D.W. ALLEY & Associates aquatic biology

Soquel Lagoon Monitoring Report- 2022

(Sampling for Tidewater Goby under USFWS Endangered Species Recovery Permit TE-793645-4)

Steelhead Data Collection in Soquel Lagoon, October 2022

Sanden Notching the Uppermost Flashboard (Flume Inlet) for Steelhead Smolt Passage, May 2022

Prepared for the
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SOQUEL CREEK LAGOON MONITORING REPORT, 2022

ACKNOWLEDGMENTS

Ed Morrison and Matt Kotila (heavy equipment operator and field supervisor and the entire Capitola Public Works Department did well in constructing the sandbar, preparing the flume and maintaining the lagoon in 2022. They teamed to daily monitor the lagoon. They adjusted the flume inlet as needed to maximize lagoon depth, maintain light penetration to the bottom to maintain oxygen levels and to provide steelhead passage through the flume as baseflow declined. Every year is different, and we are grateful for their attentiveness, along with that of other Public Works staff. We thank Cooper Sanden for assisting in relocating fish from the lateral channel prior to sandbar construction in May. We thank Steve Needens for weekend beach and sand berm maintenance and for keeping the flume inlet and outlet clear through the dry season. We again thank Nels and Susan Westman for the loan of their vintage Sears-Roebuck rowboat for fish censusing and placement/ retrieval of temperature probes.

We were grateful to the volunteers who assisted in annual fish censusing at the lagoon, despite the COVID-19 virus threat. They were local residents and other volunteers interested in preserving the steelhead population in Soquel Creek. Robin Aston, math teacher at Soquel High School, brought her students and children. They were important in providing enough help. Avid angler, Bobby Ceja, and his family joined us again this year to work the seine and process the captured steelhead. Bruce Ashley, world-traveled fisherman and photographer, also joined in again this year. College students, Nigel Circhir, and his friend, Zoe, returned to assist in capturing fish and recording data. Biologists Josie Moss, Inger Marie Laursen, Debie Chirco Macdonald and Tyler Suttle provided their positive energy in working the seine and recording data. Chad Steiner and daughter Lucinda were key in setting the seine, capturing fish and assisting in their measure. Volunteers are greatly appreciated and always welcome on typically the first two Sunday mornings in October. Seining usually ends by 1:00 pm, in time for other afternoon activities.

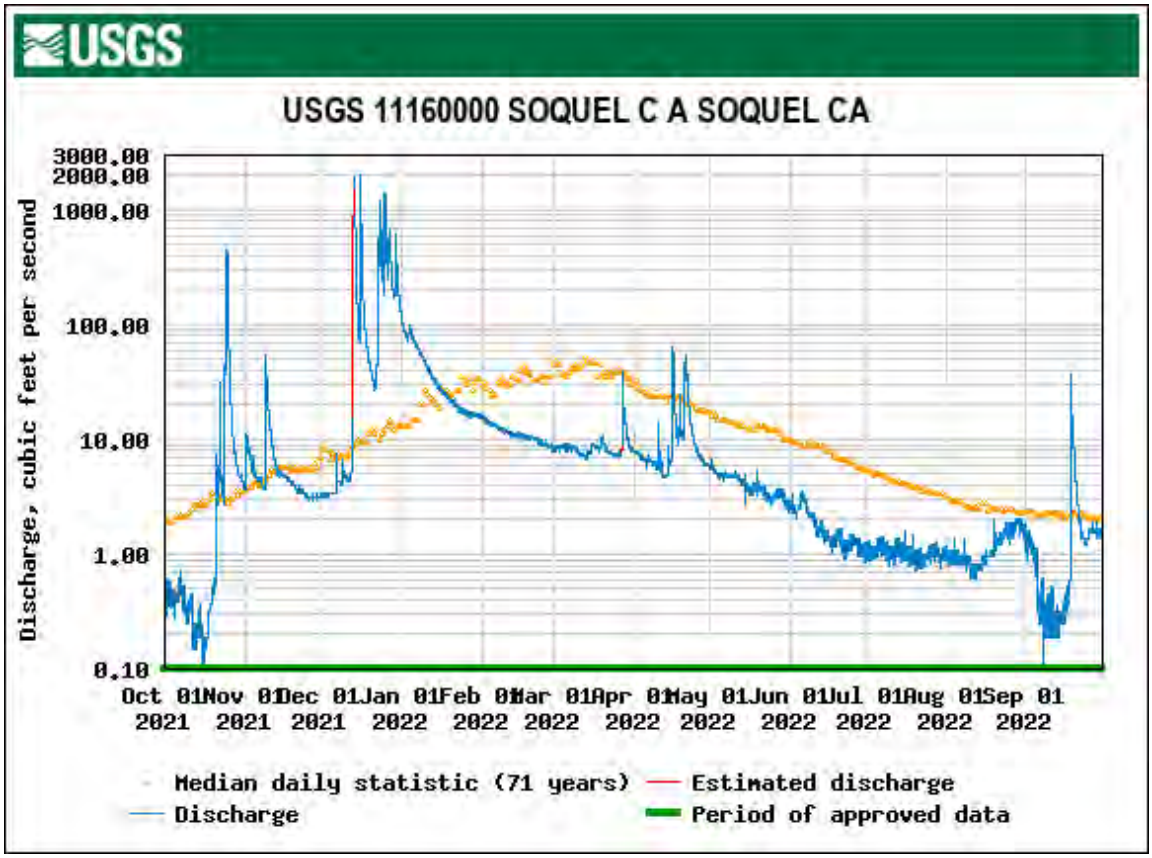
Loading the beach seine into the boat. October 2022

Setting the beach seine to capture steelhead in Soquel Lagoon. October 2022

Pulling in the beach seine (B.C. technology). October 2022

REPORT SUMMARY

Sandbar Construction. As per the 2022 permit conditions, sandbar construction began on 23 May 2022 and was completed on 26 May 2022. Previous winter stormflows had been infrequent during a relatively dry winter except in December 2022. Most rainfall occurred prior to January 1. Four likely bankfull events occurred in a wet December, with 2 reaching 2,000 cfs at the Soquel Village USGS gage, 2 miles upstream from the lagoon. However, no rain occurred between early January and mid-March 2022, typically the prime months for steelhead spawning migration. Difficult passage conditions from 30 cfs down to 7 cfs measured at the gage existed from mid-January to late March. Then only 3 small stormflows of 40−70 cfs occurred from late March to late April 2022 at the gage, offering sub-optimal adult steelhead spawning passage conditions to the upper watershed. Streamflow declined to 3.2 cfs (0600 hr) on 23 May at the USGS gage in Soquel Village.



As required in permits, a fishery biologist was present during all activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was our thirty-first year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first thirty-two years are available at the City (**Alley 1991-2022**). As stated in the Soquel Lagoon Management and Enhancement Plan (**1990**) and 2004 Soquel Creek Lagoon Management and Enhancement Plan Update (**2004**), all instream removal of kelp, sea grass and other organic debris was to be done without heavy equipment in the stream channel.

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Kelp and seagrass were present primarily in the lower estuary prior to sandbar construction. The estuary bottom was relatively hard with mostly undecomposed kelp and some decomposing plant material underneath, located downstream of Stockton Bridge. Pondweed was well distributed just below the Bridge and upstream past Noble Gulch. This was the first time in 32 years that pondweed was present this early in the dry season. Raking out of plant material was limited to within approximately 50 feet of the flume. The usual lateral channel had developed across the beach in the spring prior to sandbar construction, with a bar between the wide, slow-moving stream channel prior to flume clearing and the surf zone that allowed tidal overwash. The lateral channel went diagonally across the beach to the upper end of the jetty. One log approximately 1.5 feet in diameter lay elevated across the lateral channel.

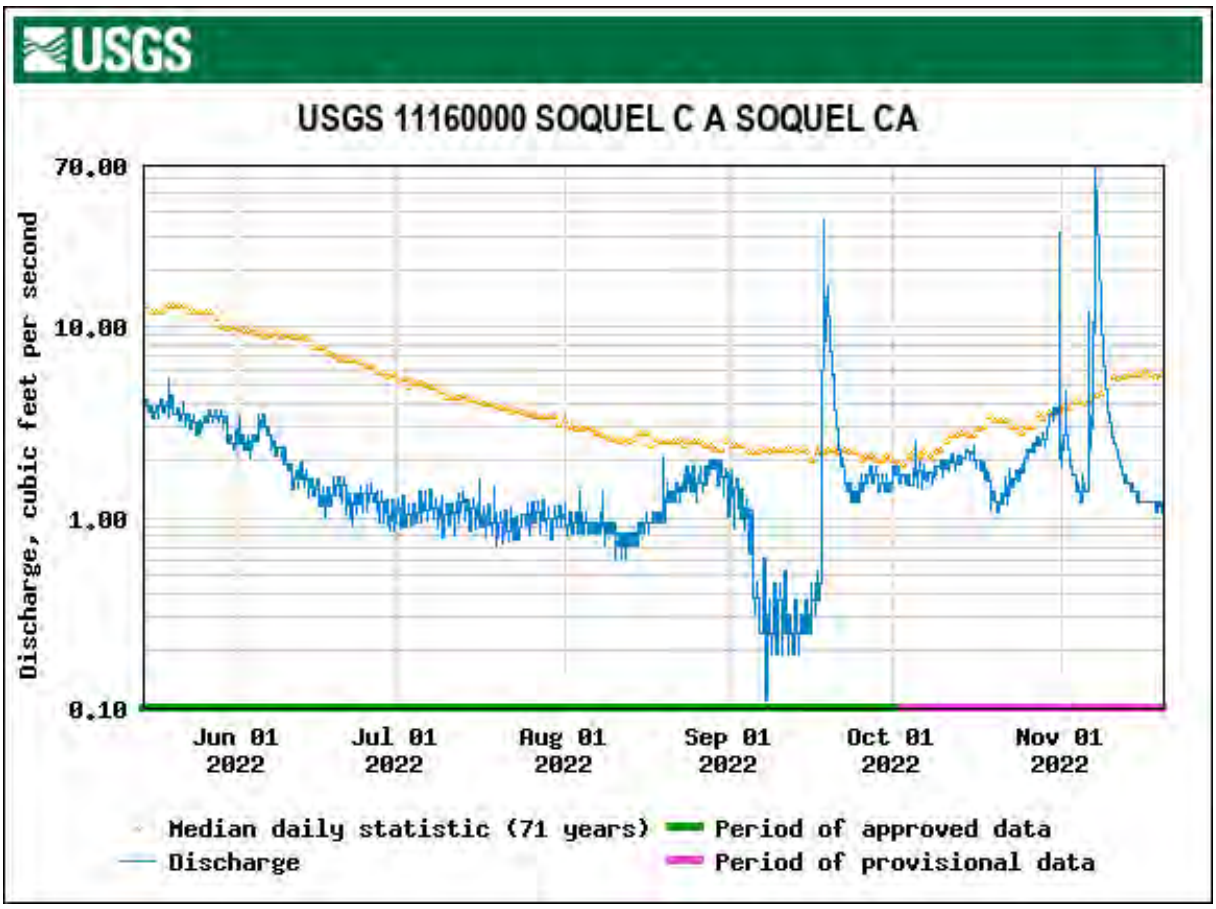
As the estuary outlet was re-directed through a channel cut adjacent to the flume on the first day of sandbar construction (23 May), fish were relocated from the lateral channel. They included both adult and young-of-the-year (YOY) tidewater gobies (*Eucyclogobius newberryi*), threespine sticklebacks (*Gasterosteus aculeatus*), staghorn sculpins (*Leptocottus armatus*) and a prickly sculpin (*Cottus asper*). No mortality of tidewater gobies was observed. The lateral channel was covered over with beach sand after the fish rescue effort was completed. This operation was monitored by the fish biologist.

Prior to sandbar construction, the plumbing of Esplanade businesses was inspected for leaks by City staff, and repairs were made as necessary (**Appendix B**). On 24 May, Cooper Sanden, Public Works staff, inspected the flume interior for possible erosion damage to the previously applied protective lining in spring of 2021. Two areas of damage were found. During the sandbar construction period, steelhead adults and smolts had access to the Bay through the flume during at least a portion of the nighttime hours every night except on the night of 26-27 May. Smolt passage access may have been discontinuous at low tide under natural conditions prior to sandbar construction due to the low baseflow throughout the spring of 2022. One artificial sandbar opening was required on 26 May during sandbar construction and preparation for the summer lagoon. After a training session, Public Works staff hand-raked decomposing kelp and seagrass from the estuary during the drawdown on this final day of sandbar construction. The biologist surveyed the estuary for stranded fish during the drawdown and found none. On 26 May, the pad around the flume inlet was covered with clear visquine and secured with sandbags. Sand was spread by shovel to cover the visquine, and the sandbar was closed for the season by Kotila. The tules planted 5 years previously in the cove beneath the railroad trestle had survived the relatively mild winter and were growing well to provide improved backwater habitat for tidewater goby. YOY steelhead hit the surface in the estuary on early mornings during the sandbar construction period and afterwards.

No stream underflow was observed near the flume outlet throughout the monitoring period, indicating that the flume repair and placement of cut-off walls beneath the flume in 2021 were successful in sealing cracks and preventing leaks. The flume's interior was lined with fiberglass and a protective resin. This insured that the City could continue to operate the flume and create good steelhead nursery habitat into the future.

Sandbar Opening. Previous to the facilitated sandbar breach that was completed on 8 November, Kotila had cut a 30-foot wide notch across the beach with an inner berm constructed near the lagoon periphery and an outer berm constructed near the surf to prevent wave action with high swells from opening the sandbar without stormflow. The notch was first cut prior to the small stormflow in mid-September, which passed successfully through the flume without sandbar breaching. The flume passed another small stormflow on 1 November. A facilitated breaching of the sandbar was required on 8 November after prior removal of a total of 8 boards from the flume inlet, The lagoon surface elevation had rapidly approached the lowermost bolt on the restaurant piling that was installed a foot below imminent flooding at the low point of the streambank along River View Road in Reach 3. The breaching was facilitated by Kotila with the tractor at 0524 hr, and flooding was prevented. A maximum gage estimate of 69.8 cfs was registered at 0715 hr at Soquel Village. The gage reading remained above 40 cfs until 1400 hr on 8 November.

Lagoon Depth. Gage height in 2022 was consistently near the highest recorded through the last 5 years at above a gage height of 2.50 until mid-September (**Figure 2**). During the summer of 2022, baseflow was consistently low, allowing good management of the flume inlet to maximize lagoon depth through the dry period until early storm events occurred. The lagoon level was rated "good" during the monitoring period until 17 September, when 4 flume inlet boards were removed in preparation for the 18 September storm (**Table 3**). By 20 September, several boards were removed from the flume inlet to allow light penetration to the lagoon bottom (**Figure 2**). With the boards removed, the water depth just above Stockton Bridge was 0.5 m (1.6 ft), which represented much of the lagoon up to the Shadowbrook Restaurant beyond Noble Gulch, except for a deeper area downstream of the Railroad trestle to Venetian Court, west side. The water depth at Station 2 along the Venetian Court wall below Stockton Bridge was 1 m (3.3 ft). The lagoon level was back to maximum depth by 1 October, with the water depth back to 1.8 m at Station 2. Then boards were removed to pass the 1 November stormflow, which made the lagoon turbid again. Additional boards were removed to allow light penetration to the lagoon bottom, with water depth at Site 2 of 1.25 m and just above the Stockton Bridge 0.8 m on 4 November. Lagoon depth remained at this level to maintain light penetration to the bottom and adequate oxygen levels until sandbar breaching was facilitate to prevent flooding on 8 November.



Water Temperature. Lagoon water temperature was within the tolerance range of steelhead in 2022 but was likely stressful from June through mid-September. Lagoon water temperature rose with warmer air temperatures, warmer inflow from Soquel Creek and with reduced stream baseflow into the lagoon in another drought year. A water temperature environmental goal is to maintain dawn water temperature near the bottom below 20° C. In 2022, this goal was met only 4 days in mid-June and after the first stormflow on 18 September (**Figure 4a**). Water temperatures near the bottom at dawn during our 2-week monitorings were mostly in the "fair" range (20-21.5°C) but was in the "poor" range (21.6-23°C) in early July and early August (**Tables 2 and 3**). Water temperature near the bottom was critically high until 8 June at Station 2 below Stockton Bridge, where a stagnant saltwater lens existed. It had dissipated by 17 June at the data logger location downstream of the railroad trestle and at Station 2 below Stockton Bridge along the Venetian Court wall. The early morning goal below 20°C was exceeded at Station 1on 8 of 11 monitorings, at Station 2 on 11 of 14 monitorings, at Station 3 on 8 of 11 monitorings and at Station 4 on 1 of 11 monitorings. The warmest morning water temperature averaged for the 4 lagoon monitoring sites was in the 20.3-22.4°C range during the warmest period from early June to early August (**Figure 3i**).

Another environmental goal is to have afternoon water temperature near the bottom not exceed 22°C. This goal was not met in 2022 at the data logger location for the first 10 weeks of the lagoon period until mid-August except 5 days in mid-June and then was met afterwards except for 11 days from 7 September to 17 September before the first stormflow (**Figure 4a**).This goal

was exceeded after freshwater conversion of the lagoon at Station 1 on 6 of 11 monitorings, at Station 2 on 3 of 11 monitorings, at Station 3 on 2 of 11 monitorings and at Station 4 at the mouth of Noble Gulch on 1 of 11 monitorings. The warmest afternoon water temperatures near the bottom at the 4 lagoon stations were from early June to early August and averaged in the 21.5− 23.6°C range (**Figure 3j**).

A third lagoon environmental goal is to maintain the daily 7-day rolling average temperature at 21°C or less near the bottom. In 2022, this goal was met at the data logger location for only 5 days in mid-June and after mid-September (**Figure 4a**). The annual trend in 7-day rolling temperature averages with respect to the maximum, average and minimum for the dry season indicates that they increase substantially in dry/drought years when stream inflow rate is much reduced (**Figure 4i**).

Stream Inflow and Influence on Lagoon Water Temperature. Lagoon water quality is generally best with higher summer baseflow from the cooler Soquel Creek. The 2022 Soquel Creek baseflow through the dry season was much below the median flow (**Table 9; Figures 25−26**). With less inflow, especially in June – August, lagoon water temperature heated up more during the day and cooled off less at night, as indicated by higher average lagoon water temperature at dawn and in the afternoon in 2022, 2021 and 2015 (other drought inflow years) (**Figures 3i and 3j**). We observed cooler lagoon water temperature in 2019 (much higher inflow) than in 2022 (low inflow) for the months of June through August (**Figures 3a-3d**). To maximize summer baseflow, water percolation into the aquifer during the rainy season must be maximized, and surface runoff must be minimized. Summer surface water diversion and pumping from the underflow of the creek reduce summer baseflow and should be curtailed quickly if surface flow becomes discontinuous in lower Soquel Creek. Baseflow atypically increased during the latter half of August before diminishing substantially. This was likely caused by a change in water diversion/well pumping patterns. Lower Soquel Creek maintained its continuity in 2022 but had very low baseflow into the lagoon by September.

Aquatic Vegetation. Kelp and seagrass were present primarily in the lower estuary prior to sandbar construction. The estuary bottom was relatively hard with mostly undecomposed kelp with some decomposing plant material underneath, located downstream of Stockton Bridge. At the time of sandbar construction, pondweed was already well distributed just below Stockton Bridge and upstream past Noble Gulch. This was the first time in 32 years that pondweed was present this early in the dry season. Raking out of plant material was limited to within approximately 50 feet of the flume inlet.

In 2022, bottom algae not attached to pondweed developed quickly and increased in thickness and coverage through July and declined as pondweed increased, bearing in mind that other algae was attached to pondweed (**Table 5**). But in early August there was a die-back of pondweed and an increase in bottom algae in Reaches 2 and 3. Pondweed then increased again in September while unattached bottom algae declined. Algae's bottom coverage and thickness were greatest in July. Pondweed's bottom coverage and thickness were greatest in early September. Surface algae and pondweed fragments increased to a maximum in September, as was typical for years when stream inflow was low and water temperature was relatively high. This floating plant material was considerably more prominent in 2022 than in recent years (**Tables 6-8**). As was typical of

past years, in 2022 the surface algae (and also floating pondweed fragments in 2022) was more abundant in Reach 3 and at the mouth of Noble Gulch than elsewhere, with a maximum of 50% lagoon coverage in Reach 3 in late September and 40% coverage at the mouth of Noble Gulch in early September.

Oxygen Concentration. Oxygen concentration was typically lowest at dawn, or soon after, because oxygen was used by cell respiration overnight before plant photosynthesis could begin producing oxygen with the light. Near dawn is the time when oxygen levels are most importantly measured and rated because they are typically the lowest. No stressfully low oxygen concentrations for steelhead (< 5 mg/L) were detected near the bottom or higher in the water column during the two-week monitorings in 2022 except on one occasion at Station 3 (under the railroad trestle) in early October (**Table 3; Figure 6a-1**). However, critically low oxygen levels (<2 mg/L) were detected on 3 days (20-22 September) after the 18 September, first flush stormflow that made the lagoon very turbid (in the range of 0.45 to 1.88 mg/L near the bottom and 0.60 and 1.94 mg/L at the surface at its worst near dawn in the vicinity of the Stockton Bridge). Fish mortalities were observed in Reaches 1 and 2 of the lagoon during this period, including steelhead for the first time in 32 years of monitoring. This was likely caused by a combination of low oxygen and toxic runoff from urban surfaces. Mortality of starry flounder and staghorn sculpin was also observed along with steelhead but not tidewater goby. A major portion of Bay Avenue had been repaved earlier in the summer. Oxygen levels began to recover in the afternoon of 22 September and were above 5 mg/L by afternoon on 23 September in the upper water column of the deeper Site 2 and throughout the water column at shallower Site 1 at the flume and above Stockton Bridge.

During the 2-week monitorings, oxygen concentrations near the bottom at dawn were in the "good" range (>7 mg/L) at all 4 monitoring stations throughout the monitoring period except at Station 3 under the railroad trestle on 2 of the 11 monitorings, with a "fair" rating (5-7 mg/L) on 4 September and a "poor" rating (<5 mg/L) on 1 October. Oxygen concentration typically increased up through the water column (**Appendix A**). The 4-station lagoon average near the bottom at dawn was above 7 mg/L (good range) on all 11 monitorings (**Figure 6a-1**). Oxygen levels generally increased through the day to afternoon measurements that were often supersaturated unless the day remained overcast (**Figure 6a-2; Appendix A**). Afternoon oxygen levels near the bottom were well above 7 mg/L (good range) at all sites during all 2-week monitorings except for 15 October, an overcast day when the average declined to just above 6 mg/L in the "fair" range.

Salinity. A saltwater lens was detected along the lagoon bottom in the deep pocket adjacent the Venetian Court wall on 24 May, with inadequate streamflow after sandbar closure on 26 May to remove it. Therefore, the shroud was installed on the flume inlet on 27 May to draw saltwater off the bottom and out through the flume. This proved inadequate. A screened, daytime pump was installed along the Venetian Court wall to remove saltwater from the deeper pocket in the lagoon out through the flume. The saltwater lens was initially slightly more than 1.6 m thick on 24 May and created very warm conditions throughout the lens. By 3 June, the saltwater lens was reduced to 0.4 m thick, less saline but still very warm. The upper 1.25 meters of the 2 meter water column had good oxygen conditions throughout the time of the saltwater lens. Steelhead inhabiting this area would avoid the poor water quality conditions within the saltwater lens by

remaining higher in the water column. By 11 June, the saltwater lens was less than 0.25 m thick, and at depth 1.75 m, less saline and still critically warm. By Friday morning, 17 June, only the bottom was slightly saline. The shroud was removed from the flume inlet on 20 June. Based on water temperature measured by our continuous temperature probes in the deep zone below the railroad trestle west side, the saltwater lens within 0.5 ft of the bottom was dissipated by 10 June (**Figure 4a**). After that, a freshwater lagoon was maintained until the sandbar breach on 8 November.

Fish Sampling Results. A total of 31 steelhead were captured, measured and marked on 2 October after 6 seine hauls. This indicated that juvenile steelhead was likely small in the lagoon in 2022. There were no mortalities. A total of 54 steelhead were captured on 9 October in 6 seine hauls. There was only one recapture and no mortalities. Using the Lincoln index for mark and recapture, the steelhead lagoon population estimate was 1,674, with a large standard error of 1,632. This estimate was above average and above the median compared to the 28-year average of 1,534 (median= 992), including the 2021 estimate (**Table 10; Figure 24**). However, with so few fish captured and only 1 recapture leading to a large standard error, the population estimate may be unreliable. Also, fish mortalities were observed after the early 18 September stormflow, including starry flounder, staghorn sculpins and 20 observed juvenile steelhead mortalities in Reaches 1 and 2. During the mid-September storm, some juveniles may have left the lagoon through the flume or moved upstream to avoid poor water quality. The lagoon steelhead population was likely larger before that storm than in October when fish were censused.

On 2 October 2022, 5 seine hauls were made to capture tidewater gobies with the 30-foot x 4-foot x 1/8-inch mesh beach seine along the portion of the lagoon periphery in Reach 1 where the 106-ft seine had not been used. Eighty-seven tidewater gobies were captured, along with 1,139 threespine stickleback, 1 staghorn sculpin and 1 adult Sacramento sucker. No tidewater goby mortality was observed after the 18 September stormflow. An annual record of tidewater goby captures may be found in **Table 12**.

Bird and Turtle Counts. Mergansers were commonly observed in 2022 as they had been in other drought years, 2013−2015 and 2021 (**Table 13)**. They were more common in 2022 than 2021. Other piscivorous birds observed in 2022 included pied-billed grebe, eared grebe, cormorant, snowy egret, common egret, black-crowned night heron, green heron and belted kingfisher. Pied-billed grebes were less common in 2022 than 2021. Egrets moved in after the lagoon level was reduced to allow light penetration after the early mid-September stormflow. They left after the lagoon level increased. As an aside, a peregrine falcon was observed soaring over the railroad trestle on the morning of 1 October.

Gull numbers during lagoon monitoring in 2022 fluctuated between 34 (25 June) and 280 (29 October), when Hermann's gulls dominated the count in Reach 1from late September to the end of October. The average gull count per monitoring day for 2014−2022 has been 63, 68, 42, 40, 46, 63, 36, 44 and 109, respectively. Mallard numbers tend to be lowest in June before ducklings become common in July − September, with a decline in October at a time when coots become common (**Figure 28**). In 2022, mallard observations increased from early to late June but then declined in early July, only to increase to a seasonal high of 39 mallards by 23 July. Significant overhanging willow cover was present in Reaches 2 and 3, which may have hidden mallard

mothers and their ducklings from censusing in early July. After July, numbers fluctuated in a downward trend between 30 and 15 birds except for an increase in mid-September to 35. Maximum mallard densities were lower than in 2018−2020, but generally higher than in 2021. The average mallard count per monitoring day for 2014−2022 has been 27, 26, 31, 18, 30, 21, 44, 23 and 28, respectively, giving 2020 the highest average in the last 9 years.

A western pond turtle was observed on 2 occasions in 2022. A turtle was observed hauled out on emergent wood near the Golino cabin in the morning on 11 June. Another turtle sighting occurred when one was basking in the afternoon across from the Golino cabin on the Arthur dock at Site 4 near Noble Gulch on 4 September. These were the first western pond turtle sightings since 2012,

Recreational Use and Pollution Solutions. Due to the managed shallow lagoon level to provide light penetration to the lagoon bottom at the scheduled time for the nautical parade, the parade was not held during the Capitola Beach Festival in 2022. Through the summer, the lagoon near the beach was posted with warning signs about potential health risks from contact with the water. However, greater human use of the lagoon has been observed since 2016 than previously. In 2016, a paddle-board concession began in the village. Paddle-boarders have become commonplace during weekend monitorings (observed on 9 of 12 afternoon monitorings in 2022), along with kayakers, pedal boaters, row boaters, canoers and barge users. In 2022, the most paddle boarders counted in a reach was 4 in Reach 3 on 23 July and 21 August. Waders and swimmers have been commonly observed in the lagoon during warm, sunny, weekend afternoon monitorings since 2016 and not previously (usually near the beach in Reach 1; 6 of 12 afternoon monitorings in 2022). The most waders observed at one time during monitoring in 2022 was 26 on 11 June in Reach 1 in the afternoon (22 observed on 25 June).

The common congregation of mallards in Margaritaville Cove in 2022 resulted from feeding by diners at Esplanade restaurants. As in previous years, mallard ducks patrolled the lagoon next to Margaritaville in the afternoon, indicating that feeding went on regularly there. This feeding should be discouraged because it is unhealthy. We observed visitors feeding the ducks on 3 of 12 monitoring days in 2022. Gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria from their excrement. They forage through human refuge left on the beach. They bathe and defecate in the lagoon. They roost and defecate on buildings surrounding the lagoon. Reducing the gull population would be a major step in reducing pollution. The use of gull sweeps has been successful in other locales to prevent gull roosting. The parallel wires strung across the roof of the Paradise Grill and other Esplanade restaurants have been effective in discouraging roosting. All of the refuse cans on the beach were equipped with gull-proof lids since 2006 (**Ed Morrison, Public Works staff, pers. comm.**). Refuse containers with gull-proof lids may reduce gull numbers. City building permit conditions of future remodeling will require addition of roof deterrents (**Steve Jesberg, Public Works Director, pers. comm.**). The increased presence of paddle boarders and boaters since 2016 has interfered with gull use in Reach 1. Gulls take wing when recreationists appear in/on their floatation devices and return quickly to bathe and congregate after they passed. Gulls avoid waders along the lagoon periphery near the flume. Human impact from gull disturbance upon the rate of gull defecation is unknown. Rock doves (pigeons) are another source of bird pollution as they circulate between the wharf and the railroad trestle over Soquel Creek Lagoon. They may increase the biological oxygen

demand somewhat under the trestle (Station 3). As stated in the original Management Plan, the trestle could be screened to eliminate pigeon roosting areas. All storm drains leading to the lagoon should ideally be re-directed away from the lagoon in summer. Included among these would be storm drains emptying into Noble Gulch. Gray water and oily slicks have been noted emptying into the lagoon from Noble Gulch in the past. None was observed in 2022.

Regarding pollution from urban runoff, once the rains start in fall, installation and maintenance of silt and grease traps on storm drains is critical to reducing pollution by petro-chemicals. Much of Bay Avenue in Capitola was repaved in summer 2022, and for the first time in 32 years of monitoring, steelhead mortality was observed in Reaches 1 and 2 of the lagoon after the first flush runoff on 18 September. Mortality of starry flounder and staghorn sculpin was also observed. The lagoon had become extremely turbid. Despite managed reduction in lagoon depth after the storm, oxygen levels at dawn were measured at below 1 mg/L throughout the water column just above Stockton Bridge on 20 September and less than 2 mg/L throughout the water column above and below Stockton Bridge on 21 September. Oxygen levels began to recover in the afternoon of 22 September and were above 5 mg/L by afternoon on 23 September in the upper water column of the deeper Site 2 and throughout the water column at shallower Site 1 at the flume and above Stockton Bridge.

All new drainage systems from new development and parking lots should be installed with effective traps and percolation basins to encourage winter percolation of storm runoff. There has been a chronic pollution problem and high flashiness in streamflow during the first small storms of the fall, as occurred in mid-September 2022. Early storms turn the lagoon water turbid (cloudy), requiring lagoon water level reduction to allow light penetration to the bottom and photosynthesis and oxygen production to continue. In most years like 2022, the lagoon required emergency breaching because the flume could not accept all of the stormflow with flooding imminent. Although costly, retrofitting of storm drainage systems with holding tanks or percolation basins could reduce the sudden increase in street runoff and pollution during early storms. Drains leading from Wharf Road (across the Rispin property), the Auto Plaza and 41st Avenue businesses north of Highway 1 are some of the sources of this problem. The storm drain along the Esplanade was connected to the sewer line in 2006 for summer diversion of water in the drain to the sewer system.

The historical lagoon had large tule beds prior to construction of the bulkheads following the 1955 flood. Tules are commonly used in managed wetlands to remove nutrients and other pollutants from wastewater effluent. Re-establishment of tule marsh in Soquel Lagoon would reduce nutrient pollution and may reduce bacterial counts. Tule re-establishment would also provide fish habitat in Soquel Lagoon. In 2017, as a pilot project, tules were planted in the cove under the railroad trestle. Some of the original plantings survived the relatively mild winter of 2017-2018 and the heavier stormflows of the 2018-2019 winter. They persisted in 2022 after a moderate winter and then expanded and grew to their greatest height in 2021 after a very mild winter. City staff will continue to monitor and augment plantings in the pilot project area.

LAGOON AND ESTUARY FORMATION

Results of Fish Relocation during Construction Activities

23 May 2022. The usual lateral channel had developed across the beach prior to sandbar construction, and went diagonally across the beach to the outer end of the jetty. It was closed to the Bay at the jetty, with streamflow passing through the flume. We had the City's operator, Kotila, slowly grade a dam across the lateral channel at the upper end at 0630 hr to prevent streamflow from entering the lateral channel. Then we had him cut a notch in the sandbar completed by 0730 hr near the jetty to open the lateral channel to the Bay to allow it to partially drain and shallow. Ten seine hauls followed by dip-netting were performed up the lateral channel that was uniformly sandy and contained kelp and instream wood. The abundance of kelp in this section prevented effective seining for fish. Thorough probing with dipnets through the kelp offered no evidence of fish life. A 30-foot long, 4-feet high, 1/8-inch meshed beach seine was used by Alley and Cooper Sanden from Capitola Public Works from 0745 hr to 1013 hr. All captured fish were placed in a livecar and then transported in a black bucket of water and released above the Stockton Bridge after seining. Then dip-netting was performed by Alley and Sanden in open water pockets near kelp and instream wood until 1229 hr. Captured fish from dip-netting relocated with the black bucket of water to above Stockton Bridge. Kotila slowly covered over the lateral channel with sand from upstream to downstream as dip-netting was done. Alley observed this process to capture any additional fish that would appear beyond the sand spreading into the channel. Fish relocated included 215 tidewater gobies (*Eucyclogobius newberryi*) with approximately 20% young-of-the-year (YOY) (<25 mm TL), 228 mostly YOY threespine sticklebacks (*Gasterosteus aculeatus*), 33 small YOY staghorn sculpins (*Leptocottus armatus*) and 1 prickly sculpin (*Cottus asper*) that was likely a yearling (**Table 1**). There were 2 staghorn sculpin mortalities observed on the lateral channel bottom during the relocation effort.

On 26 May when an outlet channel was excavated beside the flume to reduce lagoon depth, no fish stranding was observed during the survey upstream along the lagoon, past the Shadowbrook Restaurant above Noble Gulch (1405-1445 hr.).

Table 1. Observation and relocation of fish during sandbar construction, 2022.

Date	Location	Tidewater goby (Observed/ Relocated)	Juvenile Steelhead (Observed/ Relocated)	Threespine stickleback (Observed/ Relocated)	Staghorn sculpin (Observed/ Relocated)	Prickly sculpin (Observed/ Relocated)
5-23-2022	Lateral Channel	215/215	0/0	258/228	34/32	1/1
5-26-2022	Stockton Ave Bridge to upstream of Shadowbrook Restaurant	0 stranded/0	0 stranded/0	0 stranded/0	0 stranded/0	0 stranded/0

Monitoring of Flume Maintenance and Sandbar Construction

23 May 2022. The fishery biologist, Alley, arrived at 0540 hr, prior to heavy equipment operation. Alley provided a training session for Morrison and the operator, Kotila. Kotila checked for leaks in the bulldozer and inspected around it prior to operation this day. The gauged discharge at Soquel Village was 3.2 cfs at 0600 hr. Alley surveyed the margin of the lower lagoon for juvenile coho salmon. None were observed. However, YOY steelhead were observed hitting the surface above Stockton Bridge between 0600 and 0630 hr. The usual lateral channel had developed across the beach prior to sandbar construction, and went diagonally across the beach to the outer end of the jetty. It was closed to the Bay at the jetty, with streamflow passing through the flume. The lagoon was partially full and spilling 4 inches deep over a 2" x 4" base of a wooden frame in the flume inlet on the Venetian side. The restaurant side of the flume inlet was completely filled with flashboard, which would be the condition until 26 May. The entire width of the lagoon was inundated and at a water surface elevation similar to the estuary level prior to flume opening (E. Morrison pers. observation). After the fish capture and relocation effort in the lateral channel was completed, Kotila completed filling and covering the lateral channel. Morrison installed a 4" by 4" flashboard in the flume inlet on the Venetian side below the wooden frame to raise the lagoon level overnight. Water was just spilling over the base of the wooden frame when the biologist left at 1540 hr and after the lateral channel had been covered with sand. The lagoon level would increase during the night and provide adequate smolt passage through the flume. No grading was to occur around the lagoon margin this day. The sidewalk drains that empty into the lagoon were covered the previous week. The sandbar was not artificially opened this day adjacent to the flume to lower the lagoon level, and the flume was passable to fish at the end of the day.

24 May 2022. The fishery biologist, Alley, arrived at 0654 hr. High tide had scoured a section of the beach near the jetty, and Kotila was grading sand to fill it in when Alley arrived. Kotila checked for leaks in the bulldozer and inspected around it prior to operation this day. The gauged discharge at Soquel Village was again 3.2 cfs at 0600 hr. The lagoon water surface was 4 inches over the lower board in the wooden frame at 0720 hr, providing smolt passage earlier before dawn. Morrison had observed YOY steelhead hitting the surface above and below Stockton Bridge between 0600 and 0630 hr. At 0900 hr, Morrison added another 4" by 4" flashboard below the wooden frame on the Venetian side of the flume inlet to raise the lagoon level. Alley trimmed away the vegetation that obstructed the no-fishing sign along the pathway next to the lagoon. Alley detected a saltwater lens on the lagoon bottom adjacent to the Venetian Court wall. By 1420 hr, the lagoon water surface had increased to 3 inches over the base of the wooden frame in the flume inlet, thus insuring fish passage through the flume overnight. The biologist left at 1450 hr. No grading was to occur around the lagoon margin this day. The sandbar was not artificially opened this day.

Lateral channel ponded diagonally across the beach, looking upstream toward the flume. 23 May 2022

Sandbar opened near the jetty to partially drain the lateral channel. 23 May 2022

Lateral channel covered with sand after fish relocation. 23 May 2022

Steelhead passage provided through the wooden frame and flume inlet at the end of the day. 23 May 2022

Water spilling over base of wooden frame into the flume inlet (looking from above) to provide steelhead access to Monterey Bay. 23 May 2022

Lagoon spanning entire width of channel at the end of the day (pondweed visible on the right). 23 May 2022

25 May 2022. The biologist arrived at 0655 hr. Kotila was moving sand from near the surf up to the flood wall on the Esplanade, considerable distance from the lagoon margin. Kotila checked for leaks in the bulldozer and inspected around it prior to operation this day. The lagoon water surface was 5.5 inches over the base of the wooden frame in the flume inlet, having provided smolt passage the previous night. The gauged discharge at Soquel Village was again 3.2 cfs at 0600 hr. Morrison inserted another 4" x 4" flashboard in the flume inlet below the wooden frame before 0700 hr. Later, Kotila extended flume margin upstream slightly and compacted it between the flume and the restaurant walkway. Later in the afternoon, Cooper Sanden of the Public works staff inspected the flume interior for possible erosion damage to the previously applied protective lining in spring of 2021. Two areas of damage were found. No fish were observed inside the flume. No outlet channel was cut alongside the flume this day. Streamflow continued to flow through the flume and provide steelhead smolt passage over the oncoming night. The biologist left the lagoon at 1520 hr after activity around the lagoon margin ended.

Lateral channel conversion to beach completed the previous day. Kotila filling in area near the jetty with sand that was lost by tidal action overnight. 24 May 2022

Lagoon spilling over base of the wooden frame, with smolt passage previous night. 24 May 2022

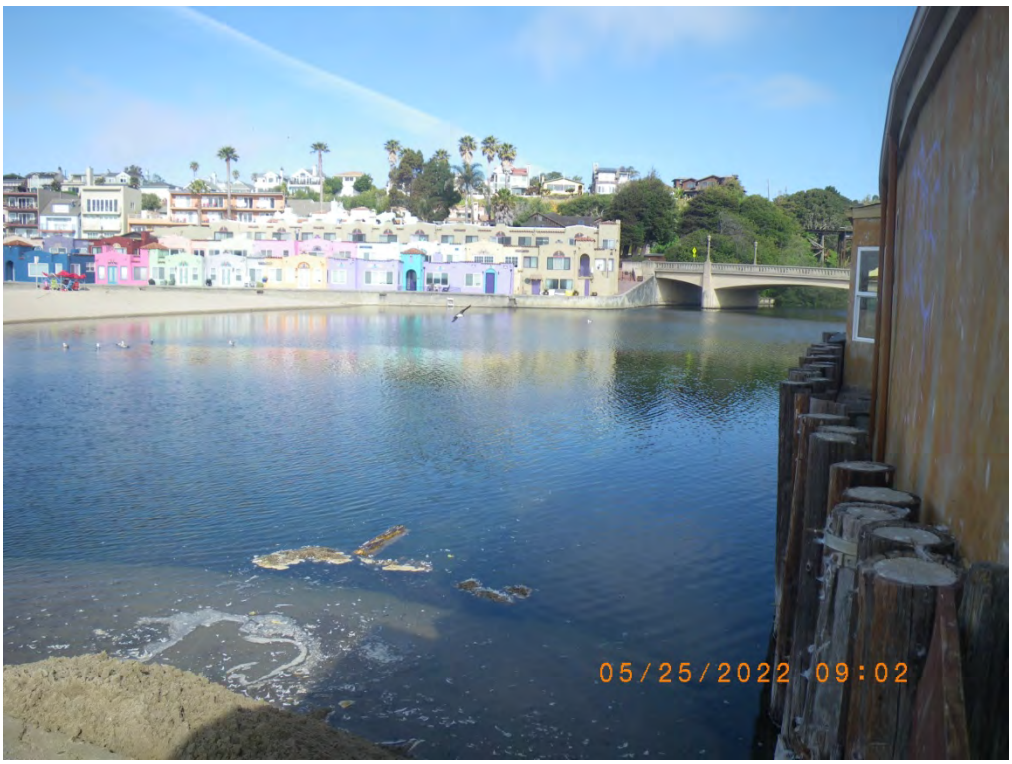
Streamflow passing through the flume the previous night for smolt passage. 24 May 2022

Lower lagoon viewed downstream from Stockton Bridge to flume inlet. 24 May 2022

Upper lagoon viewed from railroad trestle upstream. Gulls bathing near Golino cabin. 24 May 2022

Prominence of pondweed upstream of Stockton Avenue Bridge. 24 May 2022

Lagoon spilling through the wooden frame, with smolt passage previous night. 25 May 2022



Lower lagoon looking upstream from lagoon margin near flume inlet. 25 May 2022

Covered Esplanade sidewalk drains. 25 May 2022

Venetian Court wall with deep water adjacent to it, immediately downstream of the Stockton Avenue Bridge. 25 May 2022

Overhanging box elder and willow in deep area refuge immediately upstream of Stockton Avenue Bridge. 25 May 2022

26 May 2022. The fishery biologist arrived at 0850 hr. The timing of low tide delayed work this day. The gauged discharge at Soquel Village was again 3.2 cfs at 0600 hr. The lagoon water surface was near the top of the flume with a gage height of 2.52 at my staff gage on the bulkhead above Stockton Bridge. Lagoon water was spilling over the top flashboard on the Venetian side of the flume inlet at 0900 hr, indicating that steelhead smolt fish passage had been provided the previous night. Kotila checked for leaks in the bulldozer and inspected around it prior to operation this day. Alley surveyed the lower lagoon margin for coho salmon prior to the artificial opening of the sandbar next to the flume. The notch was cut with water leaving the lagoon at 0955 hr. During this time, 11 Capitola Public Works staff (including Morrison) and Alley raked the decomposing kelp out from the lower estuary to the artificial channel next to the flume. Alley provided a training session for Public Works staff. Alley, surveyed upstream for potentially stranded fish from 1405 hr to 1445 hr. No stranded fish were observed. At the lowest elevation during the partial lagoon draining on 26 May, water depth was 3-4 feet deep in a 20-ft wide, more than 400-ft long section from Venetian Court wall upstream to near the railroad trestle under Stockton bridge and overhanging box elder and willows. This reach offered ample refuge for young-of-the-year steelhead that were observed feeding in this area each morning during previous days. The sandbar was closed for the season at 1446 hr. The weir remained inside the flume to insure a splash pool for migrating steelhead at the flume inlet. Flashboards were installed all the way to the top of the flume inlet on both sides to fill the lagoon during the night after the outlet channel was dammed on 26 May. Then clear visquine plastic sheeting was secured around the flume inlet with sandbags in order to prevent underflow water leakage beneath the flume through the sandbar during the summer. An underwater adult access portal was cut through the middle flashboards and a plywood sheet attached to the flashboards on the restaurant side of the flume inlet to insure adult steelhead access through the flume. A notch was cut in the uppermost flashboard to insure smolt passage through the flume inlet and under the shroud that was installed on the restaurant slide of the flume inlet. Significant saltwater was detected in the lower 0.5 meter of the lagoon water column on 24 May, warranting placement of the shroud on the flume inlet to draw saltwater from the bottom.

27 May 2022. The fishery biologist arrived at 0840 hr. The gauged discharge at Soquel Village was 3.4 cfs at 0600 hr. Morrison had observed YOY steelhead hitting the surface between 0600 and 0630 hr above and below the Stockton Bridge. Alley and Morrison observed a Common Merganser mother and 4 ducklings feeding near the flume inlet. The ducklings were capturing threespine stickleback. The lagoon had filled approximately 1 foot higher overnight, not providing steelhead smolt passage through the flume. Alley measured salinity at the Venetian wall and confirmed that the 0.5 m thick lens remained at the bottom. Morrison and Sanden installed the shroud on the top of the flume inlet on the restaurant side of the flume inlet, as Alley observed, to pull saltwater off of the lagoon bottom. A notch was cut in the uppermost flashboard that would be beneath the shroud to allow smolt passage over it in case out-migrating smolts missed the underwater adult portal during nocturnal migration. Kotila continued to build up the sand level on the beach along the flood wall, considerable distance from the lagoon. The biologist left the lagoon at 1253 hr.

Lagoon filled overnight with added flashboards, providing smolt steelhead passage the previous night. 26 May 2022

Outlet channel with slow lagoon drawdown. 26 May 2022

Public Works staff raking kelp from the lagoon. 26 May 2022

Outlet channel at maximum width. 26 May 2022

Receded lagoon, looking upstream of railroad trestle. 26 May 2022

Receded lagoon adjacent to the Shadowbrook Restaurant wall, looking upstream. 26 May 2022

Weir intact inside the flume. New lining visible. 26 May 2022

Underwater adult steelhead portal completed on the flume inlet, restaurant side. 26 May 2022

Public Works staff covering visquine sheet with sand. 26 May 2022

Built Ford tough. Stuck in the sand. 26 May 2022

Lagoon water surface increased approximately 1 foot overnight. No steelhead smolt passage the previous night while the lagoon was filling from drought baseflow of Soquel Creek. 27 May 2022

Cooper Sanden notching the upper flashboard for steelhead smolt passage. 27 May 2022

Shroud attached to flume inlet. 27 May 2022

Shroud installed with notch for steelhead smolt passage over top flashboard (underwater adult portal established earlier in middle flashboards below). 27 May 2022

28 May 2022. Public Works staff, Steve Needens, reported to Alley that water was flowing through the adult portal at 0630 hr. Morrison sent a photo of water flowing 3 inches deep into the portal at 0700 hr, indicating that smolt passage was provided before dawn this day.

29 May 2022. Public Works staff, Ed Morrison, reported to Alley at 0733 hr that the adult portal was completely inundated, with the lagoon water surface elevation 6 inches from the top of the flume.

30 May 2022. Public Works staff, Ed Morrison, reported and provided a photo to Alley at 0943 hr that the adult portal was completely inundated, and water was flowing through the notch in the upper flashboard on the restaurant side of the flume inlet underneath the shroud and over the uppermost flashboard on the Venetian side as well.

31 May 2022. The biologist launched the temperature probes in the lagoon between Stockton Bridge and the railroad trestle (Reach 2). He also launched a probe in Soquel Creek at Nob Hill. He measured water quality at the Venetian wall and detected the saltwater lens persisting in the lower 0.5 m of the lagoon water column.

Lagoon spilling over top flashboard and smolt passage notch under shroud. 31 May 2022

Effects of Sandbar Construction on Tidewater Goby and Steelhead in 2022

215 tidewater gobies and no steelhead were observed and relocated from the lateral channel across the beach during sandbar construction in 2022. This was after a very dry winter/spring with no bankfull events after December 2021 and little rain afterwards. Only one artificial

breaching of the sandbar with partial drawdown was necessary during sandbar construction. The drawdown was slow, with very slight water velocity beyond approximately 25 feet from the flume inlet, and slackwater was present along the margin of the lagoon during drawdown. Tidewater gobies present in the upper lagoon (Reach 3) upstream of the railroad trestle of would need to retreat to the deeper slackwater in the main channel as the estuary drew down, which was similar to daily tidal fluctuations when the sandbar was open prior to construction. The smooth lagoon bottom in the center channel above the railroad trestle and smooth sloping of the lagoon margin adjacent to the Shadowbrook restaurant prevented isolated pools from developing during drawdown that may strand tidewater gobies, steelhead and or other fishes. No stranding was observed. Tidewater gobies prefer to nest in freshwater, upstream of lagoon areas subject to tidal and salinity fluctuations, especially when very high tides occur. The lower estuary locations as far upstream as at least Noble Gulch confluence are subjected to tidal fluctuations with saltwater mixing. Because of the one slow, partial drawdown during sandbar construction in 2022, lagoon width was maintained, and slackwater was abundant, likely having little effect on tidewater goby distribution. Where some lagoon bed was temporarily dewatered in Reach 3, upstream of the railroad trestle to just beyond Shadowbrook Restaurant would not strand tidewater gobies, steelhead or other fishes. Tidewater goby nesting likely occurred where loss of lagoon margin was minor. We detected no tidewater mortalities during drawdowns and flume preparations, with minimal recession of the lagoon margin downstream of Stockton Avenue Bridge. We judged impacts to tidewater gobies to be minor during sandbar construction in 2022, and no fish mortalities were observed.

The channel in lower Soquel Creek lacks sheltered backwaters for tidewater gobies to escape high water velocities during high stormflows, except possibly under the Esplanade restaurants. Some of the tules planted in the backwater beneath the railroad trestle in June 2017 survived the winter and may serve as overwintering habitat for tidewater goby in the future if they continue to grow and multiply. Several dead stalks were visible this year, however, and tule distribution has not expanded. Because of the lack of winter escape cover, tidewater goby populations that have re-occurred at Soquel Lagoon during the dry years of 2008, 2009, 2013−2016 and annually since 2018 may be transitory.

No YOY steelhead were captured in the lateral channel in 2022. However, YOY steelhead had moved into the estuary from spawning areas above the lagoon and were seen feeding on the surface during sandbar construction. With the late May sandbar closure in 2022, most steelhead smolt outmigration had likely been completed. Salmonid smolts passively drift downstream at night and are facilitated by late spring stormflows, which occurred in late March to mid-April. However, in 2022 the last notable stormflow of only 50 cfs occurred in mid-April. So, there could still have been late smolts passing through to the Bay during sandbar construction. During the sandbar construction period, adults and smolts had access to the Bay through the flume during at least a portion of the nighttime hours every night except on the night of 26-27 May. Smolt passage access may have been discontinuous at low tide under natural conditions prior to sandbar construction due to the low baseflow throughout the spring of 2022.

Data collected on smolt out-migration and YOY downstream movements in the lower San Lorenzo River just above the estuary in the late 1980's during drought indicated that smolt out-migration had ended by June and YOY had begun drifting into the estuary (**Alley, personal**

observation). A predatory mother merganser and 4 ducklings were observed on the last day of sandbar related construction (27 May) by Alley and Morrison. Morrison observed her and 3 remaining ducklings on 1 June. Deeper slackwater existed downstream and upstream of Stockton Bridge on the west side for about 100 m under overhanging box elder and willows providing shade and cover. These areas offered ample refuge for juvenile steelhead during the one artificial estuary drawdown. The lower lagoon bottom was uniformly wide and flat to minimize water velocity during the slow drawdown. No high water velocity conditions developed above the entrance of the outlet channel in 2022, and considerable slackwater refuge existed during drawdown when smolts would seek refuge during daylight hours. With all factors considered, we judged impacts to steelhead to be minor during sandbar construction, and no salmonid mortalities were observed in 2022.

Common Merganser mother and 3 ducklings at Soquel Lagoon. (Ed Morrison) 1 June 2022

The seasonal effect of typically removing organic material and constructing the sandbar is to create good summer rearing habitat for salmonids and tidewater goby. Compared to allowing natural lagoon formation, a lagoon is created with cooler, deeper, freshwater conditions, with reduced potential for eutrophication and associated increased biological oxygen demand from plant decomposition and nighttime plant respiration. Kelp and seagrass removal, when necessary, and sandbar closure create better fish habitat for tidewater goby and salmonids than if the sandbar was allowed to close naturally, and kelp and seagrass was left to decompose.

In the drought year of 2022, the sandbar likely would have naturally closed permanently for the summer soon after the timing of the manual closure. The naturally forming lagoon would have had more decomposing kelp and seagrass trapped in the lagoon to decompose. Less saltwater was trapped in the lagoon in 2022 compared to natural conditions because no tidal overwash or tidal inflow of saltwater occurred after 23 May, and the shroud installed on the flume inlet will suck saltwater from the lagoon bottom, to some extent. Under natural sandbar conditions, a lagoon would have formed with more saltwater trapped to create a thicker, unmixed, anoxic lagoon bottom, which would collect more heat and raise lagoon water temperature higher than will occur with the flume/shroud and high sandbar berm now functioning during the dry season of 2022. The naturally formed sandbar would be lower in stature, allowing more tidal overwash of saltwater during especially high tides and large swells. Increased tidal overwash would further elevate water temperature by perpetuating the stagnant saltwater lens on the bottom, making the lagoon less hospitable for salmonids and tidewater gobies. Under constructed conditions, the lagoon will likely convert to freshwater to maintain better conditions for fish (deeper, cooler, better oxygenated) than would have occurred under natural conditions.

Emergency Sandbar Breaching and Post-Breaching Bacterial Monitoring

In 1990, a bolt was set into a wooden piling adjacent to the restaurants at the lagoon. The bolt's elevation was surveyed to coincide with the water surface elevation at which flooding was imminent. That bolt is now bent. The piling bolt is at elevation 9.25 ft mean low low water (mllw) and 1.77 ft above the top of the flume, which is at 7.48 ft mllw. It allowed 1 foot of freeboard at the residence where flooding was identified as a problem. Since then, another low point has been located near the railroad trestle, which will have flooding problems at approximately 0.5 feet above the original bolt. A red line is present on a piling to indicate this elevation. The environmental goal is to pass stormflow through the flume from the first small storm events in the fall while keeping the lagoon surface below the original bolt. This is done by the City removing boards from the flume inlet prior to and during increased stormflow. Water also flows through the top grate constructed in the flume inlet in 2003.

Typically, a tractor is used in the fall to cut a notch approximately 30 feet wide in the sandbar adjacent to the flume, but slightly deflected to the east. A berm is left along the lagoon margin between the notch and the lagoon. An additional berm is constructed across the notch near the surf to prevent wave action at the beach from entering the notch. The intent is to prepare the sandbar so that it will breach at the proper time to prevent flooding. The City cuts the sandbar notch at the elevation of the piling bolt. However, the notch fills in from foot-traffic on the beach as time goes on. If, despite efforts to pass all of the stormflow through the flume, the water surface reaches the elevation of the piling bolt, then the City is to facilitate sandbar breaching. A tractor is used to re-cut the sandbar notch and breach the two berms across the notch so that the

entire sandbar breaches prior to flooding. If the flume is able to receive all of the stormflow and flooding does not become a threat, boards are replaced in the flume inlet after the stormflow has passed, maintaining light penetration to the bottom of the lagoon.

By 17 September, Kotila cut a 30-foot wide notch across the beach with an inner berm constructed near the lagoon periphery and an outer berm constructed near the surf to prevent wave action with high swells to open the sandbar without stormflow. In preparation for the first storm forecasted in the winter season to occur on 18 September 2022, 4 boards were removed from the flume inlet on the Esplanade side, and the bars at the flume outlet were removed. On 18 September after a brief stormflow registering a maximum of 36.4 cfs at the Soquel Village stream gage, the sandbar remained intact. On 1 November after a brief stormflow registering a maximum of 31.5 cfs at the Soquel Village stream gage, the sandbar remained intact.

On 8 November after prior removal of 8 boards from the flume inlet, facilitated breaching of the sandbar was required when the lagoon surface elevation rapidly approached the lowermost bolt on the lagoon piling that indicated imminent flooding at the low point of the streambank along River View Road in Reach 3. The breaching was facilitated by Kotila with the tractor at 0524 hr as the lagoon surface elevation rapidly approached the lowermost piling bolt that indicated imminent flooding 1 foot above it. The USGS gage streamflow estimate at 0515 hr was 49.2 cubic feet per second (cfs) at Soquel Village, 2 miles upstream of the lagoon. The estimated capacity of the flume is between 30 and 35 cfs. A maximum gage estimate of 69.8 cfs was registered at 0715 hr. The gage reading remained above 40 cfs until 1400 hr on 8 November. No fish mortality or water quality problems were observed during the sandbar opening.

Kotila delivered the before and after sandbar opening water samples taken at the mouth of Soquel Creek to Monterey Analytical. Lab analysis indicated that the pre-opening enterococcus bacterial count was 620 cfu/100 ml on 8 November. The post-opening count on 8 November was 5,172 cfu/100 ml, requiring additional weekly water sampling until the count was less than 104 cfu/100 ml. Water quality sampling ended on 16 November 2022 with an Enterococcus bacterial count of <10 cfu/ 100 ml.

Beach notch with inner and outer berms. 29 October 2022

Inner berm of beach notch. 29 October 2022.

Outer berm of beach notch. 29 October 2022

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www.MBASinc.com
ELAP Certification Number: 2385

Tuesday, November 15, 2022

Sample Results

Lab Number: 221108_13-01

Collection Date/Time: 11/8/2022 4:45 | Sample Collector: Kotila M | Client Sample #:
Received Date/Time: 11/8/2022 10:35 | System ID: | Coliform Designation:

Sample Description: Pre-Breach Lagoon Water @Ocean

Analyte	Method	Unit	Result	Qualifier	Dilution	PQL	Analysis Date/Time		Analyst
Enterococci	Enterolert	MPN/100mL	620	H8	10	10	11/8/2022	15:16	SB

Comments: H8: Holding time was > 8 hrs but < 24 hours.

Lab Number: 221108_13-02

Collection Date/Time: 11/8/2022 5:35 | Sample Collector: Kotila M | Client Sample #:
Received Date/Time: 11/8/2022 10:35 | System ID: | Coliform Designation:

Sample Description: Post-Breach Lagoon Water @Ocean

Analyte	Method	Unit	Result	Qualifier	Dilution	PQL	Analysis Date/Time		Analyst
Enterococci	Enterolert	MPN/100mL	5172	H8	10	10	11/8/2022	15:16	SB

Comments: H8: Holding time was > 8 hrs but < 24 hours.

Report Approved by: David Holland, Laboratory Director

The results in this report are related only to the samples analyzed.
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Abbreviations/Definitions: mg/L: Milligrams per liter (=ppm) | µg/L: Micrograms per liter (=ppb) | MPN: Most Probable Number
MDL: Method Detection Limit | PQL: Practical Quantitation Limit | MCL: Maximum Contamination Level | ND: Not Detected at the PQL (or MDL, if shown)
E: Analysis performed by External Laboratory; see Report attachments | H: Analyzed outside of method hold time | QC: Quality Control
J: Result is < PQL but ≥ MDL; the concentration is an approximate value

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Friday, November 18, 2022

Sample Results

Lab Number: 221116_08-01

Collection Date/Time: 11/16/2022 9:30 | Sample Collector: Kotila M | Client Sample #:
Received Date/Time: 11/16/2022 11:08 | System ID: | Coliform Designation:

Sample Description: City of Capitola, Post-Breach Lagoon Water @ocean

Analyte	Method	Unit	Result	Qualifier	Dilution	PQL	Analysis Date/Time	Analyst
Enterococci	Enterolert	MPN/100mL	<10		10	10	11/16/2022 16:44	SB

Comments:

Report Approved by: David Holland, Laboratory Director

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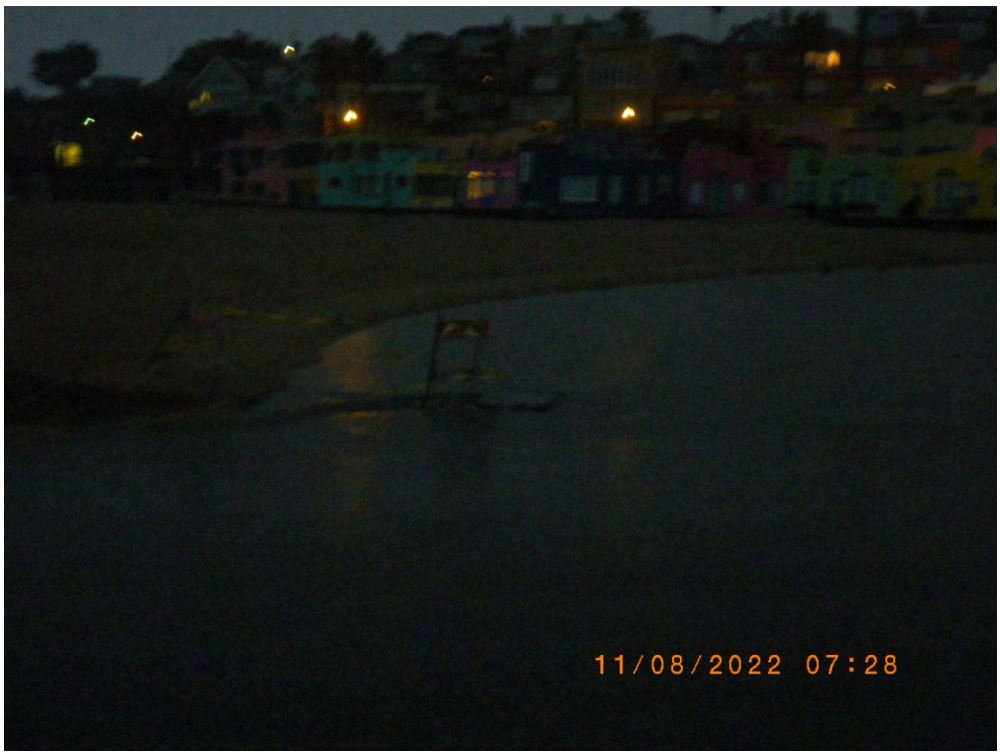
Abbreviations/Definitions: mg/L: Milligrams per liter (=ppm) | µg/L: Micrograms per liter (=ppb) | MPN: Most Probable Number
MDL: Method Detection Limit | PQL: Practical Quantitation Limit | MCL: Maximum Contamination Level | ND: Not Detected at the PQL (or MDL, if shown)
E: Analysis performed by External Laboratory; see Report attachments | H: Analyzed outside of method hold time | QC: Quality Control
J: Result is < PQL but ≥ MDL; the concentration is an approximate value.

11/28/22 SS



Streamflow over the flume inlet. 0628 hr 8 November 2022
(Photo stamp incorrect and should read 6:28 am). (Alley photo)

Outlet channel through sandbar at sandbar opening. 0628 hr, 8 November 2022
(Photo stamp incorrect and should read 6:28 am). (Alley photo)

Soquel Estuary opening to the Monterey Bay from Reach 1 at 1.7 cfs at the Soquel Village gage. 1229 hr, 13 November 2022.

Soquel Estuary, looking upstream for Stockton Bridge into Reach 2 at 1.7 cfs at Soquel Village gage. 1228 hr, 13 November 2022.

Soquel Estuary outlet adjacent to the flume at 1.7 cfs at Soquel Village gage.
1249 hr, 13 November 2022.

Flume inlet sealed for the winter. at 1.7 cfs at Soquel Village gage.
1248 hr, 13 November 2022.

Soquel Creekmouth at 1.7 cfs at the Soquel Village gage (partially submerged flume outlet visible in the surf). 1251 hr, 13 November 2022.

WATER QUALITY MONITORING IN 2022

Rating Criteria

Water quality parameters were rated according to the tolerances of steelhead. This was because they are least tolerant of low oxygen, higher salinity and higher temperatures of the resident lagoon fishes. Stress to freshwater acclimatized steelhead would probably not occur until conductivity levels reach 12,000 to 15,000 umhos, associated with sudden increases in salinity to 10 − 12 parts per thousand (**J. Cech, personal communication**). Water temperatures above 22º C (72º F) (**Table 1**) and oxygen levels below 5 parts per million (mg/L) are thought to stress steelhead. Regarding temperature optima, Moyle (**2002**) stated, "*The optimal temperatures for growth of rainbow trout are around 15−18ºC, a range that corresponds to temperatures selected in the field when possible. Thus, in a section of the Pit River containing a thermal plume from an inflowing cold tributary, rainbow trout selected temperatures of 16−18ºC. However, many factors affect choice of temperatures by trout (if they have a choice), including the availability of food.*" Rainbow trout are the same species as steelhead but with a freshwater life history pattern. Optimal temperature for rainbow trout in higher elevation mountain streams of the Sierra Nevada or Cascades may be lower than what is optimal for juvenile steelhead along the Central Coast. Coastal lagoons are very food-rich environments where steelhead growth rates are very high, despite warmer water temperatures A study completed by **Farrel et al.** (**2015**) indicated that the thermal range over which a Tuolumne River *O. mykiss* population could maintain 95% of peak aerobic capacity was 17.8°C to 24.6°C. Furthermore, up to a temperature of 23°C, all individual fish could maintain a factorial aerobic scope (FAS) value >2.0 (FAS = Maximum metabolic rate (MMR) / Routine metabolic rate (RMR)), one that is predicted to provide sufficient aerobic capacity for the fish to properly digest a meal. An added benefit of higher water temperature is that it increases digestive rate, allowing faster food processing and faster growth potential when food is more abundant. Under controlled laboratory conditions, food consumption, growth, and temperature tolerance were compared for Nimbus-strain steelhead (an introgressed breeding stock in the American River) acclimated to and held at 11, 15, and 19˚C in replicated laboratory experiments. Although food consumption rate showed no statistical difference between temperatures, the growth rate was higher at 19˚C than at 11˚C or 15˚C, providing evidence that food conversion efficiency in juvenile steelhead is higher at the warmer temperature (**Myrick and Cech 2005**).

The Santa Ynez River Technical Advisory Committee (SYRTAC) proposed guidelines with upper limits of 20 ˚C average daily temperature and 25 ˚C daily maximum as providing acceptable habitat conditions for steelhead in the Santa Ynez River, south of the Santa Maria River (**SYRTAC 2000**). The SYRTAC (**2000**) decided that a mean daily temperature of 22 ˚C in the River may be the threshold between acceptable and unsuitable from a long-term perspective. This was based on studies by Hokanson et al. (**1977**) who concluded that the highest constant temperature at which the effects of growth and mortality balance out was 23 ˚C. Bjornn and Reiser (**1991**) state that growth, food conversion efficiency, and swimming performance are adversely affected when dissolved oxygen concentrations are <5 mg/L. However, steelhead were found surviving in pools in the Carmel River at 1-2 mg/L for 1-2 hours at dawn (**David Dettman, personal observation**) and in San Simeon Lagoon near Cambria at oxygen concentrations less than 2 mg/l on repeated occasions (**Alley 1995b; 2006b**). Based on 1988 monitoring, steelhead survived in Soquel Lagoon at water temperatures of 23-25º C for 1-2 hours

in late afternoon or early evening (**Habitat Restoration Group 1990**). Water temperature may rise as much as 3-4º C from a morning minimum, after a sunny, fog-less day.

Oxygen levels critical to steelhead survival were classified as those measured in the lower 0.25 meters from the bottom, where steelhead would inhabit. Early morning oxygen levels below 2 mg/l were rated "critical" (**Table 2**). Those levels between 2 and 5 mg/l were rated "poor." Early morning oxygen levels of 5 to 7 mg/l were rated "fair" with above 7 mg/l rated as "good." Early morning water temperatures in the lower 0.25 meters of the water column of less than 20º C were rated "good" while those 20 − 21.5º C were rated "fair." Temperatures between 21.6 and 23º C were rated "poor," while those greater than 23º C at dawn were rated "critical." If salinity was less than 10 ppt, the rating was "good." If the salinity was more than 10 ppt due to tidal overwash, it was rated "poor." High levels of dissolved carbon dioxide in water will inhibit absorption of oxygen by fish. However, in the alkaline conditions of Soquel Creek Lagoon, carbon dioxide is poorly dissolved and is not a problem (**J. Smith, personal comm**.). Therefore, its monitoring was unnecessary.

Lagoon water level was monitored with the staff gage on the eastern bulkhead, upstream of the Stockton Avenue Bridge (**Figure 1**). Readings below 1.5 feet were rated "critical" while readings between 1.5 and 1.85 were rated poor (**Table 2**). Readings between 1.86 and 2.2 were rated "fair." Readings above 2.2 were rated "good." These criteria were somewhat arbitrary, based on an as yet poorly defined relationship between lagoon depth and associated fish cover, water temperature and algal growth. If the upper lagoon becomes too shallow, steelhead habitat is eliminated and algae growth may be stimulated. An important factor not directly under control by the City is change in streambed elevation resulting from winter scour or fill in the estuary.

Locations and Timing of Water Quality Monitoring

As required under the CDFW permit, water quality was monitored in late afternoon, as well as in the early morning near first light. Water quality was monitored at four lagoon stations and one stream station. Station 1 was at the flume inlet (**Figure 1**). Station 2 was just downstream of the Stockton Avenue Bridge in the deepest thalweg area. Station 3 was just downstream of the railroad trestle on the east side. Station 4 was at the mouth of Noble Gulch. Station 5 was monitored in the morning and afternoon in Soquel Creek near the Nob Hill shopping center, just upstream of the lagoon. Stream data were compared to lagoon conditions of water temperature and oxygen levels in early morning.

As required by the CDFW permit, 6 HOBO temperature loggers were launched on 31 May 2022, just downstream of the railroad trestle in Reach 2 (as in 2008−2021) at 1-foot intervals through the water column, beginning at 0.5 feet above the bottom and ending 5.5 feet from the bottom. Another logger was placed in Soquel Creek near the Nob Hill Shopping Center. The 6 lagoon loggers and one stream logger were removed on 2 October 2022 prior to sandbar opening. The stream data logger was removed on 21 November 2022.

Water quality in terms of oxygen concentration, temperature, conductivity and salinity was measured at each lagoon station at two-week intervals after the sandbar was constructed until the sandbar breached in the fall. Prior to the first full monitoring, salinity was measured in deeper portions of the lagoon to determine if saltwater had been trapped during sandbar construction.

Saltwater was detected in 2022 in the lagoon 4 days after the sandbar closure. Thus, the biologist judged that the inlet shroud was needed to pull saltwater off of the bottom.

Table 2. Criteria for Rating Water Quality Measurements within 0.25 Meters of the Bottom after Sunrise and for Rating Gage Height Readings.

MORNING RATING	MORNING TEMPERATURE (Celsius)	MORNING OXYGEN (mg/L)	GAGE HEIGHT (ft)
Good	< 20	> 7	> 2.20
Fair	20-21.5	5-7	1.85-2.20
Poor	21.6-23	2-5	1.50-1.85
Critical	> 23	< 2	< 1.50

Water Temperature Goals for Soquel Creek and Lagoon

Regarding Soquel Creek Lagoon in summer, where food is more abundant than upstream, the water temperature environmental goal for steelhead should be to maintain water temperature below 20ºC at dawn within 0.25 m of the bottom and below 22ºC near the bottom in the afternoon, with the 7-day rolling average near the bottom equal to 21°C or less. The early morning goal coincides with a "good" rating at monitoring sites (**Table 2**). The lagoon environmental goal is somewhat higher in temperature than the enhancement goal that we established for Soquel Creek upstream during the development of a watershed plan, where the goal was to maintain the 7-day rolling average at 20ºC or less. Maximum daily water temperature in the lagoon should not reach 26.5ºC. Coche (**1967, cited in Kubicek and Price 1976**) determined that water temperature between 20 and 24ºC was responsible for high maintenance requirements and low conversion efficiency of food into growth for his stock of juvenile steelhead. However, measurement of juvenile steelhead from Soquel Lagoon indicates that growth rate has been greater than in upstream stream reaches (**Alley 2008a; 2008b**), with nearly all young-of-the-year juveniles rearing in the lagoon reaching soon-to-smolt size the first summer each year. This indicates that despite higher water temperature in the lagoon, growth rate of juveniles is rapid because food is abundant. The Farrel et al. (**2015**) work indicated that near peak activity (at least 95%) can be maintained up to 24.6˚C in warm-water acclimated steelhead in the Toulumne River, and the Myrick and Cech **(2005**) work with steelhead indicated that growth rate increased with temperature provided that food was abundant.

Water temperatures above 20ºC (68ºF) are considered limiting to juvenile coho salmon in the presence of steelhead (depending on food abundance), and lagoon temperatures below 16ºC (60.8ºF) are preferred (**J. Smith, San Jose State University, pers. comm.**). Therefore, the environmental target for making Soquel Creek Lagoon habitable for coho should be to maintain summer water temperature below 20ºC (68ºF). The 2010 lagoon was the coolest in the previous 20 years, with relatively high baseflow and a deeper lagoon. Water temperature near the bottom exceeded 20° C for a 3-day period in early June and a 4-day period in mid-July. However, it is unlikely that Soquel Creek Lagoon may cool sufficiently to support juvenile coho salmon in most years.

The environmental goal for water temperature in stream habitat upstream of the lagoon should be maintenance below 20ºC (68ºF) in April and May, when baseflow still exceeds later summer baseflow, and juvenile salmonids are rapidly feeding and growing. From June 1 to September 1, water temperature should not rise above 20ºC (68ºF) more than 4 hours a day (15% of the month) and preferably the maximum daily temperature, averaged weekly (MWAT), should not rise above 20ºC (68ºF) and the maximum daily temperature should be less than 26 ºC (78.8 ˚F). The MWAT and maximum temperature goals are based on 1) conclusions drawn by Kubicek and Price **(1976),** 2) guidelines by SYRTAC **(2000)**, 3) laboratory findings on steelhead temperature lethality by Charlon (**1970**), Alabaster (**1962**) and McAfee (**1966**) , 4) findings by Farrel et al. (**2015**) and 5) our data on steelhead growth rate and water temperature in Central Coast steelhead streams. They are also based on literature review of physiological relationships between fish metabolic rate and water temperature (**Kubicek and Price (1976); Brett (1959)** (cited in Kubicek and Price 1976)**; and Snyder and Blahm (1971)** (cited in Kubicek and Price 1976).

The temperature optimum is a moving target, increasing and decreasing with food supply. As stated earlier, according to Moyle (**2002**), Baltz et al. (**1987**) reported that optimal temperatures for growth of rainbow trout (not steelhead) to be around 15-18ºC, a range that corresponded to temperatures selected in Sierran streams when possible. As stated earlier, according to Moyle (**2002**), regarding temperature optima, "*many factors affect choice of temperatures by trout (if they have a choice), including the availability of food*." As stated earlier, the Santa Ynez River Technical Advisory Committee (SYRTAC) proposed guidelines with upper limits of 20ºC average daily temperature and 25ºC daily maximum as providing acceptable habitat conditions for steelhead in the Santa Ynez River, south of the Santa Maria River (**SYRTAC 2000**), much further south of Soquel Creek and the Santa Maria River and in the southern ESU for steelhead. The SYRTAC (**2000**) decided that a mean daily temperature of 22ºC may be the threshold between acceptable and unsuitable from a long-term perspective. This was based on studies by Hokanson et al. (**1977;** Cited in Santa Ynez River Technical Advisory Committee 2000), who concluded that the highest constant temperature at which the effects of growth and mortality balance out was 23ºC.

Until systematic water temperature monitoring occurs near sites where coho salmon are found in Soquel Creek, the environmental goal regarding water temperature prior to re-introduction of coho salmon to Soquel Creek should be that water temperature in specified reaches meet the Mattole River criteria that average daily water temperature (averaged weekly) during summer/fall months (June 1 to October 1) be 16.7ºC (62ºF) or less in the warmest week and that the weekly maximum temperature be 18.0ºC (64ºF) or less during the warmest week (**Welsh et al. 2001**). The targeted stream segments include 1) the mainstem Reaches 7−9 (Moores Gulch confluence to Hinckley Creek confluence on the East Branch), 2) Reaches 11 and 12a (Soquel Demonstration State Forest between the Soquel Creek Water District Weir at the lower end of the canyon and the gradient increase below the Fern Gulch confluence) and 3) Reaches 13 and 14a on the West Branch (downstream of the lowermost Girl Scout Falls I). Coho salmon juveniles were detected in Fall 2008 after a mild winter by NOAA Fisheries biologists and D.W. ALLEY & Associates (DWA) in Reach 9 of the East Branch, supporting the potential for coho recovery in Soquel Creek. These two groups also detected them in the lower East Branch Soquel Creek in 2015. DWA also detected them at the upper mainstem Soquel Creek site (Reach 8) near

the Soquel Creek Road Bridge in 2015 during drought.

Results of Lagoon Water Quality Monitoring After Sandbar Closure

Lagoon Depth

Gage height in 2022 was consistently near the highest recorded through the last 5 years at above a gage height of 2.50 until mid-September after the first stormflow (**Figure 2**). **Appendix A** provides detailed water quality and lagoon height data. **Table 3** rates habitat conditions according to a rating scale (**Table 2**). The lagoon level was rated "good" during the monitoring period until 17 September when 4 flume inlet boards were removed in preparation for the 18 September storm. By 20 September, a total of 9 inlet boards had been removed to allow light penetration to the lagoon bottom (**Figure 2**). With 9 boards removed, the estimated gage height was 0.06 ft (2.46 ft (0.75 m) less than the previously full lagoon reading of 2.52 ft).The staff gage does not extend to the lagoon bottom. On 21 September at the gage reading of 0.07 ft, water depth at Site 2 below Stockton Bridge was 0.75 m. The depth just above Stockton Bridge where the staff plate is positioned was 0.5 m (1.6 ft), which represented much of the lagoon up to the Shadowbrook Restaurant beyond Noble Gulch, except for a deeper area downstream of the Railroad trestle, west side. On 22 September, the water depth at Station 2 along the Venetian Court wall below Stockton Bridge was 1 m (3.3 ft). After 22 September, the lagoon level was brought back to a maximum by 1 October, with the water depth back to 1.8 m at Station 2. Then a total of three boards were removed on 31 October and 1 November in preparation for the stormflow on 1 November. The stormflow passed through the flume but made the lagoon turbid. An additional five boards were removed on 3 November to allow light penetration to the lagoon bottom, with a water depth at Station 2 of 1.25 m and above Stockton Bridge of 0.8 m on 4 November (gage height of 0.7 ft). It remained at this level to maintain light penetration to the bottom and adequate oxygen levels until sandbar breaching was facilitated to prevent flooding during the stormflow on 8 November.

