Appendix D: Long-term Operating Rules Monitoring Plan

Southern California Edison

Big Creek No. 4 Hydroelectric Project (FERC Project No. 2017)

Long-Term Operating Rules
Monitoring Plan

May 2019

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List of Acronyms

CDFW	California Department of Fish and Wildlife
FERC	Federal Energy Regulatory Commission
g	gram
GPS	Global Positioning System
HSBR	Horseshoe Bend Reach
kg	kilogram
LTOR	Long-Term Operating Rules
m	meter
mm	millimeter
NASMP	Native Aquatic Species Management Plan
PIT	Passive Integrated Transponder
SCE	Southern California Edison
SJR	San Joaquin River

SWRCB	State Water Resources Control Board
TL	Total length
TRG	Technical Review Group
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WPT	Western Pond Turtle
YOY	young-of-the-year

1.0 Introduction

The following provides a description of long-term monitoring associated with implementation of Long-Term Operating Rules (LTOR)[1] for Southern California Edison's (SCE or Licensee) Big Creek No. 4 Hydroelectric Project (Big Creek No. 4 Project), Federal Energy Regulatory Commission (FERC) Project No. 2017. The goal of long-term monitoring is to determine whether implementation of the LTOR support native aquatic species and their habitats. The monitoring approach is to obtain, for comparative purposes, periodic information on water temperature, flow, fish populations, mussels, western pond turtles, and foothill yellow-legged frogs (presence/absence based on sampling for eDNA) within the Horseshoe Bend Reach (HSBR) of the San Joaquin River (SJR). This information will be compared to historic data (BioSystems 1987, SCE 1997) and data collected as part of the Adaptive Management Plan and Native Aquatic Species Management Plan (Attachment 1) to evaluate native aquatic species and habitat trends.

Monitoring will be conducted at each of the monitoring sites in Year 1 and Year 2 following adoption of the LTOR, with a requirement for monitoring in Year 3 if the first two years do not include both a spill and non-spill year. After which, monitoring will occur every 5 years for the term of the license. Details of the long-term monitoring are described below.

2.0 Monitoring Approach

Monitoring in the HSBR includes the following:

- Flow and water temperature;
- Fish population and community characteristics, including species abundance, composition, distribution, population age structure, and condition;
- Western pearlshell mussel (*Margaritifera falcata*) relative abundance;
- Western pond turtles (WPT) (*Emys marmorata*) relative abundance and population size/age structure; and
- Foothill yellow-legged frog (*Rana boylii*) presence/absence (eDNA sampling).

2.1 Monitoring Locations and Schedule

Monitoring locations are shown in Table 1 and Map 1.

Monitoring will be conducted at each location in Year 1 and Year 2, with a requirement for monitoring in Year 3 if the first two years do not include both a spill and non-spill year. After which, monitoring will occur every five years for the term of the license including license extensions.

Monitoring may be deferred to the following year with concurrence from the SWRCB, CDFW, and USFS if sampling conditions are unsuitable or unsafe (e.g., high flows[2], high turbidity, fire).

[1] The objective of the LTOR is to provide consistent boating opportunities while preserving the native aquatic species assemblage.

[2] Flows greater than approximately 80 cubic feet per second (cfs).

