Water Temperature Monitoring Report

Sacramento Municipal Utility District
Hydro License Implementation • June 2019

Upper American River Project
FERC Project No. 2101

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1.0 TEMPERATURE PLAN REVIEW

1.1 Background

This Water Temperature Monitoring Report addresses monitoring set forth in the Water Temperature Monitoring Plan (Plan) for the Upper American River Project (SMUD 2015). The requirements for this Report are found in State Water Resources Control Board (SWRCB) Condition 8.I, and U.S. Forest Service (USFS) 4(e) Condition 31.9, 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), dated July 23, 2014. The Plan was developed in consultation with the SWRCB, USFS, California Department of Fish and Wildlife, and U.S. Fish and Wildlife Services. FERC approved the Plan on September 30, 2015.

The UARP lies within El Dorado and Sacramento counties, primarily within lands of the Eldorado National Forest. The UARP consists of three major storage reservoirs—Loon Lake, Union Valley and Ice House (with a combined capacity of approximately 379,000 acre-feet), eight smaller regulating or diversion reservoirs, and eight powerhouses. The UARP has an authorized installed capacity of 637.3 megawatts (MW). The UARP also includes recreation facilities containing over 700 campsites, five boat ramps, hiking paths, and bicycle trails at the reservoirs.

1.2 Monitoring Objectives

The primary objectives and rationale for the water temperature monitoring program, as described in the Plan are as follows:

> *Annual water temperature monitoring at specified stream sites will provide information needed to determine whether cold freshwater resource objectives are being met and will provide an evaluation of breeding conditions for sensitive amphibian species. Stream temperature monitoring results will also be used to determine whether water temperature profiles within the reservoirs are needed to better understand cold water availability. An adaptive approach to water temperature monitoring will allow the removal of specific monitoring sites if results indicate water temperatures are adequate at those specific locations (Condition 8.I.).*

This monitoring will help determine if water temperatures in UARP waters meet the Basin Plan beneficial use of Cold Freshwater Habitat (CVRWQCB 1998) and other identified habitats/species needs. If such a study is inconclusive, reservoir temperature profile monitoring may be required to assist in the decision-making process. Currently, the Plan requires water temperature monitoring in stream reaches throughout the duration of the license term or until *"the Licensee can demonstrate to the satisfaction of the Deputy Director that operation of the UARP reasonably protects the "cold freshwater" beneficial use at any site for which the Licensee seeks modification to the temperature monitoring requirement."*

These data are also utilized to direct the following requirements of the new license:

- Adaptive management decisions regarding initiation of foothill yellow legged frog
- (FYLF) breeding
- Cancellation of recreational boating releases due to FYLF breeding
- Temperature monitoring related to the 'block of water' releases on Silver Creek
- Response of aquatic resources to spill events and pulse flows after thresholds
- have been reached.
- Requirement of the Basin Plan that "At no time or place shall the temperature of
- COLD or WARM intrastate waters be increased more than 5° F above the natural
- receiving water temperature.

1.3 Study Area and Sampling Locations

Continuous water temperature monitoring of stream reaches occurred in 2018 at 19 sites throughout the UARP area utilizing fixed stations or dataloggers. In general, these sites measured water temperatures in diverted stream reaches downstream of UARP reservoirs. Table 1 describes the locations and characteristics of each site. Final site development at a local scale was determined using proximity to release point, presence of isothermal water column, logistics, and channel morphology. Figure 20 depicts the monitoring site locations relative to the UARP and primary streams and rivers.

Table 1: UARP Water Temperature Monitoring Site Locations

Site Name	Site Description	UTM (NAD 83)		Sensor Type	Data Transfer	Threshold Trigger	Complete Data
		Easting	Northing				
RR5	Rubicon River immediately below Rubicon Reservoir Dam	740501	4319200	CS450L	Telemetry	None	Yes
LRR3	Little Rubicon River immediately below Buck Island Reservoir Dam	737558	4320907	CS450L	Telemetry	None	Yes
RR1	Rubicon River below confluence of Little Rubicon River at the Project	736593	4323887	Onset datalogger	Manual	None	Yes

Site Name	Site Description	UTM (NAD 83)		Sensor Type	Data Transfer	Threshold Trigger	Complete Data
		Easting	Northing				
GC7	Gerle Creek immediately below Loon Lake Reservoir Dam	732455	4320776	CS450L	Telemetry	None	Yes
GC8	Gerle Creek immediately below Gerle Creek Reservoir Dam	725745	4316219	CS107 or CS450L	Telemetry	None	Yes
SFRR5	South Fork Rubicon River immediately below Robbs Peak Reservoir Dam	726202	4314316	CS450L	Fiber Optic Network	None	Yes
SFRR6	SF Rubicon River below confluence of Gerle Creek at the Project boundary	725256	4314907	CS450L	Telemetry	None	Yes
SFRR7	SF Rubicon River immediately upstream of the confluence with the Rubicon River	719438	4316236	Onset datalogger	Manual	None	Yes
SFSC7	South Fork Silver Creek immediately below Ice House Reservoir Dam†	728745	4299871	CS450L	Telemetry	None	Yes
SFSC8	South Fork Silver Creek immediately upstream of Junction Reservoir	721498	4303358	CS450L	Telemetry	7DMAVG	Yes
SC5	Silver Creek immediately below Junction Reservoir Dam	720466	4303467	CS 450L	Fiber Optic Network	None	Yes
SC6	Silver Creek immediately above Camino Reservoir Dam	714119	4301407	CS450L	Telemetry	DAVG	Yes
SC7	Silver Creek immediately below Camino Reservoir Dam†	713631	4300155	CS450L	Fiber Optic Network	None	Yes

Site Name	Site Description	UTM (NAD 83)		Sensor Type	Data Transfer	Threshold Trigger	Complete Data
		Easting	Northing				
SC8	Silver Creek immediately upstream of SF American River	709310	4296208	CS450L	Telemetry	DAVG	Yes
BC4	Brush Creek immediately below Brush Creek Reservoir Dam	706407	4298536	CS451	Fiber Optic Network	None	Yes
SFAR13	SF American River immediately below Slab Creek Reservoir Dam	699644	4294054	CS450L	Fiber Optic Network	None	Yes
SFAR7	SF American River at Mosquito Rd Bridge	695572	4294304	Onset Datalogger	Manual	None	No
SFAR15	SF American River approximately ½ mile upstream of White Rock Powerhouse	692576	4292875	CS450L	Telemetry	7DMAVG	Yes
SFAR16	SF American River to record White Rock Powerhouse discharge temps	692212	4293046	CS450L	Fiber Optic Network	None	Yes

2.0 MODIFICATIONS AND METHODS

2.1 Temperature data at fixed-stations

The majority of sites (19) were monitored for water temperature using fixed stations. Monitoring compliance at these sites were accomplished using gaging stations located at weirs, stilling wells, or powerhouse tailraces. Each fixed station site utilized a Campbell Scientific datalogger and a redundant pair of temperature sensors. Sensor cables were contained inside conduit, and the sensors were placed as close as possible to the stream thalweg where water is well mixed. A solar shield helped prevent exposure to direct sunlight. Depending on the site, power was supplied either by photovoltaic panels and DC batteries or through an existing power supply. Data transfer occurred through radio telemetry or fiber optic network. At the fixed stations, temperature readings were collected at 15-minute intervals and telemetered to SMUD databases, where the data was summarized to hourly means and calculated to daily statistics.

2.2 Temperature data at datalogger stations

Simple, non-permanent, calibrated temperature dataloggers (ONSET HOBO Water Temperature Pro V2) were deployed prior to March 15, 2018 at the remaining three sites ('Manual' sites in Table 1). The sensors were inserted into perforated metal framed housings that allowed for adequate water movement throughout.

Each housing was secured to large boulders or bedrock using hardened 3/8" chain and placed to assure that the sensor remained submerged and was not exposed to direct sunlight (Photos 1). Two dataloggers were installed at each site to protect against data loss in the event of equipment failure or drift. Dataloggers were deployed in habitat strata where the water was well-mixed, typically at the head of a pool just below a riffle input. Table 2 describes the equipment specifications for all sensors selected for water temperature monitoring.
Hourly data from HOBO loggers were manually downloaded using Onset Computer Corporation software. All water temperature data is stored in a Microsoft SQL database designed for this purpose.

Photo 1: Rubicon River below confluence of Little Rubicon River

Table 2 : Specifications for monitoring equipment

Sampling Equipment	Accuracy	Range	Calibration
Campbell Scientific 107L	<±0.2°C from 0°to	-35° to	Annual
Campbell Scientific 450L	±0.2°C from 0°to 50°	0° to 60°C	Biennial
Onset Computer Corp.	±0.2°C from 0° to	-40° to	Annual
Campbell Scientific CR 1000	±3 min. per year	Not	Annual

2.3 QA/QC

Raw data is reviewed on a routine basis. Temperature trends inspected include physical range limits, practical range limits, and rates of temperature change. Data obtained from the fixed stations were checked for validity using procedures that run every 24 hours following data download. A report is generated and sent to pertinent SMUD staff via email for any suspected erroneous data. The same procedures are run manually following download from the data loggers. Erroneous temperature values were adjusted manually; however, the original raw data was maintained in the database.

This review, along with graphical analysis and routine equipment inspection, ensured that sensors were functioning and recording properly throughout the monitoring period. For fixed stations, this allowed for a timely response if the need arose. Any equipment malfunction that required a field visit was addressed during normal business hours, under safe conditions. Repairs were made in as timely a manner as possible.

2.4 Adaptive Management

No water temperature sensors were lost or damaged for the 2018 monitoring season (Table 1). Three thresholds that are connected to various UARP adaptive management conditions were crossed during the monitoring period (Table 3). The exact dates are listed below. However, none triggered adaptive management actions.

Table 3 : Crossed Thresholds

Site Name	Site Description	Date Crossed Threshold	Duration of crossed Threshold
SFSC8	South Fork Silver Creek immediately upstream of Junction Reservoir	June 7, 2018	101 days
SC8	Silver Creek immediately upstream of SF American River	July 23, 2018	10 days
SFAR15	SF American River approximately ½ mile upstream of White Rock	May 8, 2018	163 days

3.0 ANALYSIS AND RESULTS

Data was analyzed at varying frequencies depending on the format of data retrieval (real-time opposed to manually retrieved/downloaded). All data was summarized to include values for daily mean, minimum and maximum temperatures. Further analysis included calculating the highest seven-day moving average temperature (7DMAVG). In a typical year, sites associated with trigger thresholds (Table 1), daily minimum, maximum, average and seven day moving average values were determined to notify SMUD staff if these thresholds were being exceeded. These processes are automated in the SMUD License Implementation database, which include a notification process when threshold triggers have been reached.

Water temperature data is presented graphically in figures one through nineteen. It is impractical to place hourly and daily data for all sites into this report, although this data will be made available upon request.

4.0 LITERATURE CITED

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San Joaquin River Basins (Basin Plan). Published by the California Regional WaterQuality Control Board, Central Valley Region and the State Water ResourcesControl Board, Sacramento, CA.

