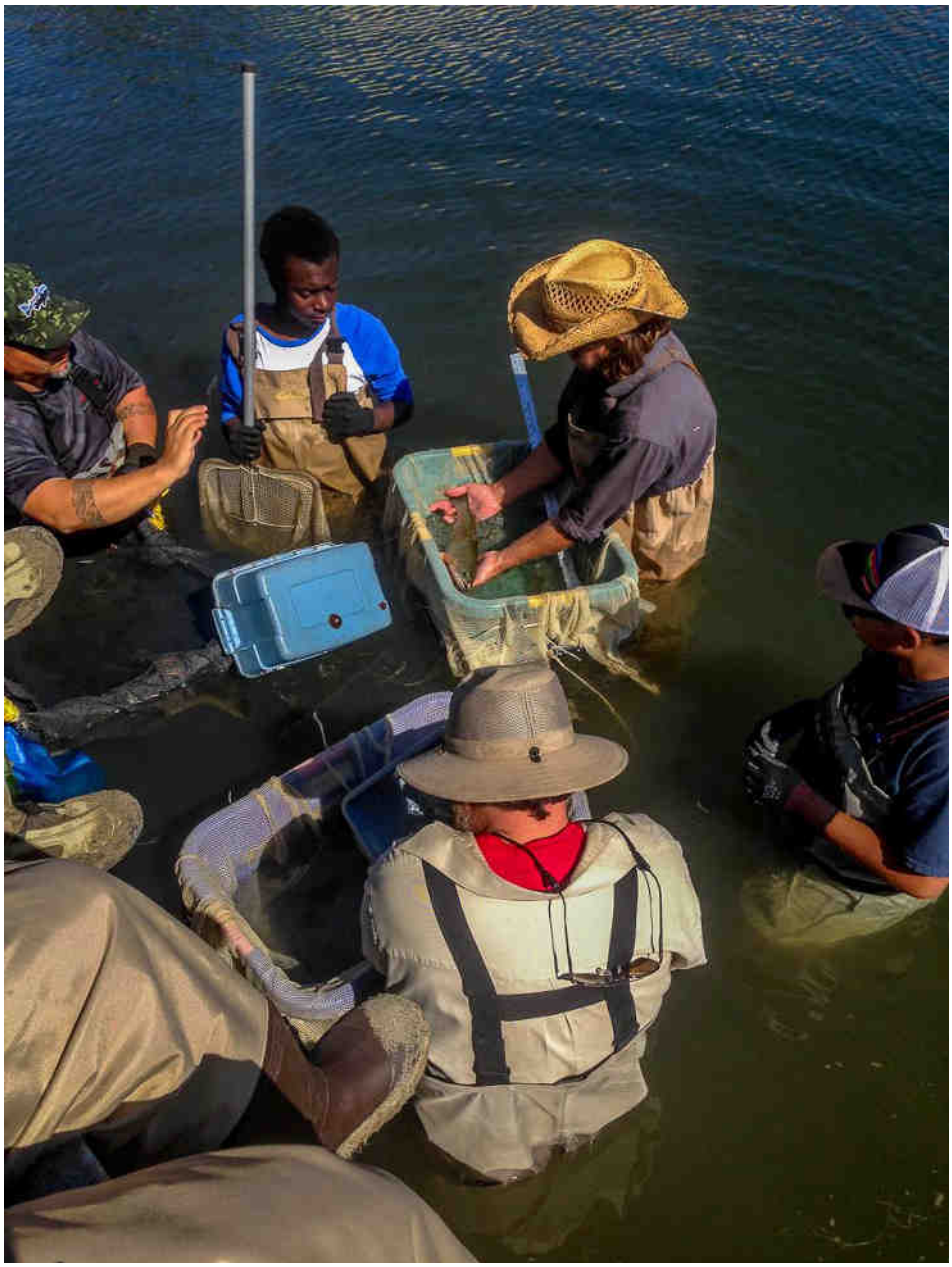
D.W. ALLEY & Associates aquatic biology

Soquel Lagoon Monitoring Report- 2018



CITY OF CAPITOLA, 420 Capitola Avenue, Capitola, California 95010

January 2019 **Project # 106-28**

340 Old River Lane, P.O. BOX 200, Brookdale, California 95007-0200 (831) 338-7971

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SOQUEL CREEK LAGOON MONITORING REPORT, 2018

ACKNOWLEDGMENTS

Ed Morrison and the Capitola Public Works Department did well in creating and maintaining the lagoon in 2018. We appreciate that Matt Kotila, as heavy equipment operator, and Ed Morrison, as Contracting Supervisor, teamed to daily observe the lagoon and adjust to its needs. Every year is different, and we are grateful for their attentiveness, along with that of other Public Works staff. Matt's fast response to a quickly-filling lagoon during the Thanksgiving night stormflow avoided flooding.

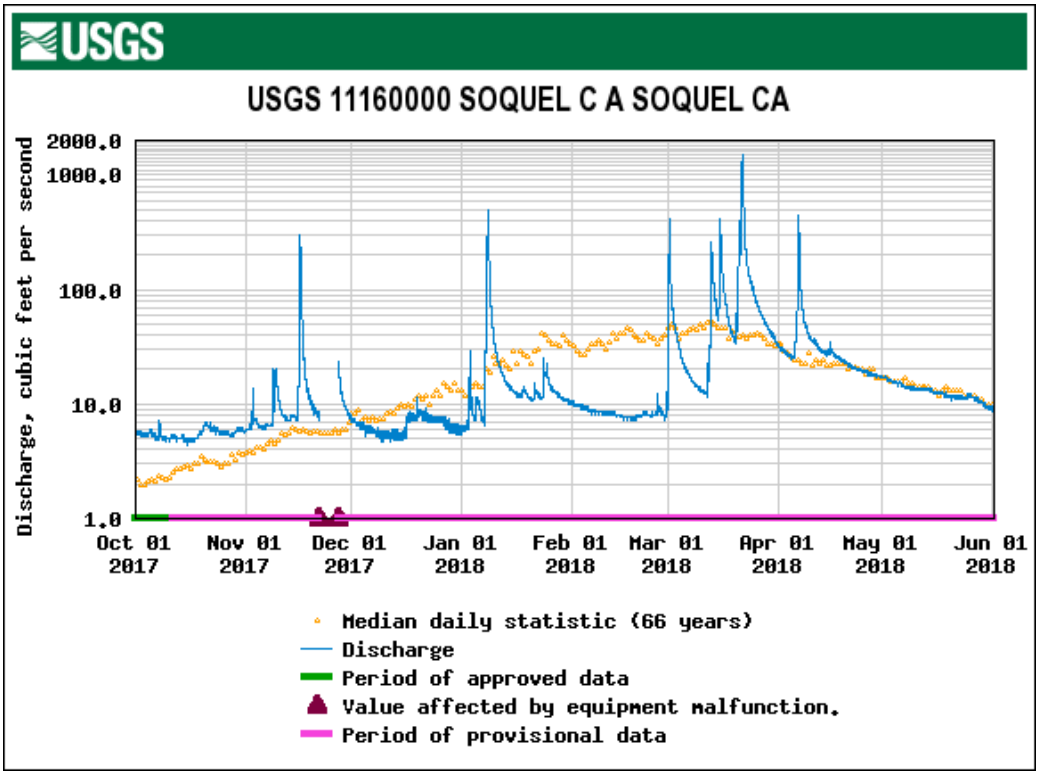
We thank Nels and Susan Westman again for the loan of their vintage Sears-Roebuck rowboat for fish censusing and placement/ retrieval of temperature probes.

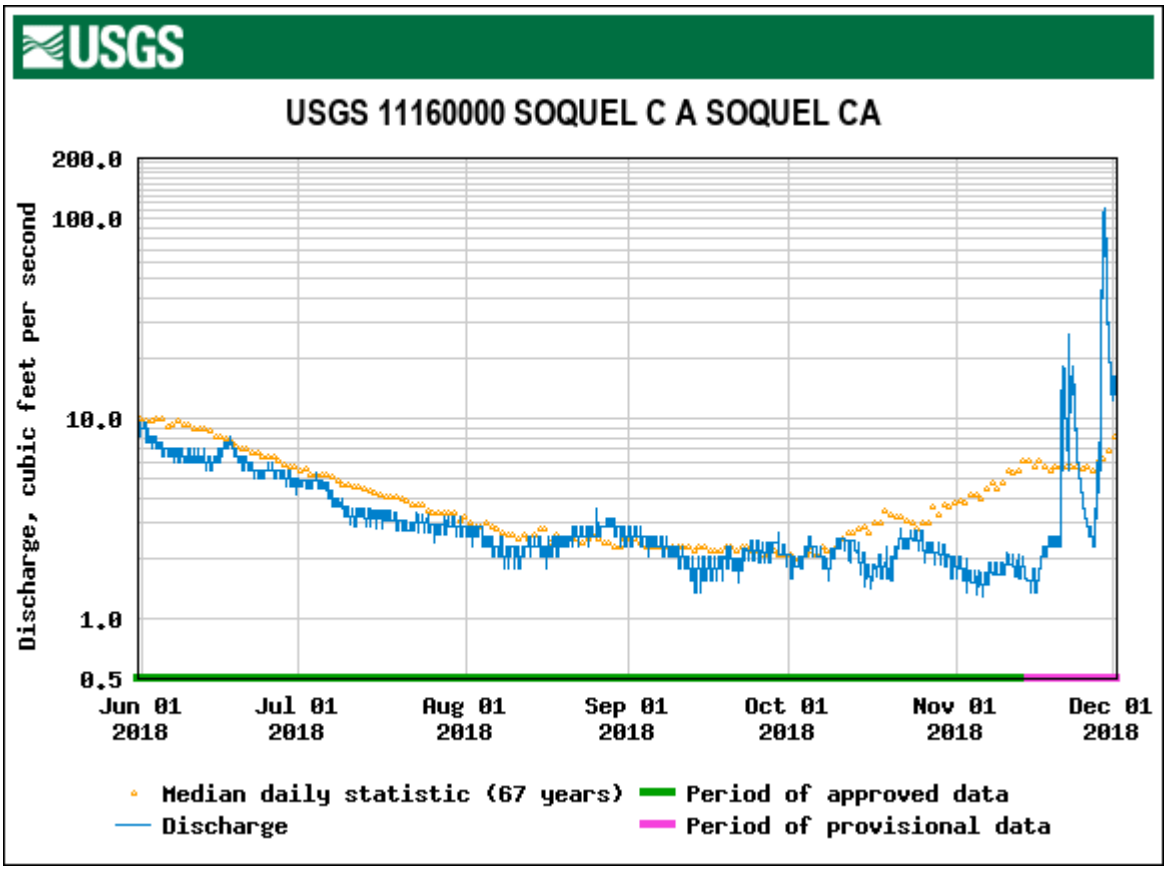
We were grateful to the volunteers who assisted in annual fish censusing at the lagoon. There were local residents and other volunteers. Ben Harris from the Monterey Bay Salmon and Trout Project helped on the first weekend. Robin Aston, math teacher at Soquel High, brought her students and children. They were important in providing enough help. Nigel, a high school biology student from Woodside High and two classmates returned to assist us, with his parents providing transportation. Nancy Scarborough (former Coastal Watershed staff member) assisted in seining and data collection. Biologists, Josie Moss (and her husband Amine), Inger Marie Laursen and Debie Chirco-Macdonald provided their positive energy in working the seine and recording data. Chad Steiner was key to setting the seine, capturing fish and assisting in measuring them. Both of Chad's daughters helped with the seining in 2018. 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.

REPORT SUMMARY

Sandbar Construction. No negative impacts to steelhead were detected during sandbar construction in 2018. Sandbar construction and creation of a freshwater lagoon of maximal depth represented habitat enhancement. Sandbar construction was completed prior to Memorial Day weekend in May 2018. Sandbar construction has been permitted by the California Department of Fish and Wildlife (1600-2017-0411-R3), the Army Corps of Engineers (2000-25714S), California Coastal Commission (CDP 3-90-041-A9) the Regional Water Quality Control Board (Certification No. 34417WQ01) and the National Marine Sanctuary (MBNMS-2004-033-A1 and MBNMS-2011-007). The entire estuary reach was surveyed for steelhead spawning redds, including the glide above estuary influence. No steelhead redds were found. As required in the permit, a fisheries biologist was present during all sandbar construction activities that could affect fish habitat in the lagoon/estuary. This was year 28 of our monitoring and activities associated with sandbar construction. Annual monitoring reports for the first 27 years are available at the City (**Alley 1991-2018**).

Previous winter stormflows had been light, with only 2 moderate stormflows (less than 500 cfs) before March provided migrational salmonid passage and meager baseflows for steelhead spawning and egg incubation until late in the spawning season. There was little or no rain in December or February. Four moderate stormflows and 1 bankfull event occurred in March and early April to improve steelhead spawning conditions afterwards. But the bankfull event likely destroyed redds that may have been created recently before it. Streamflow had declined slowly to 11.9 cfs on 21 May at Soquel Village, 2 miles upstream. Baseflow was close to the median early in the dry season and continued mostly below median flow through the dry season.





The lateral stream channel that usually forms across the beach in spring had recently filled in from natural sand deposition, with the outlet channel exiting closer to the flume. After the flume was cleared of sand on 17 May, streamflow passed through the flume. Therefore, no fish rescue was required near the beach. No tidewater gobies (*Eucyclogobius newberryi*) and only 1 steelhead smolt (*Oncorhynchus mykiss*.) were observed during sandbar construction activities. Threespine stickleback (*Gasterosteus aculeatus*) and prickly sculpin (*Cottus asper*) were rescued and relocated during drawdowns associated with sandbar construction.

Prior to sandbar construction, the plumbing of Esplanade businesses was inspected for leaks by City staff and repaired as necessary. Steelhead passage was maintained at night through the flume during sandbar construction that was completed on 24 May. On 24 May, the pad around the flume inlet was covered with clear visquine and secured with sandbags. Sandbags were stacked around the flume inlet. Sand was hand-broadcasted over the visquine by 1310 hr. Cooper Sanden filled cracks in the flume at low tide. The tules planted the previous May had survived the relatively mild winter in the cove beneath the railroad trestle.

Sandbar Breaching. A facilitated sandbar breach was required on 23 November 2018. The fish biologist was notified by Kotila of Capitola Public Works at approximately 0030 hr that the lagoon water surface was rising quickly and flooding was imminent without a facilitated breach. Four boards had been previously removed from the flume inlet with the inlet screened prior to the storm. Alley arrived at the lagoon after Kotila had performed a facilitated breach at 0045 hr

with a water sample taken at 0030 hr. The lagoon surface had risen quickly to above the first bolt on the piling prior to breaching. The bolt was 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. Kotila surmised that the flume had become blocked with sand due to the high tide, causing the rapid rise in lagoon water surface. The inner berm was breached initially to pond water on the beach, followed by breaching of the outer berm. At the time of arrival of the biologist, the wetted channel through the beach was approximately 30 feet wide. The biologist left at 0150 hr. Kotila collected a water sample at 0730 hr and delivered 2 samples to Monterey Analytical. Streamflow at the Soquel Village gage reached 35 cfs by 0045 hr. Streamflow at the lagoon was somewhat higher than in Soquel Village (about 1.5 miles upstream of the lagoon) due to surface runoff in Capitola and contributions from Noble Gulch. Lab analysis indicated that the pre-breach enterococcus bacterial count was 435 cfu/100 ml. The post-breach count was 96 cfu/100 ml and below the 104 cfu threshold for continued monitoring, allowing a cessation of additional water sampling.

Stream Inflow and Influence on Lagoon Water Temperature. Baseflow into the 2018 lagoon was above the median for the past 28 years but close to median for the flows of record. 2018 streamflow on June 1 at Soquel Village was 8.8 cfs compared to 26.7 cfs in 2017, 7.3 cfs in 2016 and 2.6 cfs in 2015 (**Table 8**). With the late storms and wet year previously, baseflow declined more slowly in 2018 than 2016. By October 1, the respective streamflows were 2.1, 5.5, 0.7 and 0.25 cfs. Lagoon water temperature heats up more during the day with less inflow, as indicated by average lagoon water temperature at the 4 monitoring stations at dawn and in the afternoon most clearly in the first half of the dry season in 2015 (low stream inflow), 2016 (intermediate stream inflow), 2017 (high stream inflow) and 2018 (intermediate streamflow higher than 2016) (**Figures 3i-3j**). However, the effect of warm air temperature can overshadow the cooling effect of higher baseflow as occurred in 2017 in late August and early September. The drought year 2015 had relatively warm air temperature (**Figure 3f**), warm inflow (**Figure 3e**) and very high lagoon water temperatures at dawn and the afternoon. The 2018 dry season had relatively cool air and inflow stream temperatures. The 2018 lagoon had intermediate average water temperature through early August, while the 2017 lagoon was the coolest of the last 4 years through early August, despite its warmer inflow throughout most of the summer and fall. However, from mid-August through mid-September, air temperature (**Figure 3f**) and stream inflow temperature (**Figure 3e**) were much warmer in 2017 than 2018, and average lagoon water temperature was similar for 2018 and 2017 from mid-August onward (**Figures 3i and 3j**). The annual trend in 7-day rolling temperature averages with respect to the seasonal maximum, average and minimum for the dry season indicates an inverse relation between stream inflow rate and average lagoon temperatures in most years (**Figure 4f**).

Water Temperature. Lagoon water temperature was well within the tolerance range of steelhead in 2018 and was not likely stressful except when management goals were unmet in July for 2 days when water temperature exceeded 22°C and for 6 days when the 7-day rolling average exceeded 21°C at 0.5 ft above the bottom (**Table 5; Figure 4a**). In 2018, the lagoon management goal of maintaining water temperature near dawn below 20°C near the bottom was not met on 3 of 12, 2-week monitorings and for 10 days in July at the continuous temperature monitoring site (**Figures 3g and 4a; Table 5**). In 2018 at the 4 lagoon sites monitored at 2-week intervals, water temperatures near the lagoon bottom just after dawn were rated "good" (<=20°C) at all sites except rated "fair" (<= 21.5°C) at 2 of 4 sites on 7 July, all sites on 21 July and 3 of 4 sites on 18 August (**Tables 2 and 3**).

No temperature stratification or lagoon thermocline was detected in 2018 except at the immediate mouth of Noble Gulch where a dilute saltwater lens on the bottom elevated water temperature (**Figure 3l**). This lens extended out approximately 10-12 feet from the mouth. As in past years, lagoon water temperatures near the bottom in 2018 reflected those of stream inflow (**Figures 3g-3h**). The seasonal maximum and minimum water temperature was warmer in the lagoon near the bottom than in the stream inflow, as were the minimum, maximum and average 7-day rolling averages (**Table 4**). The 7-day rolling average for lagoon inflow was 1−2.5 °C cooler in the dry season than near the lagoon bottom (**Table 5**). Stream inflow temperature in 2018, as in other years, had greater daily fluctuation than near the lagoon bottom.

Aquatic Vegetation. In 2018 at the time of sandbar construction on 24 May, decomposing seagrass and kelp were observed in the lower lagoon, downstream of Stockton Bridge. The lagoon bottom was soft with a layer of detritus. In 2018, approximately 90% of the decomposing kelp and seagrass had been raked out of the lower lagoon, downstream of Stockton Bridge. There were more nutrients available for plant growth in 2018 than in 2015−2017. In 2018, algae developed more quickly and pondweed was more abundant than in 2017 (**Tables 6 and 7**). As pondweed developed and spread in Reaches 1 and 2, algae thickness and coverage declined. Algae coverage of the lagoon bottom became less in 2018 compared to 2017 later in the season. The pondweed distribution in 2018 was more similar to drought years of 2013−2015. There was less surface algae in 2016−2018 compared to 2015 and much less than in 2014. Unlike in previous years, the saltwater lens that had developed at the mouth of Noble Gulch appeared to inhibit algae and pondweed growth until September. Evidence of nutrient inputs from Noble Gulch in 2013−2015 and 2017-2018 was expressed by recurrent thick planktonic algae blooms and sporadically high levels of surface algae nearby, though bottom algae was not observed thicker than at other sites in 2018.

Surface algae with floating pondweed fragments were similarly relatively uncommon in 2015−2018. Surface algae and pondweed fragments were observed on 3 of 12 monitorings through the dry season. On 7 July it covered 1−7% of the surface in the 3 reaches and 5% at Noble Gulch. On 16 September it covered 1−5% of the surface in the 3 reaches and 10% at Noble Gulch. On 29 September it covered a maximum of 2% in Reach 3 without any at Noble Gulch (**Table 6**).

Oxygen Concentration. Oxygen concentration was lowest at dawn, or soon after, because oxygen was depleted by cell respiration overnight before plant photosynthesis could begin producing oxygen with the light. Near dawn is when oxygen concentrations are most importantly measured and rated. In 2018, the oxygen concentration at each of the 4 stations near dawn and in the afternoon remained "good" (greater than 7 mg/l) for steelhead *near the bottom* at all sites during 9 of 12 two-week monitoring to November 11 (**Table 2; Figures 6a-1; 6a-2; 6b−6e**). "Fair" ratings (5−7 mg/l) occurred at 1 of 4 sites on 9 June, 2 of 4 sites on 21 July and 1 of 4 sites on 4 August. Morning oxygen concentration near the bottom ranged from 5.64 (63% saturation) on 21 July to 12.76 mg/L (134% saturation) on 16 September at the 4 lagoon stations during the 12 monitorings and 15 feet beyond the Noble Gulch mouth. Afternoon oxygen concentrations near the bottom ranged from 8.8 on 13 October to 18.1 mg/L (192% full saturation) on 27 October, 15 feet from the Noble Gulch mouth. Morning oxygen levels in the

stream inflow in 2018 were in the 7−9 mg/L range and 75−90% full saturation. Afternoon oxygen levels were within the 8 – 11.5 mg/L range and 85−105% full saturation.

Salinity. In 2018, no saline conditions were detected in the lagoon except at the mouth of Noble Gulch, where a 0.2 m saline lens of low concentration persisted throughout the dry season. This caused slight, localized temperature stratification near the bottom (**Figure 3l**). The more typical depth profile without stratification existed at Station 2 (**Figure 3k**) and at all sites when measured at least 15 feet from the mouth of Noble Gulch. On the bottom in the saline lens, salinity ranged between 2 and 5 ppt. The lens went from 0.2 m to 0.1 m thick through the dry season and was about 12 feet in diameter, with fresh water above. Thus, a mostly freshwater lagoon was maintained throughout the period of sandbar closure until sandbar breaching on 23 November. No tidal overwash was allowed to occur through the dry season in 2018, with the elevated berm constructed around the lagoon.

Nautical Procession Observations. No negative impacts to fish were detected during the nautical procession. The lagoon water level was maintained during the event. At this later date for the procession (29 September), water temperature was cool and oxygen levels were fully saturated prior to the procession (**Appendix A**). Security staff prevented pedestrian traffic and viewing from the top of the trestle due to safety concerns. Police officers were observed patrolling the walk path beside the lagoon prior to the procession. Mallards swam near the floats and seemed comfortable until one float began rotating quickly in a circle under the trestle. Nearby mallards were then startled and took flight over the crowd. The mallards may have been swimming near the floats in hopes of being fed during the procession. There were no mishaps in the lagoon during or after the procession. The well lit and life-jacketed water marshals focused on the lower lagoon, downstream of the Stockton Bridge, where the float traffic was more complex.

Fish Sampling Results. Fall sampling for steelhead occurred on 7 and 14 October 2018, from upstream of the Stockton Avenue Bridge to the beach. The lagoon population estimate was 46 steelhead (**Table 9; Figure 24**). Juveniles were relatively large (**Table 10; Figure 7a**), but the population size was relatively small compared to the 24-year average of 1,422. This small lagoon population was consistent with low densities of juvenile steelhead detected at most stream sampling sites (**Alley 2019**) and did not indicate poor lagoon nursery habitat. The high growth rate of juveniles indicated very adequate food supply. There was no bimodal shape to the size frequency histogram in 2018. This indicated that a major portion of the juveniles in the lagoon were likely yearlings and older. Other species captured with the large seine for both sampling days combined were threespine stickleback (very abundant) and Sacramento suckers.

On 15 October 2018, sampling of tidewater gobies in lower Soquel Lagoon near the beach yielded one individual (**Table 11**). Overwintering cover is scarce at Soquel Lagoon. Tules were planted in summer 2017 in the cove beneath the railroad trestle to improve cover. Threespine stickleback (100+), juvenile Sacramento suckers and staghorn sculpins were captured with the goby seine.

Recreational Use, Pollution and Solutions. The lagoon near the beach was posted with warning signs about potential health risks. However, increasing human use of the lagoon has

been observed since 2016, when a paddle-board concession began in the village. Paddle-boarders have become commonplace (observed 5 of 12 afternoon weekend monitorings in 2018), along with more kayakers, pedal boaters, row boaters, canoers and barge goers. The most paddle boarders counted in a reach were 2 as they usually came in pairs. Waders and swimmers were common (usually near the beach in Reach 1; observed 5 of 12 afternoon weekend monitorings in 2018). The most waders seen at one time were 9. Recreational use has occurred despite warning signs being posted in close proximity.

Illegal fishing was not observed at the lagoon in 2018. High-volume bird feeding was observed on 1 occasion from a pedal boat with 15 ducks present. Ducks commonly followed pedal boats and barges in hopes of handouts. On one occasion at Noble Gulch there was a congregation of 42 mallards likely having just been fed by someone. Ducks usually patrolled the lagoon next to Margaritaville in the afternoon, indicating that feeding went on there. In the past, human bird-feeding attracted gulls further up the lagoon where they usually did not go. Gulls are a threat to ducklings.

Gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the 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 is a major step in reducing pollution. The use of gull sweeps has been observed to be successful in other locales to prevent gull roosting. The parallel wires strung across the roof of the Paradise Grill and other 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.**). 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 interfered with gull use in Reach 1. Gulls took wing when visitors appeared on their floatation devices and returned quickly to bathe and raft after they passed. Gulls avoided waders along the periphery near the flume. Human impact from disturbance on the rate of gull defecation is unknown. On one occasion, a barge had 2 dogs that jumped into the water to chase mallards in Reach 1. Rock doves (pigeons) are another source of bird pollution as they circulate between the wharf and the railroad trestle over Soquel Creek Lagoon. 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 in these would be storm drains emptying into Noble Gulch. In the past, gray water and oily slicks have been noted emptying into the lagoon from Noble Gulch. No incidences of gray turbidity were observed at the mouth of Noble Gulch in 2018.
Though no gray water was detected during 2-week monitorings in 2014−2016 and 2018, gray water plumes were observed on 6 of 12 monitoring days in 2017, especially in the latter weeks of the monitoring period. Another drain into the lagoon exists under the railroad trestle, where slight oxygen depletion has been detected in recent years but not in 2018. This drain was capped upstream of the lagoon in 2018, and little to no water accumulated in the manhole, indicating very little dry weather flow.

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 never occurred lagoon-wide in the last 27 year of Soquel Creek Lagoon monitoring during the dry season.

Water quality monitoring was conducted along Noble Gulch in summer/fall 2017. Noble Gulch was also monitored upstream of urban storm drains to establish a baseline. On one occasion in 2017 when a thick gray plume emanated from the Noble Gulch culvert into the lagoon, water from a residential hose entered a lateral drain approximately 60 feet from the mouth, with plant material decomposing within. If pollution sources can be identified, source control efforts should be made to control illicit discharges or, where feasible, to direct dry weather flows from storm drains to sanitary sewers. The thick planktonic algal bloom present much of the summer of 2015 at the mouth of Noble Gulch was absent in 2016, but reappeared in 2017. That was the only location where a planktonic bloom was observed in 2017. At times the bloom was so thick that the bottom was invisible (4 of 12 monitorings) (**Table 7**). Thus, there were indications of nutrient pollution and increased eutrophication at the mouth of Noble Gulch in 2017.

Results of the 2017 water quality study in Noble Gulch are as follows. The water samples collected in Noble Gulch as it emptied into Soquel Lagoon and at upstream stations on Noble Gulch satisfied the Central Coast Ambient Monitoring Program (CCAMP) attention levels and EPA recommendations for total phosphates, as best we could tell, except for a 2.4 mg/L total nitrogen concentration detected just downstream of the Brookvale Terrace impoundment on 18 June 2017. However, plant growth, and potentially eutrophication, may be encouraged at nutrient concentrations below the CCAMP accepted attention levels. However, it appeared that nutrient levels (total nitrogen and phosphorus) in Noble Gulch were within acceptable levels for nitrogen as nitrate and phosphorus as orthophosphate on 9 of 10 monitoring days spread out over 20 weeks in summer and early fall, 2017.

Indication of human/ animal waste pollution as organic nitrogen and ammonia was detected as kjeldahl nitrogen for at least 1 of the 5 stations during 5 of the first 6 monitorings. The most consistent location for kjeldahl nitrogen during the first 6 monitorings (12 weeks) was below the Brookvale Terrace Dam, often at the 0.5−0.6 mg/L level. But the highest kjeldahl nitrogen level was 1.0 mg/L, occurring in late July at the culvert entrance below Noble Gulch Park.

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. 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 pollution problem and high flashiness in streamflow in the past during the first small storms of the fall. 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 2018, the lagoon required breaching because the flume could not accept all of the stormflow with flooding imminent. Although extremely 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. A stormwater treatment vault was installed around 1998 to capture pollutants from the auto plaza during dry weather.

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. City staff will continue to monitor and augment tule planting in the pilot area.

Bird Counts. Mergansers were uncommon in 2018 and much less common than in 2013−2015 (**Table 12**). Other piscivorous birds observed in 2018 included pied-billed grebe, black-crowned night heron, green heron, snowy egret, cormorant and great blue heron. Mergansers were observed on 2 of 12 monitoring days, while pied-billed grebes were seen on 7 of 12 monitoring days (**Table 12**).

2018 gull densities fluctuated between 23 and 87 on monitoring days (**Figure 49**). The average gull count per monitoring day for 2014−2018 has been 63, 68, 42, 40 and 46, respectively. The increased human waders, boats, barges and paddle boarders in 2016−2018 may have reduced gull bathing numbers on the weekends when monitoring took place. The highest gull count in 2018 occurred in early August when watercraft were absent. 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 50**). Clutches of mallards were high in early July 2018 to elevate their numbers then. However, mallard numbers trailed off afterwards and were relatively low by November. The average mallard count for 2014−2018 has been 27, 26, 31, 18 and 30, respectively.

LAGOON AND ESTUARY FORMATION

Fishery Rescue Actions Required Prior to Construction Activities

21 May 2018. The lateral stream channel that usually forms across the beach in spring had recently filled in from natural sand deposition, with the outlet channel exiting closer to the flume. After the flume was cleared of sand on 17 May, streamflow passed through the flume. Therefore, no fish rescue was required near the beach. No tidewater gobies (*Eucyclogobius newberryi*) and only 1 steelhead smolt (*Oncorhynchus mykiss*.) were observed during sandbar construction activities (**Table 1**).

Table 1. Observations and relocations of fish during sandbar construction activities, 2018.

Date	Tidewater goby (Observed/ Relocated)	Juvenile Steelhead (Observed/ Relocated)	Threespine stickleback (Observed/ Relocated)	Staghorn sculpin (Observed/ Relocated)	Prickly sculpin (Observed/ Relocated)
5-21-2018	0/0	1/0	20+/0	10/0	1/1
5-22-2018	0/0	0/0	20+/1	8/0	0/0
5-23-2018	0/0	0/0	20+/17	5/0	1/1
5-24-2018	0/0	0/0	20+/0	21/0	0/0

As required in the permit, a fishery biologist was present during all activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was our twenty-seventh year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first 27 years are available at the City (**Alley 1991-2018**). 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 except within 25 feet of the flume. The bulldozer/tractor could work adjacent to the flume.

Monitoring of Flume Maintenance and Sandbar Construction

21 May 2018. The fishery biologist, Alley, arrived at 0550 hr. The gauged discharge at Soquel Village was 11.9 cfs at 0600 hr. The typical lateral channel usually develops across the beach in spring was recently filled in with natural sand deposition. Streamflow was passing through the flume. The bull-dozer was checked for fluid leaks before it was operated this day, and none were found. The beach around the bull-dozer was inspected with a flashlight for animals before it was moved. The lagoon periphery was surveyed for salmonids, 0602 hr – 0635 hr, with none observed. The bull-dozer operator, Matt Kotila, opened the sandbar along the flume at 0708 hr. The outlet channel was flowing alongside the flume on the east side. The lagoon evacuated at a

rate of 1 foot decrease in water surface elevation per hour. The channel was surveyed upstream for stranded fish to Nob Hill, 0901 hr – 1020 hr. One steelhead smolt was observed and 1 adult prickly sculpin was rescued along the bulkhead in Reach 2 between Stockton Bridge and the railroad trestle. Threespine sticklebacks were also observed. During the survey upstream, 8 mallards and 1 merganser were counted. No salmonid or lamprey redds were observed within the estuary footprint or upstream of the estuary's influence. Kotila graded additional sand along the seawall where the lateral channel had been and around the eastern margin of the lagoon periphery. No vegetation raking occurred this day. The sandbar was closed at 1110 hr. Sand was graded around the flume inlet and compacted. The biologist left at 1230 hr.

Naturally filled-in lateral channel adjacent seawall.
21 May 2018

Soquel Lagoon prior to sandbar construction.
21 May 2018

22 May 2018. The biologist arrived at 0602 hr. The bull-dozer was checked for fluid leaks before it was operated this day, and none were found. The beach around the bull-dozer was inspected with a flashlight for animals before it was moved. The gauged discharge at Soquel Village was 11.2 cfs at 0600 hr. The sand berm around the lagoon margin held, and the lagoon had filled up to the underwater portal. Fish passage through the flume was maintained through the night. The lagoon periphery was walked by the fishery biologist, 0610 hr – 0635 hr, and no fish were observed. The sandbar was opened by Kotila at 0830 hr. The outlet channel was flowing alongside the flume on the east side. The lagoon evacuated slowly at a rate of 1.0 feet loss in elevation per 1.5 hours. More sand was graded along the sea wall, east of the flume and around the flume inlet. Eight staff, including Ed Morrison, plus the biologist raked decomposing plant material out of the estuary. The biologist surveyed upstream for stranded fish, 1002 hr – 1055 hr to where the channel became narrower with steep sides. One threespine stickleback was rescued. No salmonids were observed. Most of the tules survived the mild winter in the backwater under the railroad trestle. City staff will continue to monitor and augment with tule planting as needed for future tule establishment. The sandbar was closed at 1221 hr. The biologist left at 1330 hr.

Sandbar around lagoon intact overnight. Lagoon partially full. Fish passage through underwater portal in flume inlet. 22 May 2018

Streamflow from flume exit. 22 May 2018

Estuary looking upstream from Noble Gulch past Shadowbrook Restaurant at estuary drawdown. 22 May 2018

23 May 2018. The fishery biologist arrived at 0540 hr. The gauged discharge at Soquel Village was 11.7 cfs at 0600 hr. Sheet metal covers had been installed over sidewalk drains. The bull-dozer was checked for fluid leaks before it was operated this day, and none were found. The beach around the bull-dozer was inspected with a flashlight for animals before it was moved. The sandbar was intact with the lagoon partially filled and had not reached the underwater portal overnight. Therefore, steelhead smolt passage had not been maintained during the night. The biologist inspected the lagoon periphery for salmonids, 0623 hr – 0705 hr. None were observed. However, 1 greenback heron, 7 mergansers and 3 mallards were observed between the beach and Noble Gulch. Two cormorants were observed downstream of Stockton Bridge at 0755 hr. Streamflow entered the underwater portal, however, after sunrise prior to sandbar opening. Kotila opened the sandbar at 0948 hr. The outlet channel was flowing alongside the flume on the east side. The biologist with Public Works staff, Cooper Sanden, surveyed for stranded fish upstream, 1030 hr – 1130 hr. Seventeen YOY threespine stickleback and 1 juvenile prickly sculpin were rescued from an isolated pool. One decomposing lamprey was observed. Eight staff, including Ed Morrison, plus the biologist raked decomposing plant material from the lagoon. Raking occurred 1030 hr – 1200 hr. Staghorn sculpin were numerous in the lower estuary. The weir inside the flume was confirmed to be in place. Kotila closed the sandbar at low tide at 1230 hr. Kotila continued to grade sand along the beach, east of the flume. The biologist left at 1335 hr.

Sandbar intact overnight with lagoon partially full and no fish passage overnight.
23 May 2018

Estuary looking downstream with exposed margin at drawdown (no stranded fish)

23 May 2018

Estuary looking downstream at mid-channel bar above trestle (no stranded fish).
23 May 2018

Flume underwater portal prepared for sandbar closure 23 May 2018

Lagoon looking upstream from Stockton Bridge with mid-channel bar visible upstream of the trestle, shortly after sandbar closure. 23 May 2018

24 May 2018. The fishery biologist arrived at 0539 hr. The bull-dozer was checked for fluid leaks before it was operated this day, and none were found. The beach around the bull-dozer was inspected with a flashlight for animals before it was moved. The sandbar remained intact overnight, with the lagoon partially filling and streamflow passing through the underwater portal. Thus, steelhead smolt passage was provided overnight with 11.6 cfs gauged at the Soquel Village gage at 0600 hr. The lagoon periphery was surveyed for salmonids prior to sandbar opening, 0850 hr – 0915 hr. No fish were observed. One merganser was observed. A cormorant was observed capturing a staghorn sculpin downstream of Stockton Bridge at 1001 hr. The sandbar was opened at 1006 hr. The biologist surveyed upstream for potentially stranded fish, 1130 hr – 1217 hr. No stranded fish were observed. Only 2 mallards and 1 merganser were observed during the survey. At the lowest elevational stage of the estuary, the estuary depth downstream of the trestle ranged from 1 to 3 feet, averaging between 1.5 and 2 feet. The outlet channel was flowing alongside the flume on the east side. Kotila compacted the pad of sand around the flume inlet to reduce water seepage under the flume. No raking was done this day. An estimated 60% of the decomposing plant material was raked from the estuary. Ten staff, including Ed Morrison, prepared the flume inlet. The pad around the flume inlet was covered with clear visquine and secured with sandbags. Sandbags were stacked around the flume inlet Sand was hand-broadcasted over the visquine by 1310 hr. Public Works maintenance worker, Cooper Sanden, filled cracks in the flume at low tide. The sandbar was closed for the season at low tide at 1313 hr. Kotila graded sand adjacent to the flume after sandbar closure. The biologist left at 1430 hr.

Lagoon partially filled overnight to provide steelhead smolt passage. 24 May 2018

Tules survived mild winter in backwater cove beneath the railroad trestle.
24 May 2018

Public Works Maintenance Worker, Cooper Sanden, filling cracks in the flume. 24 May 2018

Flume inlet preparation prior to final sandbar closure for summer. 24 May 2018

25 May 2018. The biologist arrived at 0819 hr. The sandbar remained in place and water flowed through the flume's underwater portal to provide overnight steelhead smolt passage to Monterey Bay. The gauged streamflow at Soquel Village was 11.6 cfs at 0600 hr. The bull-dozer was checked for fluid leaks before it was operated this day, and none were found. The beach around the bull-dozer was inspected with a flashlight for animals before it was moved. Kotila filled in the lagoon margin on the east side of the flume and compacted sand with bull-dozer. The biologist left at 0935 hr.

Public Works Heavy Equipment Operator, Matt Kotila, compacts lagoon margin with bull-dozer. 25 May 2018

Lagoon periphery near the beach on 25 May 2018, after final seasonal sandbar closure the previous day.

29 May 2018. Temperature probes were installed in the lagoon and upstream.

Effect of Sandbar Construction on Tidewater Gobies and Steelhead in 2018

No tidewater gobies and 1 steelhead smolt were observed during sandbar construction in 2018. Four artificial breachings of the sandbar were necessary during sandbar construction. No tidewater gobies were detected in the lagoon in October 2017 after a wet winter. If tidewater gobies were present in May 2018, they were likely in small numbers and using the upper estuary to avoid tidal action and salinity. They would need to retreat to the deeper slackwater in the main channel as the estuary drew down. There was only one isolated pool found in 2018, downstream of the Golino property where old wooden pilings formed a wall out in the channel to cause isolation. Threespine sticklebacks were rescued from this pool. But no tidewater gobies were found. This lower estuary location was subject to tidal influences that would prevent tidewater goby nesting. A well defined, bathtub-like margin still existed in the estuary in 2018 after heavy winter stormflows of 2017, except for the tidally influenced mid-channel bar upstream of the railroad trestle. The gradual, bathtub-like margins allowed easy retreat of fish into deeper water in the more freshwater upper estuary. We detected no tidewater mortalities during sandbar

preparation, though habitat disturbance occurred during each artificial sandbar breaching. However, we judged impacts to any tidewater gobies that were present to be minimal during sandbar construction.

The channel in lower Soquel Creek lacks sheltered backwaters for tidewater gobies to escape high water velocities during high stormflows, except possibly under the restaurants. 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 grow and multiply. Tidewater goby populations that have re-occurred during the dry years of 2008, 2009, 2013−2016 and 2018 may be transitory.

One steelhead smolt was observed in shallow, moving water of the lower estuary above Stockton Bridge during artificial estuary drawdown. Salmonid smolts drift downstream at night. During the sandbar construction period, smolts had access to the Bay at night through the flume except for one evening (22-23 May). Overnight, the lagoon partially filled with the closed sandbar and had not risen to the underwater portal to direct water into the flume. Therefore, steelhead smolt passage had not been maintained during the night. Potential predators, cormorants and mergansers were observed during sandbar construction. No salmonid mortalities were observed in 2018. Most smolt migration had likely occurred before late May and YOY steelhead would not be moving into the lagoon until later in June, based on data collected on smolt outmigration and YOY downstream movements in the lower San Lorenzo River just above the estuary in the late 1980's (**Alley, personal observation**). We judged impacts to steelhead to be minimal during sandbar construction.

The seasonal effect of 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 respiration by live algae. Kelp and sea grass removal when necessary, and sandbar closure create better fish habitat for tidewater goby and salmonids than if the sandbar was allowed to close naturally. Natural sandbar formation would allow considerable kelp and sea grass to become trapped in the lagoon to decompose, as would have been the case in 2018. Under natural sandbar conditions, a much shallower lagoon would have formed with much more saltwater trapped to create an unmixed, anoxic lagoon bottom, which would collect heat and raise lagoon water temperature. 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, making the lagoon less hospitable for salmonids.

Procedure for Emergency Sandbar Breaching at Soquel Lagoon by the City of Capitola

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 management 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.

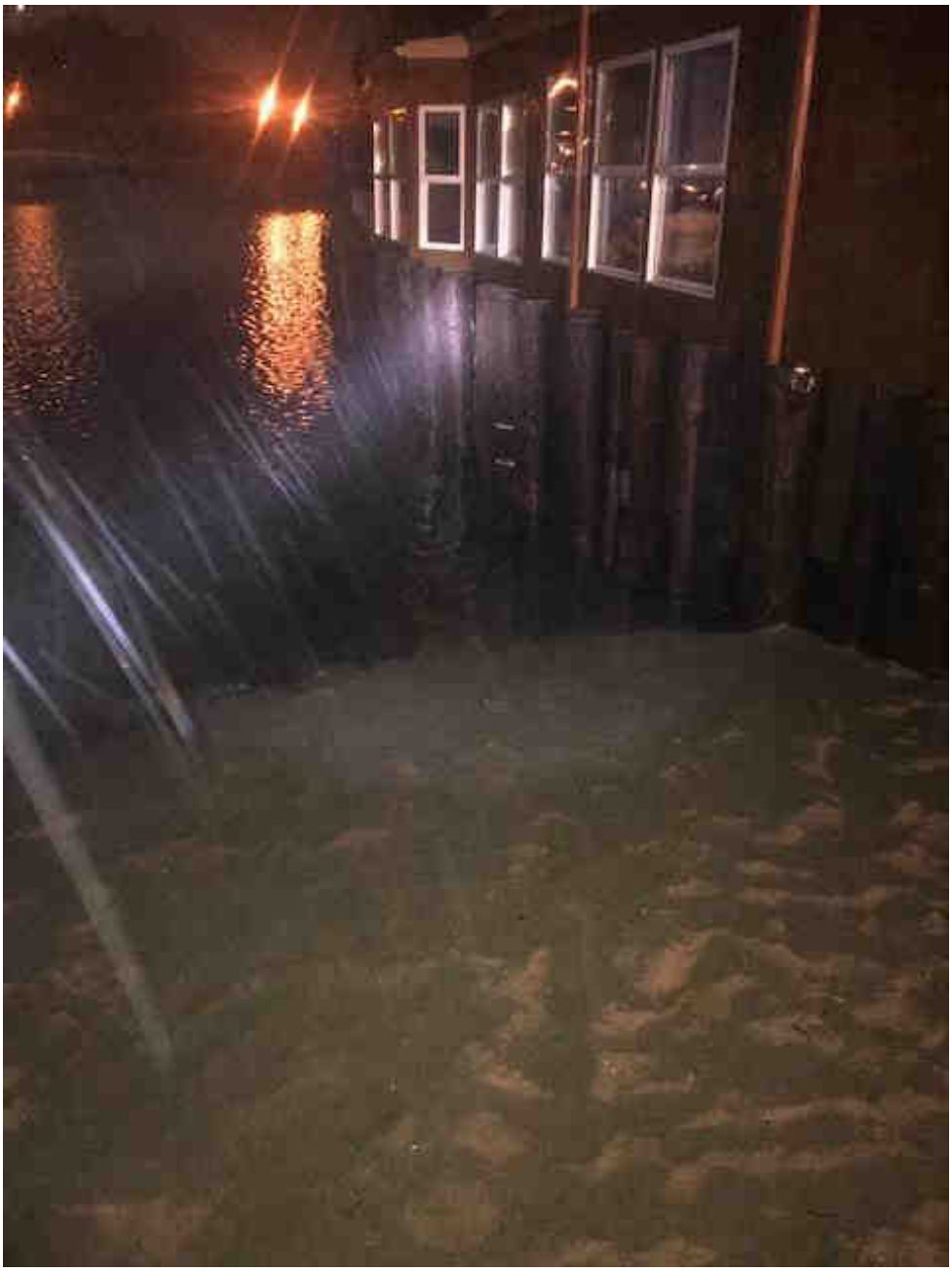
A tractor is used in the fall to cut a notch approximately 30 feet wide in the sandbar adjacent to the flume, but slightly deflected to the east. A berm is left along the lagoon margin between the notch and the lagoon. An additional berm is constructed across the notch near the surf to prevent wave action 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.

Sandbar Breaching During the 2018-2019 Rainy Season.

A facilitated sandbar breach was required on 23 November 2018. The fish biologist was notified by Kotila of Capitola Public Works at approximately 0030 hr that the lagoon water surface was rising quickly and flooding was imminent without a facilitated breach. Four boards had been previously removed from the flume inlet with the inlet screened prior to the storm. Alley arrived at the lagoon at 0126 hr. Kotila had performed a facilitated breach at 0045 hr prior to arrival with a water sample taken at 0030 hr. The lagoon surface had risen quickly to above the first bolt on the piling prior to breaching. Kotila surmised that the flume had become blocked with sand due to the high tide, causing the rapid rise in lagoon water surface. The inner berm was breached initially to pond water on the beach, followed by breaching of the outer berm. At the time of arrival of the biologist, the wetted channel through the beach was approximately 30 feet wide. The biologist left at 0150 hr. Kotila collected a water sample at 0730 hr and delivered 2 samples to Monterey Analytical. Streamflow at Soquel Village gage-

26.4 cfs at 0000 hr;
26.4 cfs at 0030 hr;
34.8 cfs at 0045 hr;
38.4 cfs at 0115 hr
22.1 cfs at 0145 hr;
12.3 cfs at 0800 hr.

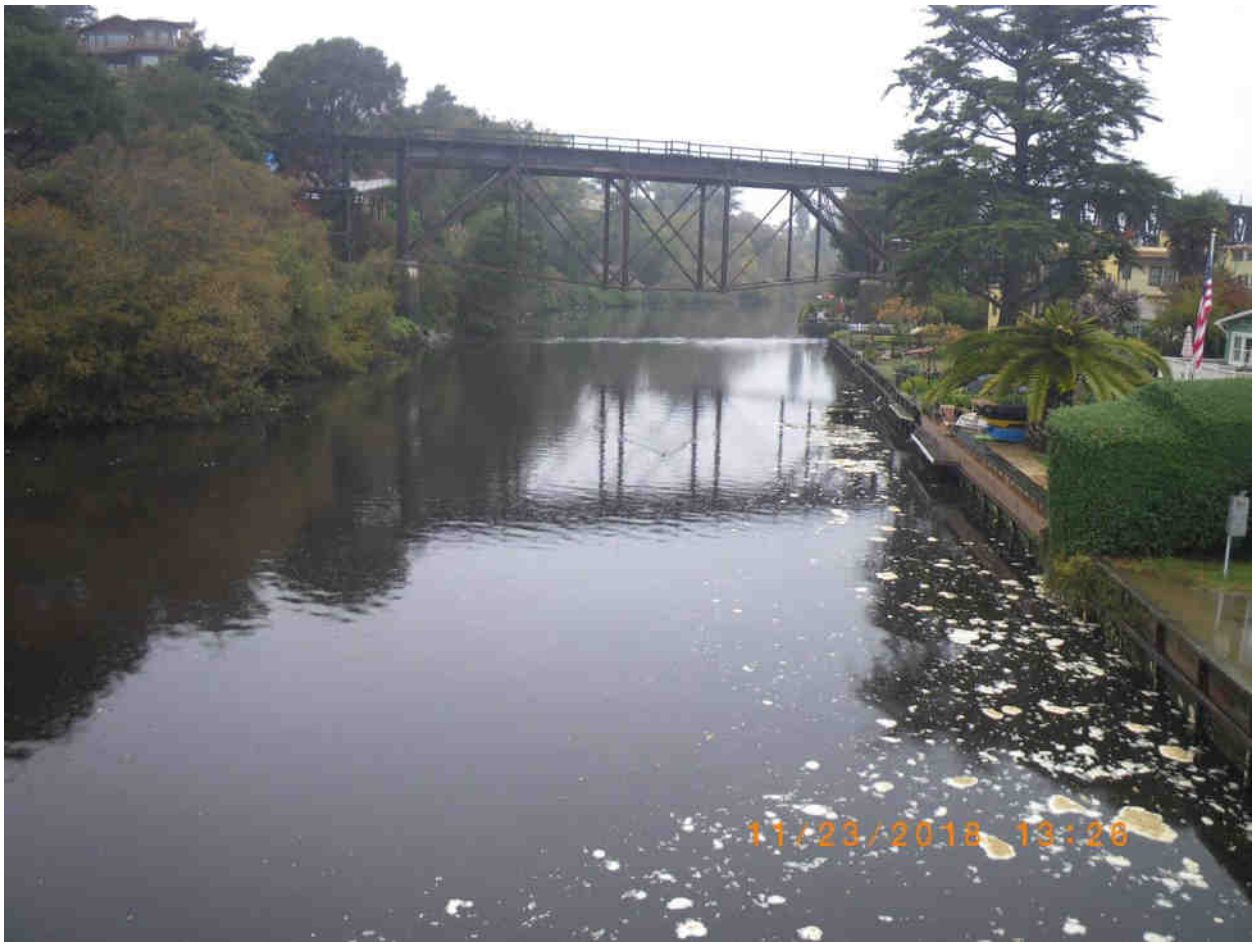
Streamflows are provisional and subject to change. Streamflow at the lagoon was higher than in Soquel Village due to surface runoff in Capitola and contributions from Noble Gulch. Lab analysis indicated that the pre-breach enterococcus bacterial count was 435 cfu/100 ml. The post-breach count was 96 cfu/100 ml, allowing a cessation of additional water sampling and monitoring. The threshold for enterococcus concentration requiring additional monitoring would be a single sample value above 104 cfu/100 ml.



Lagoon Water Surface in Relation to piling rings at 0048 hr, shortly after the facilitated emergency sandbar breach. The lower piling ring with the bolt is underwater.
23 November 2018

Estuary Water Surface in Relation to lower piling ring with bent bolt midday after sandbar breach. 23 November 2018

Outlet channel through beach at midday after facilitated breach. Flume outlet in center of photo. 23 November 2018



View of the estuary, looking upstream from Stockton Bridge at midday after sandbar breach.
23 November 2018

WATER QUALITY MONITORING IN 2018

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 21.5 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 1.85 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 for 2018, 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 for 2018, 6 HOBO temperature loggers were launched on 29 May 2018, just downstream of the railroad trestle in Reach 2 (as in 2008−2017) 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 6 October 2018 prior to any forecasted rain.

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. No saltwater was detected in 2018 in the lagoon 4 days after the sandbar closure. Thus, the biologist judged that the inlet shroud was unneeded to pull saltwater off of the bottom.

Table 1. Temperature Equivalents for Degrees Celsius and Degrees Fahrenheit.

Degrees Celsius	Degrees Fahrenheit
10	50.0
11	51.8
12	53.6
13	55.4
14	57.2
15	59.0
16	60.8
17	62.6
18	64.4
19	66.2
20	68.0
21	69.8
22	71.6
23	73.4
24	75.2
25	77.0
26	78.8
27	80.6
28	82.4
29	84.2
30	86.0

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	21.5-23	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 temperature management 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. This early morning goal coincides

with a "good" rating at monitoring sites (**Table 2**). This lagoon management goal is somewhat higher than the enhancement goal we established for Soquel Creek upstream, 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 temperatures between 20 and 24ºC were 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, personal communication**). Therefore, the management 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 last 20 years, with its relatively high baseflow and deeper lagoon. In 2010, water temperature near the bottom exceeding 20° C for only a 3-day period in early June and a 4-day period in mid-July. However, we do not believe that Soquel Creek Lagoon may be cooled sufficiently to support juvenile coho salmon in most years.

The management 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 summer baseflow, and juvenile salmonids are feeding and growing rapidly. From June 1 to September 1, the 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 Farrel et al. (2015) and 5) our data on steelhead growth rates and water temperatures in Central Coast steelhead streams. These goals are 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 management 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 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.

Results of Lagoon Water Quality Monitoring After Sandbar Closure

Lagoon Water Level

Appendix A provides detailed water quality and lagoon height data. The lagoon level was monitored 5 days after sandbar closure (29 May) and 12 times in 2-week intervals from 9 June 2018 to 11 November 2018. **Table 3** rates habitat conditions according to a rating scale (**Table 2**). The lagoon level was rated "good" throughout the monitoring period. The sandbar breach was facilitated on 23 November due to stormflow that exceeded the capacity of the flume, which may have become blocked with sand.

Gage height in 2018 was consistently near the highest recorded through the last 4 years (**Figure 2**). Baseflow was moderate, allowing good lagoon depth even with the underwater adult portal being open much of the dry period. Lagoon depth was maintained as high as possible in 2018 through good management. 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.

With the moderate baseflow, no saltwater was detected in the lagoon on 29 May, just 5 days after final sandbar closure for the season. Therefore, shroud installation was judged unnecessary by the biologist. No vandalism of the flume inlet was detected in 2018.

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 2018. 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. The flume outlet remained open continuously until late August through mid-September when it closed often at night due to high tide and swells and was reopened in the morning by Public Works staff when necessary. Prior to the rainy season, a notch was constructed across the beach, approximately 30 feet wide and oriented slightly away from the flume. Inner and outer berms were constructed in the notch. The inner berm across the beach was notched to initiate a facilitated sandbar breach on 23 November during the first stormy period of the season. The streamflow at the Soquel Village USGS gage was a measured 34.8 cfs at the time of the breach, with stormflow reaching an estimated 38.4 cfs that day. 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. Kotila reported that the flume may have become blocked with sand, causing the lagoon level to rise quicker than usual at the time of the breach. The sandbar remained open until the next small stormflow on 29 November that reached 108 cfs at Soquel Village. The sandbar remained open for the remainder of the winter and spring.

Water Temperature Results from Two-Week Monitoring

In 2018, early morning water temperature of stream inflow at Nob Hill was warmer than in 2017 in early June, July and mid-October (**Figure 3e**). But in August to late September the inflow was cooler in 2018. This was despite the much higher baseflow in 2017. This warmer inflow water temperature in 2017 may have occurred due to loss of riparian vegetation during the sustained high flow winter, resulting in reduced stream shading. A secondary cause would be the warmer air temperature in mid-August to mid-September 2017 than occurred in 2018 (**Figure 3f**). The higher water temperature in mid-October 2018 than in 2017 resulted from warmer air temperature in 2018. Morning inflow water temperature was warmer in 2018 compared to 2017 from June through mid-September on only 3 of 8 monitoring dates. Morning and afternoon water temperature at lagoon sites closely paralleled inflow water temperature (**Figures 3g-3h**). However, at lagoon monitoring sites, water temperatures were generally warmer in 2018 than 2017 by afternoon from June through mid-September at all 4 lagoon sites (6 of 9 monitoring dates) (**Figures 3a-3d**) and then in mid-October. The daily fluctuation in water temperature was greater in 2018 than 2017, presumably due to the lower stream inflow in 2018. The temperatures used at Station 4 (mouth of Noble Gulch) were measured 15 feet from the Noble Gulch Mouth because unlike elsewhere in the lagoon (**Figure 3k**), a saltwater depression existed immediately at the mouth to elevate water temperature near the bottom and cause temperature stratification (**Figure 3l**). During the last 28 years of monitoring, the 1992, 1994 and 2013−2015 lagoons were the warmest and most similar in early morning water temperatures, though the lagoons of

2007−2009 (other dry years) were nearly as warm. With the above median baseflow rates to the 2018 lagoon, average lagoon site water temperature remained much cooler than during drought years like 2015 but warmer in the morning and afternoon than 2017 in June, July, mid-August and mid-October (**Figures 3i and 3j**). This was consistent with warmer inflow and air temperature in July and October. However morning lagoon temperatures were warmer in mid to late August in 2018 even though air temperature and inflow were cooler than in 2017. By comparison, 2018 lagoon water temperatures were similar to the last 3 years when comparing around the clock 7-day rolling averages for the entire monitoring period (**Figure 4g**).

In 2018, *water temperatures near the lagoon bottom in the early morning* were rated "good" (<=20°C) at all stations during 2-week monitorings except on 7 July when 2 of 4 sites were rated "fair" (<= 21.5°C) and on 18 August when 3 of 4 sites were rated "fair" (**Tables 2 and 3**). By comparison, in the drought year 2015, ratings of "poor" (21.5−23°C) were most common with some "fair" (20−21.5°C) ratings. From 5 July to 29 August 2015 (5 consecutive monitorings) the ratings were "poor" at all stations in the morning. In drought year 2014 there were 4 such consecutive "poor" monitorings that started later in July. 2014 was also a drought year. So, when inflow rate is diminished during drought, lagoon water quality is poor regarding water temperature.

At the mouth of Noble Gulch in 2018, as in most years but less so, the water temperature near the bottom in the morning and afternoon was typically cooler than other lagoon monitoring sites by 0.2−1.5°C from June through mid-November (7 of 12 monitoring dates in the morning and 11 of 12 monitoring dates in the afternoon) (**Figures 3g and 3h**). Temperatures used for comparison were taken 15 feet from the Noble Gulch mouth because a saltwater lens existed for the first time in a depression immediately at the mouth, causing elevated water temperature there (**Figure 3l**). This warmer zone likely elevated water temperature in the vicinity.

In most years, morning lagoon water temperatures near the bottom are coolest at the upper Station 4 (mouth of Noble Gulch) and warmer progressively downstream. This was not always the case in 2018 with the station near Stockton Bridge (Station 2) being the warmest at 5 of 12 monitoring dates (**Figure 3g**). By afternoon monitorings in 2018, we saw the typical pattern of warming at downstream monitoring stations, the difference usually being approximately 1−1.5 ° C cooler at Station 4 than Station 1 (**Figure 3h**).

Table 3. 2018 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)
29May18 (Station 2 only)	open	2.65 good	good	good	good	9.7 cfs
09June18	open	2.56 good	good*	good fair good good	good	6.0 cfs
23June18	open	2.51 good	good	good	good	5.0 cfs
07July18	open	2.55 good	good fair fair good	good	good	3.9 cfs
21July18	open	2.43 good	fair	good fair fair good	good	2.6 cfs
04Aug18	open	2.59 good	good	good good good fair	good	2.4 cfs
18Aug18	open	2.55 good	fair fair fair good	good	good	2.1 cfs
02Sep18	open	2.57 good	good	good	good	2.4 cfs
16Sep18	open	2.56 good	good	good	good	1.3 cfs
29Sep18	open	2.59 good	good	good	good	1.9 cfs
13Oct18	open	2.60 good	good	good	good	1.9 cfs
27Oct18	open	2.60 good	good	good	good	1.9 cfs
11Nov18	open	2.66 good	good	good	good	1.4 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, results were consistent with temperature data collected at 2-week intervals through the water column at monitoring stations over the past 28 years. The following analysis pertains to the vicinity of these continuous data loggers only. Keep in mind that our 2-week monitoring at Station 3 near the trestle was closest to these data loggers.

