plan, dated July 28, 2015, which required a revision once the proposed modifications described in the original Plan were complete. The original Plan was developed in compliance with the State Water Resources Control Board (SWRCB) 401 Water Quality Certification Condition 6 (SWRCB 2014) and Condition 36 of the United States Forest Service (USFS) 4(e) as described in the FERC Order Issuing New License (License or new License) of July 23rd, 2014 for the Upper American River Project (UARP), FERC Project No. 2101 (FERC 2014) and amended in 2016 (FERC 2016). Attachment 1 consists of the conditions contained in the various documents which are applicable to this Plan.

The UARP lies within El Dorado and Sacramento counties, primarily within lands of the Eldorado National Forest. The UARP consists of three major storage reservoirs - Loon Lake, Union Valley, and Ice House (with a combined capacity of 379,622 acre-feet), eight smaller regulating or diversion reservoirs, and eight powerhouses. The UARP began operations in 1961 and has an authorized installed generating capacity of approximately 640 megawatts. The UARP also includes recreation facilities containing over 700 campsites, five boat ramps, and hiking and bicycling trails at the reservoirs.

SMUD owns and maintains the various dams of the UARP. The original design of the outlet works and gaging sites for these dams were engineered for the streamflows that SMUD released pursuant to the original License issued by FERC in 1957. The new License issued in 2014 requires SMUD to increase the minimum streamflow releases at all the UARP dams. It also requires SMUD to make special releases at certain dams for stream channel maintenance (referred to as pulse flows), recreation streamflows for whitewater boating, and water temperature control. Ramping rates are also required during periods when SMUD increases and decreases releases for boating and pulse flow purposes.

SMUD monitors the volume of releases from these dams to assure compliance with streamflow release requirements contained in the License. This also required SMUD to modify the outlet works and/or gaging facilities at certain dams. Additionally, as part of the License, SMUD is required to maintain minimum water surface elevations at some UARP reservoirs (SWRCB Condition 5 and USFS Condition 49, Appendices A and B, respectively, FERC 2014).

This Gaging Plan describes SMUD's current gaging facilities and methodologies necessary to demonstrate compliance with all streamflow release and reservoir operations required in the License.

2.0 Monitoring Plan Objectives

The primary objective and rationale for the streamflow and reservoir elevation gaging program is to ensure compliance with SWRCB Conditions 1, 2, 3 and 5, and USFS Conditions 27, 28, 29, and 49, by identifying the point of measurement for each required Minimum Streamflow, Pulse Flow, Recreation Streamflow, Ramping Rate and Reservoir Level, respectively (Appendices A and B, respectively, FERC 2014) . The FERC License Water Quality Certification further mandates compliance with SMUD's California water right licenses and permits; these currently require monthly/annual reporting of water diversion and use (SWRCB 2013).

3.0 Study Area and Gaging Locations

Streamflow and reservoir level compliance gaging occurs at 11 and 9 sites, respectively, throughout the UARP area (Tables 1 and 2). In most cases, SMUD maintains redundant measuring devices at each of the sites to guard against data loss and to maintain continuity of operations. Each site is described in further detail below in Section 4 (Methods) and includes current conditions at outlet works and gaging facilities. Figures 1 and 2 depict the streamflow and reservoir levels gaging locations, respectively, relative to the UARP reservoirs and primary streams and rivers.

Table 1. UARP streamflow gaging site locations and parameters.

SMUD Site ID	USGS ID	Location	Gage Type and Data Transfer	Polling Interval
24	11427960	Rubicon River below Rubicon Reservoir Dam	Acoustic Velocity Meter, and radio telemetry	15 minutes
23	11428400	Little Rubicon River below Buck Island Reservoir Dam	Submersible pressure transducers (2), and radio telemetry	15 minutes
30	11429500	Gerle Creek below Loon Lake Reservoir Dam	Pressure Sensor with Bubbler, submersible pressure transducer, and radio telemetry	15 minutes
117	114296005	Gerle Creek below Gerle Creek Reservoir Dam	Acoustic Velocity Meter and Fiber Network	30 seconds
110	11428995	South Fork Rubicon River below Robbs Peak Reservoir Dam	Submersible pressure transducers (2), and radio telemetry	30seconds
39	11441500	South Fork Silver Creek below Ice House Reservoir Dam	Pressure Sensor/ Data Logger with Bubbler, submersible pressure transducer, and radio telemetry	15 minutes
101	11441800	Silver Creek below Junction Reservoir Dam	Submersible pressure transducers (2), and fiber network	30 seconds
104	11441900	Silver Creek below Camino Reservoir Dam	Submersible pressure transducers (2), and radio telemetry	30 seconds
102	11442700	Brush Creek below Brush Creek Reservoir Dam	Submersible pressure transducers (2), and fiber network	30 seconds
105	11443500	SFAR below Slab Creek Reservoir Dam[1]	Acoustic Velocity Meter and Fiber Network	30 seconds

[1] Data for site 11443500 will have two compliance points. The first is flow released directly from or over the dam The second is further downstream at the South Fork Powerhouse.

Table 2. UARP Reservoir gaging site locations and parameters.

SMUD Site ID	USGS ID	Location	Gage Type	Polling Interval
24 [1]	11427958	Rubicon Reservoir	Submersible pressure transducers (2), and radio telemetry	15 minutes
107	11429350	Loon Lake Reservoir	Submersible pressure transducers (2), and fiber network	30 seconds
112	11429600	Gerle Creek Reservoir	Submersible pressure transducers (2), and fiber network	30 seconds
116	11441100	Ice House Reservoir	Submersible pressure transducers (2), and fiber network	30 seconds
109	11441001	Union Valley Reservoir	Submersible pressure transducers (2), and fiber network	30 seconds
103	11441760	Junction Reservoir	Submersible pressure transducers (2), and fiber network	30 seconds
100	11441890	Camino Reservoir	Submersible pressure transducers (2), and fiber network	30 seconds
106	11442690	Brush Creek Reservoir	Submersible pressure transducers (2), and fiber network	30 seconds
105	11443450	Slab Creek Reservoir	Submersible pressure transducers (2), and fiber network	30 seconds

[1] Sites 24 and 27 were merged in 2015

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Table 3. Additional management streamflow gaging sites

SMUD Site ID	USGS ID	Location	Gage Type	Measurement Interval
2	11427800	Rubicon River upstream of Rubicon Reservoir	Submersible pressure transducers (2), and radio telemetry	15 minutes
1	11428300	Buck-Loon Tunnel	Submersible pressure transducers (2) with data logger, and radio telemetry	15 minutes
22	11430000	SF Rubicon (below Gerle Creek)	Pressure Sensor/ Data Logger with Bubbler, submersible pressure transducer and radio telemetry	15 minutes
33	n/a	SF Silver Creek upstream of Icehouse Reservoir	Submersible pressure transducers (2), and radio telemetry	15 minutes
35	n/a	SF Silver Creek upstream of Junction Reservoir	Submersible pressure transducers (2), and radio telemetry	15 minutes
41	n/a	Big Silver Creek upstream of Union Valley Reservoir	Submersible pressure transducers (2), and radio telemetry	15 minutes
115	n/a	SF American River at Forebay Road	Pressure Sensor/ Data Logger with Bubbler, submersible pressure transducer, and fiber network	30 seconds
38	n/a	SF American River upstream of White Rock PH	Submersible pressure transducers (2), and radio telemetry	15 minutes

4.0 Methods

The minimum streamflow schedules and reservoir level requirements are separated into five water year type classifications described in the License: Wet, Above Normal (AN), Below Normal (BN), Dry, and Critically Dry (CD). Each month from February through May, SMUD shall determine the water year type based on the California Department of Water Resources' (DWR) Bulletin 120 forecast and shall operate for that month based on that forecast beginning three days after issuance of the forecast and continuing until two days after

issuance of a subsequent monthly forecast. The May forecast shall be used to establish the final water year type for the remaining months of the water year and the month of October. The water year type for the months of November through January shall be based on DWR's Full Natural Flow record for the American River at Folsom (California Data Exchange Center American River at Folsom [AMF] Station, sensor 65) for the preceding water year, and the Licensee shall operate based on that record beginning November 1. The water year types are defined as follows:

Year Type	American River Water Year Forecast (million acre-feet [MAF])
Wet	greater than or equal to 3.500 MAF
AN	greater than or equal to 2.600 MAF but less than 3.500 MAF
BN	greater than or equal to 1.700 MAF but less than 2.600 MAF
Dry	greater than or equal to 0.900 MAF but less than 1.700 MAF
CD	less than 0.900 MAF

In addition to these definitions, the License defines a *Super Dry (SD)* water year type, which is defined as any CD year that is immediately preceded by a Dry or CD year or any Dry year that is immediately preceded by any combination of two Dry or CD years. In the event of a SD year, SMUD shall notify and consult USFS, California Department of Fish and Wildlife (CDFW), SWRCB, and the Consultation Group regarding this condition, and discuss reservoir operations plans and reservoir levels during the SD water year. See Attachment 1, Condition 49, Section 8 for more information regarding the Super Dry conditions.

