2020 Redwood Creek, South Fork Eel River, Dry Season Stream Flow Monitoring Summary

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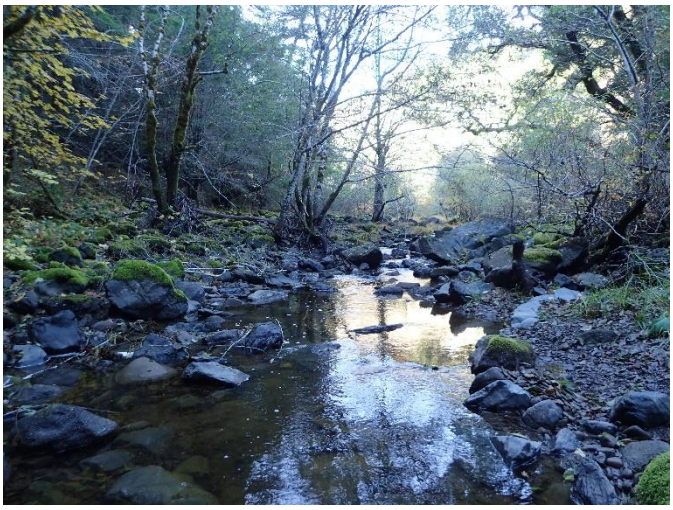

*pictures clockwise from left: site RC-2.5 after the first rain on 11/21/20, ferns at RC-4 6/4/20, Bee on a spikenard at Diner creek 8/1/20, Orange light from fires and a dry streambed at China Creek 8/27/20.

Contents

Introduction

Redwood Creek is a critical tributary for juvenile salmonids in the South Fork Eel watershed. Since 2013, Salmonid Restoration Federation (SRF) has been conducting low flow monitoring in order to understand the low flow patterns and prioritize water conservation efforts in this impaired watershed that is home to hundreds of residents as well as threatened species like coho salmon. This important tributary historically supported coho, Chinook and steelhead and provided important cold-water refugia for juvenile salmonids.

Under a Wildlife Conservation Board Streamflow Enhancement grant, SRF has continued to monitor low flows in Redwood Creek. Despite rains late into the season, the 2020 water year was dire for juvenile salmonids with dry conditions similar to the extended drought years.

Instream flows and cool water temperatures are critical for juvenile salmonids to survive the hot summer months. Adequate instream flows and dissolved oxygen are both necessary for juvenile salmon survival.

Methodology

Flow monitoring was conducted at 10 sites (Figure 1) throughout Redwood Creek during the summer of 2020, May 23rd to November 21st. Monitoring visits were taken at two week intervals. Pressure transducer data loggers were installed at six sites to measure stage. Three sites (RC-1.5, MC-2, and RC-1.8) had data loggers for the whole season, three sites (CC-2, URC-1, and RC-3) had data loggers from

7/3/20 to the end of the season, and four sites did not have data loggers. Stage and temperature from the data loggers were crossed checked with the measurements.

At many sites, the water level receded below the logger after the 8/27/20 monitoring visit and I needed to put it back in the water at the 9/13/20 monitoring visit. Rating curves were created from the measured stage and flow during the site visit. Rating curves were used to model flow from the stage recorded from the data loggers.

Pictures were taken upstream and downstream from the stage reference point at each visit. Included in this report is the picture facing downstream of the reference point at the highest flow during a monitoring visit (5/23/20), the lowest flow during a monitoring visit (11/8/20), and more pictures if needed to illustrate the conditions.

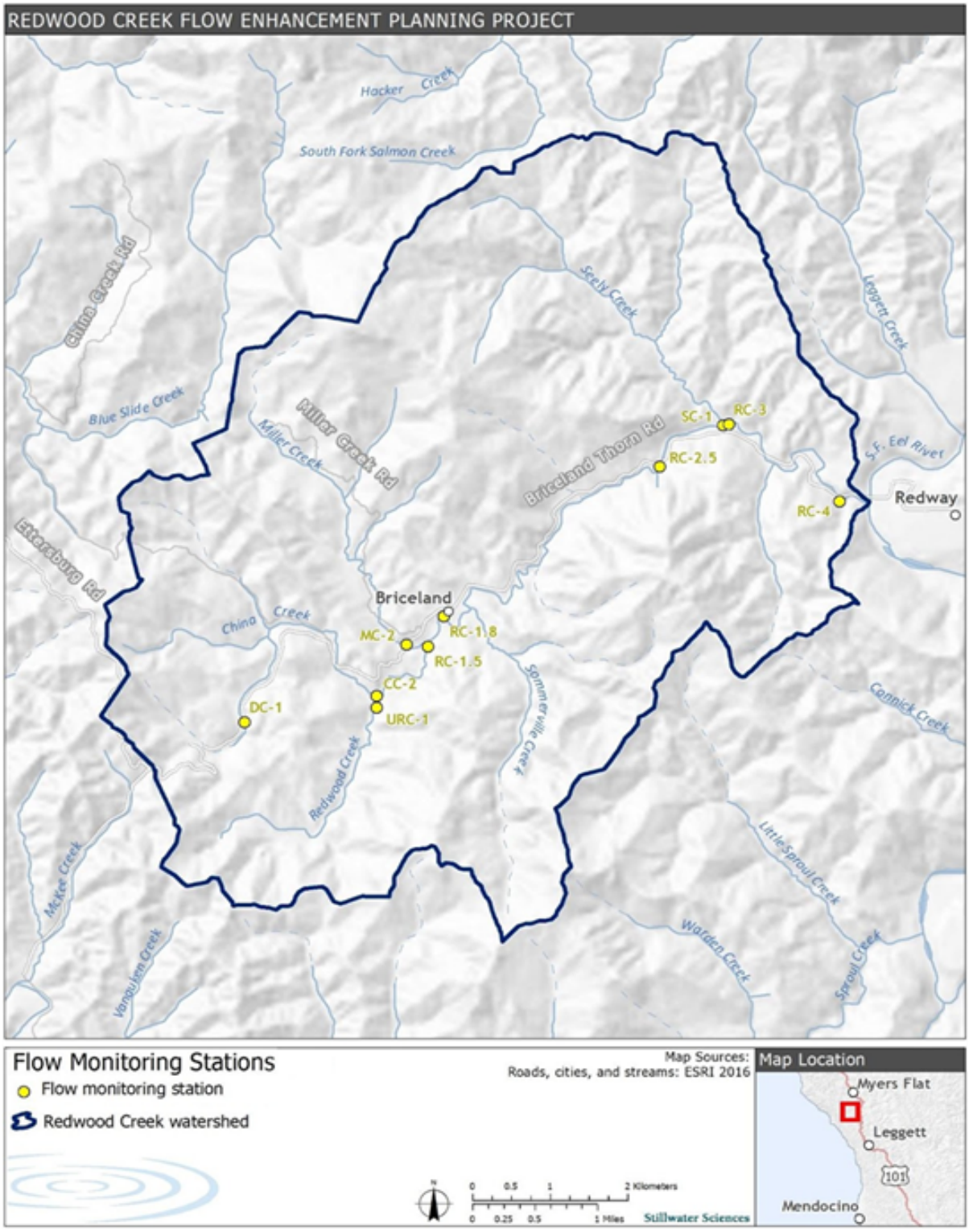

Figure 1. Flow monitoring stations/sites locations 2018-2021.

Results

May flows in Redwood Creek (RC-4) were 11,000 gallons per minute (gpm), by early August flows were only 44 gallons per minute (gpm), and in late-September, the mainstem of Redwood Creek was flowing <1gpm. Tributaries including Miller Creek were 1,800 gpm in late May and completely dry by the end of September.

By the end of the summer, most tributaries in the Redwood Creek watershed had disconnected pools, stranded juveniles, and impaired water quality. Despite recent rains, Redwood Creek still has low flow, but is no longer at crisis levels. As of November 21 (the last monitoring date) of the season, both Sproul Creek and Redwood Creek had similar flow as July 2020.

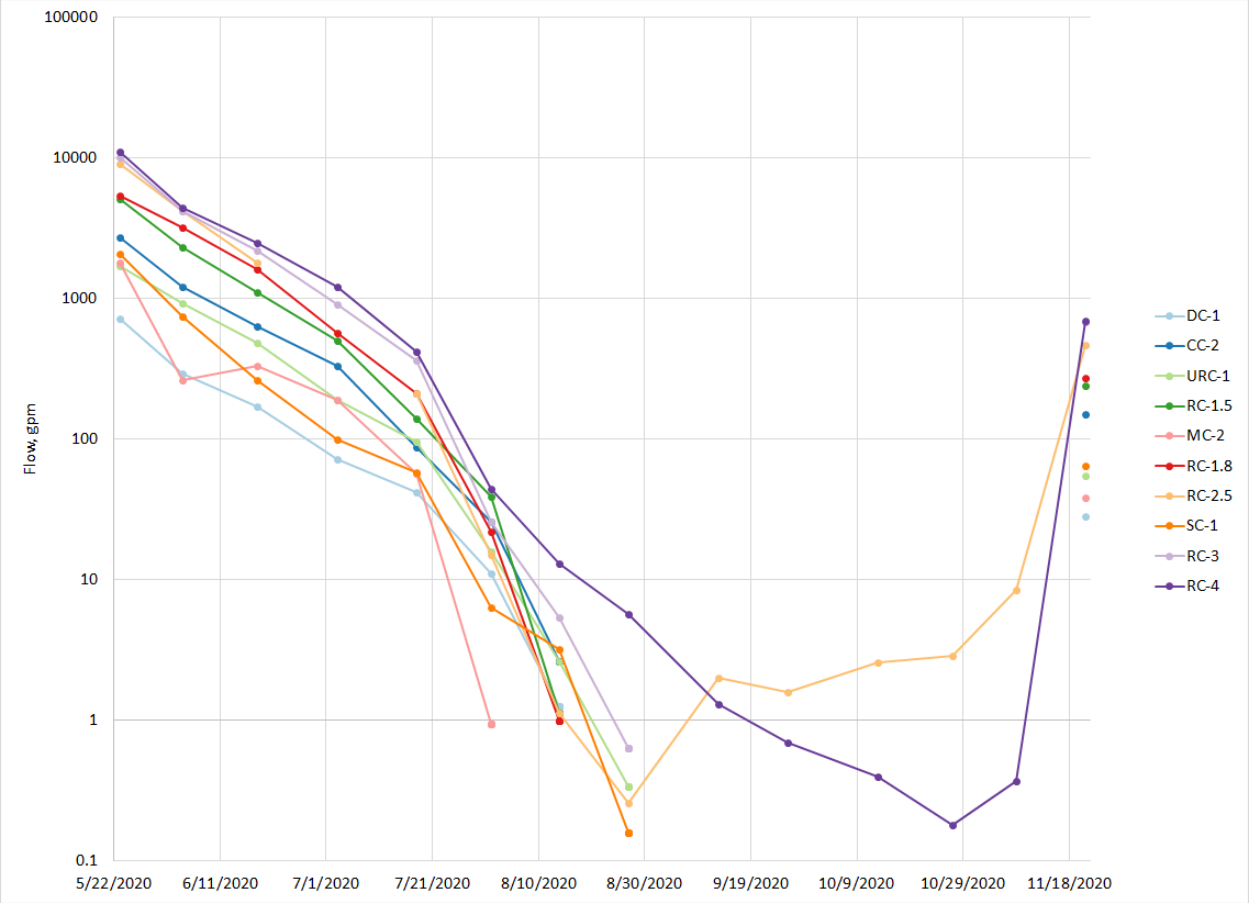

Figure 2. Redwood Creek monitoring sites visit flow measurements 5/23/20-11/21/20. Note: y-axis in logarithmic scale, zeros are not displayed.

