D.W. ALLEY & Associates aquatic biology

Soquel Lagoon Monitoring Report- 2014

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ACKNOWLEDGMENTS

Ed Morrison and the Capitola Public Works Department did well in creating and maintaining the lagoon in 2014, despite low stream inflow through the summer. Small, early storms combined with the very low stream inflow offered special challenges. We appreciated 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. The series of small rains in the fall were successfully passed through the flume by skilled personnel until a larger storm came in late November 2014, requiring facilitated breaching.

Regarding the Begonia Festival, the organizers and volunteers effectively dismantled the floats and removed flowers by boat after the Begonia Festival. We thank Nels and Susan Westman again for the loan of their boat for fish censusing. The lagoon inhabitants (wildlife and humans alike) benefitted greatly from Ed Morrison's daily attention to managing the flume inlet as streamflow lessened greatly through the summer.

We were grateful to the volunteers who assisted in the annual fish censusing at the lagoon. There were local residents and Coastal Watershed staff (Laurie Egan and Debie Chirco-MacDonald) and volunteers. Bruce Ashley of the Santa Cruz Fly Fishers and lagoon-side resident, Carla Christensen, assisted. Two interns (now employees) from the County Environmental Health Department, Nathan and Andrew Salazar, helped us on both weekends. Biologists, Josie Moss and Inger Marie Laursen, again provided their positive energy. Chad Steiner was key in setting the seine. Chad brought his father, Warren, and his daughters, Autumn and Lucinda, who helped us in seining and identifying the fish.

Volunteers are greatly appreciated and always very 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

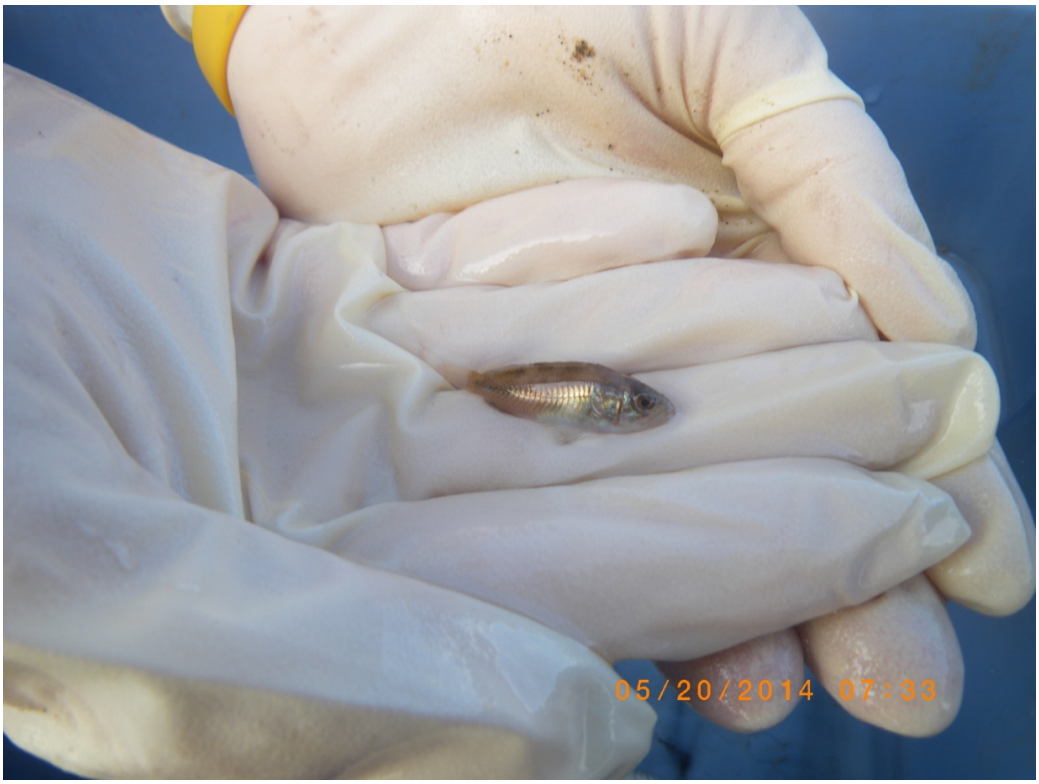
Sandbar Construction. No negative impacts to steelhead were detected during sandbar construction in 2014. Sandbar construction and creation of a freshwater lagoon of maximal depth represented habitat enhancement. Sandbar construction was done prior to Memorial Day weekend in May 2014. Sandbar construction has been permitted by the California Department of Fish and Game (1600-2003-0357-3), the Army Corps of Engineers (25714-0S) and under the National Marine Sanctuary Permit MBNMS-2004-033-A1.

Winter storms had been few and small, occurring from late February to the end of April 2014, during a largely dry winter, and streamflow had declined steadily to approximately 1.5 cfs on 19 May at the Soquel Village USGS gage, the day that sandbar construction activities began. Kelp and seagrass were prominent throughout the lower estuary, downstream of the railroad trestle. The estuary appeared to have been partially filled in by surf action with little winter stormflow. However, the estuary remained deep in 2014, maintaining 2013 conditions, downstream and under the Stockton Bridge and upstream. The estuary was too deep to wade and rake decomposing kelp from the estuary except within approximately 60 feet upstream of the flume inlet. Kelp and seagrass formed a thick layer on the estuary bottom because there had been no spring storms capable of periodically moving vegetative material out of the estuary. As a result, the estuary bottom was soft with decomposing vegetative ooze. The thalweg of the lower lagoon below Stockton Bridge appeared wide and centered. The typical lateral channel across the beach did not exist at the time of sandbar activities in 2014.

On 19 May, the pooled channel through the beach adjacent to Zelda's Restaurant was seined for fish prior to being filled in with sand. Kotila had widened the estuary outlet at the surf line near the flume to slowly drain much of the ponded area. This ponded area had a gradually sloped margin that would not strand fish. The estuary did not extend laterally to the jetty at this time. No steelhead or tidewater goby were captured in the deflected channel. The deflected channel was filled with kelp and seagrass and deep in its upper extent, preventing effective seine hauling except at the periphery of the plant mass. The deflected channel was wide (approximately 30 feet wide). Six staghorn sculpins, 3 threespine sticklebacks and one kelpfish were rescued and relocated approximately 150 feet upstream in the main estuary. On 20 May, four seine hauls were completed along the western margin of the lagoon adjacent to Venetian Courts. Fish captured and relocated to deeper water near Stockton Bridge included 1 adult tidewater goby, 16 staghorn sculpins, 24 threespine sticklebacks, 3 kelpfish, 1 YOY prickly sculpin (*Cottus asper*) and one YOY rock bass.

Approximately 20–25% of the decaying plant material was raked from Reach 1 below Stockton Avenue Bridge during 4 days of raking and 3 artificial openings of the sandbar. In normal years, 70−90% of the plant material is raked out below Stockton Bridge. During the 19−22 May construction activities and daily openings of the sandbar, at the minimum daily estuary water surface elevation, the estuary extended from bulkhead to bulkhead in width up to almost the Shadowbrook Restaurant. Above that the estuary was 20-25 feet wide to where the gradient increased and riffles were present. The estuary drew down slowly at a rate of approximately 1 foot per 90 minutes each day. An estimated 70 percent of the estuary from the beach upstream to the railroad trestle was more than 3 feet in depth at the minimum daily water surface elevation.

Kelpfish captured on 19 and 20 May 2014



Rockbass captured on 20 May 2014

No fish were stranded during estuary fluctuations because there were no estuary sidepools. A remnant of a redwood trunk with rootwad was across from the Noble Gulch confluence and adjacent to the old downed cottonwood.

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 24 of our monitoring and activities associated with sandbar construction. Annual monitoring reports for the first 23 years are available at the City (**Alley 1991-2014**). As stated in the Soquel Lagoon Management and Enhancement Plan (**1990**) and the 2004 Soquel Creek Lagoon Management and Enhancement Plan Update (**2004**), all instream removal of kelp, sea grass and other organic debris was to be accomplished without the use of heavy equipment in the stream channel except within 25 feet of the flume.

The sandbar was closed for the season on 22 May. Plywood had been positioned under the flume pilings and perpendicular to underflow to successfully reduce seepage under the flume during the summer lagoon phase.

The flume outlet was closed to steelhead passage during the period of sandbar construction and until the lagoon filled sufficiently to allow water to flow over the upper, notched board, and smolts had no access to the ocean nightly (7 nights; 20 May – 26 May). With less than 1.5 cfs inflow to the lagoon, the lagoon could not reach the flume inlet after a night of filling. It took 2 days of lagoon filling for lagoon water surface to reach the flume. The lagoon was completely full by 30 May. With the apparent absence of salmonids in the estuary during the sandbar construction period in 2014, it appeared that most of the smolt out-migration was over prior to sandbar construction. The 7-night break in steelhead smolt access to the Bay during sandbar construction and lagoon filling likely had little impact on smolt out-migration.

The shroud was placed over the flume inlet on 27 May to draw residual saltwater out of the lagoon.

Sandbar Breaching. Staff manipulated inlet boards to manage flows from 5 small fall storms through the flume and re-enforced the berm around the lagoon periphery to maintain the sandbar and minimize tidal overwash. A facilitated breaching was completed by Public Works at 1115 hr on 30 November 2014. The inner berm nearest the lagoon margin was overtopped by a quickly rising lagoon water surface before the outer berm was completely notched by Kotila with the wheeled loader. Kotila completed the notch in the outer berm as the inner berm was being overtopped, and the outlet channel overtopped it and entered the Bay. The lagoon level had risen rapidly to within approximately 8 inches of the lower bolt on the piling, which indicates flooding will become eminent, and was rising. The flume inlet was open on one side and the ceiling grate was also receiving water. The flume outlet was completely open on one side. The flume was unable to accept all of the stormflow and was underwater. (The flume capacity is approximately 25−30 cfs.) According to the gage in Soquel Village, 2 miles upstream, streamflow there peaked at 35 cfs at 10:30 am, which was likely significantly less than in Capitola with its impermeable surfaces and urban runoff. Twenty minutes were required before the lagoon level stabilized and

began to recede. By 1150 hr, the estuary level had dropped to within approximately 1 foot of the lower bolt. The outlet channel was approximately 20 feet wide. On 1 December 2014, the estuary remained open with flows at the gage mostly between 15 and 20 cfs. On 2 December 2014, more rain occurred, with streamflow reaching 71 cfs at its peak at the gage in Soquel Village. The estuary remained open. On 3 December 2014, more rain occurred, with stream flow peaking at 203 cfs at the gage in Soquel Village. The estuary remained open for the season.

Stream Inflow to the Lagoon. Stream inflow was considerably below the median and the lowest since the drought years of 1987-92 and 1994. It was insufficient to prevent water temperatures to potentially rise to stressful levels for steelhead. The management goal of maintaining early morning minimum temperature below 20°C near the bottom was not met for 80% of the monitoring period until 13 October. Baseflow at the time of sandbar closure was less than 1.5 cfs (**Table 10**). 2014 had the lowest baseflow on 1 June of the past 24 years of monitoring. By 1 September, prior to any fall rainfall, 2014 streamflow had declined to only 0.35 cfs at the Soquel Village USGS gage. This was the third lowest flow on 1 September in the last 24 years, just above those in 1992 and 1994. Since streamflow is lost between the gage and the lagoon, lagoon inflow was merely a trickle (approximately 0.1 cfs) later in September.

Water Temperature. Lagoon water temperature was within the tolerance range of steelhead in 2014 but was likely stressful much of the summer and early fall. The warmest water temperature was detected in the deepest part of the lagoon below the trestle during the first 4 weeks after sandbar closure due to a temporary saline layer there. Lagoon water temperatures through the summer/fall lagoon phase were the warmest in the last 6 years (commonly in the 21−24˚C range near the bottom) and even warmer than in 2013 except in early September (**Figures 3a−3e**). Warm conditions were likely caused by low stream inflow and consistent warm air conditions (**Figure 3f**). It occurred despite a relatively deep lagoon and good flume management to maximize depth (**Figure 2**). During the last 24 years of monitoring, the 1992, 1994, 2013 and 2014 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. All had relatively dry, previous winters with low summer inflow. Of these, 2014 usually had the warmest early morning water temperatures near the bottom, though 1994 often had warmer afternoon temperatures due to the shallow lagoon (only 1.35 m deep under Stockton Bridge compared to 2.0 m in 2014), which would heat up faster during the day.

Once the bottom saline layer had dissipated in the lagoon, the warmest water temperature measured in 2014 near the bottom in the morning at the deepest station under Stockton Bridge was 23˚C (73.4˚F) on 20 July (**Figure 3b**). The warmest early morning temperatures in 2014 (and second warmest in the past 24 years compared to 24˚C in 1992 at Stockton Bridge) were registered at the mouth of Noble Gulch with 23.1˚C in early and mid-August (**Figure 3g**). The warmest afternoon water temperature recorded in 2014 near the bottom was 24.4˚C on 20 July at the flume (**Figure 3h**). The surface water temperature of 27.7˚C measured at the flume on 20 July was the warmest in 24 years.

In 2014 during 2-week monitoring, *water temperatures near the lagoon bottom in the early morning* were rated "good" (<20°C) at all stations only from 11 October onward (**Tables 2 and 3**). Ratings of "poor" (21.5−23°C) or "fair" (20−21.5°C) were most common. From 20 July to 31 August (4 consecutive monitorings) the ratings were "poor" at all stations.

As in past years, no stratification or lagoon thermocline was detected in 2014 by the data loggers, except in a saline layer during the first 4 weeks after sandbar closure in the deepest pockets of the lagoon. As in past years, lagoon water temperatures near the bottom in 2014 somewhat reflected those of the stream inflow (**Figures 4a-l; 5a-b**), except for 31 May− 23 June, when there was a temporarily warm saline layer along the bottom in the deeper area where the data loggers were deployed. Daily temperature *minima* in the lagoon were consistently warmer near the bottom than the stream inflow (**Table 4**). Stream inflow temperature in 2014 was generally about 4−6°C cooler in the morning and 2−4°C cooler in the afternoon than near the lagoon bottom, with much greater daily fluctuation in the stream than in the lagoon (**Figures 4a and 5a**). Consistently, the difference in 7-day rolling averages, day by day, was also approximately 3−5.5°C warmer in the lagoon near the bottom in the morning compared to that in the stream inflow.

In 2014, the lagoon steelhead management goal of maintaining early morning temperature below 20°C near the bottom was not met on 113 of the 141 days (80%) (**Figure 4a**). Another management goal was to maintain afternoon maximum temperature near the bottom below 22º C (71.6º F) because higher temperatures were likely stressful to juvenile steelhead. In 2014, water temperature rose above 22º C near the bottom at the deepest location on 81 days (57% of the monitoring period).

Aquatic Vegetation. In 2014 at the time of sandbar construction, only approximately 20-25% of the decomposing kelp and seagrass had been raked out of the lower lagoon, and the lagoon bottom was soft with a thick layer of detritus. Therefore, there were considerable nutrients available for plant growth as had been in 2013. With added relatively warm conditions to speed metabolism, thickness of bottom algae and pondweed was greater in all reaches in 2014 compared to 2010−2013, with similar coverage (**Tables 5–9**). Filamentous algae was first noted a week earlier than usual in 2014. In 2014, bottom algae thickness in Reaches 1−3 and at the mouth of Noble Gulch averaged 2.0 ft, 1.8 ft, 1.4 ft and 1.5 ft, respectively (**Table 5**).

Pondweed had the thickest growth in 2014 of the past 6 years. Pondweed was first detected in mid-July, it being initially most prominent in Reaches 2 and 3 in mid-August to mid-September and then later reaching 20−80% coverage and 3−4 ft thickness, on average, in all three reaches by mid-September. Pondweed contributed a higher proportion of the aquatic vegetation in 2014 than previous years, especially in Reaches 2 and 3. It contributed 70–80% of the lagoon coverage in Reach 3 between 16 August and 13 September.

Surface algae with pondweed fragments met a 23-year high in 2014 (since 1990 when it was more), it varying between 0 and 15% in Reach 1, 0 and 30% in Reach 2, 0 and 40% in Reach 3 and 0 and 50% in 2014 at the mouth of Noble Gulch (**Table 5**). Regarding seasonal averages for surface algae (and pondweed fragments), in Reaches 1–3 it was 11.1, 5.9 and 10.9%, respectively. This was compared to averages of only 1.8, 0.6 and 2.5% in 2013. On 20 July 2014, surface algae was at a 23-year high (since 1990) between 30 and 50% coverage in all 3 reaches.

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 the time when oxygen concentrations are most importantly measured and rated.

In 2014, the average oxygen level remained "good" (greater than 7 mg/l at dawn) for steelhead *near the bottom* at all 4 stations during the first 9 of 13 two-week monitorings, except for under Stockton Bridge on the first monitoring due to a stagnant saline layer there (**Table 2; Figure 6a-1**). Then it rained on Friday, 26 September, after which there was a 3-day delay in lowering the lagoon water level so that light could reach photosynthesizing aquatic plants. This caused a depression in oxygen to "poor" and "critical" levels near the bottom on the morning of 28 September, at which time the lagoon level was reduced. By afternoon, oxygen had increased near the surface to the upper "poor" range in Reaches 1 and 2 and into the "fair" range in Reach 3. No steelhead mortality was observed. Mostly "poor" with some "fair" morning oxygen concentrations continued through 11 October (14 days), despite lowering of the lagoon level on 28 September. Fortunately, afternoon oxygen increased in to the "fair" to "good" range above 5 mg/L, fortunately. A problem was that the flume exit was closing up from low inflow, preventing maintenance of a shallower lagoon. Good morning oxygen levels were not detected until 19 October. Low lagoon inflow in 2014 delayed and prevented lagoon water clarity from completely returning after the initial stormflow in late September. In most years, the water turbidity clears up after the first storm with higher stream inflow. It was also difficult to maintain a shallower lagoon level unless the flume exit was manually excavated and opened daily.

Lower 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. In 2014, morning oxygen concentrations were typically higher, on average, than the 3 previous years until the first small stormflow in late September. This was despite lower stream inflow, higher water temperature and more plant life (**Figure 6h**). Afternoon oxygen readings followed a similar pattern (**Figure 6i**).

Salinity Monitoring. In 2014, saline conditions were only detected a short time after sandbar closure (22 May and 21 June) in the deeper lagoon area along the wall at Venetian Court and at Stockton Bridge (**Appendix A**). Warm water was also detected from data loggers in an initially 2 ft (0.7 m) layer along the bottom in the deepest part of the lagoon, downstream of the railroad trestle until 23 June. This indicated that saltwater was also present there. The saline layer was measured at Station 2 until 21 June. Saline conditions resulted from a small amount of saltwater being trapped in the lagoon at the time of sandbar closure on 22 May, which created a stagnant layer along the lagoon bottom that heated up. A shroud was installed on the sandbar inlet on 27 May to pull saltwater off the bottom and out through the flume. No salinity was detected on 21 June at the monitoring stations except for a thin, dilute layer at Stockton Bridge. Despite limited lagoon outflow in 2014, saltwater was not periodically flushed back into the flume on certain high tides. The flume outlet was partially boarded up at the bottom to maintain depth within the flume, which likely inhibited saltwater back flush. A freshwater lagoon was maintained from late June until sandbar breaching on 30 November. No tidal overwash was allowed to occur through the dry season in 2014 with the elevated berm around the lagoon.

Begonia Festival Observations and Water Quality Findings. No negative impacts to fish were detected during the Begonia Festival. The City's fishery biologist (Donald Alley) was present before, during and after the Begonia Festival procession of floats on 31 August. The day of the parade was overcast in the morning and cleared up in late morning. Air temperature at the flume was 15.1°C (59.2°F) at 0705 hr. Water temperatures near the bottom were likely stressfully warm throughout the day for steelhead and rated "poor" (above 21.5˚C) in the morning and were already above 22˚C at 2 of the 4 stations before 0800 hr. Afternoon temperatures went above 23˚C at 3 stations. However, oxygen concentrations were good in the morning and supersaturated in the afternoon at all stations. Lagoon water surface elevation was excellent and maintained relatively high at 2.55−2.57. There were 8 floats and 27 other boats, kayaks and paddle boarders. 1 paddle boarder fell off during the procession. In conformance with the permit requirements from the California Department of Fish and Game, no floats were to be propelled by waders. Means of propulsion could be by towing or use of electric motors. Five floats were electric motor-powered. One float was towed by kayak. One float was towed by paddle boarders. One float was towed by row boat initially and then by electric motor. Thus, the lagoon bottom was undisturbed. Conductivity near the bottom increased very slightly at the Stockton Avenue Bridge from 1223 before to 1238 umhos after the parade. Conductivity at the mouth of Noble Gulch was 1248 umhos near the bottom before the procession and 1298 afterwards. The measured levels of conductivity were not stressful to steelhead, though they were the highest of those measured during the summer/fall season. There was no odor of hydrogen sulfide, and no fish mortality was observed. The secchi depth (water clarity) was to the lagoon bottom after the float procession. Flower petals were collected by Begonia Festival staff and volunteers the following week, and there were more petals left by the parade of floats than the previous year that had only 5 floats.

Floats were dismantled the week following the parade, and flowers were gathered from the lagoon, using a boat. More than 90% of the petals were retrieved. Water quality measurements on 13 September detected no oxygen depletion resulting from decomposing begonias (**Figure 6a-1; Appendix A**).

Fish Sampling. A total of only 10 juvenile steelhead was captured and marked from 6 seine hauls on 12 October, and only 2 unmarked steelhead were captured on 19 October after 6 seine hauls. This made it impossible to estimate population size. There were no mortalities. There were likely few YOY steelhead in the 2014 lagoon due to poor adult passage and spawning conditions and poor egg survival due to low winter/spring streamfows (**Figures 24 and 25**). The 2013 estimate was 1,681 compared to 220 in 2012 and 678 in 2011 (**Table 11; Figure 24**) (methods in **Ricker 1971**). The average for 1993-2013 was 1,599. Other species captured with the large seine were 21 staghorn sculpins and 1 adult Sacramento sucker. Juveniles were scarce in the watershed's stream sampling sites in 2014 (**Alley 2015**). Size histograms for other years of sampling back to 1998 may be found in **Figures 11−23**.

On 19 October 2014, a total of 481 tidewater gobies were captured without mortality. Of those, 251 were <= 25 mm Total Length (TL). 213 were intermediate size between 25 and 40 mm TL. A remaining 17 were => 40 mm TL. Ten tidewater gobies were captured in 2013. Prior to that they were captured in 2008 and 2009 after dry winters. Other fish captured with the small seine

included threespine sticklebacks in high abundance, 4 staghorn sculpins and 1 juvenile steelhead. 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 to be used as refuges during high winter stormflows. This species was plentiful in Soquel Lagoon during the previous drought of the late 1980's and early 1990's and reappeared during the recent two, less severe droughts (2007-2009 and 2013-2014). 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 the two large stormflows in December 2012. They were found in Aptos Lagoon in 2011−2014 (**Alley 2012; 2013; 2014; 2015**).

Pollution Sources and Solutions. No negative impacts to fish were detected from pollution sources in 2014. The lagoon near the beach was closed to human contact due to bacterial levels above the maximum acceptable level. The 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 at Soquel Creek Lagoon would be a major step in reducing pollution. By minimizing the summer stream inflow from Noble Gulch, nutrients and bacteria entering the lagoon would be reduced.

The historical lagoon had large tule beds prior to construction of the bulkheads after 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.

New and Continuing Recommendations and Those Not Yet Fully Implemented

1. 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.

2. Continue to maintain and repair the flume as necessary. Repair the flume at a time that does not obstruct fish passage or require lowering of the lagoon water level.

3. 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. 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.

4. Prior to sandbar breaching in the fall, notch the sandbar across the beach, minimizing the gradient of the notch to slow the evacuation of water through the beach and to minimize

beach erosion. The purpose is to maximize the residual estuary depth after the emergency breach.

5. 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 high tides obliterate it. If a storm is predicted, the sandbar needs a notch as preparation.

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

7. Seek volunteers to re-establish tules in the alcoves under the railroad trestle and 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.

8. Seek funding to secure large woody material to the lagoon bottom with anchor boulders and cabling to bedrock in appropriate locations on the east bank under the railroad trestle or upstream adjacent to the Golino property. This large woody material will provide additional cover and scour deeper habitat to protect juvenile steelhead from predators. Continue to retain large woody material that naturally enters the lagoon.

9. Allow a clear path from under the bridge to the beach at Venetian Courts to enable seining for juvenile steelhead during fall censusing.

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

11. 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 the beach). If the biologist is unavailable during emergency cases, have experienced Public Works staff and Morrison 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.

12. Closing the sandbar in late May is better than mid-June or later because streamflow is sufficient to rapidly fill the lagoon in most years, and the juvenile steelhead most likely to be present in the lagoon in May 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.

13. 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.

14. 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 steelhead 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.

15. 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 Fish and Game 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**).

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

17. Continue to search under the Stockton Avenue Bridge and in Reaches 2 and 3 for stranded fish to rescue as the lagoon drains each day during sandbar construction and raking. It is best to minimize the number of days 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.

18. 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-migrating smolts until 1 July. However, in dry years such as 2007−2009 and 2013−2014, when stream inflow is insufficient to both fill an underwater portal and allow lagoon filling, opt for a larger

notch in the top plank to accommodate adult kelts and smolts in place of the underwater portal for kelts.

19. Maintain the 1-foot high baffle inside the flume until July 1 for safe entrance of out-migrating steelhead smolts into the flume inlet before they enter the Monterey Bay.

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

21. 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 visquine is preferable to black. Key the visquine into the lagoon margin to encourage its retention when the sandbar breaches in the fall.

22. Retrieve visquine from around the flume inlet before or immediately after the fall sandbar breach, if possible.

23. Require that Margaritaville staff not wash the patio and adjacent walkway (containing refuse dumpsters) off into the lagoon.

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

25. Restrict the number/weight of float participants allowed on each floats to a safe level.

26. Continue to disallow wading to propel floats during the Begonia Festival's parade.

27. Recommend to the Begonia Festival organizers that floats be safely maneuvered downstream of Stockton Avenue, with a water marshal present to direct floats around buoys in a circular direction along the periphery of the lagoon after they clear the bridge.

28. Support the ban on alcohol consumption by float participants and rowdy behavior on their floats.

29. Continue to use wedges or plywood on the flume inlet boards to prevent their dislodgment from vandals and back-flushing from the tide, especially in the fall when the beach becomes eroded.

30. If sufficient turbidity occurs after the first small storms of the season to prevent light from penetrating to the bottom of the intact lagoon for more than one day, continue to reduce lagoon depth temporarily to insure that light reaches the bottom. This will prevent death of aquatic vegetation and increased biological oxygen demand, with the associated loss of oxygen production that would have occurred from photosynthesis. Thus, anoxic conditions will be prevented. When the lagoon clears up, re-establish the maximum lagoon depth.

31. If the sandbar is in place after November 15, maintain an opening in the flume inlet

during early, small stormflows to allow early spawning adults to pass through the flume from the Bay.

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

33. Look into installing gull sweeps on restaurant roofs. The stringing of wire above roofs as observed over the Paradise Grill Restaurant should continue and be expanded to other restaurants to successfully prevent gull roosting there.

34. Look into screening the railroad trestle to discourage roosting and nesting by rock doves.

35. As stated in previous reports, if the streamflow in Soquel Creek in the vicinity of Soquel Village approaches the point of losing surface flow, notify Tiedemann Nursery and the Fish and Game Department so that direct water pumping from the stream may be reduced or discontinued until flow returns. Loss of surface flow should be prevented.

36. 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.

37. As stated in the Management Plan (**1990**), make sure that parking lots and streets draining into the lagoon are cleaned before the rainy season. This will reduce the pollutants entering the lagoon during the first storm of the season that are lethal to fish. Street sweepers with water and suction may be necessary. In addition, roadwork such as repaving and application of fresh petrochemicals should be done in the early summer to allow sufficient time for penetration and drying before the rainy season.

38. Just as the first storm of the fall season begins, remove boards from each 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 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. After the stormflow subsides, replace the cover until the next storm.

39. As stated in the 1993 monitoring report, management options to delay sandbar breaching include installation of a perimeter fence around the flume inlet to collect algae. Replace the boards after the stormflow subsides, removing them for each succeeding storm until the sandbar is eventually breached during later, larger storms usually occurring after Thanksgiving. There is now a grated opening on top of the flume inlet.

40. After the first storm of the season with the sandbar still intact, lower the lagoon level to a point where light may penetrate to the lagoon bottom. In doing so, the plant life in the lagoon may continue to photosynthesize and is kept viable. Thus, vegetation mortality and stressfully low oxygen levels are prevented until the water clarity is re-established. Re-install boards to increase lagoon depth after the lagoon clears up.

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

42. If the sandbar breaches early in the rainy season, followed by a period of 2−4 weeks of a reformed sandbar that prevents water exchange with the ocean, attempt to pull the decomposing kelp out of the stagnating lagoon. Open the flume and encourage streamflow out with the shroud installed.

43. If a stagnant, kelp-filled lagoon forms in fall after an early breach and a dry period, do not empty the lagoon by breaching the sandbar. Instead, use the flume and shrouds to pull saltwater 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.

44. The City should encourage and influence planners, architects and property owners through the permit process to maximize water percolation and to filter out and collect surface runoff pollutants from new and existing development in the City and upstream.

45. The City should request from the flood control district that sediment and grease traps be installed, inspected and cleaned on drains leading into lower Soquel Creek.

46. The City should continue to fund activities to remove Arundo from lagoon-side residences and other non-native plants in the riparian corridor between Highway 1 and the lagoon.

47. Continue to census the juvenile steelhead in the fall to monitor the use of the lagoon as an important nursery area under varying management scenarios and restoration efforts.

LAGOON AND ESTUARY FORMATION

Fishery Rescue Actions Required Prior to Construction Activities

19 May 2014. The pooled channel through the beach adjacent to Zelda's Restaurant was seined for fish prior to being filled in with sand. Kotila had widened the estuary outlet out at the surf line near the flume to slowly drain much of the ponded area, which had a gradually sloped margin that would not strand fish. The estuary did not extend laterally to the jetty at this time. The sandbar was in a pattern of opening and closing from day to day with such small streamflow. Four seine hauls were made in the deflected channel after partial draining from 0730 to 0815 hr with a beach seine that was 30 ft x 4 feet with 1/8-inch mesh. No steelhead or tidewater goby were captured in the deflected channel. The deflected channel was filled with kelp and seagrass and deep in its upper extent, preventing effective seine hauling except at the periphery of the plant mass. The deflected channel was wide (approximately 30 feet wide). Six staghorn sculpins, 3 threespine sticklebacks and one kelpfish were rescued and relocated approximately 150 feet upstream in the main estuary. Ed Morrison assisted fishery biologist, Donald Alley, in the fish relocation.

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-fourth year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first 23 years are available at the City (**Alley 1991-2014**). 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.

20 May 2014. Four seine hauls were completed along the western margin of the lagoon adjacent to Venetian Courts with the fine-meshed goby seine (0715−0800 hr). Fish captured and relocated to deeper water near Stockton Bridge included 1 adult tidewater goby, 16 staghorn sculpins, 24 threespine sticklebacks, 3 kelpfish, 1 YOY prickly sculpin (*Cottus asper*) and one YOY rock bass.

Monitoring of Flume Maintenance and Sandbar Construction

19 May 2014. The fishery biologist, Alley, arrived at 0707 hr. The equipment operator began moving sand on the beach beyond water contact. There was not the typical lateral channel across the beach to the jetty. The Creek instead deflected slightly east from the flume, across the beach, but did not reach the ocean on an outgoing tide. (The flume had been cleared of sand the previous week by Public Works staff, with adequate screening of the intake hose for water pumped into the flume.) Water was flowing through the flume and the outlet channel appeared to have been connected to the Bay a short time before at higher tide. A young male merganser was fishing in the pool area of the deflected channel without success. The stream inflow to the lagoon was approximately 2 cfs (1.7 cfs gage reading at Soquel Village). The weir inside the flume was reconstructed. After fish were captured and relocated from the deflected channel, it was slowly filled in from the margin during the next several hours by Matt Kotila, the bulldozer operator. The lagoon was not mechanically opened this day in order to build up head for more efficient removal of kelp the next day. The biologist left at 1510 hr after sand filling along the lagoon margin was completed for the day.

Reconstructed Weir Inside the Flume, 19 May 2014

20 May 2014. The biologist arrived at 0630 hr. The biologist walked the periphery of the lagoon up to Noble Gulch prior to sandbar opening, to the upper extent of the estuary (0635−0655 hr), looking for any coho salmon juveniles. No salmonids were observed. The equipment operator (Kotila) was grading sand toward the concrete wall along the beach. The sandbar had remained closed overnight. The lagoon had partially filled through the night but lost some volume early in the morning due to a flume board becoming dislodged. Thus, any out-migrant smolts could have exited the lagoon overnight. Prior to an outlet channel being opened adjacent to the flume, Alley and Morrison seined along the western margin of the lagoon, adjacent to Venetian Court. Kotila opened the outlet channel along the flume at 0802 hr. The lagoon drained slowly at a rate of approximately 1 foot per 90 minutes. The lateral boards remained under the flume to discourage

and seepage under the flume after final sandbar closure. Thirteen personnel, including Morrison and Alley, raked and pitch-forked kelp and seagrass from the lower lagoon within approximately 60 feet of the flume inlet. The head of water that had developed overnight helped in transporting the vegetative matter out of the lagoon. The biologist walked upstream to the upper extent of the estuary near the Rispin Mansion, looking for potentially stranded fish along the margin (1030−1130 hr). No stranded fish or isolated sidepools were observed. Threespine sticklebacks were the only fished observed, along with 2 mergansers, 2 mallards and a kingfisher. The first potential spawning glide for salmonids was upstream of the extent of the estuary/lagoon. No spawning redds were observed there. Raking continued until 1310 hr. The thalweg of the estuary was 3 to 4 feet deep along the west side from the railroad trestle downstream to Stockton Bridge at the lowest drained point. This offered deep refuge for any fish that were present. The sandbar was closed by Kotila at 1320 hr. The sand along the west margin of the lagoon was excavated and leveled before the lagoon level increased in order to create a deeper summer lagoon. The biologist left at 1500 hr with no other disturbance to the lagoon anticipated.

21 May 2014. The fishery biologist arrived at 0720 hr. The biologist walked the periphery of the lagoon up to Noble Gulch prior to sandbar opening, to the upper extent of the estuary (0725−0745 hr), looking for any coho salmon juveniles. No salmonids were observed. The sandbar was still closed, and the lagoon water surface elevation had not reached the flume inlet. The sandbar was opened at 0830 hr. Raking and pitch-forking began soon after with 11 city staff, Morrison and Alley. Raking continued until 1230 hr. Kotila closed the sandbar at 1245 hr. The biologist surveyed upstream in the estuary for stranded fish (1245−1345 hr). None were found because there were no isolated side pools. Observations included hundreds of threespine sticklebacks, 6 mallards, 1 kingfisher and 1 male merganser. The biologist left at 1430 hr.

22 May 2014. The fishery biologist arrived at 0735 hr. The sand berm remained in place across the creekmouth. The biologist walked the periphery of the lagoon up to Noble Gulch prior to sandbar opening, to the upper extent of the estuary (0745−0805 hr), looking for any coho salmon juveniles. No salmonids were observed. The lagoon water surface elevation was still below the flume inlet. The sandbar was opened at 1045 hr. A school of what looked like smelt swarmed around the entrance to the outlet channel after the opening. They did not look like steelhead. The flume inlet boards were removed and repositioned, with gaps filled with wood where necessary. Then plywood was placed over the inlet boards, with a notched inlet board on the very top to provide juvenile passage into the flume. No underwater portal was provided for adult fish because this would prevent lagoon filling with such low stream inflow. The plan was to create a larger opening overnight if an adult was observed in the lagoon afterwards. The flume inlet preparation was completed by 1300 hr, assisted by the biologist. Clear visquine was secured around the flume inlet with sandbags. One continuous visquine sheet was wrapped around the flume inlet and keyed into the lagoon bottom with sandbags and covered with a layer of sand. The biologist focused on getting the flume prepared and saw no need to survey upstream for stranded fish because no side pools had existed the 2 previous days. The sandbar was closed for the season at 1325 hr, with only approximately 20−25% of the kelp and seagrass having been removed from the lower lagoon up to the Stockton Bridge. The biologist left at 1430 hr.

24 May 2014. Morrison reported that on 23 May, backwash from the Bay had come up through the flume inlet and traveled under the visquine. A steel plate was installed in the flume outlet to

prevent this from happening until water travelled through the flume from the lagoon. As of 24 May, the inlet boards had not yet been overtopped with lagoon water. The biologist arrived at the lagoon at 1205 hr. The portal was installed in the flume inlet, though the water had not reached the flume inlet after 20 hours of filling at streamflow of approximately 3 cfs.

27 May 2014. Morrison reported that water was flowing out of the flume in early morning. Alley monitored later in the morning and detected saltwater along the Venetian Court wall and under Stockton Bridge. Alley recommended that a shroud be placed on the flume inlet, which was done in the afternoon. The sheet metal covers had been installed under the sidewalk grates leading to the lagoon and the street runoff had been directed to the sewer system along the Esplanade. The lagoon water surface level allowed water to flow over the notched top inlet board, approximately 6 inches from the top of the flume. Water exited the flume. The lagoon gage height was 2.07 ft. Morrison left the steel plate in one side of the flume outlet and removed upper boards in the other side to allow a 6-inch gap at the top for fish access to the Bay. This would help maintain the lagoon depth with low inflow while allowing smolt passage with adequate depth through the flume.

30 May 2014. Morrison reported that the lagoon water surface level was near the top of the flume in the morning at gage height of 2.59.

31 May 2014. Temperature probes were launched in the lagoon and in the stream near the Nob Hill Shopping Center.

Effect of Sandbar Construction on Tidewater Gobies in 2014

It was likely that most tidewater gobies, if they were present, used habitat upstream of the construction area, where there was less tidal fluctuation and salinity. Tidewater gobies were detected in good numbers in the fall between the flume inlet and the Esplanade restaurants after a relatively dry rainfall season. Slow, artificial water level fluctuations were created during sandbar construction activities. Three sandbar breaches were required during sandbar preparation, with 3 breaches allowed by the permit without regulatory consultation. The 3 breaches closely mimicked normal tidal fluctuations of the estuary. The estuary was partially filled with sand pushed in from the beach due to little winter scour. The estuary was so filled with decomposing vegetative matter and the period of flushing after each artificial breach was so short each day, raking went only about 60 feet upstream of the flume, greatly limiting lagoon disturbance during sandbar construction.

With each lowering of the water in the estuary during sandbar construction, tidewater gobies would have to retreat to deeper water in the upper estuary as water surface receded in the upper estuary. A well defined, bathtub-like margin existed in the upper estuary in 2014, allowing easy retreat to deeper water. No isolated side pools were found.

The channel in lower Soquel Creek lacks sheltered backwaters for gobies to escape high water velocity during high stormflows, and the populations that have re-occurred during the dry years of 2008, 2009, 2013 and again in 2014 may be transitory.

Effect of Sandbar Construction on Steelhead in 2014

No juvenile steelhead or coho salmon were detected in the outlet channel before it was covered over in May. No salmonids were observed along the margin of the lower lagoon prior to each daily sandbar opening. The flume outlet was closed to steelhead passage during the period of sandbar construction and until the lagoon filled sufficiently to allow water to flow over the upper, notched board, and smolts had no access to the ocean nightly (7 nights; 20 May – 26 May). With less than 1.5 cfs inflow to the lagoon, the lagoon could not even reach the flume inlet after a night of filling. It took 2 days of lagoon filling for lagoon water surface to reach the flume. The lagoon was completely full by 30 May. With the apparent absence of salmonids in the estuary during the sandbar construction period in 2014, it appeared that most of the smolt out-migration was over prior to sandbar construction. The 7-night break in steelhead smolt access to the Bay during sandbar construction and lagoon filling likely had little impact on smolt out-migration.

The seasonal effect of removing organic material and constructing the sandbar is to create good summer rearing habitat for steelhead 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 and sandbar closure create better fish habitat for tidewater goby and steelhead 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. 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. Increased tidal overwash would further elevate water temperature, making the lagoon less hospitable for steelhead.

Recommendations for Lagoon Preparation and Sandbar Construction

1. During the relocation of fishes from the lateral channel (when it is present), provide limited water in-flow to the lateral channel 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 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 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 Oyama of the 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, because of their experience in handling fish. (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 or Oyama are unavailable.) If the biologist is unavailable during emergency cases, 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. Closing the sandbar in late May is better than mid-June or later because streamflow is sufficient to rapidly fill the lagoon in most years (not 2013 or 2014), and the juvenile steelhead 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.

5. 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.

6. 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 steelhead 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.

7. 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**).

8. 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.

9. 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.

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

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

12. Search under the Stockton Avenue Bridge and in Reaches 2 and 3 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.

13. 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, when stream inflow is insufficient to fill an underwater portal and allow lagoon filling, opt for a notch in the upper boards to accommodate smolts instead of a deeper underwater portal for kelts. If kelts are observed in the lagoon in these dry years without the underwater portal, provide a larger opening in the top of the flume inlet temporarily to allow kelts the opportunity to exit the lagoon.

14. Maintain the 1-foot high weir/ baffle inside the flume until July 1 for safe entrance of out-migrating steelhead smolts into the flume inlet before they enter the Monterey Bay.

15. 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 visquine is preferable to black. Key the visquine into the lagoon margin to encourage its retention when the sandbar breaches in the fall.

16. Retrieve visquine from around the flume inlet before or immediately after the fall sandbar breach, if possible.

17. In very dry years, such as 2013 and 2014, 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.

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. The bolt is 1.77 feet above the elevation of the top of the flume inlet. 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 bolt. Another bolt 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 that was 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 2014-2015 Rainy Season.

After successfully passing 5 smaller stormflows through the flume since late September, a facilitated breaching was completed by Public Works at 1115 hr on 30 November 2014. The inner berm nearest the lagoon margin was overtopped by a quickly rising lagoon water surface before the outer berm was completely notched by Kotila with the wheeled loader. Kotila completed the notch in the outer berm as the inner berm was being overtopped, and the outlet channel overtopped it and entered the Bay. The biologist (Alley) arrived at the open creekmouth at 1150 hr after communication with Kotila of Public Works the previous evening and that morning. It looked like the Soquel watershed had missed most of the rain from this storm front, it being on the very edge. We assumed that insufficient flow would reach the lagoon to open it this day. However, when Kotila checked the lagoon in late morning, the lagoon level had risen rapidly to within approximately 8 inches of the lower bolt on the piling and was rising. He immediately notified the biologist at approximately 1050 hr and then proceeded to initiate a

controlled breach. The flume inlet was open on one side and the ceiling grate was also receiving water. The flume outlet was completely open on one side. The flume was unable to accept all of the stormflow and was underwater at this time. (The flume capacity is approximately 25−30 cfs.) According to the gage in Soquel Village, 2 miles upstream, streamflow there peaked at 35 cfs at 10:30 am, which was likely significantly less than in Capitola with its impermeable surfaces and urban runoff. Twenty minutes were required before the lagoon level stabilized and began to recede. By 1150 hr, the estuary level had dropped to within approximately 1 foot of the lower bolt. The outlet channel was approximately 20 feet wide. It had stopped raining when the biologist reached the creekmouth. However, it was still raining in the mountains. More rain was forecasted for the next few days. On 1 December 2014, the estuary remained open with flows at the gage mostly between 15 and 20 cfs at the gage in Soquel Village. On 2 December 2014, more rain occurred, with streamflow reaching 71 cfs at its peak at the gage in Soquel Village. The estuary remained open. On 3 December 2014, more rain occurred, with stream flow peaking at 203 cfs at the gage in Soquel Village. The estuary remained open for the season.

Inner Berm being overtopped at 1115 hr on 30 November 2014

Outlet channel through beach after an emergency breach on 30 November 2014.
(Time printed on the photo was 1 hour later than the actual time of 1202 hr.)

Recommendations Regarding Sandbar Breaching

1. As stated in the Management Plan (**1990**), make sure that parking lots and streets draining into the lagoon are cleaned before the rainy season. This will reduce the pollutants entering the lagoon during the first storm of the season that are lethal to fish. Street sweepers with water and suction may be necessary. In addition, roadwork such as repaving and application of fresh petrochemicals should be done in the early summer to allow sufficient time for penetration and drying before the rainy season.

2. 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. The purpose is to maximize the residual estuary depth after the emergency breach.

3. 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.

4. 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.

5. Just as the first storm of the fall season begins, remove boards from each 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.

6. As stated in the 1993 monitoring report, management options to delay sandbar breaching include installation of a perimeter fence around the flume inlet to collect algae. Replace the boards after the stormflow subsides, removing them for each succeeding storm until the sandbar is breached during later, larger storms usually occurring after Thanksgiving.

7. After the first small storms of the season with the sandbar still intact, lower the water level to a point where light penetrates to the lagoon bottom. Thus, plants in the lagoon may continue to photosynthesize and remain viable. Thus, vegetation mortality and stressfully low oxygen levels are prevented until the water clarity is re-established. Re-install boards to increase lagoon depth after the lagoon clears up.

8. Notify the California Department of Fish and Game 12 hours before the possibility of a sandbar breach and immediately after the breach occurs.

9. If the sandbar breaches early in the rainy season, followed by a period of 2-4 weeks of a reformed sandbar that prevents water exchange with the ocean, attempt to pull the decomposing kelp out of the stagnating lagoon. Open the flume and encourage streamflow out with the shroud installed.

10. If a stagnant, kelp-filled lagoon forms in fall after an early breach and 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.

WATER QUALITY MONITORING IN 2014

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. 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 CDFG permit for 2014, 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 on the downstream side 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 CDFG permit for 2014, 6 HOBO temperature loggers were launched on 31 May 2014, just downstream of the railroad trestle in Reach 2 (as in 2008−2013) 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. All 7 loggers were removed on 19 October 2014, prior to additional 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. Saltwater was detected in 2014 after the sandbar closure, and the inlet shroud was needed to pull saltwater off of the bottom. The shroud was removed after 21 June, after salinity was no longer detected in Reach 1.

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, a management goal for steelhead should be to maintain water temperature below 20ºC (68ºF) at dawn within 0.25 m of the bottom and the afternoon maximum below 22ºC (71.6ºF) near the bottom. 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 water temperature below 20ºC. Maximum daily water temperature in the lagoon should not reach 26.5ºC (79.5ºF). 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 in the lagoon 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.

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, should not rise above 21ºC (70ºF). 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. According to Moyle (**2002**), regarding temperature optima, "*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*." 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.

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 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 in Reach 9 of the East Branch, supporting the potential for coho recovery in Soquel Creek.

Results of Lagoon Water Quality Monitoring After Sandbar Closure

Lagoon Level

Appendix A provides detailed water quality and lagoon height data. **Table 3** rates habitat conditions according to a rating scale (**Table 2**). The lagoon level was maintained in the good range for the summer and during the Begonia Festival. It remained good into the fall until after the first rain in late September (**Figure 2**). The lagoon level was monitored 13 times in 2-week intervals from 7 June 2014 to 23 November 2014. For 2014, lagoon levels as measured on the staff gage were rated "good" (**Table 2**) on 9 two-week monitorings, "fair on one monitoring, "poor" on two monitorings and "critical" on another (**Table 3; Figure 2**). Lagoon water level was lowered to a "fair" level on 28 September (2.08 ft) after the 26 September stormflow that colored the water, forcing the management technique of reducing lagoon depth until water penetrated the bottom to allow continued photosynthesis for the remainder of the lagoon period. On 2 and 5 October, the gage height was maintained at 1.96 ft ("fair") and 2.11 ft ("fair") to allow more light penetration to allow photosynthesis and higher oxygen levels. A "poor" rating was noted on 26 October (gage height = 1.76 ft) after boards had been removed to pass the second stormflow of the season occurring on 25 October. A "critical" rating (1.19 ft) was noted on 8 November, after the third stormflow of the season on 1-2 November. Lagoon level remained in the "poor" range (1.66 ft) on 23 November to allow light penetration to the bottom in all but the deepest portions of the lagoon, with the sandbar breached on 30 November due to stormflow that exceeded the capacity of the flume.

Gage height in 2014 was consistently near the highest recorded through the dry period of the last 4 years (**Figure 2**). This good management, combined with the similar streambed elevation gained from scour during the 2012-1213 winter, resulted in a relatively deep lagoon in 2014. Typically, it is more difficult for the City to maintain the highest water surface elevation after wetter winters that bring higher stream inflow during the following summer.

Saltwater was trapped on the lagoon bottom near the Venetian Court wall and under Stockton Avenue Bridge at the time of sandbar closure, as measured on 27 May and 7 June, justifying shroud installation on the flume inlet. On 21 June, no salinity was detected under the Stockton Bridge, although temperature monitoring near the trestle indicated that saltwater remained at depth until 23 June, as indicated by elevated water temperature near the bottom until then (**Figure 4a**).

No vandalism of the flume inlet was detected in 2014. Plywood over the flashboards protected against both back- pressure and vandalism after the adult portal was removed. However, with early, small storms, the plywood is not used between storms. While the wedges discourage all but the most determined vandals and prevent dislodging of boards, they do not allow easy removal of boards when surface algae and debris near the flume needs to be drained out or when sandbar breaching is to be prevented by increasing the volume through the flume. The grated hole in the top of the flume alleviates the need for rapid board removal and replacement during small stormflows.

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 2014. Unfortunately because of the very low streamflow during sandbar construction, the flume outlet was closed to steelhead passage during the period of sandbar construction and until the lagoon filled sufficiently to allow water into the adult passage portal, and smolts had no access to the ocean nightly (7 nights; 20 May – 26 May). The sandbar was closed for the summer on 22 May. With only 1.5 cfs inflow to the lagoon, the lagoon could not even reach the flume inlet after a night of filling. It took 2 days of lagoon filling for lagoon water surface to reach the flume. The lagoon was completely full by 30 May. With the apparent absence of salmonids in the estuary during the sandbar construction period in 2014, it appeared that most of the smolt out-migration was over prior to sandbar construction. The 7-night break in steelhead smolt access to the Bay during sandbar construction and lagoon filling likely had little impact on smolt out-migration.

Once sandbar construction was complete, the Venetian side of the flume inlet was left completely boarded up. The Esplanade side had all flashboards repositioned to minimize leakage, and plywood was attached to the outside. The top flashboard was notched to provide smolt passage. No underwater portal was provided for adults because a portal would have prevented lagoon filling. The plan was to increase the flume inlet opening if an adult steelhead was seen in the lagoon. The flume remained passable to steelhead smolts during until sometime after 6 July to meet the permit requirements. The flume outlet was closed on 20 July and occasionally allowed a trickle of water out after.

The inner berm across the beach was notched to initiate a facilitated sandbar breach on 30 November 2014 after 4 previous small stormflows beginning on 26 September. The streamflow at the Soquel Village USGS gage was 35 cfs at the time of the breach, with stormflow reaching a maximum of 203 cfs on 3 December.

Water Temperature Results from Two-Week Monitoring

In 2014, water temperature of stream inflow for much of July and September and all of October and November was the warmest in the last 5 years and 1.5−3°C warmer from mid-July to late November than in the higher flow years of 2010 and 2011 (**Figure 3e**). During the last 24 years of monitoring, the 1992, 1994, 2013 and 2014 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. In 2014, the lagoon was warmer near the bottom in the morning and afternoon compared to 2013 except in early September (**Figures 3a-d; Appendix A**). The 3 warmest years have been 1992, 1994 and 2014, all after relatively dry winters with low summer inflow. Of these, 2014 usually had the warmest early morning water temperatures near the bottom, though 1994 often had warmer afternoon temperatures due to the shallow lagoon (only 1.35 m deep under Stockton Bridge compared to 2.0 m in 2014) which would heat up faster during the day. In contrast, 2011 had the coolest lagoon temperatures in the past 24 years of monitoring. The warmer water temperatures in 2014 corresponded with the consistently warmer air temperatures measured at the lagoon, beginning in mid-July and continuing into November and the often warmer inflow (**Figures 3e-f**). The warmest water temperature measured in 2014 near the bottom in the morning at the Stockton Bridge after the saline layer was dissipated was 23˚C (73.4˚F) on 20 July compared to 22.2°C (72°F) on 1 September 2013 (**Figure 3b**). The warmest early

morning temperatures in 2014 (and second warmest in the past 24 years compared to 24˚C in 1992 at Stockton Bridge) were registered at the mouth of Noble Gulch with 23.1˚C in early and mid-August (**Figure 3g**). In 2014, *water temperatures near the lagoon bottom in the early morning* were rated "good" (<20°C) at all stations only from 11 October onward (**Tables 2 and 3**). Ratings of "poor" (21.5−23°C) or "fair" (20−21.5°C) were most common. From 20 July to 31 August (4 consecutive monitorings) the ratings were "poor" (21.5–23˚C) at all stations in the morning.

The warmest afternoon water temperature recorded in 2014 near the bottom during two-week monitorings was 24.4˚C on 20 July at the flume (**Figure 3h**) compared to 23.5°C on 1 September 2013 (**Figure 3j**) and 21.2°C on 14 August 2012, all at the flume inlet, 19.4°C on 26 July 2011, 19.6°C in mid-July 2010, 21.9° C in late August 2009 and 24.6° C after tidal overwash that had created a stagnant saline layer under the Stockton Bridge in early July 2008. The warmest surface water temperature recorded in 24 years was in 2014 at the flume on 20 July (27.7˚C; 81.9˚F). The temperature there in the morning had been 22.8˚C. In 1992 and 1994, the warmest temperatures measured at the surface at the flume were 26˚C (78.8˚F) and 24.8°C (76.6°F), respectively.

At the mouth of Noble Gulch in 2014, unlike in past years, the water temperature near the bottom in the morning was often warmer than at other lagoon sites (7 of 13 monitorings) (**Figure 3g**). However, in afternoon it was cooler than other sites most of the time, as in past years (**Figure 3h**). In the afternoon, water temperature was sometimes 1−3°C cooler near the bottom than at the surface at Noble Gulch (**Appendix A**). However, from 6 July onward in 2014, slightly higher salinity/conductivity at the very bottom resulted in slight elevation of water temperature there.

As in past years, lagoon water temperatures in 2014 closely reflected those of the stream inflow and were 4–5˚C warmer than stream inflow temperature in the morning (**Figure 3g**). Daily temperature minima in the lagoon were consistently warmer near the bottom than the stream inflow (**Table 4**). In most years, morning temperatures are the coolest at the upper Station 4 and warm up downstream. However, this was not the case in 2014, with the low stream inflow (**Figure 3g**). By afternoon in 2014, we saw the typical pattern of warming at downstream monitoring stations, the difference usually being 0.5 to 2° C cooler at Station 4 than Station 1 (**Figure 3h**). Water temperature stratification was noted only on the first monitoring at the deepest Station 2 (7 June), with thorough nightly mixing and cooling of the water column at monitoring stations afterwards (**Appendix A**).

Table 3. 2014 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 through July; visual estimates after (cfs)
7June14	open	2.59 good	good* poor good good	good *critical* good good	good good fair fair	1.2 cfs
21June14	open	2.40 good	fair fair Fair good	good good good good	good good good good	0.5 cfs
06Jul14	open	2.39 good	fair	good	good	0.14 cfs
20Jul14	open	2.55 good	poor	good	good	0.23 cfs
3Aug14	open	2.57 good	poor	good	good	0.1–0.2 cfs
16Aug14	open	2.57 good	*poor*	good	good	0.2–0.3 cfs
31Aug14 Begonia Festival	open (morning)	2.55 good	*poor*	good	good	0.1 cfs
31Aug14	open (afternoon)	2.61 good	critical critical poor critical	good	good	0.1 cfs
13Sep14	closed	2.61 good	fair	good	good	0.1 cfs
28Sep14	open (after rain)	2.08 fair	fair	poor poor critical critical	good	0.4 cfs
11Oct14	closed	2.41 good	good	poor	good	0.2 cfs
19Oct14	open		- good - -	- good - -	- good - -	
26Oct14	open (after rain)	1.76** poor	good	good good good fair	good	2 cfs
08Nov14	closed	1.17** critical	good	good	good	1–2 cfs
23Nov13	open (after rain)	1.61** poor	good	good poor fair fair	good	3 cfs

* Four ratings refer to Monitoring Sites 1-4. One rating per column represents all sites.