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Sacramento Municipal Utility District (SMUD et al.). 2015. Temperature Monitoring Plan (Plan) for the Upper American River Project. Sacramento Municipal Utility District, Sacramento, CA.

State Water Resources Control Board (SWRCB, 2013). 2013. Water Quality Certification for the Upper American River Project. FERC Project No. 2101. State Water Resources Control Board. Sacramento, CA

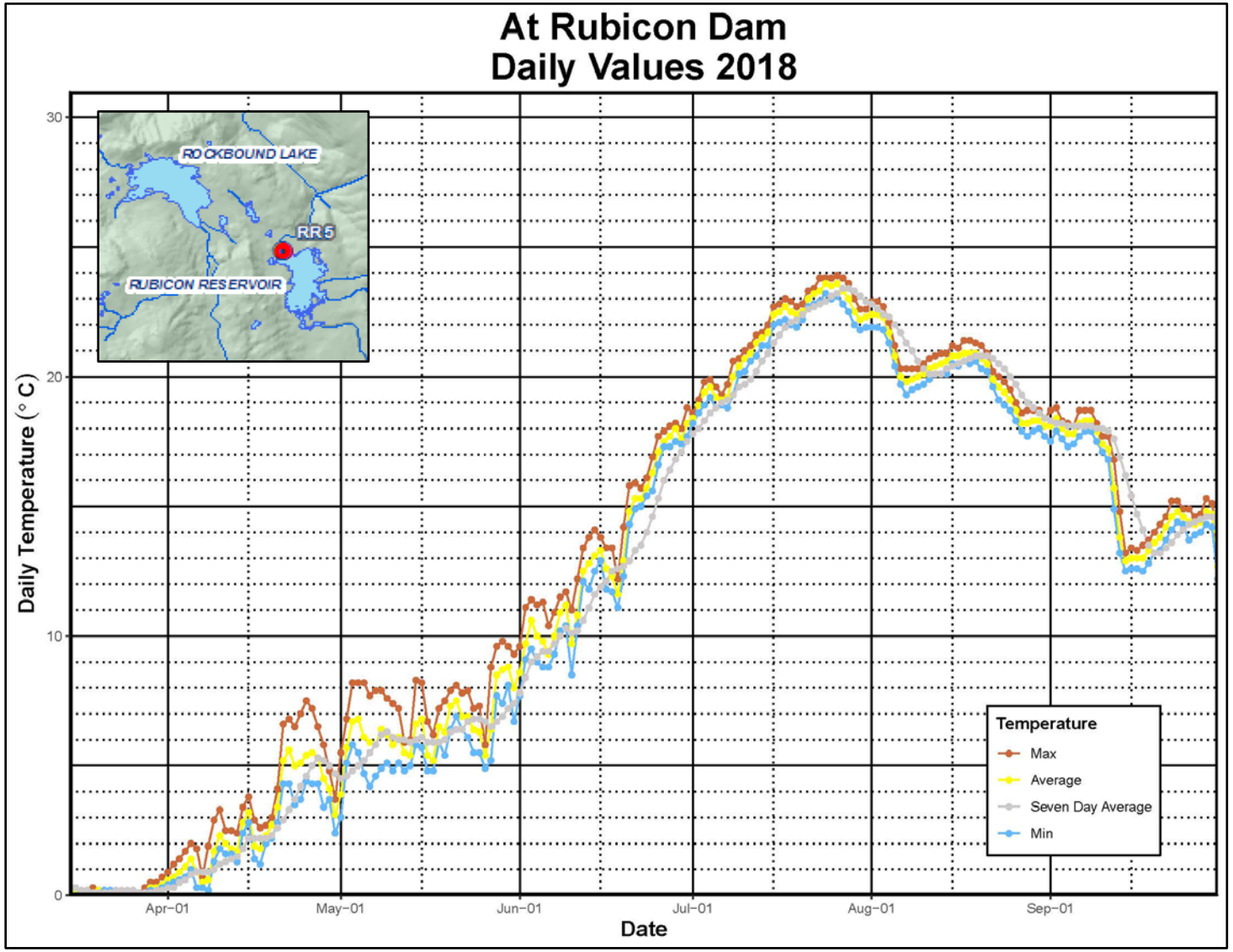

Figure 1: Little Rubicon River immediately below Rubicon Reservoir Dam (RR5)

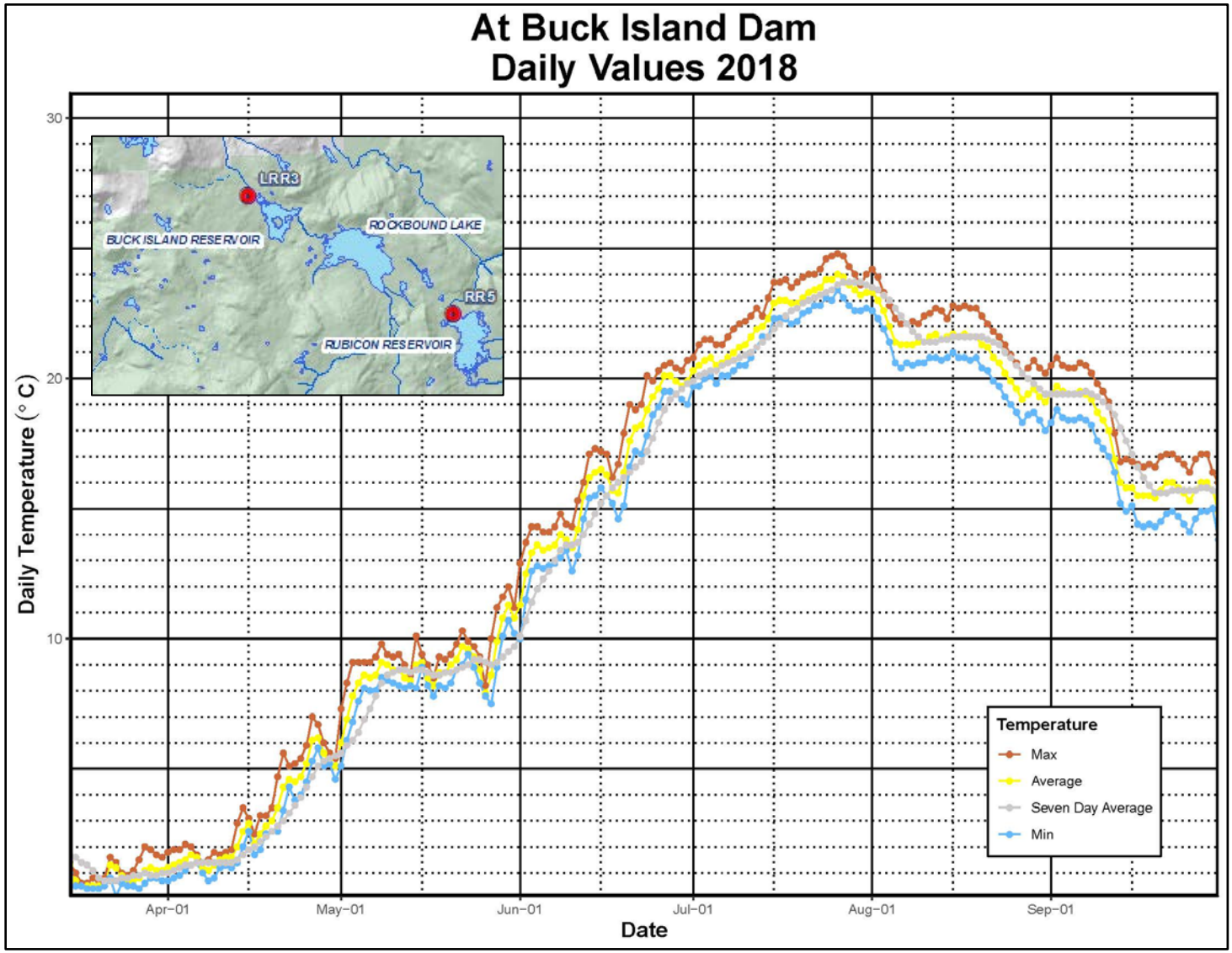

Figure 2: Little Rubicon River Immediately below Buck Island Reservoir Dam (LRR3)

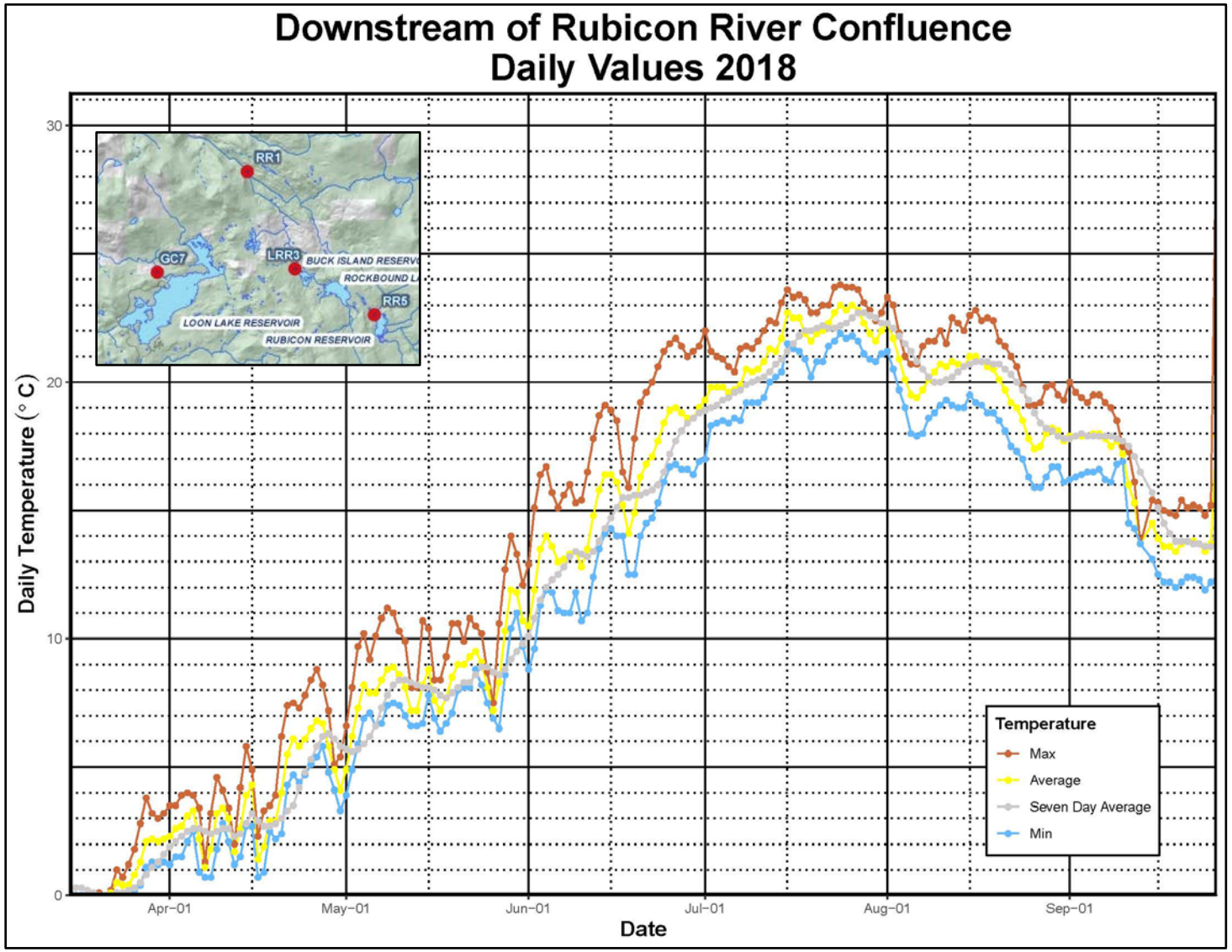

Figure 3: Rubicon River below confluence of Little Rubicon River at the Project boundary (RR1)