Table 1 Long-term Operating Rules Monitoring Locations

Monitoring Element	Study Site Name	Location (utm)		
		Zone	Easting	Northing
Flow and Water Temperature	USGS Gage No. 11242000 SJR Downstream of Dam	11S	281982.56 m E	4113705.02 m N
	USGS Gage No. 11246500 Willow Creek near confluence with the SJR	11S	2281496.69 m E	4114390.69 m N
	SJR Upstream of BC Powerhouse No. 4	11S	278833.24 m E	4113154.52 m N
Western Pond Turtle Study	Willow Creek	11S	281479.25 m E	4114438.40 m N
	Confluence of SJR and Willow Creek	11S	281353.42 m E	4113795.26 m N
	SJR Horseshoe Bend East	11S	280725.21 m E	4112034.44 m N
	Confluence of SJR and Backbone Creek	11S	280320.06 m E	4109961.97 m N
Foothill Yellow-legged Frog eDNA Study	Below Dam 7	11S	282100.02 m E	4113696.17 m N
	SJR Upstream of Willow Creek	11S	278883.64 m E	4113038.88 m N
	Willow Creek Near Confluence with SJR	11S	281353.42 m E	4113795.26 m N
	SJR Upstream of Backbone Creek	11S	280328.58 m E	4109986.23 m N
	Backbone Creek near Confluence with SJR	11S	280327.93 m E	4109778.09 m N
	Upstream of Big Creek No. 4 Powerhouse	11S	278883.64 m E	4113038.88 m N
Fish Population Study	Site 1	11S	281819.34 m E	4113761.55 m N
	Site 2	11S	281185.74 m E	4113253.58 m N
	Site 3	11S	280725.21 m E	4112034.44 m N
	Site 4	11S	279177.40 m E	4110287.80 m N
	Site 5	11S	278666.83 m E	4112226.84 m N
	Site 6	11S	278903.33 m E	4112974.37 m N
Mussel Study	Sandbar to Site 5	11S	Confidential	
	Site 5	11S	Confidential	
	Site 6	11S	Confidential	
	Site 7	11S	Confidential	
Potential Additional Water Temperature Monitoring Sites if Infrastructure Repair at Dam 7 occur and instream flows drop below 30 cfs (average daily flow; USGS Gage No. 11242000) for more than 7 days	Below Confluence of SJR and Willow Creek	11S	281353.42 m E	4113795.26 m N
	SJR Horseshoe Bend East	11S	280725.21 m E	4112034.44 m N
	Fish Population Site 5	11S	278666.83 m E	4112226.84 m N

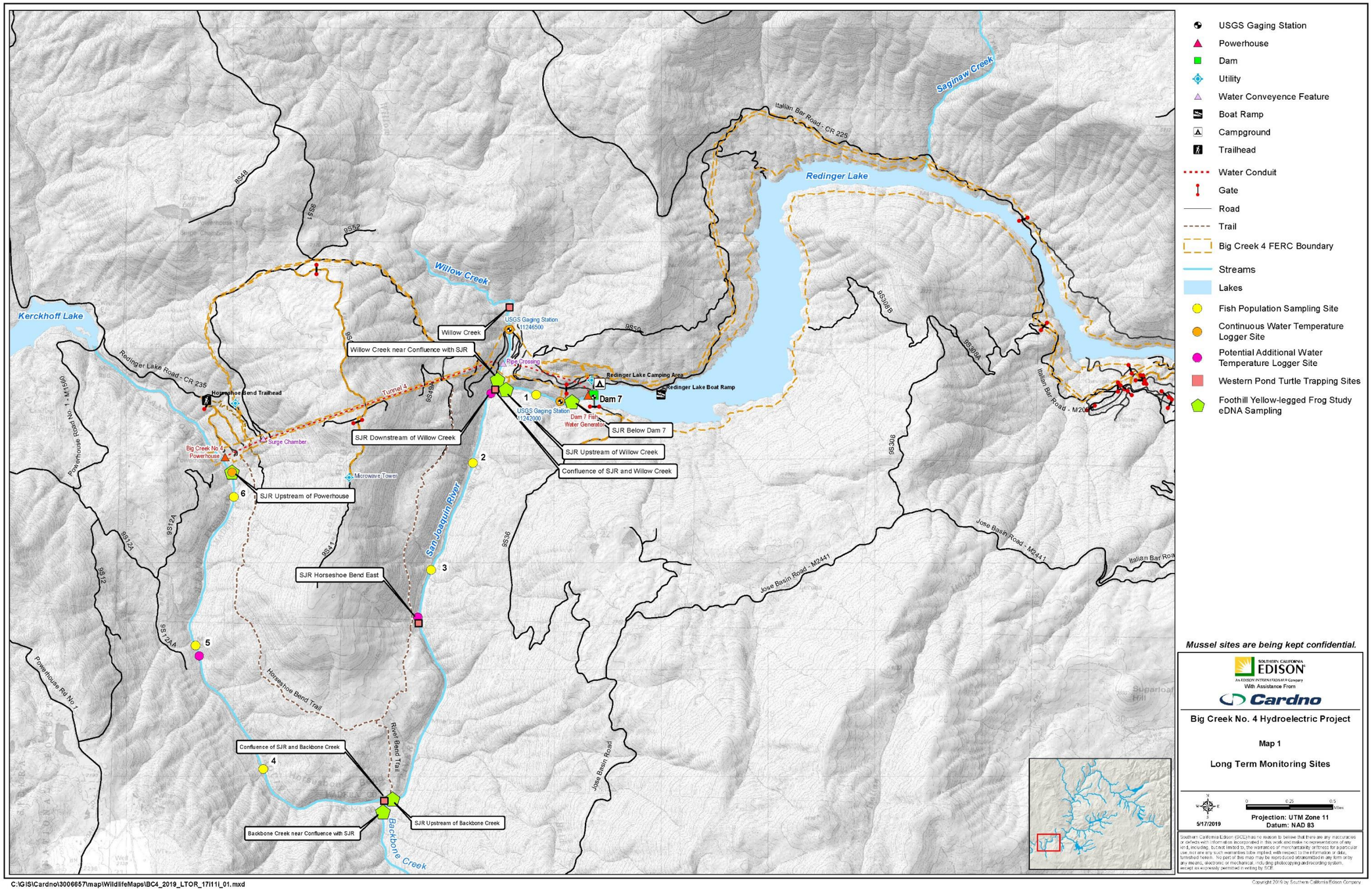
Monitoring Element	Study Site Name	Location (utm)		
		Zone	Easting	Northing
Potential Meteorological Monitoring Site if Infrastructure occur and instream flows drop below 30 cfs (average daily flow; USGS Gage No. 11242000) for more than 7 days	Dam 7	11S	282268.92 m E	4113910.15 m N

