2018 Amphibian and Aquatic Reptile Monitoring Report

Sacramento Municipal Utility District

Hydro License Implementation • June 2019

Upper American River Project

FERC Project No. 2101

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

Acronyms and Abbreviations

Acronym	Definition
°C	degrees Celsius
CD	Camino Dam
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
FERC	Federal Energy Regulatory Commission
ft	feet
FYLF	foothill yellow-legged frog
GIS	Geographic Information Systems
in	inch
mi	mile
mm	millimeter
PG&E	Pacific Gas and Electric Company
RC	Rock Creek
SCD	Slab Creek Dam
SF	South Fork
SMUD	Sacramento Municipal Utility District
SWRCB	State Water Resources Control Board
UARP	Upper American River Project
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VES	visual encounter survey
WPT	western pond turtle

1.0 INTRODUCTION AND BACKGROUND

This Amphibian and Aquatic Reptile Monitoring Report (Report) addresses monitoring requirements set forth in Sacramento Municipal Utility District's (SMUD) Amphibian and Aquatic Reptile Monitoring Plan (Plan) (SMUD 2016). Requirements for the Plan are found in State Water Resources Control Board (SWRCB) Conditions 8.C, 8.D, 9.A, 9.B, and 9.C, and U.S. Forest Service (USFS) 4(e) Conditions 31 and 32, located in Appendices A and B, respectively, of the Federal Energy Regulatory Commission's (FERC) Order Issuing New License for the Upper American River Project (UARP; FERC Project No. 2101), dated July 23, 2014 (FERC 2014). The Plan was developed in consultation with the SWRCB, USFS, California Department of Fish and Wildlife (CDFW), and U.S. Fish and Wildlife Service (USFWS). FERC approved the Plan on May 19, 2016. This Report presents results of implementing the Plan in 2018.

SMUD owns and operates the UARP which is licensed by FERC. The UARP lies within El Dorado and Sacramento counties, primarily within lands of Eldorado National Forest. The UARP consists of three major storage reservoirs: Loon Lake, Union Valley, and Ice House (with a combined capacity of approximately 379,000 acre-feet), eight smaller regulating or diversion reservoirs, and eight powerhouses. The UARP also includes recreation facilities containing over 700 campsites, five boat ramps, hiking paths, and bicycle trails at the reservoirs.

Surveys focused on Sierra Nevada yellow-legged frog (*Rana sierrae*) are described under a separate monitoring plan, as required by the License.

2.0 MONITORING PLAN OBJECTIVES

The main objectives of the Plan are to monitor for and document the presence and distribution of sensitive amphibians and aquatic reptiles, focused primarily on foothill yellow-legged frog (*Rana boylii*) (FYLF) and western pond turtle (*Actinemys marmorata*) (WPT), over the term of the License (SMUD 2016). This includes identifying FYLF breeding and larval periods in the Project-affected reaches by periodically surveying reaches of known and potential FYLF presence during spring and summer. The Plan also includes stream water temperature monitoring at specified sites with known breeding or suitable breeding habitat for FYLF.

Monitoring goals include determining the timing and success of early life stages (i.e., eggs, tadpoles, and metamorphs [newly metamorphosed individuals, also referred to as "young-of-year"]) of known populations during the first survey year[1], and documenting the size and condition of young-of-year in fall to estimate the probability of overwintering success.

[1] None of these early life stages were found during the first or second survey years (2016 and 2017).

Determining presence and distribution of sensitive amphibian species and identifying breeding and larval periods are important in identifying potential impacts resulting from streamflow modifications. In particular, along with temperature monitoring and other aquatic species monitoring, FYLF monitoring may help inform whether short-term flow fluctuations resulting from spill events below Slab Creek Reservoir Dam and/or Camino Reservoir Dam result in unacceptable environmental impacts. Identification of FYLF breeding and larval periods may also be used to monitor effects of spring recreational boating flows and future potential October recreational boating flows in the South Fork (SF) American River below Slab Creek Reservoir.

FYLF monitoring is being conducted to help determine if populations of this species in Project-affected streams are increasing or decreasing for any life stage as a result of Project streamflow changes or fluctuations. Monitoring for 1 to 2 years within each five-year period (following more intensive surveys at the beginning) provides an opportunity to detect changes in amphibian populations, following sufficient response time to streamflow modifications. Trends in population size and/or changes in distribution over time will be monitored with consideration of Project-related changes in water temperature and habitat availability. Monitoring before (when feasible) and after spill events and during flow fluctuations will provide information on whether egg masses and/or larvae are being displaced or stranded.

Water temperature monitoring in known or suitable breeding sites is intended to provide information about the relationship between water temperature and the initiation of FYLF breeding.

3.0 MONITORING SITES AND FREQUENCY

3.1 MONITORING SITES

In accordance with the Plan (SMUD 2016), four monitoring sites within three Project reaches[2] were surveyed during License Year 4 (2018), as listed in Table 1 and illustrated in Figure 1. These sites include locations with either documented FYLF presence (sites Camino Dam [CD]-A3 and CD-A4) or potential habitat, as described in the Plan.

[2] "Project reach" is a term used in this report to describe a segment of stream downstream of a dam (e.g., "Camino Dam Reach" is Silver Creek downstream of Camino Dam)

Table 1. Amphibian and Aquatic Reptile Monitoring Sites, 2018

Project Reach	Site Code	Site Description	UTM Coordinates[a]		Site Length[b,c]	Elev.[b,d]	FYLF[e] Observed		WPT[e] Observed		Water Temp. Monitoring
			Downstream End	Upstream End			2003/ 2004	2016/ 2017	2003/ 2004	2016/ 2017	
Camino Dam Reach	CD-A3	Silver Creek below Camino Reservoir Dam (near Camino Adit)	4298484 N/ 710087 E	4298651 N/ 710236 E	735 ft/ 0.14 mi	2,336 ft	Yes	Yes	No	No	Yes
	CD-A4	Silver Creek below Camino Reservoir Dam (at confluence with SF American River)	4296233 N/ 709331 E	4296310 N/ 709424 E	404 ft/ 0.08 mi	2,067 ft	Yes	No	No	No	Yes
Slab Creek Dam Reach	SCD-A1	SF American River below Slab Creek Reservoir Dam	4292873 N/ 692573 E	4295022 N/ 692931 E	10,404 ft/ 2.0 mi	1,007 ft	No	No	Yes	Yes	Yes
Rock Creek Reach	RC-A1	Rock Creek	4294981 N/ 692886 E	4296217 693204	4,954 ft/ 0.94 mi	1,102 ft	No	No	No	No	No

[a] Projection: NAD83 UTM Zone 10 North, N = Northing, E = Easting
[b] Site lengths and elevations are calculated in geographic information systems (GIS) (projection: NAD83 UTM Zone 10 North)
[c] Site lengths are reported in feet (ft) and miles (mi)
[d] Elev. = Elevation, which is for the most downstream survey location at the site
[e] FYLF = Foothill yellow-legged frog; WPT = Western pond turtle

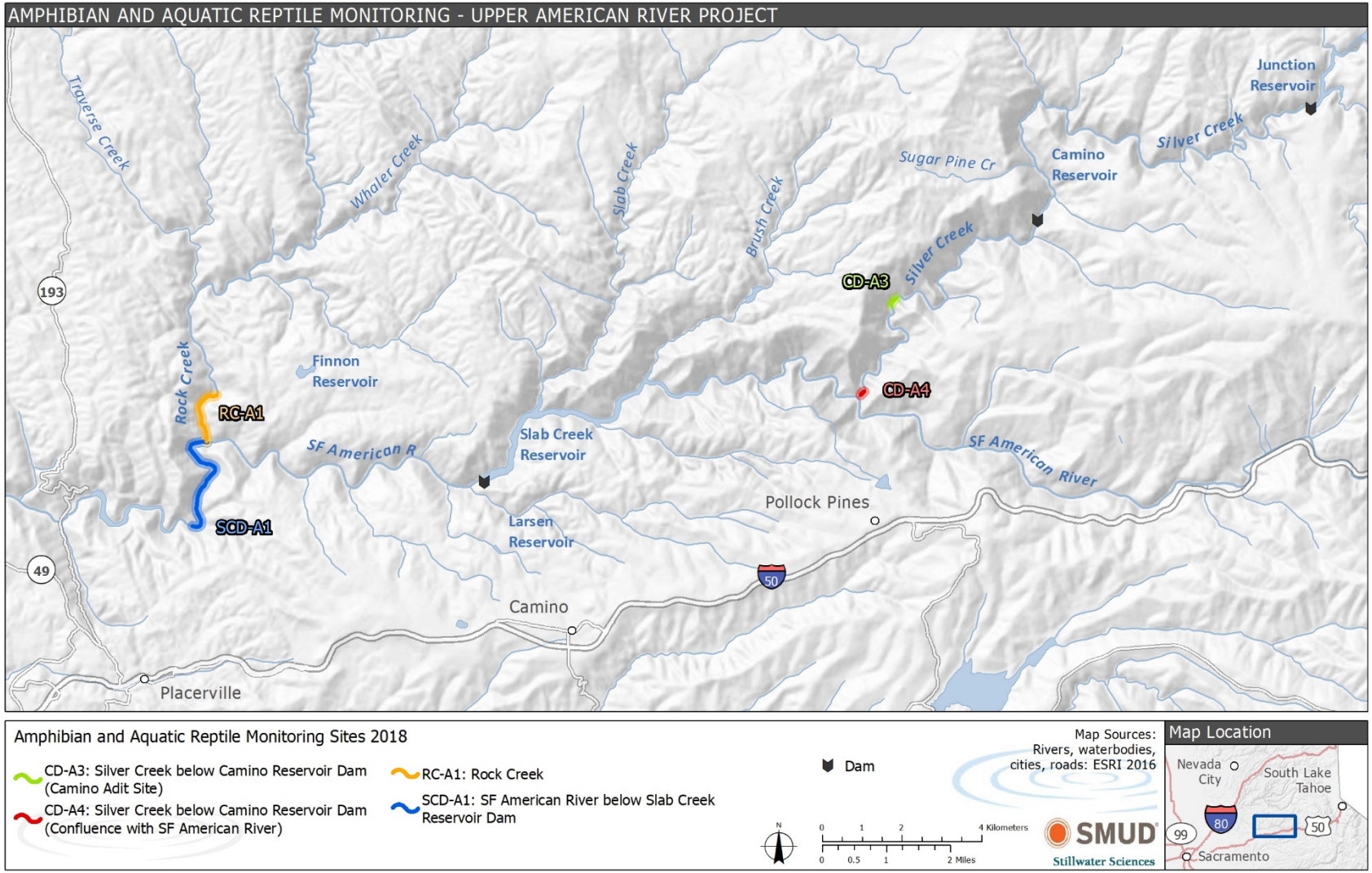


Figure 1. Amphibian and Aquatic Reptile Monitoring Sites and Study Area Overview, 2018