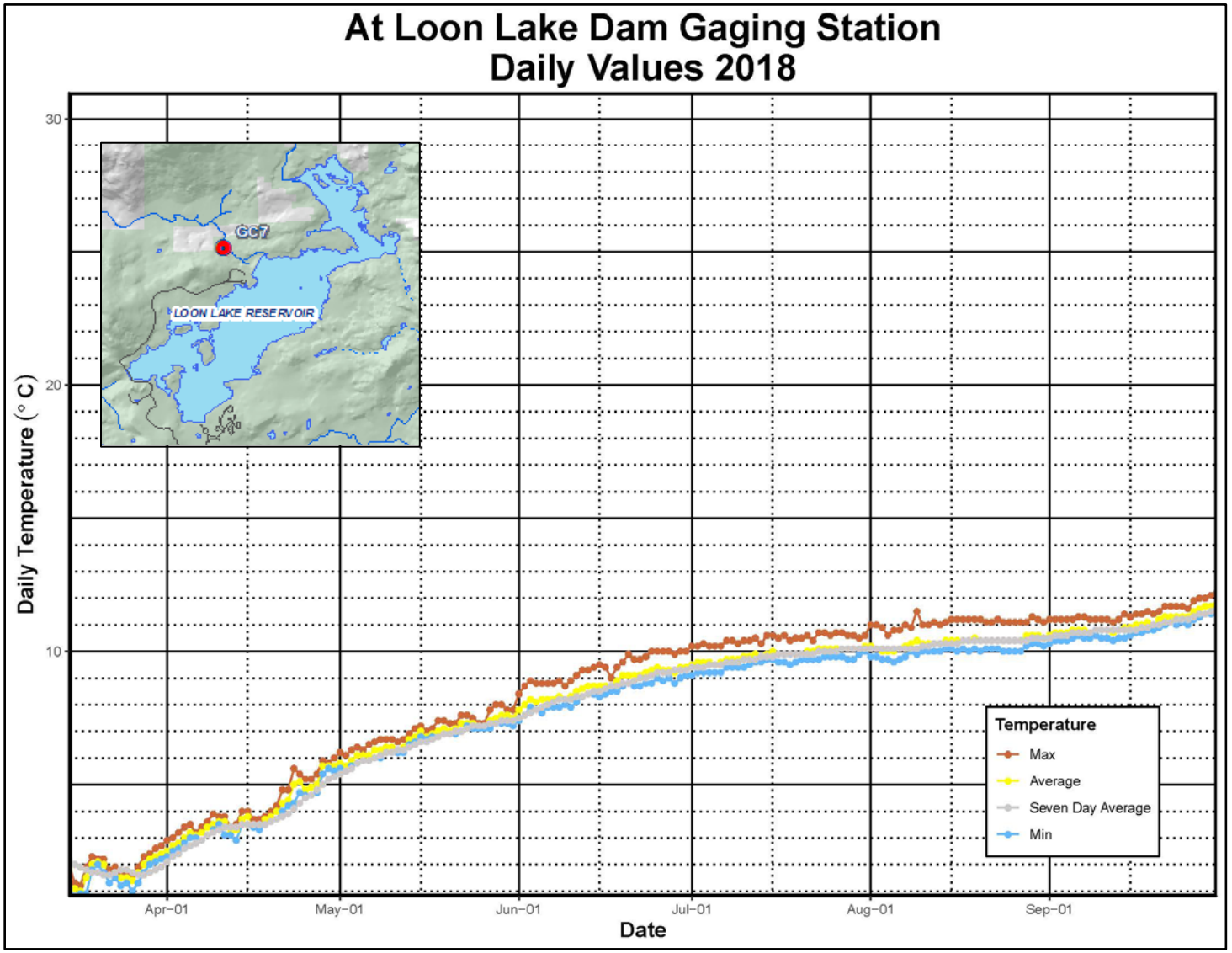

Figure 4: Gerle Creek Immediately below Loon Lake Reservoir Dam (GC7)

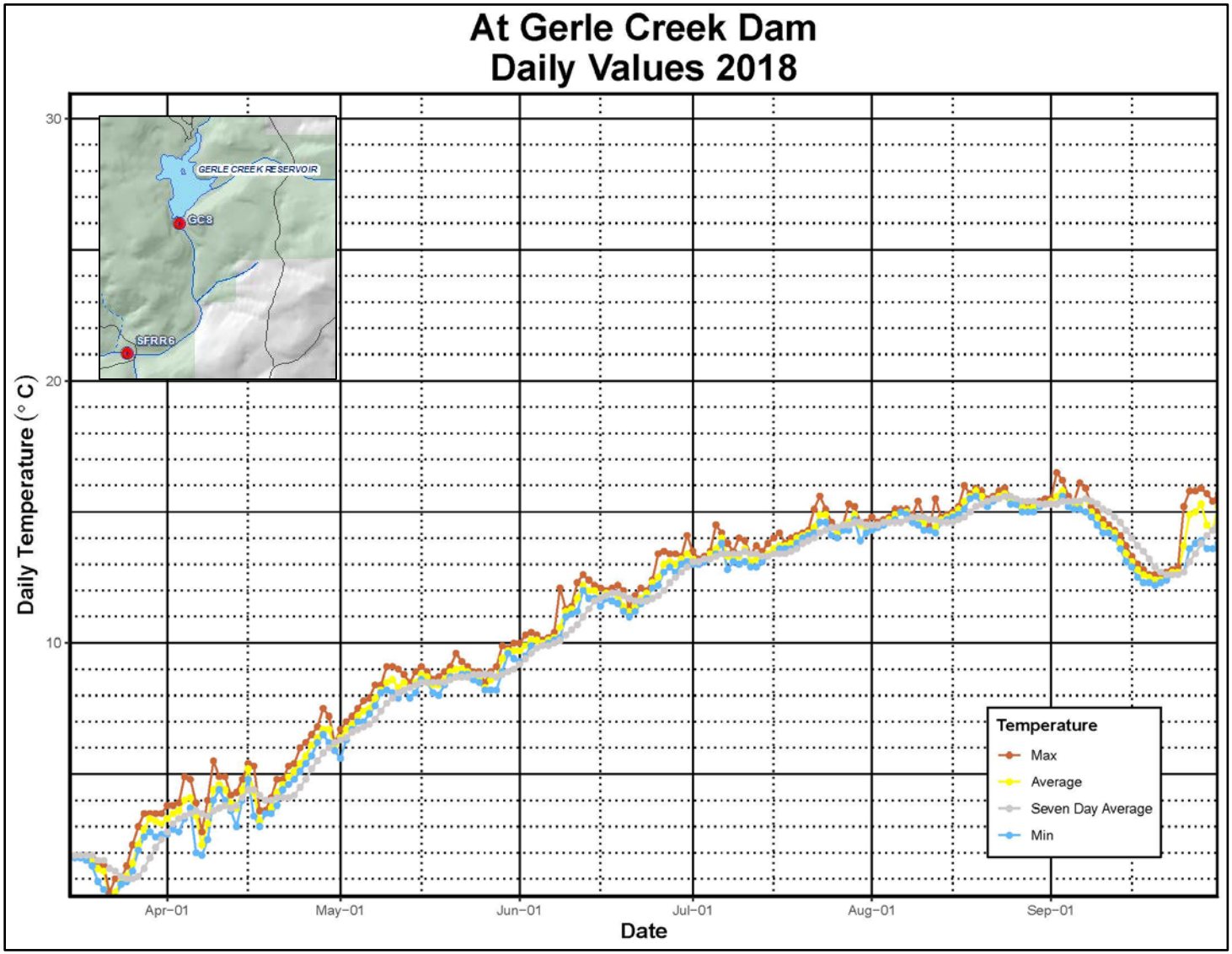

Figure 5: Gerle Creek immediately below Gerle Creek Reservoir Dam (GC8)

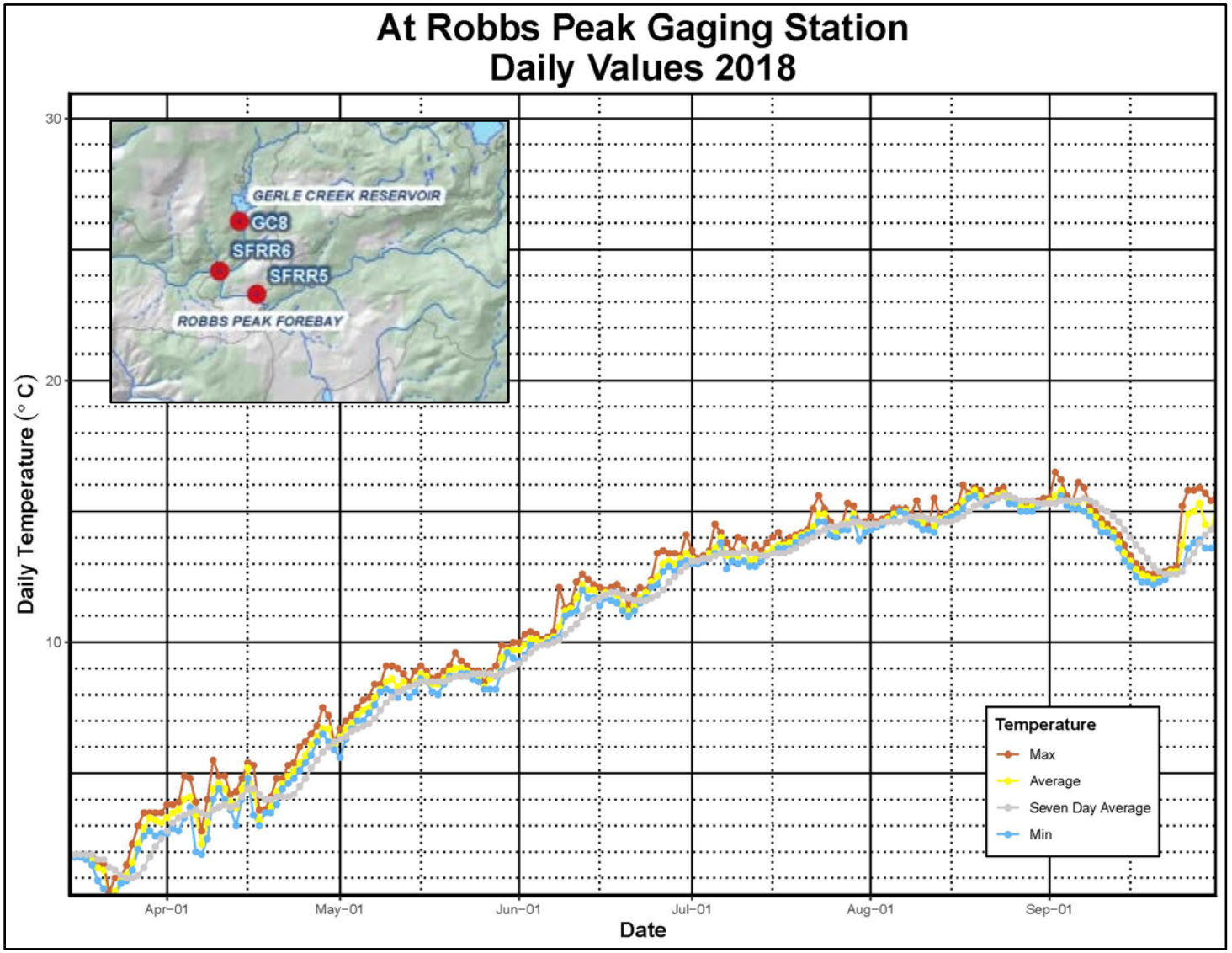

Figure 6: SF Rubicon River immediately below Robbs Peak Reservoir Dam (SFRR5)