With proper flume management and the grated flume ceiling installed in 2003, it has been easier to maintain lagoon depth and prevent fluctuations in lagoon level when the summer begins with high baseflow. During the summer of 2022, baseflow was consistently low, allowing good management of the flume inlet to maximize lagoon depth through the dry period until early storms ensued. Typically, it is more difficult for the City to maintain the highest water surface elevation after wetter winters that bring higher baseflow during the summer.

Flume Passability

According to the Management Plans (**Alley et al. 1990; 2004**), steelhead adult passage is to be maintained with an underwater portal through 15 June and smolt passage is to be maintained with a notch in the uppermost flashboard until July 1 with an open flume to the Bay. A flume depth of 12 inches or deeper is desired at the entrance until July 1. The flume was cleared of sand prior to sandbar construction in 2022. The flume outlet was maintained open throughout the sandbar construction period. Nocturnal smolt passage was not delayed during sandbar construction.

Once sandbar construction was complete, the Venetian side of the flume inlet was left completely boarded up. The underwater portal was provided for adults through 15 June as

required by the permit, and was covered on 15 July after smolt passage requirements were met. Boards were added to the top of the flume inlet to create a flat surface after that. The shroud was left in place until the week of the sandbar opening. The flume outlet remained open continuously until the sandbar opening on 24 October. On 18 October, the shroud was removed. On 21 October, the underwater portal was opened again. On 22 October, two 4x4 boards were removed on either side of the flume inlet. When the emergency breached occurred at 0610 hr on 24 October, the streamflow at the Soquel Village USGS gage was an estimated 30 cfs, and streamflow was likely above 30 cfs at the lagoon at the time of the opening, with stormflow reaching an estimated 500 cfs on early 25 October. The stormflow at the flume was somewhat higher than at the gage due to surface street runoff and contributions from Noble Gulch. The flume capacity is 25-30 cfs at best. After 25 October, the sandbar was periodically closing at low tide and closed completely by 8 November, when near midnight a stormflow of nearly 60 cfs at the gage reopened it.

Water Temperature Results from Two-Week Monitorings at Lagoon Stations

Air temperature is an important factor in determining lagoon water temperature. It partially determines the overnight cooling of the lagoon as overnight breezes circulate the entire freshwater column to contact with surface air. The warmer the air temperature at night, the less the lagoon will cool overnight. Despite similar morning air temperatures in August between 2022 and 2021 (**Figure 3f**) and cooler mid-September air temperature in mid-September in 2022, average water temperatures at dawn and in the afternoon near the bottom in August and September were mostly warmer in 2022 (**Figures 3i and 3j**). Baseflow into the lagoon was less in 2022 than 2021 until the storm on 18 September and likely contributed to the warmer water temperatures. Water temperature near the bottom at lagoon monitoring stations in the morning and afternoon in 2022 were warmer compared to those in a higher baseflow year, such as 2019, from mid-June through mid-September (**Figures 3a-3d**). Morning air temperatures at the flume in 2022 were mostly similar to 2022 and 2019 from late June to late August to leave streamflow as the main contributing factor causing a warmer lagoon in 2022 during that period. But air was warmer in 2022 than 2019 in September to contribute to the warming in 2022 (**Figure 3f**).

A second factor affecting lagoon water temperature and cooling is the inflow rate from Soquel Creek. Soquel Creek is cooler than the lagoon. So, the more inflow from the creek, the cooler the lagoon water temperature will be. Fluctuations in lagoon water temperatures near the bottom where steelhead would mostly inhabit tracked well with Soquel Creek water temperature in 2022, as in past years (**Figures 3g and 3h**). Lagoon water temperatures near the bottom were mostly 2.5−5°C warmer than the inflow temperatures in the morning for June through September and 1.5−3°C warmer in the afternoon.

Focusing on the creek upstream of the lagoon, water temperature in early morning in Soquel Creek at Nob Hill followed the pattern of air temperature fluctuation measured at the flume when comparing 2022 to 2021, two similarly low baseflow years. Soquel Creek was warmer in 2022 than 2021 on days when the air temperature was warmer in 2022 and vice versa through September (**Figures 3f, 3k, and 3l**). The daily difference between years generally increased through the day to afternoon measurements. We see that water temperature in the creek in the afternoon was generally cooler through mid-September in the higher flow year of 2019, but not

in 2017, another higher flow year (**Table 9**). However, creek temperature in September 2021 (a low baseflow year) was cooler than in the higher baseflow years of 2017 and 2019, despite cooler air temperature at dawn the last half of September in 2019. It is notable that in fall, baseflow between years becomes more similar and some morning temperatures can be cool. In September, water temperature at dawn in 2019 was warmer than in some other years. But it did not warm up as much during the day as occurred in lower baseflow years. In 2015, another low baseflow year, water temperature remained the warmest from late September to late October for the compared years.

Saltwater trapped in the lagoon also determines water temperature where saltwater lenses form in deeper pockets. Heavy, stagnant saltwater lenses on the lagoon bottom become warm and anoxic because they cannot circulate to the water surface overnight. Water temperatures were very high near the bottom at the deep Station 2 near Stockton Bridge through mid-June 2022 because of the warm saltwater lens there (**Figure 3b**). At dawn in 2022, lagoon Stations 2 and 3 were the warmest near the bottom through the dry season, while Station 4 was the coolest (**Figure 3g**). In the afternoon in 2022 after the saltwater lens at Station 2 had dissipated, Station 1 was the warmest near the bottom through September, while Station 4 remained the coolest near the bottom due to cool Noble Gulch inflow. These are typical annual patterns. In 2022, water temperatures near the bottom at dawn went from "critically warm" (>23° C) at Station 2 in early June (saltwater lens present) to mostly "fair" (20-21.5°C) through the summer/fall at Sites 1-3 except for a "poor" rating (21.6-23° C) on 2 of 11 monitorings (**Tables 2 and 3**). Site 4 at the mouth of Noble Gulch was in the "good" range below 20°C, except on 8 July and 7 August it was "fair." The early morning water temperature goal of maintaining water temperature near the lagoon bottom at 20°C or less was exceeded at Station 2 on 11 of 14 monitorings, at Station 1 on 8 of 11 monitorings, at Station 3 on 8 of 11 monitorings and at Station 4 on 9 of 11 monitorings.

In the afternoon in 2022, Station 1 at the flume had the warmest water temperatures of 24.4° C on 7 August near the bottom while the lagoon sandbar was in place and after the saltwater lens at Station 2 dissipated (**Figure 3h**). At Station 1 in the afternoon, water temperature near the bottom ranged from 21.7 to 24.4°C between mid-June and mid-September, which was warmer than in 2021. At the coolest Station 4 at the mouth of Noble Gulch, temperatures in the afternoon ranged from 19.3 to 22.4°C, which was warmer than 2021. The water temperature goal to keep maximum daily afternoon water temperature below 22°C was exceeded at Station 2 (Stockton Bridge) on 3 of 11 monitorings, at Station 1 on 6 of 11 monitorings, at Station 3 (railroad trestle) on 2 of 11 monitorings and at Station 4 on 1 of 11 monitorings. In 2022, the warmest water temperatures occurred from mid-June to early September and peaking in early August.

In most years, morning lagoon water temperatures near the bottom are coolest at the upper Station 4 (mouth of Noble Gulch) and are warmer progressively downstream (**Figure 3g**). However, in 2022, water temperature near the bottom at dawn was warmer at Station 2 in the deep area below Stockton Bridge on first 9 of 11 monitorings. In 2021, this was also the case on 9 of the 10 monitorings. In the afternoon in 2022, Station 1 at the flume was warmest on 9 of 11 monitorings (**Figure 3h**). The lagoon cooled progressively upstream at Stations 2-4.

Table 3. 2022 Morning Water Quality Ratings at Monitoring Stations in Soquel Creek Lagoon, Within 0.25 m of Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salinity	Lagoon In-flow Estimated @ 0.5 cfs less than Soquel Village Gage Readings (cfs)
3June22 (Station 2 only)	open	2.56 good	critical	critical	poor	1.8 cfs
11June22	open	2.53 good	fair* critical fair good	good good good good	good good good good	0.9 cfs
25June22	open	2.50 good	fair fair fair good	good	good	1.7 cfs
08July22	open	2.56 good	fair poor poor fair	good	good	0.7 cfs
23July22	open	2.55 good	fair fair fair good	good	good	0.3 cfs
07Aug22	open	2.52 good	poor	good	good	0.3 cfs
21Aug22 overcast)	open	2.52 good	fair fair fair good	good	good	0.7 cfs
04Sep22	open	2.52 good	fair	good good fair good	good	0.15 cfs
17Sep22	open	2.30 good	fair fair fair good	good good good fair	good	<0.05 cfs
21Sep22	open	0.07 poor	good	poor	good	1.5 cfs
01Oct22	open	2.51 good	good	good good poor fair	good	0.9 cfs
15Oct22	open	2.62 good	good	good fair good good	good	1.6 cfs
29Oct22	open	2.58	good	good	good	1.9 cfs
04Nov22	open	0.70	good	poor/fair	good	1.0 cfs

* Four ratings refer to Monitoring Sites 1-4. If one rating is given per column, it represents all sites.

Water Temperature Results from Continuous Data Loggers

In analyzing water temperature data from the 6 data loggers down the water column in the deepest portion of the lagoon, just downstream of the railroad trestle and bedrock outcrop, results were consistent with temperature data collected at 2-week intervals through the water column at monitoring stations over the past 32 years. Keep in mind that our 2-week monitoring at Station 3 near the railroad trestle was closest to these data loggers. The following analysis pertains to the vicinity of these continuous data loggers only. A 7-day rolling average on any particular day is calculated from averaging the 7 day period beyond that date. Lagoon water temperature environmental goals were not met for steelhead in 2022.

Juvenile steelhead likely spend most of their time near the bottom to avoid predators if oxygen and temperature levels are tolerable, except when feeding on emerging aquatic insects at dusk and dawn. This assumption is based on many years of underwater observations of salmonids. Therefore, the water temperature and oxygen concentration recorded near the lagoon bottom (0.5 feet from the bottom) have greatest relevance to assessing habitat quality in the lagoon.

Days when lagoon water temperatures exceeded 22º C (71.6º F) near the lagoon bottom would likely be stressful for juvenile steelhead, making that an environmental goal to maintain a daily water temperature maximum below 22ºC near the bottom in the afternoon. For fish, as water temperature increases, their metabolic rate and food demand increase while scope for activity may decline. The 22°C maximum temperature goal was not met in 2022 at the data logger location for the first 10 weeks of the lagoon period until mid-August except 5 days in mid-June and then was met afterwards except for 11 days from 7 September to 17 September before the first stormflow (**Figure 4a**). By comparison, this goal not met in 2021 for 8 of the first 10 weeks of the lagoon period until mid-August but was afterwards. It was met in 2019 and 2020 except for 5 days in mid-August 2020 (**Figures 4g and 4h; Alley 2021**).

A second lagoon environmental goal is to maintain early morning water temperature below 20°C near the bottom. In 2022, this goal was met only 4 days in mid-June and after the first stormflow on 18 September. A third lagoon environmental goal is to maintain the daily 7-day rolling average at 21°C or less near the bottom. In 2022, this goal was met at the data logger location for only 5 days in mid-June and after mid-September (**Figure 4a**). The 7-day rolling average near the bottom exceeded 20°C for more than 13 continuous weeks from early June to mid-September and went as high as 25.2°C near the bottom in early June, with a saltwater lens still present (**Figure 4a**). After the saltwater lens dissipated, the 7-day rolling average went as high as 23.7°C near the bottom in early August (**Table 4; Figure 4i**). After the saltwater lens dissipated, water temperatures as indicated by the 7-day rolling average were slightly cooler near the bottom than higher in the water column (**Table 4; Figures 4a-4f**). Water temperatures near the bottom in 2022 were warmer than in 2021, which had higher baseflow, and warmer than in 2019, which had relatively high baseflow, when all environmental goals were met in that year (**Figures 4a, 4g, 4h and 4i**).

We see from **Table 4** and **Figure 4i** that in wetter years (2006, 2010-2012, 2017 and 2019) the lagoon temperature environmental goals near the bottom for steelhead were mostly met (20°C daily minimum at dawn; 22°C daily maximum by early evening; 7-day rolling average <= 21°C). Lagoon water temperature has typically been warmer in years with reduced baseflow entering,

such as drought years of 2009, 2013-2015 and 2021-2022, as indicated by maximum and minimum temperatures and maximum, minimum and average 7-day rolling averages (**Table 4; Figure 4i**). But air temperature also contributes to stream inflow temperature to determine lagoon water temperatures, as when summer air temperature was cooler in 2016 (**Alley 2021**), allowing environmental goals to be met, and when air temperature was warmer in August and September 2017 (**Figure 3f**), causing environmental goals not to be met some of the time, despite high baseflow.

The stream inflow water temperature is another important factor in maintaining a cooler lagoon during higher baseflow years in terms of 7-day rolling averages, with the difference between inflow average 7-day rolling average temperature and lagoon average 7-day rolling average temperature near the bottom being more similar during higher baseflow years (2010-2012, 2017 and 2019) (**Alley 2020**). In 2022 when baseflow was less than in 2021 for most of the summer and fall, early morning water temperature of stream inflow at Nob Hill was warmer than in 2021 from early June to early October except for a 15-day period from mid-July to early August (**Figures 5a-b**). 2022 early morning water temperatures of stream inflow were also generally warmer than in the much higher baseflow year of 2019 (**Figures 5a and 5c**). Daily temperature *maxima* and *minima*, as well as the overall maximum, minimum and average 7-day rolling averages in the lagoon for the period of sandbar closure were consistently warmer near the bottom than the stream inflow in 1999-2022 (**Table 4**). These metrics also increased for the stream inflow in 2022 compared to those in 2019−2021, when baseflow was higher except for the last half of August 2022 when it unexplainably increased and exceeded that in 2021 on 1 September (**Table 9; Figure 26**) before declining rapidly in the first half of September 2022.

As in past years, in 2022 no lagoon thermocline (a thermocline has a warm, well-mixed, oxygen-rich epilimnion above it and a cool, non-circulated, oxygen-poor hypolimnion below) developed. However, for the first 1-2 weeks after sandbar closure (until 11 June), temperature stratification and oxygen loss were detected by the data loggers in the deep area near the railroad trestle and during water quality monitoring at Stations 2 (**Figures 3b and 4a**). This resulted from a stagnant saline layer along the lagoon bottom that dissipated by 17 June at Station 2 below Stockton Bridge. After the saline layer had passed through the sandbar and out through the flume, the freshwater lagoon was likely 7−8 feet deep, at most, and subject to daily inland breezes that circulated the water, surface to bottom. There was complete, diurnal (daily) mixing of the water column after 11 June at the data loggers (**Figures 4a-4f**). In most years, water temperature was cooler nearer the bottom and warmer near the surface, based on the continuous data loggers. This was the case in 2022.

Table 4. Water Temperature Statistics from Continuous Water Temperature Probes at 30-Minute Intervals in Soquel Lagoon after Freshwater Conversion and Immediately Upstream. (Late May to 15 September in 2013−2022.)

Year	Statistic	Stream Inflow Temperature °C	Near-Surface Lagoon Temperature @ 5.5 ft from Bottom °C	Near-Bottom Lagoon Temperature @ 0.5 ft from Bottom °C
2022	Maximum Water Temperature °C	**20.4 (11 June)**	**25.0 (12 Aug)**	**24.7 (11 Aug)**
2022	Minimum Water Temperature °C	**14.7 (1 June)**	**18.2 (1 June)**	**19.3 (20 June)**
2022	Maximum 7-Day Rolling Average*	**18.9 (5 Aug)**	**24.0 (7 Aug)**	**23.7 (7 Aug)**
2022	Minimum 7-Day Rolling Average	**16.7 (31 May)**	**20.6 (15 Sep)**	**17.6 (15 Sep)**
2022	**Average 7-Day Rolling Average**	**17.8**	**22.2**	**22.0**
2021	Maximum Water Temperature °C	**19.8 (12 Aug)**	**23.4 (10 July)**	**23.2 (10 July)**
2021	Minimum Water Temperature °C	**15.6; 15.8 (14 Sep; 26 Aug)**	**19.7 (26 Aug)**	**19.4 (26 Aug)**
2021	Maximum 7-Day Rolling Average*	**18.3; 18.1 (26 June; 5 July)**	**22.2 (5 July)**	**22.1 6 July)**
2021	Minimum 7-Day Rolling Average	**16.2 (11 Sep)**	**19.7 (14 Sep)**	**19.6 (13 Sep)**
2021	**Average 7-Day Rolling Average**	**17.4**	**21.4**	**21.2**
2020	Maximum Water Temperature °C	**21.3 (16 Aug)**	**23.6 (16 Aug)**	**23.2 (16 Aug)**
2020	Minimum Water Temperature °C	**14.1 (3July, 12 Sep)**	**16.0 (15 Sep)**	**16.4 (3 July)**
2020	Maximum 7-Day Rolling Average*	**9.0 (13 Aug)**	**21.2 (13 Aug)**	**21.8 (14 Aug)**
2020	Minimum 7-Day Rolling Average	**15.4 (9 Sep)**	**17.2 (9 Sep)**	**17.4 (10 Sep)**
2020	**Average 7-Day Rolling Average**	**16.7**	**18.8**	**19.2**
2019	Maximum Water Temperature °C	**20.2 (11 June)**	**24.4 Ignoring June Artifact (14 Aug)**	**21.0 (12 June)**
2019	Minimum Water Temperature °C	**14.5 (9,17,19,22,23,28 June)**	**14.5 22-23 June)**	**16.4 16-18, 21 June)**
2019	Maximum 7-Day Rolling Average*	**18.2 (Aug 29)**	**19.8 (9 Aug)**	**19.9 (Aug 29)**
2019	Minimum 7-Day Rolling Average	**15.2 (15 June)**	**16.7 (15 June)**	**17.3 (14 June)**
2019	**Average 7-Day Rolling Average**	**17.2**	**18.7**	**18.8**

Year	Statistic	Stream Inflow Temperature °C	Near-Surface Lagoon Temperature @ 5.5 ft from Bottom °C	Near-Bottom Lagoon Temperature @ 0.5 ft from Bottom °C
2018	Maximum Water Temperature °C	**20.6 (22July, 4 Oct)**	**23.2 (25 July, 16 Aug)**	**22.1 (11 and 22 July)**
2018	Minimum Water Temperature °C	**12.9 (1 June)**	**16 (30 June, 5 July)**	**15.6 (17 June)**
2018	Maximum 7-Day Rolling Average*	**19 (19July)**	**21.9 (23 July)**	**21.3 (20 July)**
2018	Minimum 7-Day Rolling Average	**15.9 (13 June)**	**18 (28 June)**	**17.3 (15 June)**
2018	**Average 7-Day Rolling Average**	**17.7**	**19.9**	**19.3**
2017	Maximum Water Temperature °C	**21.3 (2 and 5 Sep)**	**21.7 (4 Sep)**	**22.9 (5 Sep)**
2017	Minimum Water Temperature °C	**12.9 (13 June)**	**14.5 (12 June)**	**14.5 (13 June)**
2017	Maximum 7-Day Rolling Average*	**19.6 (1 Sep)**	**20.5 (1 Sep)**	**21.3 (1 Sep)**
2017	Minimum 7-Day Rolling Average	**15.0 (8 June)**	**15.6 (7 June)**	**15.9 (7 June)**
2017	**Average 7-Day Rolling Average**	**17.7**	**18.8**	**19.3**
2016	Maximum Water Temperature °C	**21.0 (19 June)**	**21.7 (20-23 June, 25 June, 9-13 July, 20-24 July, 31 Aug)**	**21.3 (24 and 29 July, 2 Aug)**
2016	Minimum Water Temperature °C	**13.7 (15-16 June)**	**17.1 (14 Sep)**	**16.8 (16 June)**
2016	Maximum 7-Day Rolling Average*	**17.7 (18 June)**	**20.8 (19 July)**	**20.2 (18-20 July)**
2016	Minimum 7-Day Rolling Average	**15.4 (11 Sep)**	**18.4 (10 Sep)**	**17.9 (11 Sep)**
2016	**Average 7-Day Rolling Average**	**16.7**	**19.9**	**19.3**
2015	Maximum Water Temperature °C	**20.6 (15 August)**	**24.8 (15-16 August)**	**24.0 (16-17 and 19 Aug)**
2015	Minimum Water Temperature °C	**14.5 (1, 5-6 June)**	**17.9 (30 May, 1 and 5-6 June)**	**19.0 (6-7 June)**
2015	Maximum 7-Day Rolling Average	**18.3 (16 July)**	**23.7 (13-14 August)**	**23.3 (13-15 August)**
2015	Minimum 7-Day Rolling Average	**15.7 (31 May)**	**19.2 (4 June)**	**19.6 (4-6 June)**
2015	**Average 7-Day Rolling Average**	**17.4**	**21.9**	**21.7**

Year	Statistic	Stream Inflow Temperature °C	Near-Surface Lagoon Temperature @ 5.5 ft from Bottom °C	Near-Bottom Lagoon Temperature @ 0.5 ft from Bottom °C
2014	Maximum Water Temperature °C	**20.2 (18-20 July)**	**24.8 (23,24,30 July)**	**24.0 (2 June; 30 July)**
2014	Minimum Water Temperature °C	**14.5 (1-4, 17-18,22-25 June; 9 Sep)**	**18.3 (6 June)**	**19.4 (9-10 Sep)**
2014	Maximum 7-Day Rolling Average	**18.2 (15 July)**	**23.7 (19-20, 23-26 July)**	**23.4 (25-27 July)**
2014	Minimum 7-Day Rolling Average	**15.5 (1 June)**	**19.3 (1 June)**	**20.3 (5-7 Sep)**
2014	**Average 7-Day Rolling Average**	**16.8**	**21.9**	**22.0**
2013	Maximum Water Temperature °C	21.0 (26 Jun)	23.2 (5 July; 31Aug−5 Sep)	25.2 (1 June due to saline layer)
2013	Minimum Water Temperature °C	14.1 (31 May; 4-5June)	17.1 (5 June)	17.1 (26 June)
2013	Maximum 7-Day Rolling Average	18.7 (26 June−2 July)	22.5 (30 Aug−5 Sep)	23.4 (30 May−5 June)
2013	Minimum 7-Day Rolling Average	15.7 (3-9 June)	18.4 (4-10 Jun)	18.9 (20 June−26 June
2013	**Average 7-Day Rolling Average**	**17.0**	**20.8**	**20.7**

***Rolling averages were averaged for the 7 days forward from the date they were recorded on graphs and presented in this table.**

In 2022, the coho environmental goal of keeping maximum lagoon water temperatures below 20ºC (68ºF) near the bottom in the presence of steelhead was not met from 1 June until 18 September when the first stormflow occurred (**Figure 4a**). Generally, the pattern has been that more days exceed the environmental goal as baseflow is reduced. Water temperature met the coho goal for the entire dry period only in 2011, a year with higher baseflow (**Table 9**). The coho goal was mostly met in 2010 and 2012 with moderate baseflow. The high baseflow year, 2006, also met the coho goal much of the time. However, the high baseflow year of 2017 did not fit the pattern, partially due to relatively high air temperatures from mid-August to mid-September and generally warm inflow temperatures through the summer/fall, despite higher baseflow (**Alley 2018**).

The daily stream water temperature fluctuated more than the daily lagoon water temperature near the bottom in 2022, which was typical for previous years except 2010. The maximum daily lagoon water temperature near the bottom typically occurred between 1600 and 2100 hr.

Flume outlet to the Capitola Beach and Monterey Bay. 23 July 2022

Reach 1- Looking upstream with flume inlet in foreground and Venetian Court on left. 11 June 2022

Reach1- Looking downstream from Venetian Court wall with waders along beach periphery of lagoon. 11 June 2022

Reach 2- Looking downstream at valuable fish cover under overhanging willows with pondweed present. 11 June 2022

Reach 3- Looking upstream with gulls present. 11 June 2022

Reach 3- Gulls roosting on lagoon-side houses beyond Noble Gulch. 11 June 2022

Soquel Creek at Nob Hill, looking downstream. 8 August 2021

Aquatic Vegetation Monitoring.

Kelp and seagrass were present primarily in the lower estuary prior to sandbar construction. The estuary bottom was relatively hard with mostly undecomposed kelp with some decomposing plant material underneath, located downstream of Stockton Bridge. Pondweed was well distributed just below the Bridge and upstream past Noble Gulch. This was the first time in 32 years that pondweed was present this early in the dry season. Raking out of plant material was limited to within approximately 50 feet of the flume inlet because further upstream this plant material could not be easily dislodged and transported out with the limited streamflow on the one day that the sandbar was breached during sandbar construction. The concern was that water quality problems for fish, with tidewater goby present and possibly steelhead smolts in the lower lagoon, may develop from more widespread raking that would yield limited success in removing sources of biological oxygen demand after sandbar closure. During this time, 11 Capitola Public Works staff (including Morrison) and Alley raked the decomposing kelp out from the lower estuary to the artificial channel next to the flume. Alley provided a training session for Public Works staff. Alley, surveyed upstream for potentially stranded fish. No stranded fish were observed.

In 2022, bottom algae not attached to pondweed developed quickly and increased in thickness and coverage through July and declined as pondweed increased, bearing in mind that other algae was attached to pondweed (**Table 5**). But in early August there was a die-back of pondweed and an increase in bottom algae in Reaches 2 and 3. Pondweed then increased again in September

while unattached bottom algae declined. Algae's bottom coverage and thickness were greatest in July. Pondweed's bottom coverage and thickness were greatest in early September. Surface algae and pondweed fragments increased to a maximum in September, as was typical for years when stream inflow is low and water temperature is relatively high. This floating plant material was considerably more prominent in 2022 than in 2018, 2019 and 2021, and the 2021 lagoon had more than during the higher inflow year of 2019 (**Tables 6-8**). Aquatic vegetation was not monitored in 2020, when only morning monitoring was done before the lagoon bottom became visible later in the day. Surface algae was also relatively high in previous drought years of 2014 and 2015, but with little pondweed fragments. As was typical of past years, in 2022 the surface algae (and also floating pondweed fragments in 2022) was more abundant in Reach 3 and at the mouth of Noble Gulch than elsewhere, with a maximum of 50% coverage in Reach 3 in late September and 40% coverage at the mouth of Noble Gulch in early September. Reaches 1 and 2 also had maximum coverage of surface algae and pondweed fragments in early September with 7% and 15%, respectively. Evidence of nutrient inputs from Noble Gulch in 2013−2015, 2017-2019 and 2021−2022 was expressed by recurrent thick planktonic algae blooms and sporadically high levels of surface algae nearby.

Pondweed forest in Reach 3, looking upstream from the railroad trestle. 23 July 2022

Pondweed forest in Reach 2, looking downstream from the railroad trestle. 23 July 2022

Tules in railroad trestle cove. 29 October 2022

Table 5. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2022.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ Pondweed fragments Cover
6-11	0.2 (3.0 pond-weed)	50 (50 pond-weed)	**0**	0.1 (1.0 pond-weed)	60 (40 pond-weed)	**0**	0.2 (1.0 pond-weed)	70 (30 pond-weed)	**0**	film (2.5 pond-weed)	60 (40 pond-weed)	**0**
6-25	Invis. (4.0 pond-weed)	60 (40 pond-weed)	**0**	1.0 (2.0 pond-weed)	40 (60 pond-weed)	**0**	1.0 (1.5 pond-weed)	70 (30 pond-weed)	**0**	1.5 (3.5 pond-weed)	60 (40 pond-weed)	**0**
7-8	3.0 (5.0 pond-weed)	60 (40 pond-weed)	**<1**	2.5 (3.5 pond-weed)	30 (70 pond-weed)	**<1**	2.0 (3.0 pond-weed)	70 (30 pond-weed)	**<1**	1.5 (3.3 pond-weed)	60 (40 pond-weed)	**5**
7-23	2.0 (4.0 pond-weed)	50 (50 pond-weed)	**1**	2 (3.5 pond-weed)	30 (70 pond-weed)	**<1**	1.0 (3.0 pond-weed)	30 (70 pond-weed)	**<1**	Invis. (3.5 pond-weed)	60 (40 pond-weed)	**1**
8-7	1.0 (3.5 pond-weed)	35 (60 pond-weed)	**0**	1.0 (2.5 pond-weed)	60 (40 pond-weed)	**1**	0.5 (2.0 pond-weed)	60 (40 pond-weed)	**1**	1.0 (3.5 pond-weed)	60 (60 pond-weed)	**0**
8-21 (over-cast)	Invis.	Invis.	**0**	Invis. (3.0 pond-weed)	30 (70 pond-weed)	**2**	Invis. (4.0 pond-weed)	20 (80 pond-weed)	**15**	1.0 (3.8 pond-weed)	60 (40 pond-weed)	**15**
9-04	2.0 (4.5 pond-weed)	30 (60 pond-weed)	**7**	1.5 (3.5 pond-weed)	30 (70 pond-weed)	**15**	2.5 (3.5 pond-weed)	20 (80 pond-weed)	**30**	1.0 (2.5 pond-weed)	50 (50 pond-weed)	**40**
9-17	Invis. (4.5 pond-weed)	30 (60 pond-weed)	**0**	2.0 (4.0 pond-weed)	40 (60 pond-weed)	**3**	2.0 (4.0 pond-weed)	30 (70 pond-weed)	**50**	2.0 (4.5 pond-weed)	50 (40 pond-weed)	**30**
10-1 (over-cast)	Invisible dark		0	Invisible Shaded		2	Invisible Shaded		15	Invisible dark		15
10-15 (over-cast breezy)	Invisible Dark tea color		0	Invisible Shaded tea color		0	Invisible Shaded tea color		3	Invisible Dark tea color		0
10-30 (hazy)	Invisible Dark tea color		0	Invisible Dark tea color		0	Invisible Dark tea color		3	Invisible Dark tea color		0
Avg-6-11 – 9-17	**1.6 algae (4.1 Pond Weed)**	**45 Algae (51 Pond Weed)**	**1.1**	**1.4 algae (2.9 Pond-Weed)**	**45 algae (55 Pond-Weed)**	**2.6**	**1.3 Algae (2.8 Pond-Weed)**	**46 Algae (54 Pond-weed)**	**7.0**	**1.1 Algae (3.4 Pond weed)**	**50 Algae (44 Pond weed)**	**11.4**

Table 6. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2021.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover
6-13	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-27	0.3	85	0	0.2	100	0	0.2	100	0	1.0	80	0
7-10	Invisible Breezy		<1	Invisible Breezy		2	0.7	100	2	2.0	60	5
7-25	Invisible Breezy		0	Invisible Breezy		0	0.8 (2.0 pond-weed)	99 (1 pond-weed)	0	2.0	60	0
8-8	95% Invisible Dark	Pondweed visible adjacent Restaurants	<1	1.0	100	0	1.5 (2.0 pond-weed)	99 (1 pond-weed)	<1	1.0	60	0
8-22	95% Invisible Dark (3.5 pond-weed	Pondweed visible adjacent Restaurants	<1	1.0 (1.5 pond-weed)	80 (20 pond-weed)	0	2.0 (3.0 pond-weed)	80 (20 pond-weed)	1	1.0 (3.0 pond-weed)	30 (30 pond-weed)	5
9-05	95% Invisible breezy (3.5 pond-weed	Pondweed visible adjacent Restaurants	10	Invisible breezy		2	1.5 (2.0 pond-weed)	60 (40 pond-weed)	2	1.0 (3.0 pond-weed)	40 (60 pond-weed)	10
9-19	95% Invisible breezy (4.0 pond-weed	Pondweed visible adjacent Restaurants	3	1.5 (3.0 pond-weed)	60 (40 pond-weed)	<1	1.5 (3.0 pond-weed)	40 (60 pond-weed)	7	1.0 (4.0 pond-weed)	40 (60 pond-weed)	15
10-2	95% Invisible Dark (4.0 pond-weed	Pondweed visible adjacent Restaurants	0	Invisible Shaded		<1	Invisible Shaded		3	1.0 (4.0 pond-weed)	30 (70 pond-Weed)	20
10-16	Invisible Dark breezy		2	Invisible Shaded		2	Invisible Shaded		10	1.0 (4.0 pond-weed)	30 (50 pond-Weed; 20 bare sand)	25
Avg-6-13 – 10-16			**1.5**	**0.7 algae (0.9 Pond-Weed)**	**68 algae (12 Pond-Weed)**	**0.6**	**1.0 Algae (1.5 Pond-Weed)**	**72 Algae (15.3 Pond-weed)**	**2.5**	**1.1 Algae (1.8 Pond weed)**	**43 Algae (27 Pond weed)**	**8**

Table 7. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2019.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ pondweed Cover
6-8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-24	0.8	40	<1	0.5	40	<1	0.3	20	0	1.2	80	0
7-6	0.8	80	<1	0.5	50	0	0.4	40	0	1	70	0
7-21	1.0	80	0	1.0	60	0	0.8	80	0	1	80	0
8-4	0.5	50	<1	0.5	70	<1	0.4	60	1	0.5	60	10
8-18	Dark Cloudy	Dark Cloudy	0	Dark Cloudy	Dark Cloudy	0	Dark Cloudy	Dark Cloudy	0	Dark Cloudy	Dark Cloudy	0
9-01	Dark Glare	Dark Glare	0	1.5 (3.0 Pond-Weed)	60 (20 pond-Weed)	0	1.0 (2.5 pond-weed)	60 (1 pond-weed)	0	3.0	10	5
9-15	Dark Glare	Dark Glare	0	0.8 (3.0 pond-weed)	70 (30 pond-weed)	2	0.5 (3.0 pond-weed)	95 (5 pond-weed)	2	Soupy plankton bloom (3.0 pond-weed)	Soupy plankton bloom (15 pond-weed)	15
9-28	1.5 (4.0 pond-weed)	60 (25 pond-Weed)	0	0.5 (3.5 pond-weed)	65 (35 pond-Weed)	5	0.7 (3.5 pond-weed)	75 (5 pond-Weed)	5	0.5 (3.5 pond-weed)	85 (15 pond-Weed)	0
10-12	0.5 (4.0 pond-weed)	80 (15 pond-Weed)	0	1.0 (3.5 pond-weed)	50 (50 pond-Weed)	<1	0.5 (2.5 pond-weed)	90 (10 pond-Weed)	0	Murky Invisible	Murky plankton bloom-Bottom Invisible	0
10-26	Shaded Invisible	Shaded Invisible	0	1.0 (3.0 pond-weed)	60 (40 pond-Weed)	0	1.0 (3.0 pond-weed)	95 (5 pond-Weed)	0	1.0 (3.0 pond-weed)	75 (15 pond-Weed)	5
11-09	Shaded Invisible	Shaded Invisible	0	Shaded Invisible	Shaded Invisible	0	Shaded Invisible	Shaded Invisible	0	Shaded Invisible	Shaded Invisible	0
11-23	Shaded Invisible	Shaded Invisible	**0**	Shaded Invisible	Shaded Invisible	**0**	Shaded Invisible	Shaded Invisible	**0**	Shaded Invisible	Shaded Invisible	**0**
Avg-6-08 – 10-26	**0.7 algae (1.1 pond-Weed)**	**56 Algae (6 Pond-Weed)**	**0**	**1.3 algae (1.1 Pond-Weed)**	**46 algae (18 Pond-Weed)**	**0.5**	**0.6 algae (1.1 Pond-Weed)**	**62 algae (2.6 Pond-weed)**	**0.6**	**1.0 Algae (1.1 Pond weed)**	**58 Algae (3.5 Pond weed)**	**2.7**

Table 8. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2018.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Algae Thickness (ft)	% Bottom Algae Cover	% Surf. Algae/ pondweed Cover
6-9	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-23	0.5	80	0	0.5	100	0	0.3	100	0	0.5	100	0
7-7	1.5	85	1	0.8	100	7	0.5 (3.0 pond-weed)	99 (1 pond-weed)	3	0.5	100	5
7-21	2.0 (4.0 pond-weed)	85 (5 pond-Weed)	0	2.0 (3.0 pond-weed)	99 (<1 pond-weed)	0	2.0 (3.0 pond-weed)	99 (<1 pond-weed)	0	0.3	100	0
8-4	1.5 (3.0 pond-weed)	5 (50 pond-Weed)	0	1.0 (3.0 pond-weed)	90 (10 pond-Weed)	0	0.8 (2.0 pond-weed)	95 (5 pond-Weed)	0	2.5	15	0
8-18	Dark Cloudy (3.5 pond-weed)	Dark (70 pond-Weed)	0	1.5 (3.5 pond-Weed)	90 (10 pond-Weed)	0	1.5 (3.0 pond-Weed)	95 (5 pond-Weed)	0	0.7	100	0
9-02	1.0 (4.0 pond-Weed)	40 (60 pond-Weed)	0	1.0 (2.0 Pond-Weed)	75 (25 pond-Weed)	0	2.0 (2.0 pond-weed)	95 (5 pond-weed)	0	1.0	100	0
9-16	0.2 (4.5 pond-weed)	40 (60 pond-Weed)	1	0.7 (3.0 pond-weed)	70 (25 pond-weed)	5	0.5 (2.0 pond-weed)	90 (10 pond-weed)	3	Soupy Plankton bloom	Soupy Plankton bloom	10
9-29	1.0 (4.5 pond-weed)	35 (60 pond-Weed)	<1	1.0 (2.5 pond-weed)	70 (30 pond-Weed)	<1	1.0 (1.5 pond-weed)	80 (20 pond-Weed)	2	Glare (2.5 pond-weed)	Glare (15 pond-Weed)	0
10-13	0.5 (4.0 pond-weed)	25 (60 pond-Weed)	0	Shaded	Shaded	0	Shaded	Shaded	0	1.0 (3.0 pond-weed)	90 (10 pond-Weed)	0
10-27	1.0 (3.0 pond-weed)	55 (40 pond-Weed)	0	0.5 (3.0 pond-weed)	60 (40 pond-Weed)	0	0.4 (2.0 pond-weed)	90 (10 pond-Weed)	0	1.0 (3.0 pond-weed)	90 (10 pond-Weed)	0
11-11	Shaded	Shaded	0	Shaded	Shaded	0	Shaded	Shaded	0	Shaded	Shaded	0
Avg-6-09 – 10-27	**0.9 algae (2.8 pond-Weed)**	**45 Algae (41 Pond-Weed)**	**0.2**	**0.9 algae (2.0 Pond-Weed)**	**75 algae (14 Pond-Weed)**	**1.1**	**0.9 algae (1.9 Pond-Weed)**	**84 algae (5.6 Pond-weed)**	**0.7**	**0.9 Algae (0.9 Pond weed)**	**77 Algae (3.5 Pond weed)**	**1.4**

Dissolved Oxygen Results from Two-Week Monitorings

Oxygen concentration was typically lowest at dawn, or soon after, because oxygen was used by cell respiration overnight before plant photosynthesis could begin producing oxygen with the light. Near dawn is the time when oxygen levels are most importantly measured and rated because they are typically the lowest. No stressfully low oxygen concentrations for steelhead (< 5 mg/L) were detected near the bottom or higher in the water column during the two-week monitorings in 2022 except on one occasion at Station 3 (under the railroad trestle) in early October (**Table 3; Figure 6a-1**). However, critically low oxygen levels (<2 mg/L) were detected on 3 days (20-22 September) after the 18 September, first flush stormflow that made the lagoon very turbid (in the range of 0.45 to 1.88 mg/L near the bottom and 0.60 and 1.94 mg/L at the surface at its worst near dawn in the vicinity of the Stockton Bridge). Fish mortalities were observed in Reaches 1 and 2 of the lagoon during this period, including steelhead for the first time in 32 years. This was likely caused by a combination of low oxygen and toxic runoff from urban surfaces. Mortality of starry flounder and staghorn sculpin was also observed along with steelhead but not tidewater goby. A major portion of Bay Avenue had been repaved earlier in the summer. Oxygen levels began to recover in the afternoon of 22 September and were above 5 mg/L by afternoon on 23 September in the upper water column of the deeper Site 2 and throughout the water column at shallower Site 1 at the flume and above Stockton Bridge. During the 2-week monitorings, oxygen concentrations near the bottom at dawn were in the "good" range (>7 mg/L) at all 4 monitoring stations throughout the monitoring period except at Station 3 under the railroad trestle on 2 of the 11 monitorings, with a "fair" rating (5-7 mg/L) on 4 September and a "poor" rating (<5 mg/L) on 1 October. Oxygen concentration typically increased up through the water column (**Appendix A**). The 4-station lagoon average near the bottom at dawn was above 7 mg/L (good range) on all 11 monitorings (**Figure 6a-1**). In comparison to other recent years, average morning oxygen levels in 2022 were higher than other recent years from June to early September but lower than most in mid-September to mid-October (**Figure 6b**). Oxygen levels generally increased through the day to afternoon measurements that were supersaturated unless the day remained overcast (**Figure 6a-2; Appendix A**). Afternoon oxygen levels near the bottom were well above 7 mg/L (good range) at all sites during all 2-week monitorings except for 15 October, an overcast day when the average declined to just above 6 mg/L in the "fair" range. In comparison to other recent years oxygen levels near the bottom in the afternoon, average morning oxygen levels in 2022 were higher than other recent years from June to early September but lower in mid-September to mid-October (**Figure 6c**).

When water clarity is reduced after small stormflows with a closed sandbar still intact, light does not penetrate to photosynthesizing plant life, and oxygen concentrations decline rapidly, as occurred after the 18 September, first flush stormflow and in fall 2014 and 2015. Despite removal of flashboards in the flume inlet afterwards, light did not penetrate to the bottom adequately to prevent critically low oxygen levels. Refer to the lagoon depth section for more details.

Salinity Results

Results of monitoring salinity may be found in **Appendix A.** A saltwater lens was detected along the lagoon bottom in the deep pocket adjacent the Venetian Court wall on 24 May, with

inadequate streamflow after closure on 26 May to remove it. Therefore, the shroud was installed on the flume inlet on 27 May to draw saltwater off the bottom and out through the flume. The saltwater lens was initially slightly more than 1.6 m thick on 24 May (salinity from 7.7 to 25.6 ppt), and created very warm (24.5 to 27 C) conditions throughout. A pump was installed in the deep saline pocket adjacent the Venetian Court wall on 31 May and began pumping screened saline water to the flume for removal. The pump was operated between 0800 hr and 1500 hr during the week. By 3 June, the saltwater lens was reduced to 0.4 m thick, and at depth 1.75 m, salinity was 12.3 ppt (28.3 C morning water temperature). At the bottom at 1.9 m, salinity was 22.7 (28.7 C morning water temperature). The upper 1.25 meters of the 2 meter water column had good oxygen conditions throughout the time of the saltwater lens. Steelhead inhabiting this area would avoid the poor water quality conditions within the saltwater lens by remaining higher in the water column. By 11 June, the saltwater lens was less than 0.25 m thick, and at depth 1.75 m, salinity was 3.8 ppt (25.5 C morning water temperature). At the bottom at 1.85 m, salinity was 15 ppt (27.6 C morning water temperature). By Friday morning, 17 June, only the bottom was slightly saline (2.7 ppt; water temperature of 23.6 C). The pump was removed the afternoon of 17 June. The shroud was removed on 20 June. Based on water temperature measured by our continuous temperature probes in the deep zone below the railroad trestle west side, the saltwater lens within 0.5 ft of the bottom was dissipated by 10 June (**Figure 4a**). After that, a freshwater lagoon was maintained until the sandbar breach on 8 November.

Conductivity Results

As stated earlier, stress to freshwater acclimatized steelhead would probably not occur until conductivity levels reach 12,000 to 15,000 umhos, associated with sudden increases in salinity to 10 − 12 parts per thousand (**J. Cech, personal communication**). Although conductivity went above this range in the saltwater lens at the bottom at Station 2 in late May and early June, steelhead had been exposed to daily tidal influences before sandbar closure and did not become acclimatized to freshwater until later. And, steelhead could avoid the high conductivity along the bottom in deep pockets by swimming above the saltwater lens. Therefore, it is unlikely that the saltwater lens caused stress to steelhead inhabiting the lagoon in early summer. Based on water temperature measured by our continuous temperature probes at the deep zone below the railroad trestle, the saltwater lens within 0.5 ft of the bottom was dissipated by 10 June (**Figure 4a**). After that, a freshwater lagoon was maintained until the sandbar breach on 8 November. Conductivity was not at stressful levels for steelhead throughout the water column in the vicinity of the other 3 monitoring stations during the 12 monitorings in 2022 (**Appendix A**).

Stream In-Flow to the Lagoon

Lagoon water quality is generally best with relatively higher summer baseflow. Soquel Creek in 2022 maintained a baseflow through the dry season that was much below the median flow (**Table 9; Figures 25−26; Appendix C. Figures 1−3**). Previous winter stormflows had been infrequent during a relatively dry winter except in December 2022. Most rainfall occurred prior to January 1. Four likely bankfull events occurred in a wet December, with 2 reaching 2,000 cfs at the Soquel Village USGS gage, 2 miles upstream from the lagoon. However, no rain occurred between early January and mid-March 2022, typically the prime months for steelhead spawning migration. Difficult passage conditions from 30 cfs down to 7 cfs measured at the gage existed from mid-January to late March. Then only 3 small stormflows of 40−70 cfs occurred from late March to late April 2022 at the gage, offering sub-optimal adult steelhead spawning passage conditions to the upper watershed. Streamflow declined to 3.2 cfs (0600 hr) on 23 May at the

USGS gage in Soquel Village when sandbar construction began. The sandbar was closed to the Bay at low tide on 26 May. Hydrographs for water years, 2007−2022, may be found in **Appendix C**.

Higher summer baseflow improves habitat conditions in the lagoon. Higher summer baseflow flushes saltwater out through the sandbar and flume more quickly than lower baseflow, thus reducing the heating effects of a stagnant saline layer on the lagoon bottom. Higher summer baseflow can discourage saltwater back-flushes into the lagoon during high tides. The lagoon mixes and cools more quickly overnight when inflow is higher. With less inflow in June−August, lagoon water temperature heats up more during the day and cools off less at night, as indicated by higher average lagoon water temperature at dawn in 2015 (low drought inflow) (**Alley 2020**). We observed cooler lagoon water temperature in 2019 (high inflow) than in 2018 (intermediate inflows), 2020 (intermediate inflows) or 2021(low inflow) for the months of June through August (**Figures 3a-d; 3i**). 2015 had relatively warm air temperature, warm inflow and very high lagoon water temperatures at dawn and the afternoon. The annual trend in 7-day rolling temperature averages with respect to the maximum, average and minimum for the dry season indicates that they increase substantially in dry/drought years (2009, 2013-2015 and 2021-2022) when stream inflow rate is much reduced (**Figure 4i**). However, the trend toward reduced water temperature during higher baseflow years was less evident in 2017 and 2019, when the maximum temperature and the maximum and average 7-day rolling averages were similar or higher than in intermediate baseflow years of 2016, 2018 and 2020. For 2016 and 2018, we suspect this was partially because they had cooler air temperature in late summer and fall with more stream shading than after wet 2016-2017 and 2018-2019 winters that would have contributed to warmer inflow in 2017 and 2019 due to loss of streamside vegetation and less shade. Maximum 7-day rolling average for stream inflow increased 0.6°C from 2021 to 2022 (**Table 4**). The minimum 7-day rolling average for stream inflow increased 0.5°C in 2022. The average 7-day rolling average for stream inflow during the monitoring period increased 0.4°C while the average for the lagoon water temperature near the bottom at the data loggers increased 0.8°C from WY2021 to WY2022 (both low baseflow years).

To maximize summer baseflow in the creek, water percolation into the aquifer during the rainy season must be maximized, and surface runoff must be minimized. Summer water diversion and pumping from the underflow of the creek reduce summer baseflow and should be minimized and curtailed quickly if surface flow becomes discontinuous in lower Soquel Creek.

Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon

The 5 restaurants that were contiguous with Soquel Creek Lagoon were tested for leaks and deficiencies in plumbing connections. All deficiencies were repaired prior to sandbar construction (**Appendix B**).

Table 9. Daily Mean Discharge Recorded at the USGS Stream Gage (11160000) in Soquel Village, At One Month Intervals from 1 June to 1 October, 1991-2022.

Year	1 June Streamflow (cfs)	1 July Streamflow (cfs)	1 August Streamflow (cfs)	1 September Streamflow (cfs)	1 October Streamflow (cfs)
1991*	4.1	2.6	1.5	0.65	0.37
1992	4.0	4.0	0.6	0.1	0.2
1993**	12	5.8	3	1.8	1.6
1994	4.2	1.3	0.7	0.2	0.05
1995***	24	17	7.8	4.5	3.7
1996	23	17	8	4.6	3.6
1997	9	7.7	4.2	2.6	2.3
1998	58	22	13	9.7	7.2
1999	16	10	7.4	5.7	4.3
2000	14	9.5	6.2	4.6	7.4
2001	7.2	4.0	3.4	2.6	1.6
2002	9.1	4.9	3.3	2.8	2.2
2003	15	7.2	4	2.2	1.8
2004	5.2	3.3	2.7	1.8	1.4
2005	20	13	7.5	5.1	3.1
2006	28	17	8.7	6.6	7.1
2007	4.7	2.3	2.0	1.4	1.3
2008	3.8	2.0	1.3	0.7	1.4
2009	6.2	3.3	2.5	1.2	0.5
2010	14	7.3	5.3	3.4	2.2
2011	25	15	8.6	5.8	4.5
2012	9.8	5.6	2.9	1.8	1.4
2013	3.3	1.7	1.3	0.4	0.5
2014	1.5	0.7	0.5	0.35	0.5
2015	2.6	1.2	0.6	0.4	0.25
2016	7.3	3.1	1.8	1.4	0.7
2017	27	16.4	9.7	6.2	5.5
2018	8.8	4.9	2.9	2.9	2.1
2019	21	10.1	7.0	4.8	3.5
2020	9.7	5.1	3.3	2.3	1.8
2021	3.1	1.2	1.2	0.7	0.5
2022	2.7	1.0	1.0	1.4	1.7

* Red denotes drier water years. ** White denotes intermediate water years. *** Blue denotes wetter water years.

RECREATIONAL USE, POLLUTION SOURCES AND SOLUTIONS

Due to the managed shallow lagoon level to provide light penetration to the lagoon bottom at the scheduled time for the nautical parade, the parade was not held during the Capitola Beach Festival in 2022.

Through the summer, the lagoon near the beach was posted with warning signs about potential health risks from contact with the water. However, greater human use of the lagoon has been observed since 2016 than previously. In 2016, a paddle-board concession began in the village. Paddle-boarders have become commonplace during weekend monitorings (observed on 9 of 12 afternoon monitorings in 2022; 9 of 10 in 2021; 5 of 13 in 2019; 5 of 12 in 2018, 10 of 12 in 2017; 7 of 9 in 2016), along with kayakers, pedal boaters, row boaters, canoers and barge users. In 2022, the most paddle boarders counted in a reach was 4 in Reach 3 on 23 July and 21 August. Waders and swimmers have been commonly observed in the lagoon during warm, sunny, weekend afternoon monitorings since 2016 and not previously (usually near the beach in Reach 1; 6 of 12 afternoon monitorings in 2022; 2 of 10 in 2021; 6 of 13 in 2019, 5 of 12 in 2018, 4 of 12 in 2017; 6 of 9 in 2016). The most waders seen at one time in 2022 was 26 on 11 June in Reach 1 (22 on 25 June).

Vegetation was trimmed to expose the no fishing sign along the lagoon path to discourage illegal summer/fall fishing. None was observed during monitoring in 2022.

Separation of waders/swimmers and gulls in Reach 1 (Contamination warning signs posted). 23 July 2022

The common congregation of mallards in Margaritaville Cove in 2022 resulted from feeding by diners at Esplanade restaurants. As in previous years, mallard ducks patrolled the lagoon next to Margaritaville in the afternoon, indicating that feeding went on regularly there. We observed visitors feeding the ducks on 3 of 12 monitoring days in 2022.

Gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria from their excrement. They forage through human refuge left on the beach. They bathe and defecate in the lagoon. They roost and defecate on the buildings surrounding the lagoon. Reducing the gull population would be a major step in reducing pollution. The use of gull sweeps has been successful in other locales to prevent gull roosting. The parallel wires strung across the roof of the Paradise Grill and other Esplanade restaurants have been effective in discouraging roosting. All of the refuse cans on the beach were equipped with gull-proof lids since 2006 (**Ed Morrison, pers. comm.**). Refuse containers with gull-proof lids may reduce gull numbers. City building permit conditions of future remodeling will require addition of roof deterrents (**Steve Jesberg, Public Works Director, pers. comm.**). The increased presence of paddle boarders and boaters since 2016 has interfered with gull use in Reach 1. Gulls take wing when recreationists appear in/on their floatation devices and return quickly to bathe and congregate after they passed. Gulls avoid waders along the lagoon periphery near the flume. Human impact from gull disturbance upon the rate of gull defecation is unknown.

Rock doves (pigeons) are another source of bird pollution as they circulate between the wharf and the railroad trestle over Soquel Creek Lagoon. They may increase the biological oxygen demand somewhat under the trestle (Station 3). As stated in the original Management Plan, the trestle could be screened to eliminate pigeon roosting areas.

All storm drains leading to the lagoon should ideally be re-directed away from the lagoon in summer. Included among these would be storm drains emptying into Noble Gulch. Gray water and oily slicks have been noted emptying into the lagoon from Noble Gulch in the past. None was observed in 2022. Though no gray water was detected during 2-week monitorings in 2014−2016, 2018 and 2020−2022, gray water plumes were observed after wetter winters on 6 of 12 monitoring days in 2017 and 2 monitoring days in 2019, especially in the latter weeks of the monitoring period. Another drain into the lagoon exists under the railroad trestle, where slightly below average oxygen concentrations (indicating some oxygen depletion) have been detected in recent years in mid- summer, including 2020−2022, but not in 2018 or 2019. On 3 monitorings in 2022 at dawn and 8 of 12 in the afternoon, Site 3 under the railroad trestle had the lowest oxygen concentration of the lagoon sites (**Figures 6a-1 and 6a-2**). However, oxygen levels were adequate for steelhead in all cases. This drain could be capped if summer runoff was re-directed into the sewer. Another contributing factor to below average oxygen may be that rock doves and occasionally gulls roost on the trestle and may increase waste deposits underneath to increase the biological oxygen demand (BOD) at Site 3, resulting in lower oxygen concentrations.

Central Coast lagoons are naturally productive steelhead habitats with abundant aquatic plant populations. Juvenile steelhead grow rapidly in these lagoons where food is abundant. Plant life is the base of the food web and translates into food abundance for fast-growing juvenile steelhead in Soquel Lagoon. Also, abundant pondweed creates a forest that predators must negotiate to prey upon juvenile steelhead, offering some refuge from piscivorous birds like mergansers and pied billed grebes. Eutrophication from a biological perspective occurs when excessive nutrients induce overgrowth of plants and algae that cause oxygen depletion and fish kills if severe enough. In regard to steelhead habitat, habitat-degrading eutrophication indicated by stressfully low oxygen concentrations seldom occurs at the Noble Gulch creekmouth and has not occurred in 32 years of monitoring from eutrophication.

Regarding pollution from urban runoff, once the rains start in fall, installation and maintenance of silt and grease traps on storm drains is critical to reducing pollution by petro-chemicals. Much of Bay Avenue in Capitola was repaved in summer 2022, and for the first time in 32 years of monitoring, steelhead mortality was observed in Reaches 1 and 2 of the lagoon after the first flush runoff on 18 September. Mortality of starry flounder and staghorn sculpin was also observed along with steelhead. The lagoon had become extremely turbid. Despite managed reduction in lagoon depth after the storm, oxygen levels at dawn were measured at below 1 mg/L throughout the water column just above Stockton Bridge on 20 September and less than 2 mg/L throughout the water column above and below Stockton Bridge on 21 September. Oxygen levels began to recover in the afternoon of 22 September and were above 5 mg/L by afternoon on 23 September in the upper water column of the deeper Site 2 and throughout the water column at shallower Site 1 at the flume and above Stockton Bridge.

All new drainage systems from new development and parking lots should be installed with effective traps and percolation basins to encourage winter percolation of storm runoff. There has been a chronic pollution problem and high flashiness in streamflow during the first small storms of the fall, as occurred in mid-September 2022. Early storms turn the lagoon water turbid (cloudy), requiring lagoon water level reduction to allow light penetration to the bottom and photosynthesis and oxygen production to continue. In most years like 2022, the lagoon required emergency breaching because the flume could not accept all of the stormflow with flooding imminent. Although costly, retrofitting of storm drainage systems with holding tanks or percolation basins could reduce the sudden increase in street runoff and pollution during early storms. Drains leading from Wharf Road (across the Rispin property), the Auto Plaza and 41st Avenue businesses north of Highway 1 are some of the sources of this problem. The storm drain along the Esplanade was connected to the sewer line in 2006 for summer diversion of water in the drain to the sewer system.

The historical lagoon had large tule beds prior to construction of the bulkheads following the 1955 flood. Tules are commonly used in managed wetlands to remove nutrients and other pollutants from wastewater effluent. Re-establishment of tule marsh in Soquel Lagoon would reduce nutrient pollution and may reduce bacterial counts. Tule re-establishment would also provide fish habitat in Soquel Lagoon. In 2017, as a pilot project, tules were planted in the cove under the railroad trestle. Some of the original plantings survived the relatively mild winter of 2017-2018 and the heavier stormflows of the 2018-2019 winter. They maintained their abundance in 2022 after a mild winter and after expanding in 2021 after another very mild winter. City staff will continue to monitor and augment plantings in the pilot project area.

Capitola's Soquel Lagoon with historic tule marsh.
(circa 1927; Provided by the Capitola Historical Museum.)

FISH CENSUSING

Steelhead Plantings. No steelhead were planted in Soquel Creek in 2022, as was the case in 2003–2021. CDFW has only allowed juvenile planting of smolts in spring in streams where planted juveniles were descendents of captured adult steelhead brood stock from those streams (San Lorenzo River and Scott Creek). No adult steelhead were captured from Soquel Creek for hatchery propagation. Therefore, no juveniles were planted there.

Fish Sampling Results. Fall sampling for steelhead and tidewater goby occurred on 2 and 9 October 2022, from upstream of the Stockton Avenue Bridge to the beach. To sample steelhead, a bag-seine with dimensions 106 feet long by 6 feet high by 3/8-inch mesh was used. The seine was set perpendicular to shore, parallel to the Stockton Avenue Bridge and upstream of it. Juvenile steelhead congregate in the shade under the bridge and under the willows on the west side. Other seine hauls occurred downstream of Stockton Bridge, as well. The seine was pulled to the beach in front of Venetian Court. A total of 31 steelhead were captured, measured and marked on 2 October after 6 seine hauls. This indicated that juvenile steelhead was likely small in the lagoon in 2022. There were no mortalities. A total of 54 steelhead were captured on 9 October in 6 seine hauls. There was only one recapture and no mortalities.

Using the Lincoln index for mark and recapture, the steelhead lagoon population estimate was 1,674, with a large standard error of 1,632. This estimate was above average and above the median compared to the 28-year average of 1,534 (median= 992), including the 2021 estimate (**Table 10; Figure 24**). However, with so few fish captured and only 1 recapture with a large standard error, the population estimate may be unreliable. Also, fish mortalities were observed after the early 18 September stormflow, including starry flounder, staghorn sculpins and 20 observed juvenile steelhead mortalities in Reaches 1 and 2. During the mid-September storm, some juveniles may have left the lagoon through the flume or moved upstream to avoid poor water quality. The lagoon steelhead population was likely larger before that storm than in October when fish were censused.

Some steelhead young-of-the-year (YOY) were relatively large in 2022 despite warm water conditions that increased food demands, and others were relatively small and less than 75 mm SL (**Table 11; Figure 7a**). Spawning was likely prevalent in the lower mainstem late in the spring after small stormflows, which resulted in seeding the lagoon with YOY at the beginning of summer, which could rapidly grow there until fall. In addition, some relatively small, formerly stream-dwelling YOY may have entered the lagoon late, during the mid-September stormflow. That would account for the atypically small YOY captured in October. At the upper end of the size range, some 2021 YOY likely resided in the 2022 lagoon as yearlings.

Threespine Stickleback. October 2017. (Photo by T. Suttle.)

Starry Flounder. October 2021. (Photo by T. Suttle.)

Young-of-the-Year Juvenile Steelhead. October 2021. (Photo by T. Suttle.)

Tidewater Gobies. October 2017. (Photo by T. Suttle.)

Sacramento Sucker. October 2017. (Photo by T. Suttle.)

Staghorn Sculpin. October 2021. (Photo by T. Suttle.)

Size histograms of steelhead captured from the lagoon in 2022 and other years back to 1998 may

be found in **Figures 7a−23**. No scale samples were taken to age fish in 2022. Examination of the size histogram of captured fish in 2022 indicated a gap in numbers at 105-109 mm SL. But with so few steelhead captured, that was likely a separation between smaller YOY that entered the lagoon more recently and larger YOY that spent most of the summer/fall in the lagoon. In past years, the yearling size class typically occurred in the range of 150-160 mm SL. In 2022, there were likely a mixture of large YOY and smaller yearlings in this size range, with larger ones likely being mostly yearlings. Other fish species captured in 2022 with the large seine were 2,000+ threespine stickleback (uncounted), 7 adult Sacramento suckers, 2 staghorn sculpins and 50+ tidewater gobies (uncounted).

On 2 October 2022, 5 seine hauls were made to capture tidewater gobies with the 30-foot x 4-foot x 1/8-inch mesh beach seine along a portion of the lagoon periphery in Reach 1 where the 106-ft seine had not been used. Eighty-seven tidewater gobies were captured, along with 1,139 threespine stickleback, 1 staghorn sculpin and 1 adult Sacramento sucker. No tidewater goby mortality was observed after the 18 September stormflow. An annual record of tidewater goby captures may be found in **Table 12**. The low number of tidewater gobies captured in 1992-1997, and their absence since the El Niño stormflows in winter 1997-98 until the drought years of 2008 and 2009, probably indicated a lack of backwater areas for overwintering refuge during high winter stormflows. This species was plentiful in Soquel Lagoon during the previous drought years of the late 1980's and early 1990's and reappeared during the recent three, less severe droughts (2007-2009, 2013-2015 and 2020−2022). It was surprising to find good numbers in the 2016 lagoon despite an 8,000 cfs stormflow the previous winter. Tidewater gobies were also detected upstream of the Stockton Avenue Bridge during sandbar construction in 2016. Perhaps they had migrated in from adjacent lagoons after the high stormflow in March 2016. Tidewater gobies have been reported in recent years in adjacent Moran Lake Lagoon by Jerry Smith (**pers. communication**). Tidewater gobies from up-coastal-current Moran Lake likely re-colonized Soquel Lagoon in 2008, after mild winters in 2007 and 2008. They likely re-colonized Soquel Lagoon again in 2013 after large stormflows in December 2012 and in 2020 after a mild winter. They were detected in Aptos Lagoon in 2011−2014 and 2017−2022 (no sampling in 2015 and 2016) (**Alley 2023**). A jetty at the mouth of Aptos Lagoon provides cover for overwintering tidewater gobies.

Past calculations indicated that lagoon steelhead production represented nearly 1/3 of the smolt-sized steelhead production in the lower 7.2 miles of mainstem Soquel Creek in both 1999 and 2000, when watershed estimates were made. In 1993, the lagoon production estimate of nearly 2,800 fish represented 10% of the estimated smolt production (juveniles =>75 mm SL in the fall) in the 16.6 miles of steelhead habitat in the mainstem and East and West Branches. The 2004 lagoon population estimate of 3,900 steelhead, all > 75 mm SL, represented an estimated 47% of the smolt production for the 16.6 miles of stream and lagoon habitat. Though we do not have 2007–2022 juvenile population estimates for the entire Soquel Creek watershed, the lagoon population of larger, smolt-sized fish has likely been a significant portion of the total watershed population in most dry years. The lagoon provides valuable habitat through proper management.

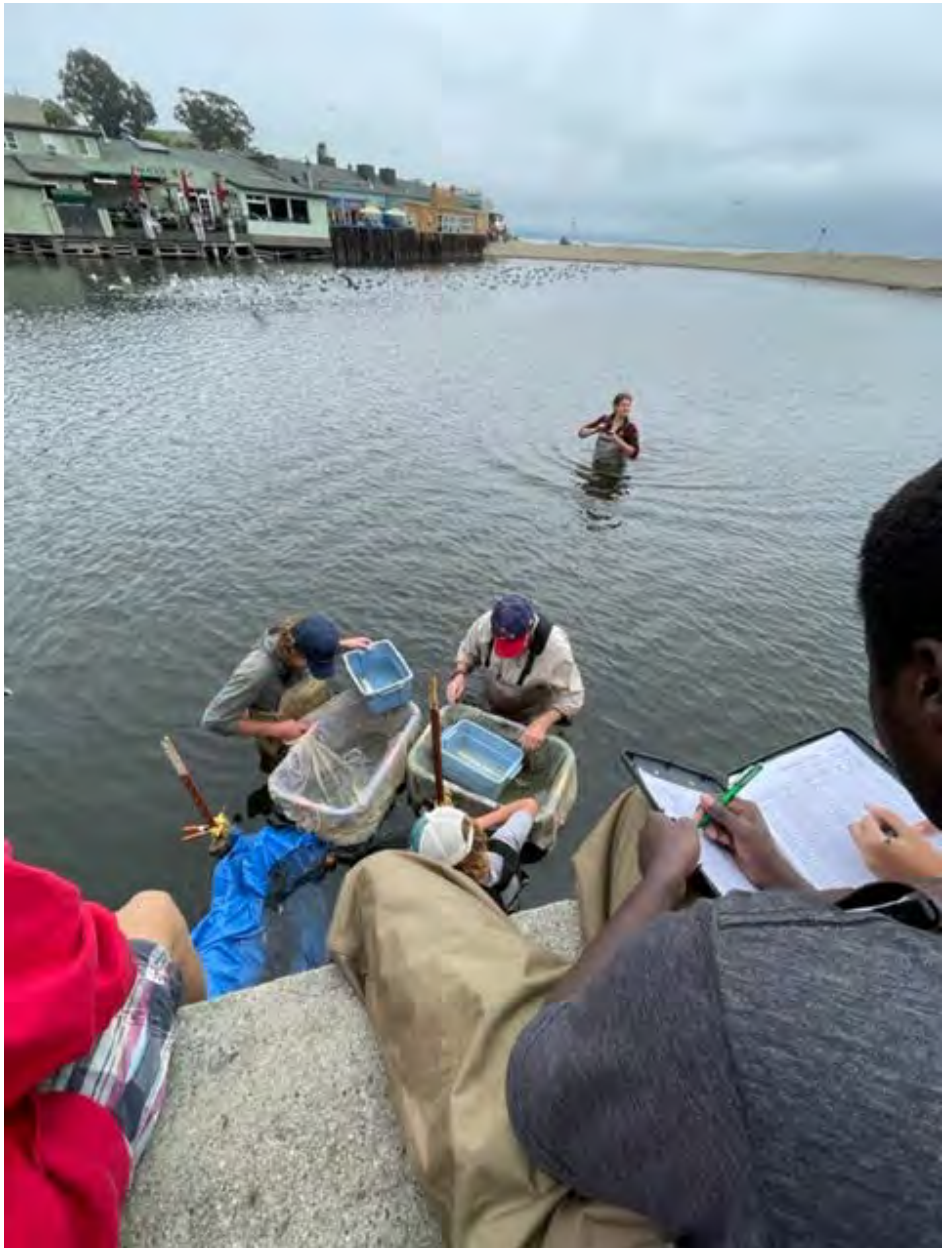
Two factors that may influence juvenile steelhead growth by the time of fall sampling are population size and time of lagoon closure prior to sampling. Another factor may be the timing of YOY entry into the lagoon. If some YOY enter the lagoon later in the summer or after a

stormflow that occurs before lagoon sampling, they will be smaller than if they entered early on. Still another factor is the proportion of yearlings versus YOY in the lagoon population. The higher the proportion of yearlings, the larger the size distribution will be. A summary table was prepared for the years, 1998−2022 (**Table 11**), corresponding to scatter plots of the data presented in previous reports (**Alley 2011**). Scatter plots of median juvenile size versus weeks of sandbar closure and versus population size done for data in 1998−2010, indicated no strong relationship between these factors and juvenile size when considered separately.

It is reasonable to predict that if the population was large, then competition for food would be high, and juvenile size at the time of fall capture would be smaller, at least for YOY. One would expect that since the lagoon is a very food-productive habitat, then juvenile size would be larger with longer lagoon growth periods. The population estimates may not be entirely precise but likely are accurate in reflecting relative annual differences in actual population size in most years. Usually the lagoon population is overwhelmingly dominated by YOY steelhead, based on past scale analysis. We suspect from the size distributions of juveniles captured that steelhead grew faster in 2006, 2009, 2011, 2014, 2016, 2018 and 2020 because of less competition for food with much smaller populations compared to large populations, such as those in 2007, 2008 or 2019 (**Table 10; Figure 24**). The food-rich lagoon was in place nearly 3 weeks less in 2006 than in 2007 and 2008 before sampling, and the steelhead still grew faster in 2006 with the much smaller population estimate than 2007, 2008 or 2019. We see that with similarly low population sizes in 1998, 2001 and 2009, as the growth period increased, the median size also increased, respectively. 2012 also had relatively large juveniles with a long growth period. However, in years like 1999 and 2003 that had similar population size to 2000 and 2006, growth rate remained relatively slower despite longer growth periods. So, other factors influence growth rate.

Famously large Prickly Sculpins from Soquel Creek (also inhabit the Lagoon). August 2012

Steelhead retrieved from holding pen for measurement. 9 October 2022



Steelhead measurement (Raft of gulls bathing in the background). 9 October 2022

Steelhead released after measurement. 9 October 2022

Table 10. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2022.

Year	Steelhead Population Estimate for Soquel Creek Lagoon
1988-	Rough estimate of a few hundred. No mark/recapture activity done. 157 juveniles captured in 5 seine hauls.
1992-	Rough estimate of a few hundred. No mark/recapture activity was done. 60 juveniles captured in 4 seine hauls.
1993-	2,787 +/- 306 (standard error). 1,046 fish marked from two seine hauls.
1994-	1,140 +/- 368 (standard error). 76 fish were marked from two seine hauls.
1995-	360 +/- 60 (standard error). 59 fish were marked from 4 seine hauls.
1996-	255 +/- 20 (standard error). 105 fish were marked from 3 seine hauls.
1997-	560 +/- 182 (standard error). 53 fish were marked from 3 effective seine hauls.
1998-	671 +/- 74 (standard error). 164 fish were marked from 3 effective and one snagged seine haul.
1999-	928 +/- 55 (standard error). 397 fish were marked in 4 effective seine hauls.
2000-	875 +/-156 (standard error).185 fish were marked in 4 effective seine hauls.
2001-	454 +/- 27 (standard error). 186 fish were marked in 4 effective seine hauls.
2002-	1,042 +/-84 (standard error). 363 fish were marked in 4 effective seine hauls.
2003-	849 +/-198 (standard error). 109 fish were marked in 5 effective seine hauls.
2004-	3,869 +/-1,009 (standard error). 281 fish were marked in 4 effective seine hauls.
2005-	1,454 +/-347 (standard error). 212 fish were marked in 5 effective seine hauls.
2006-	992 +/- 125 (standard error). 178 fish were marked in 5 effective seine hauls.
2007-	6,064 +/- 1,671 (standard error). 226 fish were marked in 5 effective seine hauls
2008 -	7,071 +/- 1,574 (standard error). 551 fish were marked in 2 effective seine hauls
2009 -	449 +/- 87 (standard error). 114 fish were marked in 6 effective seine hauls.
2010-	1,174+/- 111 (standard error). 318 fish marked in 2 effective seine hauls.
2011-	678 +/- 107 (standard error). 197 fish marked in 5 effective seine hauls
2012-	220 +/- 94 (standard error). 44 fish marked in 6 seine hauls. 1 hindered by submerged log.
2013-	1,681+/- 265 (standard error). 195 fish marked in 4 effective seine hauls.
2014-	No Estimate Possible. 10 fish marked in 6 seine hauls. 2 unmarked fish caught on day 2.
2015-	No Estimate Possible. 10 fish marked in 6 seine hauls. 5 unmarked fish caught on day 2.
2016-	237 +/- 19 (standard error). 161 fish marked from 4 effective seine hauls.
2017-	259 +/- 23 (standard error). 102 fish marked from 5 effective seine hauls.
2018-	46 +/- 10 (standard error), 13 fish marked from 6 effective seine hauls.
2019-	3,322 +/- 697 (standard error), 299 fish marked from 3 effective seine hauls.
2020-	1,344 +/- 256 (standard error), 192 fish marked from 6 effective seine hauls
2021-	2,500 estimated based on catch-per-unit-effort.335 captured; 299 marked from 5 seine hauls
2022-	1,674 +/- 1,632, 85 captured (both days): 31 marked from 6 seine hauls

Table 11. Summary of Annual Fish Sampling Dates, Population Estimates, Steelhead Size and Lagoon Growth Period Prior to Sampling, 1998−2022.

Year	Sandbar Closure Date	Fish Sampling Dates	Weeks of Sandbar Closure Prior to Final Fish Sampling	Days of Sandbar Closure Prior to Final Fish Sampling	Steelhead Population Estimate	Median Size Grouping of Captured Fish (mm SL) - 1st and 2nd Day
1998	9 July	4/11 Oct	13.1	92	671	115-119 (Day 1)
1999	18 May	3/10 Oct	20.6	144	928	120-124 (Day 1)
2000	7 June	1/8 Oct	17.4	122	875	135-139 (Day 1)
2001	14 June	7/14 Oct	17.3	121	454	125-129 (Day 1)
2002	23 May	6/13 Oct	20.3	142	1,042	105-109 (Day 1)
2003	22 May	5/12 Oct	20.3	142	849	110-114 (Day 1)
2004	26 May	3/10 Oct	19.4	136	3,869	115-119 (Day 1)
2005	9 June	2/9 Oct	18.1	127	1,454	105-109& 110-114
2006	14 June	30Sep/8 Oct	16.4	115	992	150-154 & 145-149
2007	23 May	7/14 Oct	20.4	143	6,064	125-129 Both days
2008	22 May	27Sep/ 11 Oct	18.1	127	7,071	115-119 (Day 1)
2009	21 May	4/11 Oct	20.3	142	449	155-159 Both days
2010	2 June	3/10 Oct	18.4	129	1,174	115-119 Both days
2011	20 June	2/16 Oct	15.3+1.6 weeks estuary	106+11 days estuary	678	155-159 & 160-164
2012	24 May	7/14 Oct	20.3	142	220	140-144 Both days
2013	23 May	6/13 Oct	20.3	142	1,681	125-129 & 130-134
2014	22 May	12/19 Oct	21.3	149	None possible (No recap.)	155-159 (Day 1)
2015	21 May	4/11 Oct	20.4	143	None possible (No recap.)	95-99 (Day 1)
2016	27 May	2/9 October	19.1	134	237	155-159 & 165-169
2017	1 June	8/15 October	19.4	136	259	160-164 & 155-159
2018	24 May	7/14 October	20.4	143	46	160-164 & 170-174
2019	31 May	6/13 October	19.1	134	3,322	95-99 Both days
2020	11 June	4/11 October	17.3	121	1,344	130-134 Both days
2021	1 June	3/10 October	18.6	130	2,500 C per Unit E	140-144 & 150-154
2022	26 May	2/9 October	19.4	136	1,674	130-`34 & 135-139
Avg/Median			18.9	**133/ 136**	**1,535/ 992**	

Table 12. Number of Tidewater Gobies Captured at Soquel Lagoon in October.

Year	# of Tidewater Gobies Captured in Soquel Lagoon	# of Seine Hauls (30-foot fine-mesh seine)
1988 drought	102	2
1992 drought	2	?
1993	0	4
1994 mild	35	4
1995 wet	0	8
1996 wet	0	6
1997 below avg	1	8
1998 wet	0	4
1999 wet	0	5
2000	0	5
2001	0	5
2002	0	5
2003	0	5
2004	0	5
2005	0	4
2006 wet	0	5
2007 drought	0	5
2008 drought	33	4
2009 drought	8	4
2010 above avg	0	6
2011 wet	0	6
2012 below avg	0	5
2013 drought	10	7
2014 drought	481	6
2015 drought	309	5
2016 mild	98	4
2017 wet	0	6
2018 mild	1	6
2019 wet	1	5
2020 mild	117	6 (106-ft coarse-mesh seine)
2021 drought	210	5
2022 drought	87	5

Other factors that may strongly influence growth rate are water temperature and food availability. The density of aquatic vegetation, which may be an indirect indication of food availability, may vary considerably between years. Also, pondweed with attached algae may provide more invertebrate food than just filamentous algae alone. So, the density of pondweed is also important. 2012−2015 and 2021−2022 had high densities of pondweed with attached algae (15-70% of bottom coverage in various reaches) from mid-August onward in years up to 2022**.** The 2022 summer was unusual in that pondweed was dense all summer from June onward. High

pondweed production would encourage faster steelhead growth rate. Consideration must be given to potentially diminished water quality (high water temperature or low oxygen levels at the end of the night) and/or poor fish foraging efficiency if aquatic vegetation becomes too dense, making it difficult to maintain food intake. Warmer water increases fish metabolic rate and food demands.

Cooler lagoons resulting from higher summer baseflow will reduce fish metabolic rate for maintenance and may allow a higher portion of the food intake to be used for growth. However, cooler lagoons may have less production of aquatic vegetation as occurred in 2019 compared to drought years, and fish digestion rate is slower in cooler lagoons. This slows the processing of food for growth. The 2013−2015 and 2021−2022 lagoons were relatively warm with very limited stream inflow. The lagoons in 2011−2012, 2016−2017 and 2019 were cooler. Aquatic plant production was less in 2011, 2016, 2017 and 2019 than in the warmer lagoons of 2008, 2009, 2012, 2013−2015, 2018 and 2021−2022 (more pondweed), indicating less food available in cooler lagoons (**Alley 2018a; 2020**). There may have been a higher proportion of yearlings in the lagoon population in 2011 and 2016−2018 compared to other years due to overall low YOY production in the watershed. In 2016−2018, juvenile densities were extremely low in the lower mainstem Soquel Creek (**Alley 2018b**). A higher proportion of yearlings would have increased the median size of juveniles in those years. In drought years, more adults may spawn in the lower creek near the lagoon due to restricted passage flows to the upper watershed. This has lead to high lagoon densities during the drought years of 2007 and 2008, presumably of mostly YOY fish. We suspect the same large population in 2021 and 2022 but cannot confirm this due to the apparent interference of the Soquel Creek Water District treated water spill into Noble Gulch in 2021 and the early, mid-September stormflow in 2022 that caused high lagoon turbidity and likely impacted steelhead distribution and survival in the lagoon.

