

**SANTA MARGARITA BASIN
STREAMFLOW MONITORING,
DRY SEASON OF 2021**

Report prepared for:
County of Santa Cruz, Environmental Health Services

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May 2022

(revised May 27, 2022)

A report prepared for:

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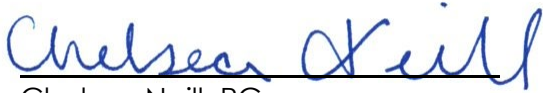
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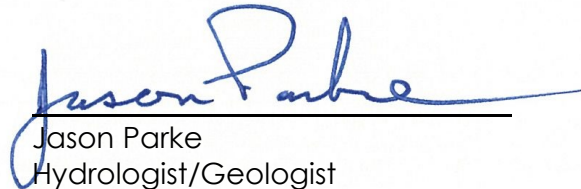
SANTA MARGARITA BASIN STREAMFLOW MONITORING, DRY SEASON OF 2021

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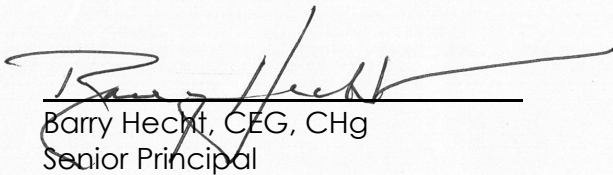
by



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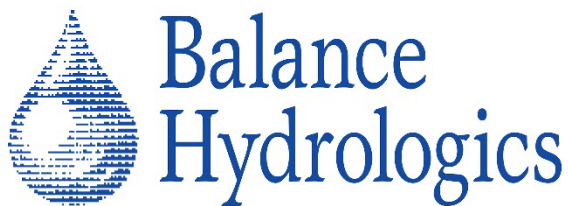
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1. INTRODUCTION

1.1 Background

Under the Sustainable Ground Water Management Act (SGMA) government and water agencies are required to develop and implement Groundwater Sustainability Plans (GSPs) to sustainably manage groundwater. One of the six sustainability indicators that must be evaluated within the GSP is the potential depletion of interconnected surface water that has significant and unreasonable adverse impacts on beneficial users of the surface water. As part of the Santa Margarita Groundwater Agency's (SMGWA) GSP process hydrologic monitoring and studies are on-going to evaluate the connection between surface water and groundwater within the basin. These studies include streamflow gaging, as part of the Santa Margarita monitoring network, and accretion studies. In addition to these studies providing an understanding of aquifer dynamics and surface-groundwater exchange, they also serve as the quantitative baseline against which the recharge and other management efforts described in the GSP can be assessed in future 5-year assessments.

The agencies sponsoring the overall investigation are the Santa Margarita Groundwater Agency, County of Santa Cruz Division of Environmental Health, the San Lorenzo Valley Water District, the Scotts Valley Water District, and the City of Santa Cruz. They have authorized Balance to continue to collect measurements of flow, conductance, water temperature, and other variables which may help characterize baseline conditions at the inception of the Santa Margarita GSP, as well as post-fire hydrology from the CZU event (2020).

1.2 Streamflow Gaging

Balance has operated streamflow gages for the County of Santa Cruz more or less continually since 2017 to establish an understanding of the current hydrologic conditions within the Santa Margarita basin. As part of the on-going GSP process, the monitoring network was adapted during water year 2020 to include five gaging locations. Three of the gages, including Zayante Creek at Woodwardia Weir, Bean Creek at Mount Hermon Camp, and Newell Creek upstream of the San Lorenzo River have been monitored previously (**Figure 1**). The gage on the San Lorenzo River upstream of Love Creek (**Figure 1**), was installed in June 2020. The fifth gage is planned for Bean Creek downstream of Mackenzie Creek and is projected to be installed during water year 2022.

During water year 2021 the stream gages were operated seasonally from May to just prior to the first rain to focus on the drier summer and early fall months. This monitoring season is critical for understanding low-flow conditions when groundwater contributions to surface flow are the most important for maintaining flows and temperature for aquatic species, as well as for other beneficial uses.

Each streamflow gage was instrumented with a pressure transducer, which measures depth, specific conductance, and temperature and takes a reading every 15-minutes. The transducers are housed in a stilling well located within a pool, somewhat out of the main flow path, but not isolated from the stream flow. A staff plate was established and nearby locations for calibration flow measurements were determined. A barometric sensor was installed in the Basin to compensate for barometric pressure (subtracted from the stream pressure transducer record).

Regular (approximately monthly) visits were performed from May to November to measure flow, collect specific conductance measurements, make observations, and maintain the gages. High-water marks were also noted to inform the gaging record, and to assess whether urbanized hydrology or waves of water and debris released during rupture of small logjams (or big ones, too, for that matter) may have affected the channel. Details of the individual measurements made during each routine visit are chronicled in **Tables 1-4**.

We have attempted to make our measurements as compatible as possible with the formal methods used by the state and federal agencies. Traditionally, these have been published as the manuals of the Federal Interagency Sedimentation Program (FISP), which is a compilation of methods from the individual agencies, traditionally updated at intervals of about 5 to 10 years.

1.3 Accretion Studies – Previous Work

This WY 2021 report and ongoing dry season flow monitoring can be put in a more meaningful context when considering the previous years' work which shows general patterns of gaining and losing reaches of streamflow as well as downstream changes in specific conductance, nutrients and water temperature. The data from these reports reflect dry to above average precipitation conditions. Previous work also includes more focused efforts on particular reaches within the San Lorenzo River basin including Eagle Creek, Bean Creek, Zayante Creek and the San Lorenzo River between Felton and the Glen Arbor Bridge. The water year 2020 report (Neill and others, 2021) includes data

reflecting the effects of the CZU fire when much of the San Lorenzo Valley was evacuated and smoke created and insulating 'cloud' cover that suppressed temperatures in the region.

Please refer to the following reports (also cited in the references section) for background on these particular topics:

Neill, C., and Hecht, B., 2020, Draft Water Year, 2019, Accretion assessment on Bean Creek and adjoining parts of lower Zayante Creek, Balance Hydrologics consulting memo 218237, 5p. plus figures.

Neill, C., Hecht, B., Goodwin, E., and Parke, J. 2021, Water Year, 2020, Santa Margarita Basin Streamflow Monitoring and Accretion Assessment, Dry Season of 2020, consulting report 220237, 19p. plus figures, tables and forms.

Parke, J., and Hecht, B., 2018, Draft San Lorenzo River longitudinal flow accretion and hydrochemistry, Balance Hydrologics consulting report 216109, 17 p. plus appendices.

Parke, J., and Hecht, B., 2020 a, Draft San Lorenzo River longitudinal flow accretion and hydrochemistry reconnaissance, summer of Water Year 2019, Balance Hydrologics consulting report 218109, 19 p. plus appendices.

Parke, J., and Hecht, B., 2020 b, Draft Eagle Creek preliminary hydrogeological reconnaissance, summer of water years 2018 - 2020, Balance Hydrologics consulting report 218109b, Dec. 2020, 18 p. plus appendices.

Richardson, C., Zimmer, M.A., Packrell, J.K., and Paytan, A., 2020, Geologic controls on source water drive baseflow generation and carbon geochemistry: Evidence of nonstationary baseflow sources across multiple watersheds: Water Resources Research, e2019WR026577, <https://doi.org/10.1029WR026577>

2. RESULTS

2.1 Conditions During Water Year 2021

2.1.1 Precipitation

Water year 2021 can be characterized as a critically dry year, with below-average annual precipitation, which resulted in lower-than-average flows (**Figure 2**). The San Lorenzo Valley Water District rain gage in Boulder Creek received 18.75 inches of rain (approximately 37% of the long-term average) and the CDEC rain gage in Santa Cruz (CRZ) received 14.58 inches of rain (approximately 51% of the long-term average) This is the second consecutive below average rainfall year. During water year 2020 in Boulder Creek received 21.40 inches of rain (approximately 42.5% of the long-term average) and the CDEC rain gage in Santa Cruz (CRZ) received 18.94 inches of rain (approximately 66% of the long-term average). The resulting runoff during water year 2021 from the San Lorenzo River was approximately 20.4 cfs or 16% of the long-term average, as measured at the USGS Big Trees stream gage. Streamflow during water year 2020 was 44.4 cfs or 35% of the long-term average at the Big Trees gage. See **Figure 1** for gage locations.

2.2 Antecedent and Episodic Events Potentially Affecting Flows

The CZU lightning Complex Fire began on August 16, 2020 after a thunderstorm produced widespread lightning throughout the Bay Area. The fire began as several small fires within the Santa Cruz Mountains, which expanded and merged with changes in wind. The fire destroyed 1,490 buildings within the communities of Boulder Creek, Bonny Doon, Swanton, and Last Chance. The fire burned 86,509 acres and was reported as contained on September 22, 2020. While the burn area was mostly outside of the Santa Margarita Basin boundary, the western portion of the San Lorenzo River watershed did burn, thus potentially directly impacting the San Lorenzo River (**Figure 1**). Water year 2021 was the first post-fire water year.

During 2017 and 2019, two very significant storms affected these watersheds. Runoff crested each year at about 30,000 cubic feet per second, among the five highest values recorded during the 80-year-plus history of the San Lorenzo River at Big Trees gage (**Figure 2**). These storms introduced considerable coarse-grained sediment into the channels, which remain locally aggraded.

2.3 Streamflow Gaging

Hydrographs of 15-minute flows and mean daily values for gaged seasonal flows for San Lorenzo River above Love Creek, Newell, Zayante, and Bean Creeks, are shown on **Figures 3 – 6**. Water temperature and precipitation were also plotted to compare natural fluctuations at the gages. Plots of specific conductance and temperature for each gage are shown in **Figures 7 -10**. Measurements and observations for each gage are shown in **Tables 1 – 4** and a summary of daily mean flow for each gage are shown in **Forms 1 – 4**.

2.3.1 San Lorenzo River Upstream of Love Creek

The mean daily seasonal baseflow recession at the San Lorenzo River upstream of Love Creek gage ranged from about 5.7 cfs down to about 1.5 to 1.8 cfs prior to the first rain in October (**Figure 3**). The slight rise in baseflow prior to rainfall is likely associated with reduced evapotranspiration.

2.3.2 Newell Creek Upstream of San Lorenzo River

The seasonal baseflow at the Newell Creek upstream of the San Lorenzo River gage slowly decreased from mean daily flow of about 1.4 cfs to approximately 1.1 cfs from May through October, which is consistent with observed flow recessions during previous years (**Figure 4**). This site is downstream of the Loch Lomond Reservoir and is highly regulated. The City regularly releases 1.0 cfs from Loch Lomond to promote aquatic and riparian habitat in Newell Creek and the river. From September 2 through October 10, 2021, the City of Santa Cruz reduced the bypassed flow due to construction related activities at the reservoir. Mean daily flow at the gage during this time ranged between approximately 0.55 cfs to 0.43 cfs.

2.3.3 Zayante Creek at Woodwardia Weir

The mean daily seasonal baseflow recession at Zayante Creek at Woodwardia Weir ranged from about 2.3 cfs in June down to just under or at 1 cfs in September/October 2021 (**Figure 5**). Water year 2020 base flow ranged between 3 cfs down to approximately 1 cfs from June to November. Baseflow for water years 2020-2021 were both lower than was observed during water 2017 and water year 2019, which were both above average years, and comparable to water year 2018, which was a dry year.

2.3.4 Bean Creek at Mount Hermon Camp

The seasonal mean daily baseflow recession during water year 2021 at Bean Creek at Mount Hermon Camp ranged from approximately 2.2 to 1.6 cfs from May until the first significant rain in October (**Figure 6**). Similar to other gages, the slight rise in baseflow prior to rainfall is likely associated with reduced evapotranspiration. During water year 2020 at Bean Creek at Mount Hermon Camp was consistently around 2.5 to 2 cfs from June until the first runoff-producing rain in November.

2.3.5 Temperature Monitoring

Detailed temperature monitoring and reporting has been conducted within the San Lorenzo River watershed by Don Alley in previous years. Within Don Alley's reports are a discussion of stream temperature tolerances and thresholds in relation to coho and steelhead lifecycle, which establish a 20° C general 7-day forward rolling average temperature guideline for evaluating steelhead life cycle (Alley, 2015). Stream temperature, including the 7-day forward rolling average, is plotted on **Figures 3-10** for each gage. The San Lorenzo River upstream of Love Creek met or exceeded this threshold for approximately 39 days between June 14, 2021 and September 14, 2021. The longest consecutive period when this threshold was exceeded was between June 24, 2021 and July 12, 2021 (19 days). San Lorenzo River upstream of Love Creek gage, also exceeded the guideline just prior and during the start of the CZU fire in water year 2020. None of the other gaged sites have exceeded the 20° C general 7-day forward rolling average temperature guideline during water 2020 or 2021.