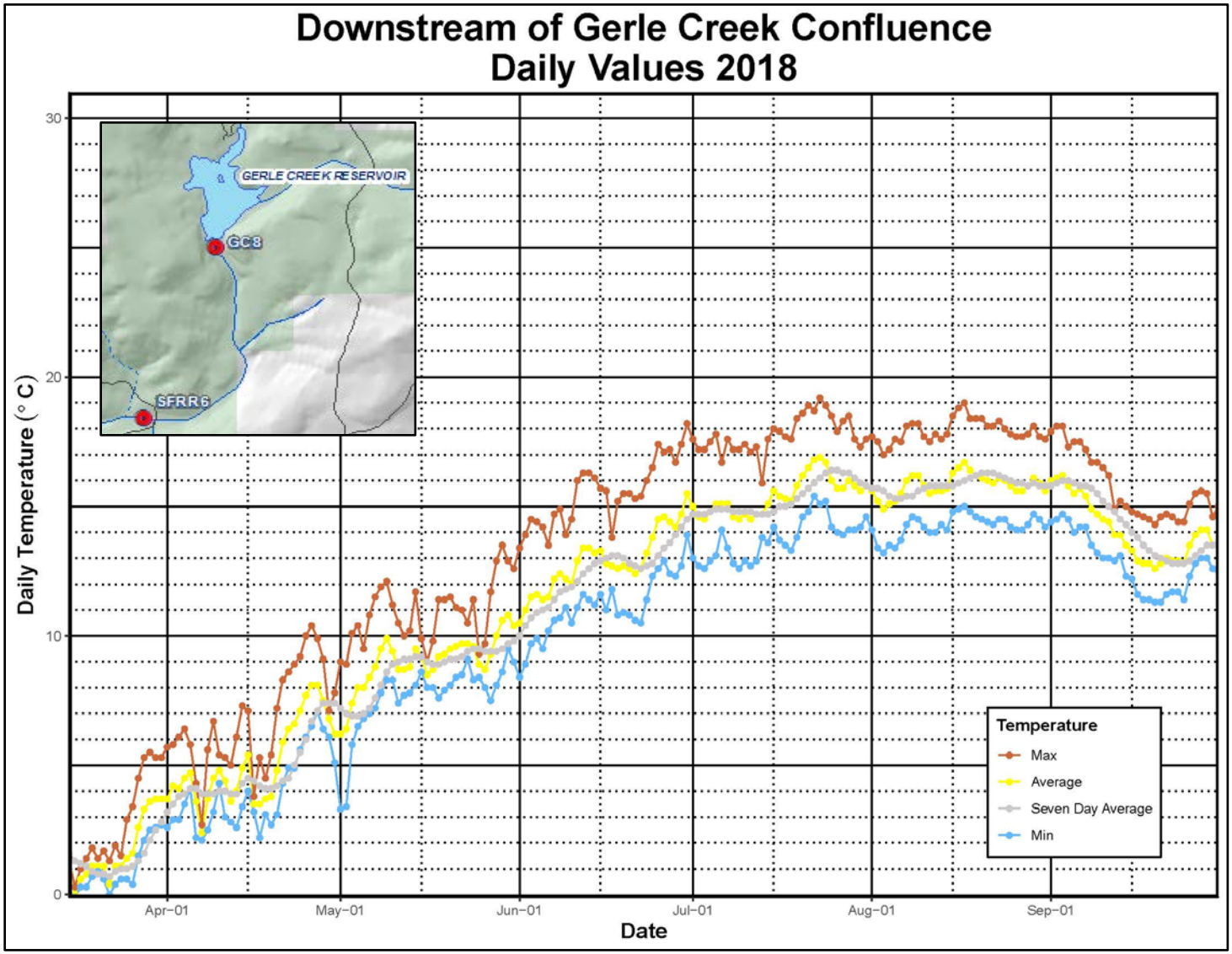

Figure 7: SF Rubicon River below confluence of Gerle Creek (SFRR6)

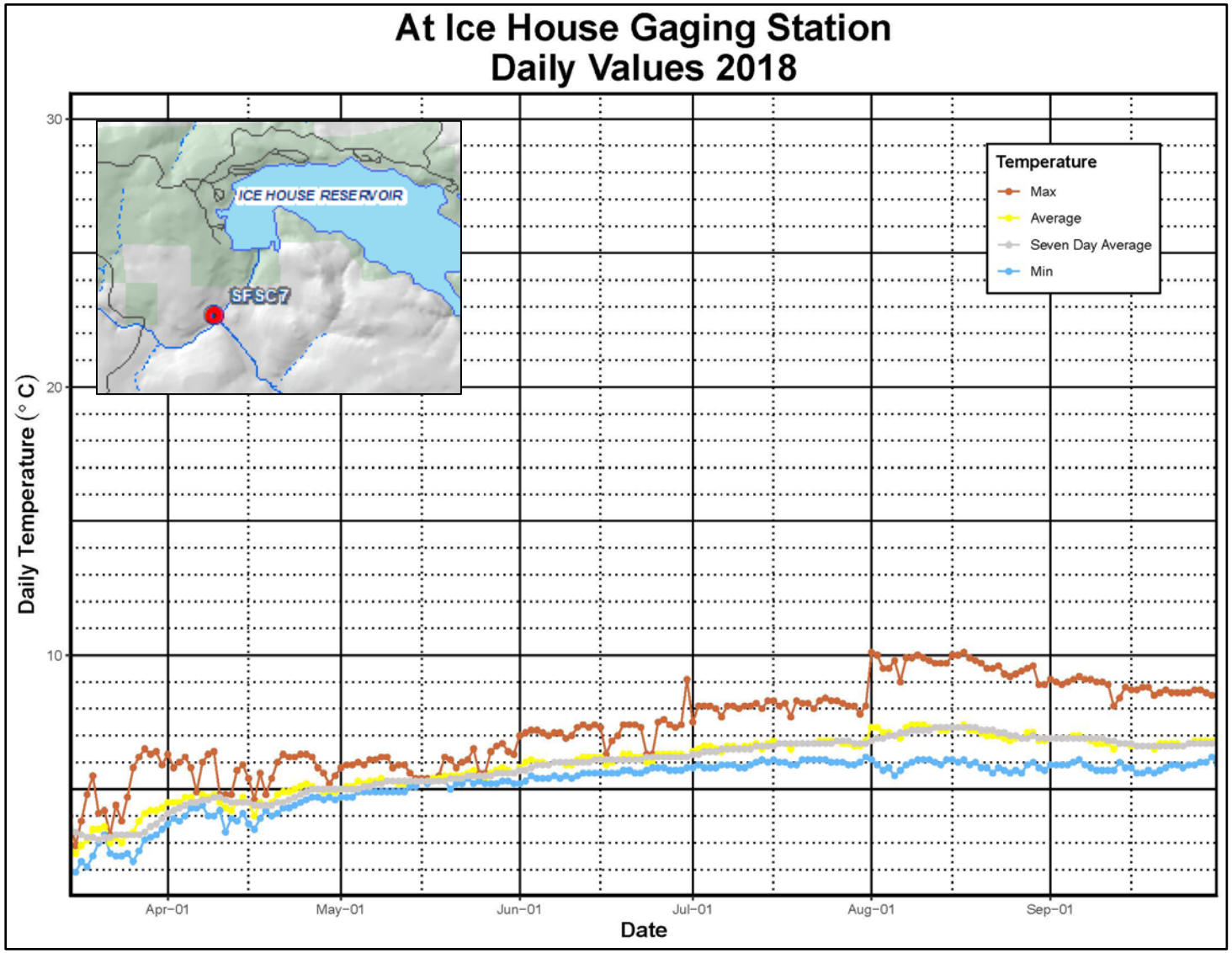

Figure 8: South Fork Silver Creek immediately below Ice House Reservoir Dam (SFSC7)