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 recorded near the lagoon bottom (0.5 feet from the bottom) has greatest relevance to assessing habitat quality.

As in past years, lagoon water temperatures near the bottom in 2018 somewhat reflected water temperature of stream inflow (**Figures 4a-e; 5a**). Daily temperature *maxima* and *minima*, as well as maximum, minimum and average 7-day rolling averages in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2018 (**Tables 4 and 5**).

In 2018, early morning water temperature of stream inflow at Nob Hill was cooler than in 2017 in late June (0.5-1 °C), early July (0.5-1.0 °C), late August (0.5-1.5 °C), and the first half of September (by 2 °C) and warmer later in July (0.5-1.5 °C), and early October (as much as 5 °C) (**Figures 5a-b**). In 2018, early morning water temperature at 0.5 feet from the lagoon bottom followed a similar pattern compared to 2017. It was cooler in late June (1 °C), early July (1 °C), late August (0.5 °C) and the first half of September (1.5-3.0 °C). 2018 water temperatures were warmer than 2017 in late July (1.2-2.0 °C) and early October (0.5-2.5 °C).

Days when lagoon water temperatures exceeded 22º C (71.6º F) near the lagoon bottom would likely be stressful for juvenile steelhead. Therefore, the lagoon management goal is to maintain a daily water temperature maximum below 22ºC near the bottom. Another lagoon management goal is to maintain early morning minimum temperature below 20°C near the bottom. A third lagoon management goal is to maintain the daily 7-day rolling average at 21°C or less near the bottom. In 2018, the daily maximum goal was unmet for 2 days (**Figure 4a**). The daily minimum goal was unmet on 10 days. The 7-day rolling average goal was unmet on 6 days. These days were in July.

We see from **Table 5** that in wetter years (2006, 2010-2012 and 2017) the lagoon temperature management goals near the bottom for steelhead were mostly met (20°C daily minimum at dawn; 22°C daily maximum in early evening; 7-day rolling average <= 21°C). Lagoon water temperature has typically been warmer in years with reduced baseflow entering, as indicated by maximum and minimum temperatures and maximum, minimum and average 7-day rolling averages (**Table 4; Figure 4g**). But air temperature also contributed to stream inflow temperature to determine lagoon water temperatures, as when summer air temperature was cooler in 2016 (**Figure 3f**), allowing management goals to be met, and when warmer in August and September 2017, causing management goals not to be met some of the time, despite high baseflow. Air temperatures in 2018 were warmer in July and October than in 2017, causing

lagoon temperatures to be warmer at those times in 2018. But cooler 2018 air temperatures in late August to mid-September caused 2018 temperatures to be less than in 2017. The stream inflow maintains a cooler lagoon during higher baseflow years in terms of 7-day rolling averages, with the difference between inflow average temperature and lagoon average temperature near the bottom being more similar during higher baseflow years (2010-2012 and 2017) (**Table 5**).

As in past years, no lagoon thermocline (a thermocline has a warm, well-mixed, oxygen-rich epilimnion above it and a cool, non-circulated, oxygen-poor hypolimnion below) or temperature stratification was detected in 2018 by the data loggers in the deep area near the railroad trestle. The mostly 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 except in the depression at the mouth of Noble Gulch where lightly saline water at the bottom maintained temperature stratification throughout the summer/fall. In 2018, the warmest part of the water column was 3.5 feet from the bottom in late June to late July and at 5.5 feet from the bottom (near the surface) from late July onward, based on 7-daily rolling averages (**Figures 4a-4d**). In most other years, water temperature was cooler nearer the bottom and warmer near the surface, based on the continuous data loggers. However, in 2017 the warmest location was 3.5 feet from the bottom, and in another relatively high baseflow year, 2006, water temperatures at 4.5 feet from the bottom were cooler than 0.5 feet from the bottom (**Alley 2018; 2006a**). Water temperatures at 0.5 and 5.5 feet from the bottom were similar in 2006.

Table 4. Water Temperature Statistics from Continuous Water Temperature Probes at 30-Minute Intervals in Soquel Lagoon and Immediately Upstream.

(Late May to 15 September in 2010−2018.)

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.**

Table 5. Water Temperature Comparisons between Stream Inflow and the Lagoon Near the Bottom, Diurnal Fluctuations and Differences between Years, Generated from Continuous Water Temperature Probes.
(Late May to 15 September in 2010–2018.)

Year/ Baseflow July1; Sept 1	Temp. Diff. (°C) between Stream inflow and near lagoon bottom- Max. 7-day Rolling Avg.	Temp. Diff. (°C) between Stream inflow and near lagoon bottom- Min. 7-day Rolling Avg.	Temp. Diff. (°C) between Stream inflow and near lagoon bottom- Daily 7-day Rolling Avg.	Temp. Diff. (°C) between Given Year and the Previous Year near lagoon bottom- Daily 7-day Rolling Avg.	Daily Temp. Fluctuat-ion (°C) near lagoon bottom	# of Days Temp. (°C) Min. near Lagoon Bottom above 20°C (STH goal unmet)	# of Days Temp. (°C) Max. near Lagoon Bottom above 22°C (STH goal unmet)	# of Days 7-day Rolling Avg > 21°C near Lagoon Bottom (STH goal unmet)	# of Days Temp. (°C) Max. near Lagoon Bottom above 20°C (Coho goal unmet)	# of Days Temp. (°C) above 20°C for 4 hours at Nob Hill Stream Site (STH stream goal unmet)
2018/ 4.9; 2.9	Cooler 2.3	Cooler 1.4	Cooler 1.0-2.5	1.0-1.5 cooler to early July; warmer 1.0-2.0 remainder of July; similar until late Aug; cooler 0.5-2.3 late Aug to mid-Sep	0.5–1.5	10	2	6	40	5
2017/ 16.4; 6.2	cooler 0.7	cooler 0.9	cooler 1.5	cooler 1.0 to late Aug; warmer by 1.0 late Aug–mid Sep	1.0–1.5	3	4	4	55	5
2016/ 3.1; 1.4	cooler 2.5	cooler 3.5	cooler 2.0–3.0	cooler 2.0–3.0	1.5–2.5	0	0	0	50	1
2015/ 1.2; 0.4	cooler 5.4	cooler 3.5	cooler 3.5–5.0	warmer 1–2	1–2	96	64	75	111	2
2014/ 0.7; 0.35	cooler 5.2	cooler 4.8	cooler 3.0–5.5	warmer 1–3	0.5–1.5	113	81	94	119	0
2013/ 1.7; 0.4	cooler 4.7	cooler 3.2	cooler 3–4	warmer 2	0.5–1.5	63	25	40	99	1
2012/ 5.6; 1.8	cooler 1.5	cooler 0.7	cooler 2	warmer 1	1–2.5	0	0	0	7	0
2011/ 15; 5.8	cooler 0.8	cooler 0.9	cooler 1.3–1.5	Similar until cooler by 1 in late Aug – Sep	1.5–2.5	0	0	0	0	0
2010/ 7.3; 3.4	cooler 1.3	cooler 1.5	cooler 1.3–1.5	cooler 1–4	1–2.5	0	0	0	7	0
2009/ 3.3; 1.2	cooler 2	cooler 1.2	cooler 1–3.5	cooler 0–2 to mid July and cooler by 0–1 after	1.5–2.5	16	8	9	75	0

2008/ 2.0; 0.7	cooler 4.1	cooler 2.6	cooler 2	similar except cooler by 1 in early Sep	1.5–2	54	13	20	90	1
2007/ 2.3; 1.4	cooler 3.2	cooler 1.5	cooler 2	–	0.5–3	35	20	23	82	5
2006/ 17.0; 6.6	– Rolling Avg not available	– Rolling Avg not available	– Rolling Avg not available	– Rolling Avg not available	1–2.5	0	4	0	19	14

In 2018, the coho management goal of keeping maximum lagoon water temperatures below 20ºC (68ºF) near the bottom in the presence of steelhead was not met for 40 days that were monitored (**Table 5**). Generally, the pattern has been that more days exceed the management goal as baseflow is reduced. Water temperature met the coho goal for the entire dry period only in 2011, a year with higher baseflow. 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 (**Figure 3f**) and generally warm inflow temperatures through the summer/fall, despite higher baseflow (**Alley 2018**).

At the creek site near Nob Hill, the stream management goal for steelhead to have *no more than 4 hours a day at greater than 20ºC (68ºF)* was met in 2018 (except 5 days) (**Table 5**). The goal was mostly met in all of the last 12 years, even during drought. No pattern is apparent between number of days of failure and baseflow. In fact, 2 of the 3 years when failure was more evident were wetter years, 2006 and 2017. The stream management goals for steelhead to have the maximum 7-day rolling average at 20°C or less and maximum daily temperature below 26°C were met in 2018, as it had in 2006–2017.

The Soquel Creek water temperature goal for coho salmon in stream habitat just upstream of the lagoon is to have an average weekly temperature (7-day rolling average) of 16.7º C (62º F) or cooler, based on the Mattole River study (**Welsh et al. 2001**). In 2018, the management goal was not met beginning in July and afterward. In 2012, the coho management goal was not met on 9 days (7%) (**Alley 2014**). In 2011, the management goal was not met 23 of 93 days (25%; reaching a maximum of 17.3°C) (**Alley 2014**). In 2010 the goal was met except for 7 days (6% of the days) consisting of 3 days in early June and 4 days in mid-July (**Alley 2014**). Coho salmon may have survived in the 2010–2012 stream habitat near the lagoon if present. However, in all other past monitoring years, more stream shading and/or streamflow would likely be required to make lower Soquel Creek habitable for coho salmon, based on the Mattole River findings (acclimation would likely raise the acceptable temperature range). Stream temperatures were especially high in low flow years such as 2013–2015 and the higher flow years of 2006 and 2017 when shading may have been lost after high stormflows. The stream shading would need to come from larger trees of tall stature along the lower mainstem, such as redwood and Douglas fir.

The daily stream water temperature fluctuated more than the daily lagoon water temperature near the bottom in 2018, which was typical for previous years except 2010. The maximum daily lagoon water temperature typically occurred between 1600 and 2100 hr each day.

Aquatic Vegetation Monitoring

In 2018 at the time of sandbar construction on 24 May, decomposing seagrass or kelp observed in the lower lagoon, downstream of Stockton Bridge. The lagoon bottom was soft with a layer of detritus. In 2018, approximately 90% of the decomposing kelp and seagrass had been raked out of the lower lagoon, downstream of Stockton Bridge (none present in 2017, 90% in 2016, 70% in 2015). In 2015−2017, the lagoon bottom had been firm without a thick layer of detritus. It was soft with a thick layer of detritus in 2014, when only 30% of the kelp and seagrass had been raked out. This was compared to 20–25% removal in 2013, 90% removal in 2012, 60% removal in 2011, 90% in 2010 and 70% in 2009. There were more nutrients available for plant growth in 2018 than in 2015−2017. In 2018, algae developed more quickly and pondweed was more prevalent than in 2017 (**Tables 6 and 7**). As pondweed developed and spread in Reaches 1 and 2, algae thickness and coverage declined. Algae coverage of the lagoon bottom became less in 2018 compared to 2017. The pondweed distribution was more similar to drought years of 2013−2015. There was less surface algae in 2016−2018 compared to 2015 and much less than in 2014. Unlike previous years, the saltwater lens that had developed at the mouth of Noble Gulch appeared to inhibit algae and pondweed growth until September. Evidence of nutrient inputs from Noble Gulch in 2013−2015 and 2017-2018 was expressed by recurrent thick planktonic algae blooms and sporadically high levels of surface algae nearby, though bottom algae was not observed thicker than at other sites in 2018.

Table 6. 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 Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae Cover	Avg. Bottom Thick-ness (ft)	% Bottom Algae Cover	% Surf. Algae 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**

Table 7. Visually Estimated Lagoon Algae/ Pondweed Coverage and Thickness in 2017.

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Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month /Day	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**	**Avg. Bottom Thick-ness (ft)**	**% Bottom Algae Cover**	**% Surf. Algae Cover**
6-11	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-25	<0.1	100	0	<0.1	100	0	<0.1	100	0	<0.1	100	0
7-9	0.8	5	0	0.3	15	0	0.3	15	0	Soupy plankton	Soupy plankton	0
7-23	1.0	100	0	0.5	100	0	0.4	100	1	0.5	80	1
8-6	1.0	60	0	0.5	100	0	0.5	100	0	0.8	80	<1
8-20	Dark Cloudy (1.5 pond-weed)	Dark	0	Dark Cloudy	Dark Cloudy	0	Dark Cloudy	Dark Cloudy	0	Dark Cloudy plankton	Dark Cloudy plankton	0
9-02	2.0 (3.0 pond-Weed)	90 (1 pond-Weed)	0	1.5 (2.0 Pond-Weed)	99 (1 pond-Weed)	5	1.0 (1.0 pond-weed)	99 (1 pond-weed)	2	3.5 Soupy plankton	80 Soupy plankton	20
9-17	2.0 (3.0 pond-weed)	85 (5 pond-Weed)	0	1.0 (2.0 pond-weed)	99 (1 pond-weed)	1	0.7 (2.0 pond-weed)	99 (1 pond-weed)	2	Murky gray	Murky gray	5
10-01	1.0 (4.0 pond-weed)	90 (5 pond-Weed)	5	Soupy Plankton bloom	Soupy Plankton bloom	5	1.0 (3.0 pond-weed)	99 (1 pond-Weed)	5	Soupy Plankton bloom	Soupy Plankton bloom	7
10-14	0.5 (4.0 pond-weed)	80 (10 pond-Weed)	<1	1.0 (3.0 pond-weed)	98 (2 pond-Weed)	0	1.0 (3.0 pond-weed)	98 (2 pond-Weed)	0	Murky Gray	Murky Gray	10
10-29	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
11-11	Dark	Dark	0	Dark	Dark	2	Dark	Dark	0	Dark	Dark	0
Avg-6-11 – 10-14	**0.9 algae (1.7 pond-Weed)**	**68 Algae (2 Pond-Weed)**	**0.4**	**0.6 algae (0.9 Pond-Weed)**	**76 algae (0.5 Pond-Weed)**	**1.1**	**0.5 algae (1 Pond-Weed)**	**79 algae (0.6 Pond-weed)**	**0.8**	**1.0 Algae (0 Pond weed)**	**68 Algae (0 Pond weed)**	**3.6**

Dissolved Oxygen Results During the 2-Week Monitorings

Oxygen concentration was typically lowest at dawn, or soon after, because oxygen was depleted by cell respiration overnight before plant photosynthesis could begin producing oxygen with the light. Near dawn is the time when oxygen concentrations are most importantly measured and rated because they are typically the lowest. In 2018, the average oxygen level and oxygen concentration at each of the 4 stations near dawn and in the afternoon remained "good" (greater than 7 mg/l at dawn) for steelhead *near the bottom* except for "fair" (between 5 and 7 mg/l at dawn) ratings in early June and late July at Station 2, a "fair" rating at Station 3 in late July and a "fair" rating at Station 4 in early August (**Table 2; Figures 6a-1; 6a-2; 6b−6e**). Morning oxygen concentration near the bottom ranged from 5.64 (63% saturation) on 21 July to 12.76 mg/L (134% saturation) on 16 September at the 4 lagoon stations during the 12 monitorings. Afternoon oxygen concentrations near the bottom ranged from 8.8 on 13 October to 18.1 mg/L (192% full saturation) on 27 October.

With clear water conditions, reduced oxygen concentration at dawn is usually associated with more algae present in concert with a previously cloudy/foggy day or a stagnant saline layer along the bottom that prevents the bottom layer from circulating with the surface and other oxygen-rich water. No stressfully low oxygen concentrations were detected in 2018 except near the bottom in the saline depression at the mouth of Noble Gulch in June and July. Fifteen feet beyond the Noble Gulch mouth and at the other monitoring stations, oxygen levels at dawn ranged mostly between 7 and 11.5 mg/L (**Figure 6g**). In the afternoon, oxygen concentration averaged between 9.8 and 14.7 mg/L (**Figure 6h**). The first stormflow of the fall season required a facilitated sandbar breach. Thus, stressful oxygen depletion was avoided in 2018 from turbid conditions that typically occur after early storms that do not breach the sandbar. When water clarity is reduced after small stormflows, if light does not penetrate to photosynthesizing plant life, oxygen concentrations decline rapidly, as occurred in fall 2014 and 2015 (**Figure 6h**).

In comparing morning and afternoon oxygen levels in the lagoon, usually oxygen concentration was higher in the afternoon than morning through the years and on all but 2 monitoring days in 2018 at Station 2 near the bottom (**Figure 6c**). Those were 7 July and 13 October. However, oxygen levels increased only slightly near the bottom on 3 other days. This was the deepest Station 2 in the lagoon. Oxygen concentration typically increases through the day, despite warmer water temperature in the afternoon, which has a lower oxygen saturation point. At or above fully saturated oxygen levels existed near the bottom at all 4 stations in afternoon throughout the 2018 monitoring period except in the saline lens at the immediate mouth of Noble Gulch in late June.

Oxygen concentrations at the stream Station 5 at Nob Hill typically measured between 0830 and 0900 hr were usually similar to oxygen concentrations at lagoon stations in 2018, with less fluctuation than lagoon stations (**Figures 6a-6f**). Oxygen levels typically increased from morning to afternoon when measurements occurred between 1630 and 1730 hr, but not typically as much as at lagoon stations. Morning oxygen levels in the stream in 2018 were in the 7−9 mg/L range and 75−90% full saturation. Afternoon oxygen levels were within the 8 – 11.5 mg/L range and 85−105% full saturation. Stream oxygen levels were much higher than in 2015, which had lower baseflow during drought.

Salinity Results

In 2018, no saline conditions were detected in the lagoon except at the mouth of Noble Gulch, where a 0.2 m saline lens of low concentration persisted throughout the dry season. This caused an unusual and slight temperature stratification near the bottom (**Figure 3l**). The more typical depth profile without stratification existed at Station 2 (**Figure 3k**) and at all sites when measured at least 15 feet from the mouth of Noble Gulch. On the bottom in the saline lens, salinity ranged between 2 and 5 ppt. The lens went from 0.2 m to 0.1 m thick through the dry season and was about 12 feet in diameter, with fresh water above. Thus, a mostly freshwater lagoon was maintained throughout the period of sandbar closure until sandbar breaching on 23 November. No tidal overwash was allowed to occur through the dry season in 2018, with the elevated berm constructed around the lagoon.

Conductivity Results

Measured conductivity was higher in 2018 than 2017, ranging between 630 and 775 umhos near the bottom at the various monitoring stations and 15 feet from the mouth of Noble Gulch. Within the saltwater lens at the mouth of Noble Gulch, conductivity rose to a maximum measured 9,427 umhos on 4 August (**Appendix A**). As in other years, conductivity was usually slightly lower at Station 5 above the lagoon than in the lagoon through the summer/fall.

Stream In-Flow to the Lagoon

The lagoon water quality is generally best with relatively higher summer baseflow. Stream inflow in 2018 started out at a modest level above the median baseflow for the past 28 years but below the median flow of the full extent of record at the Soquel Village gage (**Table 8; Figures 25 and 26**). Stormflows were largely lacking during the past winter. However the ones that occurred came late in the spring to boost baseflow. Also, the previous 2017 water year had been wet, helping to maintain a higher water table and baseflow in 2018 (**Figure 27**). 2018 streamflow on June 1 at Soquel Village was 8.8 cfs compared to 26.7 cfs in 2017, 7.3 cfs in 2016 and 2.6 cfs in 2015. By October 1, the respective streamflows were 2.1, 5.5, 0.7 and 0.25 cfs. Higher summer baseflow flushes saltwater out through the sandbar and flume more quickly than low 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. Lagoon water temperature heats up more during the day with less inflow, as indicated by average lagoon water temperature at dawn and in the afternoon in 2015 (low inflow), 2016 (intermediate inflow), 2017 (high inflow) and 2018 intermediate inflow, bearing in mind that 2016 and 2018 had cooler late summer and early fall air temperature and stream inflow than 2017 (**Figures 3e, 3f, 3i and 3j**). 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 the inverse relation between stream inflow rate and average lagoon temperatures (**Figure 4g**). However, the trend is less evident for the relatively high baseflow year of 2017, when the maximum temperature, the maximum 7-day rolling average and the average 7-day rolling averages are similar or higher than in 2016 and 2018, despite their lower baseflow. We judge this was because 2016 and 2018 had relatively cooler air temperature in late summer and fall and possibly more stream shading than after a wet 2016-2017 winter that would have contributed to warmer inflow in 2017.

In 2008, there were repeated problems with apparent saltwater back-flushes through the flume at high tides. This was not a problem in 2009−2018, perhaps resulting from partial boarding of the flume exit in 2014 and 2015 and the use of plywood over the flashboards in 2009−2018. Since 2008, the sandbar around the periphery of the lagoon has been maintained at a higher elevation to reduce/prevent tidal overwash.

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. To maximize summer baseflow, 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 curtailed quickly if surface flow becomes discontinuous in lower Soquel Creek.

Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon

The 6 restaurants that were contiguous with Soquel Creek Lagoon were tested for leaks and deficiencies in plumbing connections and repaired as necessary. Confirmation is contained in **Appendix B**.

Nautical Procession Observations

No negative impacts to fish were detected during the nautical procession. Four floats took part in a nighttime procession on 29 September. The lagoon water level was maintained during the event. At this later date for the procession, water temperature was cool and oxygen levels were fully saturated prior to the procession (**Appendix A**). Three floats were powered by electric motor. One was powered by 2 kayaks. 7 water marshals were present in kayaks. Mallards swam near the floats and seemed comfortable until one float began rotating quickly in a circle under the trestle. Nearby mallards were then startled and took flight over the crowd. Previously, during the past two summers (and earlier that day), streamside residents regularly traversed the lagoon on a barge and sometimes fed the ducks that followed them. The mallards may have been swimming near the floats in hopes of being fed during the procession.

There were no mishaps in the lagoon during or after the procession. The well lit and life-jacketed water marshals focused on the lower lagoon, downstream of the Stockton Bridge, where the float traffic was more complex.

On October 1, no parade debris was observed in the lagoon. A Zodiac-style rubber boat with Yamaha outboard motor and gas container was observed tied to the bulkhead in the lagoon above the Stockton Bridge. We were informed that it would be removed shortly when we inquired about it at City Hall.

Table 8. Daily Mean Discharge Recorded at the USGS Stream Gage (11160000) in Soquel Village, At One Month Intervals from 1 June to 1 October, 1991-2017.

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	26.7	16.4	9.7	6.2	5.5
2018	8.8	4.9	2.9	2.9	2.1

Recreational Use, Pollution Sources and Solutions

The lagoon near the beach was posted with warning signs about potential health risks. However, increasing human use of the lagoon has been observed since 2016, when a paddle-board concession began in the village. Paddle-boarders have become commonplace (observed 5 of 12 afternoon weekend monitorings in 2018, 10 of 12 afternoon weekend monitorings in 2017; 7 of 9 afternoon weekend monitorings in 2016), along with more kayakers, pedal boaters, row boaters, canoers and barge users on the lagoon. The most paddle boarders counted in a reach were 2 as they usually came in pairs. Waders and swimmers were commonly observed in the lagoon (usually near the beach in Reach 1; 5 of 12 afternoon weekend monitorings in 2018, 4 of 12 afternoon weekend monitorings in 2017; 6 of 9 in 2016). The most waders seen at one time were 9. This human contact with the lagoon occurred despite warning signs being posted in close proximity.

Illegal fishing was not observed at the lagoon in 2018. High-volume bird feeding was observed on 1 occasion from a pedal boat with 15 ducks present. Ducks commonly followed pedal boats and barges in hopes of handouts. On one occasion at Noble Gulch there was a congregation of 42 mallards likely having just been fed by someone. Ducks usually patrolled the lagoon next to Margaritaville in the afternoon, indicating that feeding went on there. In the past, human bird-feeding attracted gulls further up the lagoon where they usually did not go. Gulls are a threat to ducklings.

Gulls are a primary source of pollution, both for bio-stimulating nutrients and bacteria. They forage through the 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 observed to be successful in other locales to prevent gull roosting. The parallel wires strung across the roof of the Paradise Grill and other 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 interfered with gull use in Reach 1. Gulls took wing when visitors appeared on their floatation devices and returned quickly to bathe and raft after they passed. Gulls avoided waders along the periphery near the flume. Human impact from disturbance on the rate of gull defecation is unknown. On one occasion, a barge had 2 dogs that jumped into the water to chase mallards in Reach 1. Rock doves (pigeons) are another source of bird pollution as they circulate between the wharf and the railroad trestle over Soquel Creek Lagoon. 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 in 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. No incidences of gray turbidity were observed at the mouth of Noble Gulch in 2018.
Though none was detected during 2-week monitorings in 2014−2016 and 2018, gray water plumes were observed on 6 of 12 monitoring days in 2017, especially in the latter weeks of the

monitoring period. Another drain into the lagoon exists under the railroad trestle, where slight oxygen depletion has been detected in recent years but not in 2018. This drain could be capped if summer runoff was re-directed into the sewer.

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 never occurred lagoon-wide in the last 27 year of Soquel Creek Lagoon monitoring during the dry season.

Water quality monitoring was conducted along Noble Gulch in summer/fall 2017, including under an accessible manhole cover in the parking lot entrance, to pinpoint potential anthropogenic pollution sources. Noble Gulch was also monitored upstream of urban storm drains to establish a baseline. On one occasion in 2017 when a thick gray plume emanated from the Noble Gulch culvert into the lagoon, water from a residential hose entered a lateral drain approximately 60 feet from the mouth, with plant material decomposing within. If pollution sources can be identified, source control efforts should be made to control illicit discharges or, where feasible, to direct dry weather flows from storm drains to sanitary sewers. The thick planktonic algal bloom present much of the summer of 2015 at the mouth of Noble Gulch was absent in 2016, but reappeared in 2017. That was the only location where a planktonic bloom was observed in the lagoon in 2017. At times the bloom was so thick that the bottom was invisible (4 of 12 monitoring days) (**Table 7**). In conclusion, there were indications of nutrient pollution and increased eutrophication at the mouth of Noble Gulch in 2017.

Results of the 2017 water quality study in Noble Gulch are as follows. The water samples collected in Noble Gulch as it emptied into Soquel Lagoon and at upstream stations on Noble Gulch satisfied the Central Coast Ambient Monitoring Program (CCAMP) attention levels and EPA recommendations for total phosphates, as best we could tell, except for a 2.4 mg/L total nitrogen concentration detected just downstream of the Brookvale Terrace impoundment on 18 June 2017. However, plant growth, and potentially eutrophication, may be encouraged at nutrient concentrations below the CCAMP accepted attention levels. However, it appeared that nutrient levels (total nitrogen and phosphorus) in Noble Gulch were within acceptable levels for nitrogen as nitrate and phosphorus as orthophosphate on 9 of 10 monitoring days spread out over 20 weeks in summer and early fall, 2017.

On only one monitoring day of 10 in 2017 did total nitrogen increase at succeeding downstream stations, and that was the 4th monitoring, occurring in mid-July. One recurrent nutrient pattern throughout the water monitoring period was that phosphorus concentration was below detectable levels at all stations during the entire 20-week monitoring period, June through early October. The other nutrient pattern was that for the last 8 of 20 weeks monitored (last 4 of 10

monitorings), the source of nitrogen narrowed to only nitrate, with less total nitrogen detected during those last 8 weeks compared to earlier in the season. This was positive in that no nutrient pollution from animal waste was detected during the last 8 weeks. Evidence of organic sources of nitrogen in water samples indicated that dead plant or animal wastes were entering Noble Gulch during the first 12 weeks of the study. However, nutrient concentrations often decreased between the station closest to the creekmouth (adjacent to City Hall) and the creekmouth station. The results did not indicate consistently higher nutrient levels at any one station throughout the monitoring period that might imply chronic sewage pipe leaks.

Indication of human/ animal waste pollution as organic nitrogen and ammonia was detected as kjeldahl nitrogen for at least 1 of the 5 stations during 5 of the first 6 monitorings. The most consistent location for kjeldahl nitrogen during the first 6 monitorings (12 weeks) was below the Brookvale Terrace Dam, often at the 0.5−0.6 mg/L level. But the highest kjeldahl nitrogen level was 1.0 mg/L, occurring in late July at the culvert entrance below Noble Gulch Park.

No elevation of dissolved phosphates, nitrates or organic nitrogen and ammonia was detected in 2017 when white or gray suspended particles from Noble Gulch entered Soquel Lagoon. On the monitoring day with the highest nitrogen concentration at the Noble Gulch creekmouth, 16 July, a green, planktonic algal bloom was observed without gray or white cloudiness. Nutrient analysis of cloudy water samples collected at the creekmouth on 10 and 24 September and 8 October detected no increased total nitrogen levels and, in fact, relatively low ones with undectable phosphorus. On one occasion, surface runoff into the storm drain feeding Noble Gulch closest to Soquel Lagoon was observed when a thick gray plume formed at the Noble Gulch creekmouth in the lagoon. Organic debris was concentrated in this storm drain. Perhaps accumulated organic debris in multiple storm drains in the residential area between City Hall and the creekmouth experienced surface runoff to create the volume of gray plume turbidity that was observed.

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. 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 pollution problem and high flashiness in streamflow in the past during the first small storms of the fall. 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 2018, the lagoon required 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. City staff will continue to monitor and augment plantings in the pilot project area.

Tules in Trestle Cove (some beneath the water). 7 July 2018

FISH CENSUSING

Steelhead Plantings. No steelhead were planted in Soquel Creek in 2018, as was the case in 2003–2017. 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 occurred on 7 and 14 October 2018, from upstream of the Stockton Avenue Bridge to the beach. A bag-seine with dimensions 106 feet long by 6 feet tall 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. The seine was pulled to the beach in front of Venetian Court. A total of only 13 steelhead were captured and marked on 7 October after 9 seine hauls (first 3 had twisted net due to pondweed). There were no mortalities. A total of 25 steelhead were captured on 14 October in 7 seine hauls. There were 7 recaptures and no mortalities. The lagoon population estimate was 46 juvenile steelhead, using the Lincoln index for a closed population (**Table 9;** methods in **Ricker 1971**). Juveniles were relatively large (**Table 10; Figure 7a**), but the population size was small compared to the 24-year average of 1,422 (**Figure 24**). This small lagoon population was consistent with low densities of juvenile steelhead detected at most stream sampling sites (**Alley 2019**) and did not indicate poor lagoon nursery habitat. Size histograms of steelhead captured from the lagoon in 2018 and other years back to 1998 may be found in **Figures 7a−24**. No scale samples were taken in 2018 because the population was so small and any potential mortality from additional handling and scale sampling was judged inappropriate. Examination of the size histogram of the few captured fish in 2018 indicated no clear-cut demarcation between age classes. With the small steelhead population in the lagoon, growthrate was undoubtedly high. It is likely that steelhead larger than 184 mm SL were yearlings or older and comprised a major portion of the 2018 lagoon population. In looking at 2017 scale analysis, fish captured on 15 October 2017 indicated that scale samples from the largest YOY came from steelhead 154, 157 and 158 mm Standard Length (SL); 172, 172 and 173 mm Fork Length, respectively. The smallest yearling steelhead was 153 mm SL (163 mm FL). Therefore, there was likely year class overlap in the 150−160 mm SL range in 2017, and a major portion of the lagoon population was yearling or older juveniles. Other species captured in 2018 were 4,000+ threespine stickleback and 4 adult and 8 YOY Sacramento suckers. Sticklebacks were very abundant in the lagoon in 2018.

On 14 October 2018, 6 seine hauls were made to capture tidewater gobies with a 30-foot x 4-foot x 1/8-inch mesh beach seine in lower Soquel Lagoon near the beach. One tidewater goby was captured (**Table 11**). Numerous threespine stickleback were captured (100+). The low number of tidewater gobies captured in 1992-1997, and their absence since the El Niño stormflows in winter 1997-98 until 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 two, less severe droughts (2007-2009 and 2013-2015). 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 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**).

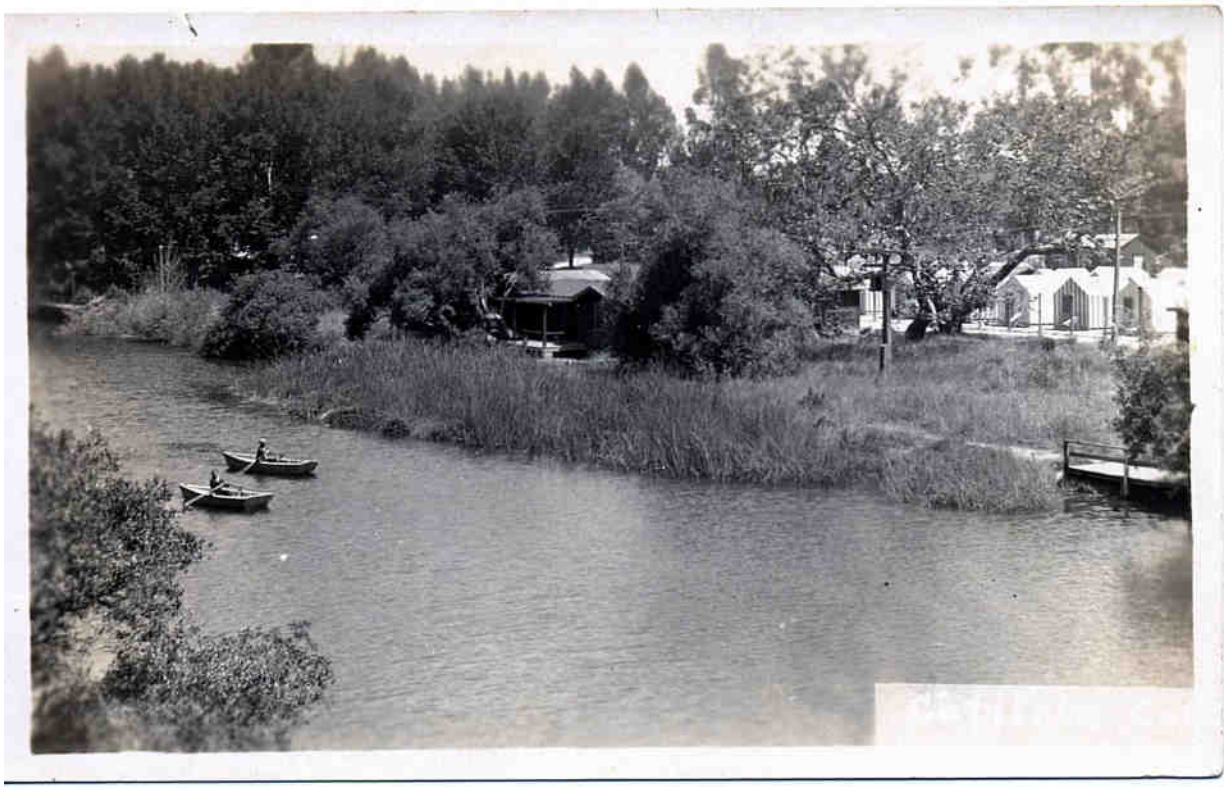
Tidewater gobies from up-coastal-current Moran Lake likely re-colonized Soquel Lagoon in 2008, when Soquel Creek had two mild winters in a row. They likely re-colonized Soquel Lagoon again in 2013 after two large stormflows in December 2012. We found them in Aptos Lagoon in 2011−2014 and 2017−2018 (**Alley 2012; 2013; 2014; 2015; 2017; 2018**).

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. In 1993, the lagoon production estimate of nearly 2,800 fish represented 10% of the estimated smolt production in the 16.6 miles of steelhead habitat in the mainstem, East and West Branches. The 2004 lagoon population estimate of 3,900 fish represented an estimated 47% of the smolt production for the 16.6 miles of stream and lagoon habitat. Though we do not have 2007–2018 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 growth of juvenile steelhead at the time of fall sampling are population size and the time of lagoon closure prior to sampling. Another factor that will affect the size distribution in the fall is timing of YOY entry into the lagoon. If some YOY enter the lagoon later in the summer, 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, 1998−2018 (**Table 10**), 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 when considered separately.

One would 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 less. 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. Usually the lagoon population is overwhelmingly dominated by young-of-the-year 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 and 2018 than in either 2007 or 2008 because of less competition for food with much smaller populations (**Table 9**). 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 or 2008. 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. In 2018 the population size was small, the lagoon period was long and the captured juveniles were mostly relatively large.



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

Large steelhead juveniles captured in Soquel Lagoon. 7 October 2018

Table 9. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2018.

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.

Table 10. Summary of Annual Fish Sampling Dates, Population Estimates, Steelhead Size and Lagoon Growth Period Prior to Sampling, 1998−2018.

Year	Sandbar Closure Date	Fish Sampling Dates	Weeks of Sandbar Closure Prior to Final Fish Measurements	Days of Sandbar Closure Prior to Final 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 First Day
1999	18 May	3/10 Oct	20.6	144	928	120-124 First Day
2000	7 June	1/8 Oct	17.4	122	875	135-139 First Day
2001	14 June	7/14 Oct	17.3	121	454	125-129
2002	23 May	6/13 Oct	20.3	142	1,042	105-109 First Day
2003	22 May	5/12 Oct	20.3	142	849	110-114 First Day
2004	26 May	3/10 Oct	19.4	136	3,869	115-119 First day
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 First day
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 (2 unmarked fish- 2nd day)	21.3	149	None possible (No recaptures)	155-159 First Day
2015	21 May	4/11 Oct (5 unmarked fish- 2nd day)	20.4	143	None possible (No recaptures)	95-99 First day
2016	27 May	2/9 Oct	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
Average/ Median					**1422/ 875**	

Table 11. Number of Tidewater Gobies Captured at Soquel Lagoon in October.

Year	# of Tidewater Gobies Captured in Soquel Lagoon	# of Seine Hauls (30-foot Seine)
1988	102	2
1992	2	?
1993	0	4
1994	35	4
1995	0	8
1996	0	6
1997	1	8
1998	0	4
1999	0	5
2000	0	5
2001	0	5
2002	0	5
2003	0	5
2004	0	5
2005	0	4
2006	0	5
2007	0	5
2008	33	4
2009	8	4
2010	0	6
2011	0	6
2012	0	5
2013	10	7
2014	481	6
2015	309	5
2016	98	4
2017	0	6
2018	1	6

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 had good densities of pondweed with attached algae (15-70% of bottom coverage in various reaches) from mid-August 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 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, and fish digestion rate is slower in cooler lagoons. This slows the processing of food for growth. The 2013−2015 lagoon was relatively warm with very limited stream inflow. The lagoons in 2011−2012 and 2016−2017 were cooler. Aquatic plant production was less in 2011, 2016 and 2017 than in the warmer lagoons of 2008, 2009, 2012 and 2013−2015 and 2018 (more pondweed) (**Tables 6−7; Alley 2018a**), indicating less food available in 2011 and 2016−2017. 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 order to maintain good steelhead nursery habitat in Soquel Creek Lagoon, the sediment input from the watershed must be reduced. The 2018 lagoon remained deeper than recent years after deepening in 2017, with scour at the base of the exposed bulkheads visible. Station 2 was 0.25 meters (10 inches) shallower in 2018 than in 2017, however.

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). 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 2013−2018. 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 2018. There were periods during the 2018 summer when threat of sink holes existed and areas were flagged on the beach nearer the flume outlet. These sinkholes were likely caused by tunneling of water that leaked from cracks in the flume. The lagoon water surface was kept at the top of the flume inlet throughout the summer/ fall in 2018 until the breach required near Thanksgiving in November. Usually, in drier years it is easier to maintain a high gage height.

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 2018 the sandbar remained open after the initial breach on 23 November. In 2017, the sandbar has periodically closed and opened since the emergency breach on 16 November because only 1 small storm had occurred until the next significant stormflow in early January 2018. In 2015, the lagoon opened and closed repeatedly after the early breaching on 9 November because streamflow was low. In 2016 the sandbar was

opened even earlier on 16 October. However, the first stormflow of the season reached 1,040 cfs at Soquel Village, and baseflow was sufficient afterwards to prevent sandbar re-closure until more stormflows occurred in November. Minimization of pollutant input from early fall storms is also important for reducing biological oxygen demand and avoiding fish kills.

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 was 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 uncommon in 2018 and much less common than in 2013−2015 (**Table 12**). Other piscivorous birds observed in 2018 included pied-billed grebe, black-crowned night heron, green heron, snowy egret, cormorant and great blue heron.

Table 12. Number of Sighting Days of Less Common Piscivorous Bird Species at Soquel Lagoon.

Year/ # Monitoring Days	Merganser	Pied-billed Grebe	Black-crowned Night Heron	Green Heron	Snowy Egret	Corm-orant	Great Blue Heron
2018/ 12	2	7	2	1	1	1	1
2017/ 12	4	6	0	0	0	1	0
2016/ 13	3	4	1	3	0	2	0
2015/ 12	6	4	1	2	1	7	0
2014/ 13	6	7	3	2	4	1	0
2013/ 18	9	10	3	3	0	3	0
2012/ 12	3	8	0	0	1	4	0

Common merganser at Soquel Lagoon

Common merganser at Soquel Lagoon

Pied-billed grebe at Soquel Lagoon

No western pond turtles were observed in 2013−2018, although a paddle-boarder observed a turtle in the upper lagoon in 2015. Previously, they regularly basked on the instream cottonwood log across from the Noble Gulch mouth and on additional logs further downstream adjacent to the Golino Property. The cottonwood was flushed out to the beach during the wet 2016-2017 winter. In 2012, as many as 3 pond turtles were observed at one time on the cottonwood log and another nearby log. The cottonwood that had been previously used had sagged and was mostly underwater in 2013−2015, offering limited basking area. In 2016 the cottonwood had moved upstream a few feet and was still partially submerged.

Gulls commonly bathed in Reach 1, downstream of the Stockton Bridge. However, when people were feeding the ducks in upstream reaches, a few gulls were attracted to the food source. 2018 gull densities fluctuated between 23 and 87 on monitoring days (**Figure 49**). Numbers in 2017 ranged between 18 and 85 (20 and 65 in 2016) during afternoon monitorings, when they are most common. The average gull count per monitoring day for 2014−2018 has been 63, 68, 42, 40 and 46, respectively. The increased human waders, boats, barges and paddle boarders in 2016−2018 may have reduced gull bathing numbers on the weekends when monitoring took place. The highest gull count in 2018 occurred in early August when watercraft were absent.

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 50**). Clutches of mallards were high in early July 2018 to elevate their numbers then. However, mallard numbers trailed off afterwards and were relatively low by November. The average mallard count per monitoring day for 2014−2018 has been 27, 26, 31, 18 and 30, respectively. 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. In late September 2018, American coots began to appear at the lagoon, as annually occurs. Coots were abundant in 2018. The maximum number of coots counted on a monitoring day in 2015−2018 was 113, 13 (early breach), 34 and 147, respectively.

MANAGEMENT RECOMMENDATIONS

Recommendations for Lagoon Preparation and Sandbar Construction

1. During 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 material is present and decomposition is occurring in the lateral channel.

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 (now a private contractor) 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 while the biologist is upstream and 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 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 possible before final closure, from the Stockton Avenue Bridge downstream, including plant material trapped under the restaurants and in depressions around the bridge piers. 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 material 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 and quickly rake out decomposing kelp and to clear the sand-filled flume.

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 June 15, while maintaining a notched top plank for out-migration of smolts until 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 the opportunity 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 add plywood cutoff sheets between the pilings and perpendicular to underflow to maintain sand under the flume and to reduce water seepage and sink holes from forming.

20. 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.

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

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

23. 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, 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 providing 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. As water clarity improves, add boards back to the flume inlet.

4. 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.

5. 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.

6. 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.

7. To delay sandbar breaching in years when algae and pondweed are especially dense in the lagoon, install a perimeter fence around the flume inlet (2"x 4" mesh and with 6-foot

panels) to collect floating aquatic vegetation and prevent plugging of the flume inlet during the first small stormflows of the season. If necessary, install a perimeter fence with around the flume entrance by October to prevent plugging of the flume's screen with aquatic vegetation during the first minor storms. The goal should be to maintain the lagoon until a pattern of larger storms occurs after Thanksgiving that will maintain an open sandbar through the winter.

8. Remove three 4x4-inch flashboards from the flume inlet on one side immediately after the first stormflow of the season in which the highly turbid stormflow passed through the flume without requiring sandbar breaching. 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, aquatic vegetation in the lagoon may continue to photosynthesize and remain viable. 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.

9. 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.

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

11. 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.

12. 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. 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. Since tules planted in the cover 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.

2. 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.

3. 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.

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

5. 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 were taken down the lagoon and then back up before dismantling back at the bridge.

6. Restrict the number/weight of float participants allowed to ride on the floats to a safe level during nautical processions.

7. Enforce the ban on waders during future nautical parades.

8. 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.

9. Continue to recommend to the lagoon parade organizers to discourage alcohol consumption by float participants and rowdy behavior on their floats.

10. Continue to retain all flume boards to maintain maximum lagoon depth during the nautical parade.

11. 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.

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

13. Continue to maximize lagoon depth through the dry season, while maintaining passage through the flume for adult steelhead until June 15 and for steelhead smolts until 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.

14. 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.

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

16. Continue to secure the flume boards at all times to prevent their lifting by vandals or bay back-flushing that may drain the lagoon.

17. 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.

18. "Gull Sweeps" should be installed on Esplanade roofs to test their effectiveness in deterring gulls.

19. 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.

20. 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.

21. 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.

22. 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.

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

24. 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 Fish and Wildlife Department 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 flow.

Recommendations Regarding Fish Management

1. Do not plant steelhead from a hatchery into Soquel Creek unless the broodstock originate from Soquel Creek and 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, maintain an opening in the flume inlet 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 management scenarios and restoration efforts.

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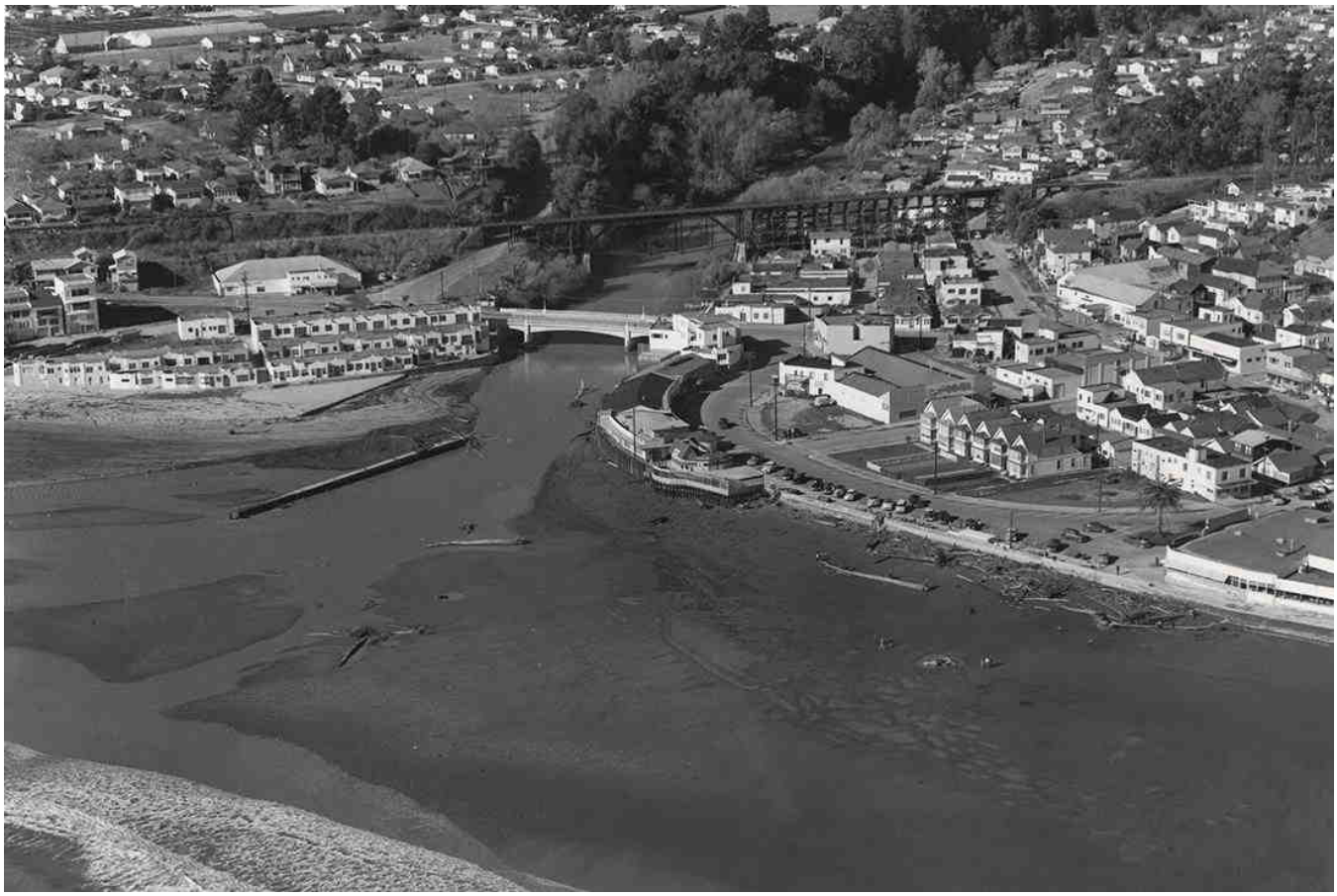
Soquel Lagoon Post-Venetian Court Construction- Older Stockton Avenue Bridge visible and prior to expanded development on eastern margin of the Lagoon, upstream and downstream of the Railroad Trestle; circa 1931.
(Courtesy of the Capitola Historical Museum)



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

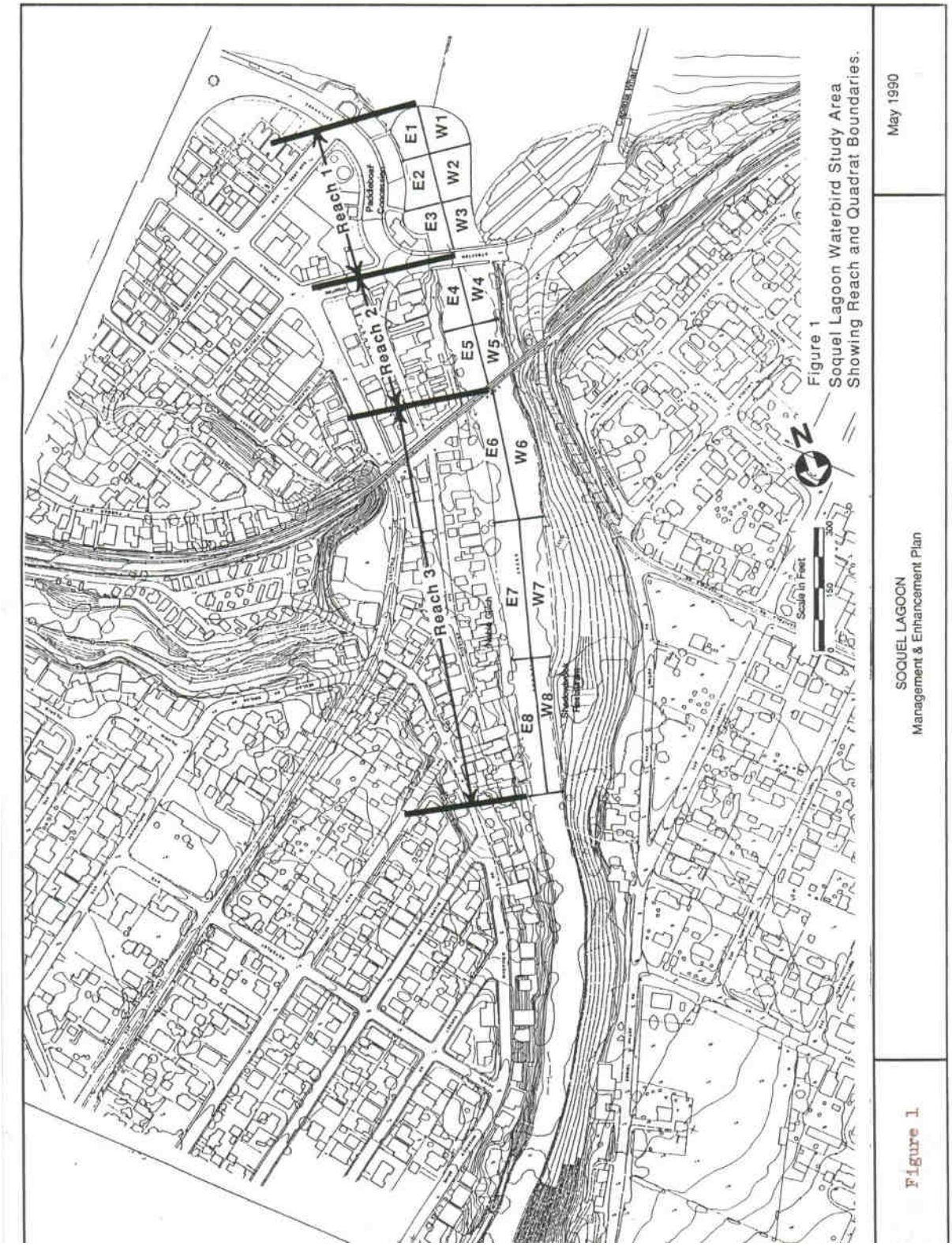


Figure 1. Map of Reaches in Soquel Creek Lagoon

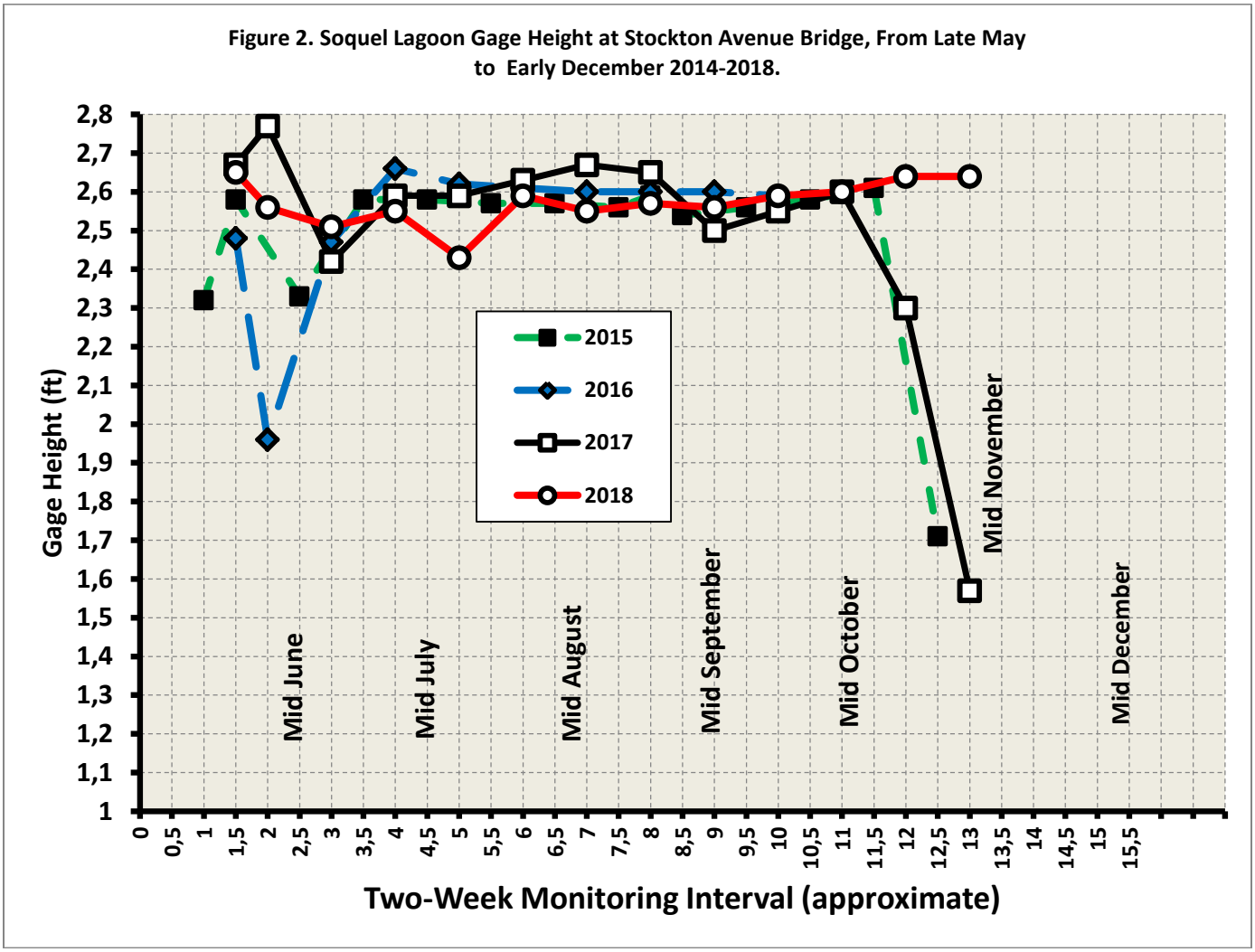


Figure 2. Soquel Lagoon Gage Height at Stockton Avenue Bridge, From Late May to Early December 2015-2018

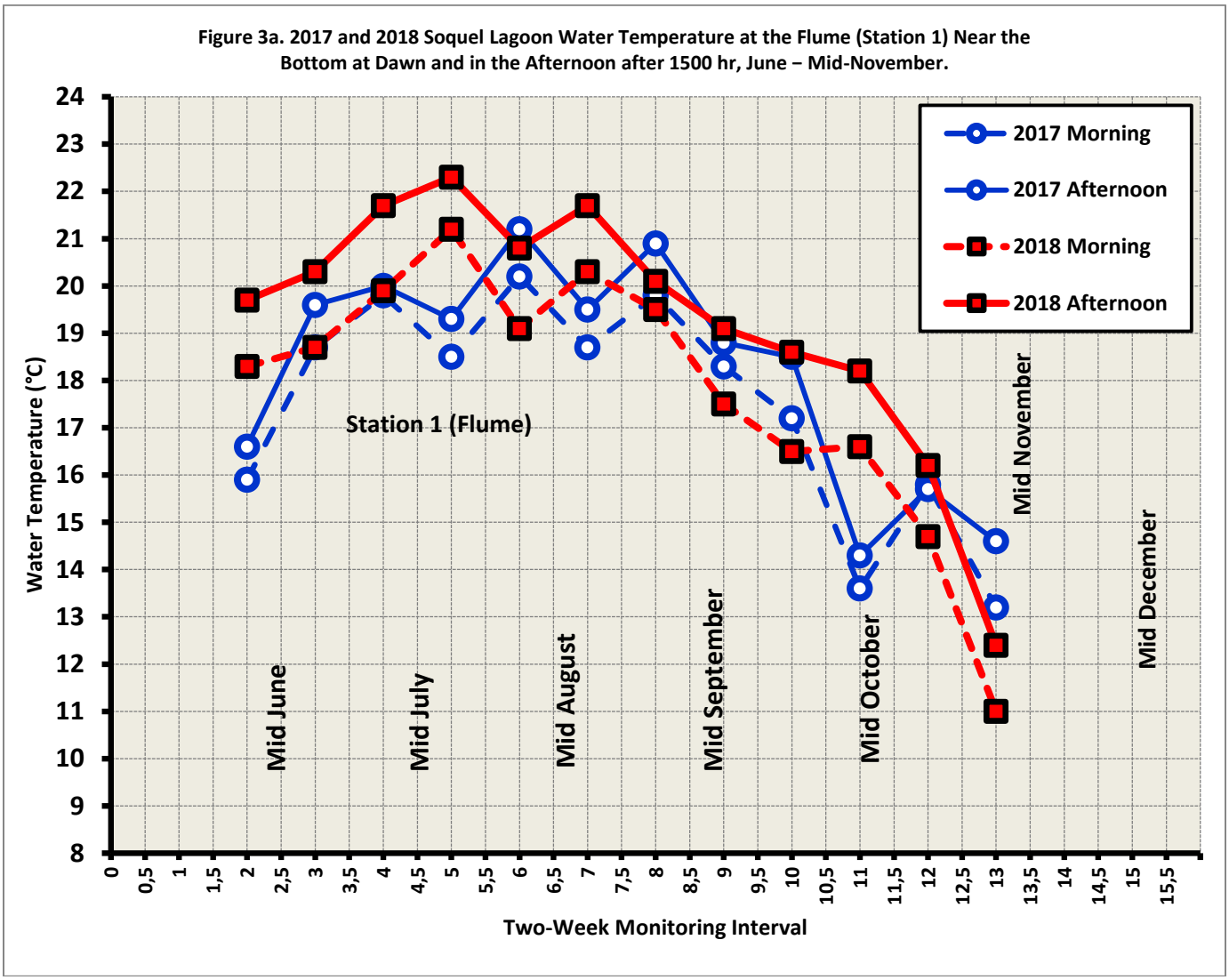


Figure 3a. 2017 and 2018 Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn and in the Afternoon after 1500 hr, June – Mid-November.