2.4 **Observations of Selected Springs and Groundwater Dependent Wetlands**

Observations of springs, seeps and wetland areas in the Bean Creek and Zayante Creek sub-watersheds have been included in **Appendix A**. These observations reflect a larger effort to document and monitor ecosystems that are groundwater dependent. As part of the SMGWA GSP monitoring network, representative groundwater dependent ecosystem (GDE) sites are monitored to evaluate potential impacts to GDEs from groundwater use, projects, or management actions.

Springs in the Bean Creek and Zayante Creek areas have been documented to contribute a significant amount of flow in the summer. Eagle Creek has been observed to contribute 100+ gpm during the dry season base flow regardless of the of water year being dry, normal, or wet (Parke and Hecht, 2020). Multiple flow measurements on Ferndell Creek suggest that this spring fed creek also consistently contributes significantly to summer baseflow.

Noteworthy spring flow comparisons from water year 2020 to 2021 are included in the table below. These springs are sourced from Santa Margarita and provide insight into the aquifer in the Bean Creek and Zayante Creek area.

Water Years 2020 - 2021 early and late dry season spring flow measurements

Spring	Water Year 2020	Water Year 2021
Eagle Creek (u/s of SLR)	Spring: 412 gpm Fall: 180 gpm	Spring: 144 gpm Fall: 103 gpm
Ferndell Creek/spring	Spring: 155 gpm Fall: 110 gpm	Spring: 81 gpm Fall: 67 gpm
Redwood Spring	Spring: 45-65 gpm (visual est.) Fall: 60	Spring: 36 gpm Fall: 34 gpm

3. PRELIMINARY CONCLUSIONS

1. The data collected during water year 2020 and 2021 establishes baseline surface water conditions during consecutive dry years.
2. Water year 2021 was the first water year after the CZU fire. The burned San Lorenzo River watershed may have impacted flow and temperature along the San Lorenzo River at the San Lorenzo River upstream of Love Creek gage. Baseflow can be elevated in post-fire conditions due to the reduced evapotranspiration. The San Lorenzo River upstream of Love Creek gage was installed during water year 2020, which limits the pre- and post-fire comparisons at this site. Comparing the early season flows between these two years, prior to the fire in August, shows that there was more flow in water year 2020 than in water year 2021. The decreased flow in water year 2021 is likely the result of the second consecutive dry year.
3. Water years 2017 to 2020 included accretion measurements along the San Lorenzo River as well as Zayante and Bean Creeks. These studies document conditions, such that future changes in flow may be distinguishable as conditions evolve in the Santa Margarita groundwater basin in response to water management, climate change, and other trends.
4. Streams flowing through the Santa Margarita formation in the San Lorenzo Valley all share common traits of elevated baseflows and low solute loads (measured as specific conductance). This can be seen in the San Lorenzo River, Zayante Creek and Bean Creek as they pass through the portions of the watershed influenced by the Santa Margarita formation.
5. Temperature monitoring at the gages showed that none of the sites exceeded the 20°C general 7-day forward-rolling average temperature guideline for steelhead lifecycle, except for the San Lorenzo River upstream of Love Creek gage, which exceeded the guideline for extended periods of time during water 2021.
6. Runoff from the San Lorenzo River at Big Trees runoff during water year 2021 from the San Lorenzo River was approximately 20.4 cfs or 16% of the long-term average, and water year 2020 was 35% of the long-term average.
7. The mean daily seasonal baseflow recession at Zayante Creek at Woodwardia Weir during water year 2021 ranged from about 2.3 cfs in June down to just

under or at 1 cfs in September/October 2021. Water year 2020 base flow ranged between 3 cfs down to approximately 1 cfs from June to November

8. The mean daily seasonal baseflow recession at Bean Creek at Mount Hermon Camp during water 2021 ranged from approximately 2.2 to 1.6 cfs from May until the first significant rain in October 2021. During water year 2020 flow at Bean Creek at Mount Hermon Camp was consistently around 2.5 to 2 cfs from June until the first runoff-producing rain in November 2020. The baseflow was slightly lower during water year 2021.

4. ACKNOWLEDGMENTS

The data presented in this memo represents a coordinated effort amongst the staffs of Balance Hydrologics and the Santa Cruz County Health Department. We are grateful for the cooperation and sharing of data between the Santa Margarita Groundwater Agency, County of Santa Cruz Environmental Health, the San Lorenzo Valley Water District, Scotts Valley Water District and the City of Santa Cruz. The San Lorenzo Valley Water District has previously contributed to the project by providing valuable supporting flow data from a number of year-round and seasonal flow gages throughout the San Lorenzo River as well as the western tributaries. The City of Santa Cruz has also aided this effort by providing flow data from the gage its staff maintains on Newell Creek downstream of Loch Lomond as well as supporting the real-time stream gage on the San Lorenzo River at Big Trees which is operated by the United States Geological Survey's (USGS) Water Resources Division.

Finally, John Ricker, recently retired Water Manager for the County, actively abetted the accretion studies with helpful comments and suggestions, data contributions, and locating older data which would otherwise have been overlooked.

5. LIMITATIONS

The annual monitoring report was prepared in general accordance with the accepted standard of practice of hydrology existing in California for projects of similar scale at the time the investigations were performed. No other warranties, expressed or implied, are made.

As is customary, we note that readers should recognize that interpretation and evaluation of physical factors affecting the hydrologic context of any site is difficult and an inexact art, and a variety of physical factors can affect the results from what has been presented herein; in particular creating records of flow during low flow conditions. Judgments leading to conclusions and recommendations are generally made with an incomplete knowledge of the conditions present. Many sources of uncertainty can influence the data. More extensive studies or increased level of design can reduce the inherent uncertainties associated with such studies. If the client wishes to further reduce the uncertainty beyond the level associated with this study, Balance Hydrologics should be notified for additional consultation.

Concepts, analyses, findings and interpretations contained in this report have been developed solely for the Santa Margarita Streamflow Monitoring for the exclusive use of the Santa Margarita Groundwater Agency and the County of Santa Cruz for the purposes of dry season streamflow monitoring. Information and interpretations presented should not be applied to projects or sites without additional site-specific information, nor should they be used beyond the particular area or reach to which we have applied them. Use of information outlined in this report beyond the boundaries of the site could lead to environmental or structural damage, significant error, and/or to noncompliance with relevant policies, regulations or permits. Balance Hydrologics should be consulted (and expressed written permission should be provided) prior to applying the contents of this report to other projects or for purposes not specifically cited in this report.

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FORMS

Stream and Station

Dry Season:	2021
Stream:	San Lorenzo River
Station:	Upstream of Love Creek
County:	Santa Cruz County, CA

Form 1

**Annual Hydrologic Record: San Lorenzo River
Estimated daily flow upstream of Love Creek
Dry Season 2021**

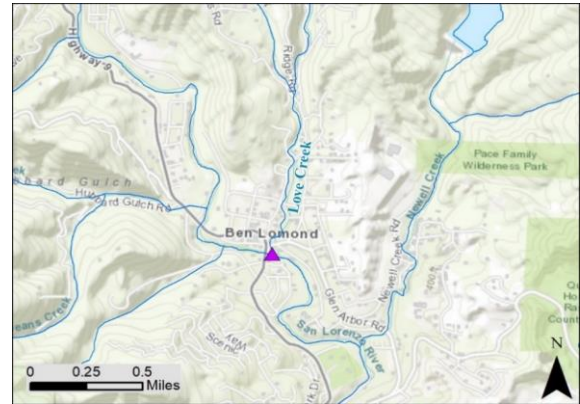
Station Location and Watershed

Latitude: 37° 5'16.83"N, Longitude: 122° 5'16.60"W (WGS84), Santa Cruz County, CA. Gage is located on the right bank approximately 150 ft downstream of the HWY 9 bridge in Ben Lomond and approximately 80 ft upstream of the confluence with Love Creek. The drainage area is approximately 57.9 square miles.

Period of Record

Gage originally installed on June 24, 2020, sensors removed on a seasonal basis. Gaging sponsored by Santa Cruz County Environmental Health and the Santa Margarita Groundwater Agency. Sensor removed temporarily for the wet season.

Station Location Map



Dry Season 2021 Daily Mean Flow (cubic feet per second)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY ⁴	JUN	JUL	AUG	SEPT	OCT ⁵
1									4.67	3.06	2.42	2.09	1.77
2									4.57	3.15	2.34	2.15	1.70
3									4.54	3.16	2.25	2.13	1.89
4									4.48	3.07	2.22	2.25	1.72
5									4.34	3.06	2.25	1.98	1.66
6									4.35	3.01	2.33	2.03	1.68
7									4.42	2.91	2.31	1.94	1.74
8									4.24	2.81	2.19	1.75	1.70
9									4.14	2.75	2.29	1.70	1.79
10									4.09	2.61	2.39	1.66	1.82
11									4.05	2.60	2.25	1.61	1.83
12								5.66	4.03	2.56	2.25	1.73	1.75
13								5.72	4.00	2.51	2.11	1.53	1.75
14								5.69	4.02	2.43	2.09	1.60	1.82
15								5.66	3.89	2.52	2.02	1.77	1.70
16								5.74	3.74	2.56	2.01	1.84	1.76
17								5.77	3.65	2.56	2.02	2.10	1.52
18								5.69	3.51	2.73	1.99	2.05	1.76
19								5.62	3.34	2.76	2.15	1.98	1.82
20								5.54	3.43	2.71	2.09	1.91	
21								5.51	3.48	2.58	2.30	1.80	
22								5.32	3.63	2.54	2.41	1.85	
23								5.33	3.69	2.53	2.57	1.75	
24								5.16	3.72	2.50	2.66	1.77	
25								5.17	3.63	2.51	2.62	1.83	
26								4.99	3.55	2.53	2.45	1.83	
27								5.00	3.41	2.41	2.30	1.87	
28								5.24	3.30	2.42	2.29	1.83	
29								5.00	3.13	2.43	2.18	1.77	
30								4.79	3.07	2.45	2.10	1.89	
31								4.98	-	2.42	2.13	-	-
MEAN								5.38	3.87	2.67	2.26	1.87	1.75
MAX. DAY								5.77	4.67	3.16	2.66	2.25	1.89
MIN. DAY								4.79	3.07	2.41	1.99	1.53	1.52
cfs days								108	116	83	70	56	33
ac-ft								213	230	164	139	111	66
gallons								69,500,000	75,100,000	53,600,000	45,200,000	36,200,000	21,500,000

Monitors' Comments

- Daily values with more than 2 to 3 significant figures result from electronic calculations. No additional precision is implied.
- Mean daily values are cumulated from 96 15-minute measurements of stage; several stage shifts have been applied to account for changes in bed conditions over the course of the monitoring program.
- Diversion activities upstream may influence the gaged flow.
- Stream gage was re-installed on 5/12/21. Totals for May are partial.
- The first significant rains occurred on October 20, 2021. Data not reported past these dates. Totals calculated for October 2021 are partial.

Dry Season 2021 Totals

<i>Seasonal totals calculated from 5/12/21 to 10/19/21</i>		
Mean seasonal flow	2.89	(cfs)
Max. seasonal flow	5.77	(cfs)
Min. seasonal flow	1.52	(cfs)
Seasonal total	466	(cfs-days)
Seasonal total volume	924	(ac-ft)
Seasonal total volume	301,100,000	(gallons)

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Stream and Station

Dry Season:	2021
Stream:	Newell Creek
Station:	Newell Creek approx. 150 feet upstream of San Lorenzo River
County:	Santa Cruz County, CA

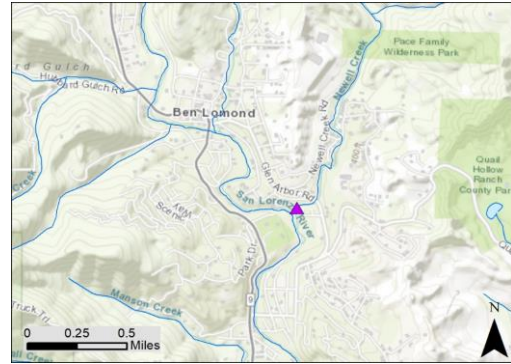
Form 2

**Annual Hydrologic Record: Newell Creek
Estimated daily flow approx. 150 feet upstream of SLR
Dry Season 2021**

Station Location and Watershed

Coordinates: 37.08204, -122.07973 (WGS84), Santa Cruz County, CA. Gage is located approximately 150 feet upstream of the confluence with the San Lorenzo River. Drainage area is approximately 9.9 square miles. Land use in the watershed includes residential neighborhoods, Ben Lomond Transfer Station, Loch Lomond reservoir and recreation area. The City of Santa Cruz uses the reservoir as a water source and maintains bypass-flow of 1.00 cfs just downstream of the impoundment.