In order to maintain good steelhead nursery habitat in Soquel Creek Lagoon, the sediment input from the watershed must be reduced. The 2022 lagoon remained deeper than recent years in Reaches 2 and 3 after deepening in 2017, with scour at the base of the exposed bulkheads visible.

In order to minimize water temperature, the City must maintain the water level as high as possible throughout the summer until sandbar breaching, without large fluctuations. It is potentially easier to maintain good water quality and water depth when there is higher streamflow into the lagoon in summer (known as summer baseflow). But flashboards must be added steadily through the summer as baseflow recedes. The ceiling grate constructed in 2003 makes it easier to maximize lagoon depth because a portion of the flow can spill over the boards into the ceiling opening with all of the flashboards in place. However, even with the grate, it was difficult to maximize lagoon depth in 2006 because of the seepage of water and sand under the flume. Seepage again occurred in 2009 as previously, and sandbags were piled into the hole that developed in front of the flume inlet. Seepage was prevented in 2007, and lagoon depth was maintained. Although a seepage problem existed in 2012, it was largely solved in 2013−2020. Prior to sandbar construction in 2013, plywood sheets were inserted between the flume pilings to slow or divert any water and sand underflow beneath the flume and discourage undermining. These sheets remained in 2020. In , seven permanent, hard plastic sheets were evenly positioned under the flume from the inlet to near the outlet. No stream underflow beneath the flume has been observed since. The lagoon water surface was kept at the top of the flume inlet throughout

the summer/ fall in 2020 and 2022 until the series of small storms occurred in early fall but did not require sandbar breaching. This required periodic lowering of the lagoon level to insure that light penetrated to the bottom for plant photosynthesis after stormflows that created turbidity. Lagoon height was increased after water clarity returned after these small stormflows. Usually, in drier years it is easier to maintain a high water surface elevation because streamflow recedes early and requires all flashboards in place early on.

If the lagoon water surface drops, steelhead habitat in the upper lagoon is lost. Therefore, the lagoon level should be kept as high as possible during summer. The flume's flashboards must be secured against vandals removing them and against tidal backpressure that may dislodge them.

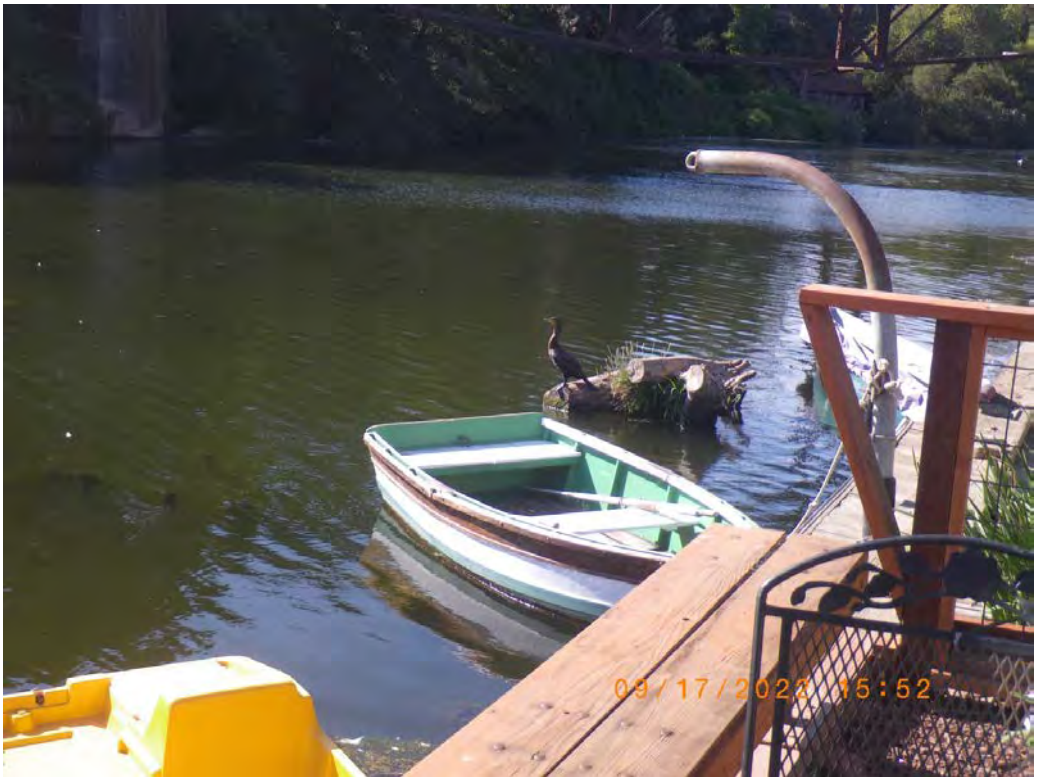
Maintenance of the lagoon in the fall after the first small storms is important. If the sandbar opens with the first small stormflows and closes again, kelp and seagrass may become trapped to rot and create an anoxic lagoon leading to a fish kill. In 2022, an early, small stormflow occurred in mid-September but the sandbar was maintained by removing many boards from the flume inlet. As a result, lagoon turbidity and oxygen depletion after this early storm were issues, and the lagoon level had to be greatly reduced to bring oxygen levels back up. The sandbar opened after the third small stormflow in early November. Hopefully, more rain will follow to maintain an open sandbar later in 2022. Minimization of pollutant input from early fall storms is also important for reducing biological oxygen demand and avoiding fish kills. Capitola Road in Capitola was repaved in summer, 2022. The first flush runoff in mid-September 2022 into the lagoon may have washed considerable petro-chemical pollutants and suspended particles into the lagoon, likely contributing to oxygen depletion and fish mortality. Mortality occurred with starry flounder, staghorn sculpin and some steelhead. No tidewater goby mortality was observed.

BIRD AND POND TURTLE CENSUSING

Piscivorous Birds and other Waterfowl. Predation may be a factor in population size and body size distribution of juvenile steelhead. If bird predation rate is heavier, smaller steelhead would be most vulnerable because fish swimming speed increases with size. Heavy predation could increase the size distribution of juveniles surviving until fall sampling. Maximizing lagoon depth is important to make feeding more difficult for piscivorous animals.

Mergansers were commonly observed in 2022 as they had been in other drought years, 2013−2015 and 2021 (**Table 13)**. They were more common in 2022 than 2021. Other piscivorous birds observed in 2022 included pied-billed grebe, eared grebe, cormorant, snowy egret, common egret, black-crowned night heron, green heron and belted kingfisher. Pied-billed grebes were less common in 2022 than 2021. Egrets moved in after the lagoon level was reduced to allow light penetration after the early mid-September stormflow. They left after the lagoon level increased. As an aside, a peregrine falcon was observed soaring over the railroad trestle on the morning of 1 October.

Common mergansers in Reach 2 (with mallards in the foreground), 7 August 2022



Cormorant roosting on emergent wood in Reach 2, downstream of the railroad trestle. 17 September 2022

Table 13. Number of Sighting Days of Less Common Piscivorous Bird Species at Soquel Lagoon on Two-Week Interval Monitoring Days.

Year/ # Monitoring Days	Common Goldeneye	Common Merganser	Pied-billed Grebe	Black-crowned Night Heron	Green Heron	Snowy Egret	Corm-orant	Great Blue Heron
2022/11	0	7	3	1	3	2 (2 common egrets)	3	0
2021/10	0	8	6	0	2	2 (2 common egrets)	2	1
2020/16 (morning only)	6	3	9	1	0	1	1	0
2019/13	1	3	5	0	0	0	1	0
2018/ 12	0	2	7	2	1	1	1	1
2017/ 12	0	4	6	0	0	0	1	0
2016/ 13	0	3	4	1	3	0	2	0
2015/ 12	0	6	4	1	2	1	7	0
2014/ 13	0	6	7	3	2	4	1	0
2013/ 18	3	9	10	3	3	0	3	0
2012/ 12	0	3	8	0	0	1	4	0

Gulls commonly bathed in Reach 1, downstream of the Stockton Bridge and did so in 2022. However, in past years when people were observed feeding the ducks in upstream reaches, a few gulls were attracted to the food source. 2019 was the first year in 31 years of monitoring that rafts of Western gulls consisting of as many as 24 birds were commonly observed in Reach 3. They were also observed perching in groups on lagoon-side house roofs in Reach 3 in 2019. This has continued in 2020−2022. As many as 17 western gulls were observed in the afternoon in Reach 3 in 2022 (maximum of 22 western gulls in 2021). In 2022, Western gulls were observed congregating in Reach 3 on June and July afternoons but not after that, even when large numbers of Hermann's gulls congregated with Western gulls in Reach 1 in September and October (**Figure 27**). In 2021, the gull rafts in Reach 3 were most common until early August, and only a few were observed after that. Some gulls may choose Reach 3 to bathe in to avoid human

interference. Because paddle-boarding and wading have become more common at the lagoon since 2016, more paddleboard traffic has occurred, especially in Reach 1, along with human wading along the margin of Reach 1. These activities were minimal before that. Now, wading persists heavily on weekends until early September when school resumes and weather cools down. Previously, individual gulls were occasionally observed beyond Reach 1 when someone was feeding the ducks. Gulls are a threat to ducklings when they spread into Reach 3. More gulls are using the lagoon-side roofs in Reach 3 to roost, as well, to the dismay of residents. On 11 June, 24 gulls were observed from Site 4, roosting on lagoon-side roofs in Reach 3.

Gull numbers during lagoon monitoring in 2022 fluctuated between 34 (25 June) and 280 (29 October), when Hermann's gulls dominated the count in Reach 1from late September to the end of October. The average gull count per monitoring day for 2014−2022 has been 63, 68, 42, 40, 46, 63, 36, 44 and 109, respectively.

Gulls bathing in Reach 1 (mostly Hermann's Gulls). Notch prepared in sandbar preliminary to stormflows. 29 October 2022

Mallard numbers tend to be lowest in June before ducklings become common in July − September, with a decline in October at a time when coots become common (**Figure 28**). In 2022, mallard observations increased from early to late June but then declined in early July, only to increase to a seasonal high of 39 mallards by 23 July. Significant overhanging willow cover was present in Reaches 2 and 3, which may have hidden mallard mothers and their ducklings

from censusing in early July. After July, numbers fluctuated in a downward trend between 30 and 15 birds except for an increase in mid-September to 35. Maximum mallard densities were lower than in 2018−2020, but generally higher than in 2021. The average mallard count per monitoring day for 2014−2022 has been 27, 26, 31, 18, 30, 21, 44, 23 and 28, respectively, giving 2020 the highest average in the last 9 years. Mallards no longer had the cottonwood log across from Noble Gulch to roost on or congregate around because it was washed away during the wet 2016−2017 winter. They were observed roosting on docks and barges instead.

Mallards roosting on a barge near Noble Gulch, Reach 3. 21 August 2022

Two coots inhabited the lagoon most of the summer of 2022. Coots were more common in 2022 in fall, as is typical. The first detected increase in coot numbers was 17 September (19 September in 2021; 3 October in 2020; 28 September in 2019), as coots typically arrive in late September and early October. Coots were less common than other recent years. The maximum number of coots counted on a monitoring day in 2015−2022 was 113, 13 (early breach), 34, 147, 58, 38 (early breach) and 30, respectively. The large, gray-brown domestic duck that came to the lagoon in 2020 and was present throughout the 2021 monitoring period, was absent in 2022. A different domestic gray duck was observed during the two September monitorings in 2022. No other domestic waterfowl were observed.

A western pond turtle was observed on 2 occasions in 2022. A turtle was observed hauled out on

emergent wood near the Golino cabin in the morning on 11 June. Another turtle sighting occurred on 4 September when one was basking in the afternoon across from the Golino cabin on the Arthur dock at Site 4 near Noble Gulch. These were the first western pond turtle sightings since 2012, although a paddle-boarder observed a turtle (species unknown) in the upper lagoon in 2015. Previously, they basked on the instream cottonwood log across from the Noble Gulch mouth and on additional logs further downstream adjacent to the Golino Property. In 2012, as many as 3 pond turtles were observed at one time on the cottonwood log and another nearby log. The cottonwood log had sagged and was mostly underwater in 2013−2015, offering limited basking area. In 2016, the log had moved upstream a few feet and was still partially submerged. Then it was flushed out to the beach during the wet 2016-2017 winter.

Western pond turtle hauled out on emergent wood near Golino cabin. 11 June 2022

NEW AND CONTINUING MANAGEMENT RECOMMENDATIONS

Recommendations for Lagoon Preparation and Sandbar Construction

1. During morning relocation of fishes from the lateral channel (when it is present), provide limited water in-flow to the lateral channel, if necessary, to keep it wetted until fish relocation is completed. In this way, water quality in the lateral channel will be maintained for fish in the event that considerable vegetative matter is present and decomposition is occurring there.

2. Insure that the flume is completely open for out-flow to the Bay before the work-day has ended during all sandbar construction activities. This includes during any required sandbar re-construction activities late in the smolt out-migration period. Do not use manhole cover spacers to flush sand out of the flume through the manholes during darkness when the entire outflow from the lagoon must exit through the flume and there is a chance that smolts are still exiting.

3. If stranded fish are detected as a result of sandbar closure or flume clearing, alert the monitoring biologist to discuss the appropriate relocation method for fish, and have the biologist capture and relocate the fish with assistance from Public Works staff. The biologist should be present during all sandbar closure and flume clearing activities when fish may be present (not when the flume is being cleared the week prior to sandbar construction and streamflow is still flowing through to the beach). However, if fish become stranded due to unforeseen circumstances unassociated with sandbar closure/ flume clearing and insufficient time is available for the biologist to reach the site, as occurred on 21 June 2011, Public works staff should consult with the biologist prior to any response. Then Morrison and Public Works staff should capture and relocate the fish with available dip nets or seine and buckets filled with fresh estuary/ lagoon water, after consultation with the biologist. (Other public works staff should be given experience in relocating fish from the lateral channel in the future or during fall sampling so that they may fill in if Morrison is unavailable.) If the biologist is unavailable during emergency cases when fish survival is in jeopardy, relocate fish to the main body of the estuary or lagoon near the pilings and boulders adjacent to the restaurants, where cover and good water depth are available.

4. If salmonids are detected in the raking area during preparation for sandbar construction and while the biologist is upstream, searching for stranded fish in isolated pools, then stop raking, leave the water and contact him via cell phone. The biologist will return to the lower lagoon as soon as isolated pools upstream are cleared. Do not resume raking until water turbidity in the raked area has dissipated and salmonids have left the immediate area.

5. Closing of the sandbar in late May is better than mid-June or later because streamflow is usually sufficient to rapidly fill the lagoon in most years (not 2013−2015), and the juvenile salmonids most likely to be present in the lagoon are out-migrating smolts. Late May is prior to down-migration of most YOY steelhead from spawning sites above the lagoon. Small steelhead fry remain in the vicinity of spawning sites before moving down into the

lagoon. Down-migrant trapping on the nearby San Lorenzo River in 1987 and 1988 by Donald Alley and Stafford Lehr (now with CDFW) indicated that a few YOY steelhead were down-migrating into the lagoon in May. But the number greatly increased in June.

6. The management solution for minimizing the time required for sandbar construction is for the City to remain flexible on timing of the work. If rain is in the forecast within two days after the intended starting date for sandbar construction, Public Works should postpone construction until clear weather is forecasted. If 4-5 working days are set aside to construct the sandbar, the sandbar construction may be delayed as late as 4-5 days before the Memorial Day weekend and may still satisfy the tradition of lagoon formation before then.

7. During daily artificial breaching during sandbar construction, continue to maintain water depth in the estuary such that no isolated pools and backwaters form at the margins to strand fish. Blocking of the sandbar may be required to maintain sufficient depth. Check the estuary margins to prevent stranding of fish.

8. Continue to rake as much kelp and sea grass out of the lagoon as is possible before final closure, including plant material trapped under the restaurants and in depressions around the bridge piers. Focus efforts from the Stockton Avenue Bridge downstream to the flume. Discontinue raking if juvenile salmonids are observed near the water surface. It is best to minimize time required to stockpile sand, rake out the decomposing organic matter and prepare the flume inlet for fish passage. This will minimize the number of instances of artificial fluctuation of lagoon water level. Sufficient City staff should be assigned to be ready to enter the estuary at the earliest opportunity each day to quickly rake out decomposing kelp and to clear the sand-filled flume initially.

9. Continue to dispose of kelp in the Bay rather than bury it in the sandbar. Disperse it up and down the beach. Continue to include this in the state Fish and Wildlife permit for sandbar construction. County Environmental Health approved of this method so long as kelp is spread over a wide area (**J. Ricker, personal communication cited in the original 1990 Soquel Creek Lagoon Management and Enhancement Plan**).

10. To provide cover for juvenile fishes, continue to leave any large woody material deposited in the lagoon from winter storms. Allow a clear path from under the bridge to the beach at Venetian Courts to enable seining for juvenile steelhead during fall censusing.

11. Annually evaluate the structural integrity of the flume and its supports. Continue to repair cracks and supports as necessary. This will prevent sinkholes from forming and reduce water leaking from the lagoon along the flume.

12. Repair the flume at a time that does not obstruct fish passage or require lowering of the lagoon water level.

13. During sandbar construction, continue to close the lagoon each day before the incoming tide can wash in salt water and kelp. Re-open the sandbar and unplug the flume, if necessary, each morning to facilitate kelp and sea grass removal.

14. Continue to search under the Stockton Avenue Bridge and in upstream Reaches 2 and 3 past the Rispin Mansion for stranded fish to rescue as the lagoon drains each day during raking. It is best to minimize the number of days required to construct the sandbar and rake out the decomposing organic material. This will minimize the artificial fluctuation of lagoon water level. Having a maximum number of personnel to rake decomposing organic material into the bay and to clear the flume of sand will minimize the days needed to prepare the lagoon for the summer.

15. Continue to maintain an underwater portal in the flume intake for out-migration of adult steelhead until at least June 15, while maintaining a notched top plank for out-migration of smolts until at least 1 July. However, in dry years such as 2007−2009 and 2014−2015, when stream inflow is insufficient to fill an underwater portal and allow lagoon filling, opt for a large notch in the upper boards/screen to accommodate smolts and kelts, if possible, instead of a deeper underwater portal for kelts. If kelts are observed in the lagoon in these dry years without the underwater portal or large notch at the top, provide a larger opening in the top of the flume inlet temporarily to allow kelts to exit the lagoon.

16. Continue to maintain the 1-foot high weir/ baffle inside the flume until at least July 1 for safe flume entrance of out-migrating salmonid smolts migrating to the Monterey Bay.

17. Continue to place a 4-inch by 4-inch plank in the base of the flume outlet to maintain adequate flume depth, if necessary.

18. Take special care to pack sand under the flume, between the pilings, during final sandbar closure in order to prevent seepage under the flume after closure.

19. Continue to cover the visquine around the flume inlet with manually shoveled sand instead of tractor shoveled sand. This will prevent the tractor from displacing the visquine. Clear or white visquine is preferable to black. Key the visquine into the lagoon margin to encourage its retention when the sandbar opens in the fall.

20. During sandbar construction, continue to lash floating logs together under the bridge to create fish cover if logs are present and time allows.

21. Continue to retrieve visquine from around the flume inlet immediately after the fall sandbar opening, if possible.

22. In very dry years, such as 2013−2015, when stream inflow is low and no stream outflow occurs through the flume for one or more days after final sandbar closure, partially close the flume outlet to prevent tidal influx of saltwater through the flume into the lagoon at high tide. This will reduce the saltwater volume collected in the lagoon prior to the lagoon filling and provide freshwater outflow to prevent tidal influx. The partial closure of the flume outlet worked well in 2015.

Recommendations Regarding Sandbar Breaching

1. Prior to sandbar breaching in the fall, notch the sandbar across the beach just below the elevation of the piling bolt indicating flooding, minimizing the gradient of the notch to slow the evacuation of water through the beach and to minimize beach erosion. Continue

to orient the notch laterally (diagonally) across the beach to also maximize the probability of maintaining an estuary with some depth after the breach. The purpose is to maximize the residual estuary depth after the emergency breach.

2. The notch in the sandbar should be cut slightly lower than the piling bolt. Continue to orient the notch laterally (diagonally) across the beach to the southeast of the flume. Continue to make the notch at least 30 feet wide across the beach to also maximize the possibility of maintaining an estuary with some depth after the breach. The City may have to periodically re-establish the notch if it does not rain or high tides obliterate it. If a storm is predicted, the sandbar needs a notch as preparation. Continue to maintain an outer berm near the surf and an inner berm near the lagoon margin with the wide notch in between. When breaching must be facilitated, notch the inner berm first, allowing the notch across the beach to fill with water. Then notch the outer berm to the east to finish the sandbar breach.

3. Continue to remove three 4x4-inch boards from the flume inlet on one side as soon as possible after the first stormflow of the season (which does not require sandbar breaching). This will insure light penetration to the lagoon bottom. If turbidity still prevents light penetration to the bottom, remove enough boards to achieve complete light penetration. This will allow algal growth despite the high turbidity. Plant photosynthesis will produce oxygen and prevent anoxic conditions. If turbidity still prevents light penetration to the bottom, remove enough boards to lower the water level to a point where light penetrates to the lagoon bottom. Thus, vegetation mortality and stressfully low oxygen levels for steelhead are prevented until water clarity is re-established. Re-install boards to increase lagoon depth after the lagoon clears up. Repeat this process for each succeeding small stormflow that does not require sandbar breaching.

4. After a small stormflow in the fall that has made the lagoon turbid, if the flume exit closes after boards have been removed from the flume inlet to reduce the lagoon water level, excavate the flume exit daily, if necessary, to maintain lagoon outflow and a shallower lagoon for effective light penetration.

5. In preparation for sandbar opening in the fall, continue to maintain an outer berm near the surf and an inner berm near the lagoon margin with a wide notch in between. The notch in the sandbar should be cut slightly lower than the piling bolt. Continue to make the notch at least 30 feet wide across the beach. The City may have to periodically re-establish the notch if it does not rain or if high tides obliterate it. If a storm is predicted, the sandbar may require a fresh notch.

6. When breaching must be facilitated to prevent flooding, notch the inner berm first, allowing the notch across the beach to fill with water. Then notch the outer berm to finish the sandbar breaching, if necessary. If possible, allow the streamflow and tidal action to "naturally" breach the outer berm.

7. Just as the first storm of the fall season begins, remove boards from at least one side of the flume if a small storm is anticipated. The number of boards removed will be dictated by the anticipated size of the storm. Remove two boards or more from either side if a

large storm is anticipated. Clear the exit to the flume by removing the plate from one side of the exit.

8. Continue to notify the California Department of Fish and Wildlife 12 hours before the possibility of an emergency sandbar breach and immediately after the breach occurs.

9. Take water samples for fecal bacteria analysis within 24 hours prior to the anticipated facilitated sandbar breach and within 12 hours after the breach in the surf near the creekmouth. While the sandbar remains open, collect weekly water samples for analysis until the fecal indicator bacterial count meets the standard of 104cfu/100 ml.

10. If a stagnant, kelp-filled lagoon forms in fall after an early breach followed by a dry period, do not empty the lagoon by breaching the sandbar. Instead, use the flume and shrouds to pull salt water out. Breaching of the lagoon will increase the opportunity for more kelp to enter and probably will not empty the entire lagoon anyway. Upstream fish passage need not be maintained through the flume because it should be discouraged until sufficient stormflows develop to provide passage up the Creek. If adult salmonids enter too early, they will become stranded and unable to migrate upstream because of insufficient streamflow.

Recommendations to Maintain Good Water Quality and Fish Habitat in the Lagoon

1. NEW−If a significant saltwater layer (0.25−0.5 m thick) is trapped in deeper pockets along the lagoon bottom adjacent Venetian Courts and upstream after sandbar construction under drought conditions (low stream inflow), then pump water from the very warm, oxygen-depressed saltwater lens through a hose to the flume until the saltwater lens is substantially removed and water quality is restored. The pump intake shall be screened to prevent fish mortality.

2. Since tules planted in the cove under the railroad trestle withstood winter stormflow, pursue planting more tules under the trestle and in other lagoon locations. Seek volunteers to re-establish tules near the Golino property. When this becomes successful, approach the restaurants to allow tule plantings in Margaritaville Cove. This will provide additional cover for steelhead and tidewater gobies against predators and may reduce dissolved nutrients and bacteria in the lagoon.

3. A previous recommendation in the original Management Plan (**1990**) should be emphasized to prevent fish mortality; parking lots and streets draining into the lagoon should be cleaned thoroughly before the first fall rains.

4. Road repaving and application of petrochemicals should be done early in the summer. This will allow chemical penetration into the pavement and drying before fall rains.

5. Continue to require that Margaritaville staff not wash their patio and adjacent walkway (containing refuse dumpsters) off into the lagoon.

6. Regarding the nautical parade, we continue to recommend that float propulsion by

surfboard paddling or rowboat or electric outboard motor be required by the City rather than allowing pulling and pushing by waders. The latest CDFW permit prohibits wading. Allow float passage in one direction only, presumably downstream, before dismantling near the Stockton Avenue Bridge. In the past, floats proceeded down the lagoon and then back up before dismantling back at the bridge.

7. Continue to have the biologist monitor the annual nautical parade.

8. Regarding the nautical parade, require that all floats, boats, kayaks, barges, paddle boards, etc., be clearly lit at night to make them clearly visible and to avoid collisions.

9. Regarding the nautical parade, protect tules from destruction by floats during nautical parade-related activities and from recreational boating activities, in general.

10. Regarding the nautical parade, restrict the number/weight of float participants allowed to ride on the floats to a safe level during nautical processions.

11. Regarding the nautical parade, enforce the ban on waders during future nautical parades.

12. Regarding the nautical parade, continue to recommend to the lagoon parade organizers that floats be safely maneuvered downstream of Stockton Avenue, with a water marshal present to direct floats in a circular direction along the periphery of the lagoon after they clear the bridge.

13. Regarding the nautical parade, continue to recommend to the lagoon parade organizers to discourage alcohol consumption by float participants and rowdy behavior on their floats.

14. Regarding the nautical parade, continue to retain all flume boards to maintain maximum lagoon depth during the nautical parade.

15. Continue to use gull-proof lids on refuse cans at and around the lagoon and beach. Use enough refuse containers to satisfy the demand for refuse disposal.

16. Consider screening the railroad trestle to discourage roosting and nesting by rock doves.

17. Continue to maximize lagoon depth through the dry season, while maintaining passage through the flume for adult steelhead until at least June 15 and for steelhead smolts until at least July 1. If the lagoon level begins to drop below the notched upper flashboard for steelhead smolts because of the adult portal after June 15, close the portal. If inflow is sufficient to maintain depth with the adult portal open, leave it open through the dry season. If adult steelhead are seen in the lagoon after June 15 with the portal closed, then open it for a week to allow out-migration.

18. After July 1, leave the flume exit closed once it closes, unless flooding is eminent. Continue to install visquine or plywood on the outside of the flashboards to prevent leakage into the flume.

19. Maximize the number of boards in the flume entrance to maximize lagoon depth. Seal the boards with visquine or plywood to prevent leakage.

20. To prevent draining of the seasonal lagoon, continue to secure the flume boards at all times to prevent their lifting by vandals or by bay back-flushing.

21. Check the gage height at the lagoon once a week (preferably the same day each week) and log the measurements so that the biologist may contact the City to obtain updates.

22. "Gull Sweeps" should be installed on Esplanade roofs to test their effectiveness in deterring gulls.
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23. The City should influence planners, architects and property owners through the permit review to maximize water percolation and to filter out and collect surface runoff pollutants from new and existing land development within the City and upstream.

24. The City should request from the responsible flood control district that sediment and grease traps leading into lower Soquel Creek be annually inspected and cleaned before the first stormflow in fall.

25. The City should continue to fund activities to permanently remove invasive Arundo (Giant Reed) from residences along the lagoon and other non-native plants in the riparian corridor between Highway 1 and the lagoon in order to maximize stream shading, minimize water temperature of inflow water and to protect aquatic and streamside wildlife habitat.

26. The City should continue to seek funding to secure large wood to the lagoon bottom with anchor boulders as added fish cover and as scour objects to deepen the lagoon and enhance rearing habitat. Consider appropriate locations along the west bank under the railroad trestle or upstream adjacent to the Golino property.

27. Continue to retain large woody material that naturally enters the lagoon.

28. If the streamflow in Soquel Creek in the vicinity of Soquel Village approaches the point of losing surface flow, notify nurseries having surface diversions upstream and the CDFW so that direct surface water diversion may be reduced or discontinued until flow returns. Pumping by the Soquel Creek Water District from the Main Street well may also need to be curtailed. Avoid complete loss of surface streamflow.

Recommendations Regarding Fish Management

1. Do not plant steelhead from a hatchery into Soquel Creek unless the broodstock originate from Soquel Creek, which contain sufficient genetic diversity regarding spawning timing.

2. Maintain the postings of the fishing season at the entrance to the lagoon path to Noble Gulch and the path to the park on the west side of the lagoon upstream of the Stockton Bridge.

3. Maintain the ecological interpretive signs and the no bird feeding signs in the lagoon vicinity.

4. Report any illegal fishing at the lagoon outside of the fishing season to CDFW via the Cal-Tip hotline: 1-888-334-2258.

5. Continue to allow a clear path from under the Stockton Avenue Bridge to the beach at Venetian Court to enable seining for juvenile steelhead during fall censusing.

6. If the sandbar is still in place after November 15, create an opening in the upper flashboards of the flume inlet just prior to forecasted stormflow to allow early spawning adult steelhead or coho salmon to pass through the flume from the Bay.

7. Continue to census steelhead and tidewater goby in the fall to monitor lagoon use as important nursery habitat under varying streamflow conditions, management scenarios and restoration efforts.

Community Support during Steelhead Censusing. October 2021

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Soquel Lagoon Post-Venetian Court Construction- Older Stockton Avenue Bridge visible and prior to expanded development on eastern margin of the Lagoon, upstream and downstream of the Railroad Trestle; circa 1931.
(Courtesy of the Capitola Historical Museum)

Post-World War II Soquel Creek Estuary at very low tide (present-day Stockton Bridge with flume exposed on the beach after the December 1955 flood). Riparian corridor re-established on west side upstream of Stockton Bridge since 1931 photo; circa 1955-56 after the flood.
(Courtesy of the Capitola Historical Museum)

FIGURES

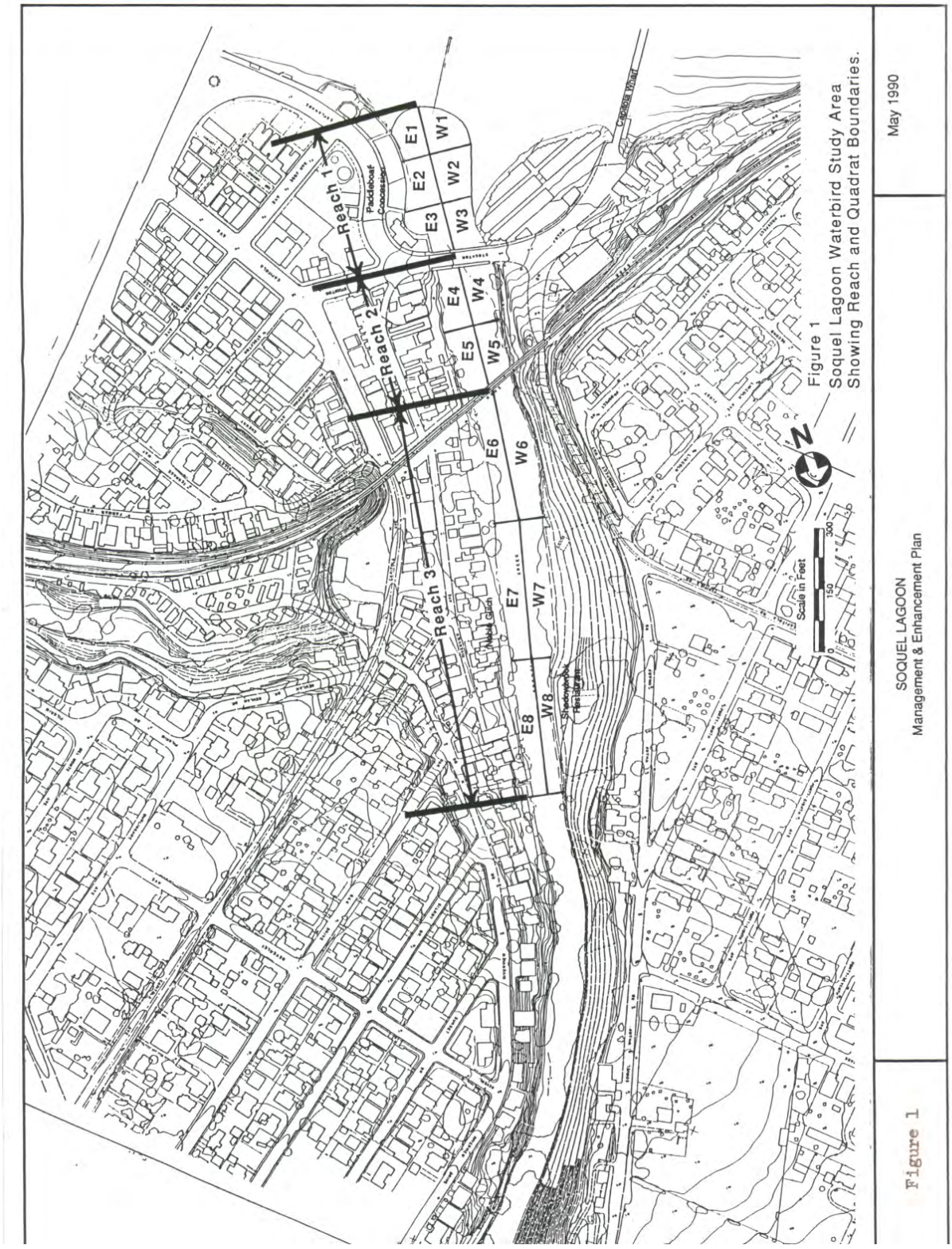


Figure 1. Map of Reaches in Soquel Creek Lagoon

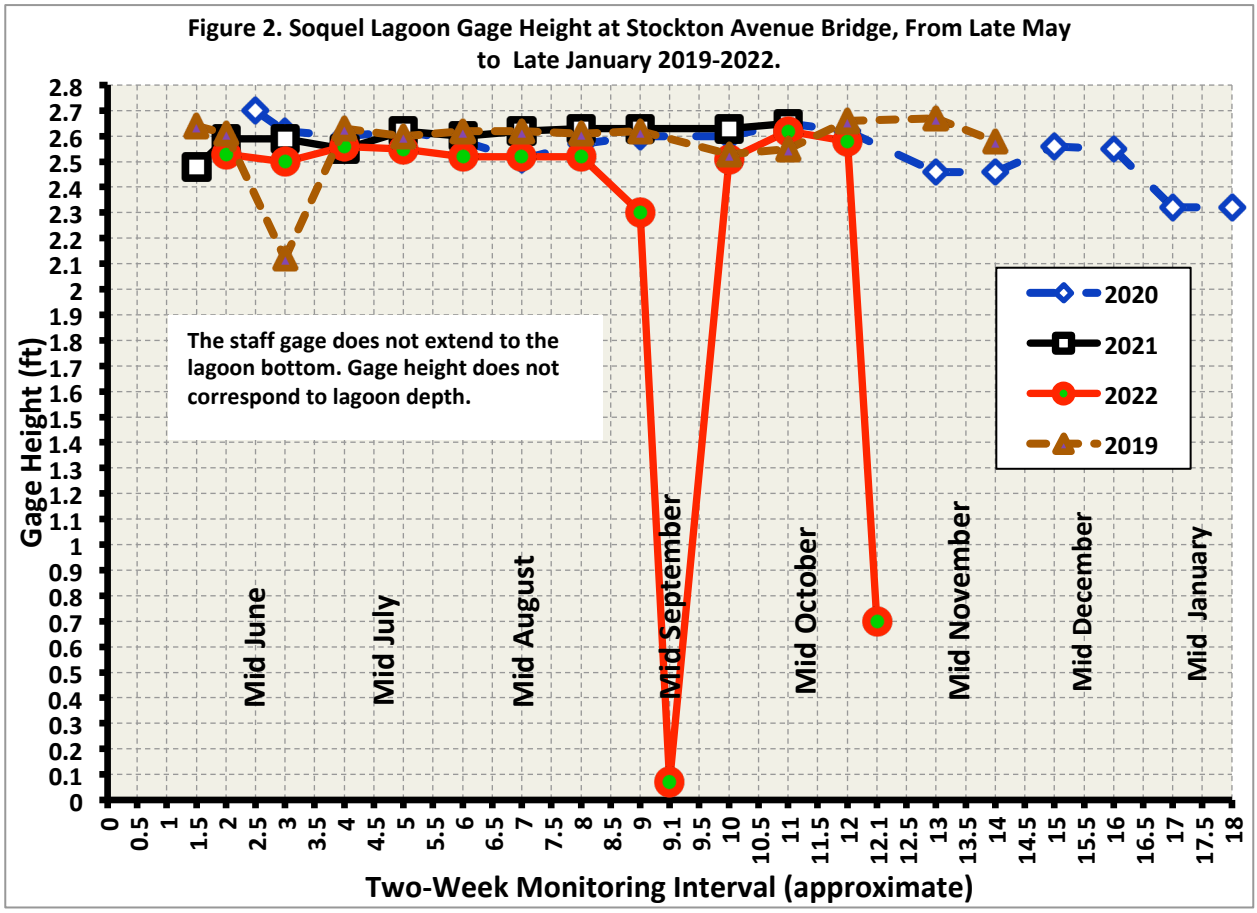


Figure 2. Soquel Lagoon Gage Height at Stockton Avenue Bridge, From Late May to Early December 2019-2022

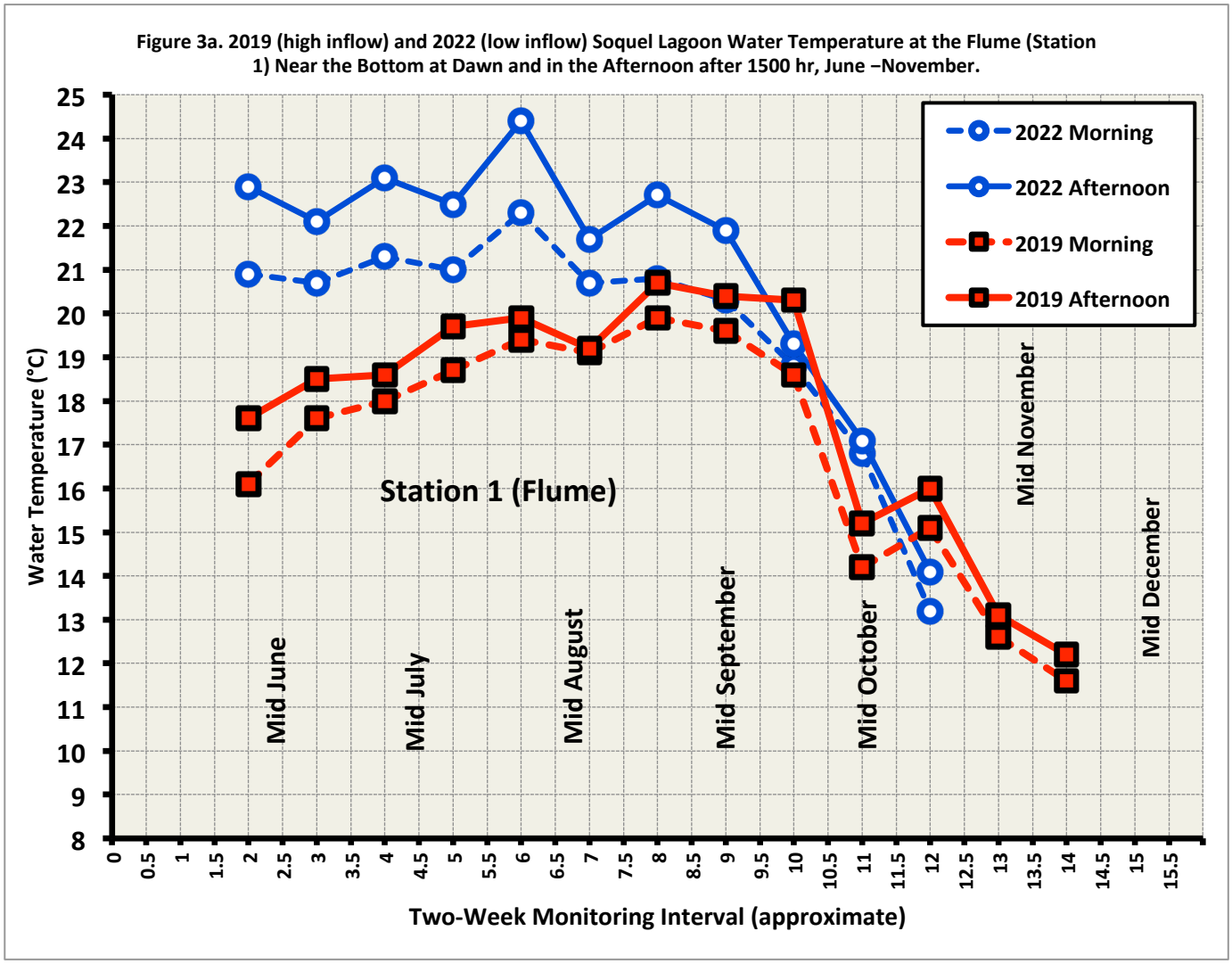


Figure 3a. Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn and in the Afternoon, Comparing 2022 to the higher flow year, 2019, June – October.

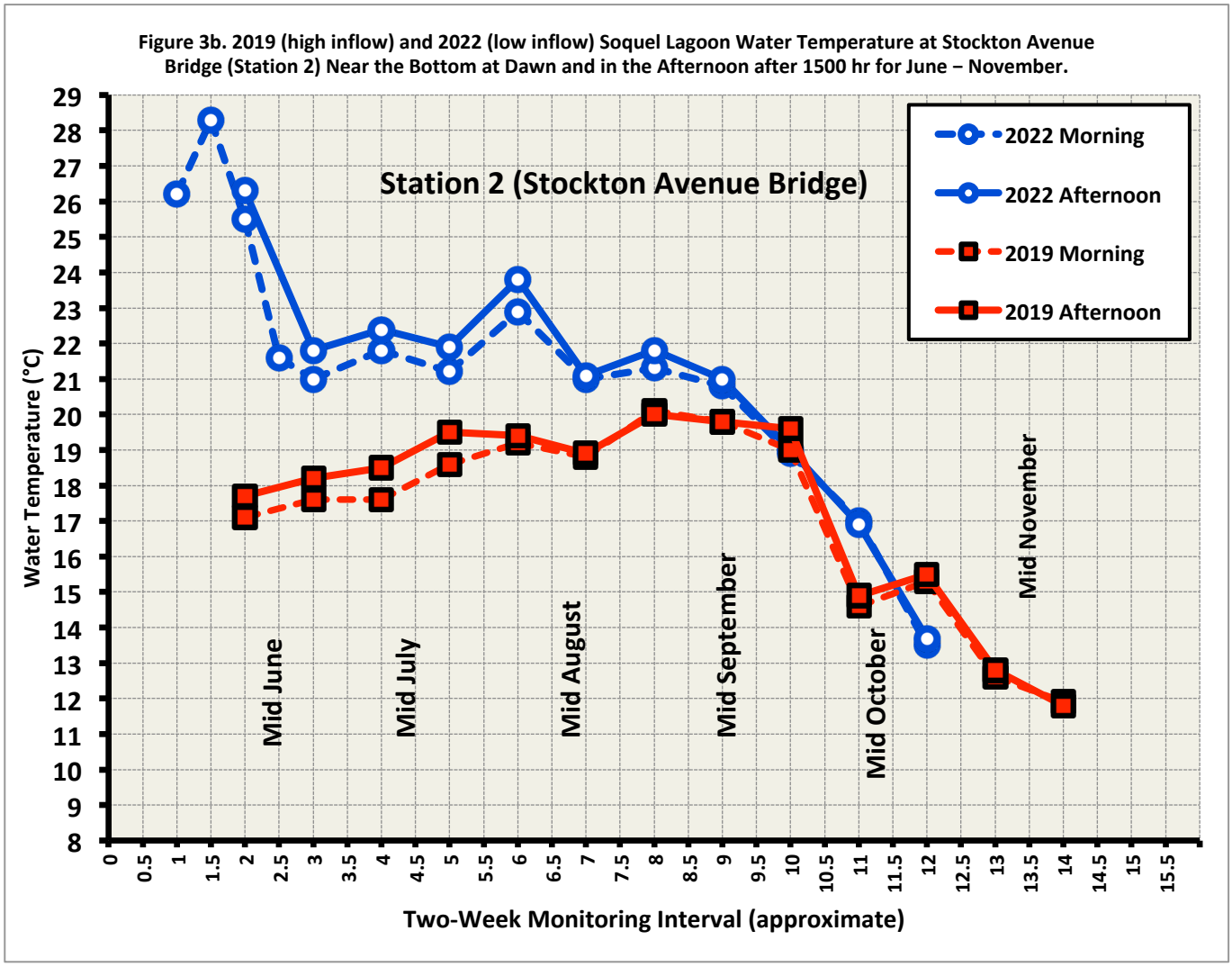


Figure 3b. Soquel Lagoon Water Temperature at Stockton Avenue Bridge (Station 2) Near the Bottom at Dawn and in the Afternoon, Comparing 2022 to the higher flow year, 2019, June – October.

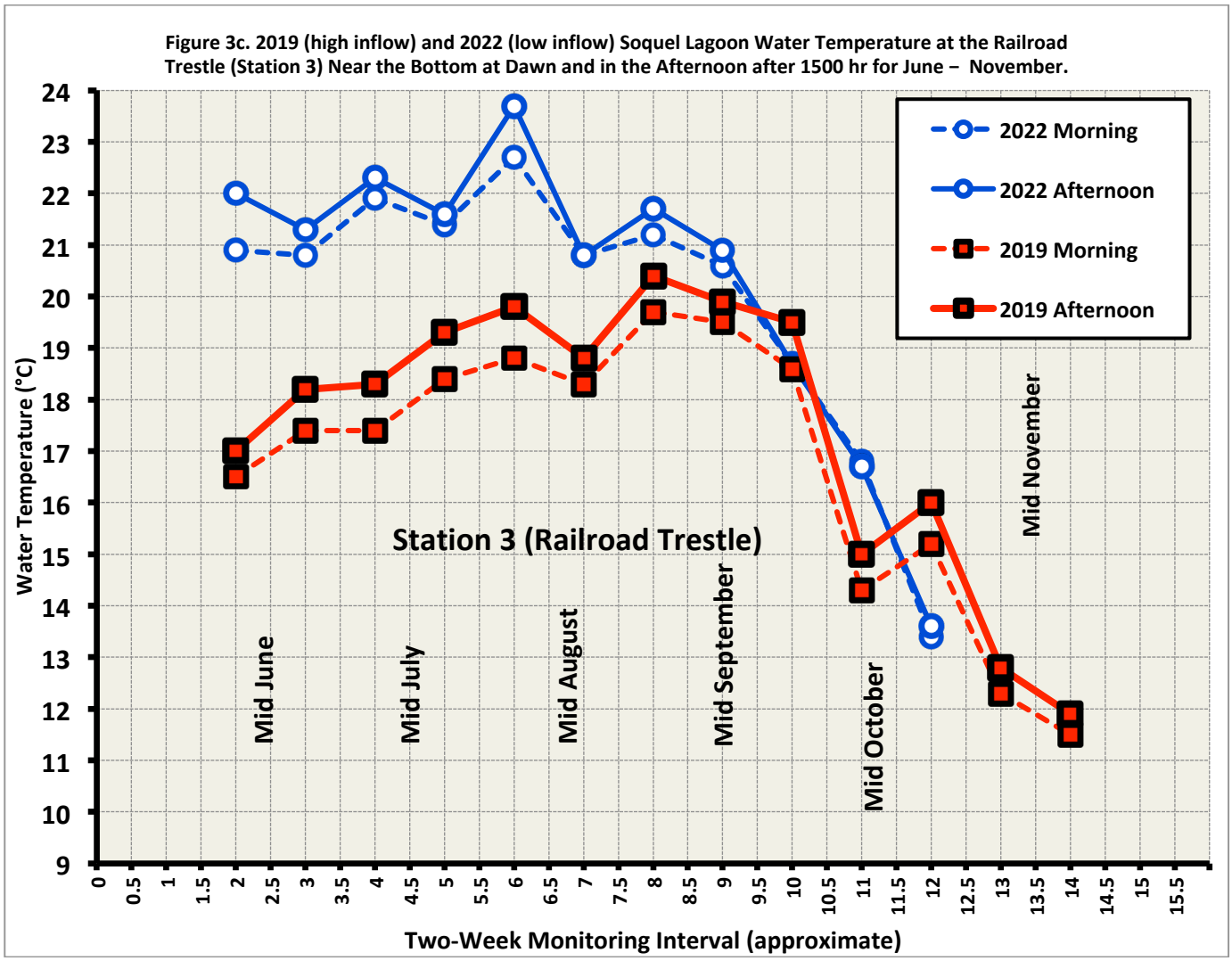


Figure 3c. Soquel Lagoon Water Temperature at the Railroad Trestle (Station 3) Near the Bottom at Dawn and in the Afternoon, Comparing 2022 to a Higher Flow Year, 2019, June – October.

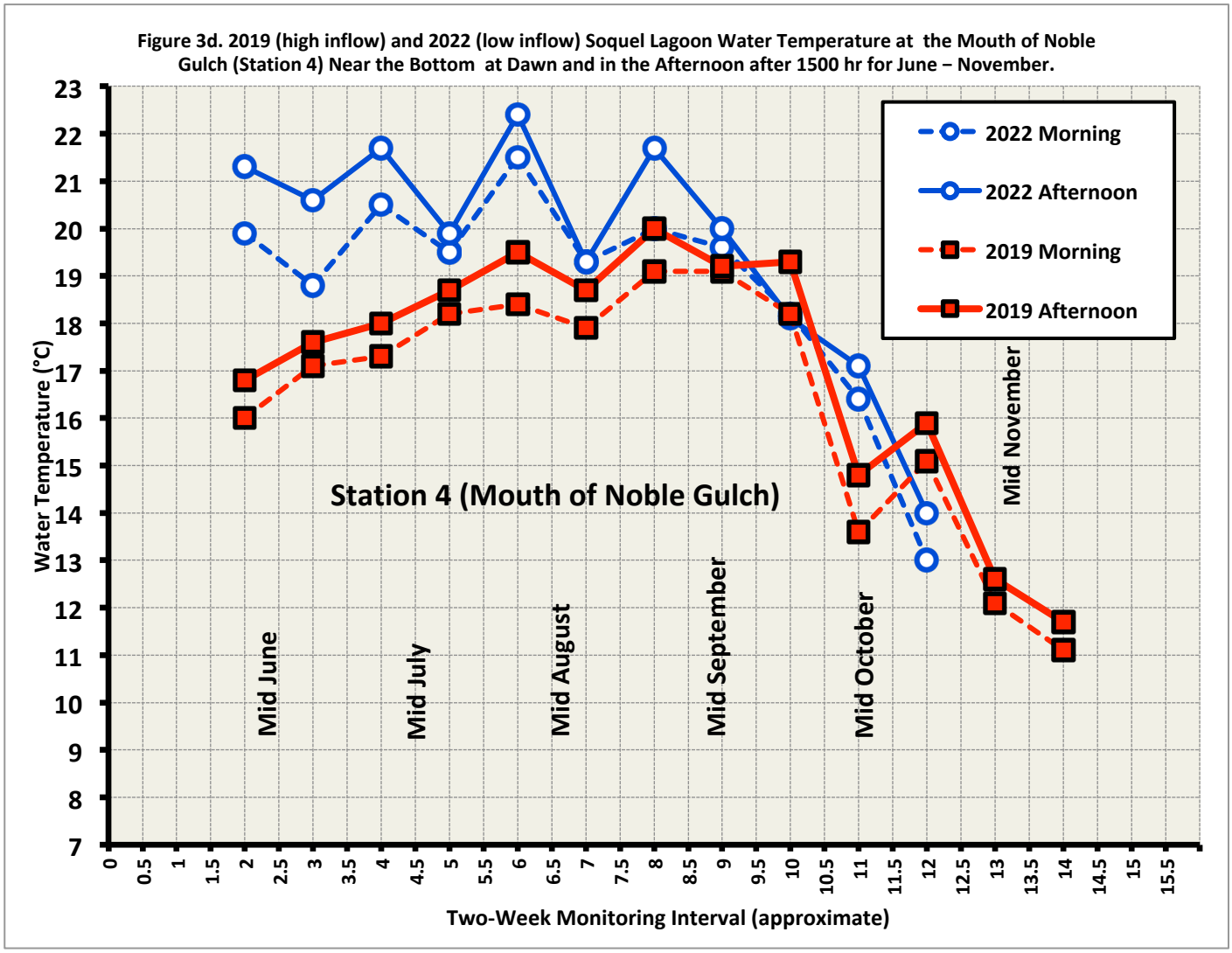


Figure 3d. Soquel Lagoon Water Temperature at the Mouth of Noble Gulch (Station 4) Near the Bottom at Dawn and in the Afternoon, Comparing 2022 to a Higher Flow Year, 2019, June – October.

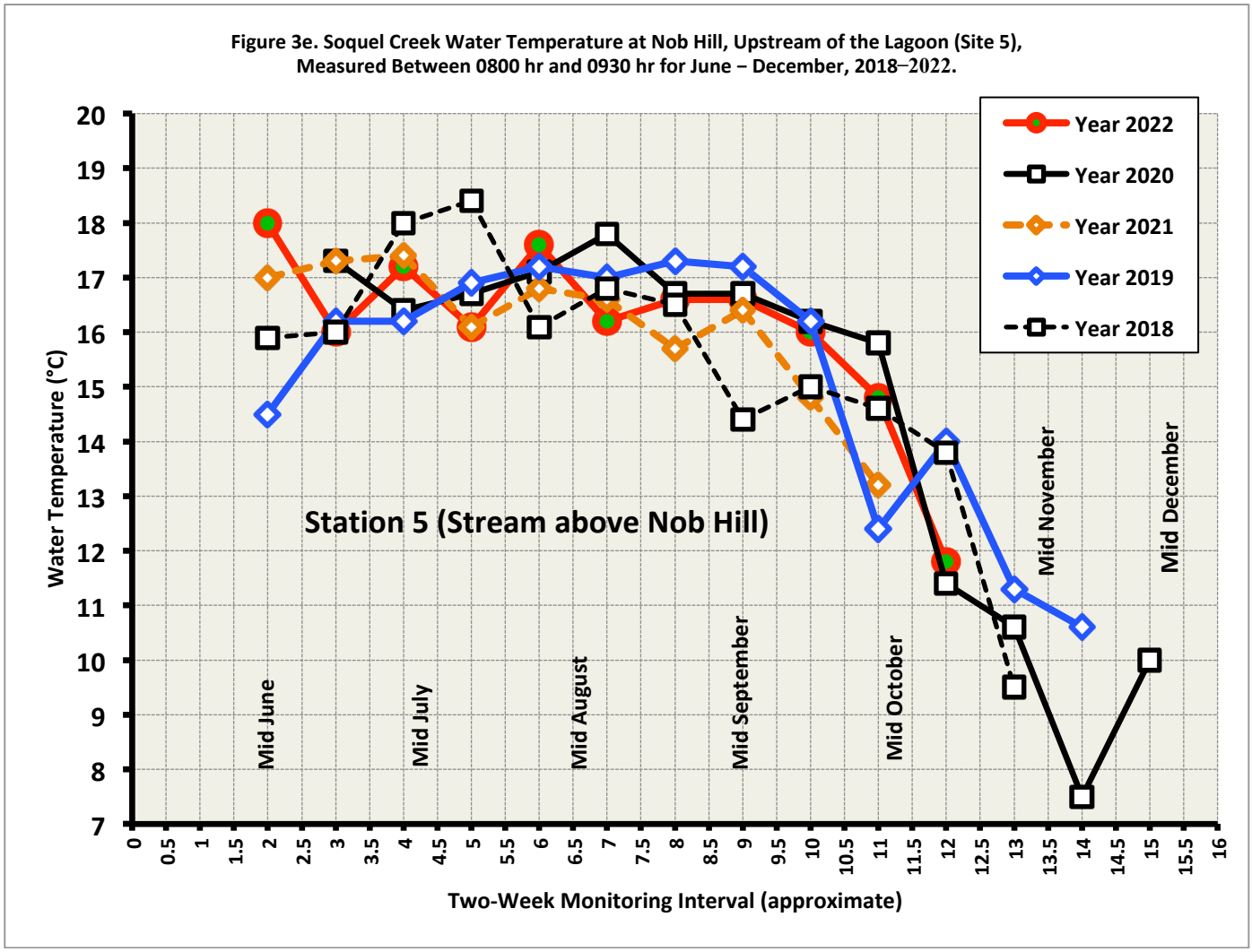


Figure 3e. Soquel Creek Water Temperature at Nob Hill Upstream of the Lagoon, 2018−2022. Measured Between 0800 hr and 0930 hr for June – Mid-December.

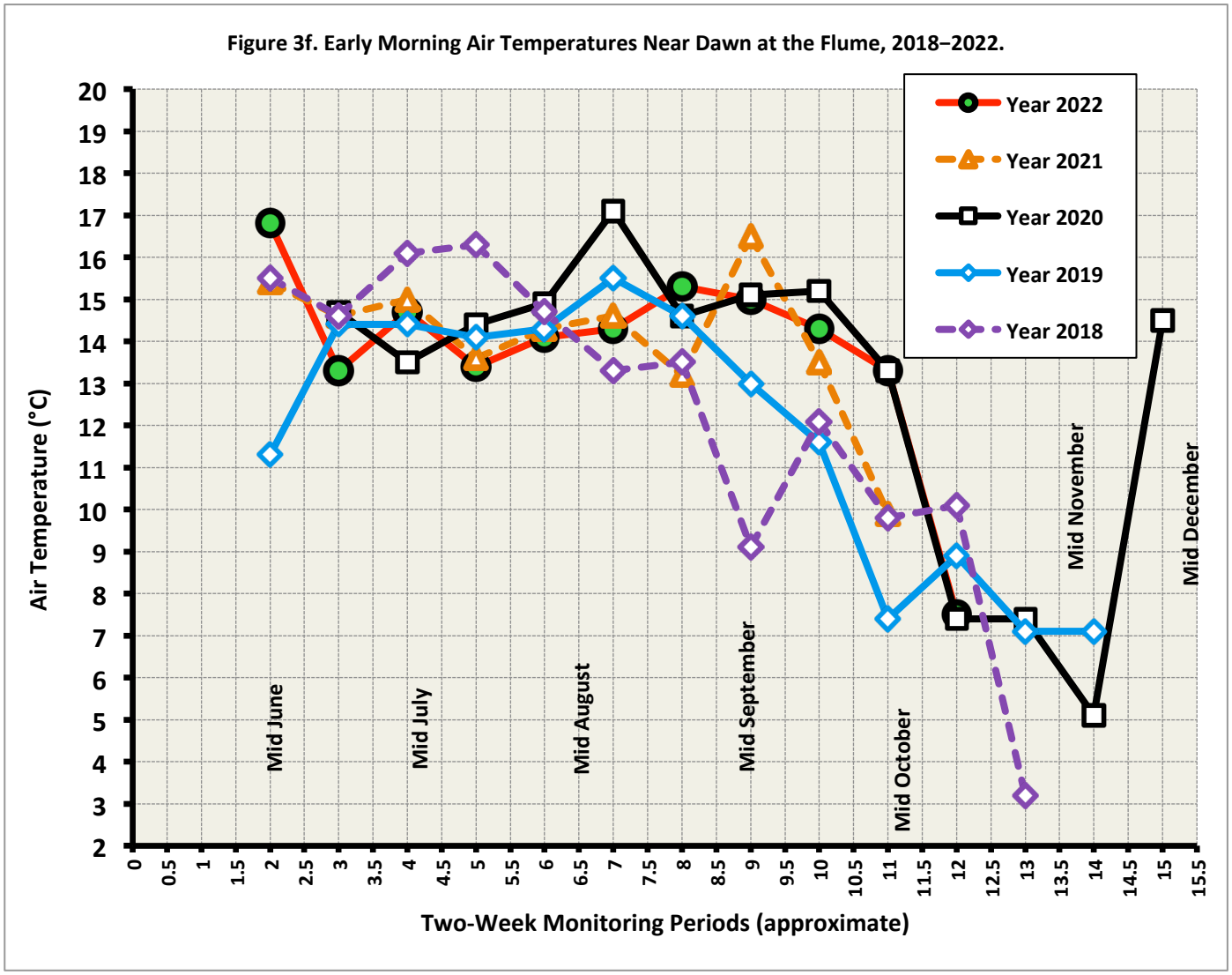


Figure 3f. Early Morning Air Temperatures Near Dawn at the Flume, 2018−2022.

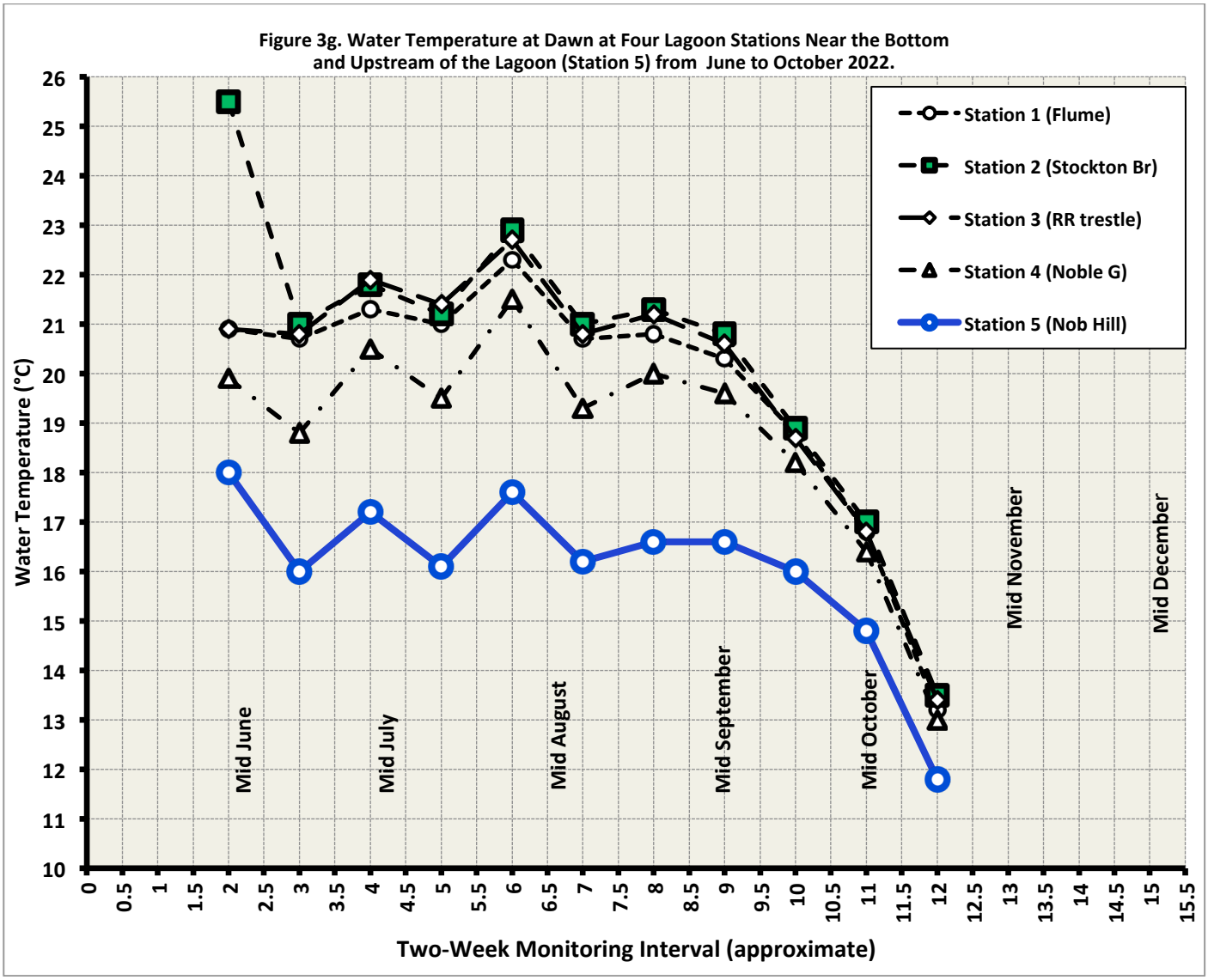


Figure 3g. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream from June to Late October 2022.

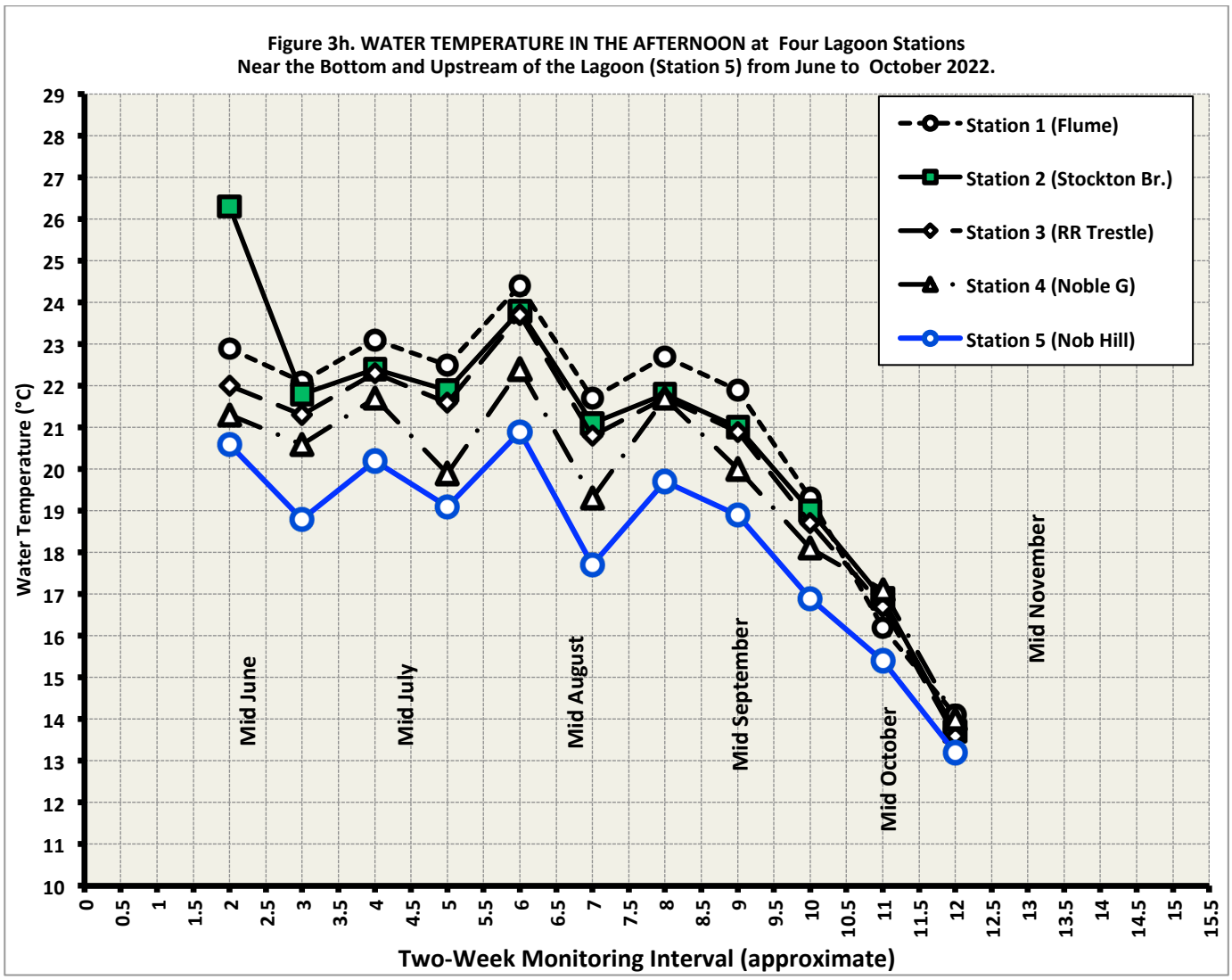


Figure 3h. Water Temperature in the Afternoon at Four Lagoon Stations Near the Bottom and Upstream from June to Late October 2022.

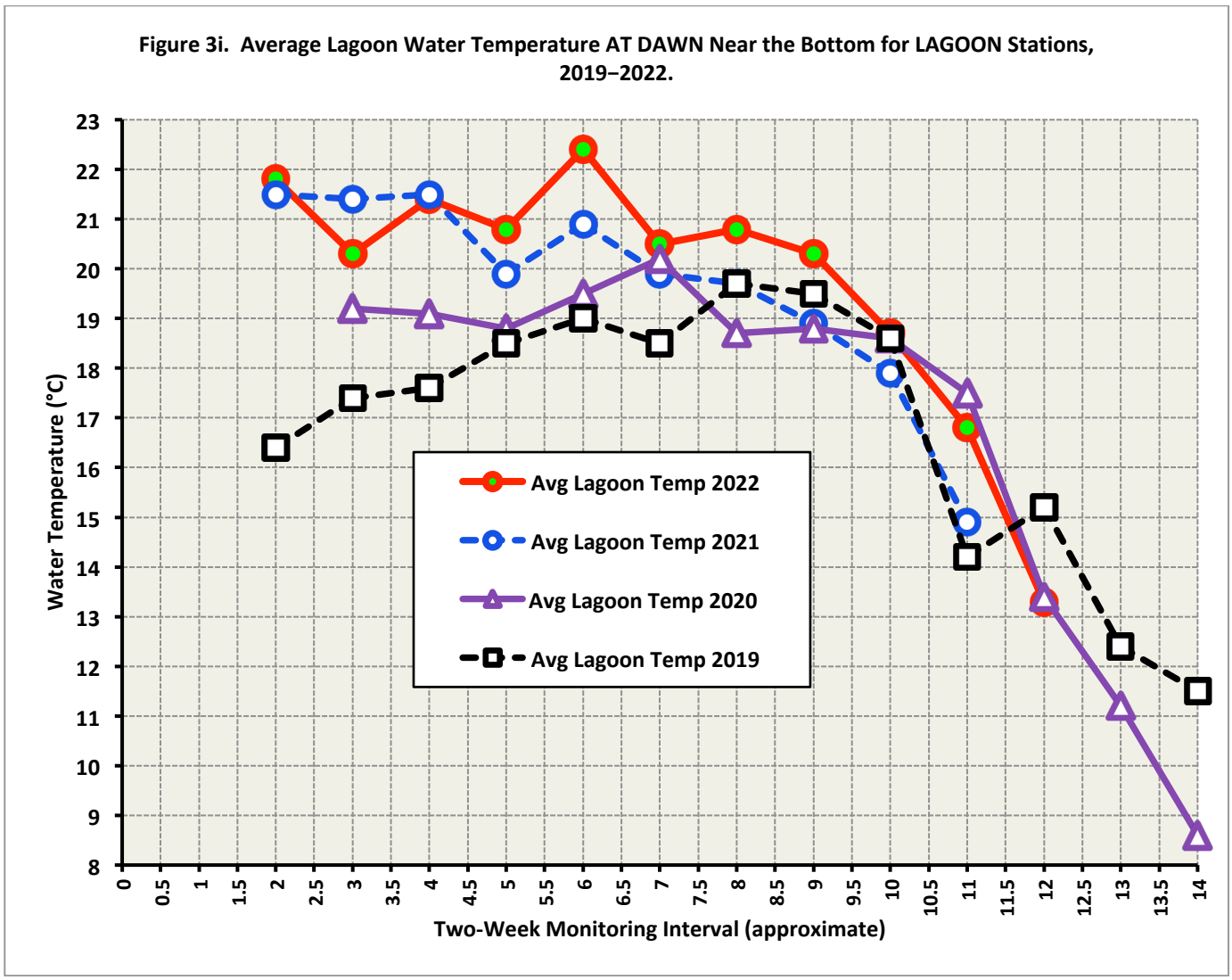


Figure 3i. Average Lagoon Water Temperature at Dawn Near the Bottom for 4 Stations, 2019–2022.

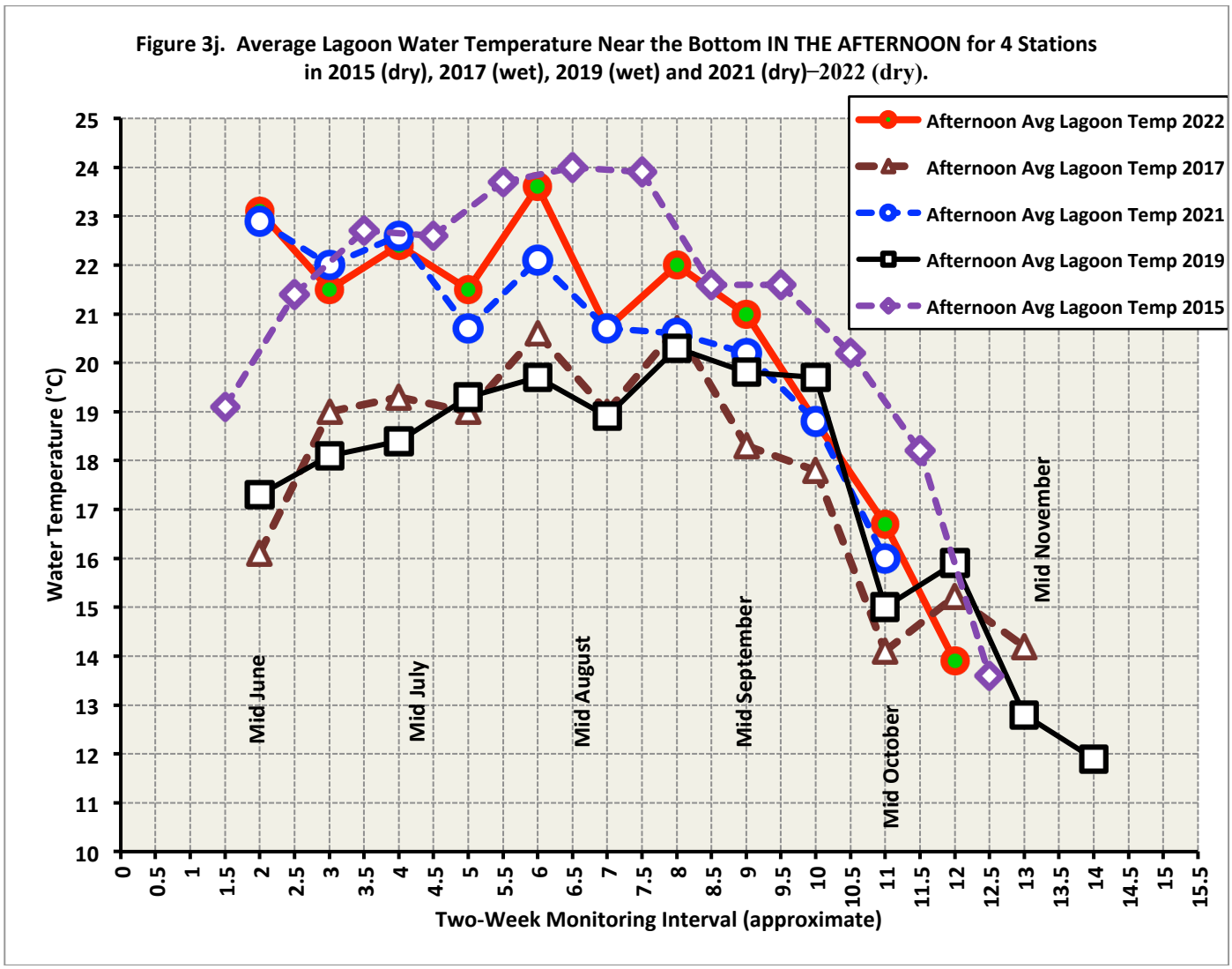


Figure 3j. Average Lagoon Water Temperature Near the Bottom in the Afternoon for 4 Stations, 2015, 2017, 2019 and 2021-2022.

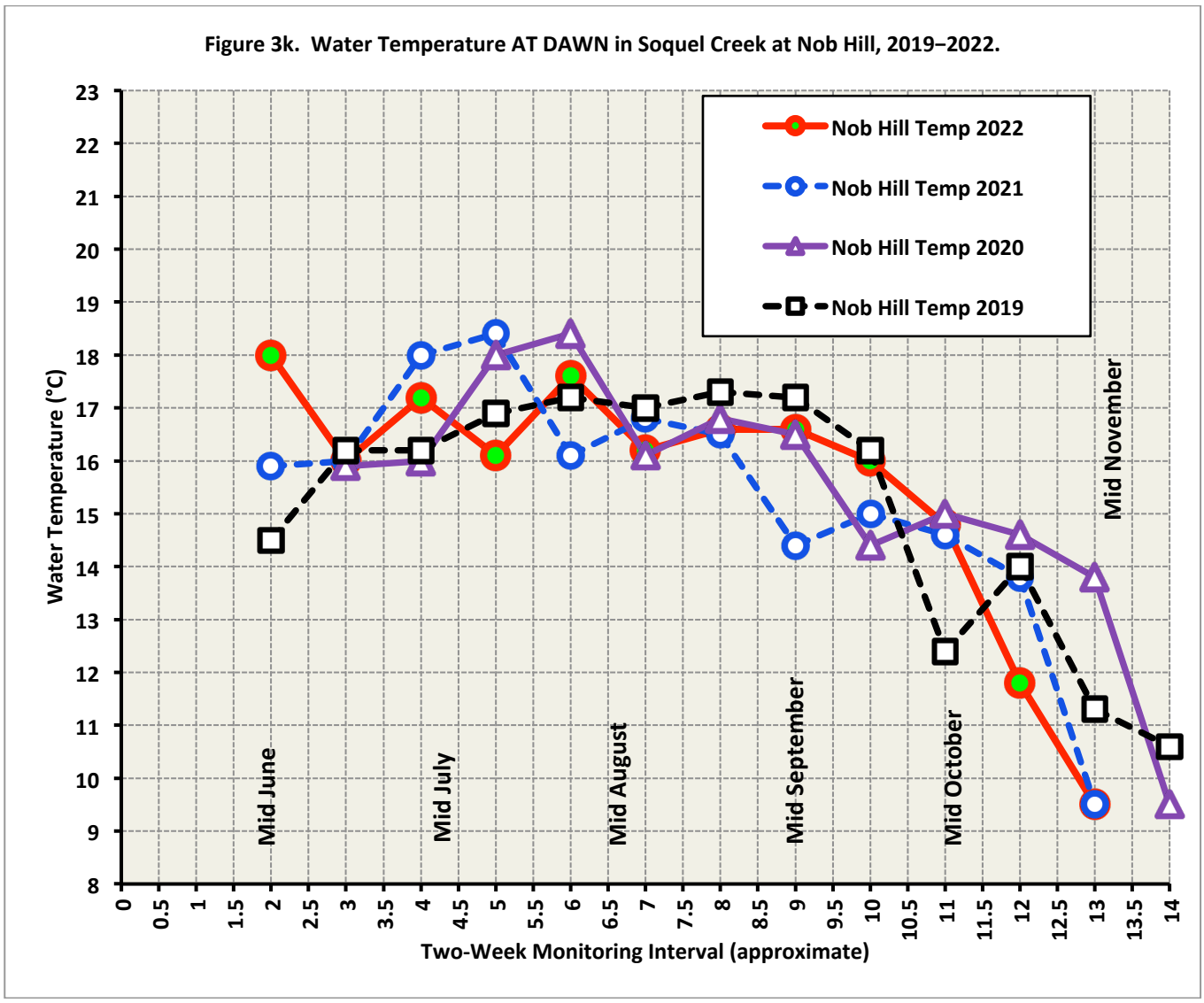


Figure 3k. Water Temperature AT DAWN in Soquel Creek at Nob Hill, 2019−2022.