China Creek, Site CC-2

Located about 100 yards upstream of confluence with Upper Redwood Creek near Briceland, CA

Monitoring began 5/23/2020 with two week intervals between monitoring visits. A pressure sensor was placed in the gage pool on 7/3/2020. The stage dropped below the logger 9/4/2020, I moved the logger back into the water on 9/13/2020 (Figure 3). Temperatures vary the highest amount during the time

when the logger is out of the water. Streamflow stopped 8/18/20 and didn't start again until 11/17/20 (Figure 4).

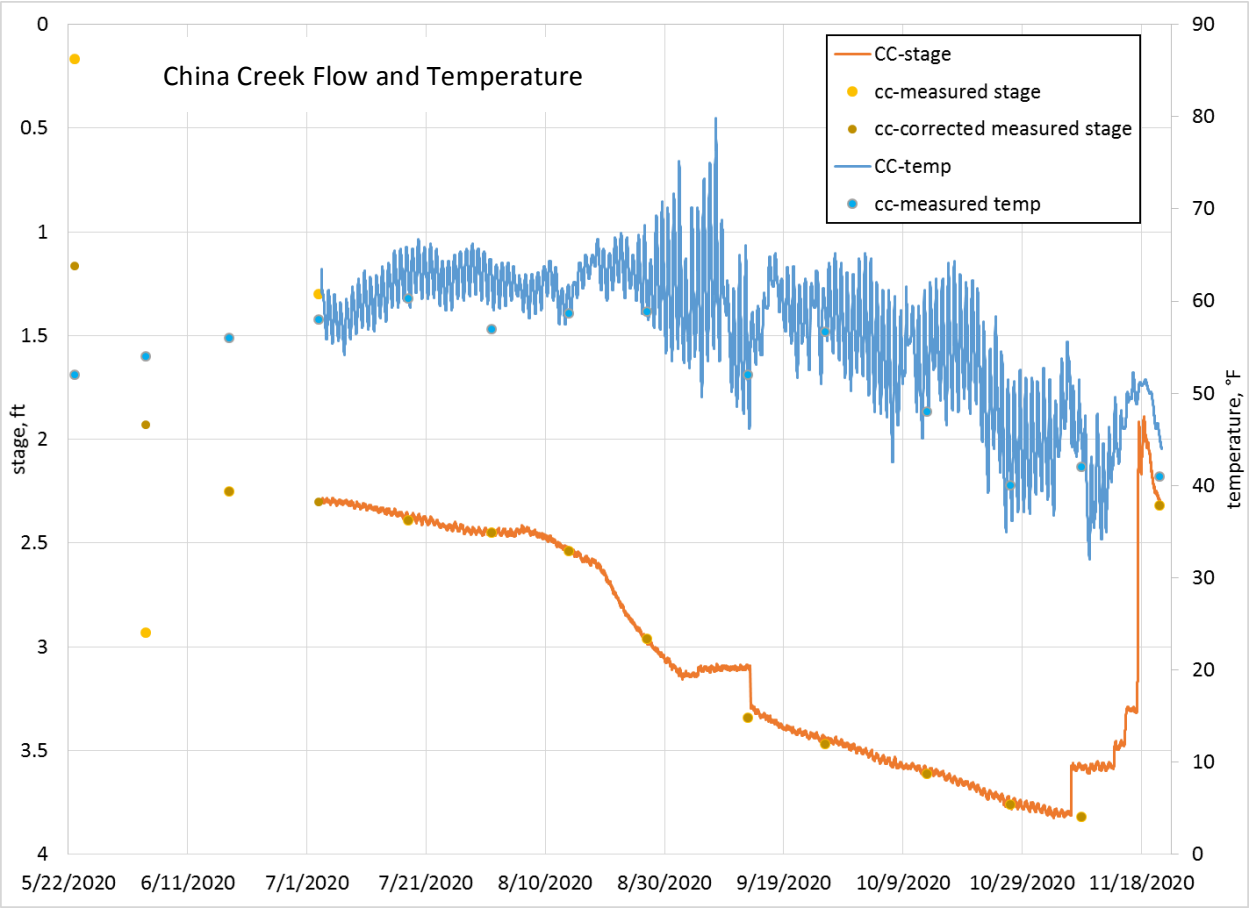

Figure 3. China Creek stage and temperature, measurements and sensor readings.

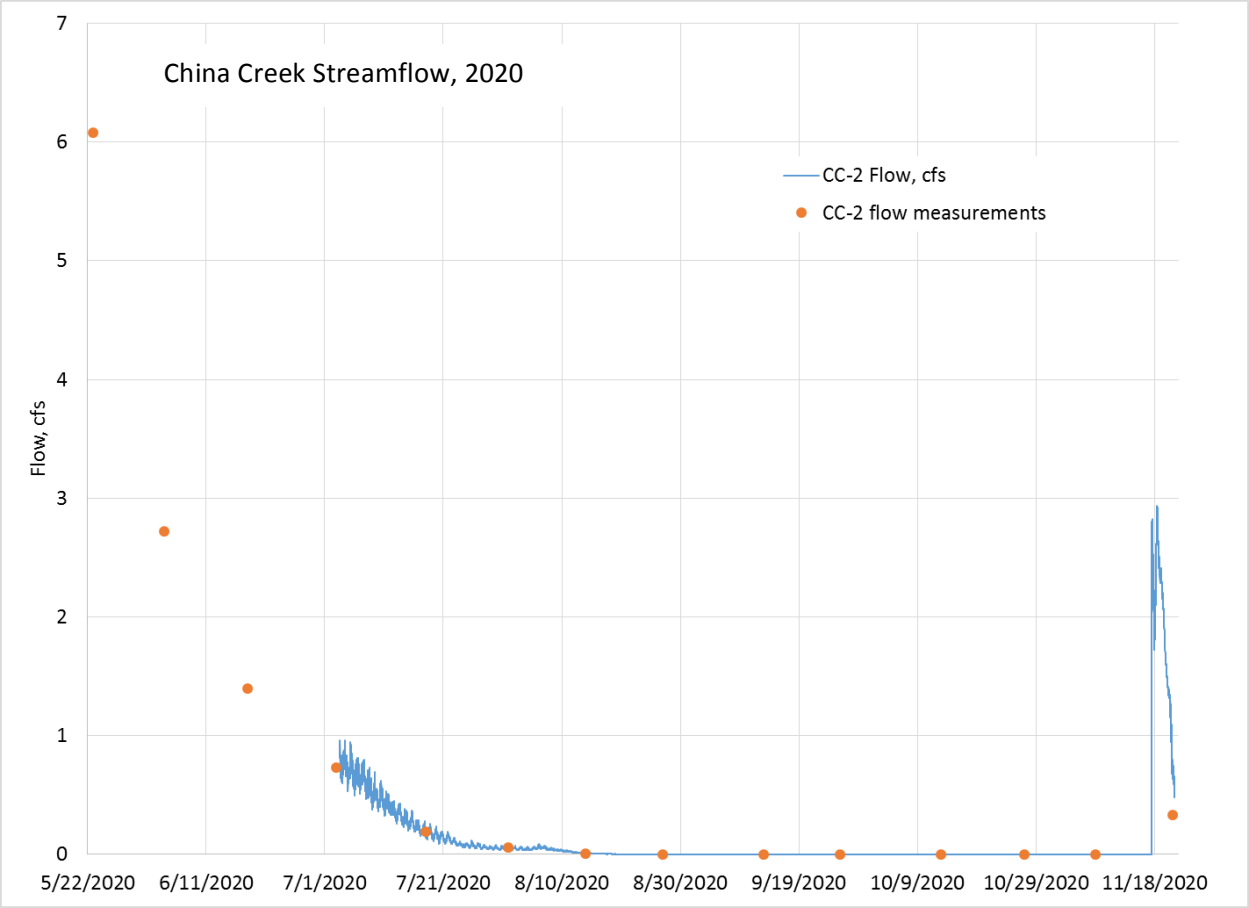

Figure 4. China Creek 2020 measured and modeled flow, cfs 5/23/20-11/-11/21/20.

Figure 5. China Creek standing near gage and looking towards riffle crest 5/23/20.

Figure 6. China Creek standing at gage and looking towards riffle crest 11/8/20.

Upper Redwood Creek, site URC-1

Located about 100 yards upstream of confluence with China Creek near Briceland, CA

The gage pool was completely dry on the monitoring visits 9/13/20 through 11/21/20 (Figure 7). There is a wide range of temperatures when the sensor was not submerged in water, it is more like the ambient air temperature. The riffle crest is at stage 1.229 ft. There was still flow coming into the gage pool when I measured at stage 1.48 ft, I estimate there was still flow coming in until stage 1.5 ft. The logger came out of the water at 1.55 ft. Streamflow stopped on 8/27/20 and did not start again until 11/17/20 (Figure 8).

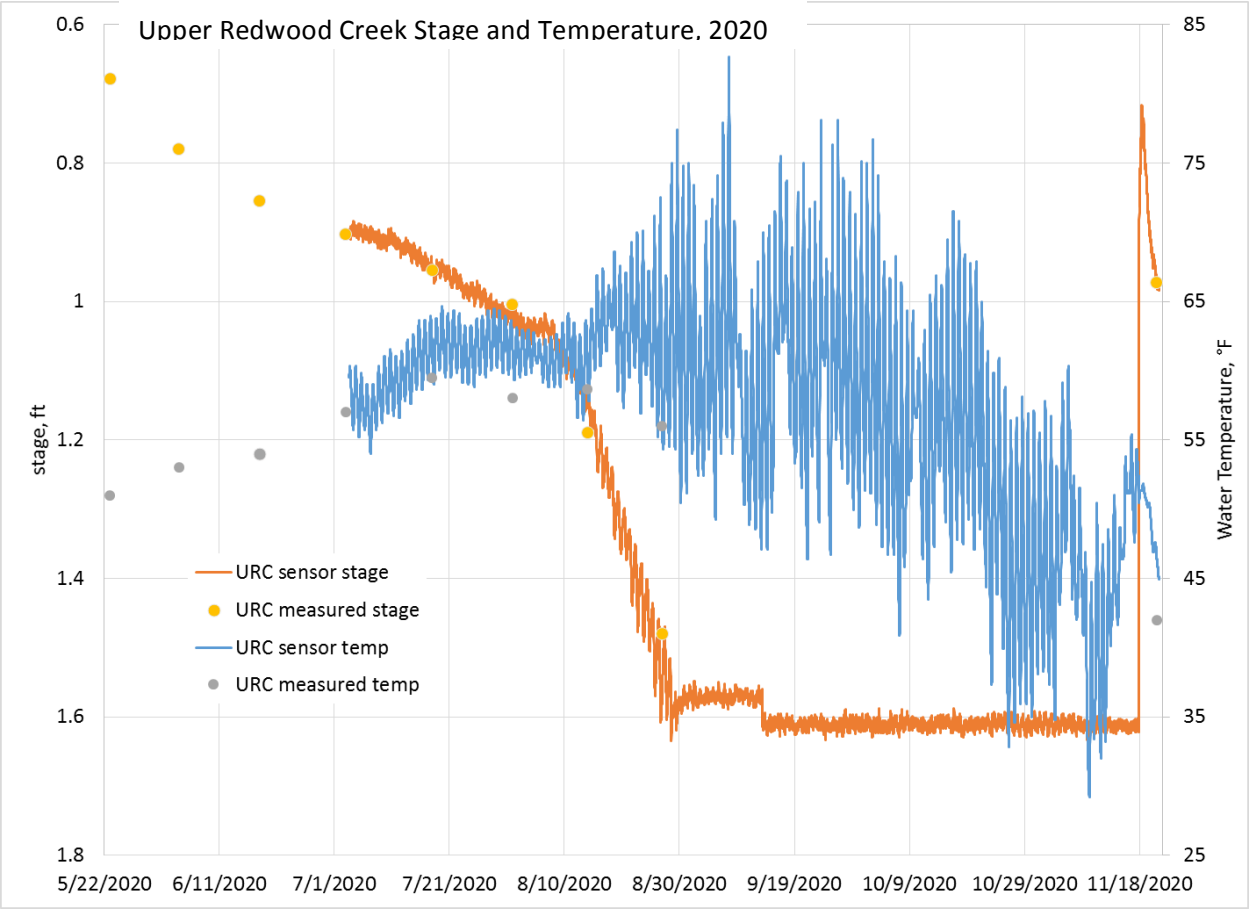

Figure 7. Upper Redwood Creek stage and water temperature. There was no water in the gage pool 8/28/20 to 11/17/20, there was a data download on 9/13/20.