During relicensing studies in 2003 and 2004, FYLF were documented along the Camino Dam Reach of Silver Creek at sites CD-A3 and CD-A4 (SMUD and PG&E 2005). Relicensing studies did not document species presence at the Slab Creek Dam (SCD) Reach of SF American River (SCD-A1), though they contained FYLF habitat and were therefore included in the Plan. Rock Creek (RC) was included in the Plan to provide information on whether FYLFs are using this major tributary of the reach below Slab Creek Dam.

During 2016 and 2017, the first two years of implementing the Plan after License issuance, FYLF were found at Site CD-A3. No FYLF were documented at any other monitoring sites in 2016 or 2017 (SMUD 2017 and SMUD 2018).

3.2 MONITORING FREQUENCY

The Plan specifies that surveys will be conducted at each site over the term of the License during specific years (SMUD 2016). Table 2 outlines the monitoring schedule for each site (including sites not surveyed in 2018) over the term of the license. Surveys can also be triggered by spill events and flow fluctuations (see Section 4.1.3).

Table 2. Monitoring Schedule for Each Amphibian/Aquatic Reptile Monitoring Site Over Term of License[a]

Site Description	License Years 1 through 25																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Silver Creek below Junction Reservoir Dam		X	X		X					X					X					X					X
Silver Creek below Camino Reservoir Dam		X	X	X	X	X				X	X				X	X				X	X				X
SF American River below Slab Creek Reservoir Dam		X	X	X	X	X	X			X	X				X	X				X	X				X
Rock Creek		X	X	X																					
SF Rubicon River below Gerle Creek		X																							
Site Description	**License Years 26 through 50**																								
	26	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
Silver Creek below Junction Reservoir Dam					X					X					X					X					X
Silver Creek below Camino Reservoir Dam	X				X	X				X	X				X	X				X	X				X
SF American River below Slab Creek Reservoir Dam	X				X	X				X	X				X	X				X	X				X
Rock Creek																									
SF Rubicon River below Gerle Creek																									

[a] Year 1 is 2015
X = Amphibian and aquatic reptile monitoring years

4.0 METHODS

Visual Encounter Surveys (VESs) were performed in all safely accessible and permissible areas within each site, following protocols outlined in the Visual Encounter Survey Protocol for *Rana boylii* in Lotic Environments (Peek et al. 2017), as well as protocols similar to those outlined in Heyer et al. (1994), Lind (1997), and Pacific Gas and Electric Company (PG&E) (2002a, 2002b). In addition to FYLF, all other amphibian and reptile species observed during the surveys were recorded, as well as any potential predators (e.g., fish, crayfish, and bullfrogs). The specific survey methodology for each species is addressed below, as are methods for adaptive management monitoring.

4.1 FOOTHILL YELLOW-LEGGED FROG

4.1.1 Visual Encounter Surveys

At least four focused VESs were conducted at each site in 2018 as follows:

- two egg mass surveys during the late breeding and early tadpole development period (June),
- one tadpole survey during the tadpole development period (July–August), and
- at least one survey for newly metamorphosed (young-of-year) FYLF in fall (September–October).

Survey dates for each site are listed in Table 3.

Table 3. Amphibian and Aquatic Reptile Monitoring Survey Dates, 2018

Site Code	Site Description	Survey Date (2018)				
		VES 1	VES 2	VES 3[a]	VES i[b]	VES4
CD-A3	Silver Creek below Camino Reservoir Dam (near Camino Adit)	6/4	6/18	7/30	9/4	10/2
CD-A4	Silver Creek below Camino Reservoir Dam (near confluence with SF American River)	6/6	6/19	7/31	9/4	10/3
SCD-A1	SF American River below Slab Creek Reservoir Dam	6/5	6/20	8/1	--	10/4
RC-A1	Rock Creek	6/7	6/21	8/2	--	10/5

[a] Focused western pond turtle surveys were conducted during VES 3.
[b] Adaptive management survey conducted following a Camino Dam spill event.

Two to four surveyors initiated each VES at the downstream end of the site and surveyed upstream, except for Site SCD-A1, where all four surveys were initiated at the upstream end and moved downstream (due to the larger river channel and flow and increased difficulty surveying against the current). When wading in near-shore habitat, surveyors used a carefully gauged zig-zag pattern to search the shallows in one pass. Data from the surveys was recorded on a field form adapted from Peek et al. 2017 (Attachment 1). Water and air temperatures were recorded at the beginning of every

VES. Start and end times were recorded, as well as the actual time spent exclusively searching for FYLF.

During egg mass surveys, each team included one snorkeler to survey deeper areas where safe and feasible (e.g., in water 1.6–9 ft deep in and adjacent to suitable breeding habitat). Surveyors carefully used their hands to feel in areas where they could not see, including under bedrock or boulder ledges, and in deep pockets beneath large cobble in low-velocity areas.

Larval surveys focused on shallow water habitats, where hand dip nets were sometimes used to carefully seine the channel bottom to collect tadpoles while minimizing habitat disturbance. At locations where FYLF tadpoles were documented, the number of tadpoles, Gosner stage, and nearest bank were recorded. Data collected at any tadpole group location included total water depth, dominant substrate, and estimated average total length of tadpoles. Water velocity measurements were estimated near the center of any tadpole group at a mid-column velocity to represent the average flow velocity at the location of the tadpoles.

Surveys for post-metamorphic individuals focused on the surface of the ground, on rocks, or at the water's edge. Data collected for any post-metamorphic individual captured included sex[3] and snout-to-vent length. An individual was classified as adult if it possessed secondary sexual characteristics (such as enlarged nuptial pads in males) or was equal to or greater than 37 millimeters (mm) (2 inch [in]) snout-to-vent length (Storer 1925, Zweifel 1955). An individual would be classified as a young-of-year based on size (which can measure from 22 to 27 mm [0.8 to 1 in] snout-to-vent length, but typically from 22 to 24 mm [0.8 to 0.9 in] [Nussbaum et al. 1983, Zeiner et al. 1988, PG&E 2002a]) and possible evidence of tail absorption; in addition, young-of-year are present in fall only.

Habitat data collected as part of the post-metamorphic frog surveys included perch substrate, dominant riparian type, and geomorphic unit. Chin photographs were taken to use for comparison with future FYLF captures, allowing potential identification of individual frogs and potential tracking of movement by individual frogs. Chin patterns are hypothesized to be unique to each frog and persist throughout the life of the frog (Marlow et al. 2016).

4.1.2 Water Temperature Monitoring

The Plan (2016) requires temperature monitoring as an indicator of FYLF breeding initiation at the two sites below Camino Reservoir Dam (historical breeding sites CD-A3 and CD-A4) and below Slab Creek Reservoir Dam (suitable breeding Site SCD-A1)

[3] For size classes of juvenile and younger, when determination of sex is not feasible, sex was recorded as "unknown."

during years 2 through 6 of the new License. Six Onset Hobo© Pro v2 water temperature loggers were deployed at each site to ensure an adequate sample size and for redundancy in the case of equipment failure. The approximate temperature monitoring locations are depicted in Figures 2–4.