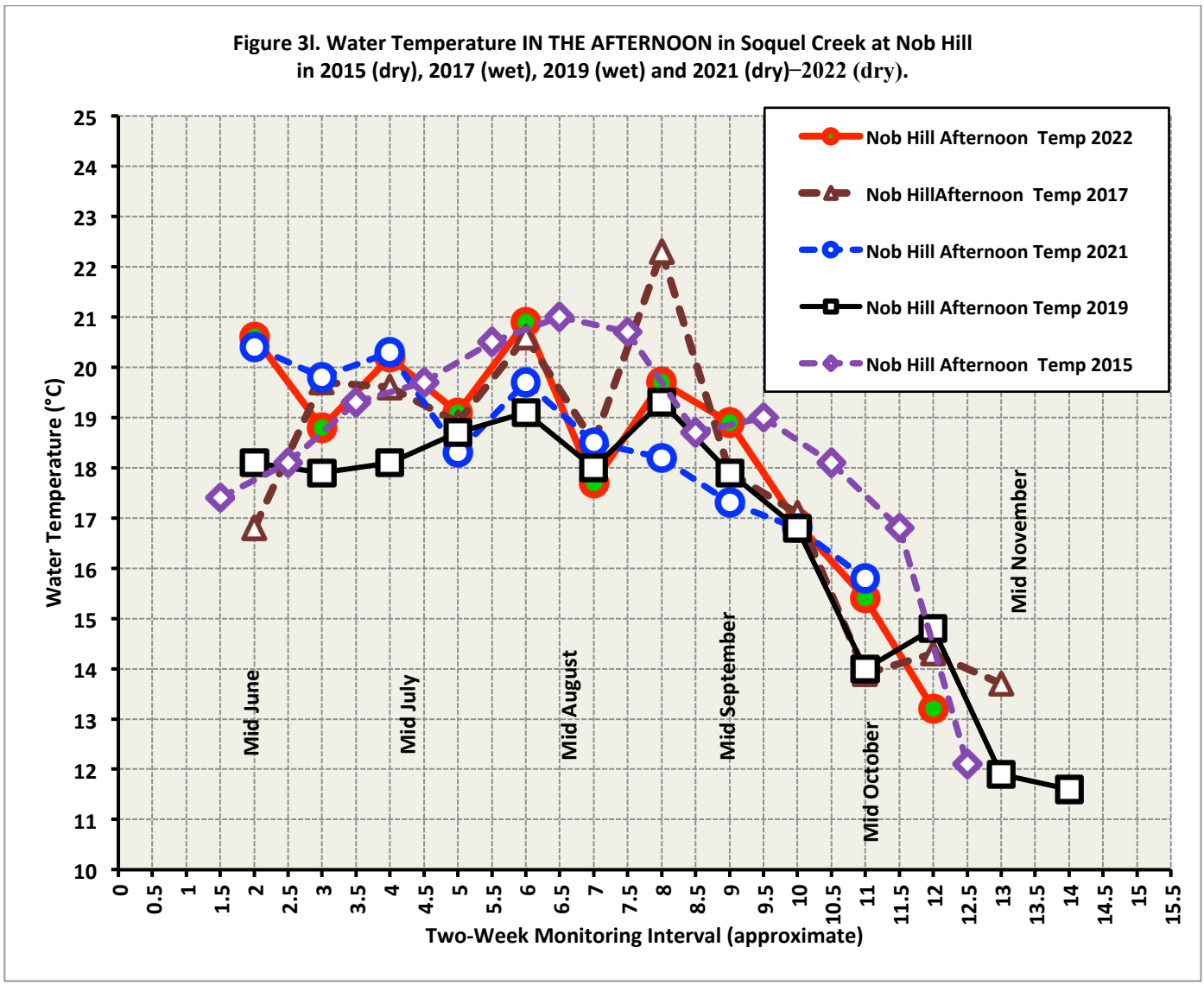


Figure 3l. Water Temperature IN THE AFTERNOON in Soquel Creek at Nob Hill in 2015 (dry), 2017 (wet), 2019 (wet) and 2021 (dry)–2022 (dry).

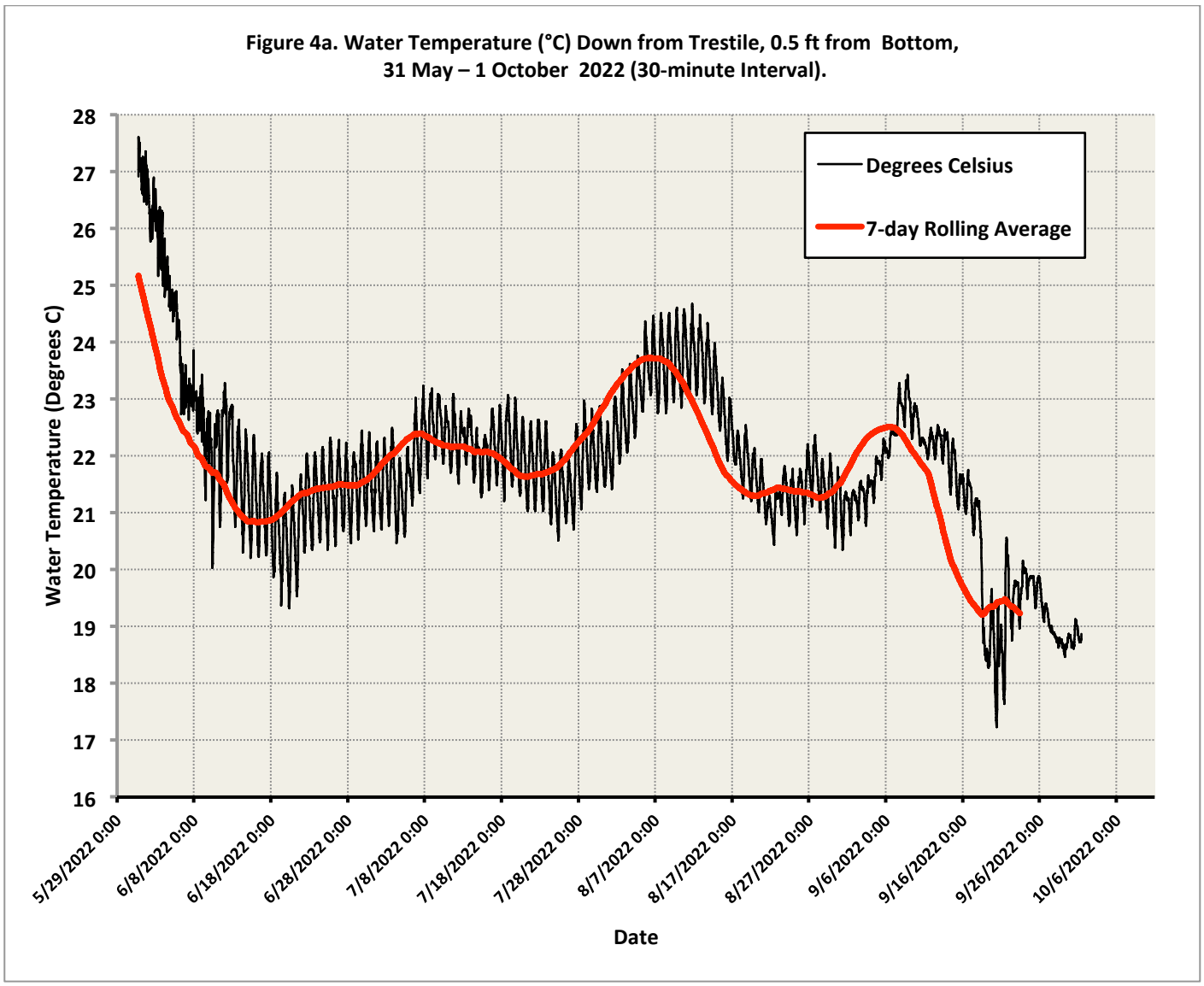


Figure 4a. Water Temperature (°C) Down from Trestile, 0.5 ft from the Bottom, 31 May – 1 October 2022 (30-minute Interval).

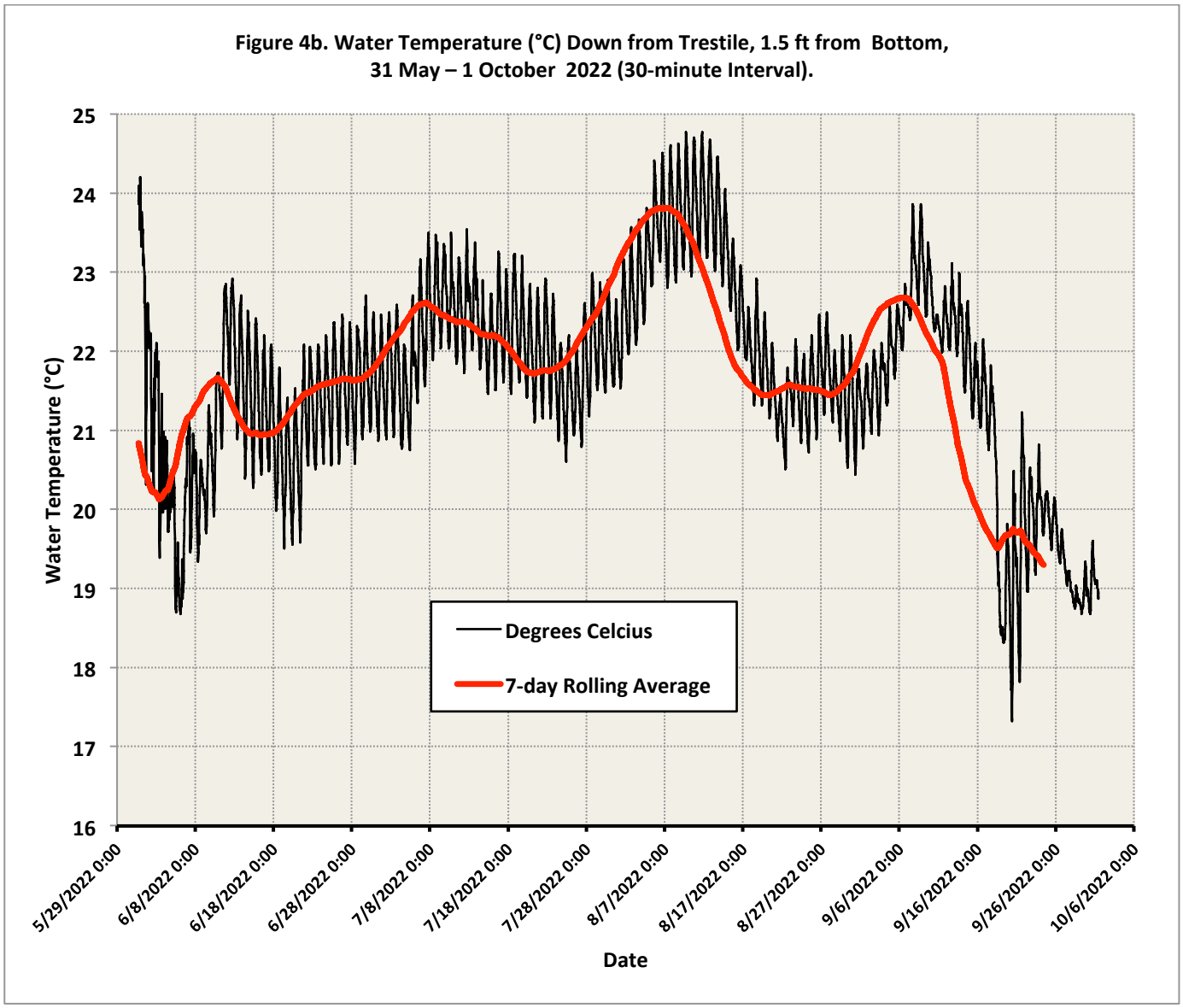


Figure 4b. Water Temperature (°C) Down from Trestle, 1.5 ft from the Bottom, 31 May – 1 October 2022 (30-minute Interval).

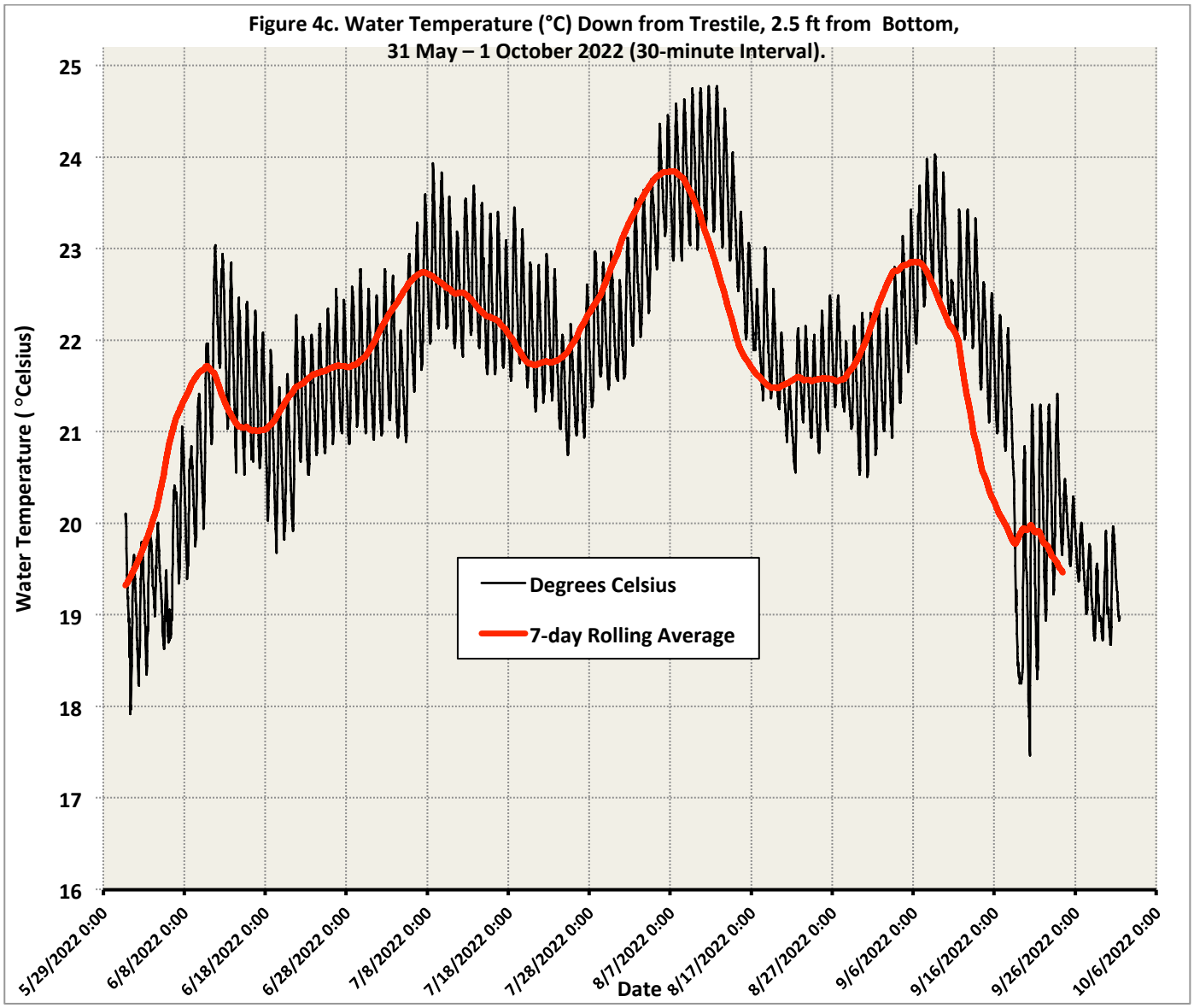


Figure 4c. Water Temperature (°C) Down from Trestle, 2.5 ft from the Bottom, 31 May – 1 October 2022 (30-minute Interval).

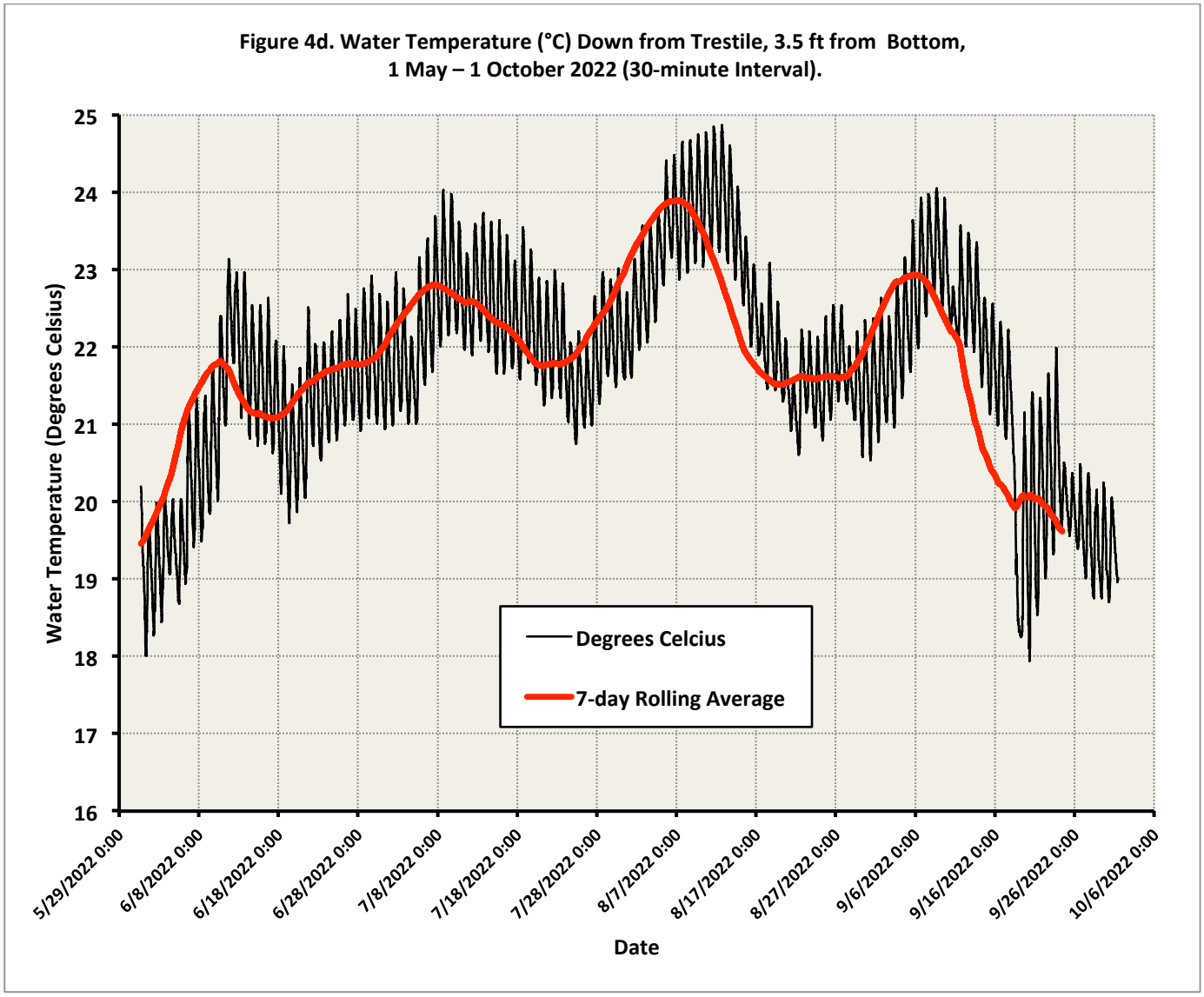


Figure 4d. Water Temperature (°C) Down from Trestle, 3.5 ft from the Bottom, 31 May – 1 October 2022 (30-minute Interval).

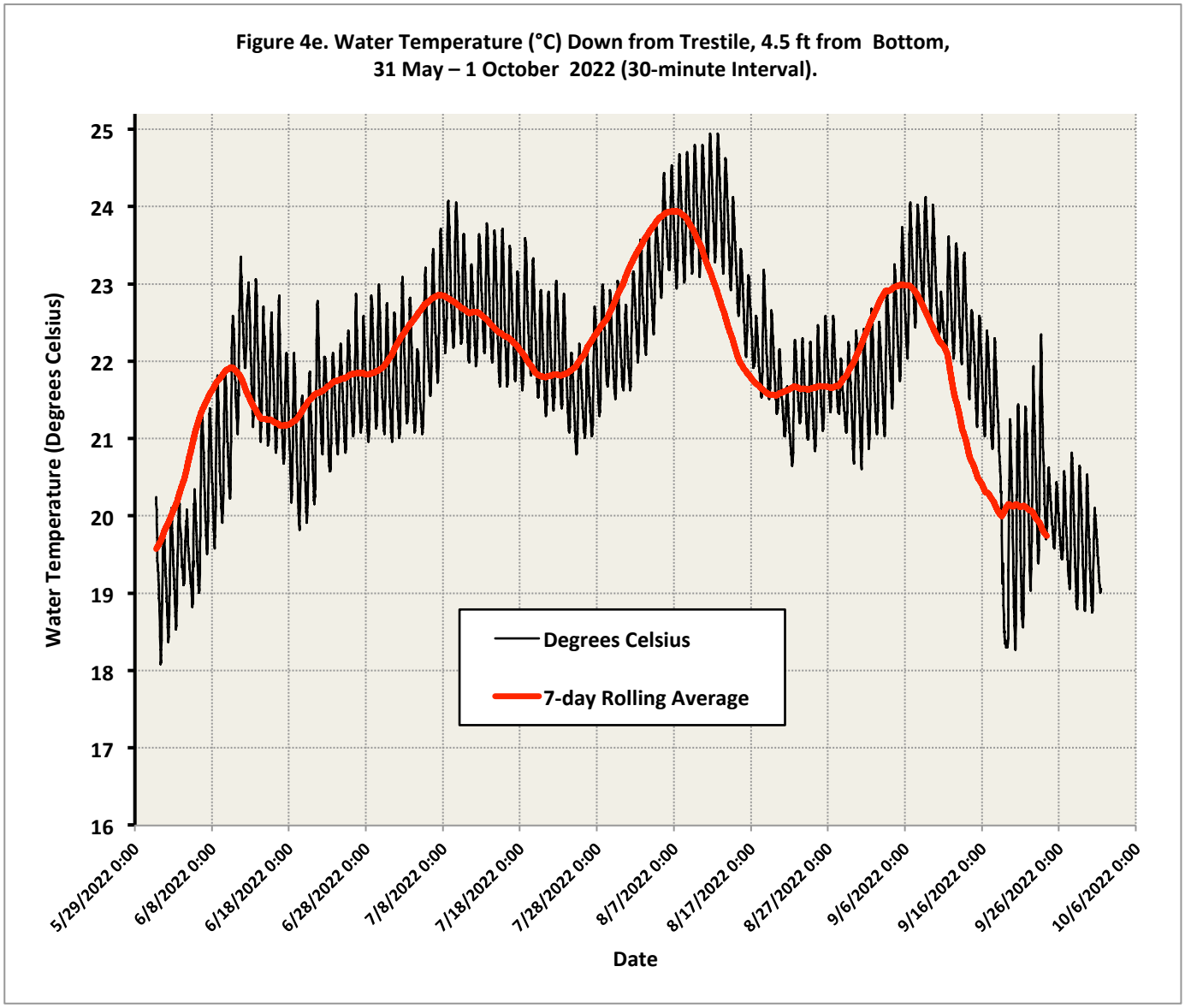


Figure 4e. Water Temperature (°C) Down from Trestle, 4.5 ft from the Bottom, 31 May – 1 October 2022 (30-minute Interval).

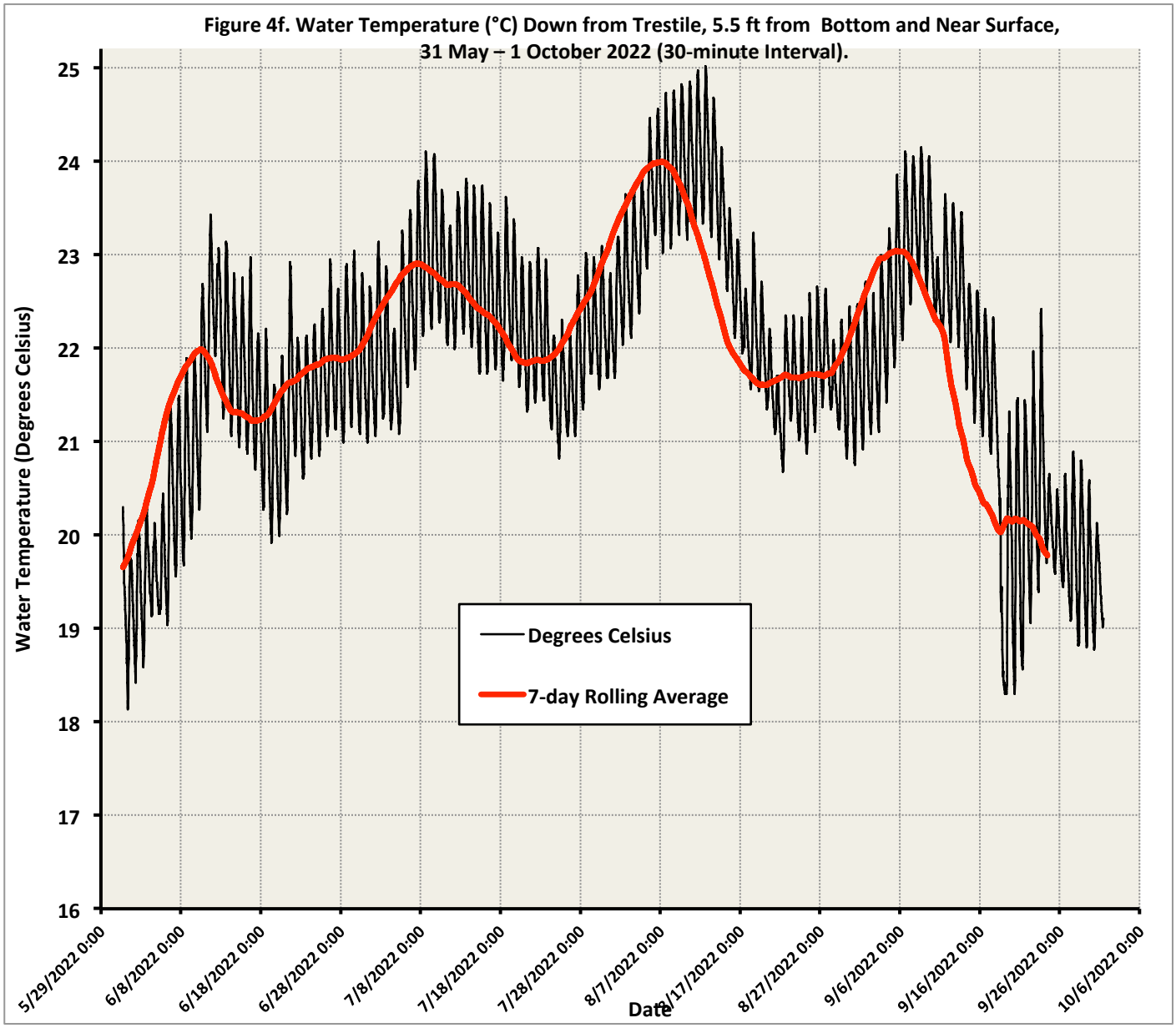


Figure 4f. Water Temperature (°C) Down from Trestle, 5.5 ft from the Bottom, 31 May – 1 October 2022 (30-minute Interval).

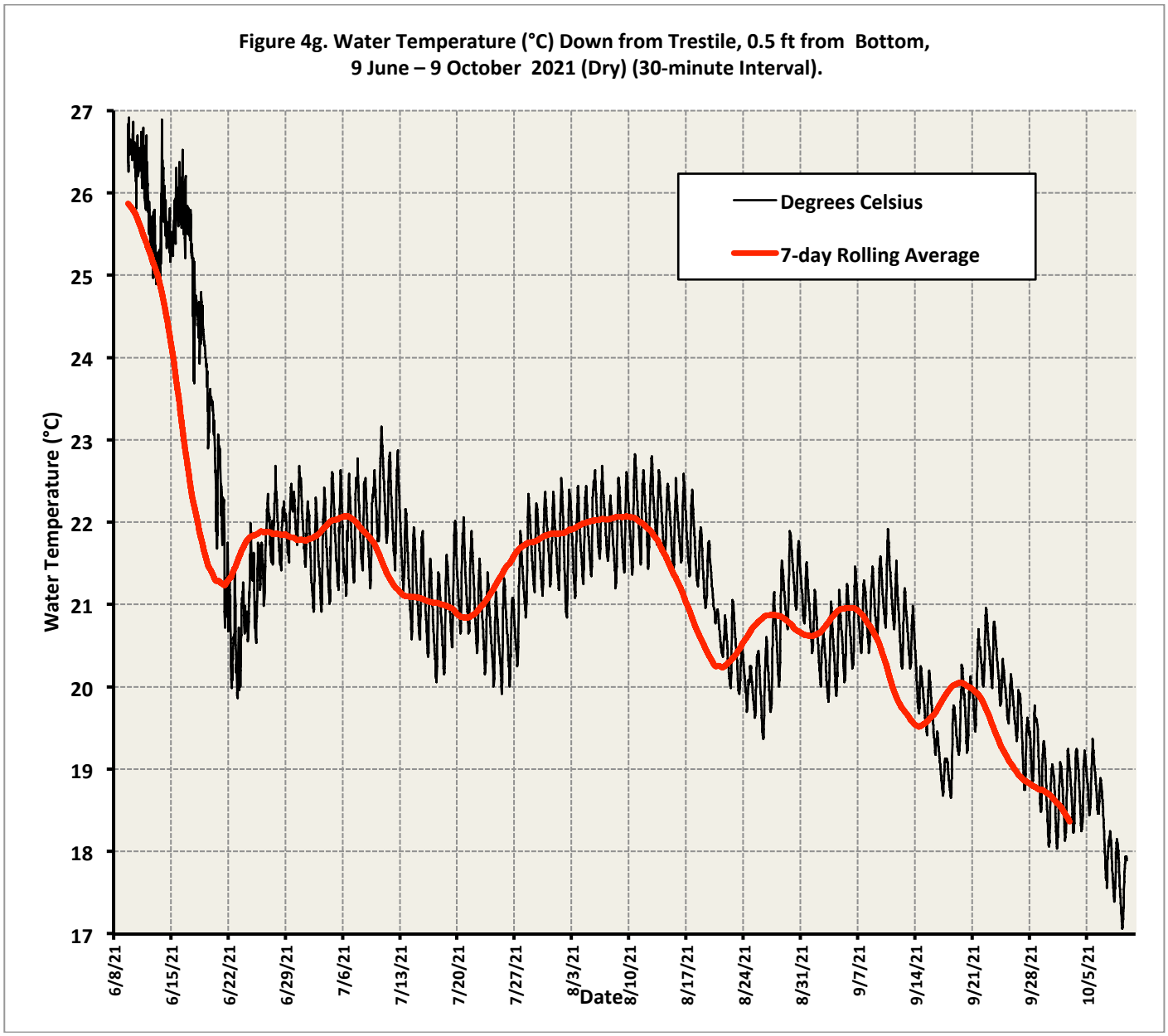


Figure 4g. Water Temperature (°C) Down from Trestle, 0.5 ft from the Bottom, 9 June – 9 October 2021 (30-minute Interval).

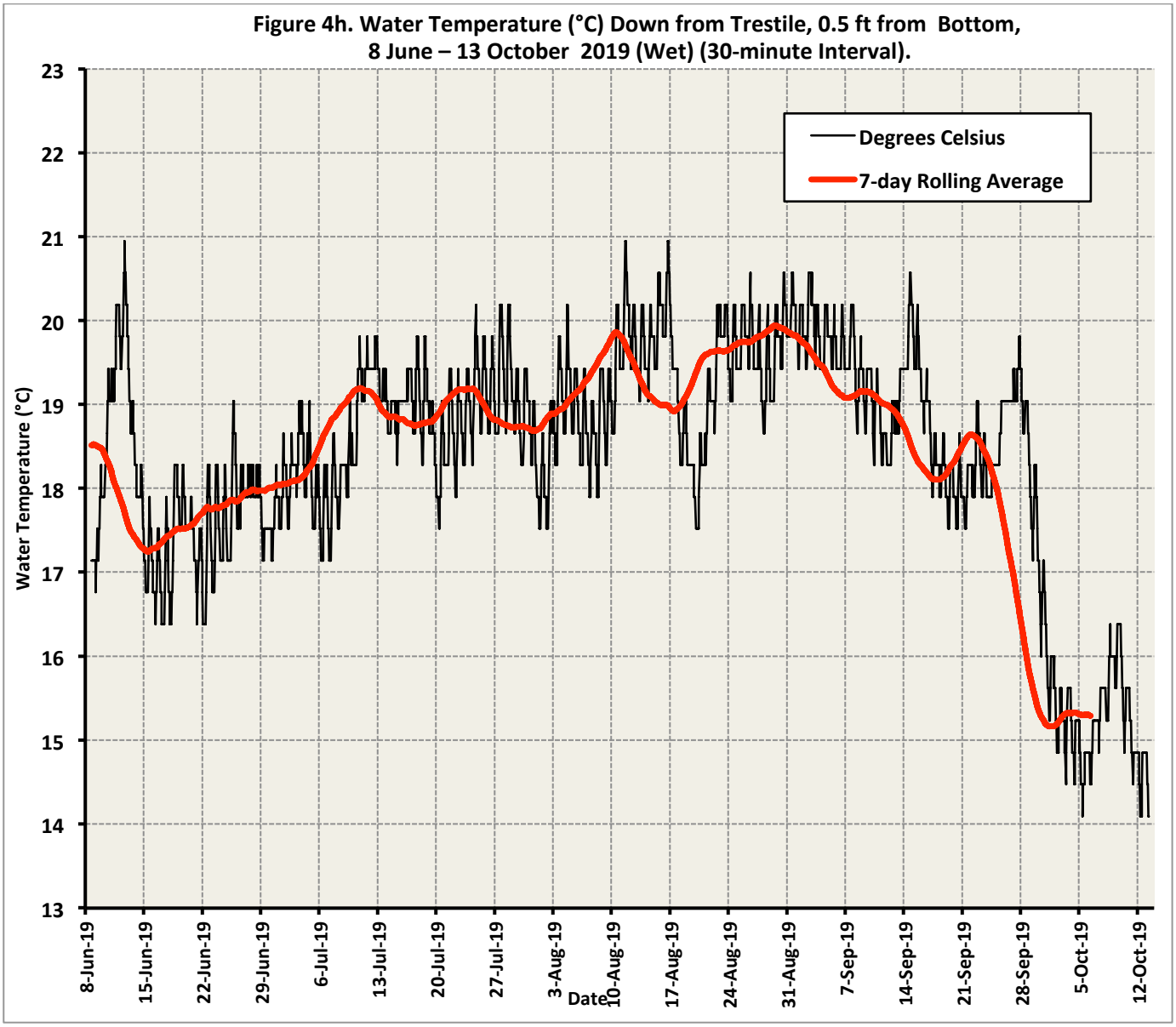


Figure 4h. Water Temperature (°C) Down from Trestle, 0.5 ft from the Bottom, 8 June – 13 October 2019 (30-minute Interval).

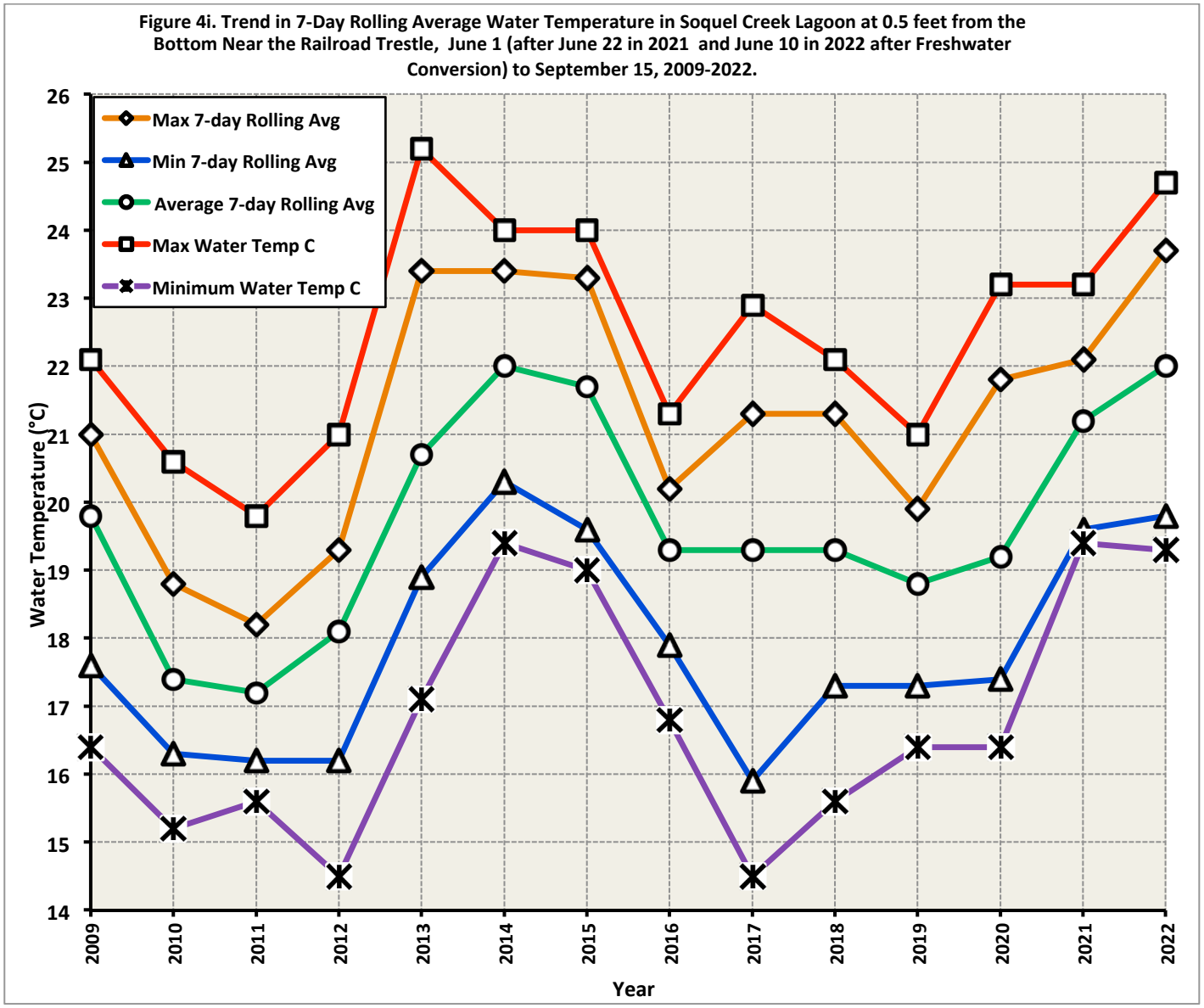


Figure 4i. Trend in 7-day Rolling Average Water Temperature in Soquel Creek Lagoon at 0.5 ft from the Bottom in Reach 2, Near the Railroad Trestle, 2009–2022.

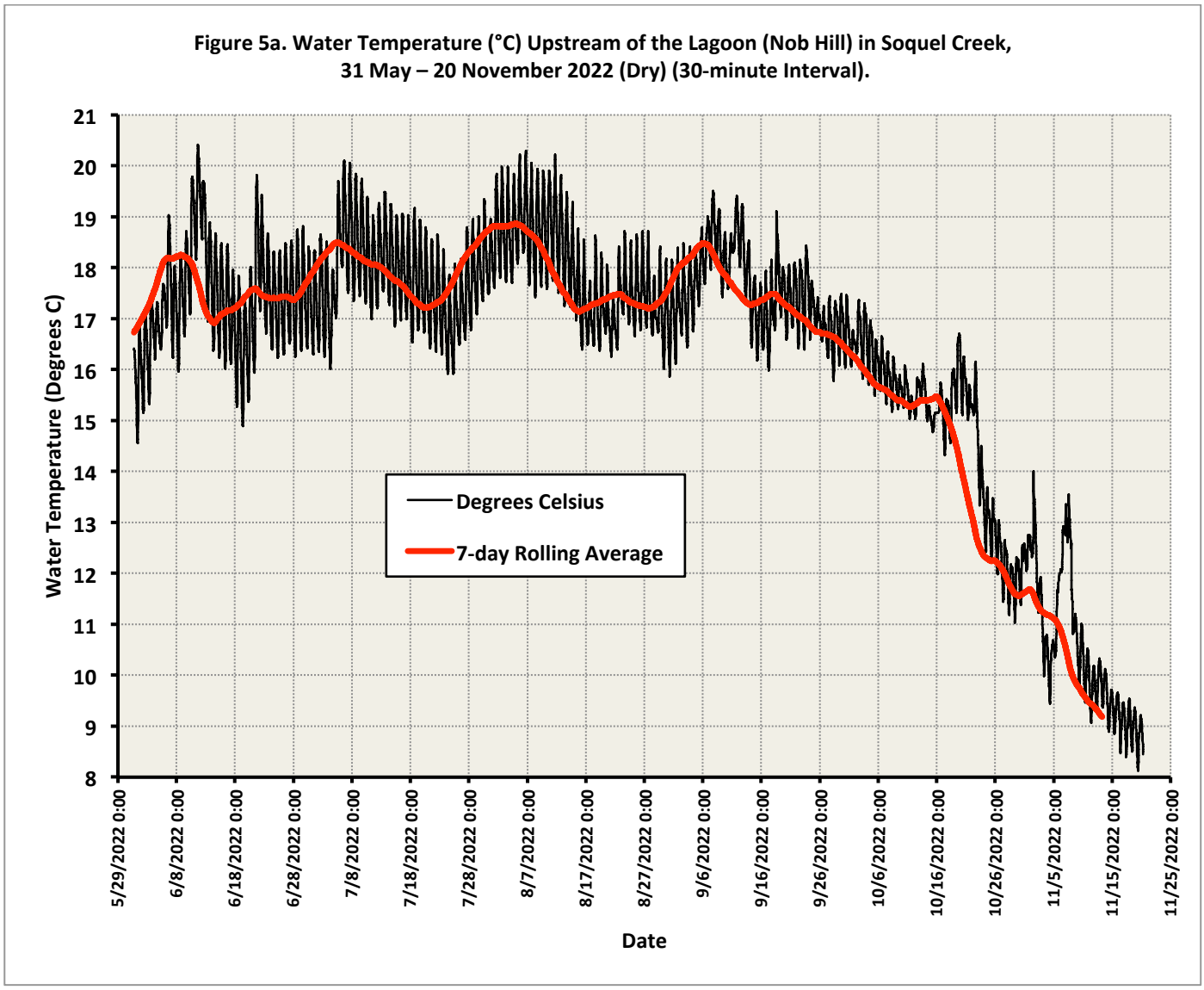


Figure 5a. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 31 May – 20 November 2022 (30-minute Interval).

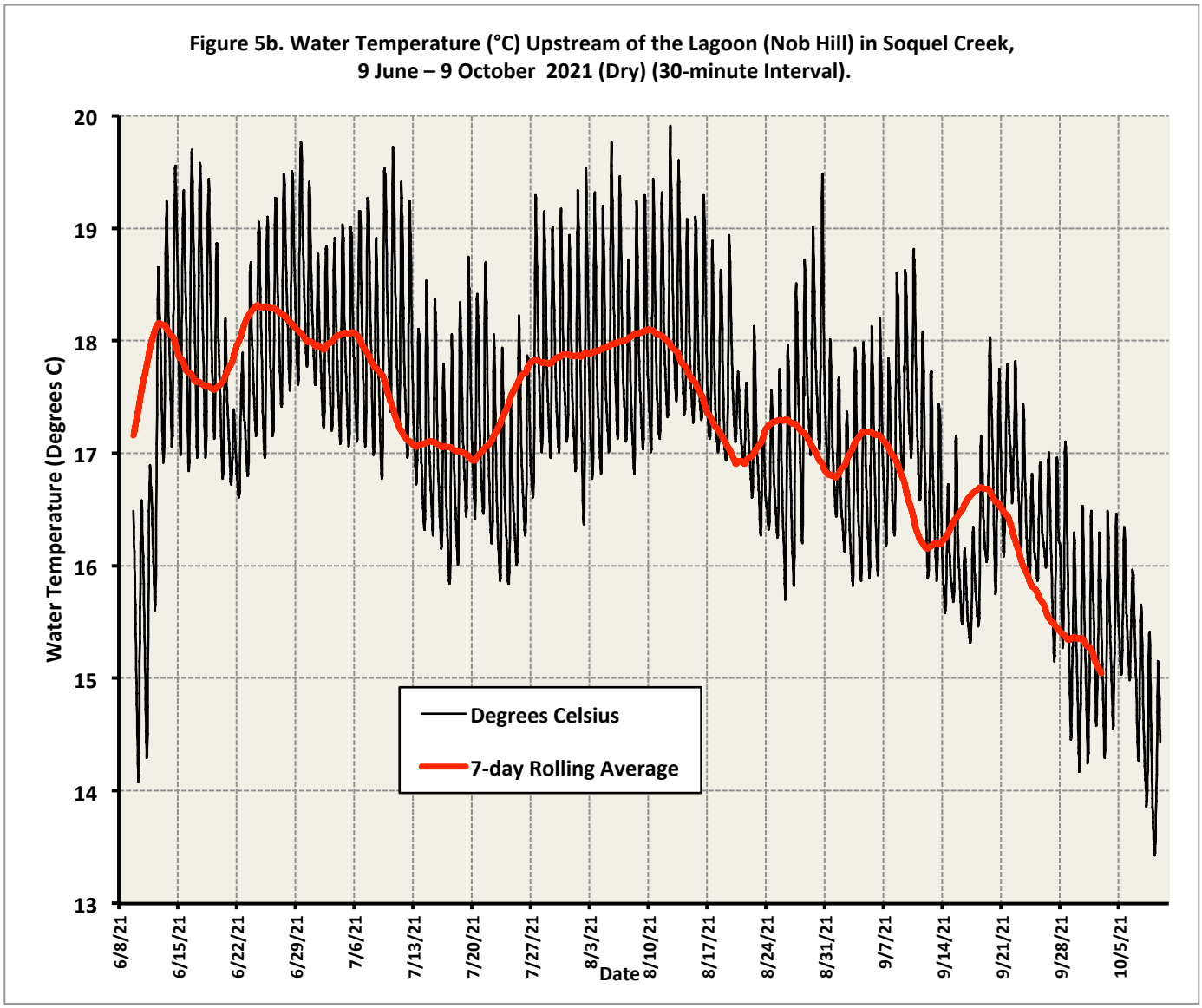


Figure 5b. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 9 June – 9 October 2021 (30-minute Interval).

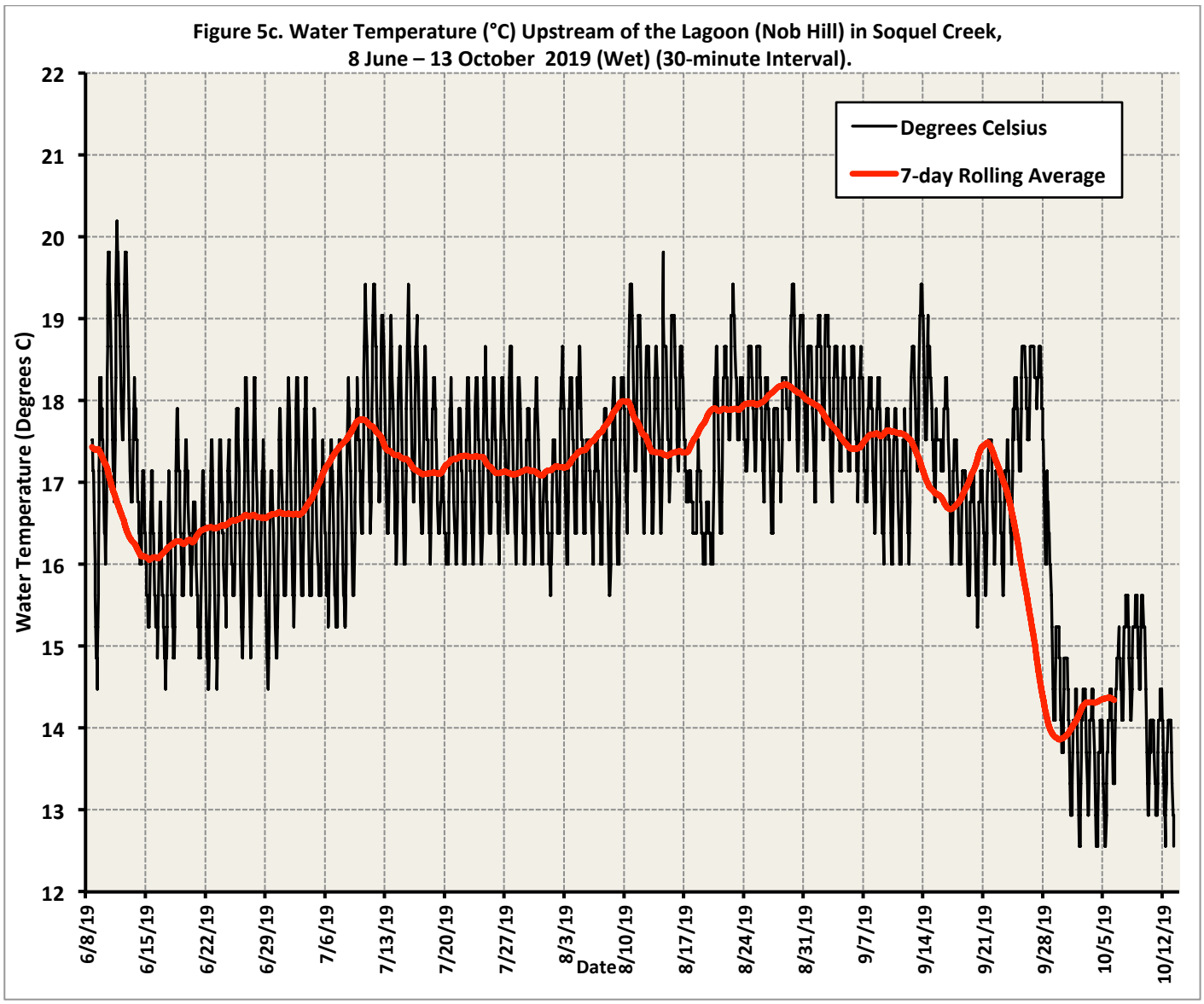


Figure 5c. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 8 June – 13 October 2019 (30-minute Interval).

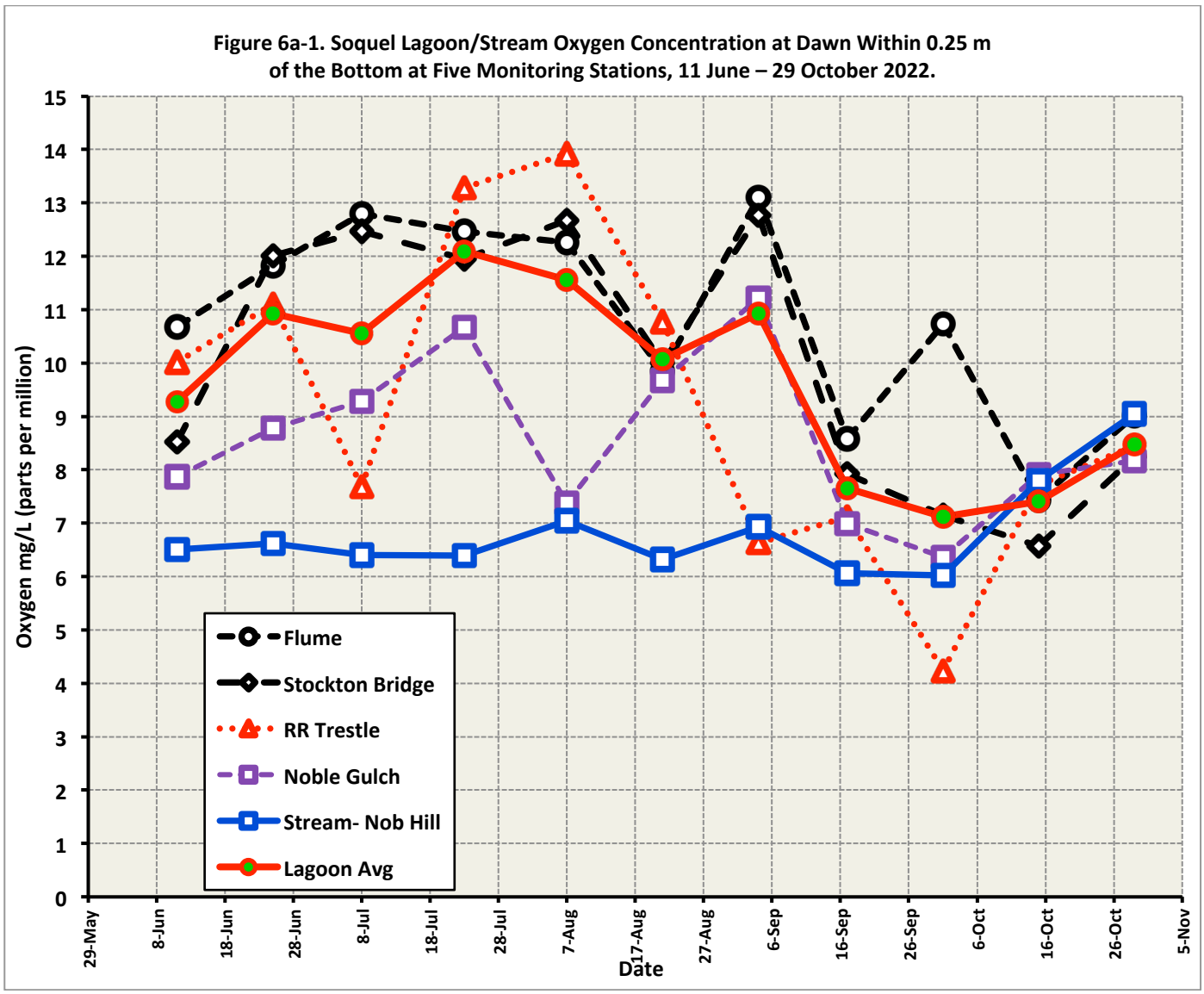


Figure 6a-1. Soquel Lagoon/Stream Oxygen Concentration at Dawn Within 0.25m of the Bottom at Five Monitoring Stations, 11 June – 29 October 2022.

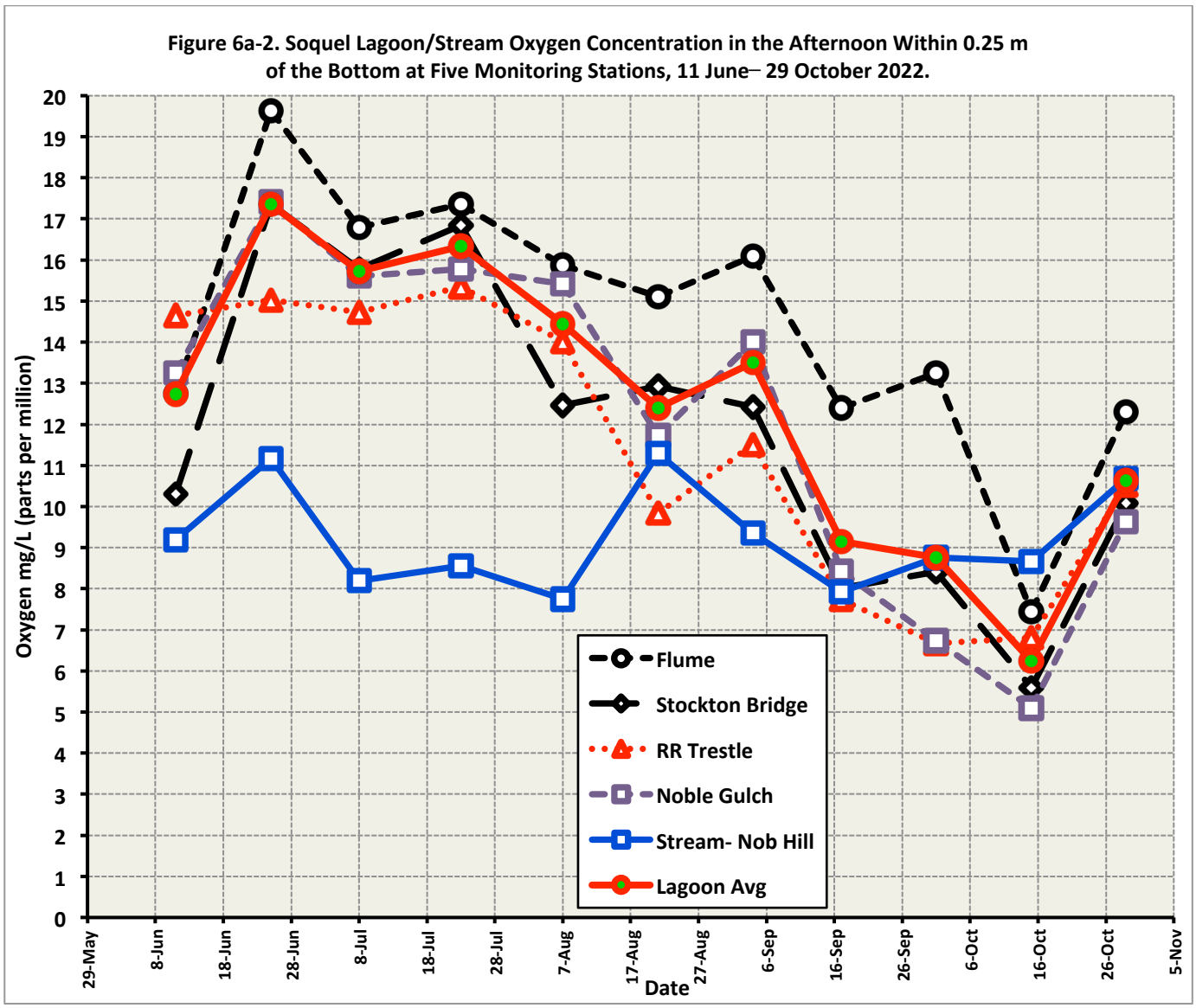


Figure 6a-2. Soquel Lagoon/Stream Oxygen Concentration in the Afternoon Within 0.25m of the Bottom at Five Monitoring Stations, 11 June – 29 October 2022.

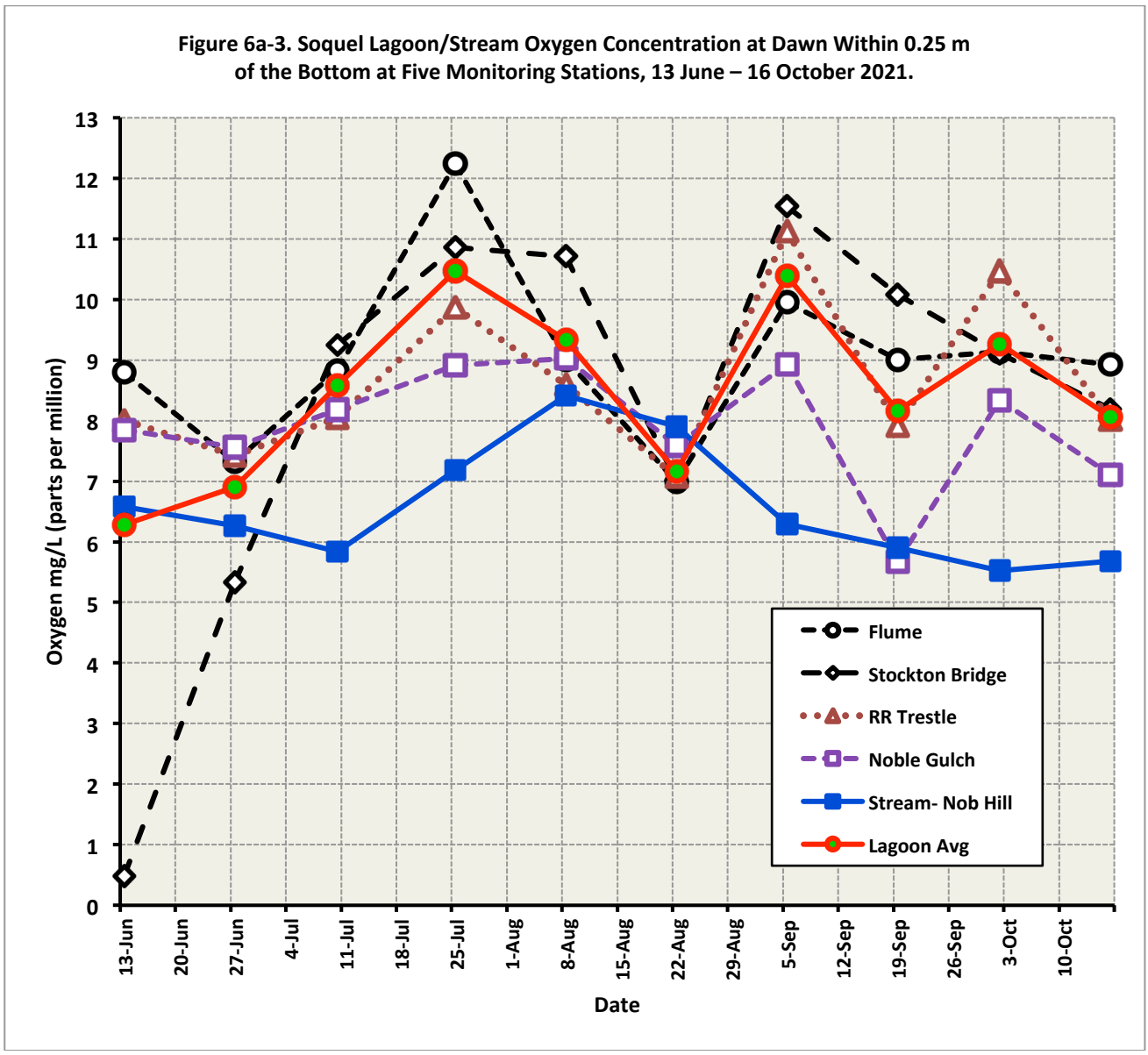


Figure 6a-3. Soquel Lagoon/Stream Oxygen Concentration at Dawn Within 0.25m of the Bottom at Five Monitoring Stations, 13 June – 16 October 2021.

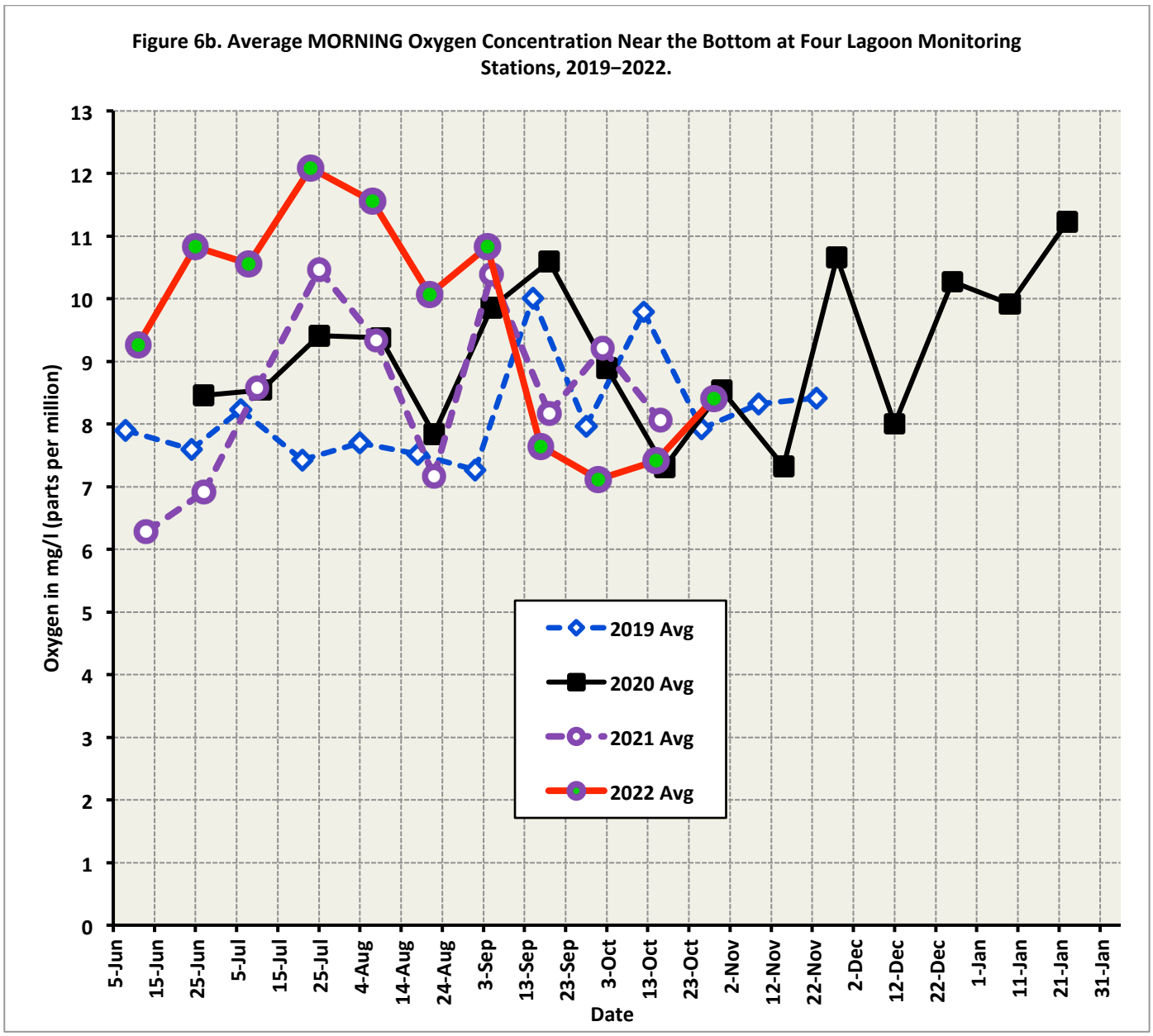


Figure 6b. Average MORNING Oxygen Concentration at Four Lagoon Monitoring Stations, 2019−2022.

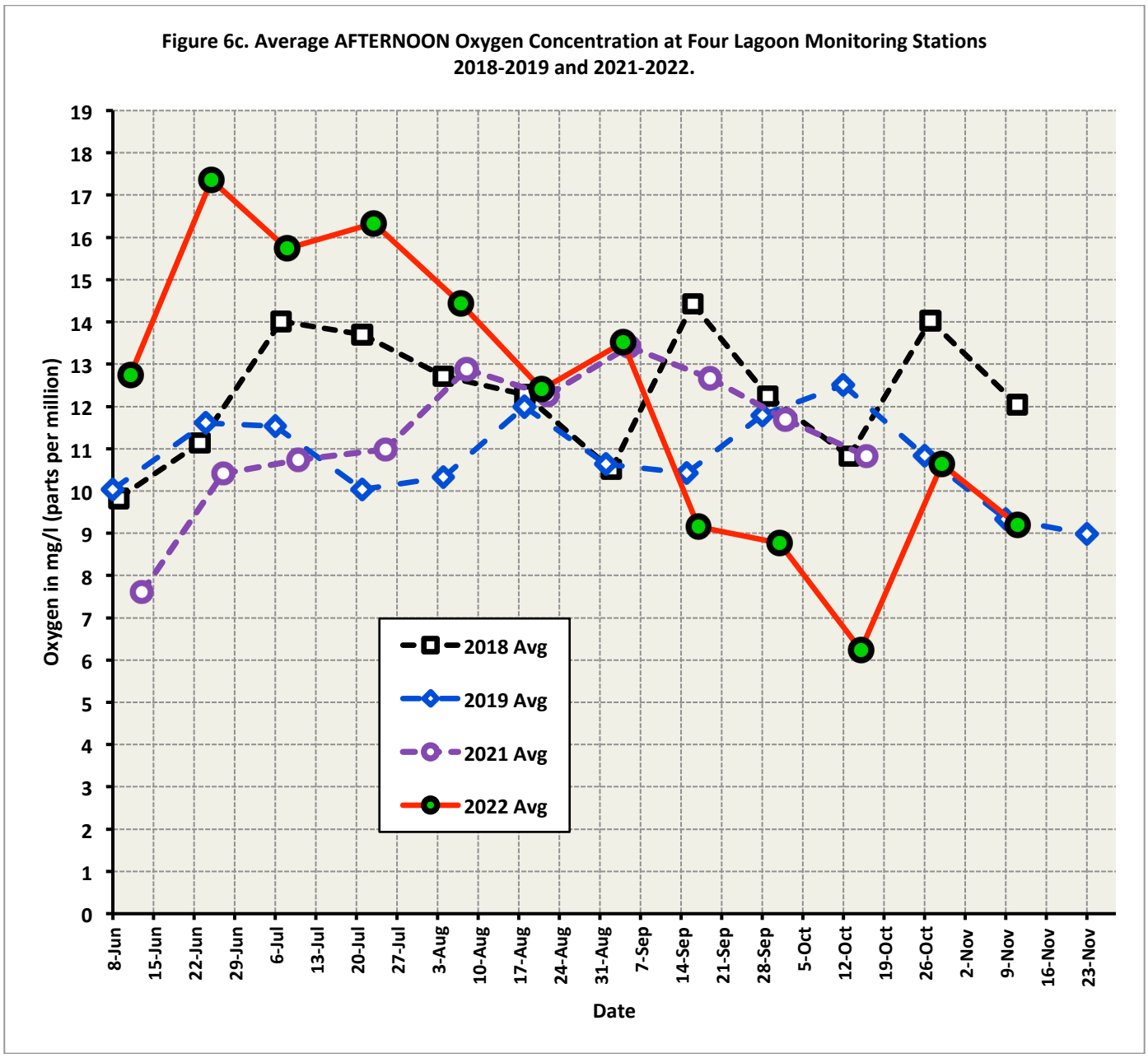


Figure 6c. Average AFTERNOON Oxygen Concentration at Four Lagoon Monitoring Stations, 2018–2019 and 2021–2022.