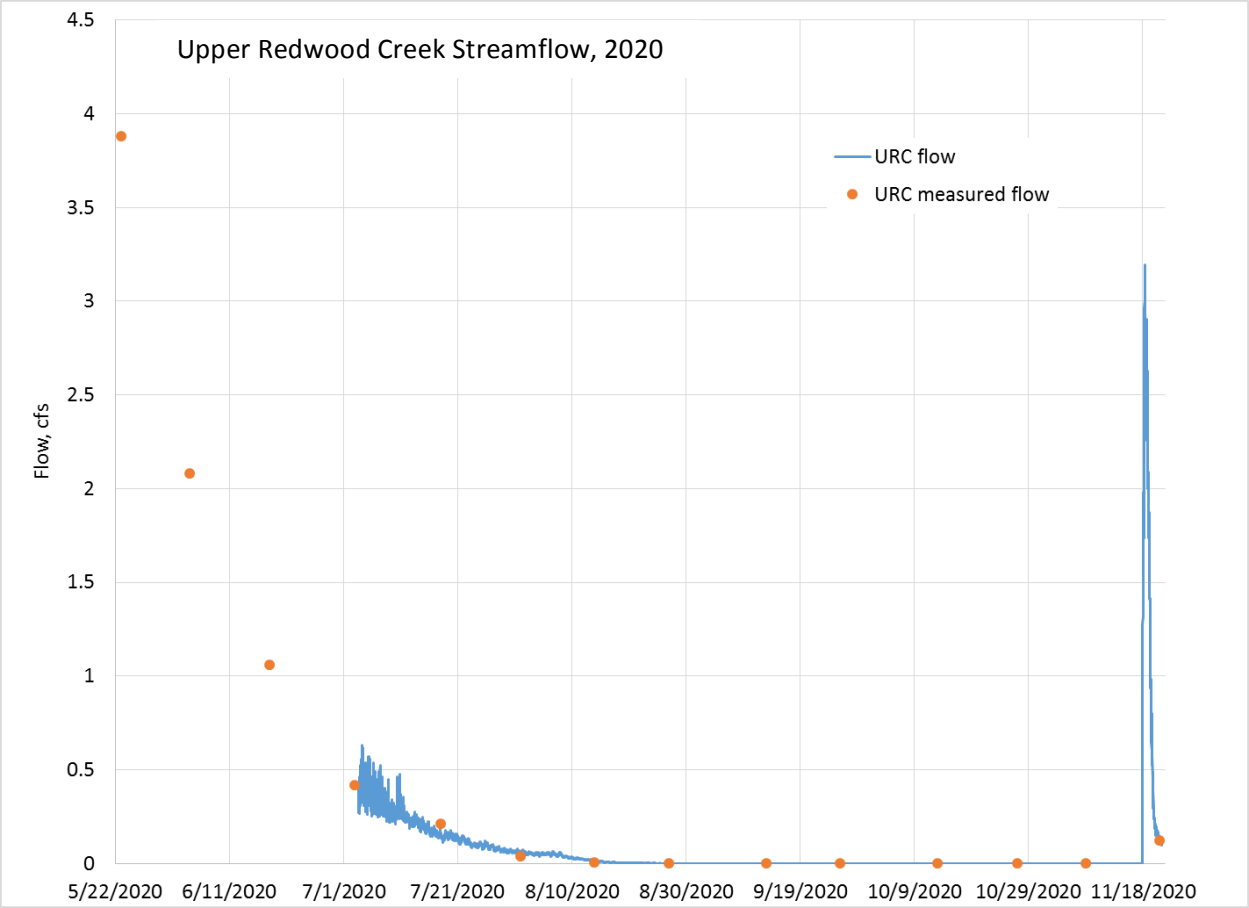

Figure 8. Upper Redwood Creek measured and modeled flow 5/23/20 to 11/21/20.

Figure 9. Upper Redwood Creek standing near gage and looking towards riffle crest 5/23/20

Figure 10. Upper Redwood Creek standing near gage and looking towards riffle crest 11/8/20.

Figure 11. Upper Redwood Creek gage pool 8/27/20, flow coming into the gage pool (0.00076 cfs), but the riffle crest was dry. The sensor was not submerged, just the tip touched the water to read water level.

Redwood Creek, site RC-1.5

Located upstream of Miller Creek in Briceland, CA

The water receded below the sensor on 8/29/20 and was put back in the water at the next monitoring visit on 9/13/20 (Figure 12). The water receded from the logger again on 9/28/20 and stays out of the water until 11/17/20, there wasn't enough water to move the logger. On 10/27/20 and 11/8/20 the water receded too far away from the stage reference to measure water level. The temperatures begin to have a high diurnal variance when the logger is not completely submerged, about 8/20/20 to 9/13/20 and 8/20/20 to 11/27/20. The streamflow stops on 8/15/20 and doesn't start again until 11/17/20 (Figure 13).

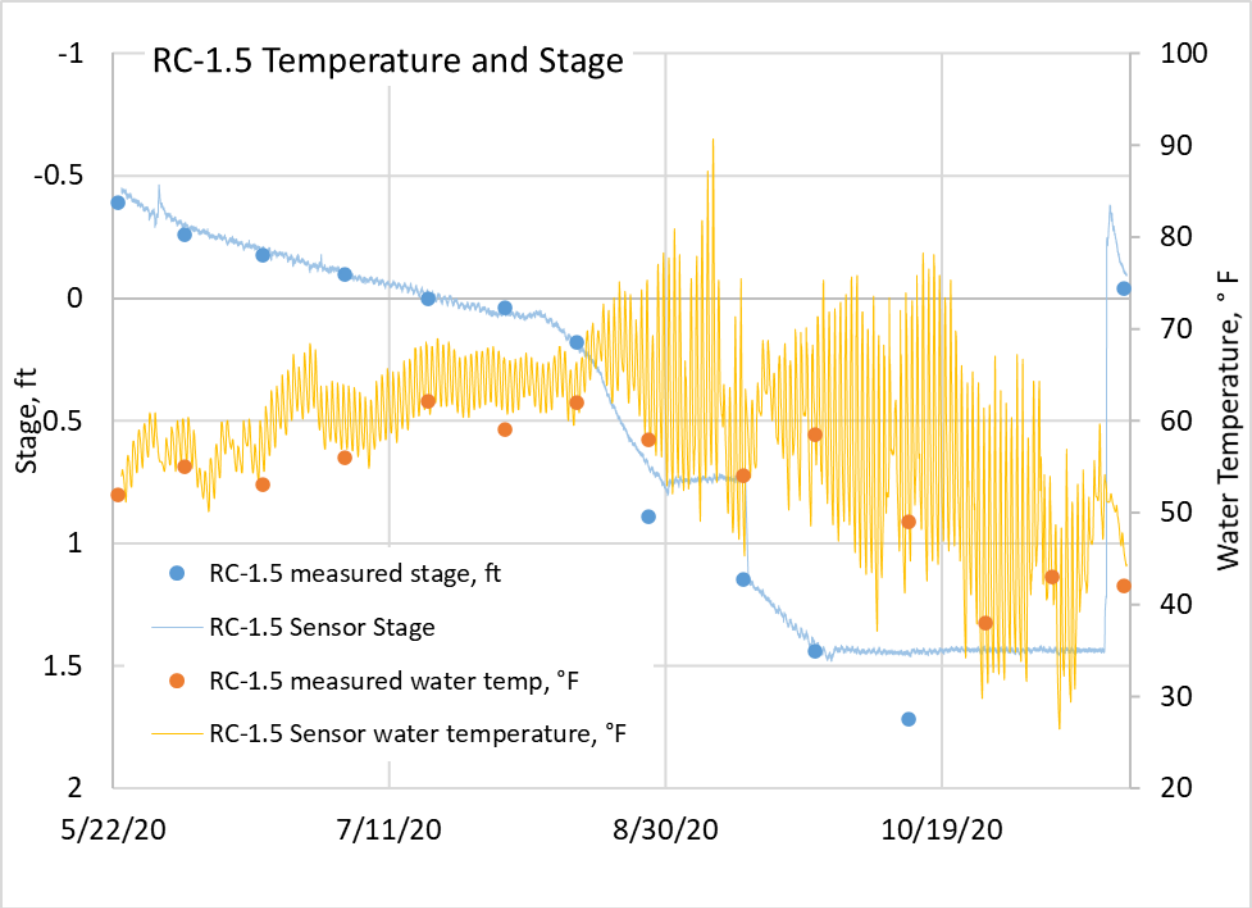

Figure 12. RC-1.5 water temperature (°F) and stage (ft) measured and from the sensor 5/23/20 to 11/21/20.

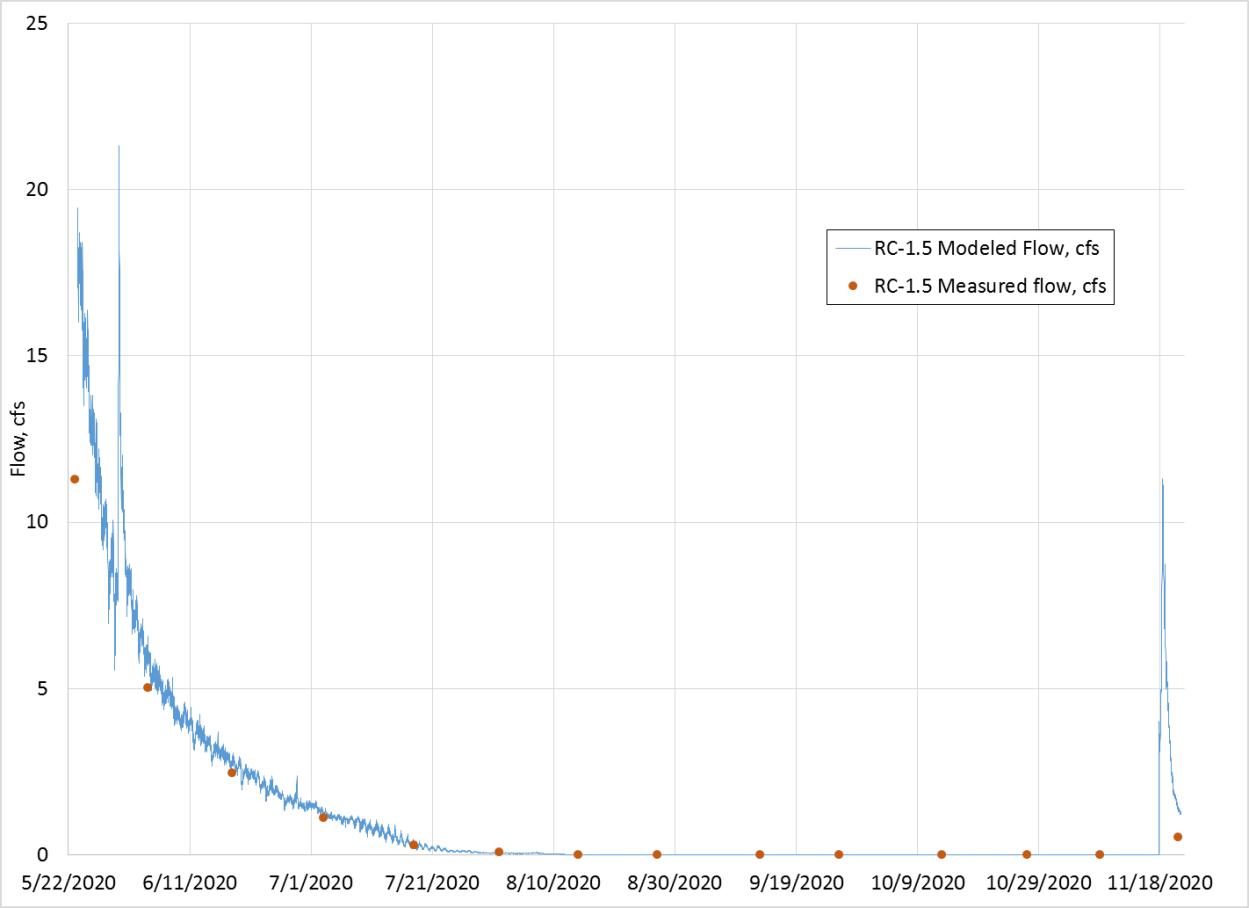

Figure 13. RC-1.5 measured and modeled flow (cfs), 5/23/20 to 11/21/20.

