POTENTIAL RESOURCE ISSUE:

- Special-status amphibians and aquatic reptiles and their habitat.

PROJECT NEXUS:

- Project operations and maintenance activities could result in direct and indirect effects on special-status amphibians and aquatic reptiles and their habitat.
- For foothill yellow-legged frog (FYLF), flow conditions in the bypass river reaches could affect habitat availability and suitability (e.g., water temperature) for all life stages. Project operations that result in flow fluctuations could create changes in water stage and velocity that may scour or strand egg masses and tadpoles. Water temperature regimes downstream of Project facilities could alter the timing of breeding and subsequent tadpole development.
- For western pond turtle (WPT), flow conditions in the bypass river reaches could affect habitat availability and suitability (e.g., water temperature) and affect potential nesting habitat (e.g., inundation of nesting habitat).

POTENTIAL LICENSE CONDITIONS:

- Instream flow releases.
- Vegetation and Integrated Pest Management Plan.
- Special-status amphibian and aquatic reptile protection measures.

STUDY OBJECTIVES:

- Identify and map potential habitat for FYLF in the study area.
- Document the distribution and abundance of FYLF populations in the study area.
- Document the timing and length of FYLF breeding season, if FYLF are present.
- Characterize the water stage, velocity, and temperature of various flow regimes as it relates to FYLF habitat through coordination with the instream flow and water temperature studies.
- Document the presence of WPT during FYLF surveys.
- Document the presence of potential WPT nesting habitat.

EXTENT OF STUDY AREA:

- The study area for FYLF and WPT is the bypass river reaches and comparison river reaches.
- The study area for WPT also includes off-channel ponds and wetlands that may be present within the following study areas around Project facilities where maintenance activities occur (Table AQ 7-1).
- It should be noted that the majority of lands along the bypass reaches and around select Project facilities are privately owned and outside the FERC Project boundary. For the purposes of the special-status amphibian and reptile surveys described herein, SCE will take the following steps to obtain approval to conduct field studies on private property:

- Provide notification to landowner of Project relicensing and request authorization to enter property to conduct field studies.
- If authorization is obtained, SCE will complete field studies as described in this technical study plan.
- If authorization is not obtained, SCE will limit field studies to only those lands where landowners have provided access.

STUDY APPROACH:

The study approaches for each species are provided below.

Foothill Yellow-legged Frog (FYLF)

Study Sites

- In order to determine the distribution and abundance of FYLF within the bypass river reaches and comparison river reaches, different types of sampling sites will be selected. These include representative sites, tributary confluence sites, and comparison sites. A stratified sampling approach was used to select representative sampling sites by geomorphic stream type. Additional sampling sites were selected at the confluences of accessible perennial tributaries where potential breeding habitat may exist. Comparison sampling sites were selected in non-Project affected reaches. In addition, qualitative observations will be completed during other studies, particularly mesohabitat mapping (AQ 1 – Instream Flow Study Technical Study Plan [TSP]) to expand the habitat areas searched. Map AQ 7-1 provides the locations of all amphibian and reptile study sites. Table AQ 7-2 lists each study site.

Methods

- The following describes the approach to meet each of the study objectives: (1) identify and map potential habitat; (2) determine the distribution and abundance of FYLF in the study area; (3) determine the timing and length of the breeding season; and (4) characterize the potential effects of stage and velocity fluctuations on FYLF and their habitat through coordination with the AQ 1 – Instream Flow TSP.

Habitat Characterization:

- Identify and map potential breeding and rearing habitat for FYLF in collaboration with resource agencies in the bypass river reaches based on review of aerial photography and helicopter surveys. Potential breeding and rearing habitat are defined as:

  Breeding Habitat – Shallow, near-shore areas of low velocity with cobble/boulder substrate in open, sunny areas with little riparian vegetation; often adjacent to low gradient cobble/boulder bars, tributary confluences, side and backwater pools, or pool tail-outs with coarse substrates.

  Rearing Habitat – Similar to breeding habitats early in the season; but tadpoles may distribute to shallow, warm, low-velocity near-shore habitats with smaller substrate (i.e., gravel/sand) as the season progresses.

- Complete a habitat characterization of the study sites and comparison sites (see Map AQ 7-1) in the field during distribution and abundance surveys that includes information on the presence of predators and food availability. This information will be used to extrapolate observed habitat conditions to potential habitats identified during helicopter surveys and review of existing data.
- Following completion of habitat mapping, develop a GIS map of potential FYLF habitat.