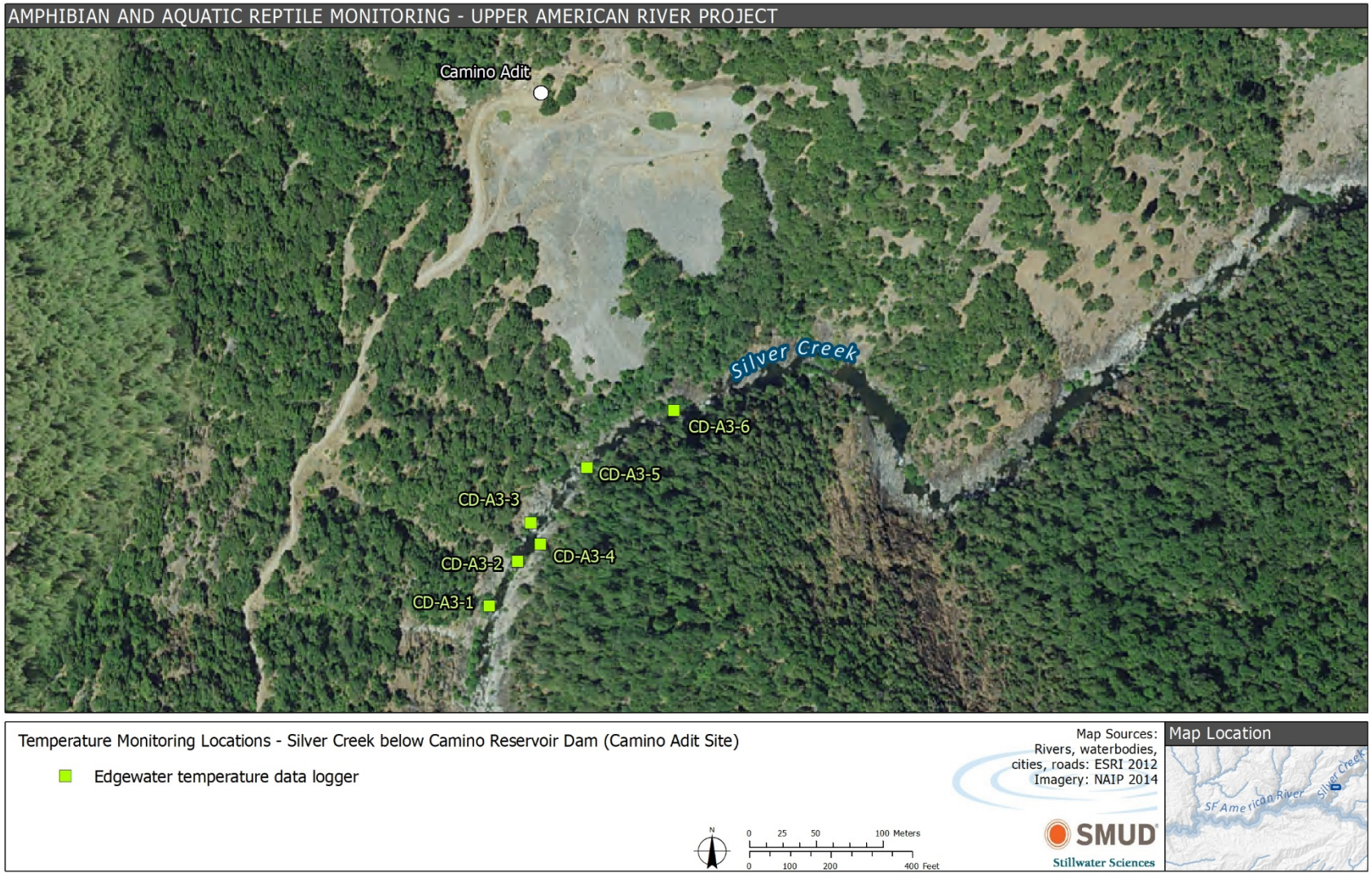


Figure 2. Temperature Logger Locations at Monitoring Site CD-A3, 2018

Figure 3. Temperature Logger Locations at Monitoring Site CD-A4, 2018

Figure 4. Temperature Logger Locations at Monitoring Site SCD-A1, 2018

The areas targeted for temperature logger installation generally included relatively shallow and slow-moving edgewater locations, though monitoring sites were of varying velocities, depths, and substrates to represent areas with a variety of potential breeding habitats. Six temperature loggers per site were deployed during April at sites CD-A3 and CD-A4, and during June at Site SCD-A1. The temperature loggers were deployed when flows were still relatively high; therefore, loggers were positioned in areas that were expected to remain submerged during anticipated lower summer flows. All temperature loggers were deployed in water less than 2.5 ft deep (an estimated average of 1.3 ft deep) and within 12 ft of the shoreline. Temperature loggers were retrieved during the September VESs at sites CD-A3 and CD-A4, and in October at Site SCD-A1. At the time of retrieval, fifteen of the temperature loggers were situated between 0.1 and 1.5 ft deep, and within 4 ft of the shoreline; three of the temperature loggers (CD-A3-5, CD-A4-2, and SCD-A1-1) were found on the river bank, having become dewatered and consequently exposed to air.

The temperature loggers were housed within metal cylinders and anchored to trees or large boulders using 1/8th-in stainless steel cable; cable loops were secured with aluminum crimping sleeves (Figure 5). Loggers were secured inside the housing using two (redundant) brightly colored nylon zip ties with the excess zip tie material left in place to help relocate the logger in the event of burial of the housing. Loggers were periodically checked on during VESs and cleaned of any debris or gravel around the cylinders. Temperature logger location photos are provided in Attachment 2.

Figure 5. Temperature Data Logger Set-up at Monitoring Site SCD-A1 (June 5, 2018)

Temperature monitoring in stream margin habitats was conducted concurrently with stream thalweg water temperature monitoring performed under SMUD's Water Temperature Monitoring Plan (SMUD 2015). Statistical analyses will be performed at the end of the 5-year monitoring period to establish data relationships between edgewater temperatures and thalweg temperatures. These data relationships may eventually be used to initiate egg mass VESs based on reach-specific temperature thresholds identified from results of this initial five-year investigation.

4.1.3 Adaptive Management Monitoring

As part of adaptive management, the Plan outlines requirements for SMUD to monitor amphibians and aquatic reptiles following spill events at Camino and Slab Creek reservoirs, and during flow fluctuations from Camino Dam. Monitoring for effects to FYLF include looking for evidence of damage, displacement, or scouring of egg mass or larvae, as well as evidence of egg mass or larval stranding/desiccation.

4.1.3.1 Following Spill Events at Camino and Slab Creek Reservoirs

For spill events at Camino Dam, VES sites CD-A3 and CD-A4 are to be monitored for effects on FYLF as soon as possible after the decline of spill flows that occur after water temperatures rise above a daily mean of 12°C (Celsius) for a seven-day running average at Water Temperature Monitoring Site 8.I.14 (located on Silver Creek immediately upstream of the SF American River) (Figure 3). A brief spill event occurred at Camino Dam on August 29; monitoring was conducted at VES sites CD-A3 and CD-A4 on September 4, as soon as possible after the decline of spill flows (Table 3).

For spill events at Slab Creek Dam, VES Site SCD-A1 is to be monitored for effects on FYLF as soon as possible after the decline of spill flows that occur after water temperatures rise above a daily mean of 12°C for a seven-day running average at Water Temperature Monitoring Site 8.I.18 (located approximately ½ -mile upstream of White Rock Powerhouse) (Figure 4).

4.1.3.2 During Flow Fluctuations from Camino Reservoir Dam

As required under the approved Plan, VESs for FYLF are to be conducted in Silver Creek below Camino Reservoir Dam at any time during June through September when the following criteria are triggered:

- the streamflows are 100 cubic feet per second (cfs) or less; and
- the flows fluctuate more than 40 cfs over one week's time.

4.2 WESTERN POND TURTLE

WPT surveys were conducted concurrently with the mid-summer (July–August) FYLF survey (see Section 4.1.1) during VES 3, where one additional dedicated surveyor independently looked for WPT (for the survey on the SF American River, this increased to two surveyors due to the larger river channel width).

The surveyor(s) typically walked in an upstream direction[4], first scanning ahead and searching from a distance to identify potential basking locations, such as sunlit rocks, logs, exposed banks, floating vegetation, and for WPT at the surface of the water. The surveyor(s) also searched for skeletal remains and evidence of WPT nests, such as the scrapes produced by females when digging nest-holes, signs of nests opened by predators, and remnants of hatched eggshells. Surveyors also searched for WPT while snorkeling in deep pools and backwaters.

5.0 RESULTS

Table 4 provides survey start and end times, along with water and air temperatures recorded during VESs at each site. Representative habitat photos are included in Attachment 3.

[4] Except for site SCD-A1, where all four surveys were performed upstream to downstream, due to the larger river channel and flow and increased difficulty surveying against the current.

Table 4. Foothill Yellow-legged Frog and Western Pond Turtle Survey Conditions, 2018

Site Code	Survey Date (2018)	VES #	Start Time (hours)	End Time (hours)	Temperature Ranges	
					Water Temp. (°C)	Air Temp. (°C)
CD-A3	6/4	1	1426	1539	13	30–37.5
	6/18	2	1352	1440	12.5–13	24–24.5
	7/30	3	1053	1207	14.5	31–32.5
	9/4	i[a]	1500	1626	16.5–18	34.5–35
	10/2	4	1050	1249	12.5	20–23.5
CD-A4	6/6	1	1104	1218	12.5–13	27–30.5
	6/19	2	1017	1104	13.5–14	29-29.5
	7/31	3	1000	1040	17	28–34
	9/4	i[a]	1005	1122	16–18	24.5–25.5
	10/3	4	0900	1016	14–15	17–19.5
SCD-A1	6/5	1	1045	1738	13–16	24–34
	6/20	2	1000	1550	15–18	23–32
	8/1	3	0945	1428	17.5–21	26–32
	10/4	4	0920	1524	14	16–17
RC-A1	6/7	1	0942	1426	13.5–15	19–22
	6/21	2	0940	1351	16–17	20–29
	8/2	3	0915	1315	18–20	21–29.5
	10/5	4	0930	1200	14	13–16.5

VES # = visual encounter survey number
Temp. = temperature
°C = degrees Celsius
[a] Adaptive management survey conducted following a Camino Dam spill event.

5.1 FOOTHILL YELLOW-LEGGED FROG

5.1.1 Visual Encounter Surveys

5.1.1.1 Foothill Yellow-legged Frog Observations

No egg masses were found in the study area during 2018. FYLF tadpoles and one young-of-year were found at one location at site CD-A3 (Table 5, Figure 6). One juvenile FYLF was found at site CD-A4 (Table 5, Figure 7). No adult FYLF were found at any monitoring site during formal VESs; however, adult FYLF were found on two occasions in a tributary informally searched for FYLF while surveyors were hiking to the main channel site, CD-A3 (Table 5, Figure 6).