Figure 14. RC-1.5 looking downstream from reference point. Brandon Craig measuring flow at 11.31 cfs on 5/23/20.

Figure 15. RC-1.5 facing downstream 11/8/20. Dry stream bed.

Figure 16. Very little surface water in gage pool at RC-1.5 on 11/8/20.

Miller Creek, site MC-2

Monitoring site located about 500 yards upstream of confluence with Redwood Creek in Briceland, CA.

There is a cistern within bankfull of the gage pool. Miller Creek makes up the boundary between two properties. The property that uses the cistern uses the water up the hill and rarely comes down to the cistern, the other property owner spends time near the creek. On 8/14/20 the property owner that spends time on the creek observed dead fish from the pool drying after the cistern was on. The pools upstream of the cistern were full, but the pools downstream were impacted by the pumping. The property owners discussed the situation and the cistern owners cut the line to the cistern on 8/15/20 and began using an alternate source of water for the rest of the dry season. During my monitoring visit on 8/14/20, the logger was about a foot out of the water, I moved the logger back into the water without downloading the logger.

MC-2 stage and temperature readings from the sensor align with the measurements during monitoring visits. Pumping events from the cistern are apparent 7/30, 8/3, and 8/6 before the stage dropped below the sensor 8/7/20. I placed the sensor back in the water 8/14/20. The landowner observed the water level come up after the pump line was cut but not to previous levels before it started to drop again which corresponds to the sensor. The stage drops below the sensor again on 10/6/20. There wasn't enough water to take a stage reading 10/13 to 11/8. I forgot to measure temperature 7/3/20. There was not enough water to measure temperature 10/27 and 11/8. The flow stops on 8/3/20 and does not start again until 11/18/20.

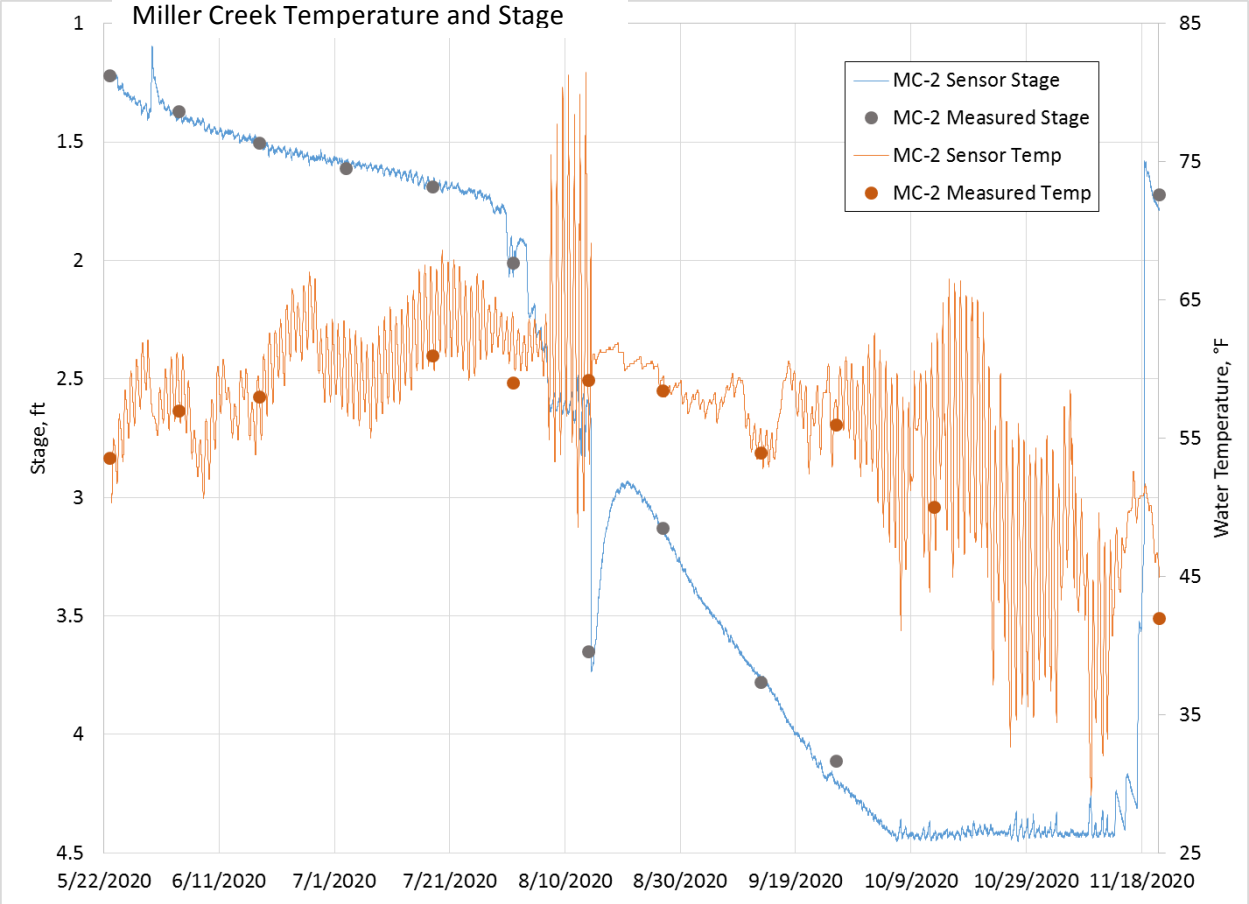

Figure 17. MC-2 sensor and measured stage and temperature 5/23/20-11/21/20.

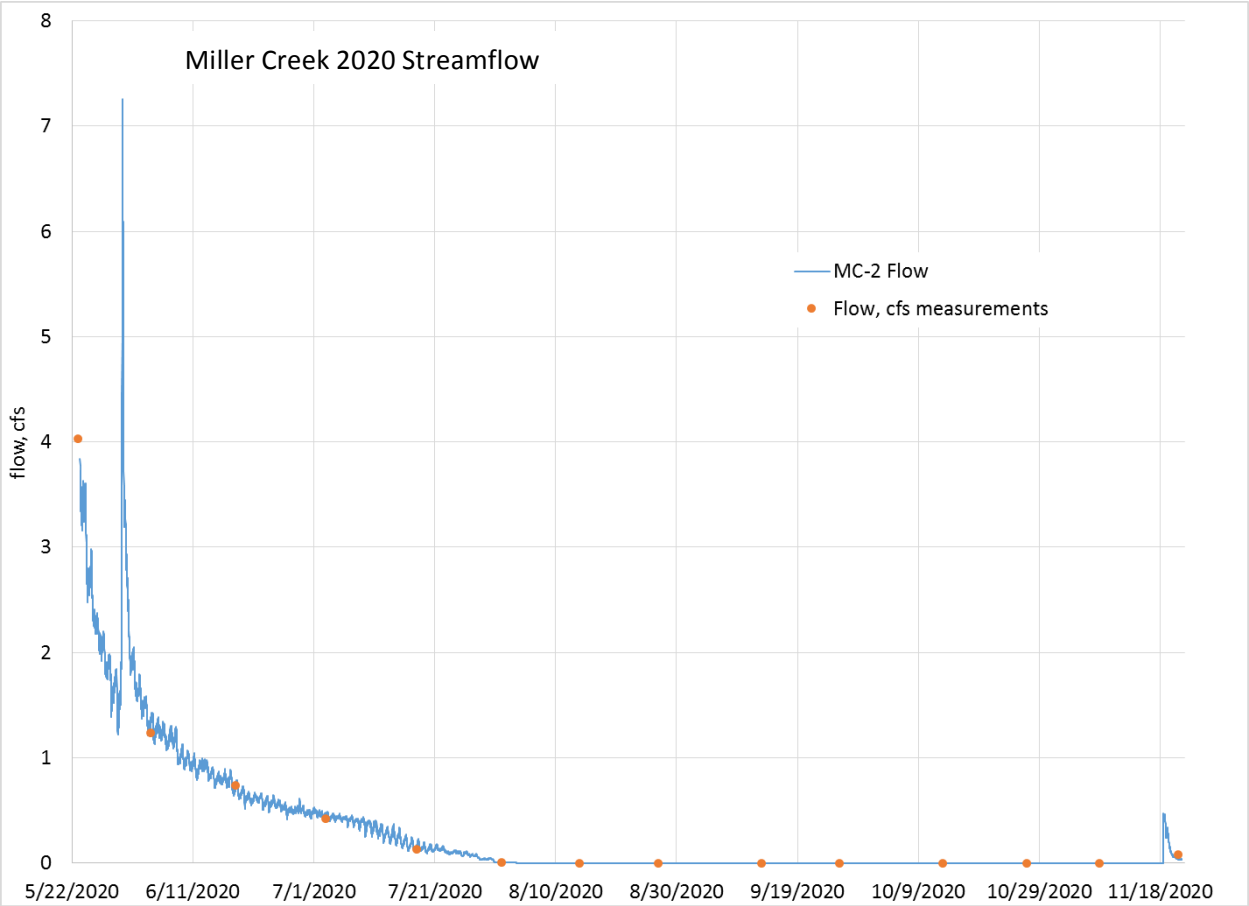

Figure 18. Modeled and measured flow at monitoring site MC-2.

Figure 19. Site MC-2 looking downstream from gage on 6/4/20.

Figure 20. Site MC-2 looking downstream from gage on 11/8/20.

Redwood Creek, site RC-1.8

Located downstream of Miller Creek in Briceland, CA

On 11/8/2020, the water surface had receded away from my measuring nail and I could not take a stage reading (Figure 21).