4.1 Streamflow Gaging

SMUD follows methods prescribed by the United States Geological Survey (USGS). Currently these are set forth in *Techniques of Water-Resources Investigations of the United State Geological Survey* (TWRI), Book 3, *Applications of Hydraulics*, Section A, *Surface-water techniques.*

The frequency of visits at individual sites will vary based on expected changes in conditions, with gaging systems located in streams with natural controls visited more frequently than relatively stable weir-based systems.

Typically, velocity is measured using USGS sanctioned measurement devices (Price AA, Pygmy, Flow-Tracker current meters). Under higher discharge conditions, such as those required for pulse and boating flow releases, velocity may be measured with a float-mounted acoustic Doppler current profiler. Instrumentation will regularly be maintained and calibrated to USGS standards.

This Gaging Plan describes the current control structures at these stations. With the exception of gaging stations in the UARP that monitor flow with acoustic velocity meters (AVMs), each station is currently equipped with a surveyed, vertical staff plate used as a reference gage for the respective water-level sensors. Where the control was altered during infrastructure modifications, the stage-discharge relationship was re-established through the development of a new rating. Stream gaging and the development of new stage-discharge curves follow USGS standards.

4.1.1 Rubicon River below Rubicon Reservoir Dam

From its headwaters, the Rubicon River flows generally north for about 8 miles to Rubicon Reservoir, then northwest about 4.8 miles to the mouth of the Little Rubicon River, and about 5 miles further to Placer County Water Agency's Hell Hole Reservoir, part of the Middle Fork American River Project (FERC Project No. 2079). SMUD diverts water to Loon Lake from Rubicon Reservoir through tunnels and surface channels that also connect Rockbound and Buck Island Lakes.

Under the License, SMUD is required to release minimum flows and pulse flows below Rubicon Reservoir Dam. Required minimum releases vary by month and water year type, ranging from 1 to 35 cfs (Table 4). In many months, the required release is 6 cfs or the natural flow of the Rubicon River into the reservoir. When the natural inflow is less than 6 cfs, SMUD will make appropriate calculations and match the instream release with the natural inflow, down to 1 cfs. In some cases, SMUD may match the instream release with natural inflow when inflow is less than 1 cfs (see footnote in Table 4). SMUD validates and maintains these inflow records and will provide them to FERC, other agencies, or the public, upon request.

Pulse flow releases are required in BN, AN, and Wet water years. The objective of these releases is to provide at least 600 cfs for 3 days in winter or spring of these water years. Since the storage capacity of Rubicon Reservoir is only 1,439 acre-feet, pulse flow releases from storage are not possible, leaving a forced dam spill as the only means of providing pulse flows. This is accomplished by partially lowering the gates at the opening of Rubicon-Rockbound Tunnel to impede water flow into the tunnel, thereby creating a backup of water in the reservoir until it passes over the main and auxiliary dam spillways. In lieu of achieving the above-stated objective, the License also recognizes pulse flow compliance under the following alternative scenarios: (1) at least 3,600 acre-feet of water spilling over the dams within a 10-day period, or (2) the tunnel gates are lowered for a minimum of 60 days, regardless of the volume of spill.

Currently, minimum streamflow release monitoring at Rubicon Reservoir Dam (Site 24 USGS ID 11427960) is conducted using a 36" remotely-operated knife gate valve and 30' of discharge pipe below the toe of the spillway. using an ultrasonic flow meter integrated into the discharge pipe. The ultrasonic flow meter has three paths where both primary and secondary are the average of 3 paths. Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via radio telemetry to SMUD's Supervisory Control and Data Acquisition (SCADA) system.

Natural inflow is measured at the existing USGS Site (ID 11427800), located upstream of the reservoir within the FERC Project boundary. The current site consists of a natural, bedrock-formed control with digital pressure transducers (2), datalogger, PV panels, battery, and radio telemetry equipment. Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via radio telemetry to SMUD's SCADA. This site allows for accurate and

responsive minimum flow releases corresponding to the natural inflow to Rubicon Reservoir. This capability also assists with planning logistics for spilling pulse flows and with maintaining the overwinter pool. When conditions and/or resources allow, a minimum of two site visits per year are made to confirm the recorded stage corresponds with the reference gage and take discharge measurements to calibrate the rating.

Pulse flow monitoring is performed by converting gaged water surface elevation data for Rubicon Reservoir to spill volume using the spillway rating curves for the main and auxiliary dams. The two spillways are standard ogee crest designs. A combined spillway rating curve was generated during the original UARP design from an engineering equation describing the relationship between water elevation in Rubicon Reservoir and flow over the dam spillways. In 2012, the dam spillways were re-surveyed and new spillway rating curves were developed.

Table 4. Rubicon River below Rubicon Reservoir Dam

Minimum Streamflow by Water Year Type (cfs)

Month	CD	Dry	BN	AN	Wet
October	6 or NF*	6 or NF*	6 or NF*	6 or NF*	6 or NF*
November	6 or NF*	6 or NF*	6 or NF*	6 or NF*	6 or NF*
December	6 or NF*	6 or NF*	6 or NF*	6 or NF*	6 or NF*
January	6 or NF*	6 or NF*	6 or NF*	6 or NF*	6 or NF*
February	6 or NF*	6 or NF*	6 or NF*	6 or NF*	6 or NF*
March	6 or NF*	8	15	15	15
April	8	12	20	20	20
May	10	15	35	35	35
June	6 or NF*	8	15	15	15
July	6 or NF*	6 or NF*	6 or NF*	6 or NF*	6 or NF*
August	6 or NF*	6 or NF*	6 or NF*	6 or NF*	6 or NF*
September	6 or NF*	6 or NF*	6 or NF*	6 or NF*	6 or NF*

* The minimum streamflow shall be 6 cfs or the NF, whichever is less. NF as used here is natural flow, subject to the following condition: If natural flow measured in the Rubicon River above Rubicon Reservoir is below 1 cfs, the minimum streamflow shall be 1 cfs. In CD water years, if the useable storage in Rubicon Reservoir is less than 60 ac-ft and SMUD cannot maintain 1 cfs due to lack of natural flow into and storage in Rubicon Reservoir, after notification of USFS, USFWS, CDFW, and the State Water Board, SMUD may reduce minimum flows below 1 cfs until sufficient water is available to resume prescribed minimum streamflow releases; however, at no time shall the minimum streamflow be less than the natural flow into Rubicon Reservoir. SMUD shall make every effort to notify USFS, USFWS, CDFW, and the State Water Board at least 30 days prior to the date upon which SMUD will not meet the streamflow, or as much in advance as possible.

4.1.2 Little Rubicon River below Buck Island Reservoir Dam

From its headwaters, Highland Creek flows generally north for about 3 miles to Rockbound Lake (a non-project waterbody) and then to Buck Island Reservoir on the Little Rubicon River. From Buck Island Reservoir, the Little Rubicon River flows generally northwesterly 2.5 miles to its mouth at the Rubicon River.

Under the License, SMUD is required to release minimum flows below Buck Island Reservoir Dam. Required minimum releases vary by month and water year type, ranging from 1 and 8 cfs into the Little Rubicon River. In many months, the required release is 1 cfs. In some cases, SMUD may match the instream release with natural inflow when inflow is less than 1 cfs (See footnote of Table 5). SMUD validates and maintains these inflow records and will provide them to FERC, other agencies, or the public, upon request.

Streamflow monitoring is conducted using duplicate submersible pressure transducers located at Site 23 (USGS ID 11428400). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via radio telemetry to SMUD's SCADA system. . A new compound weir was installed in 2015 to gage the increased streamflows required by the License.

Table 5. Little Rubicon River below Buck Island Reservoir Dam

Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	1*	1*	1*	1*	1*
November	1*	1*	1*	1*	1*
December	1*	1*	1*	1*	1*
January	1*	1*	1*	1*	1*
February	1*	1*	1*	1*	1*
March	1*	2	3	3	3
April	2	3	5	5	5
May	2	3	8	8	8
June	1*	2	3	3	3
July	1*	1*	1*	1*	1*
August	1*	1*	1*	1*	1*
September	1*	1*	1*	1*	1*

* If natural flow measured in Highland/Rockbound Creek above Buck Island Reservoir is below 1 cfs, the minimum flow shall be 1 cfs. In CD water years, if the useable storage in Buck Island Reservoir is less than 60 ac-ft and SMUD cannot maintain 1 cfs due to lack of natural flow into and storage in Buck Island Reservoir, SMUD, after notification of USFS, CDFW, USFWS, and the State Water Board, may reduce minimum flows below 1 cfs until sufficient water is available to

resume prescribed minimum streamflow releases; however, at no time shall the minimum streamflow be less than the natural flow into Buck Island Reservoir. SMUD shall make every effort to notify USFS, USFWS, CDFW, and the State Water Board at least 30 days prior to the date upon which the SMUD will not meet the streamflow, or as much in advance as possible.

4.1.3 Gerle Creek below Loon Lake Reservoir Dam

The Gerle Creek headwaters originate at an elevation of about 7,200 feet as Ellis Creek, flowing generally westerly and southerly for a distance of 2.1 miles to Loon Lake Reservoir (elevation 6,400 feet). From Loon Lake Reservoir, Gerle Creek runs in an 8.5-mile-long arc before entering Gerle Creek Reservoir.

Under the License, SMUD is required to release minimum flows and pulse flows below Loon Lake Reservoir Dam. Required minimum releases vary by month and water year type, ranging from, 5 to 58 cfs (Table 6).