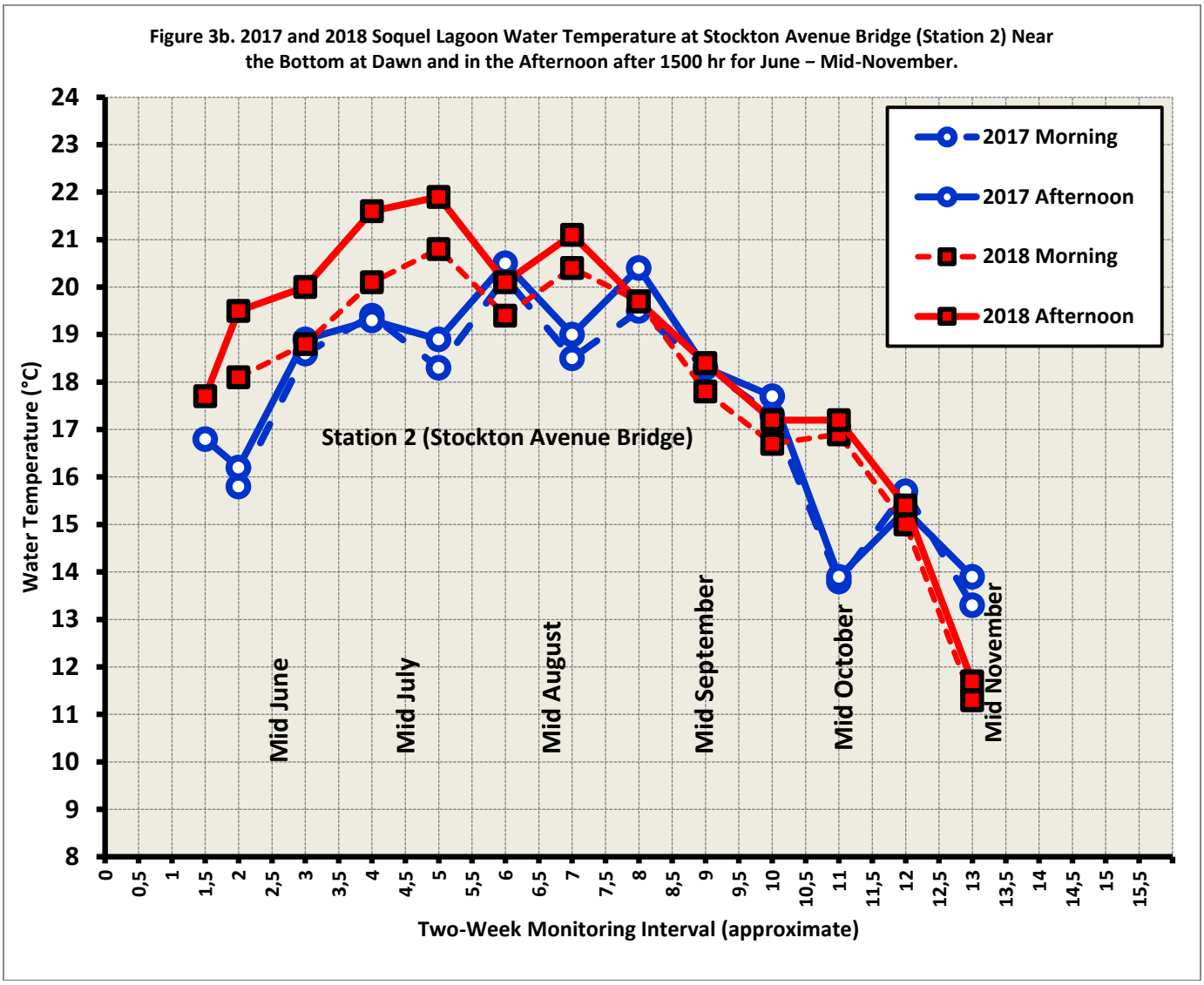


Figure 3b. 2017 and 2018 Soquel Lagoon Water Temperature at Stockton Avenue Bridge Near the Bottom at Dawn and in the Afternoon after 1500 hr for June – Mid-November.

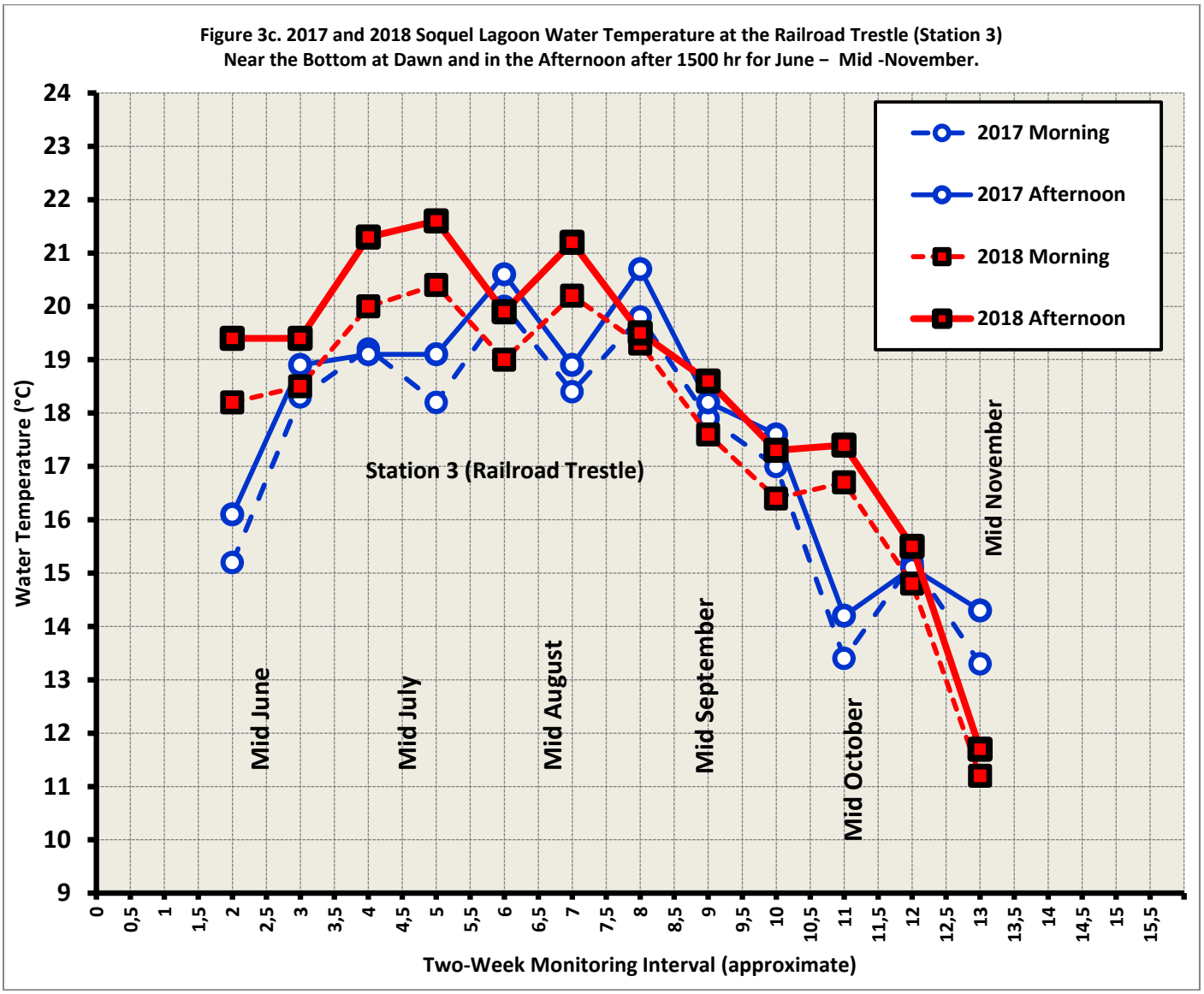


Figure 3c. 2017 and 2018 Soquel Lagoon Water Temperature at the Railroad Trestle (Station 3) Near the Bottom at Dawn and in the Afternoon after 1500 hr for June– Mid-November.

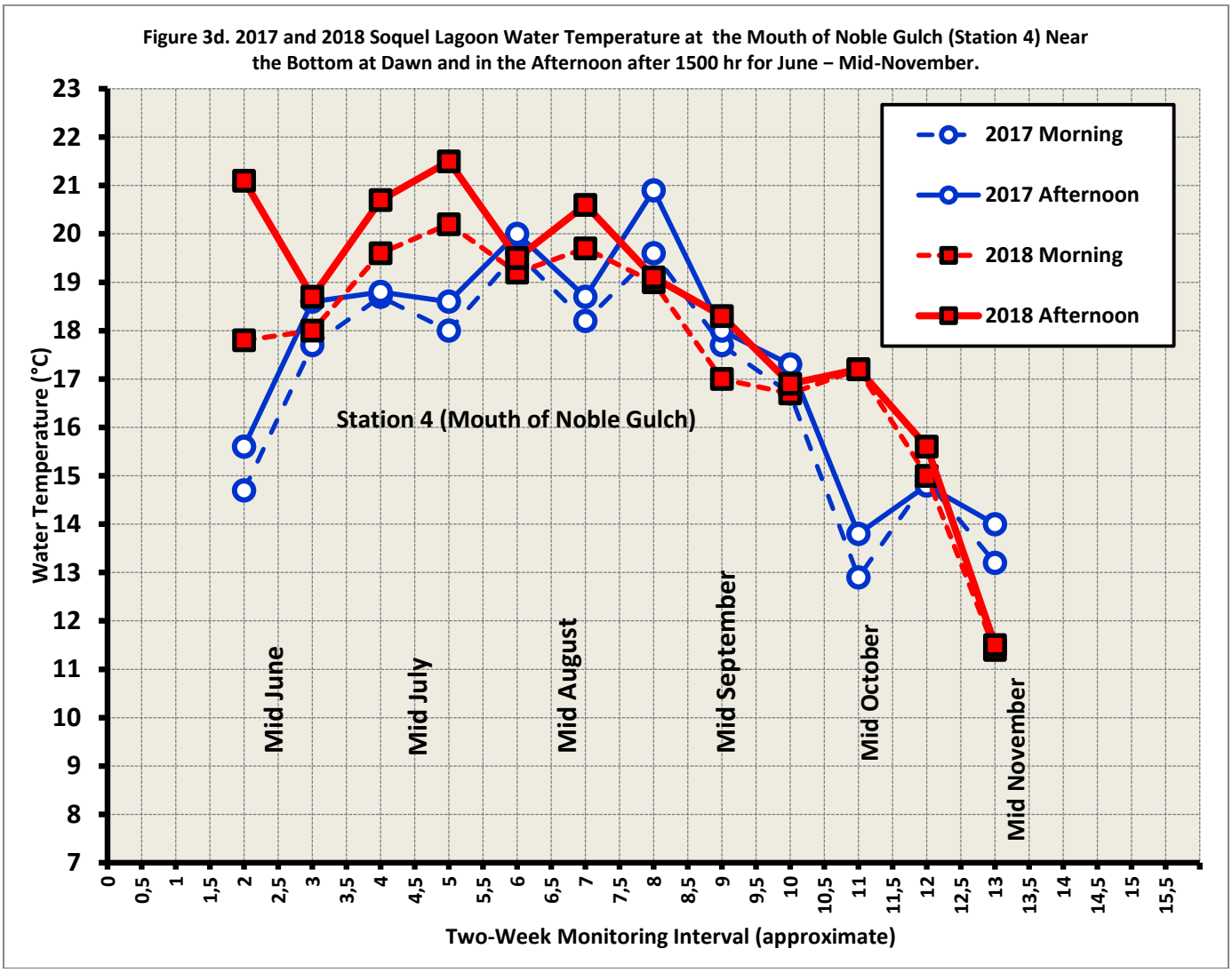


Figure 3d. 2017 and 2018 Soquel Lagoon Water Temperature at Noble Gulch Near the Bottom at Dawn (Station 4) and in the Afternoon after 1500 hr for June – Mid-November.

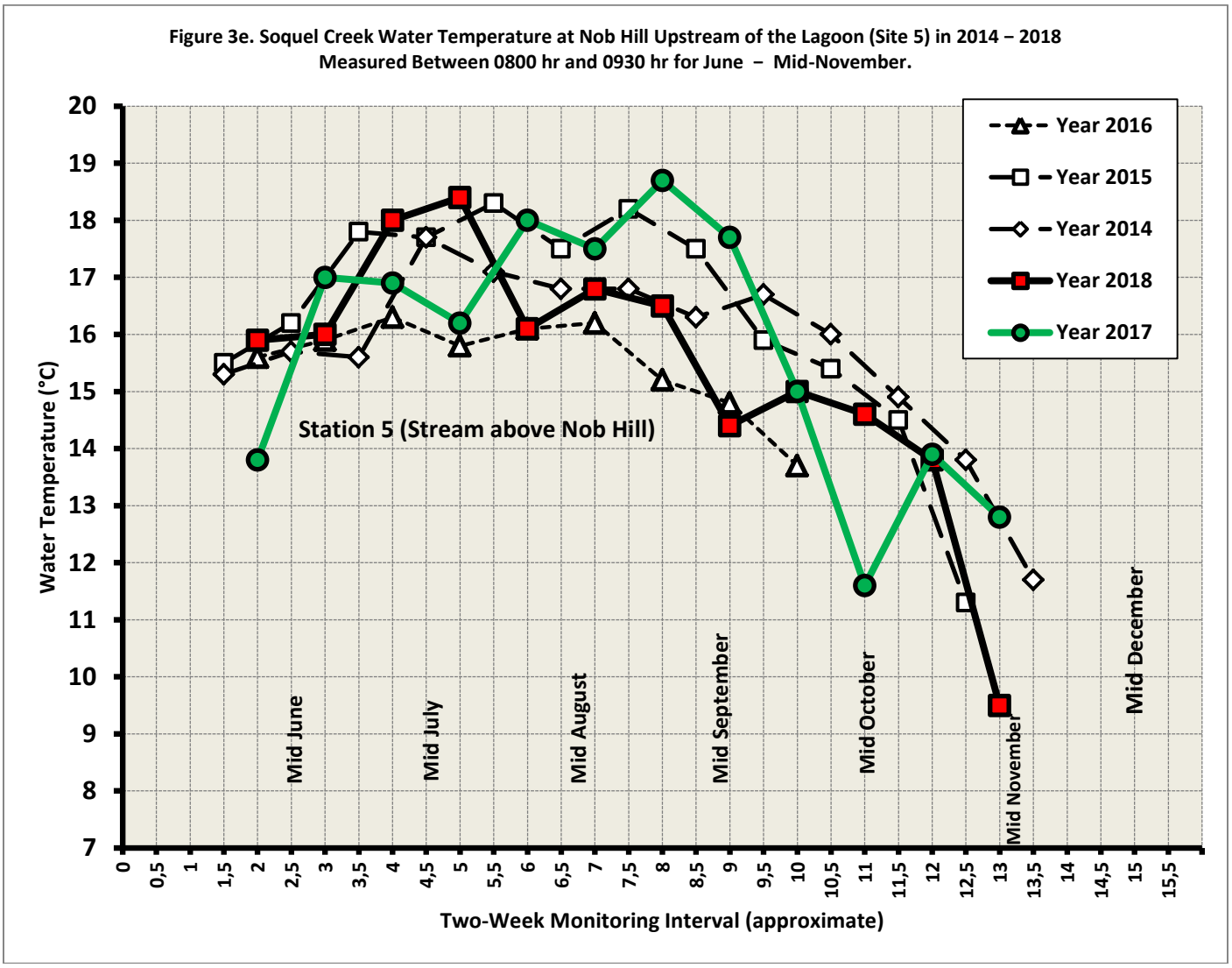


Figure 3e. Soquel Creek Water Temperature at Nob Hill Upstream of the Lagoon, 2014−2018. Measured Between 0800 hr and 0930 hr for June − Mid-November.

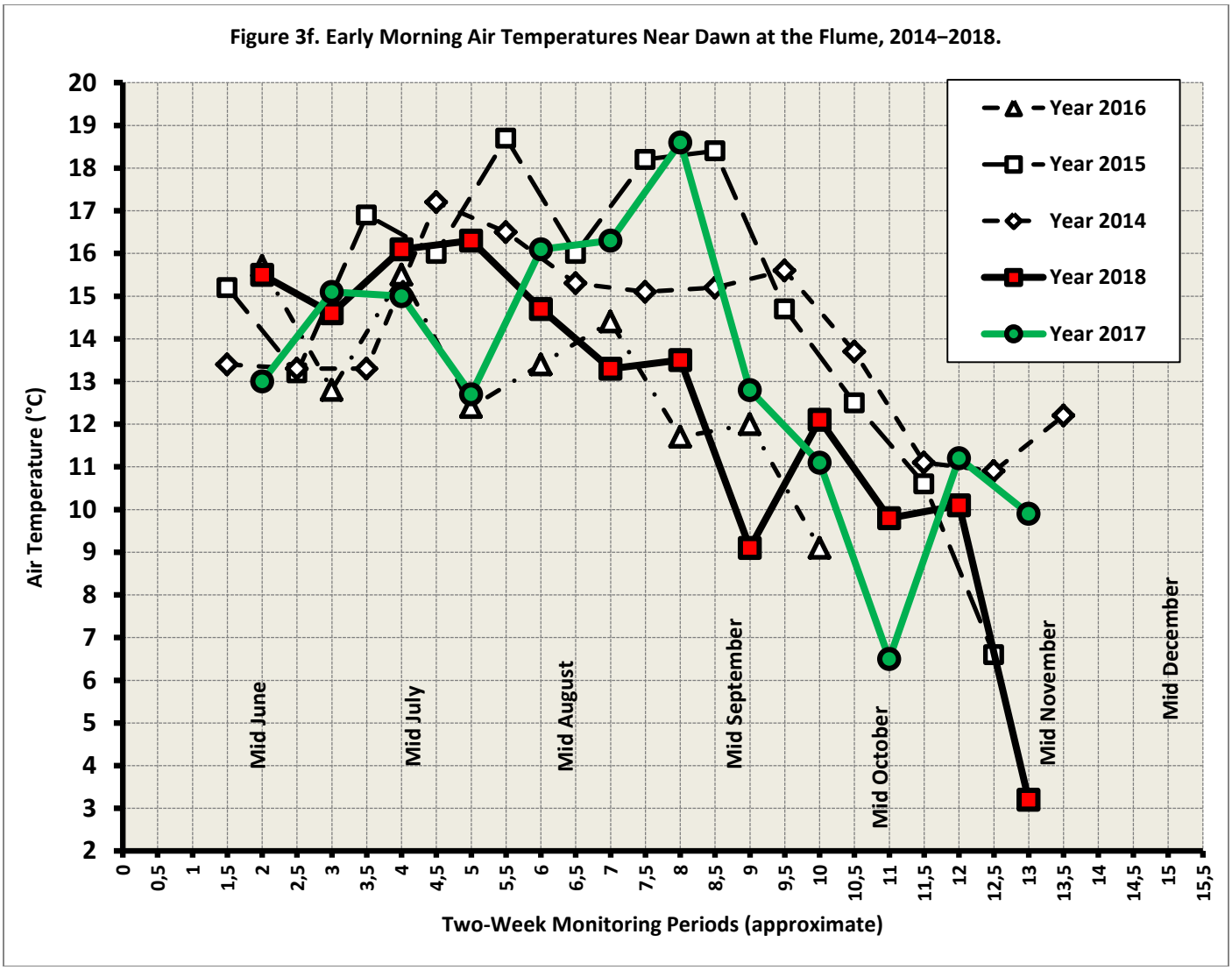


Figure 3f. Early Morning Air Temperatures Near Dawn at the Flume, 2013−2017.

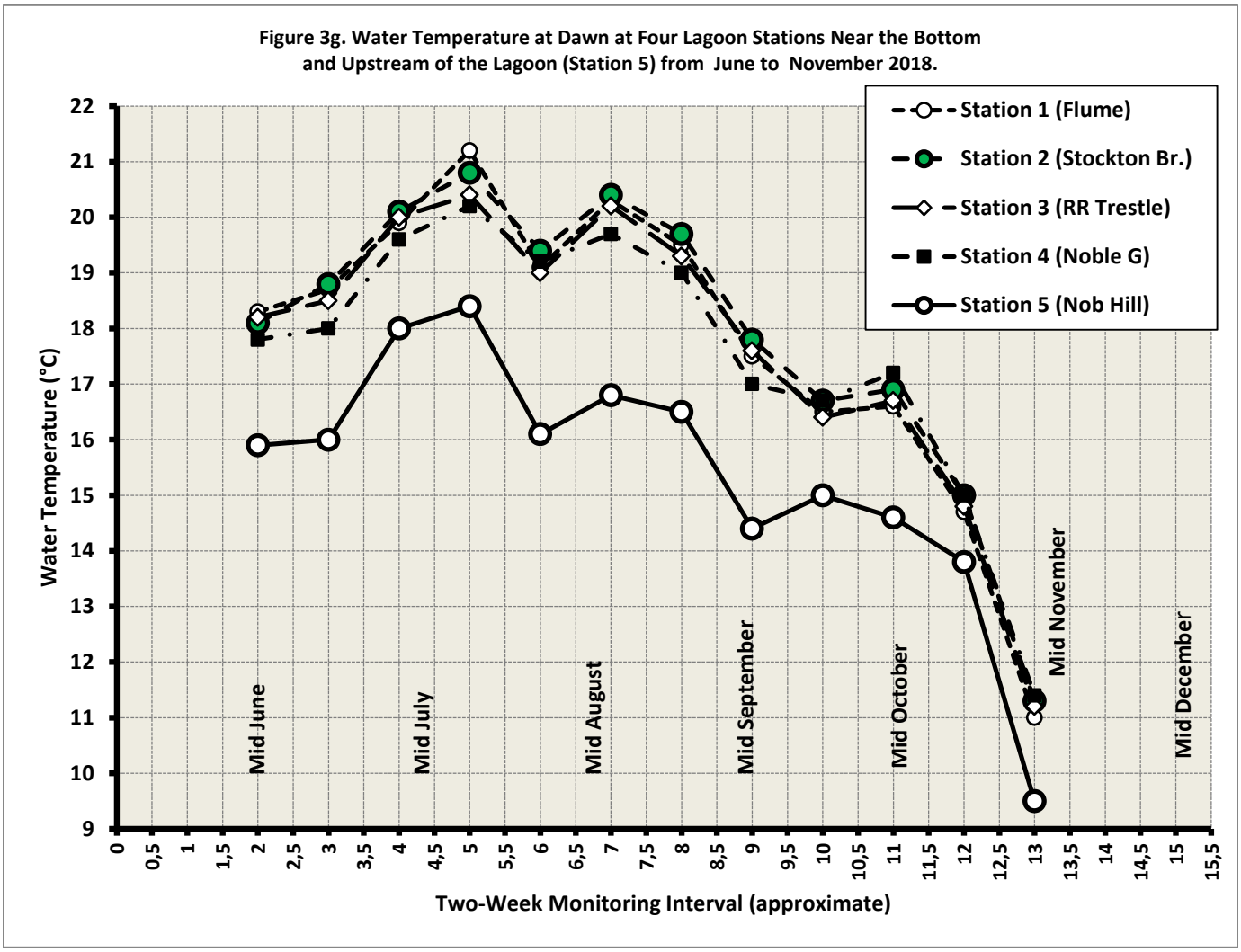


Figure 3g. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream from June to November 2018.

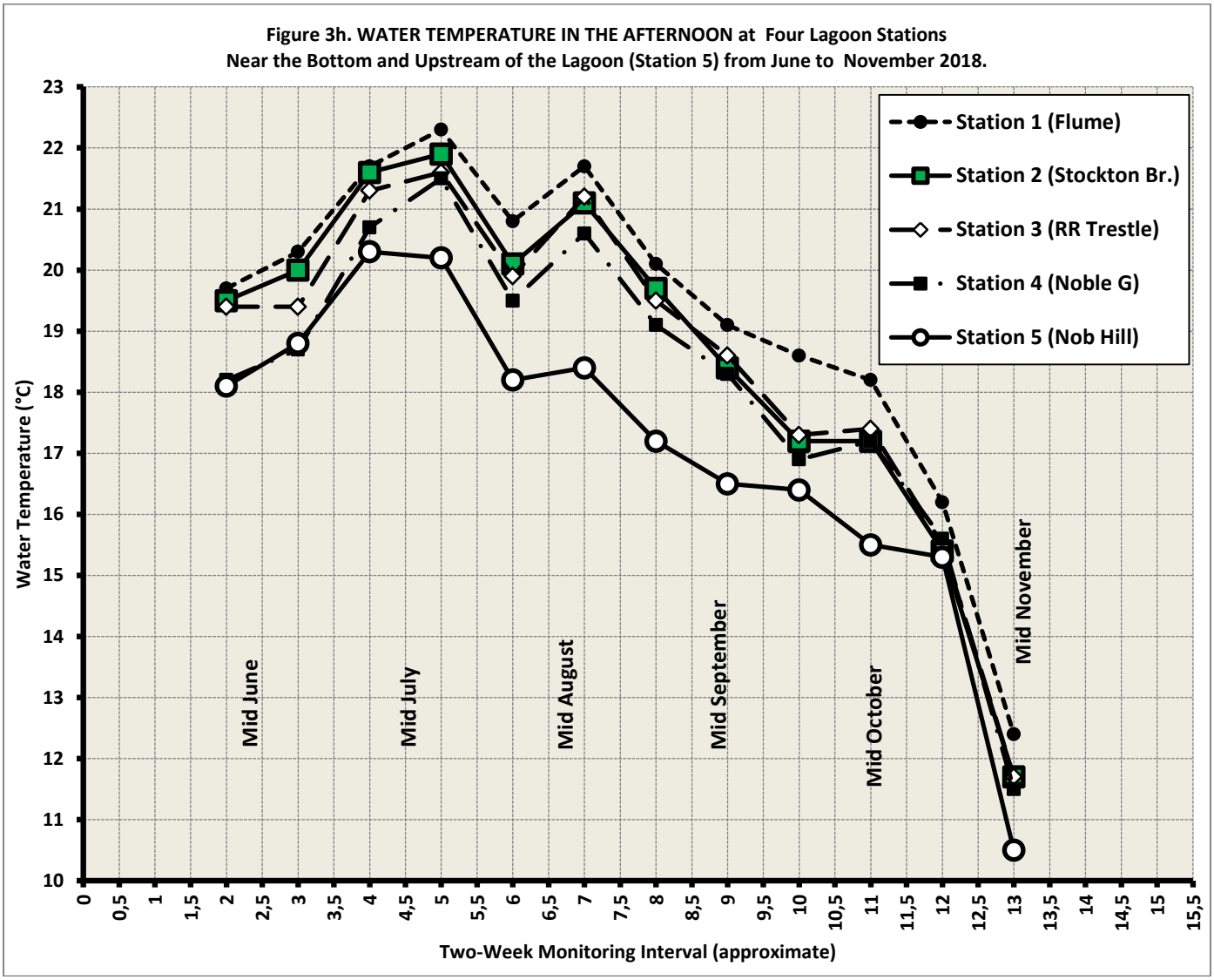


Figure 3h. Water Temperature in the Afternoon at Four Lagoon Stations Near the Bottom and Upstream from June to November 2018.

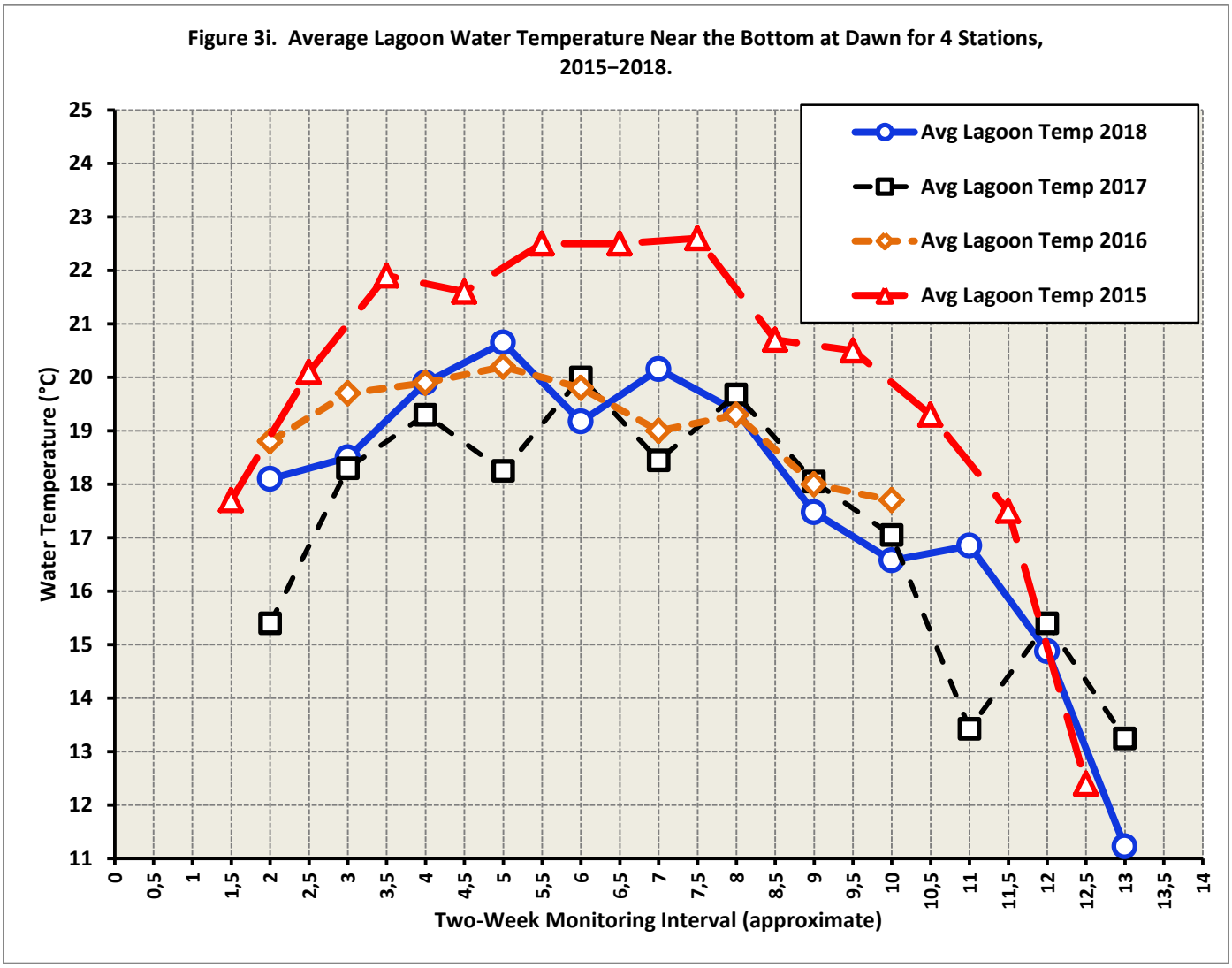


Figure 3i. Average Lagoon Water Temperature Near the Bottom at Dawn for 4 Stations, 2015–2018.

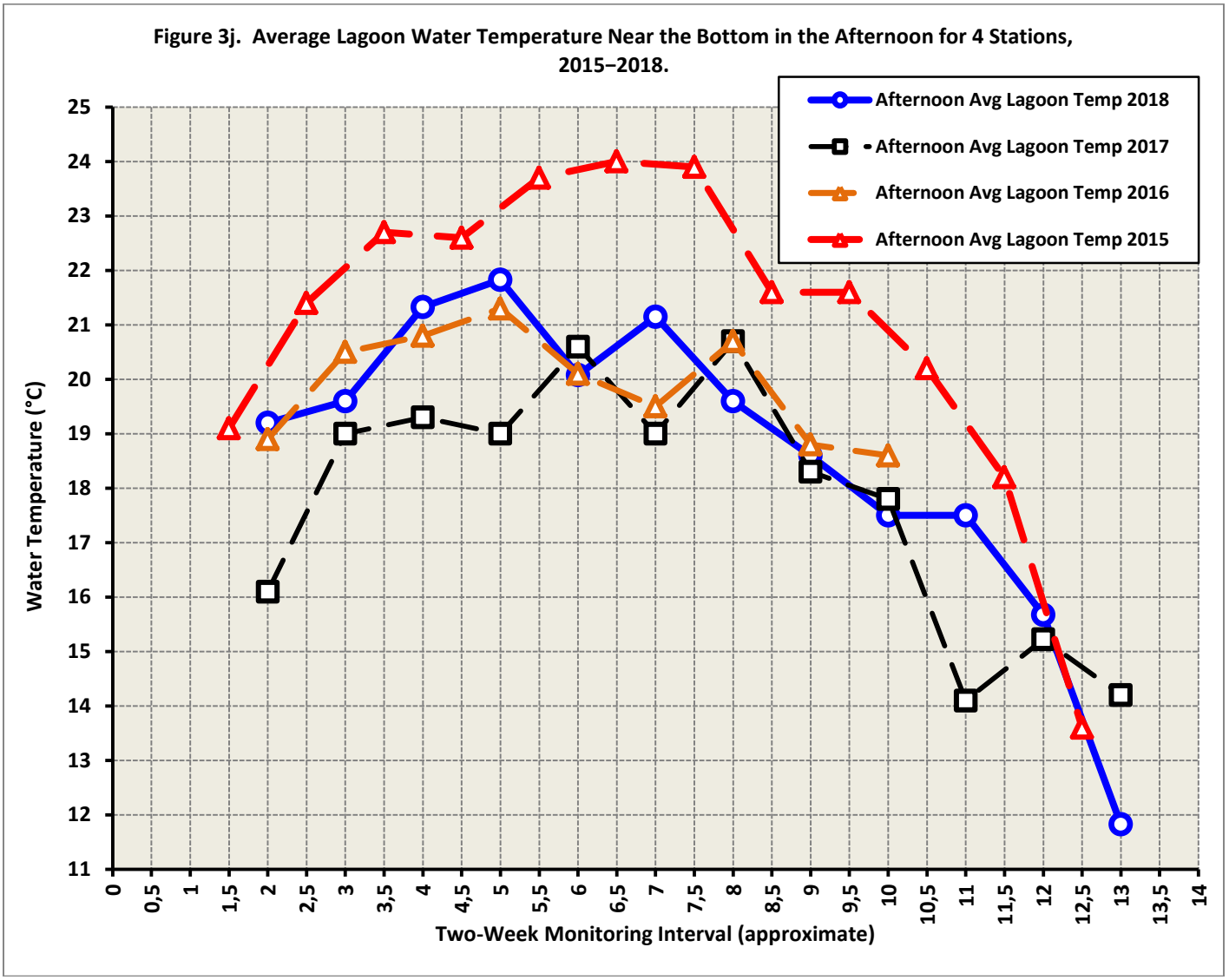


Figure 3j. Average Lagoon Water Temperature Near the Bottom in the Afternoon for 4 Stations, 2015–2018.

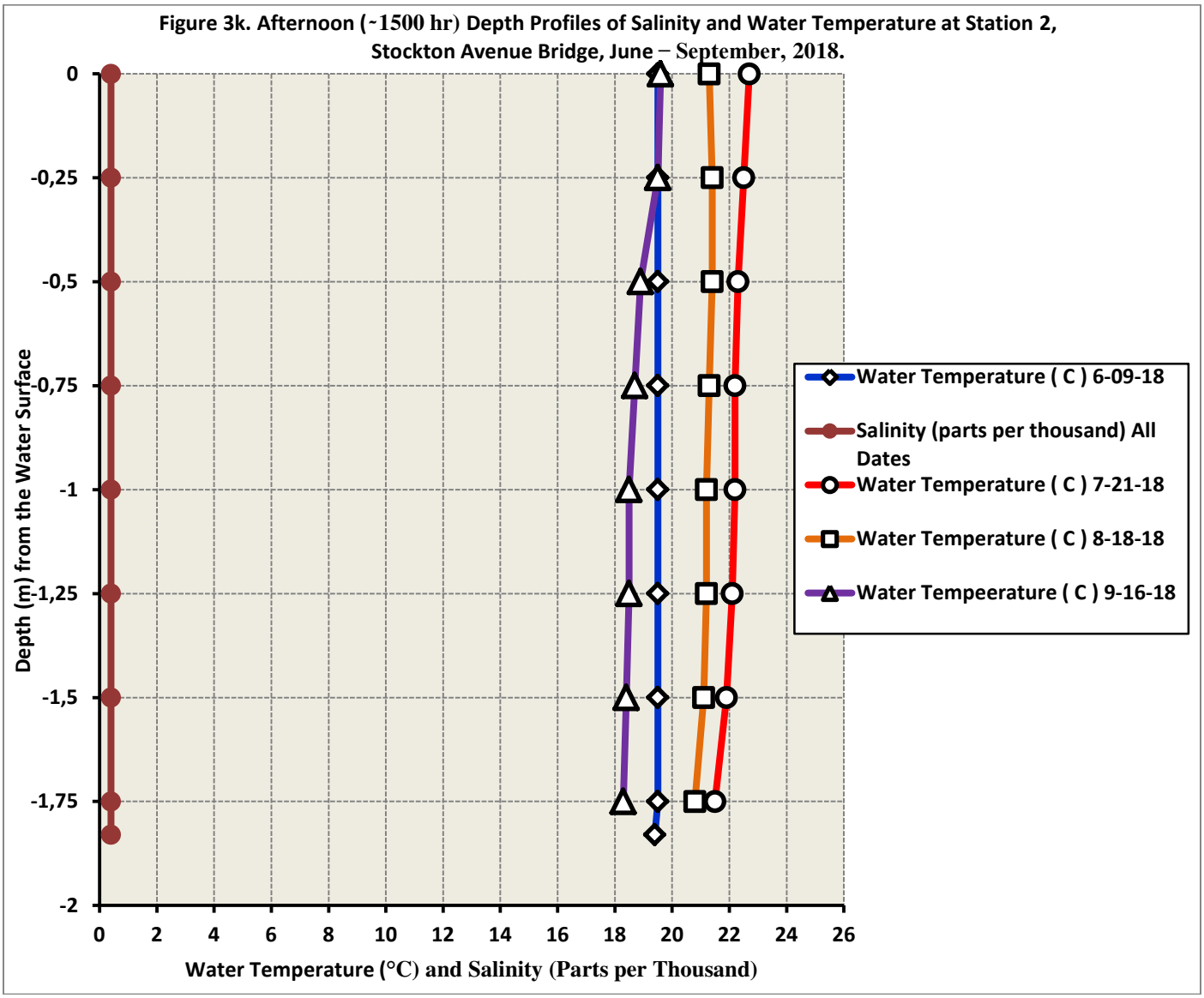


Figure 3k. Afternoon Depth Profiles of Salinity and Water Temperature at Station 2, Stockton Avenue Bridge, June − September, 2018.

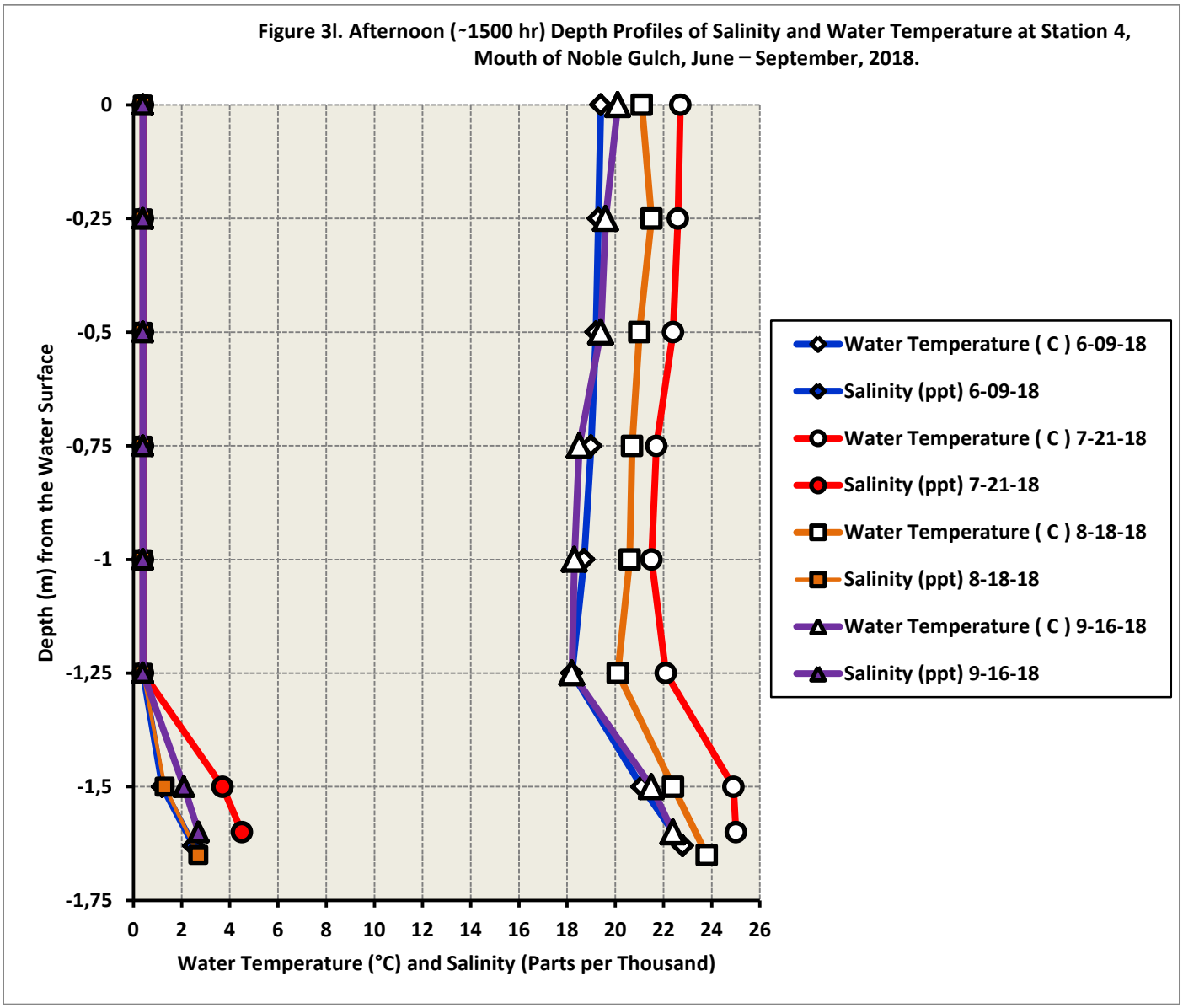


Figure 3l. Afternoon Depth Profiles of Salinity and Water Temperature at Station 4, Mouth of Noble Gulch, June – September, 2018.

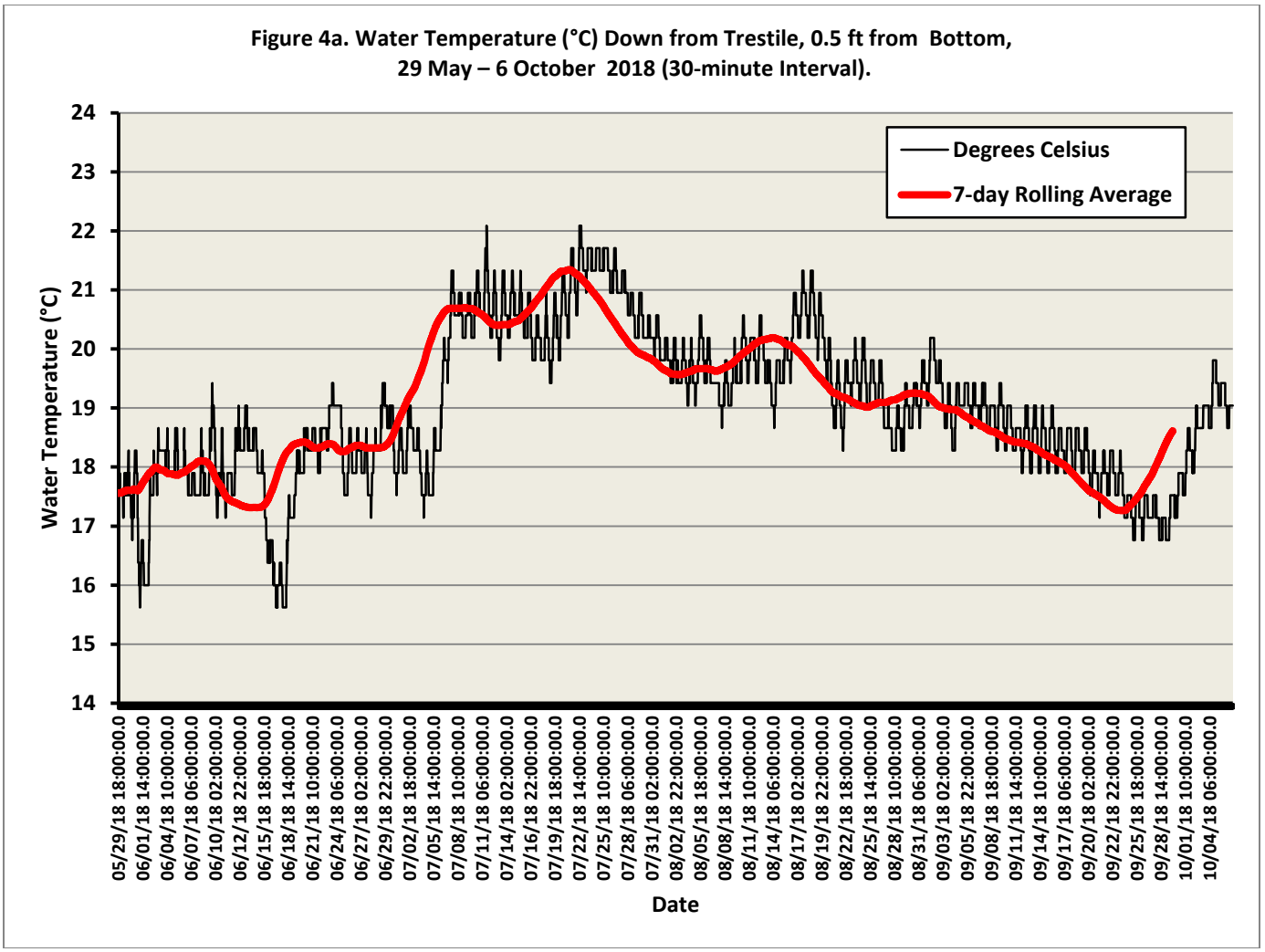


Figure 4a. Water Temperature (°C) Down from Trestile, 0.5 ft from Bottom, 29 May – 6 October 2018 (30-minute Interval).

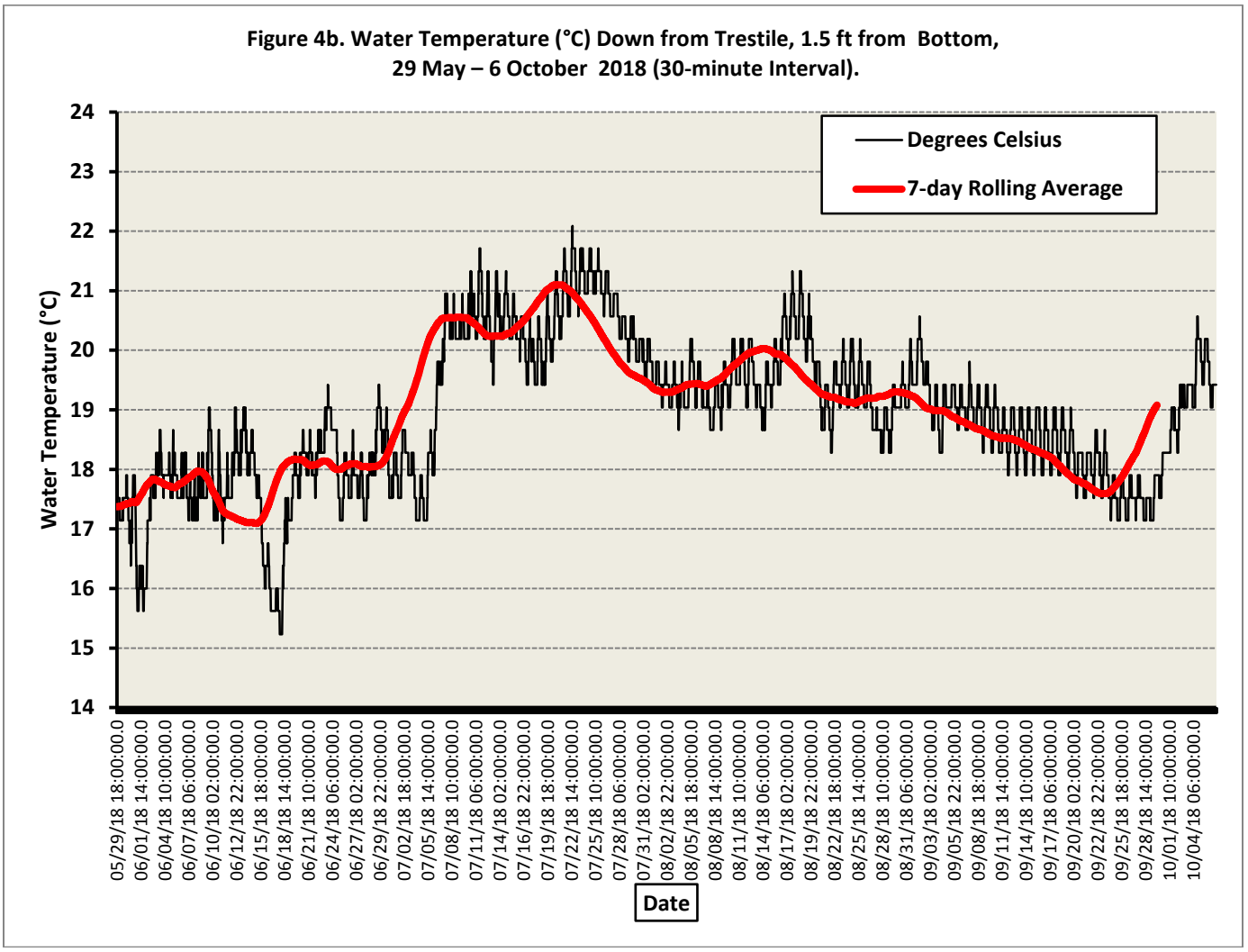


Figure 4b. Water Temperature (°C) Down from Trestle, 1.5 ft from Bottom, 29 May – 6 October 2018 (30-minute Interval).

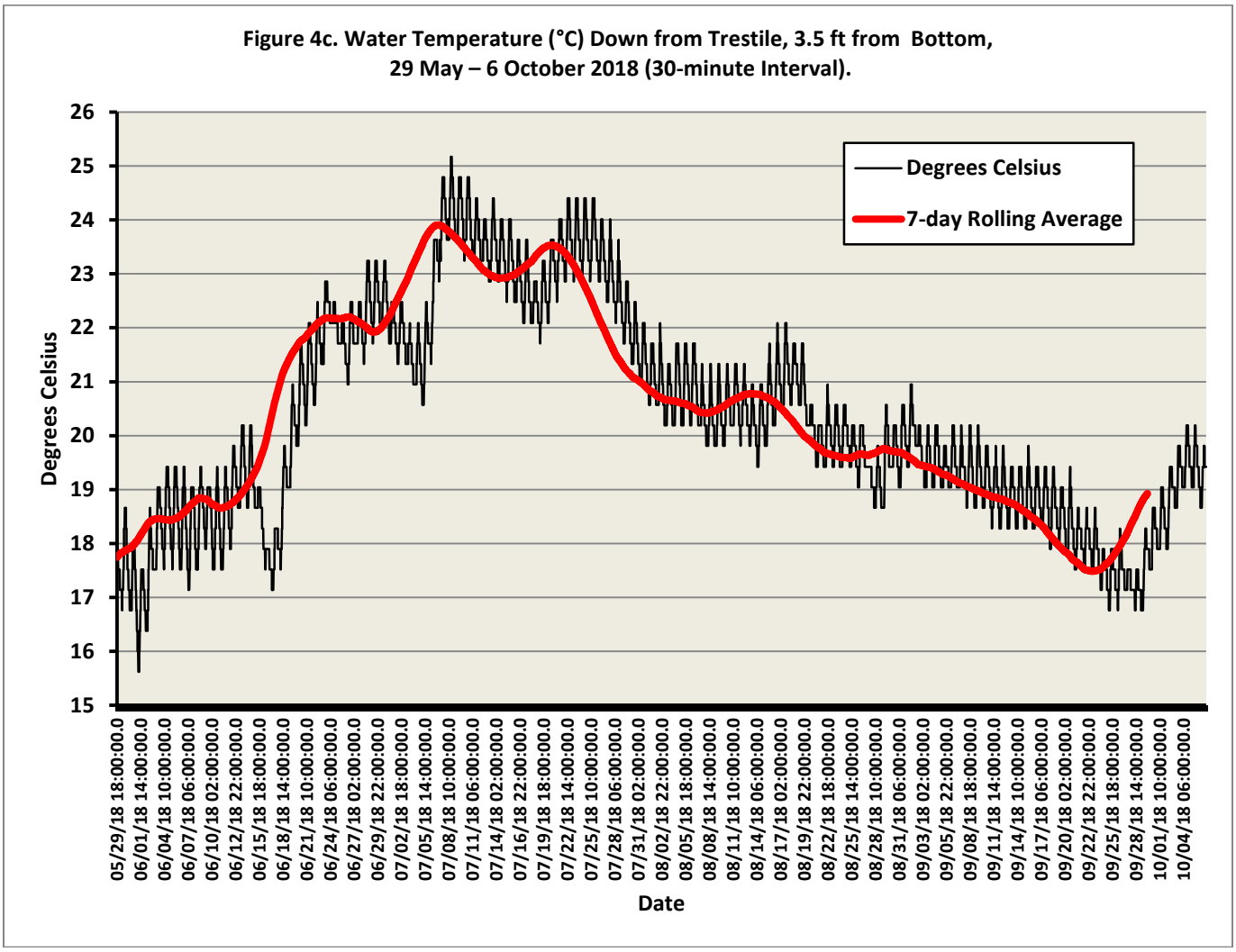


Figure 4c. Water Temperature (°C) Down from Trestle, 3.5 ft from Bottom, 29 May – 6 October 2018 (30-minute Interval).

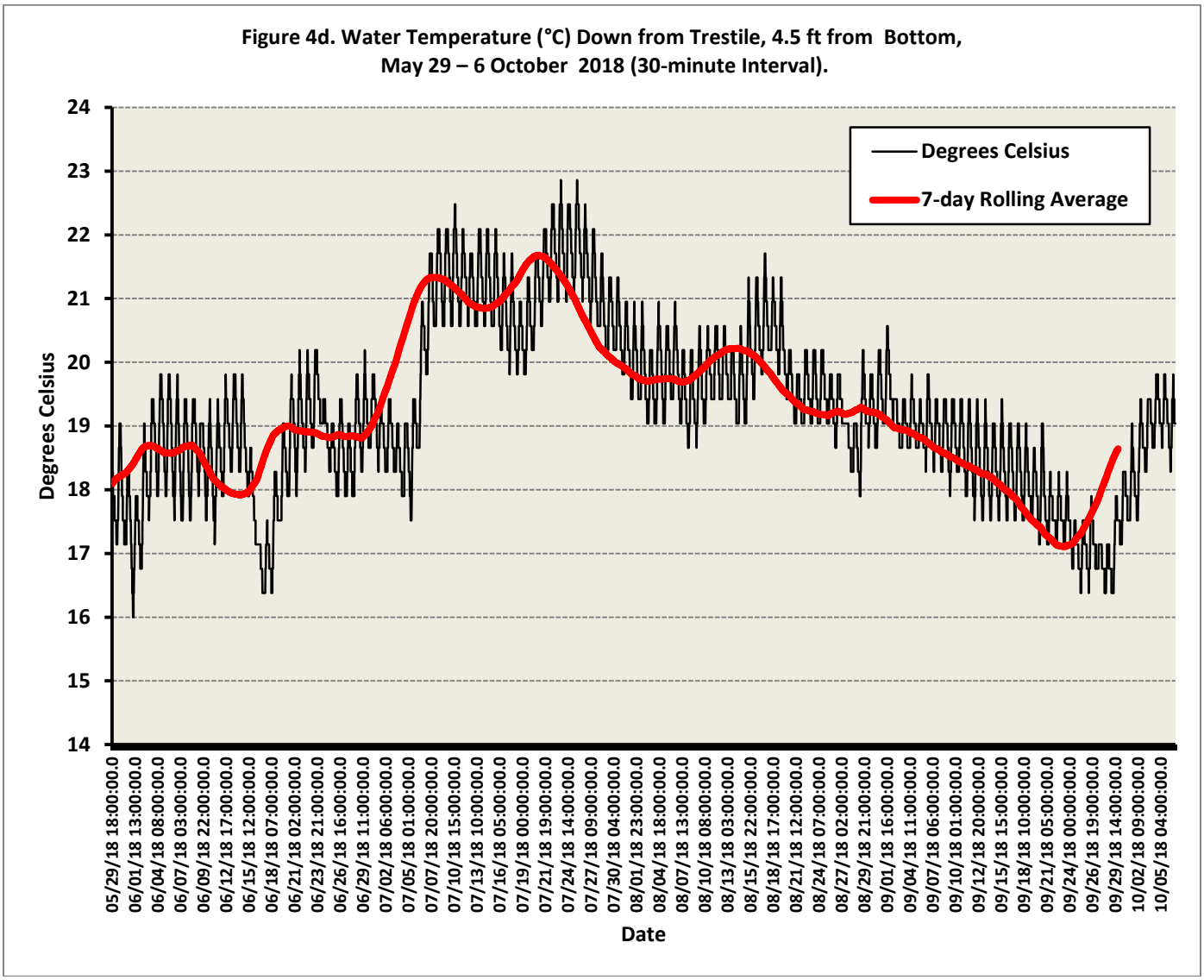


Figure 4d. Water Temperature (°C) Down from Trestle, 4.5 ft from Bottom, 29 May – 6 October 2018 (30-minute Interval).

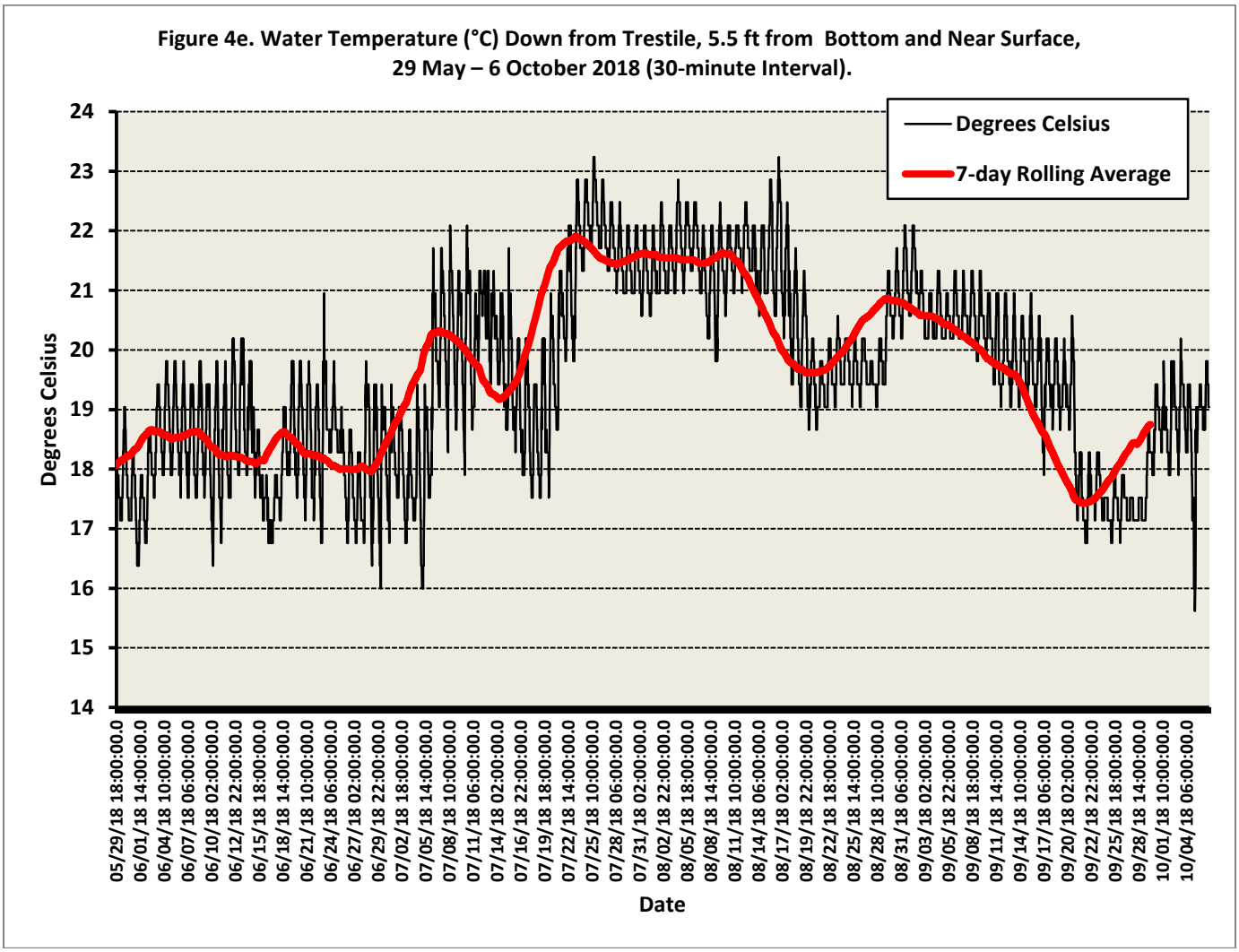


Figure 4e. Water Temperature (°C) Down from Trestle, 5.5 ft from Bottom, 29 May – 6 October 2018 (30-minute Interval).