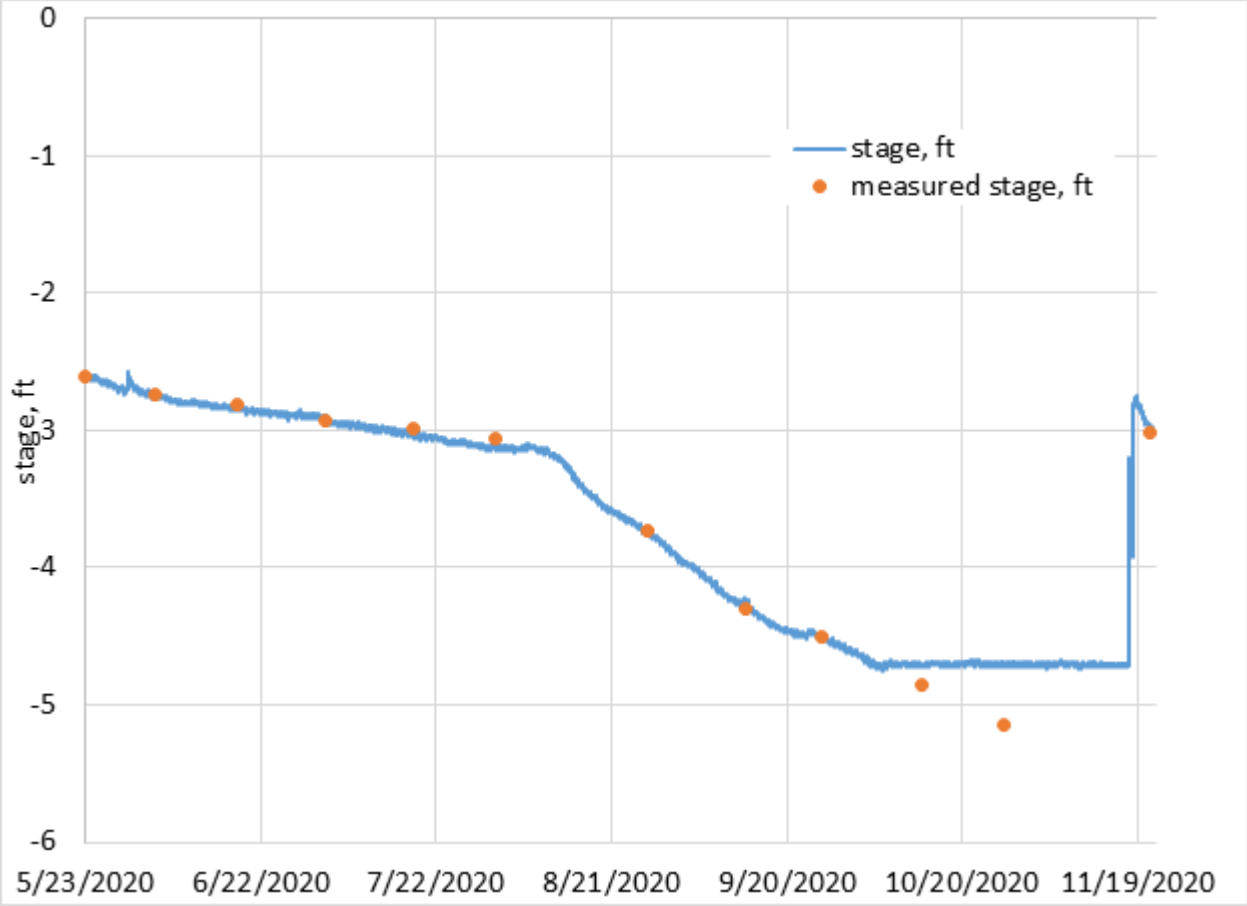

Figure 21. RC-1.8 predicted stage compared to measured stage 5/23/20-11/21/20.

The logger was mostly out of the water on 9/13, so moved back into the water (Figure 22). The logger was barely in the water 9/2-9/13. Between 10/7-11/18 the logger was not in the water, the pressure readings between the water and air loggers are similar during this time. I did not display the water temperature between 10/7 and 11/18 because the temperature shows the riparian air temperature, not the water temperature. Flow stopped around 8/11/2020 and did not return until suddenly on 8/17/20 (Figure 22).

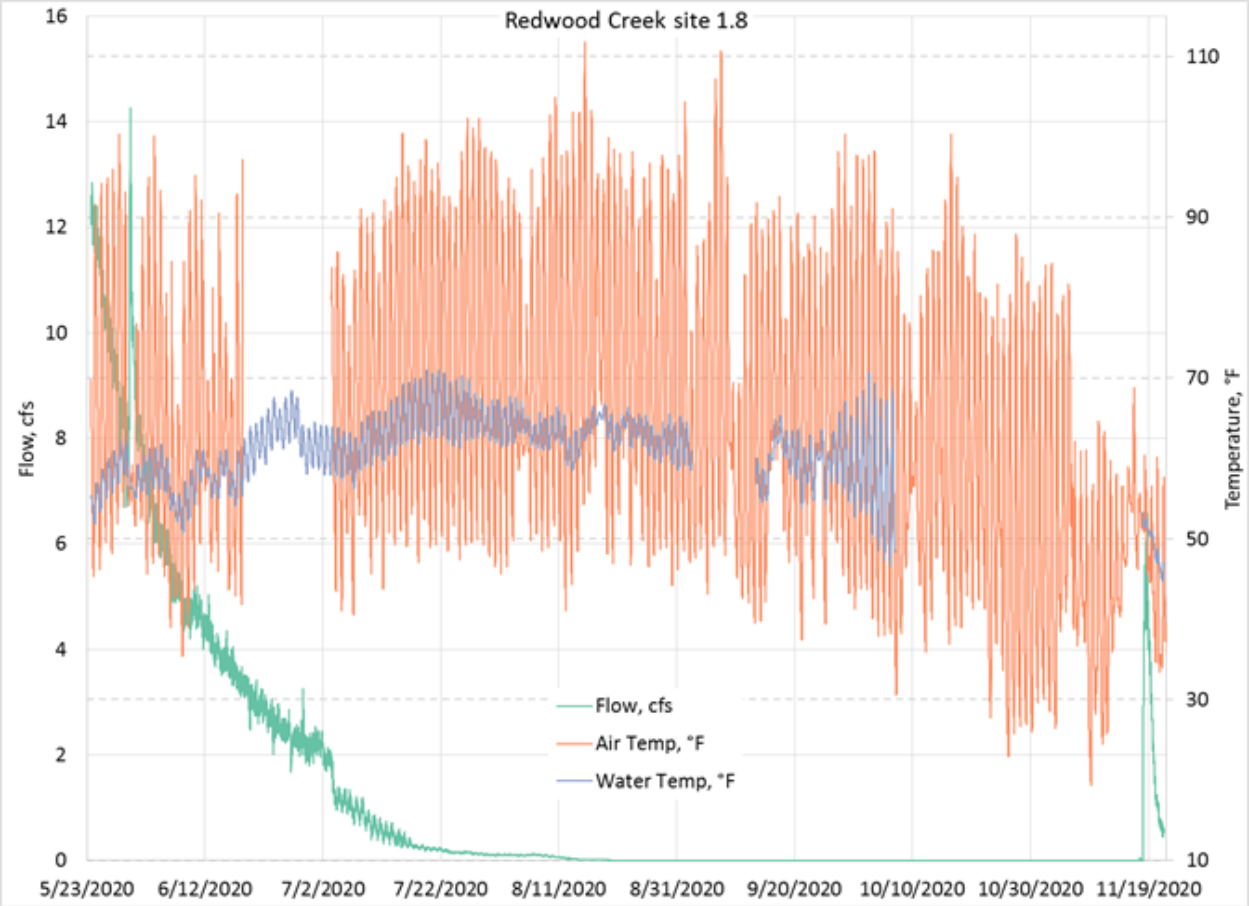

Figure 22. RC-1.8 Flow, water temperature, and air temperature.

Figure 23. RC 1.8 looking downstream 5/23/2020, 12 cfs.

Figure 24. RC 1.8 looking downstream 8/14/2020. Water surface receded from riffle crest.

Figure 25. RC 1.8 looking downstream 11/8/2020, most of the channel is dry.

Redwood Creek, site RC-3

Downstream of Seely Creek

The water level receded from the logger 9/7/20, I put the logger at the bottom of the pool on 9/13/20 (Figure 26). The pool dried up 10/2/20 and didn't get surface water again until 11/12/20.

The riffle crest in the gage pool is dry at 0.43 ft, but flow did not entirely stop at RC3 until a stage of 1.0 ft (Figure 27). The riffle crest in the gage pool starts to dry 8/3/20. The flow stops at the site on 8/30/20 and does not start again until 11/13/20.

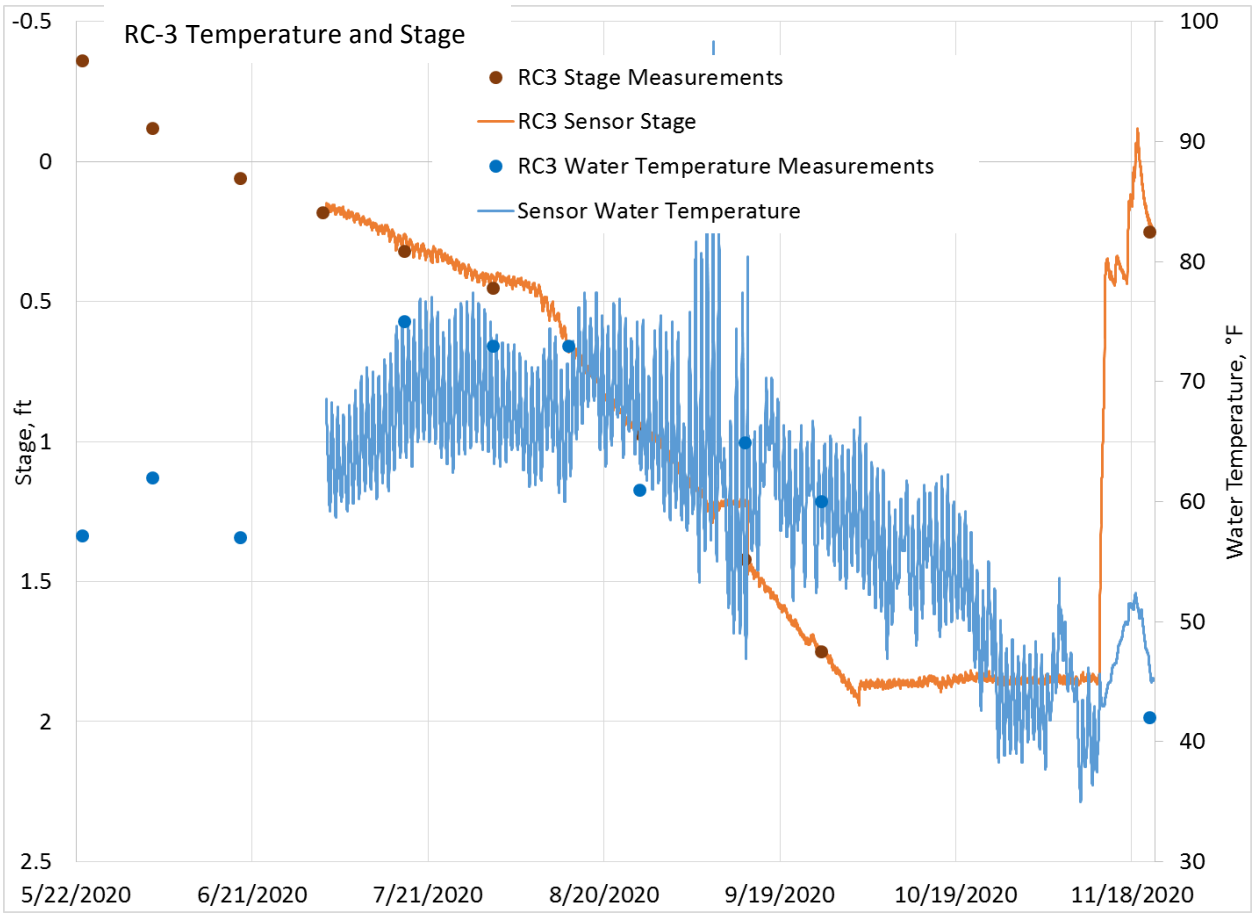

Figure 26. Redwood Creek site 3 sensor and measured stage and temperature 5/23/20 to 11/21/20.