Table 5. Foothill Yellow-legged Frog Observation Locations at or Near Sites CD-A3 and CD-A4, 2018

Location Description	UTM Coordinates[a]		Date (2018)	Foothill Yellow-legged Frog Observations
	Northing	Easting		
Site CD-A3 along Silver Creek	4298632	710195	9/4[b]	Three tadpoles at the upstream end of Site CD-A3 during adaptive management survey
	4298633	710195	10/2	One young-of-year at the upstream end of Site CD-A3 during young-of-year survey
Site CD-A4 along Silver Creek	4296284	709394	6/6	One juvenile at the upstream end of Site CD-A4 during egg mass survey
Tributary to Silver Creek, downstream of access road and adjacent to foot trail to Silver Creek	4298734	710270	4/26[c]	One adult, sex unknown, in small tributary
			6/18	One adult, sex unknown, in small tributary

[a] Projection: NAD83 UTM Zone 10 North
[b] Adaptive management survey following a Camino Dam spill event.
[c] Incidental observation during thermograph installation

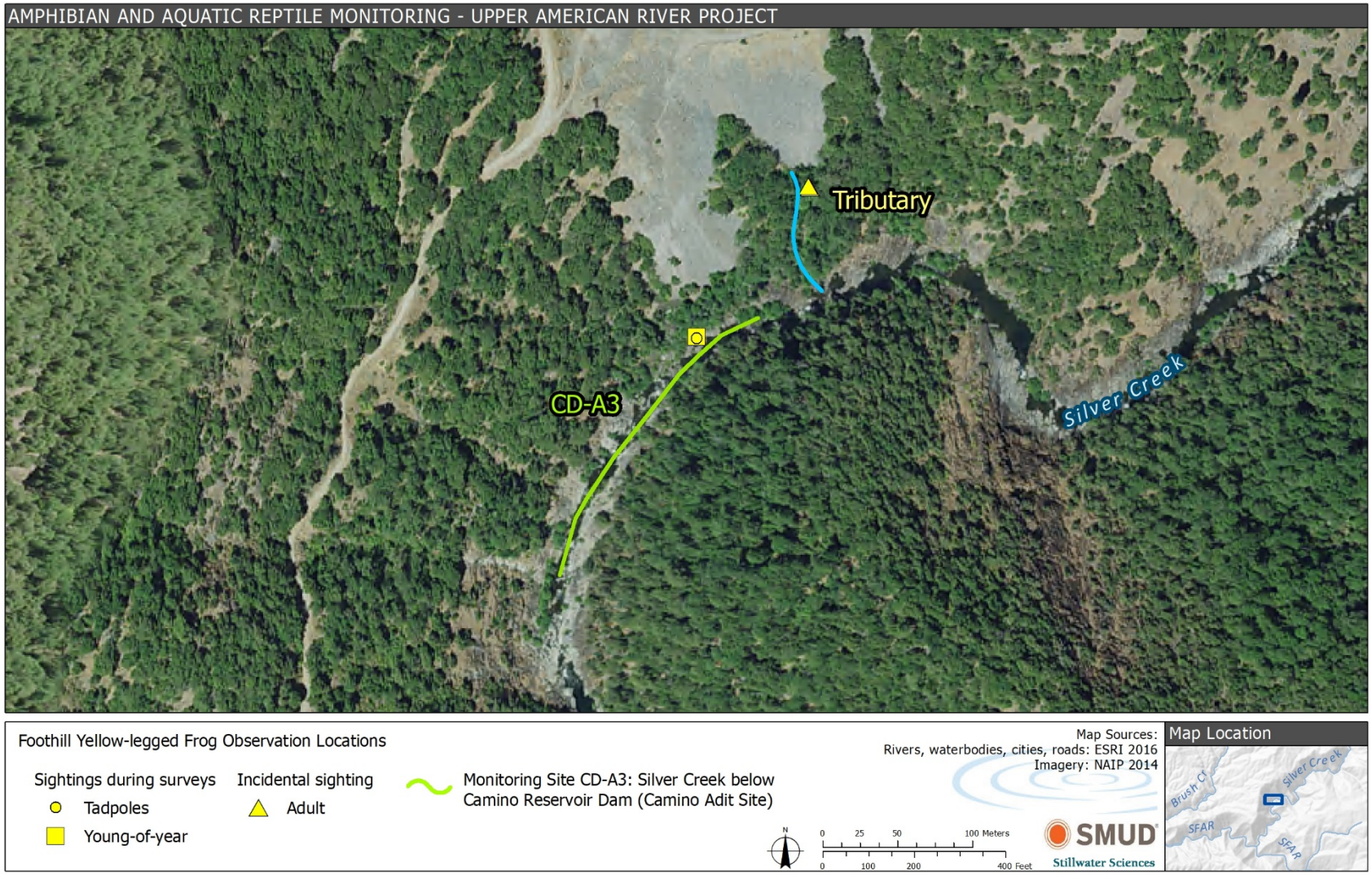


Figure 6. Foothill Yellow-legged Frog Observation Locations at or Near Site CD-A3, 2018

Figure 7. Foothill Yellow-legged Frog Observation Locations at Site CD-A4, 2018

Three FYLF tadpoles and one FYLF young-of-year were documented at one location within Site CD-A3 in 2018 (Table 5, Figure 6 and Figure 8). The tadpoles were observed on September 4 during an adaptive management survey following a brief spill event at Camino Dam. They were observed in a connected side pool with no observable flow, located on the right river bank. The dominant substrate was bedrock and the bottom of the pool was covered with algae. The pool was separated from the main channel by surrounding bedrock and was hydrologically connected to the main channel only at its downstream end (Figure 8). Total water depth at the tadpoles was 0.08 m (0.3 ft). One tadpole was captured; it was 55 mm (2.2 in) long and its Gosner stage was estimated at 37 to 38. The other two tadpoles were similar in length and Gosner stage. A FYLF young-of-year was observed during VES 4 on October 2, perched on bedrock adjacent to the same pool in which the tadpoles were observed on September 4. This frog was not captured. Its estimated length was 20 mm (0.8 in) and estimated Gosner stage was 45 to 46.

One juvenile FYLF was documented at the upstream end of CD-A4 during the egg mass survey on June 6, 2018 (VES 1) (Table 5, Figure 7 and Figure 9). This frog was observed in a connected side pool using mid-channel cobble bar habitat with no riparian vegetation (Figure 9). The frog's snout-to-vent length was 34 mm (1.3 in).

One adult FYLF was incidentally detected during informal surveys on April 26 and June 18 in a small tributary to Silver Creek, located near the top of Site CD-A3 (Table 5, Figure 6, and Figure 10). The frog was not captured but was assumed to be the same individual on both survey dates, based on location.

Other areas with historical, incidental FYLF sightings that were informally searched for FYLF during site visits in 2018 included the Camino Adit and a wet roadside ditch associated with a seep along a bedrock cliff face, located on the west side of the access road to and approximately 0.5 miles before Camino Adit. These locations were visited several times throughout the monitoring season since FYLFs were observed using these habitats during monitoring in 2016 (SMUD 2017); no FYLFs were found at these sites in 2018.

Figure 8. Foothill Yellow-legged Frog Tadpole (Top Left) Found in Side-channel Pool Habitat (Bottom Left and Right) at Site CD-A3 on September 4, 2018

Figure 9. Foothill Yellow-legged Frog Juvenile (Above) Observed in Pool Habitat (Below) at Site CD-A4 on June 6, 2018

Figure 10. Adult Foothill Yellow-legged Frog Observed along Tributary near Site CD-A3 on June 18, 2018

5.1.1.2 Habitat Conditions

Habitat conditions along the Silver Creek sites (CD-A3 and CD-A4), the Rock Creek site (RC-A1), and the SF American River site (SCD-A1) were similar to conditions observed during 2017 monitoring (Figures 11–16). The decreased cover along the channel and banks caused by the high stream flows during the wet 2017 water year persisted in 2018. The increased sun exposure resulting from this loss of cover to the channel led to continued presence of benthic algae at all sites in 2018. Additional habitat photos are provided in Attachment 3.

Figure 11. Stripped Riparian Vegetation along Silver Creek, Site CD-A4, June 19, 2018

Figure 12. Stripped Riparian Vegetation along Silver Creek, Site CD-A3, July 30, 2018

Figure 13. Cobble Bank on Silver Creek, Site CD-A3, October 2, 2018

Figure 14. Cobble Bank on SF American River, Site SCD-A1, October 4, 2018

Figure 15. Benthic Green Algae in Silver Creek, Site CD-A3, June 4, 2018

Figure 16. Benthic Green Algae in Rock Creek, Site RC-A1, August 2, 2018

5.1.2 Water Temperature Monitoring

Table 6 provides edgewater temperature[2] data recorded at water monitoring locations, summarized by month[3]. The mean monthly edgewater temperatures for all three sites ranged from 8.6°C to 19.8°C during the primary FYLF breeding and rearing months of April through October. Maximum daily averages for this time period ranged from 8.7°C to 21.2°C (Table 6). Mean monthly temperatures for Silver Creek were approximately 2°C to 3°C warmer at CD-A4 (near the confluence with SF American River) than at Site CD-A3 (near the Camino Adit Site).

Figures 17–19 provide plots of mean daily edgewater temperatures for all three sites, including the dates of foothill yellow-legged frog observations.

Although a robust statistical analysis of the temperature data, including data relationships between edgewater and thalweg temperatures, will be conducted after data collection in Year 5, a few preliminary observations from this year's data can be made:

- In relatively confined, steep-gradient channels lacking broad, shallow, exposed, low-velocity microhabitats, different edgewater areas tend to have very similar temperatures (Figure 17 [Site CD-A3] and Figure 18 [Site CD-A4]).
- Longitudinal locations of edgewater measurements relative to the thalweg measurement site have a significant effect on the differences in temperature between the two. For example, Site CD-A3 edgewater temperatures are all colder than the thalweg measurement site further downstream near Site CD-A4 (Figure 17), and edgewater temperatures at thermographs SCD-A1-4 and SCD-A1-6 are colder than at the thalweg measurement site further downstream at Site SCD-A1 (Figure 19). This suggests that water temperatures are not yet at equilibrium with air temperatures, and longitudinal changes in water temperature as you proceed downstream are going to be more significant than any lateral (across-the-channel) changes.
- Unique differences in solar exposure and/or hydraulics can result in a temperature difference at one edgewater site (i.e., thermographs CD-A4-3 [Figure 18] and SCD-A1-5 [Figure 19]) compared to another.