Distribution and Abundance Surveys:

- Identify and map known occurrences of FYLF within the study area based on agency consultation and a review of existing information.
- Conduct surveys at study sites and comparison sites identified on Map AQ 7-1 to determine the distribution and abundance of FYLF. Surveys will follow the Visual Encounter Protocol described in *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians* (Heyer et al. 1994; Appendix AQ 7-A) and will incorporate United States Fish and Wildlife Service (USFWS) decontamination guidelines (USFWS 2005 [Appendix B]). Specifically, two surveyors will search stream banks, back channel areas, and potential instream habitats for FYLF progressing in a slow, methodical fashion. To aid in the detection of eggs and tadpoles, surveyors will use a viewing box in shallow margin areas and snorkel in deeper water where needed and possible. During surveys, a minimum of 1,000 meters (m) will be surveyed. For sites located at tributary confluences, a minimum of 1,000 m will be surveyed in the mainstem as well as 1,000 m up the tributary where possible. Data collected during each survey includes:
    - Sampling Site: time of survey (start, end and total search effort), GPS locations (start and end), weather conditions, and water and air temperatures (at start, mid-day, and end of survey) in both the channel margin and main channel; and
    - Observation: lifestage, sex, size, and GPS location.
- Three quantitative surveys (i.e., 1,000 m each) will be conducted; two surveys in the spring/early summer for the detection of eggs and early tadpoles (onset of breeding), and one in the late summer/early fall to detect older tadpoles and young-of-the-year. The first spring visit will be completed when river temperatures have reached a daily average of 11ºC and/or when breeding has been verified in one or more rivers in Sierran watersheds.
- In addition, qualitative surveys will be conducted once during breeding season and once during the fall to detect young-of-the-year at up to three additional high likelihood breeding sites identified by agencies and/or the FYLF surveying crew leader after a review of aerial photography and after viewing the river habitat during the first spring/early summer ground surveys. The qualitative sampling is designed to provide additional FYLF detection coverage in the Project area.
- Prepare and submit a California Native Species Field Survey Form for all FYLF recorded to the California Natural Diversity Database (CNDDB).
- Provide an electronic database (Excel spreadsheet) of FYLF sampling data (date, location, species) to BLM, resource agencies, and interested stakeholders.

Timing and Length of Breeding Season:

- If FYLF are found breeding during the spring/early summer surveys (described above) and breeding does not appear to be finished following completion of the two Distribution

and Abundance Surveys (i.e., fresh 1-2 day old eggs are found during the second survey), then a third visit will be completed at up to three breeding sites to identify the end of the breeding season. The third survey visit at the selected breeding sites will follow the same survey methods as described above under Distribution and Abundance Surveys.

- Because the timing and length of breeding can vary from year to year depending on climatic and hydrologic factors, data collected during the study will be compared to ongoing studies in other Sierra watersheds to determine if breeding in the study area is coincident to breeding in other watersheds. This data will be used to help determine a range of dates when breeding is likely to occur.

Coordination to Determine Stage and Velocity Effects

- Use Habitat Suitability Criteria (HSC) information for eggs and tadpoles developed as part of the Middle Fork Project (PCWA 2011) for modeling. Adjust HSC information based on habitat availability (Appendix AQ 7-B).
- Develop a life stage periodicity chart for FYLF that identifies the season of the year (time period) when each life stage is likely to be present within the study area. This data will be used to determine when the HSC information is applicable in evaluating effects of flow alterations on potential FYLF habitat.
- Coordinate with the instream flow modeling effort (AQ 1 – Instream Flow TSP) to evaluate habitat suitability for FYLF egg masses and tadpoles under alternative flow regimes. Specific objectives for the FYLF modeling effort include:
    - Determine the range of flows that create suitable breeding habitat and suitable basking habitat below the riparian vegetation line.
    - Assess the potential effects of seasonal flow changes on breeding and rearing habitat connectivity.
- FYLF modeling sites will be identified in coordination with the resource agencies as part of the AQ 1 – Instream Flow TSP study site selection process that includes field visits during the summer.
- Evaluate output from the AQ 4 – Water Temperature Modeling TSP and compare changes in average, maximum, and minimum daily temperatures in FYLF breeding and rearing habitat between alternative flow regimes.

<u>Western Pond Turtle (WPT)</u>

- Identify and map known occurrences of WPT within the study area, based on agency consultation and a review of existing information.
- Record sightings of WPT during implementation of aquatic technical studies. In particular, surveyors will be visually inspecting pools and backwaters for WPT at each study site during the FYLF surveys and during other field studies, particularly the mesohabitat mapping (AQ 1 – Instream Flow TSP).
- Develop a GIS map of potential WPT nesting habitat locations in the study area. GIS selection criteria include:
    - Slope of 15 degrees or less;
    - Southeast, south or southwest aspect;

  - 150-foot buffer around perennial streams and reservoirs; and
  - Below 6,000 feet in elevation.
- Conduct a field reconnaissance survey of potential nesting locations identified in the GIS map near Project facilities (Table AQ 7-1).
- Evaluate output from the AQ 4 – Water Temperature Modeling TSP and compare changes in water temperature (average, maximum, and minimum) near potential nesting habitats between unimpaired and impaired flow regimes.
- Prepare and submit a California Native Species Field Survey Form for all WPT recorded to the CNDDB.
- Provide an electronic database (Excel spreadsheet) of WPT sampling data (date, location, species) to BLM, resource agencies, and interested stakeholders.