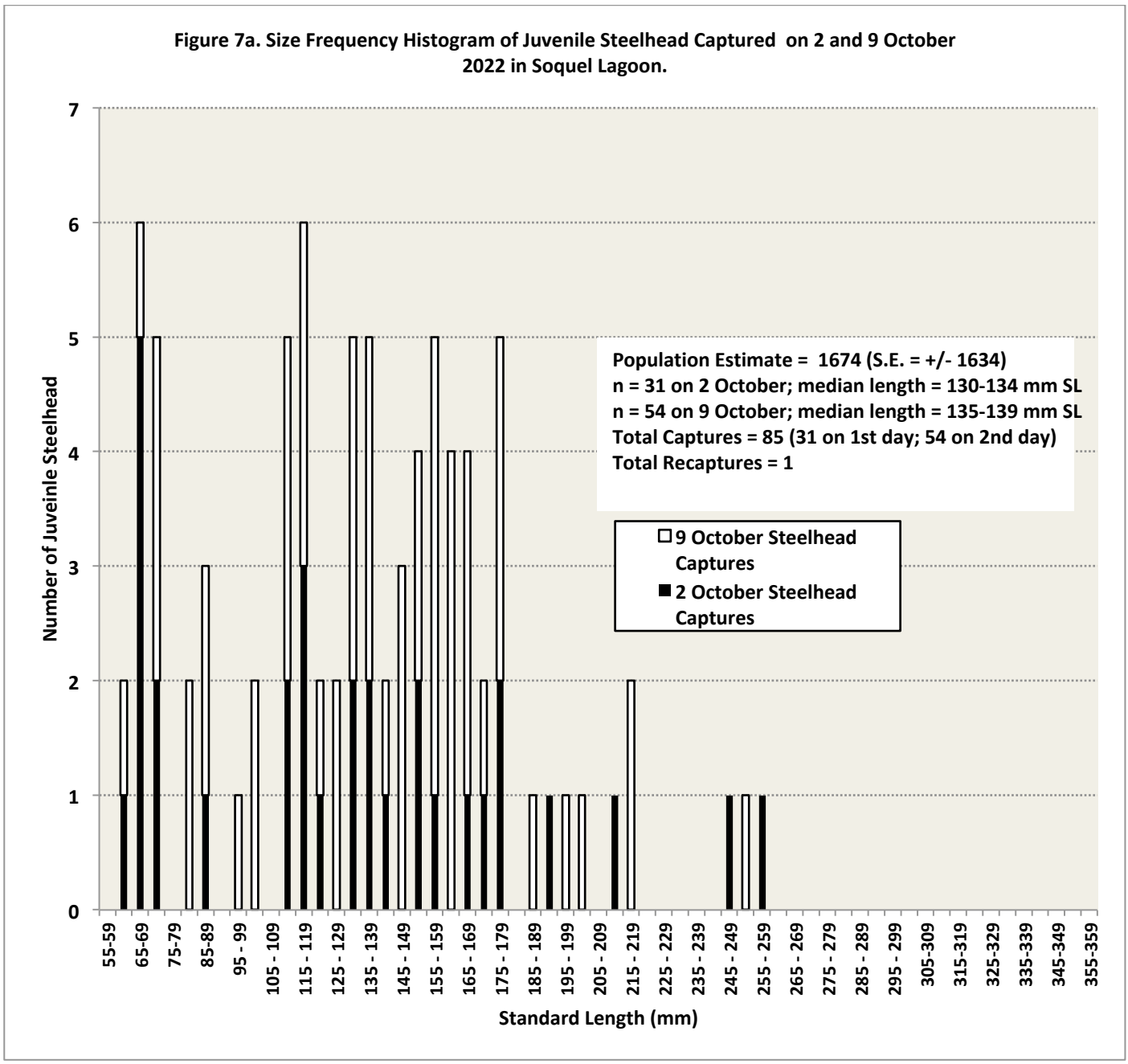


Figure 7a. Size Frequency Histogram of Steelhead Captured on 2 and 9 October 2022 in Soquel Lagoon

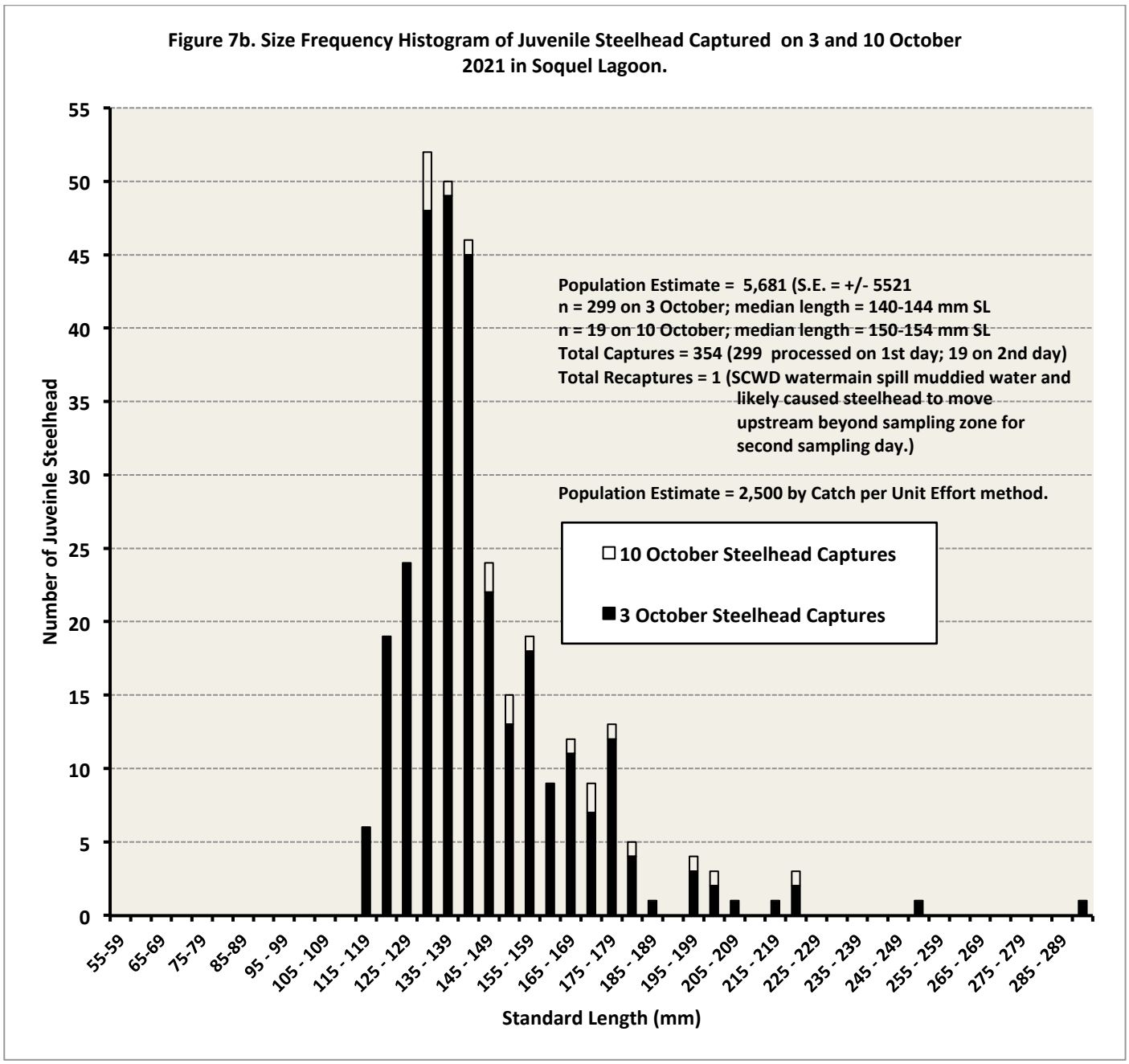


Figure 7b. Size Frequency Histogram of Steelhead Captured on 3 and 10 October 2021 in Soquel Lagoon

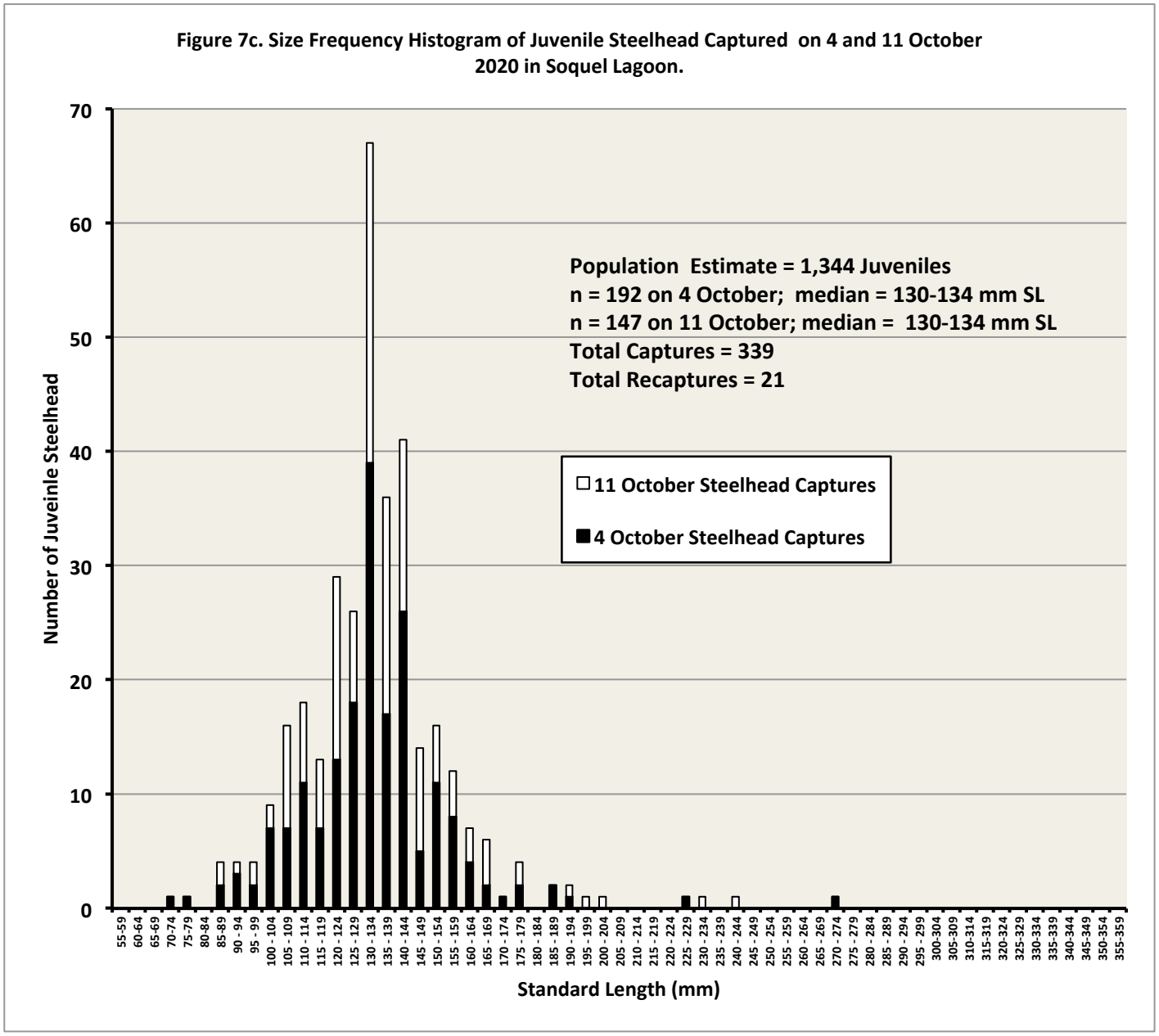


Figure 7c. Size Frequency Histogram of Steelhead Captured on 4 and 11 October 2020 in Soquel Lagoon

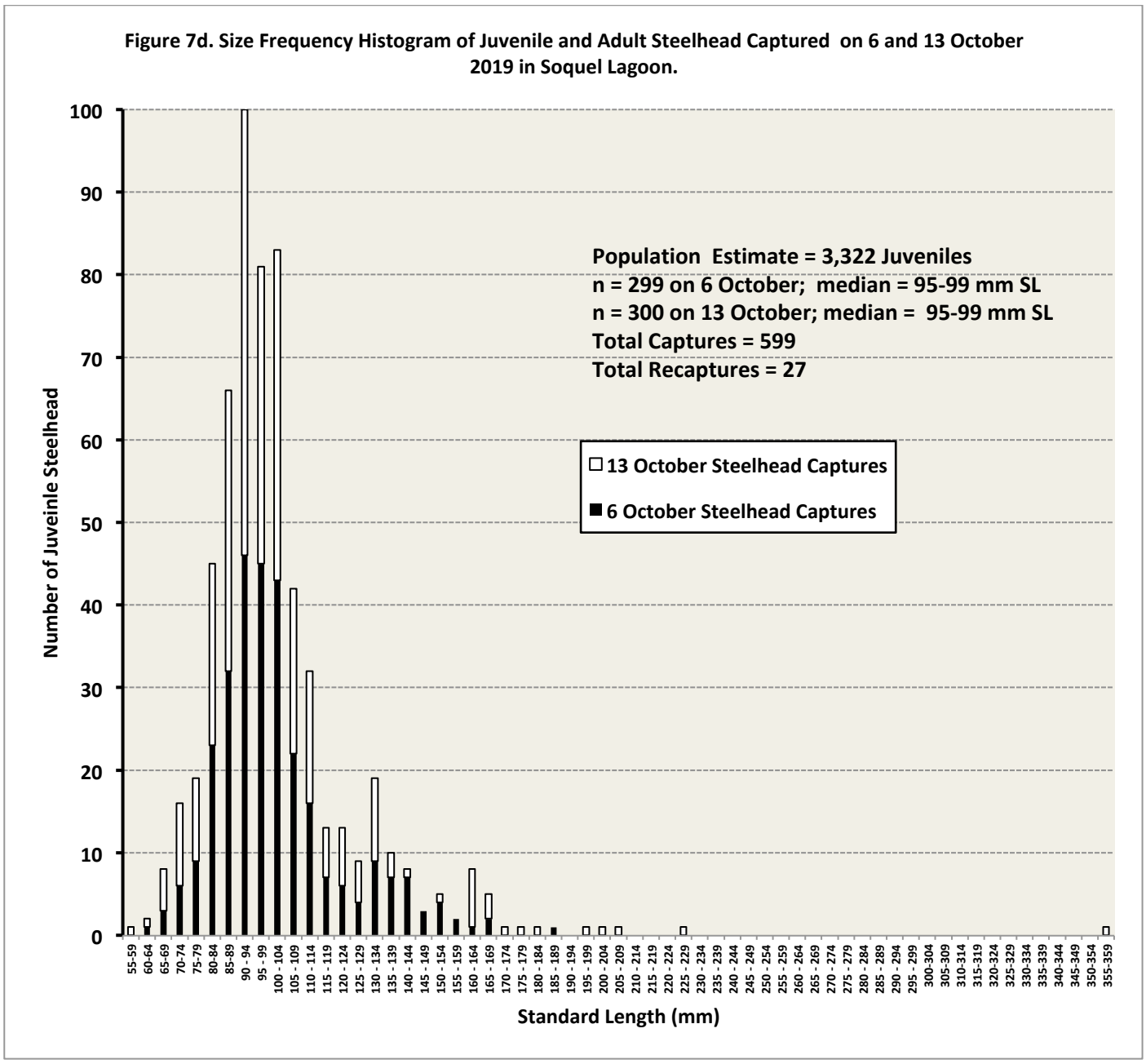


Figure 7d. Size Frequency Histogram of Steelhead Captured on 6 and 13 October 2019 in Soquel Lagoon.

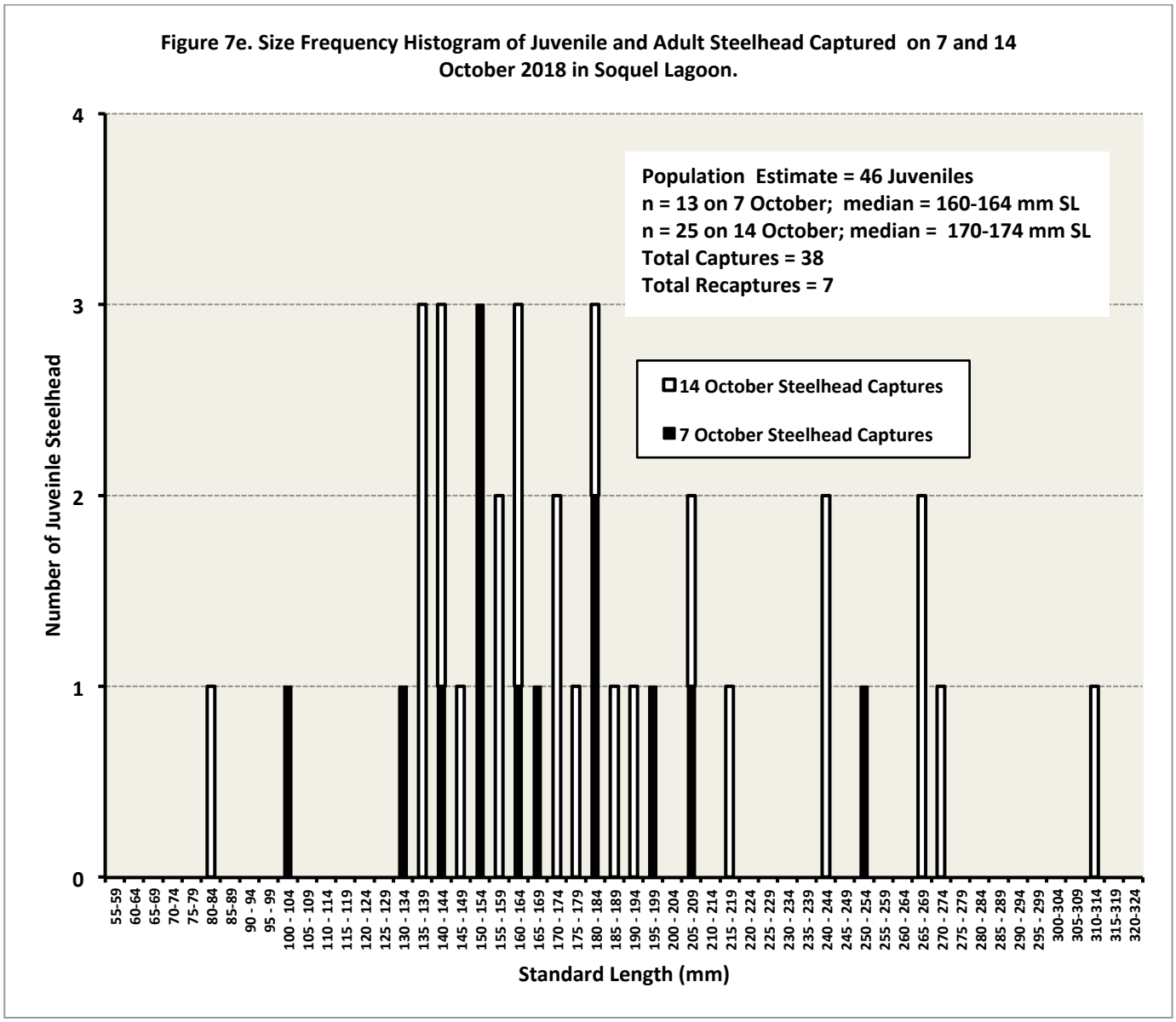


Figure 7e. Size Frequency Histogram of Steelhead Captured on 7 and 14 October 2018 in Soquel Lagoon.

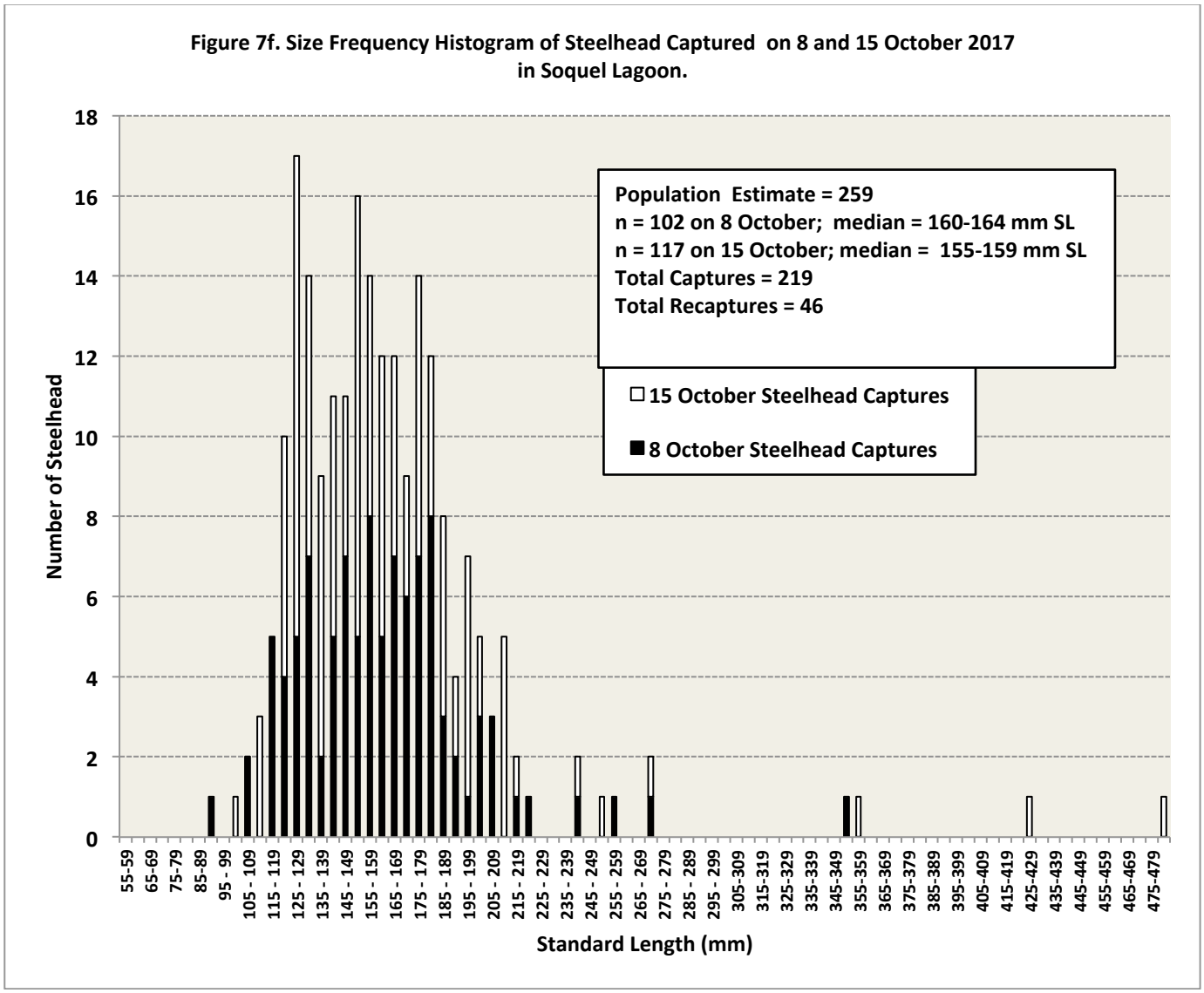


Figure 7f. Size Frequency Histogram of Steelhead Captured on 8 and 15 October 2017 in Soquel Lagoon.

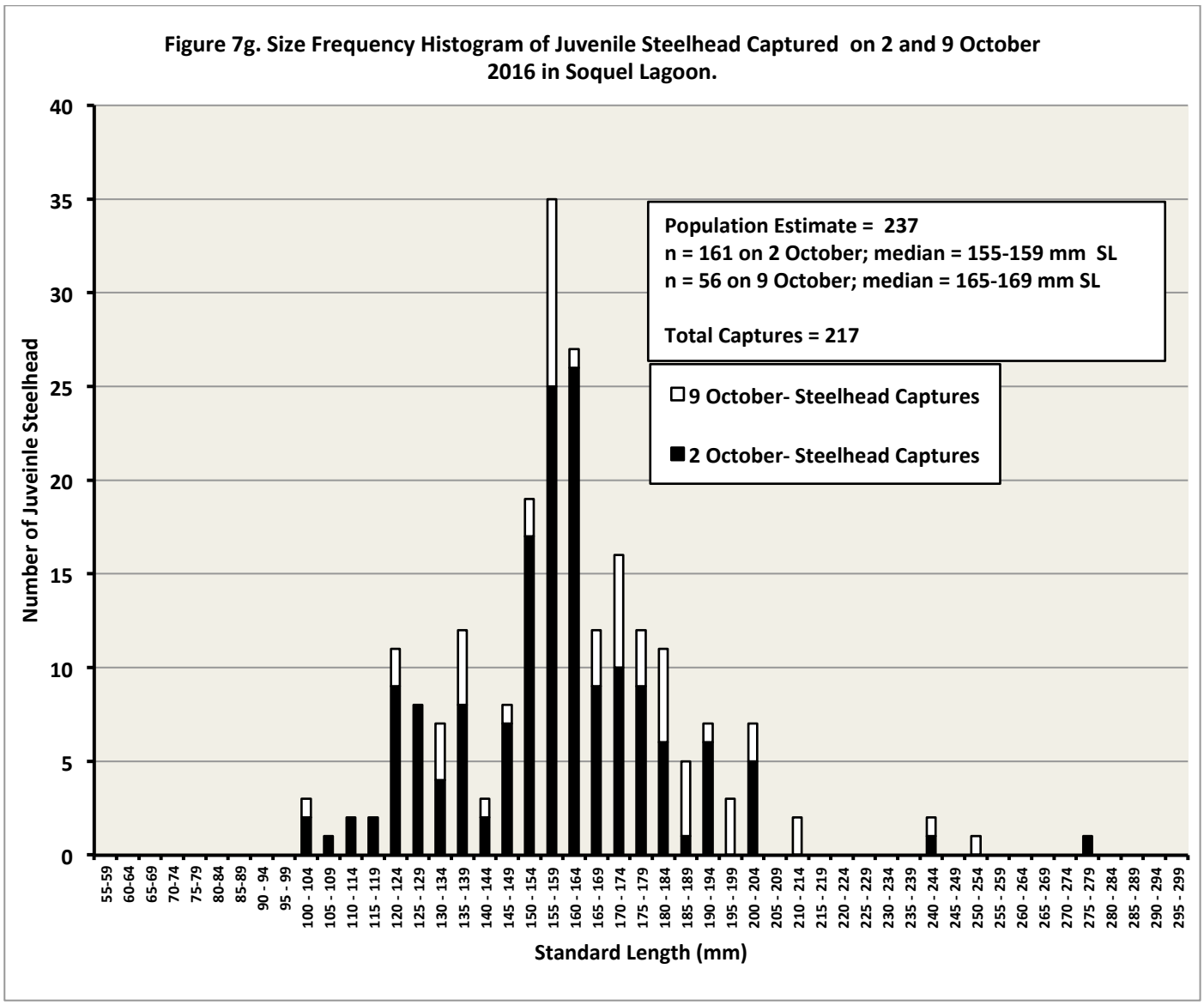


Figure 7g. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 9 October 2016 in Soquel Lagoon.

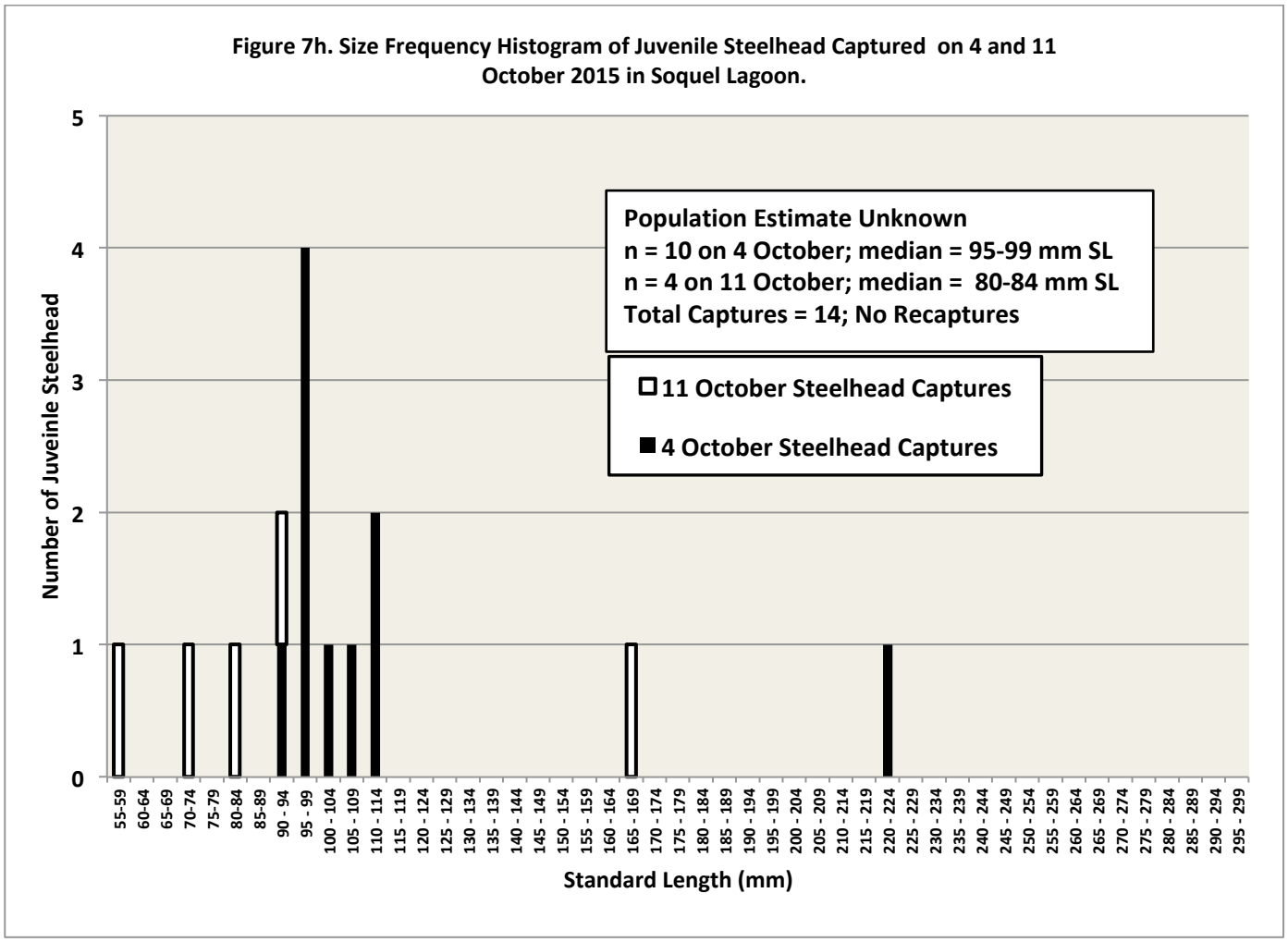


Figure 7h. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2015 in Soquel Lagoon.

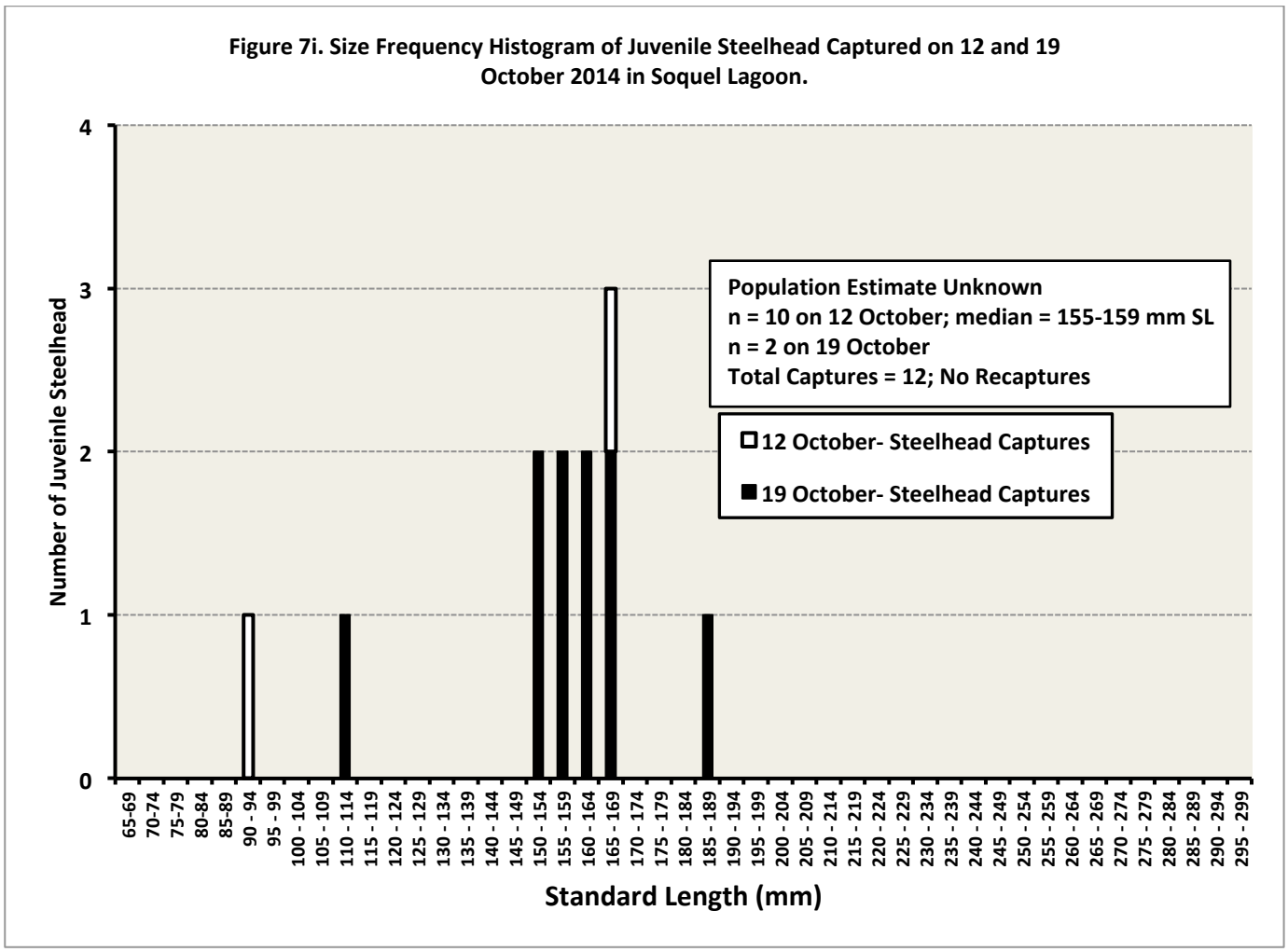


Figure 7i. Size Frequency Histogram of Juvenile Steelhead Captured on 12 and 19 October 2014 in Soquel Lagoon.

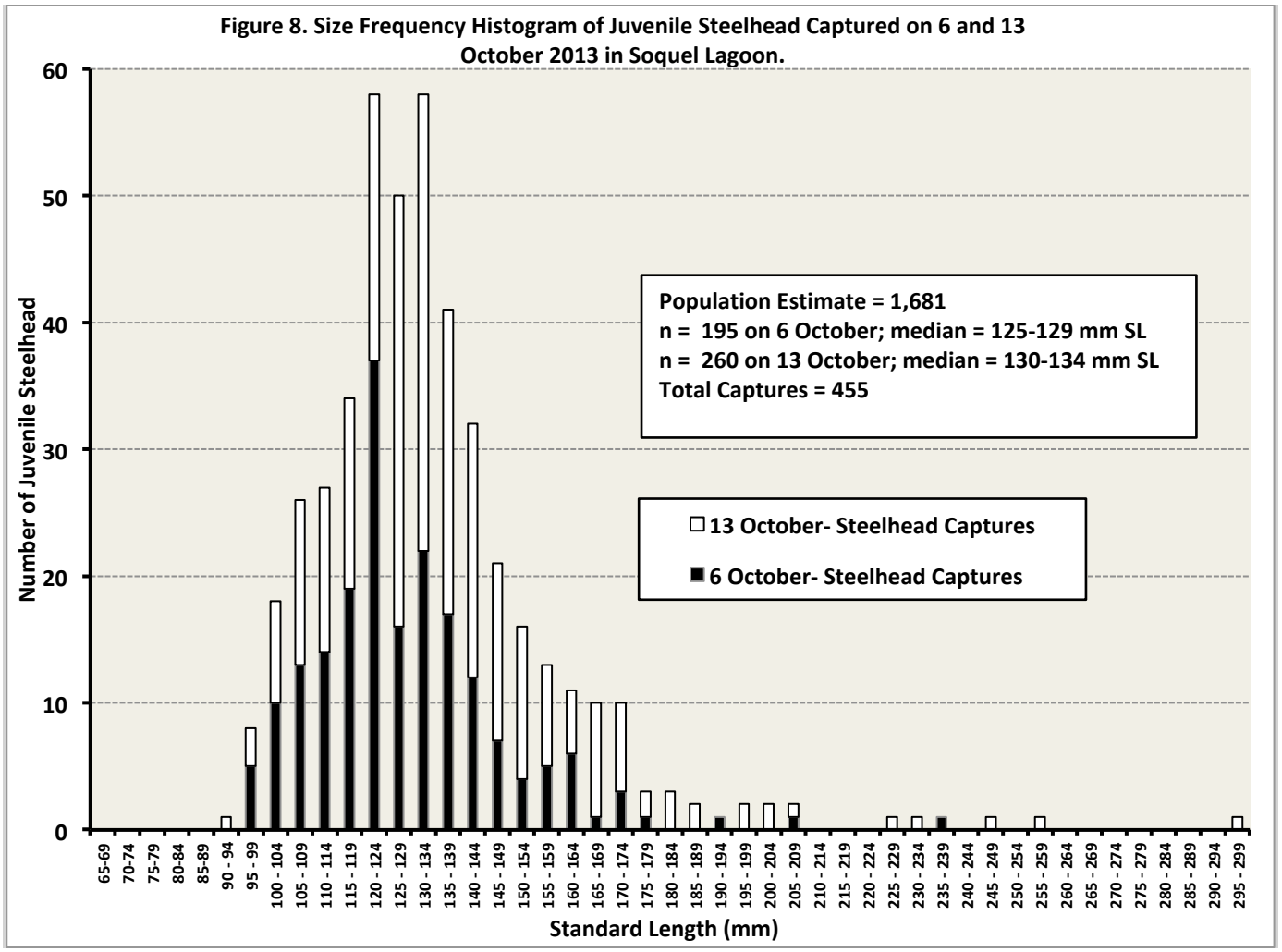


Figure 8. Size Frequency Histogram of Juvenile Steelhead Captured on 6 and 13 October 2013 in Soquel Lagoon.

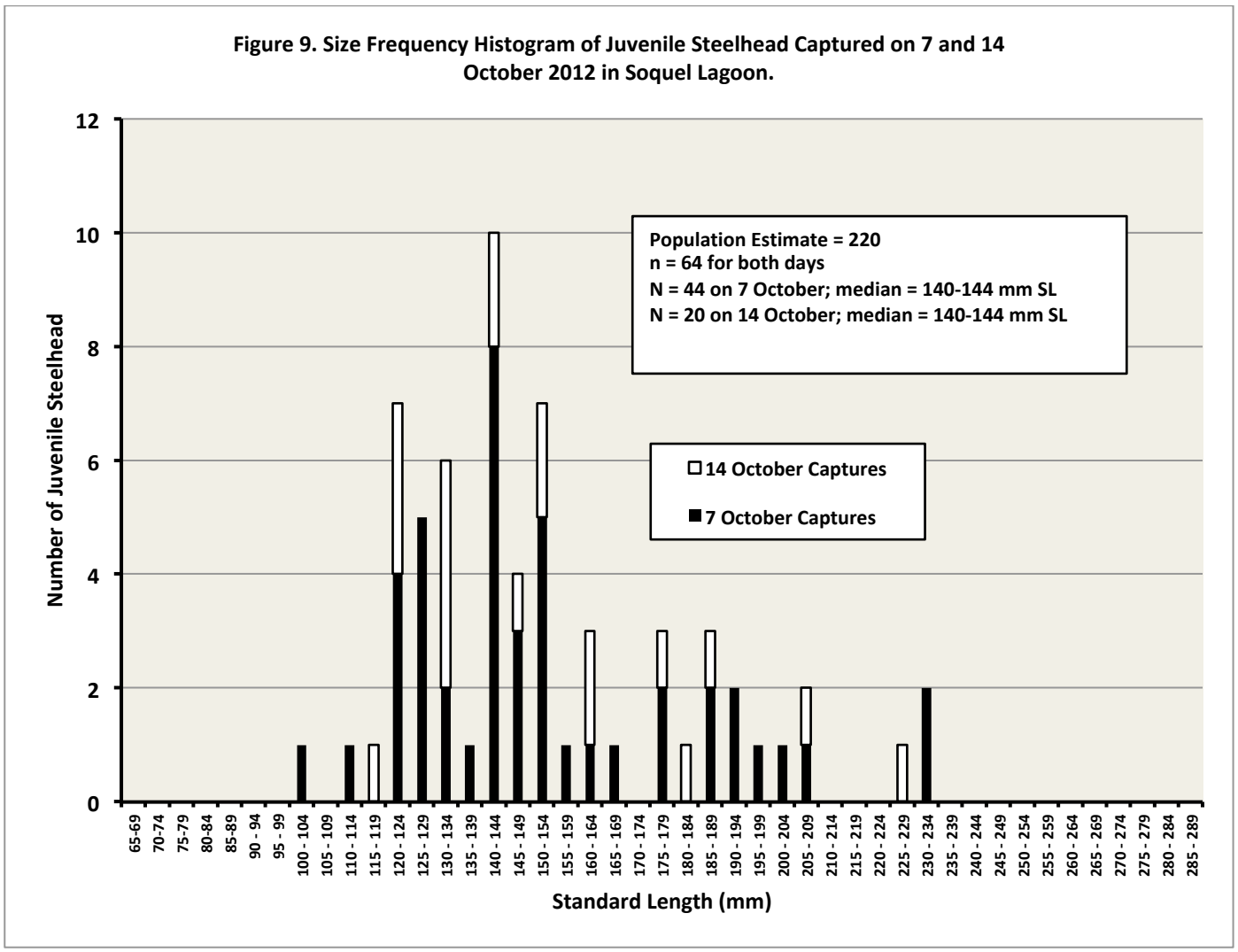


Figure 9. Size Frequency Histogram of Juvenile Steelhead Captured on 7 and 14 October 2012 in Soquel Lagoon.

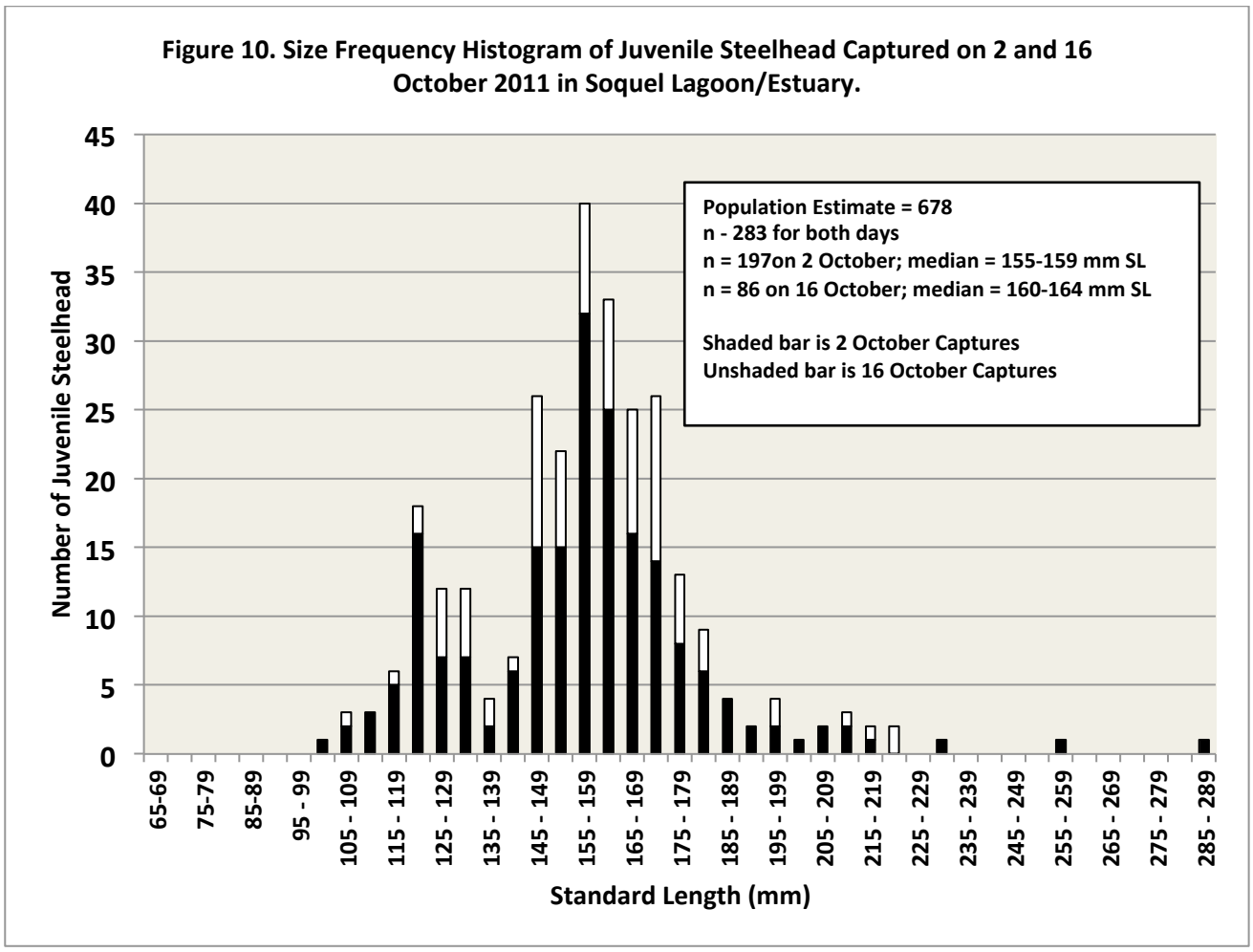


Figure 10. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 16 October 2011 in Soquel Lagoon/Estuary.

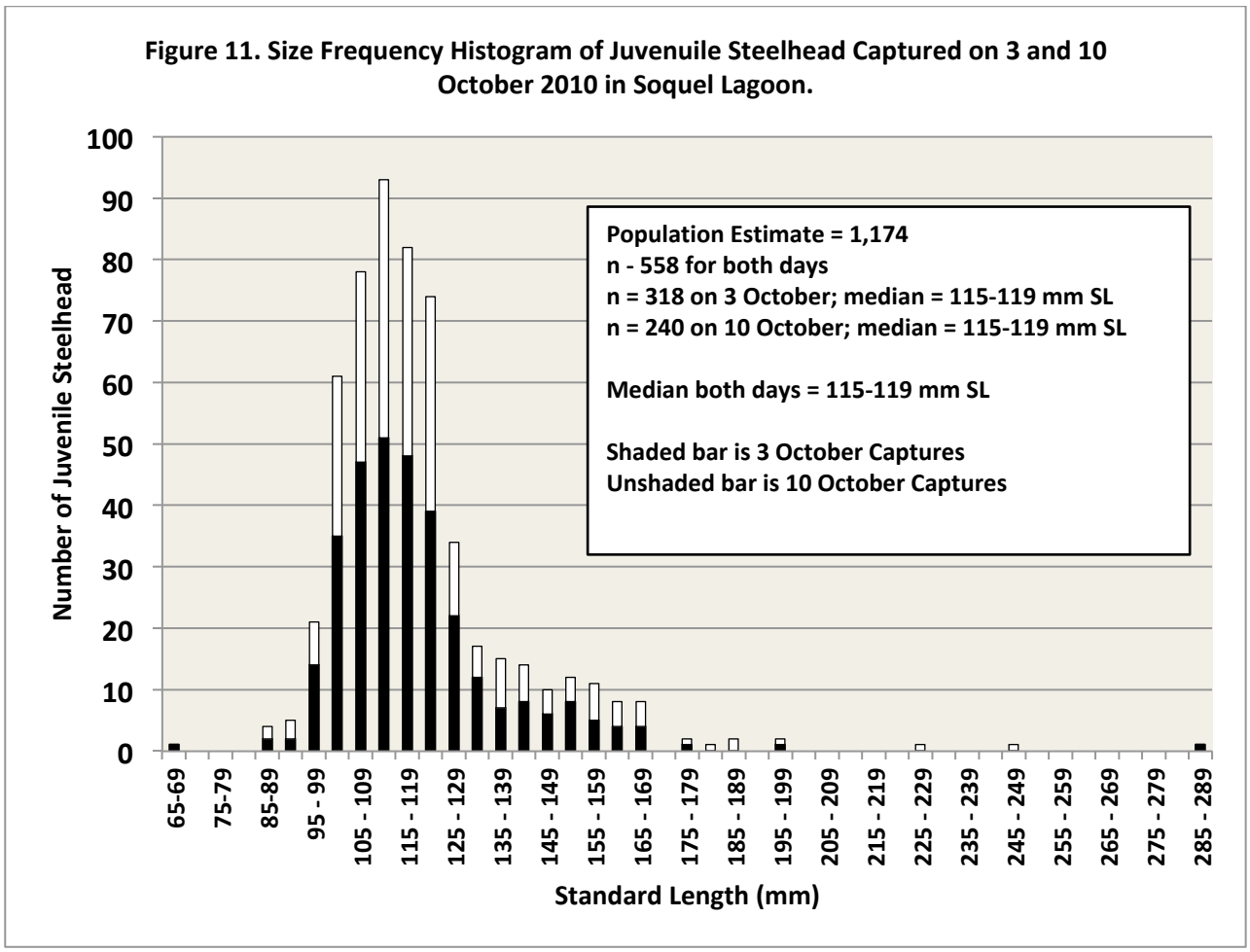


Figure 11. Size Frequency Histogram of Juvenuile Steelhead Captured on 3 and 10 October 2010 in Soquel Lagoon.

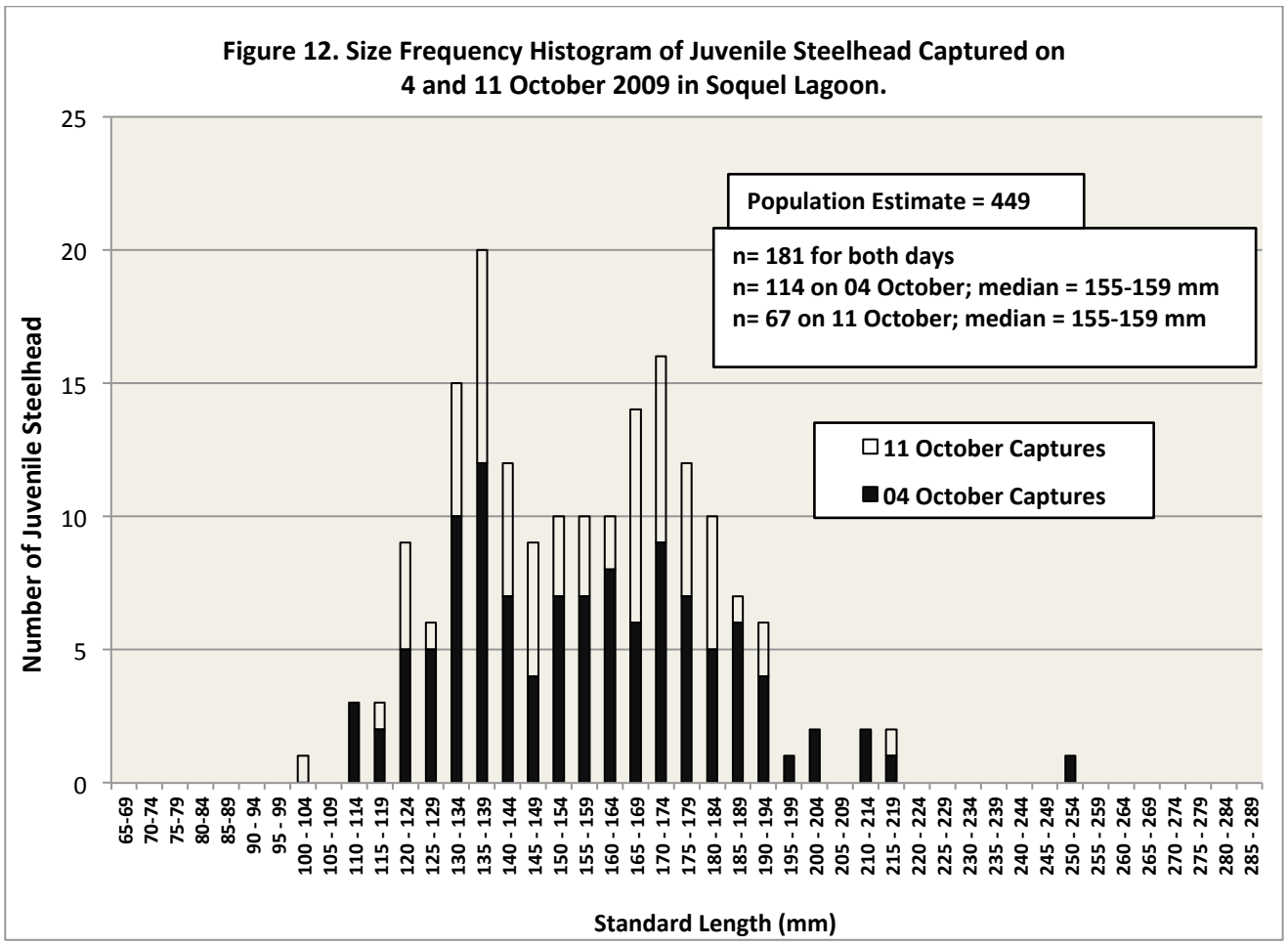


Figure 12. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2009 in Soquel Lagoon.

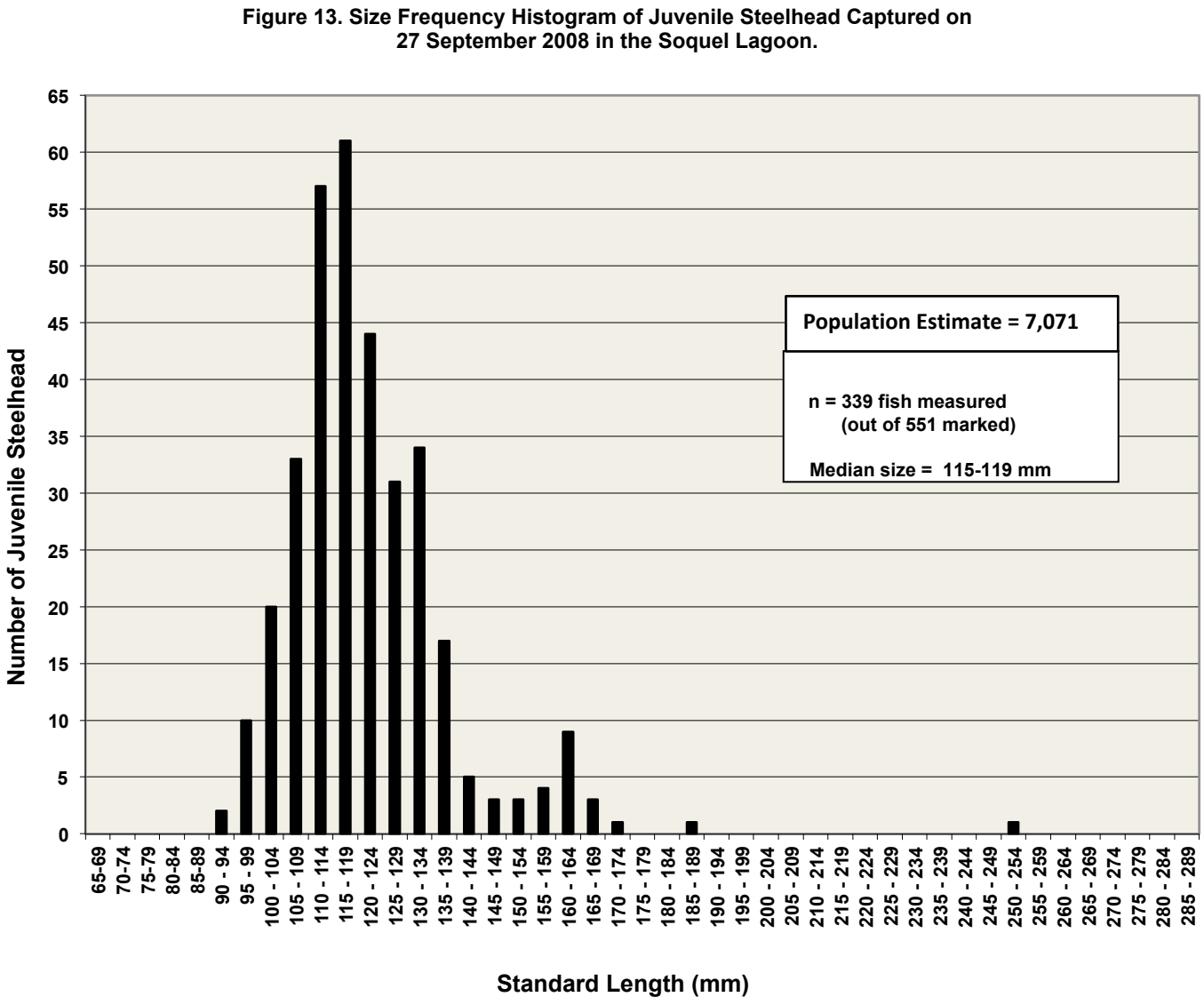


Figure 13. Size Frequency Histogram of Juvenile Steelhead Captured on 27 September 2008 in the Soquel Lagoon.

Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 & 14 October 2007 in the Soquel Lagoon.

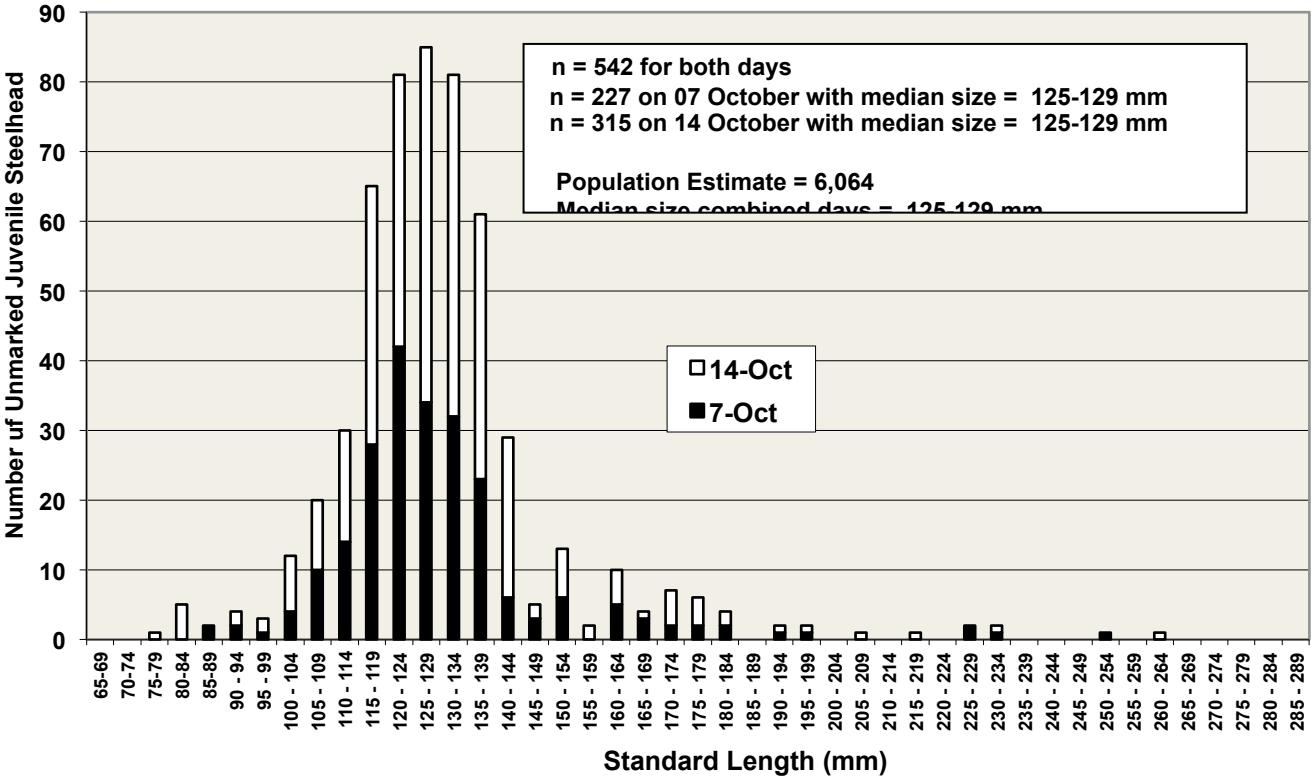


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 & 14 October 2007 in the Soquel Lagoon.

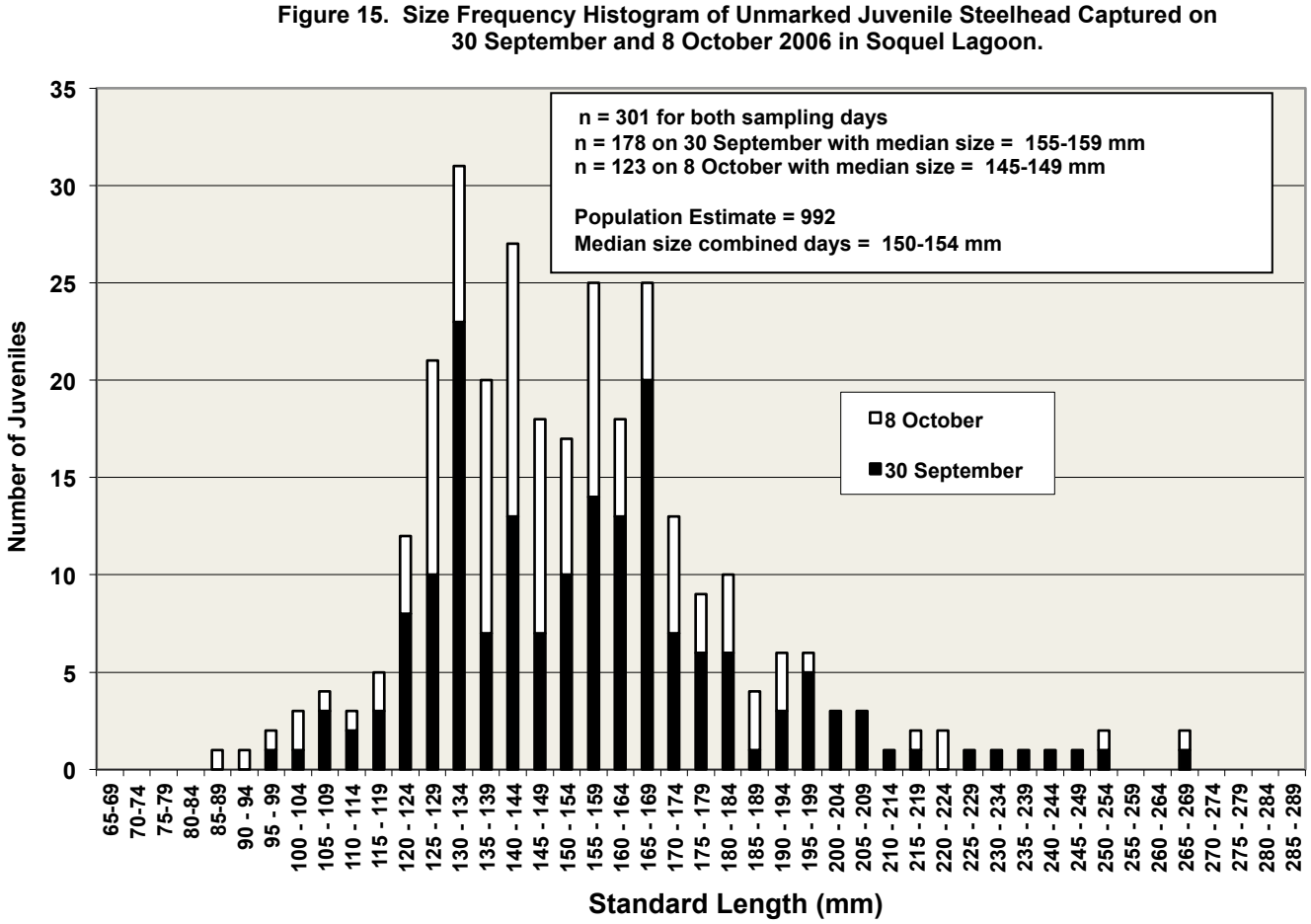


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 30 September and 8 October 2006 in Soquel Lagoon.

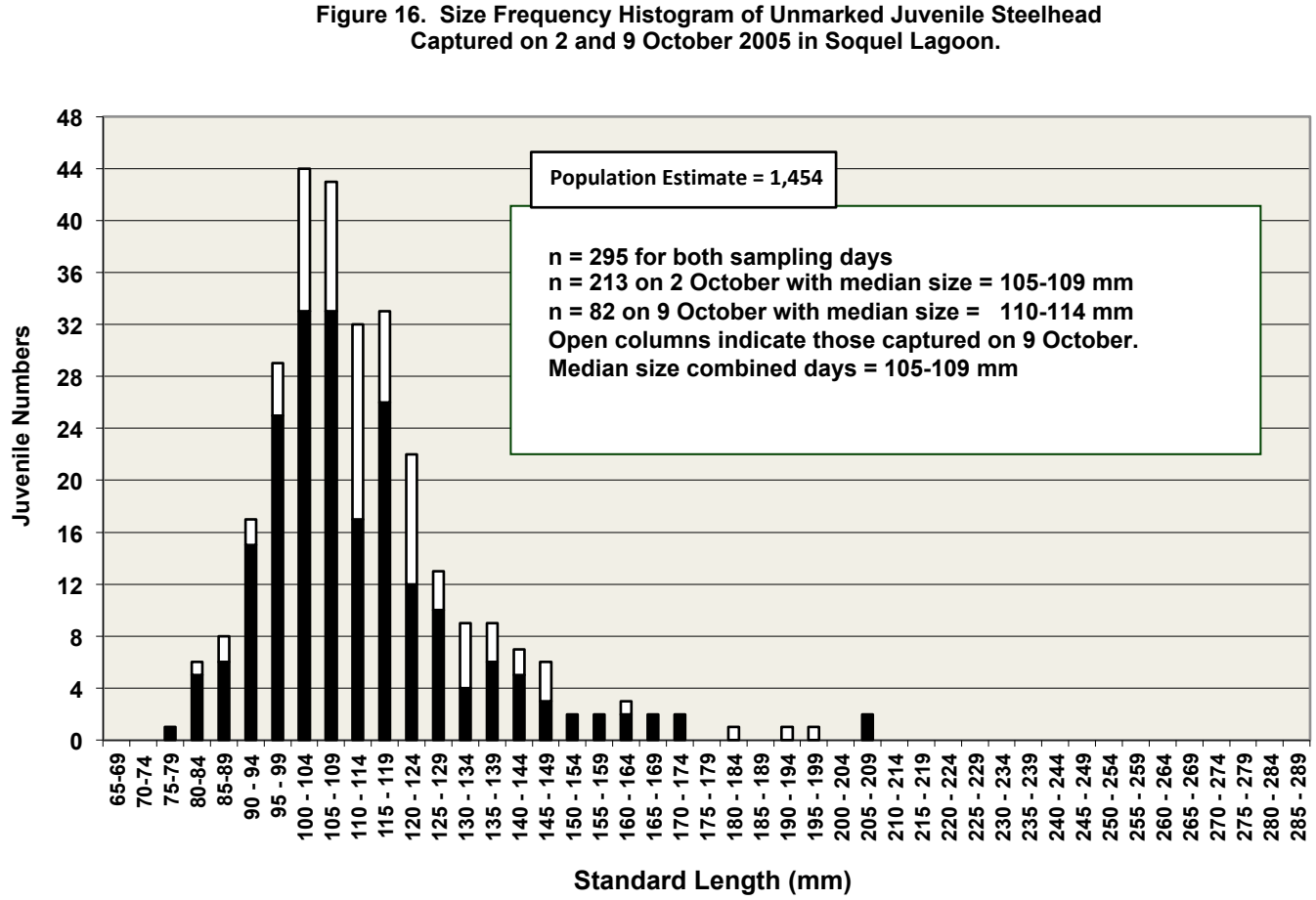


Figure 16. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 2 and 9 October 2005 in Soquel Lagoon.

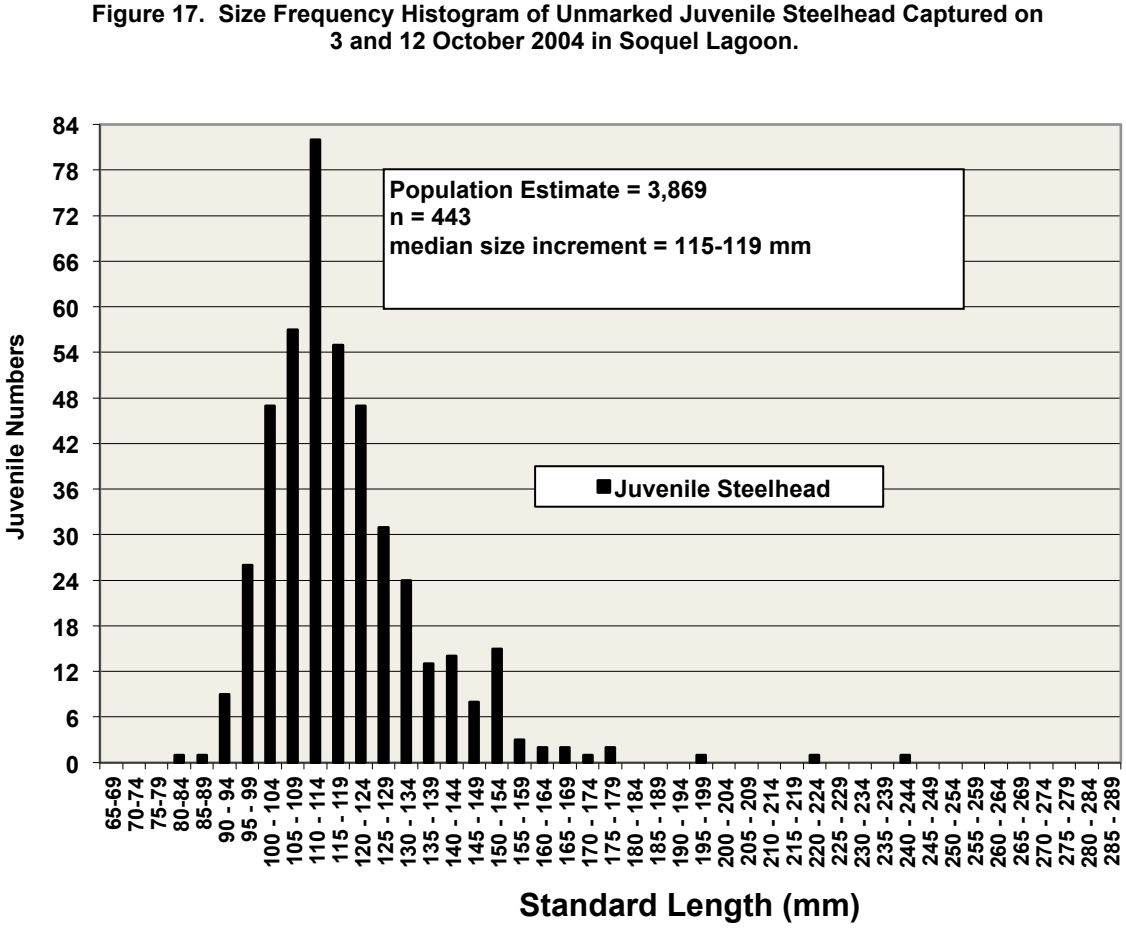


Figure 17. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

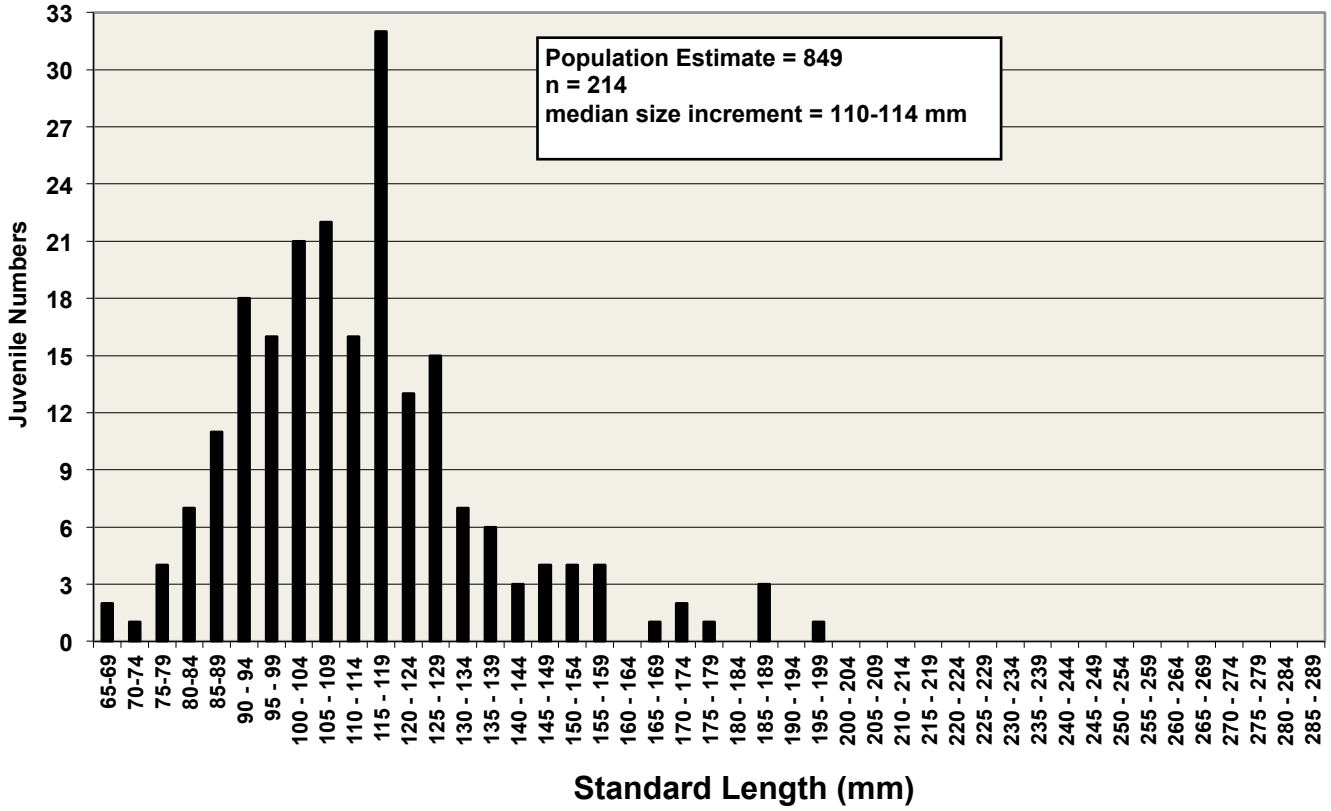


Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

Figure 19. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002 in Soquel Lagoon.

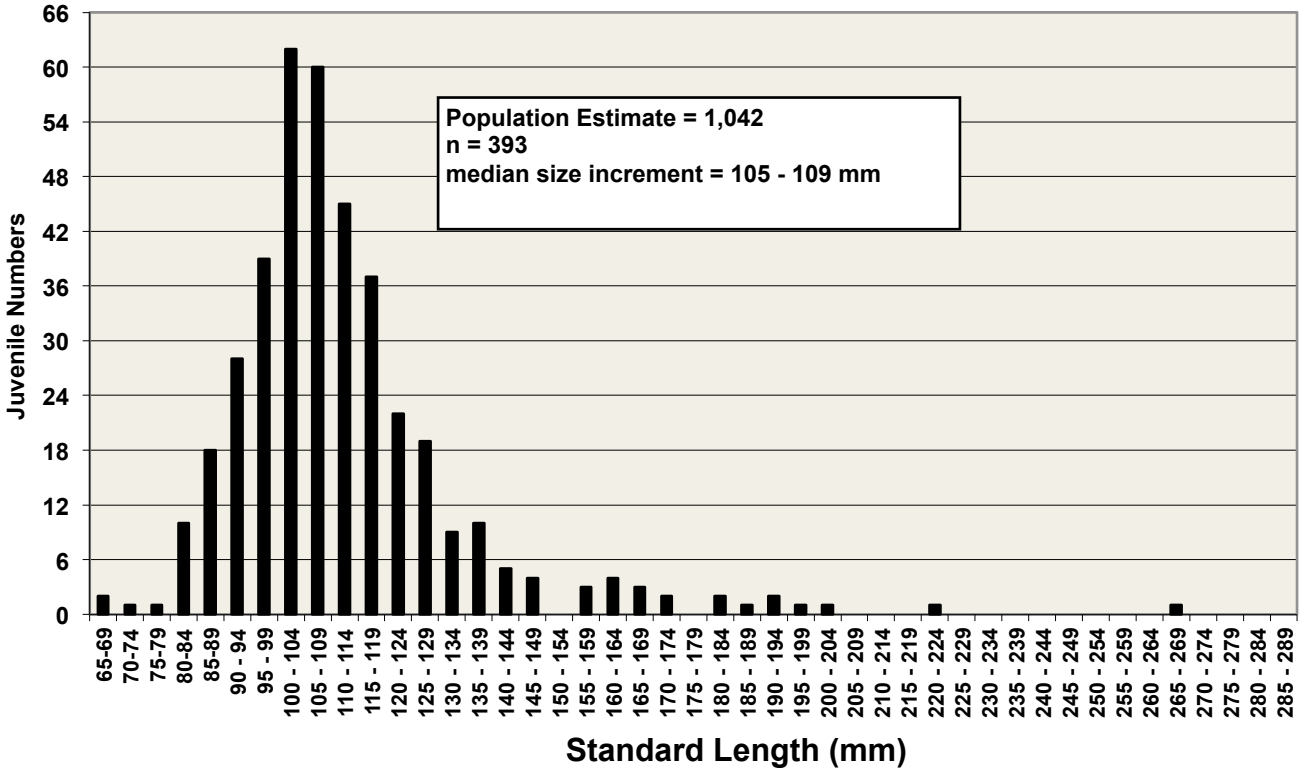


Figure 19. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002 in Soquel Lagoon.