Notes:

cfs: cubic feet per second

SJR: San Joaquin River

USGS: U.S. Geological Survey


Kerckhoff Lake
Redinger Lake
Saginaw Creek
Willow Creek
San Joaquin River
Backbone Creek
Italian Bar Road - CR 225
Redinger Lake Road - CR 235
Powerhouse Road No. 1 - M1500
Jose Basin Road - M2441
Jose Basin Road
Horseshoe Bend Trail
River Bend Trail
Tunnel 4
Surge Chamber
Big Creek No 4 Powerhouse
Microwave Tower
Rock Crossing
Redinger Lake Camping Area
Redinger Lake Boat Ramp
Dam 7
Dam 7 Fish Water Generator
USGS Gaging Station 11246500
USGS Gaging Station 11242000
Willow Creek
Willow Creek near Confluence with SJR
SJR Downstream of Willow Creek
SJR Below Dam 7
SJR Upstream of Willow Creek
Confluence of SJR and Willow Creek
SJR Upstream of Powerhouse
SJR Horseshoe Bend East
Confluence of SJR and Backbone Creek
SJR Upstream of Backbone Creek
Backbone Creek near Confluence with SJR
1
2
3
4
5
6
USGS Gaging Station
Powerhouse
Dam
Utility
Water Conveyence Feature
Boat Ramp
Campground
Trailhead
Water Conduit
Gate
Road
Trail
Big Creek 4 FERC Boundary
Streams
Lakes
Fish Population Sampling Site
Continuous Water Temperature Logger Site
Potential Additional Water Temperature Logger Site
Western Pond Turtle Trapping Sites
Foothill Yellow-legged Frog Study eDNA Sampling
Mussel sites are being kept confidential.
SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL Company
With Assistance From
Cardno
Big Creek No. 4 Hydroelectric Project
Map 1
Long Term Monitoring Sites
5/17/2019
Projection: UTM Zone 11
Datum: NAD 83
Miles
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2.2 Monitoring Methods and Analysis

Physical Data

Continuous Monitoring[3]

Flows will be monitored in the San Joaquin River downstream of Dam 7 and in Willow Creek at the U.S. Geological Survey (USGS) gages No. 11242000 and No. 11246500, respectively, operated by SCE. Water surface elevation at Redinger Lake will be monitored using USGS Gage No. 11241950.