**Water level was intentionally lowered after a small stormflow to allow light to penetrate to plant life to maintain healthy oxygen concentrations.

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 24 years. However, for the period 31 May− 23 June, a temporarily warm saline layer (initially approximately 2 feet (0.7 meter) thick) along the bottom was detected by the data loggers in this deeper area. 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 nearest these data loggers (**Figures 3g and 3h**).

Juvenile steelhead likely spend most of their time near the bottom 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 2014 somewhat reflected those of the stream inflow (**Figures 4a-l; 5a-b**), except for 31 May− 23 June, when there was a temporary warm saline layer along the bottom in the deeper area where the data loggers were deployed. Daily temperature *minima* in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2014 (**Table 4**). In 2014 from 31 May to 15 September, the maximum and minimum 7-day rolling average temperatures were 5.2°C and 4.8°C cooler, respectively, in the stream than near the lagoon bottom near the trestle, as was substantiated by seasonal maxima (20.2°C vs. 24.0°C) and minima (14.5° C vs. 19.4°C) (**Table 4**). The average 7-day rolling average of 16.8°C in the stream (17.0˚C in 2013) was 5.2°C less than the average 7-day rolling average of 22.0˚C (20.7°C in 2013) at 0.5 feet from the lagoon bottom. Consistently, the difference in 7-day rolling averages, day by day, was also approximately 3−5.5°C warmer in the lagoon near the bottom in the morning compared to that in the stream inflow. Stream inflow temperature in 2014 was generally about 4−6°C cooler in the morning and 2−4°C cooler in the afternoon than near the lagoon bottom, with much greater daily fluctuation in the stream than in the lagoon (**Figures 4a and 5a**). We see from comparisons of the 7-day rolling average for 2014 versus 2013 near the bottom that it was 1-3˚C warmer in mid-summer 2014. Previous comparisons of 7-day rolling averages in 2013 versus 2012 and 2011, in 2013 it was at least 2°C warmer than in 2012 and about 3°C warmer than in 2011 (higher stream inflow) for July through August. In fact, 2014 consistently had the warmest 7-day rolling averages heretofore recorded (**Table 4; Figures 4a-n; 5a-c; Alley 2014**).

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*) was detected in 2014 by the data loggers in the deep area near the railroad trestle. However, temperature stratification associated with a saline layer initially approximately 2 feet (0.7 meter) thick was detected as late as 23 June by the data loggers (**Figures 4a-41**). The 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 deeper pockets when a temporary, heavy and stagnant saline layer developed from saltwater being trapped during sandbar closure. In this case, the saltwater had dissipated between 21 and 28 days under Stockton

Bridge and 30 days afterwards just downstream of the railroad trestle in deeper areas.

Lagoon water temperature was warmer near the surface than near the bottom in the heart of the dry summer season (mid-July through August), as indicated by the maximum water temperatures and 7-day rolling averages (**Table 4; Figures 4a−b and 4k−l**).

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 water temperature below 22ºC. In 2014, water temperature rose above 22º C at 0.5 feet above the bottom at the data logger location for 81 days (57% of the monitoring period; 11 days 31 May–10 June, 2 days 17–18 June, 70 days 26 June–3 September) compared to 25 days in 2013 (18.5% of the monitored period) (**Figures 4a and 4n**). 2014 had by far the warmest water temperatures near the bottom since continuous data logger measurements began in 1999. In 2010−2012, water temperature did not rise above 21°C near the bottom, with a maximum in 2012 of 21°C on 1 July. The years 2007−2009, stream inflow was lower and water temperatures were higher. In 2009, it was above 22° C on 8 days, primarily in early August (4 successive days). In 2008, it was above 22ºC on 13 days, primarily in early July (4 successive days) and mid-July (6 successive days) related to a warm saline layer. In 2007, it was above 22º C on 20 days, primarily in mid-July (9 successive days) and early September (6 successive days). This was compared to only 4 days (22-25 July) in the higher stream inflow year of 2006 (**Alley 2006**). In 2005, water temperature near the bottom never reached this threshold with high stream inflow. It only went above 22°C once (12 July) at the surface (**Alley 2005**). In 2004, the <22ºC goal near the bottom was not met for 5 days after tidal overwash on 19 July, 4 days in August and 2 days in early September (**Alley 2005**). But conditions were more stressful in 2001 when there had been two major tidal overwashes. In 2001, daily temperatures near the bottom fluctuated between approximately 23 and 26ºC (73.4–78.8ºF) for 14 days (**Alley 2003c**).

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 2011, 2012, 2013 and 2014; 30 June – 15 September in 2011.

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; 31 Aug–5 Sep)	25.2 (1 June due to saline layer)
2013	Minimum Water Temperature °C	14.1 (31 May; 4-5 June)	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**
2012	Maximum Water Temperature °C	20.2	23.2	21.0
2012	Minimum Water Temperature °C	12.6	11.0	14.5
2012	Maximum 7-Day Rolling Average	17.7	19.9	19.3
2012	Minimum 7-Day Rolling Average	15.5	15.6	16.2
2012	**Average 7-Day Rolling Average**	**16.2**	**17.9**	**18.1**
2011	Maximum Water Temperature °C	20.3	21.0	19.8
2011	Minimum Water Temperature °C	14.1	16.0	15.6
2011	Maximum 7-Day Rolling Average	17.3	19.0	18.2
2011	Minimum 7-Day Rolling Average	15.4	16.8	16.2
2011	**Average 7-Day Rolling Average**	**16.4**	**18.0**	**17.2**
2010	Maximum Water Temperature °C	19.8	21.0	20.6
2010	Minimum Water Temperature °C	13.7	15.2	15.2

2010	Maximum 7-Day Rolling Average	17.5	19.5	18.8
2010	Minimum 7-Day Rolling Average	14.8	16.7	16.3
2010	**Average 7-Day Rolling Average**	**16.0**	**17.9**	**17.4**

In 2014, the lagoon steelhead management goal of maintaining early morning minimum temperature below 20°C near the bottom was not met on 113 of the 141 days (80%) compared to 63 of 135 days (47%) (**Figures 4a and 4n**). In 2010−2012, the lagoon met the steelhead management goal of maintaining early morning minimum temperature below 20°C near the bottom throughout the season (**Alley 2014**) compared to not meeting the goal on 16 of 131 days (12%) in 2009, 54 of 130 days (42%) in 2008 and 35 of 124 days (28%) in 2007 (**Alley 2010b)**. In 2005 and 2006 (after wetter winters), the management goal was reached during the lagoon season. In the 2004 lagoon, 27% of the days (34 of 125 days) failed to meet the management goal partially due to tidal overwash. This was compared to 19% in 2003 and 10% in 2002 of the days not meeting the goal.

The coho management goal of keeping maximum water temperatures below 20ºC (68ºF) near the bottom in the presence of steelhead was NOT met until late September in 2014 (85% of the 140 days) compared to 73% of the days in 2013. However, it was met for all but 5% of the days in 2012, it being met all the time in 2011, it NOT being met 6% of the days measured (7 of 127 days) in 2010 and NOT being met 57% of the days measured (75 of 131 days) in 2009; 69% in 2008, 66% in 2007 and 17% in 2006.

At the creek site near Nob Hill, the stream management goal was met for steelhead of *no more than 4 hours a day at greater than 20ºC (68ºF)* was met in 2014 and in 2013 (except for 1 day) (**Figures 5a and 5c**). In 2009−2012, the stream management goal was met for steelhead (**Alley 2014**) and failed on only 1 day (**0.8%**) in 2008 (**Alley 2013**). In 2014, water temperature reached 20°C on 3 days compared to 7 days in 2013. In 2011 and 2012, water temperature reached 20°C on one day while, in 2009 and 2010, water temperature did not reach 20°C. In 2007, water temperature failed to meet this management goal on **4%** of the days compared to **12%** in 2006 (**Alley 2014**). At the creek site in 2005, water temperature failed to meet the management goal **5%** of the days (**Alley 2005**). In 2004, **7%** of the days did not meet the goal. September was unusually cool in 2004 and 2005 (**Alley 2005**). At the Creek site in 2003, **17%** of the days failed to meet the management goal (**Alley 2005**).

The Soquel Creek water temperature goal for coho salmon in stream habitat is to have an average weekly temperature (7-day rolling average) of 16.7º C (62º F) or cooler. In 2014, the management goal was not met on 71 of 134 days (53%) compared to 83 of 128 days (65%) in 2013 (**Figures 5a and 5c**). In 2012, the coho management goal was not met on 9 days (7%) (**Alley 2014**). In 2011, the management goal was not met 23 days (25%) in July of the 93-day lagoon period, with it 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, especially a low flow years such as 2013 and 2014, considerably more stream shading and streamflow would likely be required to make

lower Soquel Creek habitable for coho salmon. The shading would need to come from larger trees of tall stature, such as redwood and Douglas fir.

The daily stream water temperature fluctuated more than the daily lagoon water temperature near the bottom in 2014, which was typical for previous years except 2010. The maximum daily lagoon water temperature typically occurred between 1700 and 2100 hr each day.

Creek water temperatures in 1999-2014 were much cooler than in 1998 (measured by Brooke Kraeger in 1998), despite the much higher baseflow in 1998. In 1998, there was a 20-day period in which water temperature rose above 21º C (69.8º F) for several hours each day in the stream above the lagoon, with a maximum of approximately 23.5º C (74.3º F) on 3 August 1998 (**Alley 2005**). Daily maxima were still approaching 21ºC on 4 September 1998. Considerable riparian vegetation had been removed by El Niño stormflows the previous winter. Despite warm stream temperatures and higher stream inflow in 1998, lagoon water temperatures were relatively cool compared to other years (**Alley 2003**).

Aquatic Vegetation Monitoring

In 2014 at the time of sandbar construction on 23 May, only approximately 30% of the decomposing kelp and seagrass had been raked out of the lower lagoon, and the lagoon bottom was soft with a thick layer of detritus. This was compared to 20–25% removal in 2013, 90% removal in 2012, 60% removal in 2011, 90% in 2010 and 70% in 2009. Therefore, there were more nutrients available for plant growth in 2013 and 2014 than previous years. Thicknesses of bottom algae and pondweed (with attached algae) were greater in all reaches in 2014 compared to 2010−2013, with similar coverage (**Tables 5–9**). Thickness and coverage was similar in 2010−2012 (except reduced at the mouth of Noble Gulch in 2012) and less than in 2009 (**Tables 6-9**). Evidence of nutrient inputs from Noble Gulch in 2013 and 2014 was expressed by recurrent thick planktonic algae and sporadically high levels of surface algae nearby, though bottom algae was not thicker than at other sites as had been the case in past years. Pondweed with attached algae contributed a higher proportion of the aquatic vegetation than previous years, especially in Reaches 2 and 3. It contributed 70–80% of the lagoon coverage in Reach 3 between 16 August and 13 September.

Filamentous algae was first noted earlier than usual, on 7 June compared to mid-June 2013. In 2014, bottom algae thickness in Reaches 1−3 and at the mouth of Noble Gulch averaged 2.0 ft, 1.8 ft, 1.4 ft and 1.5 ft, respectively (**Table 5**) compared to 2.0 ft, 1.1 ft, 1.2 ft and 1.2 ft, respectively in 2013, (**Table 6**) and 0.5 ft, 0.4 ft, 0.4 ft and 0.5 ft, respectively in 2012 (**Table 7**). This was compared to 2011 averages of 0.6 ft, 0.6 ft, 0.3 ft and 1.1 ft, respectively (**Table 8**), 2010 averages of 0.8 ft, 0.8 ft, 0.8 ft and 2.2 ft, respectively (**Table 9**), and 2009 averages of 1.7 ft, 1.2 ft, 0.9 ft and 1.4 ft, respectively (**Alley 2014**).

Pondweed had nearly disappeared in 2011, but flourished in 2012–2014 with the thickest growth in 2014 of the past 6 years. Pondweed was first detected in mid-July, it being initially most prominent in Reaches 2 and 3 in mid-August to mid-September and then later reaching 20−80% coverage and 3−4 ft thickness, on average, in all three reaches by mid-September.

Surface algae with pondweed fragments met a 23-year high in 2014 (since 1990), it varying between 0 and 15% in Reach 1, (0 and 7% in 2012 and 2013), 0 and 30% in Reach 2 (0 and 5% in 2012 and 2013), 0 and 40% in 2014 in Reach 3 (0 and 10% in 2013 and(0 and 25% in 2012) and 0 and 50% in 2014 at the mouth of Noble Gulch (0 and 30% in 2013 and 0 and 15% in 2012) (**Tables 5–7**). Regarding season averages for surface algae (and pondweed fragments), in Reaches 1–3 for 2014 it was 11.1, 5.9 and 10.9%, respectively. This was compared to averages of only 1.8, 0.6 and 2.5% in 2013. On 20 July 2014, surface algae was at a 23-year high (since 1990) between 30 and 50% coverage at all stations. Surface algae was less prevalent in 2010−2013, on average, than 2009 (**Alley 2014).**

Table 5. Visually Estimated Algae Coverage and Thickness in the 2014 Lagoon (pondweed with attached algae included).

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
6-7	**0.2**	**25**	**0**	**0.2**	**70**	**0**	**0.2**	**15**	**0**	**Soupy**	**Soupy**	**0**
6-21	Soupy	Soupy	0	Soupy	Soupy	0	Soupy	Soupy	0	Soupy	Soupy	0
7-6	1.0	60	0	1.0	100	0	1.0	100	0	0.8	40	0
7-20	3.5	100	50	3.0	99 (1 pond-weed)	30	3.0	100	40	3.0	60	50
8-3	2.5 (5 pond-weed)	95 (3 pond-weed)	15	2.5 (2.5 pond-weed)	70 (30 pond-weed)	2	1.0 (3.0 pond-weed)	70 (30 pond-weed)	7	0.7	70	10
8-16	3.0 (5.0 pond-2eed)	95 (5 pond-weed)	10	3.0 (3.0 pond-weed)	60 (40 pond-weed)	2	1.5 (3.0 pond-Weed)	25 (75 pond-Weed)	3	Soupy	Soupy	0
8-31 Begonia Festival	2.0 (4.0 Pond-weed)	85 (15 Pond-weed)	7	2.0 (3.0 Pond-weed)	70 (30 pond-weed)	10	2.0 (3.5 pond-weed)	30 (70 pond-weed)	15	Soupy	Soupy	5
9-13	soupy (4.0 pond-weed)	80 (20 pond-Weed)	8	1.0 (3.5 pond-weed)	60 (40 pond-weed)	10	1.0 (3.5 pond-weed)	20 (80 pond-weed)	15	soupy (3.0 Pond-weed)	soupy (20 pond-weed)	2
9-28	Turbid	Turbid	10	Turbid	Turbid	10	Turbid	Turbid	20	Turbid	Turbid	10
10-11	Turbid	Turbid	7	Turbid	Turbid	10	Turbid	Turbid	20	Turbid	Turbid	10
10-26	Turbid	Turbid	0	Turbid	Turbid	<1	Turbid	Turbid	<1	Turbid	Turbid	0
11-8	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0
11-23	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0
Avg-6-07 – 9-28	**2.0 algae (4.5 pond-Weed)**	**77 Algae (6.1 Pond-Weed)**	**11.1**	**1.8 algae (3.0 Pond-Weed)**	**76 algae (20 Pond-Weed)**	**5.9**	**1.4 algae (3.25 Pond-Weed)**	**51 algae (38 Pond-weed)**	**10.9**	**1.5 algae**	**57 algae**	**7.9**

Table 6. Visually Estimated Algae Coverage and Thickness in the 2013 Lagoon (pondweed with attached algae included).

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
6-8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-22	Soupy	Soupy	0	0.8	20	0	0.8	15	0	0.2	30	0
7-6	Soupy	Soupy	0	0.8	100	0	1.0	100	0	0.5	100	0
7-20	Dark	Dark	0	1.0	100	0	Dark	Dark	0	1.2	100	0
8-3	2.0	100	0	1.5	100	0	0.5 (1.0 Pond-Weed	99 (<1% pond-weed)	0	2.0	60	0
8-17	2.0	100	0	1.0	100	0	0.5 (2.0 pond-Weed)	99 (1 pond-Weed)	0	1.5	100	0
9-1 Begonia Festival	3.0 (4.0 Pond-weed)	85 (15 Pond-weed)	0	1.0 (2.0 Pond-weed)	78 (20 pond-weed)	0	2.0 (2.0 pond-weed)	85 (15 pond-weed)	1	2.0	100	30
9-14	3.0 (4.0 pond-weed)	85 (15 pond-Weed)	5	2.0 (4.0 pond-weed)	85 (15 pond-weed)	2	3.0 (4.0 pond-weed)	85 (15 pond-weed)	10	2.0	100	1
9-28	2.0 (5.0 pond-weed)	80 (20 pond-weed)	3	2.0 (4.0 pond-weed)	80 (20 pond-weed)	0	2.0 (3.0 pond-weed)	75 (25 pond-weed)	10	1.0 (3.5 pond-weed)	75 (25 Pond-Weed)	0
10-12	Dark	Dark	5	1.0 (3.0 pond-weed)	80 (20 pond-weed)	<1	1.0 (3.0 pond-weed)	80 (20% pond-weed)	2	1.0 (2.5 pond-weed)	80 (20 Pond-Weed)	2
10-26	Dark	Dark	7	Dark	Dark	5	Dark	Dark	5	2.0 (3.0 pond-weed)	70 (30 Pond-Weed)	10
11-9	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
11-23	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
12-8	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
Avg-6-08 – 10-26	**2.0 algae**	**50 algae**	**1.8**	**1.1 algae**	**74 algae**	**0.6**	**1.2 algae**	**62 algae**	**2.5**	**1.2 algae**	**74 algae**	**3.9**

Table 7. Visually Estimated Algae Coverage and Thickness in the 2012 Lagoon (pondweed with attached algae included).

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
6-5	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6-19	0.2	10	0	0.2	30	0	0.4	60	0	0.4	60	0
7-3	0.50	90	5	0.7	100	5	0.5	100	25/3 below/above Noble G.	0.4	60	15
7-16	1.0	70	0	0.5	40 (<1% pond-weed)	0	1.0	90	0	Thick plankton bloom- no vis.	Turbid	0
8-1	0.4	90	0	0.4 (1.0 pond-Weed)	99(1% pond-weed)	0	0.2 (1.0 Pond-Weed	99(1% pond-weed)	0	0.2	100	0
8-14	0.2 (1.5 pond-Weed)	80 (10 pond-Weed)	0	0.3 (0.8 pond-Weed)	85 (15 pond-Weed)	0	0.3 (0.8 pond-Weed)	85 (15 pond-Weed)	0	0.5	80	0
8-29	0.4 (2.5 Pond-weed)	70 (25 Pond-weed)	0	0.3 (2.5 Pond-weed)	85 (15 pond-weed)	0	0.4 (2.5 pond-weed)	80 (20 pond-weed)	0	0.5	70	10
9-12	0.2 (3.0 pond-weed)	65 (35 pond-Weed)	<1	0.5 (2.5 pond-weed)	70 (30 pond-weed)	0	0.5 (2.0 pond-weed)	70 (30 pond-weed)	0	0.4	70	0
9-26	2.0 (3.0 pond-weed)	55 (35 pond-weed)	0	0.7 (1.5 pond-weed)	70 (30 pond-weed)	0	0.3 (1.0 pond-weed)	50 (50 pond-weed)	0	1.5 (2.5 pond-weed)	70 (10 pond-weed)	0
10-10	Dark	Dark	0	Film (1.5 pond-weed)	60 (40 pond-weed)	0	Film (1.0 pond-weed)	30 (70% pond-weed)	0	Thick plankton bloom- no vis.	Turbid	0
10-24	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0
11-7	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
Avg-6-05 – 9-26	**0.5 algae**	**59 algae**	**0.6**	**0.4 algae**	**64 algae**	**0.6**	**0.4 algae**	**70 algae**	**3 below Noble G.; 0.3 above**	**0.5 algae**	**64 algae**	**3**

Table 8. Visually Estimated Algae Coverage and Thickness in the 2011 Lagoon (pondweed with attached algae included).

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
7-10	0	0	0	0	0	0	0	0	0	Turbid-Yellow/brown water	Turbid	0
7-26	0.6	60	0	0.5	70	0	0.3	60	0	Thick plankton bloom	Turbid	0
8-10	1.0	60	0	1.0	70	0	Dark	Dark	2% ds Noble; 5% us Noble	1.0 Thick plankton bloom	80	20 after-Noon
8-23	Dark	Dark	<1 morning	0.3	100	25 morning	0.3	80	10% ds Noble; <1% us Noble	Turbid Thick plankton bloom	Turbid	5 morning
9-5	0.5	100	<1	1.0	70 (1 pond-weed)	0	0.3	70 (1 pond-weed)	0	Thick plankton bloom/gray water	Turbid	0
9-18	0.4	100	0	0.6	100 (1 pond-weed)	0	0.4	100	0	0.8 Thick plankton bloom/gray water	100	0
10-01	1.0	90	0	0.5	100 (5 pond-weed)	0	0.5	95	0	1.5 Turbid-gray/brown Water	90	0
Avg-7-10 – 10-01	**0.6**	**68**	**0.1**	**0.6**	**73**	**3.6**	**0.3**	**68**	**1.7 ds Noble/ 0.8 us/ 1.3 total**	**1.1 (limited obs.)**	**90 (limited obs.)**	**1**

Table 9. Visually Estimated Algae Coverage and Thickness in the 2010 Lagoon (pondweed with attached algae included).

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
6-19	0.3	10	0	0.3	15	0	0.3	25	0	Turbid	Turbid	0
7-04	0.3	30	0	0.3	60	0	0.3	30	0	Turbid	Turbid	0
7-19	0.8	70	<1	0.8	60	2	0.5	80 (<1 pond-weed)	20 ds Noble/<1 us/8 total	Turbid	Turbid	25
8-02	1.0	80 (1 pond-weed)	0	1.0	65	5	2.0	40 (<1 pond-weed)	15 ds Noble/ 1 us/5 total	0.5	30	5
8-15	1.0(pond-weed 3.0)	85 (15 pond-weed)	0	0.8	40	0	1.0	50 (<1 pond-weed)	0	Turbid	Turbid	0
8-29	2.0(pond-weed 4.0)	60 (10 pond-weed)	0	1.0	30	0	1.0	99	0	Turbid	Turbid	0
9-12	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
9-26	0.5(pond-weed 2.0)	40 (20 pond-weed)	<1	0.5 (pond-weed 2.0)	85 (15 pond-weed)	3	0.5(pond-weed 3.5)	90 (10 pond-weed)	2	3.0	35	30
10-09	0.7(pond-weed 4.0)	60 (20 pond-weed)	1	2.0(pond-weed 3.0)	50 (30 pond-Weed)	1	1.0(pond-weed 3.0)	70 (20 pond-weed)	1	3.0	30	15
10-23	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	0
Avg-6-19 – 10-23	**0.8**	**53**	**0.1**	**0.8**	**51**	**1.1**	**0.8**	**97**	**3.8 ds Noble/ 0.4 us/ 1.6 total**	**2.2 (limited obs.)**	**32 (limited obs.)**	**7.5**

Dissolved Oxygen Results During the 2-Week Monitorings

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 the time when oxygen concentrations are most importantly measured and rated. In 2014, the average oxygen level remained "good" (greater than 7 mg/l at dawn) for steelhead *near the bottom* at all 4 stations during the first 9 of 13 two-week monitorings except for under Stockton Bridge on the first monitoring, due to a stagnant saline layer there (**Table 2; Figure 6a-e**). Then it rained on 26 September, after which there was a 3-day delay in lowering the lagoon water level so that light could reach photosynthesizing aquatic plants. This caused a depression in oxygen to "poor" and "critical" levels near the bottom on the morning of 28 September, at which time the lagoon level was reduced. By afternoon, oxygen had increased near the surface to the upper "poor" range in Reaches 1 and 2 and into the "fair" range in Reach 3. No steelhead mortality was observed. Mostly "poor" with some "fair" morning oxygen concentrations continued through 11 October (14 days), despite lowering of the lagoon level on 28 September. Fortunately, afternoon oxygen increased in to the "fair" to "good" range above 5 mg/L, fortunately. A problem was that the flume exit was closing up from low inflow, preventing maintenance of a shallower lagoon. Good morning oxygen levels were not detected until 19 October. Low lagoon inflow in 2014 delayed and prevented lagoon water clarity from completely returning after the initial stormflow in late September. In most years, the water turbidity clears up after the first storm with higher stream inflow. It was also difficult to maintain a shallower lagoon level unless the flume exit was manually excavated and opened daily.

Lower 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. In 2014, morning oxygen concentrations were typically higher, on average, than the 3 previous years until the first small stormflow in late September, despite lower stream inflow, higher water temperature and more plant life (**Figure 6h**). Afternoon oxygen readings followed a similar pattern (**Figure 6i**). At dawn after a previously sunny day with good water clarity, oxygen levels are higher because the water becomes supersaturated with oxygen from high photosynthetic rates of the lagoon algae and pondweed the previous day. When water clarity is reduced after small stormflows, if light does not penetrate to photosynthesizing plant life, oxygen concentrations will rapidly decline, as occurred after 26 September.

In comparing morning and afternoon oxygen levels in the lagoon, usually oxygen concentration was higher in the afternoon than morning, despite warmer water temperature in the afternoon, which has a lower oxygen saturation point. This was the case for lagoon sites in 2014 except for 13 September and 26 October at Station 2 (**Figures 6b-e**). Station 1 at the flume showed the largest increases in oxygen concentration from morning to afternoon, with supersaturated oxygen levels existing near the bottom in afternoon throughout the lagoon from 6 July to 13 September. At the stream Station 5 at Nob Hill, afternoon oxygen was higher by 1 mg/L or less through most of the dry season (**Figure 6f**). In stream settings, oxygen is typically at or close to full saturation due to water turbulence in riffles. However, oxygen was only between 50 and 70% full saturation in the morning in August 2014, and it failed to reach full saturation from 6 July onward until 8 November.

Salinity Results

In 2014, saline conditions were only detected a short time after sandbar closure (22 May and 21 June) in the deeper lagoon area along the wall at Venetian Court and at Stockton Bridge (**Appendix A**). Warm water was also detected from data loggers in an initially 2 ft (0.7 m) layer along the bottom in the deepest part of the lagoon, downstream of the railroad trestle until 23 June. This indicated that saltwater was also present there. The saline layer was measured at Station 2 until 21 June. Saline conditions resulted from a small amount of saltwater being trapped in the lagoon at the time of sandbar closure on 22 May, which created a stagnant layer along the lagoon bottom that heated up. A shroud was installed on the sandbar inlet on 27 May to pull saltwater off the bottom and out through the flume. No salinity was detected on 21 June at the monitoring stations except for a thin layer under Stockton Bridge. Despite limited lagoon outflow in 2013 and 2014, saltwater was not periodically flushed back into the flume on certain high tides. The flume outlet was partially boarded up to maintain depth within the flume, which likely inhibited saltwater back flush. A freshwater lagoon was maintained from late June until sandbar breaching on 30 November. No tidal overwash was allowed to occur through the dry season in 2014 with the elevated berm around the lagoon.

Conductivity Results

Measured conductivity remained low throughout 2014, except in the Venetian Court's wall-hole and beneath the Stockton Bridge (and likely in the deep area near the railroad trestle) early on when saltwater was present at the bottom. Otherwise, it ranged between a low near the bottom of 1035 umhos at the mouth of Noble Gulch on 21 June and a high of 1298 on 31 August at the mouth of Noble Gulch (Begonia Festival Day) until stormflow reduced conductivity (**Appendix A**). Conductivity was the highest since the drought years of 1991−92 (**Alley 1992 and 1993**) but not stressful to steelhead. Conductivity was lower at Station 5 above the lagoon than in the lagoon through the summer.

Stream In-Flow to the Lagoon

The lagoon water quality is generally best with relatively higher summer baseflow. Higher summer baseflow flushes saltwater out through the sandbar and flume more quickly than less baseflow, thus reducing the heating effects of a stagnant saline layer on the lagoon bottom. Higher baseflow causes more outflow through the flume to prevent saltwater back-flushing through the flume into the lagoon. The lagoon mixes and cools more overnight when inflow is higher. Inflow in 2014 was the lowest over an extended part of the summer since 1994 (**Table 10)**. The lagoon cooled down less at night in 2014 than previous years, as indicated by the minimum water temperature and minimum 7-day rolling average compared to other years (**Table 4**). In 2008, there were repeated problems with apparent saltwater back-flushes through the flume at high tides. This was not a problem in 2009−2014, perhaps resulting in partial boarding of the flume exit in 2014 and the use of plywood over the flashboards. The year 2001 was most affected by tidal overwash in the last 14 years (**Alley 2002a**). In recent years since 2008, the sandbar around the periphery of the lagoon has been maintained at a higher elevation to reduce tidal overwash.

With proper flume management and the new grated flume ceiling installed in 2003, it should be 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.

Stream inflow in 2014 was considerably below the median and the lowest since the drought of 1987-92 and 1994. Stream baseflow was insufficient to prevent water temperatures from rising to stressful levels. The management goal of maintaining early morning minimum temperature below 20°C near the bottom was not met for 80% of the monitoring period between 7 June and 19 October. Stream inflow to the 2014 lagoon followed a much below average winter rainfall amount that came primarily from three very small stormflows during the late February−April period, resulting in very low baseflows through the entire dry season (**Figures 25–28**). Baseflow in Capitola at the time of sandbar closure was less than 1.5 cfs (compared to 2–3 cfs in 2013, 10 cfs in 2012 and 25 cfs in 2011) (**Table 10**). 2014 had the lowest baseflow on 1 June at the gage of the past 24 years of monitoring. By 1 September, prior to any fall rainfall, 2014 streamflow had declined to only 0.35 cfs at the Soquel Village USGS gage, compared to 0.4 cfs in 2013, 1.8 cfs in 2012 and 5.8 cfs in 2011. The 1 September 2014 baseflow at the gage was third lowest in the last 24 years, just above those in 1992 and 1994. Since streamflow is lost between the gage and the lagoon, streamflow was merely a trickle as it entered the lagoon in September. However, baseflow did not appear to decline between the gage and the lagoon as much in 2014 compared to 2013. A record of annual hydrographs since 2007 are provided in **Figures 25−39**.

The 4th relatively small stormflow in the fall of 2014 peaked at 35 cfs at the USGS gage in Soquel Village, but exceeded the flume capacity. This required a facilitated breach of the sandbar on 30 November 2014 to prevent flooding (**Figure 28**). Another, larger stormflow occurred soon after on 3 December, which peaked at 203 cfs at the Soquel Village USGS gage.

Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon

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

Table 10. Daily Mean Discharge Recorded at the USGS Stream Gage (11160000) in Soquel Village, At One Month Intervals from 1 June to 1 October, 1991-2014.

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

Begonia Festival Observations and Water Quality Findings

No negative impacts to fish were detected during the Begonia Festival. The City's fishery biologist (Donald Alley) was present before, during and after the Begonia Festival procession of floats on 31 August. The day of the parade was overcast in the morning and cleared up in late morning. Air temperature at the flume was 15.1°C (59.2°F) at 0705 hr. Water temperatures near the bottom were likely stressfully warm throughout the day for steelhead and rated "poor" (above 21.5˚C) in the morning and were already above 22˚C at 2 of the 4 stations before 0800 hr. Afternoon temperatures went above 23˚C at 3 stations. However, oxygen concentrations were good in the morning and supersaturated in the afternoon at all stations. Lagoon water surface elevation was excellent and maintained relatively high at 2.55−2.57. There were 8 floats and 27 other boats, kayaks and paddle boarders. 1 paddle boarder fell off during the procession. In conformance with the permit requirements from the California Department of Fish and Game, no floats were to be propelled by waders. Means of propulsion could be by towing or use of electric motors. Five floats were electric motor-powered. One float was towed by kayak. One float was towed by paddle boarders. One float was towed by row boat initially and then by electric motor. Thus, the lagoon bottom was undisturbed. Conductivity near the bottom increased very slightly at the Stockton Avenue Bridge from 1223 before to 1238 umhos after the parade. Conductivity at the mouth of Noble Gulch was 1248 umhos near the bottom before the procession and 1298 afterwards. The measured levels of conductivity were not stressful to steelhead, though they were the highest of those measured during the summer/fall season. There was no odor of hydrogen sulfide, and no fish mortality was observed. The secchi depth (water clarity) was to the lagoon bottom after the float procession. Flower petals were collected by Begonia Festival staff and volunteers the following week, and there were more petals left by the parade of floats than the previous year that had only 5 floats.

Floats were dismantled the week following the parade, and flowers were gathered from the lagoon, using a boat. More than 90% of the petals were retrieved. Water quality measurements on 13 September detected no oxygen depletion resulting from decomposing begonias (**Figure 6a-1; Appendix A**).

Pollution Sources and Solutions

The lagoon near the beach was closed to human contact due to bacterial levels above the maximum acceptable level. The 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 at Soquel Creek Lagoon 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 have been effective in discouraging roosting on that restaurant. 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.**). 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 is the culvert draining Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch, though none was detected in 2014. A thick planktonic algal bloom was present much of the summer at the mouth of Noble Gulch, and slightly elevated conductivity at the bottom the entire summer indicate that Noble Gulch continues to be a pollution source to the summer lagoon. In past years when gray water was observed at the Noble Gulch culvert outlet to the lagoon, streamflow was clear in Noble Gulch at the park when checked, before the creek went underground into the culvert. By minimizing the summer stream inflow from Noble Gulch, nutrients and bacteria entering the lagoon would be reduced.

Another drain into the lagoon is situated under the railroad trestle, where slight oxygen depletion has been detected in recent years but not in 2014. This drain could be capped if summer runoff was re-directed into the sewer.

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 dark, requiring lagoon water level reduction to allow light penetration to the bottom and photosynthesis and oxygen production to continue. In most years like 2014, the lagoon required breaching prematurely because the flume could not accept all of the stormflow with flooding imminent. 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. However, the pump was in manual mode,

requiring Public Works staff to turn it on and off. Now an automatic pump switch has been connected to a float system to improve the operation.

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.

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

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

1. Prior to sandbar breaching in the fall, notch the sandbar across the beach at an elevation just below the piling bolt for flooding, minimizing the gradient of the notch to slow the evacuation of water through the beach and to minimize beach erosion. 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. *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. Seek volunteers to re-establish tules in the alcoves under the railroad trestle, near the Golino property and in Margaritaville Cove.

4. To provide cover for juvenile fishes and to scour deeper habitat, secure large woody material to the lagoon bottom with anchor boulders in appropriate locations. Continue to retain large woody material that naturally reaches the lagoon.

5. Allow a clear path from under the bridge to the beach at Venetian Courts to enable seining for juvenile steelhead during fall censusing.

6. Require that Margaritaville staff not wash their patio and adjacent walkway (containing refuse dumpsters) off into the lagoon.

7. Restrict the number/weight of float participants allowed to ride on the floats to a safe level.

8. Enforce the ban on waders during the Begonia Festival Parade.

9. Continue to recommend to the Begonia Festival 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.

10. Continue to recommend to the Begonia Festival organizers to discourage alcohol consumption by float participants and rowdy behavior on their floats.

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. Re-install the 12-inch high wooden baffle inside the flume prior to directing water through the flume, if it was destroyed during the previous winter.

14. Maximize lagoon depth throughout the dry season, while maintaining passage through the flume for adult steelhead until June 1 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 1, close the portal. If inflow is sufficient to maintain lagoon depth with the adult portal open, leave it open through the dry season. If adult steelhead are seen in the lagoon after June 1 with the portal closed, then open it for a week to allow out-migration.

15. After July 1, leave the flume exit closed once it closes, unless flooding is eminent. Install visquine or plywood on the outside of the flashboards to prevent leakage into the flume. Maximize the number of boards in the flume entrance to maximize lagoon depth.

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

17. If the lagoon bottom becomes invisible due to turbidity after the rains that do not breach the sandbar, immediately lower the lagoon level to the point where the bottom is visible. This will allow algal growth despite the high turbidity. Plant photosynthesis will produce oxygen and prevent anoxic conditions. 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.

18. 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.

19. 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.

20. Do not reduce the lagoon level for the Begonia Festival's nautical parade.

21. Regarding the nautical parade during the Begonia Festival, 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 CDFG 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.

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

23. "Gull Sweeps" sold by West Marine Products should be installed on Esplanade roofs to test their effectiveness in deterring gulls. According to the catalogue, "Powered by the slightest breeze, the Gull Sweep's motion will deter the most determined bird." These were successfully used on San Diego restaurants (**Y. Sherman, pers. communication**).

24. 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.

25. 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.

26. The City should continue to fund activities to permanently remove invasive Arundo 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 protect aquatic and wildlife habitat.

FISH CENSUSING

Steelhead Plantings. No steelhead were planted in Soquel Creek in 2014, as was the case in 2003–2013. CDFW allowed juvenile planting of smolts in spring only 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 12 and 19 October 2014, from just upstream of the Stockton Avenue Bridge to the beach. A bag-seine with dimensions 106 feet long by 6 feet high by 3/8-inch mesh was used. The seine was set perpendicular to shore, parallel to the Stockton Avenue Bridge and just upstream of it. Juvenile steelhead congregate in the shade under the bridge. The seine was pulled to the beach in front of Venetian Court. With this larger, coarser-meshed seine, no tidewater gobies were captured. A total of only 10 juvenile steelhead were captured and marked on 12 October after 6 seine hauls. There were no mortalities. Only 1 juvenile steelhead was captured on 19 October in 6 seine hauls. Another juvenile steelhead was captured with the shorter goby seine on 19 October. There were no recaptures and no mortalities. Therefore, it was impossible to obtain a steelhead population estimate based on mark and recapture for fall 2014. There were likely few YOY steelhead in the 2014 lagoon due poor adult passage and spawning conditions and poor egg survival due to low winter/spring streamflows (**Figures 24 and 25**). Juveniles were scarce in the watershed's stream sampling sites in 2014 (**Alley 2015**). Size histograms for other years of sampling back to 1998 may be found in **Figures 11−23**. The 2013 estimate was 1,681 compared to 220 in 2012 and 678 in 2011 (**Table 11; Figure 24**) (methods in **Ricker 1971**). The average for 1993-2013 was 1,599.

Other species captured with the large seine on both days combined were 21 staghorn sculpins and 1 adult Sacramento sucker. The median size of juvenile steelhead captured on 12 Oct 2014 was 155-159 mm SL (**Figure 7; Table 12**) compared to 125-129 mm SL on the first day and 130-134 mm SL on the second day in 2013 (**Figure 8**), 140-144 mm SL on both sampling days in 2012 (**Figure 9)**, 155-159 mm SL on the first day and 160-164 mm SL on the second day in 2011 (**Figure 10**).

On 19 October 2014, 6 seine hauls were made for tidewater gobies with a 30-foot x 4-foot x 1/8-inch mesh beach seine in lower Soquel Lagoon near the beach. A total of 481 tidewater gobies were captured without mortality. Of those, 251 were <= 25 mm Total Length (TL). 213 were intermediate size between 25 and 40 mm TL. A remaining 17 were => 40 mm TL. Ten tidewater gobies were captured in 2013. Prior to that they were captured in 2008 and 2009 after dry winters. Other fish captured with the small seine included threespine sticklebacks in high abundance, 4 staghorn sculpins and 1 juvenile steelhead. 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 to be used as refuges during high winter stormflows. This species was plentiful in Soquel Lagoon during the previous drought of the late 1980's and early 1990's and reappeared during the recent two, less severe droughts (2007-2009 and 2013-2014). 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 the two large stormflows in December 2012. They were found in Aptos Lagoon in 2011−2014 (**Alley 2012; 2013; 2014; 2015**).

Past calculations indicated that lagoon 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 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 2007–2013 population estimates for the entire Soquel Creek watershed, the lagoon population of larger smolt-sized fish was likely a significant percentage of the total watershed population in both of these 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. A summary table was prepared for the years, 1998−2014 (**Table 12**), corresponding to scatter plots of the data found 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. The proportion of larger yearlings may also vary between years. But usually the lagoon population is overwhelmingly dominated by young-of-the-year steelhead, based on past scale analysis. Median size was slightly smaller in 2013 compared to 2012, which had a much smaller juvenile population, a likely higher proportion of yearlings and presumably less competition. In addition, the 2013 lagoon was warmer than previously, which increased metabolic rates and food demands of juvenile steelhead and may have slowed growth rate in 2013. The median size in 2011 was larger than the following years with the population likely dominated by larger yearlings after poor overwinter YOY survival with multiple large stormflows as late as April (**Figure 31**).

Table 11. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2014.

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 and one with rope tangled around one pole.
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.

Table 12. Summary of Annual Fish Sampling Dates, Population Estimates, Steelhead Size and Lagoon Growth Period Prior to Sampling, 1998−2014.

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)
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 (no lengths)	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 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 fish)	21.3	149	None possible	155-159 First Day

We suspect from the size distributions of juveniles captured, that steelhead grew faster in 2006, 2009 and 2012 than either 2007 or 2008 because of less competition for food with much smaller juvenile populations (**Table 12**). 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. 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.

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. 2013 had good densities of pondweed with attached algae (15-25% of bottom coverage in various reaches) from 1 September onward **(Table 5).** However 2012 had much higher densities (15-70% bottom coverage in various reaches) that began in mid-August **(Table 6).** Consideration must be given to potentially diminished water quality (oxygen levels at the end of the night) and/or fish foraging efficiency if aquatic vegetation becomes too dense.

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, which slows the processing of food for growth. The 2013 lagoon was relatively warm with very limited stream inflow. The 2012 lagoon was cooler with the 2011 lagoon cooler still. Aquatic plant production was less in 2011 than in the warmer lagoons of 2008, 2009, 2012 and 2013 (more pondweed) (**Tables 5-9**), indicating less food in 2011. There may have been a higher proportion of yearlings in the lagoon population in 2011 compared to other years due to overall low YOY survival in the watershed. 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 2014 lagoon was relatively deep as in 2013. There was limited sedimentation over the very mild winter of 2013-2014. 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 (**Figure 2**). 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 and 2014. 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 2014. The lagoon

water surface was kept at the top of the flume inlet throughout the summer/ fall until lagoon depth had to be reduced to allow light penetration to the bottom after early, small stormflows that created turbidity. 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. Public Works staff succeeded in maintaining the sandbar and intact lagoon until 30 November 2014 when stormflow that could maintain an open sandbar finally occurred. Minimization of pollutant input from early fall storms is also important for reducing biological oxygen demand and avoiding fish kills.

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

In 2013 and 2014, mergansers were more common than in 2011 or 2012, ranging between 1 and 6 individuals at a time (**Appendix A**). Six mergansers were first observed on 21 June 2014 and fewer later, totaling 6 of 13 monitoirngs (46%) compared to 9 of the 18 two-week monitorings (50%) in 2013. In 2012, one merganser was observed on only 3 days of monitorings (25% of the time). Snowy egrets were more common in 2014 with presence on 4 monitorings (as many as 3 at one time). No egrets were sighted in 2013 (1 observation in 2012). One cormorant was observed on one occasion in 2014 compared 3 times in 2013 and 4 times in 2012. A pied-billed grebe was observed on 6 July but not again until 13 September, after which 1-3 were observed during the 5 monitoring after that (54% of the monitorings). Similarly, 1-4 pied-billed grebes were seen in the lagoon not until 14 September but for the 10 monitorings thereafter (56% of the monitorings). In 2012, 1 pied billed grebe was observed on 4 monitoring days early in the season and a pair of pied-billed grebes were observed on 4 monitoring days late in the season (67% of the monitoring days with grebe sightings). No brown pelicans were observed in the lagoon in 2014. Black-crowned night herons were observed on 3 occasions, including the first day of sandbar construction and the morning of the sandbar emergency breach. Greenback heron were observed on 2 monitorings compared to 3 occasions in 2013. Black-crowned night herons were observed on 3 monitorings in 2014 (as many as 3 at one time). Eared grebes came late in the season, 1-4 being present in October and November.

As in 2013, no piscivorous western pond turtles were observed in 2014. Previously, they regularly basked on the instream cottonwood log and additional logs further downstream adjacent to the Golino Property. However, in 2013 no turtles were observed. The cottonwood that had been previously used had sagged and was mostly underwater in 2013 and 2014, offering limited basking area. In 2012, as many as 3 pond turtles were observed at one time on the cottonwood log and another nearby log.

Other bird species that utilized the 2014 lagoon included mallards (as many as 34 with especially high survival of ducklings), coots (as many as 83 in late October but reduced to 33 by late November) and gulls (as many as 106 in mid-August).

Recommendations Regarding Fish Management

1. Seek volunteers to re-establish tules in the alcoves under the railroad trestle, near the Golino property and beside Margaritaville.

2. 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.

3. 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 Game Department of the streamflow conditions so that direct water diversion of surface flow 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. Complete loss of surface flow should be avoided.

4. Maximize lagoon depth by maximizing flashboards in the flume inlet as streamflow declines and by sealing the boards with visquine and/or plywood, as was done in the past.

5. Secure the flume boards at all times so that vandals cannot pry them up and drain the lagoon. This will prevent tidal surges through the flume from dislodging boards and doing the same thing. Installation of a louver system on one side of the flume inlet would eliminate the need to deal with boards all summer. The design and installation of a louver system is recommended.

6. Do not unplug the flume exit after 1 July unless flooding is eminent.

7. Do not remove flume boards for the Begonia Festival's nautical parade or prior to taking fall vacation time.

8. Remove flume boards as the first small storms begin in fall and replace the boards after the stormflow has subsided while maintaining light penetration to the lagoon bottom. The effort should be to minimize lagoon fluctuation until the sandbar actually breaches for the winter. Many forecasts for rain and storm intensities are incorrect in the early fall. It is harmful to steelhead to drop the lagoon level in anticipation of a storm that fails to develop, followed by failure to re-install the flume board afterwards.

9. Maintain the lagoon in fall until streamflow has increased enough (20-25 cfs) to prevent stranding of spawning adult steelhead or coho salmon and to prevent osmotic stress to lagoon-inhabiting steelhead. If necessary, install a perimeter fence with 2"x 4" mesh and with 6-foot panels around the flume entrance by October to prevent plugging of the flume's screen with aquatic vegetation during the first minor storms. Maintain the lagoon until approximately Thanksgiving in late November, before allowing stormflow to breach the sandbar. By this

time, the winter storm pattern has usually developed to keep the sandbar open.

10. If sufficient turbidity occurs after the first small storms of the season to prevent light from penetrating to the bottom of the intact lagoon for more than one day, reduce lagoon depth temporarily to insure that light reaches the bottom. This will prevent death of aquatic vegetation and increased biological oxygen demand, with the associated loss of oxygen production that would have occurred from photosynthesis. Thus, anoxic conditions will be prevented. When the lagoon clears up, re-establish the maximum lagoon depth.

11. If the sandbar is still in place after November 15, maintain an opening in the flume inlet to allow early spawning adults to pass through the flume from the Monterey Bay.

12. Continue to census the juvenile steelhead in the fall to monitor the use of the lagoon as an important nursery area under varying management scenarios and restoration efforts.

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Soquel Lagoon Post-Venetian Court Construction- Older Stockton Avenue Bridge and prior to expanded development on eastern margin of the Lagoon, above and below 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 above Stockton Bridge since 1931 photo; circa 1955-56 after the flood.
(Courtesy of the Capitola Historical Museum)

FIGURES

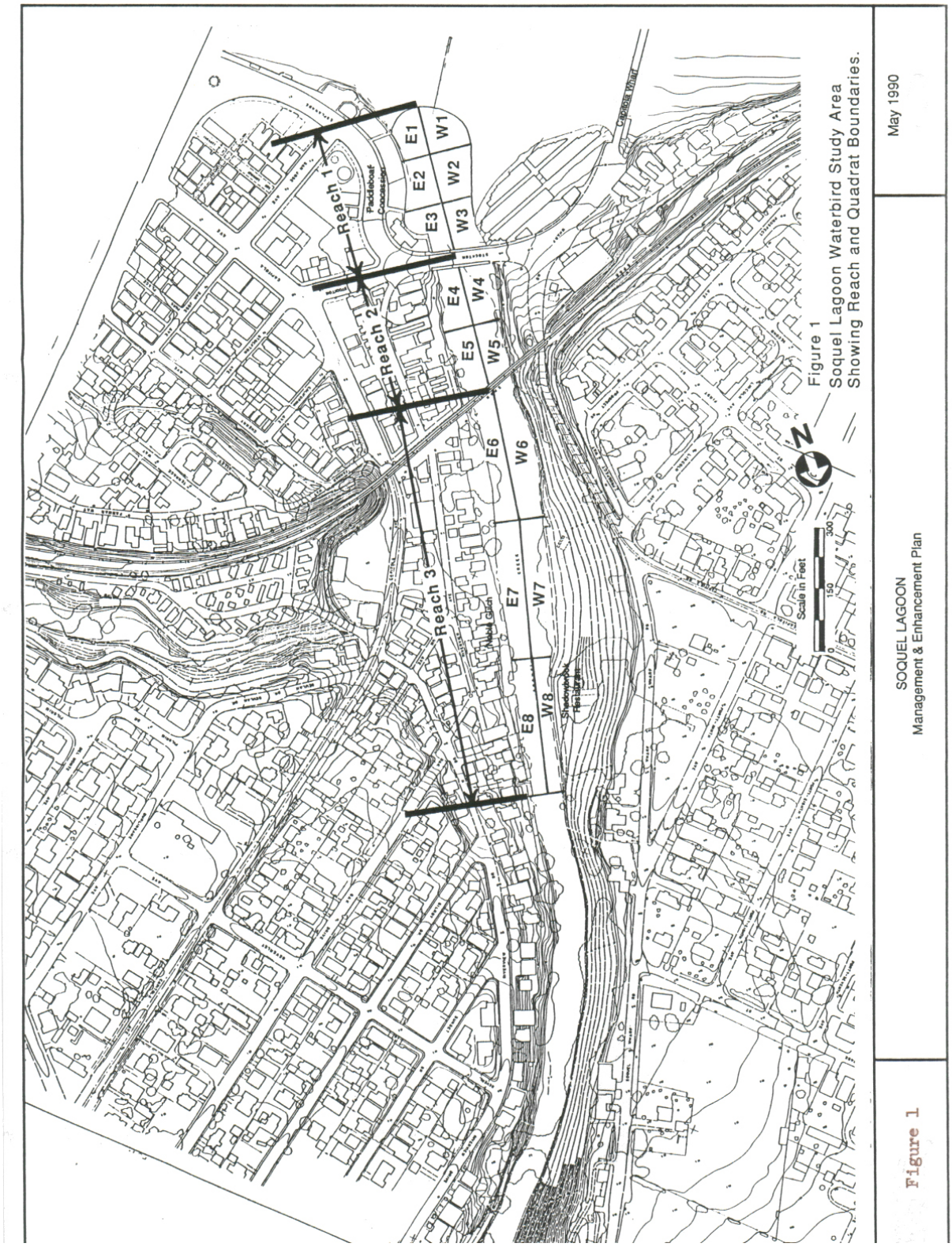


Figure 1. Map of Reaches in Soquel Creek Lagoon

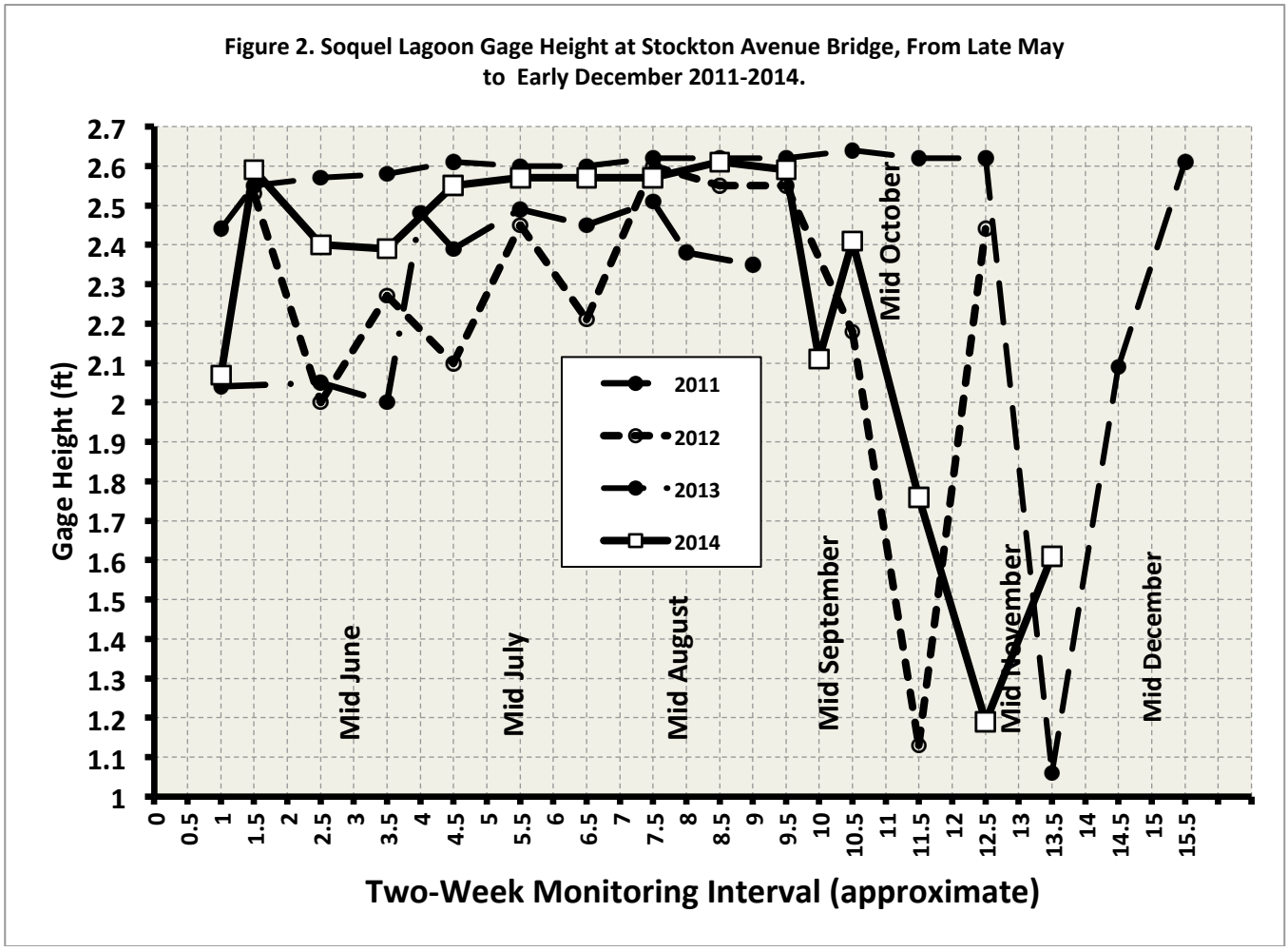


Figure 2. Soquel Lagoon Gage Height at Stockton Avenue Bridge, From Late May to Early December 2011-2014

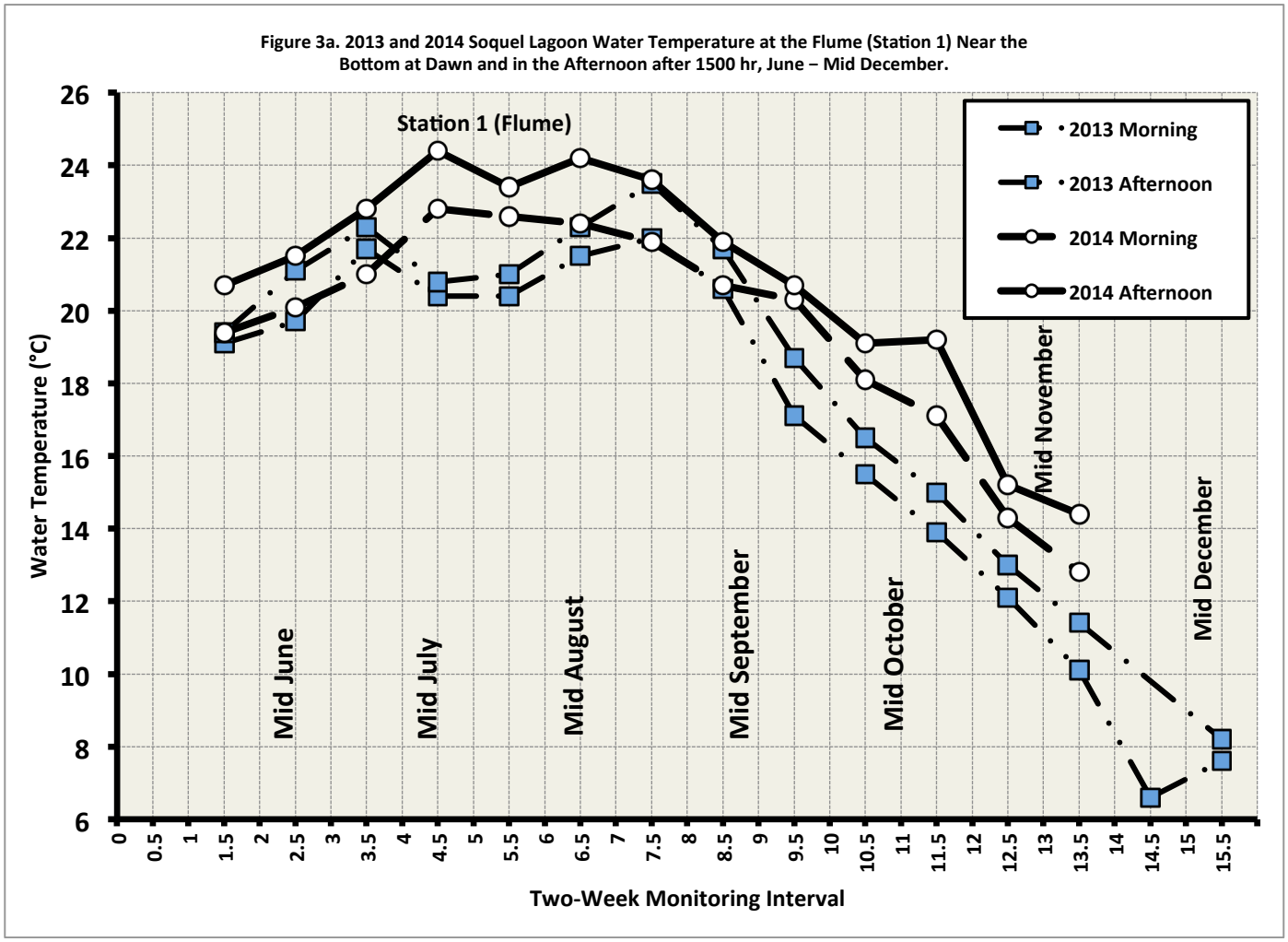


Figure 3a. 2013 and 2014 Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn and in the Afternoon after 1500 hr, June – Mid-December.