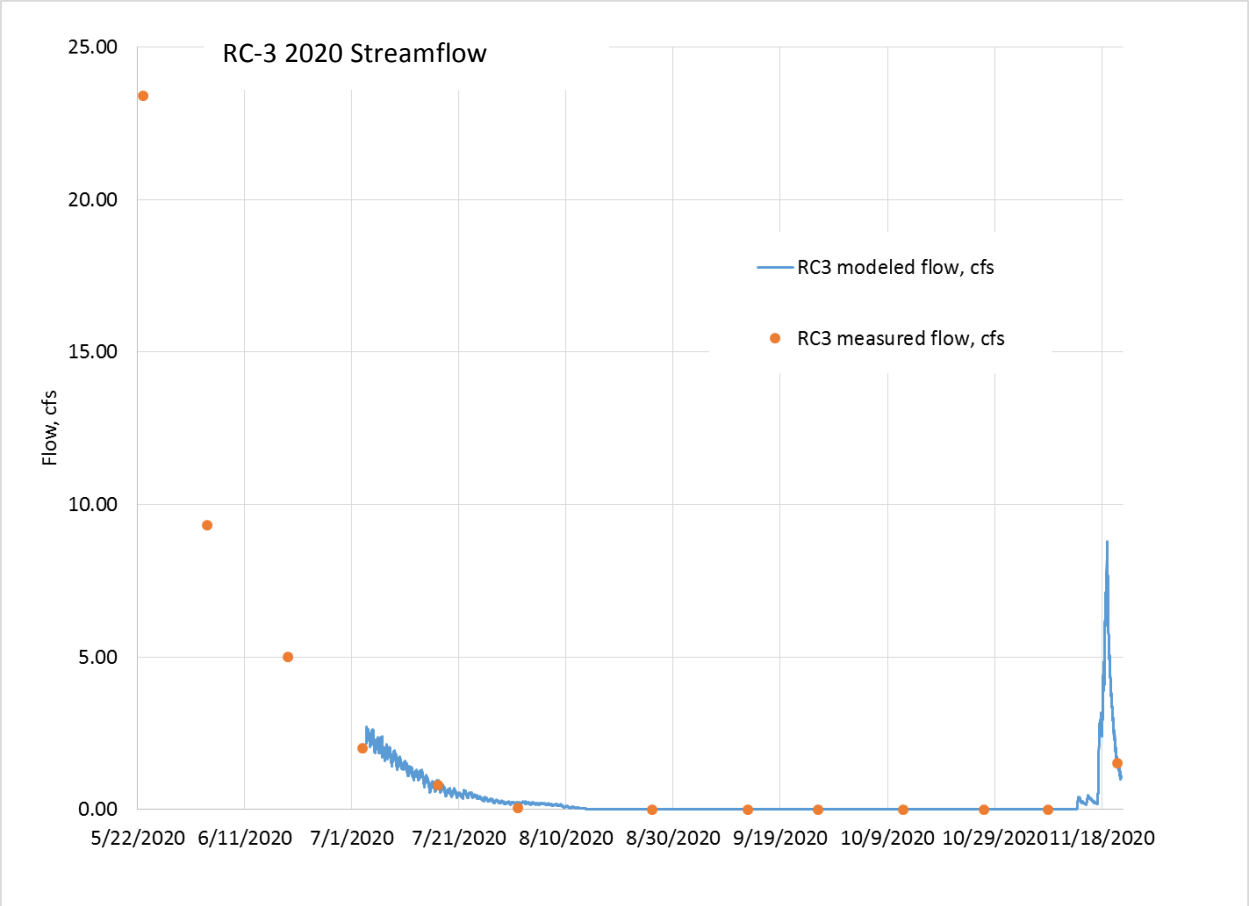

Figure 27.RC-3 flow measurements and the modeled flow from the sensor 5/23/20 to 11/21/20.

Figure 28. RC-3 facing downstream 8/1/20. The riffle crest at the downstream end of the gage pool is dry, but there is measurable flow at the boulder lip downstream (0.058 cfs).

Figure 29. RC-3 looking downstream from the gage site 5/23/20. Brandon Craig measured flow at 23.40 cfs.

Figure 30. RC-3 looking downstream from gage site 11/3/20. Stream bed dry.

Diner Creek, site DC-1

Diner Creek is a tributary to China Creek, the monitoring site is located about 100 meters upstream of the culvert that goes under the Briceland Road.

Zero flow is observed starting 8/27/20 until the last monitoring visit on 11/21/20 (Figure 31). The highest water temperature of 57.7°F was observed on 7/18/20. The lowest dissolved oxygen of 3.15 ppm was observed on 9/26/20 (Figure 32). There was not a dissolved oxygen reading on 10/27/20.

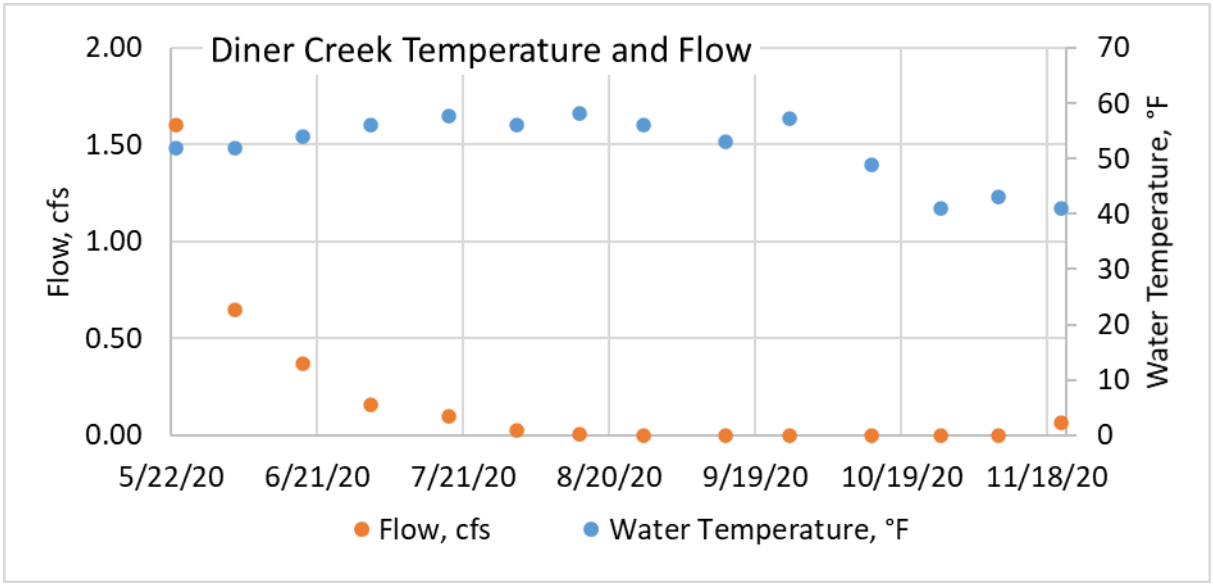

Figure 31. Measurements of flow (cfs) and water temperature (°F) at DC-1.

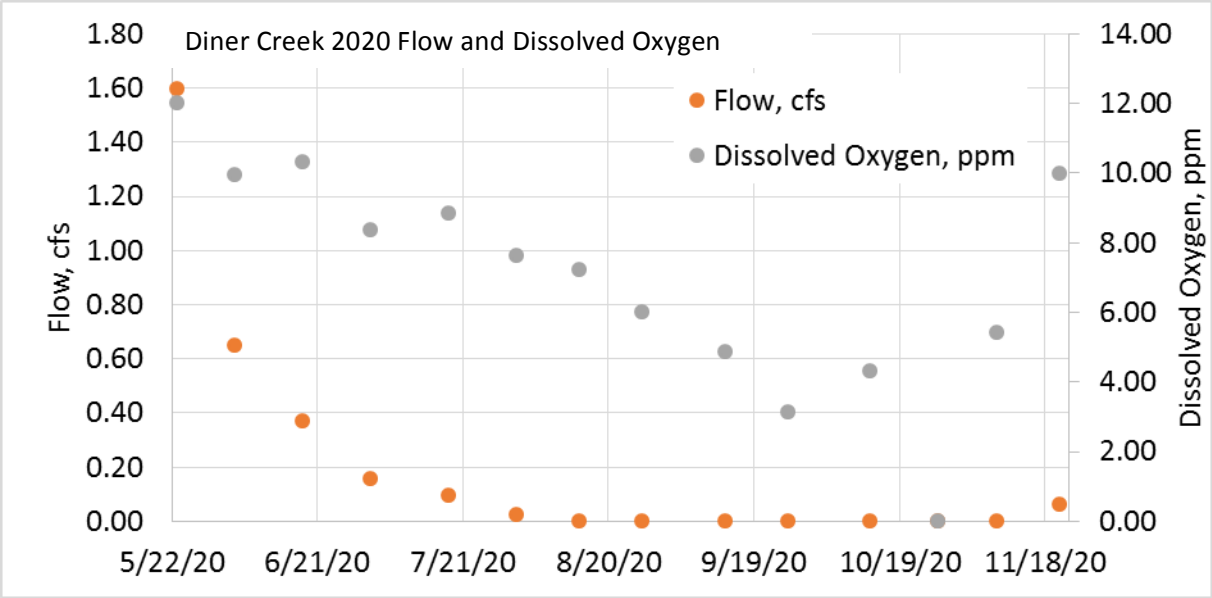

Figure 32. Measurements of flow (cfs) and dissolved oxygen (ppm).

Figure 33. Diner Creek facing downstream from the gaging site 5/23/20.

Figure 34. Diner Creek looking downstream from gaging site on 11/8/20.

Redwood Creek, site 2.5

There is a spring just upstream of the gage pool at RC-2.5 that kept a trickle of water coming through the site throughout the dry season (average of 0.006 cfs or 2 gpm). There were no measurements taken the week of 7/3/20. The lowest dissolved oxygen reading was 2.49 ppm on 10/27/20 (Figure 36).

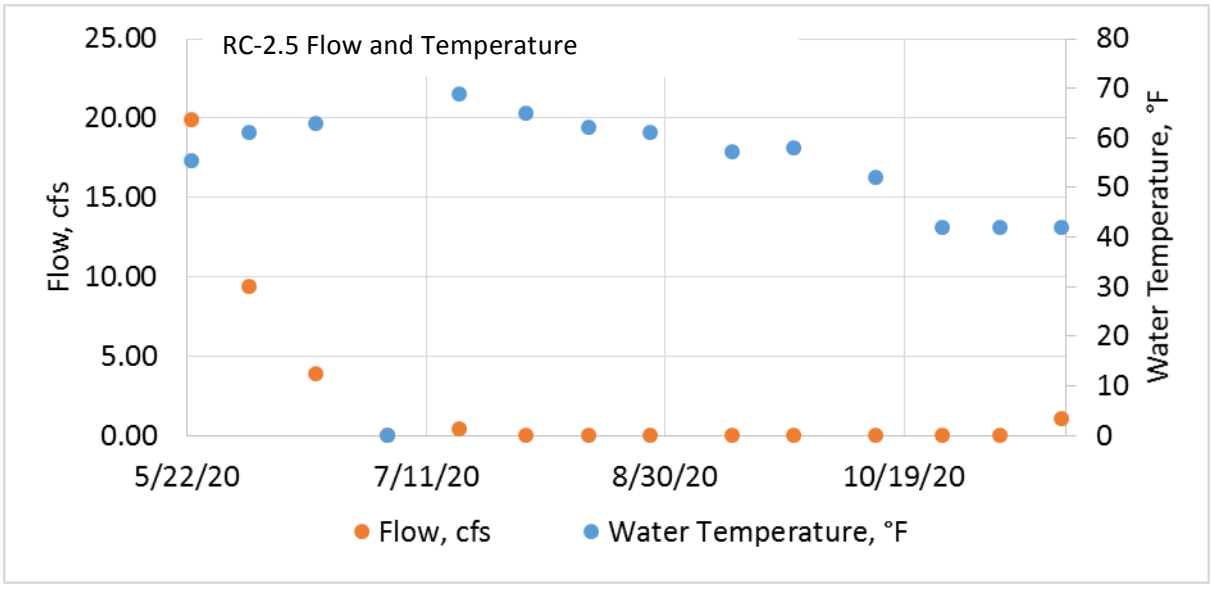

Figure 35. Redwood Creek site RC-2.5 flow (cfs) and water temperature (°F).