SCHEDULE:

Date	Activity
May–June 2018	Conduct spring field surveys
August–September 2018	Conduct fall field surveys
October–December 2018	Analyze data and prepare draft report
January 2019	Distribute draft report to the stakeholders
February–April 2019	Stakeholders review and provide comments on draft report (90 days)
May–July 2019	Resolve comments and prepare final report
August 2019	Distribute final report in Draft License Application

REFERENCES:

Ashton, D.T., A.J. Lind, and K.E. Schlick. 1997. Western Pond Turtle (*Clemmys marmorata*). Natural History. USDA Forest Service, Pacific Southwest Research Station, Arcata, CA.

Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L. C. Hayek and M. S. Foster, Eds. 1994. Measuring and monitoring biological diversity: Standard methods for amphibians. Biological Diversity Handbook Series. Washington D.C., Smithsonian Institution Press.

Holland, D.C. 1994. The western pond turtle: habitat and history. Oregon Department of Fish and Wildlife, USA.

Jennings, M. R., and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California, USA.

Placer County Water Agency (PCWA). 2011. Application for New License. Middle Fork American River Project (FERC Project No. 2079). AQ 1 – Instream Flow Technical Study Report (2010). Exhibit E, Volume 3, Supporting Document B. February 2011.

United States Fish and Wildlife Service (USFWS). 2005. *Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog, August 2005.*

TABLES

Table AQ 7-1. Survey Areas for Western Pond Turtle around Project Facilities[1].

Project Facility	Survey Area[2]
Diversion Dams and Pools	15 feet around the perimeter
Flowlines[1]	20 feet on either side
Forebays/Forebay Tank	20 feet around the perimeter
Penstocks	15 feet on either side
Powerhouses and Switchyards	Within and up to 15 feet around the perimeter fence
Transmission, Power, and Communication Lines	25 feet on either side
Gages	10 feet around gages
Project Access Roads	20 feet on either side
Project Trails	15 feet on either side
Ancillary and Support Facilities	
Kaweah No. 1 Powerhouse Campus	Within the developed campus
Repeaters and Solar Panels	15 feet around the perimeter
River Access Parking	10 feet around parking area and beach

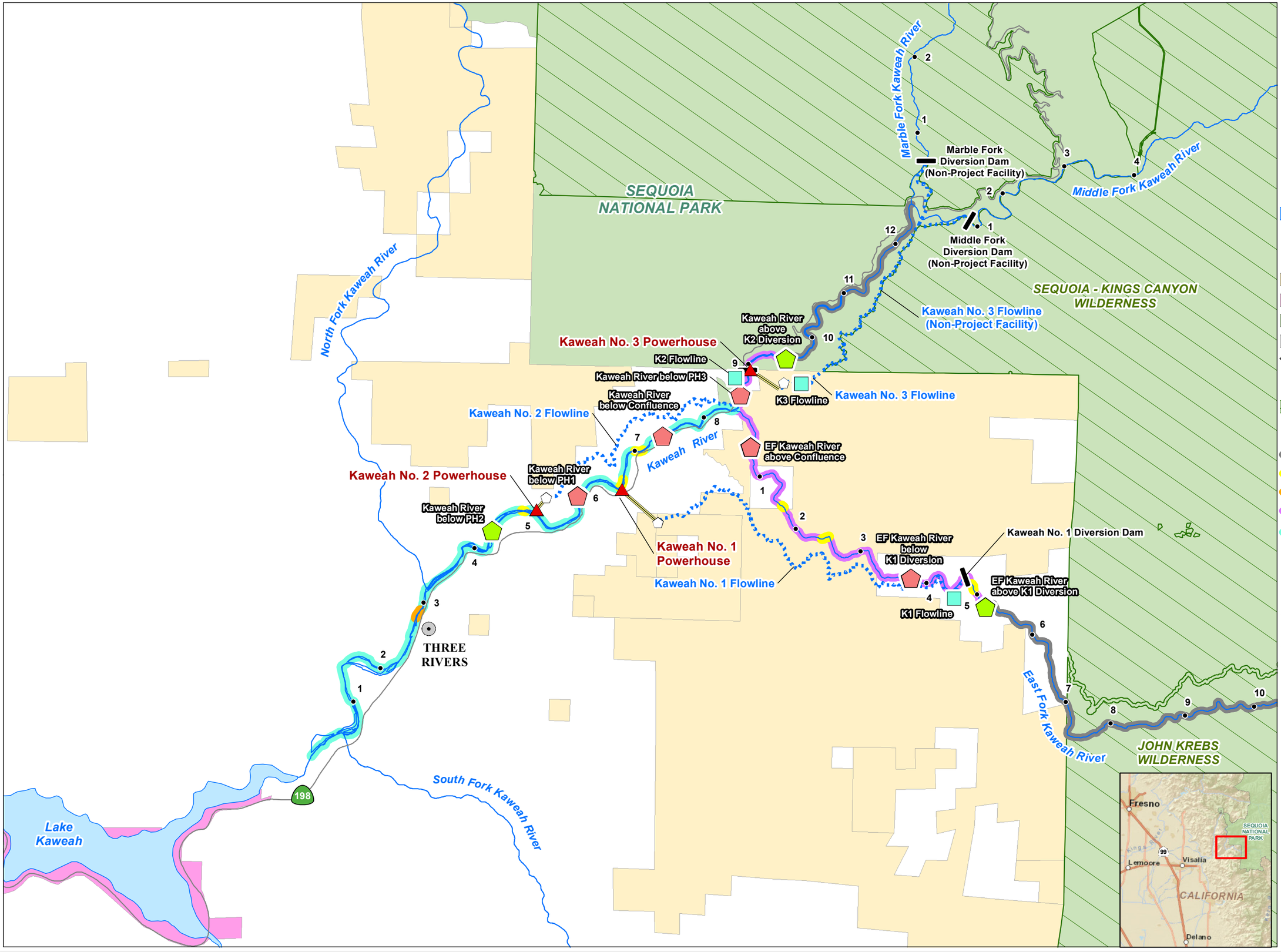
[1]Includes off-channel ponds and wetlands that may be present around Project facilities.