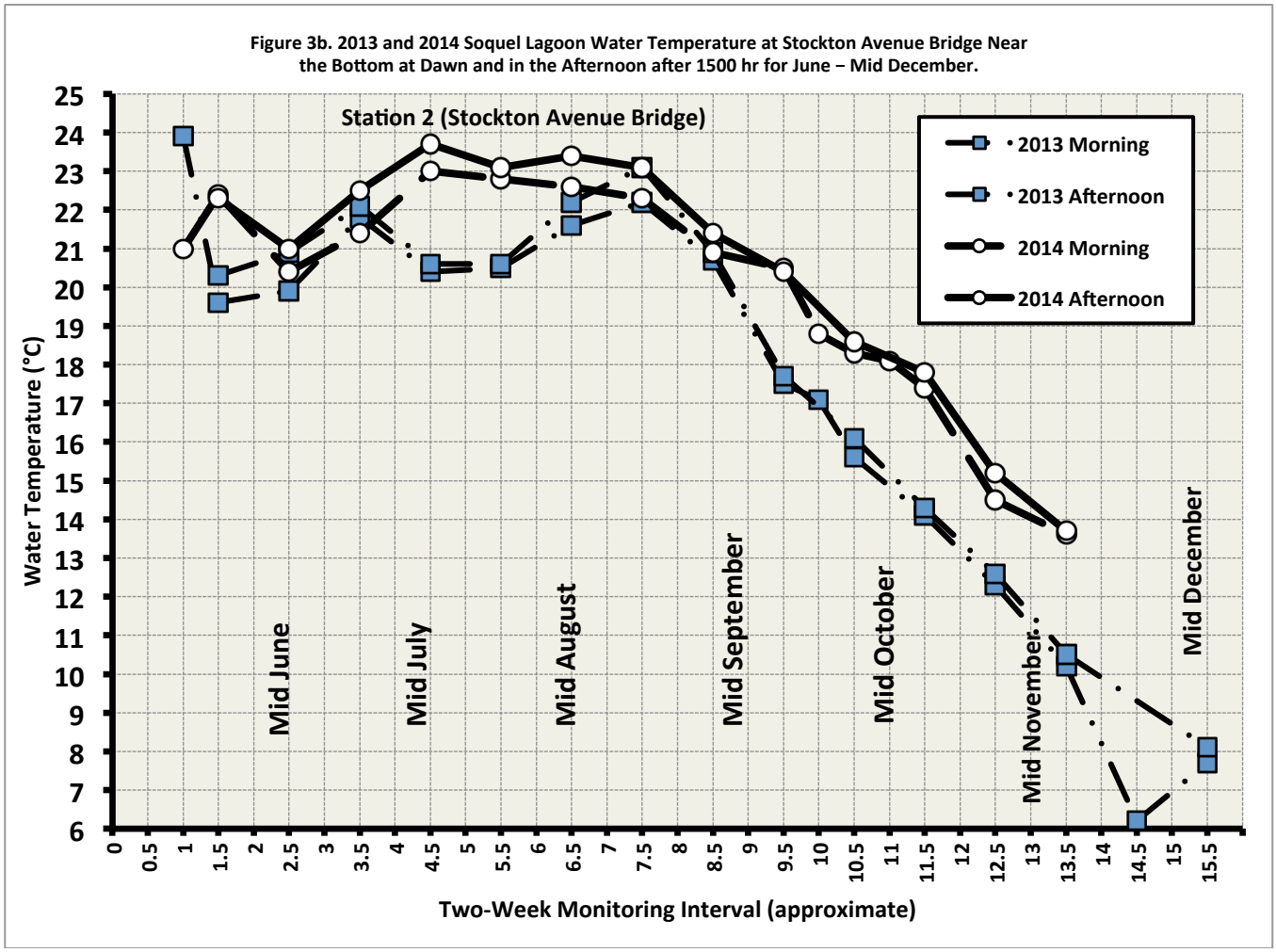


Figure 3b. 2013 and 2014 Soquel Lagoon Water Temperature at Stockton Avenue Bridge Near the Bottom at Dawn and in the Afternoon after 1500 hr for June − Mid December.

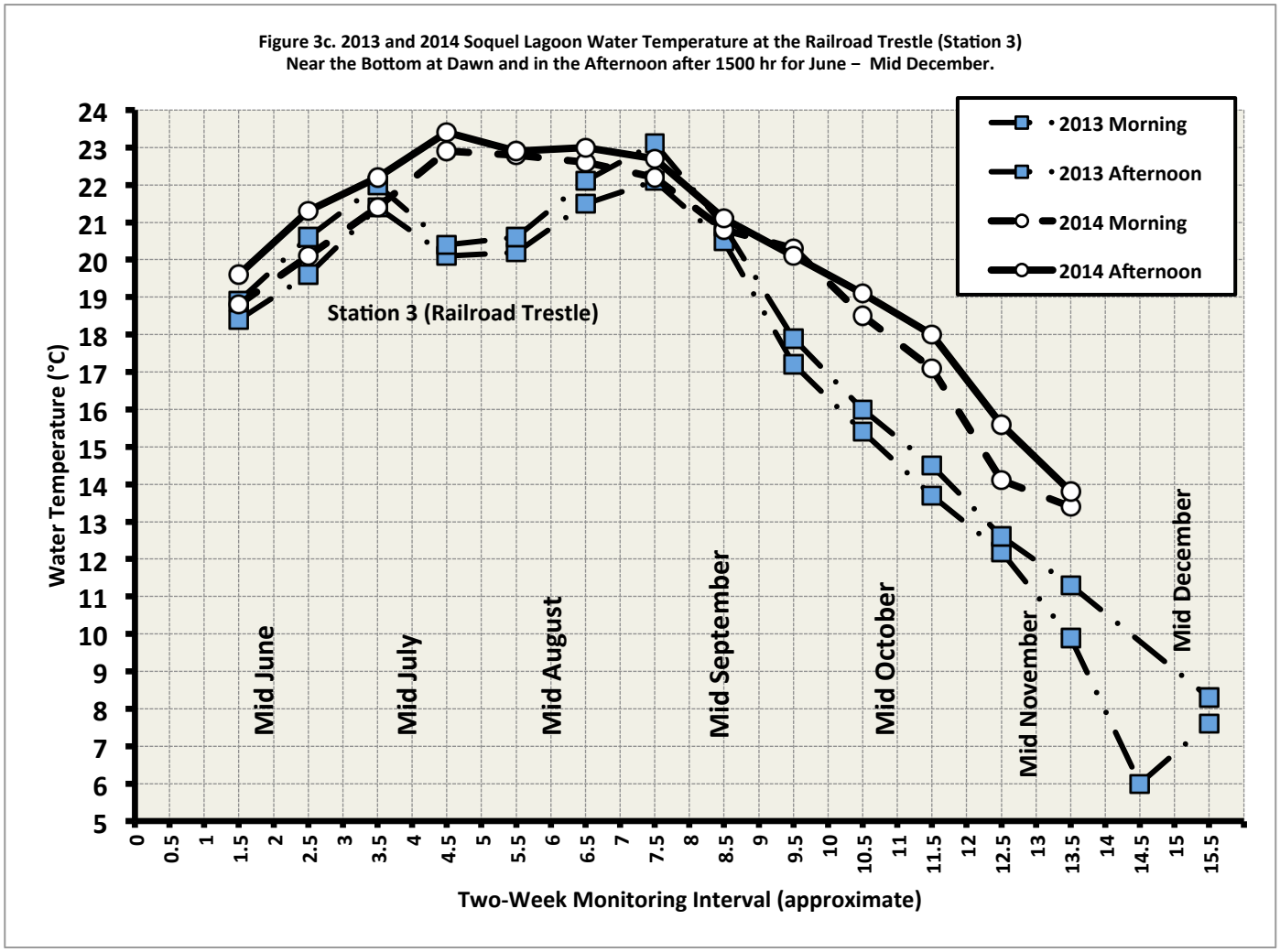


Figure 3c. 2013 and 2014 Soquel Lagoon Water Temperature at the Railroad Trestle (Station 3) Near the Bottom at Dawn and in the Afternoon after 1500 hr for June– Mid December.

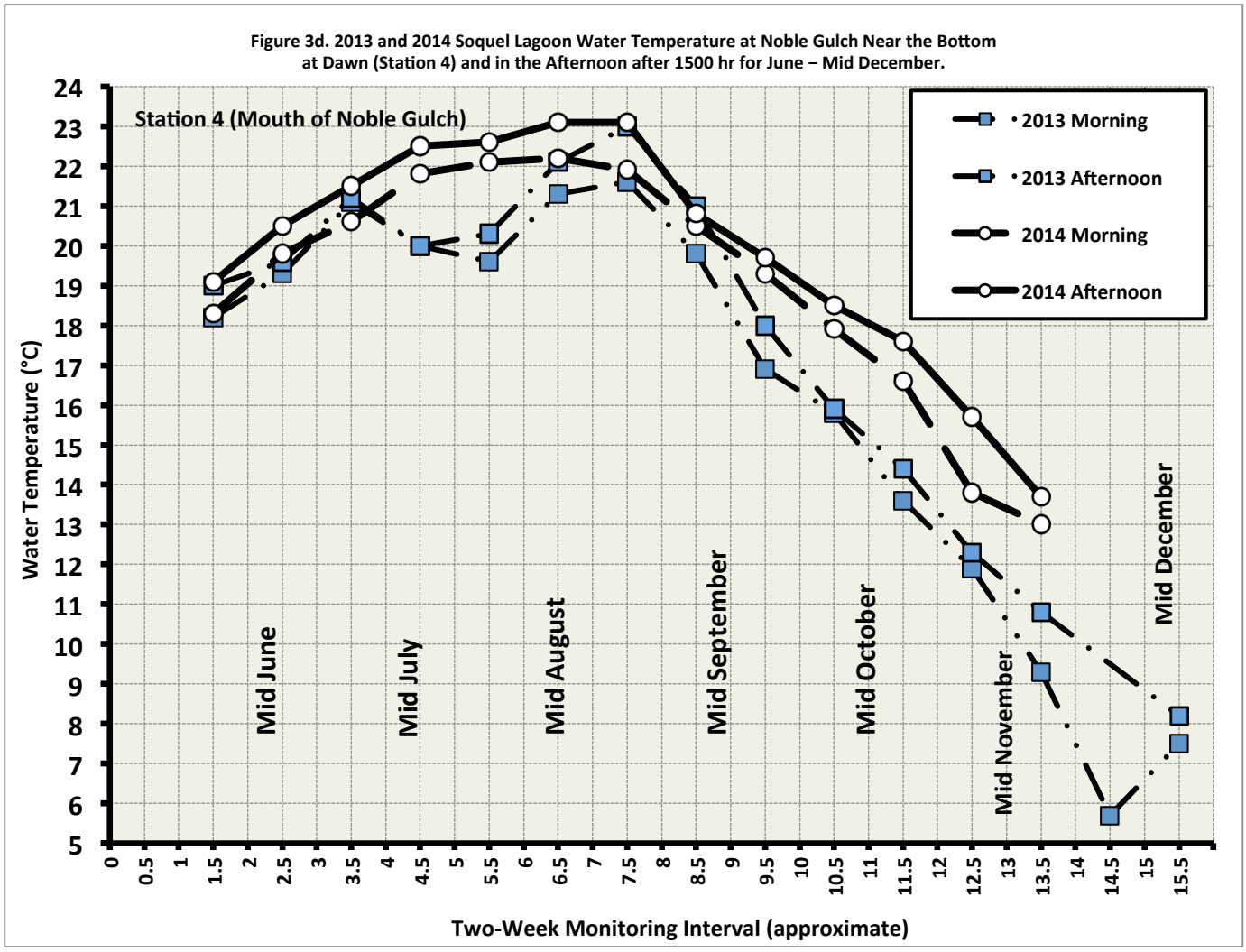


Figure 3d. 2013 and 2014 Soquel Lagoon Water Temperature at Noble Gulch Near the Bottom at Dawn (Station 4) and in the Afternoon after 1500 hr for June – Mid-December.

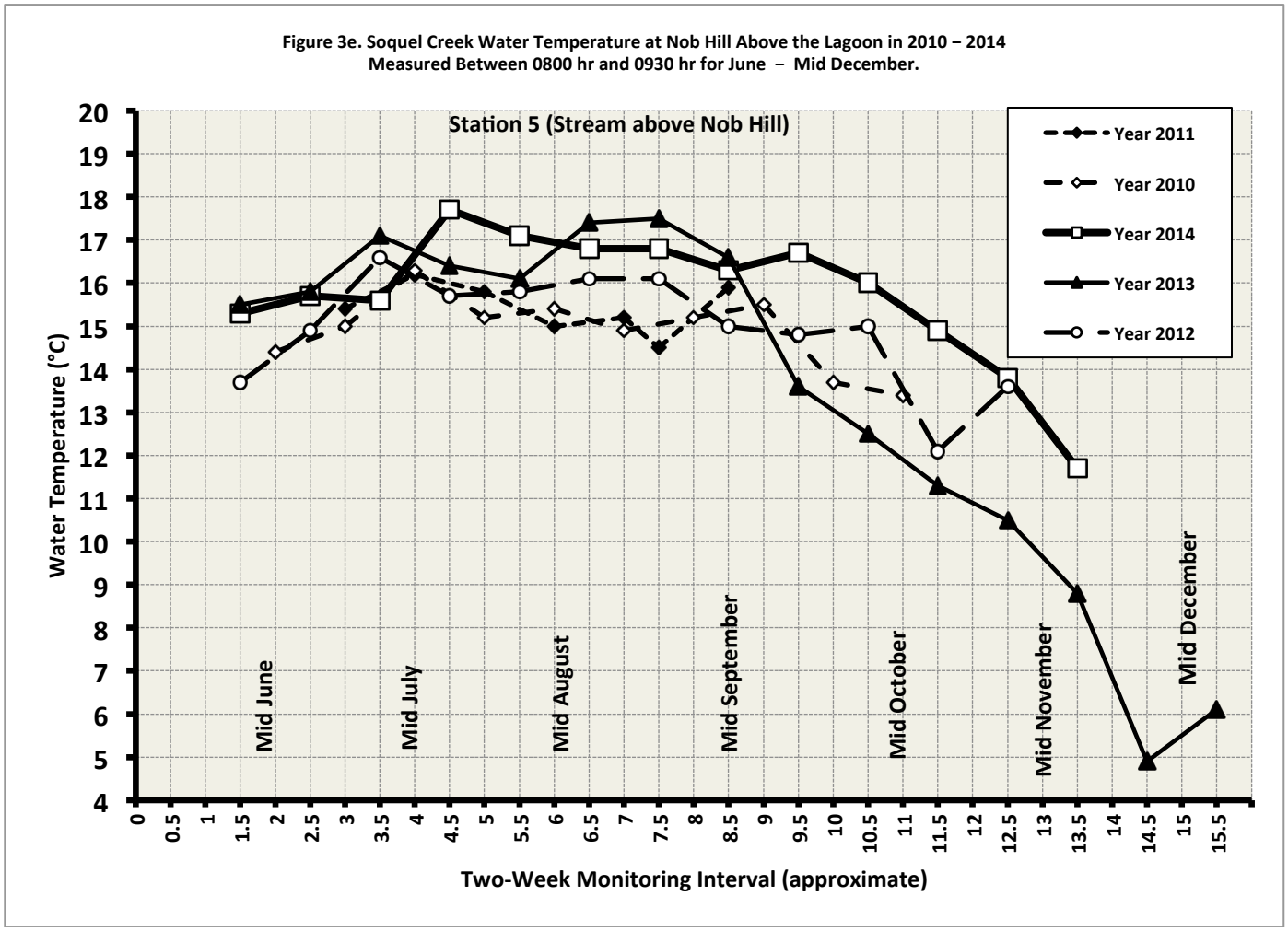


Figure 3e. Soquel Creek Water Temperature at Nob Hill Above the Lagoon in 2010−2014 Measured Between 0800 hr and 0930 hr for June − Mid-December.

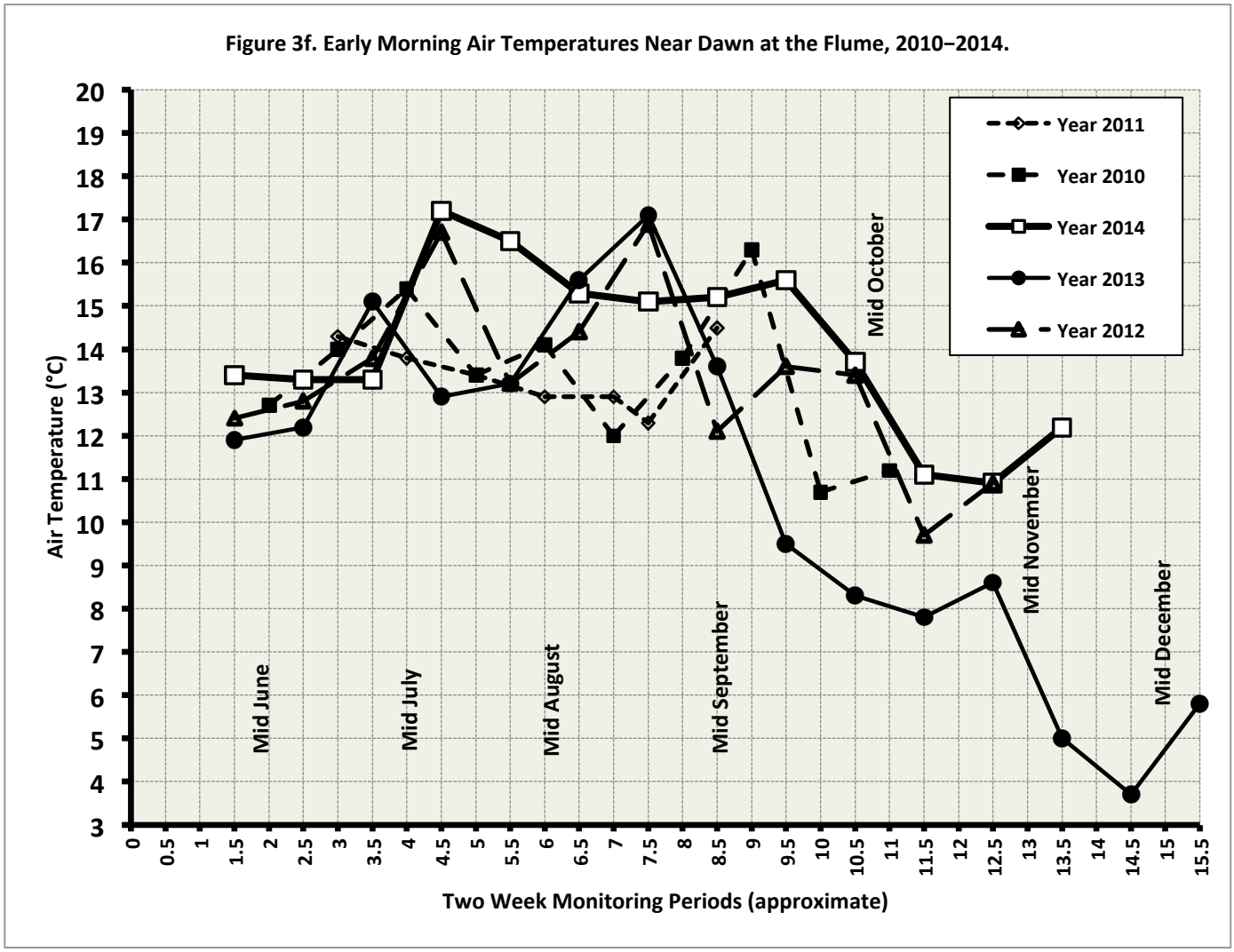


Figure 3f. Early Morning Air Temperatures Near Dawn at the Flume, 2010−2014.

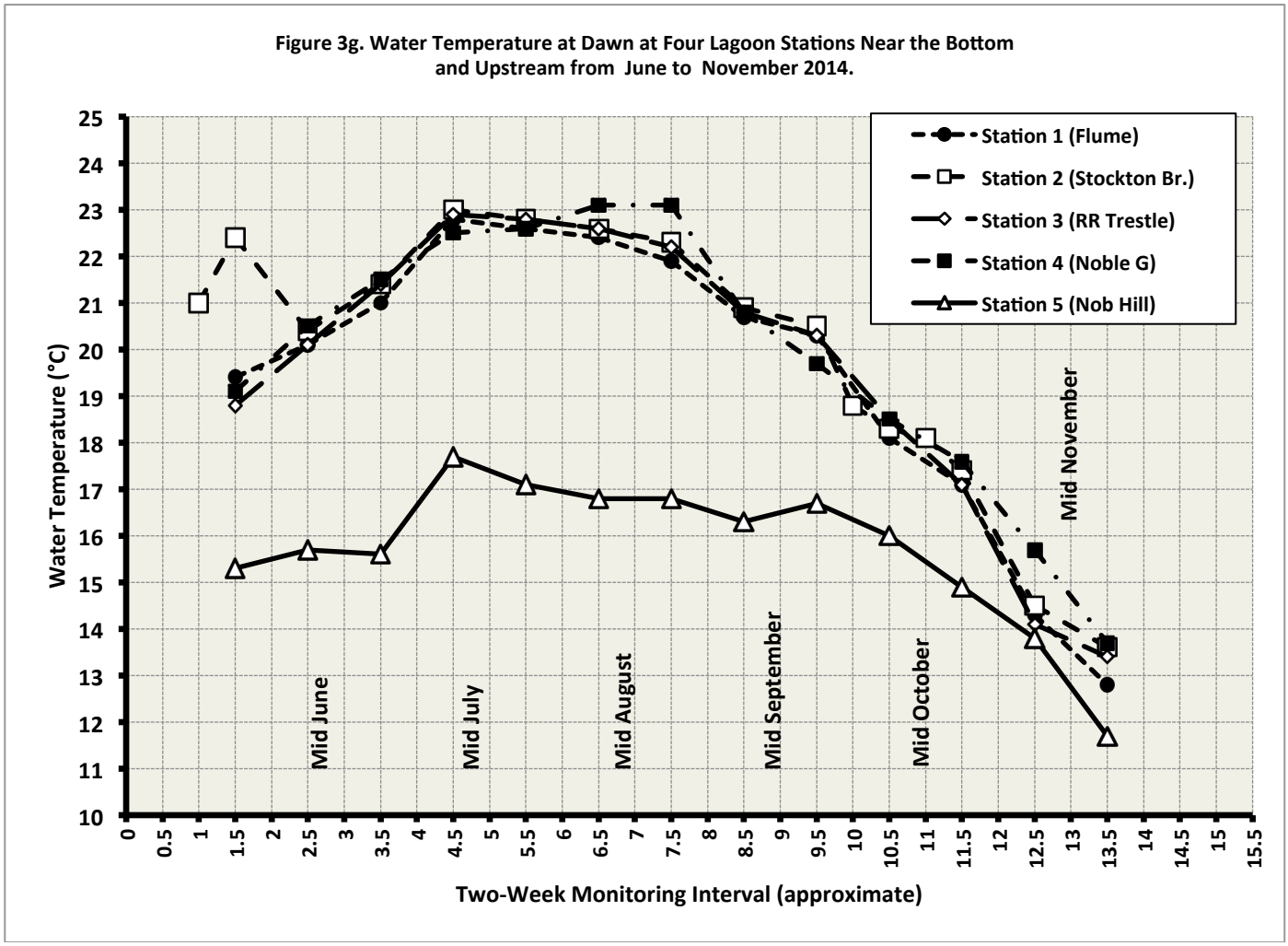


Figure 3g. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream from June to November 2014.

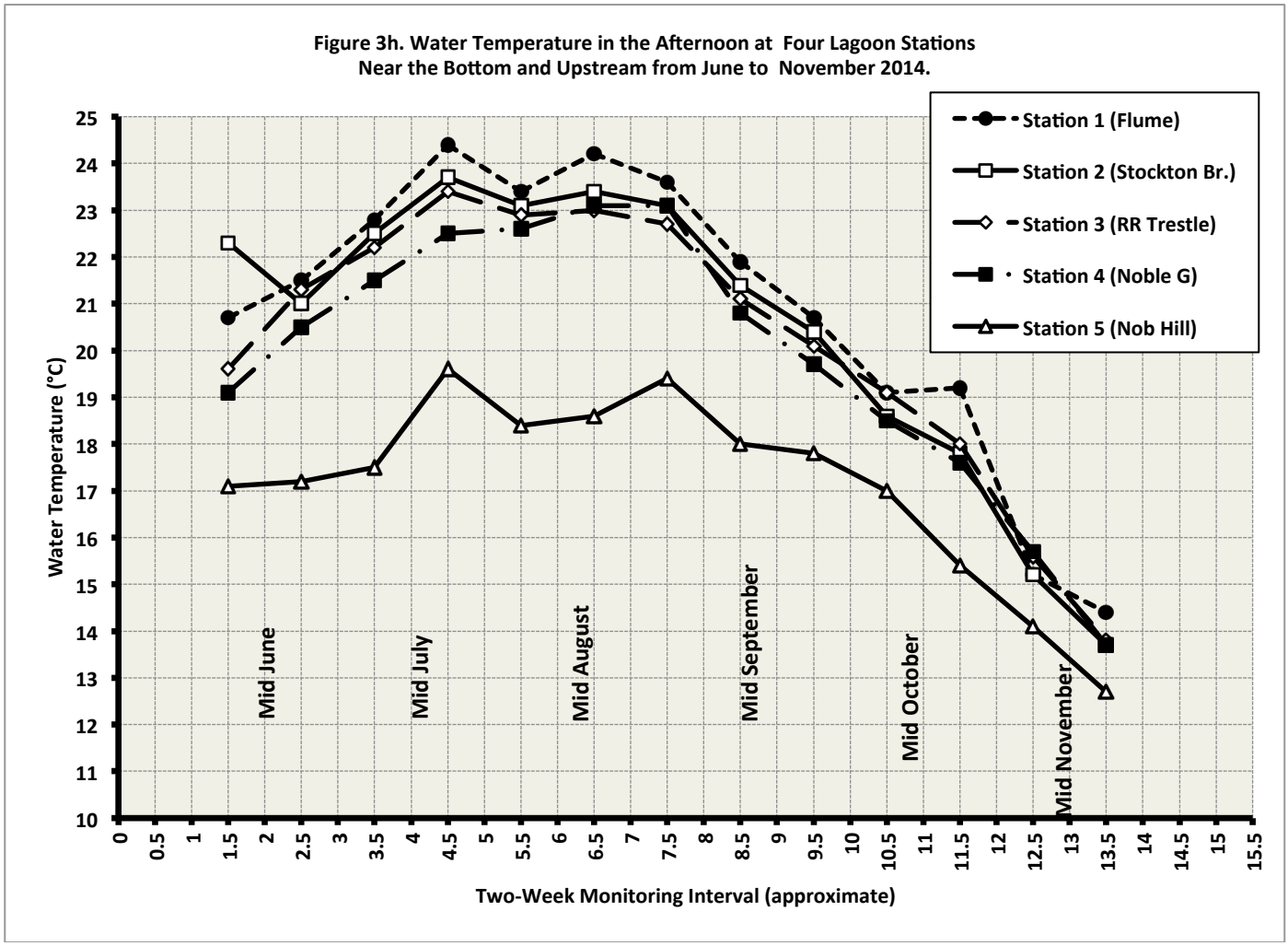


Figure 3h. Water Temperature in the Afternoon at Four Lagoon Stations Near the Bottom and Upstream from June to November 2014.

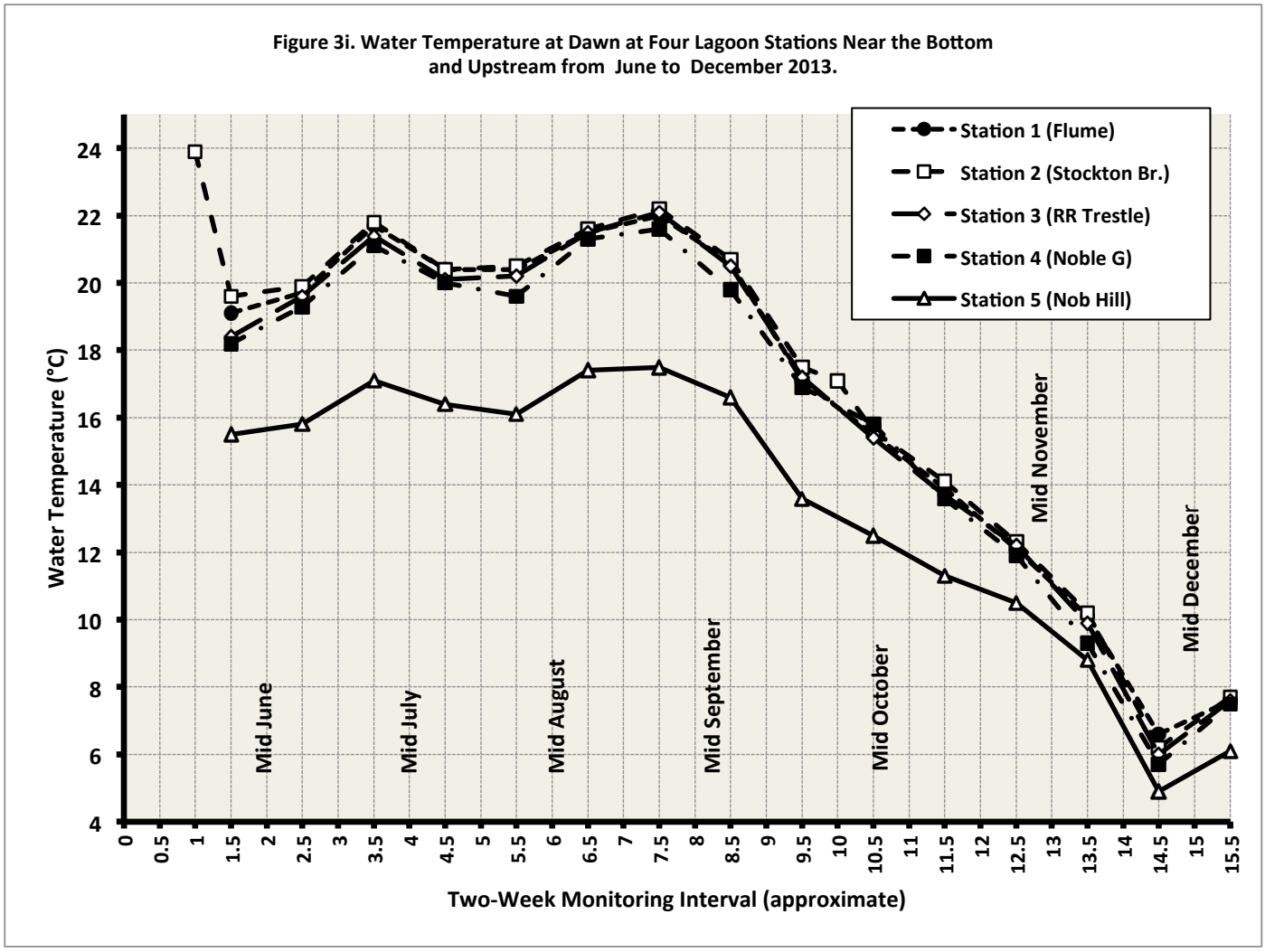


Figure 3i. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream from 8 June to 21 December 2013.

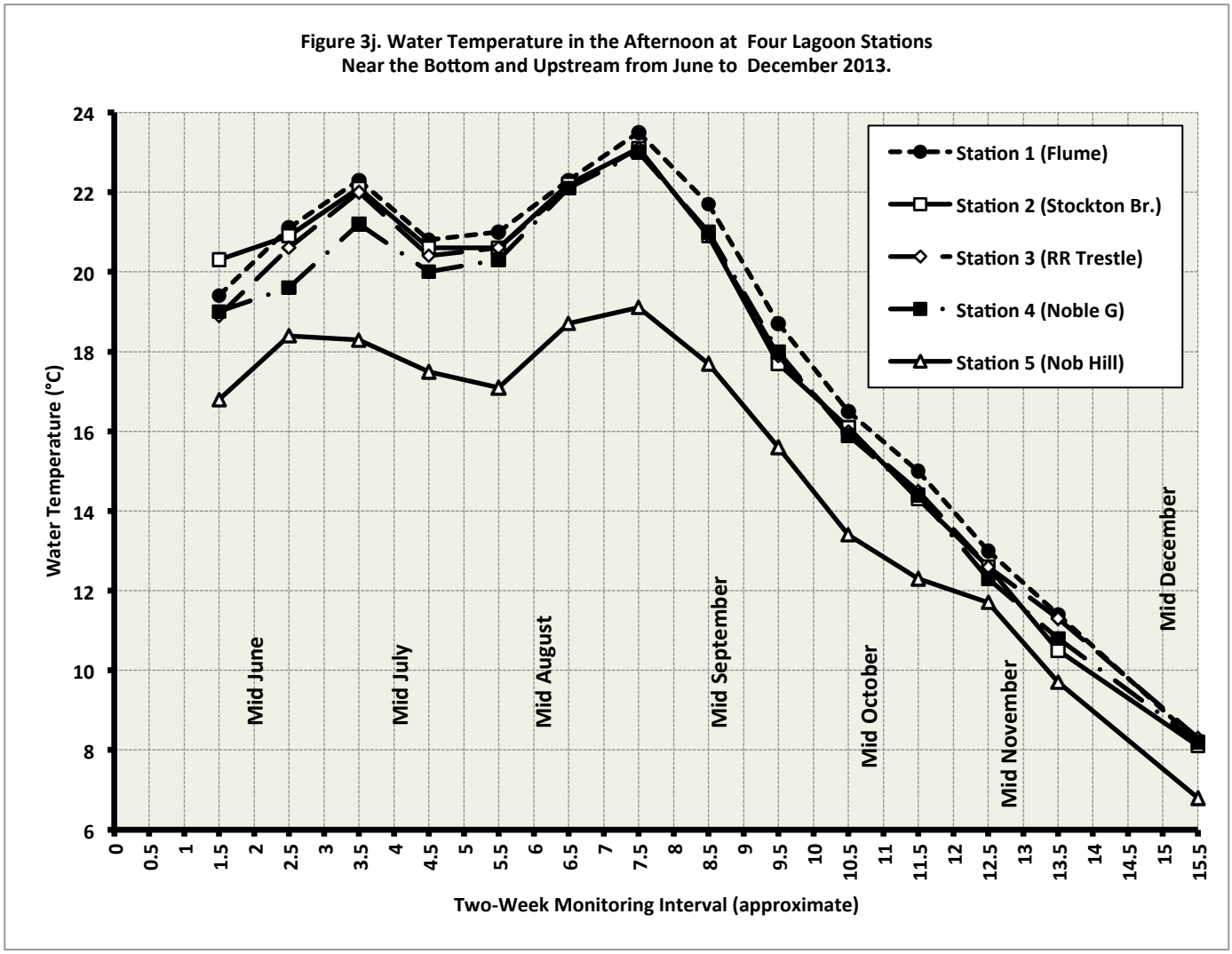


Figure 3j. Water Temperature in the Afternoon at Four Lagoon Stations Near the Bottom and Upstream from 8 June to 21 December 2013.

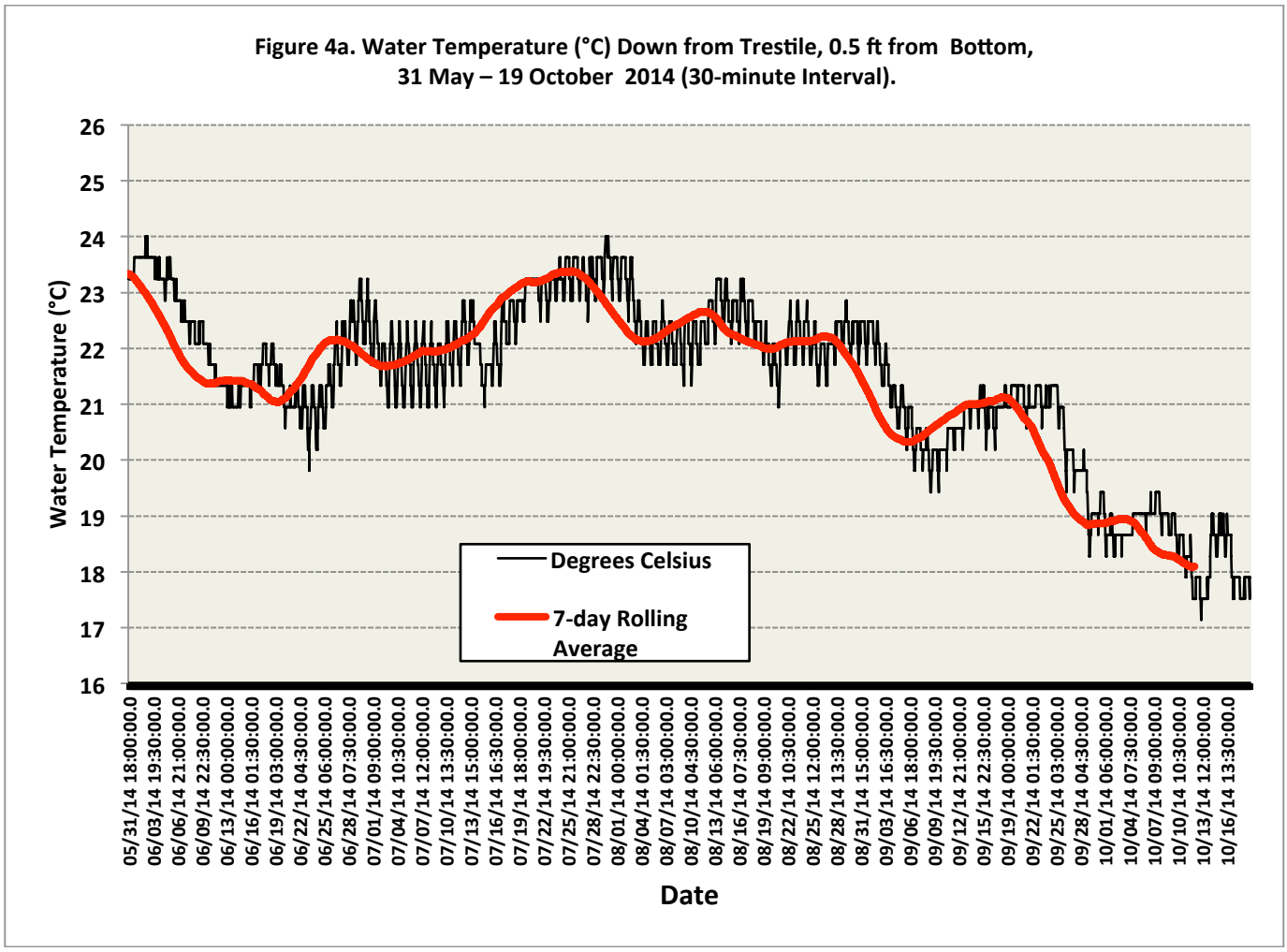


Figure 4a. Water Temperature (°C) Down from Trestile, 0.5 ft from Bottom, 31 May – 19 October 2014 (30-minute Interval).

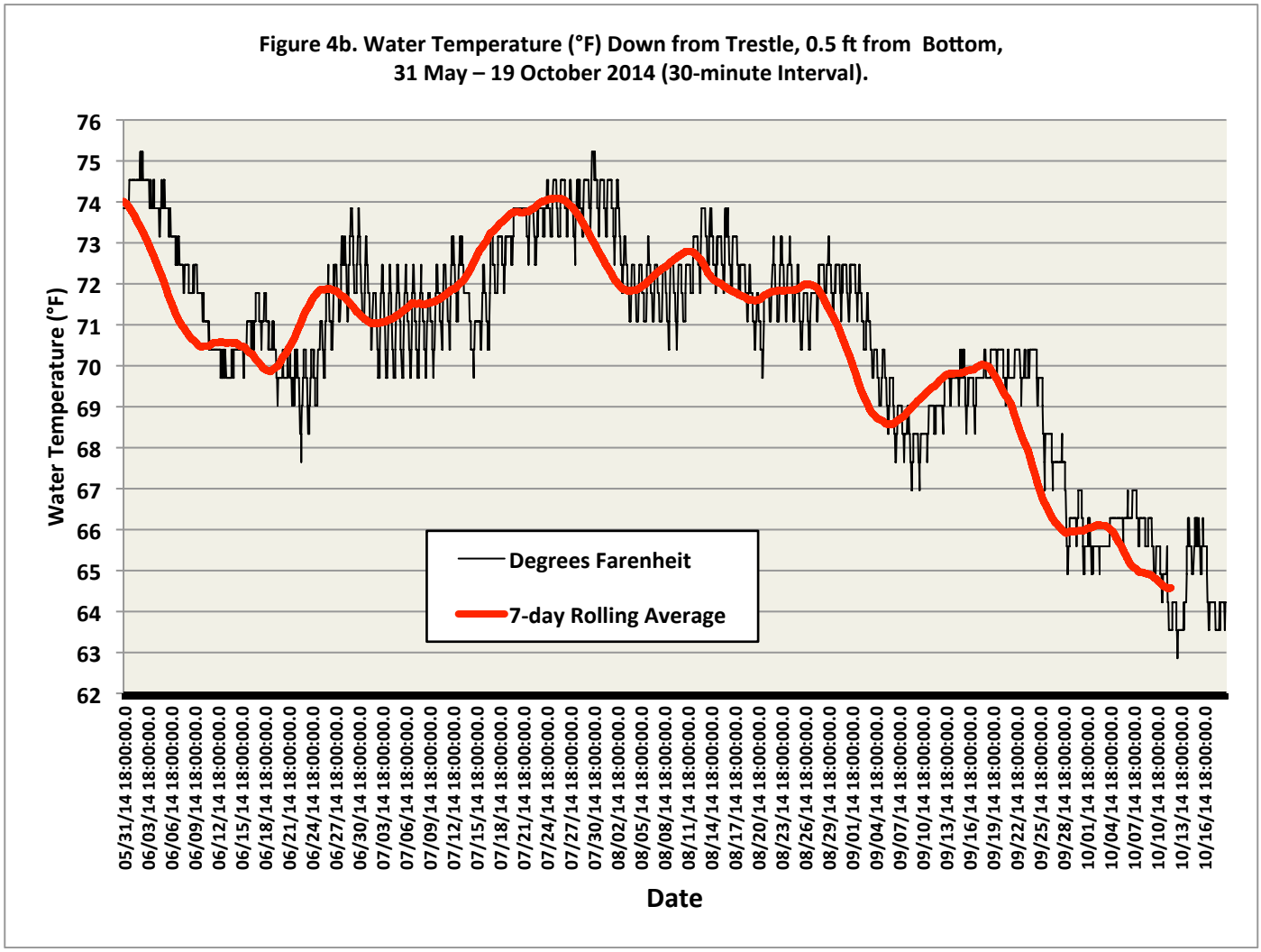


Figure 4b. Water Temperature (°F) Down from Trestle, 0.5 ft from Bottom, 31 May – 19 October 2014 (30-minute Interval).

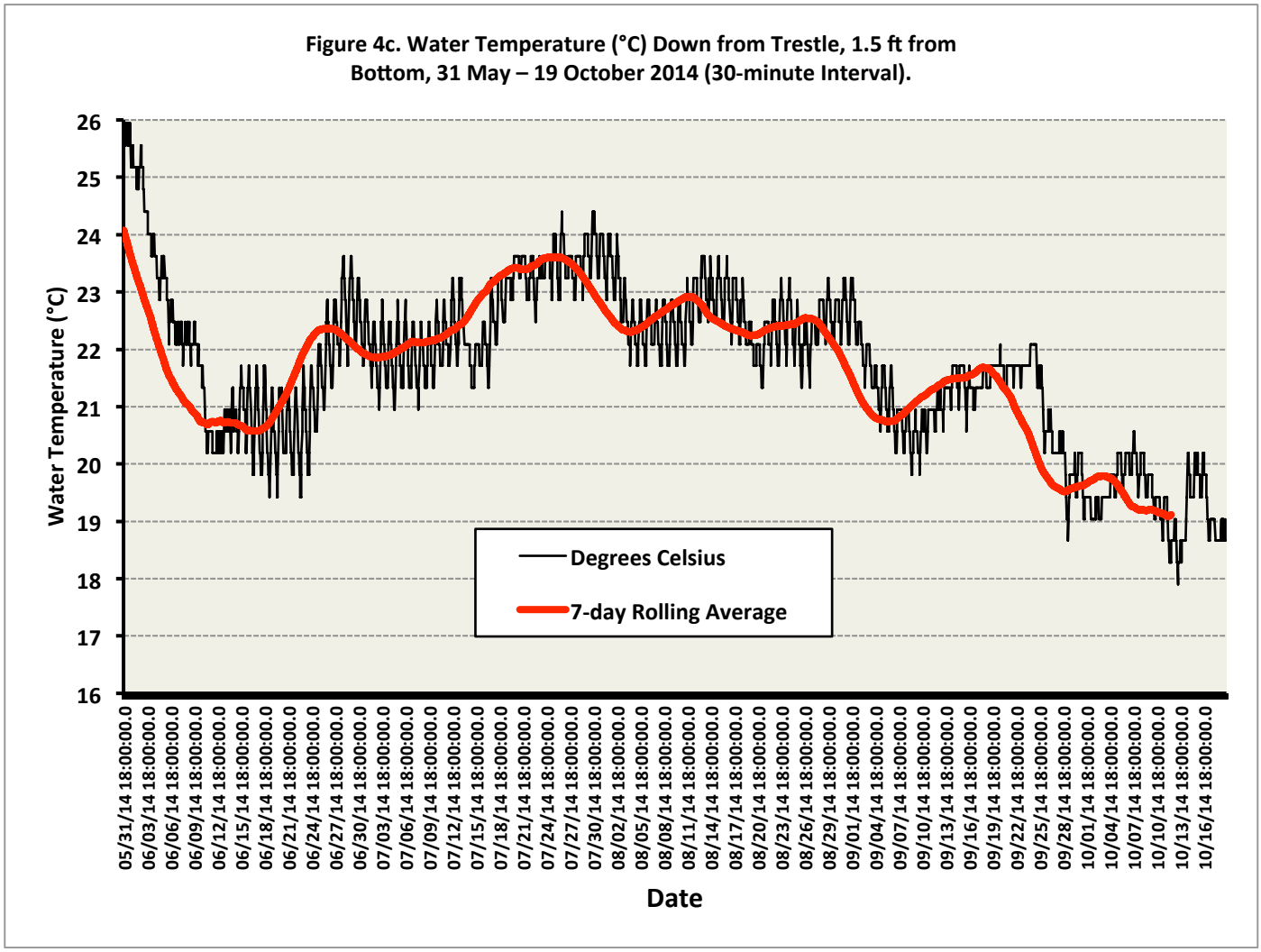


Figure 4c. Water Temperature (°C) Down from Trestle, 1.5 ft from Bottom, 31 May – 19 October 2014 (30-minute Interval).

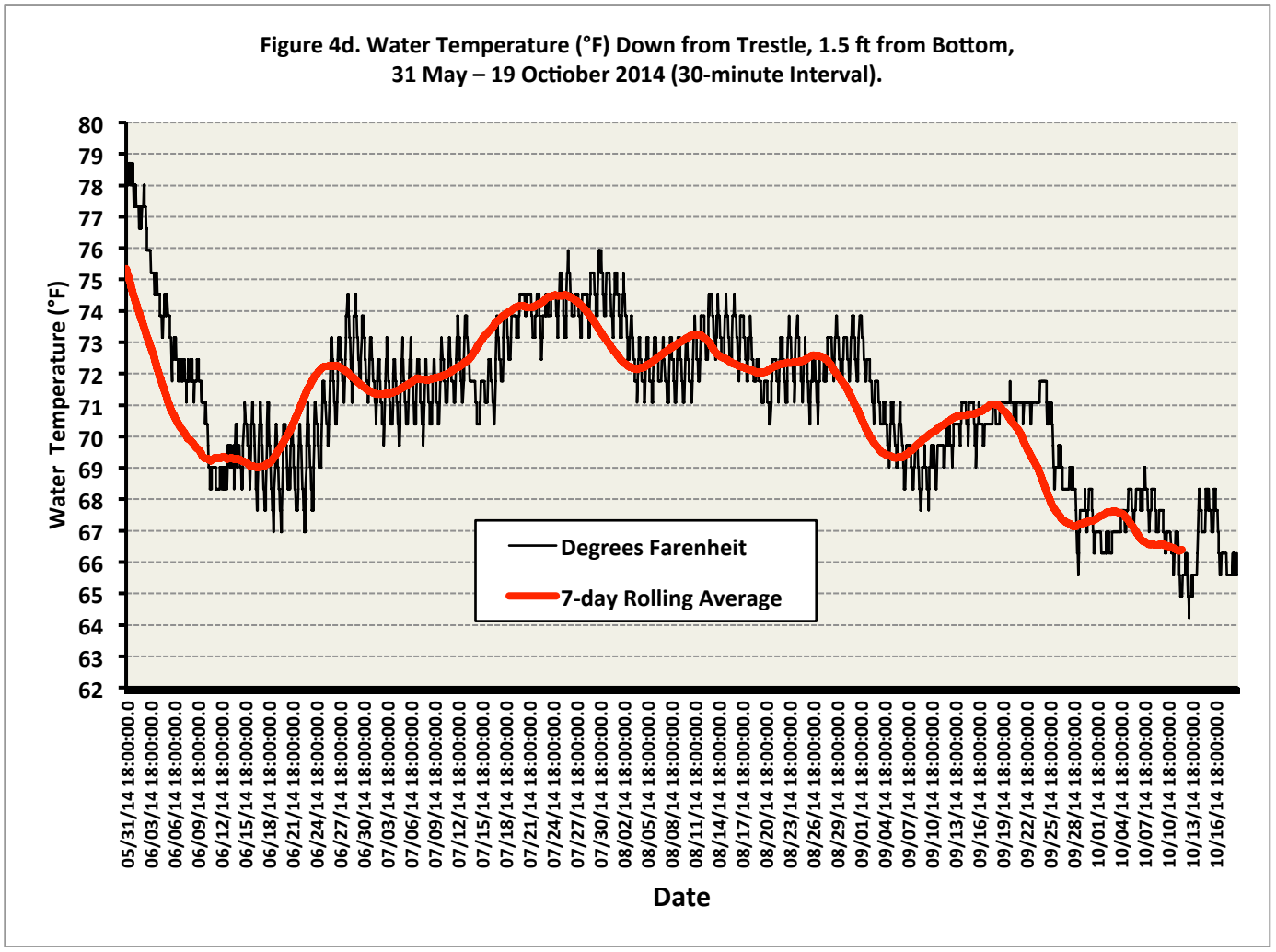


Figure 4d. Water Temperature (°F) Down from Trestle, 1.5 ft from Bottom, 31 May – 19 Octiober 2014 (30-minute Interval).

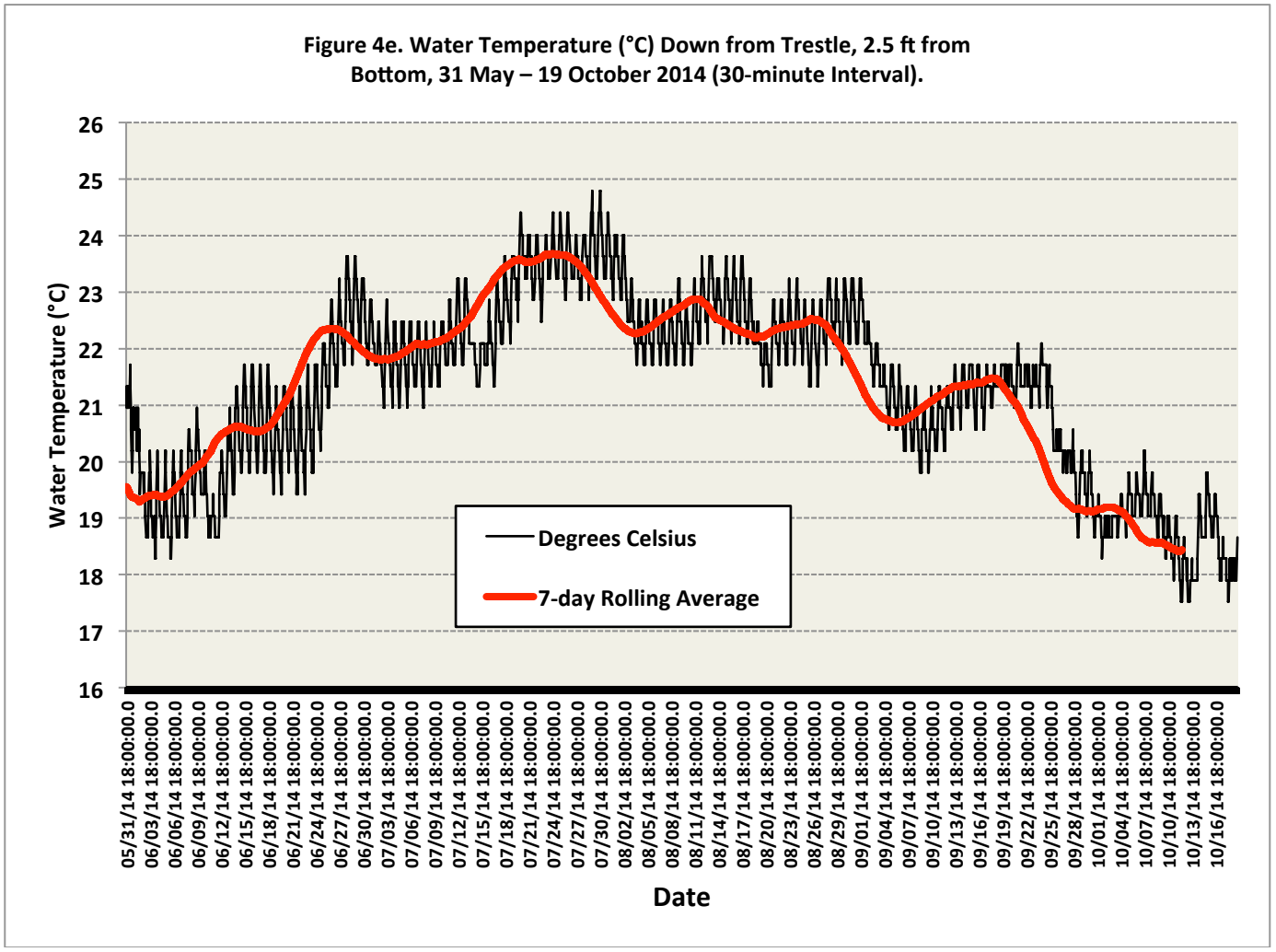


Figure 4e. Water Temperature (°C) Down from Trestle, 2.5 ft from Bottom, 31 May – 14 October 2014 (30-minute Interval).