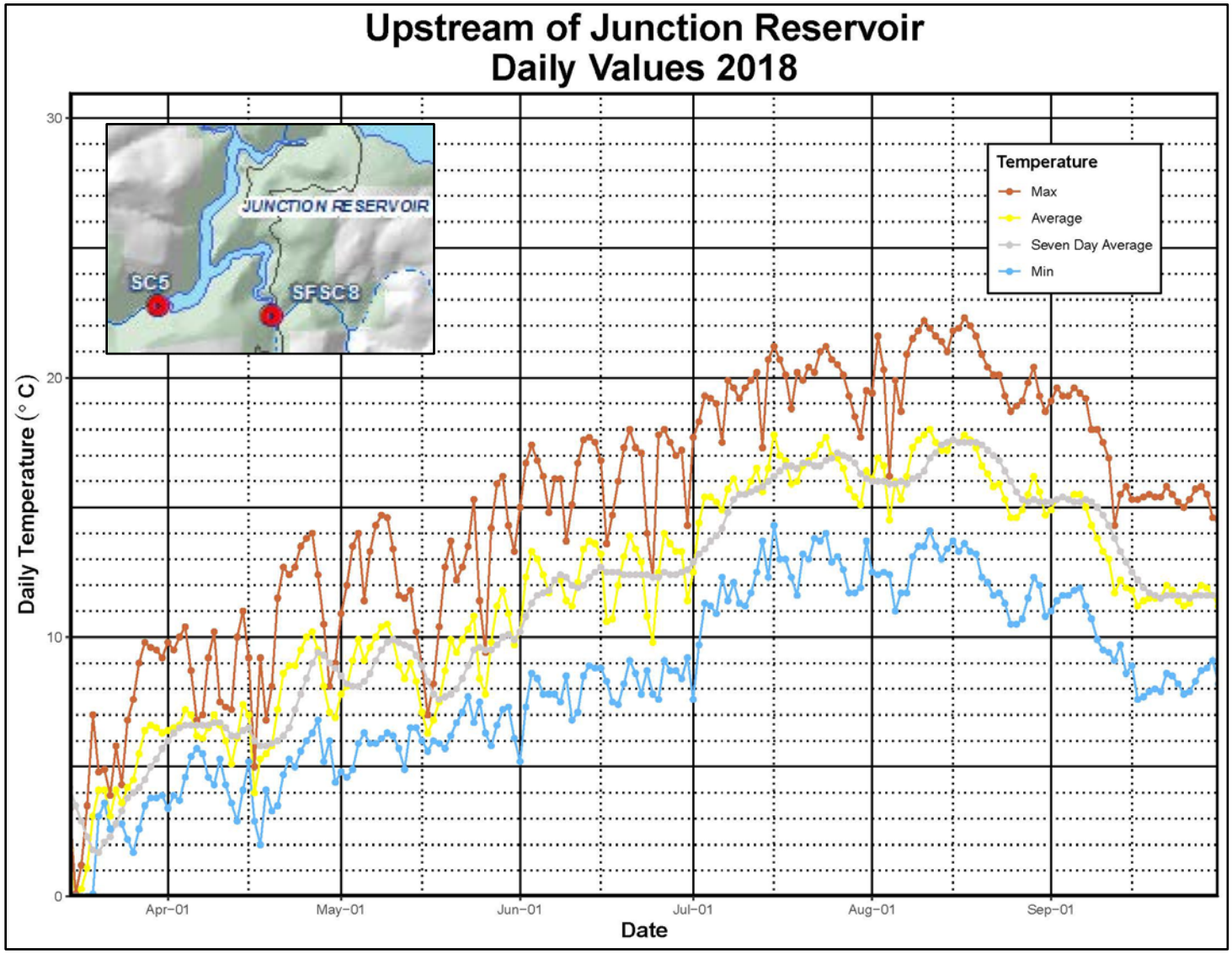

Figure 9: South Fork Silver Creek immediately upstream of Junction Reservoir (SFSC8)

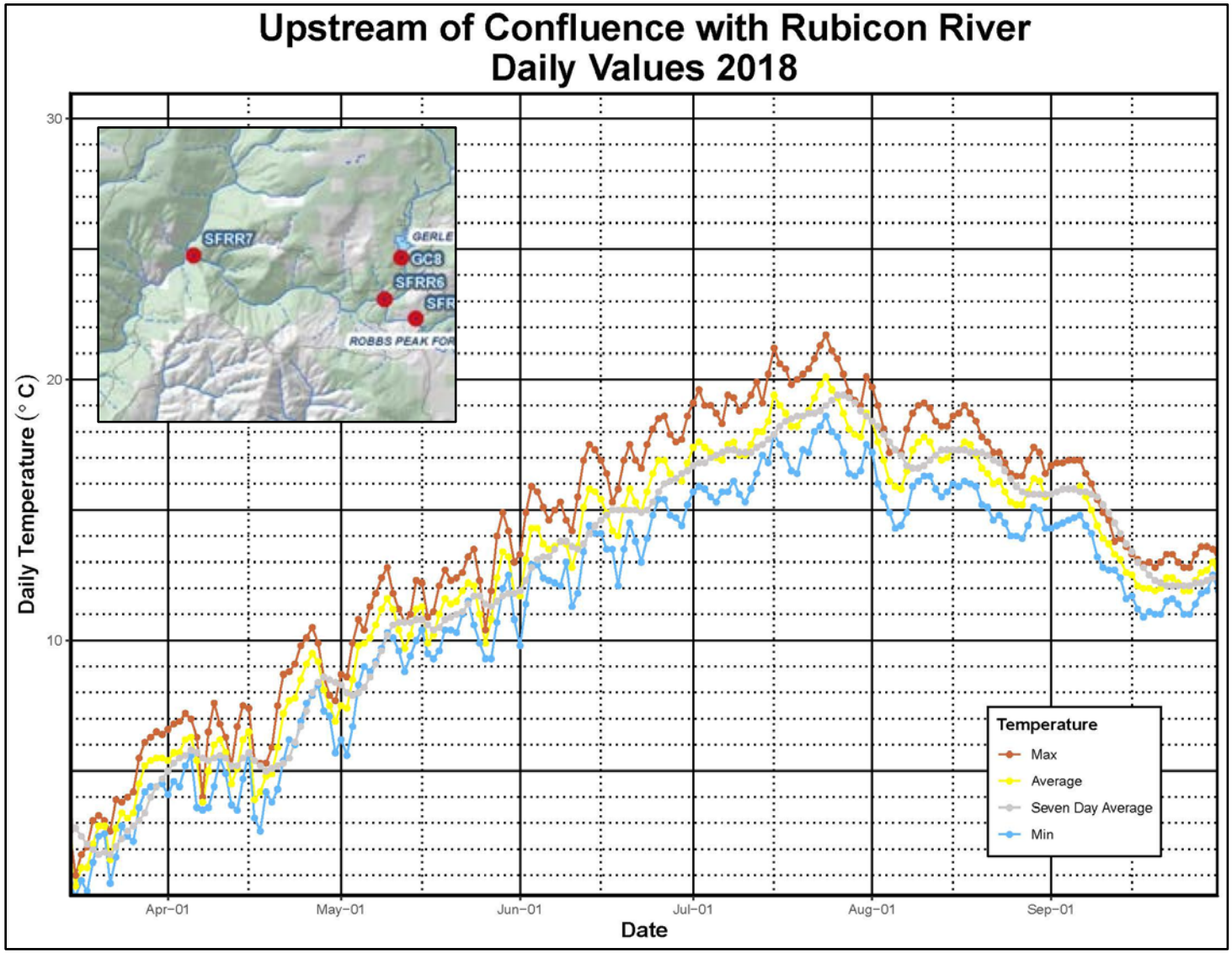

Figure 10: SF Rubicon River immediately upstream of the confluence with the Rubicon River (SFRR7)

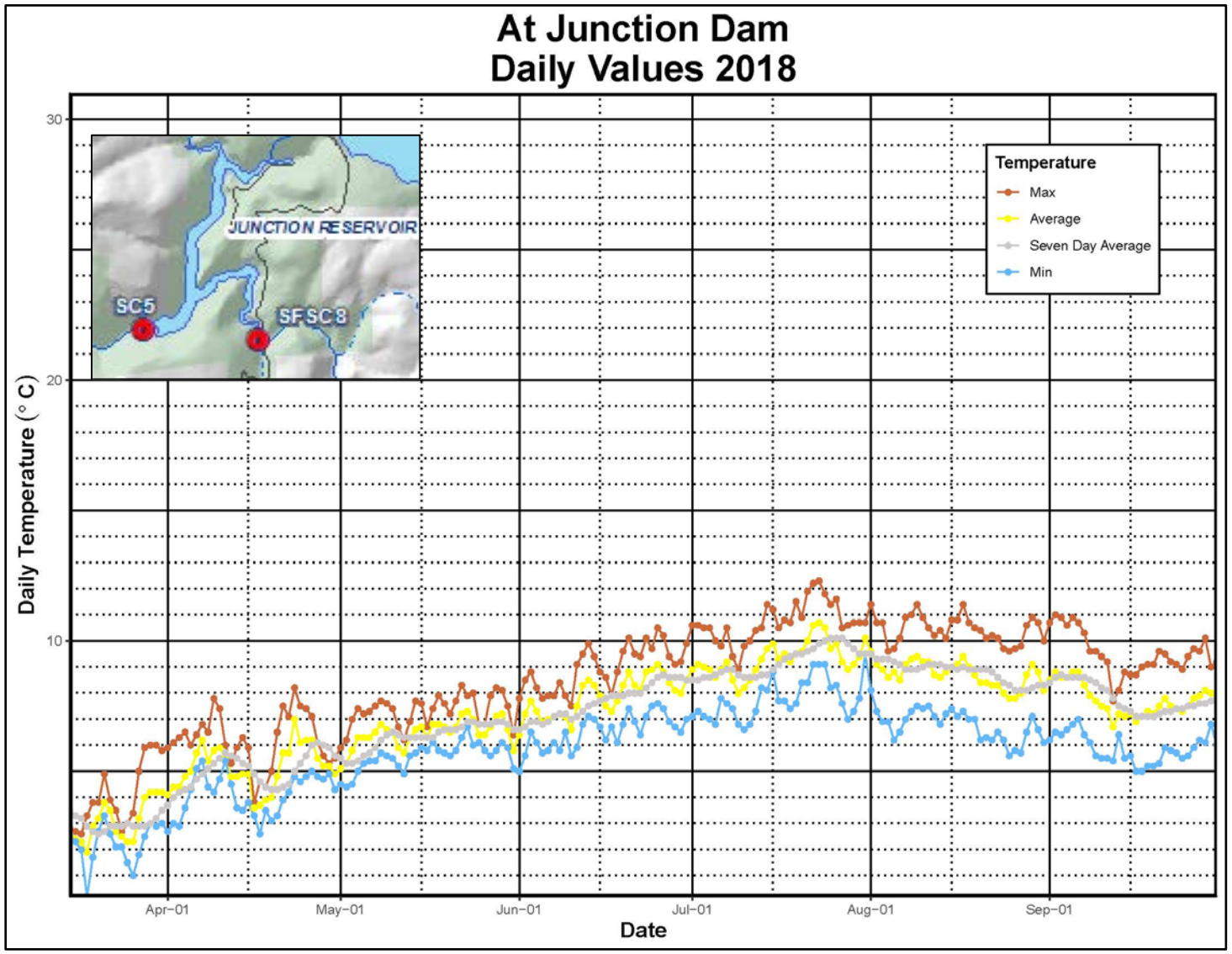

Figure 11: Silver Creek immediately below Junction Reservoir Dam (SC5)