[2]Survey areas represent locations where potential operation and maintenance activities occur.

Table AQ 7-2. Foothill Yellow-Legged Frog Sampling Sites.

Study Reach	Site ID	Bypass Reaches	Reaches Upstream of Project Facilities or Comparison Reaches	Study Site Type
Kaweah River				
Kaweah River Upstream of Kaweah No. 3 Powerhouse	K9.5		●	Mainstem
Kaweah River Downstream of Kaweah No. 3 Powerhouse and Upstream of the East Fork Kaweah River Confluence	K8.7	●		Mainstem/ Tributary Confluence
Kaweah River Downstream of East Fork Kaweah Confluence and Upstream of Kaweah No. 1 Powerhouse	K7.3	●		Mainstem
Kaweah River Downstream of Kaweah No. 1 Powerhouse and Upstream of Kaweah No. 2 Powerhouse	K6.9	●		Mainstem
Kaweah River Downstream of Kaweah No. 2 Powerhouse	K4.3		●	Mainstem/ Tributary Confluence
East Fork Kaweah River				
East Fork Kaweah River Upstream of the Kaweah No. 1 Diversion	EFK5.2		●	Mainstem
East Fork Kaweah River Downstream of the Kaweah No. 1 Diversion	EFK3.8	●		Mainstem
East Fork Kaweah River Upstream of Confluence with Kaweah River	EFK0.7	●		Mainstem

MAP



Facilities

- Powerhouse
- Diversion
- Forebay
- Flowline
- Penstock

Other Features

- City/Town
- Highway/Road
- Watercourse
- Water Body
- River Mile

Land Jurisdiction*

- Bureau of Land Management
- U.S. Army Corps of Engineers
- National Park Service
- Private

*SOURCE: BLM 2012

Land Management

- National Wilderness Area

Channel Characterization

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

Sampling Locations

- Entrainment Monitoring (flowlines)
- Fish, BMI, FYLF, Riparian
- Fish, BMI, FYLF, Riparian, Instream Flow

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

Eastern Hydro Generation

Map AQ 7-1

Kaweah Project
Aquatic and Riparian Sampling Locations

Date: 12/8/2015

0 0.25 0.5 1 Miles

Projection: UTM Zone 11
Datum: NAD 83

APPENDIX AQ 7-A

Visual Encounter Survey Protocol

Visual Encounter Survey Protocol for *Rana boylii* in Streams

Standard VES (Heyer et al. 1994) with augmented field datasheets
Yarnell, S. 2007.

This Visual Encounter Survey (VES) protocol and associated datasheet are for use in stream reaches up to several thousand feet in length where information on all lifestages and the micro-habitat associations of each individual is desired. The data from this survey protocol is intended to 1) describe the abundance, distribution and micro-habitat associations of *R. boylii*, and 2) provide the data necessary to coordinate with other stream reach study efforts, such as instream flow studies where hydrodynamic modeling will be used.

The VES protocol is as described in Heyer et al. (1994), and is summarized for stream habitats as follows. Habitats are searched along a several meter wide transect parallel to the stream at the water's edge, and the number of animals encountered over a period of time is recorded. Using a moderate level of search effort, individuals active on the surface of the ground, on rocks, or at the water's edge are identified, and captured and measured if possible. Rocks, logs and other surface cover objects are also overturned in search of individuals, then returned to their original position to minimize disturbance to the habitat. Habitats are not systematically destroyed in order to find animals, and voucher specimens are not collected unless absolutely necessary for identification. In shallow water habitats, hand dip nets are used to capture individual adults and sub-adults, and to seine the channel bottom to collect tadpoles. This search effort in shallow water habitats is balanced to minimize habitat disturbance, but adequately sift through any silt, gravel or vegetation where individuals may be hiding. Use of a viewing box in shallow, wadeable areas to help in detection of egg and tadpole lifestages is recommended. Likewise, where safe and possible, snorkeling in deeper water (0.5-2m deep) adjacent to good breeding habitat (e.g. edges of cobble bars) can greatly aid in detection of egg masses, and is recommended during spring surveys. To effectively survey stream segments, both banks are walked with a minimum of two surveyors. Wherever possible, surveys are completed walking upstream so that as individuals seek cover in the stream, often swimming downstream, they are not counted twice. In addition, eggmasses are generally attached to the downstream side of cobbles and are easier to detect when walking upstream. However, surveys could proceed in the downstream direction if surveyors are well-practiced in identification, are manually feeling and checking behind cobbles and boulders for eggmasses, and can adequately keep track of any downstream migrating individuals.