Water temperature (15-minute data) will be collected in the San Joaquin River downstream of Dam 7 at the existing USGS Gage No. 11242000 and upstream of Big Creek No. 4 Powerhouse following installation of a new temperature monitoring probe. The new temperature probe will be installed within 90 days of approval of the LTORs by FERC. The temperature probe/data logger will be placed in a bedrock portion of the channel and will not require any ground disturbance activities. All necessary permits will be obtained by the licensee prior to the installation of any stream monitoring devices.

Water temperature data will also be collected in Willow Creek at the existing USGS Gage No. 11246500.

Analysis and Reporting

Flow and temperature time series will be plotted for each monitoring year and compared to historical flow and water temperature data. Data will be provided electronically to the USFS, CDFW, SWRCB, Tribes and TRG by January 15 of the year following completion of the flow and temperature data collection. In cases where a gap in the data exists, the Licensee will describe the reason for the missing data. If requested, the Licensee will conduct additional analysis/modeling, as appropriate, to identify the approximate location of the water temperature transition zone (20 °C) within the bypass reach. Additional analysis/modeling may also be used to estimate approximate water temperatures at historic water temperature monitoring sites within the bypass reach, as appropriate.

Fish Population

Fish population sampling will be conducted in September/October at minimum flow, if possible. The Licensee will coordinate with PG&E regarding flows in the sampling timeframe. The Licensee will notify USFS, CDFW, and SWRCB of the outcome of the coordination. Fish population sampling will generally be conducted according to the methods of the Native Aquatic Species Management Plan (NASMP) (SCE 2008) and as implemented in baseline data collections (Attachment 1).

Sampling will use multiple pass depletion electrofishing, snorkeling, and cast net/seine/dip net sampling. Snorkeling will be conducted in water too deep to electrofish. Cast net/seining/dip netting will be used to qualitatively characterize young-of-the-year (YOY) fishes in water too deep to electrofish and/or along channel margins.

[3] Data will be collected in 15-minute intervals from January 1 to December 31.

Survey Reaches

Fish sampling will be conducted in the six historic sampling locations within the HSBR (Map 1) used in previous studies (BioSystems 1987, SCE 1997) and the SCE NASMP sampling (2008-2018). At each of the fish sampling locations, an electrofishing site and a snorkel survey site will be selected based on the locations of earlier studies. Generally, electrofishing will be conducted in sites shallower than about 1 meter (m) (3 feet) deep.

Sample Timing

The sampling will be conducted in September/October at minimum flow, if possible.

Electrofishing

Quantitative fish population surveys will be conducted at each sampling location by electrofishing a minimum of 100 meters of habitat shallow enough to sample (e.g., riffle and run habitat). Multiple pass removal population estimates will be conducted within sections of stream that have been block netted on the downstream and upstream end with 0.25-inch mesh netting. A typical electrofishing team will consist of two backpack electrofishers, three net persons, and two net/livecar persons. Electrofishing will generally be conducted as described by Reynolds (1996). Sampling will use multiple pass depletion, where fish are stunned and removed from the site using a minimum of two thorough electrofishing passes (sequential) with equal sampling effort. If depletion does not exceed approximately 65% between pass one and pass two, a third pass will be completed. Sampling will typically be performed in an upstream direction beginning at the downstream block net and finishing at the upstream block net.

All captured fish will be identified to species, measured for length to the nearest millimeter (mm) total length (TL), and weighed to the nearest 0.1 gram (g) for fish up to 2 kilograms (kg), or to the nearest gram for fish over 2 kg. Each fish processed will be examined for disease, or injury and its condition noted on the field data sheets. Fish will be released back into the river. Population estimates will be based on the maximum likelihood technique of Zippin (1958) using the MicroFish computer program (Deventer and Platts 1989) or a comparable method. Length and weight data will be used to compute Fulton's condition factor (Ricker 1975).