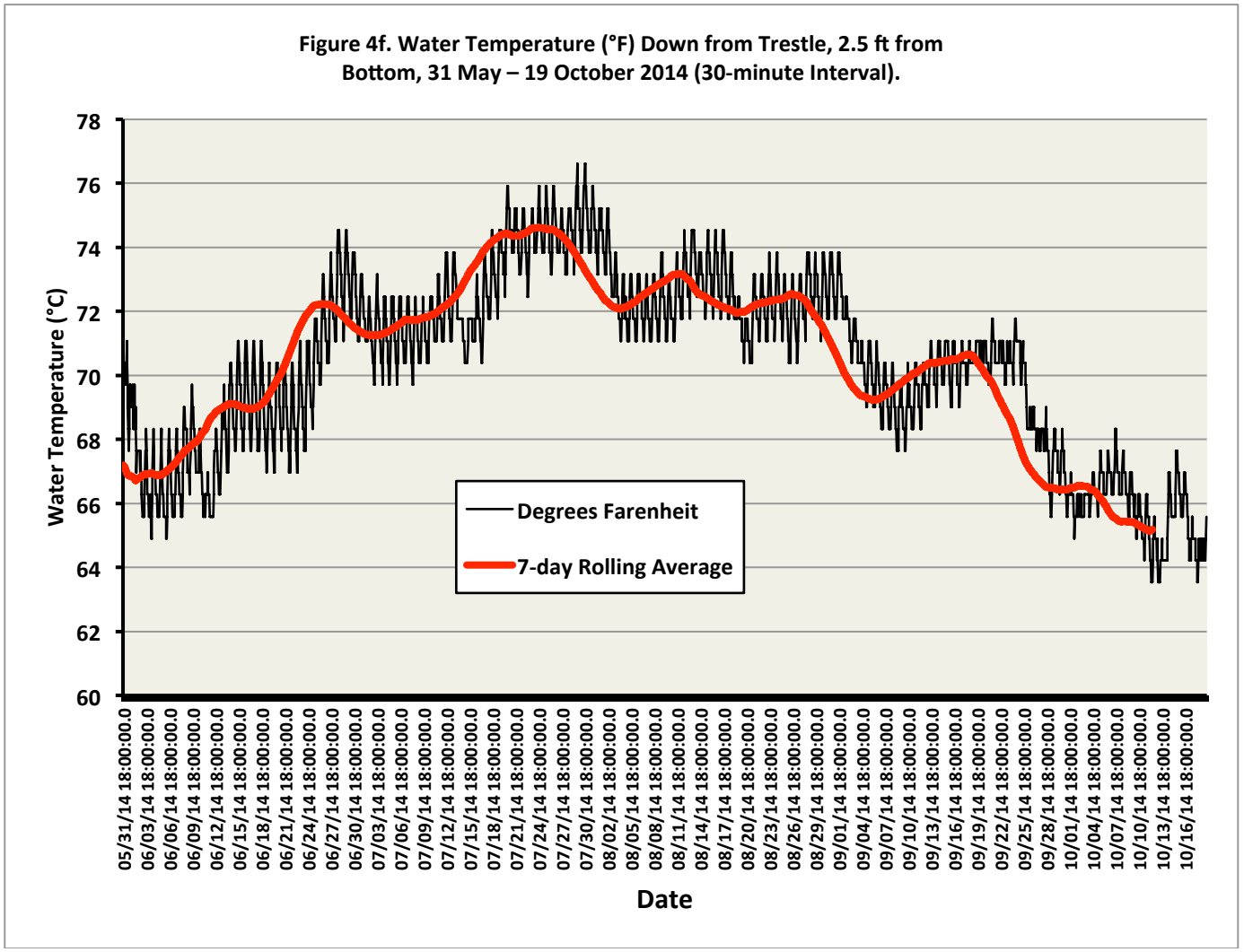


Figure 4f. Water Temperature (°F) Down from Trestle, 2.5 ft from Bottom, 31 May – 19 October 2014 (30-minute Interval).

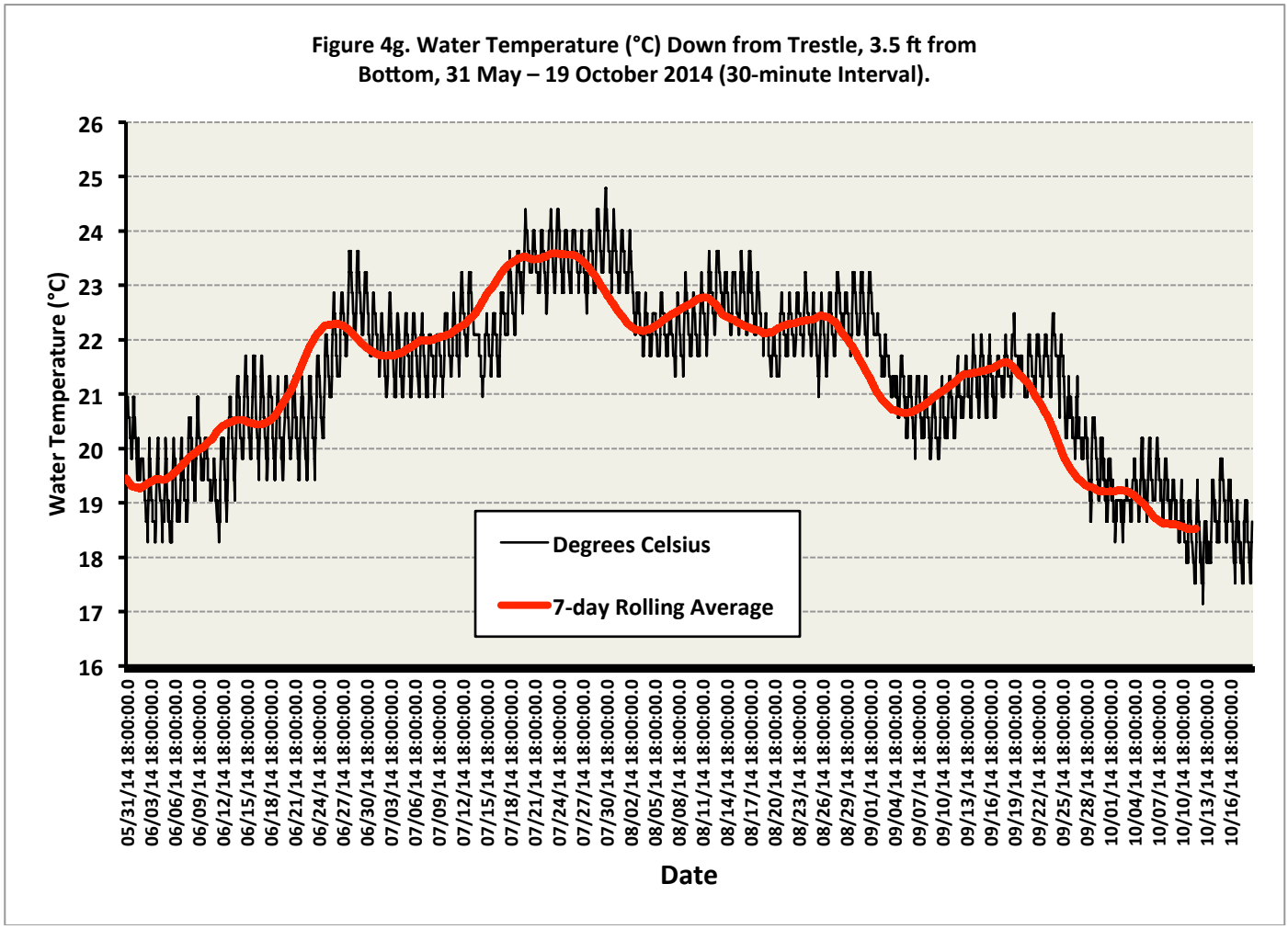


Figure 4g. Water Temperature (°C) Down from Trestle, 3.5 ft from Bottom, 31 May –19 October 2014 (30-minute Interval).

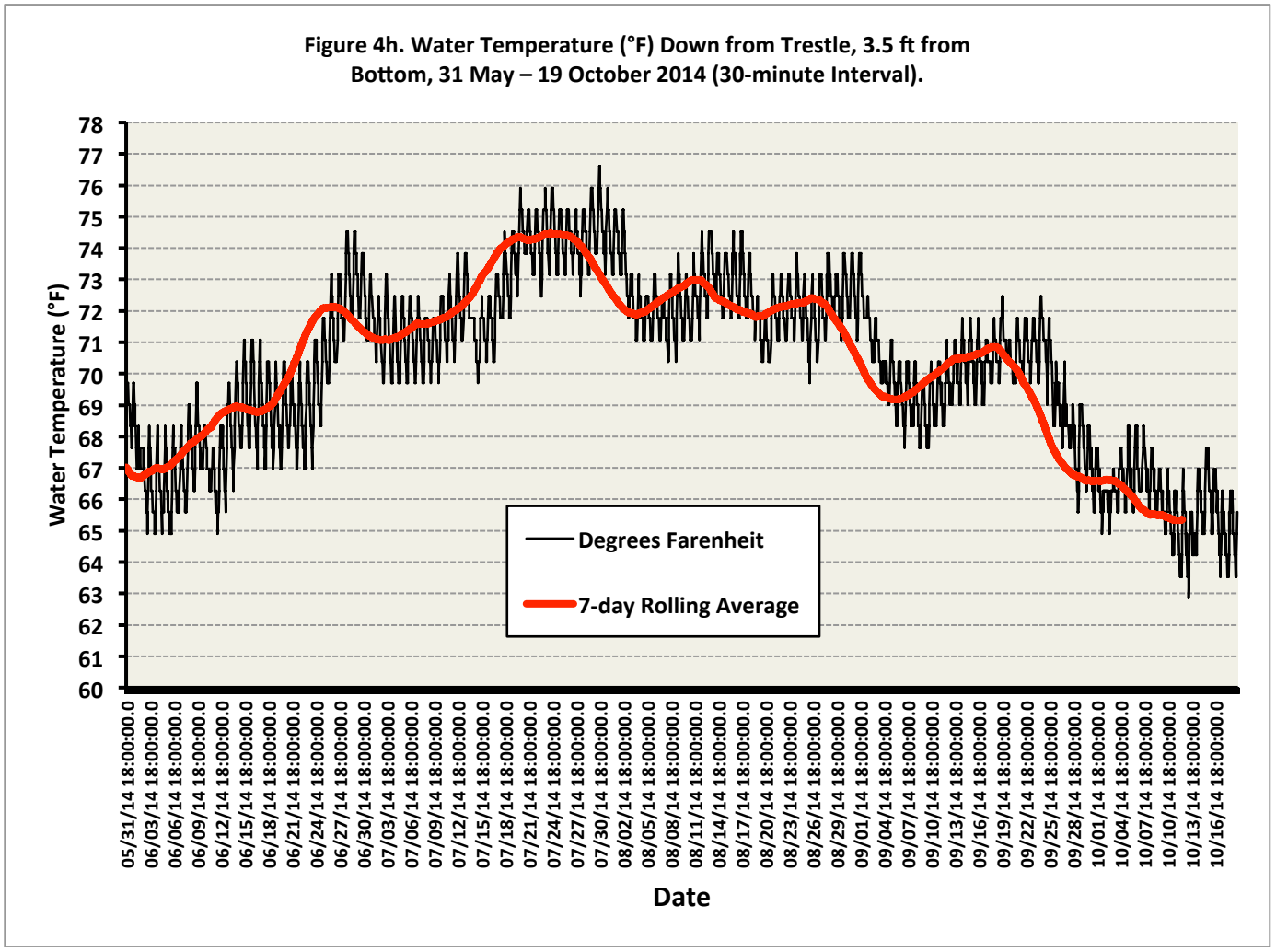


Figure 4h. Water Temperature (°F) Down from Trestle, 3.5 ft from Bottom, 31 May – 19 October 2014 (30-minute Interval).

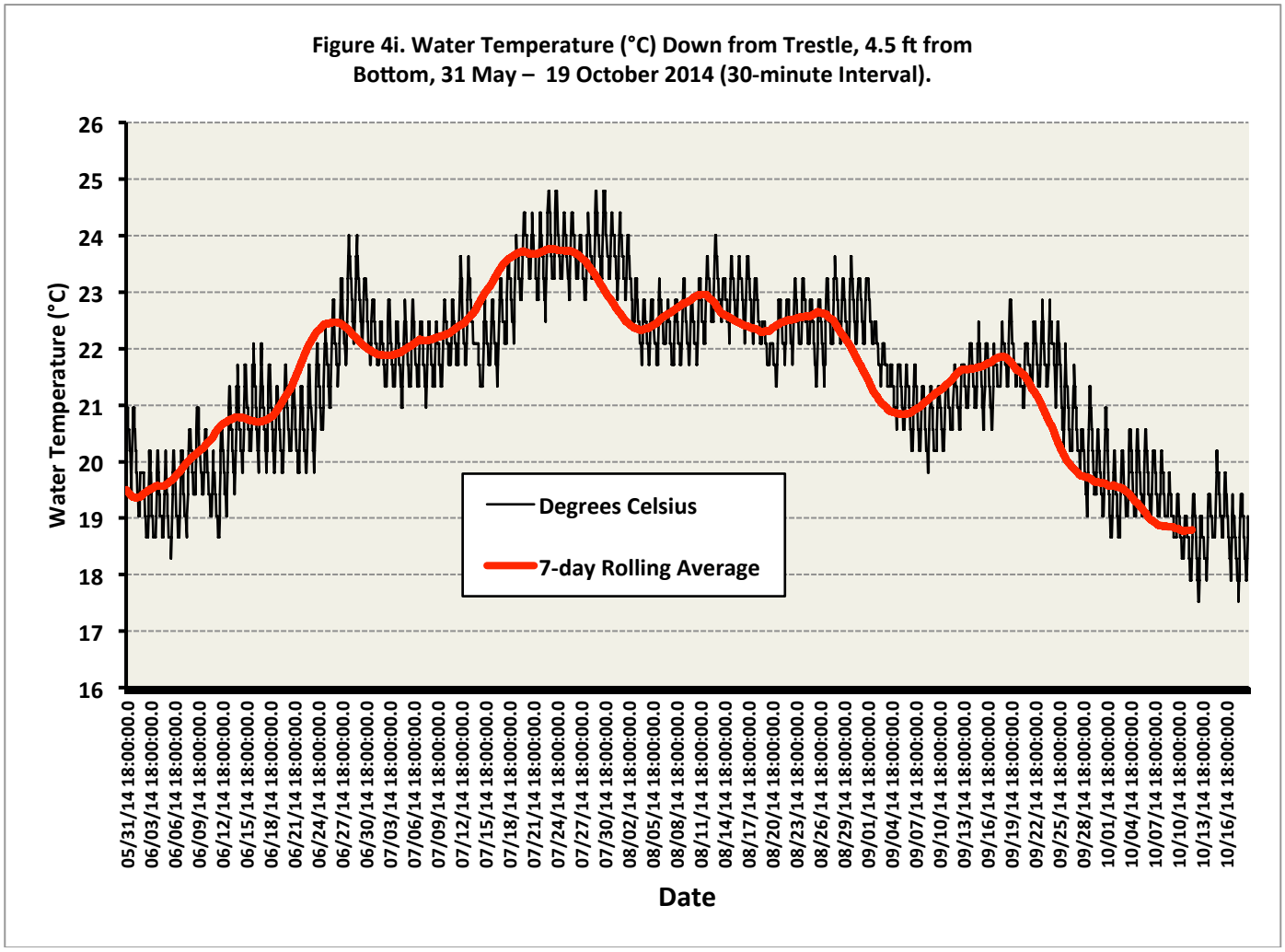


Figure 4i. Water Temperature (°C) Down from Trestle, 4.5 ft from Bottom, 31 May – 13 October 2014 (30-minute Interval).

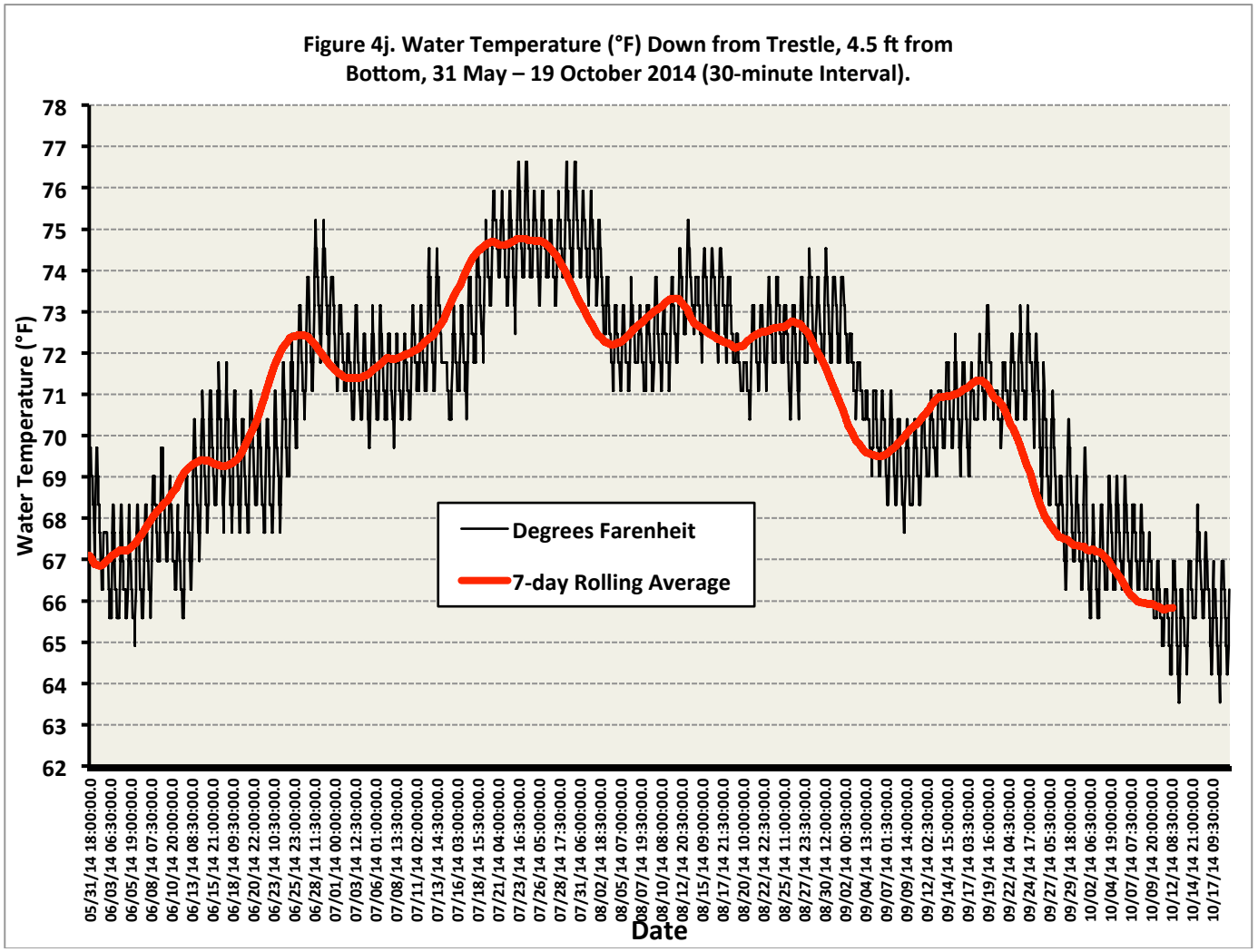


Figure 4j. Water Temperature (°F) Down from Trestle, 4.5 ft from Bottom, 31 May – 19 October 2014 (30-minute Interval).

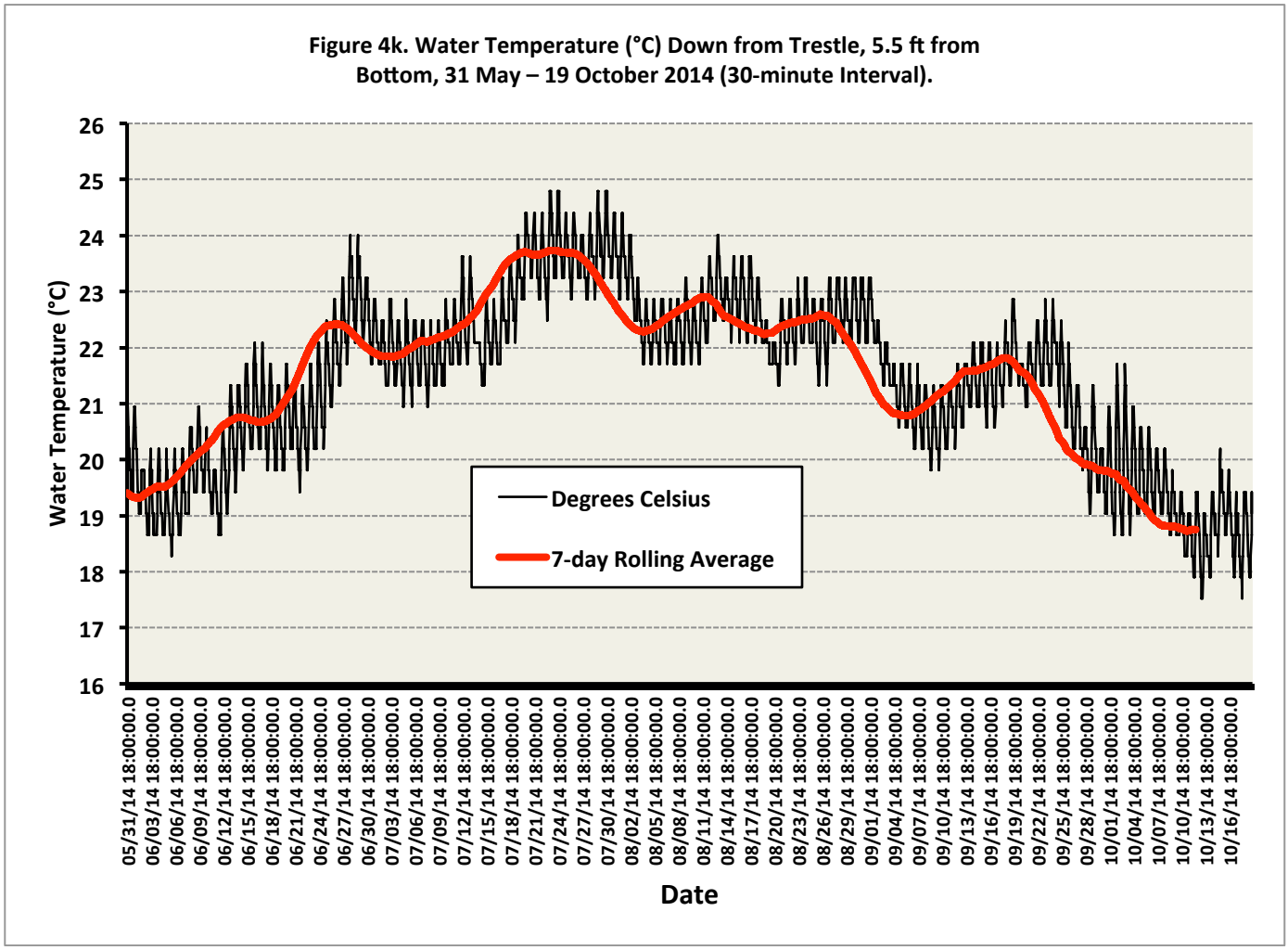


Figure 4k. Water Temperature (°C) Down from Trestle, 5.5 ft from Bottom, 31 May – 19 October 2014 (30-minute Interval).

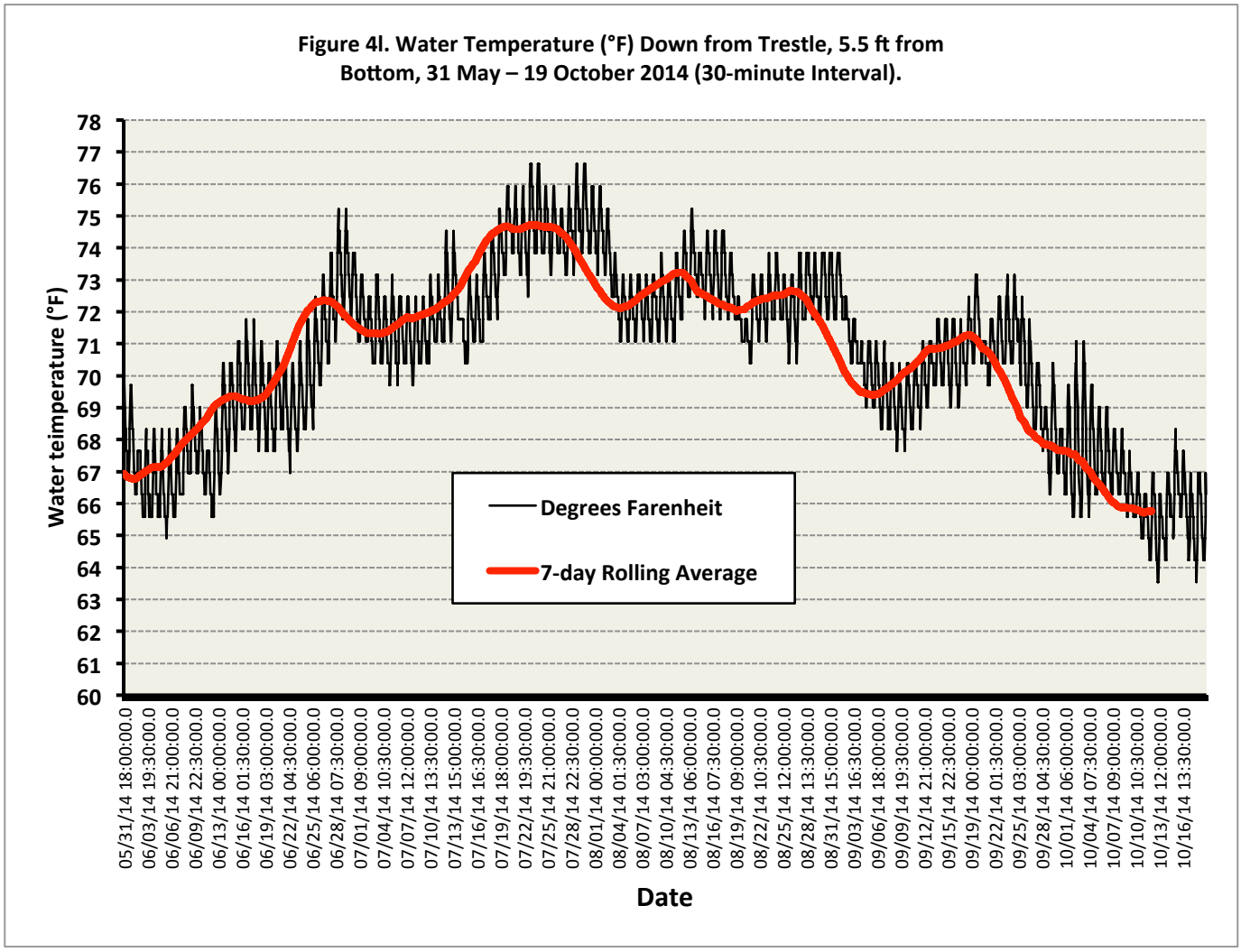


Figure 4l. Water Temperature (°F) Down from Trestle, 5.5 ft from Bottom, 31 May – 19 October 2014 (30-minute Interval).

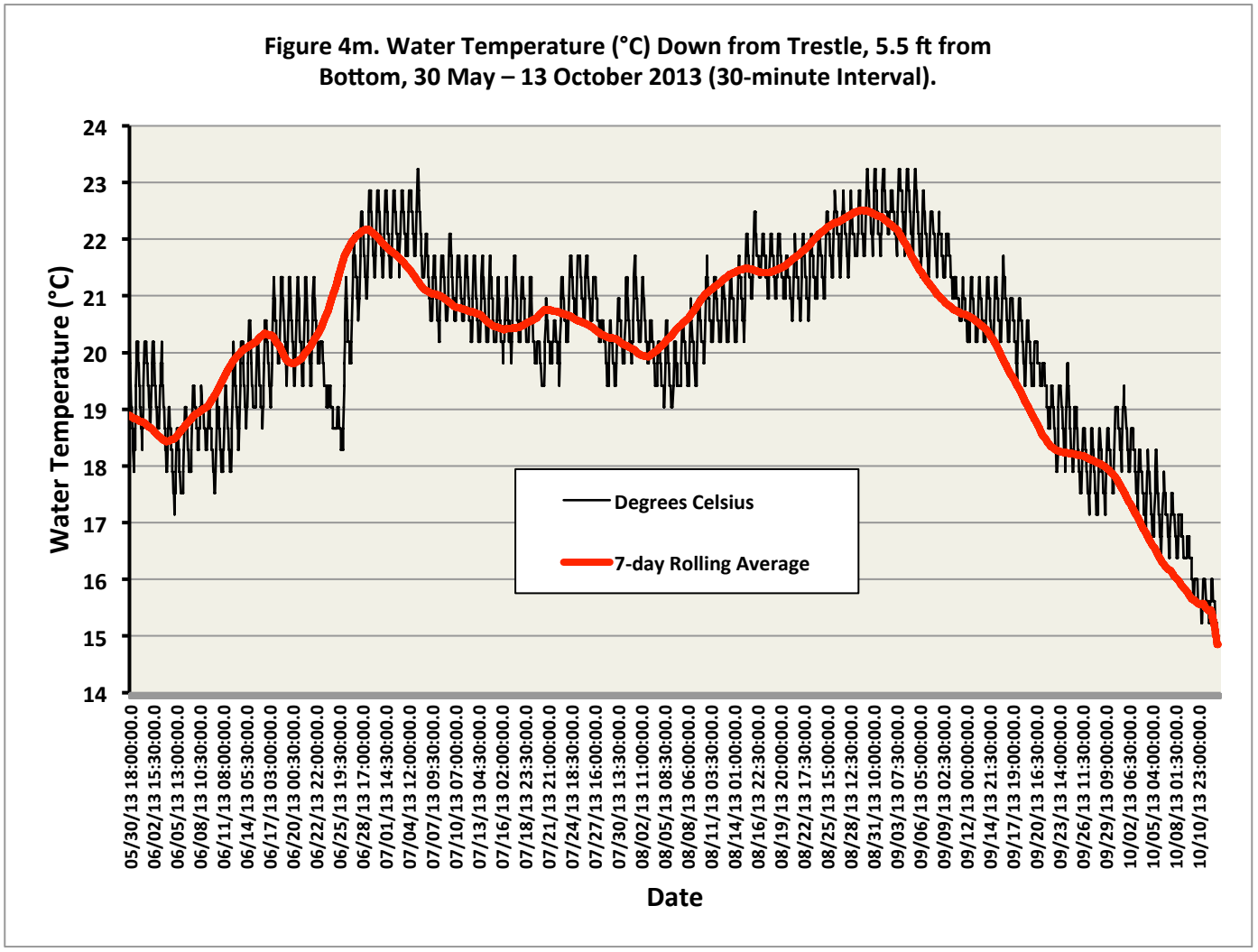


Figure 4m. Water Temperature (°C) Down from Trestle, 5.5 ft from Bottom, 30 May – 13 October 2013 (30-minute Interval).

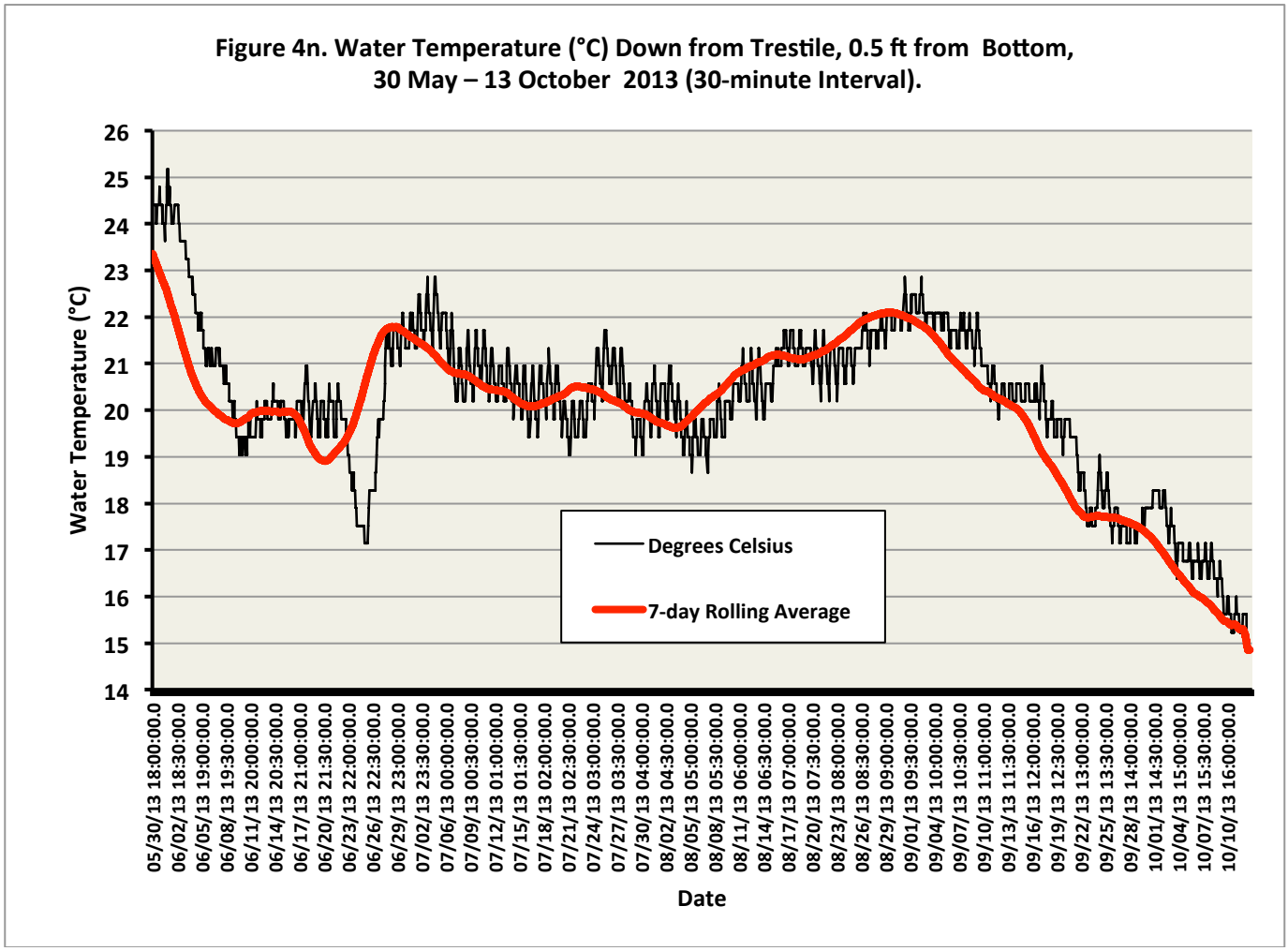


Figure 4n. Water Temperature (°C) Down from Trestile, 0.5 ft from Bottom, 30 May – 13 October 2013 (30-minute Interval).

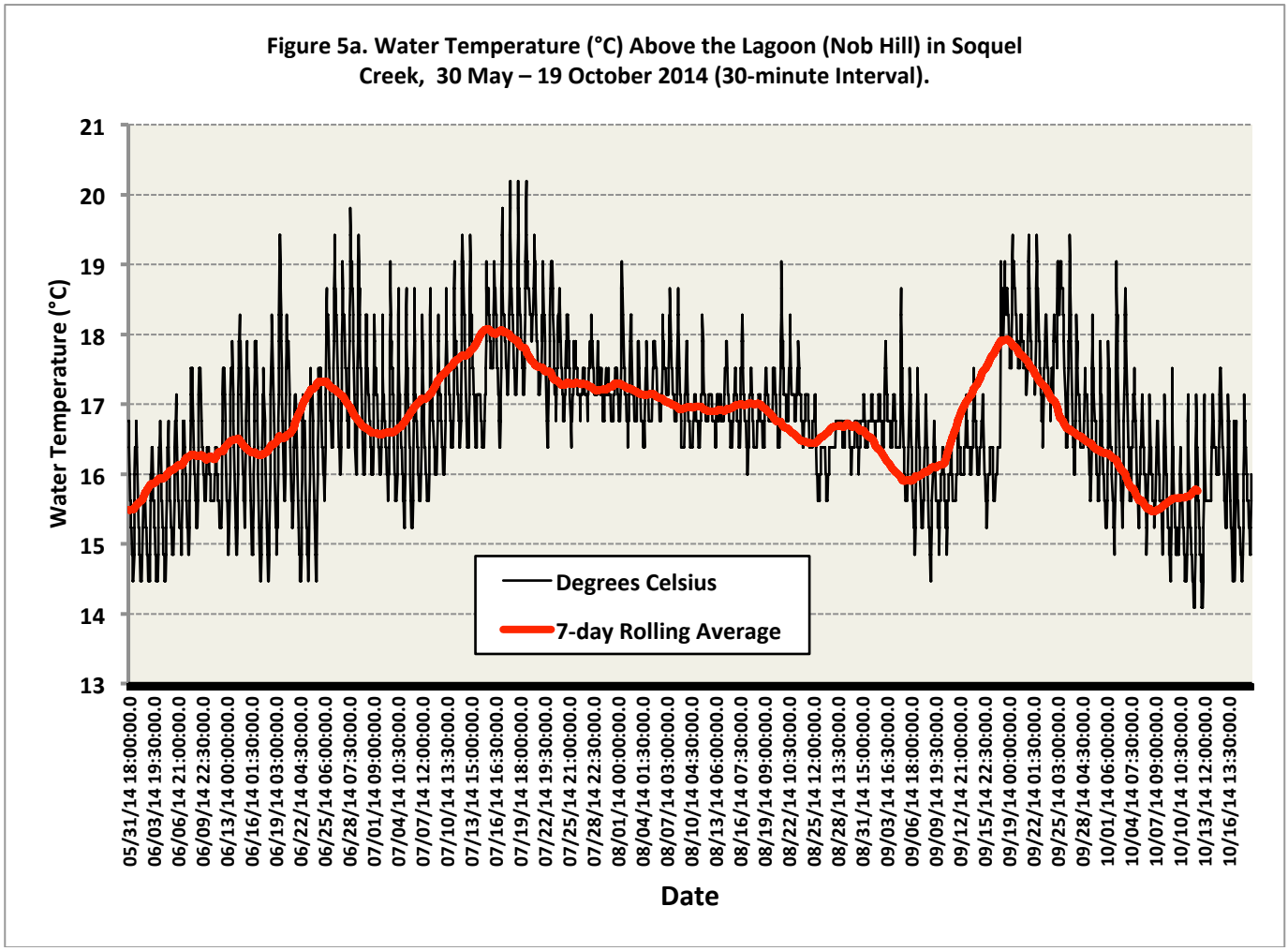


Figure 5a. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 31 May – 19 October 2014 (30-minute Interval).

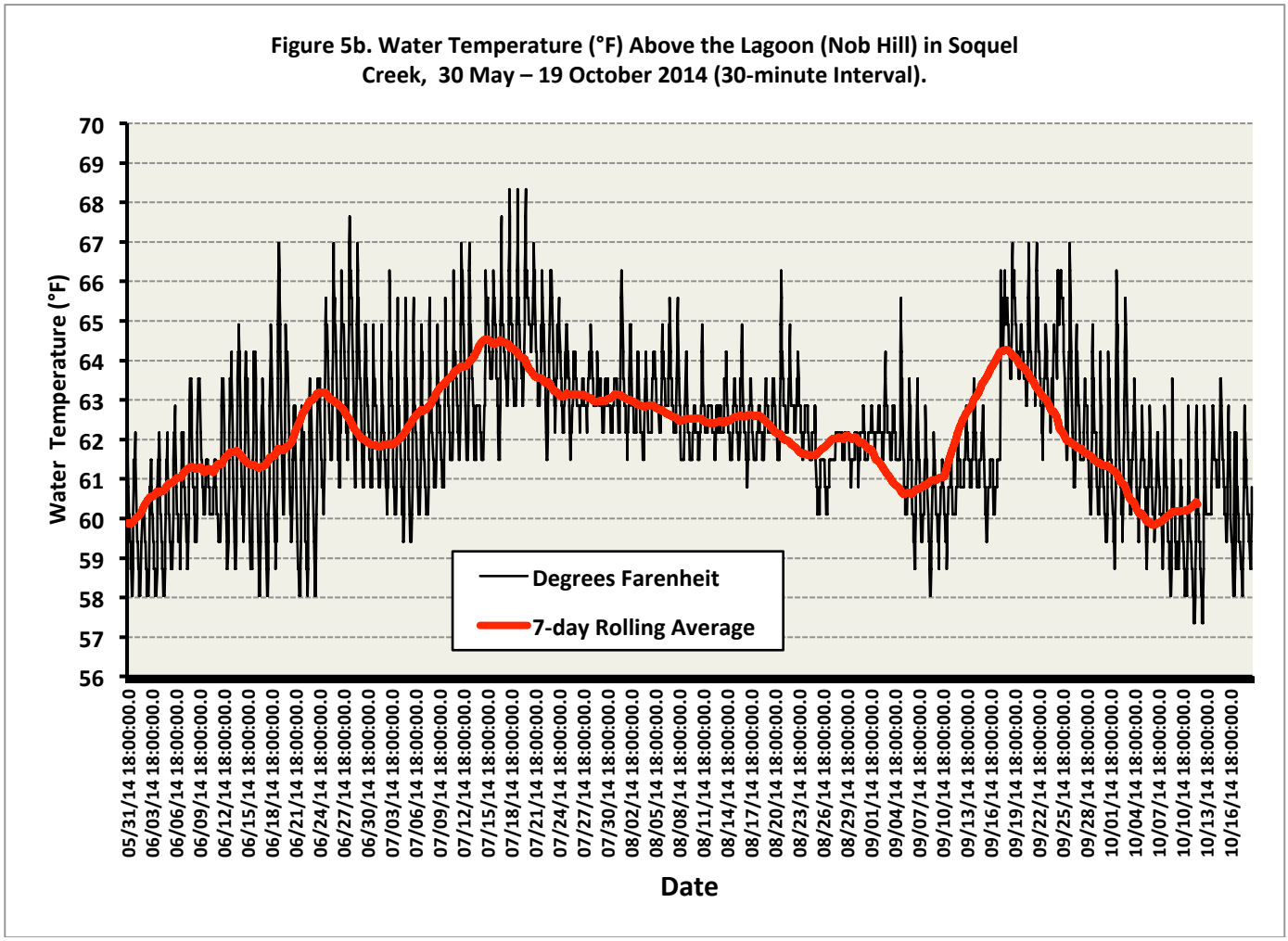


Figure 5b. Water Temperature (°F) Above the Lagoon (Nob Hill) in Soquel Creek, 31 May – 19 October 2014 (30-minute Interval).

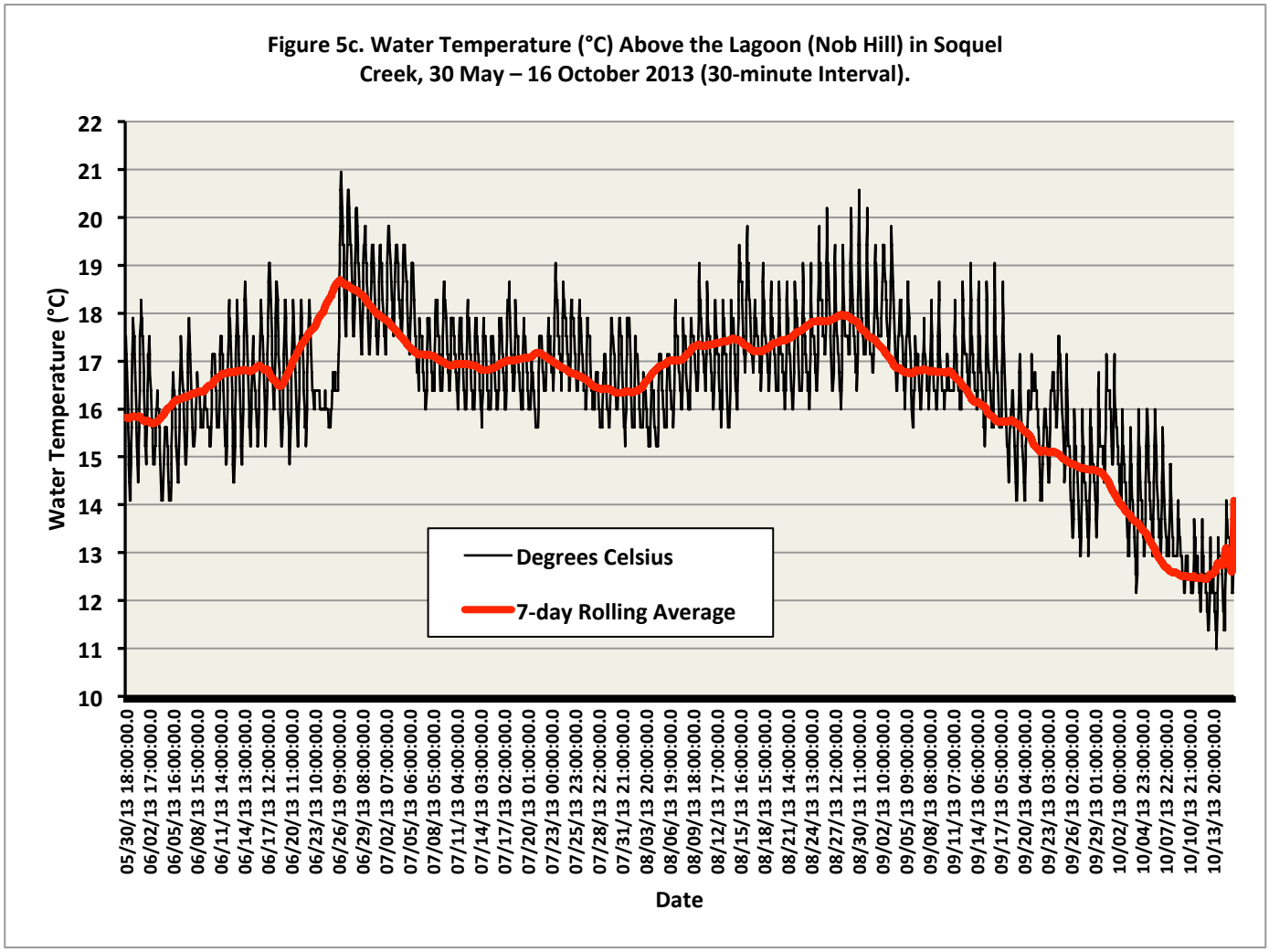


Figure 5c. Water Temperature (°C) Above the Lagoon (Nob Hill) in Soquel Creek, 30 May – 16 October 2013 (30-minute Interval).

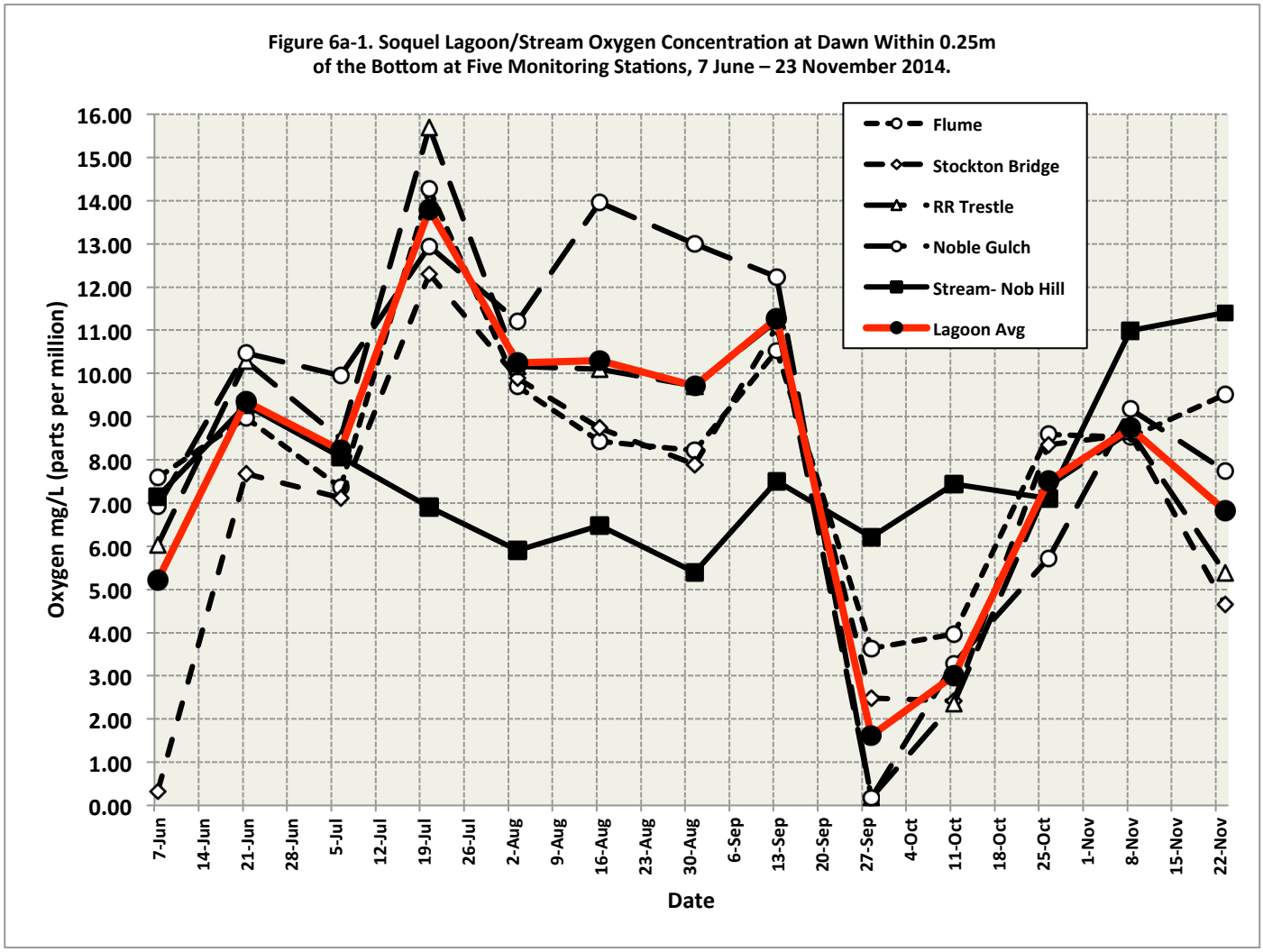


Figure 6a-1. Soquel Lagoon/Stream Oxygen Concentration at Dawn Within 0.25m of the Bottom at Five Monitoring Stations, 7 June – 23 November 2014.

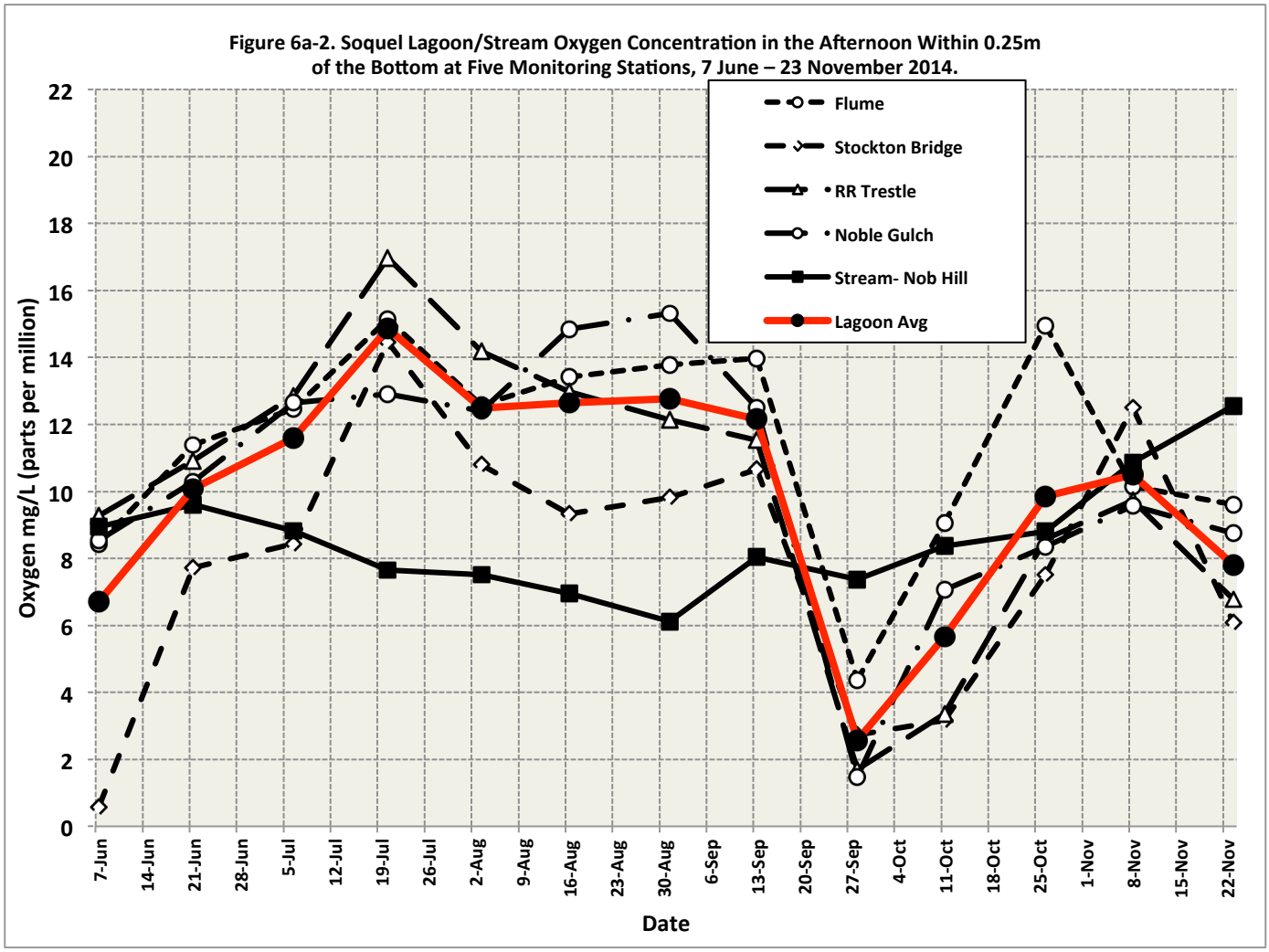


Figure 6a-2. Soquel Lagoon/Stream Oxygen Concentration in the Afternoon Within 0.25m of the Bottom at Five Monitoring Stations, 7 June – 23 November 2014.