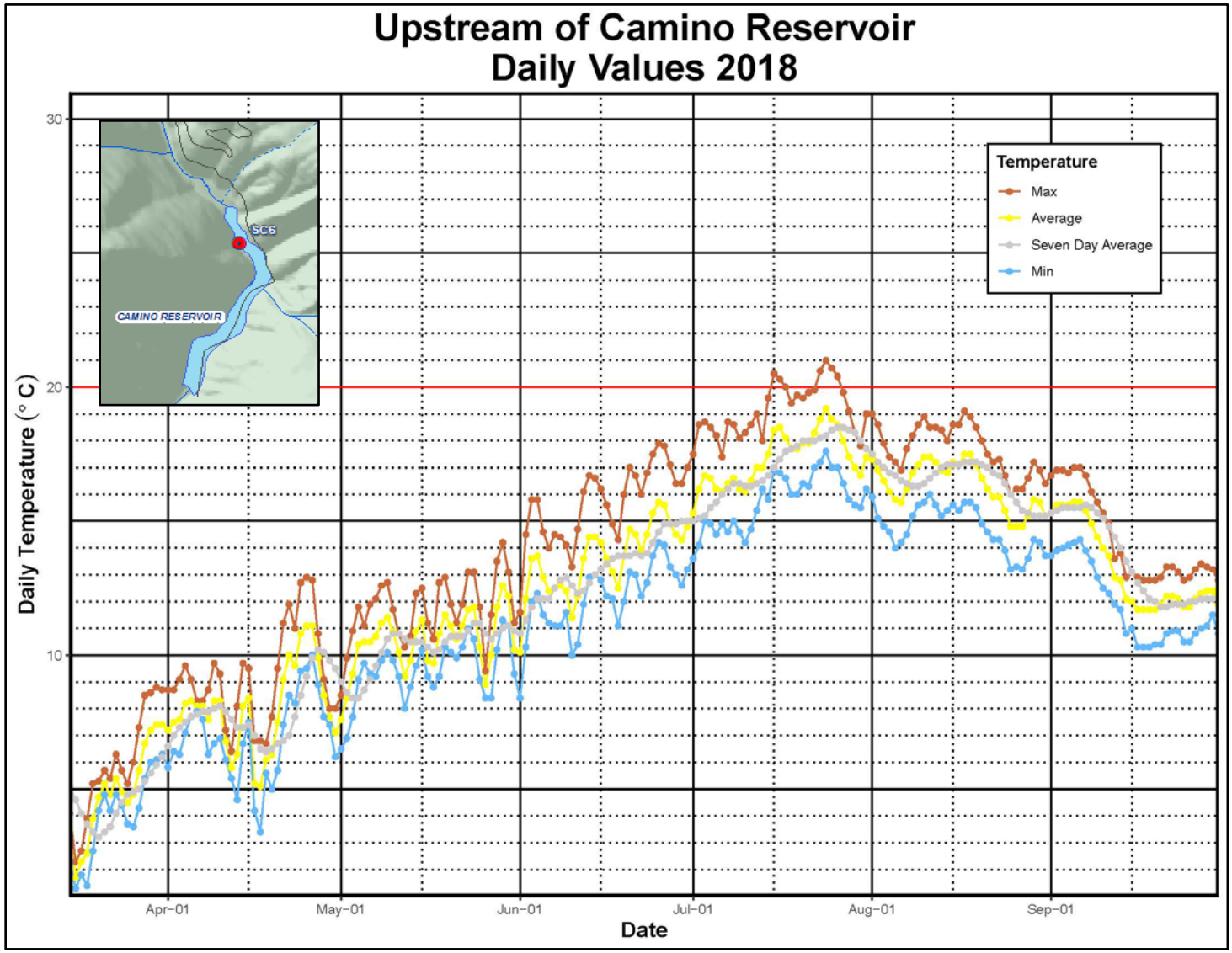

Figure 12: Silver Creek immediately above Camino Reservoir Dam (SC6)

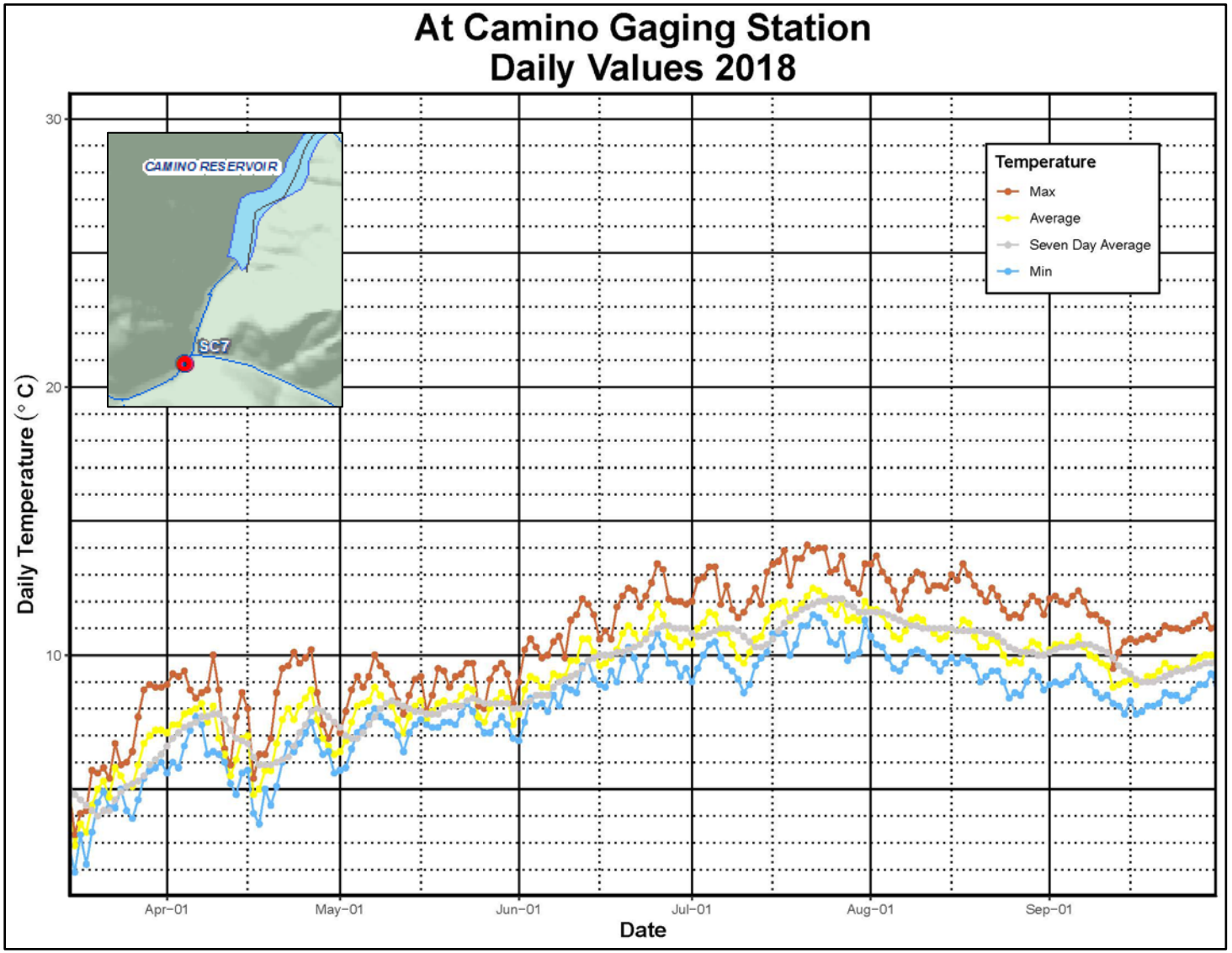

Figure 13: Silver Creek immediately below Camino Reservoir Dam (SC7)

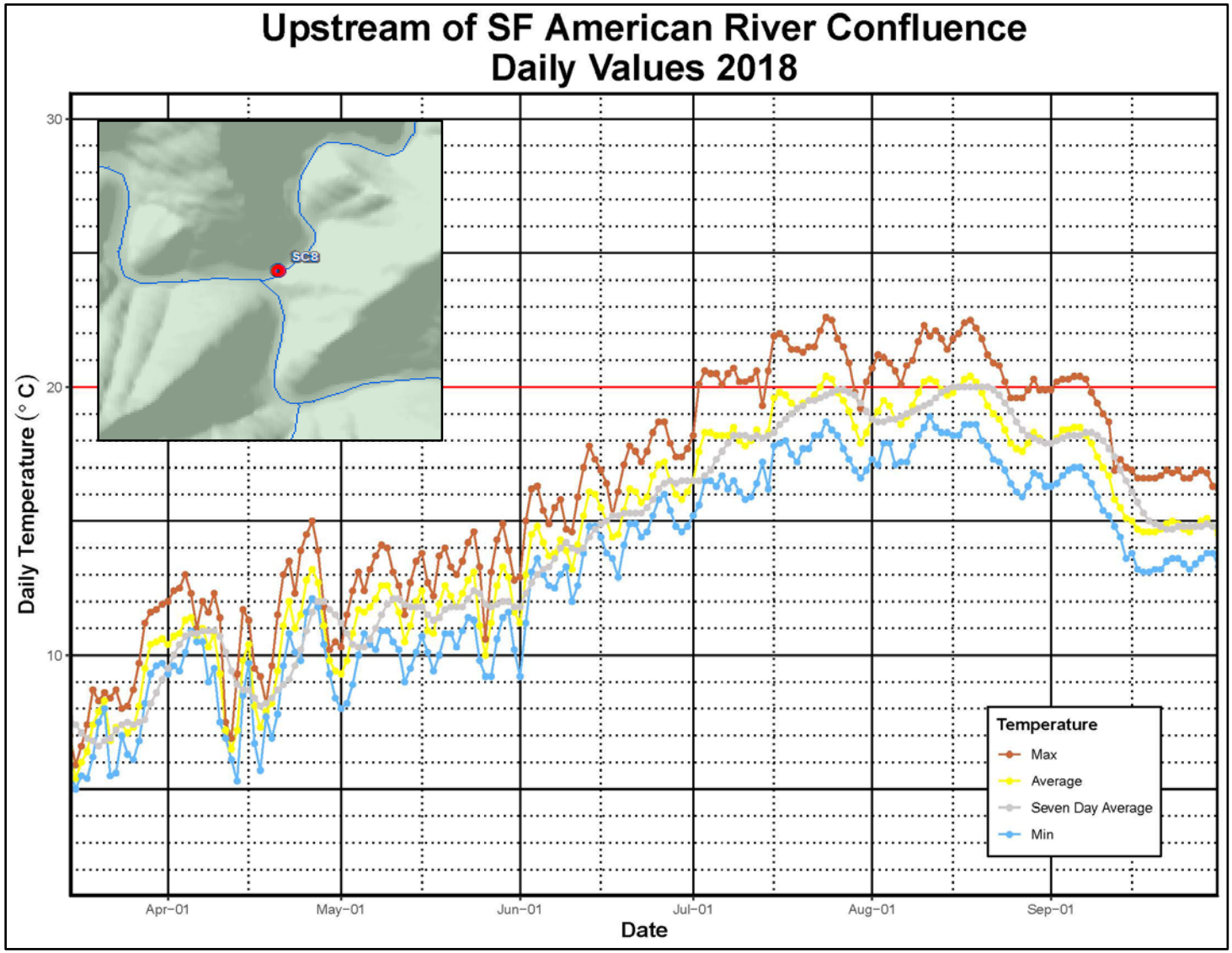

Figure 14: Silver Creek immediately upstream of SF American River (SC8)