Fulton's Condition Factor: $K = (W * X) / L^3$

Where:
- K = Fulton's Condition Factor
- W = Weight (g)
- L = Total length (mm)
- X = 100,000 (a scaling constant)

Snorkeling

Snorkel surveys will be conducted in habitats that are too deep (pools and deep runs >3 ft deep) for effective sampling by electrofishing. Both techniques provide information on fish abundance and length. However, direct observation snorkeling provides lower resolution length information, since lengths are visually estimated in comparison to a target. Length bins for fish species observed during snorkeling are as follows: 0-3 inches (0-76 mm), 3-6 inches (76-152 mm), 6-9 inches (152-228 mm), and fish greater than nine inches (228 mm) in length.

The snorkeled habitat units will be divided into one or more swimming lanes parallel to the direction of stream flow. A minimum of 100 meters of habitat will be snorkeled at each site. Methods generally are similar to those used in SCE (2009a) and presented in Griffith (1972), Platts et al. (1983), Hicks and Watson (1985), Hankin and Reeves (1988), and Hillman et al. (1992). Underwater visibility will be measured by taking a Secchi disk measurement and, also,

by measuring the distance at which a three-inch fishing lure can be viewed under water. The data will be used to determined lane width (e.g., Hillman et al. 1992). Surveys will be performed between 0900 and 1600 hours (Hankin and Reeves 1988) to maximize the likelihood that light intensities are suitable for observing fish. Direct observation surveys will not be conducted on overcast days (Platts et al. 1983).

Divers will enter the water slightly below the downstream end of the sample unit (Hankin and Reeves 1988) and move directly across and slightly below the lowermost boundary of the sample unit into their designated swimming lane. When in position, the divers will move upstream to the lowermost boundary of the sample unit. From a fixed position and prior to moving upstream, the divers will look upstream to locate fish on the fringe of vision (Platts et al. 1983). Divers will then identify and count fish species in their lane, while moving slowly upstream at a uniform, even, pace with no abrupt movements. Fish will be counted as they pass below or to the side of an observer. Cover for fish, such as interstitial spaces between substrate particles, woody debris, bubble screens, crannies in bedrock, and along stream margins will be inspected closely for concealed fish to the best of the divers' abilities (Fausch and White 1981; Hicks and Watson 1985). A bank-side observer will be employed and stationed to monitor and verbally direct diver distribution and sampling rate when possible. Fish lengths will be estimated by comparison with a fish length calibration cord or ruler. The calibration cord is a piece of small-diameter rope with size length categories marked on it. In addition, divers will be trained in estimating fish lengths, so estimates of fish length will be consistent and as accurate as possible.

Small cyprinids in large schools that cannot be adequately identified during snorkel surveys as either hardhead or Sacramento pikeminnow will be classified as "unidentified cyprinids."

Cast Net/Seining/Dip Netting

During sampling in September/October, YOY fish are primarily small juveniles and not larvae. Captures will be made using cast nets, seines, or dip nets and fish will be identified and measured. The data will be combined with snorkel data to determine relative composition of portions of "unidentified cyprinids."

Habitat

Habitat data will be collected at each electrofishing and snorkeling site sampled. Parameters collected at each site include length, width, depth, substrate composition, and mesohabitat type(s) of the sampling site. Also, the coordinates (UTM, WGS84) of the upstream and downstream ends of each unit will be recorded using a Global Positioning System (GPS).

Analysis

Fish abundance (fish/kilometer) for YOY, juvenile and adult fish species will be calculated and compared to historical data (both at each site and for all sites combined). Fish community parameters, such as percent of each species and size/age distribution of each species will be documented and compared to historical data. Individual parameters such as growth (length-frequency histograms), condition factor, and disease will be documented and compared to historical data.