Figure 20. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

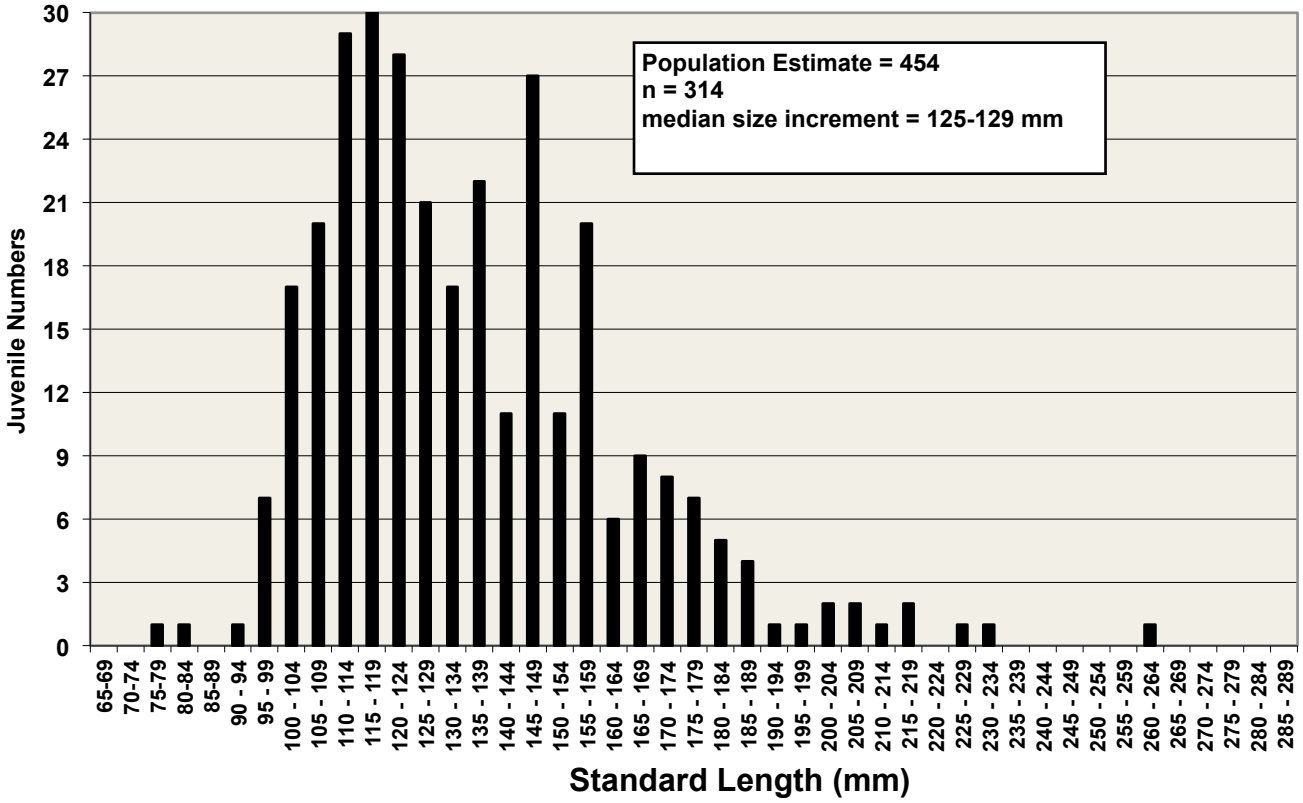


Figure 20. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

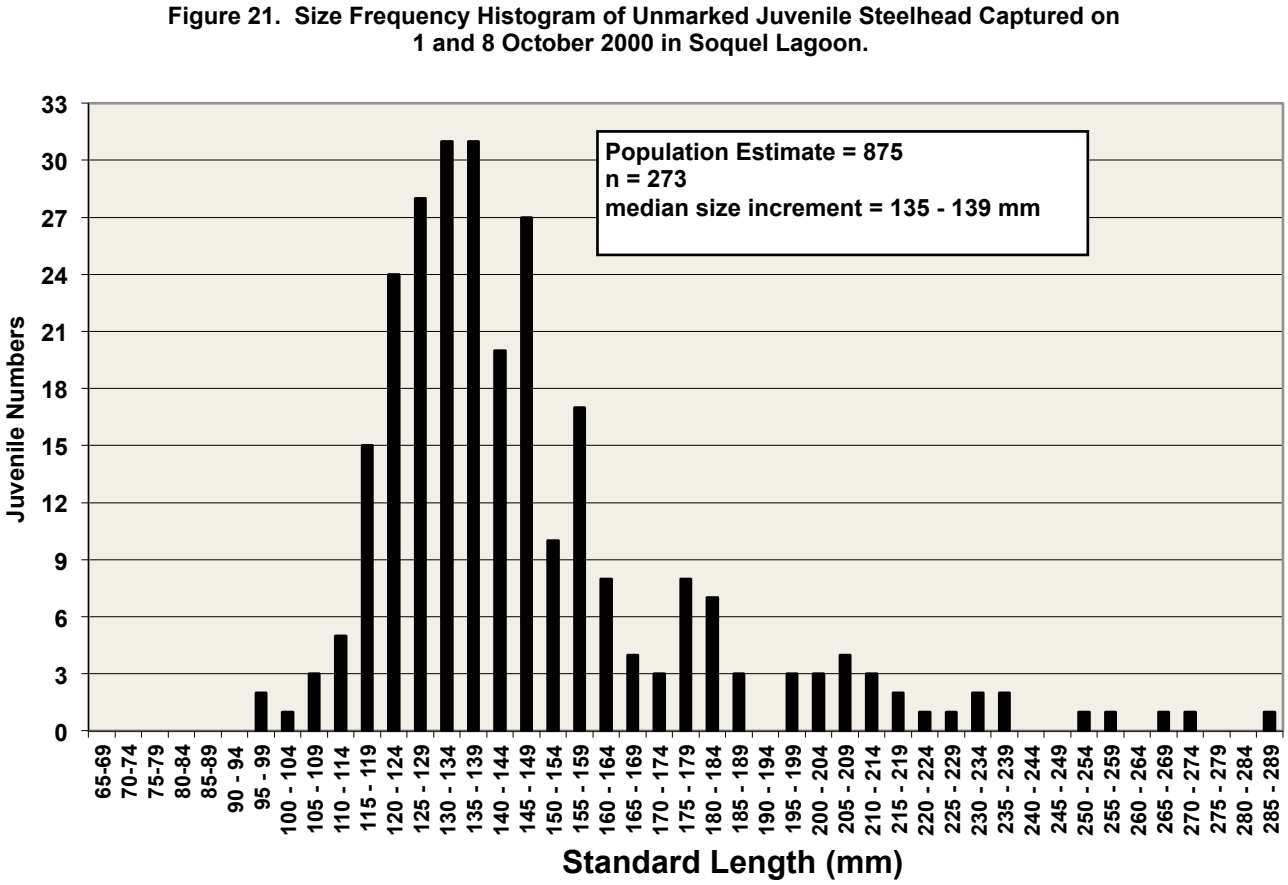


Figure 21. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

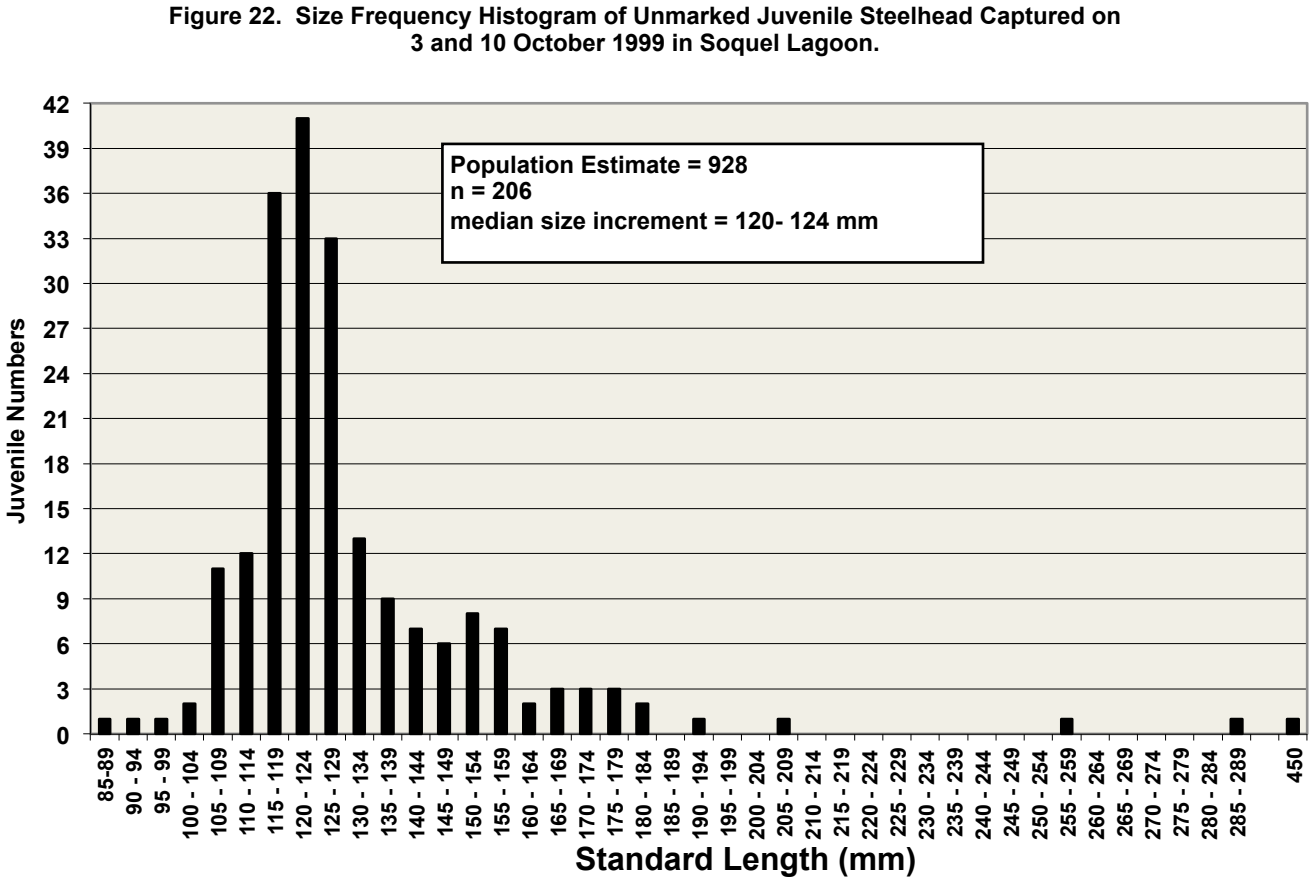
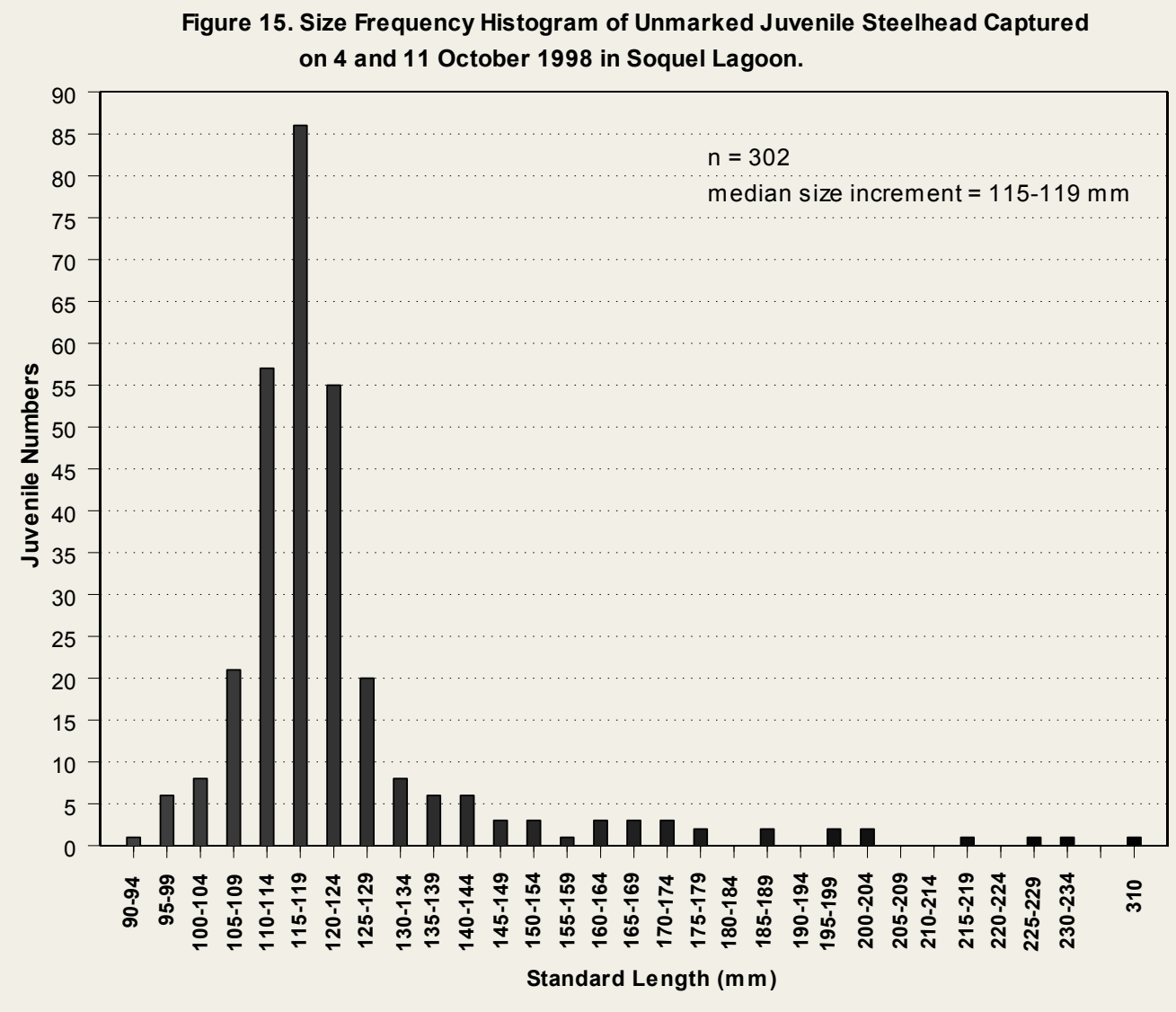


Figure 22. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 10 October 1999 in Soquel Lagoon.



Population Estimate in 1998 = 671.

Figure 23. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

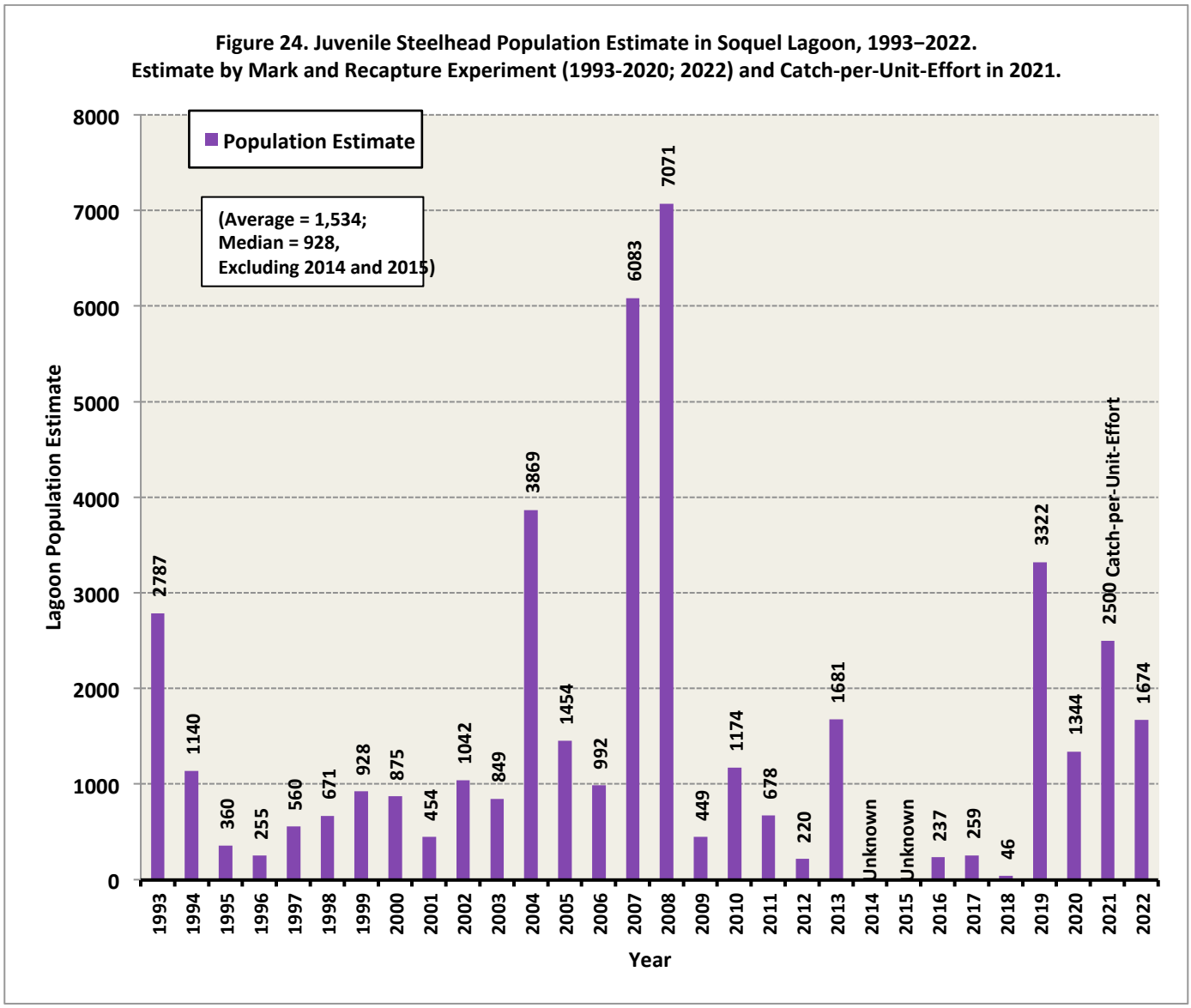


Figure 24. Steelhead Population Estimate in Soquel Lagoon, 1993−2022.

Figure 25. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2022.

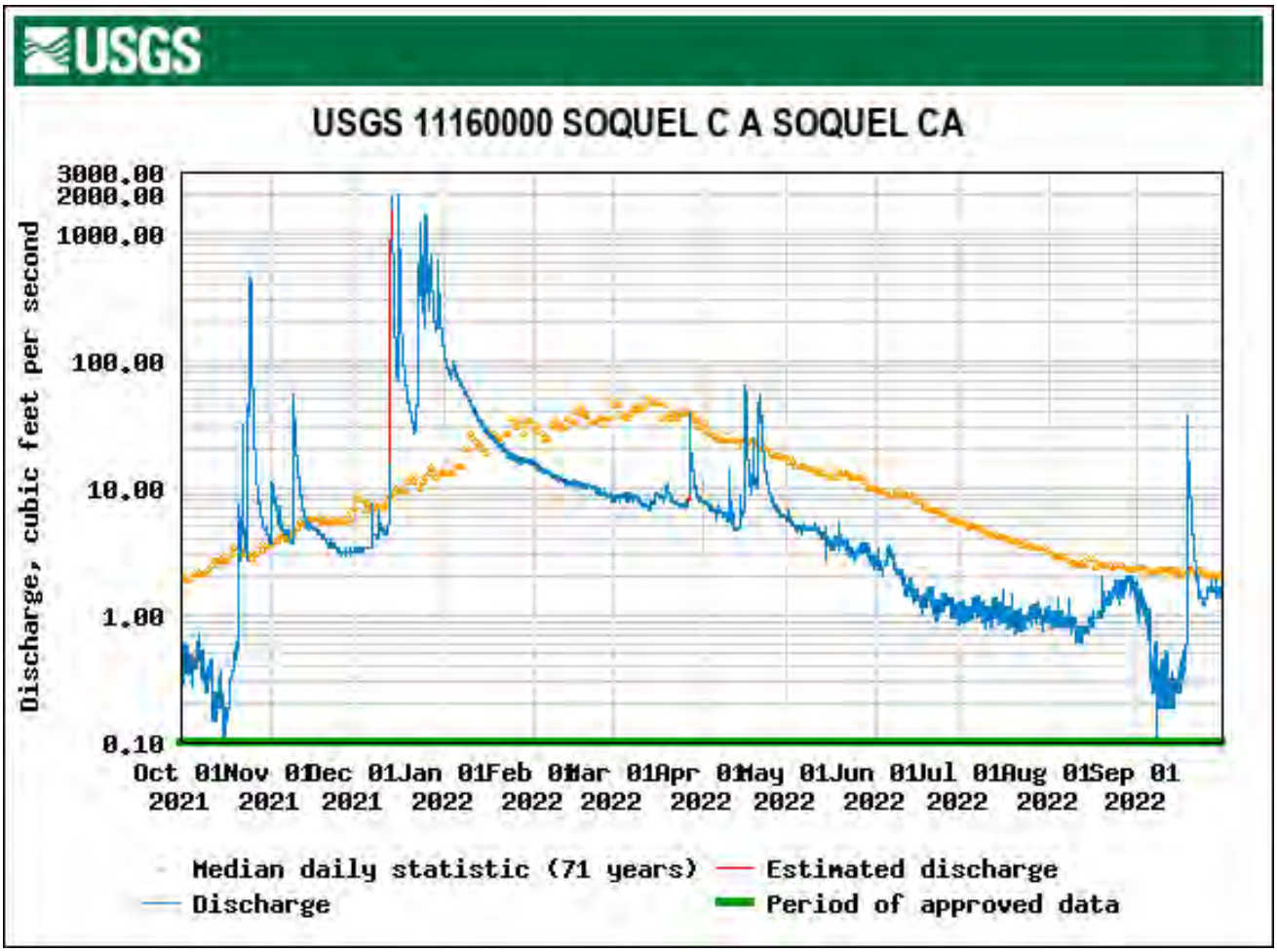


Figure 26. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2022−20 November 2022.

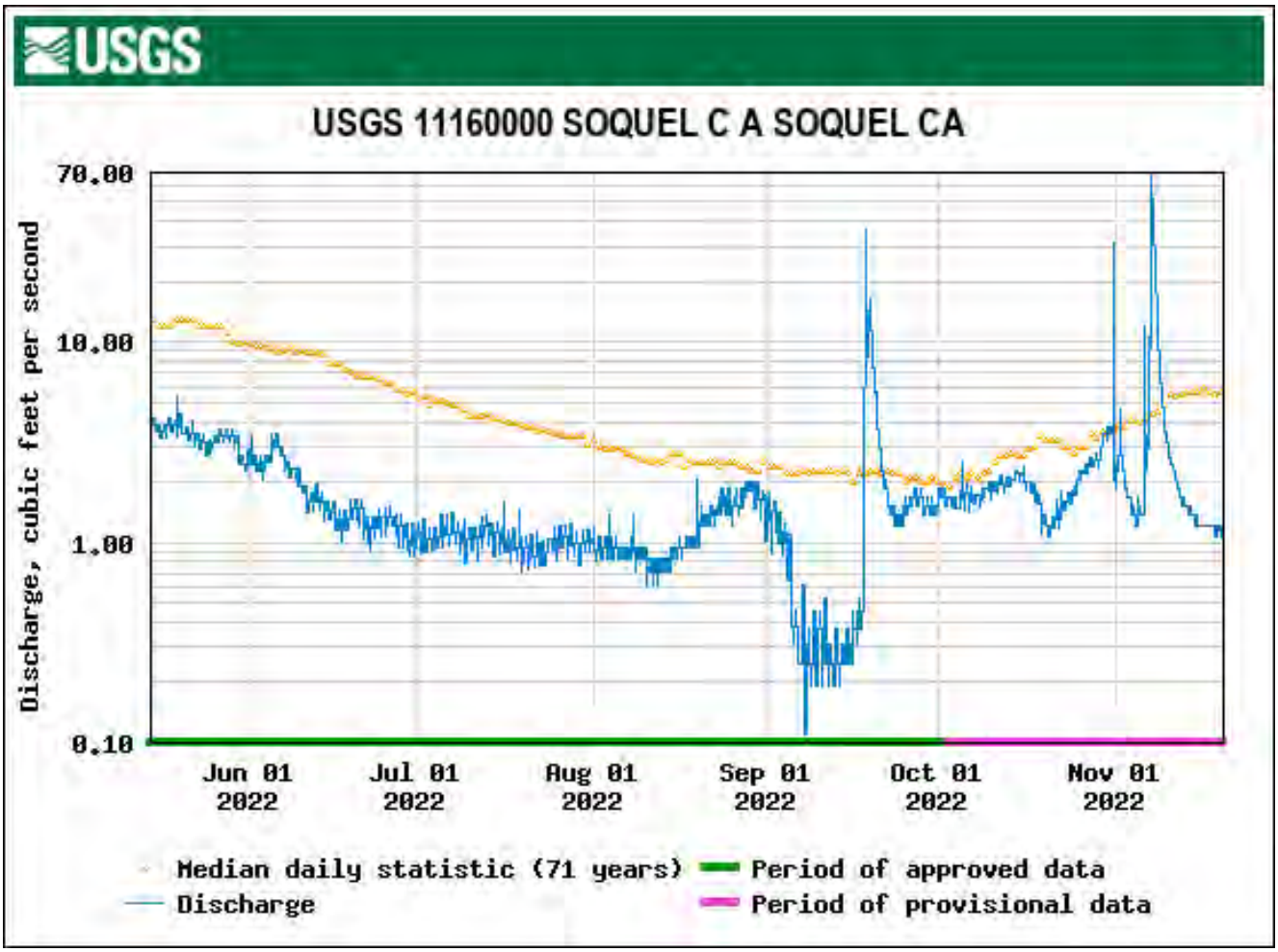


Figure 27. Maximum Visual Gull Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2018–2022.

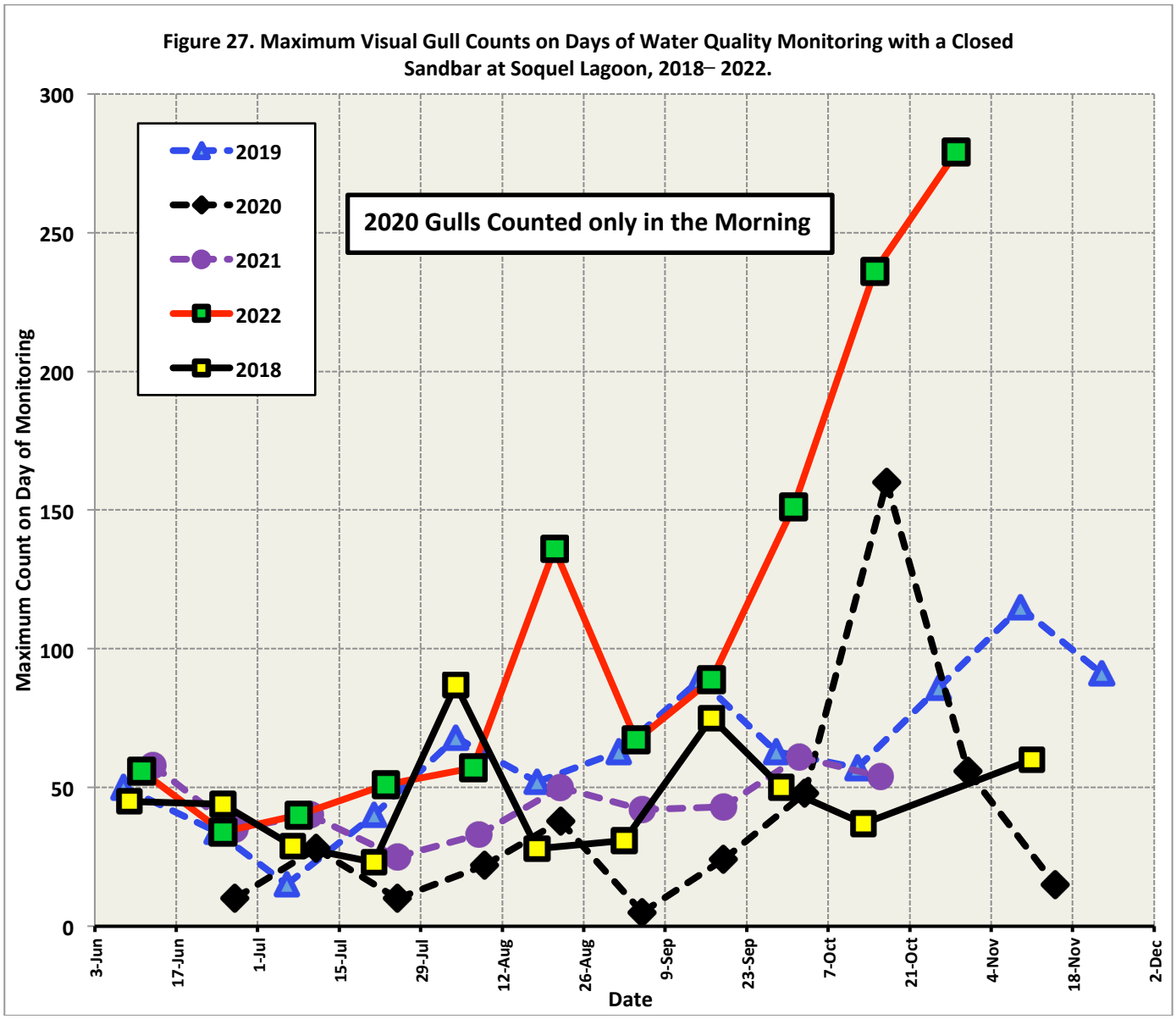
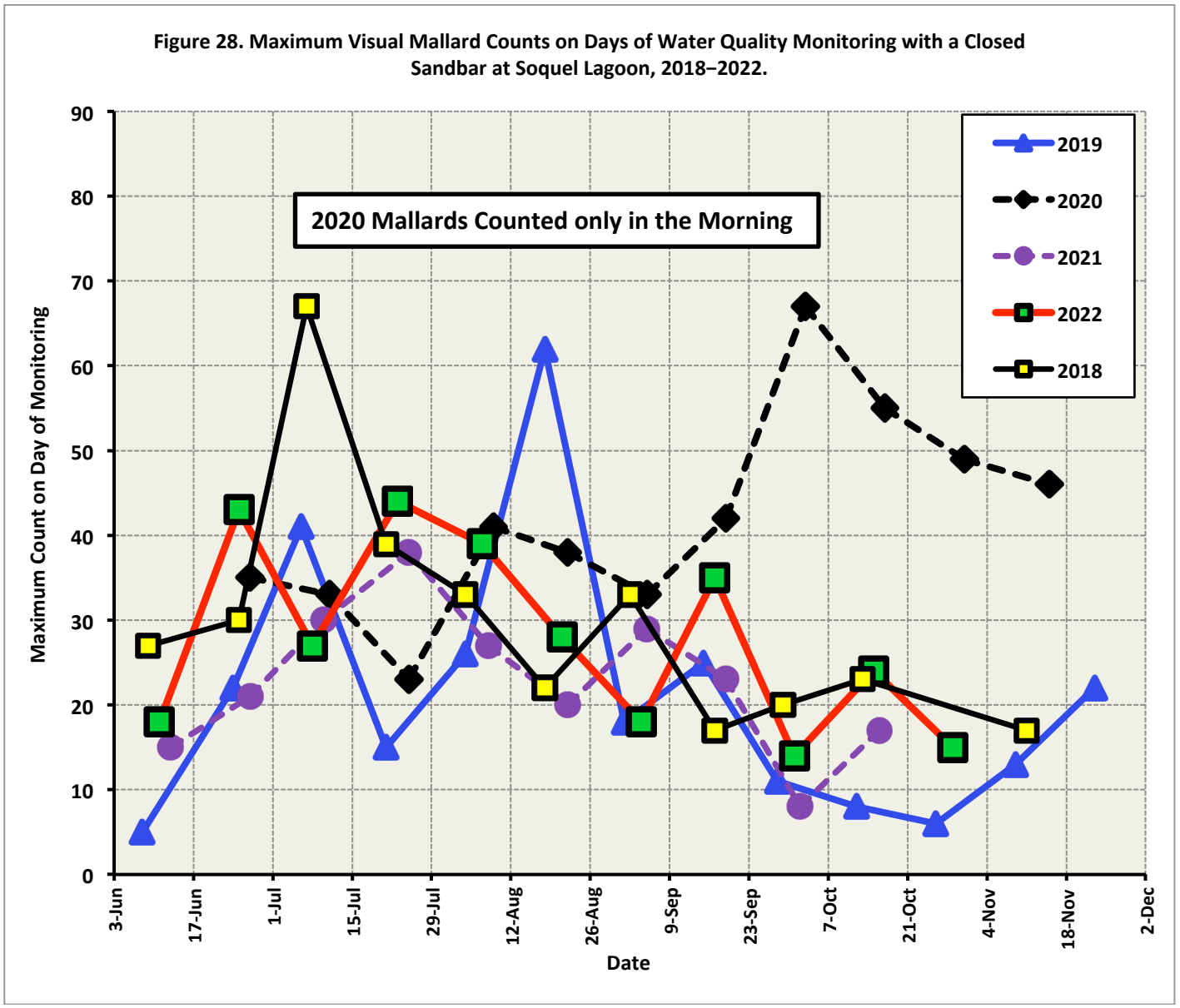


Figure 28. Maximum Visual Mallard Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2018–2022.



APPENDIX A. Water Quality and Stormflow Data and Observations of Birds and Sandbar Opening.

24 May 2022–13 November 2022.

24 May 2022. The sandbar would be closed on 26 May. However, Public Works staff wanted to know if saltwater was present in the lagoon earlier. A saltwater lens was detected beside the Venetian Court wall that extended across the lagoon to a more shallow location above the Stockton Avenue Bridge. Water temperature and salinity were stratified through the water column, with both increasing with depth. Water temperature was cooler above the bridge than below. Oxygen increased with depth down to 1.25 meters from the surface and sharply declined below that. At 1145 hr the air temperature was 21 C on a clear day.

			24 May 2022					
	Below Stockton Ave Bridge (Venetian Court Wall)			1145 hr	**Above Stockton Ave Bridge**			1205 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.4	1.4	10.88	2378	17.7	0.8	11.28	1379
0.25	19.2	1.4	10.66	2338	17.5	0.8	11.18	1366
0.50	18.8	1.4	11.90	2321	17.9	0.9	11.05	1592
0.75	21.9	3.1	19.40	5229	20.9	2.4	12.29	3867
1.00	25.1	7.7	17.81	13410	24.9	10.2	10.64	17264
1.05 bott					20.3	20.7	12.94	34078
1.25	27.0	22.0	11.72	26389				
1.50	26.2	23.7	1.8	38318				
1.63 bott	24.5	25.6	0	39670				
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	Nob Hill							
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**

26 May 2022. The sandbar was closed for the summer season, with an adult portal present in the flume inlet and all flashboards installed. 3.17 cfs at gage,

27 May 2022. The uppermost flashboard was notched by Sanden to insure smolt passage later. The shroud was placed on the flume inlet when a saline lens was detected along the Venetian Court wall. A 0.5 m thick lens remained at the bottom. Water temperature increased with depth as did salinity. Oxygen decreased with depth. The lagoon had partially filled overnight but had a ways to go to reach maximum depth. The water level had not reached the adult portal overnight, thus preventing smolt passage for one night. At 1002 it was overcast, with an air temperature of 15.9 C.

			27 May 2022					
	Below Stockton Ave Bridge (Venetian Court Wall)			1002 hr	**Above Stockton Ave Bridge**			1205 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	16.8	.08	8.65	1455				
0.25	17.36	1.9	9.61	3110				
0.50	19.6	4.6	8.66	7450				
0.75	21.8	6.3	3.56	10436				
1.00	25.3	17.8	0.35	30047				
1.25 bott	25.1	25.5	0	40037				
1.50								
1.63								
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	Nob Hill							
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**

28 May 2022. The lagoon level had reached the adult portal overnight, thus providing smolt passage.

31May 2022. The lagoon had reached maximum filling with a gage height of 2.56 and an air temperature of 15 C at 1430 hr. Water temperature had increased near the bottom since 28 May, with a modest reduction in salinity. The saline layer was stagnant and becoming hotter. Oxygen levels had improved primarily because measurements were later in the afternoon, and water temperature had increased near the surface for the same reason. All 3 parameters were stratified through the water column. Temperature probes were launched in Reach 2 below the railroad trestle and upstream at Nob Hill.

			31 May 2022					
	Below Stockton Ave Bridge (Venetian Court Wall)			1430 hr	**Above Stockton Ave Bridge**			1205 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.1	0.7	9.77	1279				
0.25	20.2	0.7	9.71	1269				
0.50	19.7	0.7	9.39	1226				
0.75	19.6	0.7	9.49	1216				
1.00	19.6	0.7	9.40	1240				
1.25	20.4	0.8	13.51	1500				
1.50	26.5	5.6	9.95	10167				
1.75	29.2	19.3	4.15	33728				
1.85 bott	29.7	22.5	1.76	39123				
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	Nob Hill							
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**

3 June 2022. Water temperature and salinity increased in the lower water column adjacent to the Venetian Court wall while oxygen decreased. Oxygen concentration and water temperature were excellent in the upper 1.5 meters of the water column and sharply went poorly in the saline lens in the lower 0.25 meters. For steelhead, water temperature went stressfully high to lethal at the bottom and oxygen went stressfully low to anaerobic at the bottom. Air temperature was a cool 14.9 C at 0828 hr.

			3 June 2022					
	Below Stockton Ave Bridge (Venetian Court Wall)			0828 hr	**Above Stockton Ave Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	18.8	0.6	10.90	987				
0.25	18.8	0.6	10.91	985				
0.50	18.8	0.6	11.14	991				
0.75	18.8	0.6	11.80	991				
1.00	18.8	0.6	11.24	1003				
1.25	19.9	0.7	12.9	1227				
1.50	24.0	3.7	13.24	6618				
1.75	25.3	12.3	2.36	21593				
1.85 bott	28.7	22.7	0	38878				
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	Nob Hill							
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**

11 June 2022. The first complete water quality monitoring of the season was accomplished after the sandbar had been closed on 26 May. Temperature probes were launched on 31 May in the lagoon and upstream. Gage height was 2.53 in morning and 2.52 in afternoon. Flume inlet 1.1 ft deep; flume outlet 0.8 ft deep in morning. Flume inlet 1.4 ft; flume outlet 0.7 ft in afternoon. Sky clear in morning and afternoon. Air temperature warm 16.8°C at 0718 hr; 18.7 C at 1601 hr.. Oxygen in the morning was 85-120% full saturation near the bottom and rated good at all 4 lagoon sites. Inflow oxygen in the morning was fair (69% full saturation) at Nob Hill. Oxygen in the afternoon was 135-169% full saturation near the bottom at all 4 lagoon sites. Water temperature ranged 19.9-21.0 °C in the morning near the bottom at the 3 shallow sites in the good to fair range, but was 25.5 C (critically high) in the saltwater lens near the bottom at Site 2. In the afternoon, water temperature near the bottom ranged 21.3-22.9 C (fair to poor) at the 3 shallow sites and 26.3 C (critically high) near the bottom at Site 2. No surface algae. Secchi depth to the bottom. No phytoplankton bloom. Pondweed was atypically abundant in early summer.

			11 June 2022					
	Flume		0718 hr	Air temp 16.8 C	**Belo Stockton Avenue Bridge**			0736 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.0	0.5	10.79	988	21.3	0.5	11.22	963
0.25	21.0	0.5	10.73	986	21.3	0.5	11.13	963
0.50	20.9	0.5	10.72	992	21.2	0.5	11.77	962
0.75	20.9	0.5	10.68	995 (120)	21.2	0.5	11.48	965
1.00 bott	21.3	0.5	10.32	1009	21.3	0.5	11.41	1021 (129)
1.25					21.8	0.7	11.12	1342
1.50					22.0	0.7	12.56	1399
1.75					25.5	3.8	8.52	6961
1.85 bott					27.6	15.0	0.21	25993
	Railroad Trestle			0759 hr	**Mouth of Noble Gulch**			0817 hr
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.9	0.5	9.96	904	20.1	.05	8.53	846
0.25	20.9	0.5	9.94	908	20.1	0.5	8.43	850
0.50	20.9	0.5	9.96	905	20.1	0.5	8.22	846
0.75	20.9	0.5	10.02	907	20.0	0.5	8.03	836
1.00	20.8	0.5	10.03	907	19.9	0.5	7.87(85)	826
1.25b	20.9	0.5	10.02 (112)	905	20.6	0.7	1.41	1292
1.42b	20.9	0..5		942				
	Nob Hill			0855 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	18.0	0.4	6.51 (69%)	681				

Station 1: Flume at 0718 hr- Air temp. 16.8°C. no surface algae and no planktonic algal bloom throughout the lagoon. Reach 1- 0 gulls bathing. Swallows overhead. Lagoon water level at near top of the flume. Shroud in place on restaurant side.
Station 2: Stockton Avenue Bridge at 0736- hr- No surface algae. No plankton bloom. Secchi depth to bottom. Reach 1 female mallard and 6 ducklings in water. 2 mallards on trestle abutment. 2 mallards on bulkhead west tide.
Station 3: Railroad Trestle at 0759 hr- No surface algae. Reach 3- 7 gulls, 2 mallards, 1 greenback heron roosting in willows. **1 western pond turtle on wood adjacent Golino cabin**. Swallows active.
Station 4: Mouth of Noble Gulch at 0801 hr. No surface algae. No gray water plume.
Station 5: Nob Hill at 0817 hr- Water temp. 1.9-2.9° C cooler than lagoon near the bottom in morning at 3 shallow sites above the saltwater lens. Oxygen 3.5-4.16 mg/l less than in lagoon in the morning at those sites. Streamflow – 1.75 cfs at Soquel Village gage.

			11 June 2022					
	Flume		1601 hr	Air temp 18.7 C	**Stockton Avenue Bridge**			1538 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.9	0.6	12.59	1085	23.1	0.5	13.18	999
0.25	22.9	0.6	12.84	1090	23.1	0.5	13.08	1014
0.50	22.9	0.6	12.83	1094	22.9	0.5	12.11	1007
0.75	22.9	0.6	12.75 (149)	1096	22.8	0.5	11.89	1001
1.00b	22.9	0.6	12.51	1096	22.5	0.5	11.71	1000
1.25					22.3	0.5	11.81	981
1.50					22.0	0.5	11.94(135)	1007
1.75					26.3	3.5	10.31	6440
1.85b					28.7	8.0	0.21	14989
	Railroad Trestle			1517 hr	**Mouth of Noble Gulch** 1500 hr			Air temp. 20.1 C
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	23.3	0.5	12.62	1028	23.0	0.5	11.31	940
0.25	23.2	0.5	12.83	1032	23.2	0.5	10.69	947
0.50	23.1	0.5	13.15	1028	22.7	0.5	10.92	954
0.75	22.8	0.5	13.62	1005	21.8	0.5	11.90	886
1.00	22.6	0.5	13.54	994	21.3	0.5	13.24(149)	868
1.25	22.0	0.5	14.65(169)	978	21.9	0.5	15.47	928
1.42b	21.8	0.5	14.45	988				
	Nob Hill			1700 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	20.6	0.4	9.19(101%)	719				

Station 1: Flume at 1601 hr- Air temp. 18.7 °C. No surface algae or planktonic algal bloom. Reach 1- only 3 gulls bathing, 26 waders, 1 paddleboard. 50% bottom pondweed (0.5-4 ft thick; avg= 3ft). 50% algal film to 0.3 ft; avg= 0.2ft. Gage height 2.52.
Station 2: Stockton Avenue Bridge at 1538 hr- <1% surface algae, no plankton bloom. Secchi depth to bottom. Reach 2- 6 mallards and 1 female mallard with 6 ducklings. 40% bottom pondweed (0.5-1.2 ft thick; avg= 1 ft). 50% algal film to 0.2 ft; avg= 0.1 ft.
Station 3: Railroad Trestle at 1517 hr- <1% surface algae. Reach 3- 53 gulls, 3 mallards, 2

kayakers. 30% bottom pondweed (0.5-2 ft thick; avg= 1 ft). 70% algal film to 0.2 ft; avg= 0.1ft.
Station 4: Mouth of Noble Gulch at 1500 hr. No surface algae. No gray water plume. 24 gulls on rooftops. 40% bottom pondweed (1-3 ft thick; avg= 2.5 ft). 60% algal film.
Station 5: Nob Hill at 1700 hr- Water temp. 0.7-2.3° C cooler than lagoon near the bottom in afternoon at 3 shallow sites above the saltwater lens. Oxygen 2.7-5.4 mg/l less than in lagoon at those sites.

17 June 2022. The lagoon was near maximum filling with a gage height of 2.52 and an air temperature of 13.5 C at 0736 hr. Water temperature cooled slightly near the bottom since 11 June, with a significant reduction in salinity. The saline layer was stagnant but becoming thinner and cooler. Oxygen levels had improved with aerobic conditions to the bottom beside the Venetian Wall.

			17 June 2022					
	Below Stockton Ave Bridge (Venetian Court Wall)			0736 hr	**Above Stockton Ave Bridge**			0759 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.7	0.5	13.05	952	20.9	0.5	12.01	948
0.25	20.8	0.5	13.15	961	20.9	0.5	11.99	951
0.50	20.8	0.5	13.06	959	20.9	0.5	11.99	952
0.75	20.9	0.5	12.80	964	20.9	0.5	11.98	952
1.00	20.8	0.5	12.91	965	20.9	0.5	12.05(134)	952
1.25 bott	20.8	0.5	12.91	967	20.9	0.5	11.44	953
1.50	20.8	0.5	12.74(142)	977				
1.75	21.6	0.7	13.00	1235				
1.85 bott	23.6	2.7	6.75	4896				
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	Nob Hill							
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**

25 June 2022. Gage height was 2.50 morning and afternoon. Sand berm built up around the lagoon margin. Flume inlet 1.1 ft. Flume outlet 1.0 ft (incoming tide). No sinkholes on beach. Sky overcast

in morning and clear and breezy in afternoon. Air temp. 13.3 °C (morning); 17.2 C (afternoon at flume); 22.3 C afternoon at Noble Gulch). Saline lens dissipated adjacent Venetian Court wall. Shroud removed. Oxygen was 62-85% full saturation in the morning near the bottom and fair to good; 94-134% full saturation in the morning near the bottom and good. Oxygen at Nob Hill inflow was 67% full saturation and fair in the morning and 120% full saturation and good in the afternoon. Water temperature ranged 18.8-21.0 ° C in the morning in the lagoon near the bottom and good to poor, it being approximately 3-5°C warmer than the stream inflow water temperature. No surface algae. Secchi depth to the bottom.

			25 June 2022					
	Flume		0723 hr		**Stockton Avenue Bridge**			0739 hr
Depth	**Temp 1**	**Salin 1**	**O2 1(sat.)**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2 (sat.)**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.8	0.5	11.67	869	20.9	0.5	12.17	862
0.25	20.7	0.5	11.69	876	20.9	0.5	12.16	875
0.50	20.8	0.5	11.79	876	20.9	0.5	12.16	876
0.75	20.7	0.5	11..82(132)	876	21.0	0.5	11.47	876
1.00b	20.7	0.5	11.46	875	21.0	0.5	11.91	878
1.25					21.0	0.5	12.03	879
1.50					21.0	0.5	12.01	877(134)
1.75b					20.9	0.5	11.55	875
	Railroad Trestle			0759 hr	**Mouth of Noble Gulch**			0819 hr
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4(sat.)**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	20.8	0.4	11.13	825	19.3	0.4	8.95	788
0.25	20.8	0.4	11.08	829	19.2	0.4	8.98	795
0.50	20.8	0.4	11.11	829	19.2	0.4	9.01	788
0.75	20.8	0.4	11.11	828	19.1	0.4	8.80	786
1.00	20.8	0.4	11.12	828	18.8	0.4	8.78 (94)	758
1.25b	20.8	0.4	11.10(124)	828	20.8	0.7	1.96	1712
1.45b	20.8	0.4	9.66	828				
	Nob Hill			0854 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	16.0	**0.4**	**6.62 (67%)**	**624**				

Station 1: Flume at 0723 hr- Air temp. 13.3 C. no surface algae. Reach 1- 6 gulls bathing ; 1 female mallard and 3 ducklings: 1 female merganser and 3 ducklings.
Station 2: Stockton Avenue Bridge at 0739- hr- No surface algae. Secchi depth to bottom. Reach 2- 6 adult mallards in water with 1 female mallard and 1 small duckling, 3 mallards roosting on Michelle's dock near railroad trestle.
Station 3: Railroad Trestle at 0759 hr- no surface algae. Reach 3- 7 mallards in water being fed by 2 women 50 m downstream of Noble Gulch. Male mallards molting. Steelhead hitting surface 150 hits/min above trestle at 0802 hr..

Station 4: Mouth of Noble Gulch at 0819 hr. No surface algae. No gray water plume. 2 mergansers roosting on emergent wood near Golino cabin.
Station 5: Nob Hill at 0854 hr- Water temp. 3-5° C cooler than lagoon near the bottom in morning. Oxygen 2-5.4 mg/l less than at lagoon sites near the bottom in the morning. Streamflow – 1.2 cfs at Soquel Village gage.

			25 June 2022					
	Flume		1601 hr		**Stockton Avenue Bridge**			1545 hr
Depth	**Temp 1**	**Salin 1**	**O2 1(sat.)**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2 (sat.)**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.1	0.5	18.06	881	22.3	0.5	16.76	979
0.25	22.2	0.5	18.44	884	22.3	0.5	16.96	882
0.50	22.2	0.5	19.29	884	22.3	0.5	16.79	883
0.75	22.1	0.5	19.63 (226)	875	22.1	0.5	16.05	880
1.00b	22.1	0.5	18.23	873	22.1	0.5	15.93	878
1.25					22.0	0.5	16.17	878
1.50					21.8	0.5	17.36 (199)	878
1.75b					21.6	0.5	14.92	877
	Railroad Trestle			1528 hr	**Mouth of Noble Gulch**			1504 hr
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4(sat.)**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	21.9	0.4	15.71	858	22.4	0.4	13.51	855
0.25	22.2	0.4	15.85	863	22.2	0.4	13.46	849
0.50	22.1	0.4	15.88	8/59	21.9	0.4	14.01	840
0.75	22.0	0.4	15.23	853	20.8	0.4	17.45	820
1.00	21.5	0.4	15.56	841	20.6	0.4	17.41 (194)	/824
1.25b	21.3	0.4	15.03 (170)	835	21.3	0.8	6.03	1508
1.45b	20.9	0.4	16.43	831				
	Nob Hill			1652 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	18.8	**0.4**	**11.17 (120)**	**677**				

Station 1: Flume at 1601 hr- Air temp. 17.2 C. No surface algae. Reach 1- 15 gulls bathing ; 17 adult mallards and 5 ducklings. 40% pondweed 3-5 ft thick; avg 4 ft; remainder of lagoon invisible with phytoplankton bloom. 22 waders, 1 paddle boarders.
Station 2: Stockton Avenue Bridge at 1545- hr- No surface algae. Secchi depth to bottom. R-2 3 mallards, 5 gulls on trestle. 40% bottom pondweed 1-3 ft thick avg 2 ft; 60% bottom algae 0.5-1.5 ft thick: avg 1.0 ft. 3 paddle boarders.
Station 3: Railroad Trestle at 1528 hr- No surface algae. Reach 3- 11 adult mallards and 3

ducklings in water,4 mallards roosting on barge. 19 gulls in water, 2 gulls roosting on wood. R-3 70% bottom algae 0.5-1.5 ft thick: avg 1 ft; 30% pondweed 1-2 ft thick; avg 1 ft.
Station 4: Mouth of Noble Gulch at 1504 hr. No surface algae. No gray water plume. 30% pondweed 2-4 ft thick, avg 3.5 ft; 60% bottom algae 1-2 ft thick; avg 1.0 ft; remainder algal film.
Station 5: Nob Hill at 1652 hr- Water temp. 2-3 °C cooler than lagoon near the bottom in afternoon. Oxygen less than in lagoon near the bottom in the afternoon but supersaturated.

8 July 2022. Gage height of 2.56 in morning and 2.57 in afternoon. Flume inlet 1.1 ft. Flume outlet 0.8 ft with tidal influence at outlet. No flume underflow or sink holes on beach. Clear sky at 0717 hr; air temperature of 14.7 C. Morning oxygen levels were good (87% – 139% super saturation), oxygen concentration similar to 2 weeks previous in morning with warmer water temperatures in the fair to poor range near the bottom (20.5-21.9 C). Secchi depth to bottom. Flume inlet 1.2 ft. Flume outlet 1.2 ft on incoming tide. Oxygen levels supersaturated in afternoon near the bottom (159-197%) with warmer water temperatures than 2 weeks previous near the bottom (21.7-23.1 C).

			8-July-2022					
	Flume			0717 hr	**Stockton Avenue Bridge**			0734 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.3	0.4	12.70	804	22.0	0.4	13.39	816
0.25	21.3	0.4	12.74	804	22.0	0.4	13.25	818
0.50	21.3	0.4	12.84	804	22.0	0.4	13.70	818
0.75	21.3	0.4	12.80	804	22.0	0.4	13.37	817
1.00b	21.3	0.4	12.66	803	21.9	0.4	12.88	822
1.25					21.8	0.4	12.65	825
1.50					21.8	0.4	12.37	827
1.75					21.8	0.4	12.46 (139)	826
1.80b					21.8	0.4	11.62	827
	Railroad Trestle			0751 hr	**Mouth of Noble Gulch**			0810 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.9	0.4	12.95	813	20.5	0.4	9.22	
0.25	21.9	0.4	12.80	813	20.5	0.4	9.21	
0.50	21.9	0.4	12.78	813	20.5	0.4	9.20	
0.75	21.9	0.4	12.69	814	20.5	0.4	9.20	
1.00	21.9	0.4	11.52	814	20.5	0.4	9.28 (103)	
1.25b	21.9	0.4	7.68 (87)	817	21.2	0.7	0.53	
1.45b	21.8	0.4	3.81	828				
	Nob Hill			0839 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	17.2	0.4	6.40 (66%)	647				

Station 1: Flume 0717 hr. Reach 1- 6 gulls bathing. 4 adult mallards and 1 duckling. No surface algae.
Station 2: Stockton Bridge 0734 hr. Reach 2- 15 mallards in water, 1 mallard on trestle abutment, 1 cormorant. No surface algae.
Station 3: Railroad trestle 0751 hr. Reach 3- 5 mallards, 3 gulls, 4 mergansers fishing. Children feeding ducks at Stockton Bridge. No surface algae.
Station 4: Noble Gulch 0810 hr. No surface algae or gray water.
Station 5: Nob Hill at 0839 hr. 0.8° C cooler water temperature than 2 weeks previous and 3-4.5 °C cooler than lagoon near bottom. Streamflow– 0.88 cfs at Soquel Village gage.

			8-July-2022					
	Flume			1600 hr	**Stockton Avenue Bridge**			1544 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	23.1	0.4	14.93	831	23.7	0.4	14.87	839
0.25	23.1	0.4	16.65	830	23.6	0.4	15.11	841
0.50	23.1	0.4	16.98	829	23.5	0.4	14.26	837
0.75	23.1	0.4	16.79 (197)	829	23.3	0.4	13.90	831
1.00b	23.1	0.4	16.04	826	23.2	0.4	13.63	834
1.25					22.7	0.4	14.03	830
1.50					22.5	0.4	14.04	827
1.75					22.4	0.4	13.78 (159)	825
1.85b					22.3	0.4	11.10	827
	Railroad Trestle			1528 hr	**Mouth of Noble Gulch**			1507 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	24.5	0.4	16.33	843	24.7	0.4	14.20	864
0.25	24.4	0.4	13.27	848	24.7	0.4	14.21	863
0.50	24.0	0.4	15.54	844	22.7	0.4	15.44	828
0.75	23.6	0.4	15.22	838	21.8	0.4	15.65	809
1.00	23.0	0.4	15.24	825	21.7	0.4	15.61 (177)	807
1.25b	22.3	0.4	14.73 (169)	821	20.8	0.4	9.84	794
1.45b	22.1	0.4	11.86	825				
	Nob Hill			1647 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	20.2	0.4	8.19 (90%)	695				

Station 1: Flume 1600 hr. Reach 1- 24 gulls bathing. 1 adult mallard, 1 female merganser and 2 ducklings. <1% surface algae. Clear sky and breezy. 30% pondweed 4-5.5 ft thick; avg 5 ft. 70% algae 2-4 ft thick; 3 ft avg. 6 waders.
Station 2: Stockton Bridge 1544 hr. Reach 2- 3 adult mallards, 1 merganser, 8 gulls on trestle. <1% surface algae. 70% pondweed 2-4 ft thick; avg 3.5 ft. 70% bottom algae 1-3 ft thick; avg 2 ft.
Station 3: Railroad trestle 1528 hr. Reach 3- 14 adult mallards and 5 ducklings, 1 merganser, 4 paddle boarders. <1% surface algae.70% bottom algae 1-3 ft thick; avg 2 ft. 30% pondweed 2-4 ft thick; avg 3 ft.
Station 4: Noble Gulch 1507 hr. air temperature 24.8 C. 5% surface algae, no gray water. 60% bottom algae 1.5 ft thick; 40% pondweed 3-3.5 ft thick; avg 3.25.
Station 5: Nob Hill at 1647 hr. 0.4 °C cooler water temperature than 2 weeks previous and 1.5-2.9 °C cooler than lagoon near bottom.

23 July 2022. Gage height of 2.55 in morning. Overcast at 0730 hr. Flume inlet 1.1 ft. Flume outlet 0.8 ft. Air temperature of 13.4 C. Morning oxygen levels were good at super saturation near the bottom, oxygen similarly high as 2 weeks previous in morning with 0.5-1.1 C cooler water temperatures in the fair to good range near the bottom (19.6-21.4 C). Secchi depth to bottom. Gage height of 2.56 in the afternoon. Flume inlet 1.1 ft. Flume outlet 1.0 ft on incoming tide. Oxygen levels were very supersaturated in the afternoon at all 4 sites near the bottom (174-200%) with cooler water temperatures than 2 weeks previous near the bottom (19.9-22.5 C).

			23-July-2022					
	Flume			0730 hr	**Stockton Avenue Bridge**			0748 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.0	0.4	12.49	782	21.3	0.4	13.42	784
0.25	21.0	0.4	12.47	785	21.4	0.4	13.19	795
0.50	21.0	0.4	12.44	785	21.4	0.4	13.27	795
0.75	21.0	0.4	12.47 (140)	785	21.4	0.4	13.01	795
1.00b	21.0	0.4	12.02	785	21.4	0.4	11.61	795
1.25					21.3	0.4	12.06	794
1.50					21.2	0.4	12.02	794
1.75					21.2	0.4	11.95	791
1.85b					21.3	0.4	11.64	791
	Railroad Trestle			0815 hr	**Mouth of Noble Gulch**			0832 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.4	0.4	13.22	791	19.6	0.4	11.63	780
0.25	21.4	0.4	13.15	796	19.6	0.4	11.52	791
0.50	21.4	0.4	13.16	797	19.6	0.4	11.49	790
0.75	21.4	0.4	13.38	796	19.6	0.4	11.57	790
1.00	21.4	0.4	12.83	796	19.5	0.4	10.67	777
1.25b	21.4	0.4	13.28	795	20.8	1.2	0.45	2122
1.45b	21.5	0.4	3.93	815				
	Nob Hill			0904 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	16.1	0.4	6.39	618				

Station 1: Flume 0730 hr. Reach 1- 8 gulls bathing, No surface algae.
Station 2: Stockton Bridge 0748 hr. Reach 2- 7 mallards in water, 1 merganser, 1 pied billed grebe, 1 paddle boarder. 3 people feeding ducks at Stockton Bridge No surface algae.
Station 3: Railroad trestle 0815 hr. Reach 3- 22 adult mallards and 2 ducklings, 3 mergansers, 4 paddle boarders. No surface algae.
Station 4: Noble Gulch 0832 hr. No surface algae or gray water. 1 female mallard and 4 ducklings paddle out from Noble Gulch culvert.
Station 5: Nob Hill at 0904 hr. 1.1° C cooler water temperature than 2 weeks previous and 3.4-5.3°C cooler than lagoon near bottom. Streamflow– 0.78 cfs at Soquel Village gage.

			23-July-2022					
	Flume			1550 hr	**Stockton Avenue Bridge**			1535 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.5	0.4	16.44	803	22.7	0.4	15.25	810
0.25	22.5	0.4	16.94	844	22.6	0.4	15.29	810
0.50	22.5	0.4	17.06	802	22.5	0.4	15.36	809
0.75	22.5	0.4	17.36 (200)	802	22.5	0.4	15.18	808
1.00b	22.5	0.4	17.21	802	22.3	0.4	14.62	804
1.25					22.0	0.4	15.55	804
1.50					21.9	0.4	16.84 (193)	798
1.75b					21.7	0.4	12.70	804
	Railroad Trestle			1511 hr	**Mouth of Noble Gulch**			1500 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	23.0	0.4	16.58	809	22.7	0.4	14.24	838
0.25	22.9	0.4	16.63	812	22.3	0.4	15.12	832
0.50	22.6	0.4	16.85	811	21.3	0.4	15.42	812
0.75	22.2	0.4	18.30	804	20.4	0.4	15.21	794
1.00	21.8	0.4	19.08	800	19.9	0.4	15.78 (174)	781
1.25 b	21.6	0.4	15.35 (175)	802	20.8	0.7	6.83	1331
1.45b	21.7	0.4	7.97	812				
	Nob Hill			1635 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	19.1	0.4	8.56 (92)	658				

Station 1: Flume 1550 hr. Reach 1- 46 gulls, 9 adult mallards, 5 paddle boarder, 7 waders. 1% surface algae. Clear and breezy. 50% pondweed 3-5 ft thick; avg 4 ft. 50% bottom algae 1-3 ft thick; avg 2 ft.
Station 2: Stockton Bridge 1535 hr. Reach 2- 11 adult mallards and 2 ducklings, 3 paddle boarders. 3 adults feeding ducks at Stockton Bridge. <1% surface algae. 70% pondweed 2-5 ft thick; avg 3.5 ft. 30% bottom algae 0.5-2 ft thick; avg 1 ft.
Station 3: Railroad trestle 1515 hr. Reach 3- 27 adult mallards, 5 gulls, 1 merganser, 3 greenback herons roosting in willows, 4 paddle boarders. <1% surface algae. 30% bottom algae 0.5-2 ft thick; avg 1 ft. 70% pondweed 1-4 ft thick; avg 3 ft.
Station 4: Noble Gulch 1500 hr. 1% surface algae. No gray water. 40% pondweed 1-4 ft thick; avg 3.5 ft. Phytoplankton bloom prevented algae estimate due to restricted visibility.
Station 5: Nob Hill at 1635 hr. 1.1° C cooler water temperature than 2 weeks previous and 0.8-2.4 °C cooler than the lagoon near bottom.

7 August 2022. Gage height of 2.52 in morning with high clouds and some sun. Flume inlet 1.1 ft. Flume outlet 0.8 ft. Exit bars in place. Air temperature of 14.1 C. Morning oxygen levels were good (87% – super saturation near the bottom), oxygen similar to 2 weeks previous in morning with warmer water temperatures in the poor range near the bottom (21.5-22.9 C). Secchi depth to bottom. Gage height of 2.53 in the afternoon. Flume inlet 1.3 ft. Flume outlet 0.9 ft with tidal

influence. Clear sky. Oxygen levels very supersaturated in afternoon at all 4 sites (165-191%) with warmer water temperatures in the afternoon than 2 weeks previous near the bottom (22.4-24.4 C). These were the warmest water temperatures monitored during 2 week interval monitorings in 2022.

				7-August-2022				
	Flume			0722 hr	**Stockton Avenue Bridge**			0739 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.3	0.4	12.07	773	22.8	0.4	13.16	779
0.25	22.4	0.4	12.12	779	22.8	0.4	13.27	787
0.50	22.3	0.4	12.19	779	22.9	0.4	13.25	787
0.75	22.3	0.4	12.26	779	22.9	0.4	12.97	786
1.00b	22.4	0.4	11.96	779	22.9	0.4	12.83	788
1.25					22.9	0.4	12.85	788
1.50					22.9	0.4	12.82	788
1.75					22.9	0.4	12.67	788
1.85b					22.9	0.4	12.04	788
	Railroad Trestle			0800 hr	**Mouth of Noble Gulch**			0815 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.7	0.4	13.65	784	21.7	0.4	14.48	784
0.25	22.7	0.4	11.88	791	21.7	0.4	14.86	785
0.50	22.7	0.4	14.02	791	21.7	0.4	15.09	786
0.75	22.8	0.4	14.08	791	21.6	0.4	14.69	784
1.00	22.7	0.4	14.05	792	21.5	0.4	7.37	842
1.25b	22.7	0.4	13.92	791	22.6	1.9	0	3481
145b	22.7	0.4	11.88	792				
1.50								
	Nob Hill			0848 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	7.6	0.4	7.04 (74%)	645				

Station 1: Flume 0722 hr. Reach 1- 14 gulls bathing. 11 adult mallards and 2 large ducklings in water, 4 mallards roosting on sandy margin at Venetian Courts. No surface algae.
Station 2: Stockton Bridge 0739 hr. Reach 2- From Reach 1- 11 adult mallards and 2 ducklings. In addition in Reach 2 – 14 adult mallards and 3 ducklings, 6 mergansers and 1 Canada goose. No surface algae.
Station 3: Railroad trestle 0800 hr. Reach 3- 7 adult mallards and 2 coots in water; 2 mallards roosting on emergent wood adjacent Molino property.1 kingfisher overhead. No surface algae.
Station 4: Noble Gulch 0815 hr. No surface algae or gray water.
Station 5: Nob Hill at 0848 hr. 1.5 °C warmer water temperature than 2 weeks previous and 3.9 – 5.3 °C warmer than lagoon near bottom. Streamflow– 0.95 cfs at Soquel Village gage.

				7-August-2022				
	Flume			1610 hr	**Stockton Avenue Bridge**			1555 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	24.4	0.4	15.24	803	24.4	0.4	13.44	810
0.25	24.5	0.4	15.79	806	24.4	0.4	14.57	813
0.50	24.5	0.4	15.91	807	24.4	0.4	13.15	813
0.75	24.5	0.4	15.88 (191)	807	24.3	0.4	13.11	812
1.00b	24.5	0.4	14.52	807	24.2	0.4	12.98	811
1.25					24.0	0.4	12.21	808
1.50					23.9	0.4	12.77	807
1.75					23.8	0.4	12.47 (148)	803
1.83b					23.5	0.4	10.27	801
	Railroad Trestle			1537 hr	**Mouth of Noble Gulch**			1511 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	24.7	0.4	13.15	821	25.4	0.4	15.65	835
0.25	24.7	0.4	13.16	825	25.3	0.4	15.61	834
0.50	24.7	0.4	13.60	825	24.7	0.4	15.47	829
0.75	24.5	0.4	14.81	822	23.3	0.4	15.37	807
1.00	24.2	0.4	14.41	816	22.4	0.4	15.41 (175)	862
1.25b	2307	0.4	14.01 (165)	811	22.3	0.7	2.67	1191
1.45b	23.2	0.4	10.11	810				
	Nob Hill			1700 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	20.9	0.4	7.75 (86%)	679				

Station 1: Flume 1610 hr. Air temp. = 19.8 C. Reach 1- 46 gulls bathing (some Hermann's). 2 adult mallards + 8 mallards from Reach 2, 11 waders. No surface algae. 60% Pondweed 3-4.5 ft thick; avg 3.5 ft. 35% bottom algae approx. 1.0 ft thick.
Station 2: Stockton Bridge 1555 hr. Reach 2- 8 adult mallards, 1 greenback heron. 2 paddle boarders. 1% surface algae. 40% Pondweed 1.5-3.5 ft thick; avg 2.5 ft. 60% approx 1 ft thick.
Station 3: Railroad trestle 1537 hr. Reach 3- 11 gulls. 13 adult mallards in water; 4 mallards roosting on emergent wood. 4 mergansers in water; 3 mergansers roosting on emergent wood. 1 pied billed grebe.. 1% surface algae. 60% bottom algae 0.2-1.0 ft thick; avg 1.0 ft. 40% pondweed 1-3 ft thick; avg 2 ft. Pondweed looks like it is dying as it is covered with thick algae.
Station 4: Noble Gulch 1511 hr. Air temp. = 21.7 C. No surface algae or gray water. 40% bottom algae 0.2-1.5 ft thick; avg 1 ft. 60% pondweed 2-4 ft thick; avg 3.5 ft.
Station 5: Nob Hill at 1700 hr. 1.8 °C warmer water temperature than 2 weeks previous and 1.5-3.5 °C cooler than lagoon near bottom.

21 August 2022. Gage height of 2.52 in morning. Flume inlet 1 ft. Flume outlet 0.8 ft at low tide. Air temperature of 14.3 C at 718 hr. Overcast. Morning oxygen levels good (105% – 121% super

saturation near the bottom), oxygen lower than 2 weeks previous in morning (except at mouth of Noble Gulch) with much cooler water temperatures in the good to fair range near the bottom (19.3-21 C). Secchi depth to bottom. Gage height of 2.54 in the afternoon. Still overcast and also breezy. Oxygen levels higher in afternoon at all 4 sites (111-172%) with much cooler water temperatures than 2 weeks previous near the bottom (19.3-21.7 C) in the afternoon.

			21-August-2022					
	Flume			0718 hr	**Stockton Avenue Bridge**			0737 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.7	0.4	9.83	780	20.9	0.4	9.93	803
0.25	20.7	0.4	9.86	805	20.9	0.4	9.97	808
0.50	20.7	0.4	9.86	806	20.9	0.4	9.60	810
0.75	20.7	0.4	9.84	806	21.0	0.4	9.64	811
1.00b	20.7	0.4	9.55	807	21.0	0.4	9.93	811
1.25					21.0	0.4	10.05	811
1.50					21.0	0.4	10.12	811
1.75					21.0	0.4	10.00 (112)	811
1.81b					21.0	0.4	8.64	811
	Railroad Trestle			0756 hr	**Mouth of Noble Gulch**			0813 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.8	0.4	10.65	817	19.5	0.4	10.24	751
0.25	20.8	0.4	10.78	820	19.5	0.4	10.25	765
0.50	20.8	0.4	10.82	820	19.5	0.4	10.24	763
0.75	20.8	0.4	10.84	820	19.5	0.4	10.25	763
1.00	20.8	0.4	10.87	820	19.3	0.4	9.66 (105)	755
1.25b	20.8	0.4	10.77 (121)	820	20.8	1.3	0	2230
138b	20.8	0.4	9.84					
1.50								
	Nob Hill			0844 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	16.2	0.3	6.32 (64%)	582				

Station 1: Flume 0718 hr. Reach 1- 57 gulls bathing. 2 adult mallards in water. 5% surface algae.
Station 2: Stockton Bridge 0737 hr. Reach 2- 1 mallard in water; 3 mallards on trestle abutment. 10% surface algae and pondweed fragments.
Station 3: Railroad trestle 0756 hr. Reach 3- 11 adult mallards, 1 cormorant, black crowned night heron perched on willow. 15% surface algae and pondweed fragments.
Station 4: Noble Gulch 0813 hr. 15% surface algae and pondweed fragments. No gray water.
Station 5: Nob Hill at 0844 hr. 1.4 °C cooler water temperature than 2 weeks previous and 3.1-4.8 °C cooler than lagoon near bottom. Streamflow– 1.21 cfs at Soquel Village gage.

				21-August-2022				
	Flume			1555 hr	**Stockton Avenue Bridge**			1535 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.7	0.4	13.66	814	21.6	0.4	13.42	
0.25	21.7	0.4	14.82	814	21.6	0.4	13.64	
0.50	21.7	0.4	14.99	814	21.6	0.4	13.22	
0.75	21.7	0.4	15.11 (172)	814	21.4	0.4	13.17	
1.00b	21.7	0.4	15.02	814	21.3	0.4	13.07	
1.25					21.2	0.4	12.76	
1.50					21.2	0.4	12.88	
1.75					21.1	0.4	12.93 (146)	
1.80b					21.2	0.4	11.01	
	Railroad Trestle			1519 hr	**Mouth of Noble Gulch**			1500 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.5	0.4	12.84	821	20.9	0.4	16.44	781
0.25	21.5	0.4	13.09	823	20.8	0.4	16.09	775
0.50	21.5	0.4	13.18	823	20.5	0.4	15.35	771
0.75	21.5	0.4	13.28	823	19.8	0.4	14.08	735
1.00	21.0	0.4	12.21	822	19.3	0.4	11.72	711
1.25b	20.8	0.4	9.84 (110)	835	20.6	0.4	0.80	1005
1.37b	20.8	0.4	8.63	837				
	Nob Hill			1643 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	17.7	0.4	11.29 (125%)	621				

Station 1: Flume 1555 hr. Air temp. = 17.6 C. Reach 1- 136 gulls bathing (some Hermann's). 14 adult mallards, 4 mergansers from upstream. Inshore breeze No surface algae. Pondweed with attached algae visible adjacent Margaritaville 3-4 ft thick with remainder invisible.
Station 2: Stockton Bridge 1535 hr. Reach 2- 3 mergansers roosting on Michelle's dock near trestle and flushed into the water. 2% surface algae and pondweed fragments. 70% pondweed with algae 2.5-4 ft thick; avg 3 ft. remainder invisible.
Station 3: Railroad trestle 1519 hr. Reach 3- 3 adult mallards, 1 merganser, 2 coots, 4 paddle boarders. 15% surface algae and pondweed fragments. 80% pondweed with algae 3-4.5 ft thick; avg 4 ft, remainder invisible.
Station 4: Noble Gulch 1500 hr. 15% surface algae or gray water. 60% bottom algae 1 ft thick. 40% pondweed 3-4 ft thick; avg 3.8 ft.
Station 5: Nob Hill at 1642 hr. 2.8 °C cooler water temperature than 2 weeks previous and 1.7- 4 °C cooler than lagoon near bottom.

4 September 2022. Gage height of 2.52 in morning. Flume inlet 0.9 ft. Flume outlet 0.5 ft across outlet sill at low tide. Air temperature of 15.3 C at 0708 hr, with clear sky. Morning oxygen levels fair to very good (72% – 146% saturation near the bottom), oxygen mostly higher than 2 weeks previous in morning with slightly higher water temperatures in the fair range near the bottom (20.0-21.3 C). Secchi depth to bottom. Gage height of 2.52 in the afternoon. Flume inlet 2.1 ft. Flume outlet 0.5 ft with sand partially obstructing outlet. Clear sky. Oxygen levels supersaturated in afternoon at all 4 sites (142-187%) with significantly warmer water temperatures near the bottom to 2 weeks previous when it was overcast (21.7-22.7 C). We were experiencing a heat wave with 100+ °F air temperatures inland. Highest surface water temperature of the season was measured in the afternoon at the mouth of Noble Gulch, 25.1 °C.

			4-September-2022					
	Flume			0708 hr	**Stockton Avenue Bridge**			0728 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.8	0.4	12.98	781	21.2	0.4	12.33	786
0.25	20.8	0.4	13.11	782	21.2	0.4	12.55	793
0.50	20.8	0.4	13.11	782	21.3	0.4	12.52	793
0.75	20.8	0.4	13.11 (146)	783	21.4	0.4	12.10	796
1.00b	20.8	0.4	12.76	783	21.3	0.4	12.46	795
1.25					21.3	0.4	12.69	794
1.50					21.3	0.4	12.76 (145)	794
1.75b					21.3	0.4	12.42	794
	Railroad Trestle			0753 hr	**Mouth of Noble Gulch**			0811 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.1	0.4	11.66	800	20.1	0.4	11.27	753
0.25	21.1	0.4	11.81	802	20.1	0.4	11.36	757
0.50	21.1	0.4	11.85	802	20.1	0.4	11.49	757
0.75	21.1	0.4	11.70	803	20.0	0.4	11.22	756
1.00 b	21.1	0.4	11.71	802	21.3	2.3	0.32	3870
1.25	21.2	0.5	6.63	855				
138b	21.2	0.5	5.06	868				
	Nob Hill			0843 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	16.6	0.4	6.93 (71)	602				

Station 1: Flume 0708 hr. Reach 1- 42 gulls (Western and Hermann's). 3 mallards. <1% surf. algae.
Station 2: Stockton Bridge 0728 hr. Reach 2- 3 mallards from Reach 1 and 1 gray domestic duck (white breast) in water. 3 mallards roosting on trestle abutment. 2 mergansers roosting on moored kayak. 5% surface algae.
Station 3: Railroad trestle 0753 hr. Reach 3- 6 adult mallards. 25% surface algae and pondweed fragments.
Station 4: Noble Gulch 0811 hr. 40% surface algae and pondweed fragments and no gray water.
Station 5: Nob Hill at 0843 hr. 0.9° C warmer water temperature than 2 weeks previous and 3.4-4.7 °C cooler than lagoon near bottom. Streamflow– 0.64 cfs at Soquel Village gage.

			4 September-2022					
	Flume			1601 hr	**Stockton Avenue Bridge**			1547 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.7	0.4	14.27	811	23.0	0.4	14.23	817
0.25	22.7	0.4	15.60	813	23.1	0.4	14.54	819
0.50	22.7	0.4	15.91	811	23.0	0.4	14.40	819
0.75	22.7	0.4	16.09 (187)	810	22.8	0.4	13.10	818
1.00b	22.7	0.4	13.61	810	22.5	0.4	12.36	816
1.25					22.0	0.4	11.77	810
1.50					21.8	0.4	12.42 (142)	806
1.75b					21.6	0.4	9.33	805
	Railroad Trestle			1530 hr	**Mouth of Noble Gulch**			1515 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	23.9	0.4	13.74	832	25.1	0.4	16.17	861
0.25	23.7	0.4	14.82	832	23.9	0.4	15.62	850
0.50	23.5	0.4	14.61	829	22.9	0.4	14.37	824
0.75	23.1	0.4	14.42	823	21.7	0.4	14.01 (160)	795
1.00b	22.2	0.4	12.96	814	21.9	1.2	0.51	2053
1.25	21.7	0.4	11.51 (131)	820				
1.45b	21.5	0.4	6.46	825				
	Nob Hill			1652 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	19.7	0.4	9.35 (102%)	660				

Station 1: Flume 1601 hr. Air temp. = 18.6 C. Reach 1- 67 gulls bathing (Western and Hermann's). 5 adult mallards adjacent Margaritaville, 1 merganser from Reach 2, 4 brown pelicans, 19 waders, 1 barge, 2 paddle boarders . 7% surface algae and pondweed fragments. 60% Pondweed 3-5 ft thick; avg 4.5 ft. 30% bottom algae 2 ft thick, remaining 10%r was algal film.
Station 2: Stockton Bridge 1547 hr. Reach 2- 1 merganser, 5 paddle boarders, 1 canoe. 15% surface algae and pondweed fragments. 30% bottom algae 1.5 ft thick,70% pondweed with algae 3-5 ft thick; avg 3.5 ft.
Station 3: Railroad trestle 1530 hr. Reach 3- 13 adult mallards, 2 coots, 2 paddle boarders. 30% surface algae. 20% bottom algae 2 ft thick. 80% pondweed with algae 3-5 ft thick; avg 3.5 ft.
Station 4: Noble Gulch 1515 hr. Air temp. = 19.5 C. 1 western pond turtle basking on Arthur dock, 40% surface algae. No gray water. 50% bottom algae 1 ft thick; 50% pondweed with algae 3-3.5 ft thick; avg 3.4 ft..
Station 5: Nob Hill at 1652 hr. 2 °C warmer water temperature than 2 weeks previous and 2- 3 °C cooler than lagoon near bottom.

17 September 2022. Gage height of 2.30 in morning. One board removed from flume inlet on Esplanade side. Notch observed cut through the beach with berms at the surf and along the lagoon margin. Partly cloudy. Flume inlet 1.05 ft. Flume outlet 0.6 ft. Air temperature of 15 C at 0721 hr. Morning oxygen levels fair to good (76% – 95% saturation near the bottom), oxygen concentration much lower than 2 weeks previous in morning with cooler water temperatures in the fair to good range near the bottom (19.6-20.8 C). Secchi depth to bottom. Gage height of 2.27 in the afternoon. Flume inlet 1.7 ft. Flume outlet 0.7-1.0 ft with tidal influence. Clear and breezy. Oxygen levels supersaturated in afternoon at only the flume site near the bottom (87-148%) with cooler water temperatures compared to 2 weeks previous near the bottom (20.0-21.9 C) in the afternoon. Later in the afternoon, a total of 4 boards were removed on the Esplanade side of the flume inlet, along with the bars at the flume outlet. Notch cut in sandbar.

			17 September-2022					
	Flume			0721 hr	**Stockton Avenue Bridge**			0740 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.3	0.4	8.51	814	0.4	20.7	8.62	818
0.25	20.3	0.4	8.54	816	0.4	20.7	8.51	825
0.50	20.3	0.4	8.52	816	0.4	20.7	8.12	825
0.75	20.3	0.4	8.58 (95)	816	0.4		7.85	826
0.87b	20.3	0.4	7.01	815		20.8		
1.00					0.4	20.8	7.84	826
1.25					0.4	20.8	7.17	826
1.50					0.4	20.8	7.92 (89)	825
1.75b					0.4	20.8	7.32	825
	Railroad Trestle			0805 hr	**Mouth of Noble Gulch**			0820 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.6	0.5	7.38	838	19.6	0.5	7.50	823
0.25	20.6	0.5	7.17	842	19.6	0.5	7.17	828
0.50	20.6	0.5	7.20	842	19.6	0.5	7.15	830
0.75	20.6	0.5	7.27	842	19.6	0.5	7.14	830
1.00	20.6	0.5	7.25	843	19.6	0.5	6.99 (76)	830
1.20b					20.8	0.7	0.31	1305
1.25	20.6	0.5	7.12	843				
132b	20.6	0.5	6.19	843				
	Nob Hill			0856 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	16.6	0.3	6.06 (61%)	574				

Station 1: Flume 0721 hr. Reach 1- 15 gulls bathing, 4 mallards. <1% surface algae.
Station 2: Stockton Bridge 0740 hr. Reach 2- 23 mallards. <1% surface algae.
Station 3: Railroad trestle 0805 hr. Reach 3- 3 mallards roosting on emergent wood, 2 mallards on moored barge, 1 domestic gray duck in water, 3 coots. 15% surface algae and pondweed fragments.

Station 4: Noble Gulch 0820 hr. 10% surface algae and no gray water.
Station 5: Nob Hill at 0856 hr. same water temperature as 2 weeks previous and 3-4.2 °C cooler than lagoon near bottom. Streamflow– 0.37 cfs at Soquel Village gage.

			17 September-2022					
	Flume			1614 hr	**Stockton Avenue Bridge**			1556 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.1	0.4	11.68	843	22.2	0.4	11.22	848
0.25	22.0	0.4	12.41	842	22.2	0.4	11.46	849
0.50	22.0	0.4	12.62	842	22.0	0.4	9.38	849
0.75	21.9	0.4	12.90 (148)	841	21.7	0.4	8.33	848
0.80b	21.9	0.4	12.71	841				
1.00					21.5	0.4	7.78	845
1.25					21.3	0.4	7.12	844
1.50					21.0	0.4	8.02	842
1.75b					20.9	0.4	1.51	841
	Railroad Trestle			1535 hr	**Mouth of Noble Gulch**			1505 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.9	0.4	11.13	863	23.9	0.5	13.42	902
0.25	22.7	0.4	11.08	862	22.6	0.5	7.67	894
0.50	22.1	0.4	11.18	857	21.2	0.5	10.60	861
0.75	21.8	0.4	10.42	855	20.3	0.4	9.94	821
1.00	21.3	0.4	9.70 (109)	853	20.0	0.4	8.42 (93)	814
1.20b					21.9	0.5	13.12	935
1.25	20.9	0.5	7.74 (87)	884				
132b	20.8	0.5	5.92	889				
	Nob Hill			1705 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	18.9	0.3	7.43 (79%)	597				

Station 1: Flume 1614 hr. Air temp. = 18.6 C. flume inlet = 1.7ft; flume outlet = 0.7-1 ft with tidal influence. Clear sky. Becoming windy. Reach 1- 82 gulls bathing (some Hermann's). 6 adult mallards, 1 wader, 1 canoe from upstream. Reach 1- No surface algae. 60% pondweed with attached algae visible 4-5 ft thick with remainder invisible.
Station 2: Stockton Bridge 1556 hr. Reach 2- 22 mallards roosting in park westside above Stockton Bridge, 1 cormorant on wood, 1 gull and 1 pied-billed grebe in water. Reach 2- 3% surface algae and pondweed fragments. 60% bottom algae 2 ft thick. 40% pondweed with algae 3-5 ft thick; avg 4 ft.
Station 3: Railroad trestle 1535 hr. Reach 3- 7 mallards, 4 coots, 1 pied billed grebe, 1 merganser. Reach 3- 50% surface algae and pondweed fragments up to Shadowbrook Restaurant, with little upstream. 30% bottom algae 2 ft thick. 70% pondweed with algae 3-5 ft thick; avg 4 ft.

Station 4: Noble Gulch 1505 hr. Air temp. = 20 C. 30% surface algae and no gray water. 60% bottom algae 2 ft thick; 40% pondweed with algae 3-4.5 ft thick; avg 4 ft. Visible inflow from Noble Gulch.
Station 5: Nob Hill at 1705 hr. 0.8 °C cooler water temperature than 2 weeks previous and 1.1- 3.0 °C cooler than lagoon near bottom.