Pulse flow releases are required in BN, AN, and Wet water years, ranging from 125 to as much as 740 cfs (or maximum capacity of the outlet works and reservoir elevation). However, as required by the License, SMUD performed an investigation in 2016 to ensure that pulse flow releases do not have negative impacts to various downstream features and that desired outcomes are occurring (SWRCB Condition 3, License Appendix A). This investigation concluded and pulse flows at Gerle Creek below Loon Lake Dam began in water year 2019 and will continue provided the water year type is at or above the “Below Normal” threshold. While releasing pulse flows into Gerle Creek below Loon Lake Reservoir, SMUD is also required to implement a ramping rate of 1 foot per hour.

Streamflow monitoring below Loon Lake is conducted at Site 30 (USGS ID 11429500) using a pressure sensor/ data logger with bubbler and a submersible pressure transducer. Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via radio telemetry where stream flow control is done remotely using two 10” knife gate valves at the outlet works located at the base of the dam. All levels, valve positions, and flows are sent to SMUD’s SCADA system. Modifications, including reinforcement of the existing weir were completed in 2012. Discharge measurements are taken either 15 ft upstream of the weir site or approximately 100 ft upstream to measure discharge up to approximately 375 cfs.

Ramping rate compliance is monitored using the stage-discharge relationship developed from measurements of test flows, pulse flows, storm events, and minimum streamflows.

Table 6. Gerle Creek below Loon Lake Reservoir Dam					
Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	7	11	16	20	23
November	7	11	16	20	23
December	8	13	18	22	26
January	12	15	19	23	28
February	14	18	22	27	32
March	19	24	30	37	44
April	23	32	40	49	58
May	25	32	40	49	58
June	10	16	22	27	32
July	5	14	22	27	32
August	5	10	14	17	20
September	5	10	14	17	20

4.1.4 Gerle Creek below Gerle Creek Reservoir Dam

From Loon Lake Reservoir, Gerle Creek runs in an 8.5-mile-long arc before entering Gerle Creek Reservoir. Below Gerle Creek Reservoir, Gerle Creek runs another 1.2 miles before terminating at the confluence with the South Fork Rubicon River. Under the License, SMUD is required to release minimum flows below Gerle Creek Reservoir into Gerle Creek. Required minimum releases vary by month and water year type, ranging from 5 to 15 cfs (Table 7).

Minimum release monitoring under the License is achieved using the existing 10” outlet pipe in Gerle Creek Dam. The previous globe valve attached to the outlet pipe was replaced with a knife gate valve in September 2011. Subsequently, in May 2012, the pipe bore was cleaned out to remove build-up and restore the original inside diameter. Currently, minimum streamflow release monitoring at Gerle Creek Dam is conducted using an acoustic velocity meter with wetted transducers in a single traverse array located in the outlet structure at the dam. Measurements from this instrumentation are used to determine the proper opening of the outlet valve to maintain required flow. Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD’s SCADA system.

Table 7. Gerle Creek below Gerle Creek Reservoir Dam					
Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	5	9	10	10	10
November	4	4	6	6	6
December	4	5	6	6	6
January	5	6	6	6	6
February	5	6	6	6	6
March	7	10	12	9	9
April	9	12	15	9	9
May	9	12	15	15	15
June	9	12	15	15	15
July	7	10	13	15	15
August	5	9	12	12	12
September	5	9	10	10	10

4.1.5 South Fork Rubicon River below Robbs Peak Reservoir Dam

The headwaters of the South Fork Rubicon River originate at an elevation of about 8,870 feet near Tells Peak. The South Fork Rubicon River flows generally westerly to the confluence with the Rubicon River at about elevation 3,850 feet, a distance of approximately 13 miles. Gerle Creek, described above, is the major tributary of the South Fork Rubicon River, entering the river about 4.8 miles upriver of its mouth.
Under the License, SMUD is required to release minimum flows below Robbs Peak Reservoir into Gerle Creek. Required minimum releases vary by month and water year type, ranging from 1 to 13 cfs (Table 8).

The current facilities at Robbs Peak Reservoir are inadequate for releasing and measuring the higher streamflows required by the License. The existing 6inch diameter valve diaphragm was replaced in 201 with a new 16” valve to make adequate releases. A new weir was installed approximately 500 feet downstream of the forebay in 2016. Currently, minimum streamflows are measured utilizing duplicate submersible pressure transducers at the new downstream weir, and data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via radio telemetry to SMUD’s SCADA system. A new stage-discharge relationship was developed shortly after construction.

Table 8. South Fork Rubicon River below Robbs Peak Reservoir Dam					
Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	3	3	3	3	3
November	1	2	3	3	3
December	1	3	4	4	4
January	2	5	7	7	7
February	2	5	8	8	8
March	3	7	11	9	9
April	4	9	13	10	10
May	4	9	13	13	13
June	4	9	13	13	13
July	3	5	6	13	13
August	3	5	6	11	11
September	3	5	6	6	6

4.1.6 South Fork Silver Creek below Ice House Reservoir Dam

The South Fork Silver Creek headwaters originate in the Desolation Wilderness at an elevation over 9,000 feet in the Crystal Range. The South Fork Silver Creek flows generally westerly and northerly to Silver Creek at Junction Reservoir at about elevation 4,450 feet, a distance of 24 miles. The segment of South Fork Silver Creek downstream of Ice House Reservoir extends 11.5 miles.

Under the License, SMUD is required to release minimum, pulse, and recreation flows below Ice House Reservoir Dam. Required minimum releases vary by month and water year type, ranging from 5 to 68 cfs (Table 9). SMUD is also required to implement: (1) pulse flow releases between 450 and 780 cfs, (2) whitewater boating releases between 300 and 500 cfs, and (3) ramping rates of one foot per hour.

Streamflow monitoring is currently conducted using a pressure sensor/ data logger with bubbler and submersible pressure transducer located at Site 39 (USGS ID 11441500). Data is transmitted via radio telemetry to a Campbell Scientific CR1000 where stream flow control is done remotely using two 10” knife gate valves at the outlet works located at the base of the dam. All levels, valve positions and flows are transmitted to SMUD’s SCADA system. In 2012, a new weir with an integrated low flow box was constructed at the existing site.

Pulse flows, boating flows, and ramping rate monitoring are performed using this USGS 11441500 gage.

Table 9. South Fork Silver Creek below Ice House Reservoir Dam					
Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	5	10	15	15	15
November	5	7	8	8	8
December	5	8	11	11	11
January	6	12	18	18	18
February	6	12	18	18	18
March	8	16	24	24	24
April	15	28	41	41	41
May	30	46	68	68	68
June	25	31	46	46	46
July	21	21	30	30	30
August	14	14	15	15	15
September	10	10	15	15	15

4.1.7 Silver Creek below Junction Reservoir Dam

The Silver Creek headwaters originate in the Desolation Wilderness at an elevation of over 9,000 feet in the Crystal Range. Silver Creek originates at the confluence of Tells Creek, Big Silver Creek and Jones Fork Silver Creek at Union Valley Reservoir. From the reservoir, Silver Creek flows generally southwesterly to its terminus at the South Fork American River (SFAR) at 2,050 feet elevation, a distance of 14.6 miles.

Junction Reservoir lies directly downstream of Union Valley Reservoir. Tailrace water from Union Valley Powerhouse flows into Junction Reservoir. Water is released from Junction Reservoir into Silver Creek, which runs 8.3 miles before entering Camino Reservoir.

Under the License, SMUD is required to release minimum flows below Junction Reservoir into Silver Creek. Minimum releases vary by month and water year type, ranging from 5 to 68 cfs (Table 10). SMUD is also required to make additional releases above minimum values in Wet water years on an as-needed basis to maintain water temperatures below a 20° C daily average. The incremental releases are limited to the months of July, August, and September and are capped at maximum monthly volumetric release totals of 1044, 491, and 475 acre-feet, respectively.

Streamflow monitoring below Junction Reservoir Dam is conducted at Site 101 (USGS ID 11441800) using duplicate pressure transducers. Data is stored in a Campbell Scientific CR-1000 datalogger and transmitted via fiber network to SMUD's SCADA system. No facility

modifications were required at this site, and existing equipment and formats have been retained.

Table 10. Silver Creek below Junction Reservoir Dam					
Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	5	10	15	15	15
November	5	7	20	20	20
December	5	8	20	20	20
January	6	12	20	20	20
February	6	12	20	20	20
March	8	16	25	25	25
April	15	28	42	42	42
May	30	46	68	68	68
June	25	31	50	59	59
July	21	21	30	35	35*
August	14	14	15	18	18*
September	10	10	15	18	18*

4.1.8 Silver Creek below Camino Reservoir Dam

Camino Reservoir lies on Silver Creek roughly midway between Union Valley Reservoir and the mouth of Silver Creek at the confluence with the South Fork American River. Water released from Junction Reservoir into Silver Creek runs 6.2 miles before entering the South Fork American River.

Under the License, SMUD is required to release minimum flows below Camino Reservoir into Silver Creek. As with Junction Reservoir, minimum releases from Camino Reservoir range from 5 to 68 cfs (Table 11). Also, like Junction Reservoir, SMUD is required to make additional releases from Camino in Wet water years to maintain water temperatures below a 20° C daily average in lower Silver Creek. The incremental releases are limited to the months of July, August, and September and are capped at the same volumetric totals: 1044, 491, and 475 acre-feet in July-September, respectively.