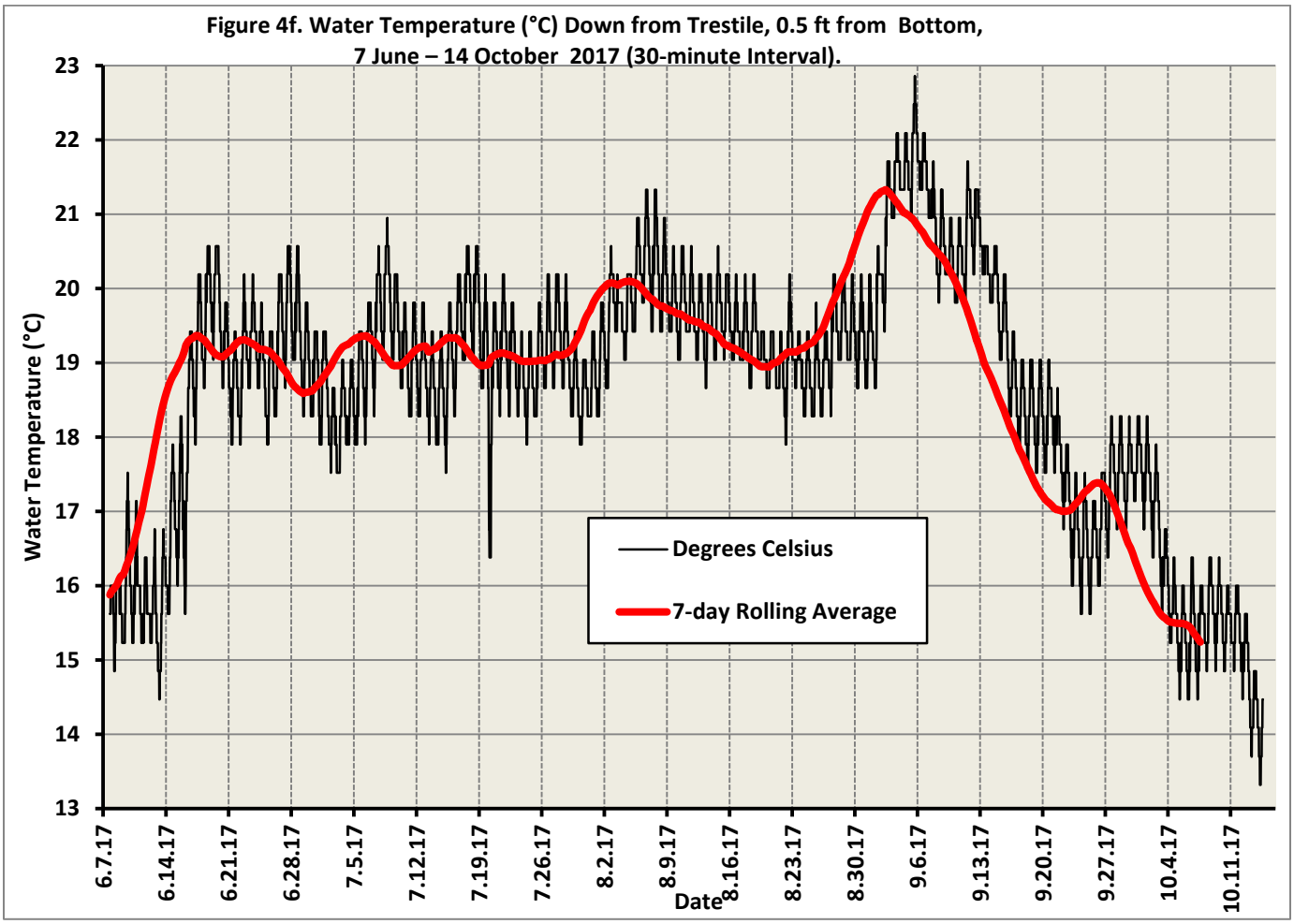


Figure 4f. Water Temperature (°C) Down from Trestile, 0.5 ft from Bottom,
7 June – 14 October 2017 (30-minute Interval).
Water Temperature (°C)
23
22
21
20
19
18
17
16
15
14
13
Degrees Celsius
7-day Rolling Average
6.7.17
6.14.17
6.21.17
6.28.17
7.5.17
7.12.17
7.19.17
7.26.17
8.2.17
8.9.17
8.16.17
8.23.17
8.30.17
9.6.17
9.13.17
9.20.17
9.27.17
10.4.17
10.11.17
Date

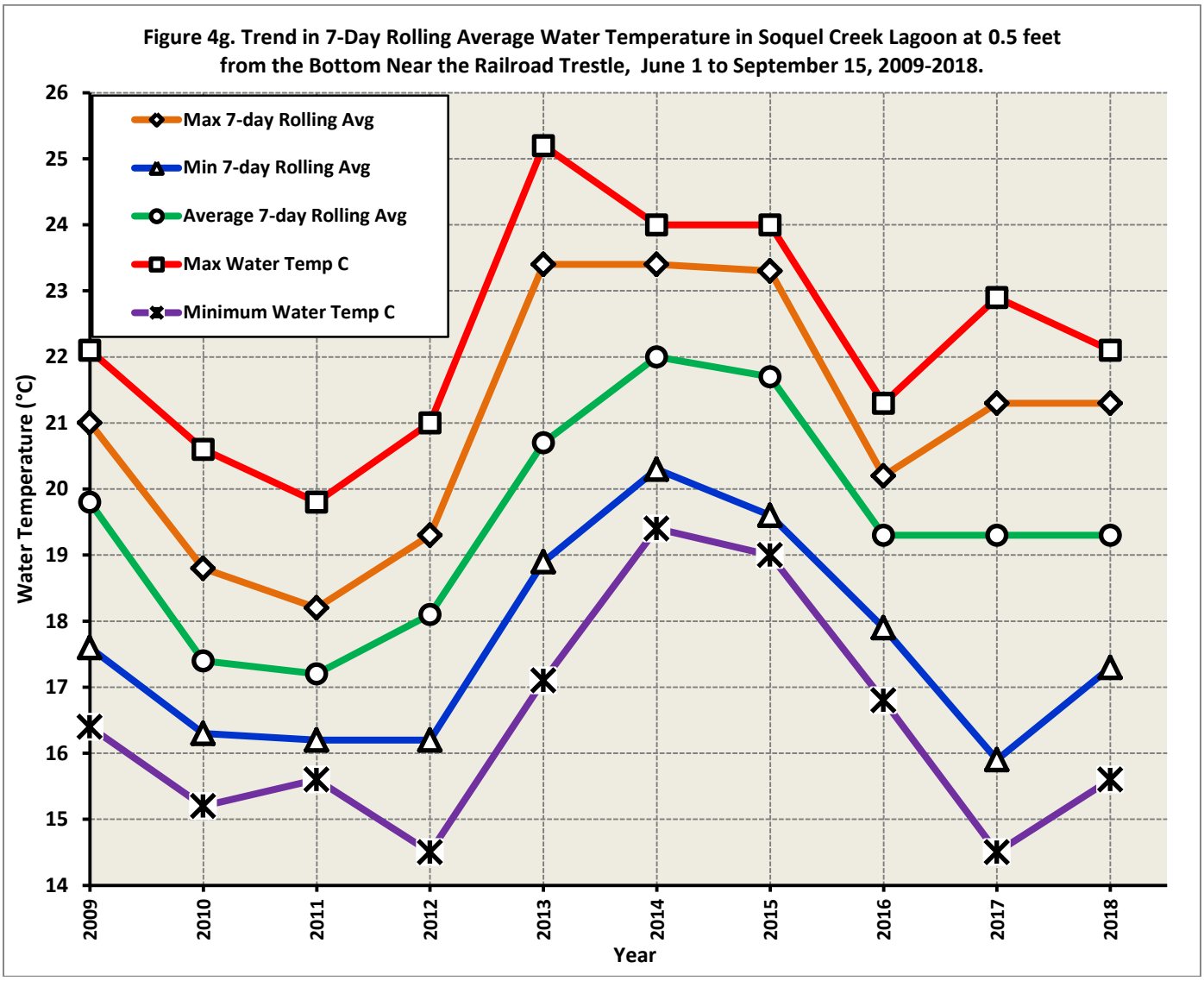


Figure 4f. Trend in 7-day Rolling Average Water Temperature in Soquel Creek Lagoon at 0.5 ft from the Bottom Near the Railroad Trestle, 2009–2018.

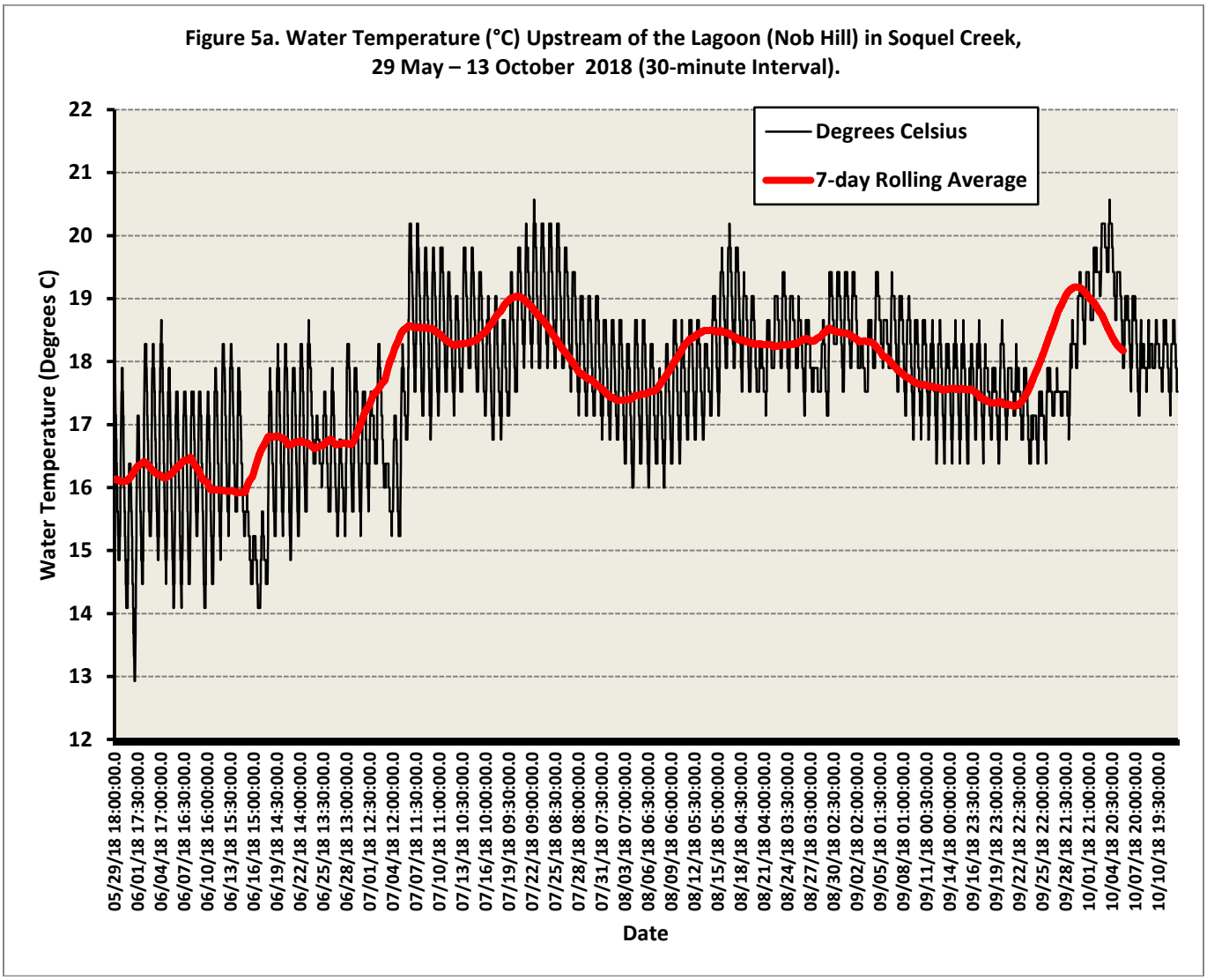


Figure 5a. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 29 May – 6 October 2018 (30-minute Interval).

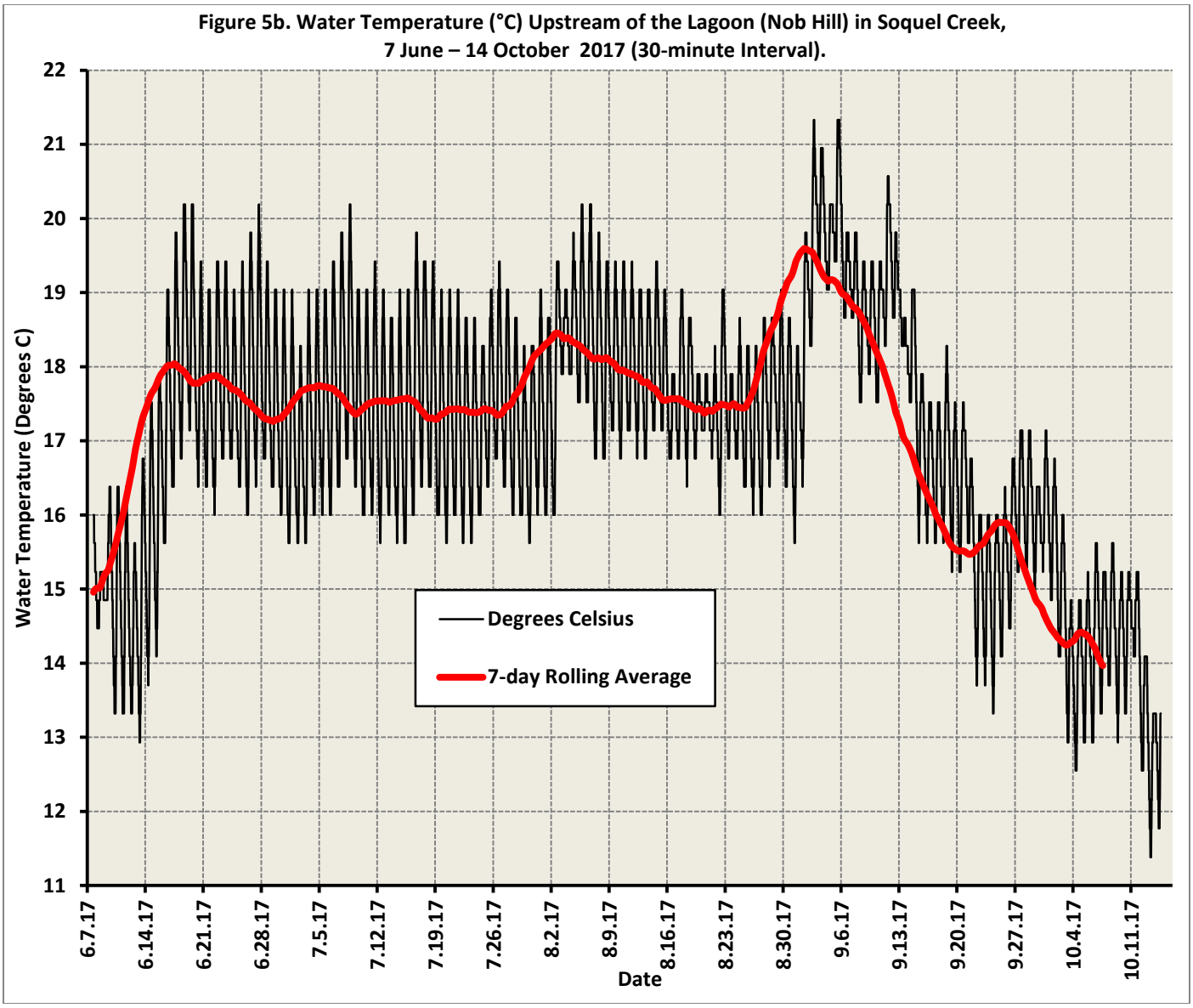


Figure 5b. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 7 June – 14 October 2017 (30-minute Interval).

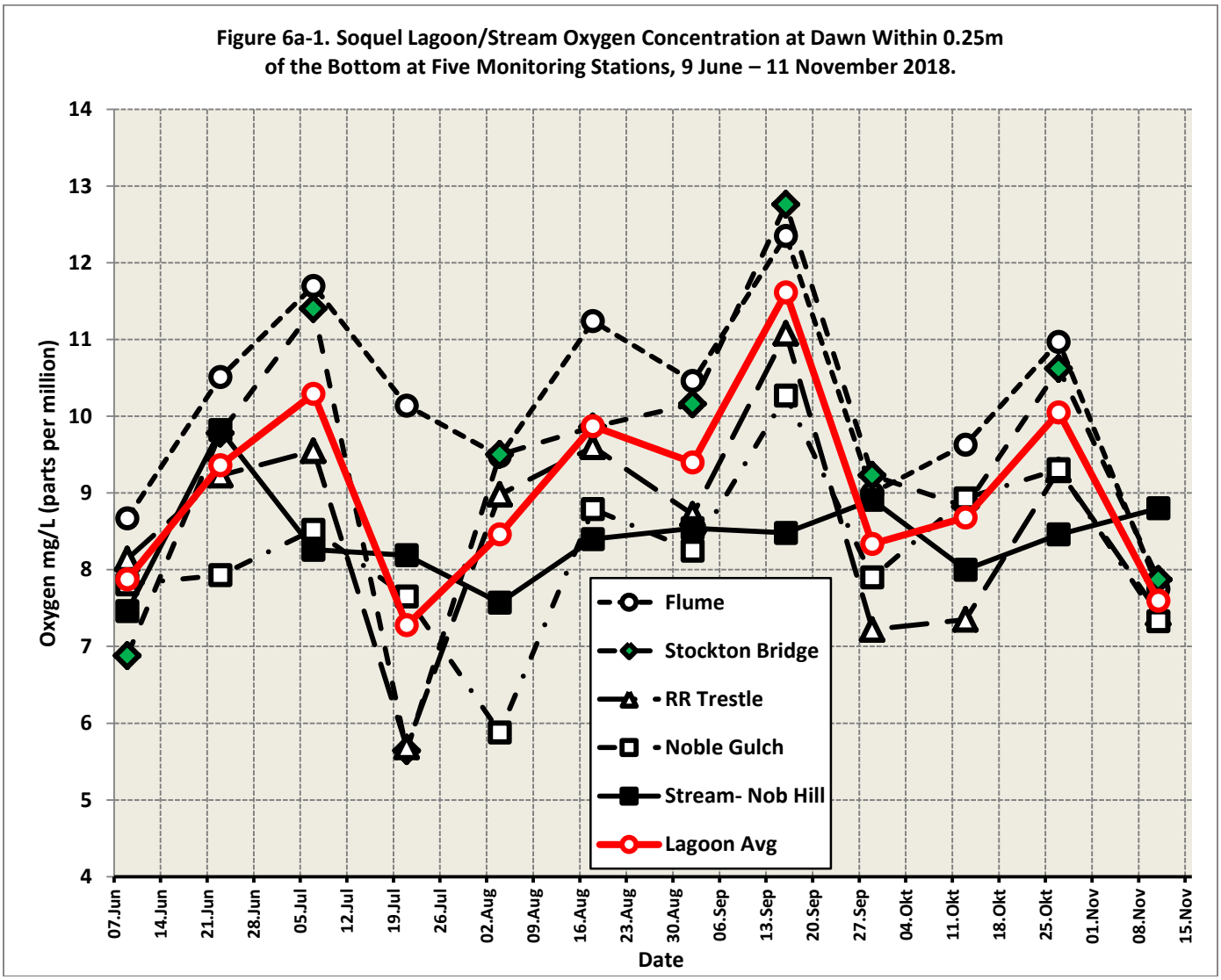


Figure 6a-1. Soquel Lagoon/Stream Oxygen Concentration at Dawn Within 0.25m of the Bottom at Five Monitoring Stations, 9 June – 11 November 2018.

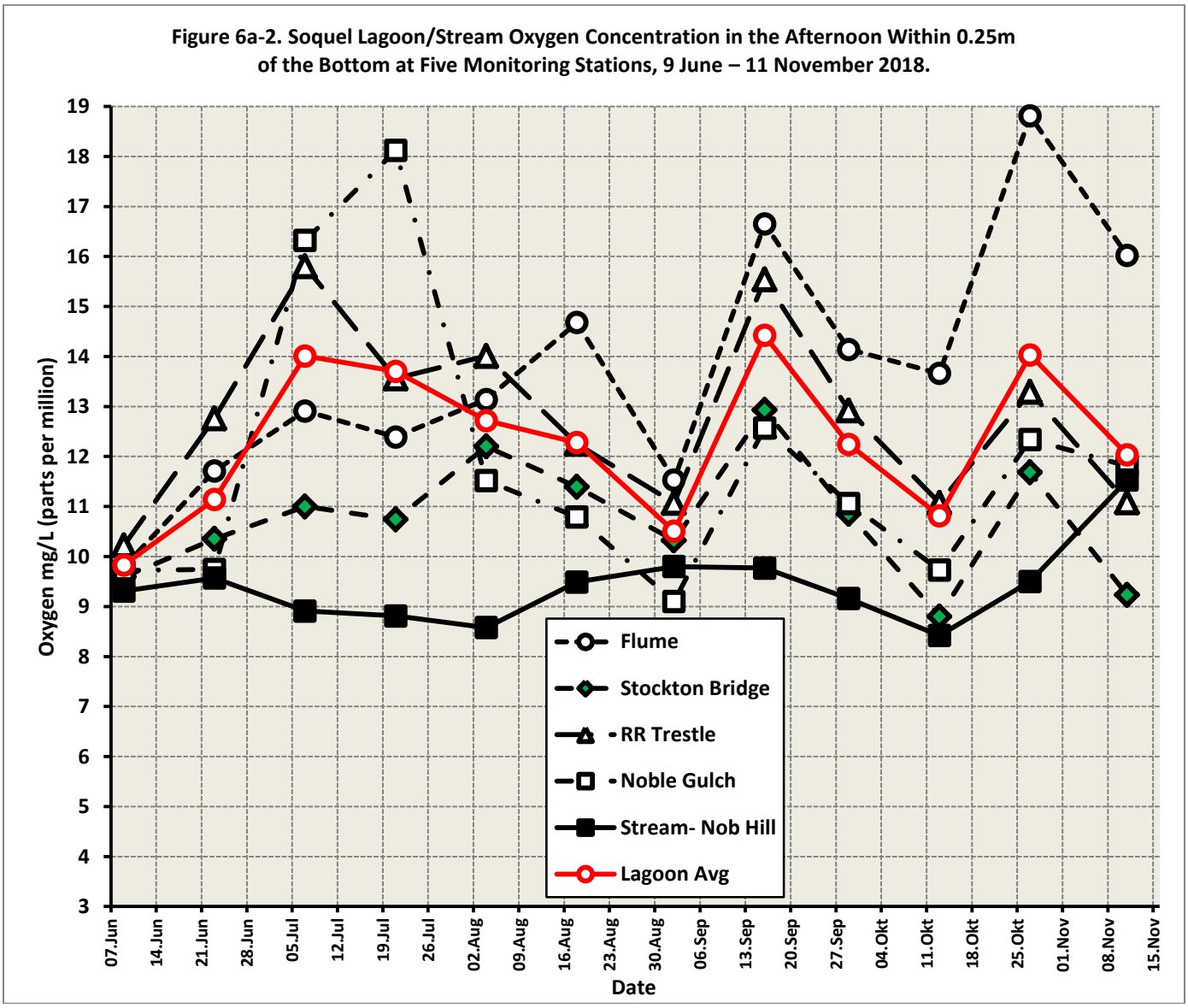


Figure 6a-2. Soquel Lagoon/Stream Oxygen Concentration in the Afternoon Within 0.25m of the Bottom at Five Monitoring Stations, 9 June – 11 November 2018.

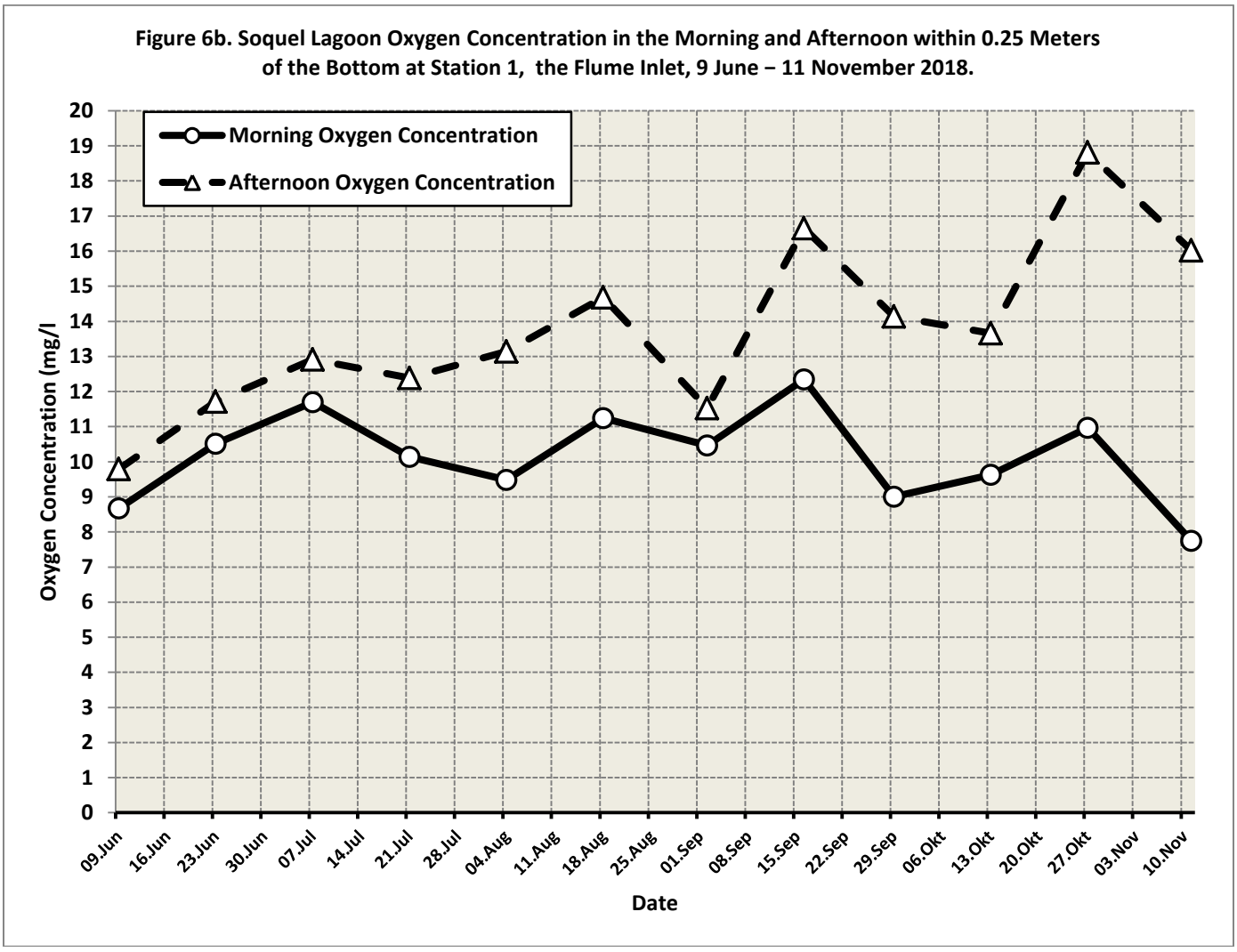


Figure 6b. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 1, the Flume Inlet, 9 June – 11 November 2018.

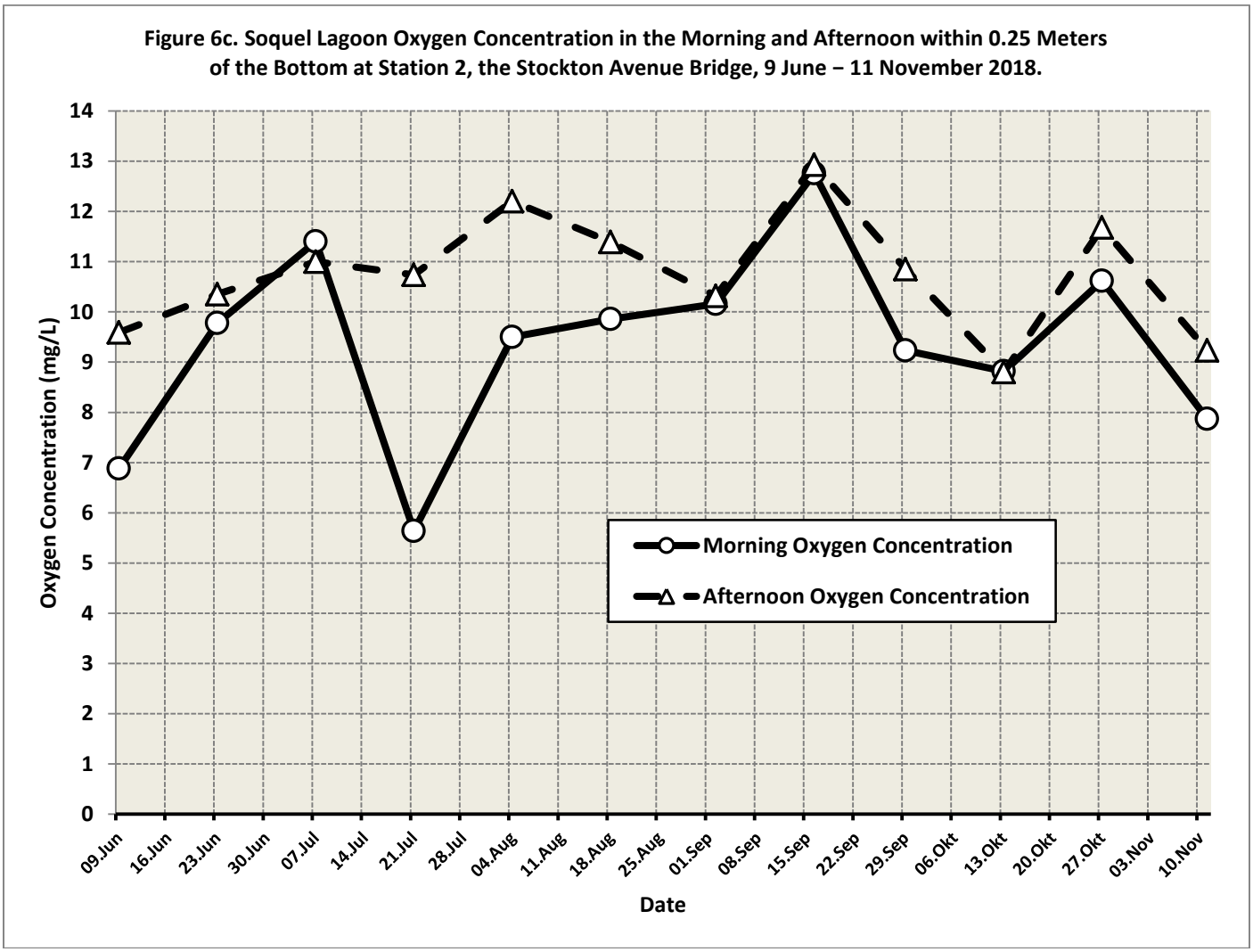


Figure 6c. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 2, the Stockton Avenue Bridge, 9 June – 11 November 2018.

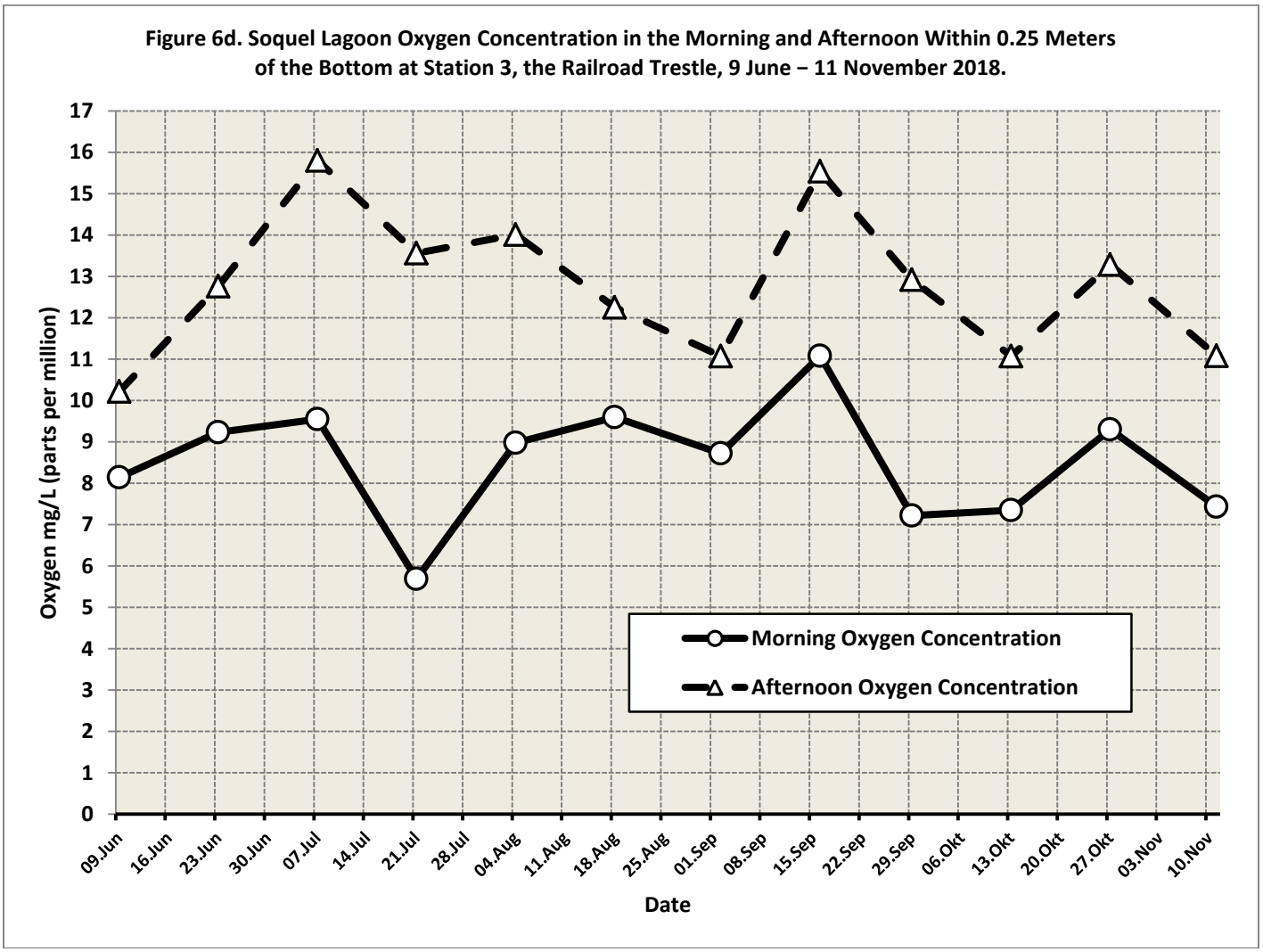


Figure 6d. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 3, the Railroad Trestle, 9 June – 11 November 2018.

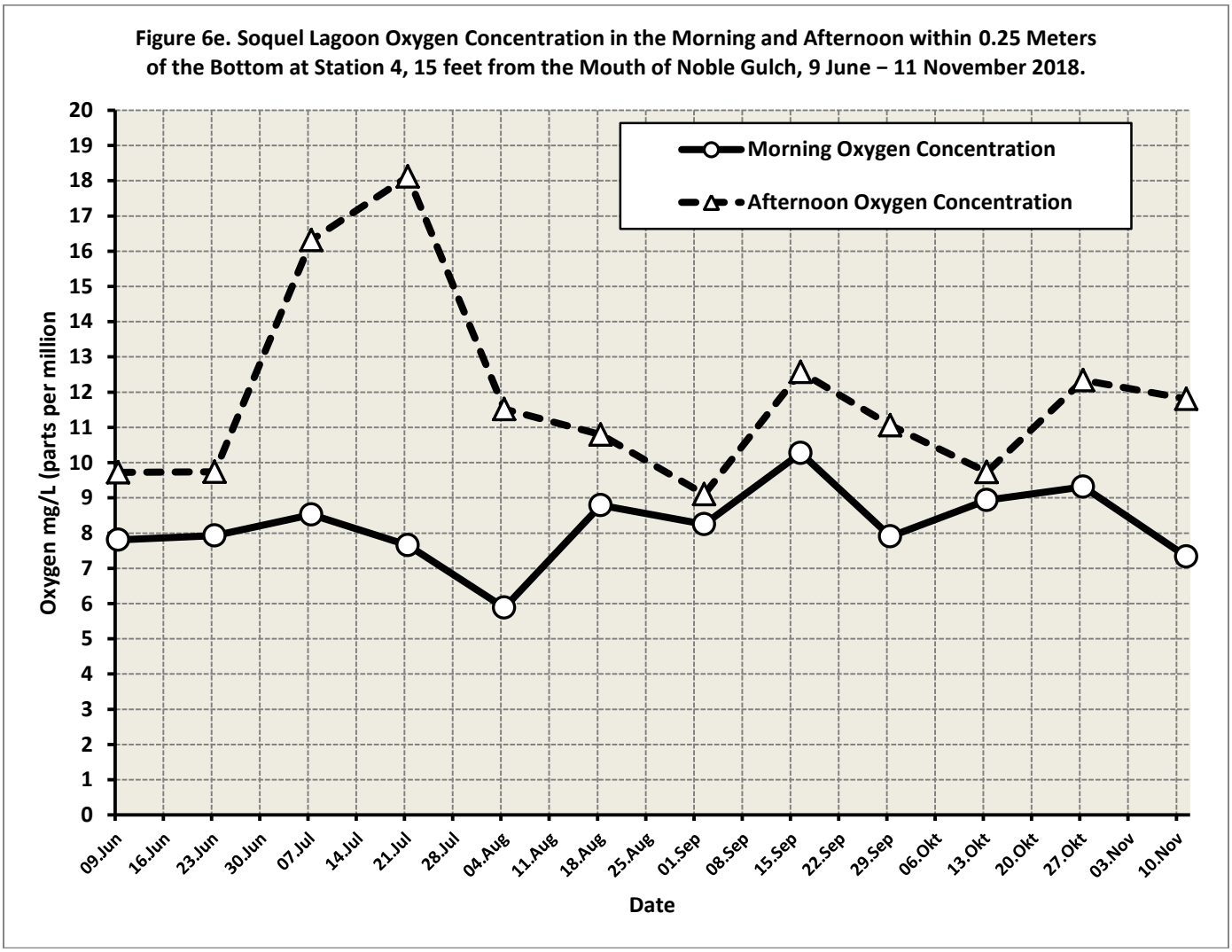


Figure 6e. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 4, 15 feet from the Mouth of Noble Gulch, 9 June – 11 November 2018.

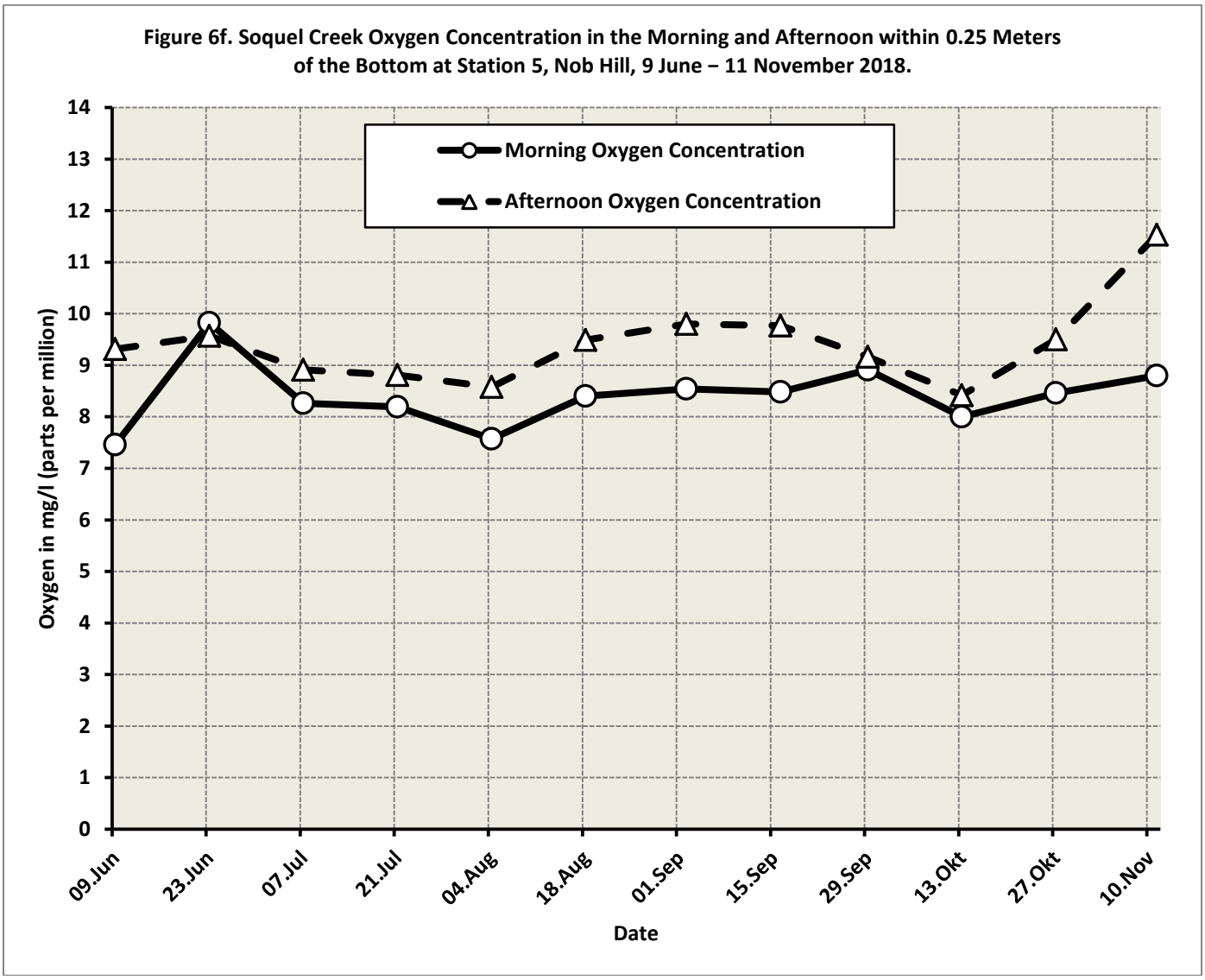


Figure 6f. Soquel Creek Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 5, Nob Hill, 9 June – 11 November 2018.

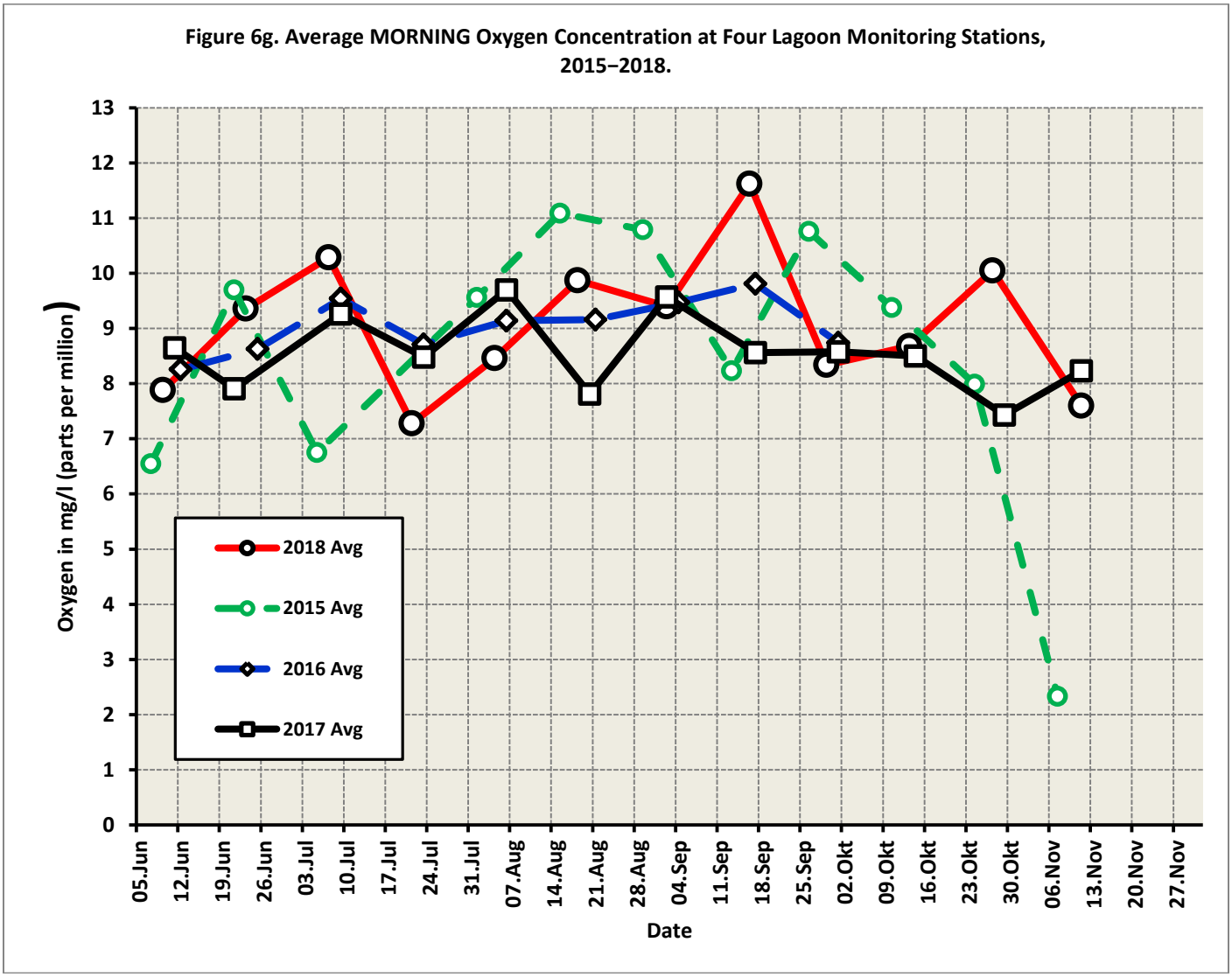


Figure 6g. Average MORNING Oxygen Concentration at Four Lagoon Monitoring Stations, 2015–2018.

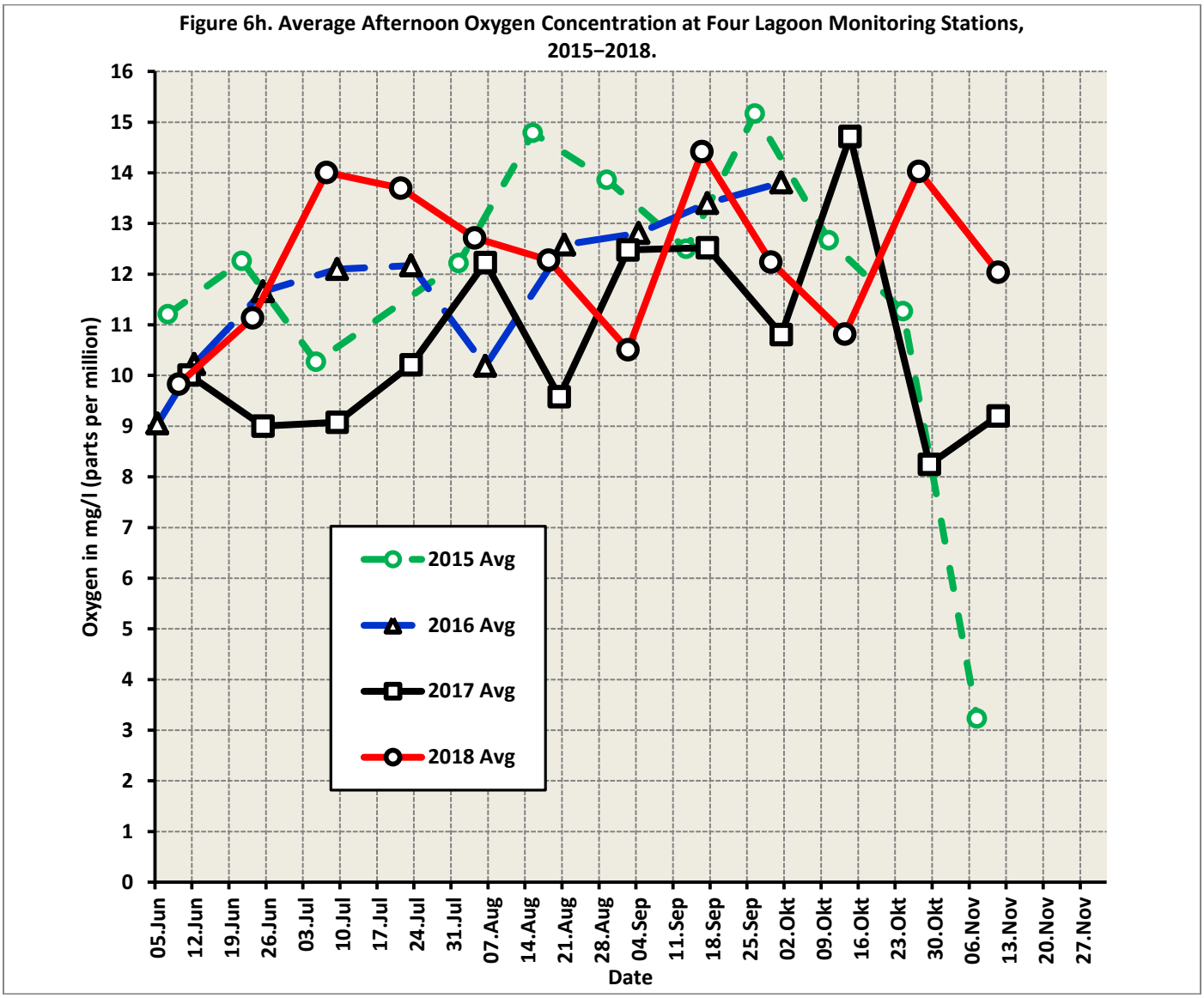


Figure 6h. Average AFTERNOON Oxygen Concentration at Four Lagoon Monitoring Stations, 2015–2018.

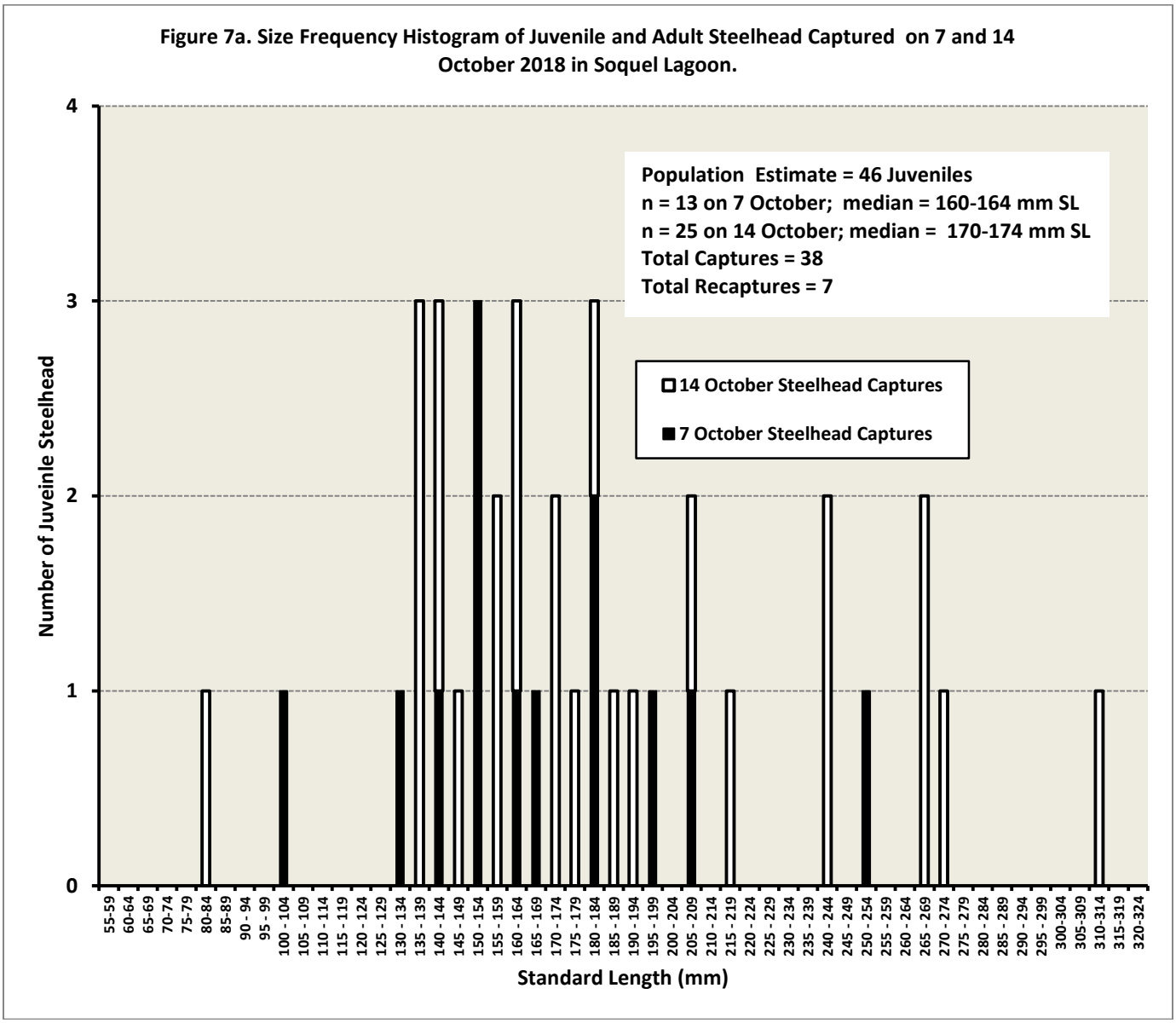


Figure 7a. Size Frequency Histogram of Steelhead Captured on 7 and 14 October 2018 in Soquel Lagoon.

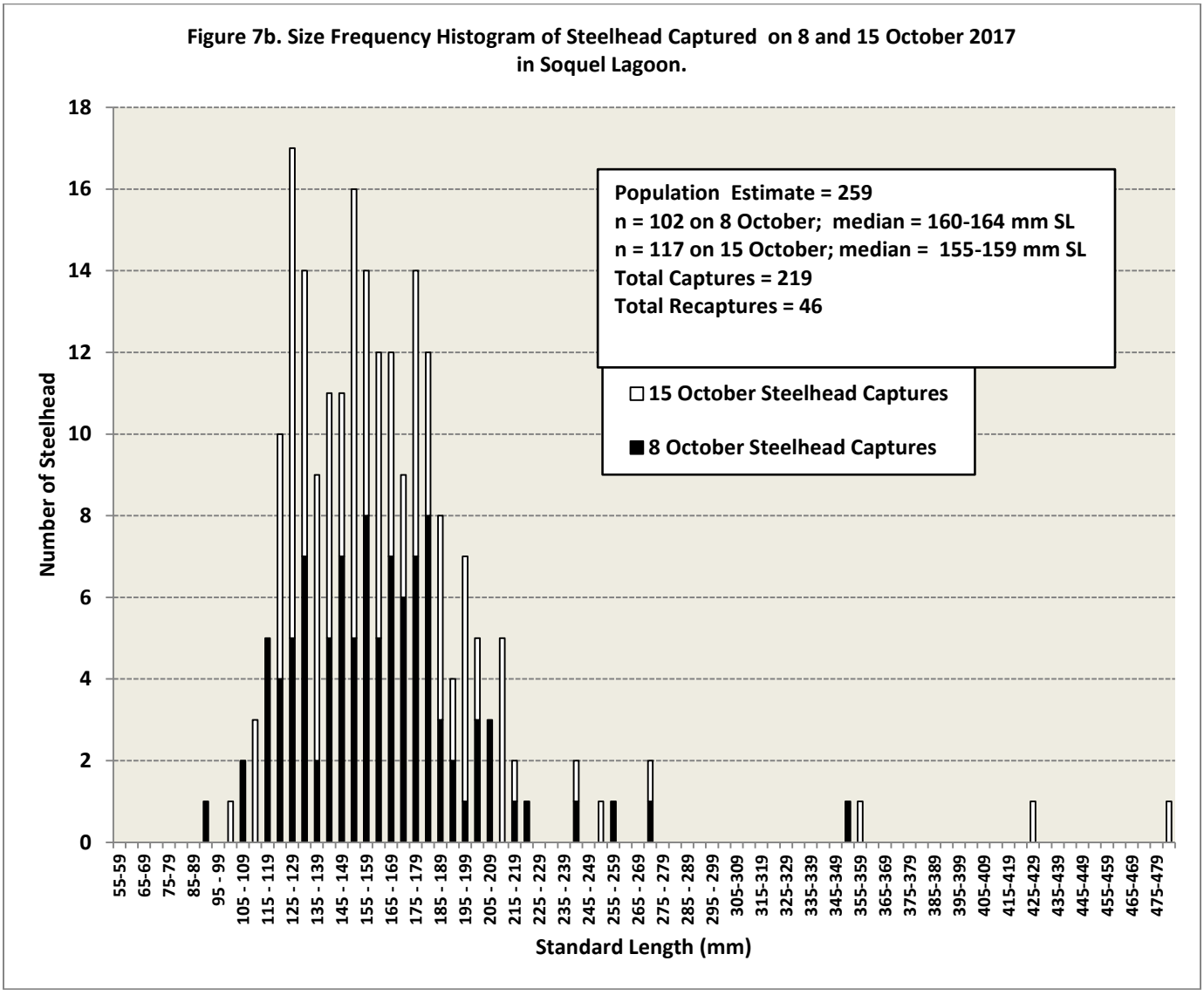


Figure 7b. Size Frequency Histogram of Steelhead Captured on 8 and 15 October 2017 in Soquel Lagoon.