18 September 2022. Rain with stormflow up to 29.5 cfs at Soquel Village. Sandbar remained intact.

19 September 2022. Recommended 2 more boards removed from Esplanade side of flume inlet, totaling 6 boards out to promote light penetration. Considerable turbidity.

20 September 2022. Partly cloudy. Measured oxygen above Stockton Bridge at 0720 hr. Oxygen concentration 0.42 mg/L at bottom and 0.60 mg/L at surface (depth 0.7 meters). Fish mortality observed in Reach 1 and 2, primarily staghorn sculpin and starry flounder with some steelhead (approx. 20). Recommended all boards be removed on Esplanade Side of flume inlet. Total of 9 boards removed. Measured oxygen above Stockton Bridge at 1644 hr. Oxygen concentration 4.45 mg/ L at bottom and 3.70 at surface (depth 0.5 meters). Bottom visible. Measured oxygen below Stockton Bridge at 1658 hr. Oxygen concentration 0.52 mg/L at bottom and 3.76 mg/L at surface (depth 1 meter).

21 September 2022. Overcast. Measured oxygen above Stockton Bridge at 1540 hr. Oxygen concentration 1.40 mg/L at bottom and 1.97 mg/L at surface (depth 0.5 meters). Bottom visible. Measured oxygen below Stockton Bridge at 0735 hr. Oxygen concentration 0.23 mg/L at bottom and 1.94 mg/L at surface (depth 1 meter).
Measured oxygen above Stockton Bridge at 1540 hr. Oxygen concentration 4.61 mg/L at bottom and 5.64 mg/L at surface (depth 0.5 meters). Bottom visible. Measured oxygen concentration at railroad trestle at 1610 hr. Oxygen concentration 1.42 mg/L at bottom and 8.08 mg/L at surface (depth 0.7 meters). Bottom visible. One board added to flume inlet.

22 September 2022. Clear sky. Measured oxygen above Stockton Bridge at 1630 hr. Oxygen concentration 5.69 mg/L at bottom and 7.07 mg/L at surface (depth 0.63 meters). Bottom visible. Measured oxygen below Stockton Bridge at 1640 hr. Oxygen concentration 0.43 mg/L at bottom and 7.34 mg/L at surface (depth 1.25 meter). Measured oxygen at flume inlet at 1655 hr. Oxygen concentration 2.70 mg/L at bottom and 7.13 mg/L at surface (depth 0.5 meters). Bottom visible. 1.52 cfs at Soquel USGS gage.

1 October 2022. Gage height of 2.51 in morning. Flume inlet 1.0 ft. Flume outlet 1.0 ft at low tide. Air temperature of 14.3 °C at 0730 hr with overcast sky. Secchi depth to bottom. Morning oxygen levels poor to good (44% – 115% saturation near the bottom), oxygen lower than 2 weeks previous in morning with cooler water temperatures in the good range near the bottom (18.2-18.9 °C). Secchi depth to bottom. Gage height of 2.51 in the afternoon. Flume inlet 1.9 ft. Flume outlet much impacted by tidal influence, with sound of waves at flume inlet. Still overcast at 1500 hr. Oxygen levels fair to good in afternoon (72-144%) near the bottom, with cooler water temperatures compared to 2 weeks previous near the bottom (18.1-19.3 °C) in the afternoon.

			1 October-2022					
	Flume			0730 hr	**Stockton Avenue Bridge**			0746 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(°C)**	**(ppt)**	**(mg/l)**	**umhos**	**(°C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	18.8	0.5	10.61	956	18.9	0.5	9.79	937
0.25	18.8	0.5	10.72	959	18.9	0.5	9.82	943
0.50	18.8	0.5	10.68	958	18.9	0.5	9.63	944
0.75	18.8	0.5	10.73 (115)	958	18.9	0.5	8.61	944
1.00b	18.8	0.5	10.25	957	18.9	0.5	9.19	947
1.25					18.9	0.5	9.44	946
1.50					18.9	0.5	9.54	945
1.75					18.9	0.5	7.15 (72)	947
1.80b					19.0	0.5	5.49	956
	Railroad Trestle			0806 hr	**Mouth of Noble Gulch**			0828 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(°C)**	**(ppt)**	**(mg/l)**	**umhos**	**(°C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	18.8	0.5	8.69	912	18.3	0.4	8.14	789
0.25	18.8	0.5	8.61	916	18.3	0.5	8.01	800
0.50	18.9	0.5	8.49	916	18.3	0.5	7.85	801
0.75	18.9	0.5	8.62	919	18.3	0.5	7.43	799
1.00	18.8	0.5	7.74 (83)	917	18.2	0.5	6.36 (66)	792
1.20b					19.2	0.8	0.18	1368
1.25	18.7	0.5	4.24 (44)	918				
140b	18.5	0.5	3.73	928				
	Nob Hill			0859 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(°C)**	**(ppt)**	**(mg/l)**	**umhos**	**(°C)**	**(ppt)**	**(mg/l)**	**umhos**
	16.0	0.4	6.02 (61%)	621				

Station 1: Flume 0730 hr. Reach 1- 67 gulls in lagoon (Western and Hermann's), 6 mallard in water, 1 coot. No surface algae.
Station 2: Stockton Bridge 0746 hr. Reach 2- 1 coot, 5 mallards in water, falcon flew overhead. 15% surface algae and pondweed fragments.
Station 3: Railroad trestle 0806 hr. Reach 3- 2 coots, 3 mallards. 15% surf. algae and pondweed fragments. Floating duckweed present. A peregrine falcon soared over the trestle.
Station 4: Noble Gulch 0828 hr. 15% surf algae and pondweed frag.. No gray water. Duckweed present.

Station 5: Nob Hill at 0859 hr. 0.6° C cooler water temperature than 2 weeks previous and 2.2-2.9 °C cooler than lagoon near bottom. Streamflow– 1.69 cfs at Soquel Village gage.

			1 October-2022					
	Flume			1552 hr	**Stockton Avenue Bridge**			1536 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.4	0.5	12.51	961	19.4	0.5	11.91	948
0.25	19.3	0.5	12.89	961	19.4	0.5	11.95	948
0.50	19.3	0.5	13.12	962	19.2	0.5	11.66	944
0.75	19.3	0.5	13.24 (144)	961	19.1	0.5	10.58	943
1.00b	19.3	0.5	12.92	961	19.2	0.5	10.72	943
1.25					19.1	0.5	9.97	945
1.50					19.0	0.5	9.76 (106	945
1.75					19.0	0.5	8.41 (91)	963
1.80b					19.0	0.5	5.76	978
	Railroad Trestle			1516 hr	**Mouth of Noble Gulch**			1500 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.3	0.5	11.73	931	19.3	0.5	10.81	850
0.25	19.3	0.5	11.90	931	19.2	0.5	10.83	851
0.50	19.3	0.5	11.95	926	18.6	0.4	10.08	770
0.75	19.1	0.5	11.64	910	18.3	0.4	6.68	765
1.00	19.0	0.5	8.80	918	18.1	0.5	6.74 (72)	801
1.20b					19.3	0.8	1.79	1325
1.25	18.7		6.67	915				
1.40b	18.7	0.5	4.76	914				
	Nob Hill			1642 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	16.9	0.4	8.76 (90%)	649				

Station 1: Flume 1552 hr. Air temp. = 17.1 °C. Reach 1- 151 gulls bathing (Western and Hermann's). 7 mallards adjacent to Margaritaville with humans feeding. No surface algae. Bottom shaded and invisible with overcast sky.
Station 2: Stockton Bridge 1536 hr. Reach 2- No waterfowl. 2% surface algae and pondweed fragments. Bottom shaded and invisible.
Station 3: Railroad trestle 1516 hr. Reach 3- 4 mallards, 6 coots, 1 kingfisher overhead. 15% surface algae and pondweed fragments. Bottom shaded and invisible.
Station 4: Noble Gulch 1500 hr. Air temp. = 18.6 C. 15% surface algae and pondweed fragments and no gray water. Bottom shaded and invisible.
Station 5: Nob Hill at 1624 hr. 2 °C cooler water temperature than 2 weeks previous and 1.2- 2.4 °C cooler than lagoon near bottom.

9 October 2022. Temperature probes retrieved.

15 October 2022. Gage height of 2.62 in morning. Flume inlet 1.1 ft. Flume outlet 1.1 Air temperature of 13.3 C at 0752 hr and foggy. Morning oxygen levels fair to good (68% – 81% saturation near the bottom), Oxygen lower at the lower 2 sites and higher at the upper 2 sites than 2 weeks previous in morning, with cooler water temperatures in the good range near the bottom (16.4-17.0 C). Secchi depth to 1.5 m. Gage height of 2.63 in the afternoon. Flume inlet 1.2 ft. Flume outlet 1.1 -1.7 ft with tidal influence. Overcast, misty, no breeze then slight breeze. Oxygen levels lower in afternoon than morning at all 4 sites in the fair to good range (52-77% saturation) near the bottom. Cooler water temperatures compared to 2 weeks previous near bottom (16.2-17.1 C) in the afternoon.

			15 October-2022					
	Flume			0752 hr	**Stockton Avenue Bridge**			0816 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	16.8	0.5	7.62	769	16.9	0.5	7.58	770
0.25	16.8	0.5	7.52	769	16.9	0.5	7.48	772
0.50	16.8	0.5	7.51	769	16.9	0.5	7.21	772
0.75	16.8	0.5	7.47 (77)	769	16.9	0.5	6.15	772
1.00	16.8	0.5	7.44 (77)	770	16.9	0.5	7.05	773
1.13b	16.8	0.5	7.19	769	16.9			
1.25					16.9	0.5	7.15	772
1.50					16.9	0.5	7.11	773
1.75					17.0	0.5	6.57 (68)	773
1.82b					17.0	0.5	5.06	773
	Railroad Trestle			0842 hr	**Mouth of Noble Gulch**			0900 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	16.8	0.4	8.03	764	16.4	0.4	7.70	667
0.25	16.8	0.4	7.89	767	16.4	0.4	7.68	744
0.50	16.8	0.5	7.84	768	16.4	0.4	7.97	744
0.75	16.8	0.5	7.82	768	16.4	0.4	7.93	744
1.00	16.8	0.5	7.85	768	16.4	0.4	7.91 (81)	744
1.25b	16.8	0.5	7.72 (80)	768	17.2	0.5	2.71	905
1.47b	16.8	0.5	6.15	764				
	Nob Hill			0940 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	13.2	0.3	5.68 (54%)	532				

Station 1: Flume 0752 hr. Reach 1- 236 gulls (Western and Hermann's), 1 coot. No surface algae.
Station 2: Stockton Bridge 0816 hr. Reach 2- 1 coot, 13 mallards. No surface algae
Station 3: Railroad trestle 0838 hr. Reach 3- 18 coots, 6 mallards. 7% algae and pondweed fragments.
Station 4: Noble Gulch 0842 hr. No gray water. 10% surface algae and pondweed fragments.
Station 5: Nob Hill at 0940 hr. 1.2°C cooler water temperature than 2 weeks previous and 1.6-2.2

°C cooler than lagoon near bottom. Streamflow– 2.06 cfs at Soquel Village gage.

				15 October-2022				
	Flume			1559 hr	**Stockton Avenue Bridge**			1546 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	17.1	0.5	7.86	775	17.1	0.5	8.12	773
0.25	17.1	0.5	7.75	774	17.1	0.5	7.84	773
0.50	17.1	0.5	7.58	774	17.1	0.5	7.67	773
0.75	17.1	0.5	7.45	775	17.1	0.5	7.16	774
1.00	17.1	0.5	7.44	775	17.1	0.5	6.19	774
1.13b	17.1	0.5	6.97	774				
1.25					17.0	0.5	6.62	773
1.50					16.9	0.5	6.47	771
1.75					16.9	0.5	5.59 (58)	770
1.87b					16.9	0.5	4.41	771
	Railroad Trestle			1526 hr	**Mouth of Noble Gulch**			1506 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	17.0	0.4	949	768	16.7	0.4	10.41	659
0.25	17.0	0.4	949	768	16.8	0.4	10.20	739
0.50	17.0	0.4	948	767	16.8	0.4	9.96	743
0.75	17.0	0.4	940	767	16.7	0.4	9.40	744
1.00	16.9	0.4	868	765	16.2	0.5	5.10 (52)	759
1.25b	16.7	0.5	681 (70)	768	17.4	0.6	0.12	1040
1.47b	16.7	0.5	5.79	769				
	Nob Hill			1648 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	15.4	0.4	8.67 (87)	632				

Station 1: Flume 1559 hr. Air temp. = 15.1 C. Reach 1- 162 gulls bathing, 12 mallards, 1 canoe. No surface algae. Bottom invisible.
Station 2: Stockton Bridge 1546 hr. Reach 2- 6 mallards, 1 snowy egret on willow. 1 kayaker. No surface algae. Bottom shaded and invisible.
Station 3: Railroad trestle 1526 hr. Reach 3- 8 mallards, 13 coots. 3% surface algae and pondweed fragments. Bottom shaded and invisible.
Station 4: Noble Gulch 1506 hr. No surface algae and no gray water. Bottom invisible.
Station 5: Nob Hill at 1648 hr. 1.5 °C cooler water temperature than 2 weeks previous and 0.8-1.7 C cooler than the lagoon near the bottom.

29 October 2022. Gage height of 2.58 in morning. Notch across sandbar in place. Flume inlet 1.2 ft. Flume outlet 0.7-1.2 with tidal influence. Air temperature of 7.5 C at 0839 hr and clear sky. Morning oxygen levels good (78% – 86% saturation near the bottom), Oxygen concentrations higher than 2 weeks previous in morning, with much cooler water temperatures in the good range near the bottom (13.0-13.5 C). Secchi depth to 1.5 m- water tea-colored. Gage height of 2.60 in the afternoon. Flume inlet 1.3 ft. Flume outlet 0.6 -1.4 ft with tidal influence and partially sand-plugged outlet. Hazy sunshine. Oxygen levels in the good range (93-120% saturation) near the bottom. Much cooler water temperatures compared to 2 weeks previous near bottom (13.6-14.1 C) in the afternoon.

			29 October-2022					
	Flume			0839 hr	**Stockton Avenue Bridge**			0859 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	13.1	0.5	9.03	733	13.5	0.5	9.22	740
0.25	13.1	0.5	9.00	735	13.5	0.5	9.06	740
0.50	13.2	0.5	9.00	733	13.5	0.5	9.04	740
0.75	13.2	0.5	9.00	734	13.5	0.5	8.99	740
1.00	13.2	0.5	9.02 (86)	733	13.5	0.5	8.84	739
1.05b	13.1	0.5	8.92	733				
1.25					13.5	0.5	8.83	739
1.50					13.4	0.5	8.77	739
1.75					13.5	0.5	8.24 (79)	739
1.83b					13.6	0.5	6.40	740
	Railroad Trestle			0919 hr	**Mouth of Noble Gulch**			0940 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	13.3	0.5	9.25	737	13.0	0.5	8.54	707
0.25	13.4	0.5	8.78	737	13.0	0.5	8.21	713
0.50	13.4	0.5	8.62	737	13.0	0.5	8.22	715
0.75	13.4	0.5	8.54	737	13.0	0.5	8.23	714
1.00	13.4	0.5	8.51	737	13.0	0.5	8.17 (78)	714
1.25b	13.4	0.5	8.45 (81)	737	15.4	0.5	2.40	849
1.46b	13.4	0.5	8.16	738				
	Nob Hill			1014 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	11.8	0.4	9.05 (83%)	581				

Station 1: Flume 0839 hr. Reach 1- 61 gulls (Western and Hermann's), 3 coot. No surface algae.
Station 2: Stockton Bridge 0859 hr. Reach 2- 5 coots, 6 mallards on trestle abutment. No surface algae
Station 3: Railroad trestle 0919 hr. Reach 3- 19 coots, 2 mallards heading toward trestle abutment, 6 mallards on Golino wood and log near Shadowbrook Restaurant. 1 greenback heron roosting on Golino wood. No surface algae.
Station 4: Noble Gulch 0940 hr. No gray water. No surface algae.

Station 5: Nob Hill at 1014 hr. 3 °C cooler water temperature than 2 weeks previous and 1.2-1.7 °C cooler than lagoon near bottom. Streamflow– 2.57 cfs at Soquel Village gage.

				29 October-2022				
	Flume			1600 hr	**Stockton Avenue Bridge**			1544 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	14.2	0.5	11.75	751	14.3	0.5	11.88	754
0.25	14.1	0.5	12.13	749	14.2	0.5	11.74	751
0.50	14.1	0.5	12.21	748	14.2	0.5	11.40	750
0.75	14.1	0.5	12.22	748	14.2	0.5	11.75	749
1.00	14.1	0.5	12.31 (121)	748	14.1	0.5	11.46	749
1.07b	14.1	0.5	12.16	748				
1.25					13.9	0.5	10.96	746
1.50					13.8	0.5	10.57	744
1.75					13.7	0.5	10.08 (98)	743
1.82b					13.7	0.5	7.57	743
	Railroad Trestle			1525 hr	**Mouth of Noble Gulch**			1504 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	14.7	0.5	11.54	758	15.0	0.4	11.85	730
0.25	14.6	0.5	11.66	753	14.7	0.5	11.65	741
0.50	14.5	0.5	11.59	750	14.5	0.5	11.43	745
0.75	14.4	0.5	11.41	749	14.4	0.5	11.52	739
1.00	14.2	0.5	11.05	745	14.0	0.5	9.63 (93)	729
1.25b	13.6	0.5	10.52 (102)	737	14.2	0.5	3.68	766
1.46b	13.6	0.5	9.64	735				
	Nob Hill			1633 hr				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
	13.2	0.4	10.68 (100%)	599				

Station 1: Flume 1600 hr. Air temp. = 15.1 C. Reach 1- 279 gulls bathing, 10 mallards (8 adjacent Margaritaville), 2 coots, 1 snowy egret roosting on wood in restaurant cove. No surface algae. Bottom invisible.
Station 2: Stockton Bridge 1544 hr. Reach 2- 3 mallards, 3 coots, 1 gull, 1 kingfisher overhead. No surface algae. Bottom shaded and invisible.
Station 3: Railroad trestle 1525 hr. Reach 3- 2 mallards, 25 coots, 1 eared grebe. No surface algae. Bottom shaded and invisible.
Station 4: Noble Gulch 1504 hr. No surface algae and no gray water. Bottom invisible.
Station 5: Nob Hill at 1633 hr. 2.2 °C cooler water temperature than 2 weeks previous and 0.4-0.9 C cooler than the lagoon near the bottom.

31 October 2022. Public Works staff removed upper two boards from the Esplanade side of flume inlet in preparation for stormflow. .

1 November 2022. Public Works staff removed another flashboard around 1200 hr from the Esplanade side of flume inlet as precipitation began from minor storm event. Notch in sandbar refreshed prior to storm. The stream gage reading reached 31.5 cfs at Soquel Village at 1315 hr. The flume passed the stormflow, and the sandbar remained intact. The lagoon became turbid.

3 November 2022. Morrison and Public Works removed 5 more boards from the flume inlet down to the narrowing of the flume inlet opening to allow light penetration to the bottom. This totaled 8 boards removed.

			4 November-2022					
	Above Stockton Avenue Bridge			0943 hr	**Below Stockton Avenue Bridge**			0957 hr
Depth	**Temp 2b**	**Salin 2b**	**O2 2b**	**Cond 2b**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	11.0	0.4	5.27	625	11.6	0.4	5.52	609
0.25	11.0	0.4	5.15	622	11.4	0.4	5.28	621
0.50	10.8	0.4	5.32	638	11.1	0.4	5.23	620
0.75	10.8	0.4	5.28	638	11.0	0.4	4.92	670
0.80b	10.9	0.4	4.71	640				
1.00					10.9	0.5	4.97	697
1.25b					10.9	0.5	3.80	686
1.50								
1.75								
1.82b								
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00								
0.25								
0.50								
0.75								
1.00								
1.25b								
1.46b								
	Nob Hill			r				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**

Station 2b: Above Stockton Bridge 0943 hr. Air temp. = 8.2 C. Mostly clear sky with high cirrus clouds. Secchi depth just to bottom. Water tea-colored. Two-foot opening from the top of the flume to flashboards in flume inlet.
Station 2: Stockton Bridge 0957 hr. Secchi depth just to bottom. Water tea colored. Recommended to Morrison that the boards not be put back into the flume inlet in order to maintain light penetration to bottom. Estimated gage height was 0.71.

8 November 2022. At between 0500 and 0515 hr, Alley was notified by Morrison by phone that a sandbar breaching was imminent. The breaching was facilitated by Kotila with a loader at 0524 hr,

with a gage streamflow estimate of 49.2 cfs at 0515 hr at Soquel Village, 2 miles upstream of the lagoon. The estimated capacity of the flume is between 30 and 35 cfs. Five boards had previously been removed from the flume inlet to facilitate water passage through the flume. The lagoon water surface was approximately 6 inches below the lowermost piling bolt at the time of the breach (**K. Mozumder pers. comm.**). The water surface increased rapidly to approximately 4 inches above the piling bolt before the estuary began to drawdown after the breach. No flooding into streamside properties occurred. Alley arrived at 0608 hr at the creek outlet with light rain. At that time the water surface was just above the top of the flume, and the outlet channel was 15-20 feet wide. Warning posts were being placed across the beach on either side of the outlet channel. The water sample required by the Water Resources Control Board had already been taken by Kotila. The Public Works Director was present at the time of the breach. The stream gage estimate increased to a maximum of 69.8 cfs at 0715 hr and remained above 40 cfs until 1400 hr.

			13 November-2022					
	Above Stockton Avenue Bridge			1221 hr	**Below Stockton Avenue Bridge**			1235 hr
Depth	**Temp 2b**	**Salin 2b**	**O2 2b**	**Cond 2b**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	11.9	10.0	9.54	12720	10.8	11.9	10.11	14551
0.25	12.1	10.6	8.99	13504	11.6	13.6	9.42	17075
0.50	13.2	24.5	8.62	30086	12.9	25.4	8.95	30740
0.75	13.4	26.8	9.02 (102%)	32695	13.3	27.0	9.13	32654
0.80b	13.5	27.6	8.69	33507				
1.00					13.5	28.5	9.22 (106%)	34492
1.25b					13.6	29.0	9.02	35063
1.50								
1.75								
1.82b								
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00								
0.25								
0.50								
0.75								
1.00								
1.25b								
1.46b								
	Nob Hill			r				
Depth	**Temp 3**	**Salin 3**	**O2 3(sat.)**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**

Station 2b: Above Stockton Bridge 1221 hr. Air temp. = 12.3 C. Clear sky. Secchi depth to bottom. Water murky. Sandbar open with tidal mixing. Sandbar reforming with stream outlet 0.1-0.2 ft deep.

Station 2: Stockton Bridge 1235 hr. Secchi depth just to bottom. Water murky. 1.87 cfs at Soquel gage.

APPENDIX B. 2022 Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon.

2022 DRAIN LINE STATIC PRESSURE TESTS
FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK

RESTAURANT	NOTIFICATIONS	TEST DATE	COMMENTS	BUILDING PERMIT SIGN OFF
MY THAI BEACH **207 Esplanade** Owner: Chuck Hammers chuck@pizzamyheart.com Tenant: Pronpimol Suwonsupar Pinky2503@hotmail.com	4/8/22 1st letter sent email & 1st Class mail	5/5/22 8:30AM	Grease Trap Needs Service	[signature] 5/5/22 ok
BAY BAR **209-B Esplanade** Owner: Chuck Hammers chuck@pizzamyheart.com Tenant: Patrick & Mike Lynn Patricklynn11@gmail.com	4/8/22 1st letter sent email & 1st Class mail	5/5/22 8:30AM	Bay Bar & Pizza My Heart Share a common Drain observed low spot in Pizza My Heart Floor Drain	[signature] 5/5/22 ok
PIZZA MY HEART **209-A Esplanade** Owner: Chuck Hammers chuck@pizzamyheart.com	4/8/22 1st letter sent email & 1st Class mail	5/5/22 8:30AM	Grease trap Needs Service Both Business	[signature] 5/5/22 ok
SAND BAR **211 Esplanade** Owner: Chuck Hammers chuck@pizzamyheart.com Tenant: Jeff Lantis thesandbarcapitola@gmail.com	4/8/22 1st letter sent email & 1st Class mail	5/5/22 8:30AM	Grease Trap OK	[signature] 5/5/22 ok
PARADISE BAR & GRILL **215 Esplanade** Owner: Esplanade Properties Manager: Bob Coe controller@paradisebeachgrille.com	4/8/22 1st letter sent email & 1st Class mail	5/12/22 8:30AM	met in person 5/5/22 to notify	[signature] 5/12/22 ok
ZELDA'S **203 Esplanade** Owner: Jill Ealy Jealy7@ao.com j.whitby@hotmail.com zelonbeach@aol.com	4/8/22 1st letter sent email & 1st Class mail	5/12/22 8:30AM	met in person 5/5/22 to Notify	[signature] 5/12/22 ok

APPENDIX C. Hydrographs for USGS 11160000 Soquel Creek Stream Gage at Soquel, CA; Water Years 2007−2022.

Figure 1. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2022.

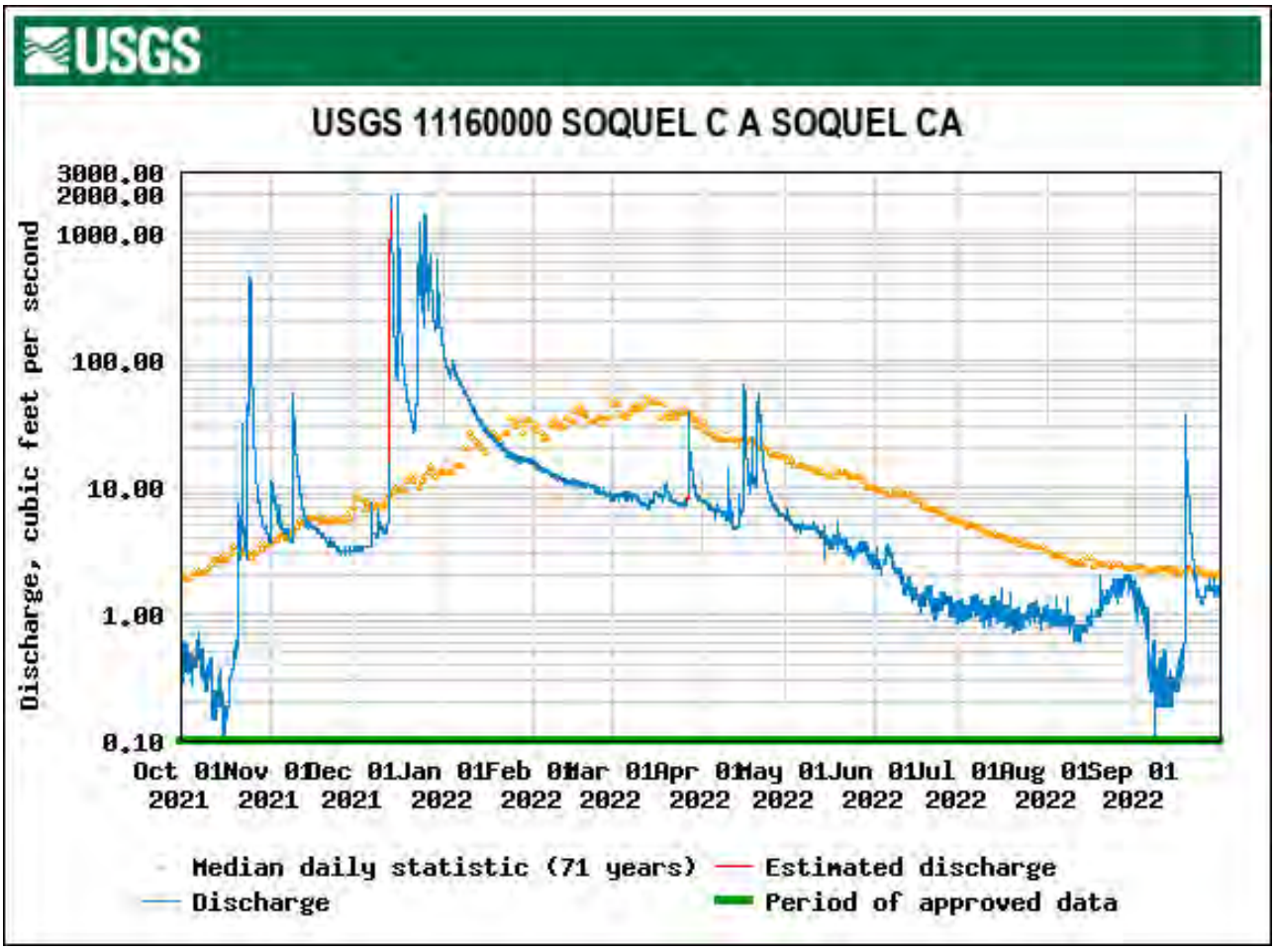


Figure 2. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2022.

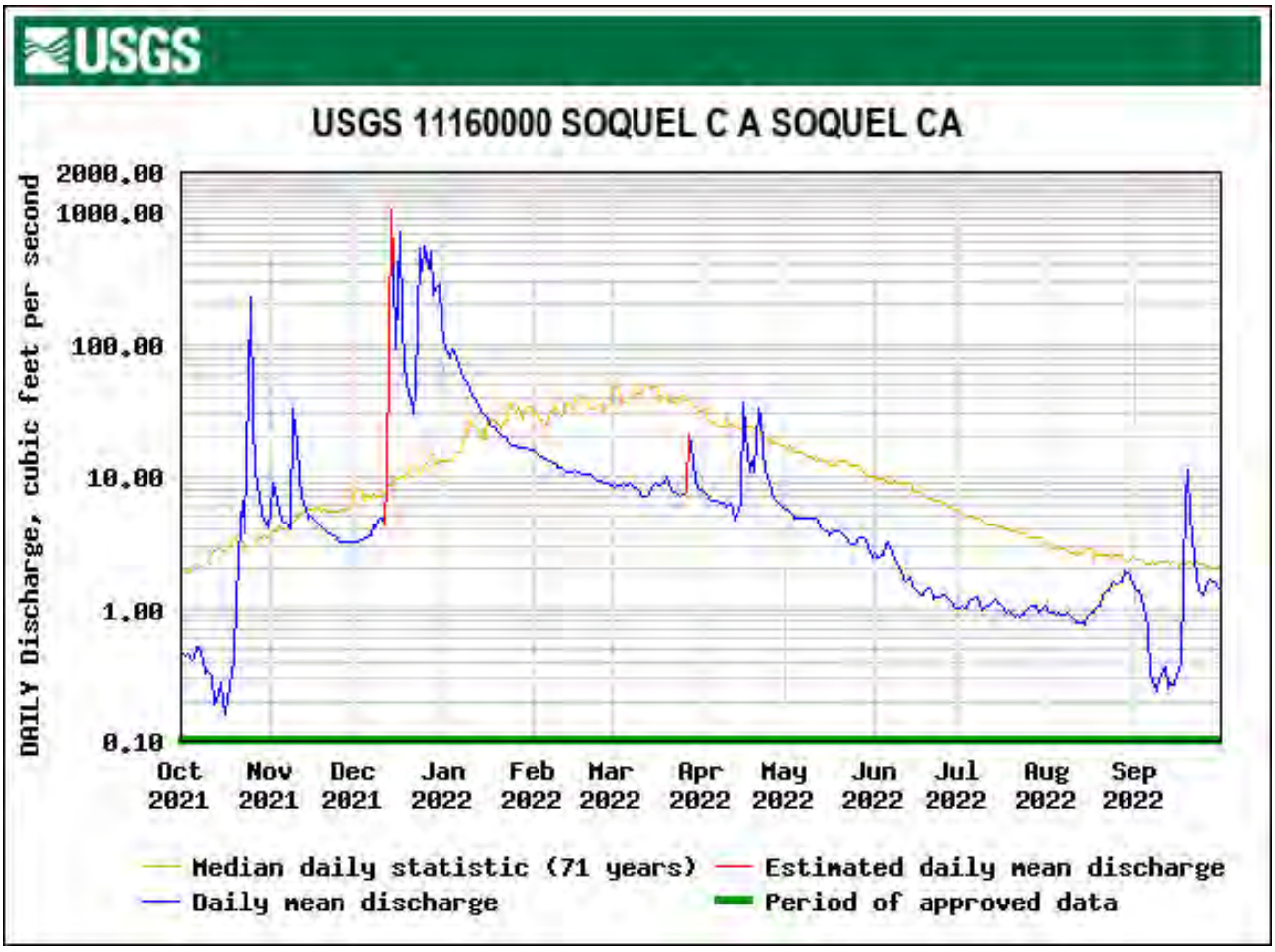


Figure 3. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2022 – 20 November 2022.

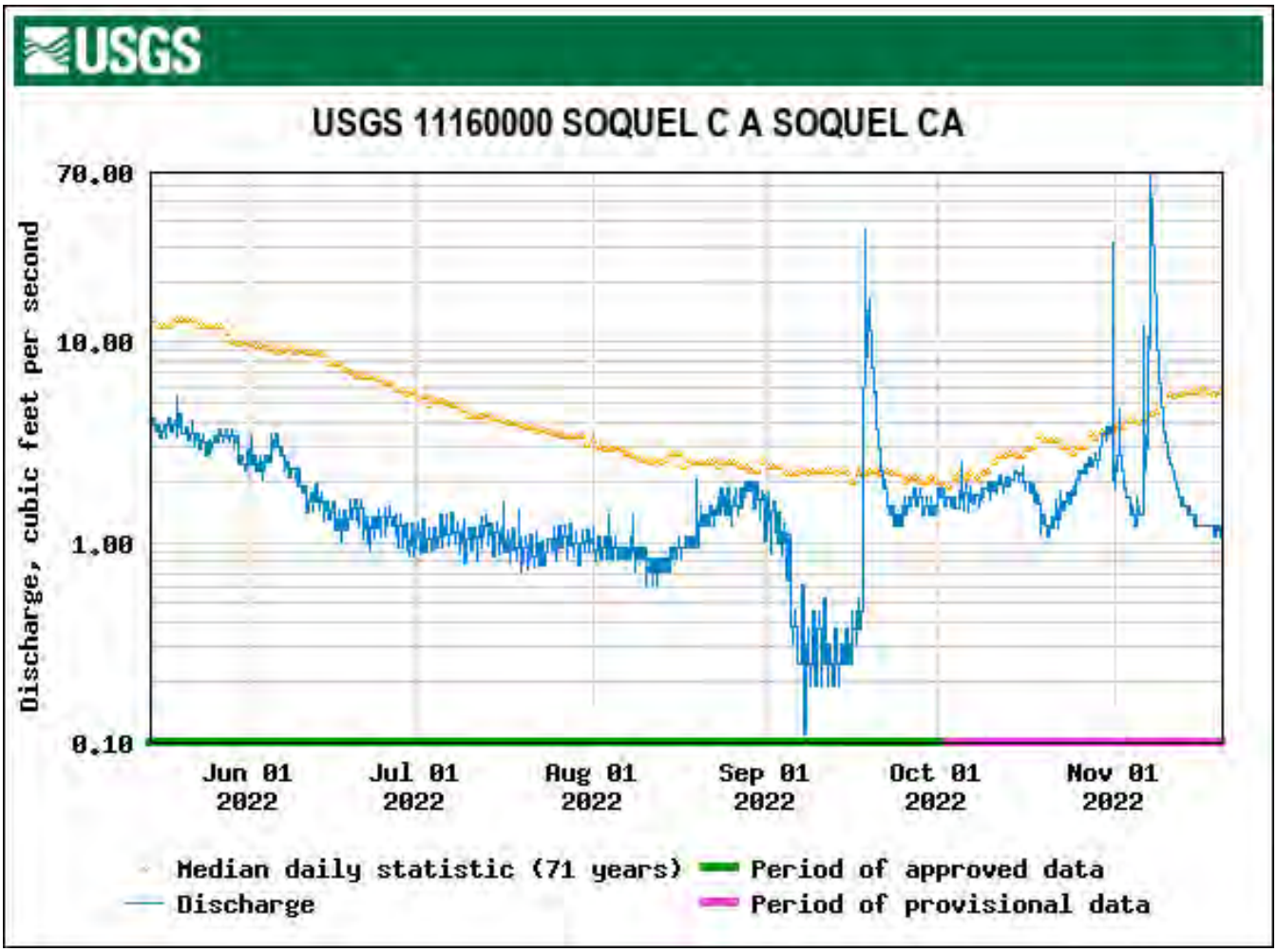


Figure 4. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2021.

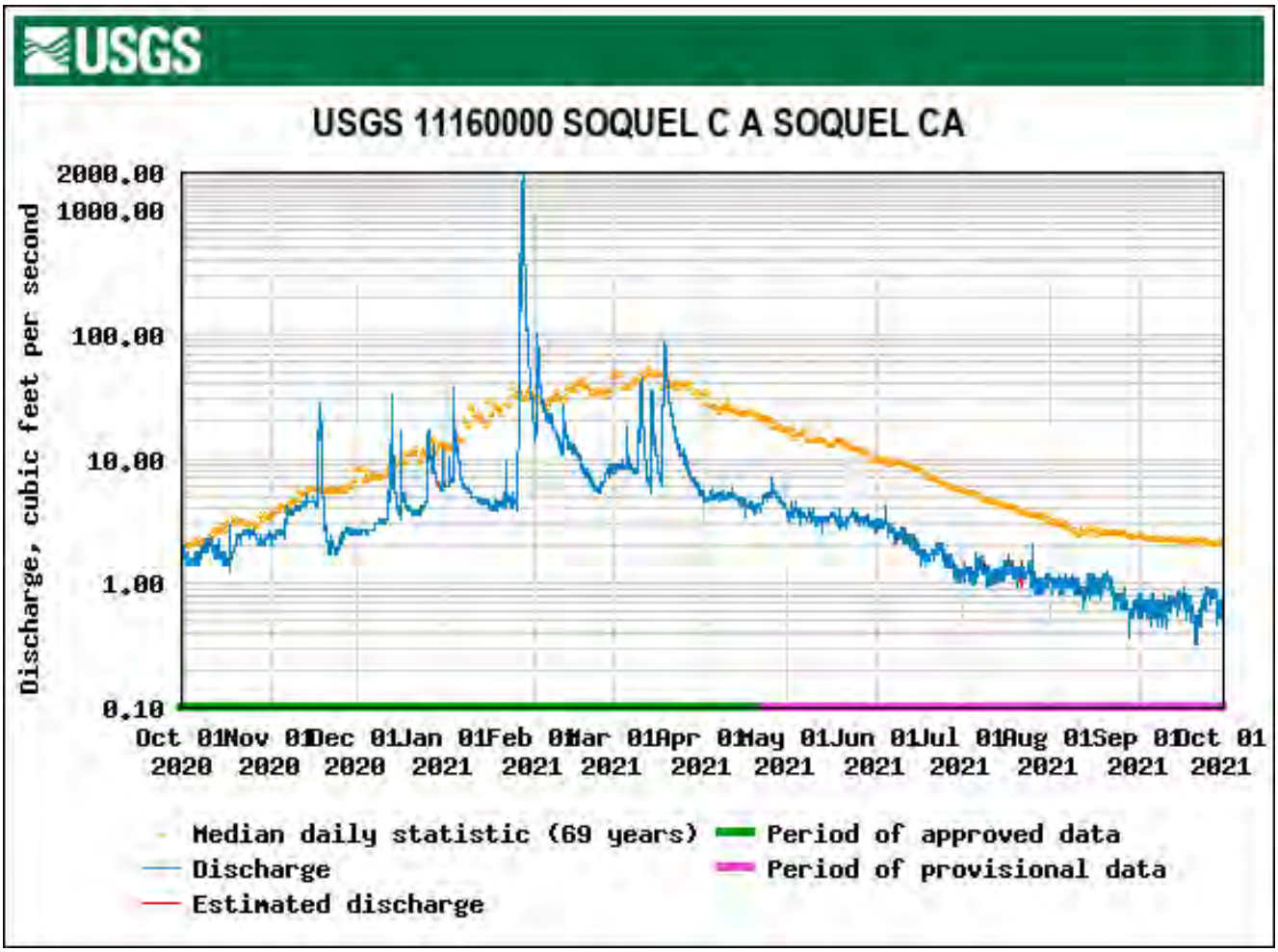


Figure 5. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2021.

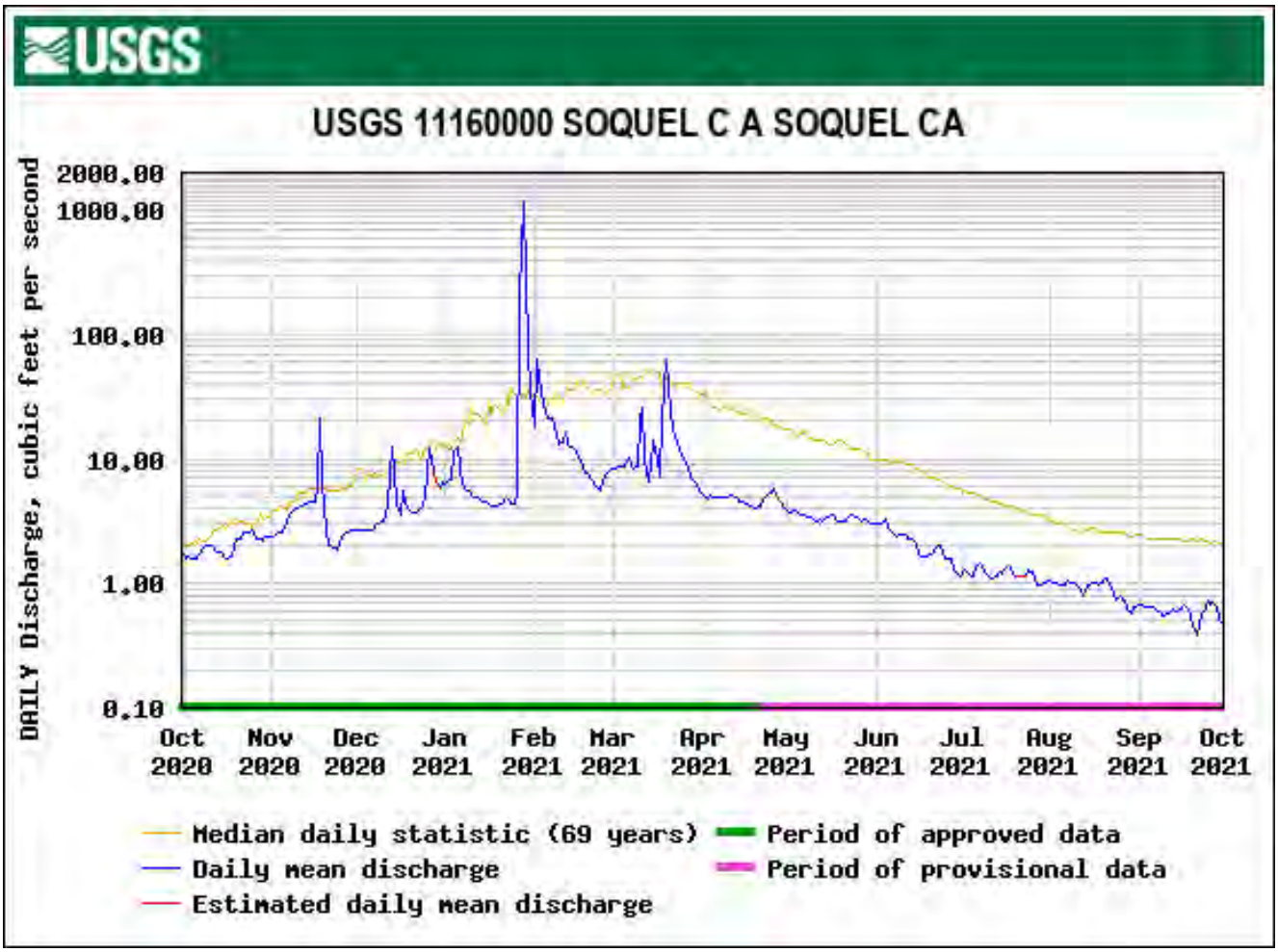


Figure 6. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 24 May 2021 – 25 October 2021.

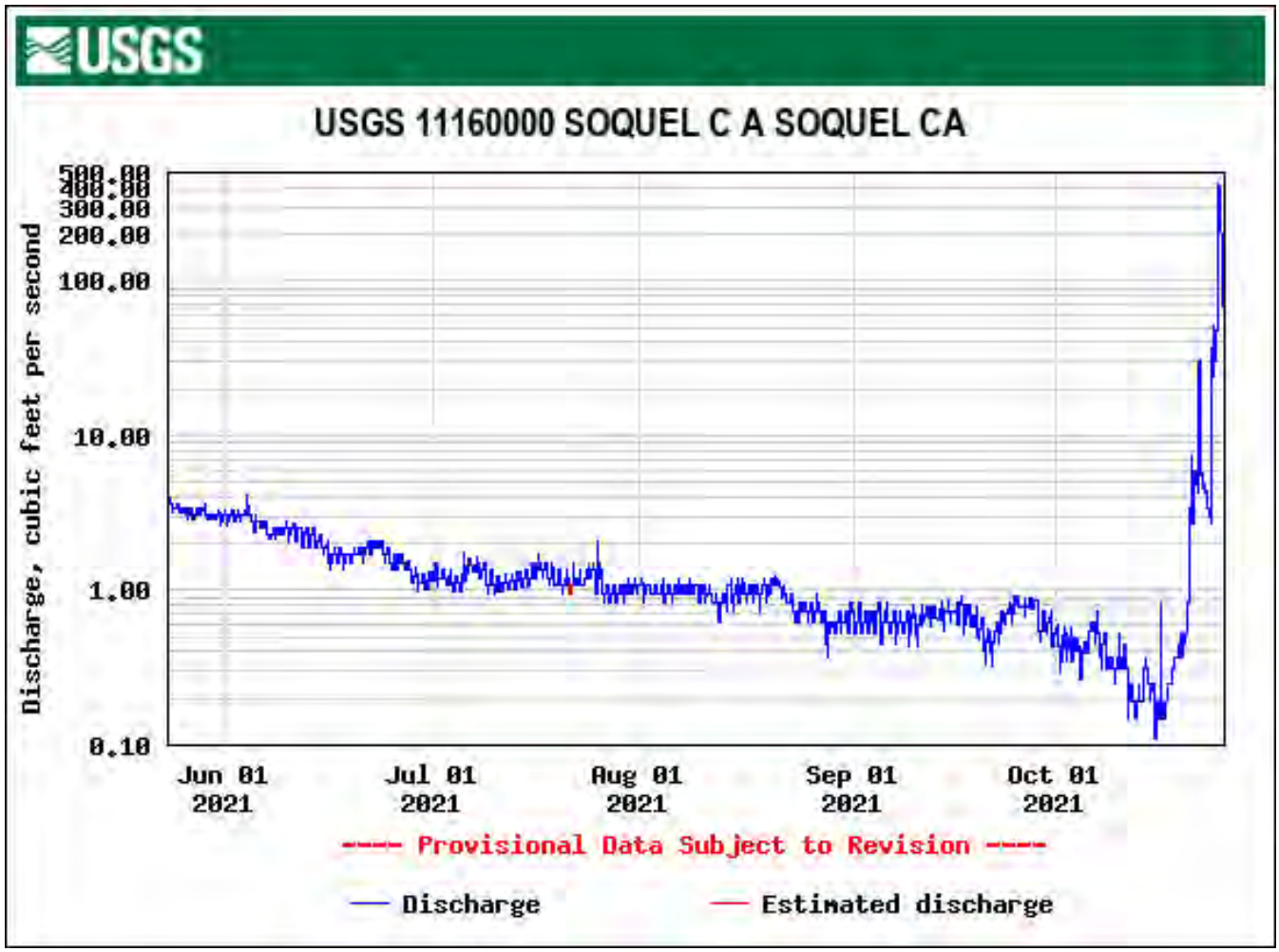


Figure 7. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2020.

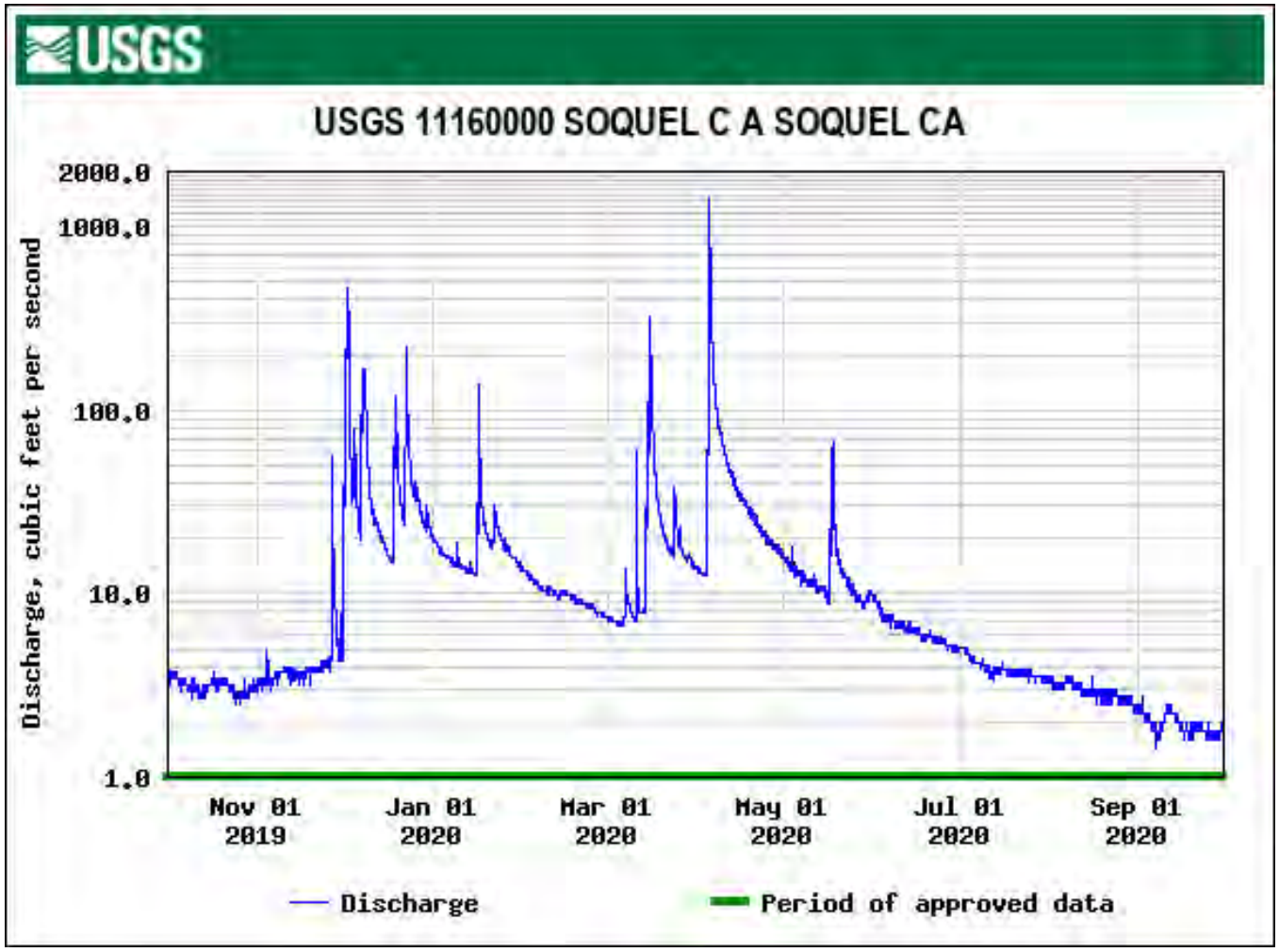


Figure 8. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2020.

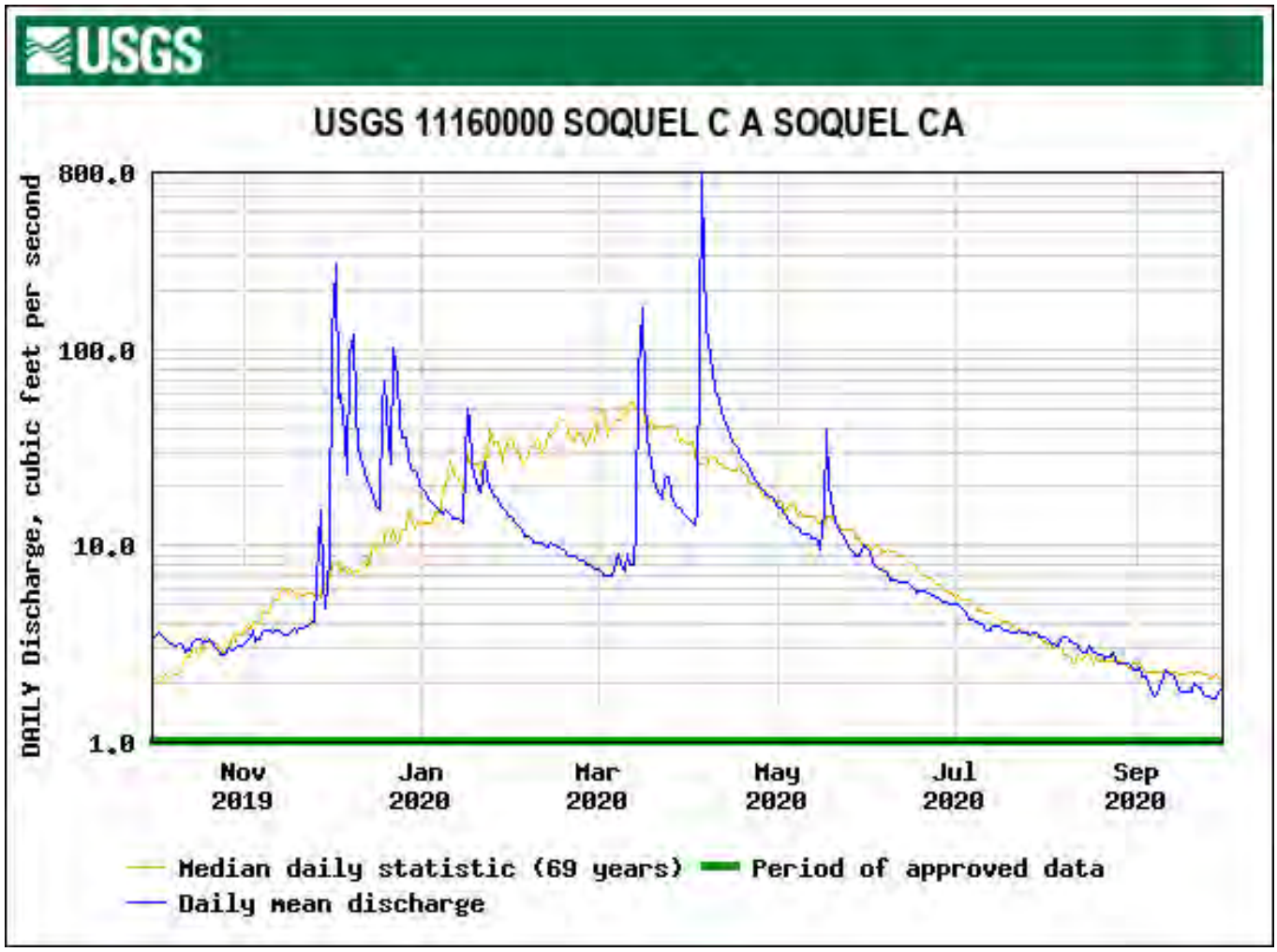


Figure 9. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2020– 1 February 2021.

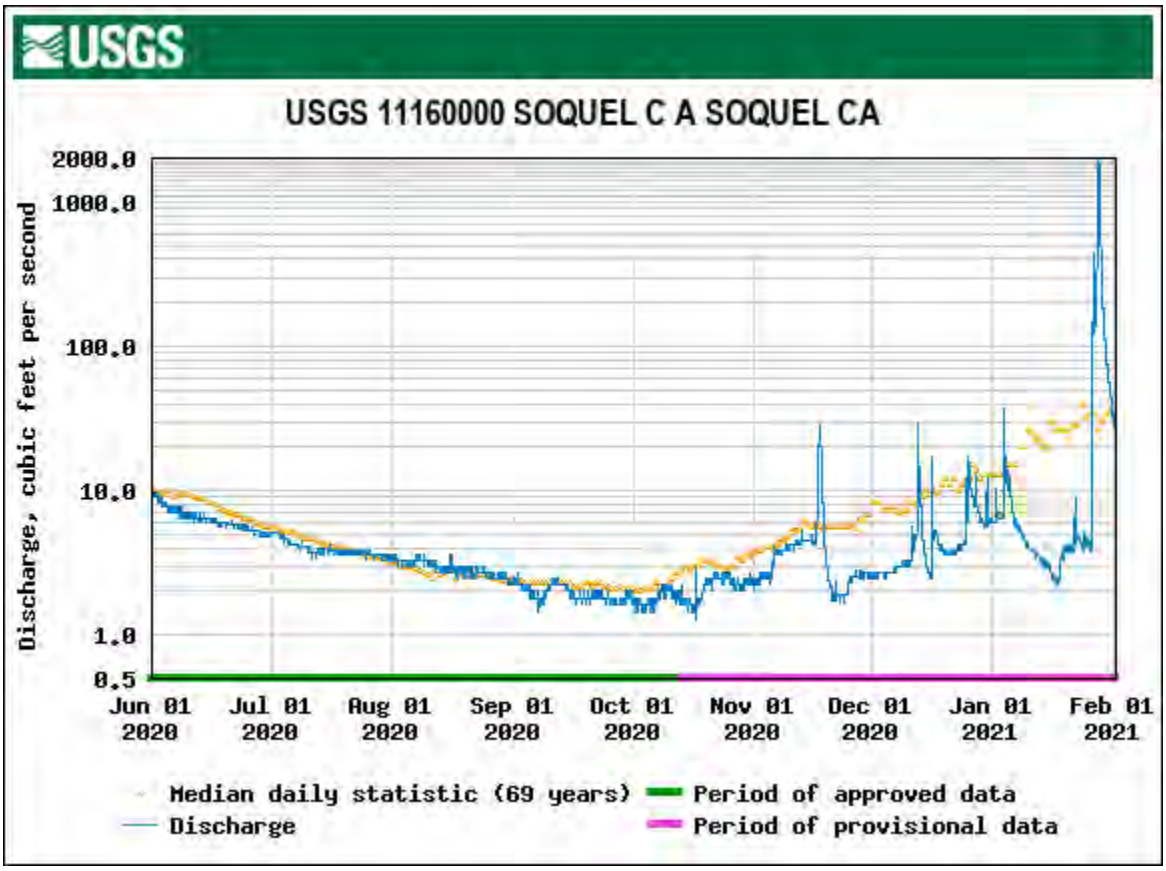


Figure 10. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2019.

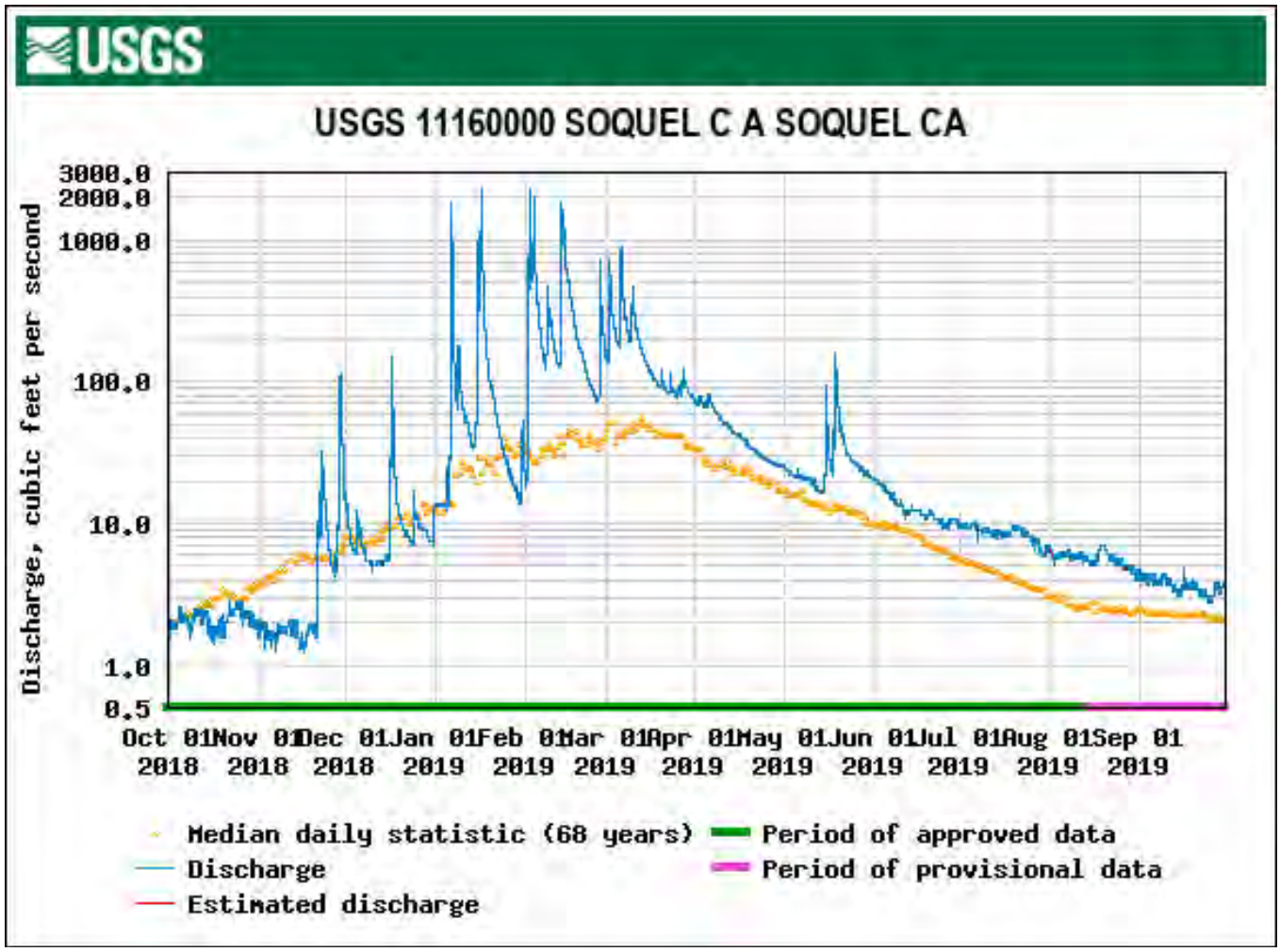


Figure 11. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2019.

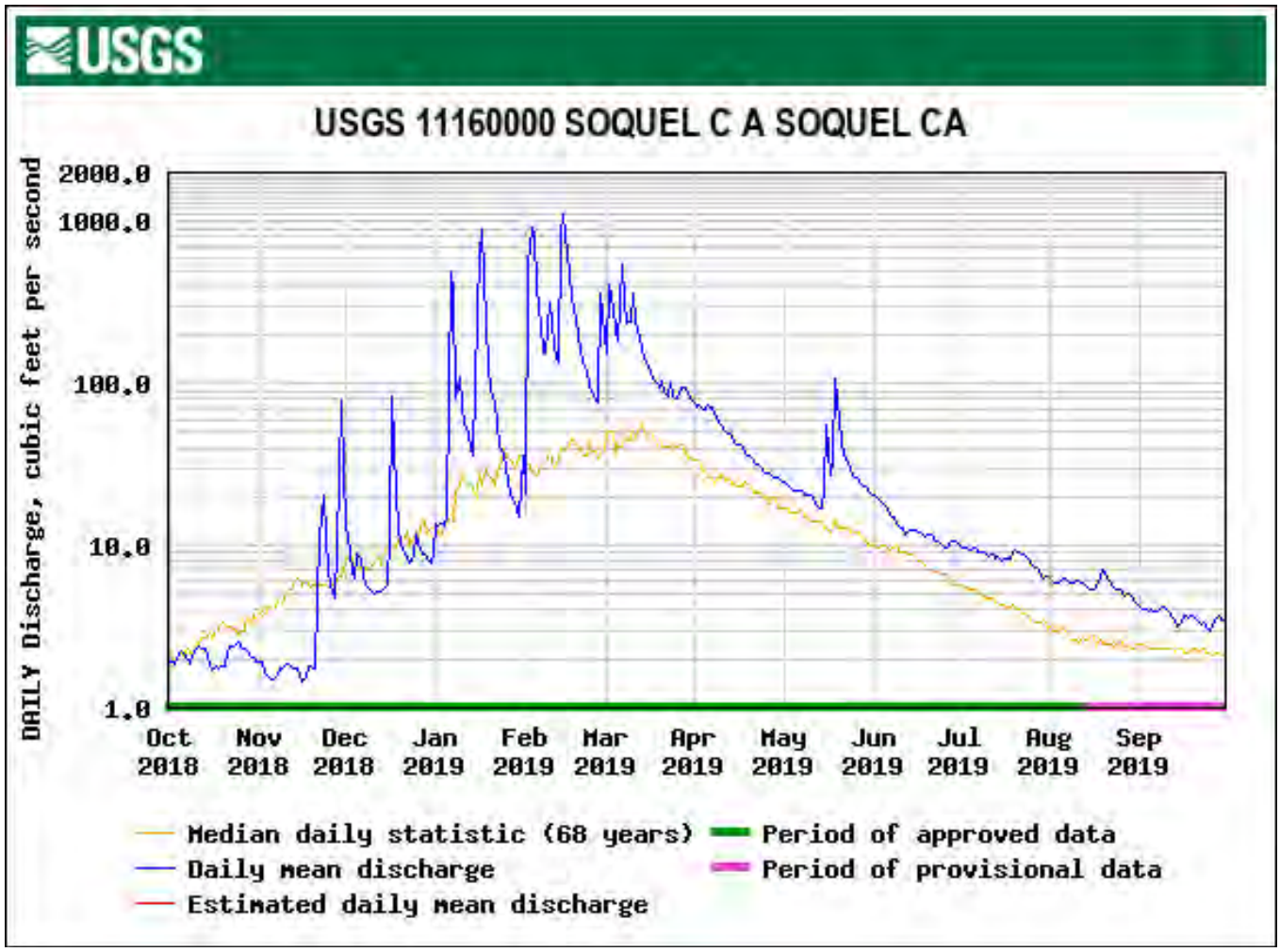


Figure 12. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May – 9 December 2019.

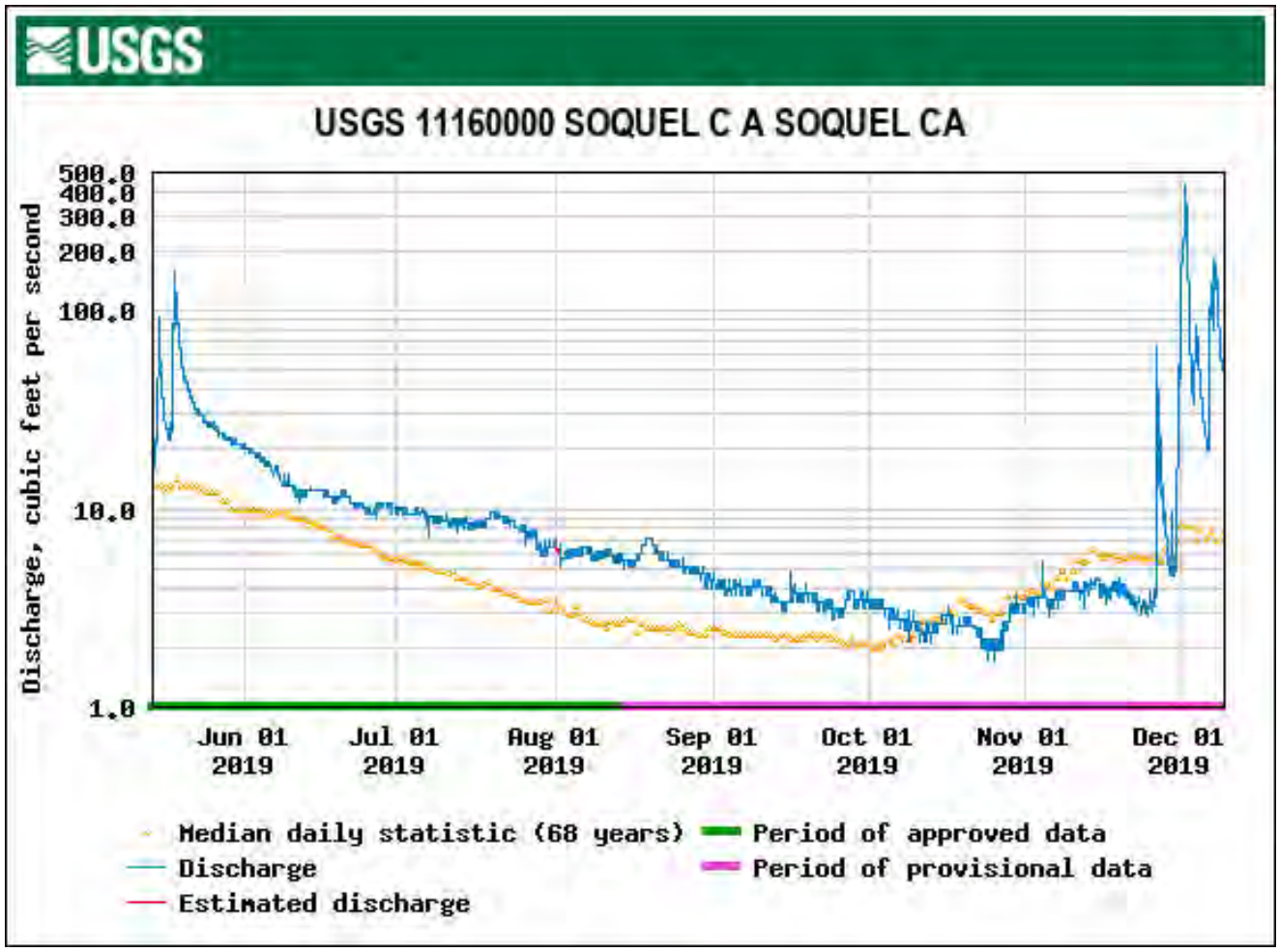


Figure 13. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2018.

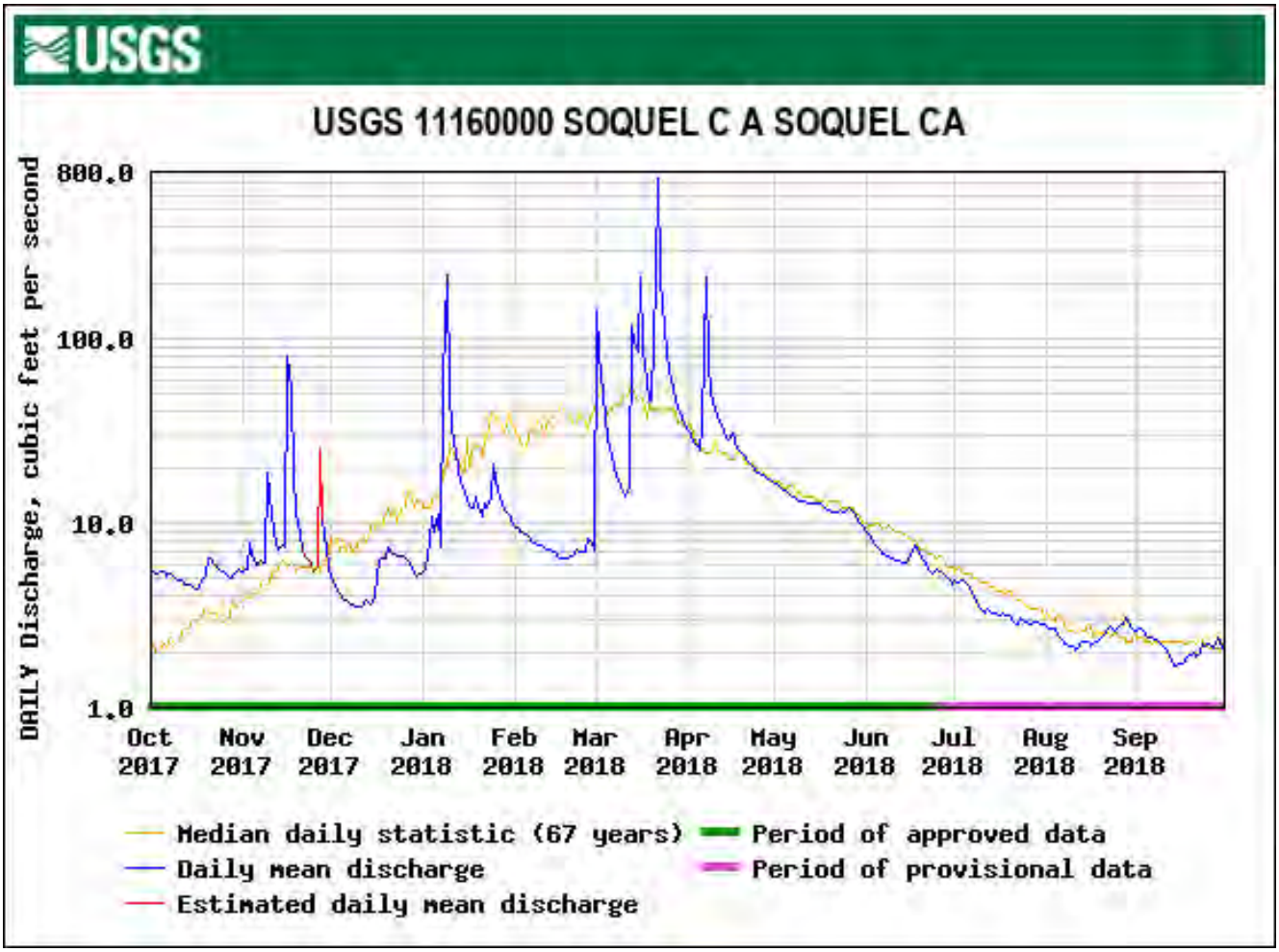


Figure 14. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2018.

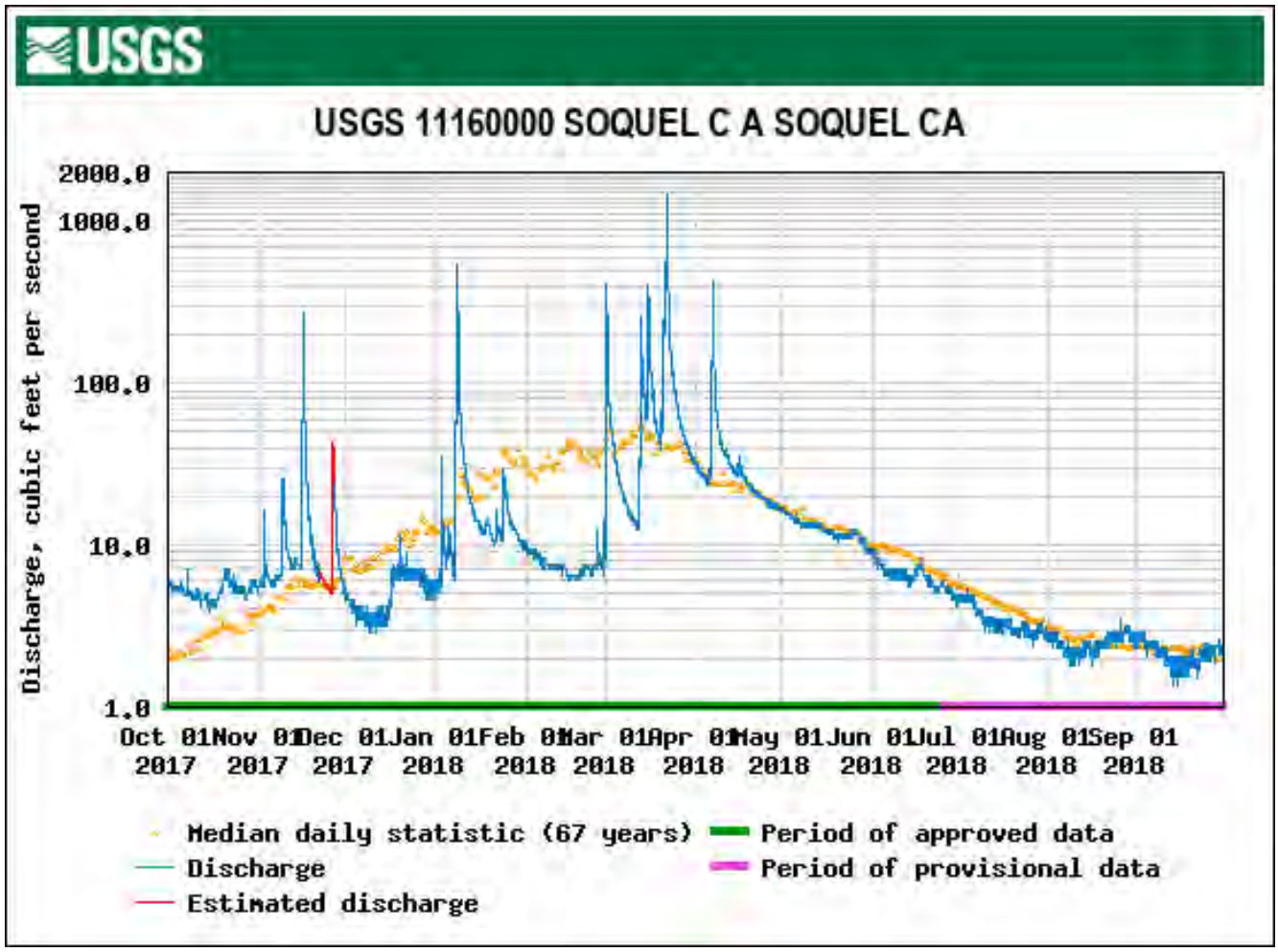


Figure 15. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2017 – 1 December 2018.