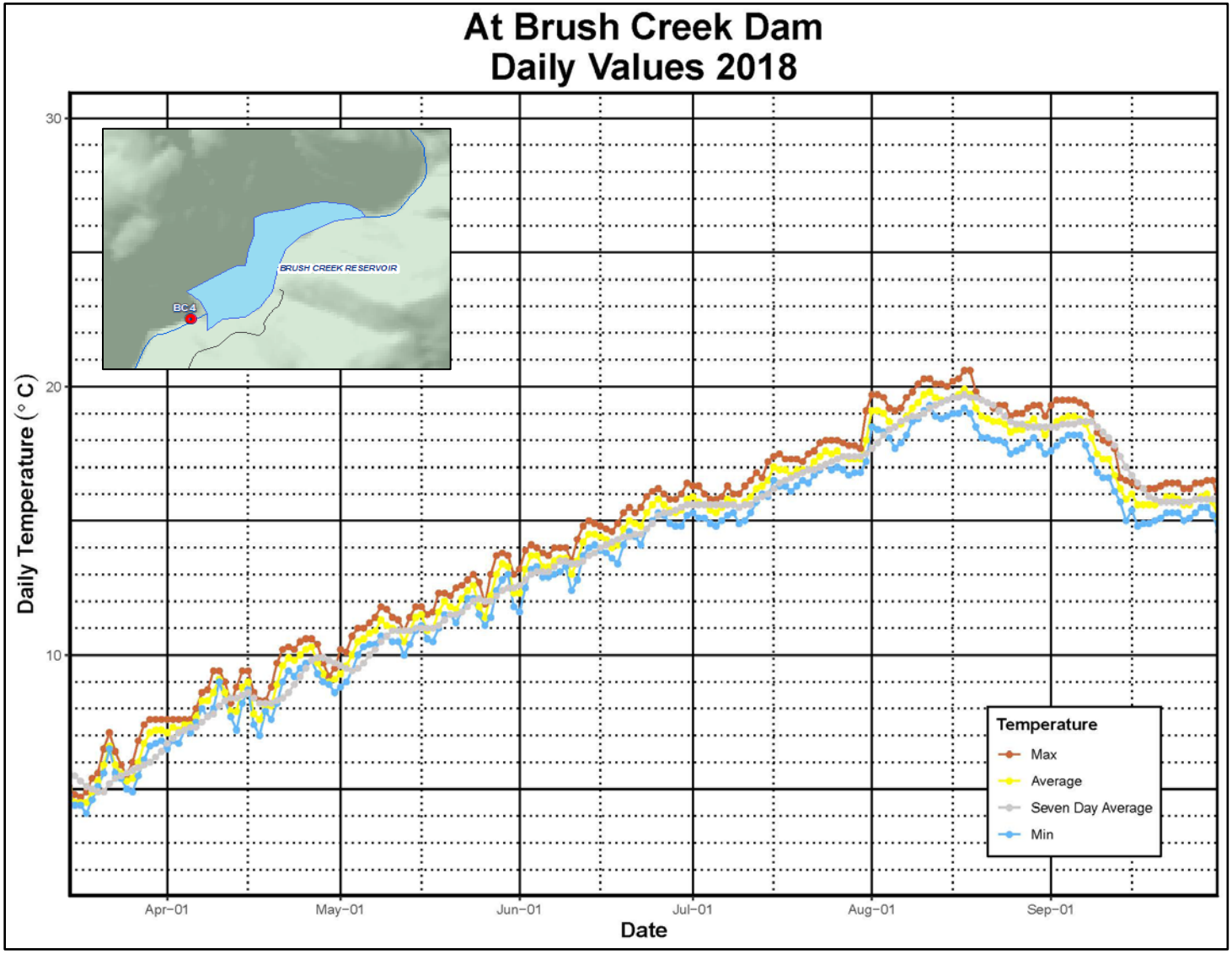

Figure 15: Brush Creek immediately below Brush Creek Reservoir Dam (BC4)

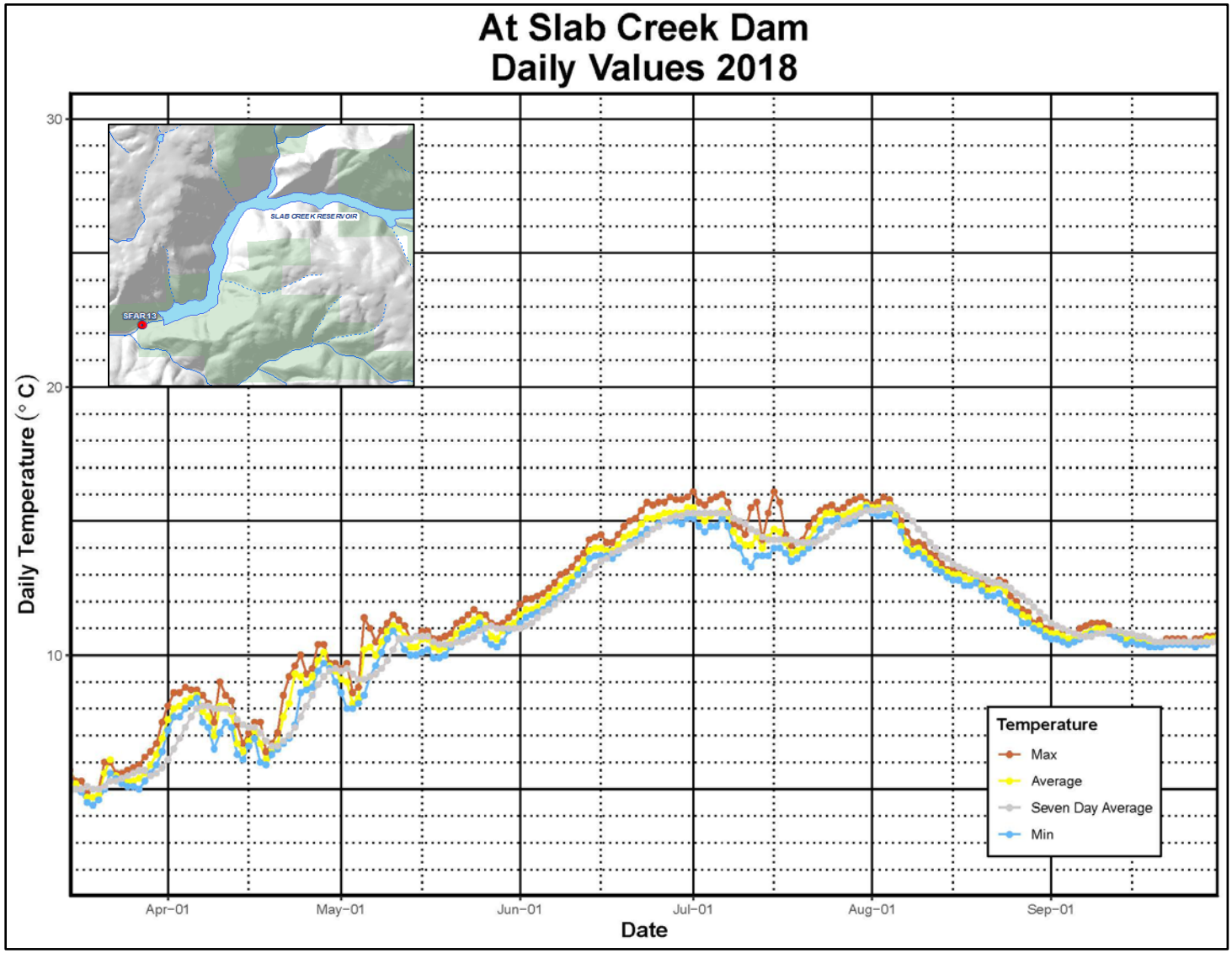

Figure 16: SF American River immediately below Slab Creek Reservoir Dam (SFAR13)

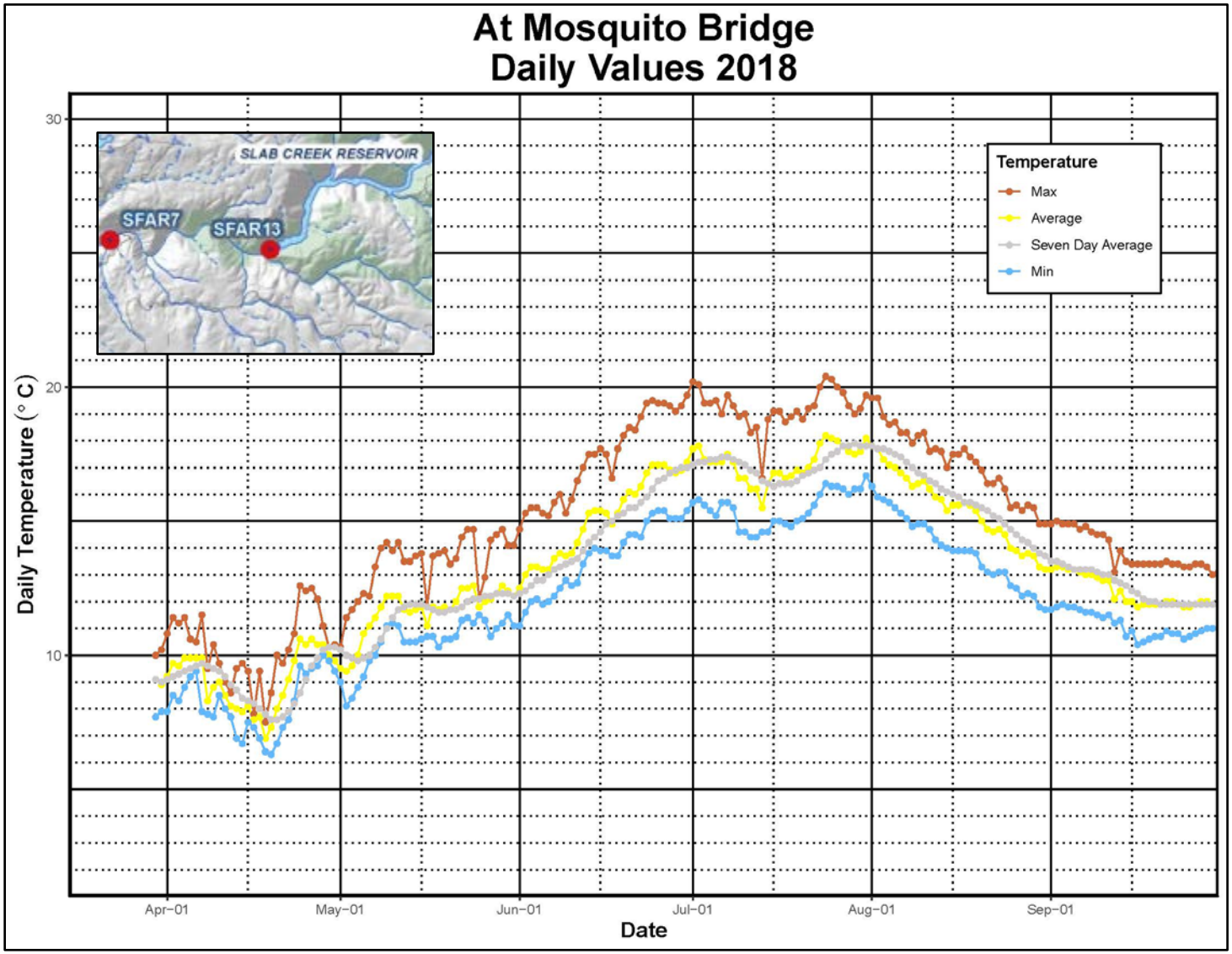

Figure 17: SF American River at Mosquito Rd Bridge (SFAR7)