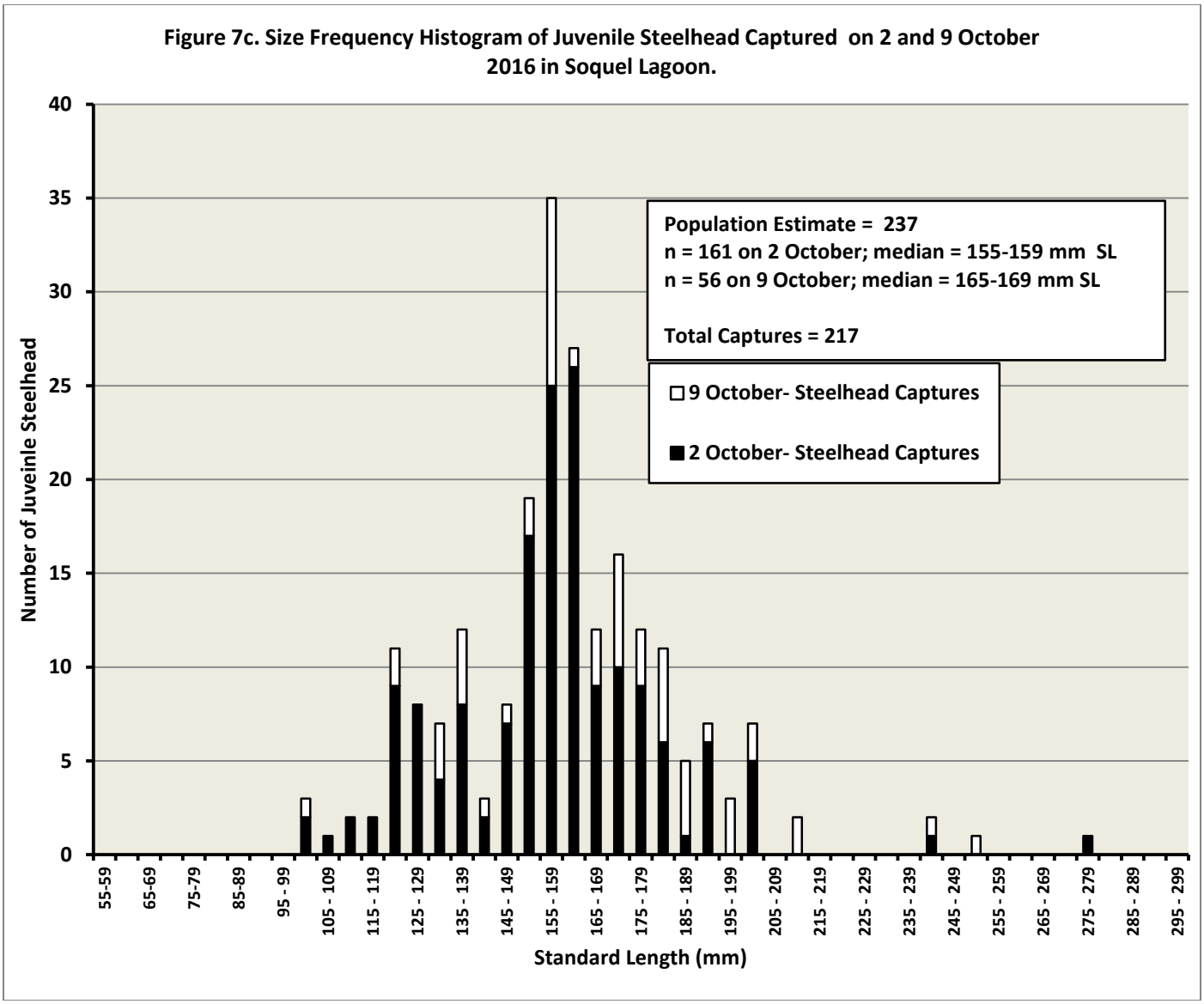


Figure 7c. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 9 October 2016 in Soquel Lagoon.

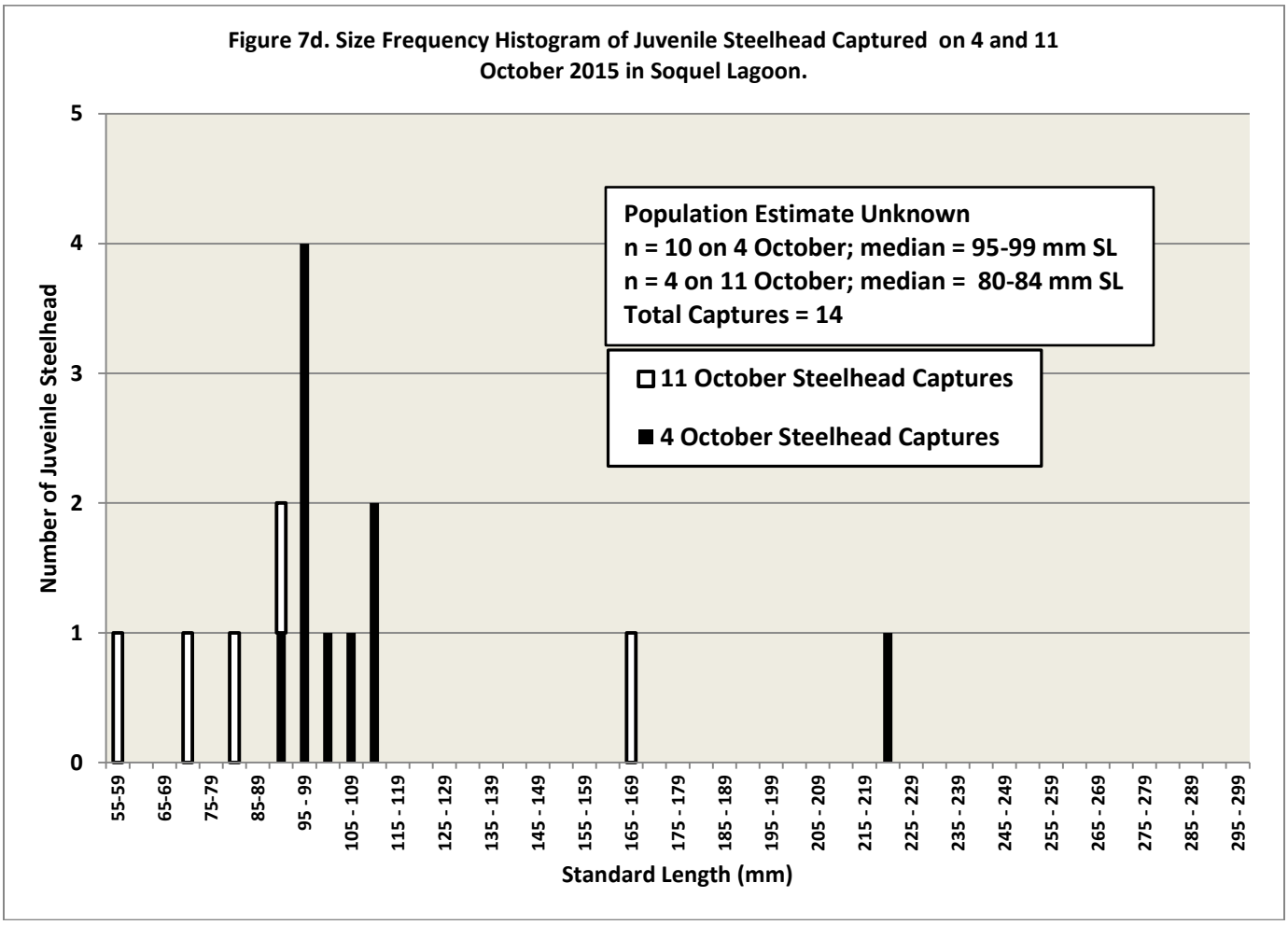


Figure 7d. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2015 in Soquel Lagoon.

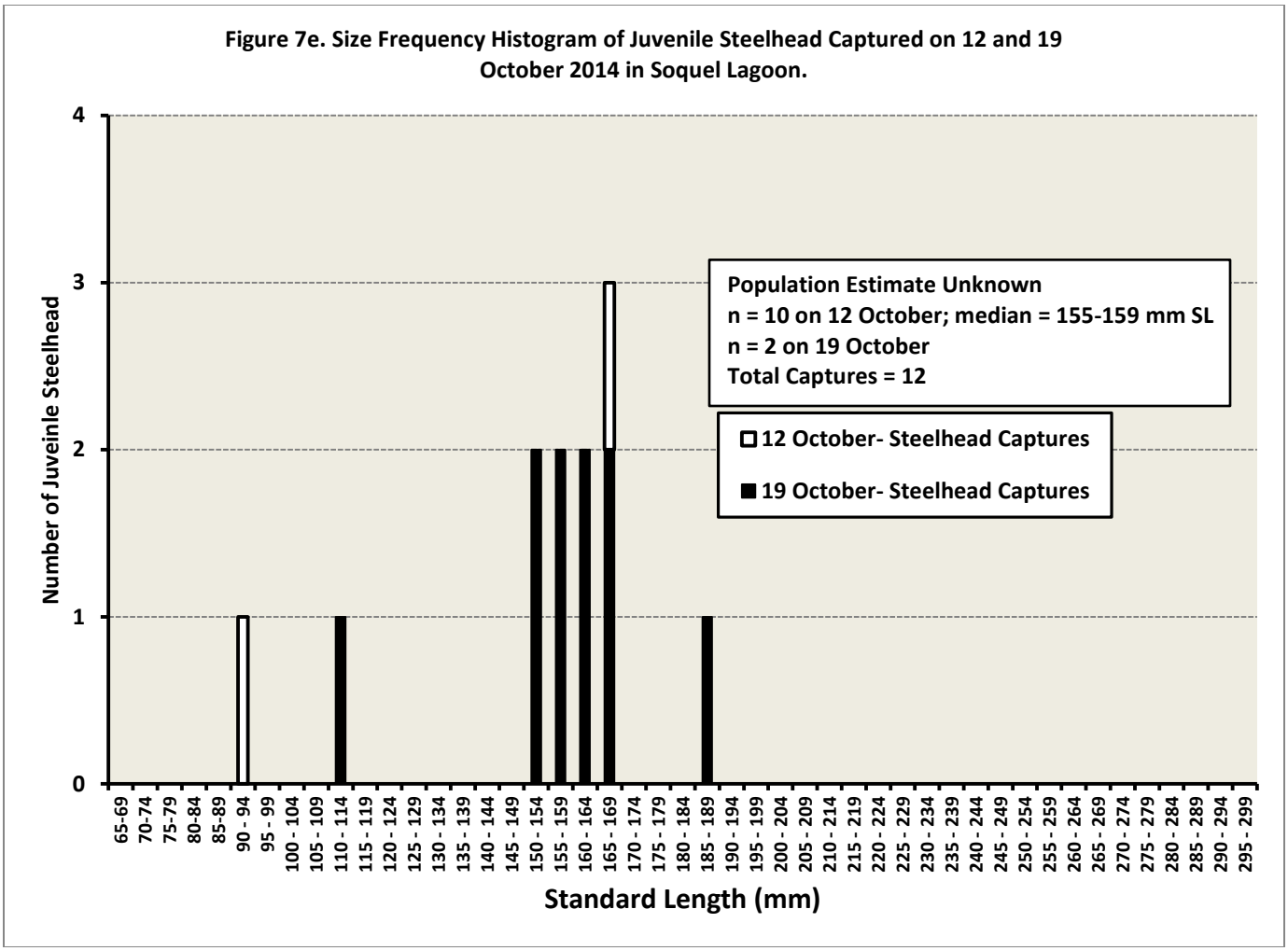


Figure 7e. Size Frequency Histogram of Juvenile Steelhead Captured on 12 and 19 October 2014 in Soquel Lagoon.

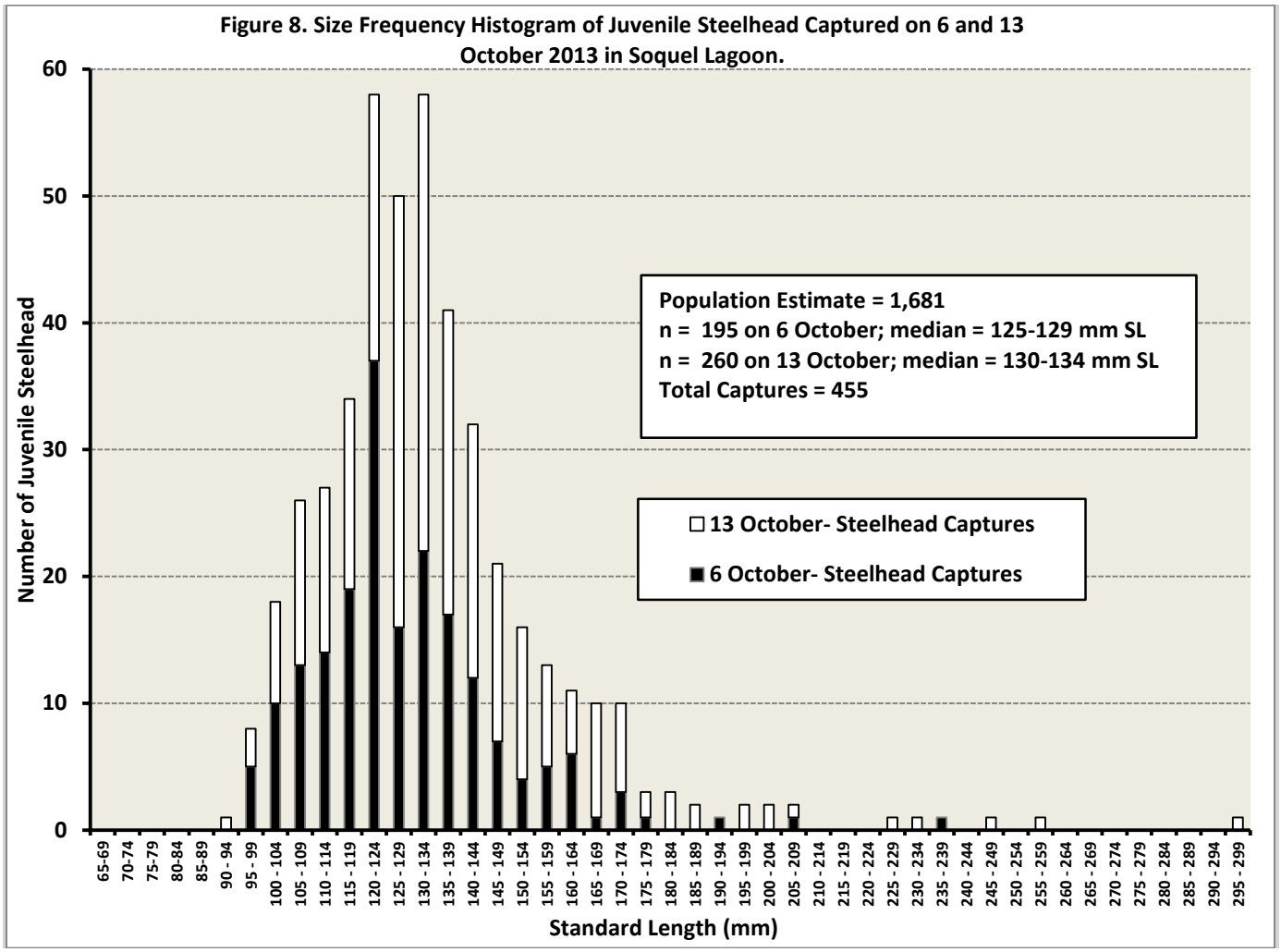


Figure 8. Size Frequency Histogram of Juvenile Steelhead Captured on 6 and 13 October 2013 in Soquel Lagoon.

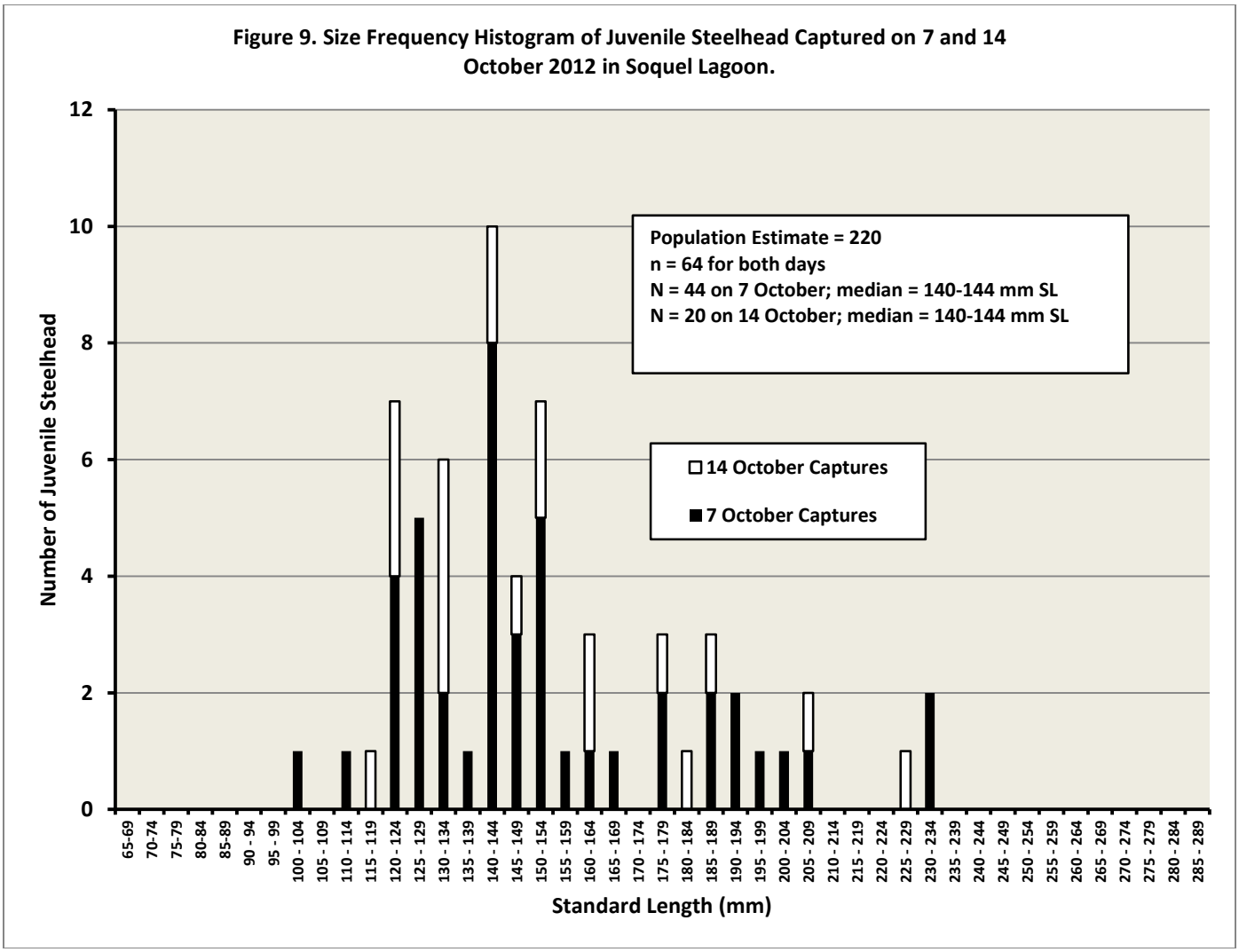


Figure 9. Size Frequency Histogram of Juvenile Steelhead Captured on 7 and 14 October 2012 in Soquel Lagoon.

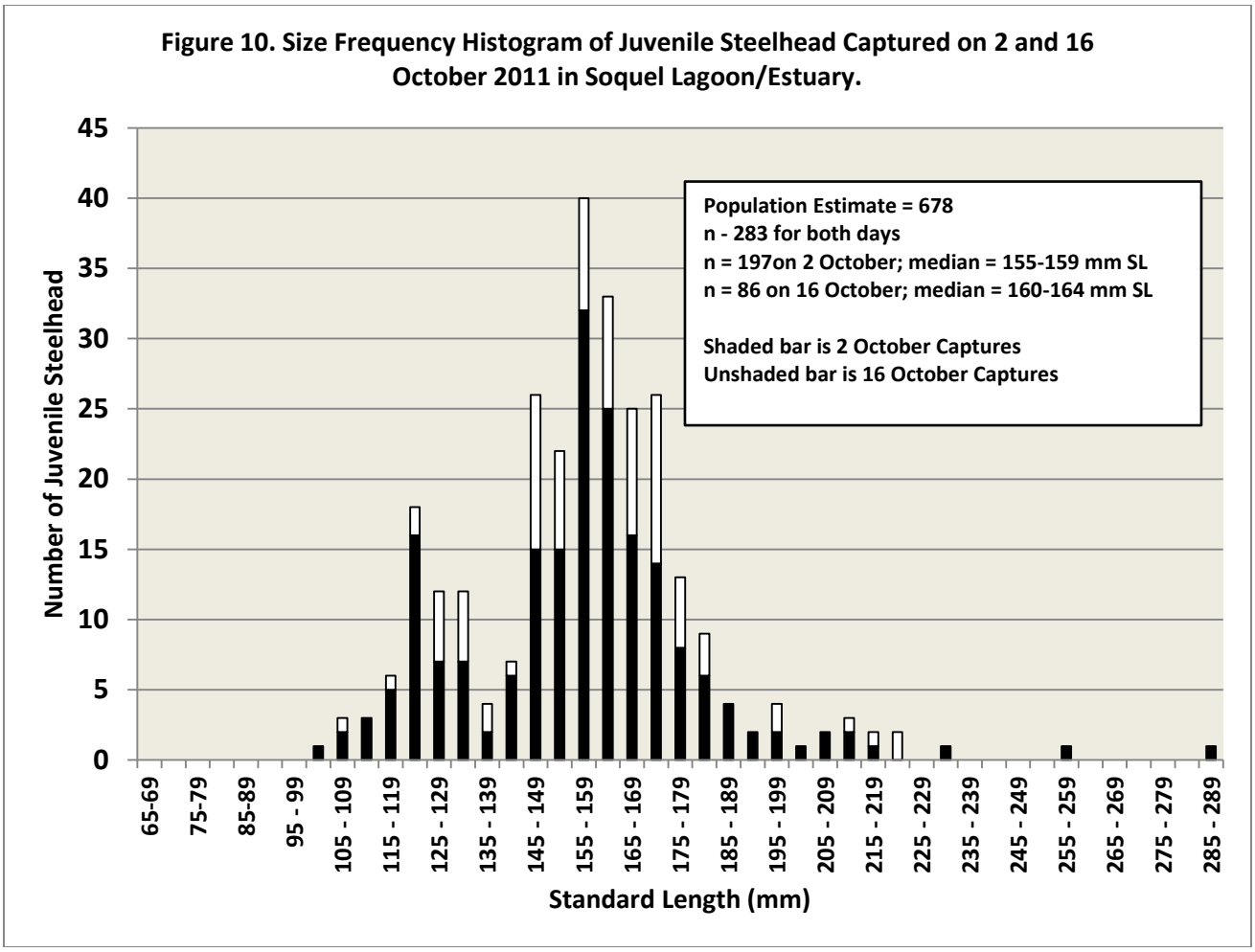


Figure 10. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 16 October 2011 in Soquel Lagoon/Estuary.

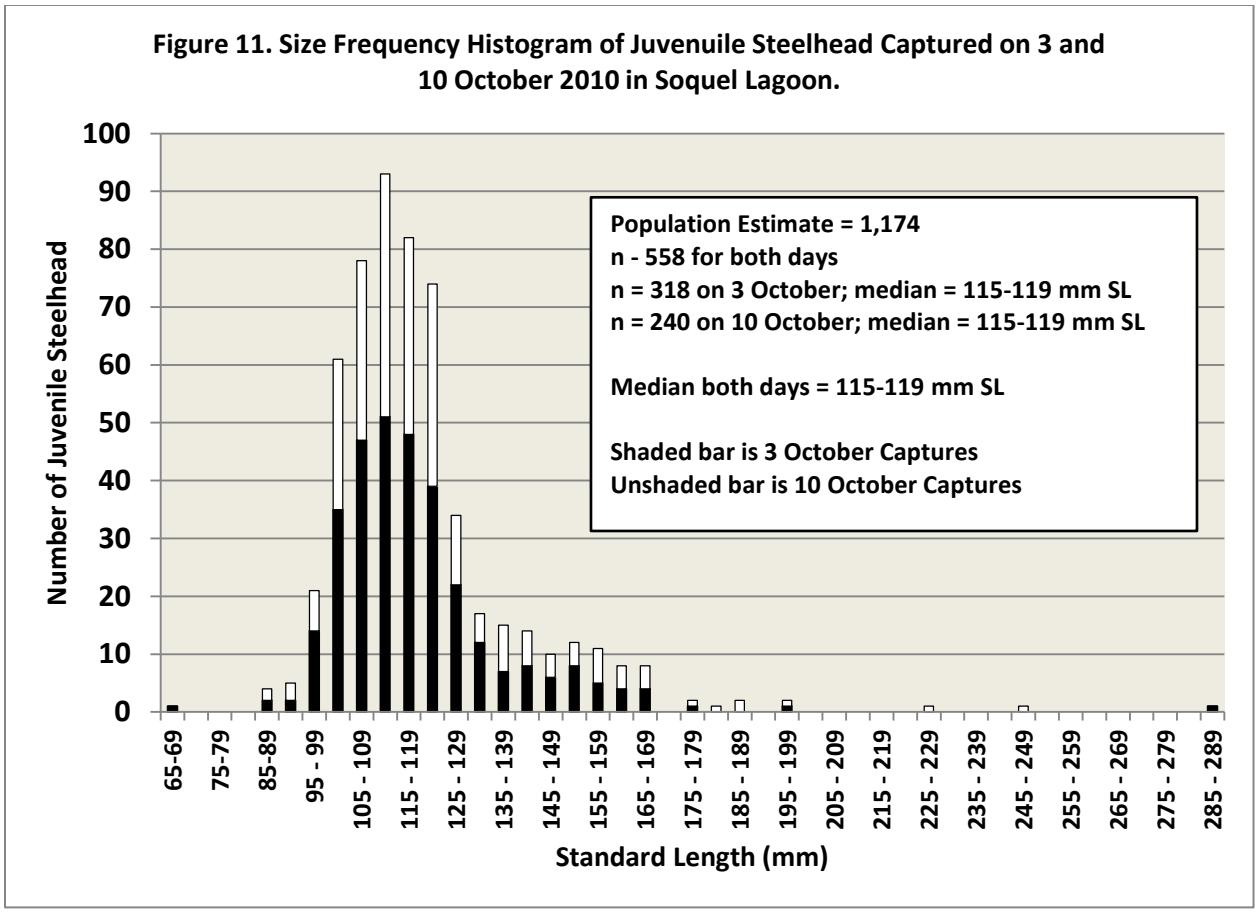


Figure 11. Size Frequency Histogram of Juvenuile Steelhead Captured on 3 and 10 October 2010 in Soquel Lagoon.

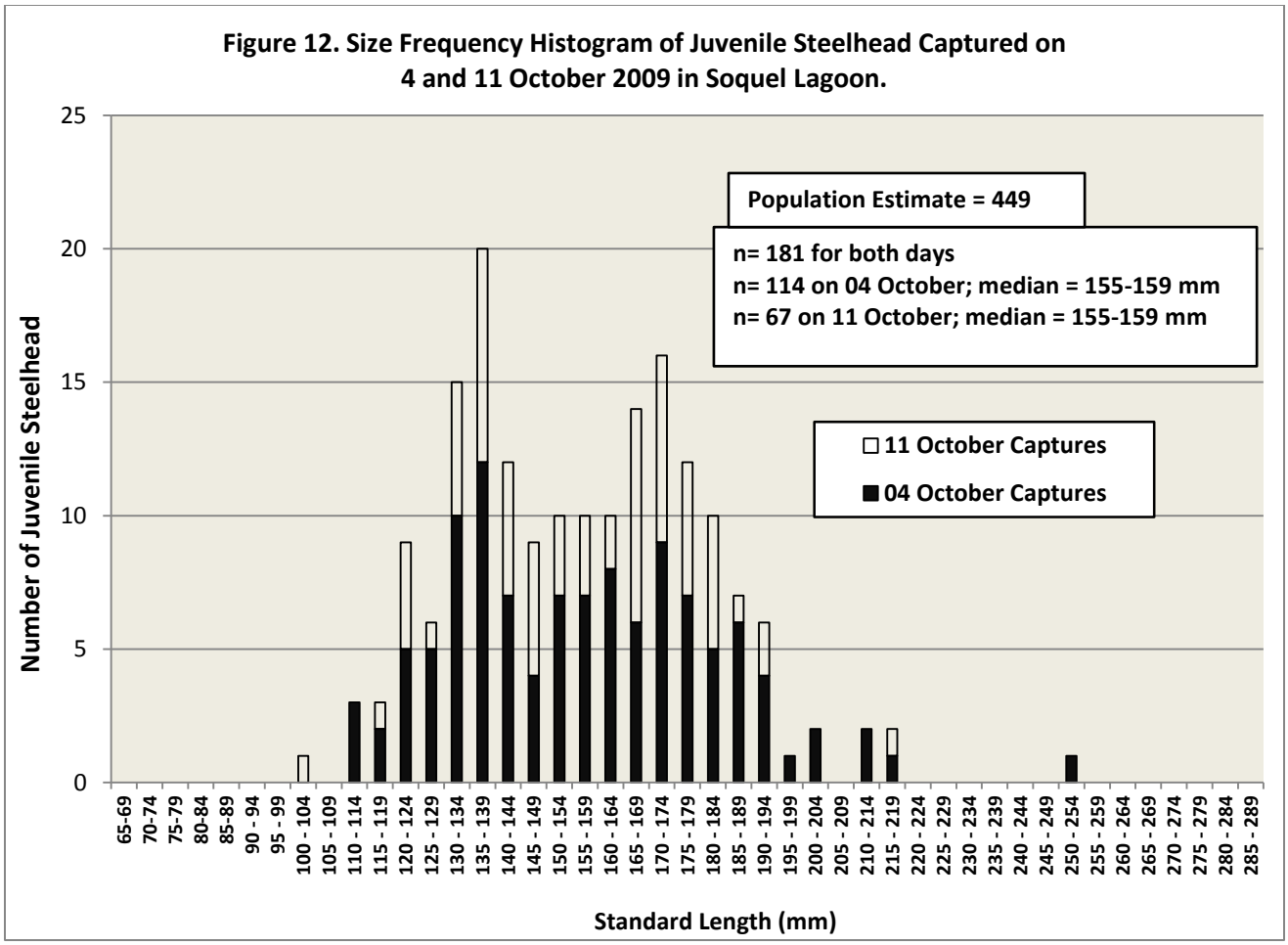


Figure 12. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2009 in Soquel Lagoon.

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

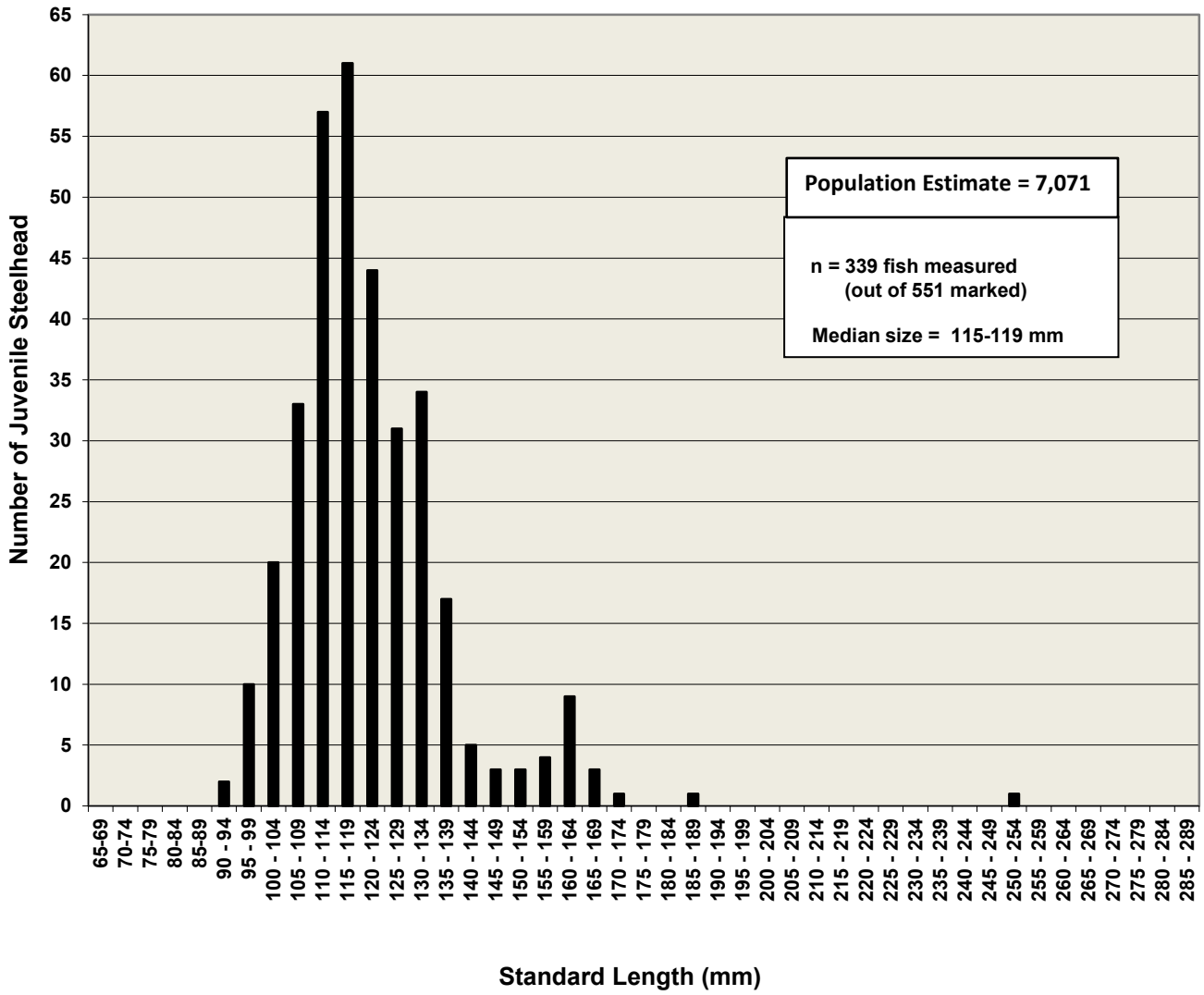


Figure 13. Size Frequency Histogram of Juvenile Steelhead Captured on 27 September 2008 in the Soquel Lagoon.

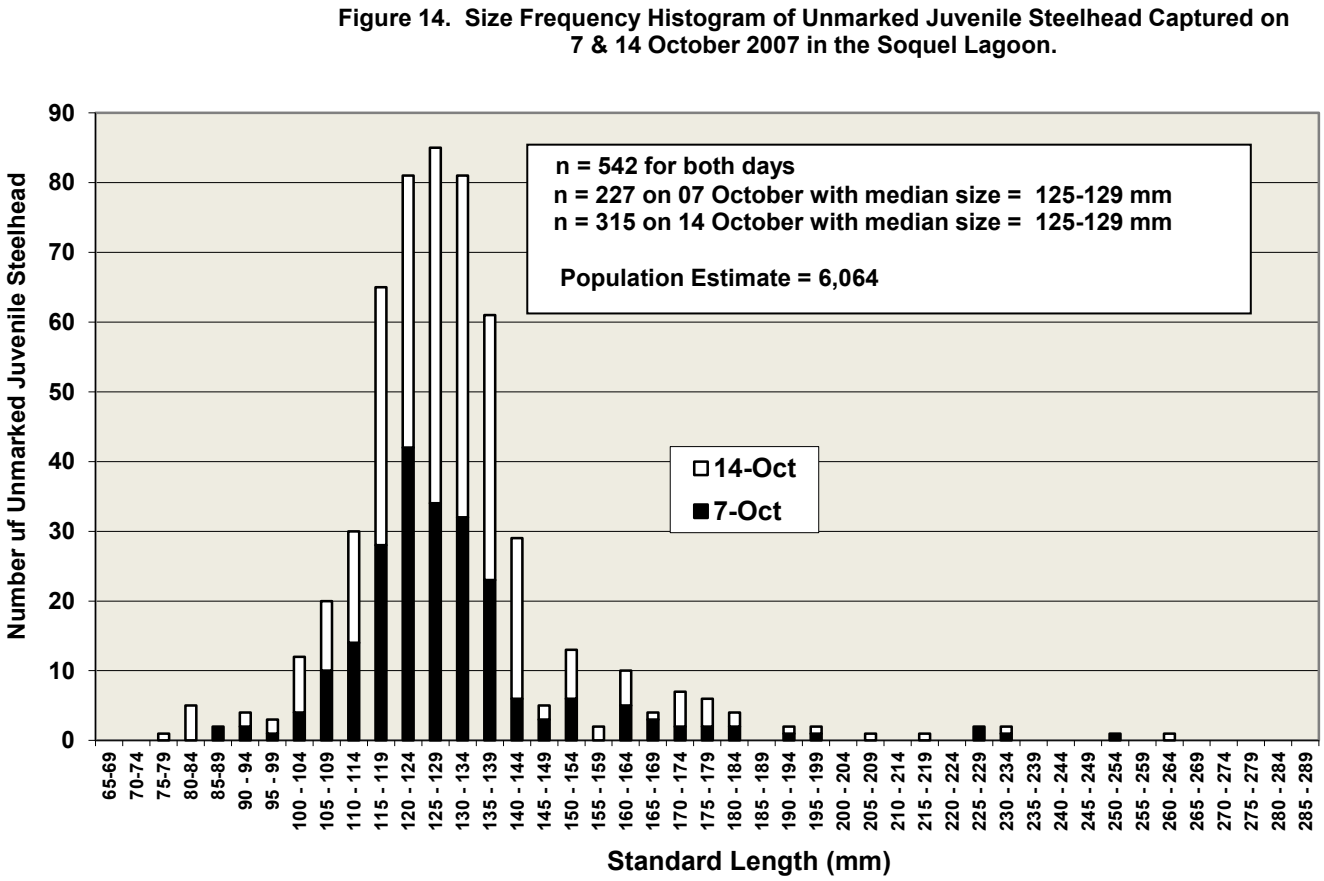


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 & 14 October 2007 in the Soquel Lagoon.

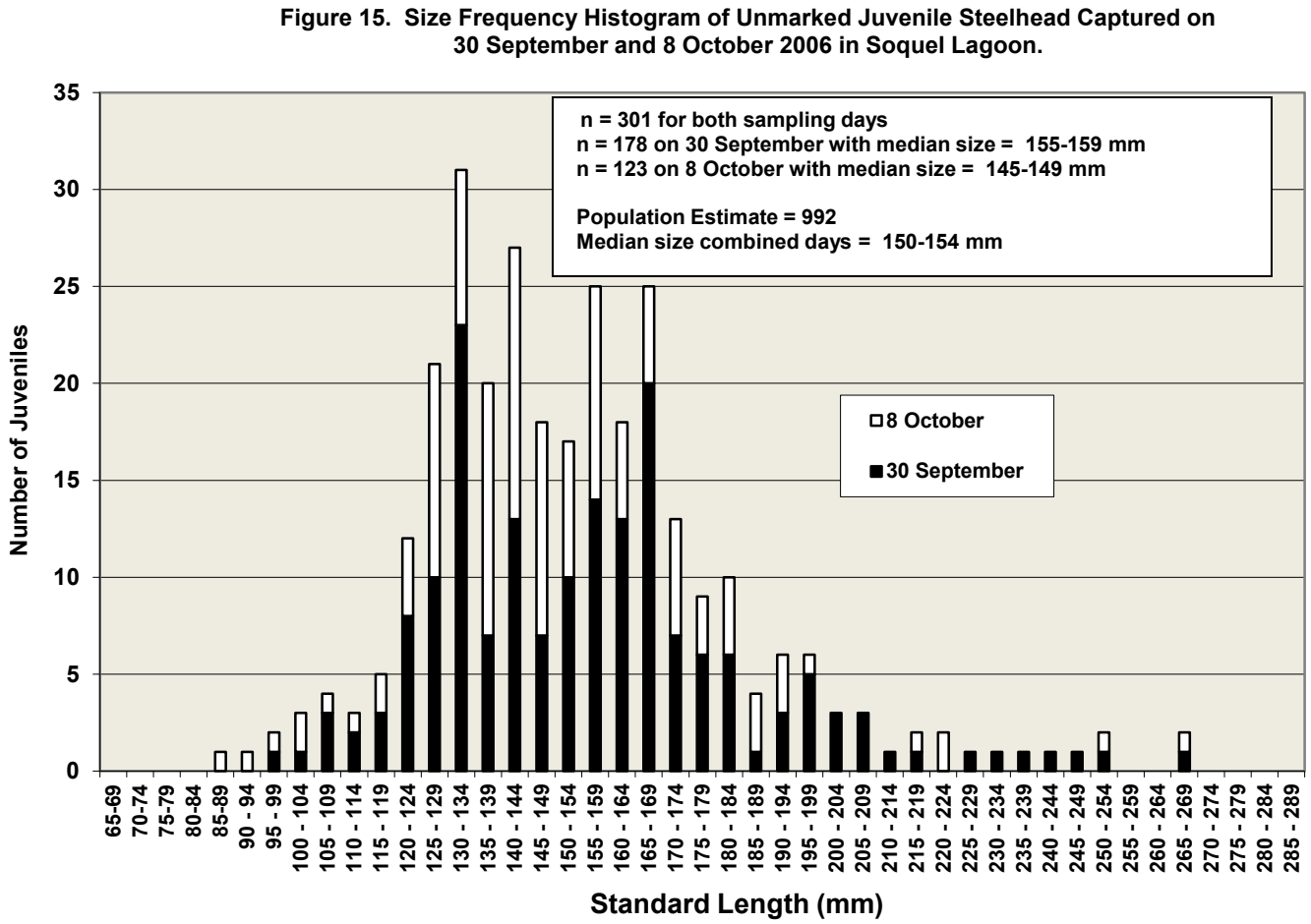


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 30 September and 8 October 2006 in Soquel Lagoon.

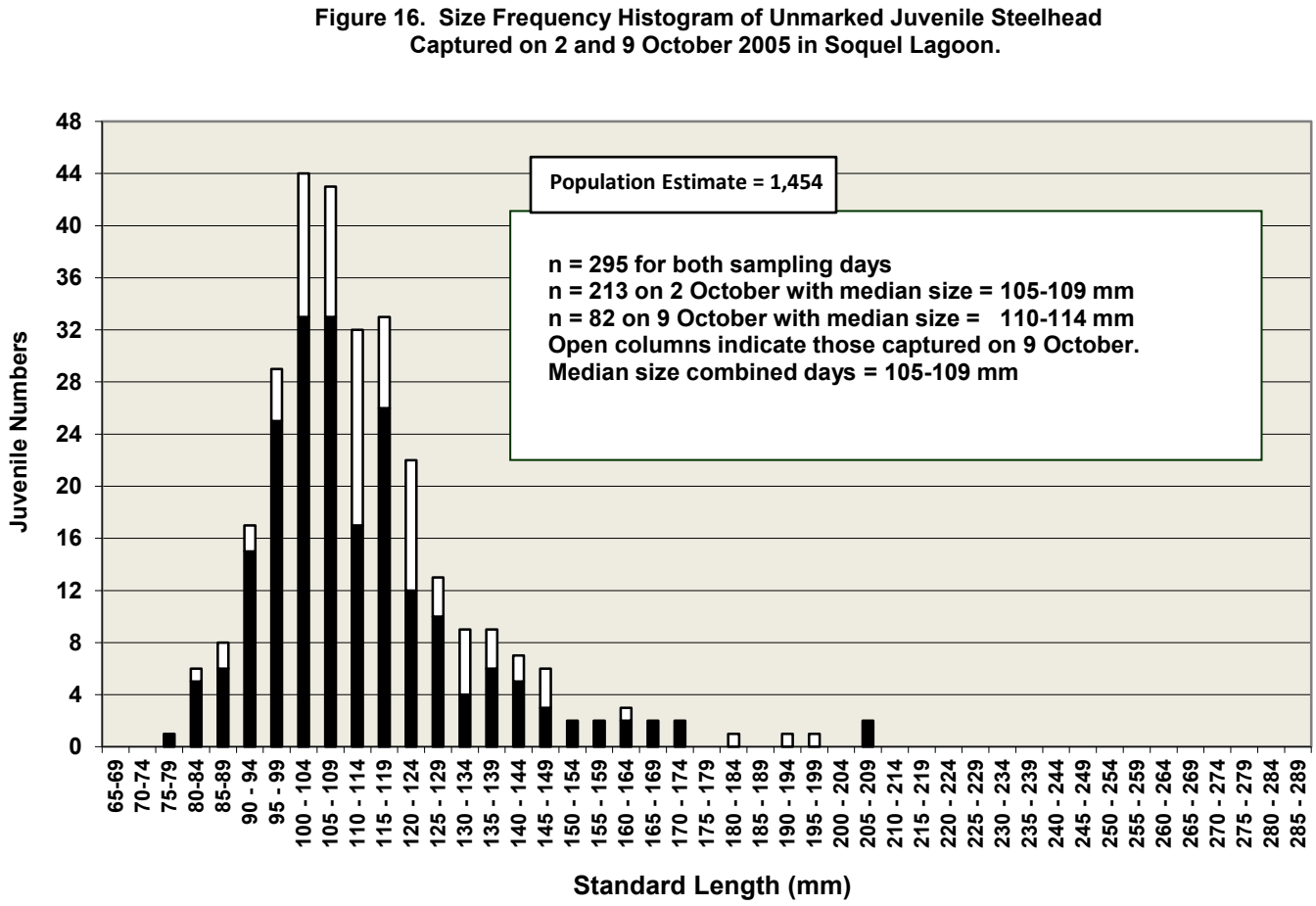


Figure 16. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 2 and 9 October 2005 in Soquel Lagoon.

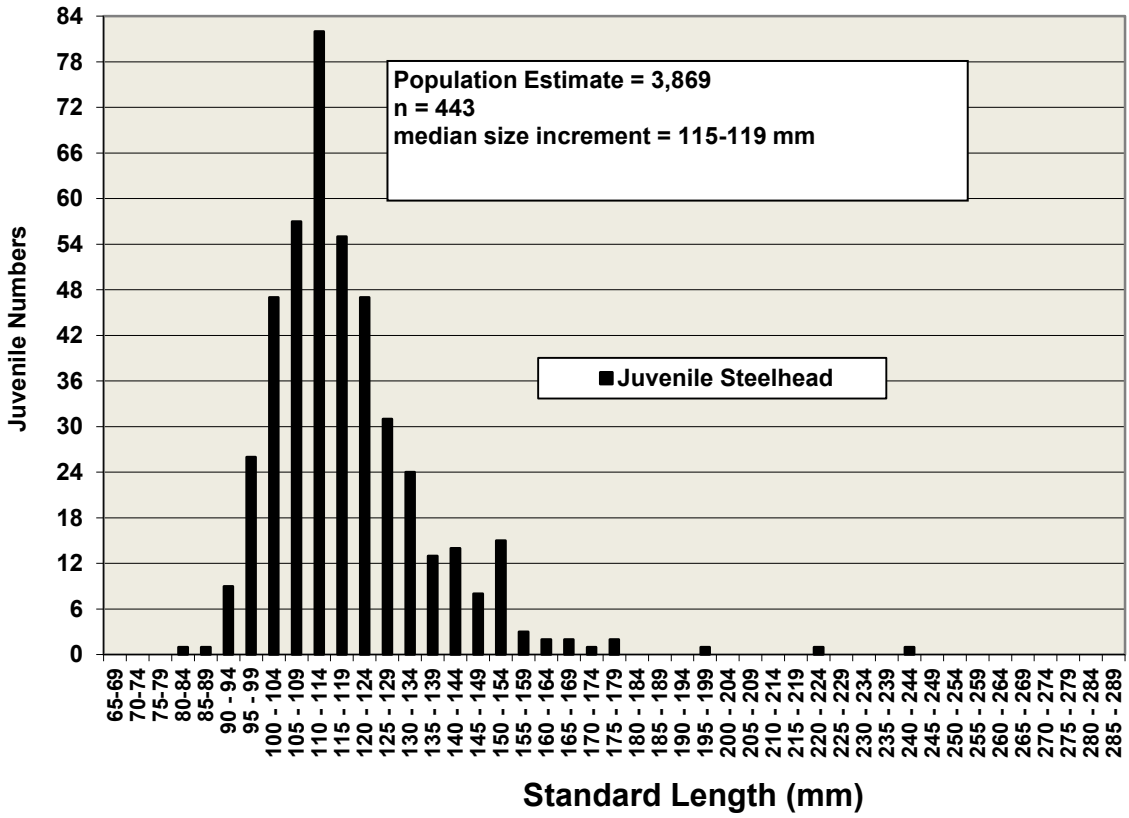


Figure 17. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

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

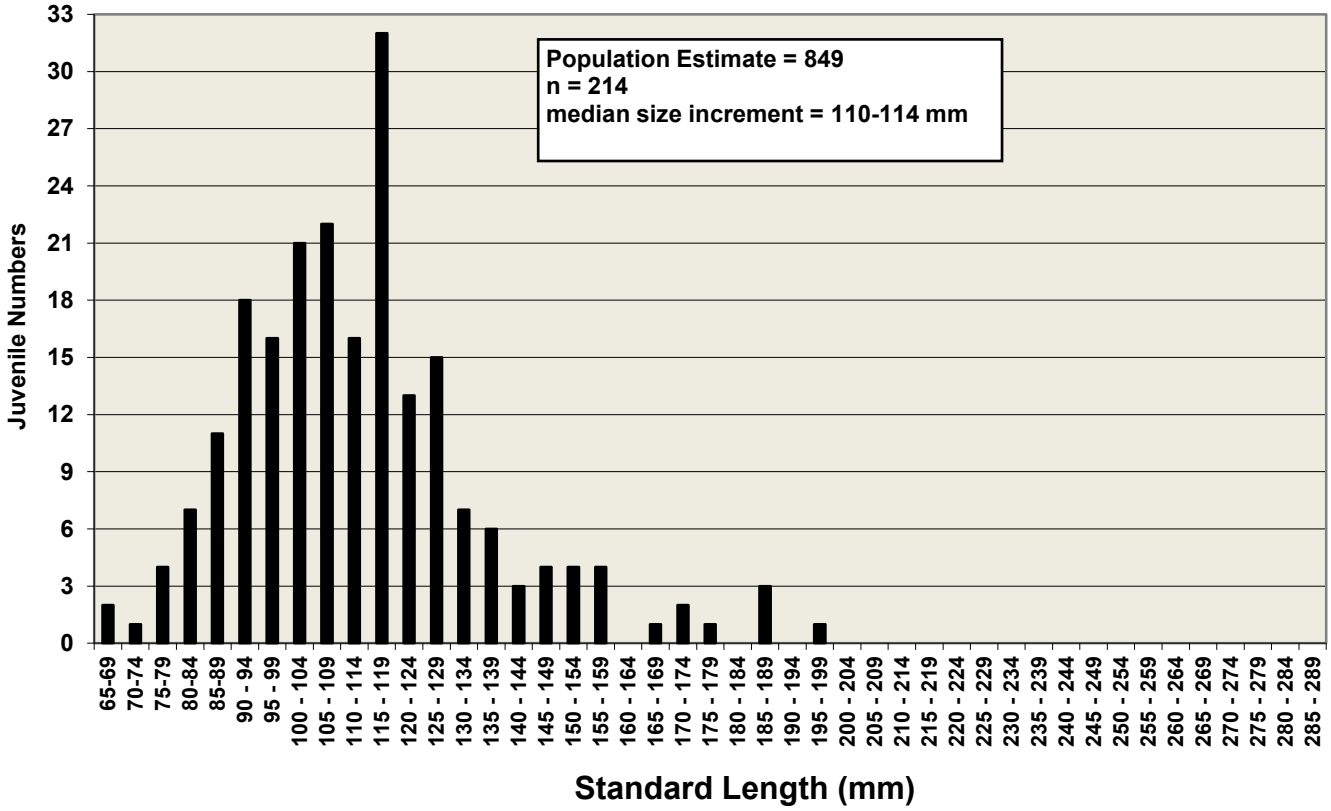


Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

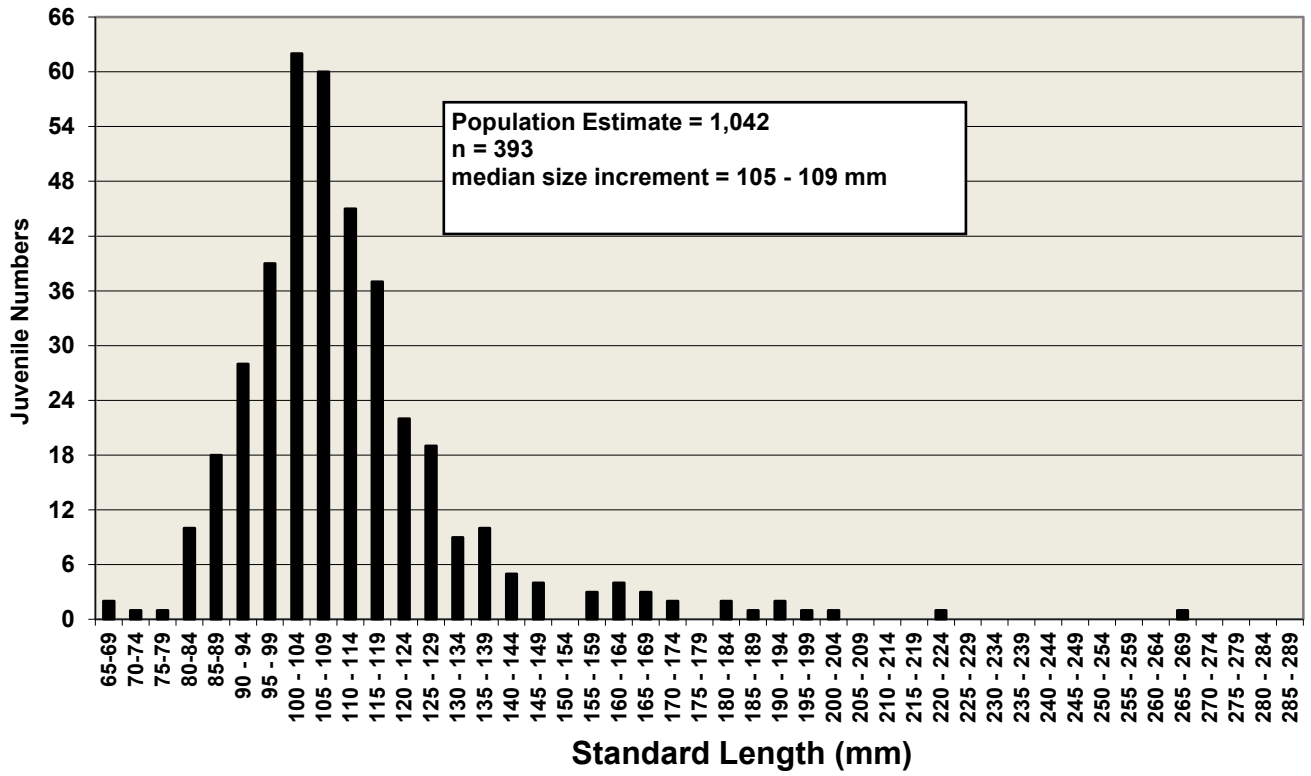


Figure 19. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002 in Soquel Lagoon.

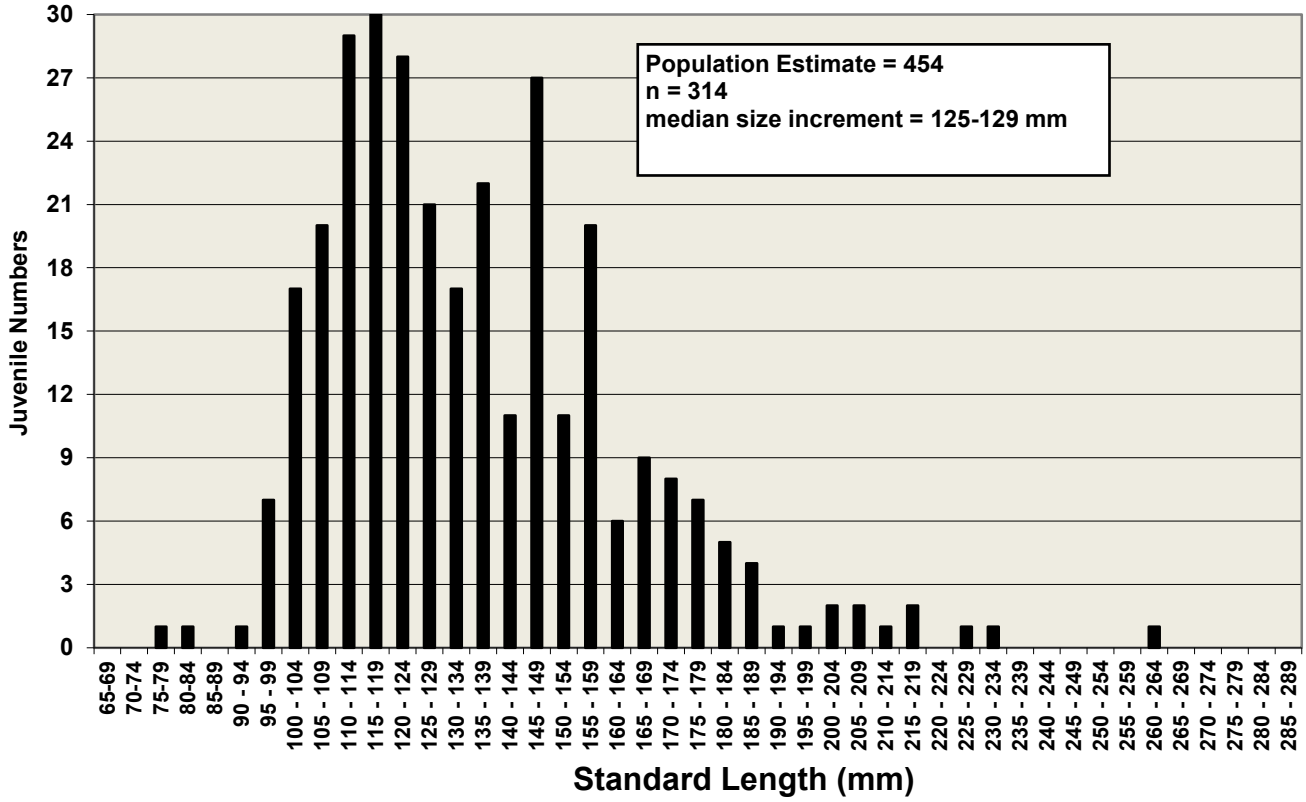


Figure 20. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

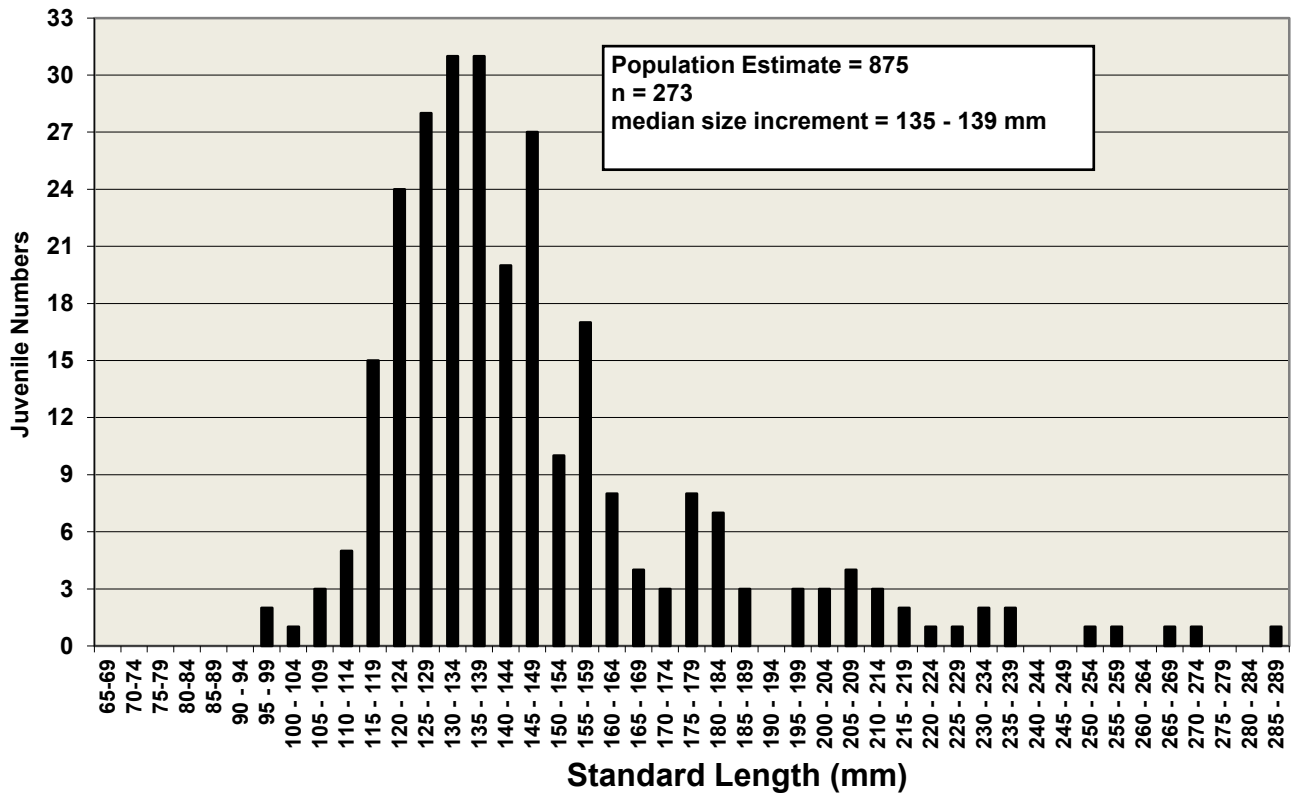


Figure 21. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

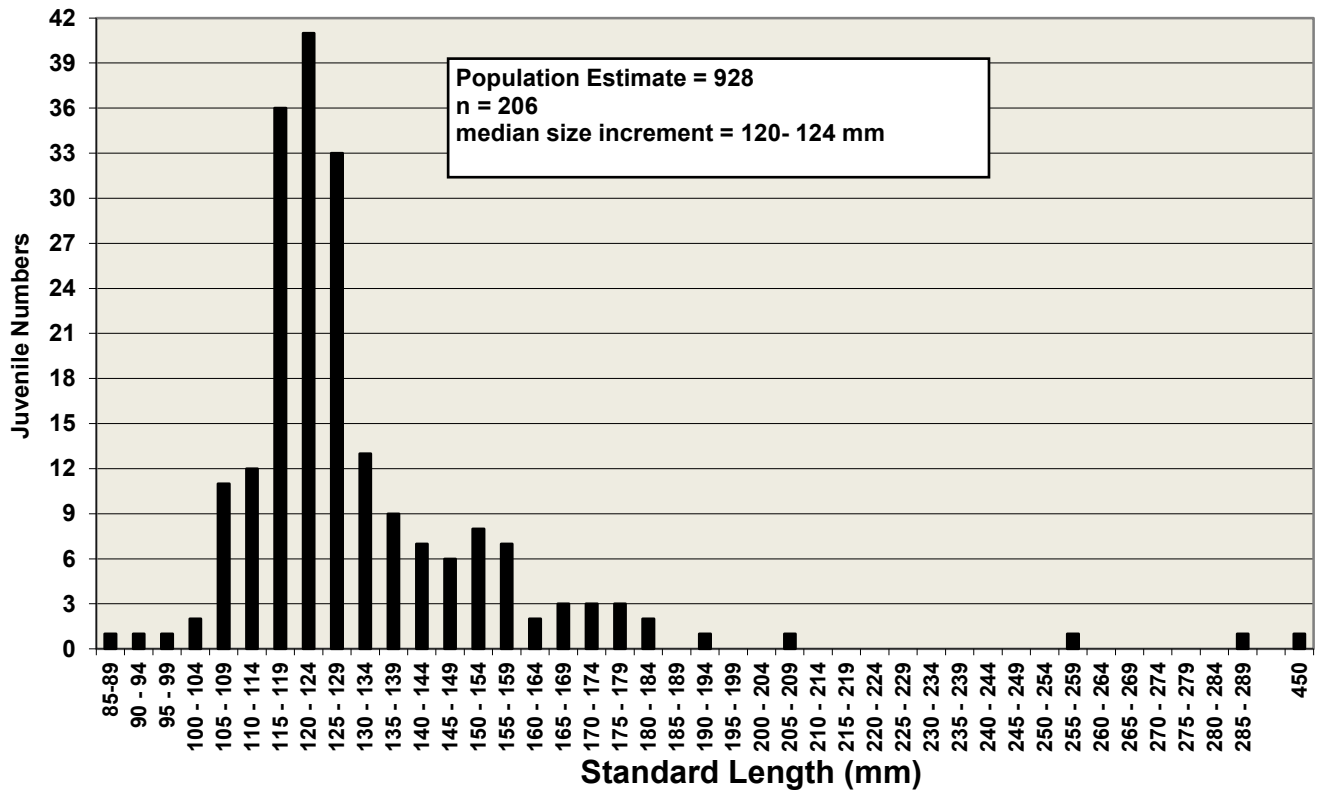


Figure 22. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 10 October 1999 in Soquel Lagoon.