Station Location Map



Period of Record

Gage installed on June 14, 2018. Gaging sponsored by Santa Cruz County Environmental Health and the Santa Margarita Groundwater Agency. Sensor removed temporarily for the wet season. Site very near a USGS gage operated from water years 1959 to 1962.

Dry Season 2021 Daily Mean Flow (cubic feet per second)

DAY	OCT	NOV ⁵	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT ⁵
1								1.36	1.23	1.19	1.17	1.10	0.46
2								1.35	1.19	1.20	1.14	0.92	0.43
3								1.31	1.22	1.19	1.14	0.46	0.43
4								1.29	1.21	1.17	1.15	0.47	0.44
5								1.31	1.22	1.16	1.16	0.47	0.46
6								1.32	1.25	1.15	1.13	0.45	0.47
7								1.31	1.26	1.14	1.13	0.43	0.46
8								1.27	1.25	1.14	1.13	0.48	0.48
9								1.29	1.24	1.11	1.18	0.52	0.62
10								1.31	1.22	1.09	1.06	0.55	0.99
11								1.30	1.21	1.11	1.05	0.52	1.06
12								1.32	1.20	1.12	1.04	0.50	1.08
13								1.33	1.19	1.14	1.07	0.50	1.08
14								1.31	1.20	1.12	1.06	0.52	1.16
15								1.30	1.19	1.13	1.01	0.53	1.17
16								1.29	1.21	1.14	1.04	0.54	1.15
17								1.27	1.23	1.11	1.08	0.55	1.19
18								1.28	1.23	1.11	1.10	0.51	1.22
19								1.27	1.19	1.11	1.07	0.50	1.18
20								1.25	1.25	1.13	1.10	0.48	
21								1.24	1.28	1.14	1.12	0.60	
22								1.23	1.28	1.14	1.11	0.62	
23								1.23	1.25	1.16	1.13	0.47	
24								1.21	1.24	1.16	1.14	0.49	
25								1.25	1.24	1.15	1.13	0.50	
26								1.21	1.22	1.16	1.04	0.50	
27								1.23	1.20	1.15	1.05	0.49	
28								1.24	1.21	1.17	1.09	0.48	
29								1.25	1.21	1.17	1.07	0.47	
30								1.22	1.21	1.18	1.08	0.46	
31								1.24	-	1.19	1.11	-	
MEAN								1.28	1.22	1.15	1.10	0.54	0.82
MAX. DAY								1.36	1.28	1.20	1.18	1.10	1.22
MIN. DAY								1.21	1.19	1.09	1.01	0.43	0.43
cfs days								40	37	36	34	16	16
ac-ft								79	73	70	68	32	31
gallons								25,600,000	23,800,000	23,000,000	22,000,000	10,400,000	10,000,000

Daily mean flow reported through October 19, 2021 prior to significant rain

Monitors' Comments

- Daily values with more than 2 to 3 significant figures result from electronic calculations. No additional precision is implied.
- Mean daily values are cumulated from 96 15-minute measurements of stage; several stage shifts have been applied to account for changes in bed conditions over the course of the monitoring program.
- Irregularities in flow over the dry season are likely attributed to activities at the upstream dam and other diversions or releases upstream of the gage.
- Gage was destroyed over the winter of water year 2019. Gage was reinstalled on July 11, 2019.
- The first significant rains occurred on October 20, 2021. Data not reported past this date. Totals calculated for October 2021 are partial.

Dry Season 2021 Totals		
Seasonal totals calculated from 5/1/21 to 10/19/21		
Mean seasonal flow	1.03	(cfs)
Max. seasonal flow	1.28	(cfs)
Min. seasonal flow	0.43	(cfs)
Seasonal total	101	(cfs-days)
Seasonal total volume	201	(ac-ft)
Seasonal total volume	65,400,000	(gallons)

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Stream and Station

Dry Season:	2021
Stream:	Zayante Creek
Station:	Zayante Creek at Woodwardia Weir
County:	Santa Cruz County, CA

Form 3

**Annual Hydrologic Record: Zayante Creek
Estimated daily flow at Woodwardia Weir
Dry Season 2021**

Station Location and Watershed

Latitude: 37° 03' 19.85" N, Longitude: 122° 03' 36.69" W (WGS84), Santa Cruz County, CA. Gage is located on the upstream side of the concrete weir just upstream of the Woodwardia Bridge 0.47 miles up E. Zayante Rd from the intersection with Graham Hill Rd. Site is almost directly under Mount Hermon bypass bridge. Land use is primarily rural residential. Drainage area is approximately 16.76 square miles.

Period of Record

Gage was operated from 10/2/08 to 10/22/10 by Balance Hydrologics and included estimation of suspended sediment loads using turbidity instrumentation during this time. Gage was seasonally reinstalled with the same datum from 7/14/17. Gaging sponsored by Santa Cruz County Environmental Health and the Santa Margarita Groundwater Agency. Previous measurements by H. Esmail, & Associates (1979-1981) and UCSC (1973).

Station Location Map



Dry Season 2021 Daily Mean Flow (cubic feet per second)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT ⁵
1								2.25	1.82	1.47	1.10	1.08	1.05
2								2.21	1.75	1.47	1.07	1.06	1.04
3								2.13	1.77	1.48	1.06	1.07	1.04
4								2.12	1.78	1.51	1.09	1.04	1.08
5								2.17	1.71	1.46	1.09	1.01	1.12
6								2.10	1.78	1.44	1.05	0.97	1.18
7								2.08	1.70	1.41	1.06	0.98	1.17
8								1.99	1.65	1.41	1.07	1.06	1.16
9								2.01	1.66	1.34	1.08	1.03	1.18
10								1.99	1.64	1.32	1.05	1.01	1.18
11								1.97	1.62	1.31	1.08	1.01	1.13
12								2.02	1.63	1.26	1.04	0.99	1.09
13								2.12	1.64	1.27	1.00	0.98	1.09
14								2.10	1.59	1.27	1.02	1.01	1.09
15								2.03	1.58	1.30	1.02	1.05	1.11
16								2.05	1.59	1.30	1.04	1.09	1.14
17								2.00	1.62	1.27	1.09	1.16	1.14
18								1.96	1.58	1.28	1.10	1.11	1.22
19								1.93	1.47	1.25	1.04	1.08	1.24
20								1.88	1.54	1.23	1.12	1.07	
21								1.86	1.59	1.22	1.20	1.03	
22								1.89	1.68	1.21	1.21	1.07	
23								1.93	1.73	1.18	1.23	1.05	
24								1.86	1.63	1.13	1.20	1.05	
25								1.84	1.61	1.14	1.20	1.12	
26								1.83	1.53	1.11	1.10	1.14	
27								1.83	1.50	1.08	1.06	1.13	
28								1.86	1.48	1.14	1.06	1.10	
29								1.84	1.43	1.12	1.05	1.10	
30								1.80	1.44	1.16	1.05	1.07	
31								1.85	-	1.13	1.06	-	
MEAN								1.98	1.62	1.28	1.09	1.06	1.13
MAX. DAY								2.25	1.82	1.51	1.23	1.16	1.24
MIN. DAY								1.80	1.43	1.08	1.00	0.97	1.04
cfs days								61.52	48.74	39.68	33.71	31.70	21.44
ac-ft								122.02	96.68	78.71	66.87	62.88	42.53
gallons								3980000	3150000	2560000	2180000	2050000	1390000

Daily mean flow reported through October 19, 2021 prior to significant rain

Monitors' Comments

- Daily values with more than 2 to 3 significant figures result from electronic calculations. No additional precision is implied.
- Mean daily values are cumulated from 96 15-minute measurements of stage; several stage shifts have been applied to account for changes in bed conditions over the course of the monitoring program.
- Flow measurement accuracy constrained by boulders in standard cross sections.
- A near-perennial spring emanates from the Santa Margarita formation on the eastern floodplain. We frequently record observations of this "Tsm spring"
- The first significant rains occurred October 20, 2021. Data not reported past this date. Totals calculated for October 2021 are partial.

Dry Season 2021 Totals		
<i>Seasonal totals calculated from 5/1/21 to 10/19/21</i>		
Mean seasonal flow	1.24	(cfs)
Max. seasonal flow	1.82	(cfs)
Min. seasonal flow	0.97	(cfs)
Seasonal total	127	(cfs-days)
Seasonal total volume	251	(ac-ft)
Seasonal total volume	81,800,000	(gallons)

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Stream and Station

Dry Season:	2021
Stream:	Bean Creek
Station:	Bean Creek above mouth at Mount Hermon Camp
County:	Santa Cruz County, CA

Form 4

**Annual Hydrologic Record: Bean Creek
Estimated daily flow above mouth at Mount Hermon Camp
Dry Season 2021**

Station Location and Watershed

Latitude: 37.05246, Longitude: -122.05971 (WGS84), Santa Cruz County, CA. Gage is located approximately 80 feet upstream of the abandoned foot bridge on the right bank. Previously located (WY09-12) downstream of the current gage approximately 150 feet or about 70 feet downstream of the abandoned foot bridge on the left bank (facing downstream). Gage is upstream of the confluence of Ferndell Creek. Drainage area is approximately 9.64 square miles.

Period of Record

Seasonal gage was operated from 10/3/08 to 10/13/12 by Balance Hydrologics and included estimation of suspended sediment loads and turbidity using turbidity instrumentation. Gage reinstalled with a new datum 7/13/17 approx.150 ft upstream from the previous gage. Gaging sponsored by Santa Cruz County Environmental Health and the Santa Margarita Groundwater Agency. Flow and sediment also monitored in 1980 (Hecht and Enckebohl).

Station Location Map



Dry Season 2021 Daily Mean Flow (cubic feet per second)

DAY	OCT	NOV ⁴	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT ⁴
1								2.16	2.03	1.83	2.00	1.73	1.70
2								2.14	1.97	1.86	1.93	1.69	1.66
3								2.11	2.00	1.82	1.94	1.70	1.62
4								2.07	1.97	1.82	1.94	1.69	1.61
5								2.14	1.95	1.82	1.95	1.66	1.66
6								2.14	1.99	1.79	1.93	1.62	1.69
7								2.12	1.95	1.77	1.97	1.66	1.69
8								2.05	1.94	1.82	1.97	1.67	1.67
9								2.07	1.93	1.78	1.99	1.70	1.67
10								2.11	1.92	1.72	1.98	1.74	1.70
11								2.11	1.91	1.78	1.94	1.74	1.72
12								2.17	1.89	1.83	1.88	1.64	1.80
13								2.18	1.87	1.88	1.91	1.64	1.85
14								2.18	1.84	1.86	1.90	1.72	1.99
15								2.23	1.82	1.89	1.85	1.75	2.10
16								2.24	1.83	1.91	1.85	1.76	2.14
17								2.15	1.87	1.86	1.89	1.76	2.17
18								2.12	1.86	1.87	1.86	1.67	2.26
19								2.11	1.83	1.88	1.78	1.68	2.26
20								2.07	1.88	1.92	1.85	1.72	
21								2.08	1.94	1.94	1.88	1.71	
22								2.13	1.96	1.95	1.84	1.80	
23								2.09	1.90	1.95	1.81	1.80	
24								2.03	1.84	1.92	1.82	1.83	
25								2.07	1.85	1.91	1.84	1.83	
26								2.06	1.80	1.92	1.74	1.81	
27								2.07	1.80	1.89	1.72	1.80	
28								2.12	1.80	1.95	1.70	1.75	
29						-		2.08	1.79	1.97	1.70	1.75	
30						-		2.05	1.79	1.97	1.73	1.73	
31						-		2.07	-	1.98	1.72	-	
MEAN								2.11	1.89	1.87	1.86	1.72	1.84
MAX. DAY								2.24	2.03	1.98	2.00	1.83	2.26
MIN. DAY								2.03	1.79	1.72	1.70	1.62	1.61
cfs days								66	57	58	58	52	35
ac-ft								130	113	115	115	103	69
gallons								42,300,000	36,700,000	37,500,000	37,400,000	33,400,000	22,600,000

Daily mean flow reported through October 19, 2021 prior to significant rain

Monitors' Comments

1. Daily values with more than 2 to 3 significant figures result from electronic calculations. No additional precision is implied.
2. Mean daily values are cumulated from 15-minute measurements of stage; several stage shifts have been applied to account for changes in bed conditions over the course of the monitoring program.
3. Diversion activities upstream may influence the gaged flow.
4. The first significant rains occurred on October 20, 2021. Data not reported past this date. Totals calculated for October 2021 are partial.