A list of field equipment required to complete the surveys is attached at the end of this protocol. In general, equipment should be selected to be lightweight and compact enough to fit within a daypack so that surveyors can be fully mobile.

The associated datasheet was developed to document the additional microhabitat data needed at each observation. It is similar to datasheets used in previous academic research and hydropower relicensing studies (Lind, 1997; PG&E 2002; Yarnell, 2005). In order to simplify the complications and potential errors associated with multiple datasheets each for a different lifestage, a single datasheet is used for each survey, regardless of time of year and focus of survey (ex: breeding surveys in spring vs. tadpole/rearing surveys in summer). The data for each lifestage observed during the survey is recorded on a single row. The microhabitat data collected for each lifestage may differ and as a result, some fields in the row may be marked as N/A (ex: depth at eggmass for an adult observation). Small modifications to the datasheet may be made to accommodate unique survey situations (such as associated mesohabitat number rather than

associated GPS point when identifying observation location), but these should be kept to a minimum.

Note that the datasheet is designed to be printed in landscape format on 8x14 paper with the code list printed on the back side of the page (see FYLF VES survey datasheet.xls file). Details on recording data are provided below. The datasheet is designed for collection of data in metric units, so use of English units must be explicitly noted.

General Data

Site: Name of stream and reach to be surveyed. If sub-reaches are used, clarify which sections are to be surveyed. For example: South Yuba River, Reach A-1, river mile 12.5-13.5.

Start/End UTM: Coordinates of start and end survey locations on the stream in NAD27 datum (designate other datum if needed). Record saved waypoint (wypt) number accuracy of point (in meters).

Elevation: Record from Topo map or GPS and circle source (note range of error)

Photo numbers: Record digital photo ID numbers for photos taken throughout survey. Include photos of the start and end locations, typical mid-channel habitat, typical edgewater and backwater habitats, examples of breeding habitat (occupied or otherwise), example individuals where possible (adults, juveniles, eggs and tadpoles) and any other interesting or unique habitat features.

Observers(s): Names of surveyors

Date: Month, Day, Year

Survey Start/End Time: Record start/end times of survey (note time of breaks for lunch, etc on bottom of sheet if necessary). This should reflect actual survey/search time.

Weather: Describe general cloud cover; enter code from list:

C	Clear
PC	Partly Cloudy
MC	Mostly Cloudy
O	Overcast
R	Rainy

Start/End Temp (C): Record temperature of air (in the shade) and water (thalweg and edgewater) at start, mid-day (if applicable) and end of survey. Edgewater temp should be within 0.3m of shore in a shallow slow-moving location.

Bullfrogs? Fish? Note presence/absence of bullfrogs, fish or crayfish anywhere in survey reach. If needed, add notes at bottom of page.

Field sketch completed? At the bottom of the page, note whether a rough field sketch was completed on the back of the datasheet. The sketch serves as rough indicator of habitat throughout the survey reach and can be used to delineate which portions of the reach may *not* have been surveyed (e.g. very deep or fast areas near a steep heavily vegetated bank).

Detailed Data

***Note: Microhabitats are defined as the immediate/local habitat surrounding the observation site of the individual. This may be the shallow side habitat or backwater where eggs and tads occur or the habitat immediately adjacent to an adult perch site. Measurements should be made as near to the individual as possible but still describing the average conditions of the immediately adjacent habitat. On average, but not always, the microhabitat would be within a 0.5m or so of the observation.

***Note: Some fields are applicable only to certain lifestages. Be sure to record N/A in the datasheet field for field not appropriate to the observation. Do not leave fields blank.

Life Stage/Sex: Note life stage of individual; enter code from list:

AF Adult Female
AM Adult Male
AU Adult Unknown
J Juvenile/Sub-adult
Y Young of Year/metamorph (newly emerged – fall only)
T Tadpole
E Egg mass

Total #: Number of individuals noted in a single micro-habitat (ex: 1 adult male on emergent boulders in a riffle vs. 50 tadpoles in a single small side channel pool)

Length (mm): Snout to vent length for adults/sub-adults; Total length for tadpoles; Diameter for egg masses

Developmental Stage: Gosner stage for egg masses and tadpoles. If categorized, then note categories on back of datasheet.