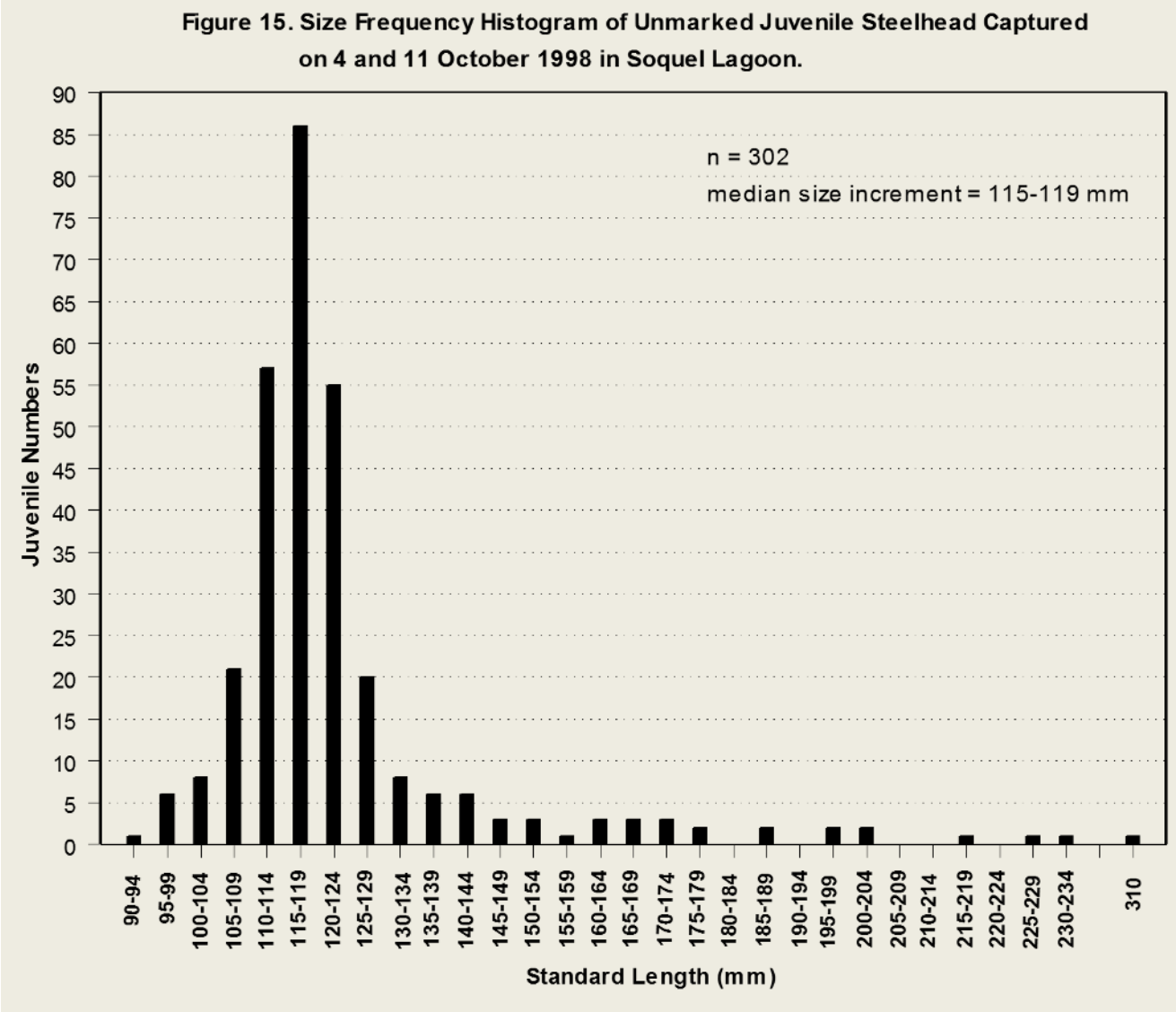


Figure 23. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

Population Estimate = 671.

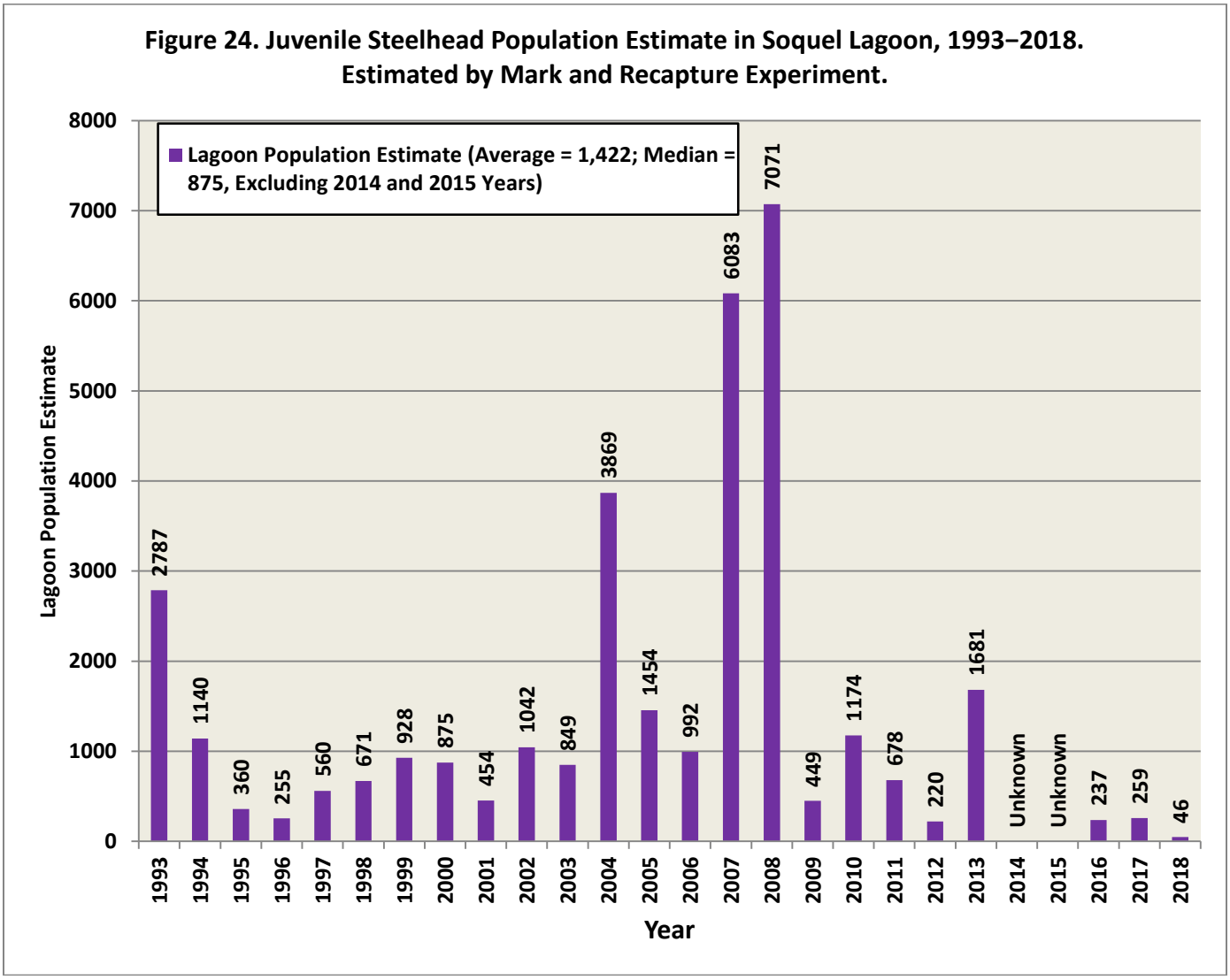


Figure 24. Steelhead Population Estimate in Soquel Lagoon, 1993−2018.

Figure 25. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2018.

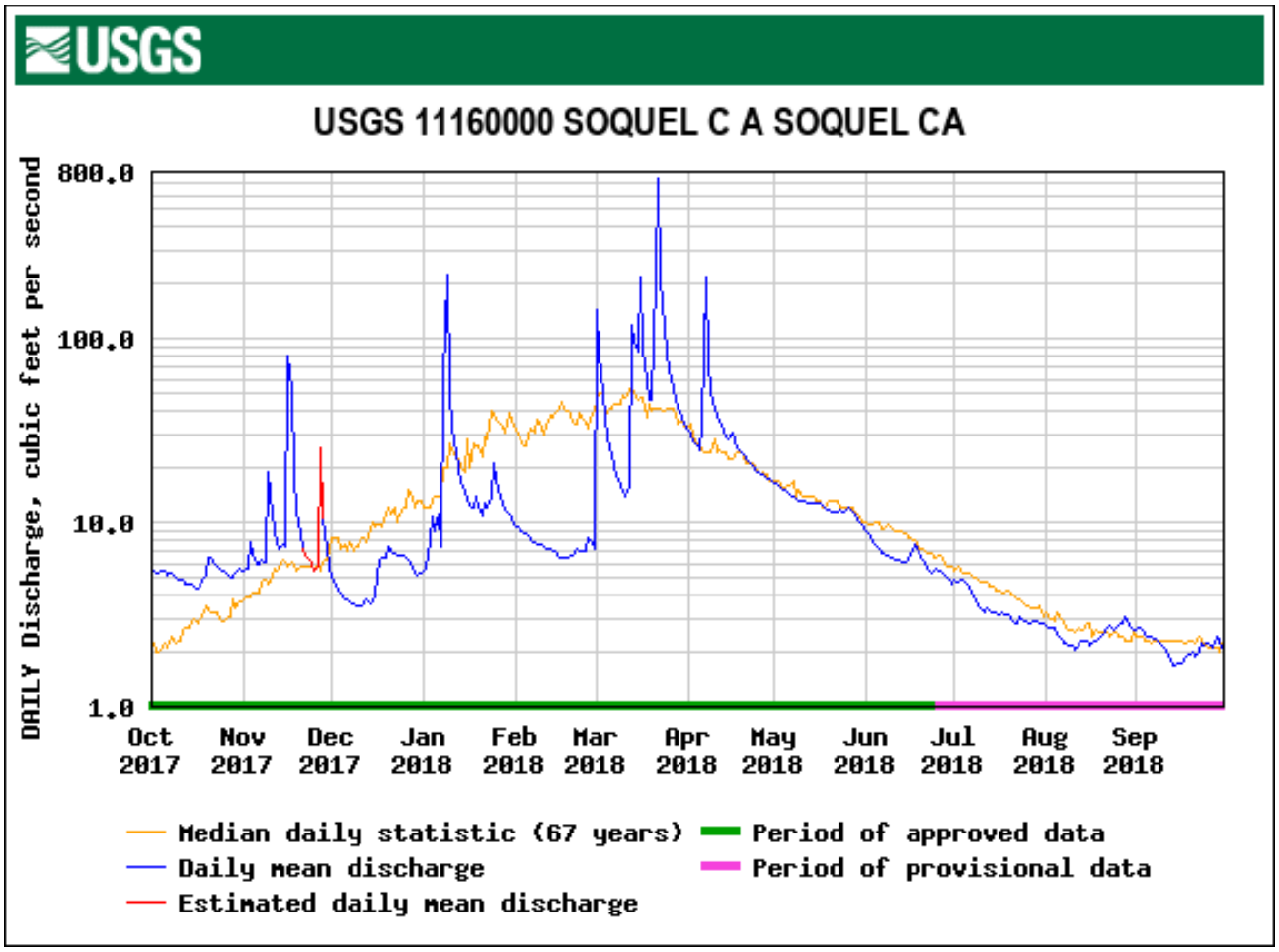


Figure 26. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2018.

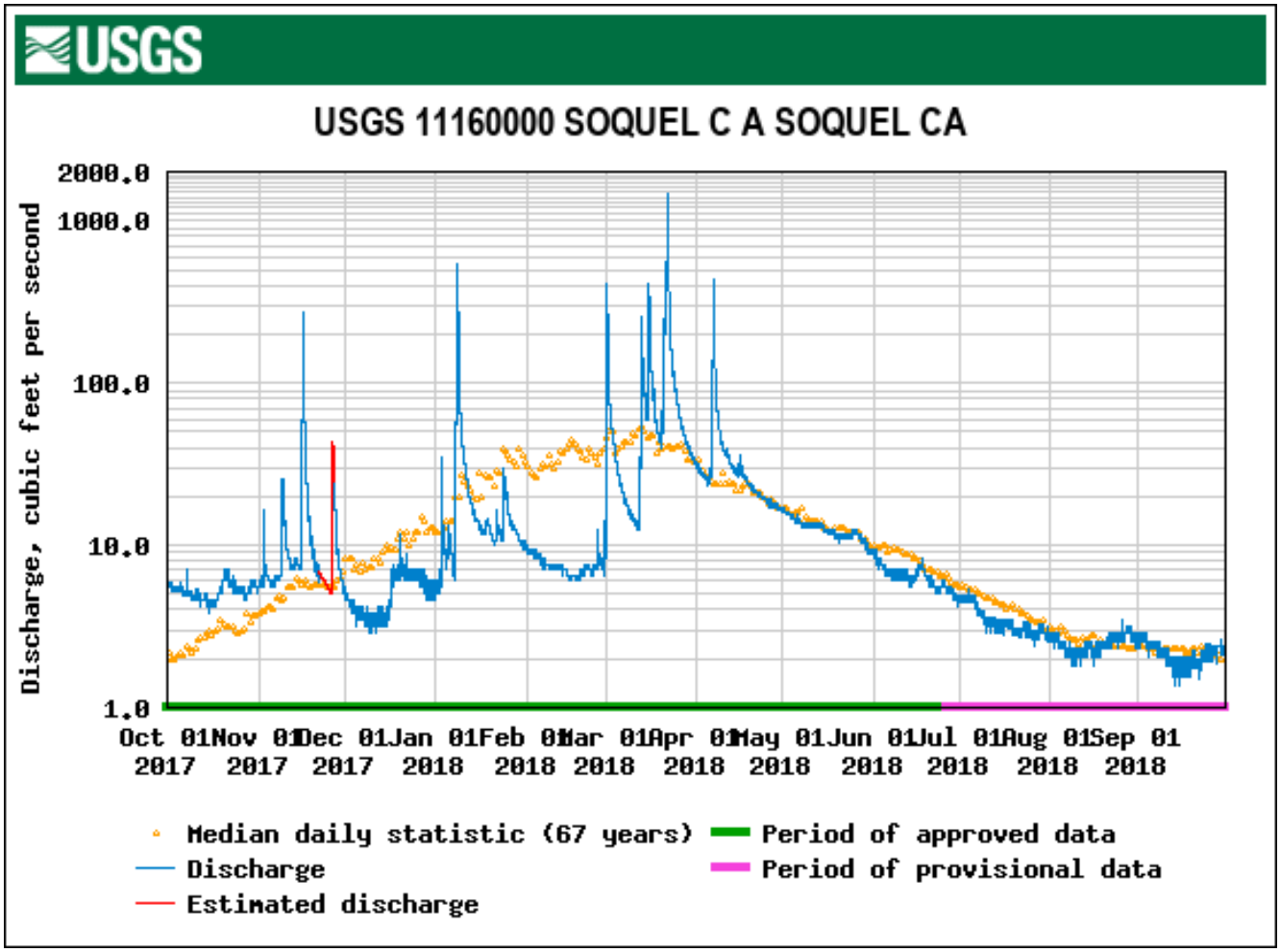


Figure 27. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2017 – 1 December 2018.

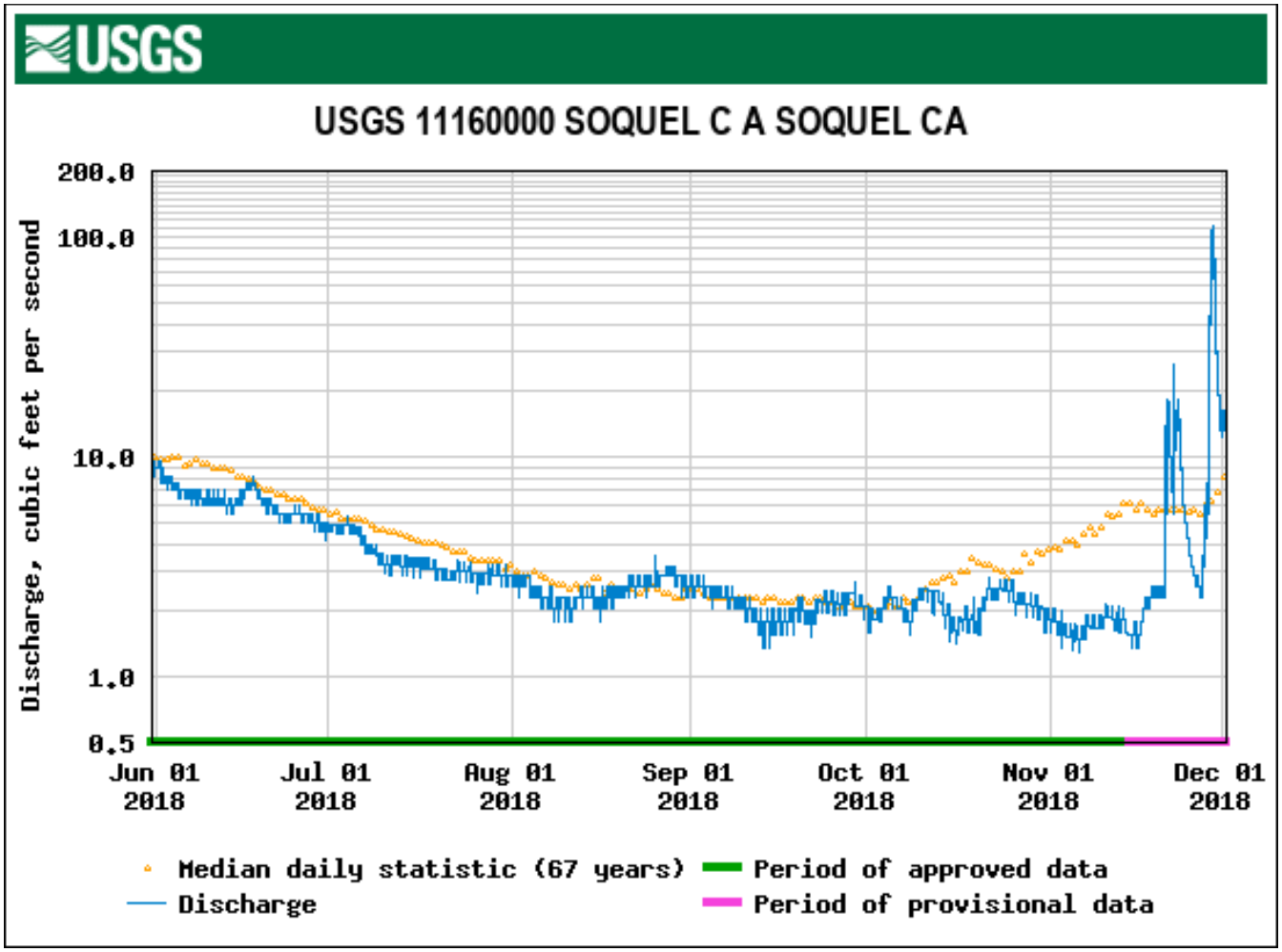


Figure 28 Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

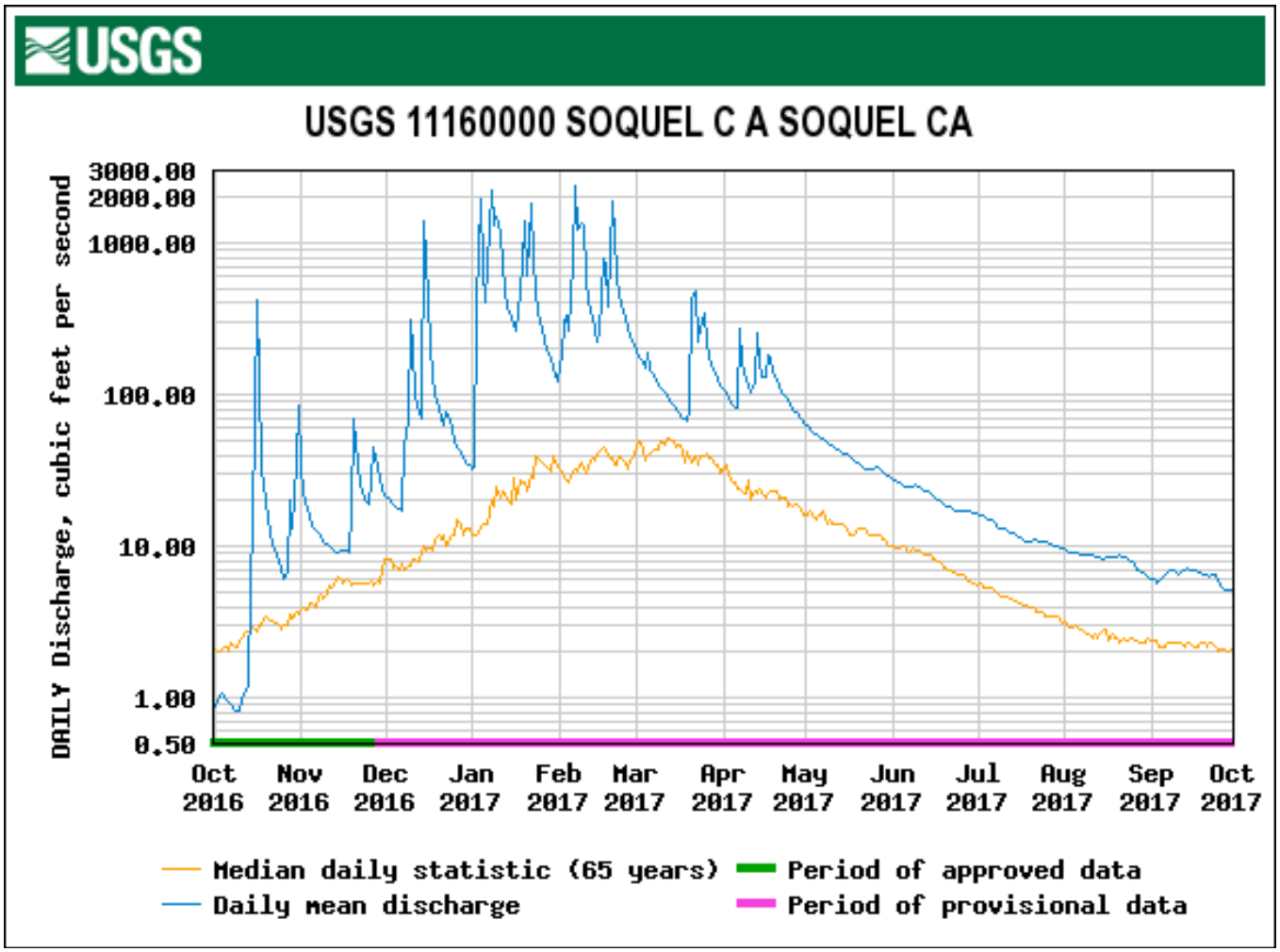


Figure 29. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2017.

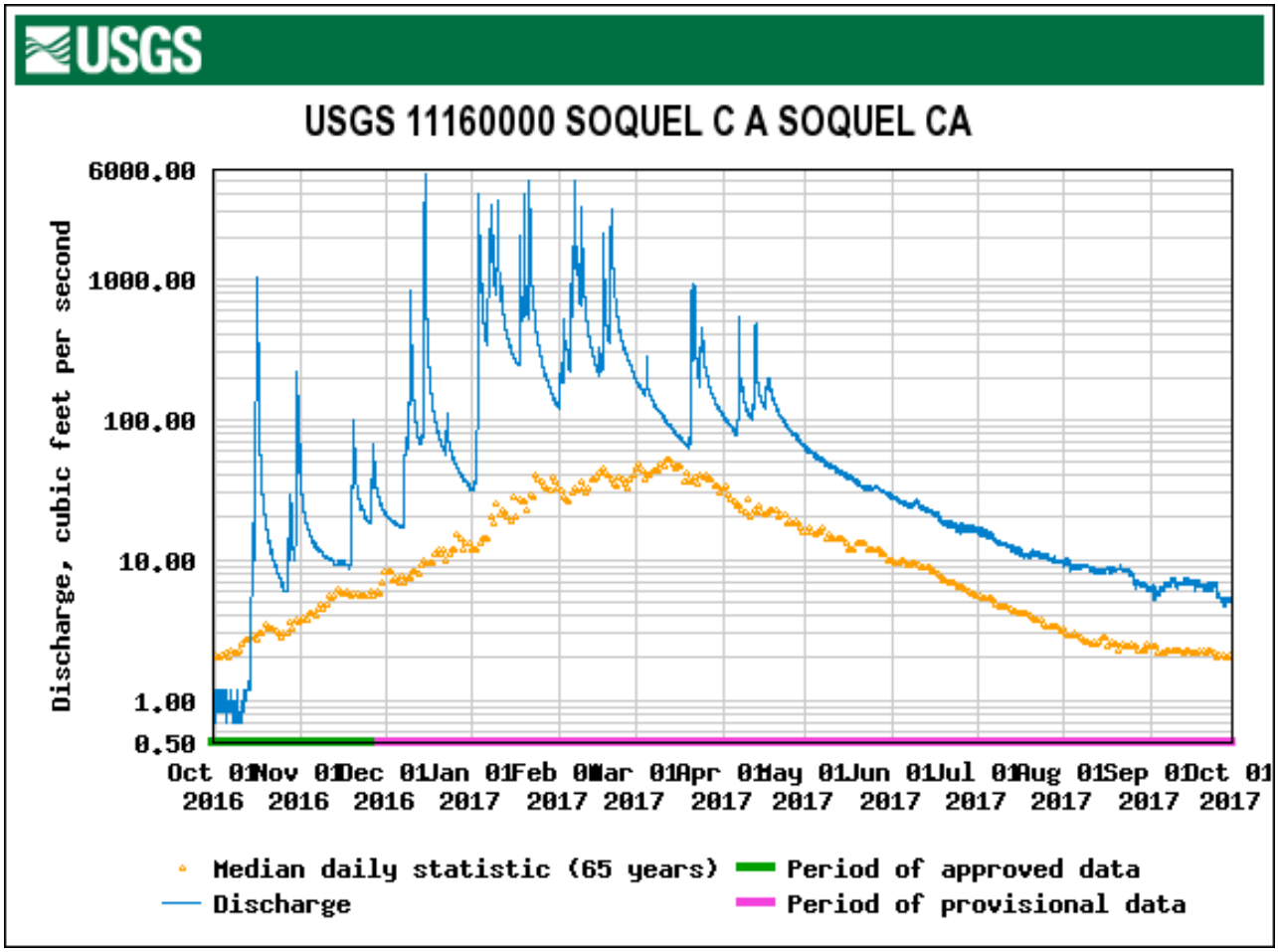


Figure 30. Soquel Creek Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2017 – 20 November 2017.

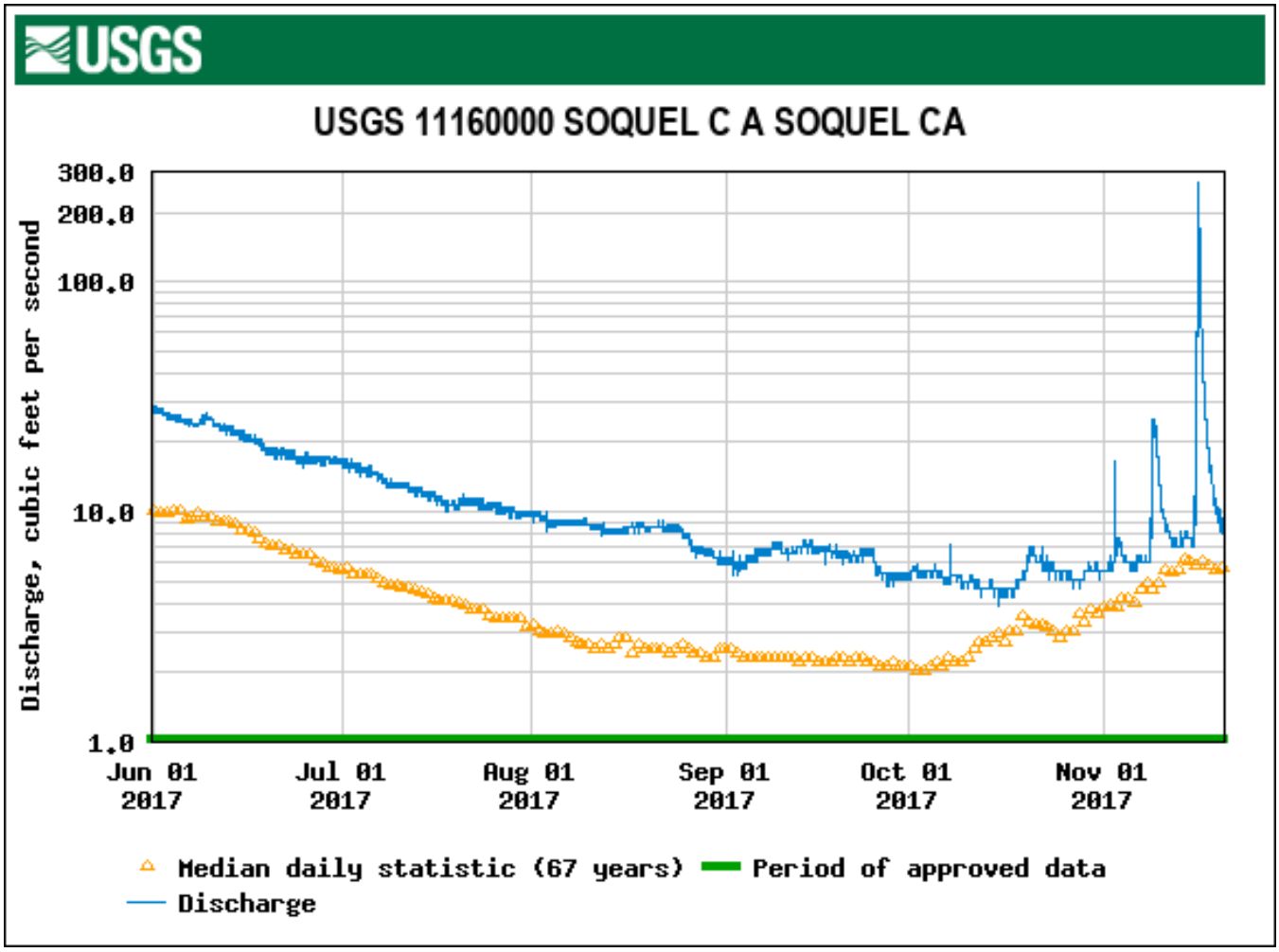


Figure 31. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016

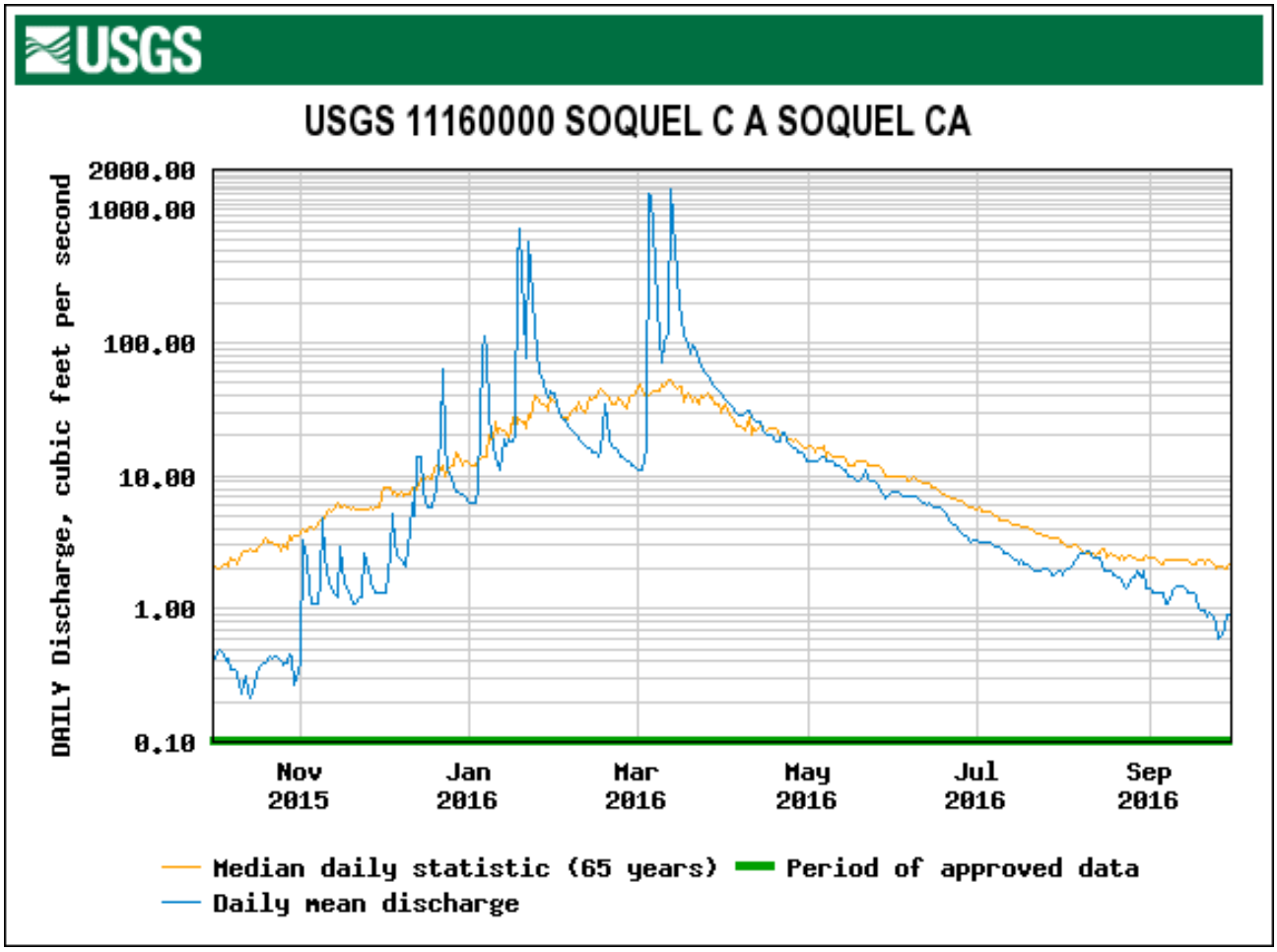


Figure 32. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2016.

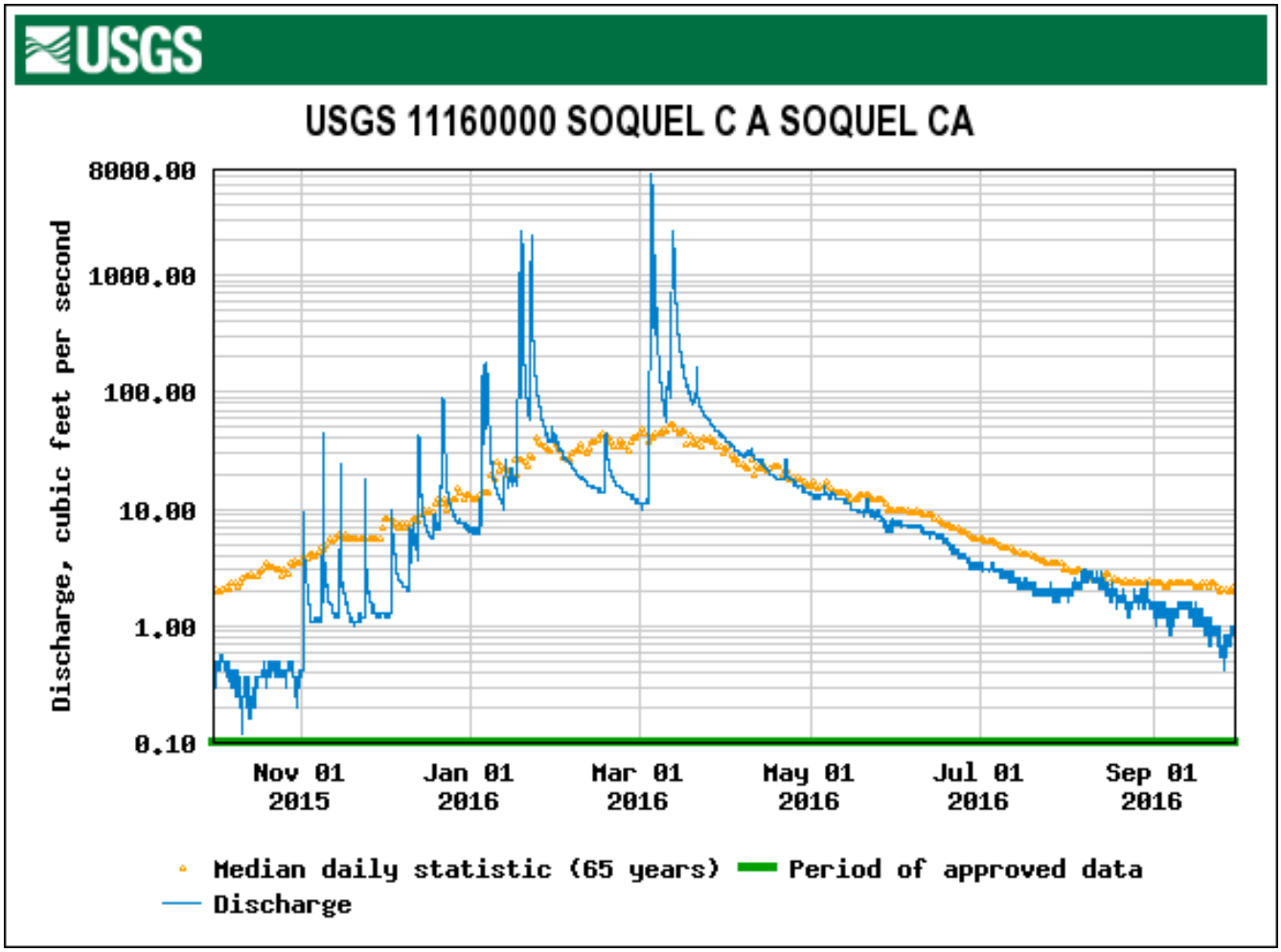


Figure 33. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2016 – 11 October 2016.

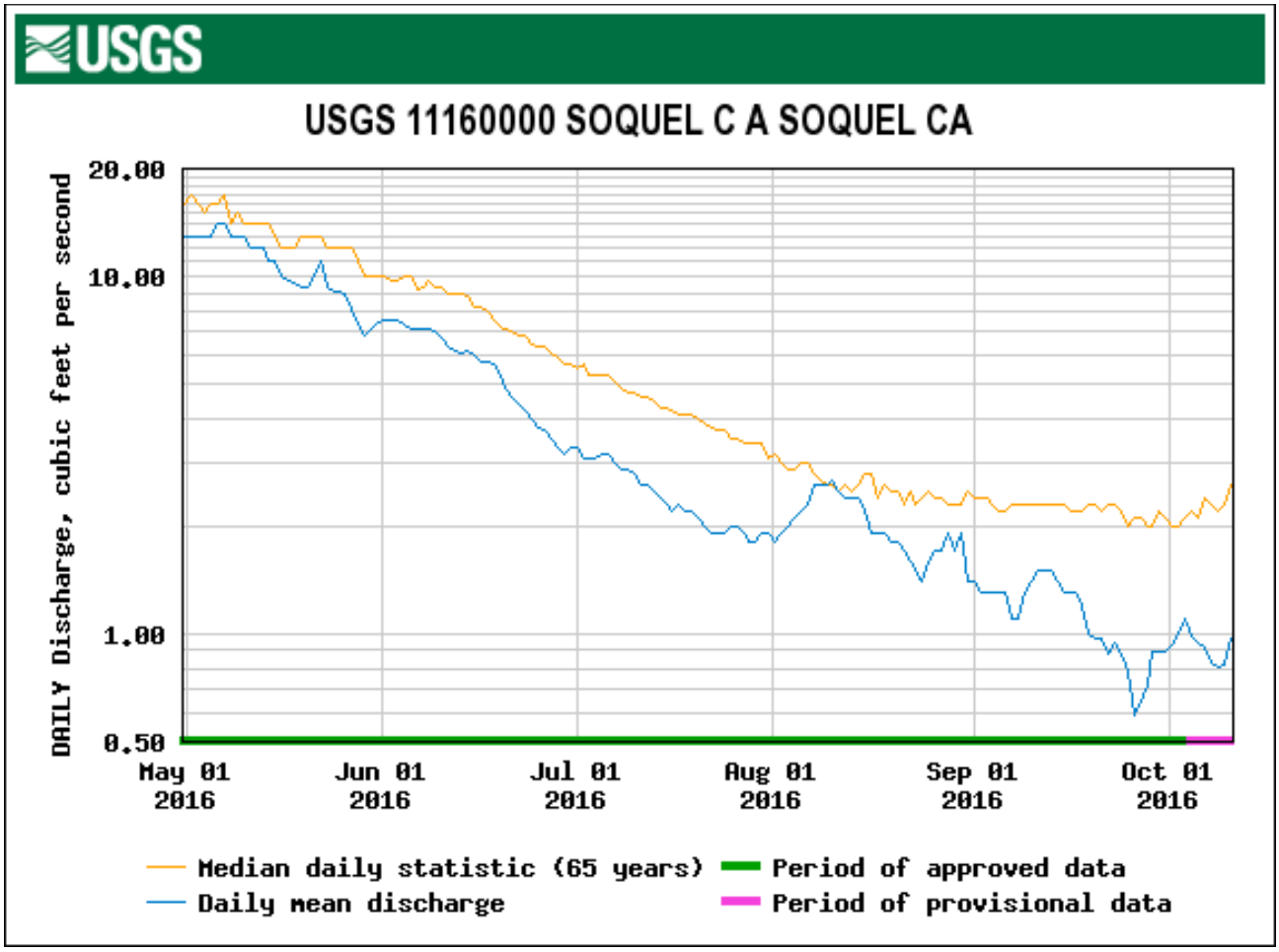


Figure 34. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

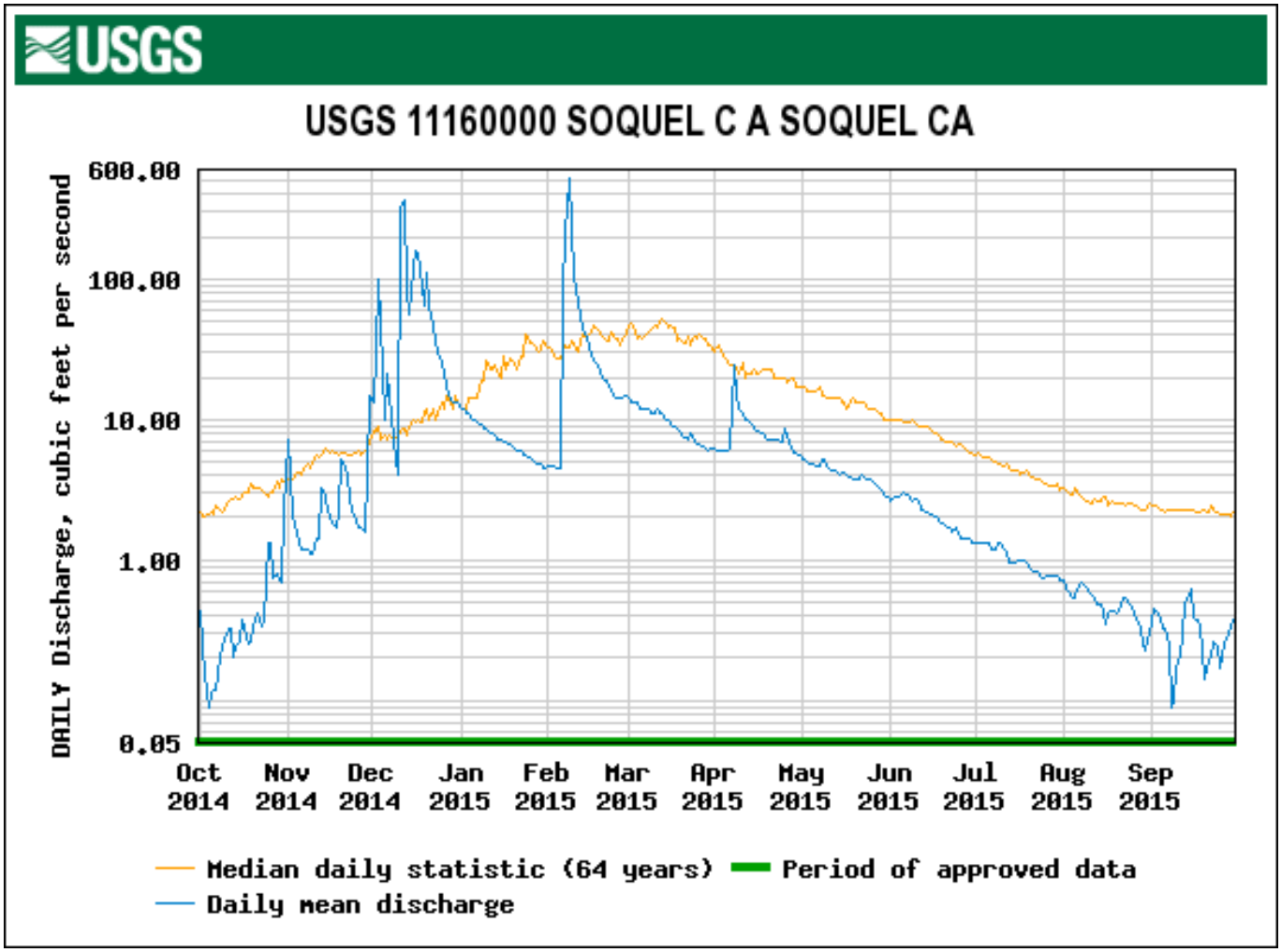


Figure 35. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2015.

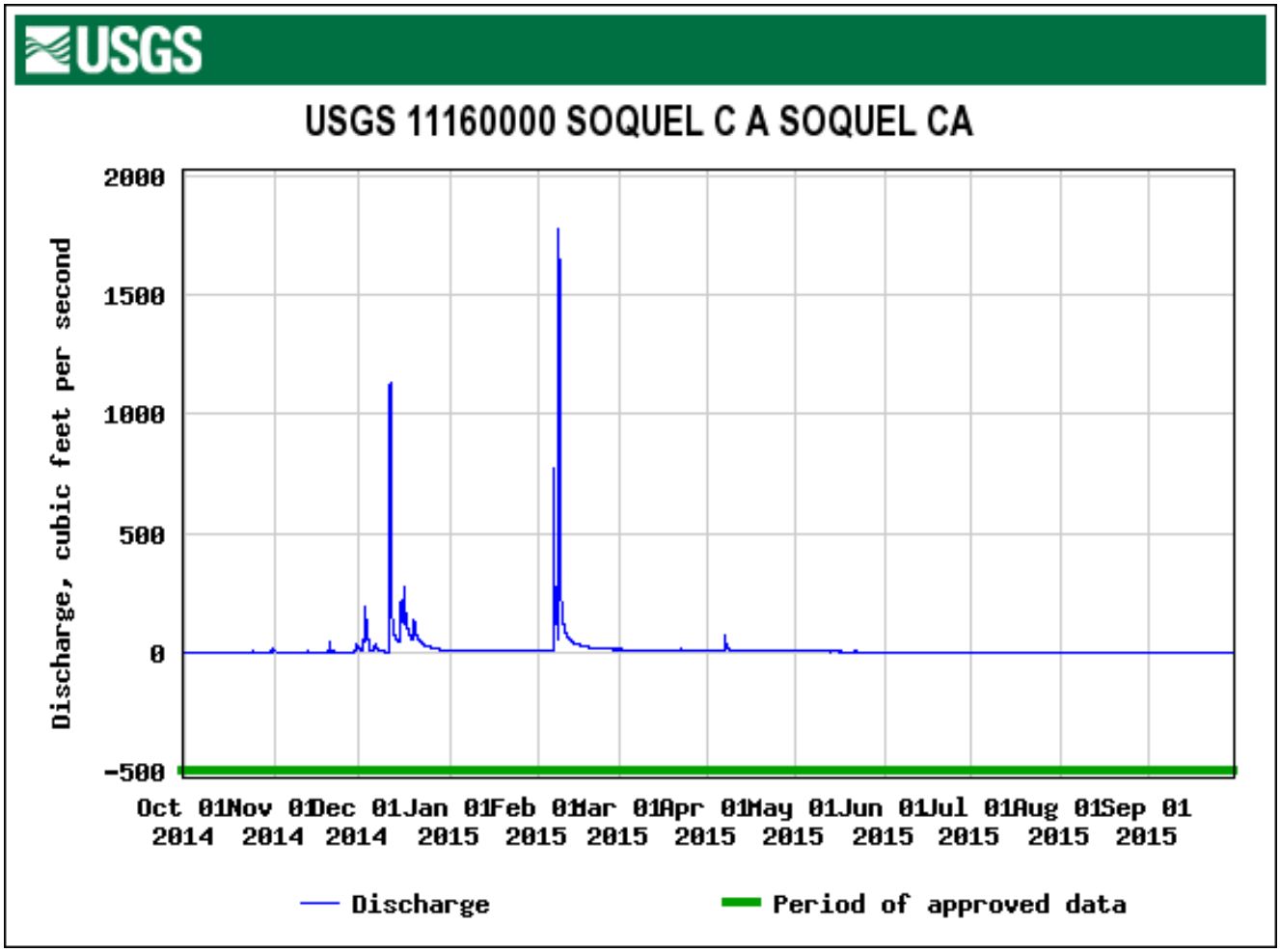


Figure 36. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2015 – 15 November 2015.

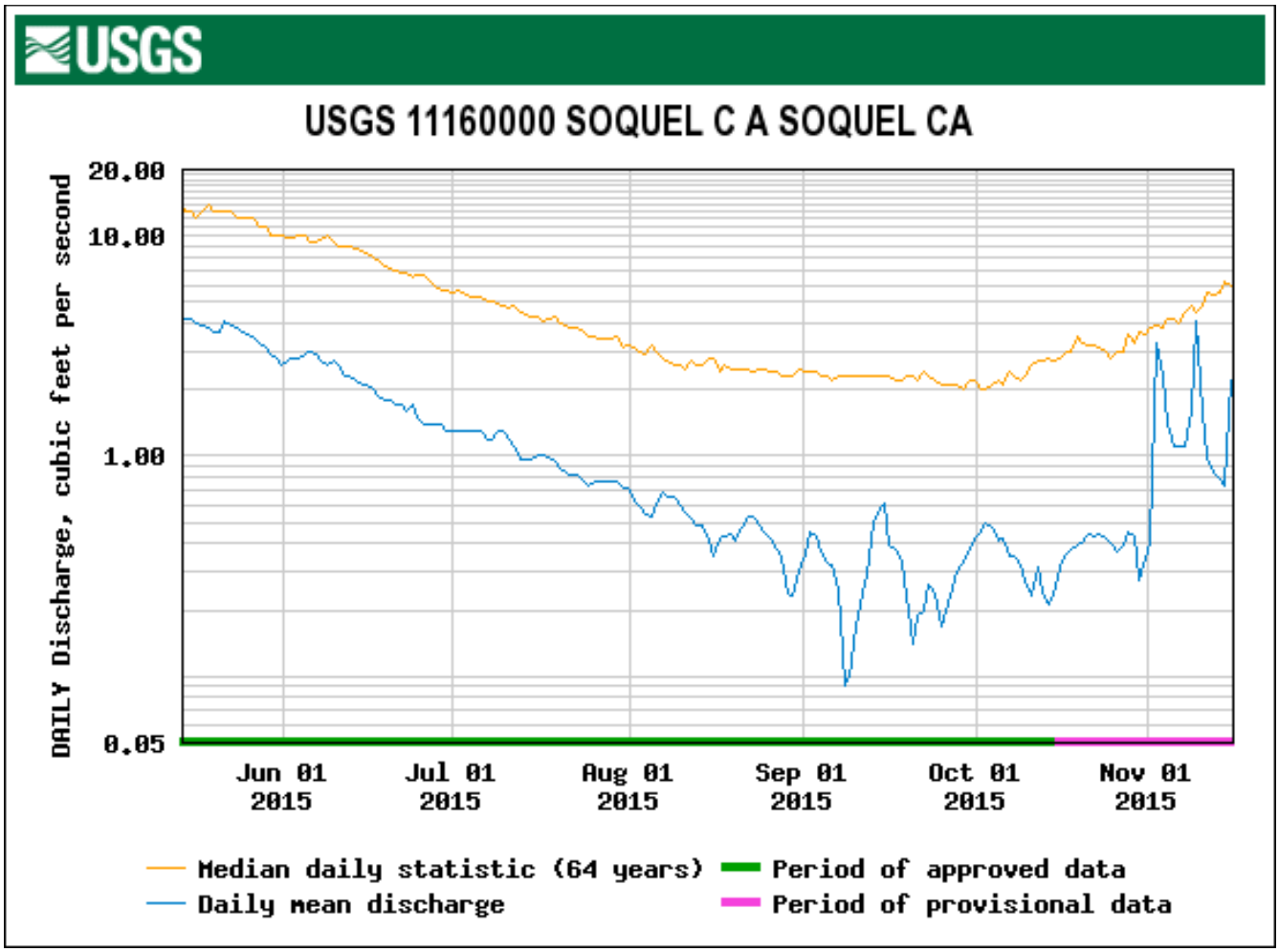


Figure 37. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

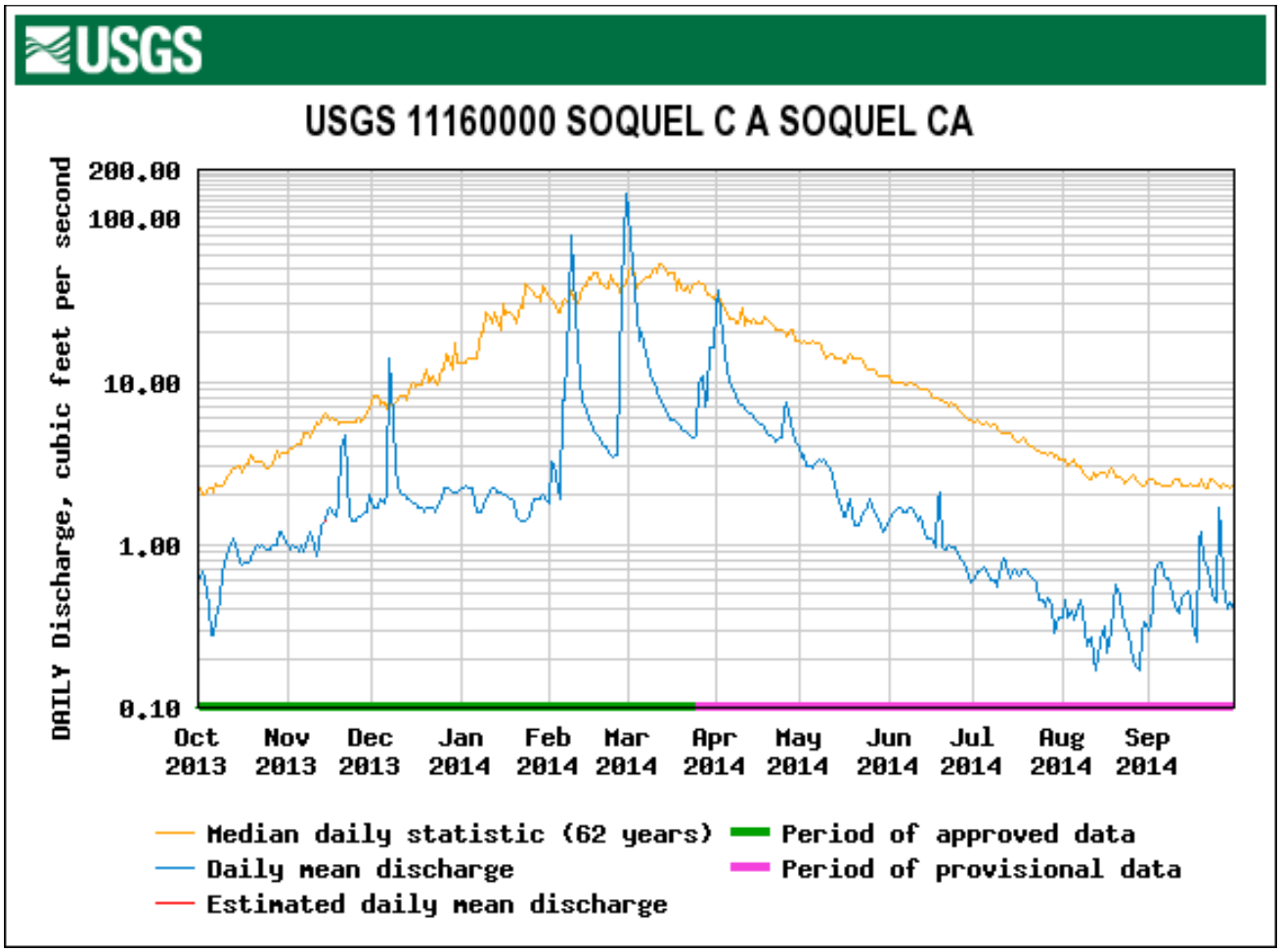


Figure 38. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

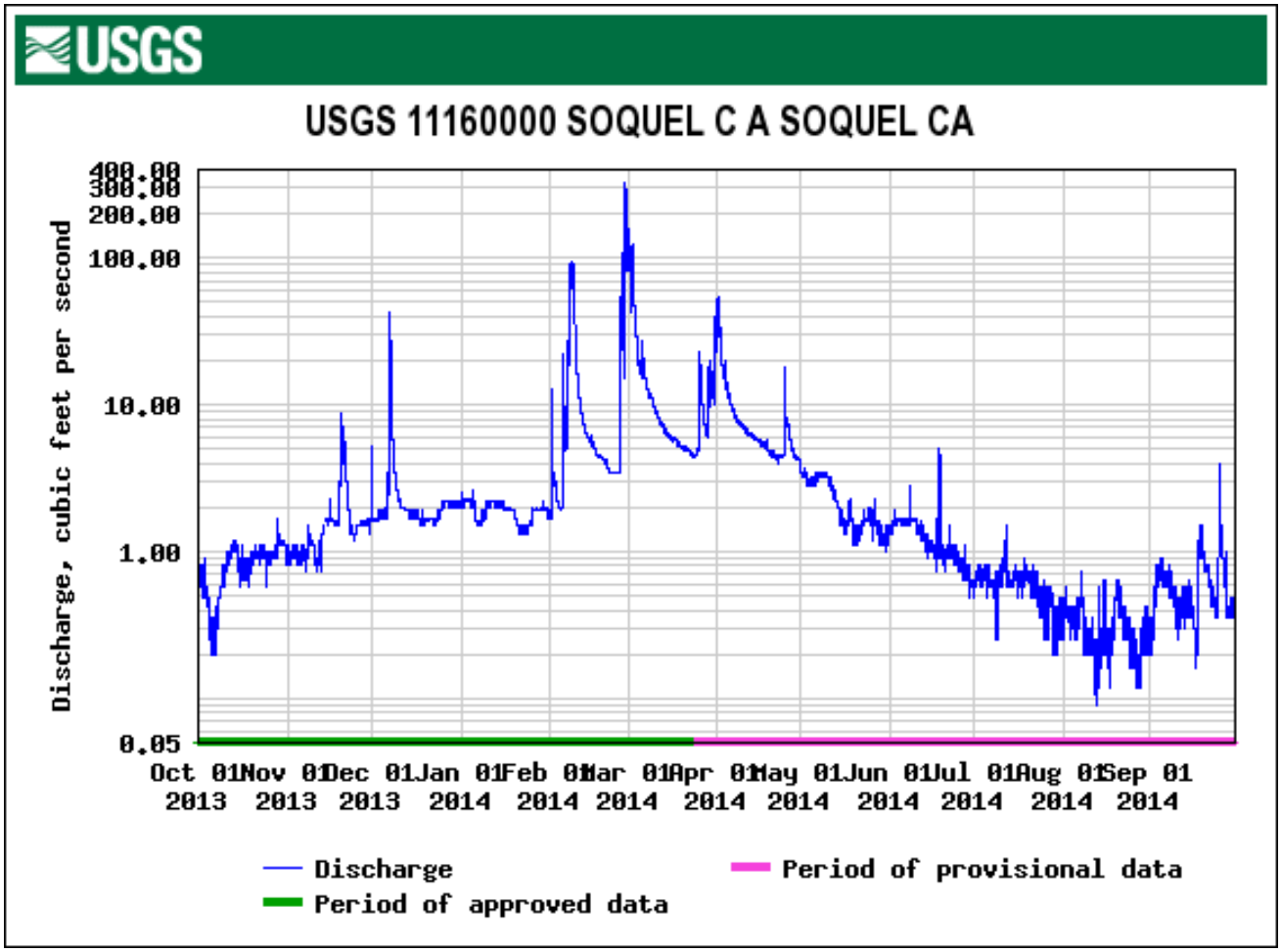


Figure 39. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2013.