Dry Season 2021 Totals		
<i>Seasonal totals calculated from 5/1/20 to 10/19/21</i>		
Mean seasonal flow	1.89	(cfs)
Max. seasonal flow	2.26	(cfs)
Min. seasonal flow	1.61	(cfs)
Seasonal total	259	(cfs-days)
Seasonal total volume	514	(ac-ft)
Seasonal total volume	167,600,000	(gallons)

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TABLES

Table 1. Station Observer Log, San Lorenzo River upstream of Love Creek, County of Santa Cruz, California, dry season 2021

Site Conditions				Streamflow				Water Quality Observations				High-Water Marks		Remarks
Date/Time	Observer(s)	Stage (staff plate)	Hydrograph	Measured Flow	Estimated Flow	Instrument Used	Estimated Accuracy	Water Temperature	Specific Conductance at field temp.	Specific Conductance at 25°C	Additional sampling?	Estimated stage at staff plate	Inferred dates?	
(mm/dd/yr)		(feet)	(R/F/S/B)	(cfs)	(cfs)	(AA/PY)	(e/g/f/p)	(°C)	(µmhos/cm)	(µmhos/cm)	(Qbed, etc.)	(feet)	(mm/dd/yr)	
San Lorenzo River upstream of Love Creek														
5/12/2021 13:30	jp	0.79	B	5.73	...	PY	g	17.2	365	428	...	...	...	Replaced stilling well and resecured the gage.
8/6/2021 13:00	jp	0.58	B	2.35	...	PY	g	20.3	362	396	...	...	...	Love Creek is dry downstream of Glen Arbor bridge - could not see flow. No debris downstream of gaged reach.
9/8/2021 11:35	jp	0.54	B	1.76	...	PY	g	18.6	369	419	...	...	...	Moved cross section 15ft upstream of Love Cr since previous cross sections were slow and spread out. No debris at the outlet of the gaged reach. Lots of 2-3 cm fish.
10/14/2021 11:10	jp	0.575	B	1.77	...	PY	g	11.4	272	365	...	...	...	No debris in riffle.
10/14/2021 17:00	jp	0.58	B	...	...	...	...	...	...	...	...	...	...	Stage observation and download.
11/11/2021 11:45	jp	1.30	B	24.50	...	AA	g	11.5	272	367	5.7	recent	...	Love Cr visual estimate of flow 0.4-0.5 cfs. At 12:25 re-secured staff plate and removed stilling well and sensors. High-water mark on Love Cr about 0.75 above water level, SRL high-water mark at stage ~5.7 ft.
Love Creek upstream of San Lorenzo River (no gage)														
5/12/2021 14:05	jp	...	B	0.13	...	PY	g	13.8	357	455	...	...	...	Water is clear, no odor.
8/6/2021 13:00	jp	...	...	dry	...	...	...	...	...	...	...	...	...	Love Creek is dry downstream of Glen Arbor bridge. Pondered right under the bridge - couldn't see flow going into ponded area.
9/8/2021 12:45	jp	...	...	dry	...	...	...	...	...	...	...	...	...	Love Creek is completely dry from the Glen Arbor bridge with no recent water visible.
10/14/2021 11:10	jp	...	...	dry	...	...	...	...	...	...	...	...	...	dry
11/11/2021 11:10	jp	...	...	...	0.45	vis.est	p	11.3	314	425	...	0.75 above wl	...	Water is clear, no odor.

Notes:
 Stage: Water level observed at outside staff plate
 Observers: (jp) Jason Parke, (dt) Denise Tu, (cn) Chelsea Neill, (jh) John Hardy
 Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), baseflow (B), or uncertain (U).
 Instrument: If measured, typically made using a standard (AA) or pygmy (PY) bucket-wheel ("Price-type") current meter. Extremely low flows are measured with a bucket+stop watch (B) If estimated, from rating curve (R) or visual (V).
 Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given
 High-water mark (HWM): Measured or estimated at location of the staff plate
 Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conductance
 Additional Sampling: Qbed = Bedload, Qss = Suspended sediment, Nutr = nutrients; other symbols as appropriate

**Table 2. Station Observer Log, Newell Creek,
County of Santa Cruz, California, dry season 2021**

Site Conditions				Streamflow				Water Quality Observations				High-Water Marks		Remarks
Date/Time (mm/dd/yr)	Observer(s)	Stage (staff plate) (feet)	Hydrograph (R/F/S/B)	Measured Flow (cfs)	Estimated Flow (cfs)	Instrument Used (AA/PY)	Estimated Accuracy (e/g/l/p)	Water Temperature (°C)	Specific Conductance at field temp. (µmhos/cm)	Specific Conductance at 25°C (µmhos/cm)	Additional sampling? (Qbed, etc.)	Estimated stage at staff plate (feet)	Inferred dates? (mm/dd/yr)	Remarks
5/12/2021 15:20	jp	2.63	B	1.31	...	PY	g	16.0	286	345	...	...	...	There is a 1.5 inch diversion hose in the gaged pool.
6/30/2021 13:45	jh	2.62	B	1.20	...	PY	g	18.0	307	355	...	...	...	Water is clear, diversion hose is in the gaged pool, log grade control in the gage reach is stable.
8/9/2021 12:00	jp	2.61	B	1.17	...	PY	g	16.7	304	362	...	staining at 2.64	...	There is a 1.5 inch diversion hose in the gaged pool. Some leaves/twigs in the channel upstream of the gage may affect the average depth of the flow measurement but not the gage record.
9/8/2021 12:40	jp	2.49	B	0.46	...	PY	g	16.1	205	247	...	...	...	Measured flow downstream of gage to include any potential diversion reflected in the stage. Stage dropped slightly after clearing some debris from the outlet of the gaged pool.
10/14/2021 12:20	jp	2.59	B	1.03	...	PY	g	11.9	329	439	...	...	...	Diversion hose is still in the gaged pool, measured flow downstream of gage, no vegetation blockages affecting the gaged reach.
11/11/2021 13:45	jp	2.585	B	0.97	...	PY	g	13.3	262	340	...	3.0	...	Diversion hose is still in the gaged pool, measured flow downstream of gage, no vegetation blockages affecting the gaged reach.

Notes

Stage: Water level observed at outside staff plate

Observers: (jp) Jason Parke, (dt) Denise Tu, (cn) Chelsea Neill, (jh) John Hardy

Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), baseflow (B), or uncertain (U).

Instrument: If measured, typically made using a standard (AA) or pygmy (PY) bucket-wheel ("Price-type") current meter. Extremely low flows are measured with a bucket+stop watch (B) If estimated, from rating curve (R) or visual (V).

Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given

High-water mark (HWM): Measured or estimated at location of the staff plate

Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation $(1.8813774452 - [0.050433063928 * \text{field temp}] + [0.00058561144042 * \text{field temp}^2]) * \text{Field specific conductance}$

Additional Sampling: Qbed = Bedload, Qss = Suspended sediment, Nutr = nutrients; other symbols as appropriate

Table 3. Station Observer Log, Zayante Creek at Woodwardia Weir, County of Santa Cruz, California, dry season 2021

Site Conditions				Streamflow				Water Quality Observations					High-Water Marks		Remarks
Date/Time	Observer(s)	Stage (staff plate)	Hydrograph	Measured Flow	Estimated Flow	Instrument Used	Estimated Accuracy	Water Temperature	Specific Conductance at field temp.	Specific Conductance at 25°C	Additional sampling?	Estimated stage at staff plate	Inferred dates?		
(mm/dd/yr)		(feet)	(R/F/S/B)	(cfs)	(cfs)	(AA/PY)	(e/g/f/p)	(°C)	(µmhos/cm)	(µmhos/cm)	(Qbed, etc.)	(feet)	(mm/dd/yr)		
5/19/21 18:11	jh	0.58	B	...	...	...	...	...	...	...	...	1.7	winter 2021	Download only. Water clear; stagnant downstream of weir; leaves and aquatic vegetation racked on weir at edges of flow
5/19/21 13:15	jp	...	B	1.96	...	PY	g	14.4	293	367	...	...	...	Measured flow at Mnt Hermon Camp to calibrate the fish bypass weir for Mnt Hermon Camp.
5/19/21 13:45	jp	0.58	B	1.98	...	PY	f	13 Tsm 13.9 Zayante	215 Tsm 362 Zayante	279 Tsm 459 Zayante	...	...	...	Had to move cobbles around to create a cross section since the usual cross sections upstream and downstream were too deep and slow. Some turbulence in the new cross section. Tsm seep was a trickle at <1 gpm.
6/15/21 11:50	jp	...	B	1.66	...	PY	g	16.9	243	289	...	...	...	Measured flow at Mnt Hermon Camp to calibrate the fish bypass weir for Mnt Hermon Camp.
8/9/21 13:30	jp	0.53	B	1.10	...	PY	g	16.0 Tsm 18.0 Zayante	339 Tsm 340 Zayante	410 Tsm 393 Zayante	...	...	...	Tsm seep is just barely a trickle. Strong intermittent sewage smell, some turbulence in the cross section but less than in previous higher flow measurements. Cleaned algae off the staff plate at the current stage.
9/10/21 10:00	jp	0.50	B	1.08	...	PY	g	15.4 Tsm 16.6 Zayante	314 Tsm 340 Zayante	418 Tsm 406 Zayante	...	...	...	Cleared some leaves from the concrete notch after measuring flow - stage dropped slightly from 0.51 ft to 0.50 ft. Tsm seep is barely a trickle, zero flow is likely at 0.41 ft below this stage based on depth at the concrete notch.
10/14/21 16:20	jp	0.52	B	1.08	...	PY	g	11.2	274	373	...	...	...	Tsm seep is not flowing, barely wet.
11/11/21 15:45	jp	0.66	B	4.37	...	PY	g	13.1 Tsm 11.8 Zayante	278 Tsm 368 Zayante	360 Tsm 494 Zayante	...	1.20	recent	Sand and vegetation has aggraded locally at the gage. Tsm seep is about 1 gpm. Flow cross section was very turbulent.	

Notes:
 Stage: Water level observed at outside staff plate
 Observers: (jp) Jason Parke, (dt) Denise Tu, (cn) Chelsea Neill, (jh) John Hardy
 Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), baseflow (B), or uncertain (U).
 Instrument: If measured, typically made using a standard (AA) or pygmy (PY) bucket-wheel ("Price-type") current meter. Extremely low flows are measured with a bucket+stop watch (B) If estimated, from rating curve (R) or visual (V).
 Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given
 High-water mark (HWM): Measured or estimated at location of the staff plate
 Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conductance
 Additional Sampling: Qbed = Bedload, Qss = Suspended sediment, Nutr = nutrients; other symbols as appropriate
 Tsm = Spring located on the left bank just upstream of the weir, draining from the Santa Margarita Sandstone

Table 4. Station Observer Log, Bean Creek at Mount Hermon Camp, County of Santa Cruz, California, dry season 2021

Site Conditions				Streamflow				Water Quality Observations				High-Water Marks		Remarks
Date/Time	Observer(s)	Stage (staff plate)	Hydrograph	Measured Flow	Estimated Flow	Instrument Used	Estimated Accuracy	Water Temperature	Specific Conductance at field temp.	Specific Conductance at 25°C	Additional sampling?	Estimated stage at staff plate	Inferred dates?	
(mm/dd/yr)		(feet)	(R/F/S/B)	(cfs)	(cfs)	(AA/PY)	(e/g/f/p)	(°C)	(µmhos/cm)	(µmhos/cm)	(Qbed, etc.)	(feet)	(mm/dd/yr)	
5/19/21 16:18	jh	1.07	B	2.10	2.58	AA	g	14.9	405	501	...	2.6	winter 2021	Water is clear. Flow is passing freely through downstream riffle; no evidence of recent recreational dam building downstream of gage. Some vegetation debris caught on downstream riffle but not impeding flow - left in place. Gage reach appears to be in similar condition as last summer, no significant sand aggradation in gage reach. Bottom of stilling well packed with sand; cleaned stilling well and resecured to staff at 17:34. Stage remained at 1.07 ft at 17:35
6/30/21 15:30	jh	1.07	B	1.78	1.78	AA	f	18.5	430	489	...	...	...	Water clear, flow passing freely through downstream riffle; no evidence of recreational dam building; A lot of people visiting the gaged reach.
8/9/21 16:00	jp	1.05	B	2.08	...	PY	g	18.0	431	496	...	...	...	Water at gage is deep and slow - went 300 ft downstream and found an excellent laminar cross section (placed a blue flag on left bank). People were walking through the gaged reach.
9/10/21 17:15	jp	1.04	B	1.80	...	PY	g	17.9	416	489	...	...	...	Added a cap to the bottom of the stilling well. Minimal leaves in the riffle downstream of gaged reach. Very laminar flow cross section.
10/14/21 15:10	jp	1.05	B	2.00	...	PY	g	12.0	352	469	...	...	...	Cleared leaves and needles from riffle downstream of gage at 15:15. Cross section is very laminar.
11/17/21 11:00	jp	1.105	B	2.59	...	PY	g	11.1	348	475	...	...	...	Removed tree in the cross section just downstream of the gage. Stilling well was fairly clear of sand. Localized scour in the thalweg at the gage. Zero flow estimate at stage of approx. 0.4-0.5 feet.