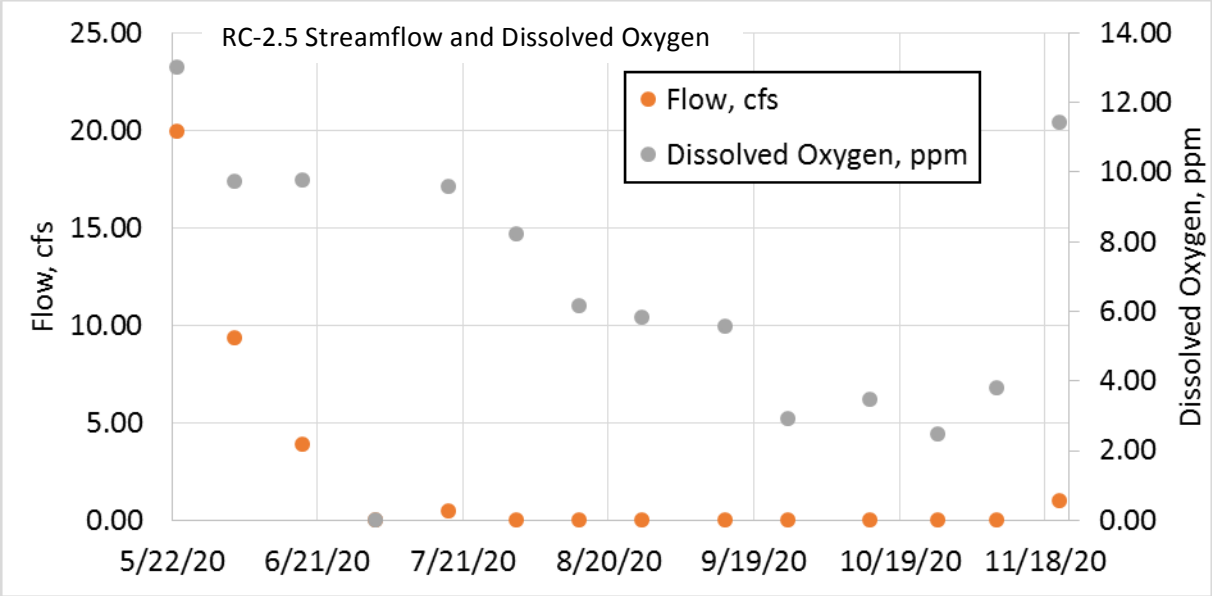

Figure 36. Redwood Creek site RC-2.5 streamflow (cfs) and dissolved oxygen (ppm).

Figure 37. Redwood Creek facing downstream from gaging point 5/23/20.

Figure 38. Redwood Creek site RC-2.5 facing downstream of gage pool 11/8/20.

Seely Creek, site SC-1

Located between confluence with Redwood Creek and the first bridge.

Very little flow was measured on 8/26/20 (Figure 39). The gage pool was observed to be dry on 9/13/20. Water was again observed in the gage pool on 11/21/20. Seely Creek was skipped for time the week of 7/3/20.

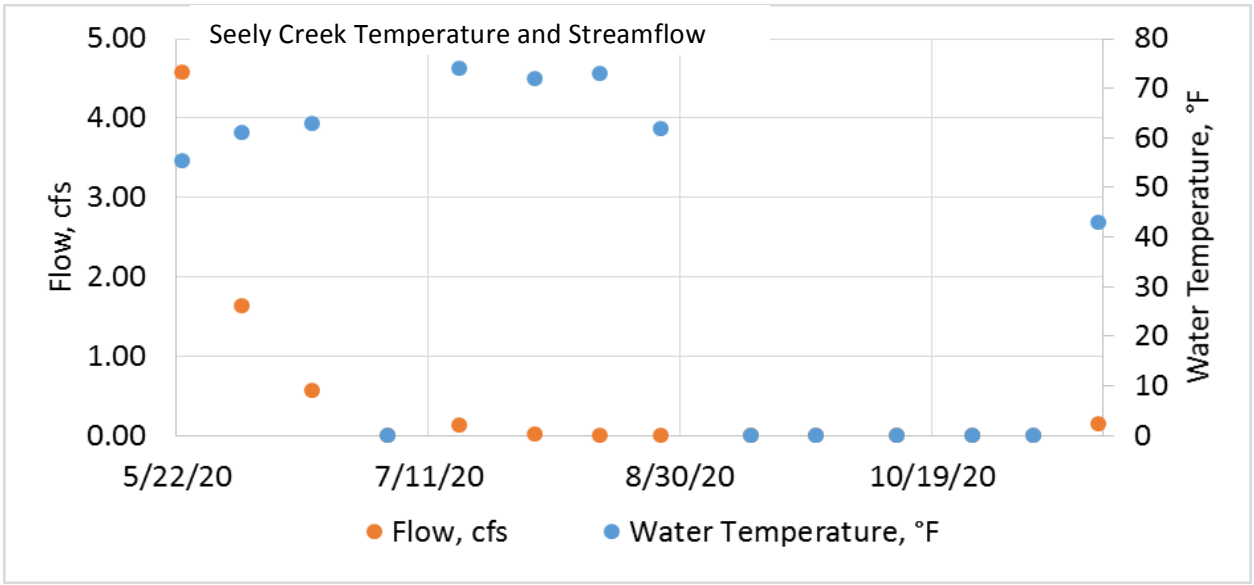

Figure 39. Seely Creek streamflow (cfs) and water temperature (°F).

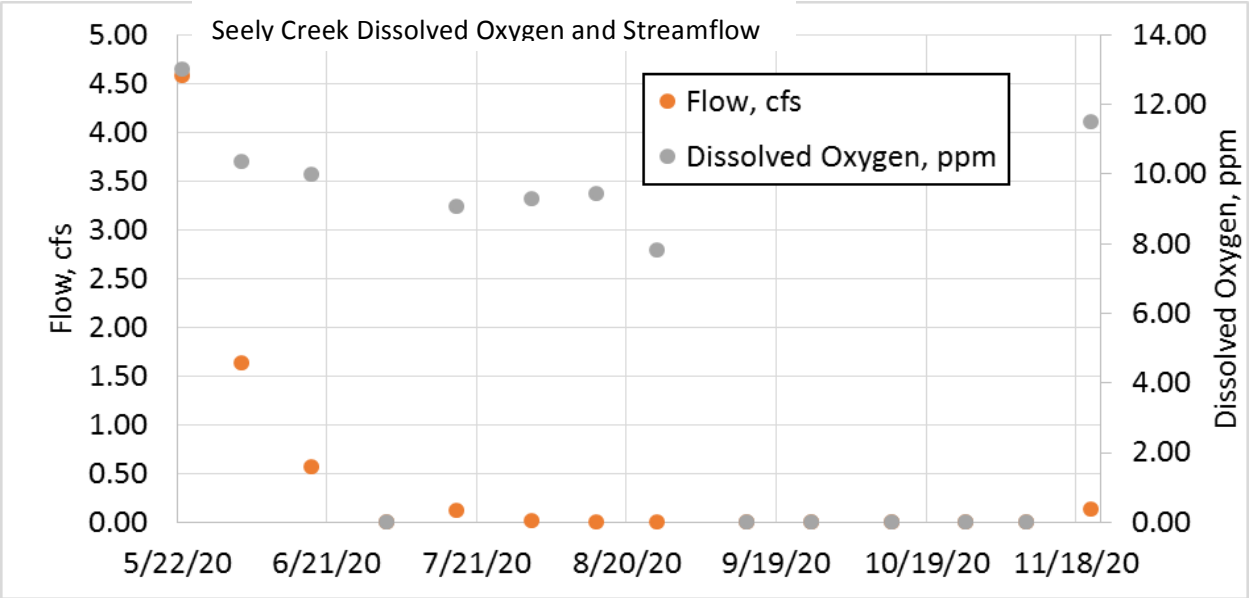

Figure 40. Seely Creek streamflow (cfs) and dissolved oxygen (ppm).

Figure 41. Brandon Craig measuring stream flow on Seely Creek 5/23/20.

Figure 42. Seely Creek, SC-1 looking downstream, 11/8/20.

Redwood Creek, site RC-4

Site RC-4 is located about 200 meters upstream of the Briceland road bridge, about a quarter mile upstream of the confluence with the South Fork of the Eel River. Areas around RC-4 became subsurface, but throughout the season there were places at RC-4 to measure surface flow (Figure 43). The lowest surface flow was 0.0004 cfs (0.18 gpm) measured on 10/27/20. The lowest dissolved oxygen was measured on 9/27/20 at 3.83 ppm.

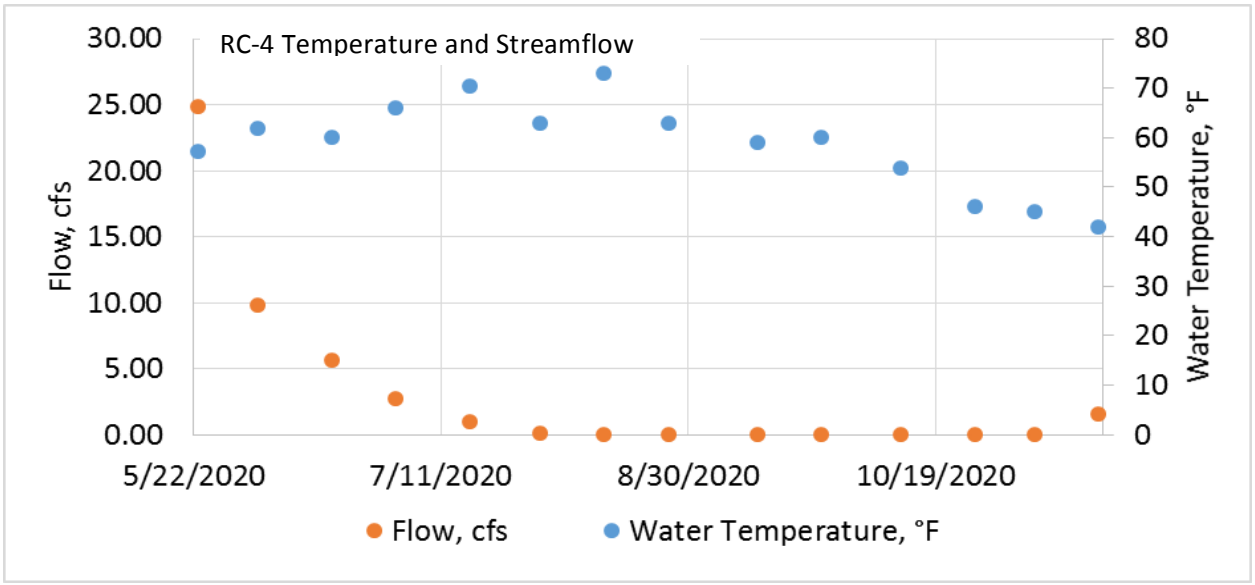

Figure 43. Redwood Creek site RC-4 flow (cfs) and water temperature (°F).