[2] For site CD-A3 between the dates of 9/5–10/4/2018, edgewater temperatures were estimated by calculating the average difference between edgewater and thalweg temperatures during July–Sept, then subtracting that difference from the thalweg temperatures.

[3] Data excluded from analysis due to suspected thermograph exposure to air or instrument error include: CD-A3 Edgewater 5 during 8/2–9/4/2018, CD-A4 Edgewater 1 during 5/25–9/4/2018, CD-A4 Edgewater 2 during 8/2–9/4/2018; SCD-A1 Edgewater 1 during 7/15–10/4, and SCD-A1 Edgewater 3 during 7/19–8/1/2018.

Table 6. Edgewater Temperature Data Summarized by Month, 2018

Temperature Monitoring Site	Month	Mean Monthly Temperature (°C)	Maximum Daily Average Temperature (°C)
Silver Creek Near Camino Adit (CD-A3)	April[a]	8.6	8.7
	May	10.5	11.7
	June	13.4	15.4
	July	16.5	18.0
	August	17.0	18.2
	September[b]	16.0	16.2
Silver Creek at Confluence with SF American River (CD-A4)	April[a]	9.7	9.9
	May	11.8	13.4
	June	15.2	17.3
	July	18.9	20.5
	August	19.7	21.0
	September[b]	18.2	18.7
SF American River Upstream of White Rock Powerhouse (SCD-A1)	June[c]	17.1	19.1
	July	19.8	21.2
	August	18.1	20.2
	September	14.6	16.3
	October[d]	14.0	14.2

[a] Edgewater data used for calculations does not include the entire month of April; data included were collected between April 29 and April 30
[b] Edgewater data used for calculations does not include the entire month of September; data included were collected between September 1 and September 4
[c] Edgewater data used for calculations does not include the entire month of June; data included were collected between June 5 and June 30
[d] Edgewater data used for calculations does not include the entire month of October; data included were collected between October 1 and October 4

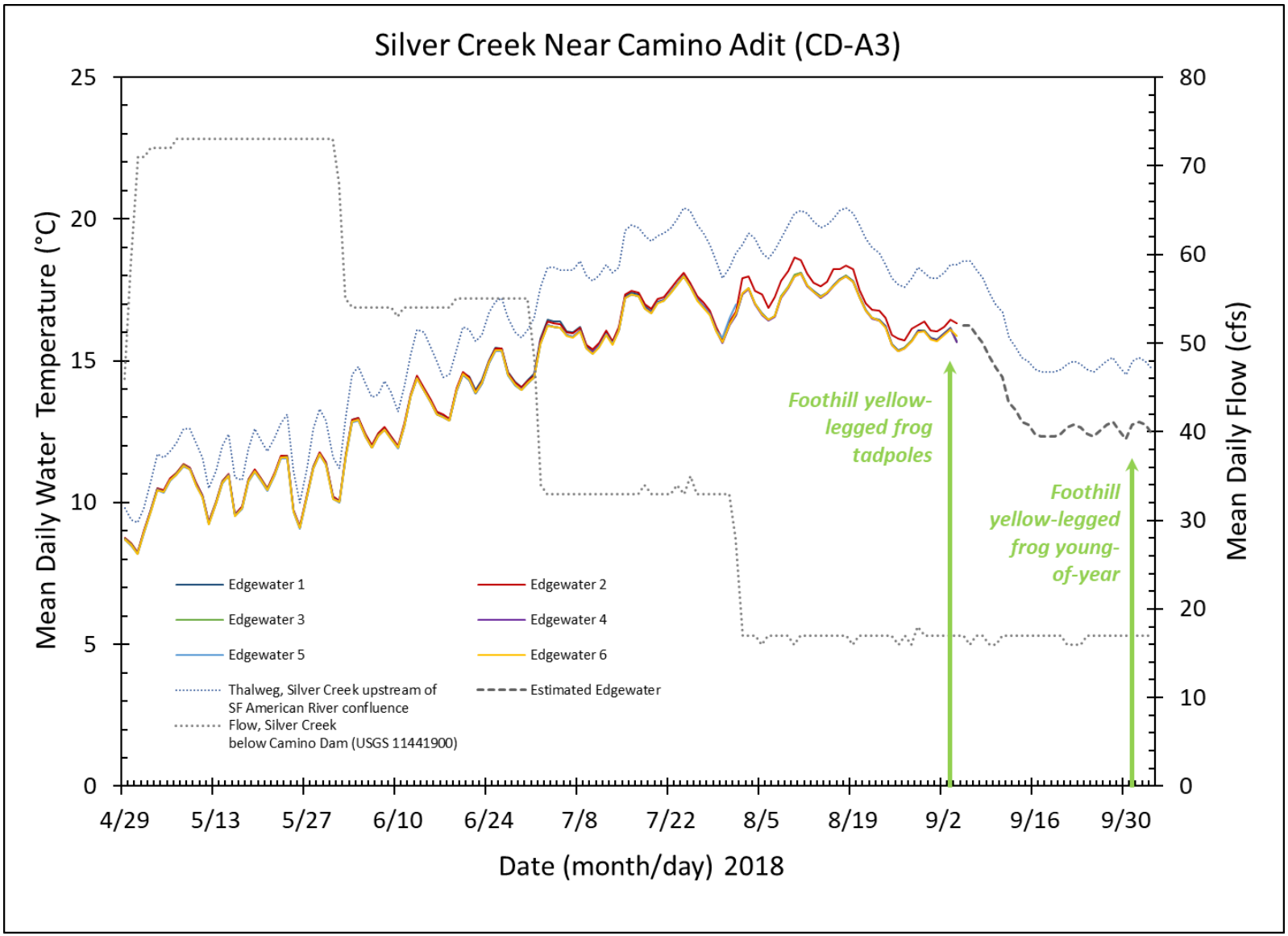


Figure 17. Edgewater Temperature Data for Silver Creek Near Camino Adit (CD-A3) and Flow Data for Silver Creek below Camino Dam, with foothill yellow-legged frog observations

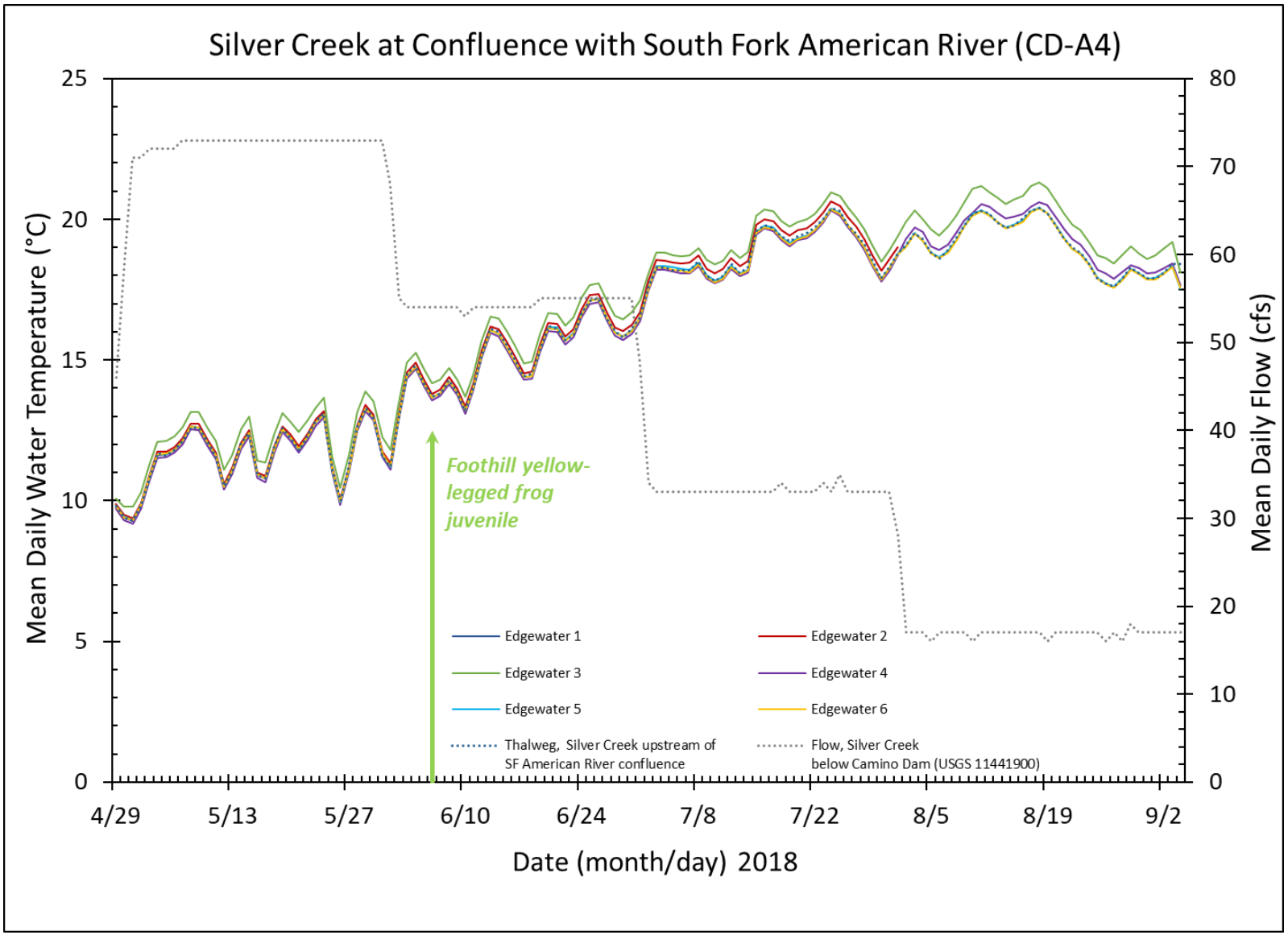


Figure 18. Edgewater Temperature Data for Silver Creek Upstream of SF American River Confluence (CD-A4) and Flow Data for Silver Creek below Camino Dam, with foothill yellow-legged frog observations