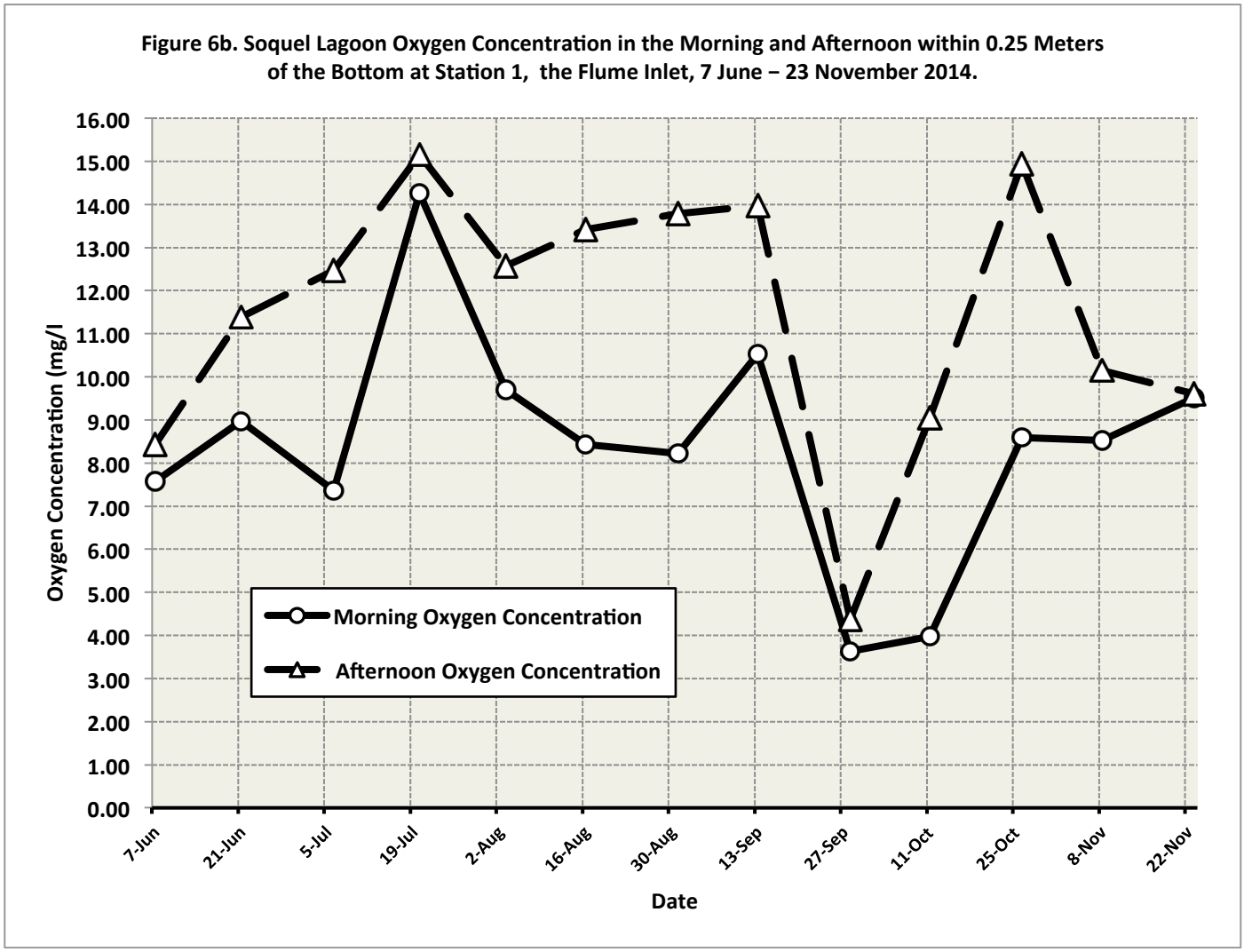


Figure 6b. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 1, the Flume Inlet, 7 June – 23 November 2014.

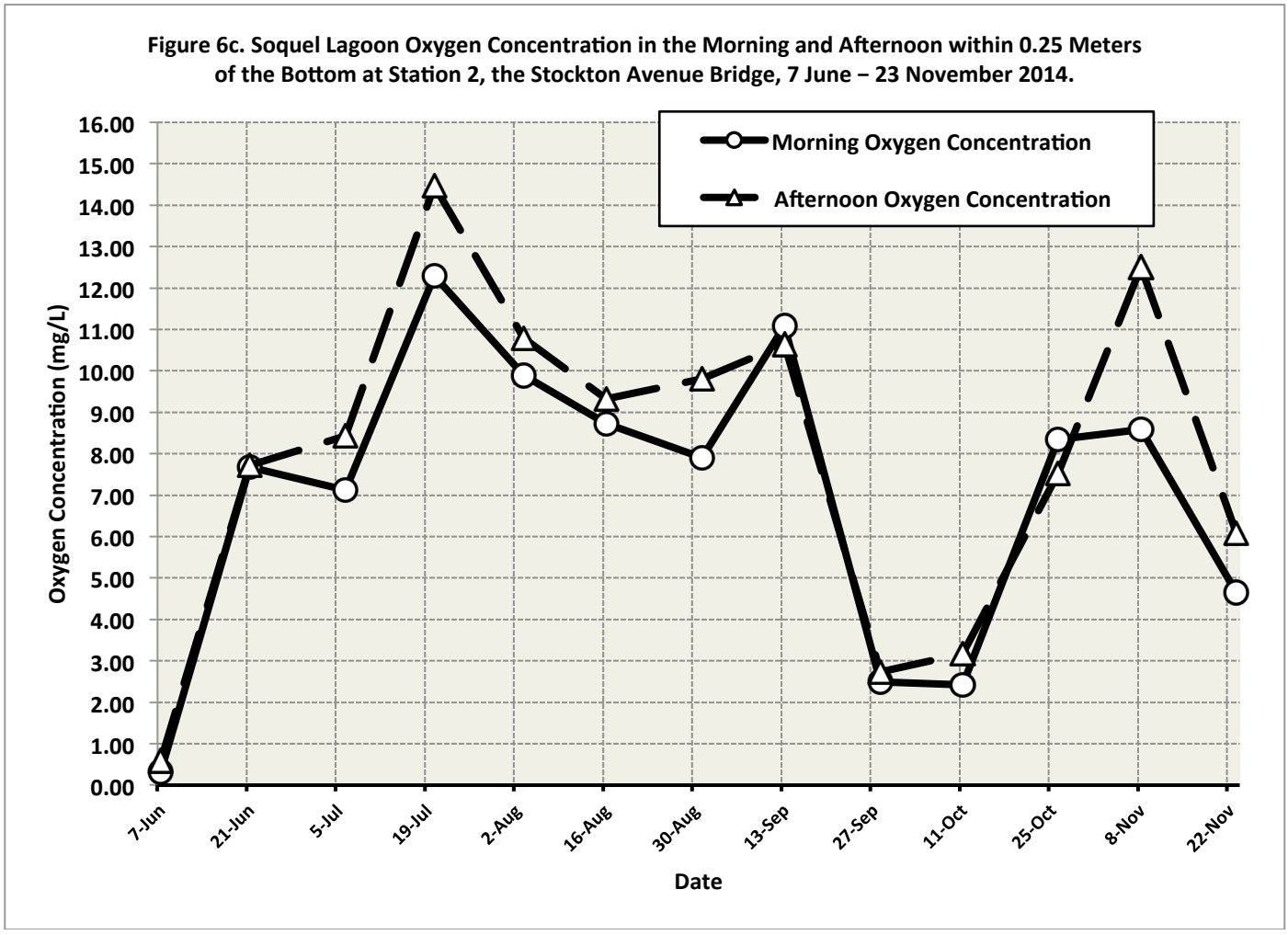


Figure 6c. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 2, the Stockton Avenue Bridge, 7 June – 23 November 2014.

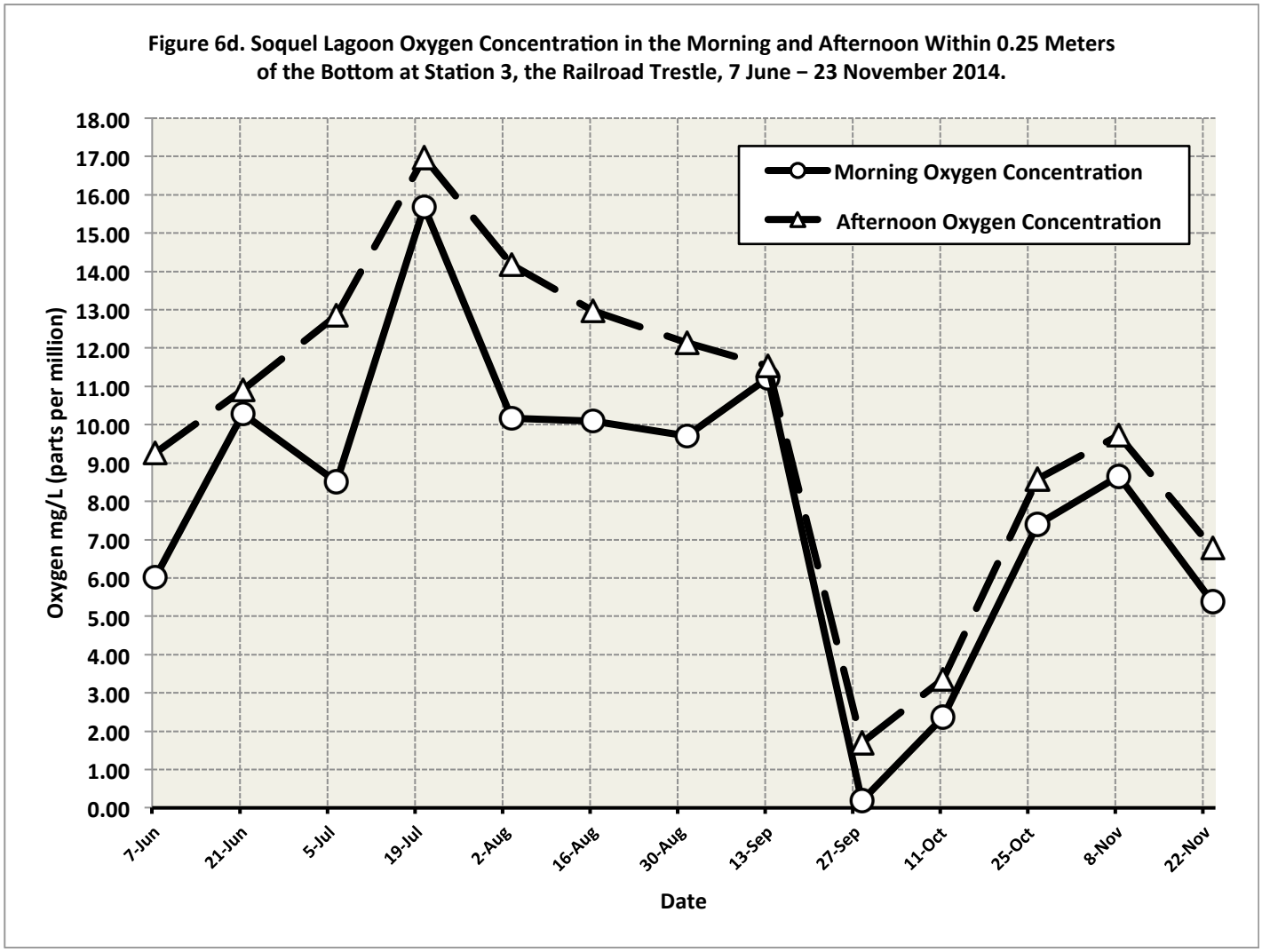


Figure 6d. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 3, the Railroad Trestle, 7 June – 23 November 2014.

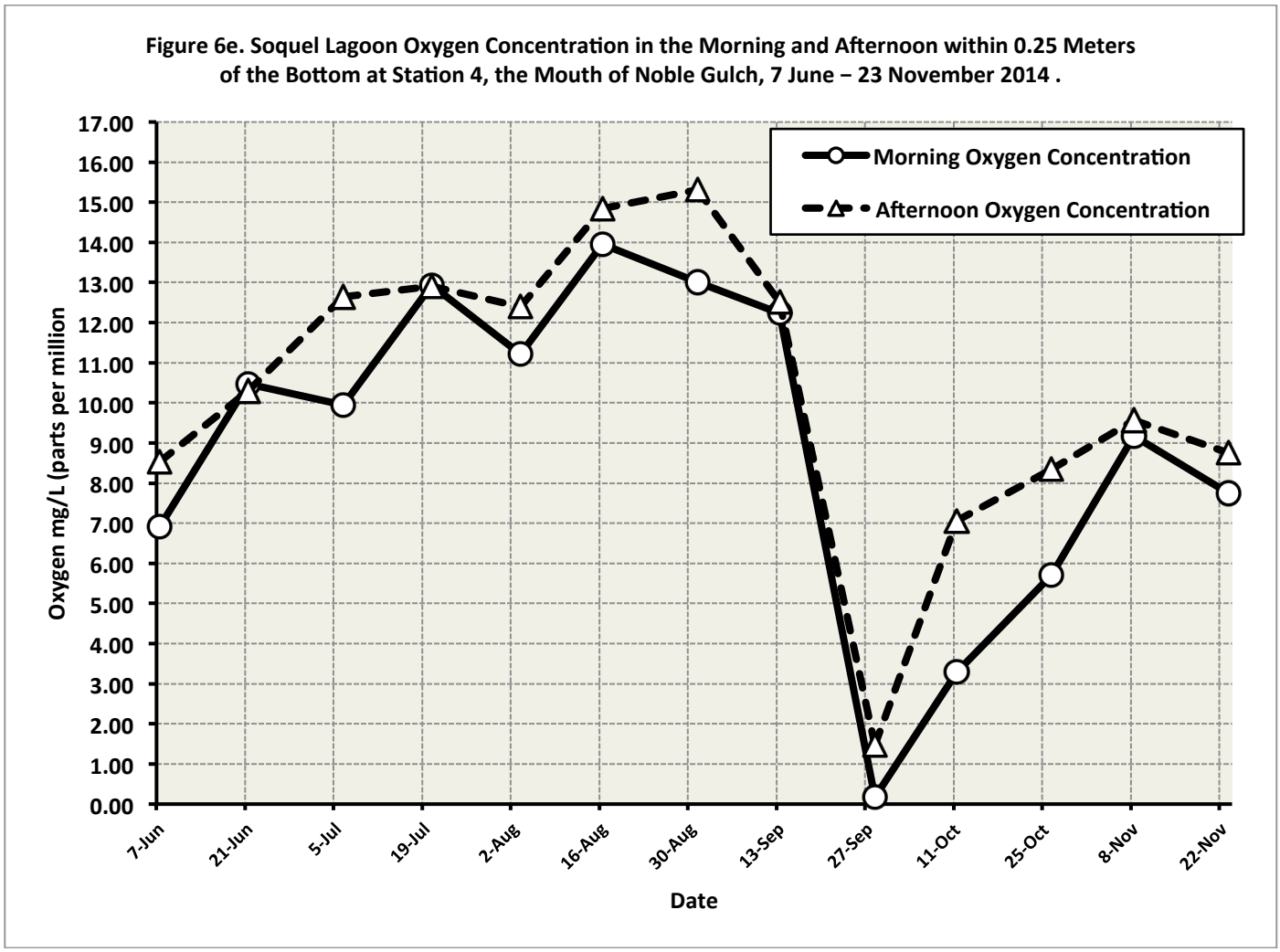


Figure 6e. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 4, the Mouth of Noble Gulch, 7 June – 23 November 2014 .

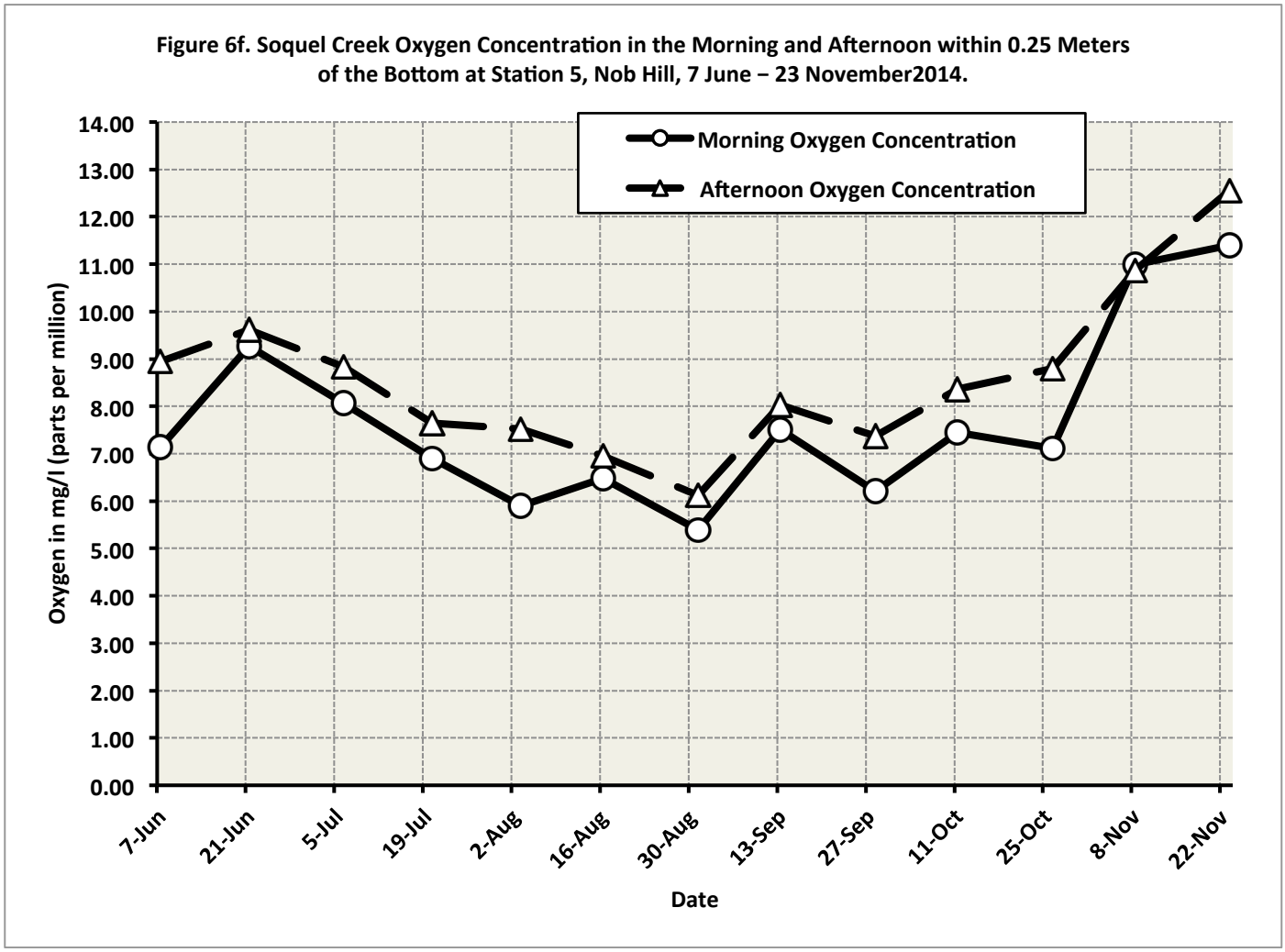


Figure 6f. Soquel Creek Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 5, Nob Hill, 7 June – 23 November 2014.

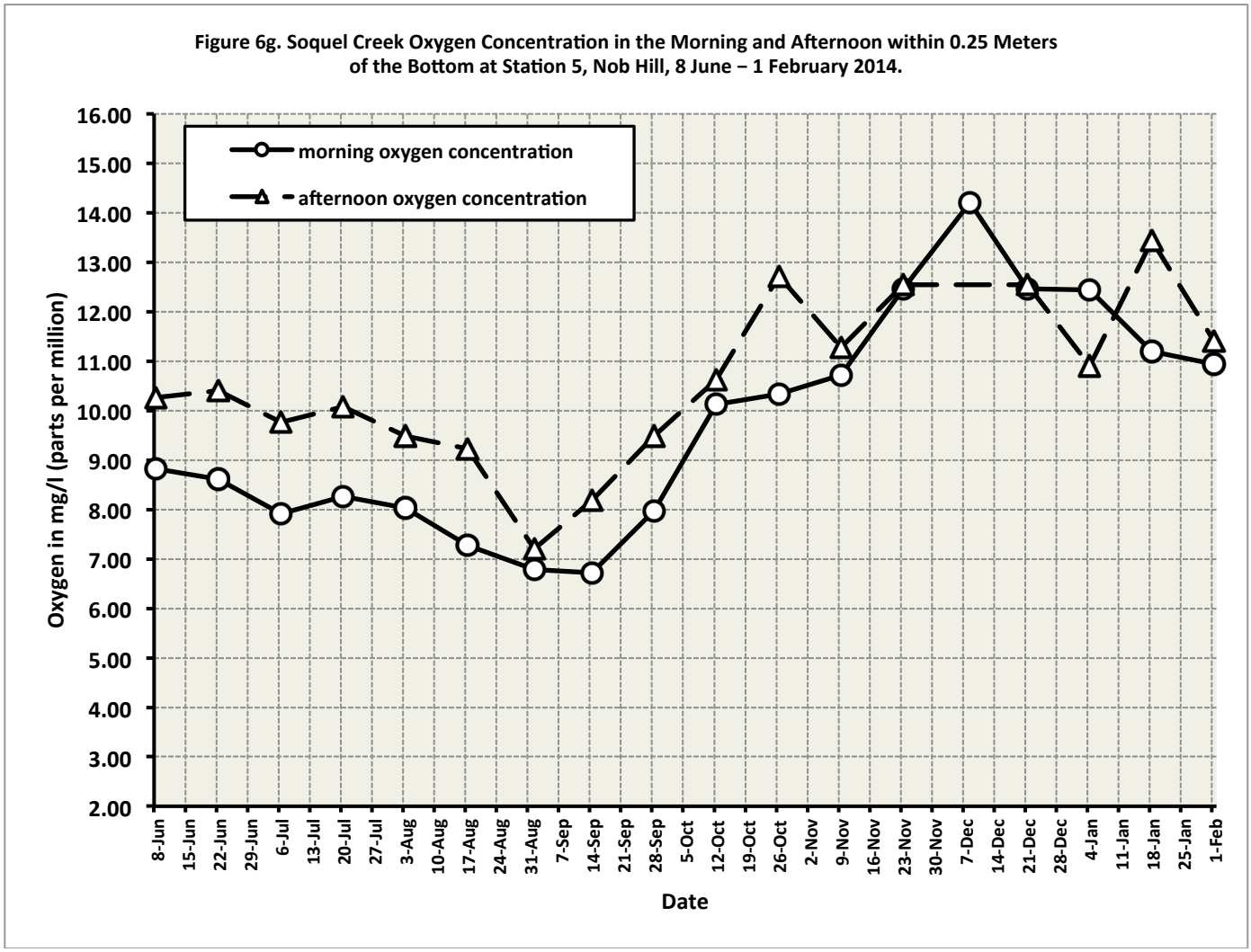


Figure 6g. Soquel Creek Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 5, Nob Hill, 8 June − 1 February 2014.

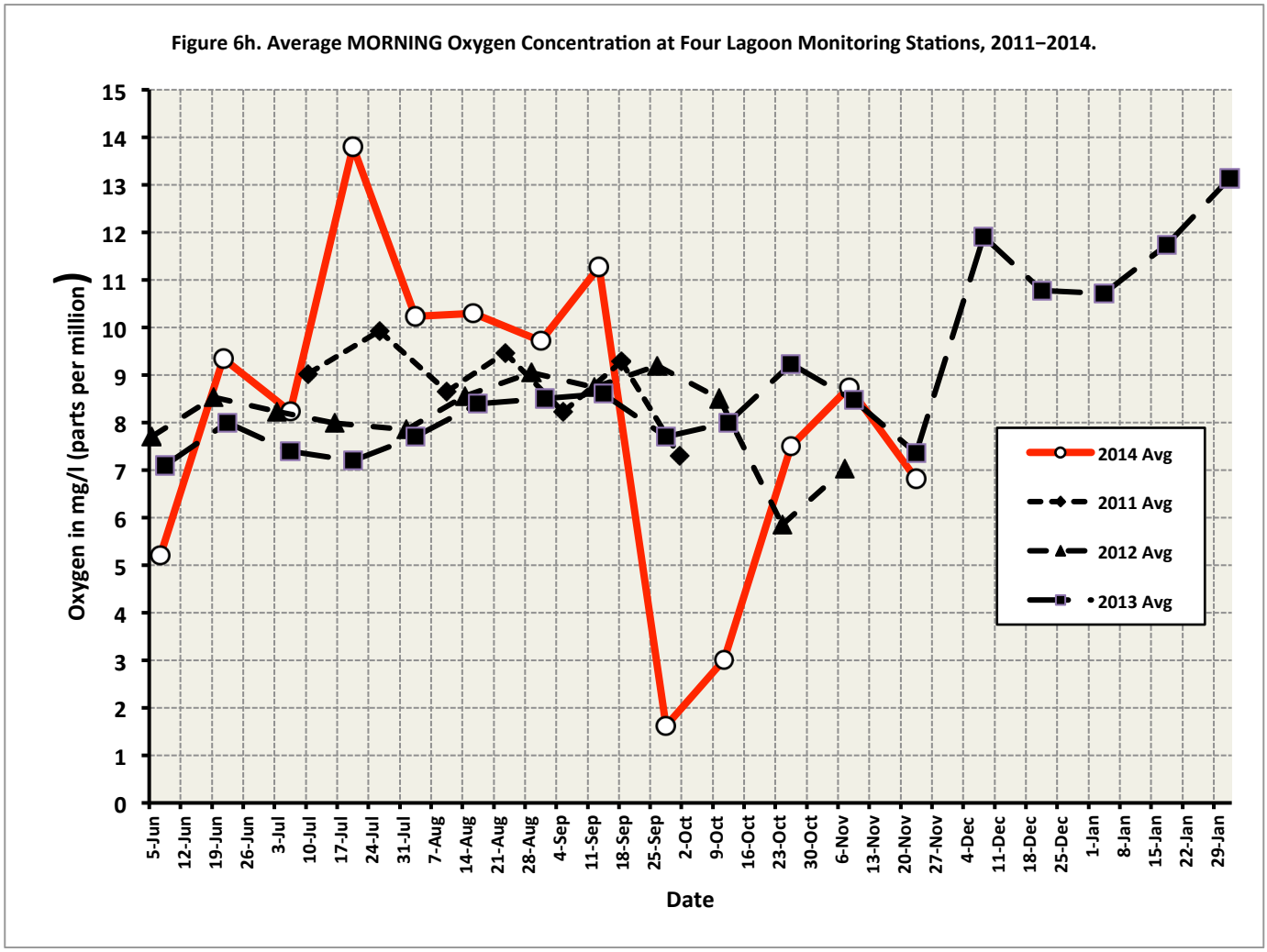


Figure 6h. Average MORNING Oxygen Concentration at Four Lagoon Monitoring Stations, 2011−2014.

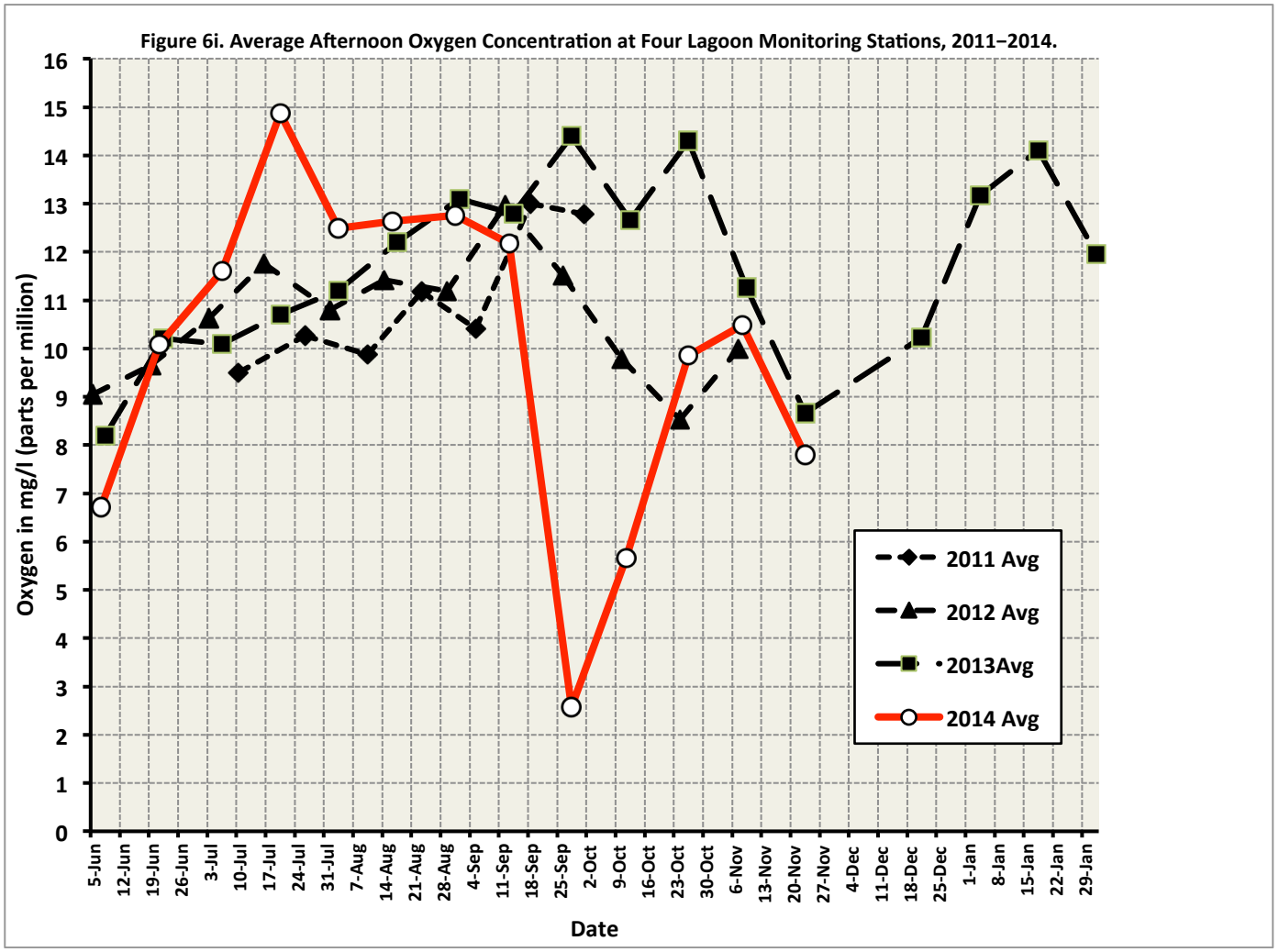


Figure 6i. Average AFTERNOON Oxygen Concentration at Four Lagoon Monitoring Stations, 2011–2014.

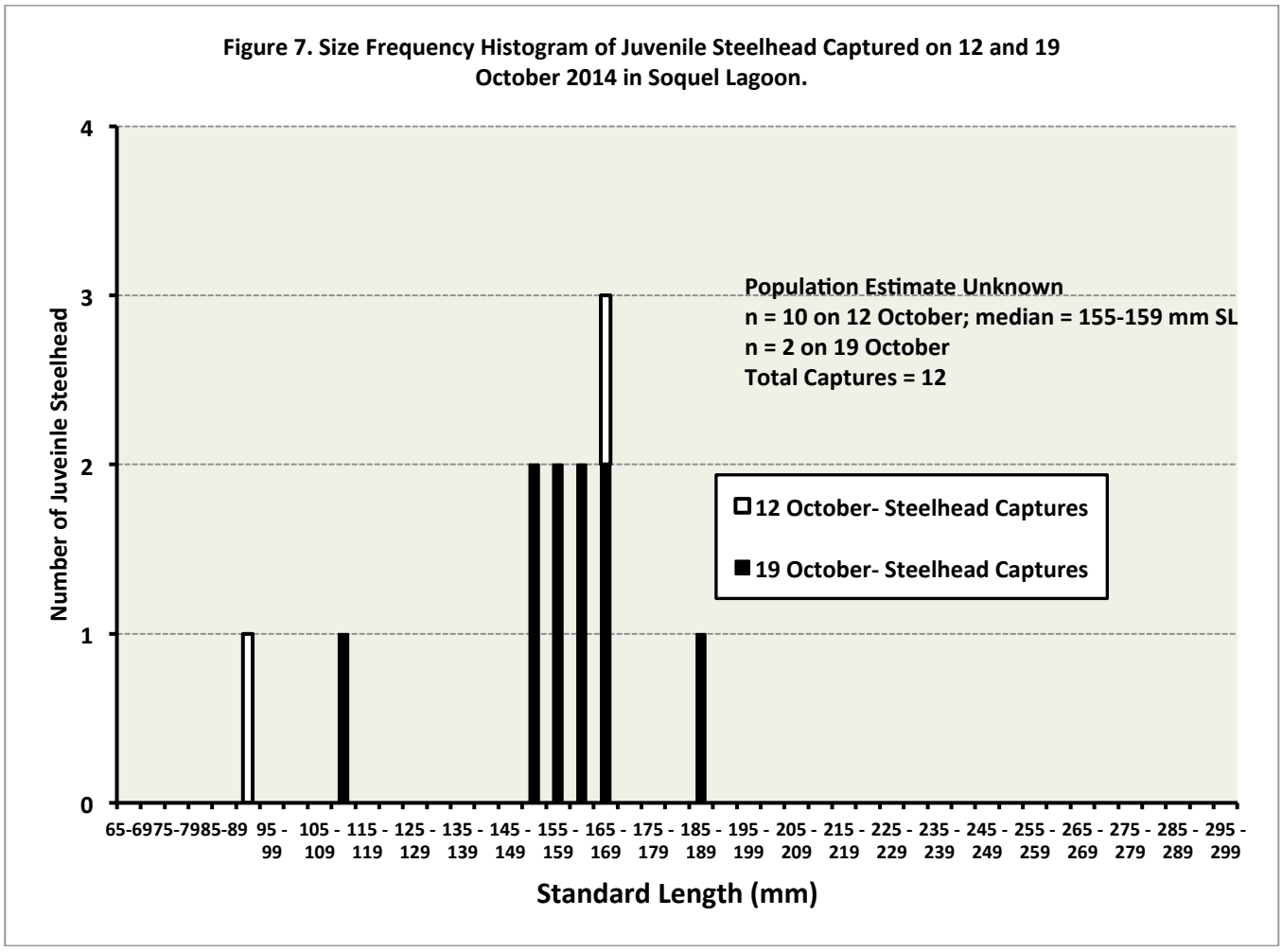


Figure 7. Size Frequency Histogram of Juvenile Steelhead Captured on 12 and 19 October 2014 in Soquel Lagoon.

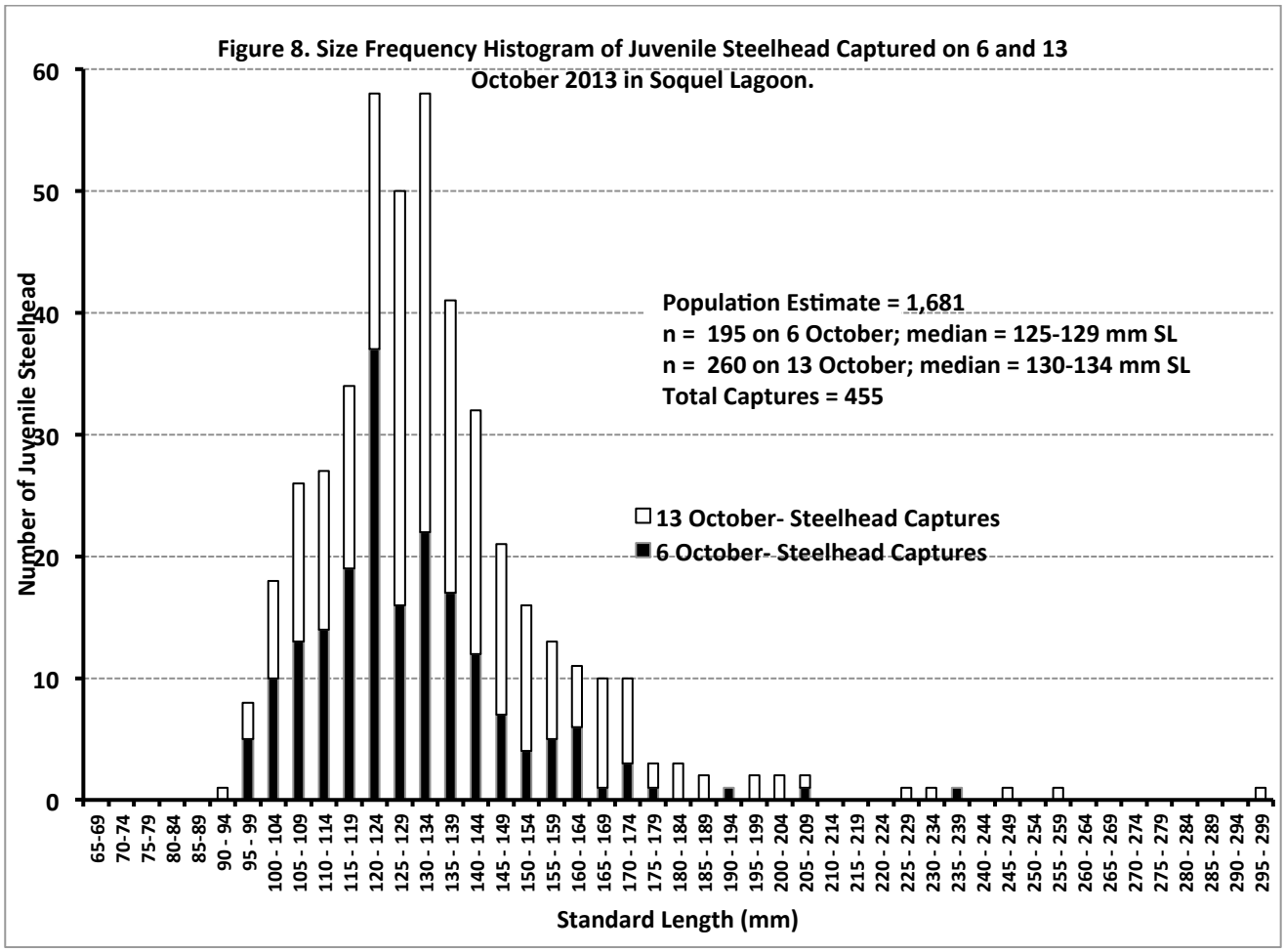


Figure 8. Size Frequency Histogram of Juvenile Steelhead Captured on 6 and 13 October 2013 in Soquel Lagoon.

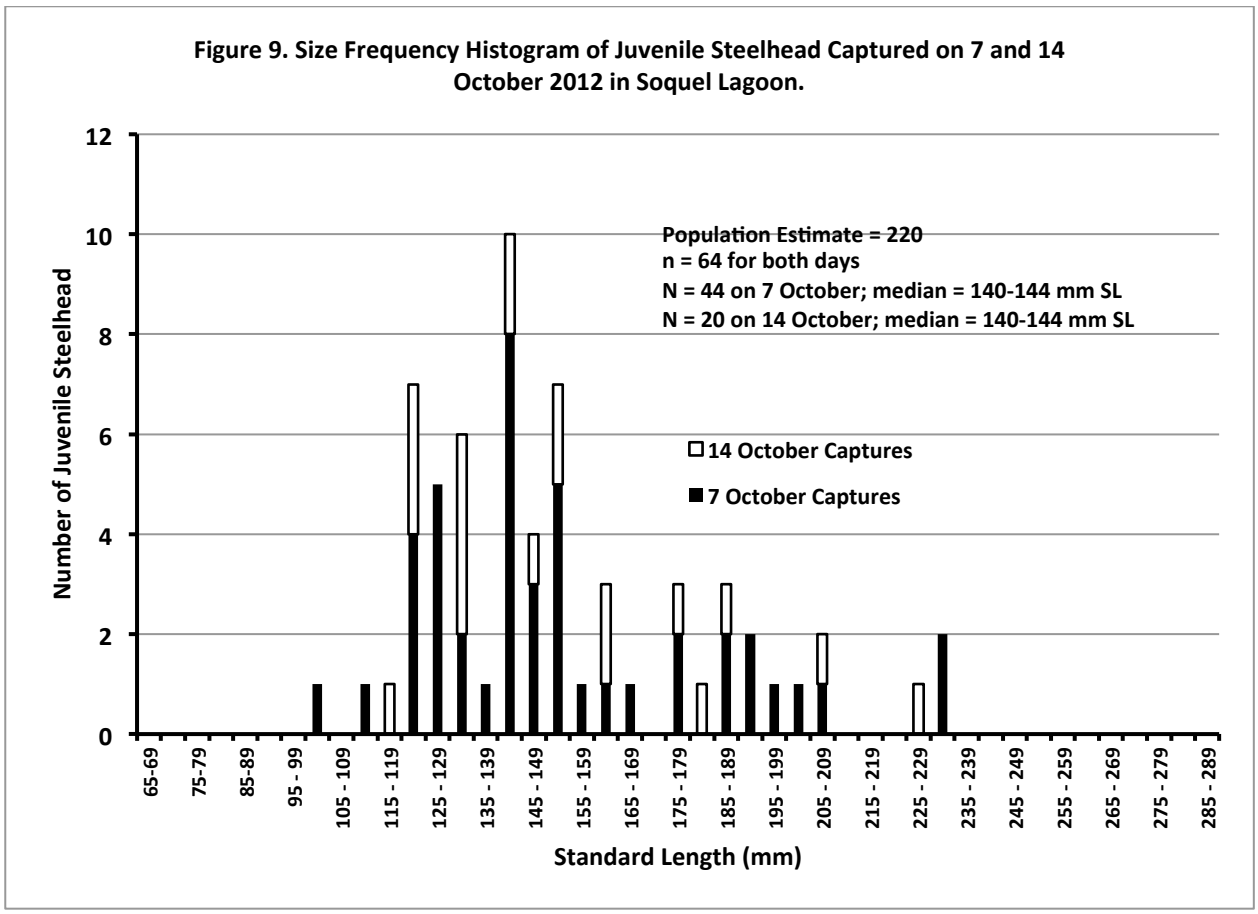


Figure 9. Size Frequency Histogram of Juvenile Steelhead Captured on 7 and 14 October 2012 in Soquel Lagoon.

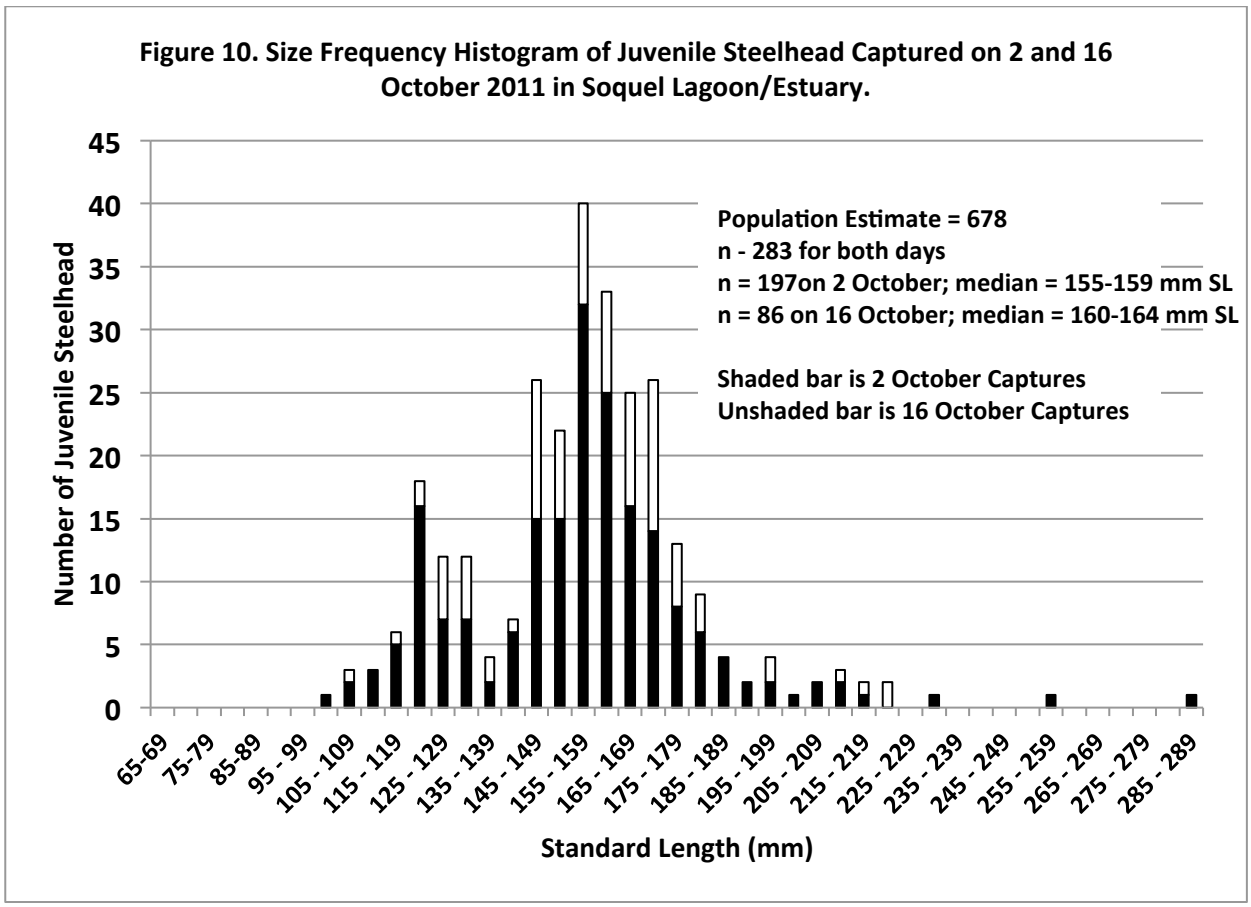


Figure 10. Size Frequency Histogram of Juvenile Steelhead Captured on 2 and 16 October 2011 in Soquel Lagoon/Estuary.

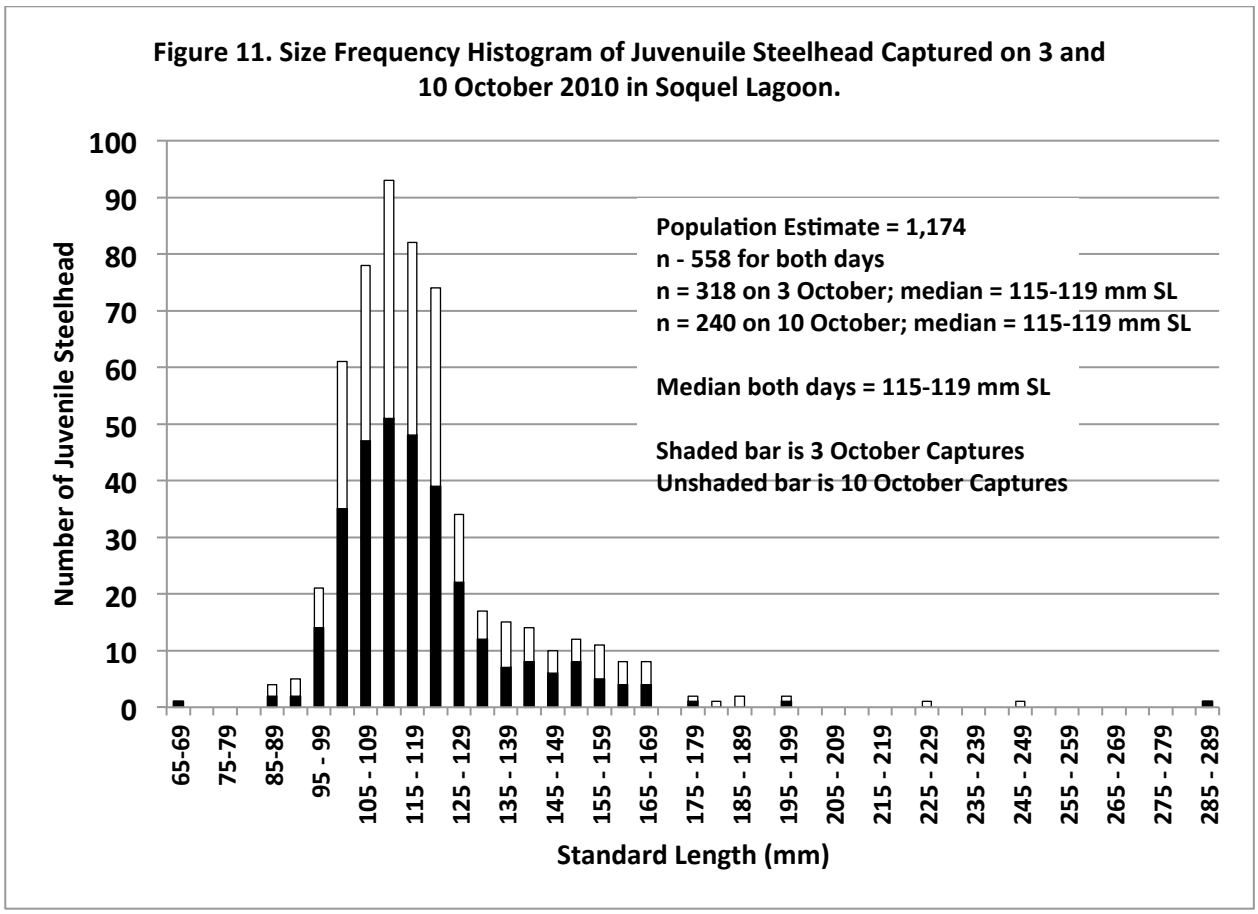


Figure 11. Size Frequency Histogram of Juvenuile Steelhead Captured on 3 and 10 October 2010 in Soquel Lagoon.

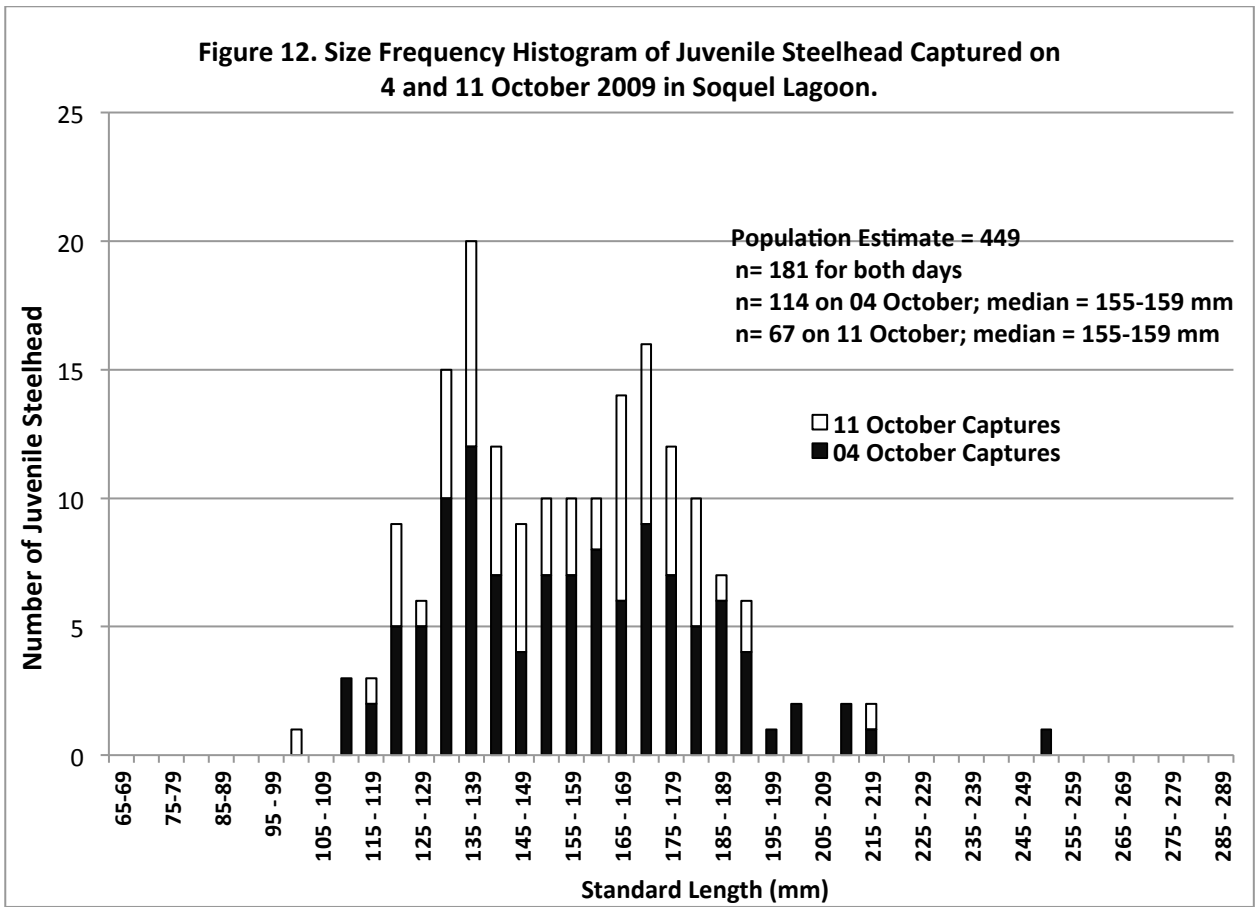


Figure 12. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2009 in Soquel Lagoon.

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

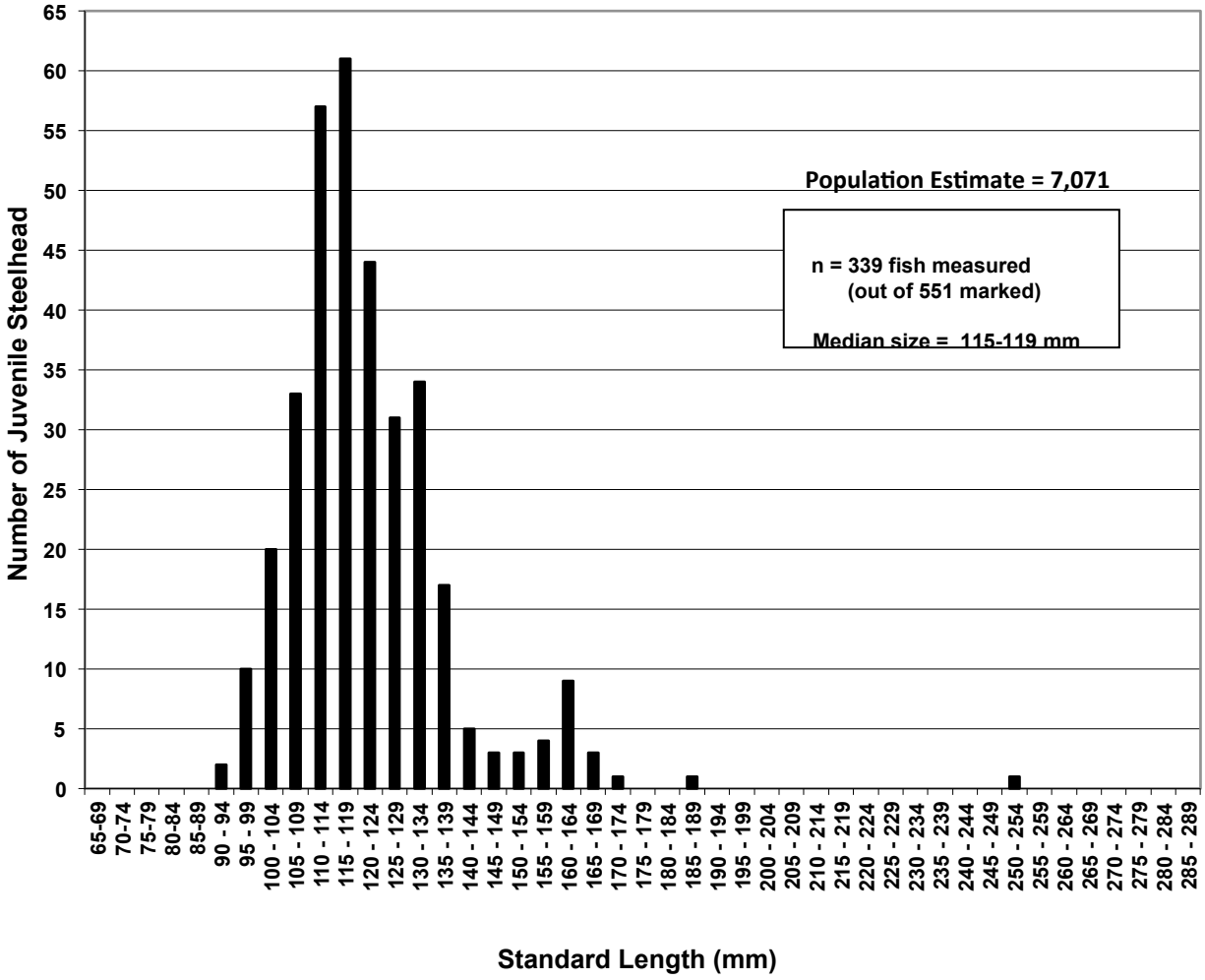


Figure 13. Size Frequency Histogram of Juvenile Steelhead Captured on 27 September 2008 in the Soquel Lagoon.