Notes:

Stage: Water level observed at outside staff plate

Observers: (jp) Jason Parke, (dt) Denise Tu, (cn) Chelsea Neill, (jh) John Hardy

Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), baseflow (B), or uncertain (U).

Instrument: If measured, typically made using a standard (AA) or pygmy (PY) bucket-wheel ("Price-type") current meter. Extremely low flows are measured with a bucket-stop watch (B) If estimated, from rating curve (R) or visual (V).

Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given

High-water mark (HWM): Measured or estimated at location of the staff plate

Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation $(1.8813774452 - [0.050433063928 * \text{field temp}] + [0.00058561144042 * \text{field temp}^2]) * \text{Field specific conductance}$

Additional Sampling: Qbed = Bedload, Qss = Suspended sediment, Nutr = nutrients; other symbols as appropriate

FIGURES

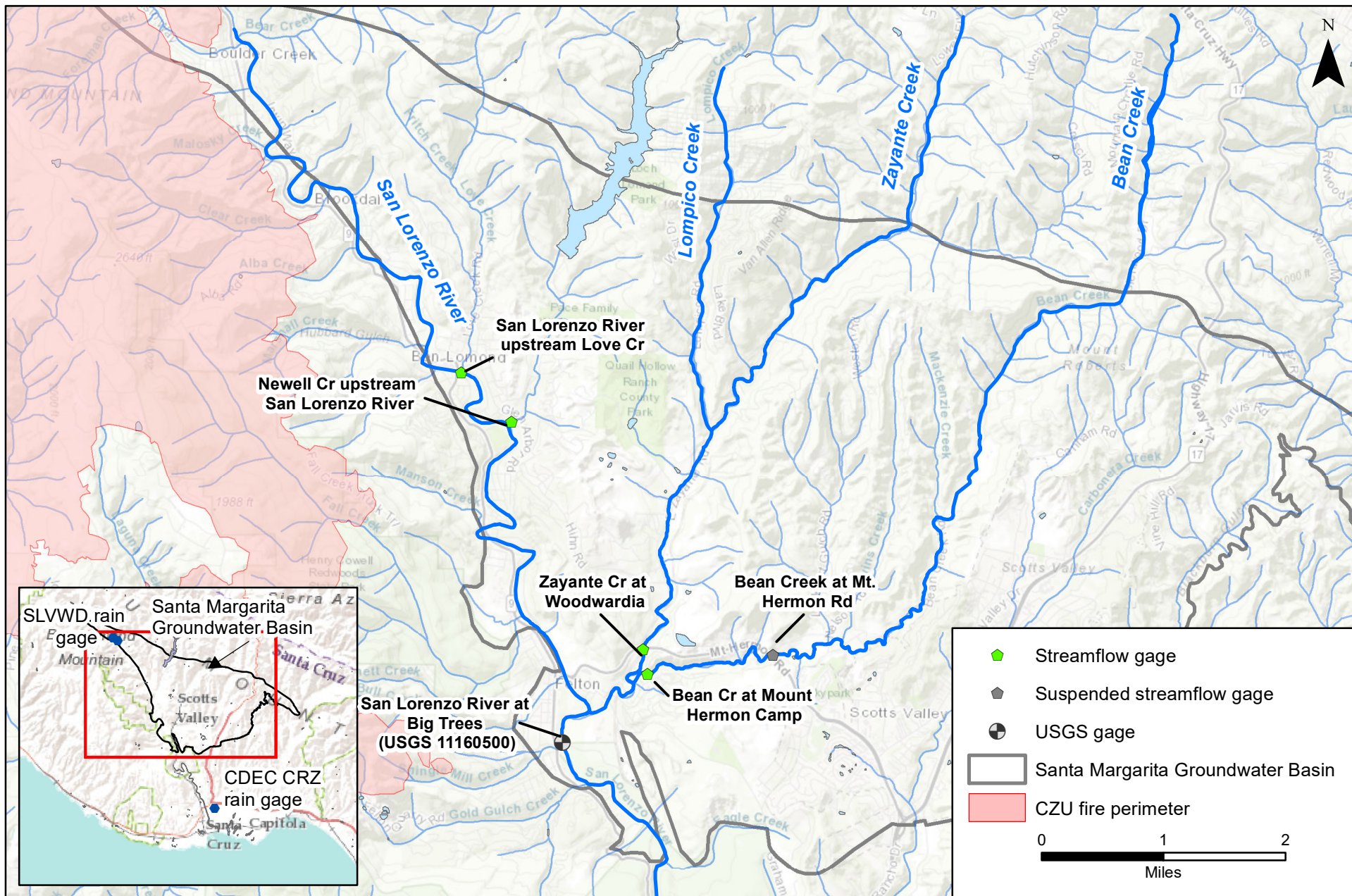


Figure 1. Santa Margarita Basin streamflow monitoring sites dry season 2021, Santa Cruz County, California

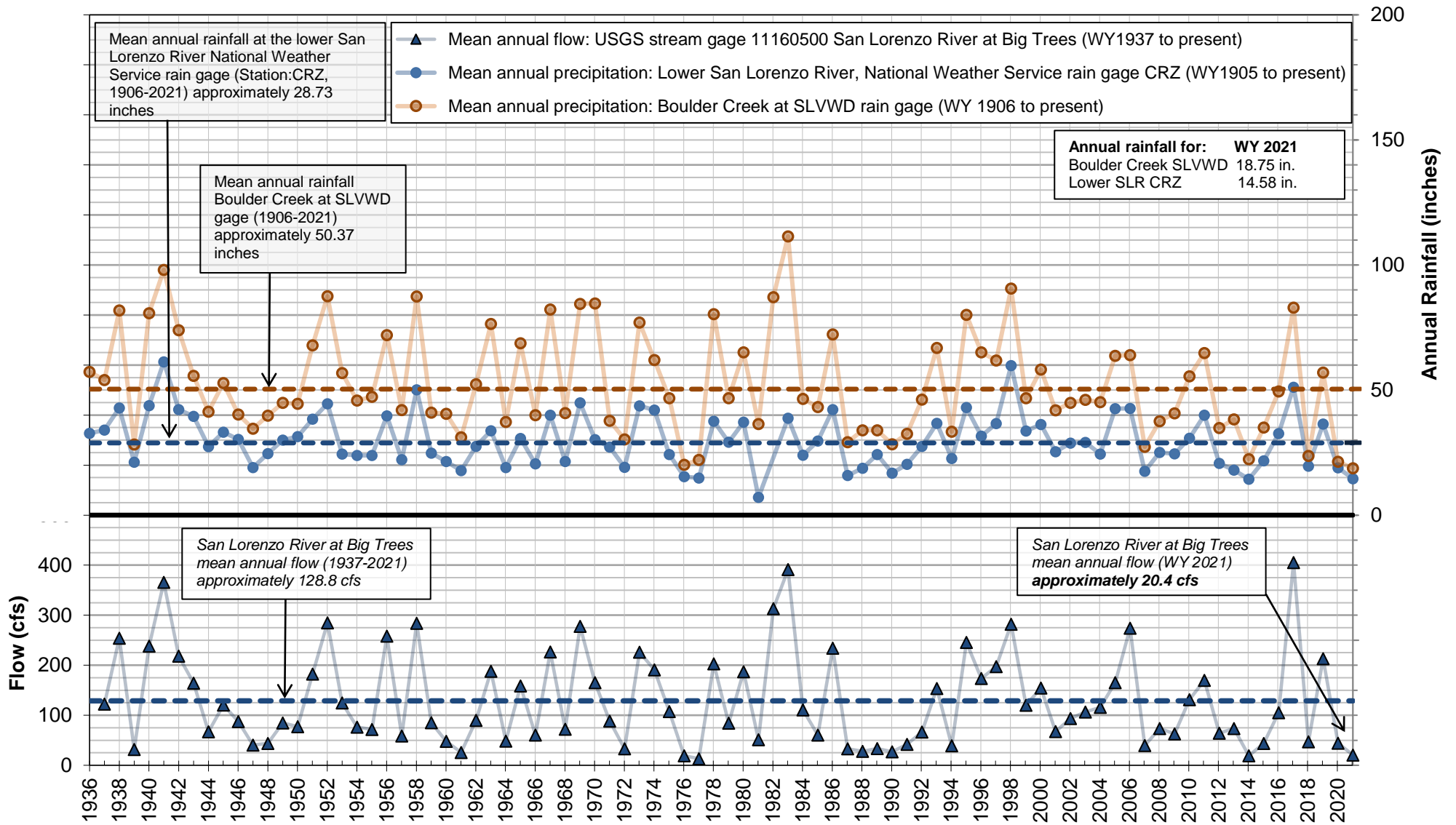
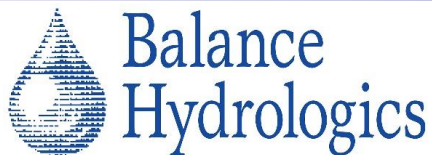


Figure 2. Comparison of historic annual rainfall in San Lorenzo Basin to annual streamflow at USGS Gage 11160500, San Lorenzo River at Big Trees, Santa Cruz County, CA



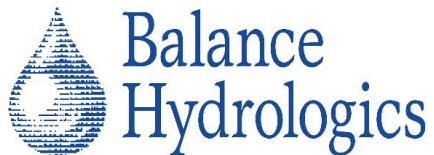
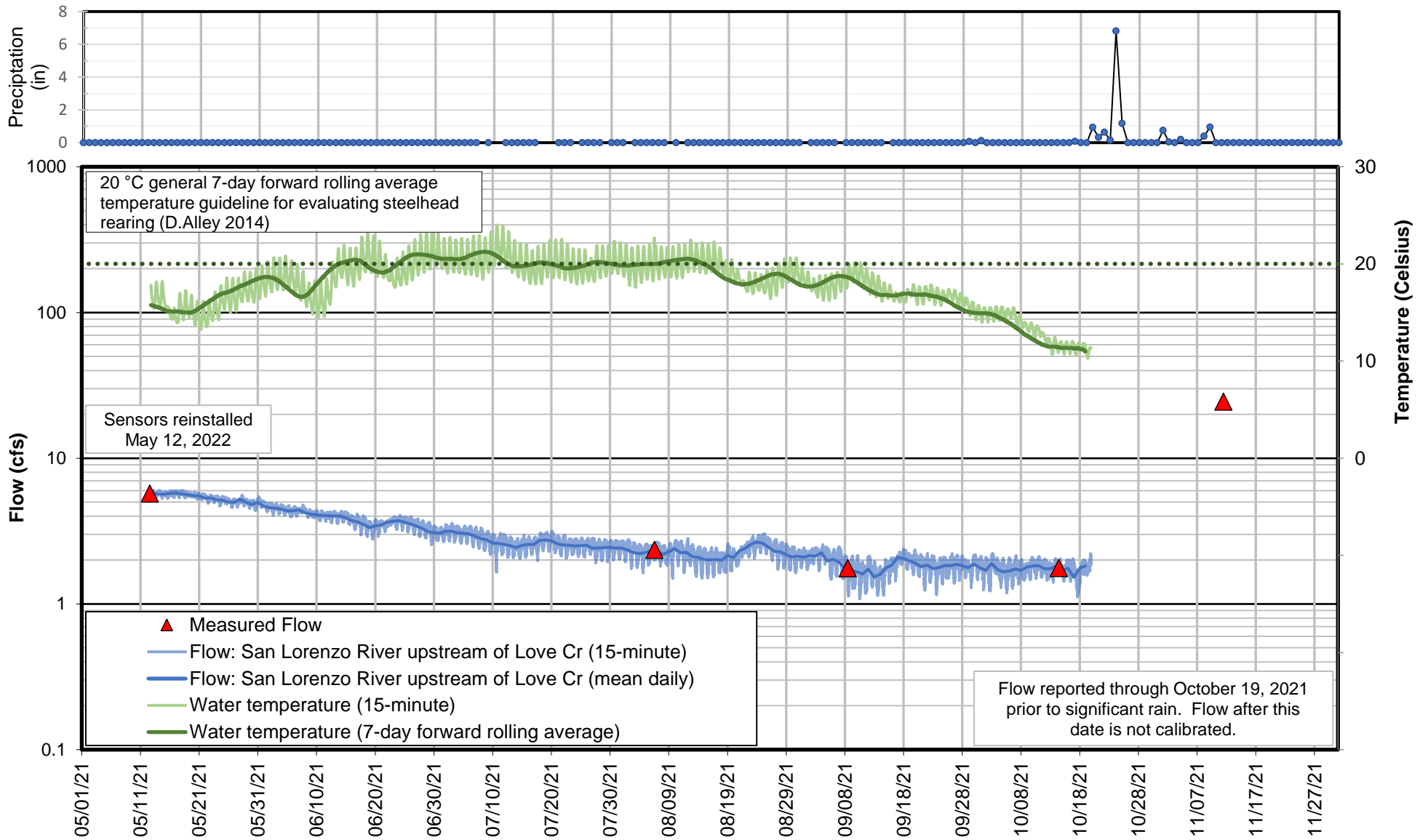