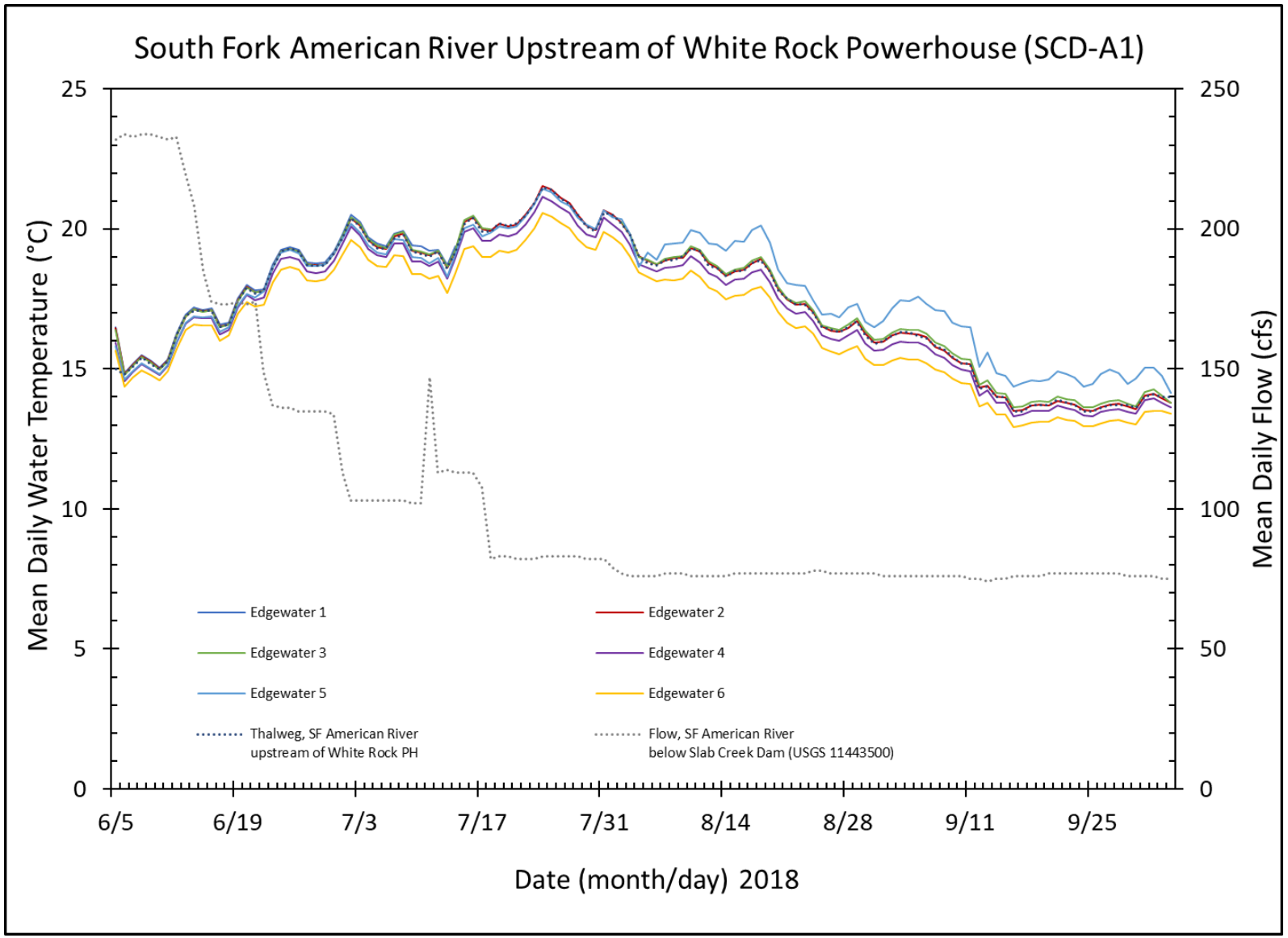


Figure 19. Edgewater Temperature Data for SF American River Upstream of White Rock Powerhouse (SCD-A1) and Flow Data for SF American River below Slab Creek Dam

5.1.3 Adaptive Management Monitoring

5.1.1.3 Following Spill Events at Camino and Slab Creek Reservoirs

There was one brief spill event at Camino Dam that occurred on August 29[7]. Monitoring was required at the two sites at Silver Creek below Camino Dam (CD-A3 and CD-A4) for effects on FYLF. Both sites were surveyed on September 4, as soon as possible after the decline of spill flows. No egg masses were found, so there was no evidence of damaged, displaced, or scoured egg masses. Three FYLF tadpoles were observed at Site CD-A3 in suitable habitat during adaptive management monitoring (see Section 5.1.1); each tadpole appeared active and healthy, with no apparent signs of injury or distress.

There were no additional spill events at Slab Creek Dam or Camino Dam during 2018 that required monitoring.

5.1.2.3 During Flow Fluctuations from Camino Reservoir Dam

Flow fluctuation criteria in Silver Creek below Camino Reservoir Dam to trigger FYLF monitoring were not met in 2018, therefore no associated adaptive management surveys were conducted.

5.2 WESTERN POND TURTLE

Conditions for WPT surveys (with one or more dedicated WPT surveyors) are provided in Table 4. Weather conditions were good to ideal during all WPT surveys, with warm temperatures, sunny/clear or partly cloudy skies, and no wind to a light breeze.

No WPT were observed in the study area in 2018.

5.3 OTHER AMPHIBIAN AND AQUATIC REPTILE SPECIES

Six non-special-status amphibian and reptile species were observed throughout the study area during VESs, listed in Table 7 by species, life stage, and location(s) where the species was/were documented. Sierran treefrogs were the most abundant and widely distributed herpetofauna species observed in the study area.

[7] Due to the short duration and small magnitude (80 cfs) of the spill event, the average daily flow remained low (18 cfs).

Table 7. Additional Herpetofauna Species Observed, by Life Stage, 2018

Species Common Name *(Scientific name)*	Life Stage				Location(s) Where Species Documented
	Egg Mass	Larvae	Young-of-Year	Juv/ Adult	
Amphibians					
Sierra newt (*Taricha sierrae*)				X	RC-A1
Sierran treefrog (*Pseudacris sierra*)		X			RC-A1, SCD-A1
American bullfrog (*Lithobates catesbeianus*)				X[a]	SCD-A1
Unidentified anuran tadpole		X[b]			SCD-A1
Reptiles					
Northwestern fence lizard (*Sceloperus occidentalis*)				X	CD-A3, RC-A1, SCD-A1
California whipsnake (*Masticophis lateralis*)				X[c]	CD-A3
Western yellow-bellied racer (*Coluber constrictor mormon*)				X	CD-A3
Sierra garter snake (*Thamnophis couchii*)				X	CD-A3

Juv = Juvenile
X = Observed
[a] Heard alarm call only
[b] Newly hatched tadpoles found in side channel pool complex, too small to confidently identify
[c] Observed incidentally on the access trail, outside of the VES area

6.0 DISCUSSION

The presence of tadpoles and young-of-year at sites CD-A3 during 2018 amphibian and aquatic reptile monitoring documents that FYLF breeding occurred in Silver Creek during 2018. The tadpoles and young-of-year FYLF found at CD-A3 were the first evidence of breeding on Silver Creek during post-license implementation surveys between 2016 and 2018; the juvenile FYLF found at CD-A4 was the first FYLF record at this site during post-license implementation surveys. New evidence of FYLF breeding and increased spatial distribution within Silver Creek during 2018 may be a result of improved habitat conditions as compared with 2016. High and prolonged winter flows of 2017, which decreased the amount of riparian vegetation/canopy and flushed sediment and silt deposited after the 2014 King Fire, potentially contributed to an increase in the quality and quantity of suitable FYLF habitat within Silver Creek. These habitat improvements may have provided more opportunities for FYLF egg laying and tadpole rearing by increasing the amount of slow-moving side pools and backwaters; adult basking opportunities may also have increased because of the reduced riparian canopy and related increased exposure to sunlight.

The lack of breeding evidence (including detections of juveniles) in Silver Creek during the 2016 and 2017 surveys and the presence of tadpoles, young-of-year, and juveniles in Silver Creek in 2018 suggests, optimistically, that there may be a trend towards improved success of the Silver Creek FYLF population, depending on future site conditions. However, while breeding has been newly documented in Silver Creek since 2003–2004 relicensing surveys and there are signs of improved habitat conditions, the number of individual FYLF tadpoles and young-of-year observed was very small (three and one, respectively). Future monitoring will provide data on population trends.

The presence of tadpoles on September 4 suggests that the onset of breeding may be occurring in Silver Creek during mid-summer (e.g., late July or early August). During this time period, edgewater temperatures in Silver Creek were suitable for tadpole-rearing (15–16 °C) and flows decreased from 33 to 17 cfs (Figure 17).

7.0 LITERATURE CITED

FERC (Federal Energy Regulatory Commission). 2014. Federal Energy Regulatory Commission Order 148 FERC 62,070 Issuing New License for the Sacramento Municipal Utility District Upper American River Hydroelectric Project No. 2101. Issued July 23.

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

Lind, A. 1997. Survey protocol for foothill yellow-legged frogs (*Rana boylii*) in streams. U.S. Forest Service, Pacific Southwest Research Station, Arcata, California. DG: S27L01A.