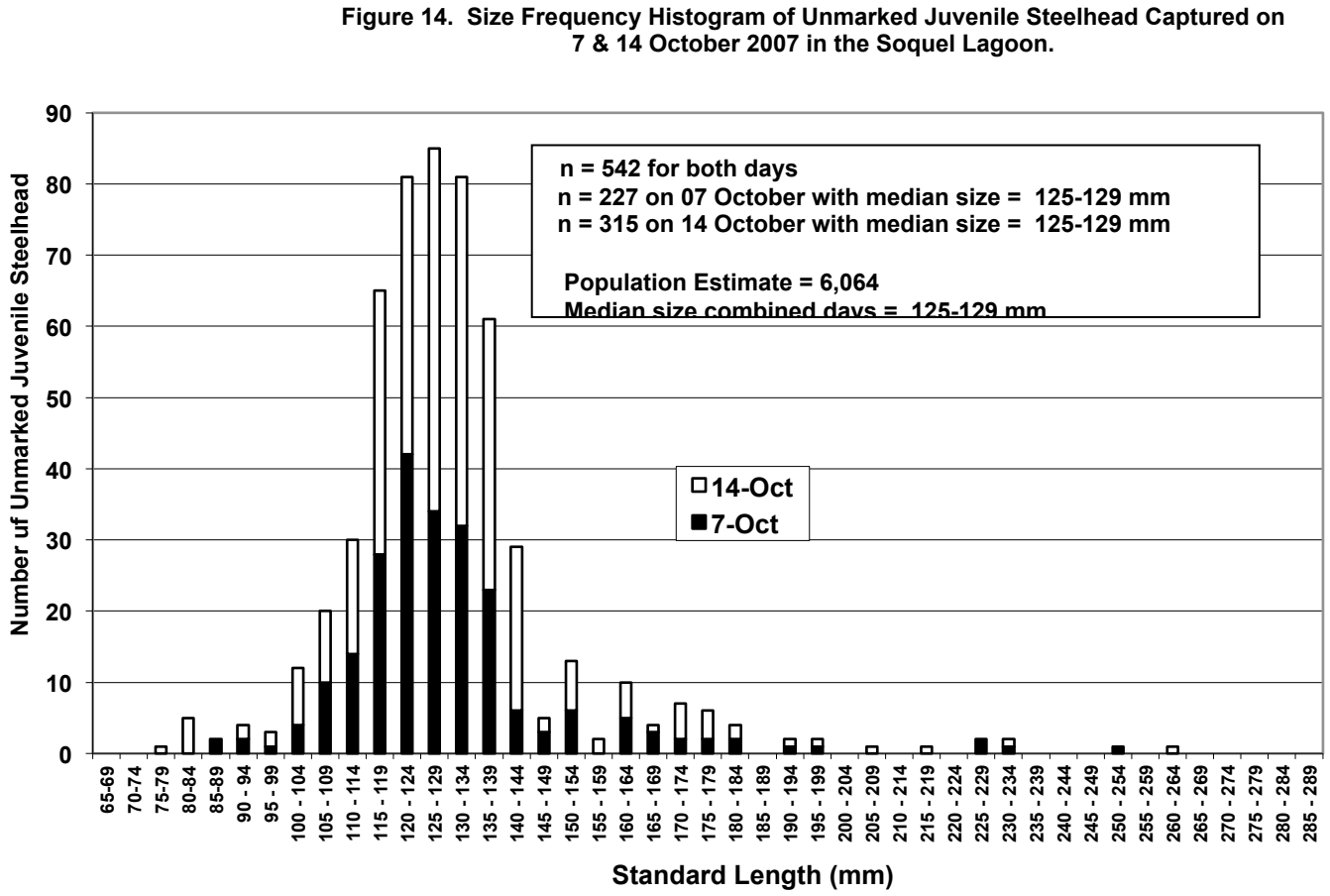


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 & 14 October 2007 in the Soquel Lagoon.

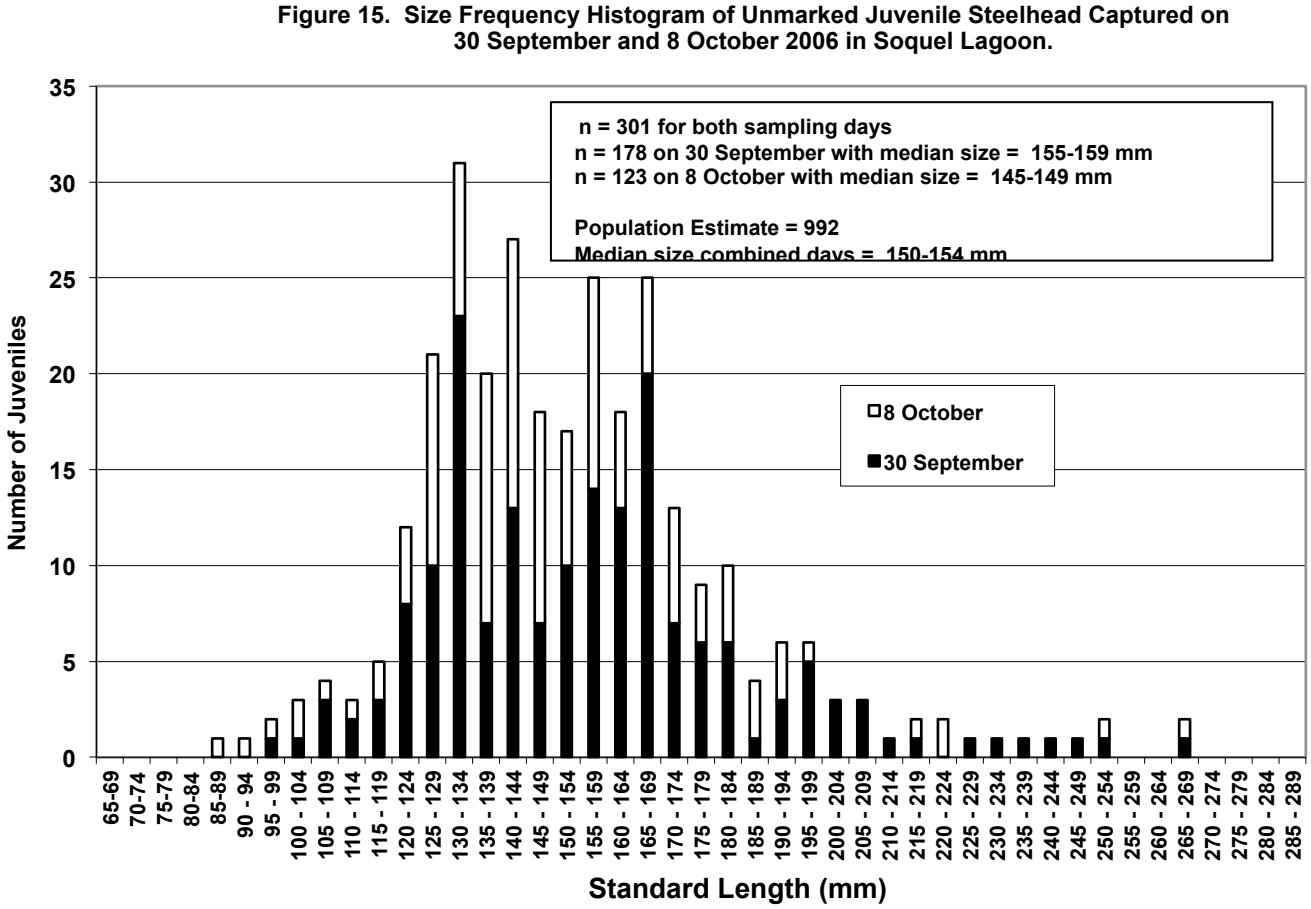


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 30 September and 8 October 2006 in Soquel Lagoon.

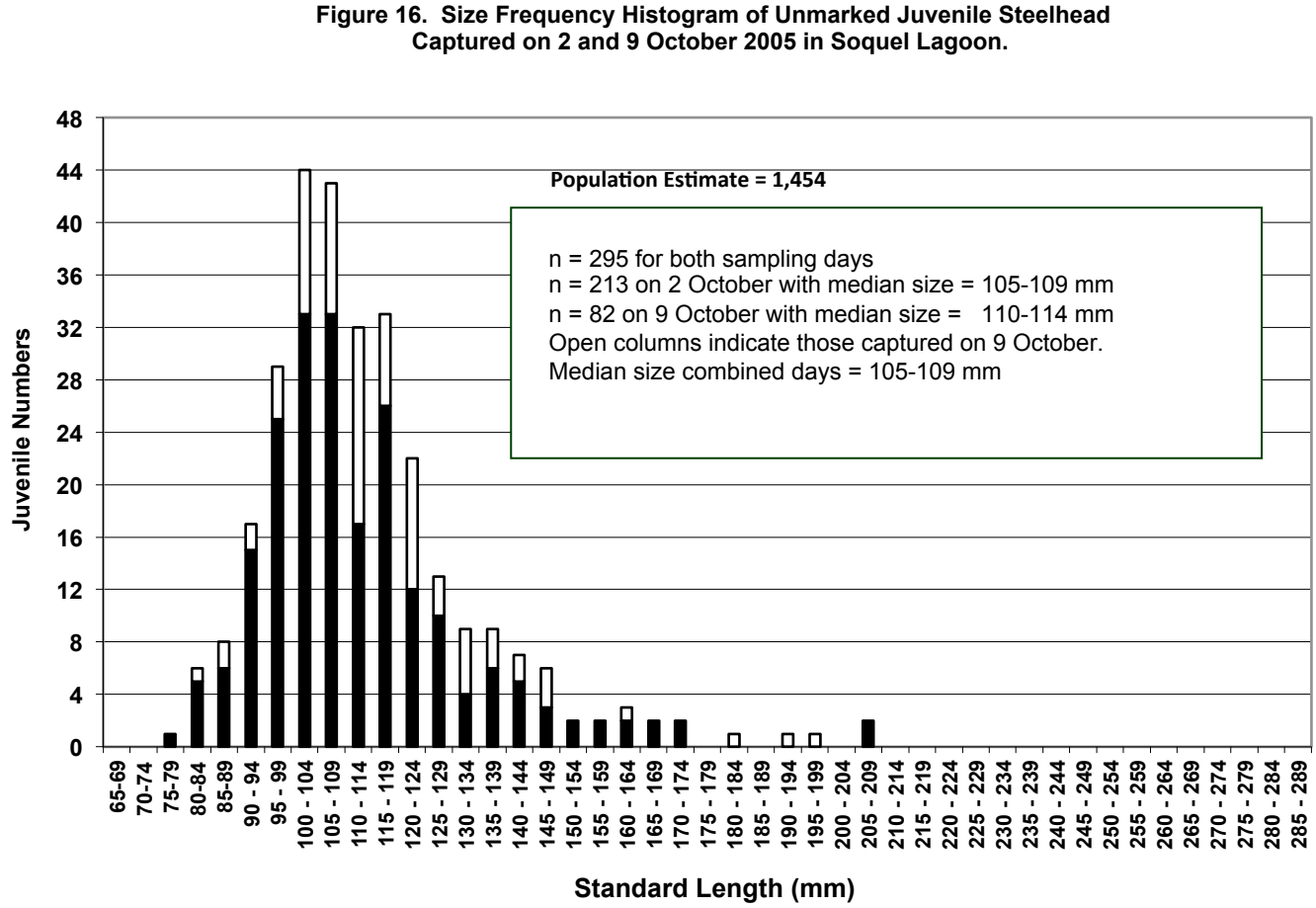


Figure 16. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 2 and 9 October 2005 in Soquel Lagoon.

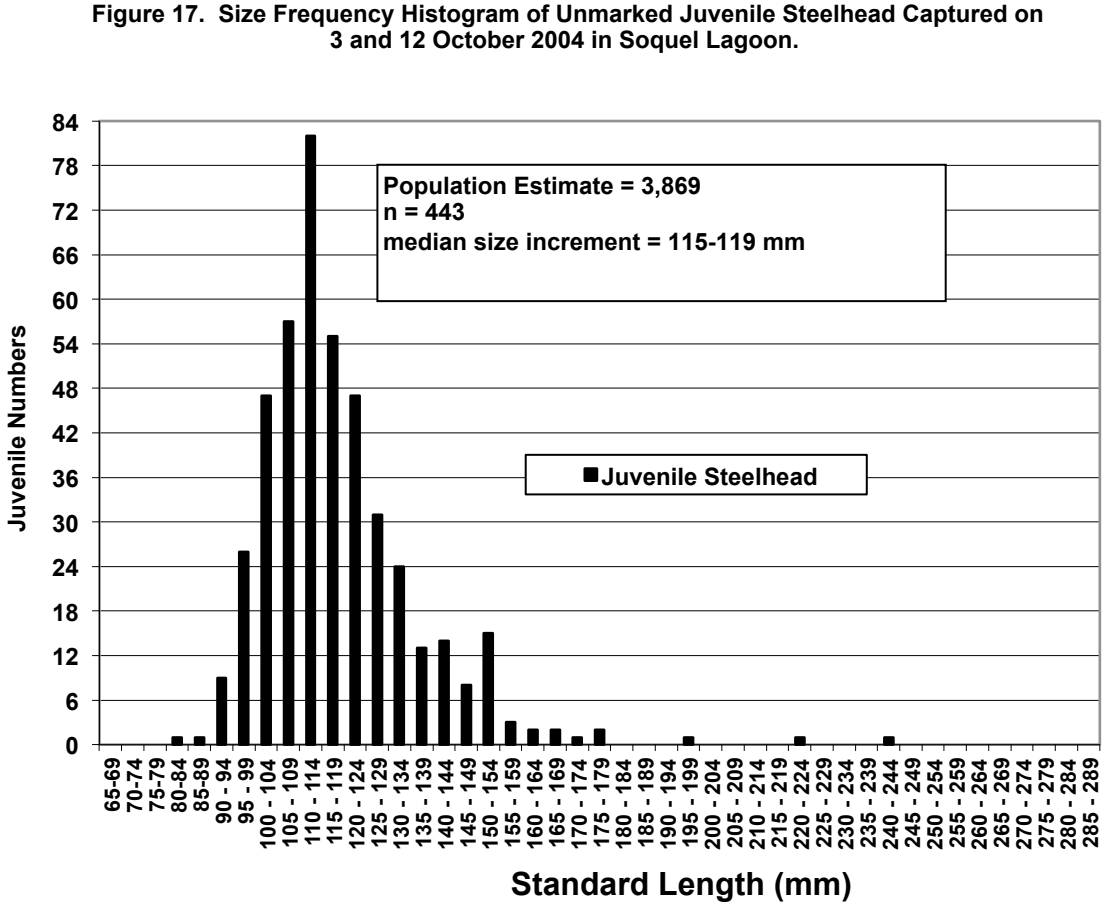


Figure 17. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

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

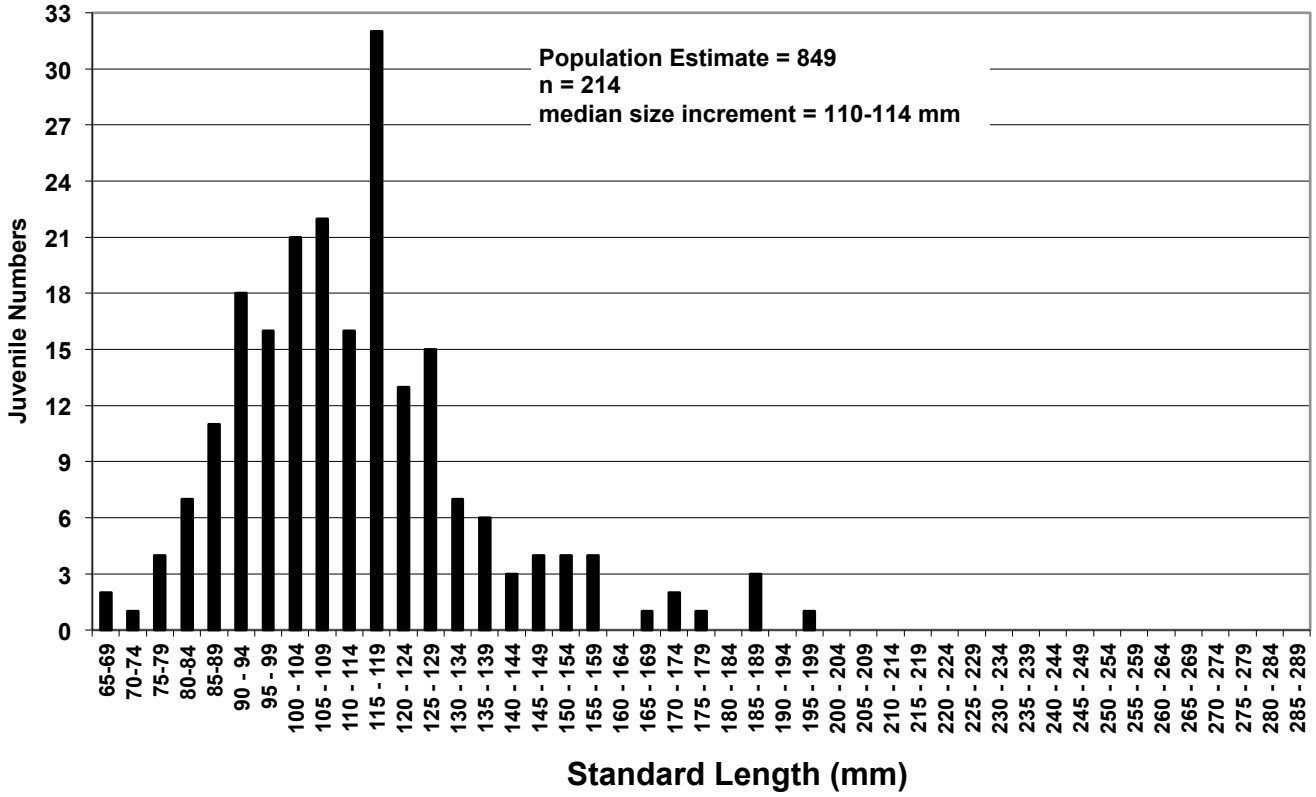


Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

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

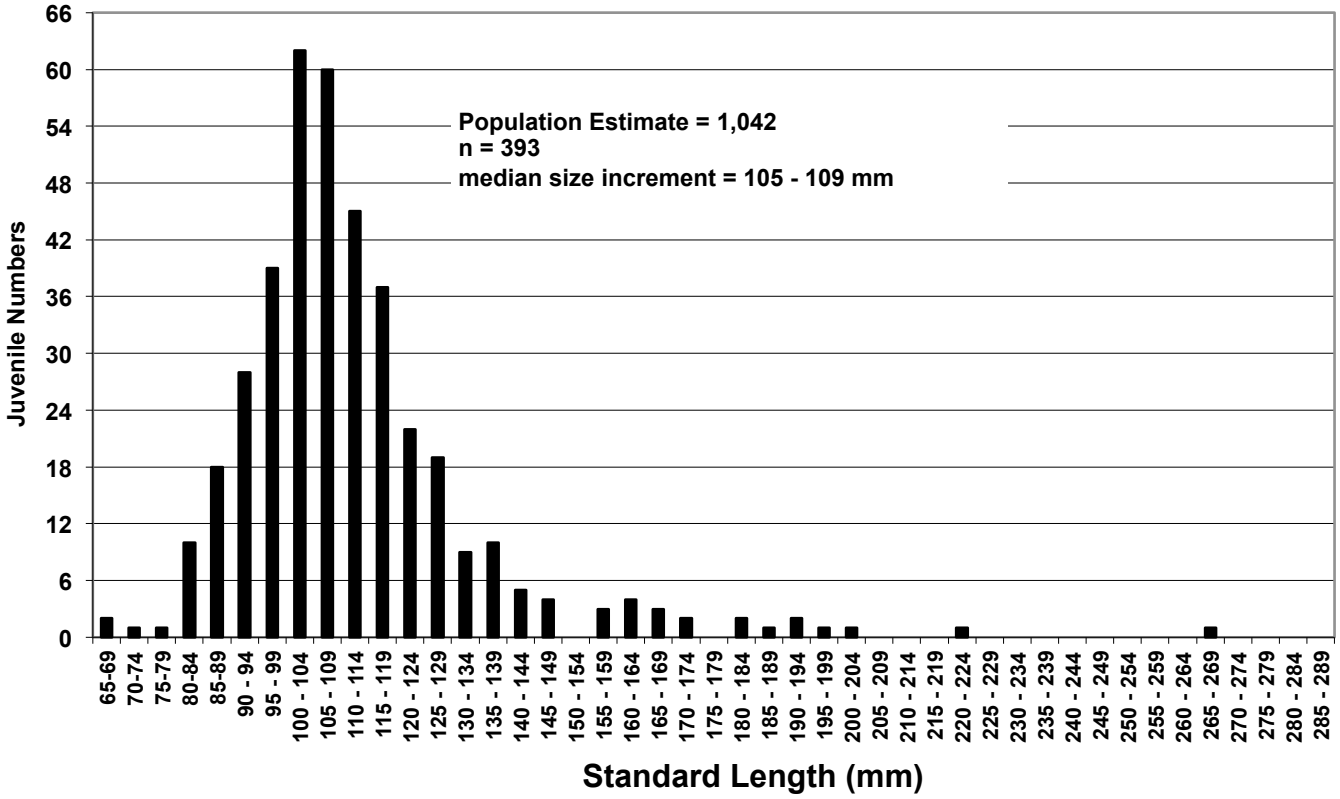


Figure 19. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 October 2002 in Soquel Lagoon.

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

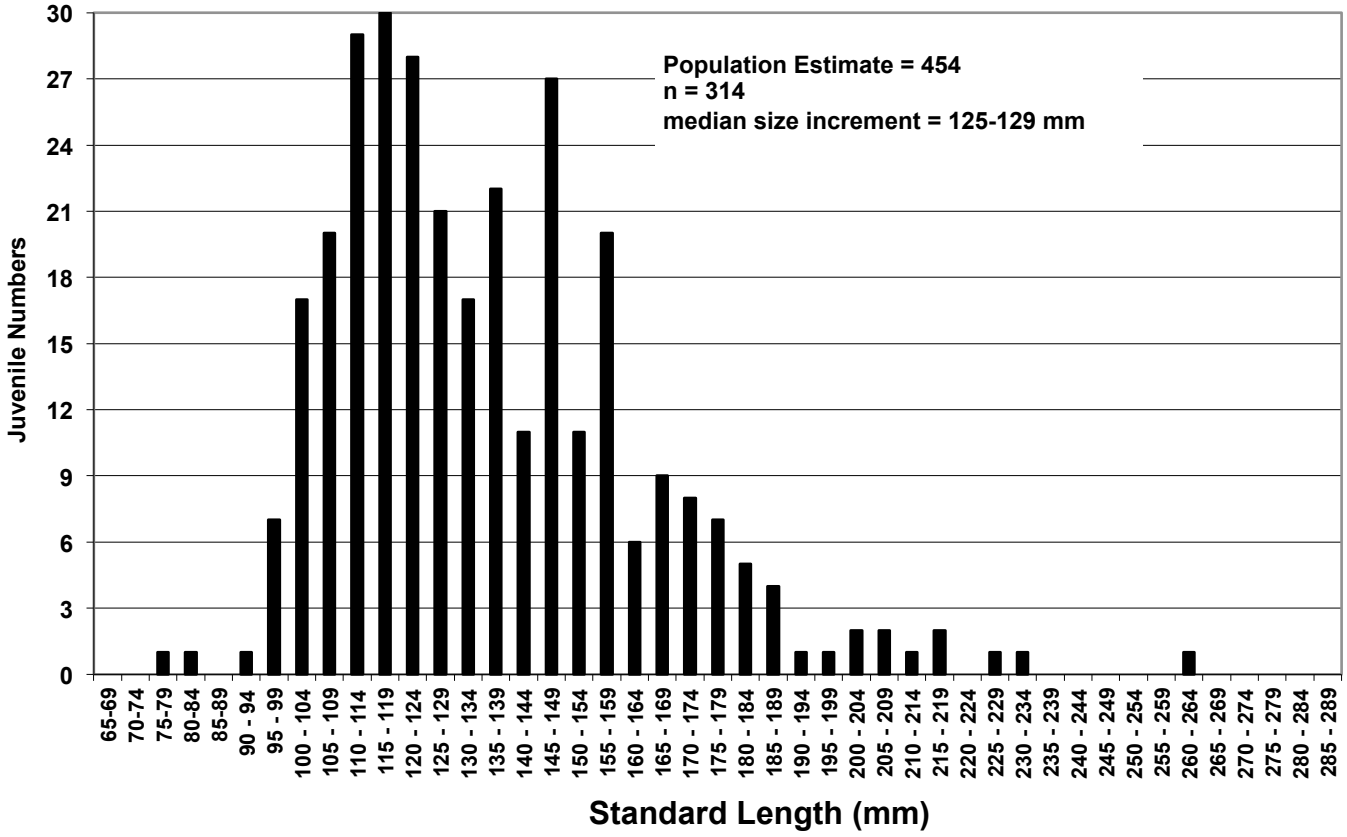


Figure 20. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

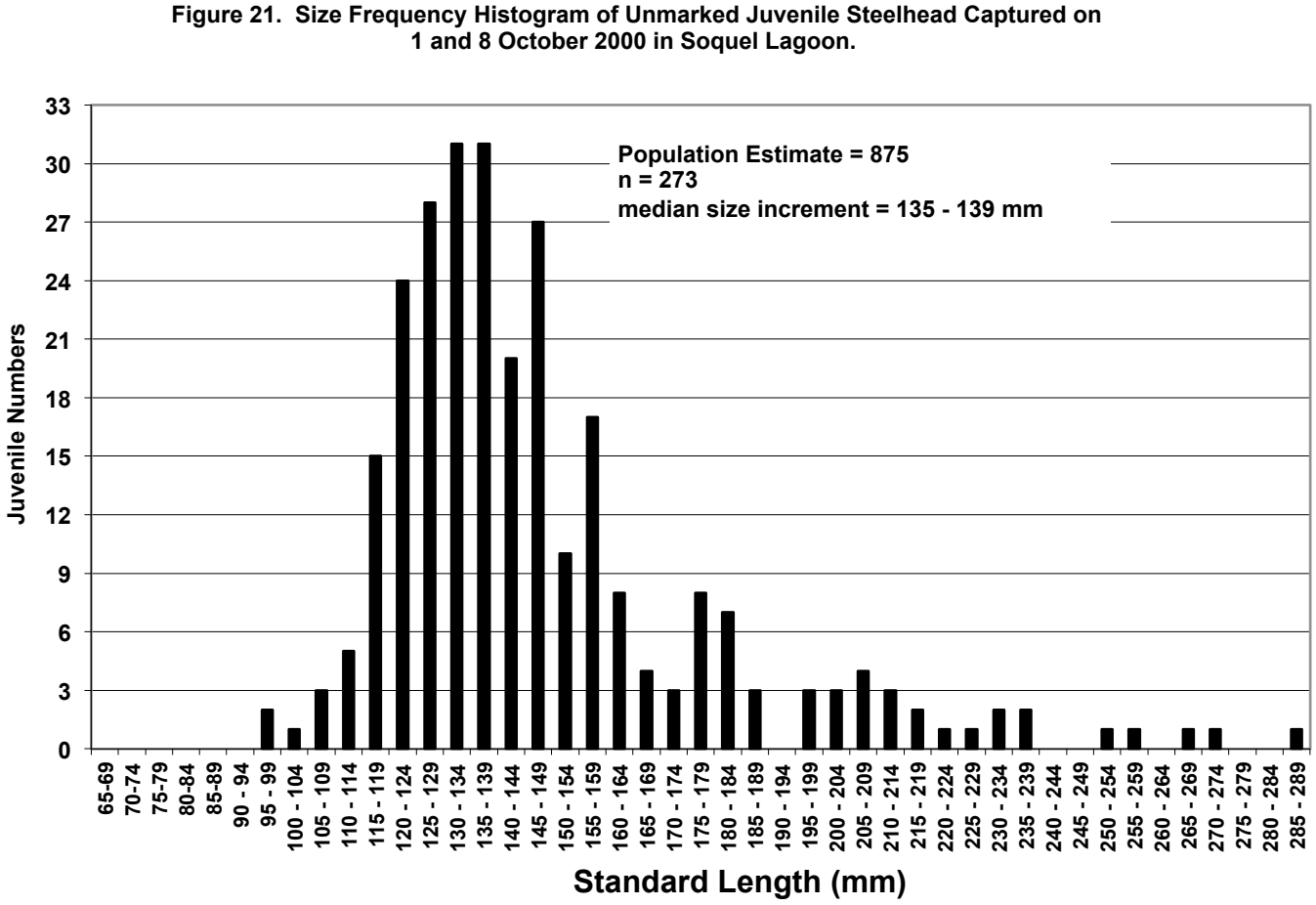


Figure 21. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

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

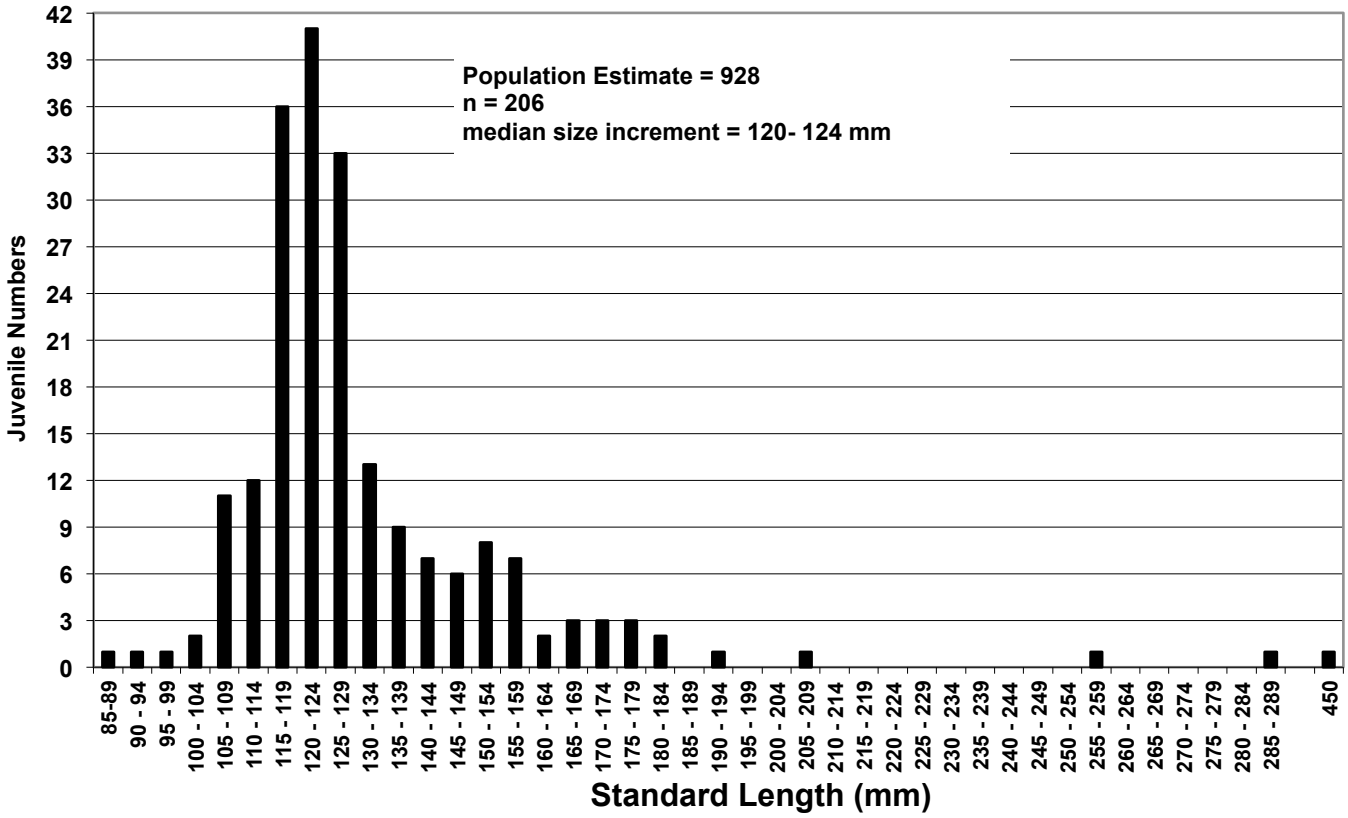


Figure 22. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 10 October 1999 in Soquel Lagoon.

Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

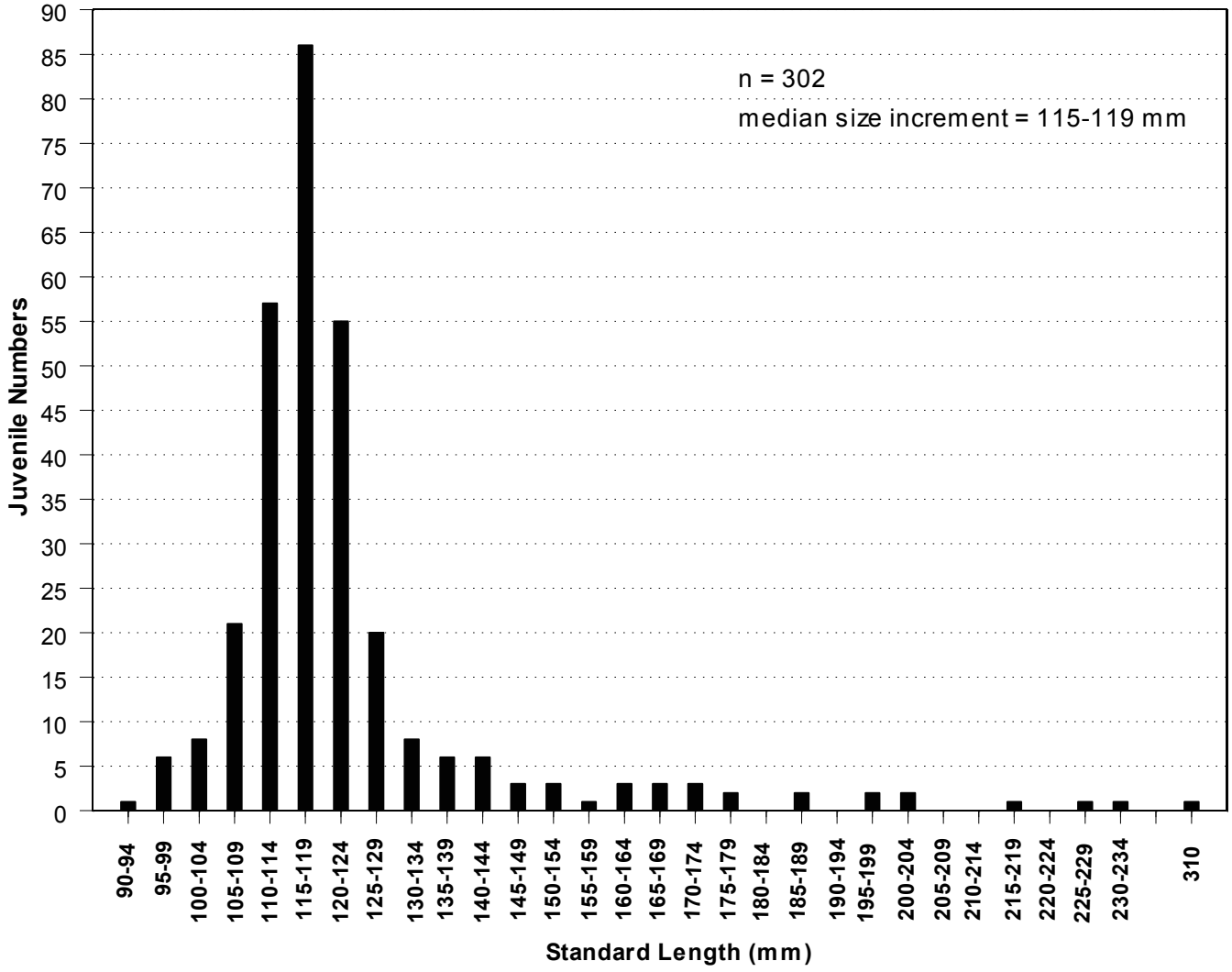


Figure 23. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

Population Estimate = 671.

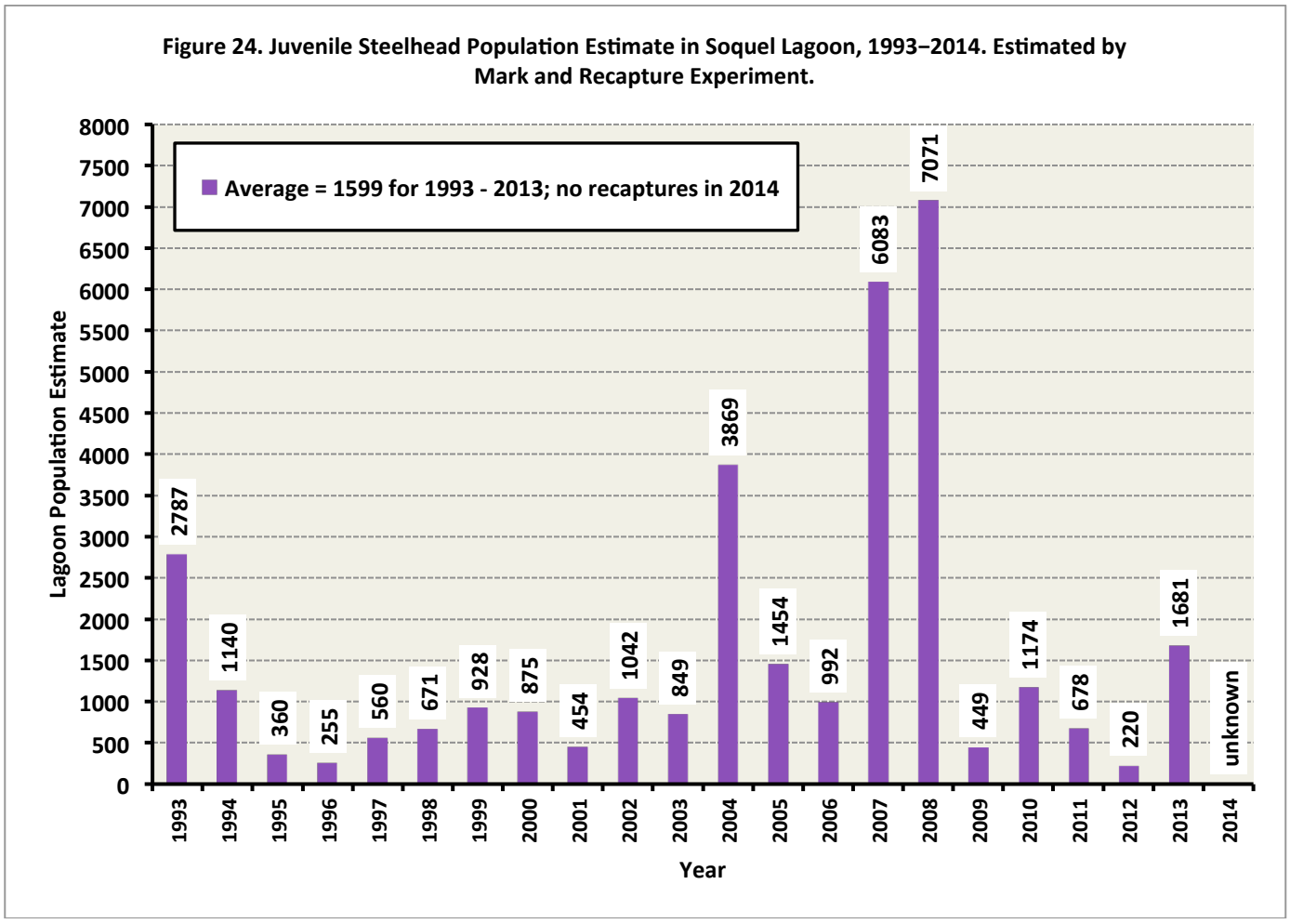


Figure 24. Juvenile Steelhead Population Estimate in Soquel Lagoon, 1993−2014. Estimated by Mark and Recapture Experiment.

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

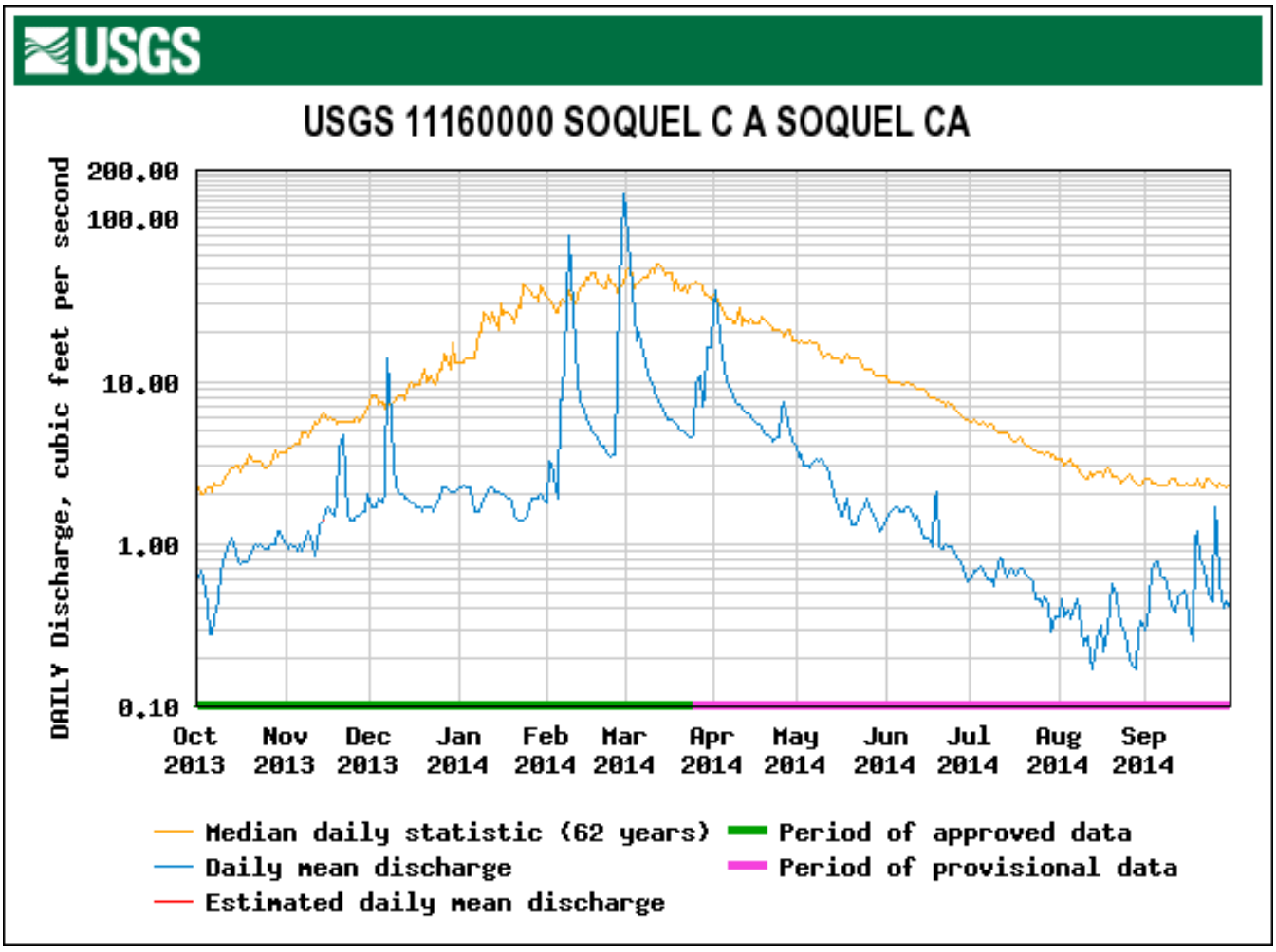


Figure 26. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2014.

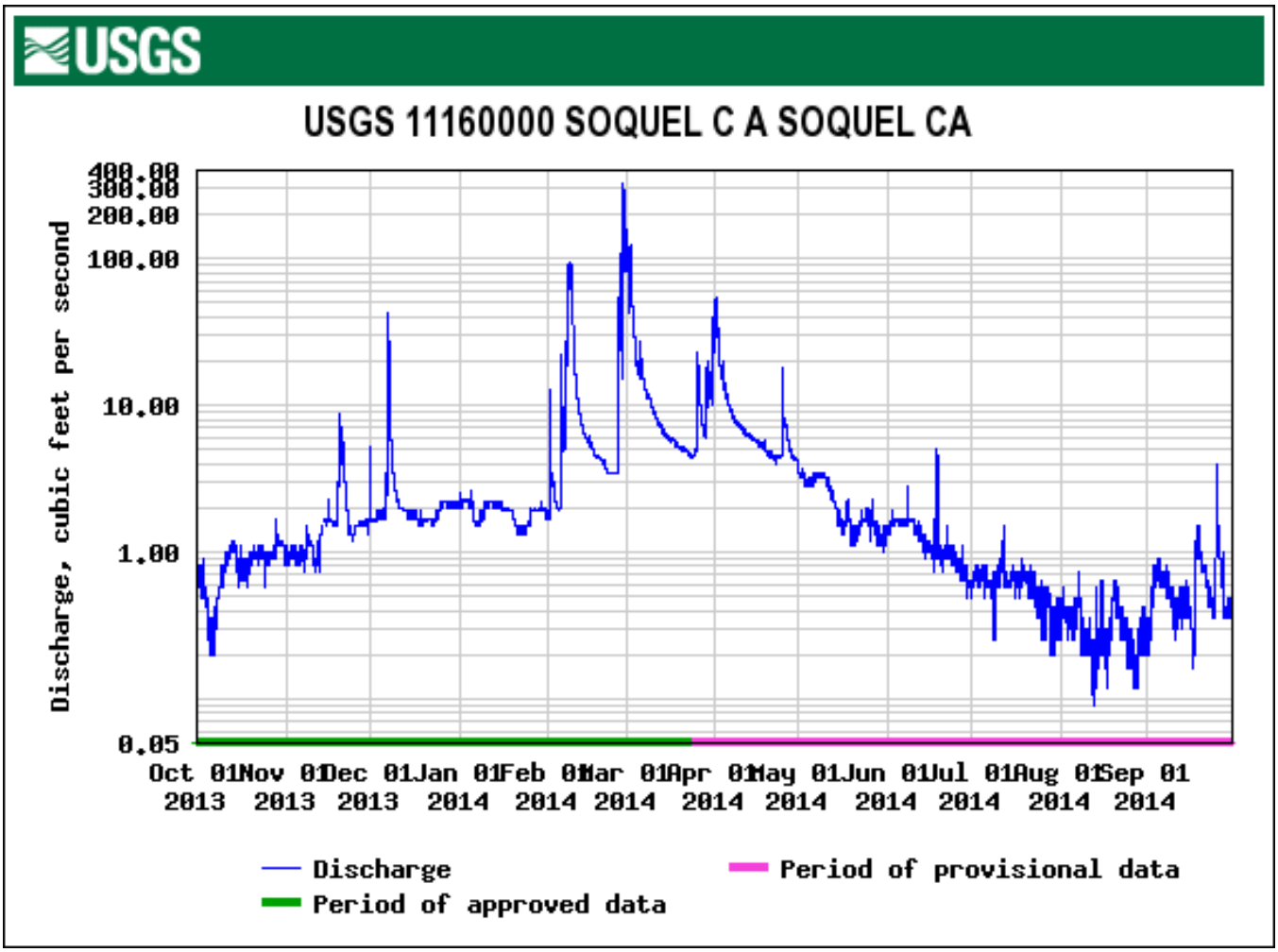


Figure 27. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2014 – 10 December 2014.

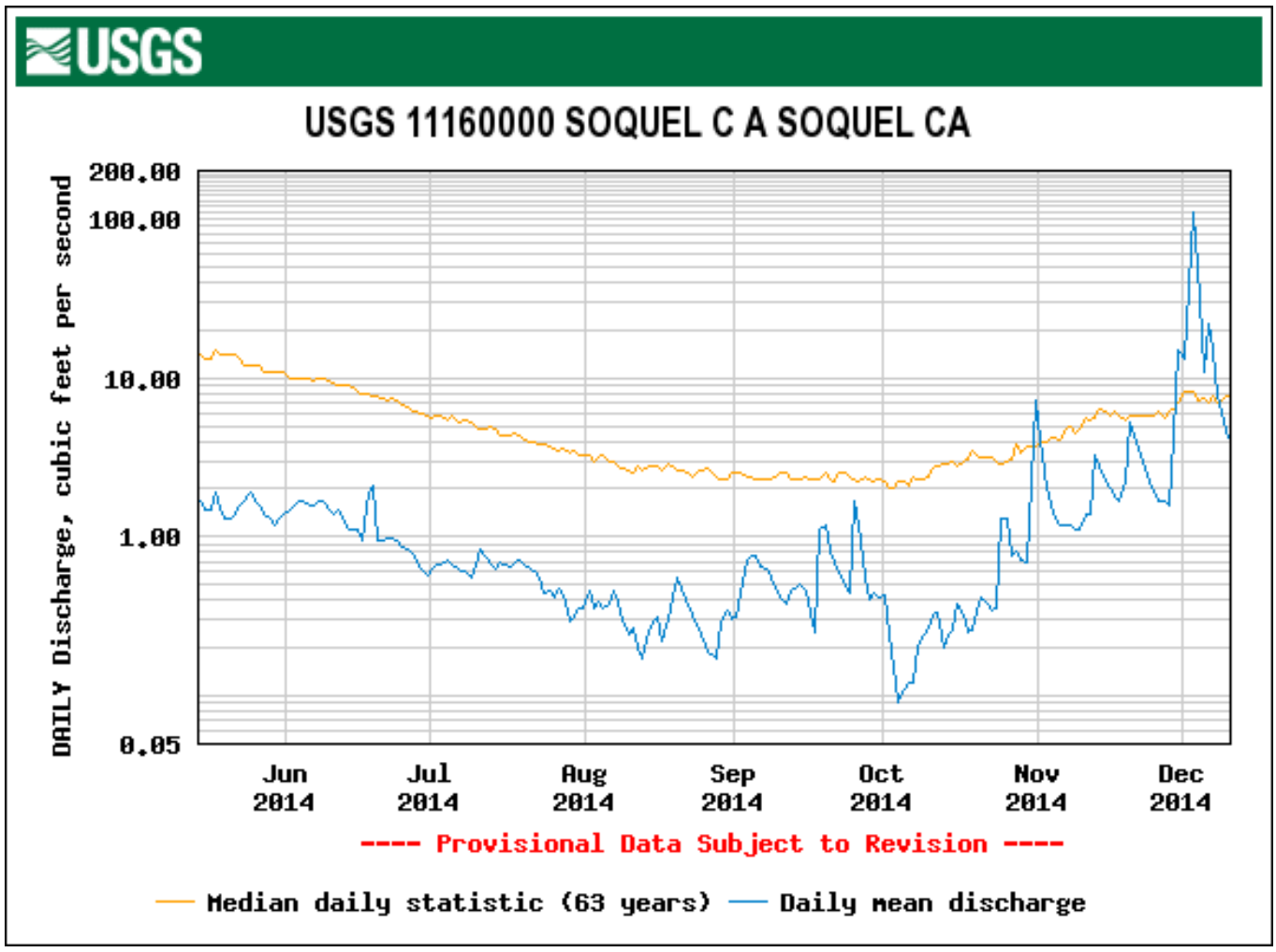


Figure 28. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2014 – 10 December 2014.

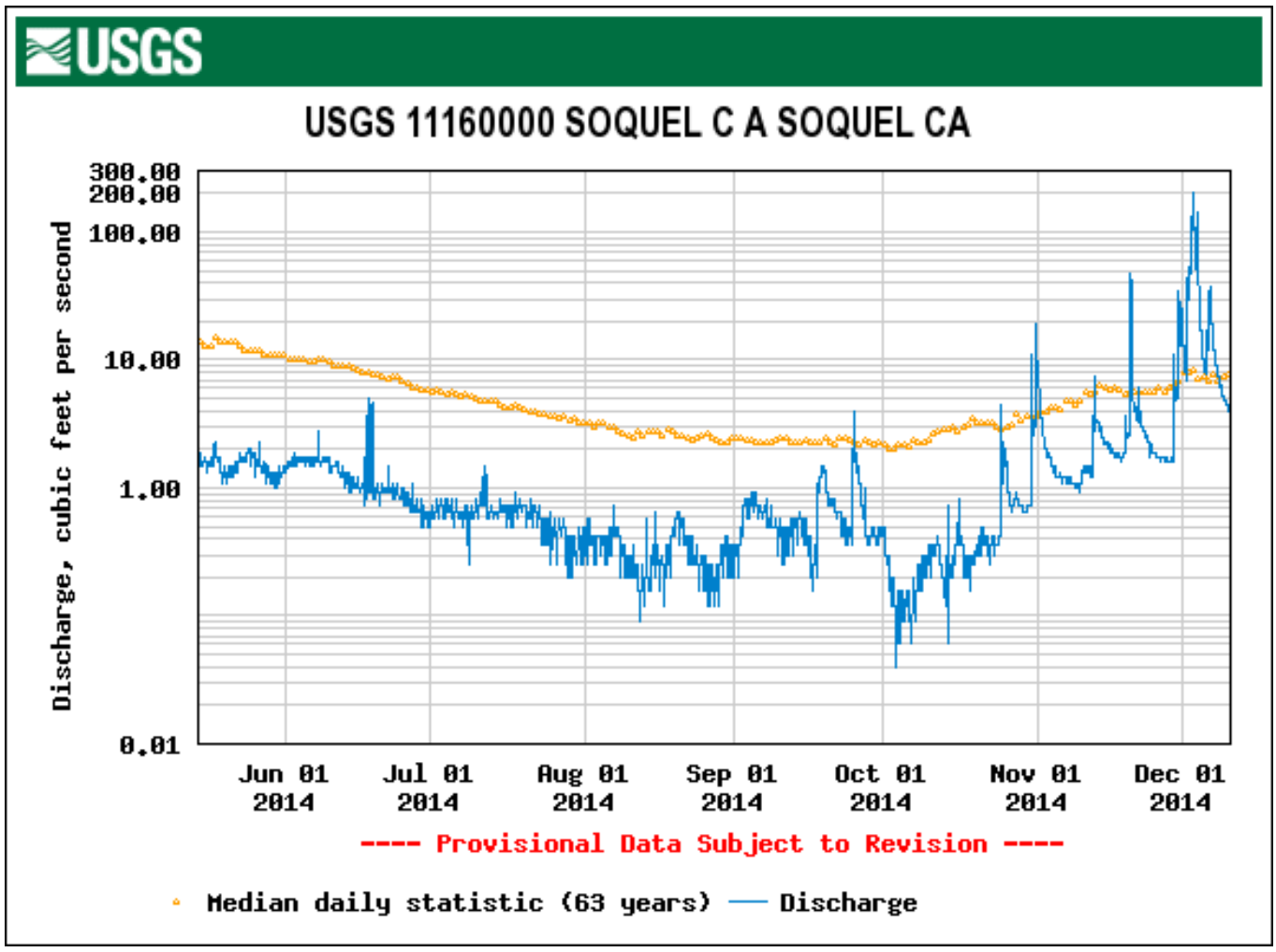


Figure 29. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2013.