Mussels

Mussel sampling will be conducted in September/October concurrent with fish sampling. Mussel surveys will be conducted in the HSBR at four sites (Sandbar to Site 5, Site 5, Site 6, and Site 7), where western pearlshell mussels have been observed and counted previously (e.g., during 2010-2016 sampling). The locations of mussels will be kept confidential at the request of the North Fork Mono Tribe.

Mussel abundance and distribution varies at the four sampling locations requiring different sampling approaches. At three sites, Sandbar to Site 5 (430 m), Site 5 (100 m), and Site 6 (30 m), mussels are in low abundance and can be fully enumerated. At these sites, surveyors will perform an exhaustive, generalized search of the river bed to count live mussels and shells and to document the locations of mussel clusters.

At Site 7, mussel abundance is higher and density will be estimated based on subsampling. At this site, surveyors will use a modification of the two-phase approach of Villella and Smith (2005). The downstream headpin established in 2010 will be relocated, and a survey tape will be stretched from the headpin to a willow tree located 50 meters (m) upstream. A reconnaissance snorkel survey will be conducted to differentiate areas of high and low mussel density. The upstream and downstream extents of the high and low-density areas will be recorded, and that information will be used to select three representative survey transects within the high-density area and two survey transects within the low-density area. The wetted width of the river along each selected transect will be divided into three strata (river-left stratum, middle stratum, and river-right stratum), each of which represented one third of the transect width. At each transect, a total of 10 locations will be sampled using a 0.25-m^2 quadrat, with a minimum of three locations from each stratum. Three quadrats will be located in each stratum to account for nine of the quadrats. The 10^{th} quadrat will be assigned to the three strata at random. The numbers of mussels observed (i.e., surface counts) within each quadrat will be recorded. Percentages of dominant and subdominant substrates and presence of algae will be visually estimated for each quadrat. GPS coordinates will be recorded for each transect end and photographs taken of representative habitats.

Analysis

The abundance of mussels at each site will be compared with historical mussel abundance. At Sandbar to Site 5, Site 5, and Site 6, the total number of mussels will be reported. At Site 7, the density of mussels (mean and standard error) will be reported.

Western Pond Turtle

WPT population abundance and population structure will be assessed based on trapping and marking turtles for two trapping events in August/September. Trapping events will be scheduled at least two weeks apart to allow sufficient time for the population to recover from investigator-caused disturbances. The WPT capture methodology used will be that same as used during past studies.

Four traps will be installed at study sites located in Willow Creek, on the SJR at the confluences with Willow and Backbone creeks, and the HSBR east historic water temperature monitoring site (Map 1). Trapping will be conducted by deploying floating collapsible nylon net hoop traps that are tied off to shoreline anchors and positioned so that entrances are submerged but upper portions of the trap are above water allowing turtles to access air. Turtle traps will be baited with sardines, set in the afternoon or evening, and checked within 24 hours. Trapping data to be collected includes date, time, crew, location, general water, and weather conditions. For each individual turtle captured or recaptured, sex, weight, age, and maximum carapace length,

external signs of disease and lesions will be recorded and each will be photographed. Age will be estimated by counting annuli on one or more scutes of the plastron and/or carapace (Bury and Germano 1998). New captures will be individually marked either with a numerical identification code, notched into the marginal scutes (Holland 1994), or with a Passive Integrated Transponder (PIT) tag. All turtles will be released at the point of capture.

Analysis

The abundance and age/sex distribution of WPTs will be compared to historical abundance and age/sex distribution. Where turtles are recaptured from previous years, an estimate of growth will be calculated and compared to historical growth rates, as applicable. Any signs of disease or unusual observations will be documented.

Foothill Yellow-legged Frog eDNA

An eDNA sample for foothill yellow-legged frogs will be collected at each of six locations during the expected breeding season, typically during late spring/early summer after high flows have receded and water temperature is appropriate. The locations will include: Redinger Reservoir outflow (sample control), SJR above the Willow Creek confluence, Willow Creek near the confluence with the SJR, SJR above the Backbone Creek confluence, Backbone Creek near the confluence with the SJR (if wet), and the SJR above Big Creek No. 4 Powerhouse.