Streamflow monitoring is conducted using duplicate submersible pressure transducers located at Site 104 (USGS ID 11441900). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD's SCADA system. A new weir with a low flow box was installed in 2016. Subsequently, minimum streamflows are measured

utilizing the existing digital pressure transducers, as well as retaining the existing data storage and transfer format. A new rating was developed shortly after construction to establish the stage-discharge relationship for the new weir.

Table 11. Silver Creek below Camino Reservoir Dam

Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	5	10	15	15	15
November	5	7	20	20	20
December	5	8	20	20	20
January	6	12	20	20	20
February	6	12	20	20	20
March	8	16	25	25	25
April	15	28	42	42	42
May	30	46	68	68	68
June	25	31	50	59	59
July	21	21	30	35	35*
August	14	14	15	18	18*
September	10	10	15	18	18*

4.1.9 Brush Creek below Brush Creek Reservoir Dam

The headwaters of Brush Creek originate at an elevation of 4,900 feet near Little Sugar Pine Mountain and then flow generally southwesterly to the SFAR at Slab Creek Reservoir, a distance of approximately 6 miles. Under the License, SMUD is required to release minimum flows below Brush Creek Reservoir into Brush Creek. Minimum releases vary by month and water year type, ranging from 3 to 10 cfs (Table 12).

Streamflow monitoring below Brush Creek Reservoir is currently conducted using 2 submersible pressure transducers located at Site 102 (USGS ID 11442700). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD's SCADA system. No facility modifications were required at this site, and existing equipment, formats and ratings were retained. Currently, there is no streamflow gage on Brush Creek monitoring inflow to the reservoir and SMUD will not install a gage to determine natural inflow. SMUD will instead comply with the minimum release requirement shown in Table 12 without regard to the natural inflow.

Table 12. Brush Creek below Brush Creek Reservoir Dam					
Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	4 or NF*	4 or NF*	4 or NF*	4 or NF*	4 or NF*
November	6 or NF*	7 or NF*	8 or NF*	9 or NF*	9 or NF*
December	6 or NF*	7 or NF*	8 or NF*	9 or NF*	10 or NF*
January	6 or NF*	7 or NF*	8 or NF*	9 or NF*	10 or NF*
February	6 or NF*	7 or NF*	8 or NF*	9 or NF*	10 or NF*
March	6 or NF*	7 or NF*	8 or NF*	9 or NF*	10 or NF*
April	6 or NF*	7 or NF*	8 or NF*	9 or NF*	10 or NF*
May	6 or NF*	7 or NF*	8 or NF*	9 or NF*	10 or NF*
June	6 or NF*	7 or NF*	8 or NF*	9 or NF*	9 or NF*
July	5 or NF*	5 or NF*	5 or NF*	5 or NF*	5 or NF*
August	4 or NF*	4 or NF*	4 or NF*	4 or NF*	4 or NF*
September	3 or NF*	3 or NF*	3 or NF*	3 or NF*	3 or NF*

The minimum streamflow shall be the value specified in Table 12 or the NF, whichever is less. NF as used here is natural flow subject to the following condition: If natural flow as measured in Brush Creek above Brush Creek Reservoir is less than 1 cfs, the minimum flow shall be 1 cfs.

4.1.10 SF American River below Slab Creek Reservoir Dam

The South Fork American River headwaters originate above Echo Summit at an elevation of over 9,000 feet in the Crystal Range. The South Fork American River flows generally westerly to its terminus at the American River at Folsom Lake, a distance of approximately 75 miles. Major tributaries of South Fork American River above Slab Creek Dam include Pyramid Creek, Strawberry Creek, Silver Fork American River, Alder Creek, Silver Creek, Brush Creek, and Slab Creek.

Under the License, SMUD is required to release minimum and recreation flows below Slab Creek Reservoir into the South Fork American River. Water is released into South Fork American River through a combination of three release points: Slab Creek Dam, South Fork Powerhouse, and South Fork Powerhouse Boating Flow Release Facility (BFRF).

Following the FERC 2016 Order Amending License, there are two locations where unique minimum flows are required. The first location is the short stretch between Slab Creek Dam and South Fork Powerhouse. Required minimum releases here vary by month and water year type, ranging from 15 to 36 cfs which are made by releasing water from the 24-inch fixed cone valve at the base of Slab Creek Dam (Table 13). The second location is the

stream reach downstream of South Fork Powerhouse released by the combination of the South Fork Powerhouse tailrace and the BFRF valve. Required minimum releases vary by week, month, and water year type, ranging from 63 to 415 cfs (Table 14). For the minimum streamflow release requirements, compliance monitoring is performed using acoustic velocity meters located on penstocks supplying all three of these release points (the acoustic velocity meter for South Fork Powerhouse /BFRF is located upstream of the penstock bifurcation and measures both releases).

SMUD is also required to implement whitewater boating releases between 800 and 1,500 cfs with ramping rates of one foot per hour. These recreation streamflows are also made with through the combination of the three release points. The maximum capacity of the Slab Creek Dam valve is approximately 270 cfs under full pool conditions in the reservoir, or a water elevation of 1,850 feet. Maximum capacity of the South Fork Powerhouse turbine is 180 cfs, and the BFRF is 1,300 cfs. For the recreation streamflow release requirements, compliance monitoring is performed using the same acoustic velocity meters mentioned above.

With this new powerhouse, the location of minimum flow and boating flow compliance from Slab Creek Reservoir changed. Site 11443500 has a record extending back to water year 1923 and SMUD recognizes that it has historically measured the total discharge in the South Fork American River within one eighth mile upstream of the confluence with Iowa Canyon Creek. Discharge for USGS site 11443500 will be computed as the sum of the discharge measured by the AVM at the base of Slab Creek Dam, spill over Slab Creek Dam as recorded by USGS site 114443450, and the acoustic velocity meter on the pipe supplying water to the South Fork Powerhouse.

SMUD works with USGS to provide streamflow measurement as required from each acoustic velocity meter compliance point to comply with the flow requirements specified in the amended License and to maintain historical continuity at site number 11443500.

Table 13. South Fork American River below Slab Creek Reservoir Dam					
Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	15	15	20	20	20
November	15	15	15	15	15
December	15	15	15	15	15
January	15	15	15	15	15
February	15	15	15	15	15
March	15	20	20	30	36
April	15	20	36	36	36
May	15	20	36	36	36
June	15	20	30	30	30
July	15	20	20	20	20
August	15	20	20	20	20
September	15	20	20	20	20

Table 14. South Fork American River below South Fork Power House					
Minimum Streamflow by Water Year Type (cfs)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
October	63	63	70	80	90
November	63	63	70	80	90
December	63	63	70	80	90
January	63	63	70	80	90
February	63	63	70	80	90
March	63	101	110-130-150-180	110-130-150-180	110-130-150-180
April	100	110-130-150-183	222-236-247-263	222-236-247-263	222-236-247-263
May	109	164-145-126-107	272-286-297-303	272-316-367-395	272-337-387-415
June	90	90	255-210-165-120	324-256-188-120	352-274-197-120
July	77	90	90	90	90
August	63	70	70	70	70
September	63	63	70	70	70

4.2 Reservoir Elevation Gaging

A general description of each UARP reservoir is found in Table 15. Beginning as early as reasonably practicable but within 6 months after License issuance, SMUD will meet or exceed the end-of-month reservoir elevations for Loon Lake, Union Valley and Ice House Reservoirs as shown in Tables 16-18. Compliance is measured at the reservoir storage gages as published by the USGS and as described in Table 2 and displayed in Figure 2.

It is recognized that USGS reviews and archives records of reservoir storage, not reservoir elevation. However, SMUD collects elevation data as the basic data for computing reservoir storage. Therefore, for these sites SMUD follows USGS standards for stage measurement set forth in TWRI Book 3, Chapter A7.

Table 15. General Information on Project Reservoirs					
Reservoir Name	**Maximum Pool Elevation (feet msl)**	**Normal Maximum Capacity (acre-feet)**	**Useable Storage (acre-feet)**	**Surface Area at Maximum Pool (acres)**	**Typical Daily/Annual Elevation Change (feet)**
Rubicon	6,545	1,439	1,408	108	<0.5/11.8
Buck Island	6,436	1,070	842	78	<0.5/11.5
Loon Lake	6,410	69,309	65,747	1,419	<0.5/36
Gerle Creek	5,231	831	380	60	1.5/9
Robbs Peak	5,231	150	141	2	<0.5/5
Ice House	5,450	43,496	35,057	675	<0.5/42
Union Valley	4,870	266,369	261,486	2,847	<0.5/60
Junction	4,450	2,609	2,100	64	20/32
Camino	2,915	543	289	20	20/30
Brush Creek	2,915	1,350	996	20	20/<1
Slab Creek	1,850	13,081	7,624	280	6/30
Total		**400,247**	**374,411**		

4.2.1 Loon Lake Reservoir

Loon Lake Reservoir is the highest elevation storage reservoir in the UARP. Water is released from the reservoir though the Loon Lake Penstock to the Loon Lake Powerhouse and then into Gerle Creek Reservoir. Water is released downstream from Loon Lake Dam by either passing over the spillway or through one or both of two 10-inch-diameter, remote controlled knife gate valves (maximum capacity of 24 cfs) or one 42-inch-diameter hollow cone valve (maximum capacity of ~600 cfs at reservoir full pool).