Mesohabitat Type: Local larger-scale habitat where individual was observed based on USFSR5 meso-habitat types (see USFSR5 publication for more info on defining mesohabitats); enter code from list:

CAS Cascade
- jumbled steep reaches with either coarse substrate or bedrock

SPO Step-pool
- includes steep reaches with plunge pools and vertical scour pools

SCP Side-channel Pool
- includes eddies, backwater pools, lateral scour pools, corner pools

POO Pool
- includes flatwater, dammed pools, confluence pools, mid-channel pools and pool tail-outs

EDG Edgewater
- shallow edgewater habitat adjacent to riffles, runs

RUN Run
- slow gently moving flow, faster than a pool, slower than a riffle

HGR High Gradient Riffle/Rapid
- rippled swift water, rapids of high gradient (~ >2%)

LGR Low Gradient Riffle
- rippled swift water of low gradient (~ <2%)

OTH Other
- describe either in same field or in comments field

Riparian Type: Describe dominant riparian/adjacent channel vegetation based on Lind 1997 to provide data on vegetation encroachment; enter code from list:

GCBar	Gravel/Cobble Bar (side or mid channel, clear of veg)
WIL	Pure Willow
WIL/ALD	Willow/Alder Mix
MRIP	Mature Riparian
BDX	Bedrock (clear of veg)

Canopy Cover Class: Cover directly above microhabitat where individual was noted; enter code from list:

1	0 – 25%
2	25 – 50%
3	50 – 75%
4	75 – 100%

Distance to Shore (m): Distance from observation perpendicular to water's edge at closest shore. Primarily important for eggs/tadpoles.

Microhabitat Substrate: Dominant substrate type near perch for adults/sub-adults, microhabitat substrate for tadpoles or egg masses

SLT	Silt
SND	Sand (< 2mm)
GRV	Gravel (2 – 64 mm)
COB	Cobble (64 – 256 mm)
BLD	Boulder (> 256 mm)
BDX	Bedrock
MXD	Mixed (describe how mixed – GC or CG with dominant size first)

Attach/Perch Substrate: Substrate size of perch for adults/sub-adults/juveniles or attachment site for egg masses (N/A for tadpoles)

SLT	Silt
SND	Sand (< 2mm)
GRV	Gravel (2 – 64 mm)
COB	Cobble (64 – 256 mm)
BLD	Boulder (> 256 mm)
BDX	Bedrock
VEG	Vegetation/LWD - specify

Total Depth (m): For all lifestages, record average total depth of the microhabitat

Depth to eggs/tads (m): For egg masses, record depth to center of egg mass; for tadpoles, record depth to tads if different than average total depth of microhabitat, if it's the same, note 'same'.

Mid-column Velocity (m/s): For all lifestages, record average local mid-column flow velocity of the microhabitat. Mid-column velocity should be taken at 0.6 times the total depth for depths < 1m. For depths > 1m, record the average of the velocity at 0.2 times the depth and 0.8 times the depth. For egg masses, this should be directly above or immediately adjacent to the oviposition site.

Velocity at eggs/tads (m/s): For egg masses, record velocity at/adjacent to center of egg mass; for tadpoles, record velocity at tads if different than mid-column velocity of microhabitat, if it's the same, note 'same'.

Local Water Temp (C): Temperature of water in local microhabitat

Location of Observation: Code or some identifier of location in survey reach where observation was recorded. Could be a GPS waypoint number or an associated meso-habitat number correlating to another study.

Comments: Include here any information on local habitat condition, species condition, presence of non-natives, photo description, etc.

References:

Heyer, W. R., M. A. Donnelly, R. W. McDiarmid, L. C. Hayek and M. S. Foster, Eds. (1994). Measuring and monitoring biological diversity: Standard methods for amphibians. Biological Diversity Handbook Series. Washington D.C., Smithsonian Institution Press.

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Seltenrich, C.P. and Pool, A.C. (2002). A Standardized Approach for Habitat Assessments and Visual Encounter Surveys for the Foothill Yellow-legged Frog (*Rana boylii*). Pacific Gas & Electric Company.

Yarnell, S. M. (2005). Spatial Heterogeneity of *Rana boylii* Habitat: Physical Processes, Quantification and Ecological Meaningfulness. PhD Dissertation. Hydrologic Sciences, University of California, Davis.

USFSR5 meso-habitat types

Field Equipment List

Required:
Field notebook
Datasheets (w/copy of survey protocol) and clipboard
Clean copies of study site aerial/topo maps (for sketching habitats, etc.)
Pencil, pen, sharpie
Stopwatch
Flagging
Thermometer
Binoculars
Dip net or small handheld net for scooping tadpoles and catching individuals
Clear see-thru rulers (marked in metric) to measure individual length
Small clear plastic vial or wide-mouth bottle to capture tads for identification
Camera – extra batteries, memory card
Scale for pictures (ruler, pencil of known length, etc)
Handheld GPS – extra batteries
Velocity meter w/wading rod or other stick/device to measure depth – Marsh McBirney recommended – need accuracy in low velocities - +/- 0.01 m/s ideal.
Waders
First Aid kit
Personal – water, food, sunscreen, bug juice, etc

Recommended:

Viewing box (ideal if made of plexiglass, but could be lightweight plastic with clear plastic affixed to hole in bottom)
Snorkeling gear – drysuit, mask/snorkel, shoes
Rope to tie off and use in swift water
Hand lens (aid in identifying mouth parts on tadpoles)
30m tape – w/metric markings

Optional:

Range finder – to record large scale distances (river width, length of bar, etc)
Compass
Walkie talkies
Inflatable kayak, inner tube, or some means of floating river if needed – includes lifejackets, dry bags, paddles, ropes, etc.