The eDNA sampling method will be consistent with Carim et al. (2016) or the most appropriate methodology current at the time of sampling. The method includes the following:

- Five liters of water will be filtered from the sampling site, taking care not to contaminate the sample water or filter.
- The filter will be dried for 30 seconds and secured in a plastic bag with desiccant beads and protected from water, heat, and sunlight.
- The samples will be immediately (<1 week) sent to a qualified laboratory for processing.

Analysis

eDNA results (detection / non-detection) of foothill yellow-legged frog markers will be reported. If data suggests the potential for presence of foothill yellow-legged frogs at a location (taking into account the control sample from the Redinger Reservoir outflow), then SCE will coordinate with agencies and discuss the potential for focused visual encounter survey (presence and abundance).

3.0 Reporting and Consultation

Annual monitoring reports will be prepared by the Licensee and distributed to the USFS, CDFW, SWRCB, Tribes, and TRG for review and comment by January 15 of the year following completion of the monitoring. A 60-day review period will be provided to the USFS, CDFW, SWRCB, Tribes, and TRG. Based on the results of the monitoring and/or comments received during the review process, the Licensee, USFS, CDFW, SWRCB, Tribes, or the TRG may hold a meeting (or conference call) to discuss the results or potential modifications to the monitoring program. Within 60 days after the review period or 60 days following any meeting regarding the report, whichever is later, comments will be addressed in the final report, which will be filed by the Licensee with the USFS, CDFW, and SWRCB and distributed to the Tribes and TRG.

If modifications to the monitoring program are deemed necessary to meet the goal of the monitoring program, the Licensee will submit any recommended modifications to the monitoring program to the USFS and SWRCB for approval. Following approval from the USFS and SWRCB, the Licensee will submit the proposed modifications to the monitoring program (along with approvals) to FERC for approval. The Licensee will implement the modified monitoring program as approved by FERC.

4.0 Literature Cited

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Zippin, C. 1958. The removal method of population estimation. Journal of Wildlife Management 22(1):82-90.

Attachment 1: List of Technical Studies Used in Development of the Long-Term Operating Rules Monitoring Plan

Report / Study	Reference
A technical report on riverine fishery studies conducted in support of the Big Creek Expansion Project.	BioSystems Analysis, Inc. 1987
Big Creek No. 4 Water Power Project (FERC No. 2017). Application for New License for Major Project Existing Dam.	SCE 1997
CAWG 2 Geomorphology, Technical Study Report.	SCE 2003
Adaptive Management Plan for River Flows and Native Aquatic Species Management Plan. Big Creek No. 4 Hydroelectric Project, FERC Project No. 2017.	SCE 2008
Whitewater Navigability Flow Survey First Rapid, Horseshoe Bend Run San Joaquin River.	SCE 2008
Native Aquatic Species Management Plan. Draft 2007 Data Collection Report. Big Creek No. 4 Hydroelectric Project, FERC Project No. 2017.	SCE 2009
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Native Aquatic Species Management Plan. 2015 Data Collection Report. Big Creek No. 4 Hydroelectric Project, FERC Project No. 2017.	SCE 2016
Hydrographic Analysis of Spills below Dam 7. Technical Memorandum.	SCE 2016
Native Aquatic Species Management Plan. Draft 2016 Data Collection Report. Big Creek No. 4, Hydroelectric Project, FERC Project No. 2017.	SCE 2017
Big Creek 4 Potential Whitewater Boating Opportunity Days Summary Analysis. Technical Memorandum.	SCE 2017
Native Aquatic Species Management Plan. 2017 Data Collection Report. Big Creek No. 4, Hydroelectric Project, FERC Project No. 2017.	SCE 2018
Experimental Flow Management. Technical Memorandum.	SCE 2018
Stage-Discharge Analysis. Technical Memorandum.	SCE 2018
Ramp-Down and Stranding Study in the Horseshoe Bend Reach below Dam 7. Technical Memorandum.	SCE 2018