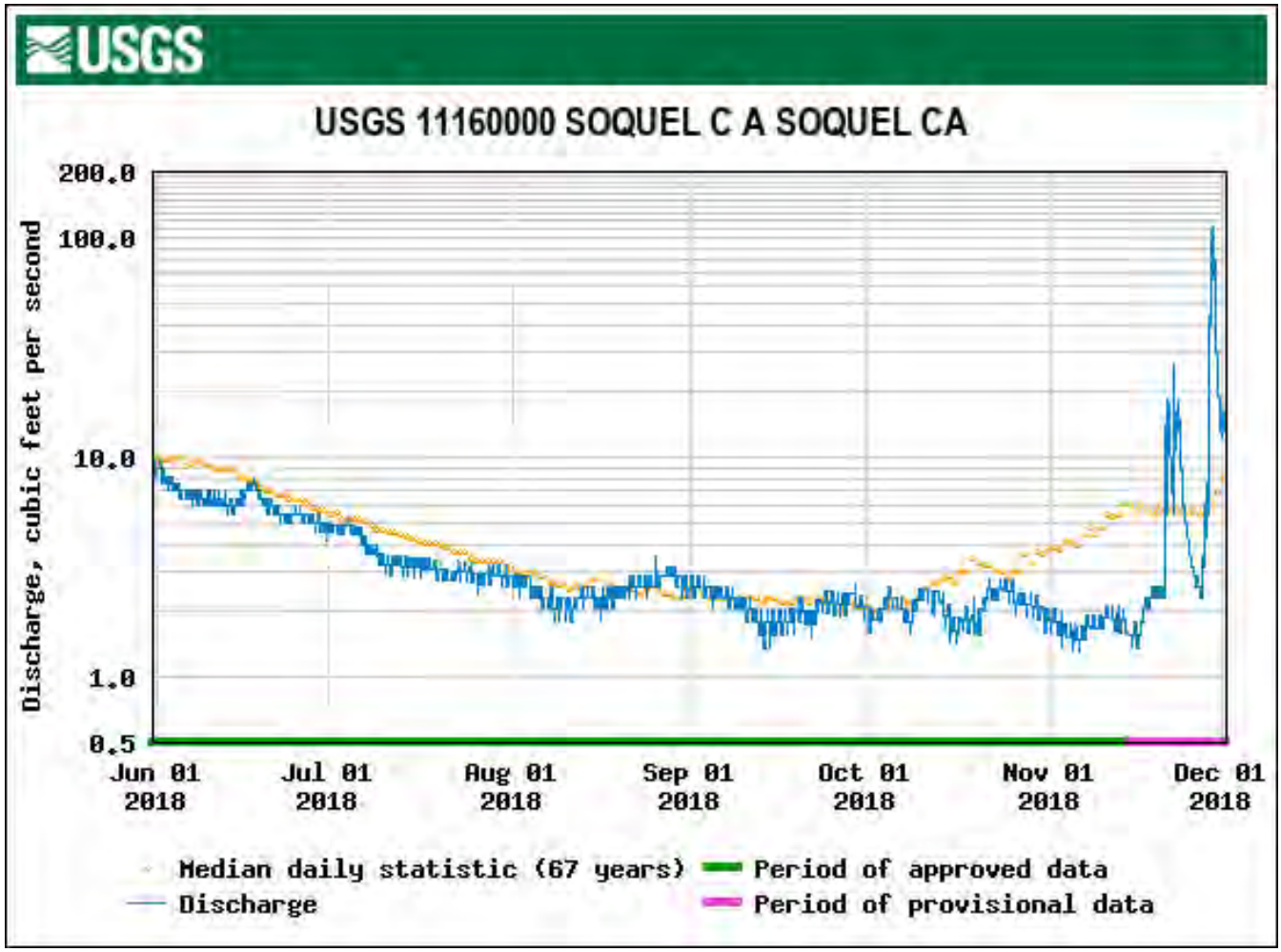


Figure 16. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

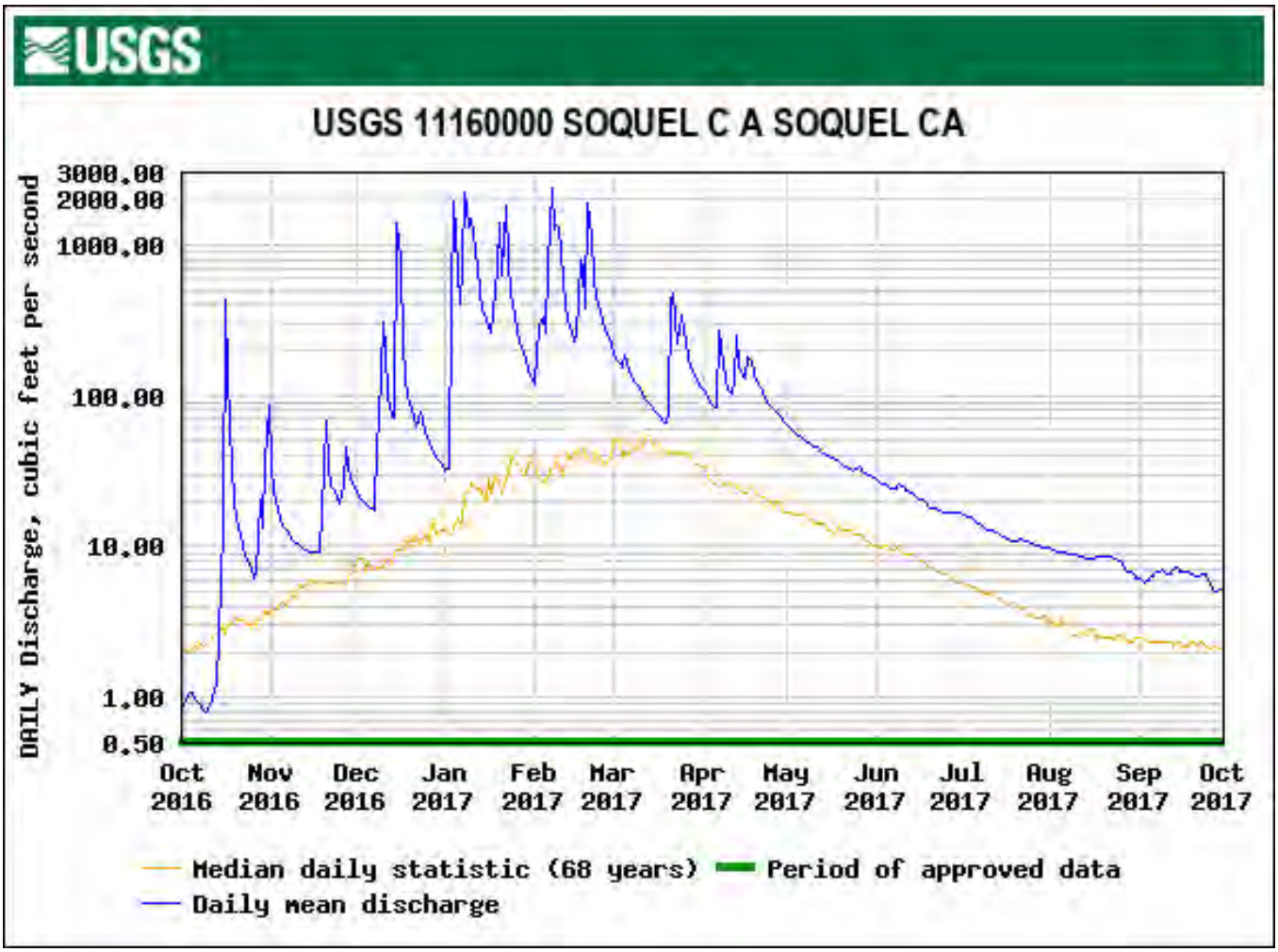


Figure 16. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

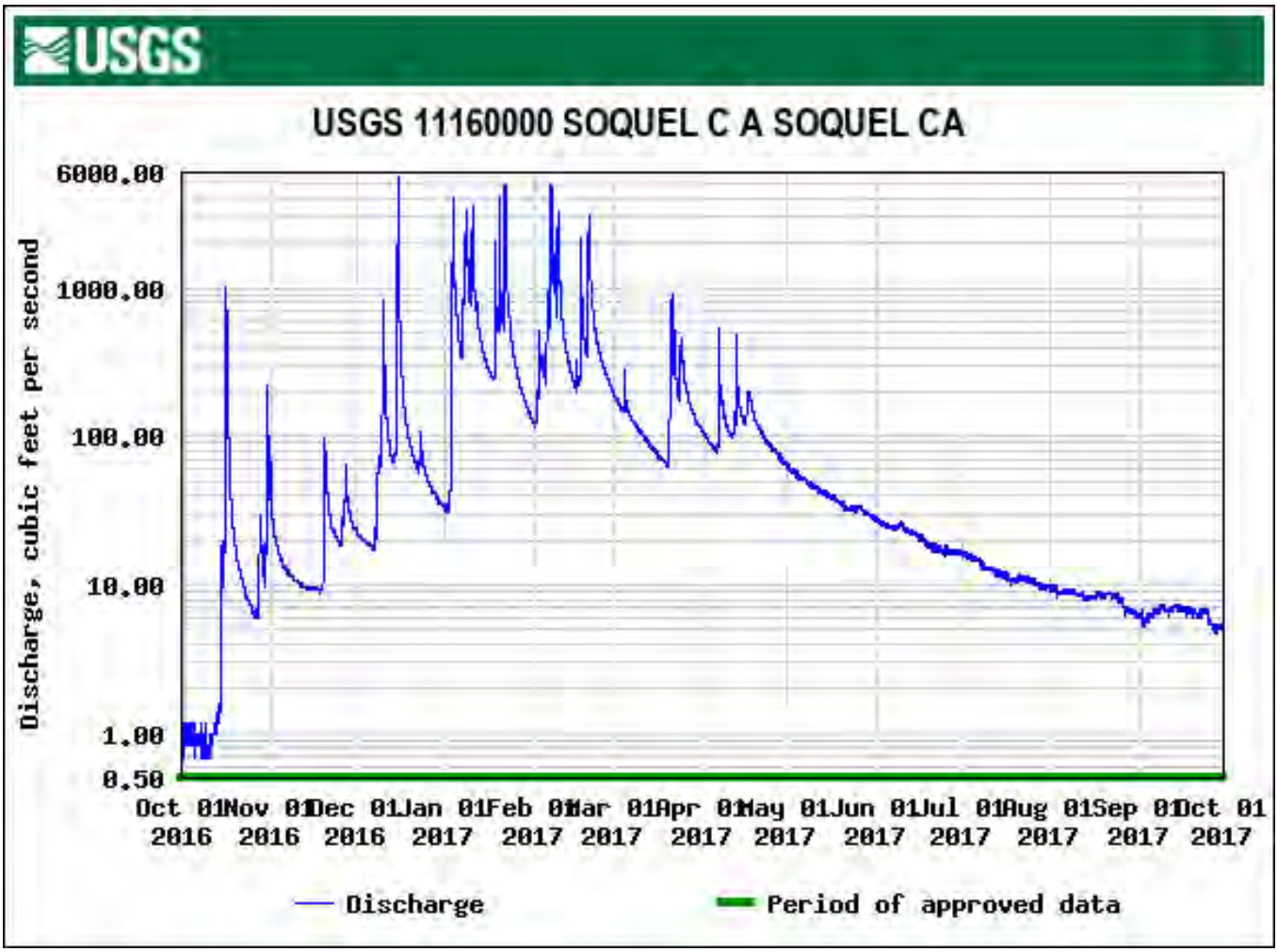


Figure 18. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2017 – 20 November 2017.

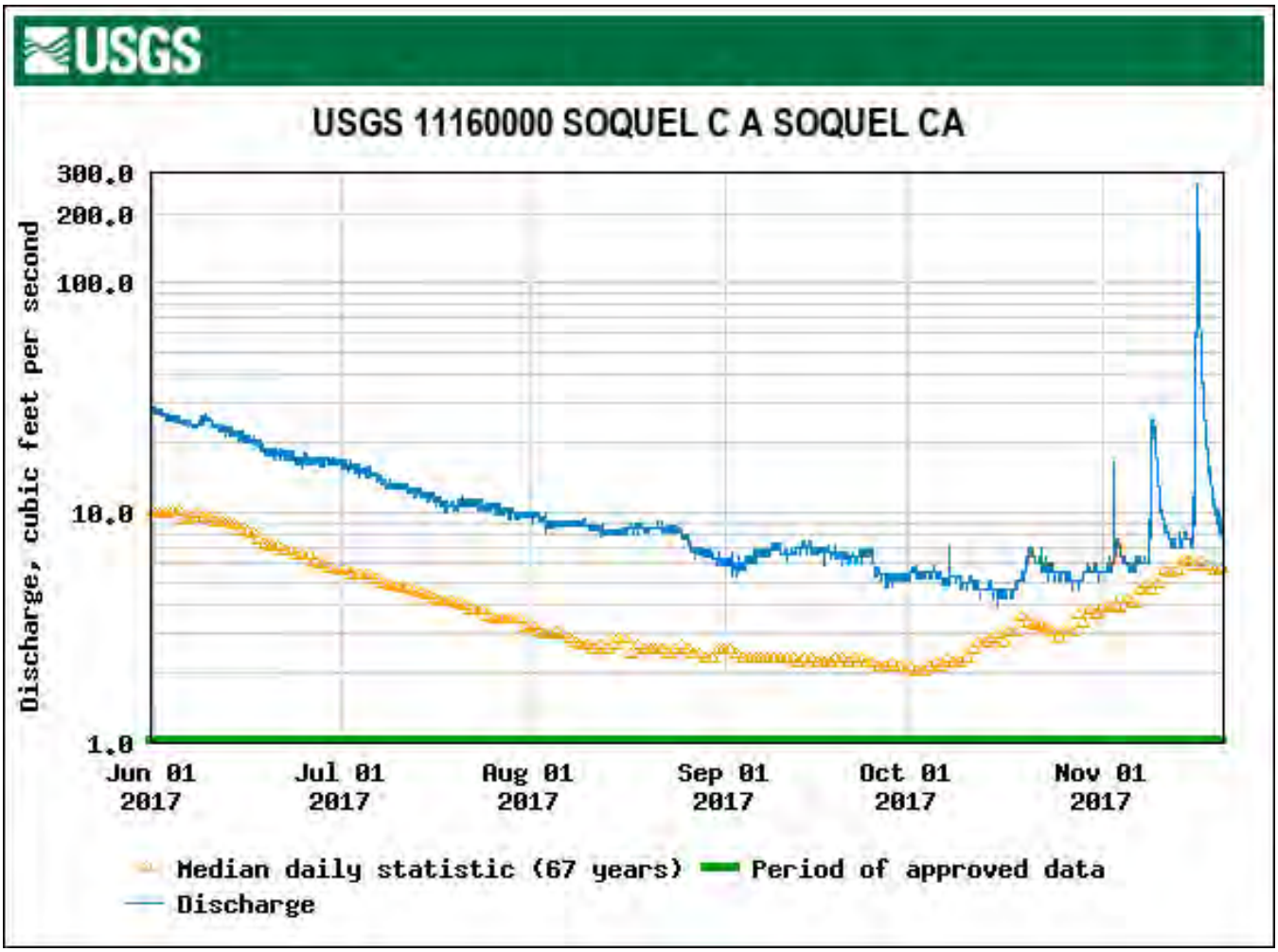


Figure 19. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016

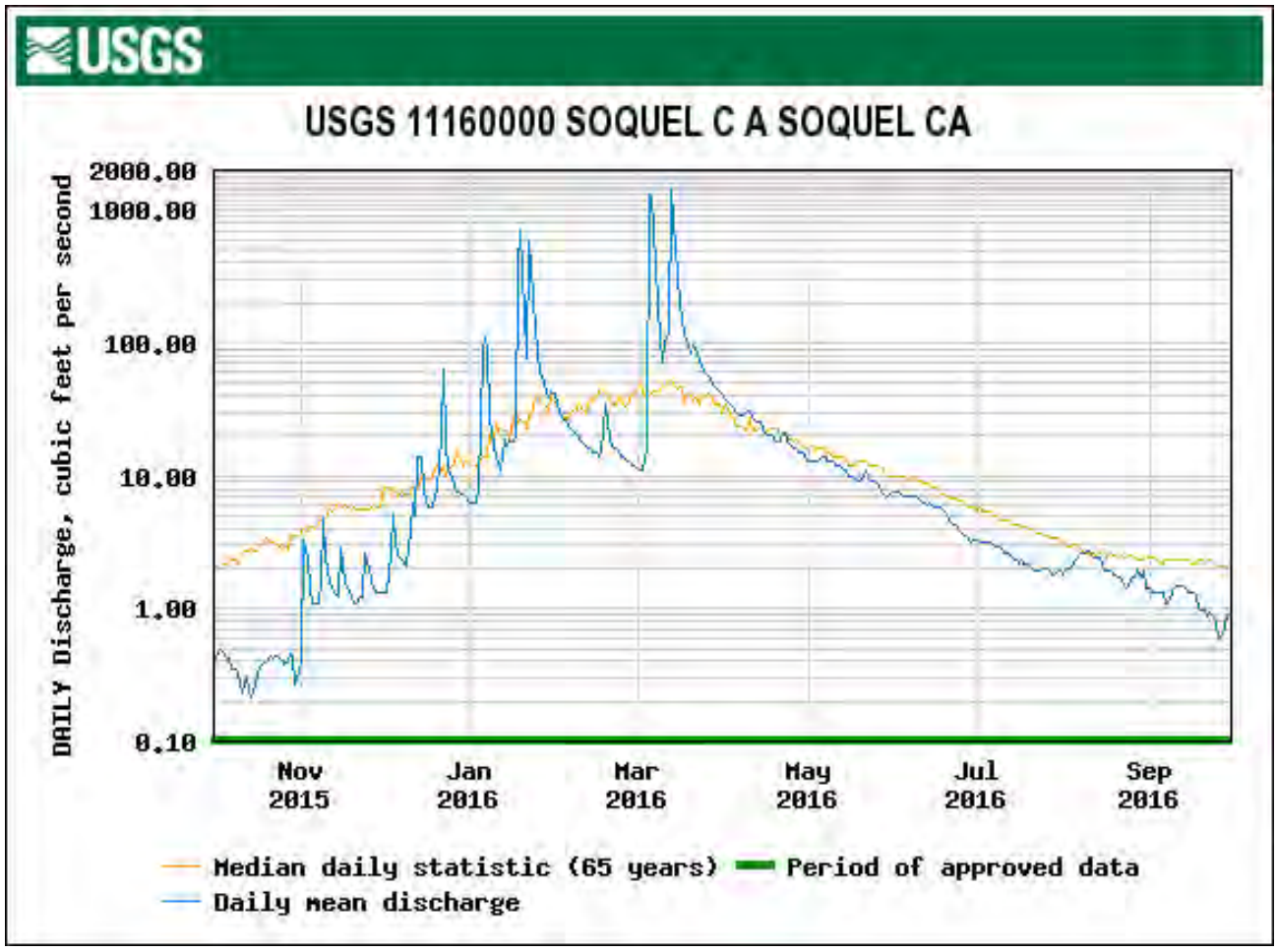


Figure 20. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016.

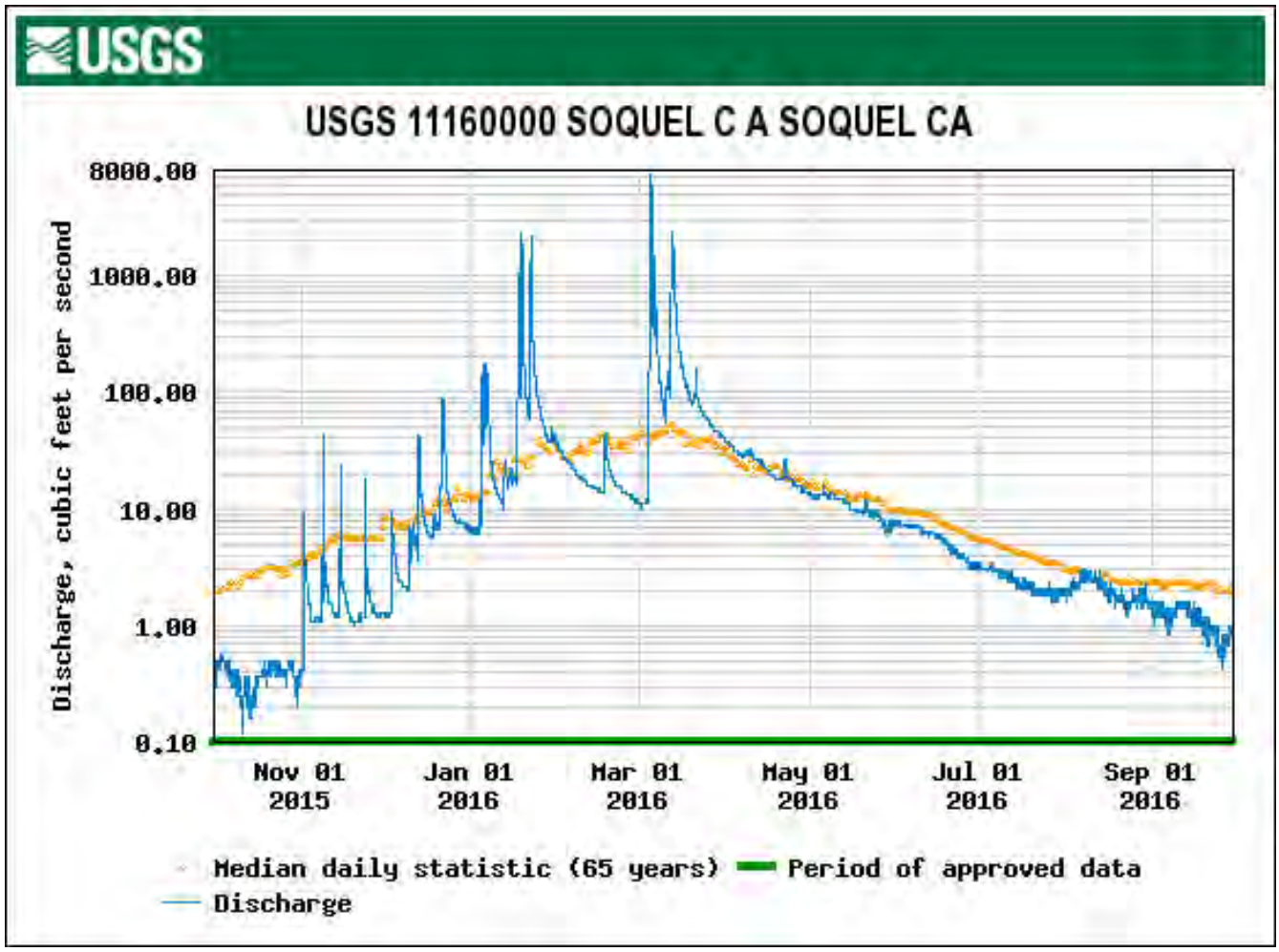


Figure 21. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2016 – 11 October 2016.

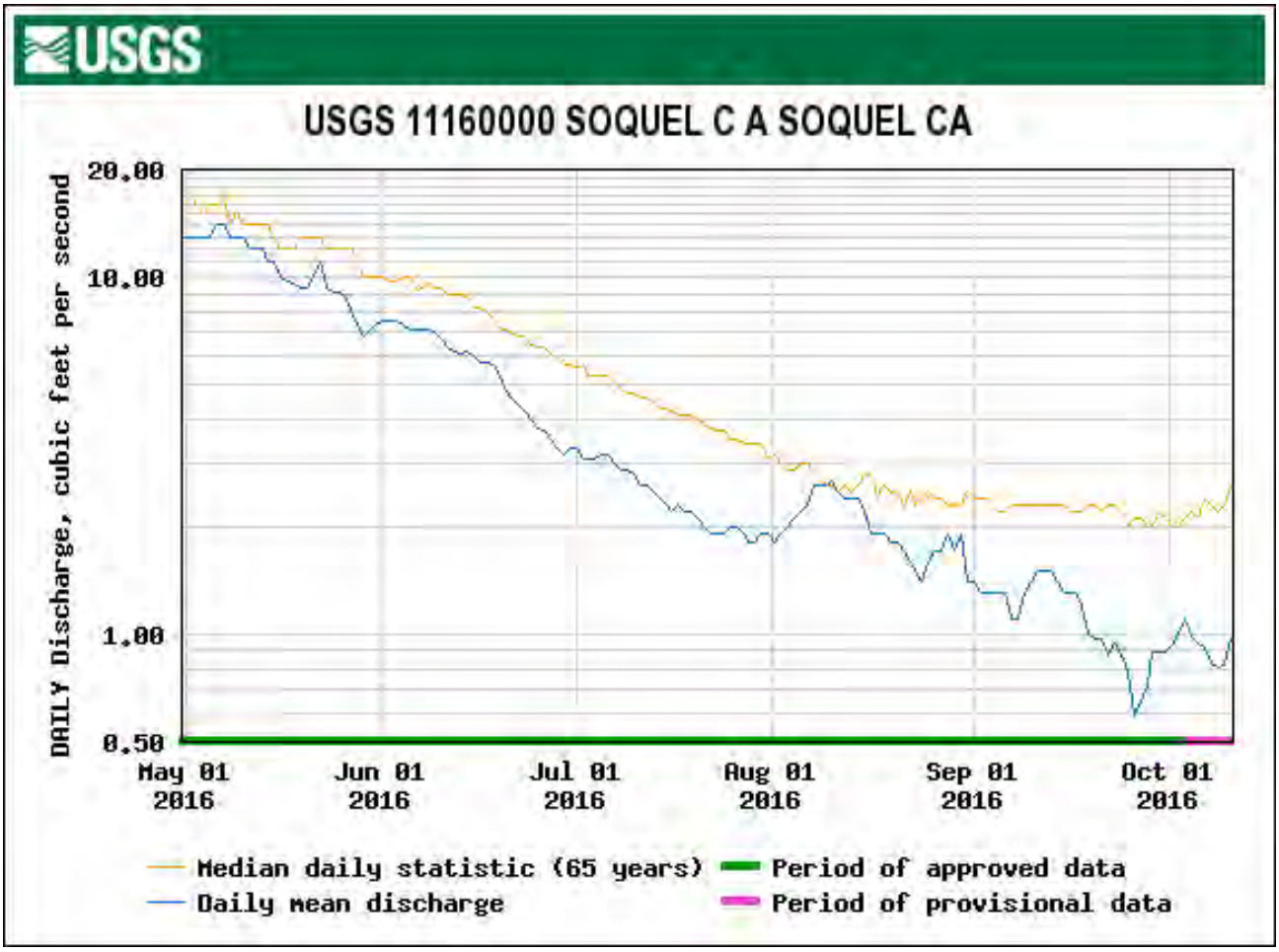


Figure 22. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

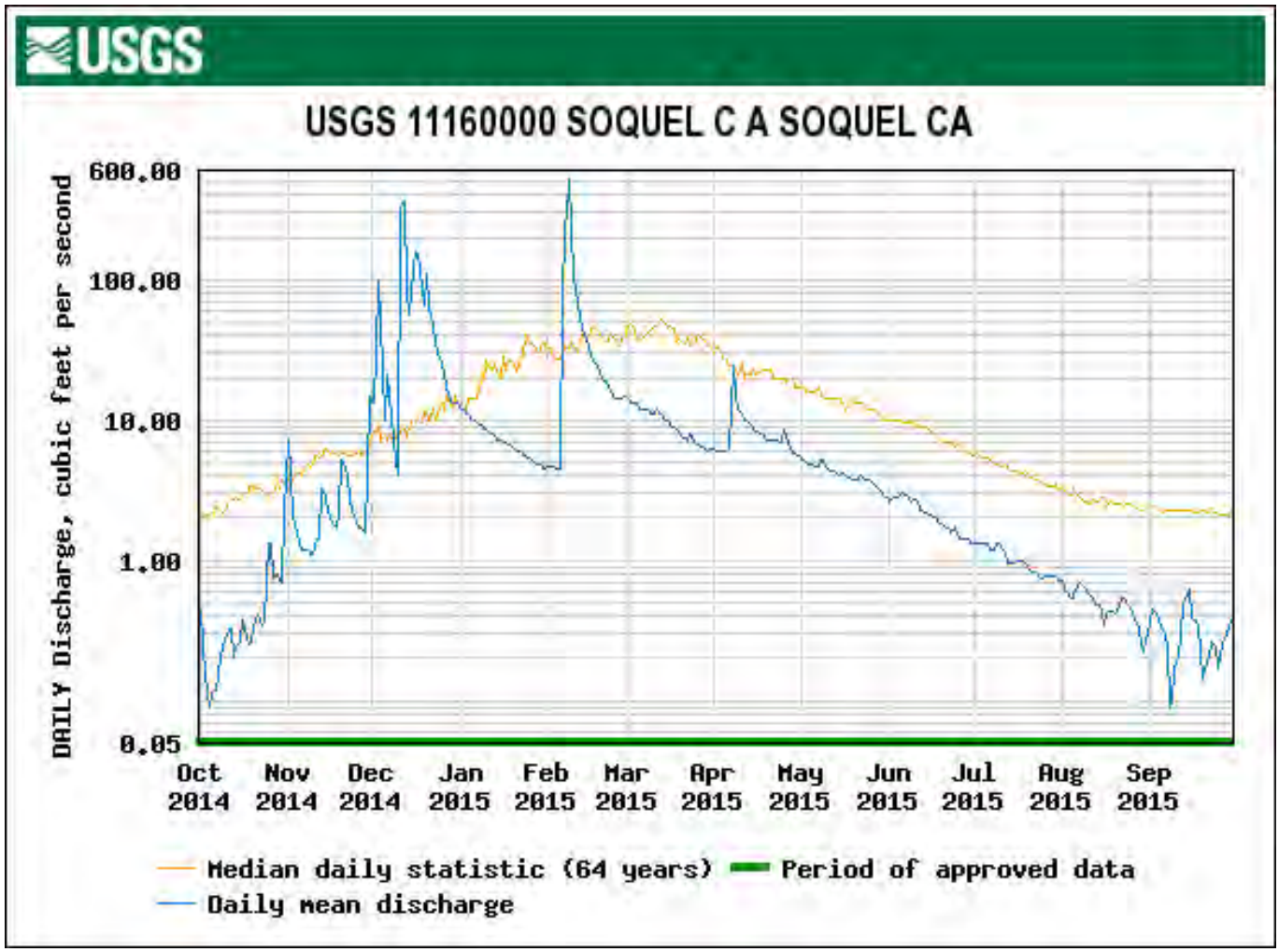


Figure 23. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

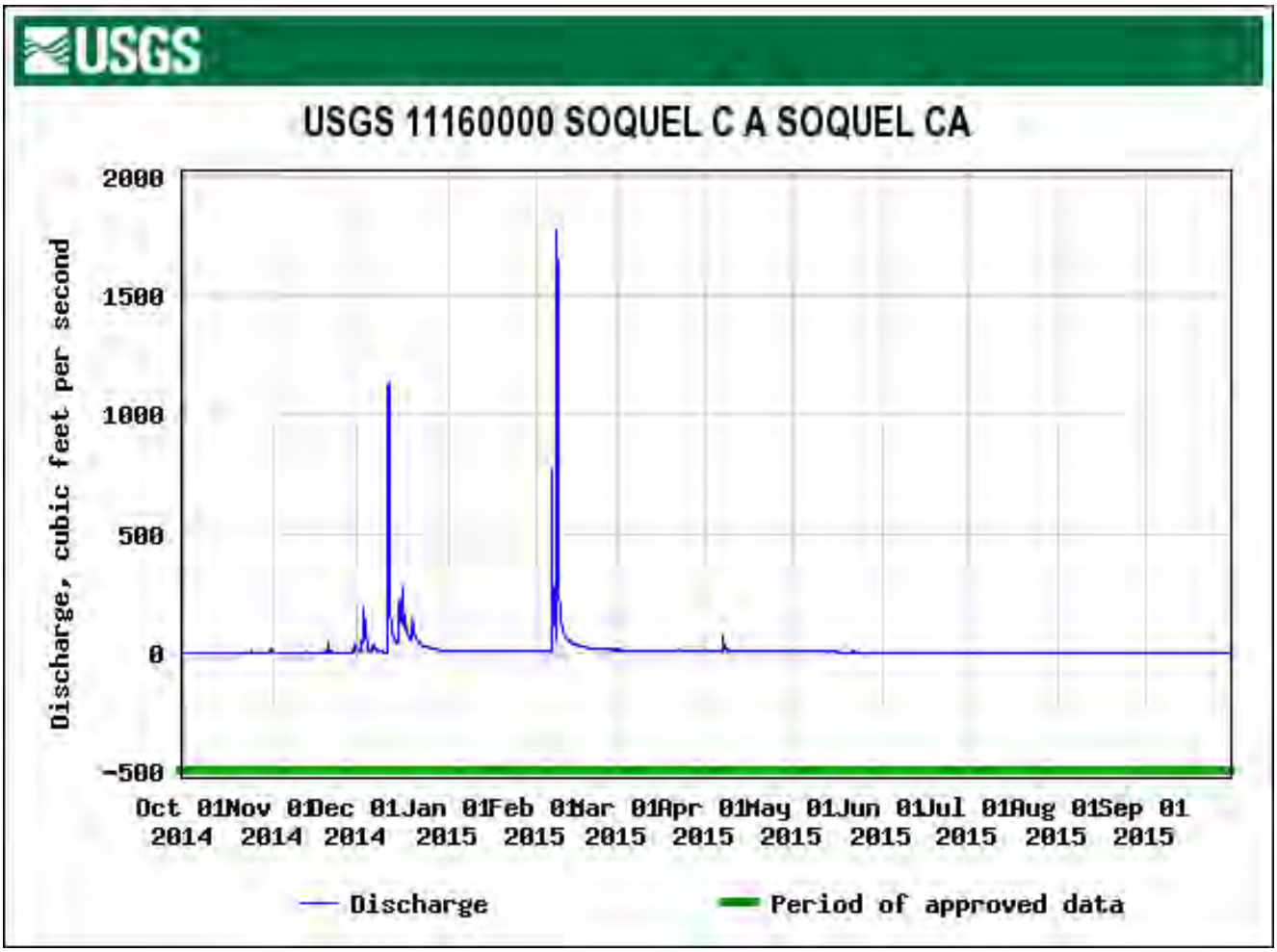


Figure 24. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2015 – 15 November 2015.

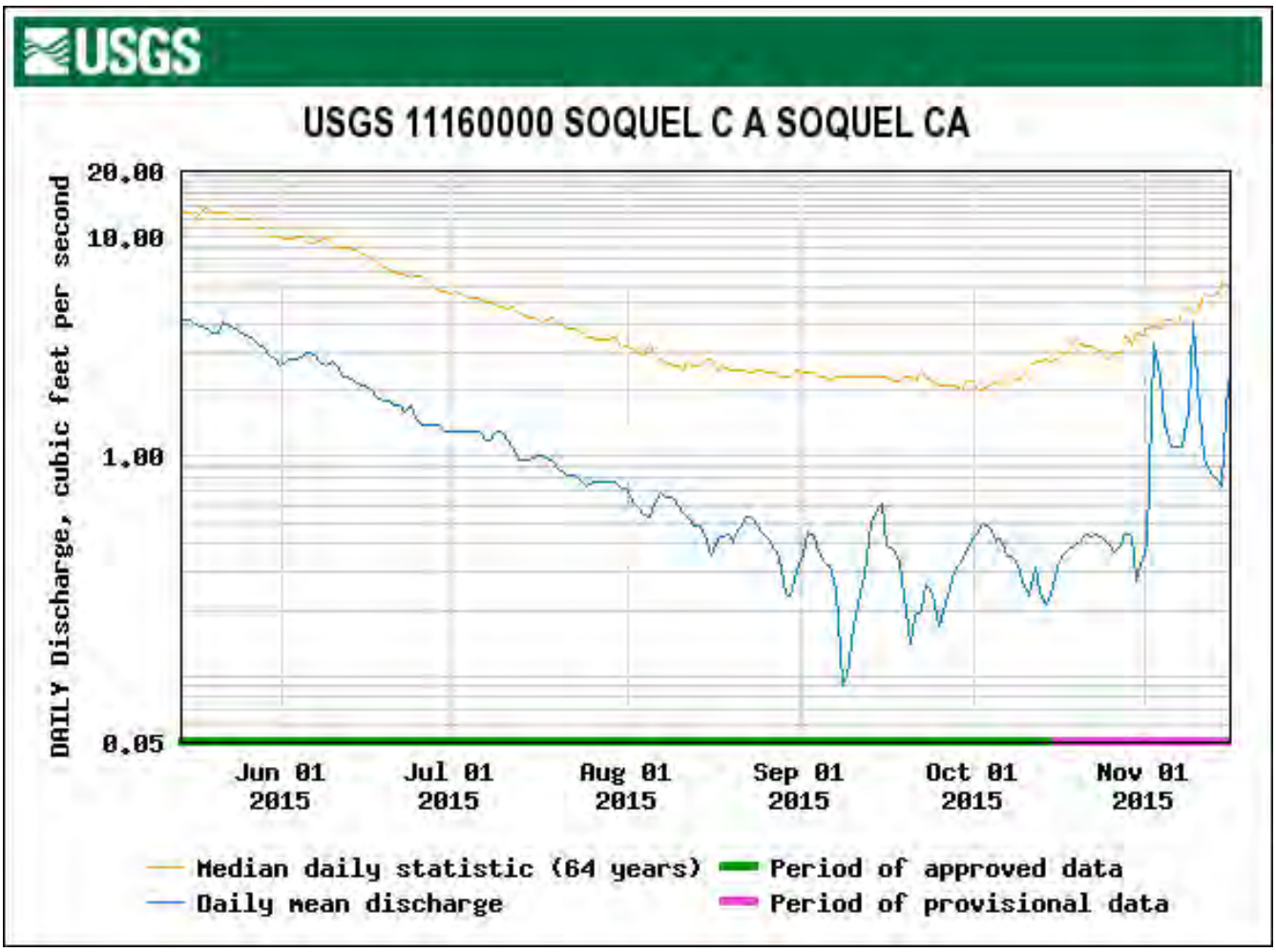


Figure 25. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

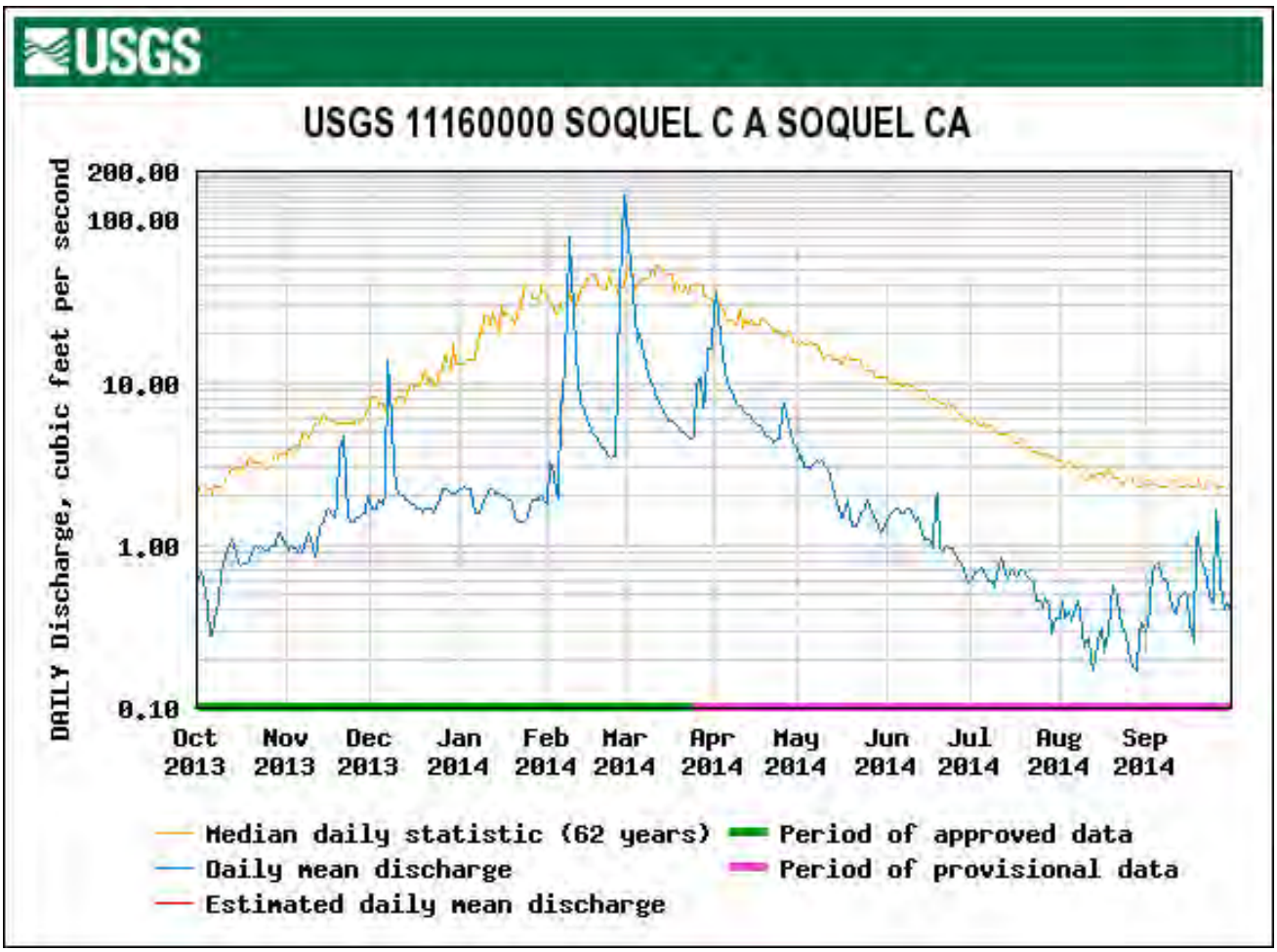


Figure 26. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

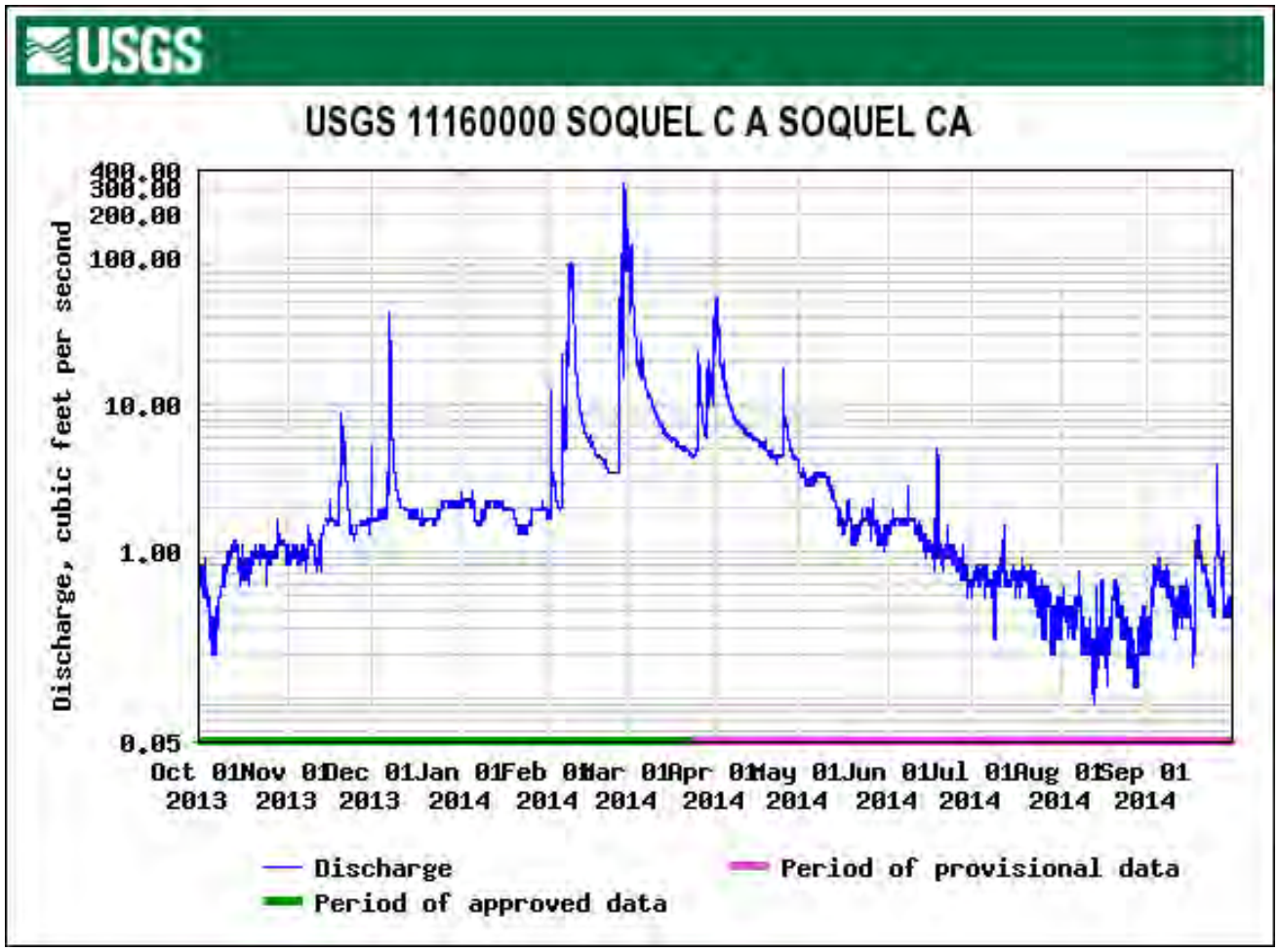


Figure 27. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2013.

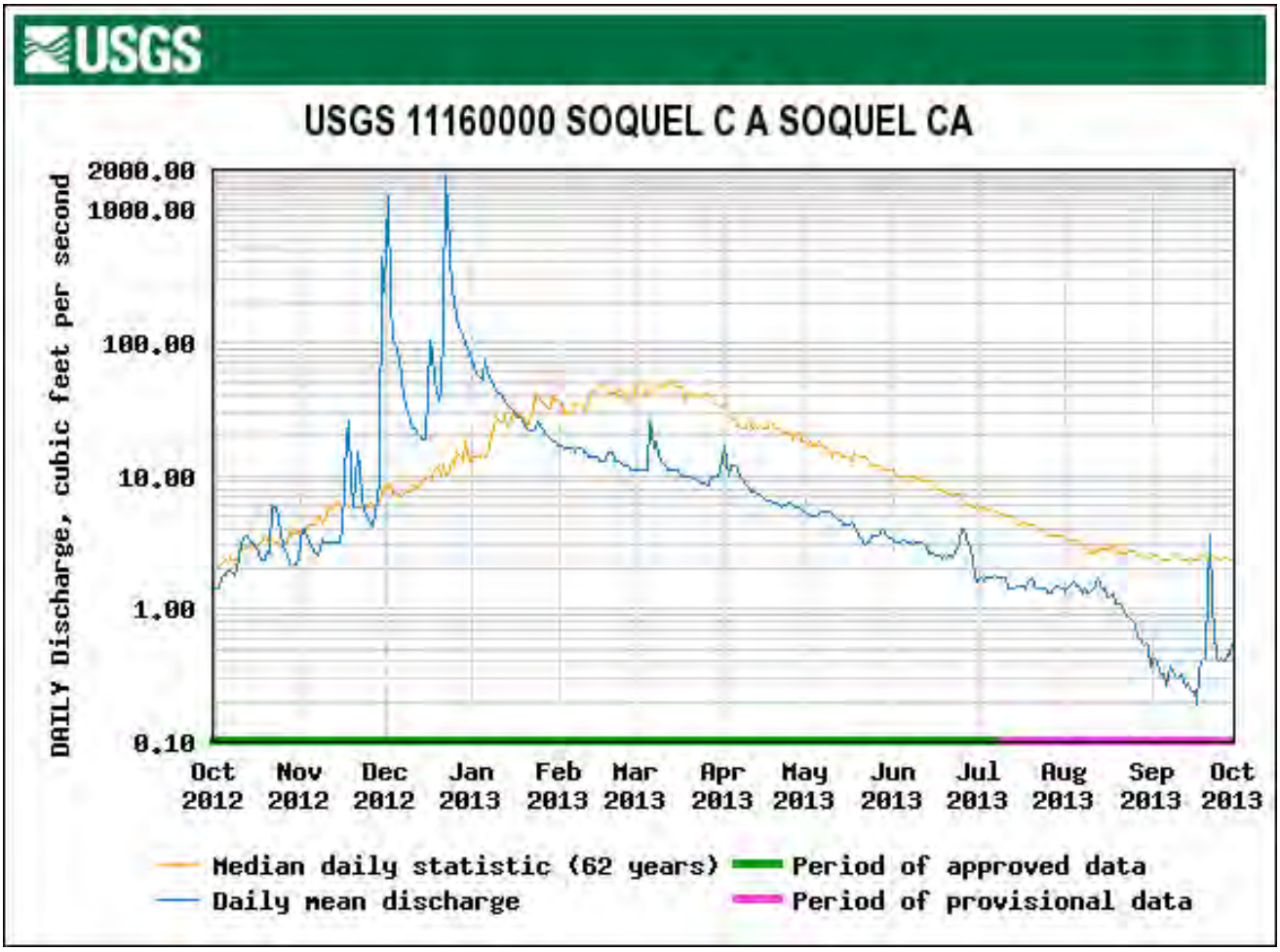


Figure 28. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, October 2012 – May 2013.

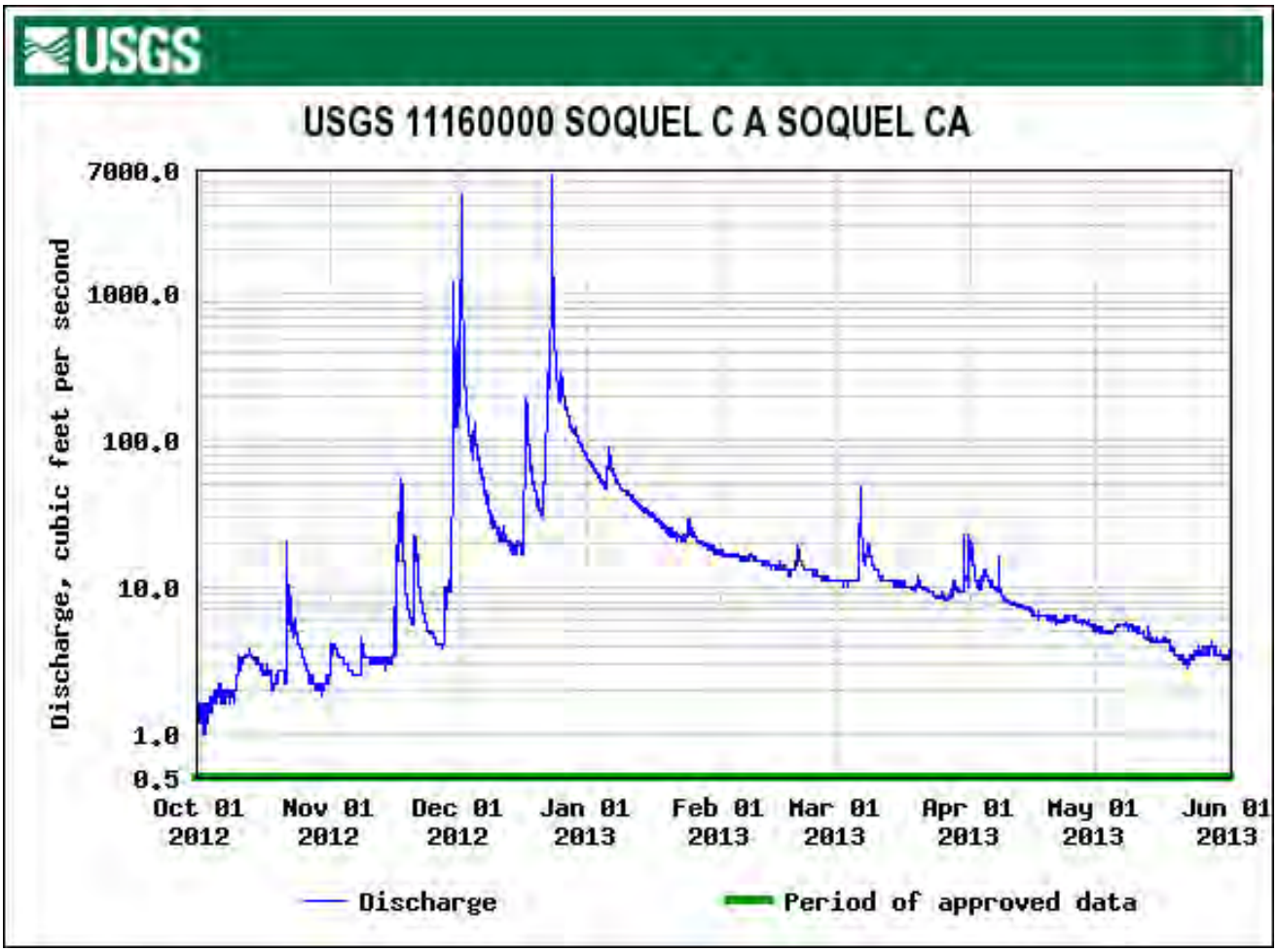


Figure 29. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

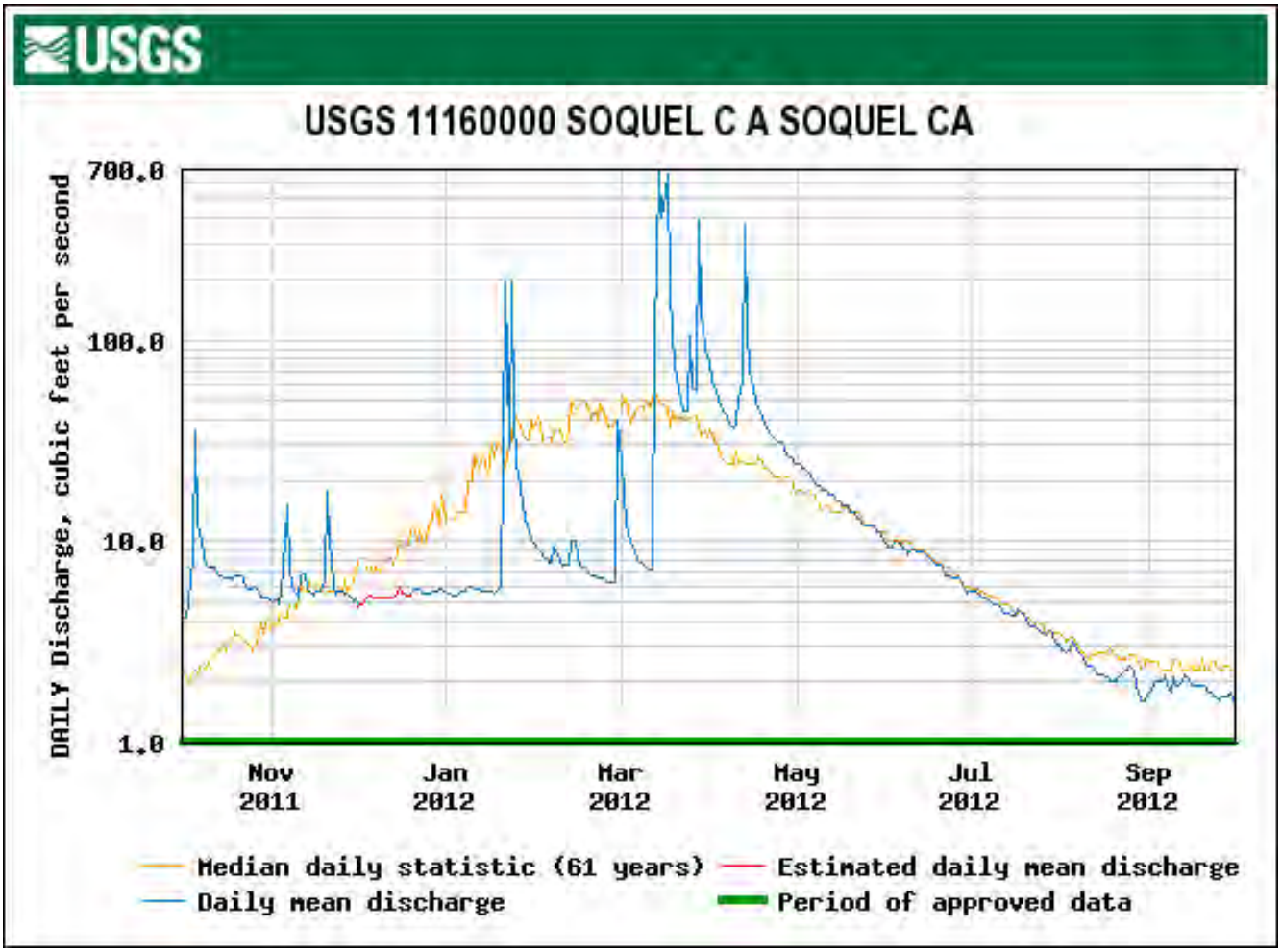


Figure 30. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

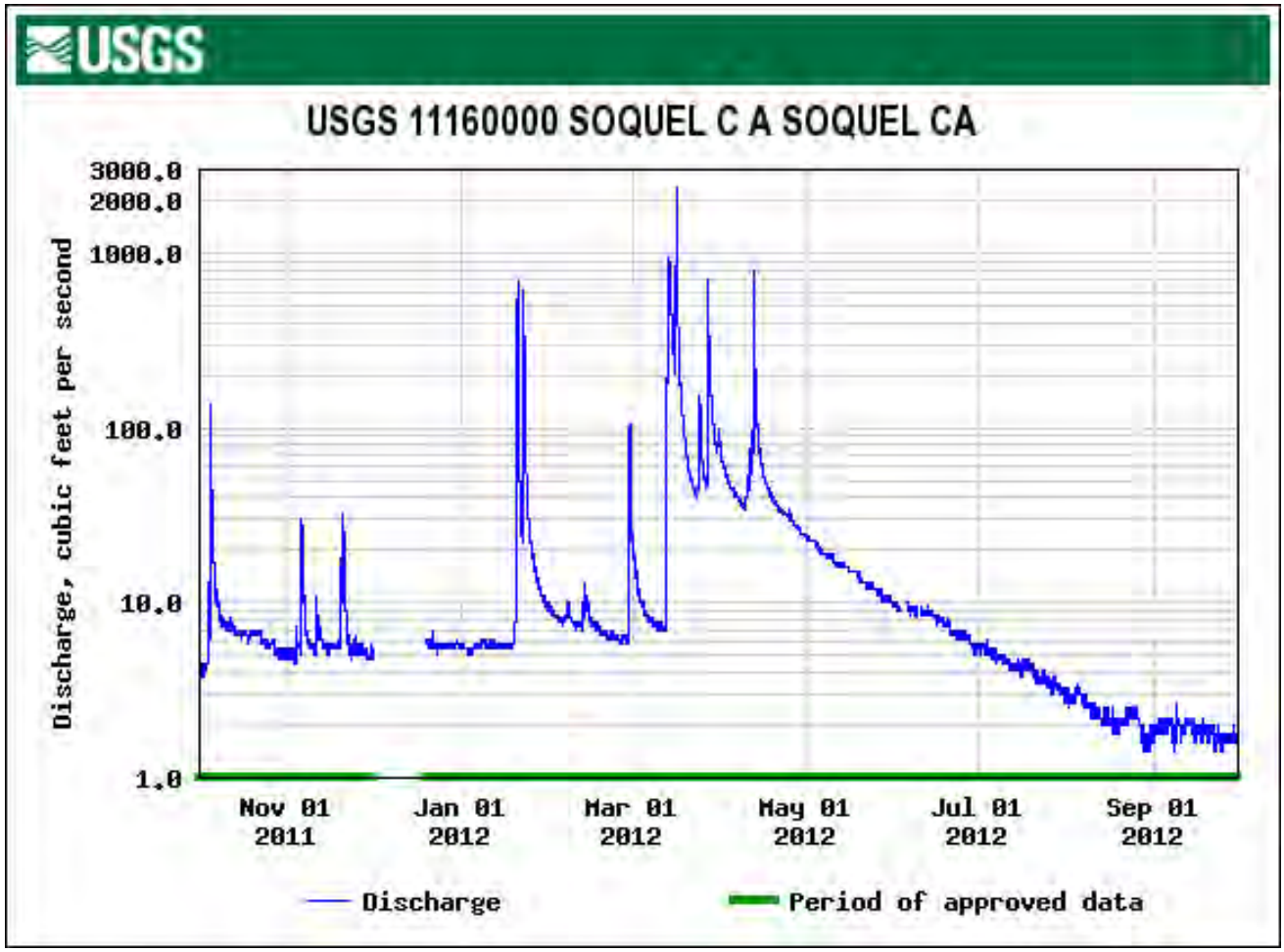


Figure 31. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

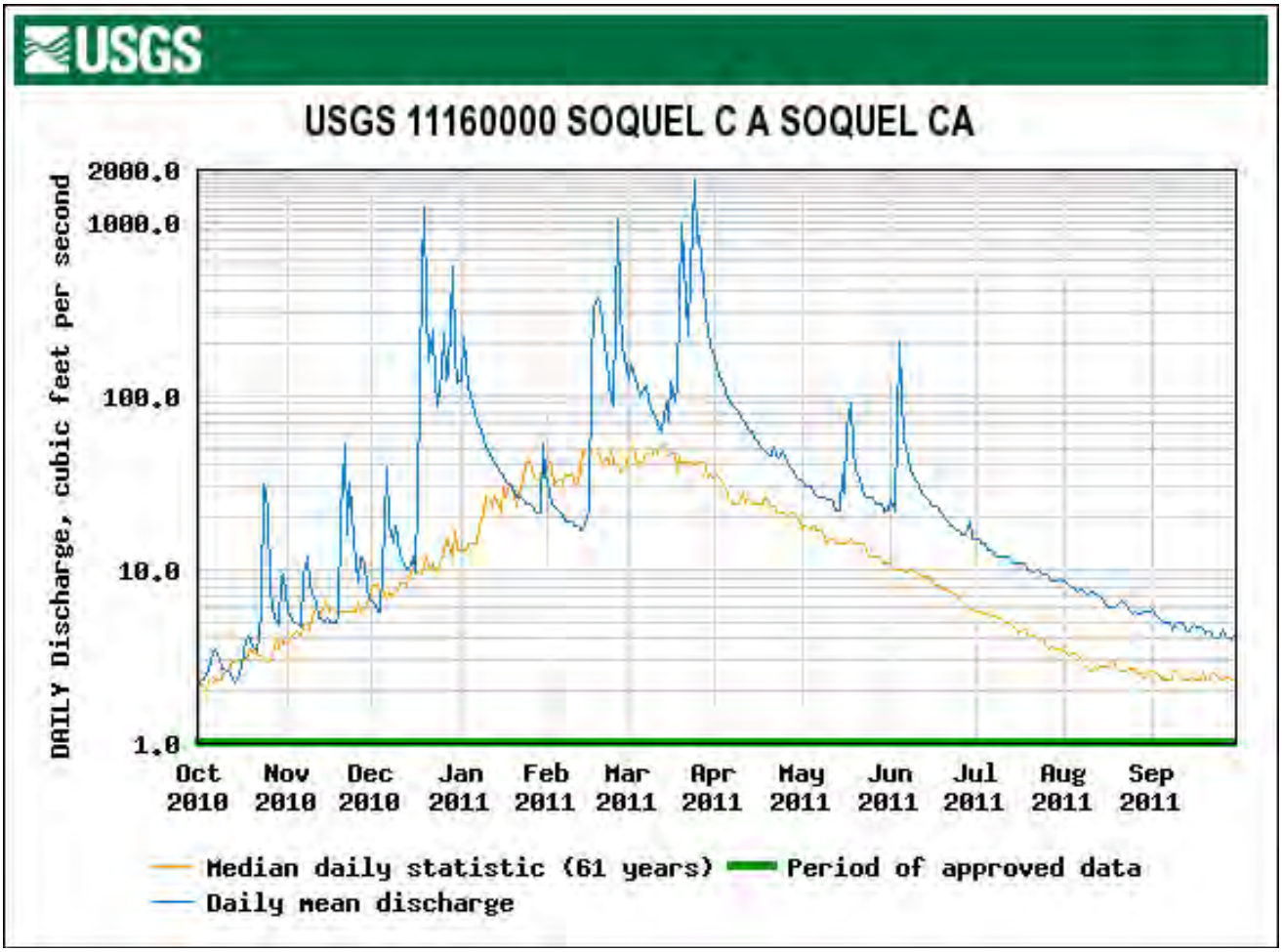


Figure 32. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

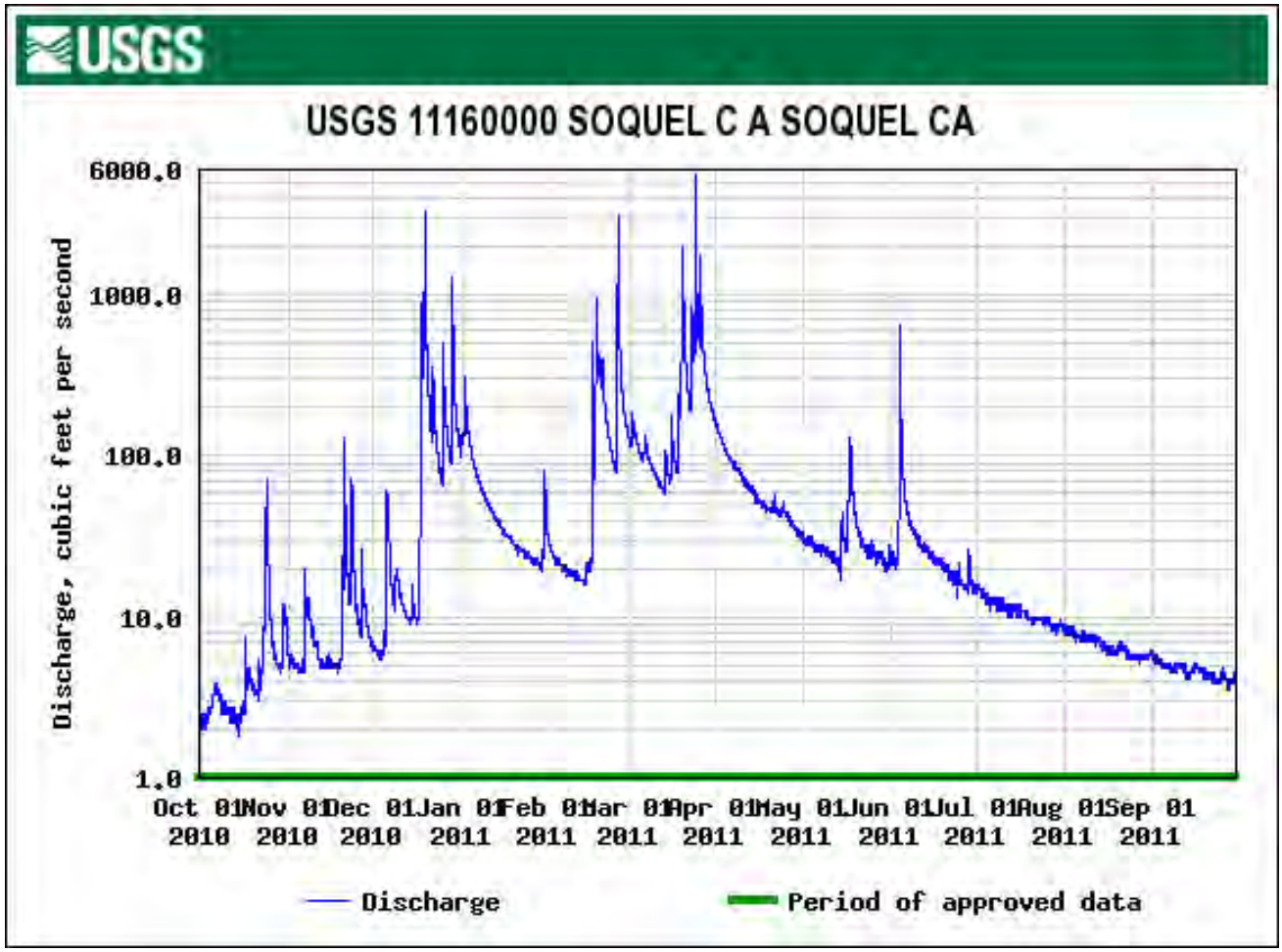


Figure 33. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2010.

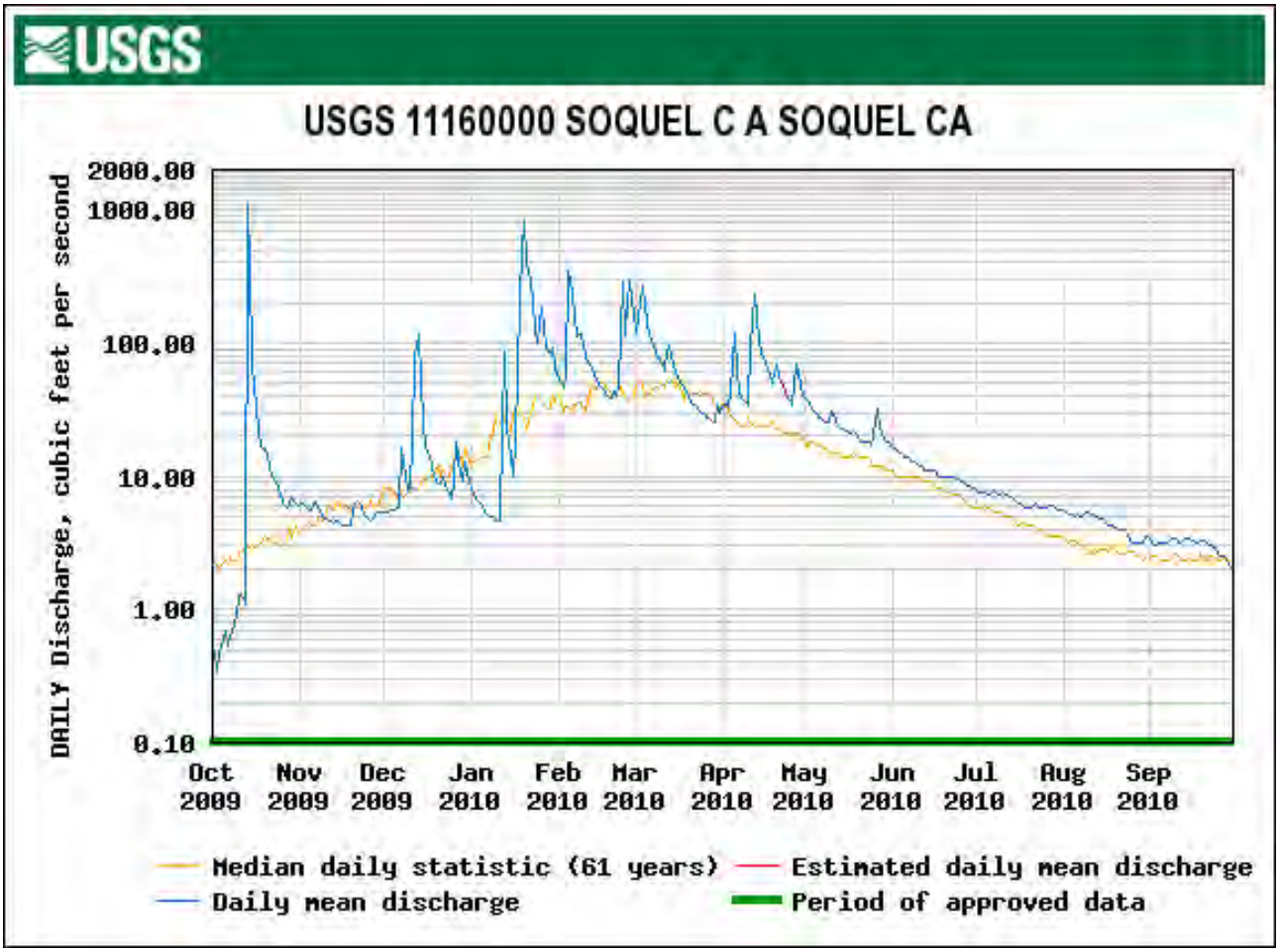


Figure 34. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2009.

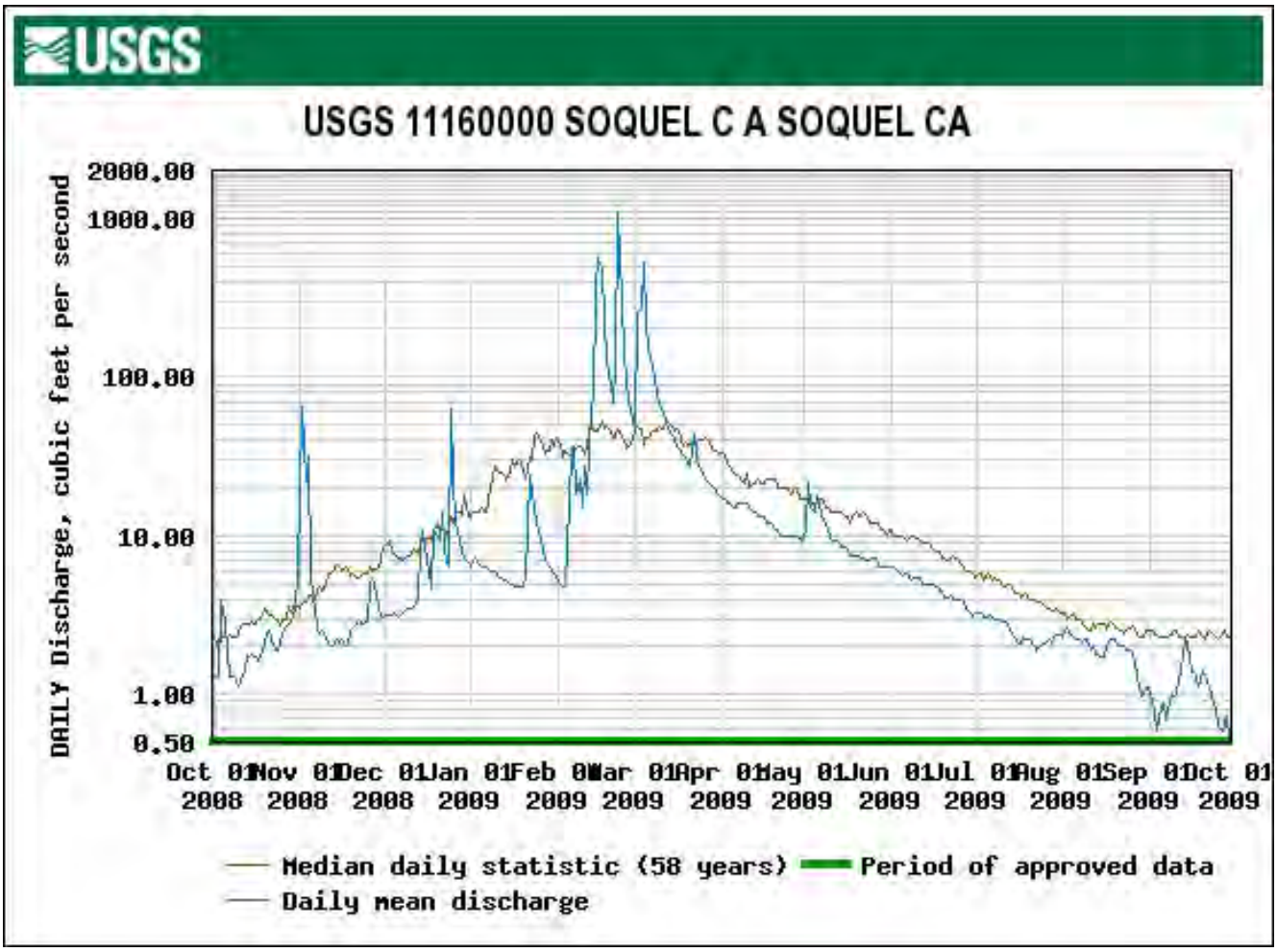


Figure 35. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2008.

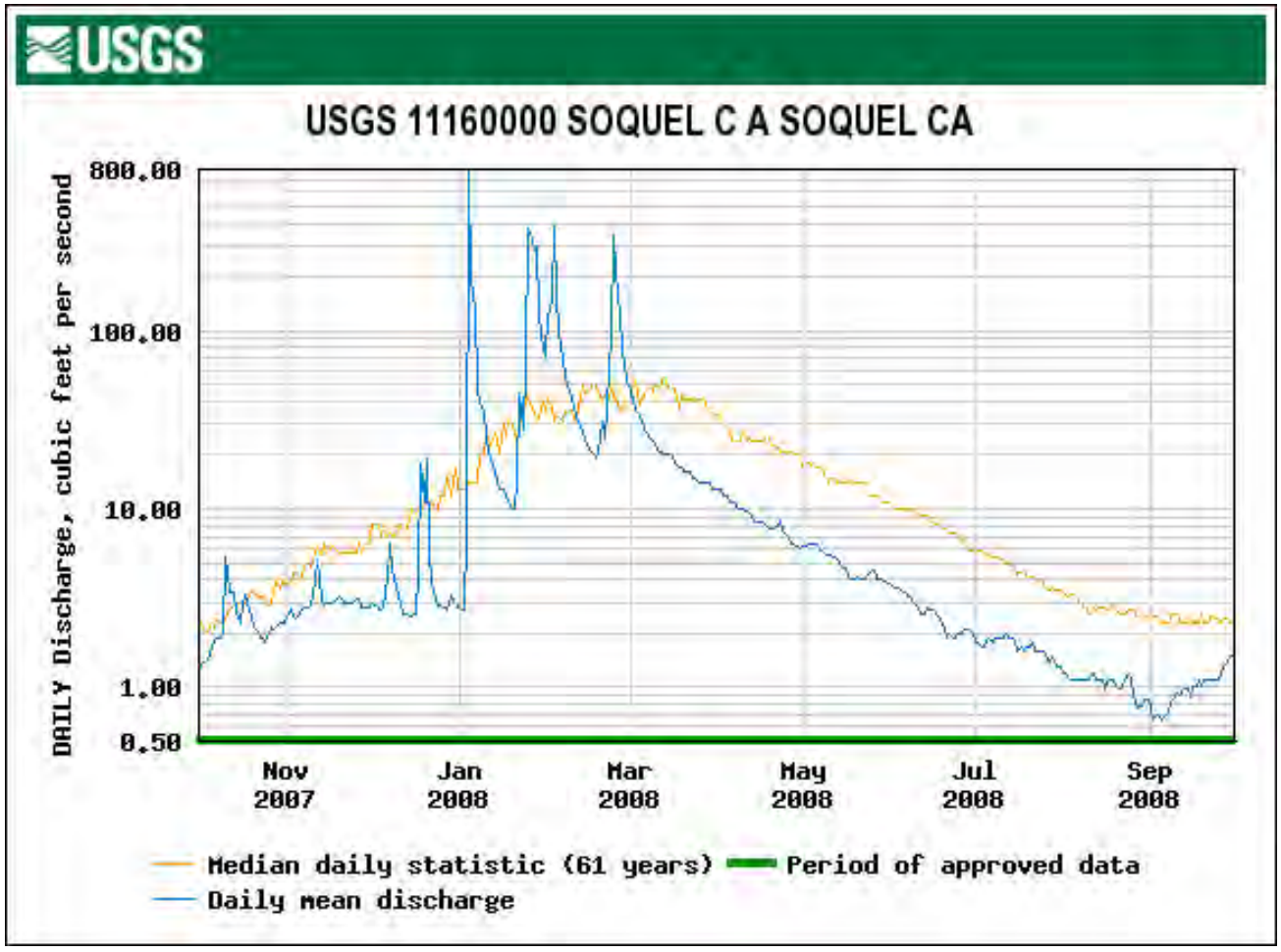


Figure 36. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2007.