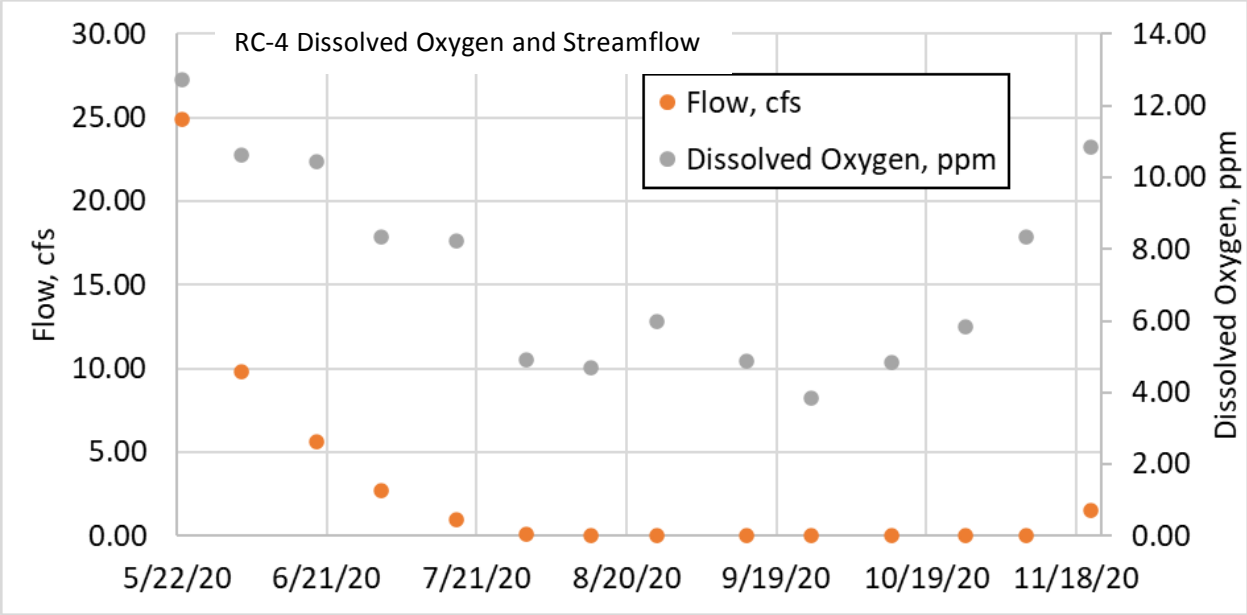

Figure 44. Redwood Creek sit RC-4 flow (cfs) and dissolved oxygen (ppm).

Figure 45. Site RC4 looking downstream from gaging site 5/23/20.

Figure 46. Redwood creek site RC-4 looking downstream from gage on 11/8/20.

There was an accident upstream of RC-4 on 8/12/20. KMUD radio reported that hydraulic fluid spilled in the creek, but the residents were able to mop most of it up. On 8/13/20 I observed a green film on the pool upstream of the RC-4 gage pool (Figure 47). I was nervous that it was a result of the spill, but on 8/14/20 I also observed the green film at RC-3 which is upstream of the accident site. A sample of the water was taken and tested for hydraulic fluid, there was no hydraulic fluid in the water.

Figure 47. Green film on pool upstream of gage pool 8/13/20.

RC-4 2013-2020

Since RC-4 is the lowest site in the watershed, it is a good site to compare against other years (Figure 48). The spring was relatively wet. Compared to some years, the flow did not stop at RC-4 this year. The winter rains came later than most years. Water year 2019 had the latest winter rains, but it was overall the wettest year since 2013.

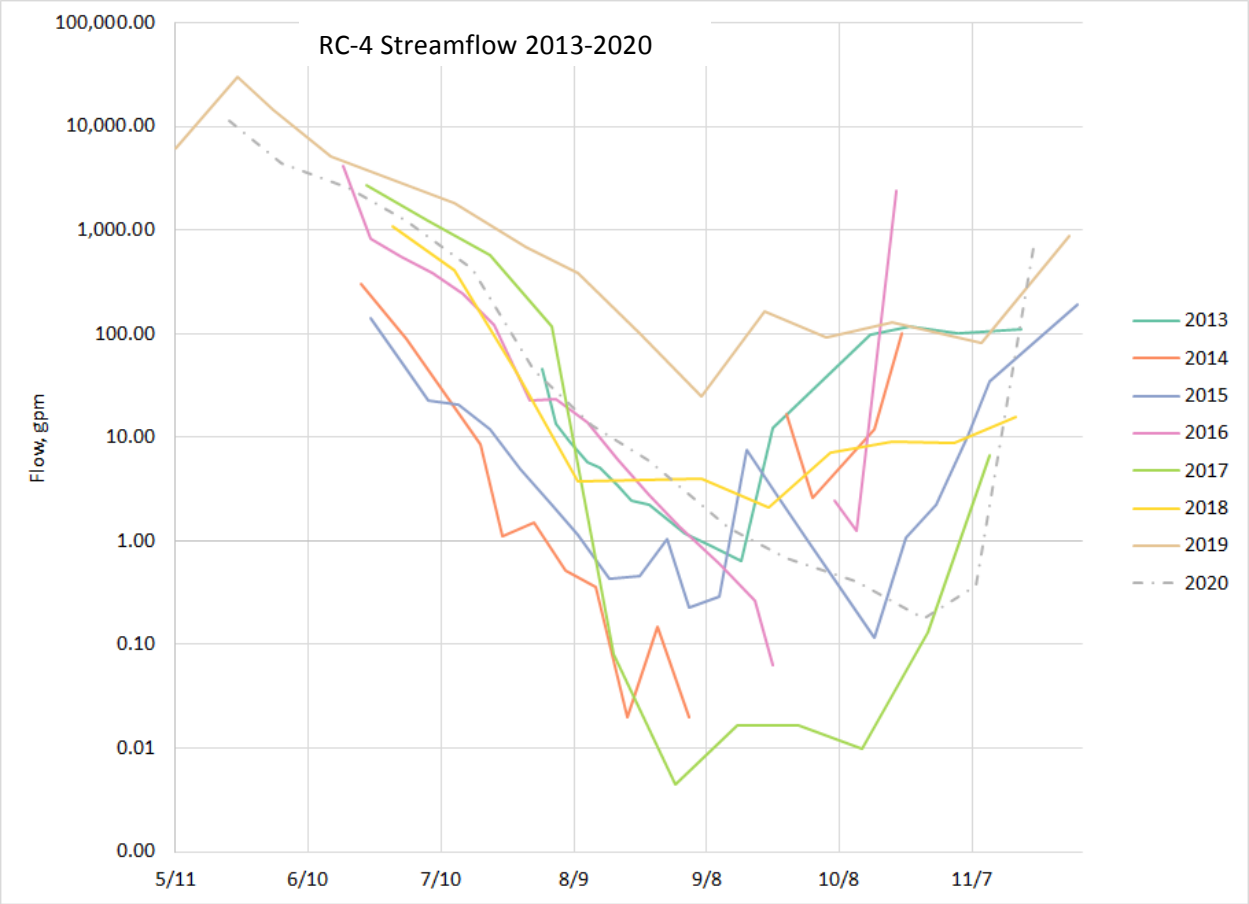

Figure 48. Redwood Creek site RC-4 measurements from 2013 through 2020. The 2020 season has a dashed line. Note the logarithmic scale in the y-axis, zero flows are not included.

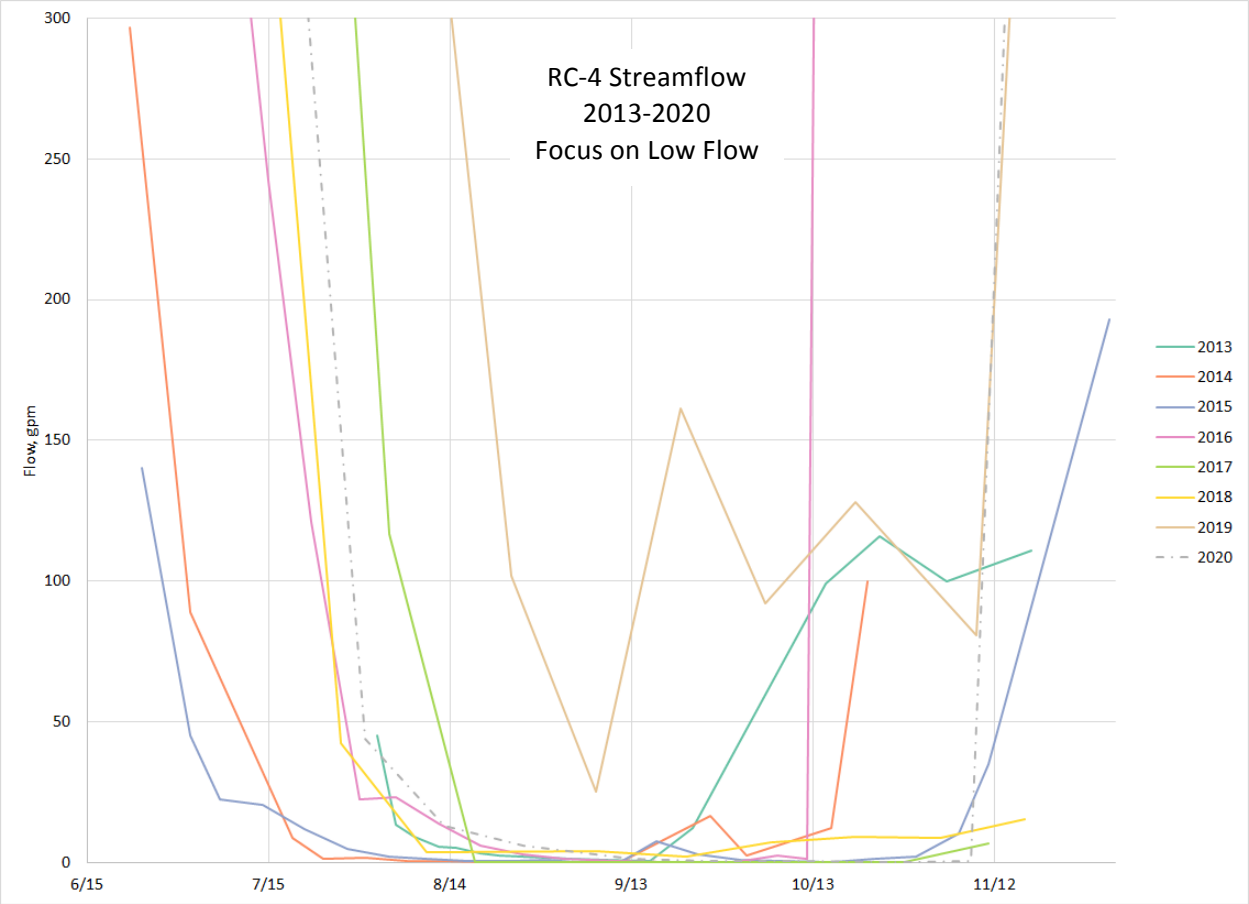

Figure 49. Redwood Creek site RC-4 measurements from 2013 through 2020. The 2020 season has a dashed line. Note y-axis and time scale zoomed in to see the low flow period.