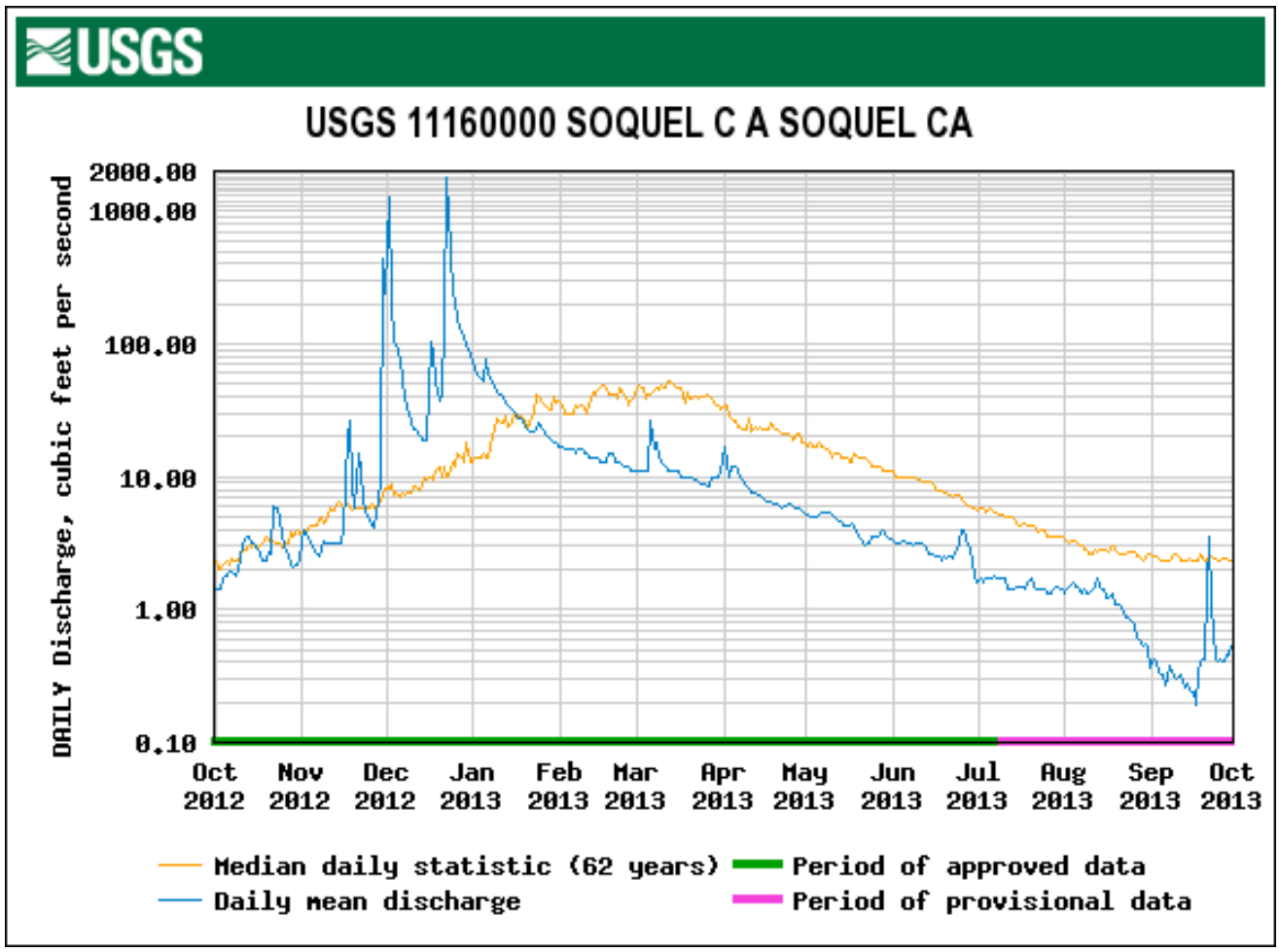


Figure 30. Soquel Creek Actual Streamflow Hydrograph for the USGS Gage in Soquel, CA, October 2012 – May 2013.

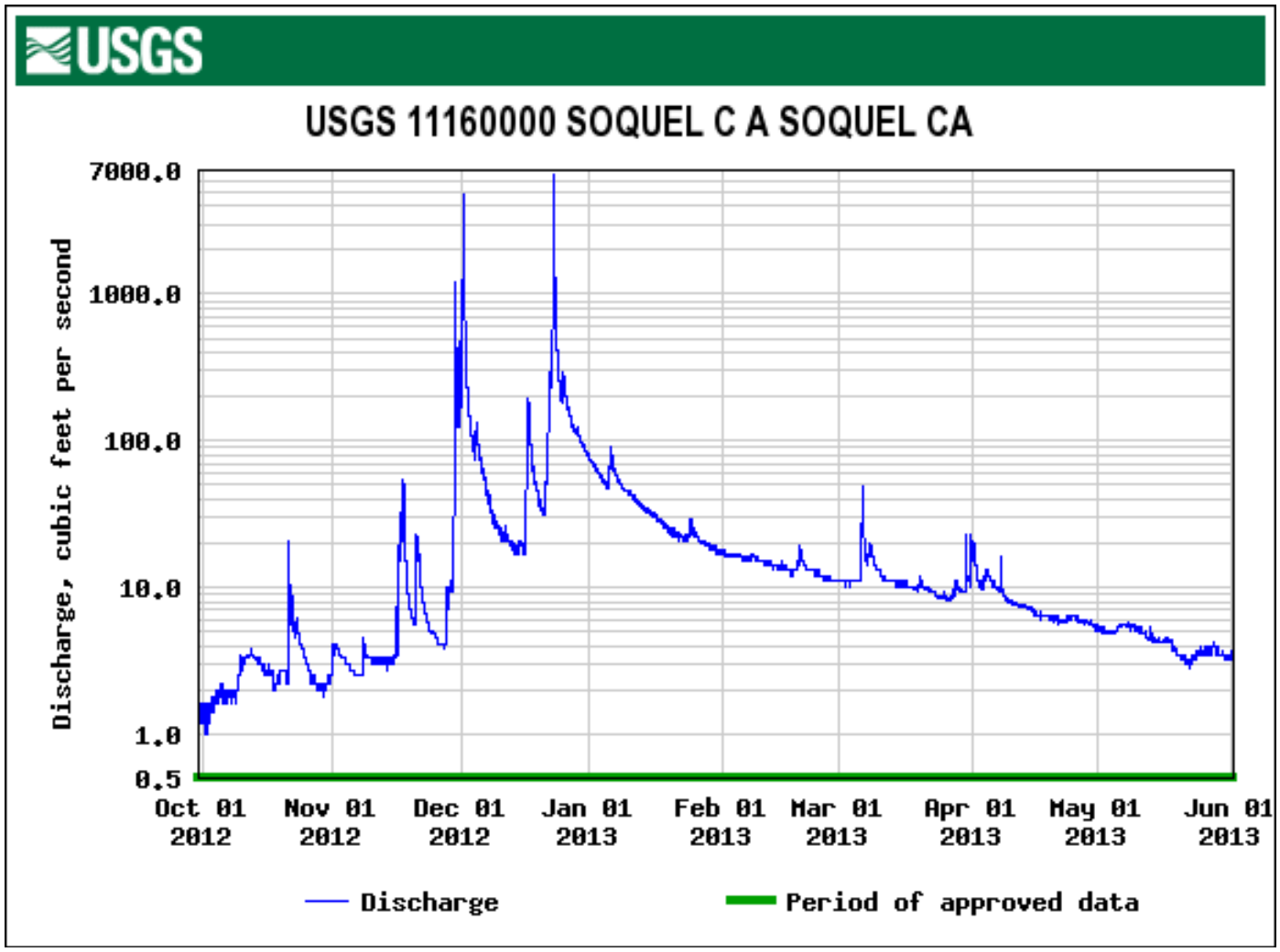


Figure 31. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

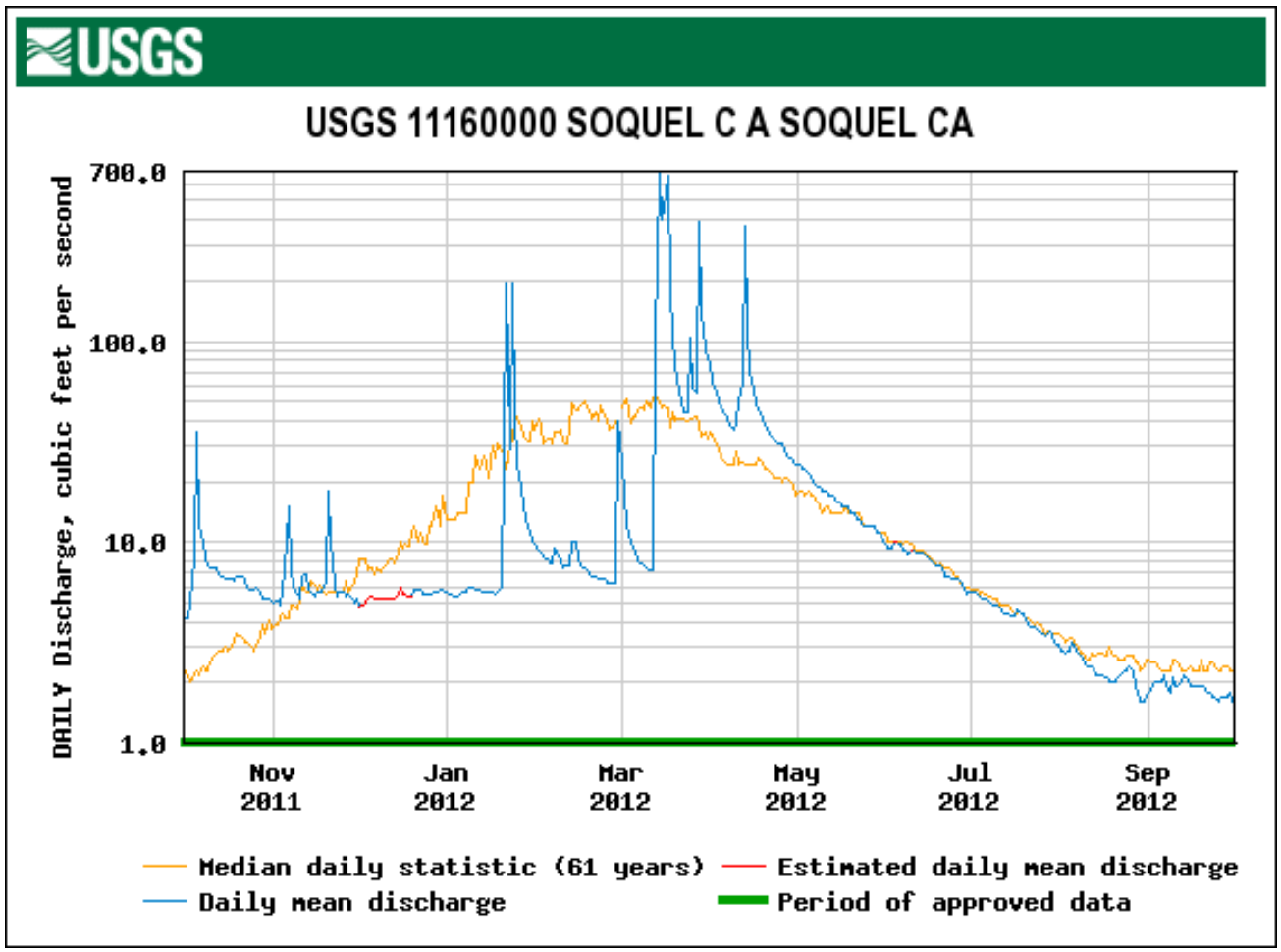


Figure 32. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2012.

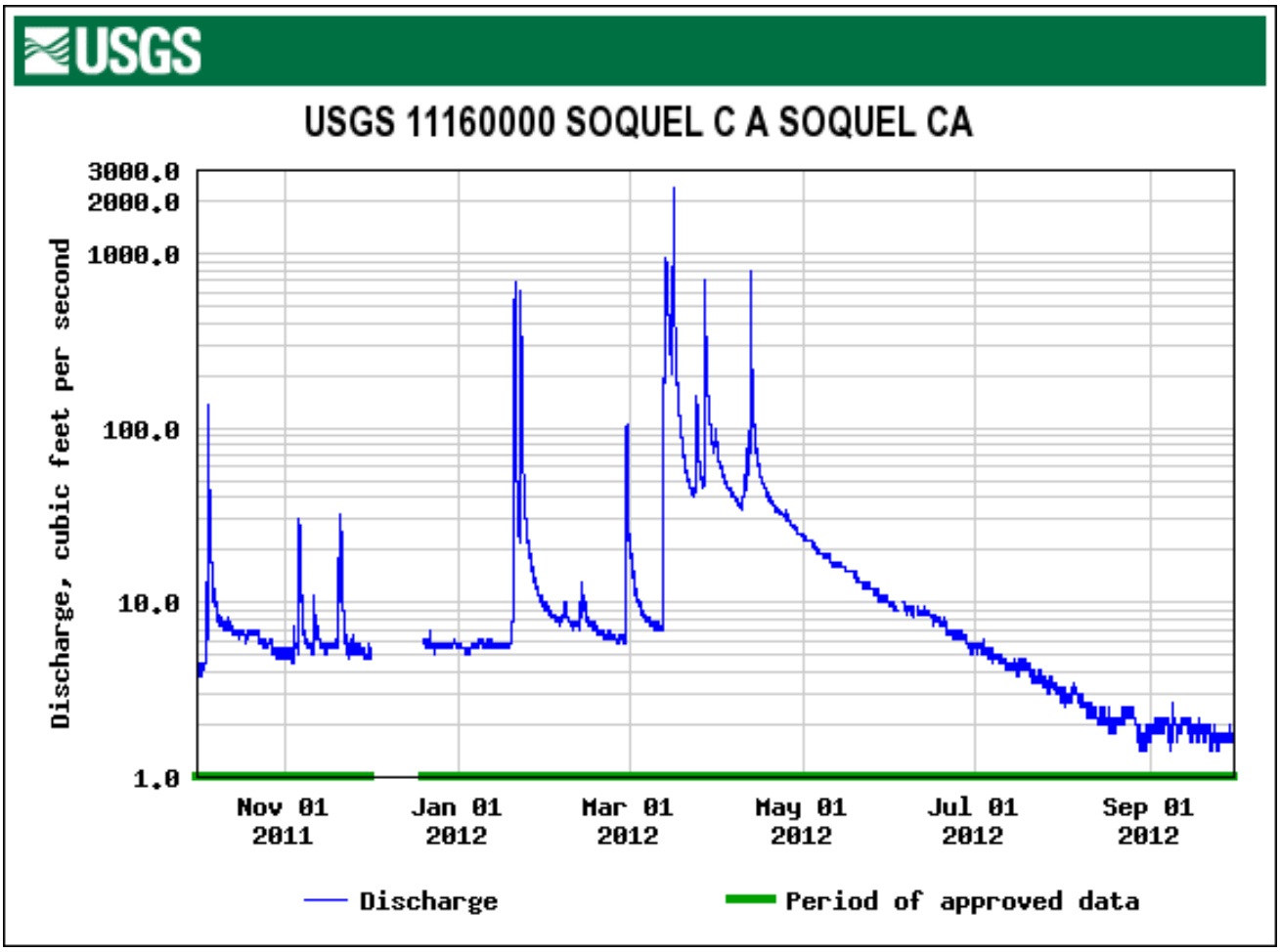


Figure 33. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 15 May 2012 – 20 November 2012.

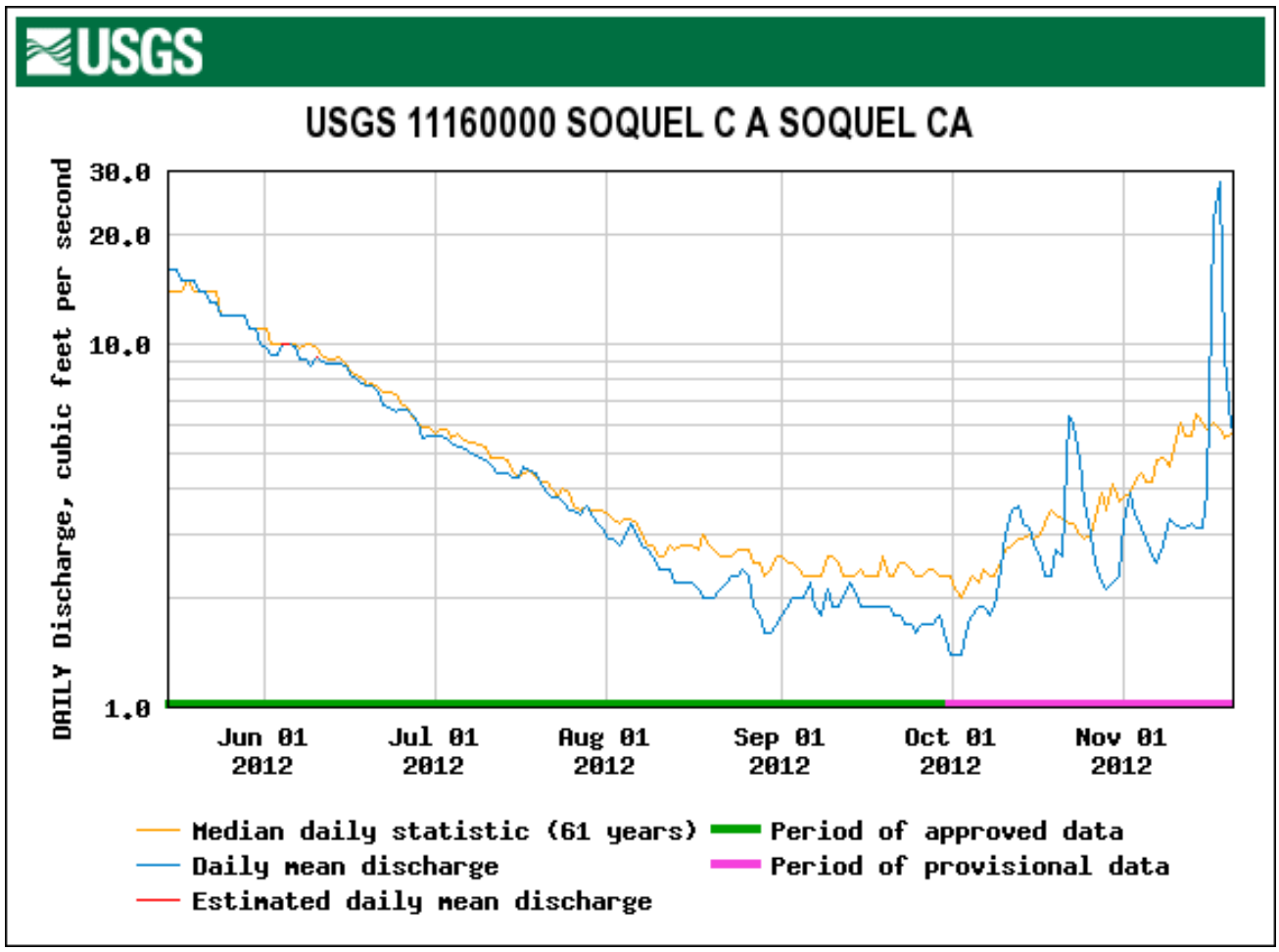


Figure 34. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

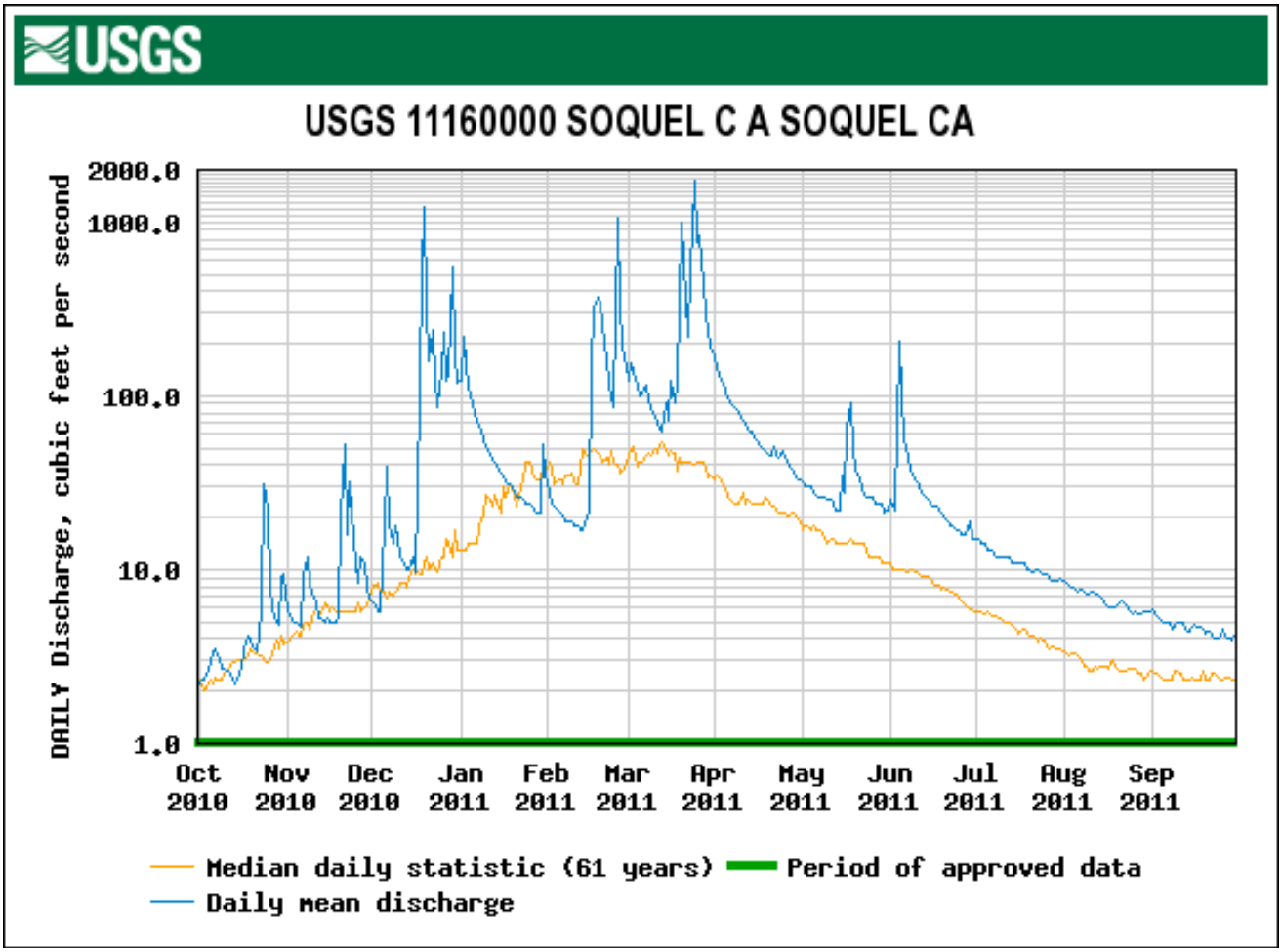


Figure 35. Soquel Creek Actual Measured Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2011.

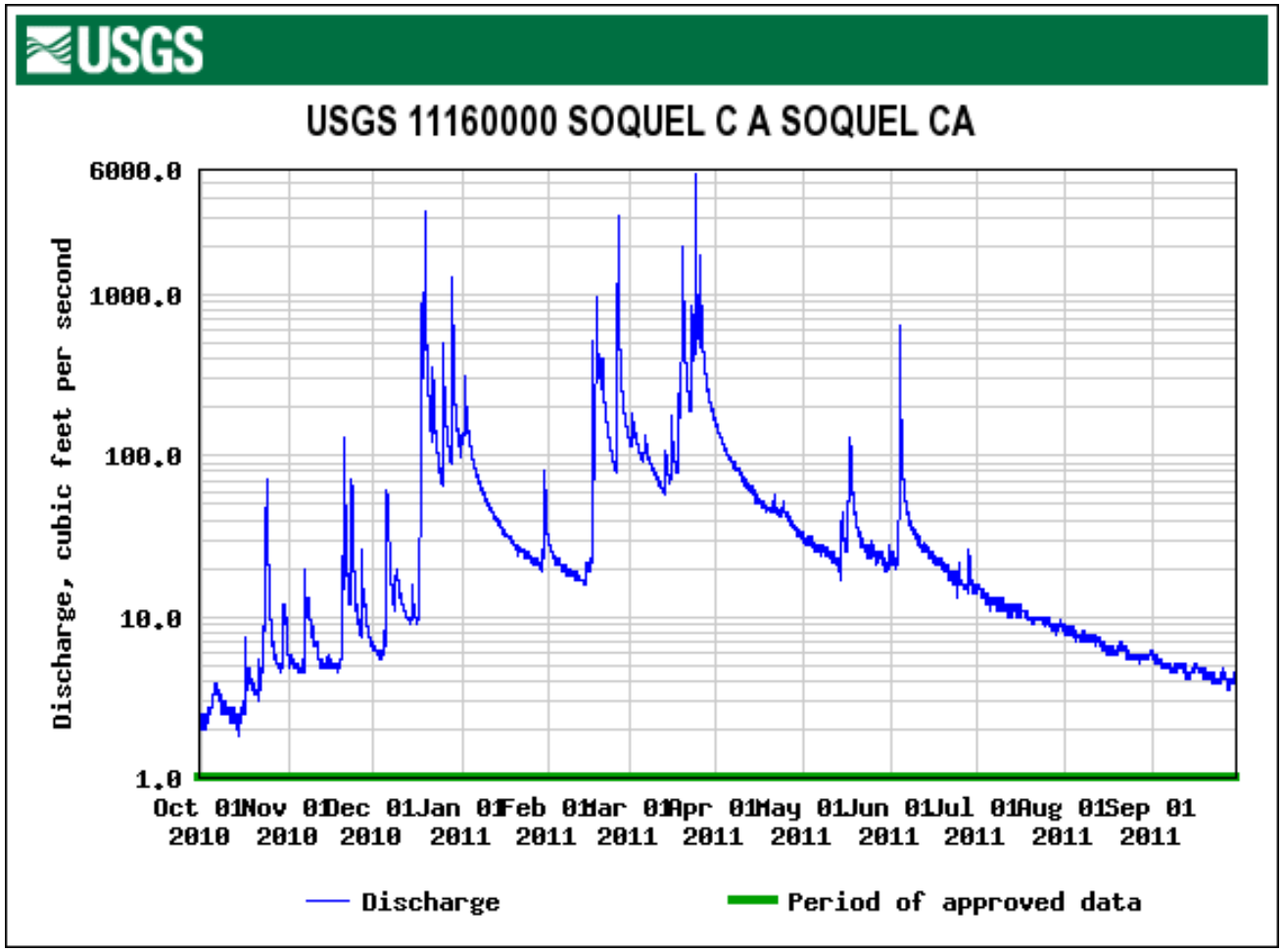


Figure 36. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2010.

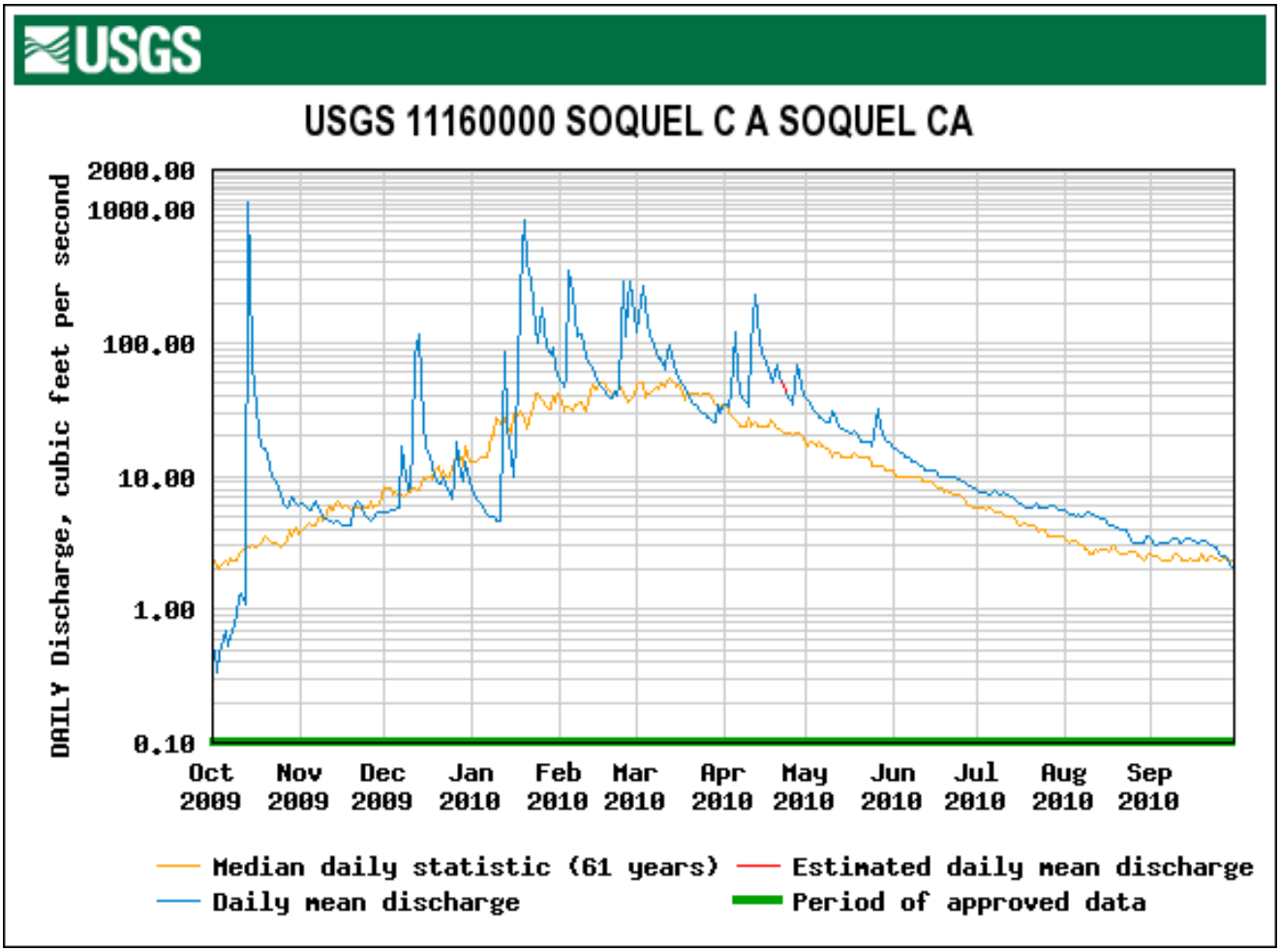


Figure 37. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2009.

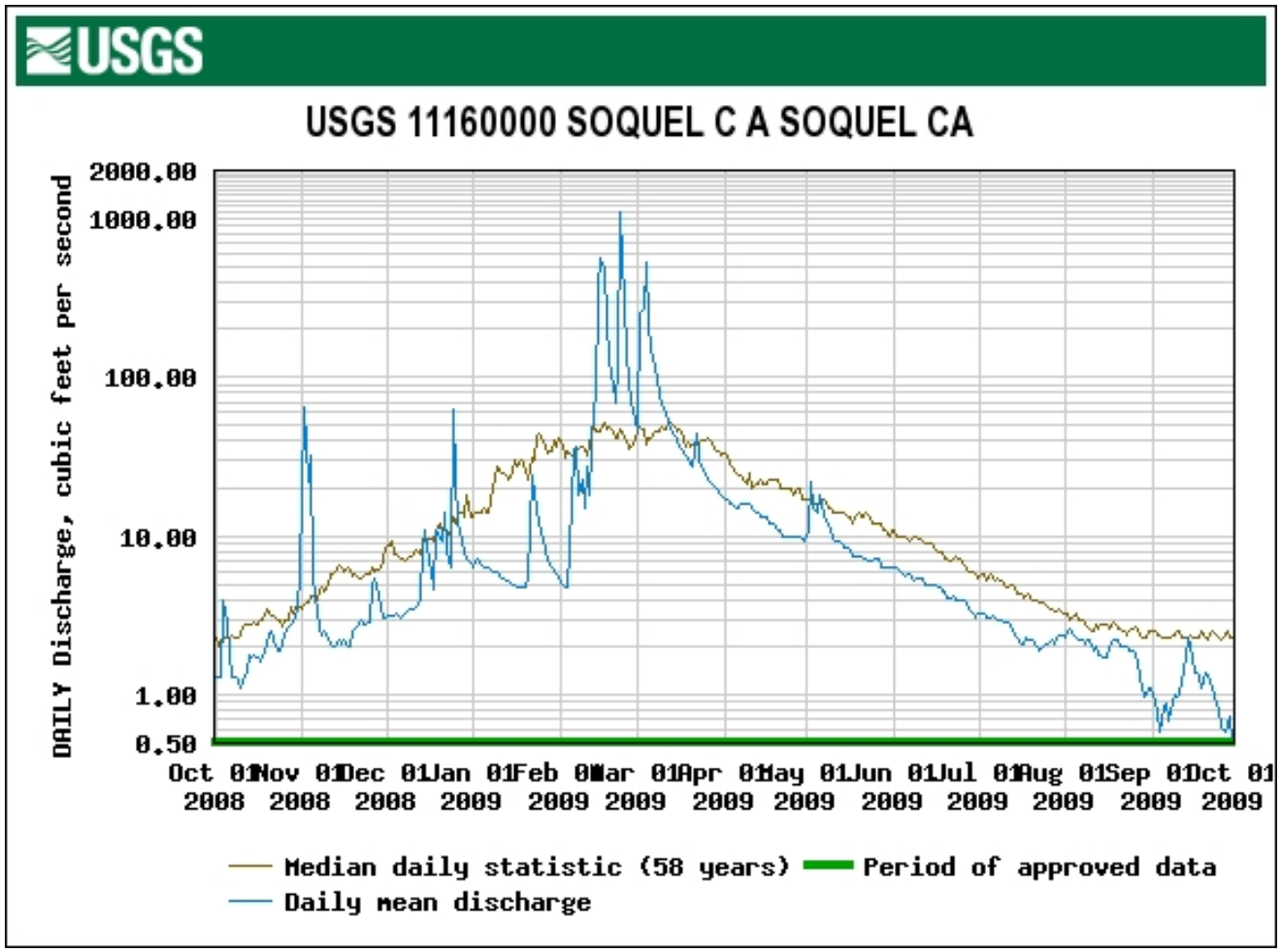


Figure 38. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2008.

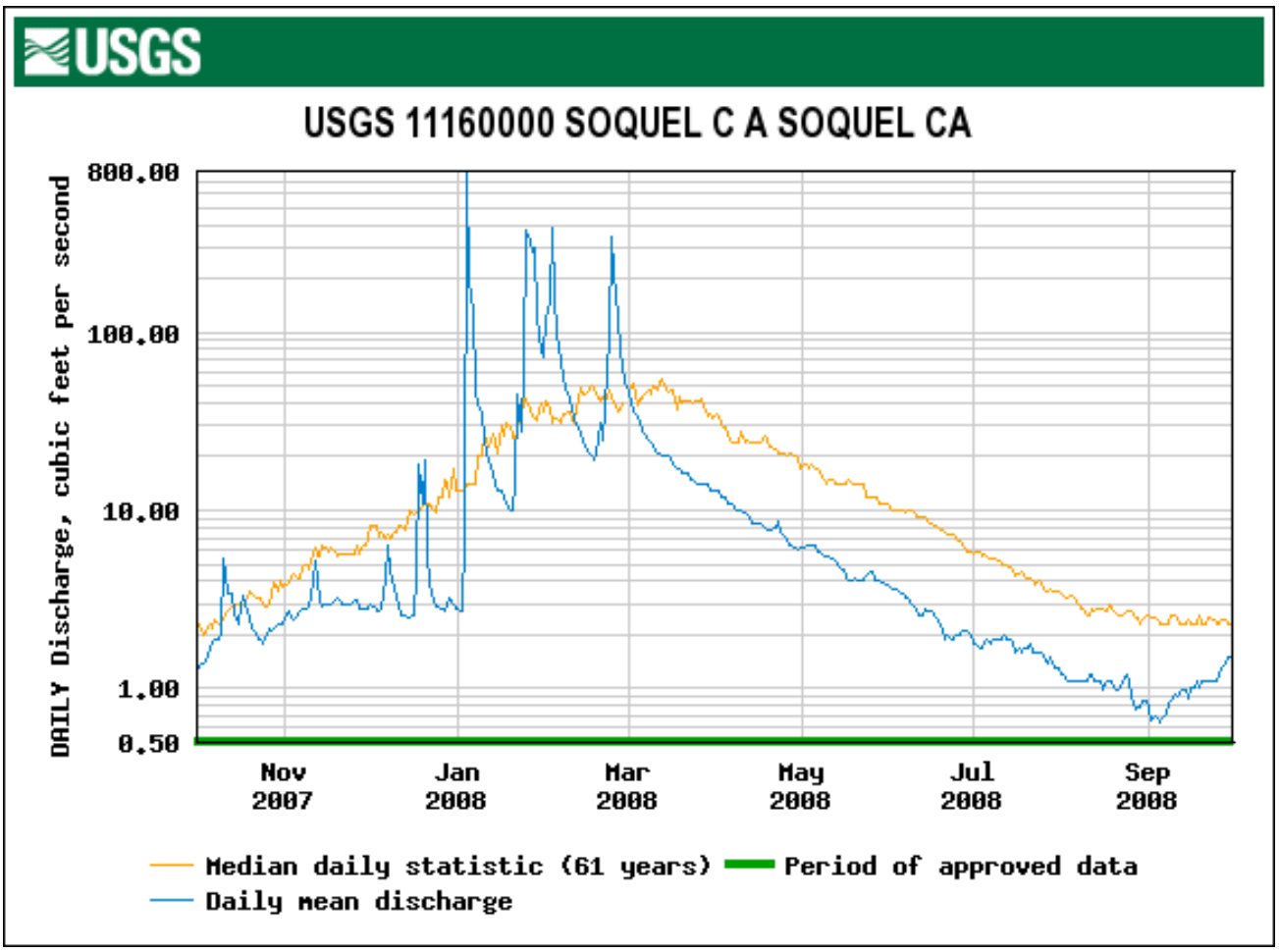
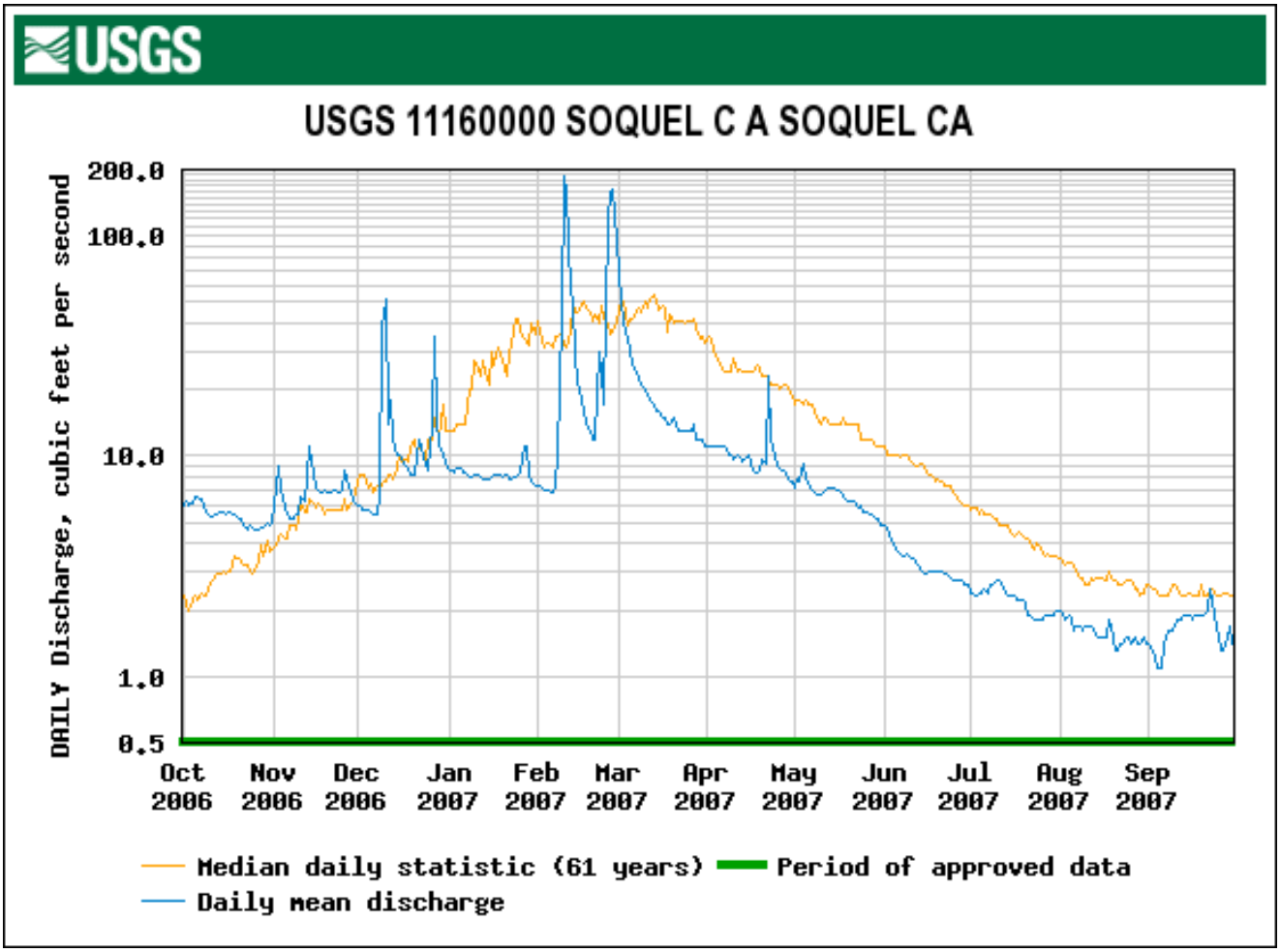


Figure 39. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, Water Year 2007.



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

27 May 2014– 30 November 2014.

27 May 2014. The sandbar had been closed since 22 May. Temperature probes were launched on 30 May in the lagoon and upstream. The lagoon was not completely full with a gage height of 2.07, without an adult portal in place. The flume had been closed at 0630 hr and was manually opened. Water was not spilling over the notched, top flashboard. When water reaches it, another flashboard will be added. There had been problems on 22 May with saltwater entering the lagoon through the flume. The steel plate was re-installed on flume outlet to prevent saltwater incursion. Water was leaking out around the plate. Saltwater was detected along the Venetian Court wall on 27 May with elevated temperature (see table below). Malfunction of usual water quality meter prevented measurements from Stockton Bridge. An alternative meter with shorter cable was used along Venetian Court wall. The biologist recommended that a shroud be placed on the flume inlet. This was accomplished with addition of a flashboard at 1030 hr.

			27-May 2014					
	Flume				**Venetian Court Wall** 0914 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	1.4		
0.25								
0.50								
0.75								
1.00								
1.25								
1.50								
1.75								
2.00								
2.25b					21.0	22.3		32790
2.50								
2.75								
3.0								

30 May 2014. Temperature probes were launched in the lagoon and upstream.

			7-June 14					
	Flume		0700 hr		**Stockton Avenue Bridge**			0720 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	0.8	7.50	1475	19.2	0.8	8.19	1356
0.25	19.4	0.8	7.56	1479	19.2	0.8	8.18	1362
0.50	19.4	0.8	6.61	1481	19.2	0.8	8.18	1346
0.75	19.4	0.8	7.58	1471	19.2	0.8	8.16	1351
0.87b	19.4	0.8	7.26	1476				
1.00					19.2	0.8	8.10 (88%)	1355
1.25					19.2	0.8	8.09	1369
1.50					19.4	0.9	5.30	1512
1.75					22.1	4.6	0.08	8053
2.0					22.4	16.6	0.32	27767
2.25b					22.3	19.5	0.30	29663
	Railroad Trestle			0748 hr	**Mouth of Noble Gulch**			0758 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	18.9	0.7	6.42	1223	18.3	0.6	6.85	1065
0.25	18.9	0.7	5.88	1224	18.3	0.6	6.62	1066
0.50	18.9	0.7	5.81	1223	18.3	0.6	6.84	1064
0.75	18.9	0.7	5.90	1221	18.3	0.6	6.96	1063
1.00	18.9	0.7	6.00	1219	18.3	0.6	6.92	1062
1.25b	18,8	0.7	6.02	1213	18.0	0.6	6.47	1029
1.40b	18.8	0.7	5.61	1215				
1.50								
1.75								
2.00								

7 June 2014. The first complete water quality monitoring was accomplished. Water quality was warm for the time of year, and a stagnant, warm, and near anoxic saltwater layer existed under Stockton Bridge. Water temperature was above 20° C in the afternoon in the lower lagoon in the freshwater layer and above 22˚ C in the saltwater layer under the bridge. Oxygen was above 80% full saturation in the morning downstream of Stockton Bridge (except in the lower saltwater layer) and in the 60-70% full saturation range from the railroad trestle to Noble Gulch. Inflow oxygen in the morning was only 70% full saturation at Nob Hill. Oxygen was in the 90-100% full saturation in the afternoon at all stations except at greater depths under the Stockton Bridge. The city did a good job of raising the gage height to 2.59 with less than 1.5 cfs inflow. The water was flowing over the top of the flume rather than through the shroud. Biologist requested that the flashboard opening within the shroud be increased to force all water through the shroud from greater depth below.

Station 1: Flume at 0700 hr. Reach 1- 16 gulls bathing, 1 mallard in the water. Juvenile steelhead hitting the surface at 0700 in Reach 2. No surface algae.

Station 2: Stockton Avenue Bridge at 0720 hr. Secchi depth to bottom. Reach 2-no birds in water. Juvenile steelhead feeding- 40 surface hits/ minute at 0812 hr. No surface algae.

Station 3: Railroad Trestle at 0748 hr. Reach 3- 2 adult mallard ducks and 5 ducklings in water. No surface algae.

Station 4: Mouth of Noble Gulch at 0758 hr. No birds roosting on the downed cottonwood or elsewhere.
Station 5: Nob Hill at 0830 hr. Water temp. = 15.5 C. Oxygen= 8.82 mg/L. (88% sat.), cond.= 616 umhos, salinity= 0.4 ppt. Streamflow - cfs (gage estimate + 0.5 cfs).

			7-June 2014					
	Flume		1601 hr		**Stockton Avenue Bridge**			1535 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	20.7	0.9	8.59	1475	20.3	0.8	9.24	1398
0.25	20.7	0.9	8.44	1479	20.3	0.8	9.16	1408
0.50	20.7	0.9	8.43	1481	20.3	0.8	9.14	1407
0.75	20.7	0.9	8.43 (94%)	1471	30.3	0.8	9.17	1408
0.87b	20.7	0.9	8.16	1476				
1.00					20.2	0.8	9.16	1403
1.25					20.2	0.8	9.08	1412
1.50					20.2	0.8	7.05	1435
1.75					23.4	4.0	0.10	6772
2.00					22.3	14.8	0.59	23133
2.25b					22.5	15.8	2.43	24653
	Railroad Trestle			1517 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	19.7	0.7	9.43	1176	19.8	0.6	8.86	1142
0.25	19.7	0.7	9.35	1177	19.8	0.6	8.84	1142
0.50	19.7	0.7	9.35	1175	19.7	0.6	8.86	1152
0.75	19.6	0.7	9.31	1173	19.5	0.6	8.85	1140
1.00	19.6	0.7	9.30	1173	19.1	0.6	8.54 (93%)	1113
1.25b	19.6	0.7	9.27 (102%)	1171	18.8	0.6	8.34	1104
1.40b	19.7	0.7	9.01	1172				

7 June 2014. Gage height of 2.59 in morning and afternoon. Inlet shroud in place. Top board notched with water flowing over flume inlet to grate on top. However, shroud not functioning because water was flowing over the top of the flume and entering the flume through the grate on top. Biologist requested that the opening be increased to force all water through shroud. Flume inlet depth = 1.5 ft. Outlet depth = 2 ft. Outlet partially closed with boards. Overcast in morning and sunny in afternoon.
Station 1: Flume at 0700 hr- Air temp. 13.4 C. no surface algae. Forgot to count waterfowl. At 1601 hr- Air temp. 15.5 C. No surface algae. Thick phytoplankton bloom underway. 25% of bottom covered with algae 0.2 ft thick. Reach 1- 21 gulls bathing.
Station 2: Stockton Avenue Bridge at 720 hr- No surface algae. Secchi depth to bottom. At 1535 hr- no surface algae, 70% of bottom covered with algae 0.2 ft thick. Reach 2- 1 adult female mallards. Oxygen dropped rapidly below 1.5 meter.
Station 3: Railroad Trestle at 0748 hr- no surface algae. At 1517 hr- no surface algae15% of bottom with algae 0.2 ft thick. Reach 3- , no waterfowl in water.
Station 4: Mouth of Noble Gulch at 1500 hr. 4 mallards and 1 coot roosting on cottonwood.
Bottom invisible due to plankton bloom.
Station 5: Nob Hill at 0830 hr/ 1631 hr- Water temp. =15.3/17.1 C, oxygen= 7.71 (71% saturation/8.95 mg/L, cond. = 715/746 umhos. Salinity =0.4/0.4 ppt.

9 June 2014. City staff and Morrison increased opening through top of shroud into flume inlet.

10 June 2014. Board added on Venetian side of flume inlet to make all water pass through the shroud to reach the flume inlet.

14 June 2014. Water quality performed at Stockton Bridge to see if salinity was dissipating with just one shroud in place. It was reducing slowly with cooler temperature and more oxygen in the salt layer near the bottom.

			14-June 2014					
	Flume				**Stockton Avenue Bridge**			1042 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	0.7	8.14	1223
0.25					20.3	0.7	8.03	1222
0.50					20.3	0.7	8.02	1220
0.75					20.1	0.7	8.10	1210
1.00					20.0	0.7	8.23	1200
1.25					20.0	0.7	8.24	1200
1.50					20.0	0.7	8.38	1198
1.75					20.0	0.7	1.62	1341
2.00					20.9	13.5	3.58	20539
2.25b					20.9	13.4	2.71	20397
	Railroad Trestle				**Mouth of Noble Gulch**			
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				1176				
0.25				1177				
0.50				1175				
0.75				1173				
1.00				1173				
1.25b				1171				
1.40b				1172				

			21-June-2014					
	Flume			0710 hr	**Stockton Avenue Bridge**			0722 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	0.6	8.73	1127	20.3	0.6	9.53	1116
0.25	20.1	0.6	8.85	1140	20.4	0.6	9.62	1153
0.50	20.1	0.6	8.97	1142	20.4	0.6	9.66	1152
0.75b	20.1	0.6	8.95	1142	20.4	0.6	9.71	1155
1.00					20.4	0.6	9.77	1154
1.25					20.4	0.6	9.84	1156
1.50					20.4	0.6	9.80	1159
1.75					20.4	0.6	7.68	1176
2.00b					20.5	0.7	1.66	1313
2.25								
	Railroad Trestle			0740 hr	**Mouth of Noble Gulch**			0800 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	20.1	0.6	10.23	1074	19.8	0.6	10.46	1030
0.25	20.1	0.6	10.24	1082	19.9	0.6	10.51	1040
0.50	20.2	0.6	10.30	1141	19.9	0.6	10.48	1039
0.75	20.2	0.6	10.34	1082	19.9	0.6	10.48	1038
1.00b	20.1	0.6	10.24	1080	19.8	0.6	10.47 (114%)	1035
1.15b					19.5	0.6	9.17	1026
1.25	20.1	0.6	10.28	1079				
1.40b	20.1	0.6	9.22	1081				

21 June 2014. Water temperature was warmer than usual for this time of year (similar to last year in the afternoon), with afternoon water temperature above 21 C near the bottom in the afternoon, even though salinity was nearly absent under the Stockton Bridge and cloudy afternoon conditions. Oxygen levels were good. Lagoon depth remained good.

21 June 2014. Gage height of 2.40 in morning. Fogbank offshore, clear over lagoon at 0710 hr. Air temperature of 13.3^{o}C at 0710 hr.

Station 1: Flume 0710 hr. Reach 1- 9 gulls bathing, 6 mergansers fishing, 6 mallards roosting on Venetian margin. No surface algae.

Station 2: Stockton Bridge 0722 hr. Reach 2 5 adult mallards (3 from Venetian margin), 6 ducklings using overhanging willow as cover, 1 merganser from Reach 1; no surface algae.

Station 3: Railroad trestle 0740 hr. Reach 3- 7 mallards (2 from Venetian margin), 1 mallard roosting on Golino wood. Female mallard with 6 ducklings moved up from Reach 1 and fought off a gull.

Station 4: Noble Gulch 0800 hr. No waterfowl on cottonwood. No surface algae.

Station 5: Nob Hill at 0829 hr. Water temperature 15.7^{o}C. Conductivity 694 umhos. Salinity 0.4 ppt. Oxygen 9.27 mg/l (94% saturation). - less than 1.5 cfs

			21 June 2014					
	Flume			1617 hr	**Stockton Avenue Bridge**			1555 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.4	0.6	11.14	1168	21.4	0.6	11.72	1162
0.25	21.5	0.6	11.25	1172	21.6	0.6	11.26	1167
0.50	21.5	0.6	11.39 (125%)	1173	21.5	0.6	11.27	1169
0.70b	21.4	0.6	11.28	1159				
0.75					21.4	0.6	11.08	1172
1.00					21.3	0.6	11.08	1168
1.25					21.3	0.6	11.19	1160
1.50					21.2	0.6	10.76	1155
1.75					21.0	0.6	7.72 (86%)	1166
2.00b					20.8	1.5	0.26	2630
2.25								
	Railroad Trestle			1539 hr	**Mouth of Noble Gulch**			1516 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.5	0.6	10.80	1144	21.6	0.6	10.26	1114
0.25	21.5	0.6	10.96	1143	21.6	0.6	10.24	1119
0.50	21.5	0.6	11.02	1142	21.6	0.6	10.33	1118
0.75	21.4	0.6	11.34	1124	21.1	0.6	10.31	1096
1.00	21.3	0.6	11.34	1103	20.5	0.6	10.29 (115%)	1043
1.15b					20.4	0.6	9.54	1072
1.25	21.3	0.6	10.91 (123%)	1104				
1.40b	21.1	0.6	9.02	1120				

21 June 2014. Gage height of 2.36 in afternoon. Cloudy. Air temperature of 16.5^{o}C at 1617 hr. Flume inlet = 1.5 ft. Flume outlet = 0.1 ft over outlet boards

Station 1: Flume 1617 hr. Reach 1- 74 gulls bathing. Cannot see bottom due to darkness on a cloudy day. Less than 1% surface algae.

Station 2: Stockton Bridge 1555 hr. Reach 2- thick phytoplankton bloom- green soup; no surface algae, no waterfowl.

Station 3: Railroad trestle 1539 hr. Reach 3- 1 female mallard with 4 ducklings; one other mallard, 4 mergansers (2 near trestle and 2 near Noble Gulch). No surface algae.

Station 4: Noble Gulch 1516 hr. 1 mallard on cottonwood. Bottom invisible. No surface algae.