Loon Lake Reservoir storage volume typically follows an annual cycle, with reservoir elevations reaching their highest levels during early summer months. The reservoir levels, then gradually lowers throughout the late summer months. This gradual lowering of the reservoir continues into the fall and winter months. The water elevation slowly rises during the spring and early summer as the rain and snowmelt runoff refill the reservoir.

Under the License, SMUD is required to maintain Loon Lake Reservoir levels above minimum elevation values in July, August and September of all water year types (Table 16).

Loon Lake Reservoir levels are measured using redundant submersible pressure transducers at Site 107 (USGS ID 11429350). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD's SCADA system.

Table 16. Loon Lake Reservoir Level by Water Year					
End-of-Month Elevation (feet msl)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
July	6388	6395	6399	6400	6400
August	6382	6389	6394	6393	6393
September	6379	6385	6390	6390	6390

4.2.2 Ice House Reservoir

The primary purpose of Ice House Reservoir is storage. Water is released from the reservoir though the Jones Fork Tunnel to the Jones Fork Powerhouse located on Union Valley Reservoir or released downstream from Ice House Dam by either passing over the spillway or through one or both of two 10” diameter remote controlled knife gate valve low-level outlets (maximum capacity of 16 cfs) and one 42” diameter hollow cone valve low-level outlet, which have a combined capacity of ~740 cfs at reservoir full pool.

The California Department of Water Resources Division of Safety of Dams (DSOD) Certificate of Approval specifies that the spillway gates be held in the full-open position from November 1 through April 1. Between April 1 and April 15, water may be impounded to the top of the spillway gates (El. 5,445.0 feet, which is considered full pool). From April 16 through May 1, water level may be increased to elevation 5,447.0 feet. After May 1, the maximum elevation may be increased to 5,450 feet. By end of October, the water level must be lowered to elevation 5,436.5 feet, the spillway crest.

Under the License, SMUD is required to maintain Ice House Reservoir levels above minimum end-of-month elevation values in July, August and September of all water year types (Table 17). Ice House Reservoir levels are measured using duplicate submersible pressure transducers at Site 116 (USGS ID 11441100). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD’s SCADA system.

Table 17. Ice House Reservoir Level by Water Year					
End-of-Month Elevation (feet msl)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
July	5435	5437	5440	5441	5441
August	5430	5433	5434	5435	5434
September	5420	5429	5430	5431	5430

4.2.3 Union Valley Reservoir

The primary purpose of Union Valley Reservoir is storage. Water is released from the reservoir though the Union Valley Tunnel to Union Valley Powerhouse located on Junction Reservoir, which is an afterbay for Union Valley Powerhouse. Union Valley Dam does not have a low-level outlet.

The DSOD Certificate of Approval specifies that the spillway gates be held in the full open position from November 1 through April 1. Between April 1 and April 15, water may be impounded to elevation 4,865 feet. From April 16 through May 1, water level may be increased to elevation 4,867.0 feet. After May 1, water level may be increased to 4,870 feet. By end of October, water level must be lowered to elevation 4,855.0 feet, the spillway crest.

Under the License, SMUD is required to maintain Union Valley Reservoir levels above minimum end-of-month elevation values in July, August and September of all water year types (Table 18). Union Valley Reservoir levels are measured using duplicate submersible pressure transducers at Site 109 (USGS ID 11441001). Data are stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD's SCADA system.

Table 18. Union Valley Reservoir Level by Water Year					
End-of-Month Elevation (feet msl)					
Month	**CD**	**Dry**	**BN**	**AN**	**Wet**
July	4816	4836	4856	4856	4856
August	4803	4827	4835	4841	4842
September	4796	4818	4830	4830	4830

4.2.4 Rubicon Reservoir

The primary purpose of the Rubicon Reservoir is diversion of high spring flow from the main stem of the Rubicon River to Buck Island Reservoir via the Rockbound Tunnel, which diverts into Rockbound Lake. Rubicon Reservoir is not used for long-term storage; however, SMUD has water rights for storage of up to 2,110 ac-ft at this reservoir. Water is currently released downstream from Rubicon Dam by either passing over the spillway or through a new 36", remotely-operated knife gate valve and 30' of new discharge pipe below the toe of the spillway installed in 2015, and upgraded in 2022.

Because Rubicon Reservoir is operated primarily as a diversion facility, the water level in the reservoir fluctuates with changing volumes of inflow, ranging between the minimum operating pool level of 6,533.5 feet and the normal full pool level of 6,545.0 feet

Water surface elevation in Rubicon Reservoir is maintained at as high an elevation as practicable, and with a minimum of fluctuation, from May 1 to September 10 of each year in order to secure the maximum recreational benefits. SMUD typically lowers gates on the entrance to Rockbound Tunnel in these months, effectively raising the level by 6.0 feet to an elevation of 6,539.5 feet and narrowing the range of water elevation fluctuation from 11.8 to 5.8 feet. This stabilizes water level fluctuation during the recreation season. Water level in the reservoir typically stabilizes once natural inflow drops below 6 cfs. A minimum water surface elevation of 6,527 feet is maintained in Rubicon Reservoir year-round for the protection of lacustrine aquatic species.

Rubicon Reservoir level is measured using duplicate submersible pressure transducers located at the main dam and telemetered via radio to Site 24 (USGS ID 11427958). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via radio telemetry to SMUD's SCADA system.

4.2.5 Buck Island Reservoir

The primary purpose of the Buck Island Reservoir is diversion of high spring flow from the Rubicon River via the Buck-Loon Tunnel to Loon Lake Reservoir. Buck Island Reservoir is not used for long-term storage; however, SMUD has water rights for storage up to 1,200 ac-ft in this reservoir. Water is released downstream from Buck Island Dam by either passing over the spillway or through one 10" knife gate, low-level outlet valve, which has a capacity of ~11 cfs at full reservoir pool.

Because Buck Island Reservoir is operated primarily as a diversion facility, the water level fluctuates with changing volumes of inflow, ranging between the minimum operating pool level of 6,424.5 feet and the normal full pool level of 6,436.0 feet. Water surface elevation in Buck Island Reservoir is maintained at as high an elevation as practicable, and with a minimum of fluctuation, from May 1 to September 10 of each year in order to secure the

maximum recreational benefits. SMUD typically lowers gates on the entrance to the Buck-Loon Tunnel during this period effectively increasing the minimum operating pool level by 8.5 feet to 6,433 feet and narrowing the range of maximum water elevation fluctuation from 11.5 to 5.0 feet.

There are no reservoir level gaging requirements under the FERC License; however, reservoir elevations are gaged using duplicate submersible pressure transducers at Site 1. Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via radio telemetry to SMUD's SCADA system.

4.2.6 Gerle Creek Reservoir

As with Rubicon and Buck Island Reservoirs, the primary purpose of the Gerle Creek Reservoir is diversion of high spring flow and water diversion from upstream UARP facilities via the Gerle Canal to Robbs Peak Reservoir and then to Robbs Peak Powerhouse on Union Valley Reservoir. There are no storage rights at Gerle Creek Reservoir. Water is released downstream from Gerle Creek Dam by either passing over the spillway or through one remote controlled 10" diameter, knife valve, low-level outlet, which has a capacity of ~16 cfs at full pool.

Water surface elevation in Gerle Reservoir is maintained at as high an elevation as practicable, and with a minimum of fluctuation, from May 1 to September 10 of each year in order to provide maximum recreational benefits, including accessibility and the ability to angle from the fishing pier. If it is anticipated the reservoir will be drawn down below 5,225 feet during this time period, the USFS, SWRCB, United States Fish and Wildlife Service (USFWS) and CDFW shall be notified following the direction in Condition 5.H. (Interim Modifications), below. In addition, the reservoir level at Gerle Creek Reservoir shall be maintained at an elevation that allows fish passage into Gerle Creek from August through October.

Gerle Creek Reservoir levels are measured using duplicate submersible pressure transducers at Site 112 (USGS ID 11429600). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD's SCADA system.

4.2.7 Junction Reservoir

The primary purpose of Junction Reservoir is to act as a regulating afterbay for Union Valley Powerhouse and a regulating forebay for the Jaybird Powerhouse, which releases into the Camino Reservoir. Water is released into Jaybird Tunnel and downstream from Junction Dam by either passing over the spillway or through one 18" diameter hollow cone valve low-level outlet, which has a maximum capacity of about 138 cfs at reservoir full pool.

Water surface elevation in Junction Reservoir is maintained within the range of elevations measured between 1975 through 2000. This equates to maintaining a water surface elevation no lower than 4398 feet at Junction Reservoir.

Junction Reservoir levels are measured using duplicate submersible pressure transducers at Site 103 (USGS ID 11441760). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD's SCADA system.

4.2.8 Camino Reservoir

Camino Reservoir is a regulating afterbay for the Jaybird Powerhouse and one of two regulating forebays for the Camino Powerhouse. Water is released from Camino Reservoir into the Camino Tunnel, which then joins Brush Creek Tunnel. Water is released downstream from Camino Dam by either passing through one of three integral bulkhead gates in the face of the dam or through one 18" diameter hollow cone valve low-level outlets, which has a capacity of about 112 cfs at full pool. There are no reservoir level conditions for Camino Reservoir.