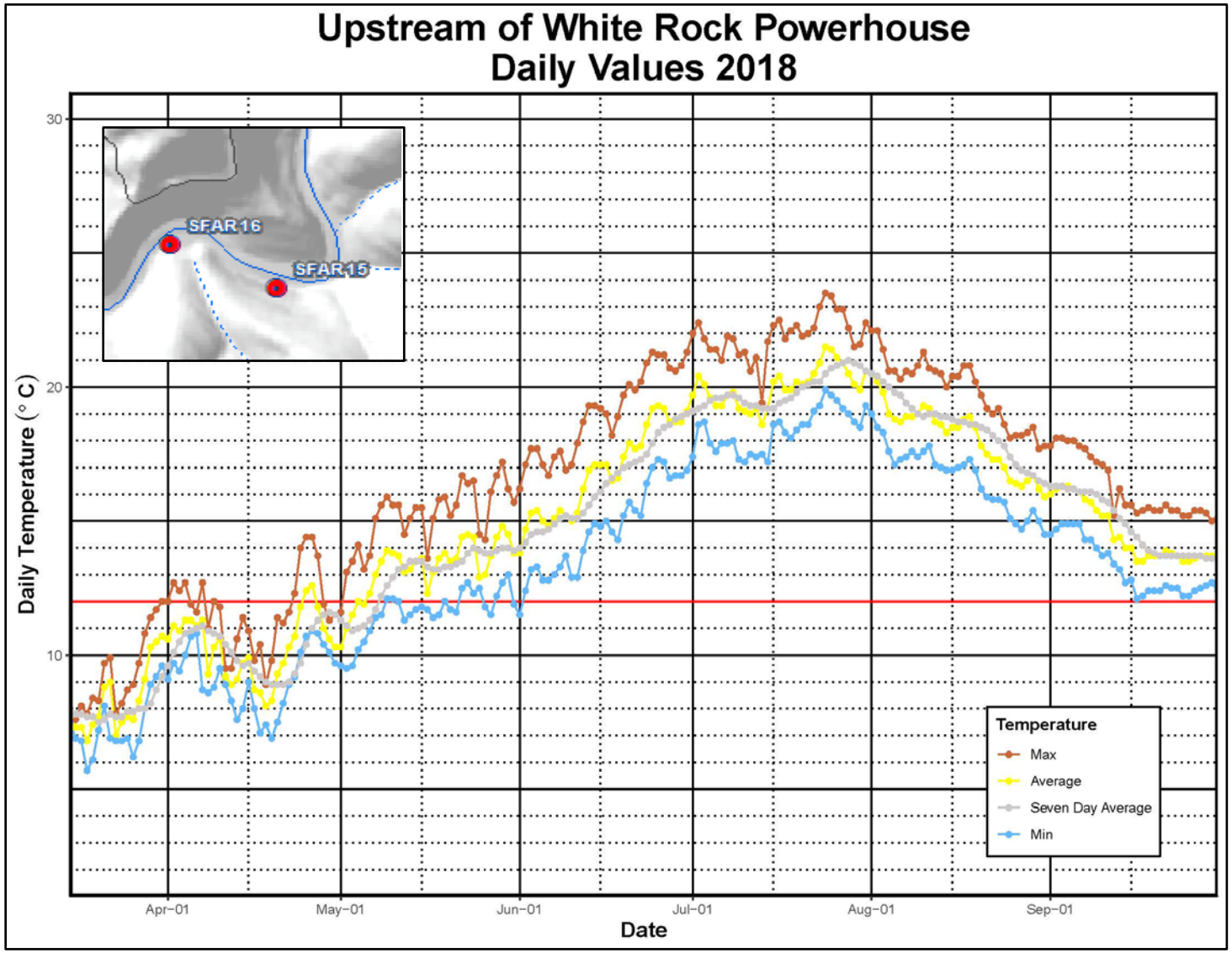

Figure 18: SF American River approximately ½ mile upstream of White Rock Powerhouse (SFAR15)

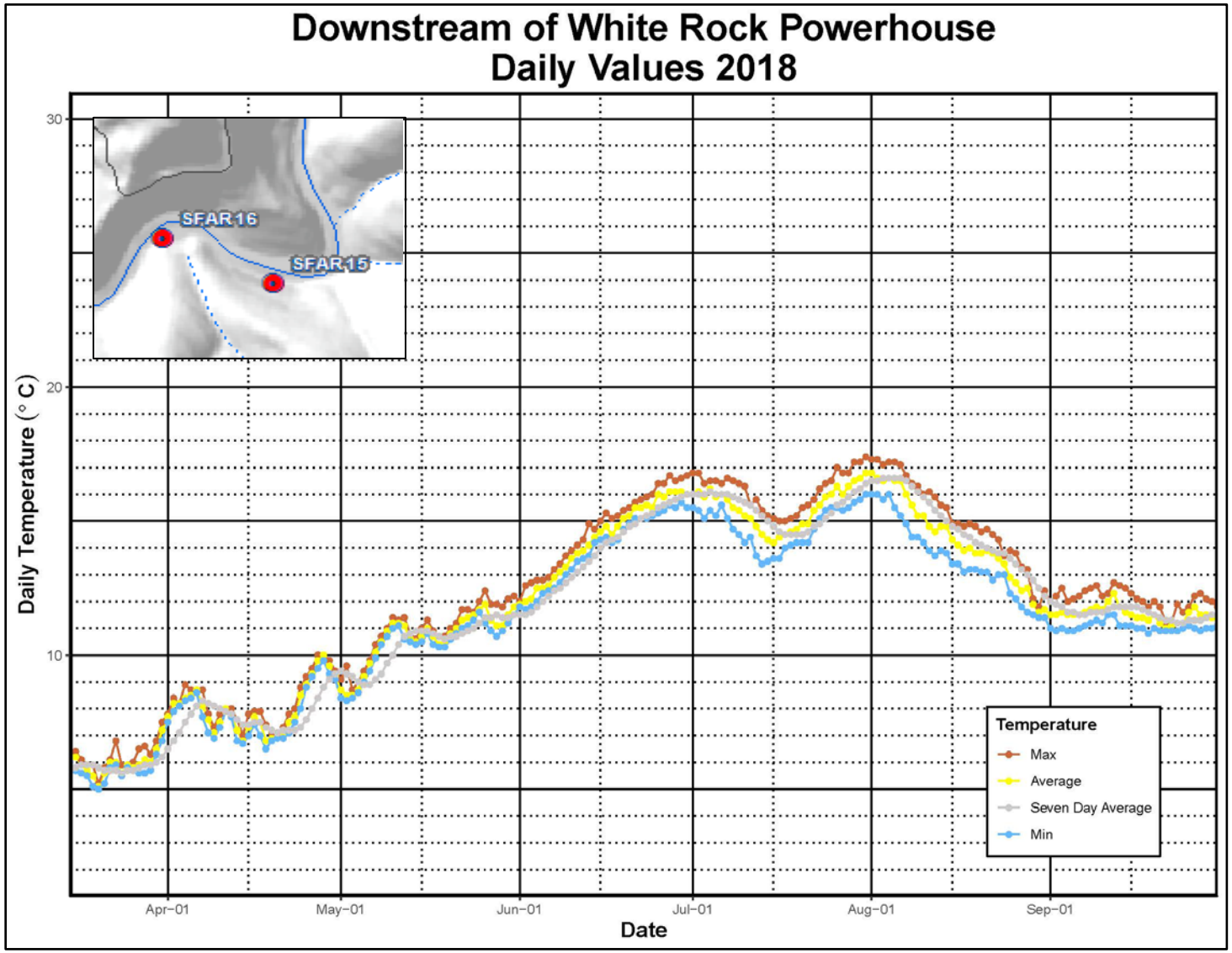

Figure 19: SF American River to record White Rock Powerhouse discharge temps (SFAR16)

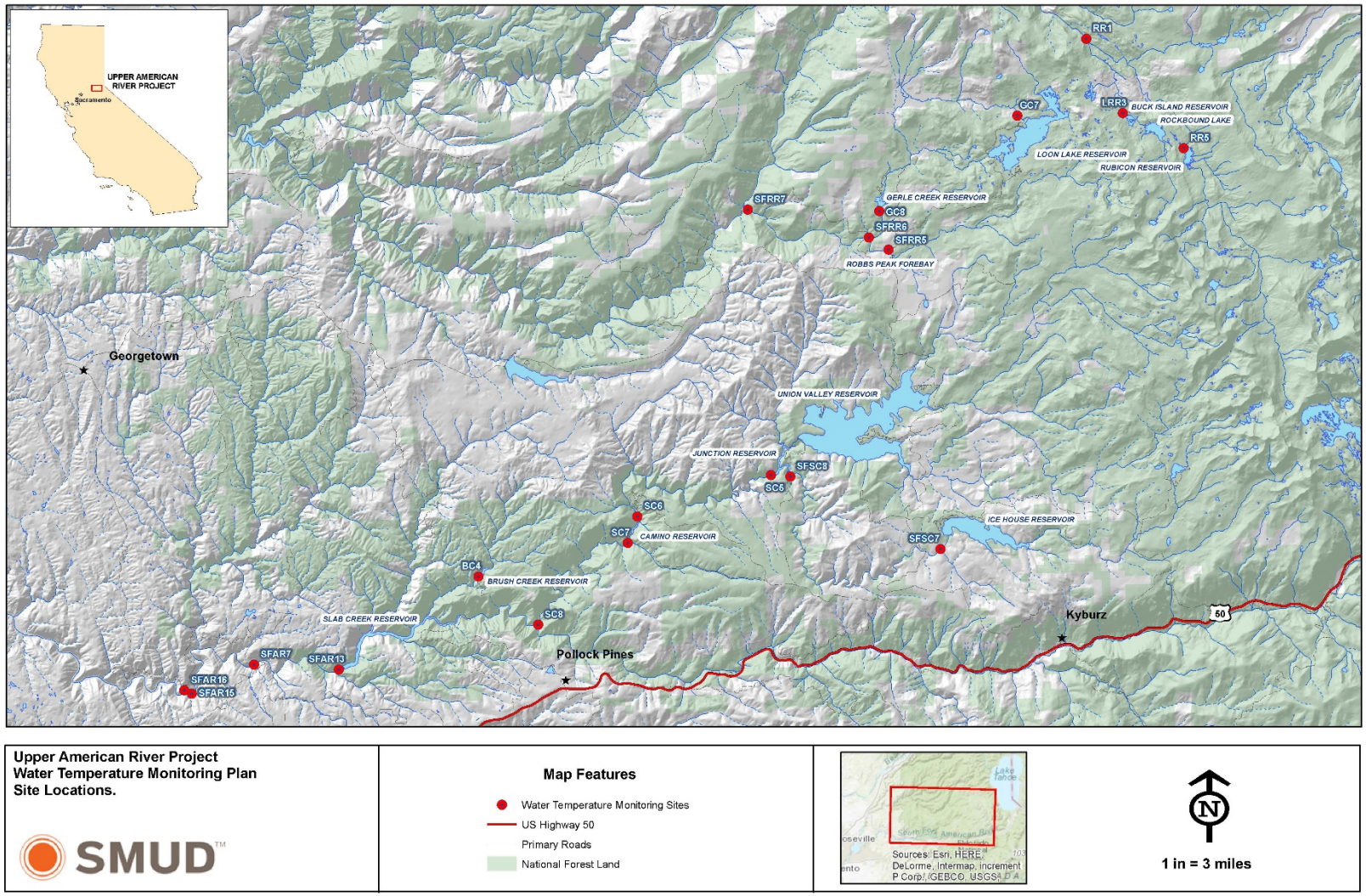

Figure 20: Location Map