Marlow, K.R., K.D. Wiseman, C.A. Wheeler, J.E. Drennan, and R.E. Jackman. 2016. Identification of individual foothill yellow-legged frogs (*Rana boylii*) using chin pattern photographs: a non-invasive and effective method for small population studies. Herpetological Review 47(2): 193-198.

Nussbaum, R.A., E.D. Brodie, and R.M. Storm. 1983. Amphibians and Reptiles of the Pacific Northwest. University Press of Idaho, Moscow ID.

PG&E (Pacific Gas and Electric Company). 2002a. A standardized approach for habitat assessment and visual encounter surveys for foothill yellow-legged frog (Rana boylii). Unpublished. By Craig P. Seltenrich, Senior Aquatic Biologist and Alicia C. Pool, Aquatic Biologist, PG&E, San Ramon, California. May.

PG&E. 2002b. Survey protocols, standard operating procedures, and data sheets for amphibian surveys and habitat assessments. Unpublished. PG&E, San Ramon, California.

Peek, R.A., S.M. Yarnell, A.J. Lind. 2017. Visual Encounter Survey Protocol for *Rana boylii* in Lotic Environments. University of California, Davis, Center for Watershed Sciences.https://watershed.ucdavis.edu/files/CWS%20FYLF%20VES%20Survey%20Protocol-Final.pdf

SMUD (Sacramento Municipal Utility District). 2015. Water Temperature Monitoring Plan. Hydro License Implementation for the SMUD Upper American River Project (FERC Project No. 2101) and PG&E Chili Bar Project (FERC Project No. 2155).

SMUD. 2016. Amphibian and Aquatic Reptile Monitoring Plan. Hydro License Implementation for the Upper American River Project (FERC Project No. 2101).

SMUD. 2017. 2016 Amphibian and Aquatic Reptile Monitoring Report. Hydro License Implementation for the Upper American River Project (FERC Project No. 2101).

SMUD. 2018. 2017 Amphibian and Aquatic Reptile Monitoring Report. Hydro License Implementation for the Upper American River Project (FERC Project No. 2101).

SMUD and PG&E (Pacific Gas and Electric Company). 2005. Sacramento Municipal Utility District Upper American River Project (FERC Project No. 2101) and Pacific Gas and Electric Company Chili Bar Project (FERC Project No. 2155) Amphibian and Aquatic Reptiles Technical Report. Prepared for SMUD and PG&E by Devine Tarbell & Associates, Inc. and Stillwater Sciences. April, Version 3.

Storer, T.I. 1925. A synopsis of the amphibia of California. University of California Publications in Zoology 27:1–342.

Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White, Eds. 1988. California's Wildlife. Vol. 1. Amphibians and reptiles. California Department of Fish and Game, Sacramento, California.

Zweifel, R.G. 1955. Ecology, distribution, and systematics of frogs of the *Rana boylei* group. University of California Publications in Zoology 54:207–292.

Attachment 1
Amphibian and Aquatic Reptile Survey Data Form

FYLF Survey Data Sheet

Date: _____ Site:_____ VES#: 1 2 3 4 Surveyors:_____ Location/Reach:_____

Start UTM:_____/_____ Error: _____ Way Point#: _____ End UTM:_____/_____ Error: _____ Way Point#: _____

Start Time: _____ End Time: _____ Total Survey Time: _____ Air Temp (C°): (start)_____ (end)_____ Water Temp (C°): (start)_____ (end)_____

Current Wx: (Sky) Overcast / Drizzle / Showers / Clear (Wind) Calm / Light / Moderate / Strong Total Site Length (m): _____ Width (m):_____

Photos: Camera #_____ Bottom (looking U/S):_____ (looking D/S):_____ Top (looking U/S):_____ (looking D/S)_____

Photo Notes: _____

UTM E	UTM N	GPS error (m)	Lifestage/ Sex[1]	#Obs	Gosner Stage	Length (mm)[2]	Total Depth (m)[3]	Mid-Col Velocity (m/s)[3]	EM/Perch Sub[4]	Dominant Riparian Type[5]	Geom Unit[6]	Nearest Bank[7]	Photo Numbers	Notes

[1]Lifestage/Sex-(L)arvae, (E)gg Mass, (Y)oung-of-year, (J)uvenile, (AM) adult male, (AF) adult female, (AU) adult unknown; Adult >= 37 mm SVL; YOY = 22-27 SVL [2]Length in mm- SVL-Snout Vent for A, J, Y; Total Length for Tadpoles

[3]Eggs/Tads: Total depth at obs. location. Velocity avg for 30 sec (m/s) at location [4]Substrate Attachment/Perch Substrate- SLT, SND, GRV, COB, BLD, BDX (Bedrock), WOOD, VEG

[5]Dominant Riparian Type- (1) Grav/ Cobb Bar, (2) Willow, (3) Willow-Alder, (4) Alder, (5) Mature Riparian/Forest, (6) Bedrock

[6]Geomorphic Unit- RIF, BAR, POOL, STEP, RUN, RAP, BDX

[7]Bank nearest Obs (looking downstream): (RB) right bank, (LB), (MC) Center Channel

Crayfish Present (circle)? Yes / No

Fish Present: Yes / No Type: Salmonid Centrarchid Cyprinid Catastomids Other: _____