Figure 3. Flow and water temperature at the San Lorenzo River upstream of Love Creek, dry season 2021, Santa Cruz County, CA Precipitation data from SLVWD downtown Boulder Creek gage

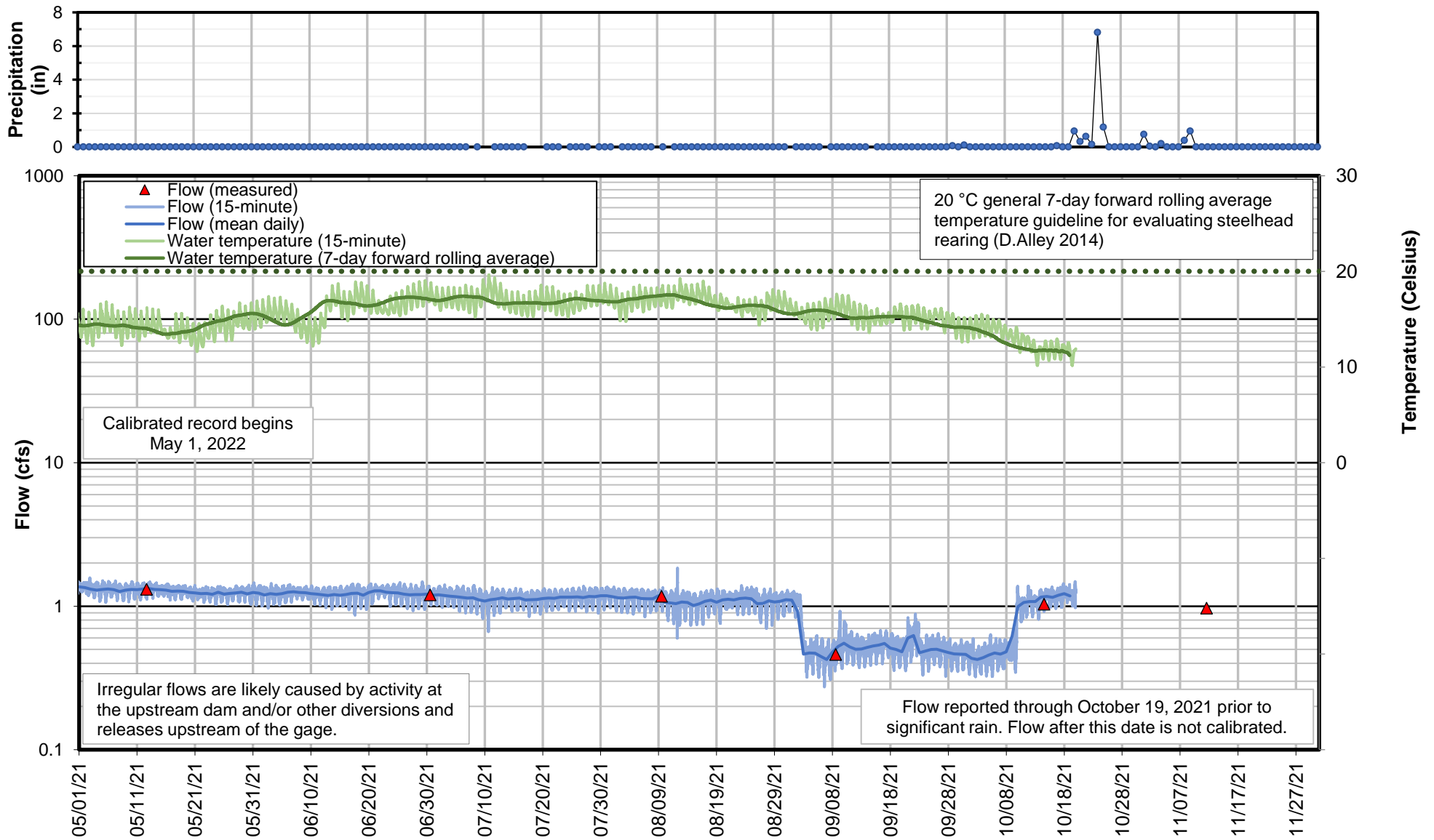
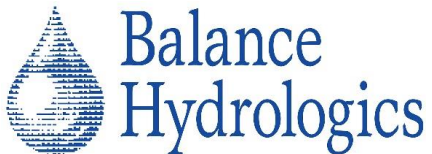


Figure 4. Flow and water temperature at Newell Creek approximately 120 ft upstream of the San Lorenzo River, dry season 2021, Santa Cruz County, CA. Precipitation data from SLVWD downtown Boulder Creek gage.



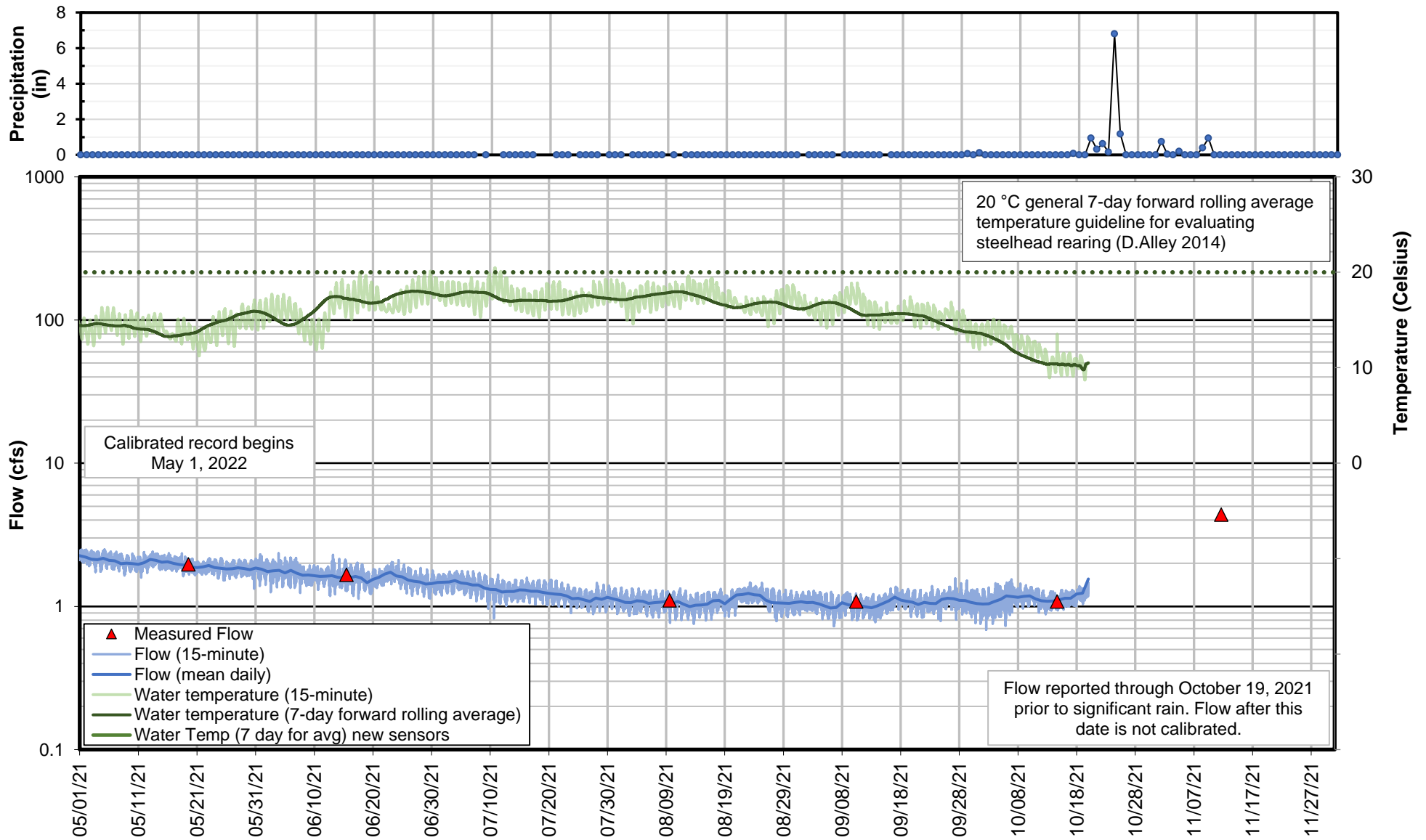
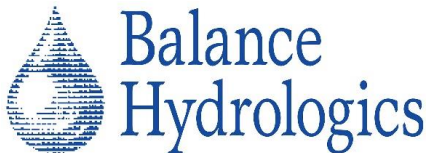


Figure 5. Flow and water temperature at Zayante Creek at Woodwardia, dry season 2021, Santa Cruz County, CA. Precipitation data from SLVWD downtown Boulder Creek gage.



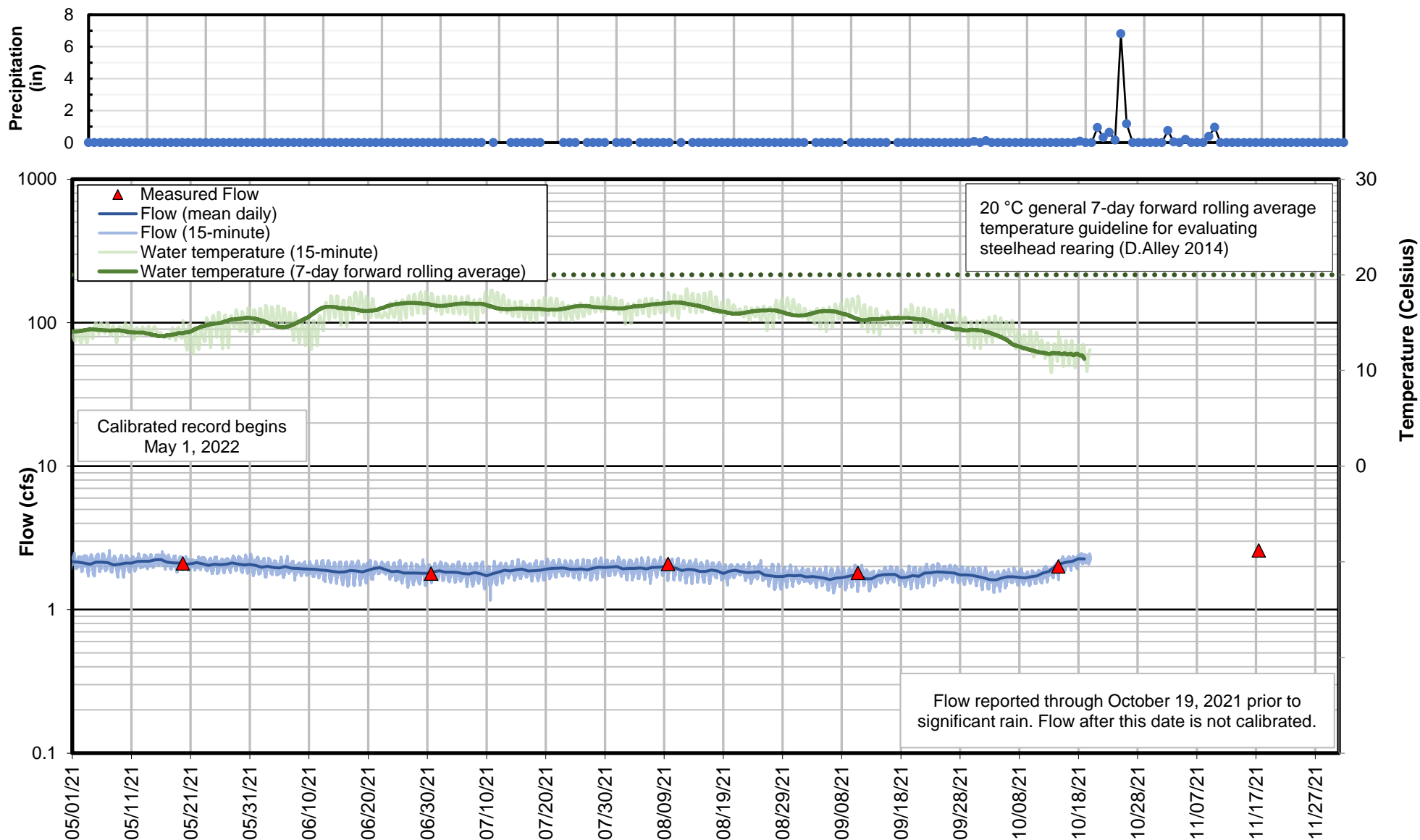
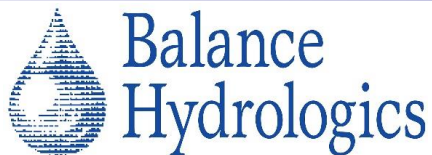


Figure 6. Flow and water temperature at lower Bean Creek above mouth at Mt. Hermon Camp, dry season 2021, Santa Cruz County, CA. Precipitation data from SLVWD downtown Boulder Creek gage.