Camino Reservoir levels are measured using pressure transducers (2) at Site 100 (USGS ID 11441890). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD's SCADA system.

4.2.9 Brush Creek Reservoir

Unlike the Camino Reservoir and other reservoirs within the UARP, Brush Creek Reservoir is often operated to provide spinning reserves for reliability purposes. It is also used to generate maximum peak power during emergency and other limited situations, such as when all available generating units are expected to operate at full load for short periods of time.

Under this super-peaking operating mode, the daily water level may fluctuate up to 20 feet, ranging between the operating pool levels of 2,895.0 feet and 2,915.0 feet. Over the appropriate nighttime periods of the next two to three days following this operating mode, SMUD typically shuts down the operation of the Camino Powerhouse while operating the Jaybird Powerhouse. Concurrently, the water exiting the Jaybird Powerhouse is transported via the Camino and Brush Creek tunnels to refill Brush Creek Reservoir. Water is released downstream from Brush Creek Dam by either passing over the spillway or through an 18" hollow cone valve, which has a capacity of ~145 cfs at full pool.

Water surface elevation in Brush Creek Reservoir is maintained within the range of elevations measured between 1975 through 2000. This equates to maintaining a water surface elevation no lower than 2,853.6 feet at Brush Creek Reservoir.

Brush Creek Reservoir levels are measured using redundant submersible pressure transducers at Site 106 (USGS ID 11442690). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD's SCADA system.

4.2.10 Slab Creek Reservoir

Slab Creek Reservoir purposes include: (1) a regulating afterbay for the Camino Powerhouse; and (2) and a regulating forebay for the South Fork and White Rock Powerhouses, which releases into SMUD's Chili Bar Reservoir (FERC Project No. 2155). Water is released downstream from Slab Creek Dam by either passing over the spillway or through one 36" diameter penstock which leads to a 24" fixed cone valve. This low-level outlet valve has a capacity of approximately 260 cfs at full pool, or 1,850 feet water elevation. For generation purposes water is conveyed from the reservoir through the White Rock Tunnel to both the South Fork and White Rock Powerhouses.

Water surface elevation in Slab Creek Reservoir is maintained above 1,830 feet in elevation during daylight hours between 10:00 am and 8:00 pm during the period between July 1 and September 30, with a fluctuation limit of less than 7 feet per day.

Slab Creek Reservoir levels are measured using redundant submersible pressure transducers at Site 105 (USGS ID 11443450). Data is stored in a Campbell Scientific CR 1000 datalogger and transmitted via fiber network to SMUD's SCADA system.

4.3 Recreational Boating Flow Gaging

A recreational staff gage has been installed at the put-in location of each stream reach with boating flows: South Fork American River below Slab Creek Dam and South Fork Silver Creek below Ice House Dam. Details of these simple staff gages can be found in Table 19. Stage-Discharge ratings for these sites will be developed and provided to interested parties through the SMUD public information website.

Table 19. UARP Recreational Staff Gages

Stream Reach	Location
South Fork Silver Creek below Ice House Dam	Affixed to bedrock/boulder on right bank, approximately 175 ft. below Ice House Dam outlet works.
South Fork America River below Slab Creek Dam	Affixed to bedrock on right bank downstream of footbridge crossing across from the South Fork Powerhouse. Approximately 60 ft downstream of footbridge, 1000 ft below Slab Creek Dam.

5.0 Quality Assurance and Quality Control

Records of streamflow and water storage will follow USGS guidelines for operation and quality assurance procedures. Procedures for making high-quality discharge measurements during site visits include all of the following:

- Care of current meters, current profilers, and sounding equipment.
- Spin tests of current meters.
- Carefulness, good judgment, and proper procedure.
- Computing and plotting the measurement on site.
- Making check measurements when necessary.
- Checking discharge measurements.
- Documentation of QA/QC procedures where possible.

The gaging stations and the equipment and instruments described in this report will meet the accuracy standard set by the USGS Office of Surface Water for the measurement of stage for most applications, which is ±0.01 foot (ft) or 0.2 percent of the effective stage. Table 20 summarizes the accuracy and measurement range estimated for the parameters of interest at the gaging site used to determine discharge, along with the maintenance/calibration intervals. Values are derived from knowledge of measurement device characteristics and accuracy and also accounting for expected field conditions.

Table 20. Specifications for the various monitoring equipment.

Sampling Equipment	Accuracy	Range	Calibration Interval
Campbell Scientific CS450-L	Standard Accuracy Option: ±0.1% FS TEB	Dependent on option chosen	Biennial
Campbell Scientific CS451	Standard Accuracy Option: ±0.1% FS TEB	Dependent on option chosen	Biennial
Campbell Scientific CR 1000 Datalogger	±3 min. per year	Not Applicable	5 Years
	±(0.12% of reading + offset), -25° to 50°C *Current source: ± 25 mA*	0-5000 mV	
YSI Waterlog 350XL	± 0.007 ft., ± 0.014 ft.	0 to 15 PSI, 0 to 30 PSI	Biennial/Annual
YSI Waterlog H-3342	1/4096 (.00024 rev)	±32,768 rev	Biennial/Annual
GE Panametrics AquaTrans™ AT868	±1% of reading typical	–40 to 40 ft/s (–12.2 to 12.2 m/s)	Annual
GE Panametrics AT600	±1% of reading typical	0 to 50 CFS	N/A
Price AA 6200	+/-2%.	0.1 - 25 ft/sec	Annual
Pygmy 6205	± 3%	0.1 – 4.9 ft/sec	Annual
SonTek Flowtracker2 Handheld ADV	±/1% of measured velocity, +/- 0.25 cm/s	+0.001 to 4.0 m/s (0.003 to 13 ft/s)	As needed
GE Panametrics PT878	±1% of reading typical	–40 to 40 ft/s (–12.2 to 12.2 m/s)	As needed
SonTek RiverSurveyor M9 ADCP	±0.25% of measured velocity, +/- 0.2 cm/s	+20 m/s	As needed

6.0 Analysis

Calculation of stream discharge and reservoir storage from indirect measurements are done by trained specialists. Data are processed using software tools specifically designed for this purpose and which have been approved by USGS hydrologists.

SMUD follows established USGS standards to manage the water resources data from its stream and reservoir gaging network. This includes:

- Maintenance of station descriptions and station analyses.
- Daily review of many data; monthly review of most, annual review of all data.
- Diligent evaluation of direct measurements for rating shifts.

In addition, SMUD stays abreast of USGS requirements and standards. This includes:

- Frequent maintenance and refurbishment of stream gauging equipment.
- Regular correspondence with USGS California Water Science Center staff.
- Periodic self-study review of USGS TWRI reports.
- Participation in meetings for California cooperators.

7.0 Reporting

Data resulting from this Gaging Plan is reviewed annually by the USGS for public use. SMUD has for many years participated in a cost-sharing agreement with the USGS California Water Science Center, which reviews and publishes streamflow, and reservoir. Costs to the government for this review must not exceed 50% of the total cost. This is done under the authority of 43 USC §50 and 43 USC §50b.

These data will also be presented to the USFS, SWRCB, USFWS, and CDFW upon request. In the interest of resource conservation, paper printouts will not be distributed. However, it is anticipated that these agencies will obtain published data from the USGS National Water Information System (NWIS) on the internet rather than from SMUD directly. Some public-domain software packages have built in capability to download any USGS site data directly from NWIS, and this would likely be the easiest way for these agencies to obtain data.

SMUD will maintain copies of all data for the life of the project and upon request will provide any of these data directly to these agencies.

SWRCB Condition 5 and USFS Condition 49 require that every five years, SMUD shall prepare a report describing whether the target reservoir levels have been achieved, and if not, the reasons and time periods when the target reservoir levels were not achieved.

Furthermore, provisional real-time data from the UARP gaging stations is available via telephone, and real-time streamflow (in cfs) via the internet, as required by SWRCB Condition 5 and USFS Condition 51

8.0 Literature Cited

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ATTACHMENT 1.