Site (stream/reach/subreach)_____ Date: _____ Page _____ of _____

Start North UTM: WYPT: East UTM: Accuracy:	Elevation: GPS Topo	Photo #s: start: end: breeding: Other: mid-channel: Edgwtr: adults: eggs/tads:		Observer(s):
End North UTM: WYPT: East UTM : Accuracy:	Survey Start Time: End Time:	Weather:	Start Temp (C) - Air: Thalweg: Edgwtr:	End Temp (C) - Air: Thalweg: Edgwtr:	Bullfrogs? Fish? Crayfish?

Life Stage /Sex	Total #	Length (mm)	Develop. Stage	Meso-habitat Type	Riparian Type	Canopy Cover Class	Dist to Shore (m)	Microhabitat Substrate (mm)	Attach/Perch Substrate (mm)	Total Depth (ft)	Dist. From Surface to Eggs/Tads (ft)	Mean Column Velocity* (ft/s)	Velocity at Eggs/Tads (ft/s)	Local Water Temp (C)	Location of Observation	Comments

* If depth is ≤ 2.5 ft then measure velocity at 0.6 of depth from the surface. If depth is ≥ 2.5 ft than measure velocity at 0.8 and 0.2 of depth from the surface.

Foothill Yellow-legged Frog VES Survey Form CODES

VARIABLE	CODE	Description	Comments
Life Stage/Sex	AF	Adult - Female	
	AM	Adult - Male	
	AU	Adult - Unknown	
	J	Juvenile/Sub-adult	
	Y	Young of Year/Metamorph (fall only)	
	T	Tadpole	
	E	Egg Mass	
Length (mm)	Snout to vent length for adults/sub-adults; Total length for tadpoles; Diameter for egg masses		
Mesohabitat Type	CAS	Cascade	jumbled steep reaches with either coarse substrate or bedrock
	SPO	Step-pool	includes steep reaches with plunge pools and vertical scour pools
	SCP	Side-channel Pool	includes eddies, backwater pools, lateral scour pools, corner pools
	POO	Pool	includes flatwater, dammed pools, edgewater, confluence pools, mid-channel pools and pool tailouts
	EDG	Edgewater	shallow edgewater habitat adjacent to riffles, runs
	RUN	Run	slow gently moving flow, faster than a pool, slower than a riffle
	HGR	High Gradient Riffle/Rapid	riffles, rapids of high gradient (~ > 2%)
	LGR	Low Gradient Riffle	riffles of low gradient (~ < 2%)
	OTH	Other	describe in comments field
Riparian Type	GCBar	gravel/cobble bar (no veg)	
(stage of succession)	WIL	pure willow	
	WIL/ALD	willow/alder mix	
	MRIP	mature riparian	
	BDX	Bedrock (little/no veg)	
Microhabitat Substrate	SLT	silt	
	SND	sand (< 2mm)	
	GRV	gravel (2 - 64 mm)	
	COB	Cobble (64 - 256 mm)	
	BLD	Boulder (> 256 mm)	
	BDX	Bedrock	
	MXD	Mixed	describe how mixed - e.g. GC for dominant gravel, secondary cobble
Microhabitat Depth	TOTAL Depth of microhabitat (m)		
Depth at Eggs/Tads	Eggs - depth to center of egg mass; Tads - depth to tads if diff than average total depth		
Microhabitat Velocity	Average MID-COLUMN velocity of microhabitat (m/s)		
Velocity at Eggs/Tads	Eggs - velocity at/adjacent to center of egg mass; Tads - velocity at tads if diff than mid-column velocity		
Local Water Temp	Water Temperature in microhabitat		
Distance to Shore (m)	Distance from observation perpendicular to water's edge on nearest shore		

VARIABLE	CODE	Description
Developmetal Stage		Gosner stage for egg masses and tadpoles.
Eggs	1	New 1-3 days old - compact, blue, no silt, small eggs
	2	~ 1 week old - looser, some silt on eggs, water in eggs
	3	~2 wks old (close to hatching) - very loose, eggs detaching, start to see tail in embryos, possibly strung out if subject to slight flow
Tadpoles	1	
	2	
	3	
	4	
	5	
Canopy Cover Class	1	0-25%
	2	25-50%
	3	50-75%
	4	75-100%
Attach/Perch Substrate	SLT	silt
	SND	sand (< 2mm)
	GRV	gravel (2 - 64 mm)
	COB	Cobble (64 - 256 mm)
	BLD	Boulder (> 256 mm)
	BDX	Bedrock
	VEG	Vegetation/LWD - specify veg type

Rough field sketch - delineate areas NOT surveyed (too deep/fast, heavy veg)

APPENDIX AQ 7-B

Habitat Availability Survey Protocol

Habitat Availability Survey Protocol for *Rana boylii* in Streams, Yarnell, S. 2007.

This protocol is for determining the amount of available habitat in a survey reach potentially suitable for *R. boylii* egg and tadpole lifestages. It is intended to provide habitat availability data that can be used with habitat suitability data collected for eggs and tadpoles in order to minimize bias in developing suitability curves.