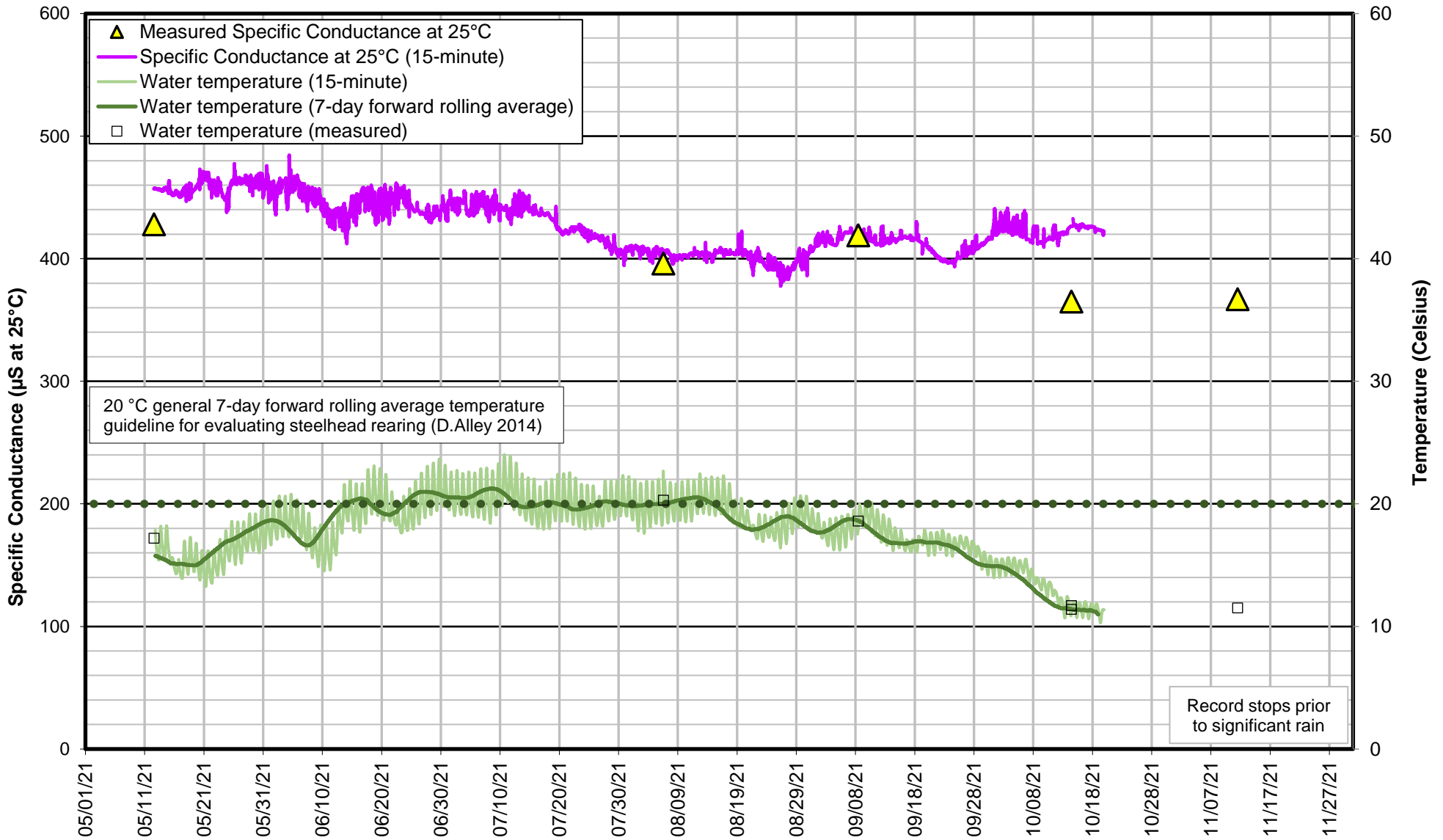
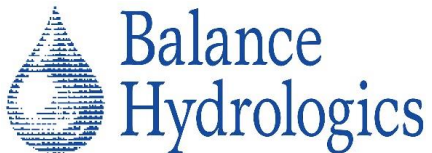


Figure 7. Specific conductance and water temperature in the San Lorenzo River upstream of Love Creek, dry season 2021, Santa Cruz County, CA



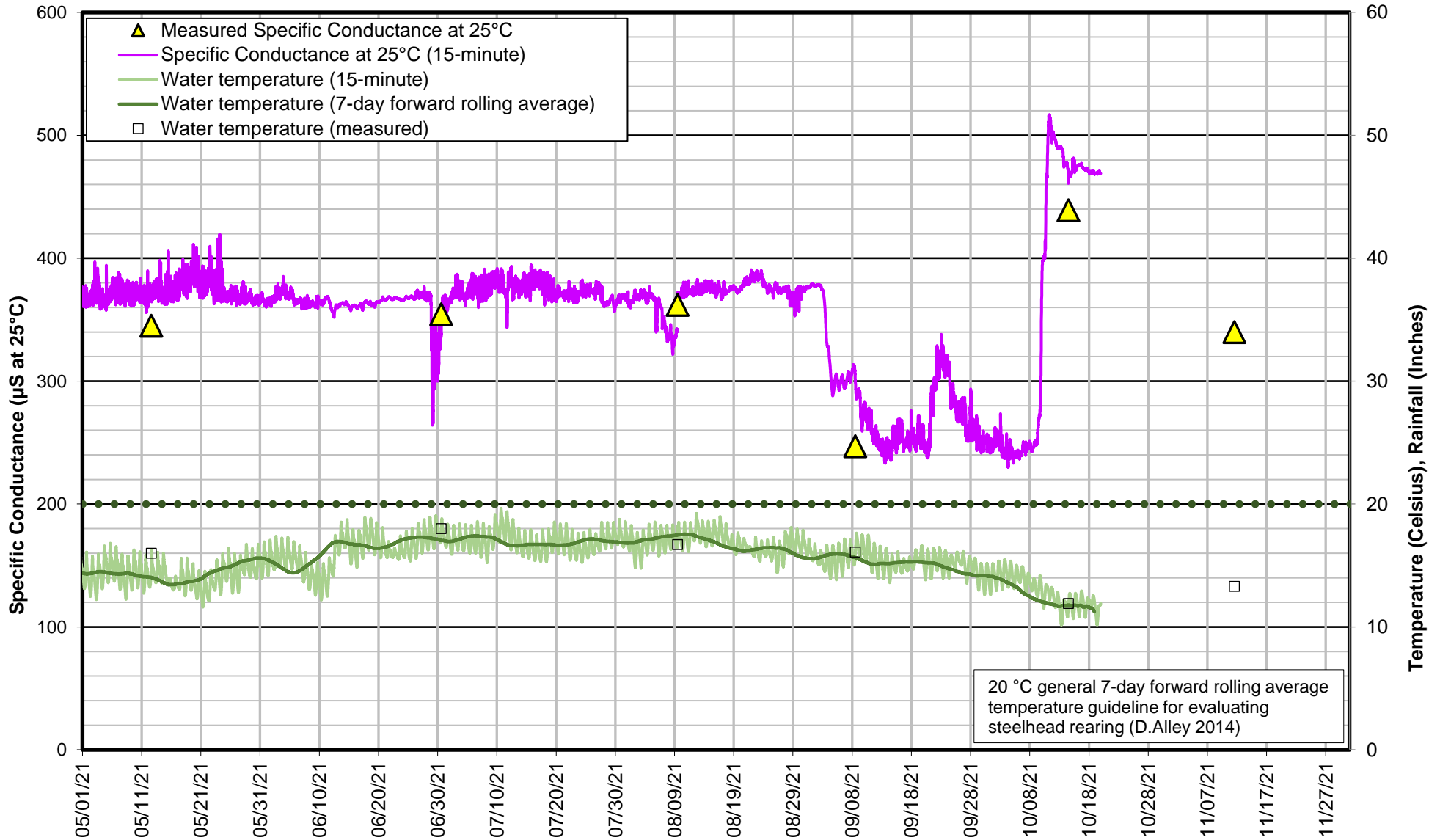
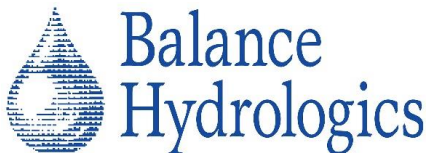


Figure 8. Specific conductance and water temperature in Newell Creek approximately 120 ft upstream of the San Lorenzo River, dry season 2021, Santa Cruz County, CA.



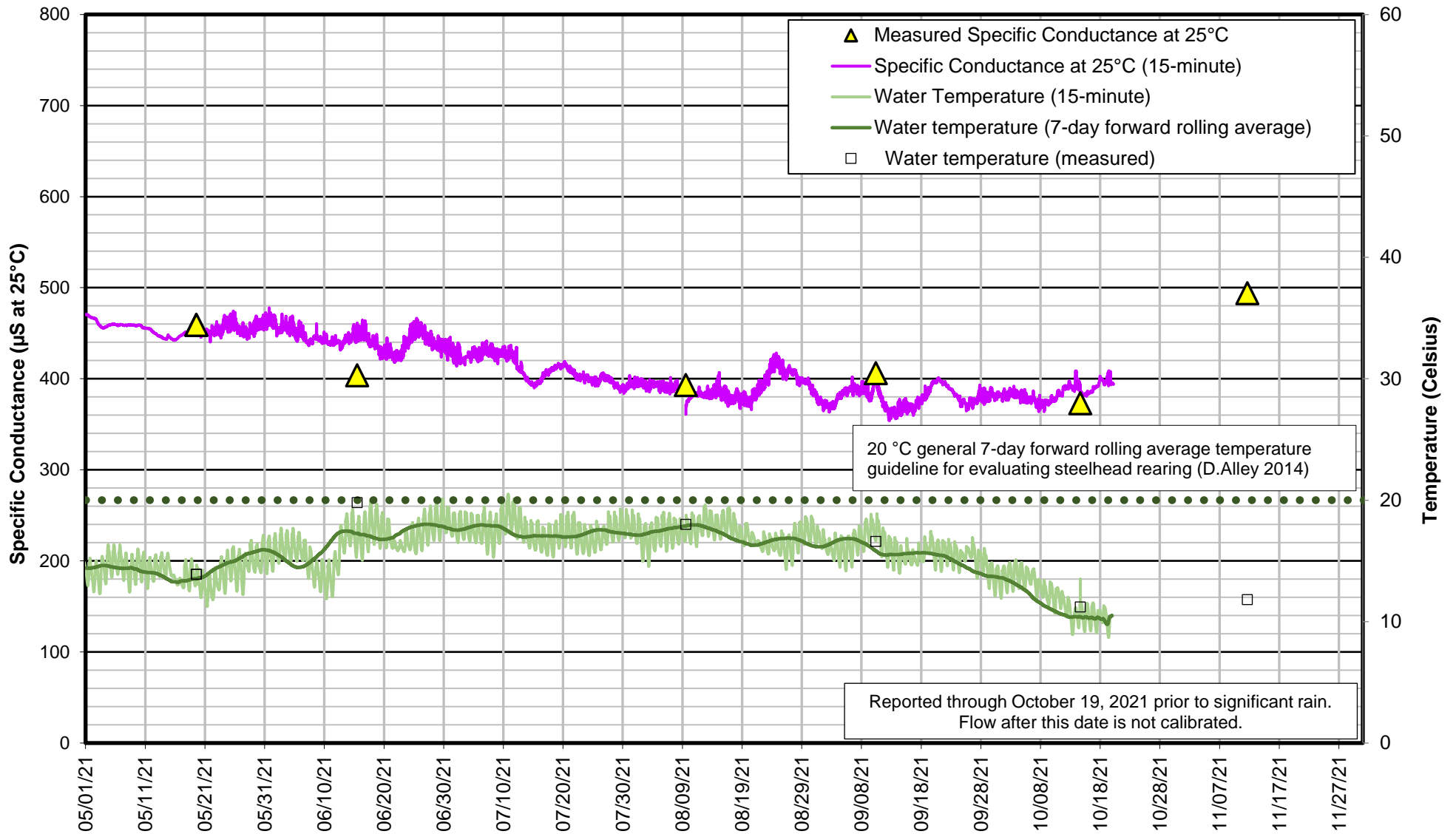
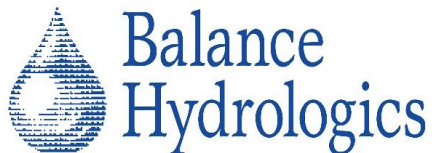


Figure 9. Specific conductance and water temperature in Zayante Creek at Woodwardia, dry season 2021, Santa Cruz County, CA.