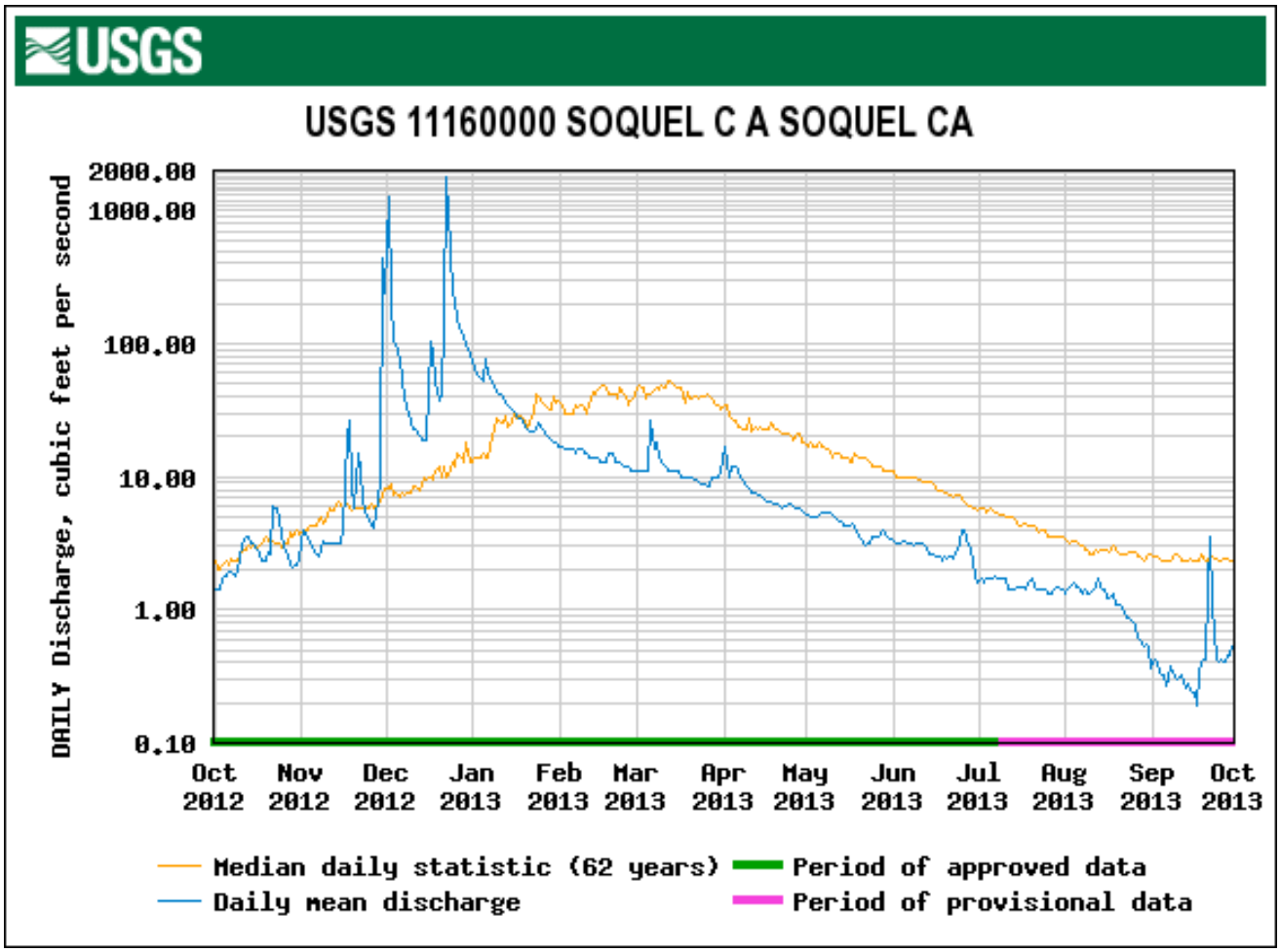


Figure 40. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, October 2012 – May 2013.

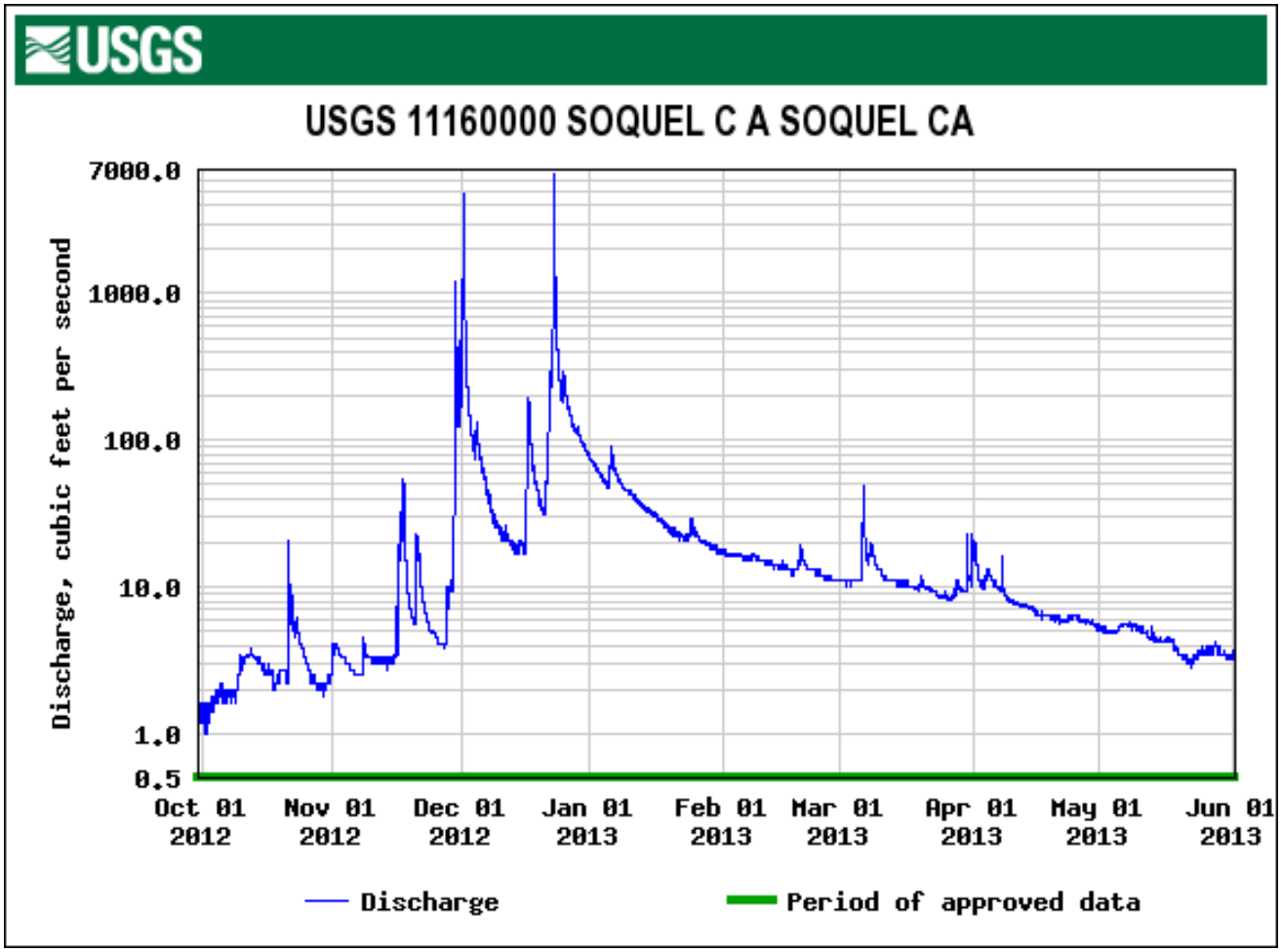


Figure 41. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

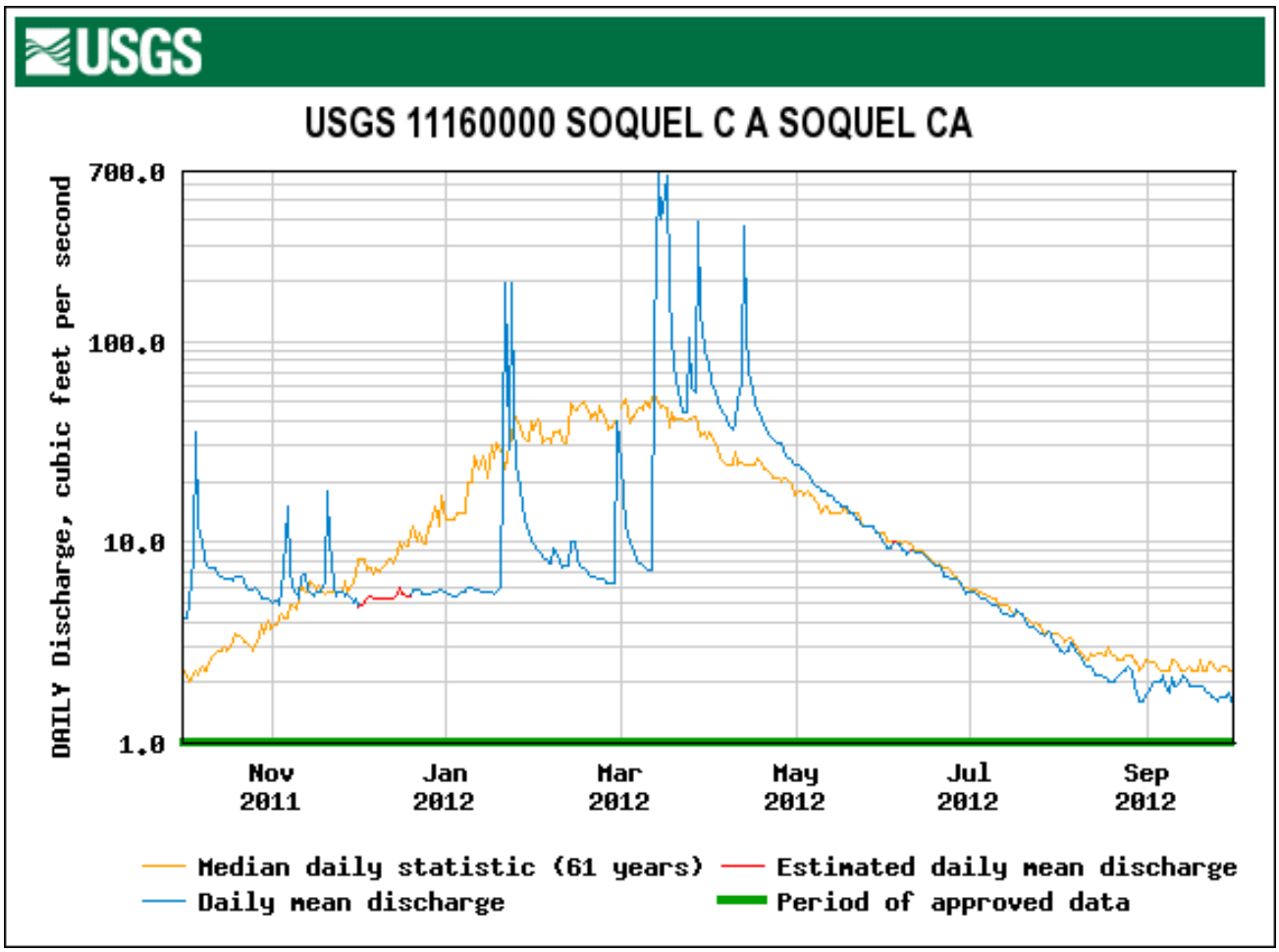


Figure 42. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

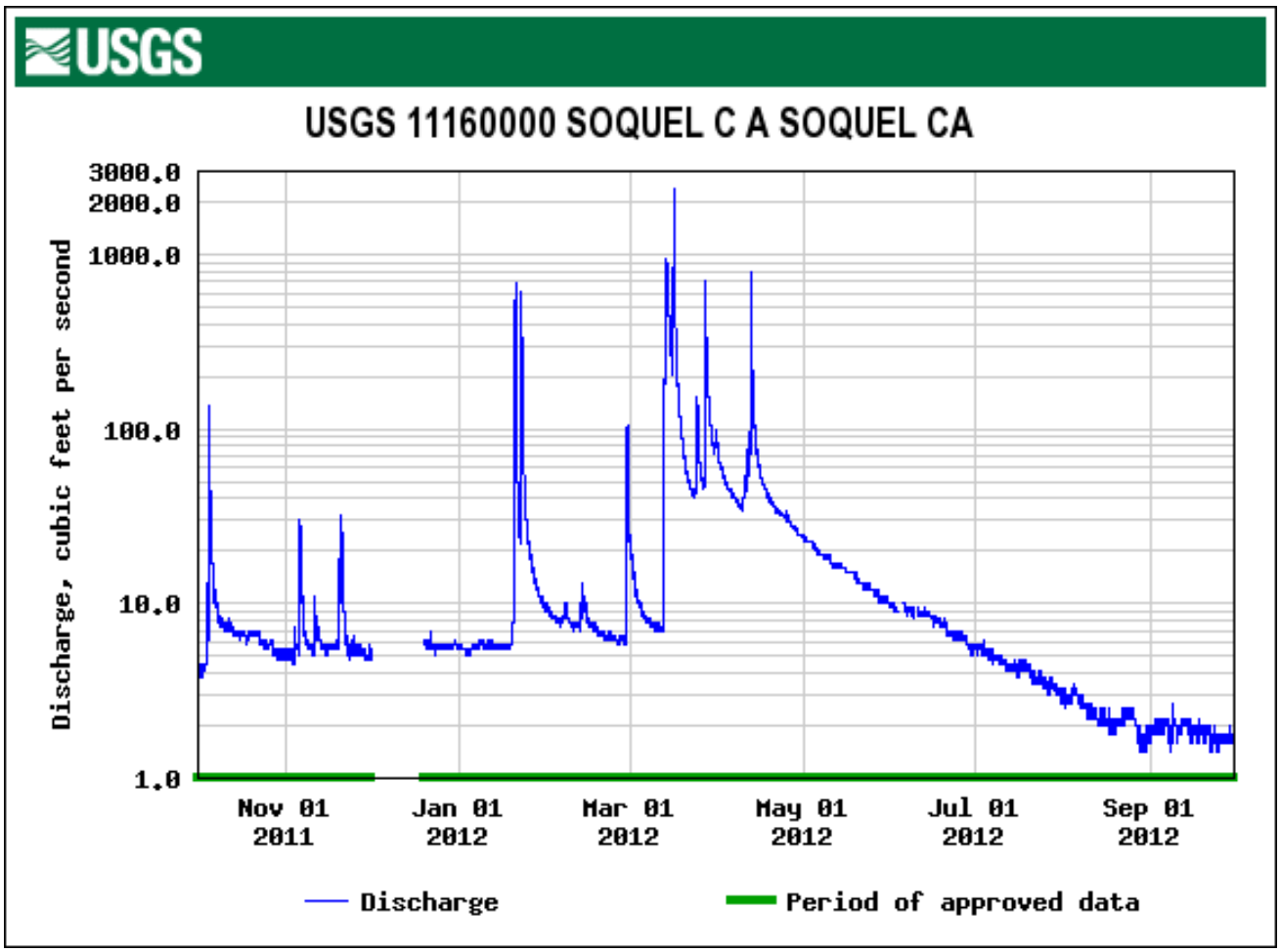


Figure 43. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

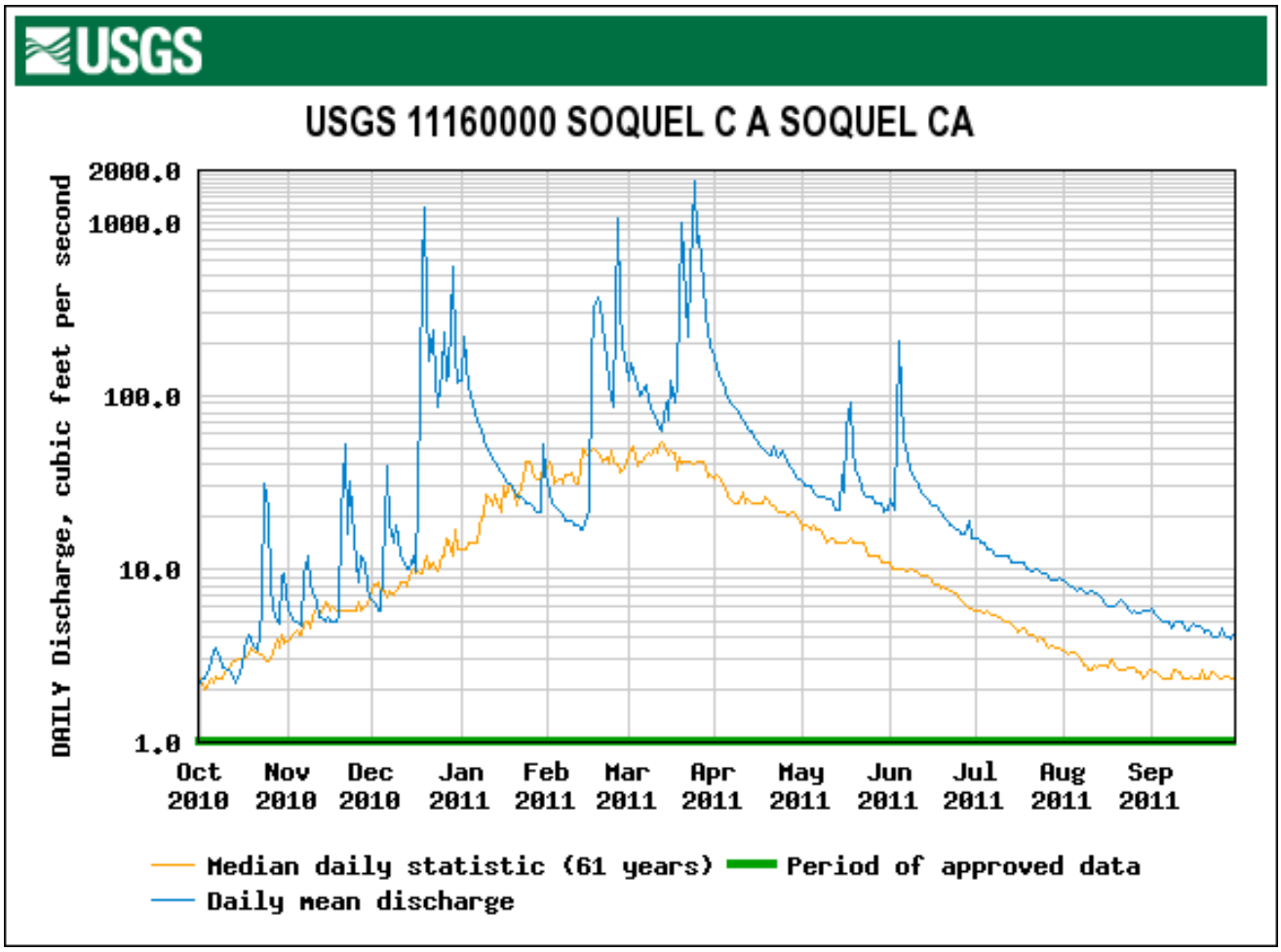


Figure 44. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

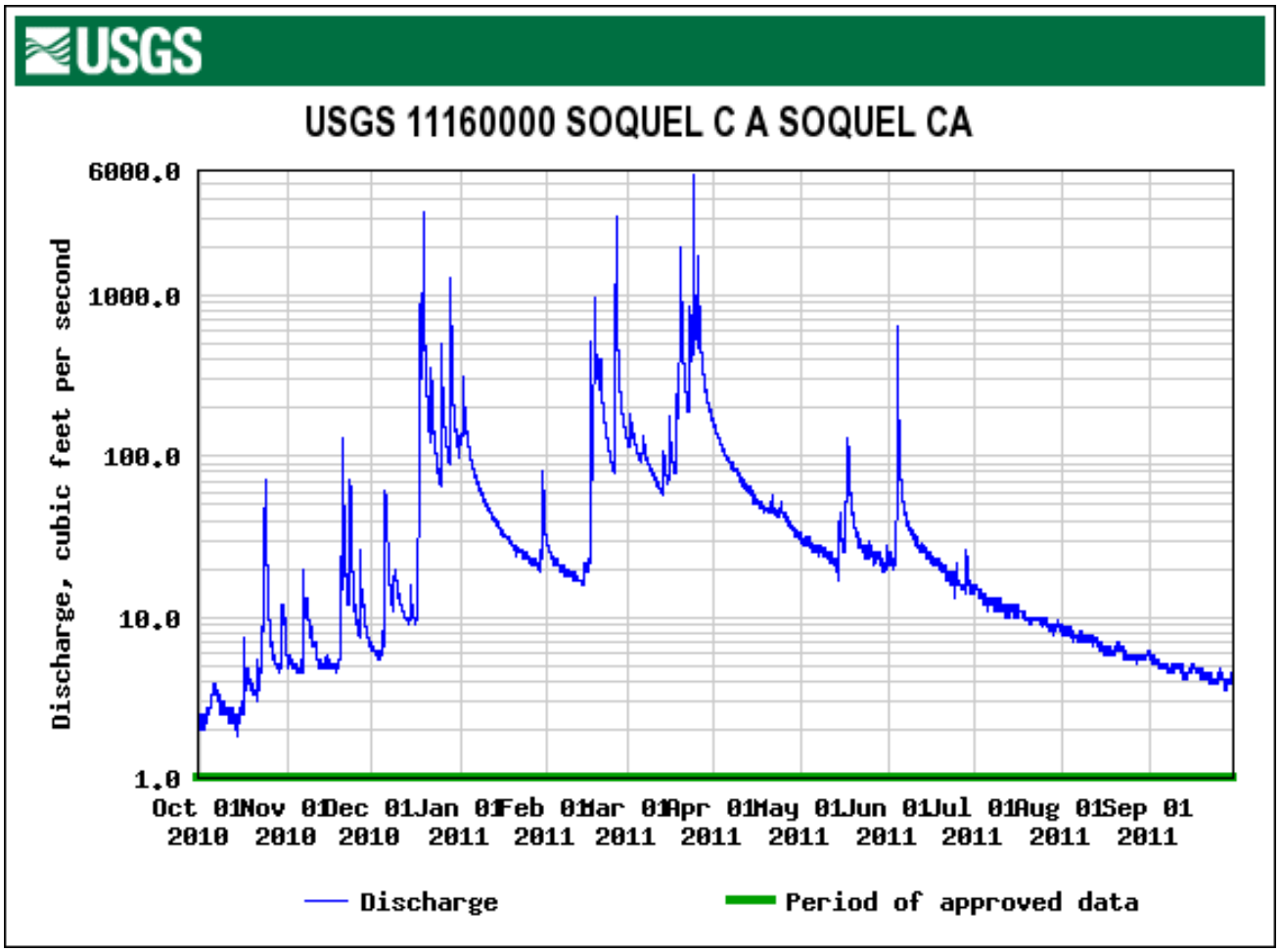


Figure 45. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2010.

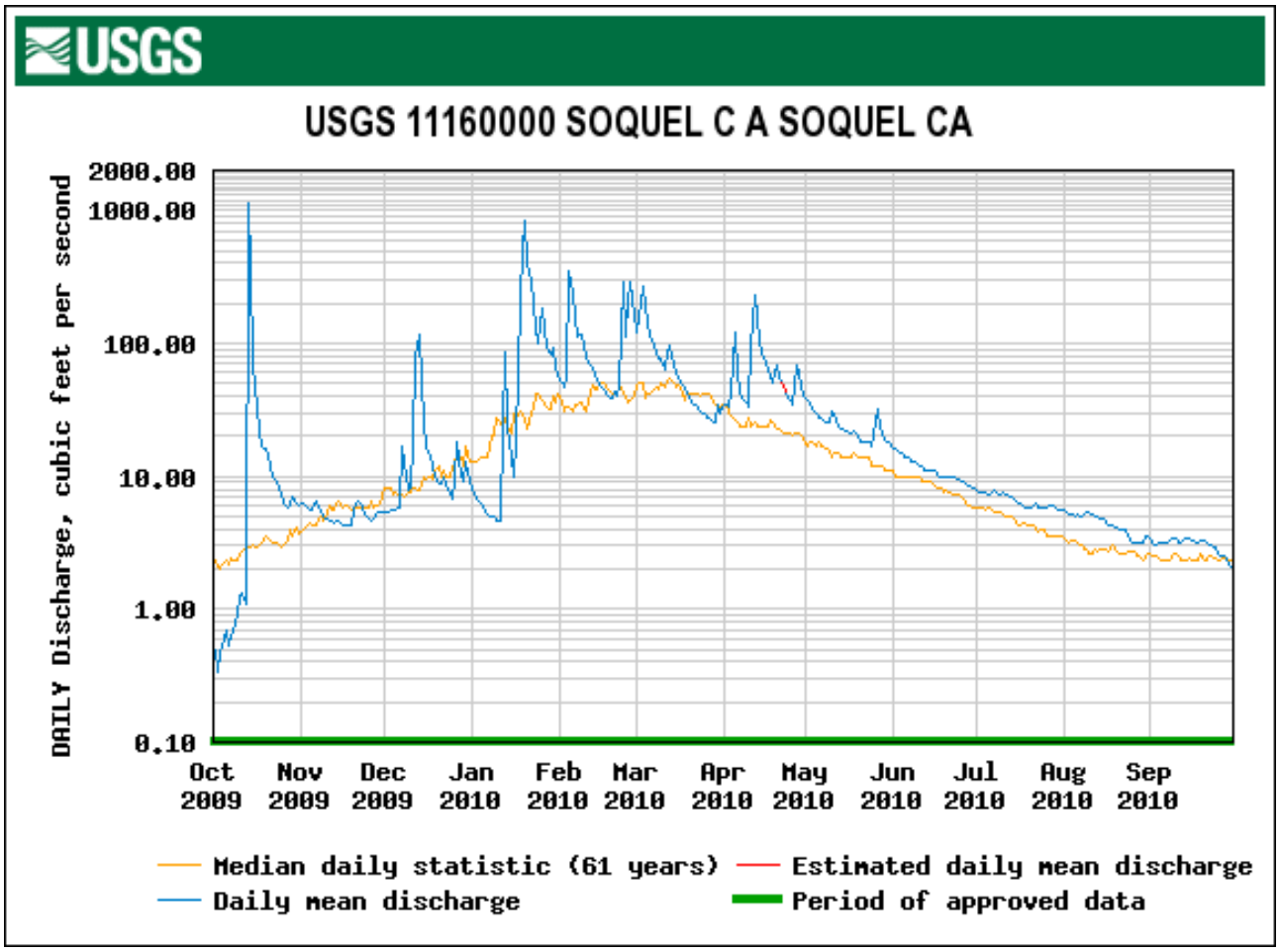


Figure 46. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2009.

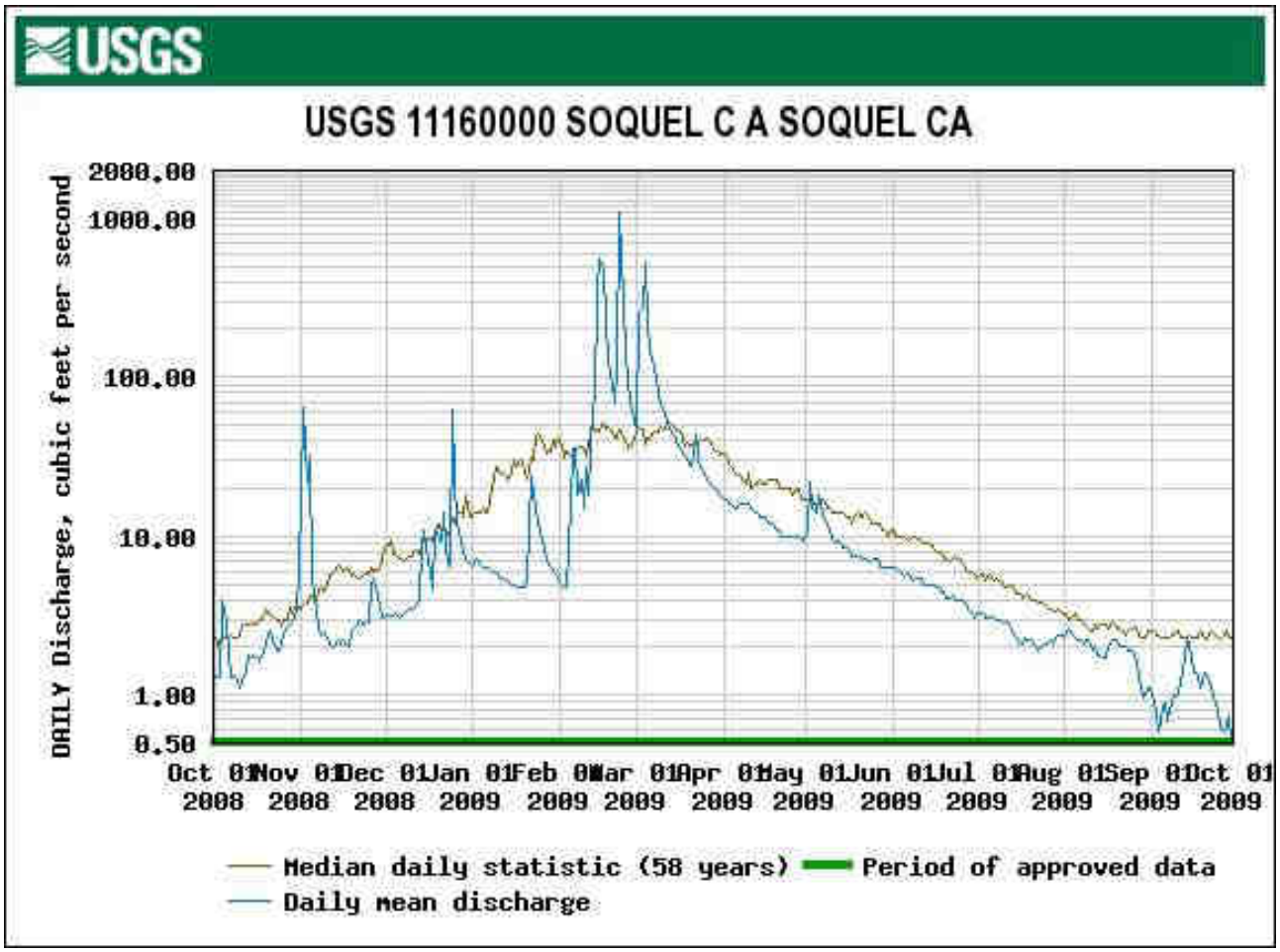


Figure 47. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2008.

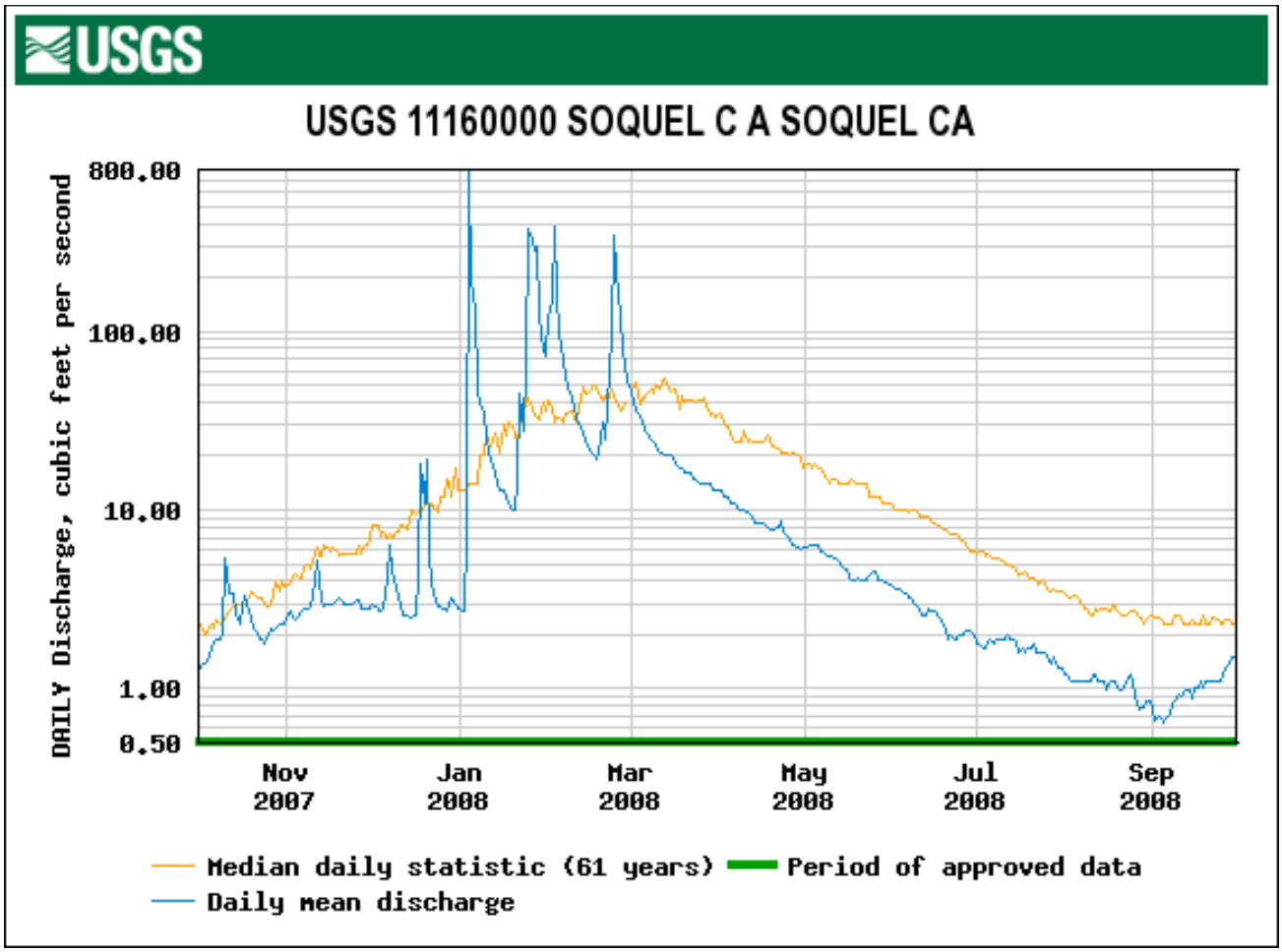


Figure 48. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2007.

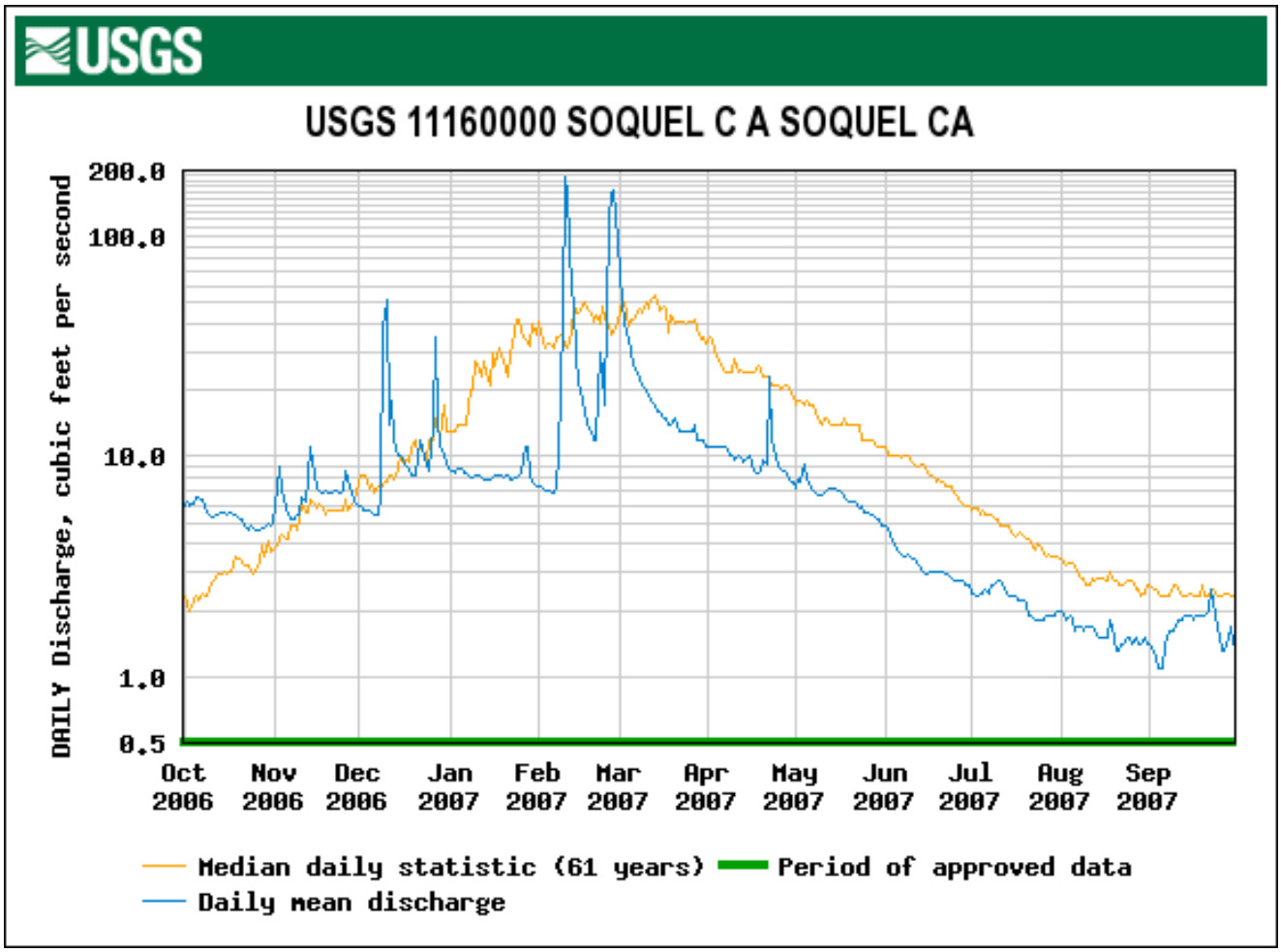


Figure 49. Maximum Visual Gull Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2014–2018.

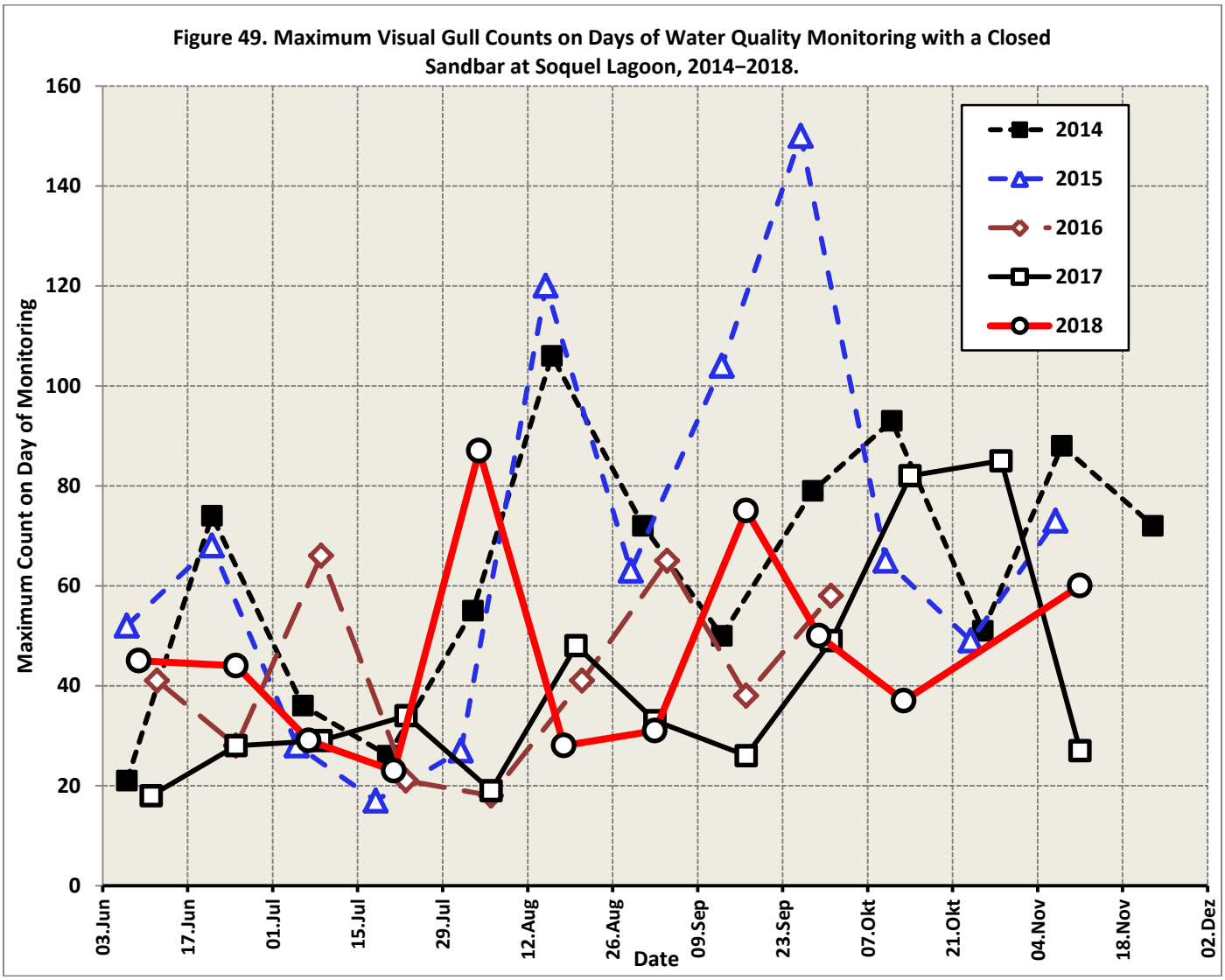
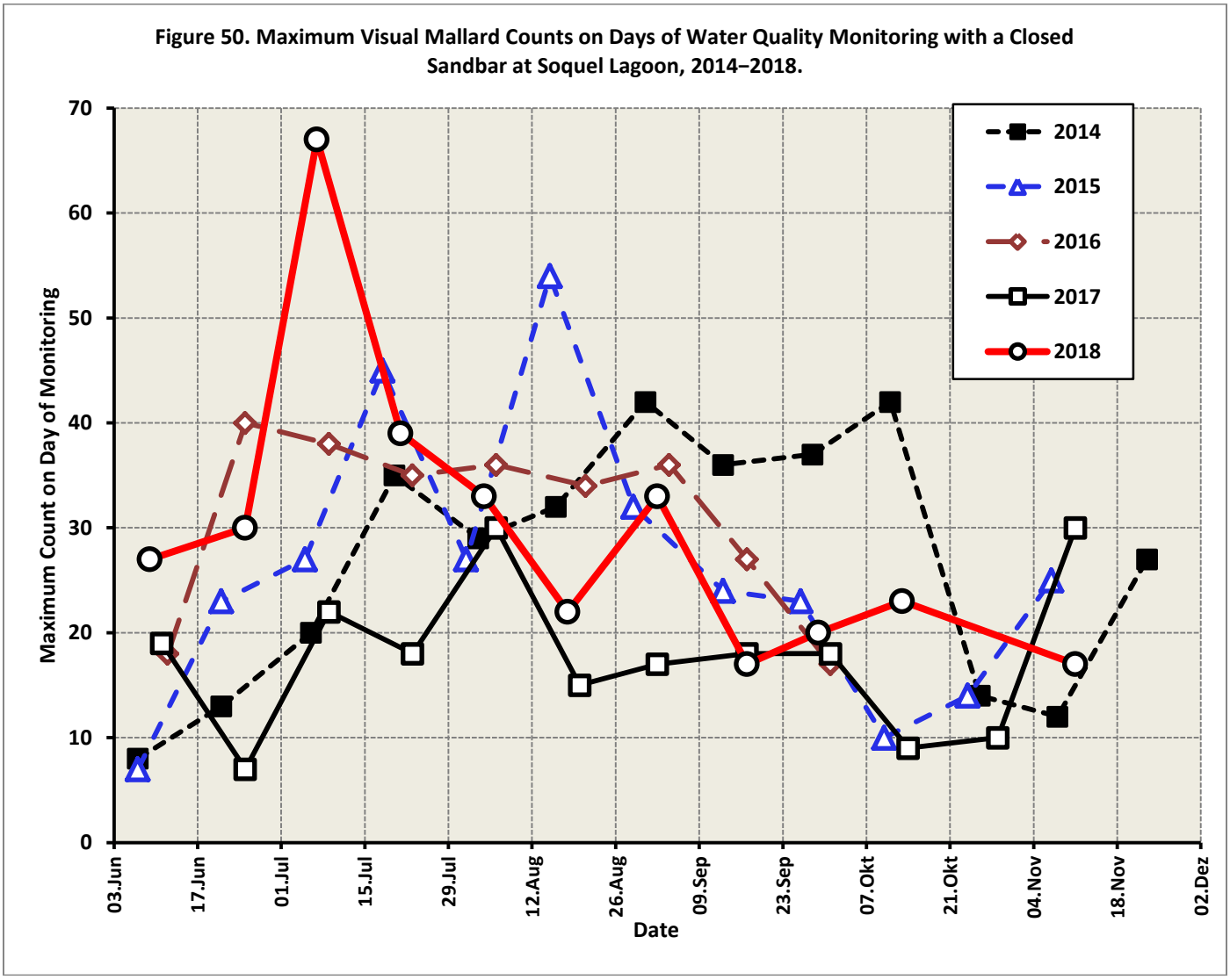


Figure 50. Maximum Visual Mallard Counts on Days of Water Quality Monitoring with a Closed Sandbar at Soquel Lagoon, 2014–2018.



APPENDIX A. Water Quality Data and General Observations of Birds and Aquatic Vegetation.

29 May 2018– 23 November 2018.

29 May 2018. The sandbar had been closed since 24 May. Temperature probes were launched on 29 May in the lagoon and upstream. The lagoon water surface was at the top of the flume on 29 May. An underwater portal was present for adult out-migrants. Gage height was 2.65. No saltwater was detected along the Venetian Court wall. The biologist recommended no need to install the shroud on the flume inlet, and it was not installed. 9.7 cfs at Soquel Village.

			29 May 2018				
	Venetian Court Wall 1614 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	18.7	0.4	9.74	649				
0.25	18.6	0.4	9.52	640				
0.50	18.6	0.4	9.61	639				
0.75	18.5	0.4	9.66	638				
1.00	18.5	0.4	9.74	636				
1.25	18.4	0.4	9.60	638				
1.50	17.9	0.4	9.34	637				
1.75	17.7	0.4	9.37	640				
2.00 bott	17.7	0.4	7.80	646				
2.25								
2.50								
2.75								

			9 June 2018					
	Flume		0706 hr		**Stockton Avenue Bridge**			0718 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	18.3	0.4	8.69	654	18.3	0.4	8.84	653
0.25	18.3	0.4	8.72	657	18.4	0.4	8.81	657
0.50	18.3	0.4	8.67	658	18.4	0.4	8.75	657
0.70b	18.3	0.4	8.42	659				
0.75					18.4	0.4	8.59	657
1.00					18.3	0.4	7.99	660
1.25					18.3	0.4	8.06	661
1.50					18.2	0.4	7.19	665
1.75					18.1	0.4	6.88 (73%)	674
1.83b					18.1	0.4	6.31	677
	Railroad Trestle			0735 hr	**Mouth of Noble Gulch**			0748 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	18.2	0.4	8.57	648	17.9	0.4	8.49	641
0.25	18.2	0.4	8.65	652	17.9	0.4	8.28	644
0.50	18.2	0.4	8.50	652	17.9	0.4	8.18	644
0.75	18.2	0.4	8.56	652	17.9	0.4	7.99	644
1.00	18.2	0.4	8.51	651	17.9	0.4	7.17	653
1.25	18.2	0.4	8.14 (86%)	651	17.8	0.4	7.81 (82%)	649
1.45b	17.9	0.4	4.62	655				
1.50b					18.4	0.7	2.83	1229
1.75								
	Nob Hill			0838 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**
	15.9	0.4	7.46 (76%)	592				

9 June 2018. The first complete water quality monitoring of the season was accomplished after the sandbar had been closed on 24 May. A berm had been completed around the entire lagoon periphery to prevent tidal overwash. Oxygen was 73-86% full saturation in the morning near the bottom and good. Inflow oxygen in the morning was 76% full saturation at Nob Hill and good. Water temperature ranged 18.2-22.8 ° C in the afternoon in the lagoon, about 3°C warmer than in the high baseflow 2017 at the 3 lower stations. However, a saltwater lens existed at the mouth of Noble Gulch, elevating bottom temperatures. Oxygen was supersaturated in the afternoon at all stations measured near the bottom in the lagoon. Oxygen was near full saturation at the stream site near Nob Hill in the afternoon. Algae was not developing in the lagoon yet as in previous drought years.

			9-June 2018					
	Flume		1544 hr		**Stockton Avenue Bridge**			1530 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	20.2	0.4	9.81	684	19.5	0.4	9.68	672
0.25	19.9	0.4	9.85	681	19.5	0.4	9.74	673
0.50	19.7	0.4	9.79 (108%)	679	19.5	0.4	9.71	673
0.75b	19.9	0.4	9.66	680	19.5	0.4	10.09	674
1.00					19.5	0.4	9.79	671
1.25					19.5	0.4	9.62	674
1.50					19.5	0.4	9.60	674
1.75					19.5	0.4	9.59 (104%)	674
1.83					19.4	0.4	9.24	675
2.00								
	Railroad Trestle			1514 hr	**Mouth of Noble Gulch**			1500 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	19.5	0.4	10.03	674	19.4	0.4	9.51	674
0.25	19.5	0.4	9.97	675	19.3	0.4	9.57	673
0.50	19.5	0.4	9.94	675	19.2	0.4	9.83	673
0.75	19.5	0.4	9.96	676	19.0	0.4	9.74	674
1.00	19.5	0.4	10.13	676	18.7	0.4	10.27	688
1.25	19.4	0.4	10.22(111%)	676	18.2	0.4	9.72(106%)	674
1.50b	19.5	0.4	10.19	676	21.1	1.2	11.49(122%)	2110
1.63b					22.8	2.5	6.47	4663
	Nob Hill			1639 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**
	18.1	**0.4**	**9.31(99%)**	**620**				

9 June 2018. Gage height was 2.56 in the morning and afternoon. Overcast in morning and hazy with high cirrus clouds and windy in afternoon.

Station 1: Flume at 0706 hr- Air temp. 15.6 C. no surface algae and no planktonic algal bloom. Reach 1- 14 gulls bathing; 2 mallards on Venetian Court margin. At 1544 hr- Air temp. 17.6 C. no surface algae. Algal film on bottom. Reach 1- 45 gulls bathing. No sinkholes along flume. Underwater portal in place. Flume inlet 1.2 ft deep. Outlet 1.0 ft deep.

Station 2: Stockton Avenue Bridge at 0718- hr- No surface algae. Secchi depth to bottom. Reach 2- 2 adult mallards with 4 YOY in water. 2 mallards fro Reach 1 moved in. At 1530 hr- no surface algae; bottom with algal film. Reach 2- no waterfowl. 1 electric motor boat and 1 kayak that moved down into Reach 1.

Station 3: Railroad Trestle at 0735 hr- no surface algae. Reach 3- 1 mallards perched on wood near Shadow Brook restaurant. At 1514 hr- no surface with algal film on bottom. Reach 3- 4 adult mallards in water. Plus 1 female mallard with 5 YOY; 1 female mallard with 7 YOY; 1 female mallard with 9 YOY

all near mouth of Noble Gulch and retreating to under cottonwood overhanging the lagoon across from Noble Gulch.
Station 4: Mouth of Noble Gulch at 0748 hr. No surface algae. No gray water plume. At 1500 hr no surface algae with algal film on bottom and no gray water plume
Station 5: Nob Hill at 0838 hr/ 1639 hr- Water temp. 2 C cooler than lagoon in morning and 1.5 C cooler in the afternoon. Oxygen less than in lagoon at both times. = Streamflow 6.0 cfs at Soquel Village gage.

23 June 2018. Afternoon water temperature cooler near the bottom than previous drought years. Morning oxygen levels were very good at 3 stations (at or near full saturation) and higher than 2 weeks before due to increased algae producing oxygen the previous day. Morning water temperature similar to 2 weeks earlier. Saltwater lens remained at mouth of Noble Gulch with elevated water temperature and reduced oxygen near the bottom. Lagoon depth was good. Afternoon oxygen was supersaturated at 3 stations (113-131%) near the bottom and at the stream site near Nob Hill (103). Afternoon water temperature about 1°C warmer than 2 weeks earlier. Lagoon water temperature 1.5-2 C warmer than Soquel Creek at Nob Hill.

				21-June-2018				
	Flume			0715 hr	**Stockton Avenue Bridge**			0730 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	18.7	0.4	10.44	647	18.9	0.4	10.31	685
0.25	18.7	0.4	10.41	682	18.9	0.4	10.05	684
0.50	18.7	0.4	10.39	683	18.8	0.4	10.06	684
0.75	18.7	0.4	10.51(113)	683	18.8	0.4	10.72	683
0.85b	18.7	0.4	10.43	685				
1.00					18.8	0.4	10.19	685
1.25					18.8	0.4	9.97	683
1.50					18.8	0.4	9.78	683
1.75b					18.8	0.4	9.71(104)	683
2.00								
	Railroad Trestle			0752 hr	**Mouth of Noble Gulch**			0805 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	18.5	0.4	9.37	667	18.0	0.4	9.17	655
0.25	18.5	0.4	9.29	674	18.1	0.4	9.09	656
0.50	18.5	0.4	9.33	674	18.1	0.4	9.20	657
0.75	18.5	0.4	9.29	674	18.1	0.4	9.22	657
1.00	18.5	0.4	9.23	674	18.0	0.4	9.03	659
1.25	18.5	0.4	9.23(99)	674	18.5	0.4	7.83(84)	739
1.40b	18.5	0.4	7.61	674				
1.50					21.2	2.2	1.20(12)	3812
1.70b					22.4	4.1	0.06	7135
	Nob Hill			0853 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	0.3	9.82	547				

23 June 2018. Gage height of 2.51 in morning. Clear and warm at 0715 hr. Air temperature of 14.6 C.
Station 1: Flume 0715 hr. Reach 1- 8 gulls bathing, 2 mergansers hunting, cloud of sticklebacks near flume. No surface algae.
Station 2: Stockton Bridge 0730 hr. Reach 2-3 mallards roosting on trestle abutment. 2 mergansers from Reach 1 moved up. Cloud of sticklebacks. No surface algae.
Station 3: Railroad trestle 0752 hr. Reach 3- 14 adult mallards in water plus 3YOY near trestle and 4 YOY across from Noble Gulch on a log. No surface algae
Station 4: Noble Gulch 0805 hr. No surface algae or gray water.
Station 5: Nob Hill at 0853 hr. Water temperature 2.5 ^{o}C cooler than the lagoon.

			23 June 2018					
	Flume			1602 hr	**Stockton Avenue Bridge**			1551 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	11.56	704	20.5	0.4	10.44	703
0.25	20.4	0.4	11.43	704	20.6	0.4	10.53	708
0.50	20.3	0.4	11.71(130)	704	20.4	0.4	10.37	705
0.75b	20.3	0.4	11.63	703	20.4	0.4	10.22	705
1.00					20.3	0.4	10.29	704
1.25					20.2	0.4	10.24	703
1.50					20.0	0.4	10.35(113)	702
1.75b					19.6	0.4	7.42	702
2.00								
	Railroad Trestle			1534 hr	**Mouth of Noble Gulch**			1508 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	20.7	0.4	10.28	710	20.8	0.4	10.10	715
0.25	20.7	0.4	10.47	711	20.8	0.4	10.15	713
0.50	20.7	0.4	10.34	711	20.7	0.4	10.02	711
0.75	20.6	0.4	10.19	711	20.1	0.4	9.26	703
1.00	20.4	0.4	10.63	708	18.9	0.4	10.20	705
1.25	19.4	0.4	12.76(131)	714	18.7	0.4	9.74	689
1.50b	19.3	0.4	12.39	715	23.1	2.7	4.27(50)	4875
1.70b					24.3	4.2	0.37	7483
	Nob Hill			1644 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	0.2	9.57(103)	364				

23 June 2018. Gage height of 2.51 in afternoon. Sunny with onshore breeze. Air temperature of 16.2^{o}C at 1602 hr. Flume inlet = 1.2 ft. deep. Flume outlet = 1.4 ft. Lower flume flagged for sinkholes. 3 children playing at flume outlet.
Station 1: Flume 1602 hr. Reach 1- 44 gulls bathing; 2 mallards begging at Margaritaville. 2 paddle boarders from Reach 2; 5 waders near margin near flume. 80% bottom algal film 0.2−1 ft thick averaging 0.5 ft. No surface algae or planktonic algal bloom.