ORDER ISSUING NEW LICENSE FOR THE UARP, FERC PROJECT NO. P-2101, ISSUED JULY 23RD, 2014

CONDITION 36. STREAMFLOW AND RESERVOIR ELEVATION GAGING

The licensee shall, within 1 year after license issuance, develop and file with FERC approval a Streamflow and Reservoir Elevation Gaging Plan (gaging plan) that meets United States Geological Survey (USGS) standards. The licensee shall provide copies of the gaging plan and USGS review results to FS, SWRCB, CDFG, USFWS, and FERC. The plan shall be approved by the Chief of the Division of Water Rights for the SWRCB prior to filing with FERC. The licensee shall implement the plan upon approval. At a minimum, the plan shall address compliance gaging at the following locations:

1. Streamflow Gaging Locations

    a. Rubicon River below Rubicon Reservoir Dam
    b. Little Rubicon River below Buck Island Reservoir Dam
    c. Gerle Creek below Loon Lake Reservoir Dam
    d. Gerle Creek below Gerle Creek Reservoir Dam
    e. South Fork Rubicon River below Robbs Peak Reservoir Dam
    f. South Fork Silver Creek below Ice House Reservoir Dam
    g. Silver Creek below Junction Reservoir Dam
    h. Silver Creek below Camino Reservoir Dam
    i. Brush Creek below Brush Creek Reservoir Dam
    j. SFAR below Slab Creek Reservoir Dam (sufficient to record spills)

2. Reservoir Elevation Gaging Locations

    k. Rubicon Reservoir
    l. Loon Lake Reservoir
    m. Gerle Creek Reservoir
    n. Ice House Reservoir
    o. Union Valley Reservoir
    p. Junction Reservoir
    q. Camino Reservoir
    r. Brush Creek Reservoir
    s. Slab Creek Reservoir

Within 2 years of license issuance, the licensee shall install and maintain simple staff gages at the put-ins for the Slab Creek and Ice House recreational boating runs. The licensee shall perform an investigation to determine whether telemetry equipment can be installed at Rubicon River below Rubicon Reservoir Dam and Little Rubicon River below Buck Island

Reservoir Dam to monitor conditions and/or control operations. If the licensee and FS concur that such equipment is economically and technologically feasible and can be installed consistent with law, regulations, and policies applicable to Desolation Wilderness, the licensee shall seek necessary approvals for such installation and shall install this equipment if the necessary approvals are received.

CONDITION 49. RESERVOIR LEVELS

The licensee shall, beginning as early as reasonably practicable within 6 months after license issuance, meet or exceed the end-of-month reservoir elevations for Loon Lake, Union Valley, and Ice House reservoirs as shown in the attached tables. Compliance will be measured at the licensee's reservoir elevation gages as published by the USGS.

1. Loon Lake Reservoir

Maintain the reservoir level to meet the end-of-month reservoir storage elevation shown in the table below.

Loon Lake Reservoir Level by Water Year						
	Month	End-of-Month Elevation				
		CD	DRY	BN	AN	WET
	JULY	6388	6395	6399	6400	6400
	AUGUST	6382	6389	6394	6393	6393
	SEPTEMBER	6379	6385	6390	6390	6390

2. Union Valley Reservoir

Maintain the reservoir level to meet the end-of-month reservoir storage elevation shown in the table below.

Union Valley Reservoir Level by Water Year						
	Month		End-of-Month Elevation			
		CD	DRY	BN	AN	WET
	JULY	4816	4836	4856	4856	4856
	AUGUST	4803	4827	4835	4841	4842
	SEPTEMBER	4796	4818	4830	4830	4830

3. Ice House Reservoir

Maintain the reservoir level to meet the end-of-month reservoir storage elevation shown in the table below.

Ice House Reservoir Level by Water Year						
	Month		End-of-Month Elevation			
		CD	DRY	BN	AN	WET
	JULY	5435	5437	5440	5441	5441
	AUGUST	5430	5433	5434	5435	5434
	SEPTEMBER	5420	5429	5430	5431	5430

4. Gerle Reservoir

The licensee shall make every reasonable effort to maintain the water surface in Gerle Reservoir at as high an elevation as practicable, and with a minimum of fluctuation, from May 1 to September 10 of each year in order to provide maximum recreational benefits, including accessibility and the ability to fish from the fishing pier. If the licensee anticipates the reservoir will be drawn down below 5,225 feet during this time period, the licensee shall consult with FS, SWRCB, FWS, and CDFG following the direction in number 8 (Interim Modification) below.

5. Slab Creek Reservoir

The licensee shall make a good faith effort to maintain the reservoir level above 1,830 feet in elevation during daylight hours between10:00 AM and 8:00 PM during the period between July 1 through September 30. The licensee shall also make a good faith effort to limit daily fluctuations to less than 7 feet per day during daylight hours between 10:00 AM and 8:00 PM during the period between July 1 through September 30.

The minimal reservoir elevation and maximum daily fluctuation shall be reassessed and modified if necessary to accommodate (1) the operation of the proposed Iowa Hill Pump Storage Project, should it be constructed, (2) the recreational use at Slab Creek Reservoir, and (3) other applicable factors. Any modifications shall be approved by the FS prior to implementation. See Appendix C.

6. Other Reservoirs

Maintain the seasonal reservoir levels at Junction, and Brush Creek Reservoirs within the range of levels measured during the period of record between 1975 through 2000. The licensee shall make every reasonable effort to maintain the water surface in Rubicon and Buck Island Reservoirs at as high an elevation as practicable, and with a minimum of fluctuation, from May 1 to September 10 of each year in order to secure the maximum recreational benefits. As described in Article 1-1, the licensee shall maintain an overwintering minimum pool of 6,527 feet in elevation in Rubicon Reservoir for the protection of aquatic species.

7. Super Dry Water Year

A Super Dry (SD) is defined as any CD year that is immediately preceded by a Dry or CD year or any Dry year that is immediately preceded by any combination of two Dry or CD years. In the event of a SD year, the licensee shall, by March 10, notify FS, CDFG, SWRCB, and the Consultation Group provided under Section 4.12.1 of the Relicensing Settlement Agreement of the licensee's concerns related to reservoir levels. By June 1 of a SD year, the licensee shall confer with FS, CDFG, SWRCB, and the Consultation Group to discuss reservoir operations plans and reservoir levels during the SD water year. The licensee may implement the revised operations for a SD year upon approval by FS, FERC, SWRCB and CDFG.

8. Interim Modifications

These reservoir elevations may be modified upon the occurrence of the following events: (1) State or Federal electrical emergencies declared by an appropriate authority where specific orders are issued or specific actions are mandated by said authority that require the licensee to produce electricity outside normal planned operations; (2) system events that cause SMUD's Operating Reserves to drop below the Western Energy Coordinating Council Minimum Operating Reliability Criteria; or (3) equipment malfunction, public safety emergency, or law enforcement activity. In the event of such an interim modification during July, August, or September, the licensee shall promptly notify FS, SWRCB, CDFG, FWS, and the Consultation Group (collectively, Interested Parties) and FERC. Each notification shall include: (1) a description of the incident, including the reason the reservoir level was not or will not be met; (2) the licensee's analysis of the implication of the incident on meeting future reservoir levels for that water year; and (3) the licensee's proposal to manage reservoir levels to minimize recreational impacts and address energy and operational requirements for any months in which reservoir levels will not be achieved. In addition, the licensee's proposal shall address: (a) Prioritizing reservoir levels among

the three reservoirs; (b) Developing measures as they relate to impacts on recreational resources, if necessary; and (c) Developing other measures as

appropriate. The measures in licensee's proposal will be commensurate with the degree and time period during which reservoir levels are not met, and may include actions to be taken by licensee or others, such as increased patrols, extension of boat ramps, or development of/contribution to a mitigation fund. Once the Project is no longer subject to the event and if the end-of-month reservoir elevations for Loon Lake, Union Valley, and/or Ice House Reservoirs cannot be achieved for that month, within 10 business days the licensee shall confer with Interested Parties (Conference). The purpose of the Conference shall be to review the licensee's proposal to manage reservoir elevations for the remainder of the recreation season. The licensee will implement the proposal upon approval by FERC, FS, and SWRCB. Within 10 business days following this conference, the licensee shall file with FERC a letter summarizing the Conference.

9. Conferences for Abnormal Precipitation Patterns

In (1) water years in which the forecast April – July unimpaired runoff[1] is less than 40 percent of the forecasted total water year unimpaired runoff[2] or water years that follow a Super Dry water year; and (2) the licensee determines that the end of month elevations may not be achievable for that year, the licensee may request a Conference with Interested Parties by June 1. At least 10 business days prior to the Conference, the licensee shall provide to Interested Parties the licensee's proposal to manage reservoir levels to minimize recreational impacts and address energy and operational requirements for any months in which reservoir levels will not be achieved. The licensee's proposal shall address: (a) Prioritizing reservoir levels among the three reservoirs; (b) Developing measures as they relate to impacts on recreational resources, if necessary; and (c) Developing other measures as appropriate. The measures in licensee's proposal will be commensurate with the degree and time period during which reservoir levels are not met, and may include actions to be taken by licensee or others, such as increased patrols, extension of boat ramps, or development of/contribution to a mitigation fund. The purpose of the Conference shall be to review the licensee's proposal measures to manage reservoir elevations for the remainder of the recreation season. The licensee will implement the plan upon approval by FERC, USFS and SWRCB. Within 10 business days following this Conference, the licensee shall file with FERC a letter summarizing the Conference.

[1] Department of Water Resources May Bulletin 120 "Report of Water Conditions in California," table "April-July Unimpaired Runoff," row "American River below Folsom Lake," column "Apr-Jul Forecasts."

[2] Department of Water Resources May 120 Bulletin "Report of Water Conditions in California," table "Water Year Unimpaired Runoff," row "American River Below Folsom Lake," column "water Year Forecast."

10. Reservoir Level Monitoring and Adjustment

Within 5 years of license issuance, and every 5 years thereafter, the licensee shall prepare a report describing whether the target reservoir levels have been achieved, and if not, the reasons and time periods when the target reservoir levels were not achieved. The licensee shall provide a copy of the report to USFS, CDFG, SWRCB, FWS, and FERC.