The associated datasheet is used to record data on point depth and velocity measurements throughout the survey reach. The associated field sketch form is used to create a scaled map of the survey reach, showing locations of control points, point measurements and general habitat characteristics (geomorphic features, mesohabitat type, substrate, etc). Data from both forms are then used to calculate the area of hydraulic habitats defined in a specified series of depth/velocity bins.

Details on the protocol and filling out the datasheets are provided below.

Note that the datasheet and field sketch form are designed to be printed in landscape format on 8.5x14 paper with the codes and description boxes printed on the back side of the page (see files: FYLF VES survey datasheet.xls and Habitat sketch form.pdf). The datasheet is designed for collection of data in metric units, so use of English units must be explicitly noted.

PROTOCOL

1. *Complete a scaled sketch of the survey reach*. Be sure to include:
   - Control points throughout the reach were possible for measuring distances and determining an appropriate map scale
   - Outlines of basic geomorphic features
   - Outlines/shading of mesohabitat unit types
   - Outlines/shading of substrate size patches
   - Outlines of large, dense vegetation patches
   - Locations of point depth/velocity measurements and/or cross-section transects depending on resolution of map

2. *Take point measurements of depth and velocity across the specified range.* Using the datasheet, record the location of each point measurement (longitudinal distance from control point, cross-sectional distance from longitudinal line if using scope and rod; survey point numbers if using a total station), total depth, mid-column velocity and substrate size. Measurements should be taken throughout the survey reach in an effort to equalize area surveyed in the following depth/velocity categories:

	Depth (m)			
Velocity (m/s)	0.0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 2.0
0.0 - 0.1	x	x	x	x
0.1 - 0.2	x	x	x	x
0.2 - 0.4	x	x	x	x
0.4 - 0.6	x	x	x	x

In order to maximize efficiency, select a cross-section across a mesohabitat. With the tape zeroed on a longitudinal tape line or perpendicular to the water's edge, start at the water's edge and take a point measurement where the velocity first reaches 0.1 m/s. Continue along the cross-section, taking point measurements when velocity reaches 0.2 m/s, 0.4 m/s and 0.6 m/s. Data is not needed at velocities higher than 0.6m/s. Continue in this fashion until a series of cross-sections have been completed throughout the reach.

3. *Calculate the area surveyed within each bin.* Using locations of point measurements recorded on the field sketch map, trace contours at each velocity level and draw polygons around each the area representing each depth-velocity bin. Count squares to determine the area within each bin and record in the depth-velocity bin table on the back of the field sketch form. If some bins are underrepresented (area too low in relation to others), select additional point measurement locations throughout the reach in an effort to equalize area sampled across the range of bins.

Point measurement datasheet details

Control Point:	Code for specific control point from which longitudinal and cross-sectional distances are measured or point used as a benchmark if using a total station. Descriptions of control points, including an assigned code, are to be recorded on the back of the field sketch form. A list of the codes can be added to the back of the datasheet for reference if needed.
Survey Point:	Number of point taken with a total station. If using a scope and rod, record station point number for cross-reference to a field notebook with the details on station and elevation information.
Mesohabitat Unit Type	Based on USFSR5 mesohabitat unit designations. See codes on the back of the VES survey datasheet.
Depth (m)	Total depth at measurement point
Velocity (m/s)	Mid-column velocity at measurement point
Substrate	Categorical size of substrate at measurement point. See categories listed on back of datasheet.
Notes	Record any anomalies or error in measurements; describe any local influences on the measurement (ex: boulder just upstream, etc)

Site (stream/reach/subreach):____

Date: Page _____ of _____

Start North UTM: East UTM:	WYPT: Accuracy:	End North UTM: East UTM:	WYPT: Accuracy:	Weather:
Elevatoin: GPS Topo	Survey Start Time: End Time:		Assoc. Field Sketch Form: Assoc. Photo #s:	
Discharge:	Observers:	Notes:		

Survey Point	Mesohabitat Unit Type	Depth (m)	Velocity (m/s)	Substrate	Notes

Notes on Collecting Habitat Suitability Criteria (HSC) availability data

Data is collected to determine range of depths and velocities available throughout the survey reach, and will be used to develop HSC curves for FYLF eggs and tadpole lifestages.

Control Point - Code for contol points identified at each site. Describe control points in description box below.

Survey Point - Point number from Total Station (**If scope and rod used instead, then reference where in field notebook details on station, elevation, etc

Mesohabitat Unit Type - Based on USFSR5 mesohabitat unit designations. See codes for VES datasheet.

Depth (m) - Total Depth at measurement point

Velocity (m/s) - Mid-column velocity at measurement point

Substrate - Categorical size of substrate at measurement point:

Silt/fines	Small Cobble (64-128n Large Boulder (>512mm)
Sand (<2mm)	Large Cobble (128-256 Bedrock
Gravel (2-64mm)	Small Boulder (256-512mm)

Notes - Any anomalies, errror or description pertaining to that measurement point

CONTROL POINTS

Code	Description