Other Herpetofauna: Yes / No Species (Lifestage, Number): _____

_____

_____

_____

_____

_____

QA/QC (initials):_____ Date:_____

Attachment 2
Temperature Logger Location Photos

Figure 1. Temperature Logger CD-A3-1 Location, April 26, 2018

Figure 2. Temperature Logger CD-A3-2 Location, September 4, 2018

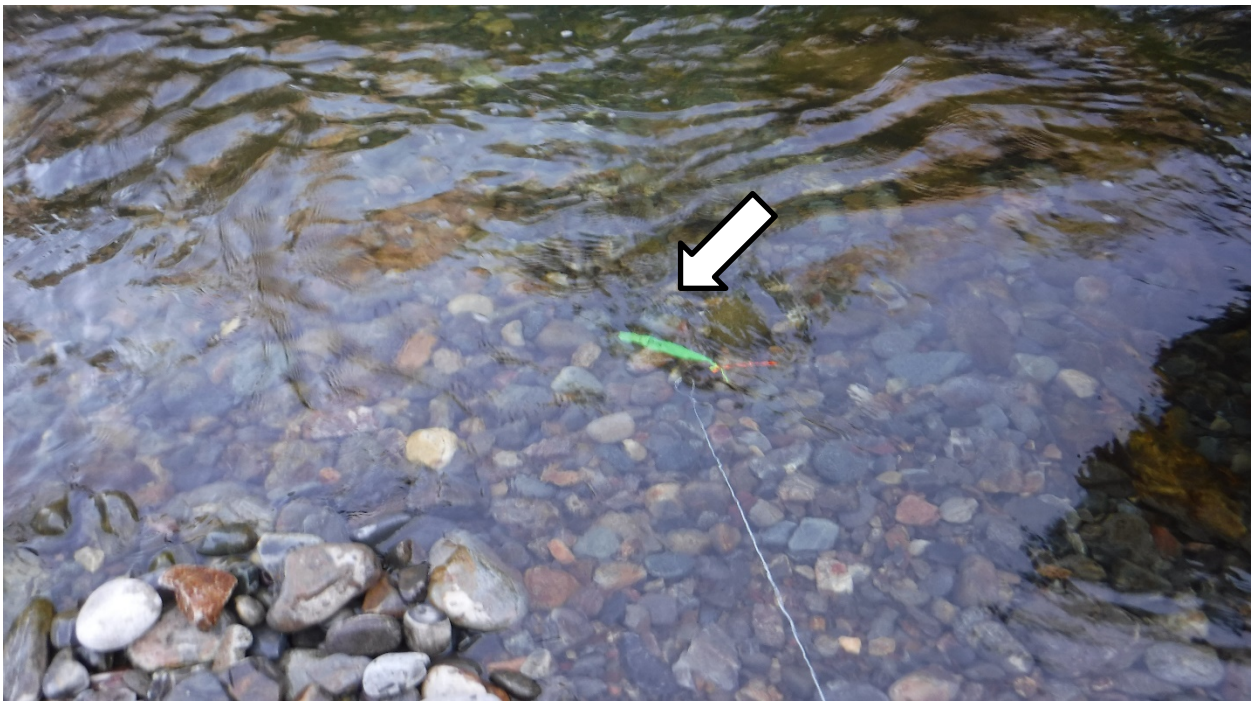


Figure 3. Temperature Logger CD-A3-3 Location, April 26, 2018

Figure 4. Temperature Logger CD-A3-4 Location, September 4, 2018

Figure 5. Temperature Logger CD-A3-5 Location, April 26, 2018

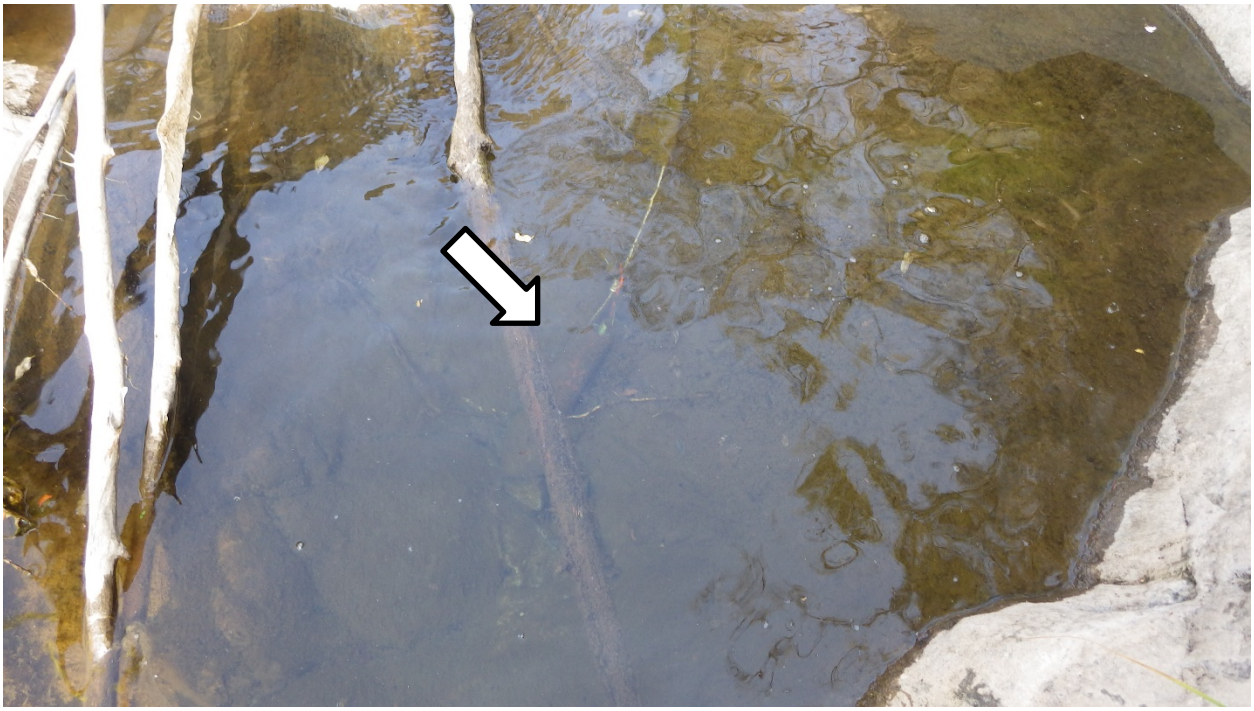


Figure 6. Temperature Logger CD-A3-6 Location, September 4, 2018

Figure 7. Temperature Logger CD-A4-1 Location, September 4, 2018

Figure 8. Temperature Logger CD-A4-2 Location, April 26, 2018

Figure 9. Temperature Logger CD-A4-3 Location, September 4, 2018

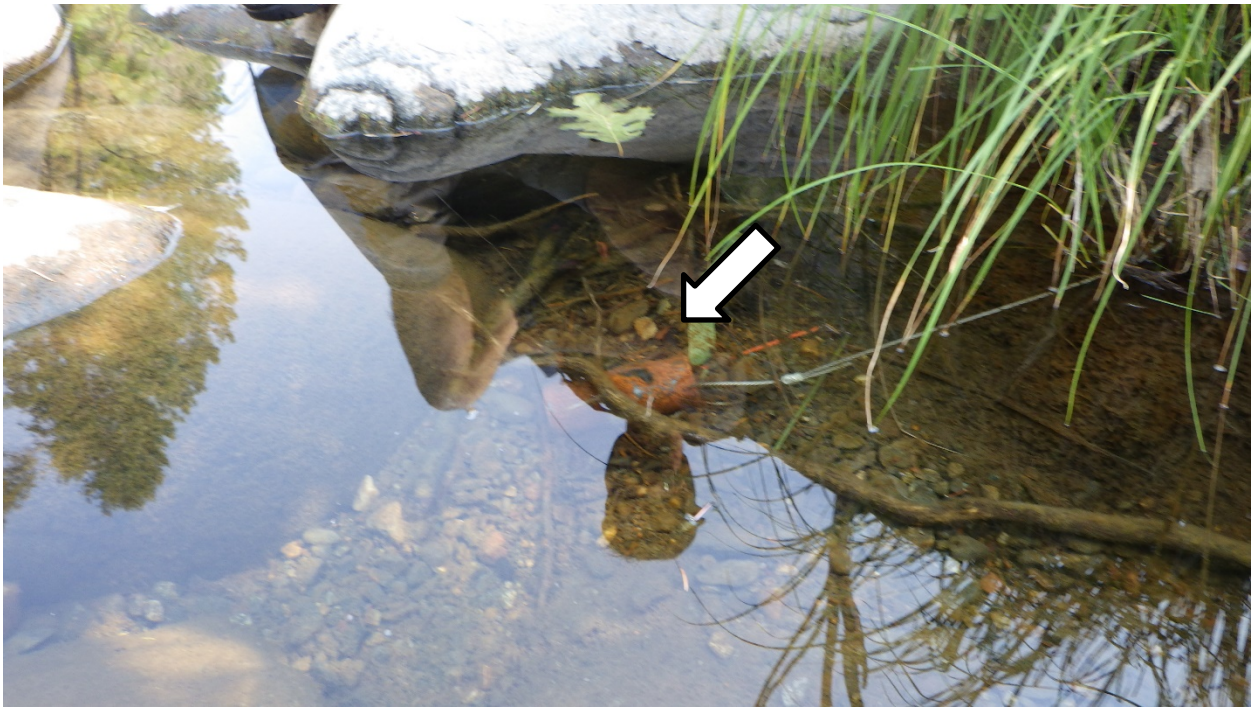


Figure 10. Temperature Logger CD-A4-4 Location, September 4, 2018

Figure 11. Temperature Logger CD-A4-5 Location, September 4, 2018

Figure 12. Temperature Logger CD-A4-6 Location, September 4, 2018

Figure 13. Temperature Logger SCD-A1-1 Location, June 5, 2018

Figure 14. Temperature Logger SCD-A1-2 Location, June 5, 2018

Figure 15. Temperature Logger SCD-A1-3 Location, June 5, 2018

Figure 16. Temperature Logger SCD-A1-4 Location, October 4, 2018

Figure 17. Temperature Logger SCD-A1-5 Location, October 4, 2018

Figure 18. Temperature Logger SCD-A1-6 Location, October 4, 2018

Attachment 3
Representative Habitat Photos

Figure 1. Silver Creek Below Camino Reservoir Dam (near Camino Adit) (CD-A3) Amphibian and Aquatic Reptile Monitoring Site Habitat Photographs, 2018

Figure 2. Silver Creek Below Camino Reservoir Dam (At Confluence with SF American River) (CD-A4) Amphibian and Aquatic Reptile Monitoring Site Habitat Photographs, 2018

Figure 3. SF American River Below Slab Creek Reservoir Dam (SCD-A1) Amphibian and Aquatic Reptile Monitoring Site Habitat Photographs, 2018

Figure 4. Rock Creek (RC-A1) Amphibian and Aquatic Reptile Monitoring Site Habitat Photographs, 2018

Camino Adit on October 2, 2018

Tributary on October 2, 2018

Seep on October 2, 2018

Figure 5. Informal Amphibian and Aquatic Reptile Monitoring Survey Areas Near Silver Creek, 2018

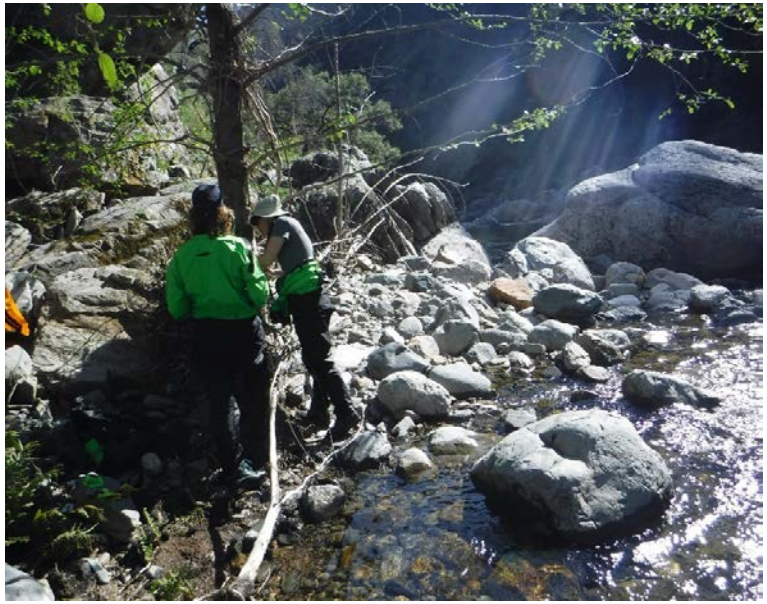
Edgewater 1

Edgewater 2

Edgewater 3

Edgewater 4

Figure 6. Edgewater Thermograph Habitat Photographs at Silver Creek below Camino Reservoir Dam (Near Camino Adit) (CD-A3), April 26, 2018 (1 of 2)



Edgewater 5

Edgewater 6

Figure 7. Edgewater Thermograph habitat photographs at Silver Creek Below Camino Reservoir Dam (Near Camino Adit) (CD-A3), April 26, 2018 (2 of 2)

Edgewater 1

Edgewater 2

Edgewater 3

Edgewater 4

Figure 8. Edgewater Thermograph Habitat Photographs at Silver Creek Below Camino Reservoir Dam (Near Confluence with SF American River) (CD-A4), April 26, 2018 (1 of 2)

Edgewater 5

Edgewater 6

Figure 9. Edgewater Thermograph Habitat Photographs at Silver Creek Below Camino Reservoir Dam (Near Confluence with SF American River) (CD-A4), April 26, 2018 (2 of 2)

Edgewater 1

Edgewater 2

Edgewater 3

Edgewater 4

Figure 10. Edgewater Thermograph Habitat Photographs at SF American River Below Slab Creek Reservoir Dam (SCD-A1), June 5, 2018 (1 of 2)

Edgewater 5

Edgewater 6

Figure 11. Edgewater Thermograph Habitat Photographs at SF American River Below Slab Creek Reservoir Dam (SCD-A1), June 5, 2018 (2 of 2)