Station 2: Stockton Bridge 1551 hr. Reach 2- no surface algae; 100% bottom algal film 0.2−1.0 ft thick, avg 0.5 ft. 3 paddle boarders, 1 row boat, 1 kayak. No waterfowl.
Station 3: Railroad trestle 1534 hr. Reach 3- 18 mallards plus 1 female with 4 YOY and 1 female with 4 YOY; 2 cormorants. All waterfowl near Noble Gulch mouth. No surface algae. 100% bottom algal film 0.2 ft−1.0 ft thick, avg 0.3 ft.
Station 4: Noble Gulch 1508 hr. 100% bottom algal 0.3−1.0 ft thick, avg 0.5 ft. No surface algae. Noble Gulch outflow clear.
Station 5: Nob Hill at 1644 hr. Water temperature 1-1.5 C cooler than lagoon. 5.0 cfs at Soquel Village.

			7 July 2018					
	Flume 0724 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	19.9	0.4	11.42	701	20.1	0.4	11.83	709
0.25	19.9	0.4	11.43	704	20.1	0.4	11.48	709
0.50	19.9	0.4	11.85	704	20.1	0.4	11.53	709
0.75	19.9	0.4	11.70(129)	704	20.1	0.4	11.69	708
0.80b	19.9	0.4	11.56	704				
1.00					20.1	0.4	12.33	705
1.25					20.1	0.4	11.53	708
1.50					20.1	0.4	11.40(126)	708
1.75b					20.1	0.4	10.74	710
2.00								
	Railroad Trestle 0755 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	20.0	0.4	9.74	703	19.7	0.4	9.17	680
0.25	20.0	0.4	9.69	704	19.8	0.4	9.22	687
0.50	20.0	0.4	9.74	703	19.7	0.4	8.91	687
0.75	20.0	0.4	9.78	704	19.7	0.4	8.94	685
1.00	20.0	0.4	9.70	704	19.6	0.4	8.94	685
1.25	20.0	0.4	9.55(105)	704	19.6	0.5	8.52	785
1.50b	19.6	0.4	2.28	710	19.7(15ft from)	0.5	8.89	825
1.75b					22.8	3.7	0.27	6477
	Nob Hill			0845 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	8.26	651				

7 July 2018. Gage height of 2.55 in morning. Clear. Air temp. = 16.1° C at 0724 hr.
Station 1: Flume 0724 hr. Reach 1- 4 gulls bathing; cloud of sticklebacks near flume. 2% surface algae. Underwater portal still present.
Station 2: Stockton Bridge 0740 hr. Reach 2- no waterfowl. Less than 1% surface algae.
Station 3: Railroad trestle 0755 hr. Reach 3- In water- 13 adult mallards in water; 5 mallards perched on wood. 2% surface algae.
Station 4: Noble Gulch 0810 hr. 5% surface algae. No gray water. Street drain dry.
Station 5: Nob Hill at 0845 hr. Water temperature 1.5-2 ° C cooler than lagoon.

			7 July 2018					
	Flume			1605 hr	**Stockton Avenue Bridge**			1549 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	21.9	0.4	12.46	729	22.0	0.4	11.58	
0.25	21.7	0.4	12.48	729	22.0	0.4	11.50	
0.50	21.7	0.4	12.49	727	21.8	0.4	11.13	
0.75	21.7	0.4	12.91(146)	725	21.7	0.4	10.87	
0.80b	21.7	0.4	12.41	726				
1.00					21.7	0.4	11.04	
1.25					21.7	0.4	11.03	
1.50					21.6	0.4	11.00(121)	
1.75b					21.1	0.4	8.82	
2.00								
	Railroad Trestle			1533 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	22.3	0.4	11.46	737	22.5	0.4	11.11	744
0.25	22.2	0.4	11.44	739	22.4	0.4	11.08	744
0.50	22.1	0.4	11.17	737	22.2	0.4	10.98	742
0.75	21.9	0.4	11.38	734	21.8	0.4	10.33	734
1.00	21.8	0.4	11.64	732	20.9	0.4	11.14	732
1.25	21.3	0.4	15.80(179)	730	20.7	0.4	16.32(183)	729
1.50b	21.0	0.4	17.10	719	20.9(bott@ 15ft from NG)	0.6	18.85	1048
1.75b					24.2	3.9	5.12	6928
	Nob Hill			1646 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**
	20.3	0.4	8.91(99)	678				

7 July 2018. Gage height of 2.56 in afternoon. Clear. Air temperature of 19.1 °C at 1605 hr. Afternoon water temperature 1°C warmer than 2 weeks earlier. Flume inlet 1.2 ft depth. Flume exit depth 1.0 ft.
Station 1: Flume at 1605 hr. Reach 1- 29 gulls bathing; 6 adult mallards plus 1 female and 6YOY, all begging at Margaritaville and down from Reach 3. 9 waders near flume. 1% surface algae. 85% bottom algae 0.5-4.5 ft thick, avg 1.5 ft. Remainder thick algal film 0.1-0.2 ft thick.
Station 2: Stockton Avenue Bridge at 1549 hr. Secchi depth to bottom. Reach 2- Planktonic algal bloom in progress. 7% surface algae. 1 mallard. 100% bottom algae 0.2-3.0 ft thick, avg 0.8 ft. Remainder thick algal film 0.1 ft thick.
Station 3: Railroad Trestle at 1533 hr. Reach 3- 3% surface algae. 99% bottom algae 0.2-3.0 ft thick, avg 0.5 ft thick, 1% pondweed with algae 3 ft thick under trestle. 42 adult mallards plus 1 female and 6 YOY and 1 female and 4 YOY.
Station 4: Mouth of Noble Gulch at 1505 hr. 5% surface algae. 100% bottom algae 0.5-1.5 ft thick, avg 1.0 ft thick,
Station 5: Nob Hill at 1646 hr. Water temperature above 20 C and 1-2 C cooler than the lagoon. 1 female mallard and 4 YOY. 3.9 cfs at Soquel Village.

			21-July-2018					
	Flume 0717 hr				**Stockton Avenue Bridge** 0731 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**mg/l (% sat.)**	**umhos**	**(C)**	**(ppt)**	**mg/l (% sat.)**	**Umhos**
0.00	21.2	0.4	10.25	724	21.1	0.4	10.08	736
0.25	21.2	0.4	10.23	743	21.1	0.4	10.08	740
0.50	21.1	0.4	10.15	743	21.1	0.4	10.09	741
0.75	21.2	0.4	10.14(114)	743	21.1	0.4	9.83	742
0.80b	21.2	0.4	9.78	743				
1.00					21.1	0.4	8.89	742
1.25					21.1	0.4	6.76	741
1.50					20.8	0.4	5.64(63)	741
1.75b					20.8	0.4	5.20	739
2.00								
	Railroad Trestle 0750 hr				**Mouth of Noble Gulch**			0805 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**mg/l (% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	20.8	0.4	9.71	731	20.4	0.3		
0.25	20.8	0.4	9.49	738	20.4	0.3		
0.50	20.8	0.4	9.71	738	20.5	0.3		
0.75	20.8	0.4	9.58	738	20.5	0.3		
1.00	20.8	0.4	9.52	738	20.2	0.3		
1.25b	20.4	0.4	5.69(75)	734	20.2 bott@15 ft from NG 20.9@ 10 ft from NG	0.4 bott@15 from NG 0.8@10 ft from NG	8.84 bott@15 ft from NG 7.09@ 10 ft from NG	715bott@15 ft from NG 1479@10 ft from NG
1.40b	20.4	0.4	0.38	723				
1.50					24.2@ 10 ft from NG	3.5@ 10 ft from NG	25.59@ 10 ft from NG	6253@ 10 ft from NG
1.60b					24.3@ 10 ft from NG	4.6@ 10 ft from NG	24.68@ 10 ft from NG	8253@ 10 ft from NG
	Nob Hill			0841 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**
	18.4	0.4	8.18 (87)	652				

21 July 2018. Gage height of 2.43 in morning. Overcast, warm and foggy. Air temperature of 16.3 °C at 0717 hr. Water temperature about 1 C warmer than morning 2 weeks previous.

Station 1: Flume at 0717 hr. Reach 1- 6 gulls bathing, 1 mallard in water; 2 mallards standing on Venetian Court margin. 1 pedal boat with 2 boys. No surface algae.
Station 2: Stockton Avenue Bridge at 0731 hr. Reach 2- 16 mallards came from Reach 3 and heading to Reach 1. No surface algae.
Station 3: Railroad Trestle at 0750 hr. Reach 3- 12 mallards and 2 pied-billed grebes in water. Grebe with staghorn sculpin in bill. 1 female mallard and 5 YOY roosting on Arthur dock. No surface algae.

Station 4: Mouth of Noble Gulch at 0806 hr. no gray water.
Station 5: Nob Hill at 0841 hr. Water temperature 2-3 C cooler than lagoon.

			21-July-2018					
	Flume 1622 hr				**Stockton Ave Bridge** 1607 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**mg/l (% sat.)**	**umhos**	**(C)**	**(ppt)**	**mg/l (% sat.)**	**Umhos**
0.00	22.6	0.4	11.30	759	33.7	0.4	10.35	765
0.25	22.6	0.4	11.83	757	22.5	0.4	10.28	763
0.50	22.3	0.4	12.39(142)	755	22.3	0.4	10.13	761
0.75b	22.3	0.4	12.19	753	22.2	0.4	10.05	758
1.00					22.2	0.4	10.05	756
1.25					22.1	0.4	10.07	758
1.50					21.9	0.4	10.74(122)	754
1.75b					21.5	0.4	8.38	752
2.00								
	Railroad Trestle 1527 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 (% sat.)**	**umhos**	**(C)**	**(ppt)**	**mg/l (% sat.)**	**Umhos**
0.00	22.3	0.4	10.16	761	22.7	0.4	9.78	772
0.25	22.3	0.4	10.35	760	22.6	0.4	9.86	766
0.50	22.3	0.4	10.47	760	33.4	0.4	9.34	763
0.75	22.1	0.4	10.46	760	21.7	0.4	13.7	753
1.00	22.0	0.4	11.80	760	21.5	0.4	18.2(201)	754
1.25b	21.6	0.4	13.56 (155)	758	21.4 bott@15 ft from NG 22.1@ 10 ft from NG	0.4bott@ 15 from NG 0.4@10 ft from NG	21.24 bott@15 ft from NG 11.23@ 10 ft from NG	753 bott@15 ft from NG 756@10 ft from NG
1.50b	21.6	0.4	10.62	756	24.9@ 10 ft from NG	3.7@ 10 ft from NG	28.52@ 10 ft from NG	6679@ 10 ft from NG
1.60b					25.0@ 10 ft from NG	4.5@ 10 ft from NG	28.88@ 10 ft from NG	8044@ 10 ft from NG
	Nob Hill			1709 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	8.81(99)	673				

21 July 2018. Gage height of 2.49 in afternoon. Clear. Air temp. = 19.2 °C at 1622 hr.

Station 1: Flume at 1622 hr. Reach 1- 23 gulls; 17 mallards (10 begging at Margaritaville); 2 paddle boarders and 5 waders. No surface algae. 85% bottom algae 1-4 ft thick, avg 2 ft. Remainder algal film.
Station 2: Stockton Avenue Bridge at 1607 hr. Secchi depth to bottom. Reach 2- No surface algae. 99%

bottom algae 1-3 ft thick, avg 2 ft. 1% pondweed with algae 3 ft thick. 1 pedal boat feeding 15 mallards. 1 cormorant present.
Station 3: Railroad Trestle at 1527 hr. Reach 3- No surface algae. 99% bottom algae 1-3 ft thick, avg 2 ft. 8 adult mallards plus 3YOY in water; 1 female mallard with 2 YOY roosting on Arthur dock. 1 canoe.
Station 4: Mouth of Noble Gulch at 1500 hr. No surface algae. Thick phytoplankton bloom at mouth of Noble Gulch, making bottom soupy. Did not see bottom algae within 10 ft of mouth. Beyond there the bottom algae was 1.5-2.5 ft thick, averaging 2 ft. thick. Saline lens appeared to restrict bottom algae.
Station 5: Nob Hill at 1709hr. Water temperature above 20 C and 1.5-2.5 C cooler than lagoon. 2.6 cfs at Soquel Village.

			4-Aug-2018					
	Flume 0714 hr				**Stockton Avenue Bridge** 0725 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)(% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)(%sat.)**	**umhos**
0.00	19.1	0.4	9.64	719	19.4	0.4	9.90	726
0.25	19.1	0.4	9.54	719	19.4	0.4	9.70	728
0.50	19.1	0.4	9.52	720	19.4	0.4	9.71	729
0.75	19.1	0.4	9.48(102)	720	19.3	0.4	9.76	729
0.87b	19.1	0.4	8.91	719				
1.00					19.5	0.4	9.70	730
1.25					19.4	0.4	9.43	729
1.50					19.4	0.4	9.57	729
1.75					19.4	0.4	9.50(104)	729
1.80b					19.4	0.4	8.75	728
	Railroad Trestle 0747 hr				**Mouth of Noble Gulch** 0801 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)(%sat.)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)(%sat.)**	**Cond 4 umhos**
0.00	19.0	0.4	8.90	715	18.6	0.4	7.93	711
0.25	19.9	0.4	8.76	718	18.5	0.4	7.89	718
0.50	19.0	0.4	9.05	718	18.5	0.4	7.84	711
0.75	19.0	0.4	9.04	719	18.5	0.4	7.83	711
1.00	19.0	0.4	8.95	719	19.2	0.4	5.88(63)	775
1.25b	19.0	0.4	8.98(97)	719	19.5 bott@15 ft from NG	0.7 bott@15 ft from NG	4.75 bott@15 ft from NG	1328 bott@15 ft from NG
1.50b	19.1	0.4	7.56	723	23.4@10 ft from NG	3.8@10 ft from NG	13.88(161) @ 10 ft from NG	6870@ 10 ft from NG
1.65b					24.3@ 10 ft from NG	5.3@ 10 ft from NG	10.94@ 10 ft from NG	9426@ 10 ft from NG
	Nob Hill			0841 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	7.57 (77)	615				

4 August 2018. Gage height of 2.59 (morning) and 2.59 (afternoon). Clear at 0714 hr with air temperature of 14.7 ° C at flume. Air temperature 17.8 ° C at 1622 hr at flume; clear and breezy. Flume inlet 1.2 ft deep. Flume outlet 1.5 ft deep on incoming tide in afternoon. Water temperatures generally 1.5-2 °C warmer in afternoon than in the morning.

Station 1: Flume at 0714 hr. Reach 1- 15 gulls; 13 mallards roosting at Venetian Court margin; 5 mallards in water; 3 mallards and 2 mergansers at Venetian margin. <1% surface algae.
Station 2: Stockton Avenue Bridge at 0725 hr. Secchi depth to the bottom. Reach 2- 2 mallards. No surface algae. 1 fresh dog poop on path.
Station 3: Railroad trestle at 0747 hr. Reach 3- 7 mallards being fed by lady; 3 other adult mallards plus 1 female and 1 YOY in water. No surface algae. 2 kayaks heading downstream.
Station 4: Mouth of Noble Gulch at 0801 hr. No surface algae. No gray water. Street drain dry.
Station 5: Nob Hill at 0845 hr. Water temperature 2 °C cooler than 2 weeks earlier.

			4-Aug-2018					
	Flume 1622 hr				**Stockton Avenue Bridge** 1606 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)(% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)(%sat.)**	**Umhos**
0.00	20.9	0.4	13.13	744	21.2	0.4	11.36	751
0.25	21.0	0.4	13,15	744	20.9	0.4	11.03	751
0.50	20.8	0.4	13.27	741	20.8	0.4	11.07	747
0.75	20.8	0.4	13.14	741	20.7	0.4	11.07	746
0.87b	20.8	0.4	11.38	742				
1.00					20.3	0.4	11.75	740
1.25					20.2	0.4	12.15	739
1.50					20.1	0.4	12.20(134)	739
1.75b					20.0	0.4	10.02	738
2.00								
	Railroad Trestle 1546 hr				**Mouth of Noble Gulch** 1503 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)(% sat.)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)(%sat.)**	**umhos**
0.00	21.5	0.4	10.92	759	21.7	0.4	10.63	762
0.25	21.5	0.4	10.77	759	21.5	0.4	10.52	761
0.50	21.1	0.4	10.90	754	21.1	0.4	10.44	752
0.75	21.0	0.4	11.12	750	20.8	0.4	10.13	751
1.00	20.5	0.4	12.61(141)	749	19.5	0.4	11.52(126)	729
1.25b	19.9	0.4	14.01	748	19.9 bott@15 ft from NG	0.7 bott@15 ft from NG	0.75 bott@15 ft from NG	1340 bott@15 ft from NG
1.37b	19.9	0.4	12.9	745				
1.50					23.7@ 10 ft from NG	3.4@ 10 ft from NG	15.81@ 10 ft from NG	6017@ 10 ft from NG
1.67b					25.0@ 10 ft from NG	5.3@ 10 ft from NG	15.43@ 10 ft from NG	9427@ 10 ft from NG

	Nob Hill			1711 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**
	18.2	0.4	8.58(91)	653				

4 August 2018.

Station 1: Flume at 1622 hr. Underwater portal partially closed. Water surface 0.1 ft above flume. Reach 1- 87 gulls bathing; 12 adult mallards plus 1 female and 1 YOY begging at Margaritaville; 1 mallard roosting at Venetian Court margin. 1 boy fishing at Venetian Court. No surface algae. 50% pondweed with algae 1-4 ft thick, averaging 3 ft. 5% bottom algae 0.5-2 ft thick, averaging 1.5 ft; remaining margins with algal film.

Station 2: Stockton Avenue Bridge at 1606 hr. Reach 2- 8 mallards. No surface algae. 90% bottom algae 0.5-1.5 ft thick; avg 1 ft. 10% pondweed with algae 2-4 ft thick, avg 3 ft.

Station 3: Railroad trestle at 1546 hr. Reach 3- No surface algae. 95% bottom algae 0.2- 4 ft thick; avg 0.8 ft. 5% pondweed with algae 1-3 ft thick, avg 2 ft. 17 adult mallards plus 1 female and 1 YOY.

Station 4: Mouth of Noble Gulch at 1503 hr. No surface algae. 15% of bottom covered by algae 2–3ft thick, averaging 2 ft. No gray water. Black crown night heron roosting near Shadow Brook Restaurant.

Station 5: Nob Hill at 1500 hr. Water temperature 1.5-2.5 C cooler than lagoon and 2 C cooler than 2 weeks earlier. 2.4 cfs at Soquel Village

			18-Aug-2018					
	Flume 0733 hr				**Stockton Avenue Bridge** 0747 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)(% sat,)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)(% sat.)**	**umhos**
0.00	20.3	0.4	11.14	725	20.4	0.4	10.72	714
0.25	20.4	0.4	11.29	739	20.4	0.4	10.71	745
0.50	20.4	0.4	11.46	739	20.4	0.4	10.59	745
0.75	20.3	0.4	11.34	739	20.4	0.4	10.03	744
1.00b	20.4	0.4	10.84	741	20.3	0.4	10.39	744
1.25					20.4	0.4	10.59	744
1.50					20.4	0.4	9.86(109)	744
1.75b					20.4	0.4	8.52	742
2.00								
	Railroad Trestle 0759 hr				**Mouth of Noble Gulch** 0813 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)(% sat.)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)(% sat.)**	**Cond 4 umhos**
0.00	20.2	0.4	9.62	738	19.7	0.4	9.00	734
0.25	20.2	0.4	9.67	745	19.8	0.4	8.74	739
0.50	20.2	0.4	9.62	744	19.8	0.4	8.92	741
0.75	20.2	0.4	9.63	744	19.8	0.4	8.90	739
1.00	20.2	0.4	9.59	744	19.7	0.4	8.79(97)	738
1.25b	20.2	0.4	9.60(106)	744	20.0 bott@15 ft from NG	0.4 bott@15 ft from NG	2.05 bott@15 ft from NG	806 bott@15 ft from NG
1.50b	20.3	0.4	8.32	745	22.5@ 10 ft from NG	2.1@ 10 ft from NG	10.77@ 10 ft from NG	3715@ 10 ft from NG

1.65b					22.8@ 10 ft from NG	3.0@ 10 ft from NG	9.64@ 10 ft from NG	5236@ 10 ft from NG
	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**
	16.8	0.4	8.40(87%)	620				

18 August 2018. Gage height of 2.55 (morning) and 2.55 (afternoon). Overcast/foggy at 0733 hr with air temperature of 13.3 ° C at flume. Air temperature 17.5 ° C at 1549 hr at flume; clear and breezy. Flume inlet 2.0 ft deep. Flume outlet 0.3 ft deep and mostly obstructed with incoming tide in afternoon. Water temperatures generally 1.5-2 °C warmer in afternoon than in the morning.

Station 1: Flume at 0733 hr. Reach 1- In water 19 gulls bathing; 4 mallards in water; 3 mallards and 2 mergansers at Venetian margin. A large juvenile steelhead hit surface. No surface algae.
Station 2: Stockton Avenue Bridge at 0747 hr. Secchi depth to the bottom. Reach 2- no waterfowl. No surface algae.
Station 3: Railroad trestle at 0759 hr. Reach 3- 6 mallards. <1% surface algae.
Station 4: Mouth of Noble Gulch at 0813 hr. No surface algae. No gray water.
Station 5: Nob Hill at 0855 hr. Water temperature 0.6°C warmer than 2 weeks earlier. 2.1 cfs at Soquel Village.

			18-Aug-2018					
	Flume 1549 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**		**(ppt)**	**(mg/l)**	**Umhos**
0.00	21.9	0.4	13.26	762	21.3	0.4	11.73	754
0.25	21.9	0.4	13.68	761	21.4	0.4	11.81	757
0.50	21.9	0.4	14.92	762	21.4	0.4	11.82	757
0.75	21.7	0.4	14.68(167)	756	21.3	0.4	11.68	757
1.00b	21.7	0.4	14.03	753	21.2	0.4	11.69	753
1.25					21.2	0.4	11.52	755
1.50					21.1	0.4	11.39(129)	754
1.75b					20.8	0.4	9.38	753
2.00								
	Railroad Trestle 1518 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	21.2	0.4	12.08	761	21.6	0.4	10.11	760
0.25	21.3	0.4	11.86	763	21.5	0.4	9.89	759
0.50	21.3	0.4	11.89	763	21.0	0.4	9.87	759
0.75	21.3	0.4	11.94	763	20.7	0.4	11.06	768
1.00	21.3	0.4	11.98	763	20.6	0.4	10.79	767
1.25b	21.2	0.4	12.25(138)	761	20.6 bott@15 ft from NG	0.4 bott@15 ft from NG	9.09 bott@15 ft from NG	816 bott@15 ft from NG

1.50b	21.1	0.4	11.58	757	22.4@ 10 ft from NG	1.3@ 10 ft from NG	12.96(151) @ 10 ft from NG	2388@ 10 ft from NG
1.65b					23.8@ 10 ft from NG	2.7@ 10 ft from NG	9.69@ 10 ft from NG	4912@ 10 ft from NG
	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**
	18.4	0.4	9.49(101)	643				

18 August 2018.

Station 1: Flume at 1549 hr. Reach 1- 28 gulls bathing; 3 mallards initially and 10 mallards (8 sub-adults) later. No surface algae; approximately 70% pondweed with algae 3-4 ft thick. Cannot see bottom to estimate algae because becoming overcast. 1 pedal boat; 1 paddle boarder; 5 waders (2 swimmers).
Station 2: Stockton Avenue Bridge at 1535 hr. Reach 2- No surface algae. 10% pondweed with algae 3-4 ft thick near Stockton Bridge; 90% bottom algae 1-2 ft thick, averaging 1.5 ft. 8 mallards in water.
Station 3: Railroad trestle at 1518 hr. Reach 3- 1% pondweed with algae 3-4 ft thick; 99% bottom algae 2-4 ft thick, averaging 3 ft. No surface algae. 3 adult mallards plus 1 female and 1 YOY. 1 canoe and 4 kayaks.
Station 4: Mouth of Noble Gulch at 1500 hr. No surface algae. 100% bottom algae 0.5-2 ft thick, averaging 0.7 ft.
Station 5: Nob Hill at 1635 hr. Water temperature 2-2.5 °C cooler than the lagoon and 0.2 C warmer than 2 weeks earlier.

			2-Sep-2018					
	Flume 0700 hr				**Stockton Avenue Bridge** 0714 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	0.4	10.27	727	19.6	0.4	10.43	723
0.25	19.5	0.4	10.56	724	19.6	0.4	10.51	731
0.50	19.5	0.4	10.46	725	19.7	0.4	10.35	731
0.75b	19.5	0.4	10.16	725	19.7	0.4	9.19	732
1.00					19.7	0.4	10.18	732
1.25					19.7	0.4	10.30	732
1.50					19.7	0.4	10.16(111)	732
1.75b					19.7	0.4	7.91	733
2.00								
	Railroad Trestle 0735 hr				**Mouth of Noble Gulch** 0753 hr			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00	19.3	0.4	9.09	716	18.9	0.4	8.25	714
0.25	19.4	0.4	9.08	733	19.0	0.4	8.24	723
0.50	19.4	0.4	9.16	732	19.0	0.4	8.25	723
0.75	19.4	0.4	9.11	732	19.0	0.4	8.11	723
1.00	19.4	0.4	9.09	732	19.0	0.4	8.25	722

1.25b	19.3	0.4	8.72(95)	732	20.2 bott@15 ft from NG	0.8 bott@15 ft from NG	6.72(89) bott@15 ft from NG	1421 bott@15 ft from NG
1.50b	19.4	0.4	7.90	733	19.7@ 10 ft from NG	0.5@ 10 ft from NG	12.80(142) @ 10 ft from NG	957@ 10 ft from NG
1.65b					22.3@ 10 ft from NG	2.6@ 10 ft from NG	11.23@ 10 ft from NG	4604@ 10 ft from NG
	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**
	16.5	0.4	8.54	628				

2 September 2018. Gage height of 2.57 (morning) and 2.58 (afternoon). Overcast. At 0700 hr- air temperature of 13.5 ° C. Cool afternoon air temperature 16.2 ° C at 1605 hr and overcast. Very limited increase in water temperature during the day, usually less than 0.5 C.
Station 1: Flume at 0700 hr. Reach 1- 9 gulls; 12 mallards roosting on Venetian Court periphery- later 8 went into water. No surface algae. 1 pedal boat.
Station 2: Stockton Avenue Bridge at 0714 hr. Reach 2-16 mallards attracted to pedal boat (most from Reach 1); 1 mallard roosting on trestle abutment. Kingfisher overhead. 3 black-crowned night herons in redwood and birch at windmill house next to trestle. No surface algae. 1 pedal boat passing through.
Station 3: Railroad trestle at 0735 hr. Reach 3-3 mallards roosting on surface wood. 2 mallards in water. No surface algae.
Station 4: Mouth of Noble Gulch at 0753 hr. No surface algae or gray water.
Station 5: Nob Hill at 0848 hr. Water temperature 0.3 C cooler than 2 weeks earlier and 3 C cooler than the lagoon.

			2-Sep-2018					
	Flume 1605 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	20.1	0.4	11.25	734	20.0	0.4	11.31	734
0.25	20.2	0.4	11.46	734	19.9	0.4	11.27	736
0.50	20.1	0.4	11.53(127)	734	19.9	0.4	11.23	735
0.75b	20.1	0.4	11.29	731	19.8	0.4	12.42	733
1.00					19.7	0.4	11.08	732
1.25					19.7	0.4	10.71	733
1.50					19.7	0.4	10.32(113)	734
1.75b					19.7	0.4	10.02	735
2.00								
	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	19.8	0.4	10.16	734	19.6	0.4	8.95	733
0.25	19.8	0.4	10.18	737	19.5	0.4	8.81	728
0.50	19.7	0.4	10.32	736	19.5	0.4	8.57	727
0.75	19.6	0.4	10.91	735	19.2	0.4	8.46	716
1.00	19.6	0.4	10.82	735	19.1	0.4	9.10	724
1.25b	19.5	0.4	11.07(121)	734	20.2 bott@15 ft from NG	0.4 bott@15 ft from NG	12.79 bott@15 ft from NG	778 bott@15 ft from NG
1.50b	19.5	0.4	11.30(73)	735	22.3@ 10 ft from NG	2.7@ 10 ft from NG	14.37@ 10 ft from NG	4816@ 10 ft from NG
1.65b					22.9@ 10 ft from NG	3.5@ 10 ft from NG	13.06@ 10 ft from NG	6120@ 10 ft from NG
	Nob Hill			1640 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	9.80(102)	636				

2 September 2018.

Station 1: Flume at 1605 hr. Reach 1- 31 gulls; 11 mallards; 4 mergansers; 1 coot. 2 waders, 1 kayak, 1 pedal boat, 2 barges moored on beach at pilings. 60% pondweed with algae 3-5 ft thick, averaging 4 ft. 40% bottom algae 0.5-2 ft thick; avg 1 ft. No surface algae.

Station 2: Stockton Avenue Bridge at 1535 hr. Reach 2-1 mallard in water; 25% pondweed with algae 1-3 ft, averaging 2 ft. 75% bottom algae approx. 1 ft thick. 1 inflated boat.

Station 3: Railroad trestle at 1516 hr. Reach 3- 1 mallards in water; 3 mallards on log near Shadow Brook Restaurant. 5% pondweed with algae 1-3 ft thick, averaging 2 ft. 95% bottom algae 1-3 ft thick, avg 2 ft. No surface algae. 1 barge moving downstream and ended up at beach.

Station 4: Mouth of Noble Gulch at 1500 hr. No surface algae or gray water. Cloud of stickleback.

Station 5: Nob Hill at 1640 hr. Water temperature 1.2 °C cooler than 2 weeks earlier and 2-2.5 C cooler than lagoon. Estimated streamflow = 2.4 cfs at Soquel Village.

			16-Sep-2018					
	Flume			0708 hr	**Stockton Avenue Bridge**			0721 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	17.4	0.4	12.36	698	17.7	0.4	12.80	699
0.25	17.5	0.4	12.40	700	17.7	0.4	12.78	705
0.50	17.5	0.4	12.35(130)	700	17.8	0.4	12.74	706
0.75b	17.5	0.4	11.95	700	17.8	0.4	11.50	705
1.00					17.8	0.4	12.59	708
1.25					17.8	0.4	12.60	707
1.50					17.8	0.4	12.76(134)	706
1.75b					17.9	0.4	10.75	707
2.00								
	Railroad Trestle			0740 hr	**Mouth of Noble Gulch**			0855 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	17.6	0.4	11.25	703	17.0	0.4	10.16	705
0.25	17.6	0.4	11.20	706	17.0	0.4	10.11	711
0.50	17.6	0.4	11.15	706	17.0	0.4	10.14	697
0.75	17,6	0.4	11.21	707	17.0	0.4	10.15	697
1.00	17.6	0.4	11.19	707	17.0	0.4	10.27(107)	701
1.25b	17.6	0.4	11.08(116)	707	18.7 bott@15 ft from NG	0.4 bott@15 ft from NG	10.42 bott@15 ft from NG	1174 bott@15 ft from NG
1.50	17.7	0.4	9.50	708	21.1@ 10 ft from NG	2.4@ 10 ft from NG	18.85@ 10 ft from NG	4227@ 10 ft from NG
1.60b					21.4 bott@ 10 ft from NG	2.8 bott@ 10 ft from NG	17.65 bott@ 10 ft from NG	4858 bott@ 10 ft from NG
	Nob Hill			0835 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**
	14.4	0.4	8.48	593				

16 September 2018. Gage height of 2.56 (morning) and 2.56 (afternoon). Clear, cool in morning and clear in afternoon with onshore breeze. Air temperature of 9.1˚ C at 0708 hr and 17.4 ° C at 1556 hr. Flume inlet 2.0 ft and exit 0.2-0.3 ft in afternoon (crack at top of flume outlet).
Station 1: Flume at 0708 hr- Reach 1- 44 gulls bathing (Hermann gulls present), 2 mallards in water, 9 mallards roosting on Venetian Court margin. No surface algae. Flume at 1556 hr- Reach 1- 75 gulls bathing, 9 mallards; 1 adult steelhead observed near Stockton Bridge. No surface algae. 60% pondweed + algae 3-5 ft thick, averaging 4.5 ft thick. 40% bottom algae 0.1-0.5 ft thick, averaging 0.2 ft. 1% surface algae.
Station 2: Stockton Avenue Bridge at 0721 hr- Reach 2 no waterfowl. No surface algae. Reach 2 at 1534 hr-. Secchi depth to bottom. 3 mallards in water; 1 pied-billed grebe. 5% surface algae. 25% pondweed with algae 2-4 ft, averaging 3 ft. 70% of bottom covered with algae 0.5-1.0 ft thick, averaging 0.7 ft thick.
Station 3: Railroad trestle at 0740 hr- Reach 3- 6 mallards; 1 pied-billed grebe. No surface algae. Reach 2 at 1519 hr- 3 mallards, 1 gull, 2 paddle boarders. 3% surface algae (raft downstream of Noble Gulch). 90% bottom algae 0.2-1.0 ft thick, avg 0.5 ft. 10% pondweed with algae 0.5- 3 ft thick, averaging 2.0 ft.
Station 4: Mouth of Noble Gulch at 0755 hr- No surface algae. No gray plume at mouth. At 1500 hr- 10% surface algae. Lack of filamentous algae at mouth of Noble Gulch in 20 ft diameter circle, but planktonic algae present.
Station 5: Nob Hill at 0835 hr. Water temperature in the morning 2 °C cooler than 2 weeks earlier. 0.7 C cooer in afternoon. Streamflow estimate- 1.3 cfs at Soquel Village in the afternoon.

			16-Sep-2018					
	Flume			1356 hr	**Stockton Avenue Bridge**			1534 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	19.3	0.4	16.78	723	19.6	0.4	13.75	732
0.25	19.2	0.4	16.47	718	19.4	0.4	13.71	730
0.50	19.1	0.4	16.65(180)	719	18.9	0.4	13.12	725
0.75b	19.1	0.4	16.56	718	18.7	0.4	13.04	720
1.0					18.5	0.4	12.89	720
1.25					18.5	0.4	12.48	720
1.50					18.4	0.4	12.93(137)	720
1.75b					18.3	0.4	9.12	721
2.00								
	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	20.3	0.4	14.09	745	20.1	0.4	12.44	752
0.25	19.7	0.4	13.49	741	19.6	0.4	12.55	741
0.50	19.3	0.4	13.98	735	19.4	0.4	12.21	737
0.75	19.0	0.4	14.01	728	18.5	0.4	11.54	713
1.00	18.6	0.4	15.54(167)	725	18.3	0.4	12.57(133)	703
1.25b	18.4	0.4	16.06	717	19.4 bott@15 ft from NG	0.5 bott@15 ft from NG	18.36 bott@15 ft from NG	952 bott@15 ft from NG
1.50					21.5 @ 10 ft from NG	2.1@ 10 ft from NG	23.15@ 10 ft from NG	3720 @ 10 ft from NG
1.60					22.4 bott@ 10 ft from NG	2.7 bott@ 10 ft from NG	21.93 bott@ 10 ft from NG	4724 bott@ 10 ft from NG
	Nob Hill			1640 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**
	16.5	0.4	9.77(100)	624				

			29-Sep-2018					
	Flume			0740 hr	**Stockton Avenue Bridge**			0753 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	16.5	0.4	8.69	682	16.7	0.4	9.41	683
0.25	16.5	0.4	8.96	679	16.7	0.4	9.37	685
0.50	16.5	0.4	9.00	682	16,7	0.4	9.25	685
0.75b	16.6	0.4	8.17	682	16.7	0.4	9.20	685
1.00					16.7	0.4	9.21	685
1.25					16.7	0.4	9.23	686
1.50					16,7	0.4	9.23(95)	685
1.75b					16.7	0.4	8.05	686
	Railroad Trestle			0815 hr	**Mouth of Noble Gulch**			0830 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	16.4	0.4	7.48	684	15.7	0.4	8.20	633
0.25	16.4	0.4	7.37	684	15.9	0.4	7.62	669
0.50	16,4	0.4	7.36	684	15.9	0.4	7.74	667
0.75	16.4	0.4	7.34	684	15.9	0.4	7.77	667
1.00	16.4	0.4	7.31	684	15.9	0.4	7.78	667
1.25	16.4	0.4	7.22(74)	684	16.7	0.5	7.90(81)	804
1.37b	16.4	0.4	6.39	684	17.3 bott@15 ft from NG	0.6 bott@15 ft from NG	7.86 bott@15 ft from NG	1006 bott@15 ft from NG
1.50					18.2	1.5	9.02 (96)	2508
1.62b					18.6 bott@ 10 ft from NG	1.9 bott@ 10 ft from NG	7.82 bott@ 10 ft from NG	3085 bott@ 10 ft from NG
	Nob Hill			0907 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**
	15.0	0.4	8.91(88%)	603				

29 September 2018. Wharf to Wharf Race this day. Nautical procession this night. Gage height of 2.59 (morning), cool and partly cloudy and 2.60 (afternoon) clear in afternoon. Air temperature of 12.2˚ C at 0740 hr and 17.1° C at 1600 hr. Flume inlet 1.3 ft and 0.5 ft deep flume exit. Water temp 1 °C warmer in afternoon.

Station 1: Flume at 0740 hr- Reach 1- 50 gulls bathing. No surface algae. Flume at 1600 hr- Reach 1- 1 gull at first because of being frightened by 2 dogs on a barge. Later 36 gulls bathing until a dog paddled from barge chasing 2 mallards. 1 paddle-boarder; 2 waders. 1% surf. Pondweed and fragments. 35% bottom algae 0.5-1.5 ft thick, avg 1.0 ft. 60% pondweed with algae 4-5 ft thick, avg 4.5 ft. Thin algae film on remainder.

Station 2: Stockton Avenue Bridge at 0753 hr- Reach 2- No surface algae. 2 mallards; 2 coots, 2 pied-billed grebes in water. 2 mallards roosting on trestle abutment. 4 kayaks parked in trestle cove- 1 tule damaged. Reach 2 at 1546 hr- No surface algae. No waterfowl. 2 paddle boarders – 1 went to Reach 1 and one to Reach 3. 30% pondweed with algae 2-3 ft thick, averaging 2.5 ft. Unknown % bottom algae about 1 ft thick but bottom dark. < 1% surface algae in fragments.
Station 3: Railroad trestle at 0815 hr- Reach 3- 2 mallards dabbling, 1 mallard perched on unoccupied barge, 4 coots. No surface algae. At 1523 hr- Reach 3- 18 mallards, 1 gull, 9 coots in water. 1 barge with 2 dogs moving downstream with canoe. 2% surface algae fragments; unknown % or thickness of bottom algae due to shaded darkness; 20% pondweed with algae 1-3 ft thick, averaging 1.5 ft. Security staff stationed at either end of railroad tracks on trestle, restricting access in preparation for nautical parade.
Station 4: Mouth of Noble Gulch at 0830 hr- No surf. algae. No gray water plume at mouth. At 1500 hr- No surface algae; 15% pondweed with algae 2-3 ft thick, averaging 2.5 ft. Remainder of bottom invisible due to glare.
Station 5: Nob Hill at 0907hr- Water temperature 0.6 C warmer in the morning than 2 weeks earlier, with similar oxygen concentration. But water temperature was similar in the afternoon compared to 2 weeks previously. – 1.9 cfs in Soquel Village in the afternoon.

			29-Sep-2018					
	Flume			1600 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	18.7	0.4	12.23	712	18.3	0.4	11.40	707
0.25	18.7	0.4	12.78	712	18.3	0.4	11.32	707
0.50	18.6	0.4	14.14(149)	698	18.0	0.4	10.95	705
0.75	18.8	0.4	13.24	693	17.7	0.4	11.02	700
1.00					17.6	0.4	10.66	698
1.25					17.2	0.4	10.86	695
1.50					17.2	0.4	10.85	692
1.75b					17.1	0.4	9.94	692
2.00								
	Railroad Trestle			1523 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	18.1	0.4	10.73	710	18.6	0.4	9.85	720
0.25	18.0	0.4	10.79	705	18.5	0.4	9.53	712
0.50	18.0	0.4	10.76	705	17.9	0.4	9.12	705
0.75	17.7	0.4	10.76	704	17.0	0.4	10.96	690
1.00	17.6	0.4	11.54	700	17.0	0.4	11.06	690
1.25	17.3	0.4	12.92(135)	694	16.9	0.4	9.95(103)	689
1.35b					17.9 bott@15 ft from NG	0.5 bott@15 ft from NG	12.46 bott@15 ft from NG	945 bott@15 ft from NG
1.50b	17.2	0.4	12.09	690	18.9@ 10 ft from NG	1.4@ 10 ft from NG	12.20@ 10 ft from NG	2324@ 10 ft from NG
1.60b					19.7 bott@ 10 ft from NG	1.8 bott@ 10 ft from NG	14.14 bott@ 10 ft from NG	3082 bott@ 10 ft from NG

	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**
	16.4	0.4	9.16 (93%)	608				

29 September 2018. Nautical Procession. Four floats took part in a nighttime procession in Soquel Lagoon. The lagoon water level was maintained during the event. 3 floats were powered by electric motor. One was powered by 2 kayaks. 7 water marshals were present in kayaks. Security staff prevented pedestrian traffic and viewing from the top of the trestle due to safety concerns. Police officers were observed patrolling the walk path beside the lagoon prior to the procession. Mallards swam near the floats and seemed comfortable until one float began rotating quickly in a circle under the trestle. Nearby mallards were then startled and took flight over the crowd. Previously during the past couple of summers (and earlier that day), streamside residents regularly traversed the lagoon on a barge and sometimes fed the ducks that followed them. The mallards may have been swimming near the floats in hopes of being fed during the procession.

There were no mishaps in the lagoon during or after the procession that might lead to wading in the lagoon. The well lit water marshals focused on the lower lagoon, downstream of the Stockton Bridge, where the float traffic was more complex.

1 October 2018. Lagoon Observations after Nautical Parade. No parade debris was observed in the lagoon. A Zodiac style rubber boat with Yamaha outboard motor and gas container was observed tied to the bulkhead in the lagoon above the Stockton Bridge. We were informed that it would be removed shortly when we inquired about it at City Hall.

			7-Oct-18 immediately prior to fish sampling					
	Flume				**Stockton Avenue Bridge**			0802 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)(% sat.)**	**umhos**
0.00					18.5	0.4	10.25	733
0.25					18.6	0.4	10.12	734
0.50					18.6	0.4	10.33	735
0.75					18.6	0.4	10.34	735
1.00					18.6	0.4	9,27	735
1.25					18.6	0.4	10.12	735
1.50					18.6	0.4	10.11(108)	736
1.75b					18,6	0.4	9.15	736
2.00								
	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								
1.05b								
1.18b								
1.25								

7 October 2018. Monitoring prior to fish sampling.

			13-Oct-2018					
	Flume			0732 hr	**Stockton Avenue Bridge**			0745 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	16.6	0.4	9.37	711	16.8	0.4	9.24	713
0.25	16.6	0.4	9.46	713	16.9	0.4	9.16	715
0.50	16.6	0.4	9.63(99)	713	16.9	0.4	9.16	715
0.75b	16.6	0.4	9.16	714	16.9	0.4	8.73	715
1.00					16.9	0.4	9.00	714
1.25					16.9	0.4	8.87	717
1.50					16.9	0.4	8.82(91)	715
1.75b					17.0	0.4	7.59	718
2.00								
	Railroad Trestle			0803 hr	**Mouth of Noble Gulch**			0817 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	16,7	0.4	7.46	706	16.4	0.4	7.93	700
0.25	16.7	0.4	7.38	708	16.4	0.4	7.95	700
0.50	16.7	0.4	7.39	709	16.4	0.4	7.93	700
0.75	16.7	0.4	7.39	709	16.4	0.4	7.90	700
1.00	16.7	0.4	7.42	709	16.4	0.4	7.93(81)	698
1.25	16.7	0.4	7.35(76)	709	17.2	0.6	8.93(93)	977
1.37b					17.9 bott@15 ft from NG	1.3 bott@15 ft from NG	8.15 bott@15 ft from NG	2224 bott@15 ft from NG
1.50b	16.7	0.4	5.86	710	19.0@ 10 ft from NG	2.1@ 10 ft from NG	11.71@ 10 ft from NG	3516@ 10 ft from NG
1.63b					19.2 bott@ 10 ft from NG	2.5 bott@ 10 ft from NG	9.81 bott@ 10 ft from NG	4079 bott@ 10 ft from NG
	Nob Hill			0907 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**
	14.6	0.4	8.00	623				

13 October 2018. Gage height of 2.60 (morning) with cool, clear, calm (morning) and 2.64 (afternoon) clear with wind gusts in afternoon. Air temperature of 9.8° C at 0732 hr and 15.6 ° C at 1603 hr. Flume closed in afternoon.

Station 1: Flume at 0732 hr- Reach 1- 37 gulls bathing, 2 mallards roosting at Venetian Court margin. No surface algae. Flume at 1603 hr- Reach 1- 33 gulls bathing and 1 mallard in water with no one eating on patio at Margaritaville. No surface algae. 25% bottom algae about 0.5 ft thick. 65% pondweed with

algae 3-5 ft thick, avg 4 ft. Thin algae film on remainder.
Station 2: Stockton Avenue Bridge at 0745 hr- Reach 2- 7 coots in water, 2 mallards roosting on trestle abutment, 2 mallards and 2 pied billed grebes in water . No surface algae. Reach 2 at 1545 hr- Secchi depth to bottom. 5 mallards and 1 pied-billed grebe in water. No surface algae. Too shaded to see vegetation on bottom.
Station 3: Railroad trestle at 0803 hr- Reach 3- 12 mallards dabbling, 21 coots, 5 mallards roosting on bulkhead and a lagoon-side patio. No surface algae. At 1520 hr- Reach 3- 24 coots, mallards and 1 pied-billed grebes in water. No surface algae. Too shaded to see vegetation on bottom.
Station 4: Mouth of Noble Gulch at 0807 hr- No surf. algae. No gray water plume at NG mouth. At 1500 hr- still no gray water. 90% bottom algae about 1 ft thick; 10% pondweed with algae 3 ft thick.
Station 5: Nob Hill at 0856 hr- Water temperature 0.4°C cooler in morning than 2 weeks earlier and 0.9 C cooler in the afternoon (1648 hr) than before, increasing only 0.9 C during the day. 1.9 cfs in afternoon.

			13-Oct-2018					
	Flume			1603 hr	**Stockton Avenue Bridge**			1545 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	18.3	0.4	13.21	747	18.2	0.4	10.61	734
0.25	18.2	0.4	13.85	747	18.1	0.4	10.35	733
0.50	18.2	0.4	13.66(145)	744	18.0	0.4	10.06	730
0.75b	18.2	0.9	10.74	1474	17.7	0.4	9.77	727
1.00					17.4	0.4	9.65	721
1.25					17.3	0.4	9.59	719
1.50					17.3	0.4	9.42(98)	718
1.75					17.2	0.4	8.80	716
1.85b					17.2	0.4	8.29	716
	Railroad Trestle			1520 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	18.1	0.4	10.05	731	18.3	0.4	8.88	729
0.25	18.1	0.4	10.05	732	18.3	0.4	8.81	728
0.50	18.1	0.4	9.93	732	18.0	0.4	8.95	720
0.75	17.9	0.4	9.72	730	17.6	0.4	8.96	712
1.00	17.6	0.4	10.86	727	17.1	0.4	8.68	703
1.25	17.4	0.4	11.07(116)	728	17.2	0.4	9.73(101)	757
1.37b					18.0 bott@15 ft from NG	0.6 bott@15 ft from NG	20.28 bott@15 ft from NG	1031 bott@15 ft from NG
1.50b	17.3	0.4	11.29	721	19.2@ 10 ft from NG	1.6@ 10 ft from NG	18.55@ 10 ft from NG	2740@ 10 ft from NG
1.63b					19.9 bott@ 10 ft from NG	2.4 bott@ 10 ft from NG	20.01 bott@ 10 ft from NG	4025 bott@ 10 ft from NG

	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**
	15.5	0.4	8.42 (85%)	631				

			14-Oct-18 immediately prior to fish sampling					
	Flume				**Stockton Avenue Bridge**			0812 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)(% sat.)**	**umhos**
0.00					17.0	0.4	11.61	716
0.25					17.1	0.4	11.58	719
0.50					17.1	0.4	11.50	719
0.75					17.1	0.4	11.59	719
1.00					17.1	0.4	10.87	719
1.25					17.1	0.4	11.42	719
1.50					17.1	0.4	11.50 (119%)	719
1.75b					17.2	0.4	7.17	744
2.00								
	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								
1.05b								
1.18b								
1.25								

14 October 2018. Monitoring prior to fish sampling.

			27-Oct-2018					
	Flume			0752 hr	**Stockton Avenue Bridge**			0806 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	14.7	0.4	10.65	660	14.9	0.4	10.61	663
0.25	14.7	0.4	11.06	660	15.0	0.4	10.71	666
0.50	14.7	0.4	11.00	660	15.0	0.4	10.75	666
0.75	14.7	0.4	10.97(107)	657	15.0	0.4	9.80	666
0.80b	14.7	0.4	10.60	659				
1.00					15.1	0.4	10.33	669
1.25					15.0	0.4	10.59	667
1.50					15.0	0.4	10.62(106)	667
1.75b					15.0	0.4	10.26	667
	Railroad Trestle			0822 hr	**Mouth of Noble Gulch**			0834 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	14.9	0.4	9.39	663	14.6	0.4	9.48	651
0.25	14.8	0.4	9.30	664	14.6	0.4	9.51	658
0.50	14.9	0.4	9.28	665	14.5	0.4	9.63	654
0.75	14.8	0.4	9.35	664	14.5	0.4	9.59	654
1.00	14.8	0.4	9.28	664	14.5	0.4	9.53	654
1.25	14.8	0.4	9.30(92)	664	15.0	0.5	9.31(90)	803
1.30b					15.6	0.7	7.99	1090
1.50	14.9	0.4	8.96	664	16.6	1.5	8.86	2381
1.68b					16.9	1.9	7.92	2964
	Nob Hill			0910 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**
	13.8	0.4	8.46 (82%)	591				

27 October 2018. Gage height of 2.60 and clear in morning) and clear and 2.68, clear and breezy in afternoon. Air temperature of 10.1˚ C at 0752 hr and 16.5 ° C at 1601 hr. Flume outlet buried in sand in the afternoon with flume inlet submerged.

Station 1: Flume at 0752 hr- Reach 1- 47 gulls bathing, 10 coots, 5 mallard, 1 pied-billed grebe in water. No surface algae. Flume at 1601 hr- Reach 1- 187 gulls bathing, 4 coots, 2 mallards, 1 egret on Venetian Court margin. 40% pondweed with algae 2-4 ft thick, averaging 3 ft. 55% bottom algae 0.5-1.5 ft thick, averaging 1.0 ft; thin film over remainder.

Station 2: Stockton Avenue Bridge at 0806 hr- Reach 2- 23 coots in water, 7 mallards in water- 2 male mallards fighting over a female. No surface algae. Reach 2 at 1547 hr- Secchi depth to bottom. 4 mallards, 9 coots, 2 pied-billed grebes, 1 gull. 40% pondweed with algae 204 ft thick, avg 3.0 ft. 60% bottom algae 0.2-1.0 ft thick, averaging 0.5 ft.

Station 3: Railroad trestle at 0834 hr- Reach 3- 6 mallards dabbling, 114 coots, 1 pied billed grebe. No surface algae. At 1530 hr- Reach 3- 3 mallards, 126 coots in water. No surf. Algae. 10% pondweed with algae 1-4 ft thick, avg 2 ft. 90% bottom algae 0.2-1.0 ft thick, avg 0.4 ft.

Station 4: Mouth of Noble Gulch at 0834 hr- No surf. algae. No gray water plume at mouth. At 1501 hr- No gray water. No surface algae. 90% bottom algae 1 ft thick; 10% pondweed with algae 3 ft thick.
Station 5: Nob Hill at 0910 hr- Water temperature 0.8 °C cooler than 2 weeks earlier in the morning. Stream 1 C cooler than lagoon. Nob Hill at 1501 hr- Water temperature 0.2 ˚C cooler than 2 weeks earlier and increasing 1.5 C during day. Stream 0.5-1 C cooler than lagoon. 1.9 cfs at Soquel Village.

			27-Oct-2018					
	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	16.4	0.4	17.82	683	16.3	0.4	13.86	685
0.25	16.3	0.4	18.84	680	16.1	0.4	13.55	682
0.50	16.2	0.4	18.81	682	16.0	0.4	13.08	679
0.75b	16.2	0.4	20.74	711	15.7	0.4	12.29	678
1.00					15.6	0.4	11.91	674
1.25					15.5	0.4	11.82	674
1.50					15.4	0.4	11.68(117)	673
1.75b					15.4	0.4	10.36	673
2.00								
	Railroad Trestle			1530 hr	**Mouth of Noble Gulch**			1501 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	17.3	0.4	13.26	710	16.6	0.4	12.43	686
0.25	16.8	0.4	13.01	696	16.2	0.4	12.30	671
0.50	16.3	0.4	12.53	690	16.1	0.4	12.46	677
0.75	15.9	0.4	12.92	682	15.9	0.4	12.45	673
1.00	15.6	0.4	13.02	682	15.6	0.4	12.85(130)	666
1.25	15.5	0.4	13.29(133)	682	15.6	0.4	12.34	676
1.30b					16.6	0.6	28.14	959
1.50	15.4	0.4	13.06	627	17.0	1.4	21.23	2211
1.67b					17.8	2.0	20.31	3186
	Nob Hill			1636 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**
	15.3	0.4	9.50(95)	623				

			11-Nov-2018					
	Flume			0719 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	10.9	0.4	7.88	624	11.2	0.4	8.09	625
0.25	11.0	0.4	7.94	628	11.3	0.4	7.98	631
0.50	11.0	0.4	7.93(72)	628	11.3	0.4	7.99	632
0.75	11.0	0.4	7.75(70)	628	11.3	0.4	7.94	633
0.82b	11.0	0.4	6.82	628				
1.00					11.3	0.4	7.94	632
1.25					11.3	0.4	7.90	633
1.50					11.3	0.4	7.93	633
1.75					11.3	0.4	7.87(72)	633
1.80b					11.4	0.4	7.58	7.58
	Railroad Trestle			0750 hr	**Mouth of Noble Gulch**			0805 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	11.1	0.4	7.49	625	10.8	0.4	7.95	570
0.25	11.1	0.4	7.45	628	10.8	0.4	7.93	609
0.50	11.1	0.4	7.43	628	10.9	0.4	7.97	618
0.75	11.1	0.4	7.44	628	10.9	0.4	7.91	622
1.00	11.1	0.4	7.46	628	11.0	0.4	7.95(72)	655
1.25	11.2	0.4	7.43(68)	629	11.4	0.5	7.33(67)	716
1.32b					12.8	0.8	6.32	1160
1.50b	11.2	0.4	7.38	629	13.6	0.9	5.76(55)	1355
1.67b					14.3	1.6	4.26	2484
	Nob Hill			0838 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**
	9.5	0.4	8.80(77)	513				

11 November 2018. Gage height of 2.66 (morning) clear, cool, smoky, breezy. Gage height 2.62 (afternoon) clear. Air temperature of 3.2˚ C at 0719 hr and 12.8 ° C at 1558 hr. Flume inlet 1.0 ft and flume exit 0.5 ft in afternoon.

Station 1: Flume at 0719 hr- Reach 1- 27 gulls bathing, 67coots, 2 mallards and 5 coots standing on Venetian Court margin. No surface algae. Flume at 1554 hr- Reach 1- 57 gulls bathing, 88 coots and 10 mallards in water. No surface algae. Bottom invisible in shade.

Station 2: Stockton Avenue Bridge at 0734 hr- Reach 2- 44 coots and 3 mallards in water. 8 mallards and 2 coots on trestle abutment. No surface algae. Reach 2 at 1543 hr- Secchi depth to bottom. 10 mallards moved up from Reach 1. 33 coots, 3 gulls in water. No surface algae. Bottom invisible because in shade.

Station 3: Railroad trestle at 0750 hr- Reach 3- 4 mallards dabbling, 24 coots, 1 pied-billed grebe. No surface algae. At 1530 hr- Reach 3- 23 coots and 5 mallards. 1 canoe moving down the lagoon. No surface algae. Bottom invisible in shade.

Station 4: Mouth of Noble Gulch at 0805 hr- No surface algae. No gray water plume at mouth. At 1504 hr- No surf.ace algae and no gray water plume. Bottom invisible in shade.
Station 5: Nob Hill at 0838 hr- Water temperature 3.3 °Cooler than 2 weeks earlier on a relatively cold morning and 1-1.5 C cooler than lagoon. Nob Hill at 1628 hr- Water temperature 5 ˚ C cooler than 2 weeks earlier in the afternoon and 0.5-1 C cooler than the lagoon. 1.4 cfs in afternoon at Soquel gage.

			11-Nov-2018					
	Flume			1554 hr	**Stockton Avenue Bridge**			1543 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	12.6	0.4	14.47	650	12.2	0.4	12.85	647
0.25	12.4	0.4	15.84	650	12.2	0.4	12.76	644
0.50	12.4	0.4	16.02(150)	645	12.2	0.4	12.75	644
0.75	12.4	0.4	15.42	644	12.2	0.4	11.67	644
1.00					12.1	0.4	11.06	644
1.25					11.7	0.4	9.28	638
1.50					11.7	0.4	9.23(85)	638
1.75b					11.7	0.4	8.59	637
2.00								
	Railroad Trestle			1530 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	12.1	0.4	11.98	646	12.1	0.4	11.76	661
0.25	12.0	0.4	11.65	639	12.0	0.4	11.67	625
0.50	12.0	0.4	11.52	637	11.9	0.4	11.71	619
0.75	11.9	0.4	11.44	635	11.8	0.4	11.57	622
1.00	11.7	0.4	11.21	633	11.4	0.4	10.67	618
1.25	11.7	0.4	11.08(102)	630	11.5	0.4	11.81(107)	617
1.30b					12.7	0.4	13.12	716
1.50b	11.6	0.4	10.53	632	14.5	0.4	25.03	717
1.67b					14.9	0.4	11.81	1910
	Nob Hill			1628 hr				2991
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**
	10.5	0.4	11.53	548				

23 November 2018. Facilitated Sandbar Breach. Fish biologist was notified by Kotila of Capitola Public Works at approximately 0030 hr that the lagoon water surface was rising quickly and flooding was imminent without a facilitated breach. 4 boards had been previously removed from the flume inlet with the inlet screened prior to the storm. Alley arrived at the lagoon at 0126 hr. Kotila had performed a facilitated breach at 0045 hr prior to arrival with a water sample taken at 0030 hr. The lagoon surface had risen quickly to above the first bolt on the piling prior to breaching. Kotila surmised that the flume had become blocked with sand due to the high tide, causing the rapid rise in lagoon water surface. The inner berm was breached initially to pond water on the beach, followed by breaching of the outer berm. At the time of arrival of the biologist, the wetted channel through the beach was approximately 30 feet wide. The biologist left at 0150 hr. Kotila collected a water sample at 0730 hr and delivered 2 samples to Monterey Analytical. Streamflow at Soquel Village gage-

26.4 cfs at 0000 hr;
26.4 cfs at 0030 hr;
34.8 cfs at 0045 hr;
38.4 cfs at 0115 hr
22.1 cfs at 0145 hr;
12.3 cfs at 0800 hr.

Streamflows are provisional and subject to change. Streamflow at the lagoon was somewhat higher than in Soquel Village due to surface runoff in Capitola and contributions from Noble Gulch.

Lab analysis indicated that the pre-breach enterococcus bacterial count was 435 cfu/100 ml. The post-breach count was 96 cfu/100 ml, allowing a cessation of additional water sampling.

APPENDIX B. 2018 Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon.

2018 DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK			
RESTAURANT	INITIAL CONTACT	TEST DATE	COMMENTS
MY THAI BEACH	Proopimol 4-6-18 831 466 3800	4-25-18	Test approves. NM
BAY BAR Note: NM. Bay Bar refused to Take my notice. 4-6-18.		4-20-18	Test approved. NM
PIZZA MY HEART	BRITTENY 4-6-18 831-475-5714	4-20-18	Test approved. NM
SAND BAR	4/6/18 Benton Shanley 831-462-1881	@4-16-18 Approved.	Test OK. NM 04-16-18
PARADISE BAR & GRILL	4-6-18 D Bonilla Manager	4-9-18 Approved.	Test OK. NM 5-9-18.
ZELDA'S	4-6-18. 475-4900	5-14-18	Test OK. NM 5-14-18