SWRCB 401 CERTIFICATION

CONDITION 6. STREAMFLOW AND RESERVOIR GAGING

The Licensee shall, within one year of license issuance, develop and file for Commission approval a Streamflow and Reservoir Elevation Gaging Plan (Gaging Plan) that meets USGS standards. The Licensee shall provide copies of the Gaging Plan and USGS review results to BLM, CDFW, USFWS, the Commission, and State Water Board staff for review and comment. Following agency consultation, the Gaging Plan and any comments received from the agencies shall be submitted to the Deputy Director for review and approval prior to filing the Gaging Plan with the Commission. The Licensee shall provide the Deputy Director with at least 90 days to review and approve the

[18] Department of Water Resources, May Bulletin 120 "Report of Water Conditions in California," table "April-July Unimpaired Runoff," row "American River below Folsom Lake," column "Apr-Jul Forecasts."

[19] Department of Water Resources, May Bulletin 120 "Report of Water Conditions in California," table "Water Year Unimpaired Runoff," row "American River below Folsom Lake," column "Water Year Forecast."

Gaging Plan prior to submittal to the Commission, if applicable. The Deputy Director may require modifications as part of the approval. The Licensee shall file the Deputy Director's approval, together with any required Gaging Plan modifications, with the Commission. The Licensee shall implement the Gaging Plan upon receiving all necessary regulatory approvals.

At a minimum, the Gaging Plan shall address compliance gaging at the following

locations: Streamflow gaging locations:

6.a. Rubicon River below Rubicon Reservoir Dam
6.b. Little Rubicon River below Buck Island Reservoir Dam
6.c. Gerle Creek below Loon Lake Reservoir Dam
6.d. Gerle Creek below Gerle Creek Reservoir Dam
6.e. SF Rubicon River below Robbs Peak Reservoir Dam
6.f. SF Silver Creek below Ice House Reservoir Dam

6.g. Silver Creek below Junction Reservoir Dam
6.h. Silver Creek below Camino Reservoir Dam
6.i. Brush Creek below Brush Creek Reservoir Dam
6.j. SF American River below Slab Creek Reservoir Dam (sufficient to record spills)

Reservoir elevation gaging locations (using Licensee's reservoir elevation gages as published by USGS):

6.k. Rubicon Reservoir
6.l. Loon Lake Reservoir
6.m. Gerle Creek Reservoir
6.n. Ice House Reservoir
6.o. Union Valley Reservoir
6.p. Junction Reservoir
6.q. Camino Reservoir
6.r. Brush Creek Reservoir
6.s. Slab Creek Reservoir

Within two years of license issuance, the Licensee shall install and maintain simple staff gages at the put-ins for the Slab Creek and Ice House recreational boating runs. The Licensee shall perform an investigation to determine whether telemetry equipment can be installed at Rubicon River below Rubicon Reservoir Dam and Little Rubicon River below Buck Island Reservoir Dam to monitor conditions and/or control operations. If the USFS and the Licensee concur that such equipment is economically and technologically feasible and can be installed consistent with law, regulations, and policies applicable to Desolation Wilderness, the Licensee shall seek necessary agency approvals for such installation and shall install this equipment if the necessary approvals are received.

ORDER AMENDING LICENSE FOR THE UARP, FERC PROJECT NO. P-2101, ISSUED NOVEMBER 9TH, 2016

SWRCB CONDITION 1

The Licensee shall, beginning as early as reasonably practicable and no later than three months after completion of Project construction, maintain minimum streamflows as specified in this condition in the 0.25 mile reach of the South Fork American River directly below Slab Creek Dam to the location of the new powerhouse. All specified streamflows are in cfs. The Licensee shall implement the required stream flows in the 0.25 mile reach throughout the term of the license and any extensions. The flow schedules described below specify minimum streamflows by month and water year type. The water year types are defined in Condition 1 of the 2014 UARP certification. Consistent with Condition for the 2014 UARP certification, the Licensee shall provide notice to the FERC, USFS, USFWS, CDFW, and the Deputy Director of the final water year type determination within 30 days of the Department of Water Resource Bulletin 120 May forecast.

The licensee shall report any deviation from the required minimum flows to the State Water Board and furnish electronic streamflow records upon request. The minimum streamflows specified in the schedules may be temporarily modified if required by equipment malfunction or operating emergencies reasonably beyond the control of the Licensee. If the streamflow is so modified, the licensee shall provide notice to the FERC, USFS, USFWS, CDFW, and the Deputy Director as soon as possible, but no later than 10 days after such incident. The minimum streamflows specified may also be temporarily modified for short periods in non-emergency situations five days after notice to the FERC; and upon approval by the Deputy Director.

Table 1.Streamflow Requirements for 0.25-mile Reach below Slab Creek Dam

Month	Minimum Streamflow by Water Year Type (cfs)				
	Critically Dry	Dry	Below Normal	Above Normal	Wet
October	15	15	20	20	20
November	15	15	15	15	15
December	15	15	15	15	15
January	15	15	15	15	15
February	15	15	15	15	15
March	15	20	20	30	36
April	15	20	36	36	36
May	15	20	36	36	36
June	15	20	30	30	30
July	15	20	20	20	20
August	15	20	20	20	20
September	15	20	20	20	20

Buck Island Reservoir

Rubicon Reservoir

Loon Lake

Gerle Reservoir

Robbs Peak Reservoir

Union Valley Reservoir

Junction Reservoir

Ice House Reservoir

Camino Reservoir

Brush Creek Reservoir

Slab Creek Reservoir

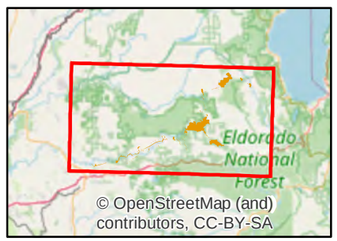
PLACER
EL DORADO
Gerle Creek
Deer Creek
Brushy Creek
RALSTON RIDGE
LONG CANYON
NEVADA POINT RIDGE
Rubicon River
South Fork Rubicon River
Eldorado National Forest
8860 ft
Cheese Camp Creek
Bassi Fork
ROCKBOUND VALLEY
Rubicon River
TUNNEL HILL
PEAVINE POINT
4000 ft
Canyon Creek
GEORGETOWN DIVIDE
3454 ft
Pilot Creek
Little Silver Creek
6000 ft
Tells Creek
CRYSTAL RANGE
8000 ft
Empire Creek
Georgetown
BALD MOUNTAIN
DARLING RIDGE
Rock Creek
Whale Creek
Slab Creek
5479 ft
Union Valley Reservoir
Big Silver Creek
Jones Fork Silver Creek
Lake Aloha
9982 ft
Bear Creek
Garden Valley
SLATE MOUNTAINS
Brush Creek
4000 ft
BIG HILL
Traverse Creek
2000 ft
SLATE MOUNTAIN
BIG X MOUNTAIN
South Fork Silver Creek
PEAVINE RIDGE
6000 ft
Soldier Creek
South Fork American River
Kyburz
50
Highway 50
Pollock Pines
Apple Mountain Golf Resort
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Upper American River Project
Streamflow Reservoir Elevation Gaging Plan
Figure 1. Streamflow Gaging Locations

SMUD™

Map Features

- Streamflow Gage
- FERC Project No. 2101 Boundary



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1 in = 2 miles

Buck Island Reservoir
Rubicon Reservoir
Loon Lake
Gerle Reservoir
Robbs Peak Reservoir
Union Valley Reservoir
Junction Reservoir
Ice House Reservoir
Camino Reservoir
Brush Creek Reservoir
Slab Creek Reservoir

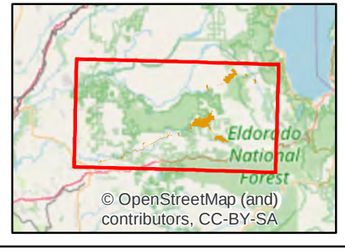
PLACER
EL DORADO
Gerle Creek
Deer Creek
Brushy Creek
RALSTON RIDGE
LONG CANYON
NEVADA POINT RIDGE
Rubicon River
South Fork Rubicon River
Eldorado National Forest
8860 ft
Cheese Camp Creek
Basil Fork
ROCKBOUND VALLEY
CRYSTAL RANGE
TUNNEL HILL
PEAVINE POINT
4000 ft
Canyon Creek
GEORGETOWN DIVIDE
3454 ft
Pilot Creek
Tells Creek
Little Silver Creek
5000 ft
Empire Creek
Georgetown
BALD MOUNTAIN
Rock Creek
Whaler Creek
DARLING RIDGE
Bear Creek
5479 ft
Slab Creek
Big Silver Creek
Jones Fork Silver Creek
Union Valley Reservoir
Lake Aloha
9982 ft
Garden Valley
SLATE MOUNTAINS
Brush Creek
BIG HILL
Traverse Creek
2000 ft
SLATE MOUNTAIN
BIG X MOUNTAIN
South Fork Silver Creek
PEAVINE RIDGE
Soldier Creek
South Fork American River
Kyburz
Highway 50
Pollock Pines
Apple Mountain Golf Resort

Upper American River Project
Streamflow Reservoir Elevation Gaging Plan
Figure 2. Reservoir Gaging Locations

SMUD™

Map Features

- Reservoir Gaging
- FERC Project No. 2101 Boundary



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1 in = 2 miles