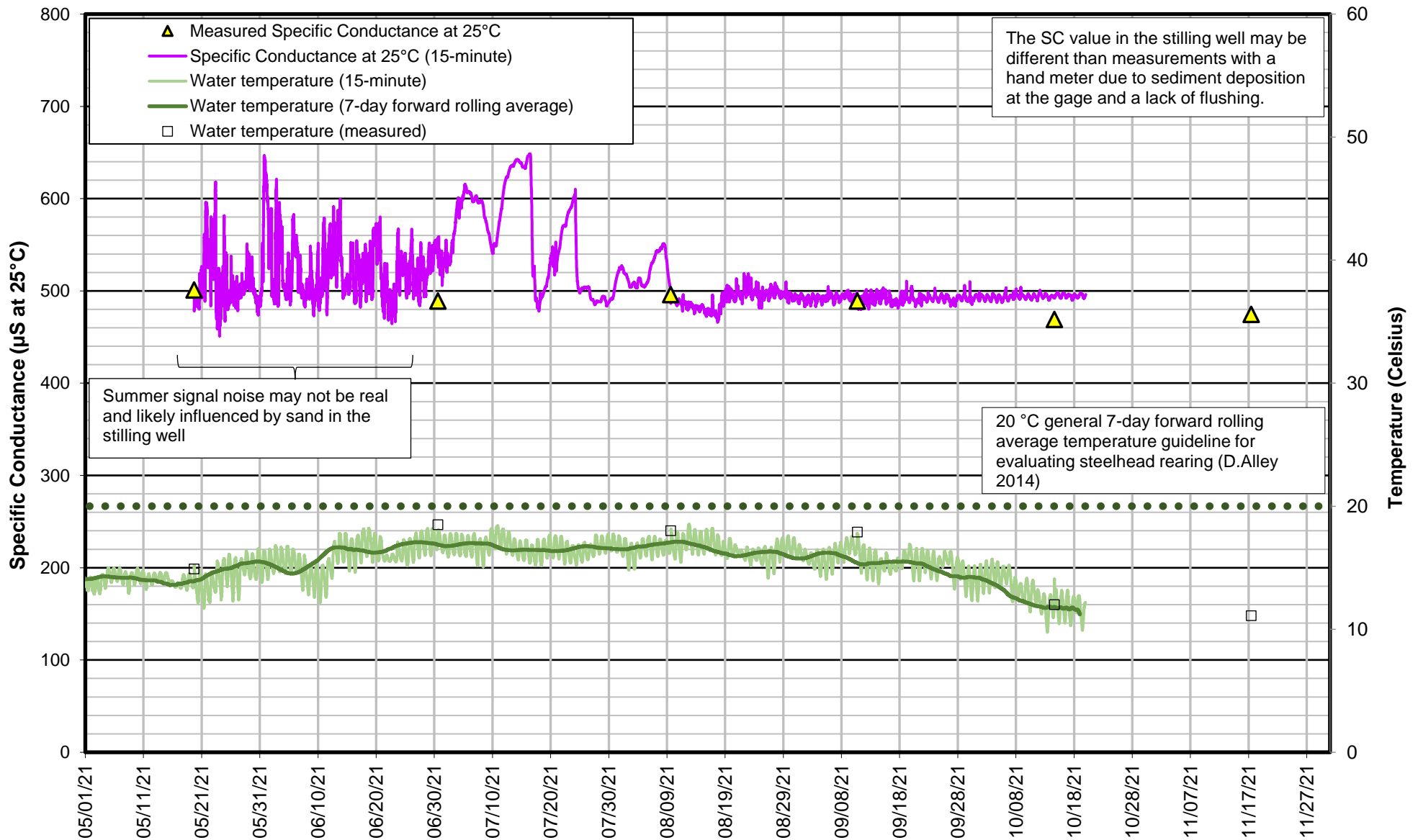
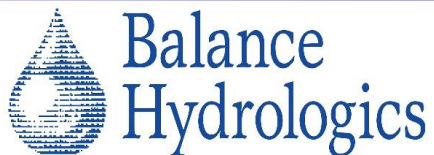


Figure 10. Specific conductance and water temperature in lower Bean Creek above mouth at Mt. Hermon Camp, dry season 2021, Santa Cruz County, CA
 Precipitation data from SLVWD downtown Boulder Creek gage.



APPENDIX A

Additional Tables

1a. & 1b.

**Appendix 1a. Observations of selected springs and groundwater dependent wetlands, and inferences regarding the source(s) their flow,
Santa Margarita Groundwater Basin, Spring 2021**

Spring No.	Name	Date	Observer(s)	Flow	Area wetted	Conductance	Temp	SCT	Other observations
				<i>gpm</i>	<i>sq. ft.</i>	<i>umhos/cm (uS)</i>	<i>deg C</i>	<i>uS at 25C</i>	
Glenwood Area Springs									
G1	Canham 1	5/26/2021	BH	-	dry	-	-	-	No flow or wet conditions observed at any of the Canham Road crossing areas. There may have been water ponded at the Willows South of the road but likely evaporated 3-5 days ago
G2	Canham 2	5/26/2021	BH	-	dry	-	-	-	
G3	Canham 3	5/26/2021	BH	-	dry	-	-	-	
G4	Canham 4	5/26/2021	BH	-	dry	-	-	-	
G5	Canham 5, willows S of Rd	5/26/2021	BH	-	dry	-	-	-	
-	Watering trough near Canham well	5/26/2021	BH	0	-	332	17.7	386	Watering trough near well is full
-	Canham well	-	-	-	-	-	-	-	Not sampled
Mid Zayante Springs									
Zay1	Azalea Spring	5/27/2021	JP	7.5	-	64	16.3	76.8	Flow is spread out through the channel, could be missing some flow
Zay2	McEnery Spring	5/27/2021	JP	67	-	116	15.7	141	This is the same channel as Azalea at E. Zayante Rd
Zay3	Olympia Quarry willow glen	-	-	-	-	-	-	-	Not sampled
Zay 4	Box Creek culvert hole	5/26/2021	BH	dry	-	-	-	-	Dry
Zay 5	E Zayante Woodwardia Spr (Tsm)	5/19/2021	JP	0.5	-	215	13	279	Flow is a trickle.
Quail Hollow County Park									
QH1	Eastern stream N of barn	5/26/2021	JP, BH	dry	-	-	-	-	No recent water, no incision.
QH2	Quail Hollow Spring box	5/26/2021	JP, BH	no flow	8	333	15	415	Water is below leaves about 1.5 below top of concrete box.
QH3	Western stream NW of Main Bldg	5/26/2021	JP, BH	damp, no flow	~36,000	-	-	-	Extensive wetted areas however not ponded or flowing, unable to get an SCT reading.
QH4	Western stream at entry road	5/26/2021	JP, BH	dry	-	-	-	-	No recent flow.
Mt Hermon Area									
M1	Redwood Spring	5/26/2021	JP	36	-	169	13.9	215	Measured flow downstream of old impoundment structure and seeping areas.
M2	Ferndell	5/27/2021	JP	81	-	164	14.7	203	
Eagle Creek Watershed									
E1	Main spring at Spreading Oaks	-	-	-	-	-	-	-	Not sampled
E2	Eagle Cr. d/s Graham Hill Rd	5/26/2021	JP	9	-	102	10.8	140	Mid-Eagle Creek area seeps cumulatively flowing at approx. 20+ gpm, can't access the largest which sounds like 10 gpm, average SCT 70-80uS at 25C, water temp approx. 14C
E3	Mid-Eagle spring complex	5/26/2021	JP, BH	108	-	72	13.9	91	
E4	Eagle above mouth	5/27/2021	JP	144	-	75	12.5	98	
Camp Evers watershed									
C1	Elena Dr. pond	-	-	-	-	-	-	-	Not sampled
C2	Morgan Court spring	5/26/2021	BH	8	-	116	14.4	142	-
C3	Camp Evers Cr at Spring Valley	-	-	-	-	-	-	-	Not sampled

Notes

Observers : JP = Jason Parke, BH = Barry Hecht

Area wetted an estimate of the area of grasses and forbs kept wetted and green by spring discharge. Optional, and only where clearly discernible. Riparian veg near stream not counted.

Sources (see references cited):

Ellis Ellis (1984) Eagle Creek report

KJ Kennedy Jenks 2015

Bal Parke and Hecht, 2020

**Appendix 1b. Observations of selected springs and groundwater dependent wetlands, and inferences regarding the source(s) their flow,
Santa Margarita Groundwater Basin, Fall 2021**

Spring No.	Name	Date	Observer(s)	Flow	Area wetted	Conductance	Temp	SCT	Other observations
				<i>gpm</i>	<i>sq. ft.</i>	<i>umhos/cm (uS)</i>	<i>deg C</i>	<i>uS at 25C</i>	
Glenwood Area Springs									
G1	Canham 1			-	-	-	-	-	No flow or wet conditions observed at any of the Canham Road crossing areas. No flow in the channel downstream of Canham or downstream of the Glenwood West parking area closer to Scotts Valley Dr.
G2	Canham 2			-	-	-	-	-	
G3	Canham 3			-	-	-	-	-	
G4	Canham 4			-	-	-	-	-	
G5	Canham 5, willows S of Rd			-	-	-	-	-	
-	Watering trough near Canham well			Trough is full, no visible flow.		-	-	-	No access, trough is full. Terrace drainage project is under construction.
-	Canham well								
Mid Zayante Springs									
Zay1	Azalea Spring	10/6/2021	JP	29	-	79	15.4	97	Measured flow downstream of old flashboards in the channel
Zay2	McEnergy Spring	10/6/2021	JP	75	-	106	13.8	135	Water is clear, no odor.
Zay3	Olympia Quarry at Willow Dr	10/6/2021	JP	10.5	-	116	15.8	141	Santa Margarita formation sand in the channel
Zay 4	Box Creek culvert hole	10/6/2021	JP	dry	-	-	-	-	Dry
Zay 5	E Zayante Woodwardia Spr (Tsm)								
Quail Hollow County Park									
QH1	Eastern stream N of barn	10/1/2021	JP	dry					-
QH2	Quail Hollow Spring box	10/1/2021	JP	dry					-
QH3	Western stream NW of Main Bldg	10/1/2021	JP	dry					-
QH4	Western stream at entry road	10/1/2021	JP	dry					-
	Main Pond	10/1/2021	JP	visible flow in/out		146	17.4	173	Water about 1 ft below stake that says "8/27/21 water level". Notably low conductivity.
Mt Hermon Area									
M1	Redwood Spring	10/1/2021	JP	34		180	15.1	221	Measured flow downstream of old impoundment structure and seeping areas. No odors.
M2	Ferndell	10/1/2021	JP	67		157	15.4	192	Water is clear, no odors.
Eagle Creek Watershed									
E1	Main spring at Hidden Glen	10/1/2021	JP	damp, not wet	400	-	-	-	Eagle Cr channel is dry, seep area is just damp.
E2	Eagle Cr. d/s Graham Hill Rd	10/1/2021	JP	0.5		119	15.2	146	Seeps SCT in this area flowing at approx. 16+ gpm (~0.04 cfs), can't access the largest which sounds like +10 gpm, avg SCT is on avg 72 uS at 25 C, water temp approx. 14.8 C
E3	Mid-Eagle spring complex	10/1/2021	JP	54	-	71	13.6	71	
E4	Eagle above mouth	10/1/2021	JP	103		59	13.1	77	
Camp Evers watershed									
C1	Elena Dr. pond								Not accessible
C2	Morgan Court spring	10/1/2021	JP	2.5	-	105	16.1	127	No odors, Santa Margarita (Tsm) sand in the channel.
C3	Camp Evers Cr - upstream of Carbona	10/1/2021	JP	40		388	14.6	485	Creek is dominated by granitics - not Tsm sand

Notes

Observers : JP = Jason Parke

Area wetted an estimate of the area of grasses and forbs kept wetted and green by spring discharge. Optional, and only where clearly discernible. Riparian veg near stream not counted.

Sources (see references cited):

Ellis Ellis (1984) Eagle Creek report
 KJ Kennedy Jenks 2015
 Bal Parke and Hecht, 2020