Station 5: Nob Hill at 1650 hr. Water temperature 17.2^{o}C. Conductivity 726 umhos. Salinity 0.4 ppt. Oxygen 9.61 mg/l.

			6 July 2014					
	Flume 0716 hr				**Stockton Avenue Bridge** 0731hr			
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	20.9	0.6	7.47	1171	21.4	0.6	7.98	1175
0.25	21.0	0.6	7.35	1174	21.5	0.6	7.46	1182
0.50	21.0	0.6	7.42	1173	21.5	0.6	7.88	1183
0.75	21.0	0.6	7.36	1172	21.5	0.6	7.40	1183
0.80b	21.0	0.6	7.20	1177				
1.00					21.5	0.6	7.77	1184
1.25					21.4	0.6	7.72	1184
1.50					21.4	0.6	7.46	1185
1.75					21.4	0.6	7.12 (81%)	1185
2.00b					21.5	0.6	1.46	1186
2.20								
	Railroad Trestle 0750hr				**Mouth of Noble Gulch**			0802hr
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	21.3	0.6	8.60	1165	20.7	0.6	9.87	1120
0.25	21.4	0.6	8.57	1165	20.7	0.6	9.86	1132
0.50	21.4	0.6	8.60	1168	20.7	0.6	10.15	1129
0.75	32.4	0.6	8.58	1169	20.6	0.6	10.07	1124
1.00	21.4	0.6	8.51	1168	20.6	0.6	9.99 (111%)	1176
1.25	21.4	0.6	8.50 (92%)	1168	20.5	0.7	8.59	1284
1.50b	21.4	0.6	7.55	1168				

6 July 2014. Gage height of 2.39 in morning. Foggy. Air temp. = 13.3° C at 0716 hr.
Station 1: Flume 0716 hr. Reach 1- 2 female mallards with 3 ducklings without mother, 3 mallards, 1 pied-billed grebe; 10 mallards and 2 mergansers roosting on Venetian margin. 15 gulls bathing. No surface algae.
Station 2: Stockton Bridge 0731 hr. Reach 2- 2 mallards under trestle, ducklings moved up from Reach 1, one other mallard and 1 merganser.
Station 3: Railroad trestle 0750 hr. Reach 3- 1 female mallard and 5 ducklings, 6 mallards from Venetian margin; 2 merganser and 1 mallard on Golino wood. No surface algae.
Station 4: Noble Gulch 0802 hr. 2 mallards on cottonwood. No surface algae.
Station 5: Nob Hill at 0828 hr. Water temperature 15.6° C. Conductivity 690 umhos. Salinity 0.4 ppt. Oxygen 8.07 mg/l (81% saturation). 0.14 cfs estimate based on 0.5 cfs at the gage.

			6 July 2014					
	Flume			1604 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	22.9	0.6	11.44	1208	23.0	0.6	12.16	1209
0.25	22.9	0.6	11.73	1212	23.0	0.6	12.17	1211
0.50	22.9	0.6	11.94	1212	22.9	0.6	12.07	1211
0.75	22.8	0.6	12.47 (147%)	1207	22.8	0.6	11.97	1207
0.80b	22.8	0.6	12.20	1177				
1.00					22.8	0.6	11.71	1205
1.25					22.7	0.6	11.30	1205
1.50					22.5	0.6	10.26	1205
1.75					22.5	0.6	8.43 (98%)	1204
2.00b					22.1	0.7	1.69	1330
2.25								
	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	23.1	0.6	11.59	1208	23.2	0.6	11.85	1228
0.25	23.0	0.6	12.01	1207	23.1	0.6	11.75	1203
0.50	23.0	0.6	12.33	1204	22.9	0.6	11.78	1197
0.75	22.9	0.6	12.29	1202	22.1	0.6	14.32	1183
1.00	22.6	0.6	13.36	1193	21.5	0.6	12.64	1175
1.20b					218	0.7	14.80	1434
1.25	22.2	0.6	12.86 (146%)	1182				
1.35b	21.9	0.6	9.71	1175				
1.50								

6 July 2014. Gage height of 2.37 in afternoon. Sunny and warm. Air temperature of 18.0^{o}C at 1604 hr. Flume inlet approx. 2.0 ft depth. Flume exit depth 0.4 ft over outlet boards.
Station 1: Flume at 1604 hr. Reach 1- Bottom 60% covered with algae 0.4- 1.5 ft thick; avg 1.0 ft. 36 gulls bathing. No surface algae.
Station 2: Stockton Avenue Bridge at 1546 hr. Secchi depth to bottom. Reach- No surface algae, 100% of bottom covered with algae, 0.4- 2.0 ft thick, averaging 1.0 ft. 1 merganser.
Station 3: Railroad Trestle at 1520 hr. Reach 3- 2% surface algae, 100% of bottom covered with algae. 0.3- 3.0 ft thick, averaging 1.0 ft. 1 female mallard and 3 ducklings; 2 female mallard and 6 ducklings, 5 other mallards.
Station 4: Mouth of Noble Gulch at 1500 hr. 1 mallard on downed cottonwood. Bottom 40% covered with algae 0.5- 1.75 ft thick, averaging 0.8 ft.
Station 5: Nob Hill at 1650 hr. Water temperature 17.5^{o}C. Conductivity 712 umhos. Salinity 0.4 ppt. Oxygen 8.83 mg/l (93%).

			20-July-14					
	Flume 0654 hr				**Stockton Avenue Bridge** 0710 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	22.8	0.6	13.96	1137	23.0	0.6	12.72	1136
0.25	22.9	0.6	14.02	1144	23.0	0.6	12.82	1151
0.50	22.9	0.6	13.45	1142	23.0	0.6	12.92	152
0.75	22.8	0.6	14.26	1140	23.0	0.6	13.01(152%)	1153
0.80b	22.8	0.6	14.23	1139				
1.00					23.0	0.6	12.98	1157
1.25					23.0	0.6	13.06	1154
1.50					23.0	0.6	13.08	1153
1.75					23.0	0.6	12.30	1157
2.00b					23.0	0.6	6.03	1192
2.25								
			20-July-14					
	Railroad Trestle 0732 hr				**Mouth of Noble Gulch**			0748 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	22.8	0.6	14.69	1100	22.2	0.6	13.02	
0.25	22.9	0.6	15.27	1103	22.2	0.6	13.17	
0.50	22.9	0.6	15.48	1103	22.2	0.6	13.33	
0.75	22.9	0.6	15.58	1103	22.2	0.6	13.46 (155%)	
1.00	22.9	0.6	15.70	1103	21.8	0.6	12.94	
1.25b	22.9	0.6	15.69 (183%)	1103	22.6	0.8	9.48 (110%)	
1.40b	22.8	0.6	10.18	1104				

20 July 2013. Gage height of 2.55 in morning. Partly cloudy and warm. Air temperature of 17.2°C at 0654 hr.

Station 1: Flume at 0654 hr. Reach 1- 22gulls bathing, 6 mergansers, 4 mallard ducklings unattended; 1 female mallard with 4 ducklings; 1 merganser roosting on Venetian margin. 30% surface algae.

Station 2: Stockton Avenue Bridge at 0710 hr. Secchi depth to bottom. Reach 2- 4 mallards near trestle. 1 mallard on abutment. 25% surface algae.

Station 3: Railroad Trestle at 0732 hr. Reach 3- 18 mallards and 1 coot in water with 1 female mallard with 6 ducklings. 30% surface algae.

Station 4: Mouth of Noble Gulch at 0748 hr. 3 mallards on redwood stump near cottonwood. 40% surface algae.

Station 5: Nob Hill at 0815 hr. Water temperature 17.7° C. Conductivity 712 umhos. Oxygen 6.90 mg/l (73% saturation). Salinity 0.4 ppt. Estimated streamflow = 0.23 cfs based on gage.

			20-July-14					
	Flume 1615 hr				**Stockton Avenue Bridge** 1554 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	27.7	0.6	15.41	1209	24.7	0.6	13.75	1171
0.25	27.4	0.6	16.46	1199	24.6	0.6	14.28	1174
0.50	25.5	0.6	16.35	1200	24.5	0.6	14.41	1171
0.75	24.4	0.6	15.15 (183%)	1172	24.4	0.6	15.32	1168
0.80b	23.4	0.6	15.09	1164				
1.00					24.3	0.6	15.04	1164
1.25					24.1	0.6	15.06	1162
1.50					23.9	0.6	15.16	1161
1.75					23.7	0.6	14.46 (172%)	1153
1.95b					23.6	0.6	12.98	1160
2.00								
			20-July-14					
	Railroad Trestle 1540 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	24.6	0.6	16.36	1138	25.8	0.6	12.53	0.6
0.25	24.6	0.6	16.89	1136	25.4	0.6	13.38	0.6
0.50	24.6	0.6	17.25	1135	24.0	0.6	13.59	0.6
0.75	24.4	0.6	17.43	1130	23.5	0.6	13.56	0.6
1.00	24.3	0.6	17.47	1128	22.5	0.6	12.90 (149%)	0.6
1.20b					23.0	0.7	18.81	0.7
1.25	23.4	0.6	16.97 (200%)	1117				
1.40b	22.9	0.6	16.13	1109				

20 July 2014. Gage height of 2.49 in afternoon. Sunny and warm Air temp. = 21.8^{o}C at 1615 hr.
Station 1: Flume at 1615 hr. Reach 1- 26 gulls. 2 female mallards with 8 ducklings. 50% surface algae. Bottom 100% coverage of algae 1- 5 ft thick; average of 3.5ft.
Station 2: Stockton Avenue Bridge at 1554 hr. Secchi depth to bottom. Reach 2- 30% surface algae. 99% of the bottom algae 2 – 4 ft thick, averaging 3.0 ft; 1% pondweed and algae attached under trestle- 3 ft thick. 1 merganser from redwood stump in Reach 3.
Station 3: Railroad Trestle at 1540 hr. Reach 3- 40% surface algae. Bottom 100% covered with algae 2 – 5 ft thick; average 3 ft. 18 mallards plus 1 female mallard with 4 ducklings in water.
Station 4: Mouth of Noble Gulch at 1500 hr. 60% of the bottom algae 1 – 3.5 ft thick, averaging 3 ft. 50% surface algae. 1 coot and 2 mergansers on redwood stump adj. cottonwood.
Station 5: Nob Hill at 1651 hr. Water temperature 19.6 ^{o}C. Conductivity 744 umhos. Oxygen 7.65 mg/l (84% saturation). Salinity 0.4 ppt. visual flow estimate of 0.2 − 0.3 cfs.

			3-Aug-14					
	Flume 0658 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	22.5	0.6	9.54	1140	22.8	0.6	10.65	1135
0.25	22.5	0.6	9.62	1142	22.8	0.6	10.67	1148
0.50	22.6	0.6	9.66	1141	22.8	0.6	10.69	1149
0.75	22.6	0.6	9.70 (112)	1141	22.8	0.6	10.73	1150
0.87b	22.6	0.6	7.13	1141				
1.00					22.9	0.6	10.67	1150
1.25					22.8	0.6	10.64	1150
1.50					22.8	0.6	10.25	1150
1.75					22.8	0.6	9.89 (117)	1152
1.95b					22.8	0.6	6.10	1157
2.00								
			3-Aug-14					
	Railroad Trestle 0730 hr				**Mouth of Noble Gulch** 0744 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	22.8	0.6	10.21		22.3	0.6	11.42	1161
0.25	22.8	0.6	10.27		22.3	0.6	11.83	1162
0.50	22.8	0.6	10.28		22.3	0.6	11.84	1166
0.75	22.8	0.6	10.30		22.3	0.6	11.83	1166
1.00	22.8	0.6	10.24		22.1	0.6	11.21 (129)	1136
1.20b					22.2	0.6	5.16	1127
1.25	22.8	0.6	10.17 (115)					
1.45b	22.8	0.6	4.58					
1.50								

3 August 2014. Gage height of 2.57 (morning) and 2.57 (afternoon). Overcast/ misty at 0658 hr with air temperature of 16.5 ^{o}C. Air temperature 19.3º C at 1556 hr and sunny with thin cirrus clouds/breezy. Flume inlet 3.0+ ft. Flume outlet closed in afternoon.
Station 1: Flume at 0658 hr. Reach 1- 23 gulls bathing, 7 adult mallards and 6 ducklings in water, 1 merganser. No surface algae.
Station 2: Stockton Avenue Bridge at 0714 hr. Secchi depth to the bottom. Reach 2-7 mallards; 3% surface algae.
Station 3: Railroad trestle at 0730 hr. Reach 3- 6 mallards in water. 7% surface algae.
Station 4: Mouth of Noble Gulch at 0744 hr. No surface algae. 3 mallards on redwood stump.
Station 5: Nob Hill at 0811 hr. Water temperature at 17.1°C. Conductivity 715 umhos, Oxygen 5.90 mg/l (61% saturation). Salinity 0.4 ppt. Estimated streamflow = 0.1−0.2 cfs. (0.42 cfs at gage)

1556 hr			3-Aug-14					1531 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	23.7	0.6	12.75	1163	23.3	0.6	10.64	1161
0.25	23.5	0.6	12.48	1158	23.4	0.6	10.54	1166
0.50	23.4	0.6	12.28	1157	23.4	0.6	10.59	1166
0.75	23.4	0.6	12.57 (148)	1156	23.3	0.6	10.58	1162
0.87b	23.5	0.6	12.84	1156				
1.00					23.3	0.6	10.74	1162
1.25					23.2	0.6	10.78	1160
1.50					23.1	0.6	10.76	1159
1.75					23.1	0.6	10.79 (167)	1159
1.95b					23.2	0.6	9.52	1159
2.00								
1518hr			3-Aug-14					1500 hr
	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	23.5	0.6	13.18	1161	23.4	0.6	12.72	1212
0.25	23.5	0.6	13.29	1162	23.1	0.6	13.33	1205
0.50	23.4	0.6	13.47	1161	23.0	0.6	12.74	1203
0.75	23.3	0.6	15.06	1160	22.7	0.6	13.21	1202
1.00	23.0	0.6	14.61	1153	22.6	0.6	12.40 (144)	1195
1.20b					23.2	0.9	16.11	1612
1.25	22.9	0.6	14.18 (166)	1152				
1.45b	23.0	0.6	2.63	1174				

Station 1: Flume at 1556 hr. Reach 1- 55 gulls. 2 mother mallards and 9 ducklings. 15% surface algae. 95% bottom algal coverage- 0.5- 5 ft thick, avg. = 2.5 ft. Margaritaville and Stockton Bridge Grille customers feeding ducks. Observed 10 times in 10 minutes.
Station 2: Stockton Avenue Bridge at 1531 hr. Secchi depth to the bottom. Reach 2- 2% surface algae. 70% of bottom covered by algae 0.5 – 2 ft thick, averaging 1.0 ft. 30% of the bottom pondweed + algae 1-4 ft thick, averaging 2.5 ft. No waterfowl.
Station 3: Railroad trestle at 1518 hr. Reach 3- 7% surface algae. 70% of bottom covered by algae 0.5-2 ft thick, averaging 1.0 ft. 30% pondweed + algae 1-4 ft thick, averaging 3 ft. Reach 3- 3 mallards in water.
Station 4: Mouth of Noble Gulch at 1500 hr. 10% surface algae. 100% of bottom covered by algae 0.3 – 3.0 ft thick, averaging 0.7 ft. 4 mallards and 1 coot on redwood stump. 4 mallards on Arthurs' dock; 7 mallards on lower dock. 1 great blue heron in trees across from Noble Gulch.
Station 5: Nob Hill at 1630 hr. Water temperature at 18.4°C. Conductivity 730 umhos, Oxygen 7.52 mg/l) (80% full saturation). Salinity 0.4 ppt.

			16-Aug-14					
	Flume 0702 hr				**Stockton Avenue Bridge** 0716 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.2	0.6	8.32	1196	22.5	0.6	8.68	1188
0.25	22.3	0.6	8.37	1196	22.6	0.6	8.76	1199
0.50	22.4	0.6	8.46	1196	22.6	0.6	8.83	1199
0.75	22.4	0.6	8.43 (98)	1196	22.6	0.6	8.69	1199
0.95b	22.4	0.6	7.67	1198				
1.00					22.6	0.6	8.72	1199
1.25					22.6	0.6	8.73	1199
1.50					22.6	0.6	8.77	1199
1.75					22.6	0.6	8.73 (101)	1199
2.00b					22.7	0.7	1.25	1243
2.25								
			16-Aug-14					
	Railroad Trestle 0735 hr				**Mouth of Noble Gulch** 0754 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	22.6	0.6	10.14	1180	22.2	0.6	13.91	1194
0.25	22.6	0.6	10.20	1187	22.2	0.6	14.06	1206
0.50	22.6	0.6	10.14	1188	22.2	0.6	14.12	1207
0.75	22.6	0.6	10.14	1188	22.2	0.6	14.17	1208
1.00	22.6	0.6	10.13	1188	22.2	0.6	13.95 (161)	1211
1.15b					22.6	0.9	5.35	1624
1.25	22.6	0.6	10.10 (117)	1188				
1.50b	22.7	0.6	5.03	1195				

16 August 2014. Gage height of 2.59 (morning) and 2.57 (afternoon). Overcast at 0702 hr with air temperature of 15.3 °C. Air temperature 19.3° C at 1613 hr and clear. Flume inlet 3.0 ft. Water trickling out of flume outlet in afternoon.

Station 1: Flume at 0702 hr. Reach 1- 17 gulls bathing. 7% surface algae- nearly all in Margaritaville cover.

Station 2: Stockton Avenue Bridge at 0716 hr. Reach 2- 7 mallards. 5% surface algae.

Station 3: Railroad trestle at 0735 hr. Reach 3- 14 mallards in water (4 adolescent). 1 merganser. 1 coot. 5% surface algae.

Station 4: Mouth of Noble Gulch at 0754 hr. 2% surface algae. No waterfowl.

Station 5: Nob Hill at 0823 hr. Water temperature at 16.8°C. Conductivity 703 umhos, Oxygen 6.48 mg/l. Salinity 0.4 ppt. Estimated streamflow = approx 0.2−0.3 cfs visual estimate. (0.36 cfs at gage)

1613 hr			16-Aug-14					1548 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	24.2	0.6	13.43	1229	24.0	0.6	10.10	1225
0.25	24.2	0.6	13.35	1230	24.0	0.6	10.11	1233
0.50	24.2	0.6	13.44	1230	23.8	0.6	9.79	1228
0.75	24.2	0.6	13.42 (161)	1229	23.7	0.6	9.85	1225
0.90b	24.2	0.6	14.10	1231				
1.00					23.7	0.6	9.89	1225
1.25					23.6	0.6	9.83	1223
1.50					23.6	0.6	9.75	1222
1.75					23.4	0.6	9.32 (110)	1221
2.00b					23.3	0.6	7.50	1225
2.25								
1533hr			14-Aug-14					1508 hr
	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	24.2	0.6	16.75	1221	24.5	0.6	15.08	1275
0.25	24.2	0.6	16.91	1220	24.3	0.6	15.84	1272
0.50	24.1	0.6	16.70	1217	24.1	0.6	15.40	1269
0.75	23.8	0.6	16.41	1212	23.5	0.6	15.59	1251
1.00	23.5	0.6	15.35	1204	23.1	0.7	14.85 (174)	1284
1.25b	23.0	0.6	12.97 (152)	1195	24.2	0.8	24.02 (178)	1412
1.45b	22.9	0.6	7.32	1199				

Station 1: Flume at 1613 hr. Reach 1- 106 gulls. 5 young mallards being fed at Margaritaville restaurants. 1 merganser. 10% surface algae mostly in cove. 95% bottom algal coverage 2 − 5 ft thick, avg. = 3 ft. 5% pondweed + algae 5 ft thick.
Station 2: Stockton Avenue Bridge at 1548 hr. Secchi depth to the bottom. Reach 2- 2% surface algae. 60% of bottom covered by algae 1 – 3 ft thick, averaging 1.5 ft. 40% pondweed + algae 1 – 4 ft thick; averaging 3 ft. 8 mallards; 1 gull.
Station 3: Railroad trestle at 1533 hr. Reach 3- 3% surface algae. 25% of bottom covered by algae 1 - 3 ft thick, averaging 1.5 ft. 75% pondweed + algae 2.0 – 4 ft thick, averaging 3 ft. 15 mallards in water. 1 merganser.
Station 4: Mouth of Noble Gulch at 1508 hr. No surface algae. Bottom invisible. 3 mallards on redwood stump; 1 mallard on cottonwood. 5 mallards roosting on dock and boulders on west side (4 adolescents).
Station 5: Nob Hill at 1705 hr. Water temperature at 18.6°C. Conductivity 725 umhos, Oxygen 6.95 mg/l (75% saturation). Salinity 0.4 ppt.

			31-Aug-31					
	Flume 0705 hr				**Stockton Avenue Bridge** 0717 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	21.8	0.6	8.48	1208	22.3	0.6	8.46	1205
0.25	21.9	0.6	8.53	1210	22.3	0.6	8.49	1219
0.50	21.9	0.6	8.58	1211	22.3	0.6	8.49	1220
0.75	21.9	0.6	8.22 (94)	1211	22.3	0.6	8.39	1221
0.80b	21.1	0.6	6.52	1212				
1.00					22.3	0.6	8.36	1221
1.25					22.3	0.6	8.30	1221
1.50					22.3	0.6	8.33	1221
1.75					22.3	0.6	7.90 (91)	1223
2.00b					22.3	0.6	3.16	1242
2.25								
			31-Aug-14					
	Railroad Trestle 0740 hr				**Mouth of Noble Gulch** 0758 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	22.2	0.6	9.83	1208	21.8	0.7	13.26	1231
0.25	22.2	0.6	9.81	1209	21.9	0.7	13.30	1234
0.50	22.3	0.6	9.81	1210	21.9	0.7	13.24	1233
0.75	22.2	0.6	9.77	1209	21.9	0.7	13.33	1235
1.00	22.2	0.6	9.74	1210	21.9	0.7	13.27	1236
1.25	22.2	0.6	9.71 (112)	1210	21.9	0.7	13.00 (149)	1248
1.37b					22.1	0.7	6.85	1403
1.45b	22.2	0.6	8.08	1210				

31 August 2014. Begonia Festival Day. Gage height of 2.57 (morning) and 2.55 (afternoon). Overcast. At 0705 hr- air temperature of 15.1 °C. Air temperature 21.2º C at 1603 hr and clear. Water trickling out of flume exit in afternoon.

Station 1: Flume at 0705 hr. Reach 1- 54 gulls. 4 mallards in water, 3 mallards along Venetian periphery. Tern hit surface. 7% surface algae.

Station 2: Stockton Avenue Bridge at 0717 hr. Secchi depth to the bottom. Reach 2-1 mallard in water. 4 mallards on trestle abutment. Bottom algae 70% coverage 1 – 3 ft. thick, avg. 2.0. Pondweed + algae 30% coverage 2 – 4 ft. thick, 3 ft average. 5% surface pondweed fragments + algae.

Station 3: Railroad trestle at 0740 hr. Reach 3- 20 mallards in water. Surface algae + pondweed fragments 15%.

Station 4: Mouth of Noble Gulch at 0758 hr. 8 mallards on cottonwood. 2 mallards + 2 coots on Golino wood. 30% bottom algae 0.5 – 4 ft thick, averaging 2 ft. 70% pondweed + algae 2 – 5 ft thick, averaging 3.5 ft.

Station 5: Nob Hill at 0825 hr. Water temperature at 16.8°C. Conductivity 715 umhos, Oxygen 5.39 mg/l (56 % saturated). Salinity 0.4 ppt. Estimated streamflow = 0.1 cfs visual estimate. (0.36 cfs at gage.)

1603 hr			31-Aug-14					1541 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	23.7	0.6	13.04	1244	23.7	0.6	11.15	1247
0.25	23.6	0.6	13.10	1244	23.7	0.6	11.21	1230
0.50	23.6	0.6	13.41	1242	23.6	0.6	10.98	1249
0.75	23.6	0.6	13.78 (161)	1240	23.6	0.6	10.78	1248
0.83b	23.6	0.6	12.52	1241				
1.00					23.4	0.6	10.64	1244
1.25					23.3	0.6	10.22	1242
1.50					23.2	0.6	10.05	1240
1.75					23.1	0.6	9.81 (115)	1238
2.00b					23.0	0.6	1.98	1324
2.25								
1522 hr			31-Aug-14					1508 hr
	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	23.8	0.6	14.54	1243	24.2	0.7	16.17	1311
0.25	23.8	0.6	14.44	1243	24.2	0.7	16.41	1311
0.50	23.8	0.6	14.89	1243	24.2	0.7	16.76	1311
0.75	23.8	0.6	14.68	1242	23.6	0.7	16.01	1301
1.00	23.5	0.6	14.84	1238	23.1	0.7	15.31 (178)	1298
1.20b					23.1	0.9	18.74	1675
1.25	22.7	0.6	12.14 (140)	1217				
1.50b	22.6	0.6	4.14	1216				

Station 1: Flume at 1603 hr. Reach 1- 72 gulls. 7% surface algae. 85% bottom algal coverage at 1 - 3 ft thick, avg. = 2 ft. 15% pondweed + algae at 3 - 5 ft thick; averaging 4 ft.
Station 2: Stockton Avenue Bridge at 1541 hr. Secchi depth to the bottom. Reach 2- 10% surface algae and pondweed fragments. No waterfowl.
Station 3: Railroad trestle at 1522 hr. Reach 3- 10% surface algae and pondweed fragments. 15 mallards upstream of Noble Gulch confluence.
Station 4: Mouth of Noble Gulch at 1508 hr. 5% surface algae. Bottom invisible due to algal bloom.
Station 5: Nob Hill at 1640 hr. Water temperature at 19.4°C. Conductivity 753 umhos, Oxygen 6.12 mg/l (67% saturated). Salinity 0.4 ppt. Streamflow approx. 0.15 cfs.
There were 8 floats, 27 other boats, kayaks and paddle boarders unrelated to floats. 5 floats were electric motor-powered. 1 float was kayak powered. 1 float was powered by surf board paddlers. 1 float powered by row boat and then motor. 1 surf-boarder fell off. More begonias in water than usual, collecting on floating pondweed.

			13-Sep-14					
	Flume			0737hr	**Stockton Avenue Bridge**			0759 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.7	0.7	10.32	1219	20.8	0.7	11.09	1217
0.25	20.7	0.7	10.43	1222	20.8	0.7	11.07	1222
0.50	20.7	0.7	10.47	1222	20.9	0.7	11.12	1223
0.75	20.7	0.7	10.53 (118)	1221	20.9	0.7	11.16	1223
0.87b	20.7	0.7	8.65	1222				
1.00					20.9	0.7	11.19	1223
1.25					20.9	0.7	11.21	1223
1.50					20.9	0.7	11.17	1223
1.75					20.9	0.7	11.09 (125)	1224
2.00b					20.9	0.7	6.61	1225
2.25								
	Railroad Trestle			0817 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	20.8	0.7	10.84	1208	20.3	0.6	14.02	1162
0.25	20.8	0.7	10.92	1212	20.3	0.6	14.14	1162
0.50	20.8	0.7	10.81	1212	20.3	0.6	14.18	1162
0.75	20.8	0.7	10.99	1212	20.3	0.6	13.94	1166
1.00	20.8	0.7	11.08	1211	20.5	0.6	12.24 (136)	1255
1.20b					20.9	0.9	7.23	1547
1.25	20.8	0.7	11.22 (125)	1211				
1.30b	20.8	0.7	9.51	1211				

13 September 2014. Gage height of 2.61 (morning) and 2.59 (afternoon). Overcast in morning and high cirrus clouds in afternoon. Air temperature of 15.2˚ C at 0737 hr and 20.0º C at 1625 hr. Flume exit closed in afternoon.

Station 1: Flume at 0737 hr- Reach 1- 11 gulls bathing, 7 mallard. 1 pied-billed grebe. 3 snowy egrets at flume. 7% surface algae in Margaritaville cove, as previous times. Flume at 1608 hr- Reach 1- 50+ gulls bathing before paddle boarder disturbed them, 1 pied-billed grebe, 5 mallards on Venetian beach. 8% surface algae. 20% pondweed + algae; averaging 4.0 ft thick. Could not see to bottom due to reflection- could not estimate bottom algae.

Station 2: Stockton Avenue Bridge at 0759 hr- Reach 2- 9 mallards, 1 coot. 2% surface algae. Reach 2 at 1542 hr- . Secchi depth to bottom. 4 mallards, 1 pied billed grebe from Reach 1. 10% surface algae. 60% of bottom covered with algae, averaging 1ft thick. 40% pondweed + algae 3 - 4 ft thick, averaging 3.5 ft.

Station 3: Railroad trestle at 0817 hr- Reach 3- 19 mallards dabbling, 2 coots, 1 black crowned night heron. 20% surface algae and pondweed fragments. At 1520 hr- 15 mallards in water. 15% surface algae and pondweed fragments. 20% of bottom covered with algae 1 ft thick. 80% pondweed + algae 3- 4 ft thick, averaging 3.5 ft.

Station 4: Mouth of Noble Gulch at 0830 hr- 1 mallard on redwood stump. 5% surface algae. At 1504 hr- 7 mallards on redwood stump near cottonwood. 2% surface algae. 20% pondweed + algae coverage 3 ft thick.

Station 5: Nob Hill at 0858 hr. Water temperature at 16.3°C. Conductivity 697 umhos, Oxygen 7.51

mg/l (77% saturation). Salinity 0.4 ppt. Nob Hill at 1646 hr. Water temperature 18.0° C. Oxygen 8.03 mg/l. Conductivity 721 umhos. Salinity 0.4 ppt. Streamflow estimate- 0.1 cfs visual estimate. (0.57 cfs at gage.)

			13-Sep-14					
	Flume			1608 hr	**Stockton Avenue Bridge**			1552 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.0	0.7	13.76	1246	22.2	0.7	12.12	1254
0.25	22.0	0.7	13.88	1245	22.1	0.7	11.96	1251
0.50	22.0	0.7	14.46	1242	22.0	0.7	11.59	1250
0.75	21.9	0.7	13.97 (160)	1241	21.9	0.7	11.25	1247
0.87b	21.5	0.7	11.42	1241				
1.0					21.8	0.7	10.86	1245
1.25					21.6	0.7	10.49	1240
1.50					21.5	0.7	10.42	1237
1.75					21.4	0.7	10.65 (120)	1235
2.00b					21.4	0.7	7.43	1230
2.25								
			13-Sep-14					
	Railroad Trestle			1520hr	**Mouth of Noble Gulch**			1504hr
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	22.8	0.7	12.45	1258	22.9	0.6	15.89	1220
0.25	22.6	0.7	12.45	1257	22.4	0.6	15.08	1189
0.50	22.2	0.7	13.53	1242	21.8	0.6	13.74	1178
0.75	22.0	0.7	13.97	1229	21.2	0.6	13.74	1157
1.00	21.4	0.7	13.60	1213	20.8	0.6	12.51 (139)	1136
1.13b					21.0	0.7	12.78	1323
1.25	21.1	0.7	11.53 (130)	1206				
1.30b	21.1	0.7	10.94	1206				

			28-Sep-14					
	Flume			0713 hr	**Stockton Avenue Bridge**			0732 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	20.2	0.5	3.74	901	20.5	0.5	2.60	895
0.25	20.3	0.5	3.65	902	20.5	0.5	2.56	902
0.50	20.3	0.5	3.63	902	20.5	0.5	2.53	903
0.75b	20.3	0.5	3.34	902	20.5	0.5	2.50	903
1.00					20.5	0.5	2.53	903
1.25					20.5	0.5	2.52	902
1.50					20.5	0.5	2.50	902
1.75					20.5	0.5	2.49	902
2.00b					20.5	0.5	1.14	909
2.25								
			28-Sep-14					
	Railroad Trestle			0747 hr	**Mouth of Noble Gulch**			0802 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	20.2	0.4	2.06	822	19.6	0.4	2.82	669
0.25	20.2	0.4	2.03	823	19.6	0.4	2.84	669
0.50	20.2	0.4	2.01	824	19.6	0.4	3.09	669
0.75	20.2	0.4	1.94	822	19.5	0.4	2.59	669
1.00	20.2	0.4	1.94	822	19.3	0.4	0.17 (1.8)	664
1.10b					19.3	0.4	0.08	705
1.25	20.3	0.5	0.18 (1.6%)	832				
1.35b	20.6	0.7	0	1241				

28 September 2014. Gage height of 2.59 (morning) and 2.08 (afternoon). Three inlet flashboards removed during day. Overcast in morning and cloudy/breezy in afternoon. Air temperature of 15.6˚ C at 0713 hr and 18.2 ºC at 1602 hr. Flume inlet 3+ ft and flume exit 2+ ft in afternoon. Notch cut in beach, slightly away from flume at slight angle. Inner berm near lagoon and outer berm near surf. **It had rained on 26 September.**

Station 1: Flume at 0732 hr- Reach 1- 15 gulls bathing, 4 mallards. 1 snowy egret along Venetian Court margin. 10% surface algae and pondweed fragments accumulating mostly adjacent Margaritaville. Flume at 1602 hr- Reach 1- 78 gulls bathing. 10% surface algae and pondweed fragments. Bottom invisible.

Station 2: Stockton Avenue Bridge at 0732 hr- Reach 2- 9 mallards and 1 coot in water, 2 black crowned night herons on overhanging willow branches. Stickleback near the water surface. 10% surface algae and pondweed fragments. Secchi depth 3.4 ft and bottom 5.5 ft under bridge in the morning. Reach 2 at 1541 hr- Secchi depth 3.5 ft and bottom 5.3 ft under bridge in the afternoon. 6 mallards, 1 coot, 1 gull. 5% surface algae and pondweed fragments. Bottom invisible.

Station 3: Railroad trestle at 0747 hr- Reach 3- 19 mallards dabbling, 5 coots, 2 pied-billed grebes, 1 cormorant. 20% surface algae and pondweed fragments. At 1523 hr- Reach 3- 6 mallard, 8 coots, 2 pied-billed grebes, 1 cormorant (captured a steelhead and a sculpin) in water. 15% surface algae and pondweed fragments. Bottom invisible.

Station 4: Mouth of Noble Gulch at 0802 hr- 1 black-crowned night heron on Golino wood, 5 mallards on redwood stump. At 1500 hr- 7 mallards on cottonwood, 1 snowy egret on adjacent emergent wood.

Bottom invisible. 10% surface algae.
Station 5: Nob Hill at 0844 hr- Water temperature at 16.7°C. Conductivity 662 umhos, Oxygen 6.62 mg/l (64% saturation). Salinity 0.4 ppt. Nob Hill at 1640 hr- Water temperature 17.8˚C. Oxygen 7.37 mg/l. Conductivity 652 umhos. Salinity 0.4 ppt. Streamflow estimate- 0.4 cfs visual estimate. (0.36 cfs at gage.)

			28-Sep-14					
	Flume			1602 hr	**Stockton Avenue Bridge**			1541 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.8	0.5	4.86	859	21.2	0.5	4.19	892
0.25	20.8	0.5	3.87	860	21.2	0.5	4.08	895
0.50	20.7	0.5	4.37 (48)	861	20.8	0.5	3.80	852
0.55b	20.7	0.7	3.98	885				
0.75					20.6	0.4	3.56	829
1.00					20.5	0.4	3.16	830
1.25					20.4	0.4	3.09	802
1.50					20.4	0.4	2.73 (30)	798
1.65b					20.3	0.4	0.83	805
1.75								
2.00								
			28-Sep-14					
	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	21.4	0.4	5.92	830	20.7	0.4	4.62	673
0.25	21.3	0.4	5.53	824	20.5	0.4	4.03 (50)	674
0.50	20.4	0.4	2.49	764	20.2	0.4	3.53	660
0.75	20.1	0.4	1.87	728	19.7	0.4	1.47 (16)	668
1.00b	20.1	0.4	1.70 (18)	734	19.9	0.5	2.18 (24)	894
1.20b	20.4	0.6	0	1215				
1.25								

			2-Oct-14					0919 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00					18.9	0.4	4.55	769
0.25					18.9	0.4	4.32	767
0.50					18.8	0.4	3.90	764
0.75					18.7	0.4	3.96	764
1.00					18.7	0.4	4.45	760
1.25					18.6	0.4	4.94 (53%)	757
1.50					18.6	0.4	4.76 (51%)	757
1.70b					18.6	0.4	3.42	757
1.75								
2.00								
2.25								
	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								

2 October 2014. Monitoring to see if oxygen had improved and to check secchi depth. It had improved 0.4 feet to 3.9 ft since 28 September- not much due to low inflow. Gage Height = 1.96

			5-Oct-14				0907 hr
	Flume				**Stockton Avenue Bridge**		
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00					19.1	0.5	6.15	
0.25					19.1	0.5	6.12	
0.50					19.0	0.4	6.19	
0.75					19.0	0.4	6.19	
1.00					18.9	0.4	6.21	
1.25					18.8	0.4	6.64	
1.50					18.8	0.4	6.51 (70%)	
1.75b					18.8	0.4	3.93	
2.00								
2.25								
	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								

5 October 2014. Monitoring to see if oxygen had improved and to check secchi depth. It had improved only 0.1 feet to 4.0 ft since 2 October- not much due to low inflow. Oxygen had improved, though.

0715 hr			11-Oct-14					0726 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	18.1	0.5	3.96	888	17.7	0.5	4.40	895
0.25	18.1	0.5	3.95	896	18.4	0.5	3.26	903
0.50	18.1	0.5	3.97	896	18.4	0.5	3.22	904
0.75b	18.1	0.5	2.81	895	18.4	0.5	2.92	903
1.00					18.4	0.5	2.92	903
1.25					18.4	0.5	2.90	903
1.50					18.4	0.5	2.66	902
1.75					18.3	0.5	2.42 (26%)	889
2.00b					18.3	0.5	1.85	902
2.25								
0750 hr			11-Oct-14					0805 hr
	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	18.4	0.5	2.53	933	17.9	0.5	5.48	896
0.25	18.4	0.5	2.47	935	17.9	0.5	5.39	906
0.50	18.5	0.5	2.46	935	17.9	0.5	5.42	908
0.75	18.5	0.5	2.43	936	17.9	0.5	5.53 (59%)	905
1.00	18.5	0.5	2.36 (25%)	940	17.9	0.5	3.28 (35%)	935
1.05b					18.2	0.6	0.55	1081
1.25b	18.5	0.5	1.65	967				
1.50								

11 October 2014. Gage height of 2.41 (morning) and 2.30 (afternoon). Overcast in morning. Clear in afternoon. Air temperature of 13.7° C at 0715 hr and 17.9ºC at 1600 hr. Flume outlet closed. Biologist requested that flume outlet be opened daily until sandbar breaching.

Station 1: Flume at 0715 hr. Reach 1- 45 gulls bathing, 12 mallards, 6 coots, 1 pied-billed grebe. 7% surface algae and pondweed fragments (Margaritaville cove). Flume at 1600 hr. Reach 1- 7% surface algae and pondweed fragments in Margaritaville cove. Bottom invisible. 93 gulls bathing, 4 coots, 1 snowy egret on periphery.

Station 2: Stockton Avenue Bridge at 0726 hr. Reach 2- 7% surface algae and pondweed fragments; 30 coots (6 from R-1), 6 mallards (from R-1). Man feeding ducks at bench above bridge. Reach 2 at 1529 hr. 10% surface algae and pondweed fragments. 2 mallards, 17 coots, 1 pied-billed grebe. Girl feeding birds from under bridge. Bottom invisible.

Station 3: Railroad trestle at 0750 hr. Reach 3- 20% surface algae and pondweed fragments; 102 coots in water, 19 mallards (some from R-2). At 1515 hr, Reach 3- 20% surface algae and pondweed fragments; 55 coots, 8 mallards, 2 eared grebes in water. Bottom invisible.

Station 4: Mouth of Noble Gulch at 0805 hr. 10% surface algae. 2 mallards and 4 coots on cottonwood. 3 mallards on Golino wood. At 1500 hr. 10% surface algae. 1 mallard and 8 coots on cottonwood. Bottom invisible.

Station 5: Nob Hill at 0837 hr. Water temperature not recorded. Oxygen 7.44 mg/l (74% saturation).

Conductivity 663 umhos. Salinity 0.4 ppt. Nob Hill at 1531 hr on 12 October. Water temperature 17.0 ˚ C. Oxygen 8.36 mg/l. Conductivity 610 umhos. Salinity 0.4 ppt. Streamflow estimated 0.2 cfs. (0.3 cfs at gage.)

1600 hr			11-Oct-14					1529 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.4	0.5	7.52	922	19.7	0.5	7.63	933
0.25	19.3	0.5	7.48	923	19.7	0.5	7.57	933
0.50	19.1	0.5	9.05 (98%)	918	19.6	0.5	7.37	932
0.68b	19.0	0.5	8.84	904				
0.75					19.2	0.5	6.70	930
1.00					18.9	0.5	5.28	933
1.25					18.8	0.5	5.03	935
1.50					18.7	0.5	4.50	937
1.75					18.6	0.5	3.17 (17%)	943
1.87b					18.6	0.5	0.12	952
2.00								
2.25								
1515 hr			11-Oct-14					1500 hr
	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	20.5	0.5	9.49	967	20.1	0.6	8.62	1001
0.25	20.3	0.5	8.70	967	19.7	0.5	8.76	986
0.50	19.6	0.5	7.73	955	19.5	0.5	8.64	976
0.75	19.13	0.5	7.71	954	18.7	0.5	6.20 (67%)	915
1.00	19.1	0.5	3.36 (36%)	955	18.5	0.6	7.06 (75%)	1009
1.05b					18.8	0.7	6.64	1291
1.25	18.7	0.6	0.17	1017				
1.50								

			12-Oct-14					0759 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00					18.0	0.5	3.56	922
0.25					18.0	0.5	3.51	917
0.50					18.0	0.5	3.47	917
0.75					18.1	0.5	3.43	917
1.00					18.1	0.5	3.39	9.18
1.25					18.0	0.5	3.39	917
1.50					18.1	0.5	3.38 (34%)	917
1.75b					18.1	0.5	0.47	918
2.00								
2.25								
	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								

12 October 2014. Monitoring prior to fish sampling. Only 10 steelhead were captured with no mortality.

			19-Oct-14					0805 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00					18.1	0.6	8.05	1044
0.25					18.1	0.6	8.13	1044
0.50					18.1	0.6	8.20	1044
0.75					18.1	0.6	8.32	1043
1.00					18.1	0.6	8.35	1044
1.25					18.1	0.6	8.32	1044
1.50					18.1	0.6	8.43	1043
1.75b					18.1	0.6	1.25	1042
2.00								
2.25								
	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								

19 October 2014. Monitoring prior to fish sampling. Only 2 steelhead were captured with no mortality. Air temperature = 13.2˚ C.

25−26 October 2014. Rained on 25 October and overnight on 26 October, prior to monitoring.

0810 hr			26-Oct-14					0824 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	17.1	0.6	8.43	1021	17.4	0.6	8.63	1011
0.25	17.1	0.6	8.59 (89)	1010	17.4	0.6	8.60	1018
0.50b	17.1	0.6	8.53	1010	17.4	0.6	8.54	1018
0.75					17.4	0.6	8.51	1016
1.00					17.4	0.6	8.50 (89%)	1016
1.25					17.4	0.6	8.47 (89%)	1015
1.50					17.4	0.6	8.35 (87%)	1014
1.75b					17.4	0.6	0.23	1013
2.00								
2.25								
0835 hr			26-Oct-14					0856 hr
	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	17.1	0.6	7.53	942	16.6	0.4	6.00	738
0.25	17.1	0.6	7.41	944	16.6	0.4	6.08	746
0.50	17.1	0.6	7.56	942	16.6	0.4	6.05 (62%)	745
0.75	17.1	0.6	7.47	934	16.6	0.5	5.71 (59%)	766
0.88b					16.8	0.5	3.04	807
1.00	17.1	0.6	7.40 (72)	945				
1.10b	17.2	0.6	5.93	946				
1.25								
1.50								

26 October 2014. Gage height of 1.76 (morning) and 1.74 (afternoon). Clear in morning and afternoon. Air temperature of 11.1° C at 0810 hr and 16.2° C at 1546 hr.
Station 1: Flume at 0810 hr. Reach 1- 10 gulls, 2 coots, 1 pied-billed grebe. No surface algae. Flume at 1546 hr. Reach 1- No surface algae. Bottom invisible. 51 gulls bathing, 2 coots, 1 pied-billed grebe. 3 boards removed from flume inlet. Flume outlet open.
Station 2: Stockton Avenue Bridge at 0824 hr. Reach 2- <1% surface algae and pondweed fragments; 21 coots, 3 mallards in water. 3 coots on trestle abutment. Reach 2 at 1525 hr. Secchi depth = 2.4 ft. 18 coots, 3 mallards.
Station 3: Railroad trestle at 0835 hr. Reach 3- <1% surface algae and pondweed fragments; 64 coots, 11 mallards, 2 pied-billed grebes. At 1511 hr, Reach 3- 63 coots, 9 mallard in water.
Station 4: Mouth of Noble Gulch at 0856 hr. No surface algae. 6 coots on Golino wood, 1 snowy egret and 1 green back heron on willows. At 1459 hr. No surface algae. 1 snowy egret on Golino wood.
Station 5: Nob Hill at 0921 hr. Water temperature 14.9 ° C. Oxygen 7.11 mg/l. Conductivity 557 umhos. Salinity 0.3 ppt. Nob Hill at 1616 hr. Water temperature 15.4° C. Oxygen 8.80 mg/l (88%). Conductivity 635 umhos. Salinity 0.4 ppt. 2 cfs visual estimate. (1.6 cfs at gage.)

1546 hr			26-Oct-14					1525 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.2	0.6	15.02	1005	18.4	0.5	12.95	
0.25	19.2	0.6	14.95 (162%)	1005	18.5	0.5	13.08	
0.50b	19.2	0.6	14.43	1006	18.4	0.5	13.11	
0.75					18.4	0.5	12.97	
1.00					18.3	0.5	12.39	
1.25					18.2	0.5	11.78 (125%)	
1.50					17.8	0.6	7.52 (79%)	
1.60b					17.6	0.6	2.15	
1.75								
2.00								
2.25								
1511 hr			26-Oct-14					1459 hr
	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	18.7	0.5	13.14	925	18.6	0.4	10.34	752
0.25	18.6	0.5	13.10	932	18.2	0.4	9.79	764
0.50	18.6	0.5	13.06	942	18.0	0.5	9.67	801
0.75	18.3	0.6	12.54	999	17.6	0.5	8.35 (88%)	915
0.88b					17.5	0.6	4.57	985
1.00	18.0	0.6	8.58 (88%)	1016				
1.12b	17.8	0.6	4.36	1029				
1.25								
1.50								

			8-Nov-14					
	Flume			0746 hr	**Stockton Avenue Bridge**			0757 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	14.3	0.5	8.49	824	14.4	0.5	8.72	829
0.25	14.3	0.5	8.52	824	14.5	0.5	8.60	826
0.35b	14.3	0.5	8.27 (81%)	823				
0.50					14.5	0.5	8.62	826
0.75					14.5	0.5	8.58	826
1.00					14.5	0.5	8.58 (84%)	825
1.25					14.5	0.5	8.59	825
1.45b					14.5	0.5	6.46	825
1.50								
1.75								
2.00								
			8-Nov-14					
	Railroad Trestle			0815hr	**Mouth of Noble Gulch**			0829 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	12.2	0.4	9.28	594	11.9	0.4	10.00	596
0.25	12.2	0.4	9.06	594	11.9	0.4	9.77	599
0.50	12.2	0.4	9.00	594	11.8	0.4	9.63	601
0.75	12.2	0.4	8.93	594	11.8	0.4	9.56 (89%)	600
1.00	12.2	0.4	8.84	594	11.9	0.4	9.10	605
1.05b					11.9	0.4	8.57	612
1.25	12.2	0.4	8.77 (82%)	594				
1.45	12.2	0.4	7.94	595				

8 November 2014. After time change. Gage height of 1.19 (morning) and 1.21 (afternoon). Clear in morning and afternoon. Air temperature of 10.9 ^{o}C at 0746 hr and unrecorded in afternoon. Flume exit closed in afternoon. **It had rained on 1-2 November.**

Station 1: Flume at 0746 hr- Reach 1- 16 gulls bathing, 6 coots dabbling, 1 snowy egret on periphery. No surface algae. Flume at 1553 hr- Reach 1- 87 gulls bathing, 26 coots. No surface algae. Bottom invisible.

Station 2: Stockton Avenue Bridge at 0757 hr- Secchi depth = 3.9 ft; 4.4 ft to bottom. Reach 2- No surface algae. 1 coot, 1 mallard, 1 pied-billed grebe, 1 eared grebe. Reach 2 at 1536 hr- No surface algae. 5 coots, 1 mallard. 1 eared grebe.

Station 3: Railroad trestle at 0815 hr- Reach 3- 4 mallards dabbling, 62 coots, 1 pied-billed grebe. At 1523 hr, Reach 3- No surface algae; 8 mallards, 46 coots, 1 gull.

Station 4: Mouth of Noble Gulch at 0750 hr- 4 mallards (may be from Reach 1) and 2 coots on cottonwood. No surface algae. At 1417 hr- No surface algae. 3 mallards on cottonwood. Too dark to observe vegetation.

Station 5: Nob Hill at 0901 hr- Water temperature at 12.9 ° C. Conductivity 733 umhos, Oxygen 10.99 mg/l. Salinity 0.5 ppt. Nob Hill at 1625 hr- Water temperature 14.1^{o}C. Oxygen 10.86 mg/l (106%). Conductivity 751 umhos. Salinity 0.5 ppt. Streamflow estimated 1 − 2 cfs. (1.2 cfs at gage.)

			8-Nov-14					
	Flume			1536 hr	**Stockton Avenue Bridge**			1553 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	15.7	0.5	12.72	853	15.9	0.5	12.78	858
0.25	15.6	0.5	12.51 (126%)	851	15.8	0.5	12.39	852
0.35b	15.5	0.5	12.06	844				
0.50					15.7	0.5	12.10	852
0.75					15.3	0.5	10.76	847
1.00					15.2	0.5	10.14	848
1.25					15.2	0.5	10.15 (101%)	851
1.45b					14.9	0.5	4.93	848
1.50								
1.75								
2.00								
2.25								
			8-Nov-14					
	Railroad Trestle			1523hr	**Mouth of Noble Gulch**			1509 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	0.5	12.13	868	16.6	0.5	10.78	889
0.25	16.3	0.5	11.95	867	16.0	0.5	10.35	864
0.50	16.0	0.5	11.46	865	15.7	0.5	9.57 (97%)	855
0.75b	15.6	0.5	9.73 (98%)	898	15.1	0.6	8.20	982
1.00b	15.3	0.6	8.05	943				
1.25								
1.50								

			23-Nov-14					
	Flume			0751 hr	**Stockton Avenue Bridge**			0803 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	12.7	0.3	9.48	485	13.1	0.3	9.41	495
0.25	12.8	0.3	9.51	483	13.1	0.3	9.27	497
0.50b	12.8	0.3	9.45 (89%)	482	13.1	0.3	9.21	494
0.75					13.1	0.3	9.15	496
1.00					13.0	0.3	9.27	492
1.25					13.1	0.3	7.98 (75%)	493
1.50					13.6	0.5	4.65 (45%)	714
1.65b					13.7	0.5	3.35	729
1.75								
2.00								
			23-Nov-14					
	Railroad Trestle			0825 hr	**Mouth of Noble Gulch**			0837 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	12.9	0.3	9.33	483	12.8	0.3	9.05	467
0.25	12.9	0.3	9.24	486	12.8	0.3	9.04	469
0.50	13.0	0.3	9.11	487	12.8	0.3	9.01	473
0.75	13.0	0.3	8.83	501	13.0	0.3	7.74 (74%)	532
0.85b					13.1	0.4	6.92	559
1.00	13.4	0.4	5.38	590				
1.08b	13.7	0.5	2.04	744				
1.25								
1.50								

23 November 2014. After time change. Gage height of 1.61 (morning) and 1.66 (afternoon). Clear in morning and afternoon. Air temperature of 12.2° C at 0751 hr; air temp. unrecorded in afternoon. Flume open in morning. It had rained on Friday, November 21, with a heavy, short-lived cloud burst that brought the streamflow and lagoon up rapidly for a short period.

Station 1: Flume at 0751 hr- Reach 1- 26 gulls bathing, 2 coots dabbling, 1 eared grebe. No surface algae. Water surface approximately 1 foot below top of flume. Flume at 1558 hr- Reach 1- 72 gulls bathing, 16 coots, 2 eared grebes. No surface algae.

Station 2: Stockton Avenue Bridge at 0725 hr- Secchi depth to 0.7 m. Reach 2- No surface algae. 6 mallards, 4 coots, 1 cormorant. Reach 2 at 1431 hr- Secchi depth to 0.75. No surface algae. 7 coots. Secchi depth = 2.3 feet in the afternoon. Bottom invisible.

Station 3: Railroad trestle at 0752 hr; Secchi depth to bottom- Reach 3- 14 mallards dabbling, 28 coots, 1 pied-billed grebe, 3 bufflehead ducks. At 1413 hr, Reach 3- No surface algae; 11 mallards, 21 coots, 2 pied-billed grebes.

Station 4: Mouth of Noble Gulch at 0812 hr- 2 mallards on willow branches next to cottonwood. No surface algae. At 1400 hr- No surface algae. 13 mallards and 1 coot on cottonwood. 3 mallards on Golino wood. Bottom invisible.

Station 5: Nob Hill at 0845 hr- Water temperature at 8.8° C. Conductivity 557 umhos, Oxygen 12.46 mg/l (107% sat.). Salinity 0.4 ppt. Nob Hill at 1529 hr- Water temperature 9.7° C. Oxygen 12.55 mg/l. Conductivity 576 umhos. Salinity 0.4 ppt. 3 cfs visual estimate. (2.8 cfs at gage.)

			23-Nov-14					
	Flume			1558 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	14.5	0.3	9.61	538	14.4	0.3	9.89	539
0.25	14.4	0.3	9.60	541	14.4	0.3	9.74	539
0.50b	14.0	0.3	8.76	550	14.3	0.3	9.63	538
0.75					14.1	0.3	9.51	537
1.00					13.7	0.3	9.52	528
1.25					13.6	0.4	7.85 (75%)	598
1.50					13.7	0.4	6.08 (60%)	647
1.75b					13.7	0.5	0.19	726
2.00								
2.25								
			23-Nov-14					
	Railroad Trestle			1519 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	14.6	0.3	11.02	540	14.6	0.3	12.25	520
0.25	14.5	0.3	10.96	540	14.4	0.3	11.97	514
0.50	14.4	0.3	10.64	563	14.4	0.3	11.49	566
0.75	14.3	0.4	9.74	572	13.7	0.5	8.75 (85%)	742
0.85b					13.6	0.6	7.52	882
1.00	13.8	0.5	6.78	831				
1.08b	13.8	0.5	5.98	843				
1.25								
1.50								

30 November 2014. The biologist (Alley) arrived at the open creekmouth at 1150 hr after communication with Kotila of Public Works the previous evening and that morning. The rising lagoon water surface overtopped the inner berm at 1115 hr and flowed across the beach to the notched outer berm and onto the Bay. It looked like the Soquel watershed had missed most of the rain from this storm front, it being on the very edge. We assumed that insufficient flow would reach the lagoon to open it this day. However, when Kotila checked the lagoon in late morning, the lagoon level had risen rapidly to within approximately 8 inches of the lower bolt on the piling and was rising. He immediately notified the biologist at approximately 1050 hr and then proceeded to initiate a controlled breach. The flume inlet was open on one side and the ceiling grate was also receiving water. The flume outlet was completely open on one side. The flume was unable to accept all of the stormflow and was underwater at this time. (The flume capacity is approximately 25−30 cfs.) According to the gage in Soquel Village, 2 miles upstream, streamflow there peaked at 35 cfs at 10:30 am, which was likely significantly less than in Capitola with its impermeable surfaces and urban runoff. Twenty minutes were required before the lagoon level stabilized and began to recede. By 1150 hr, the estuary level had dropped to within approximately 1 foot of the lower bolt. The outlet channel was approximately 20 feet wide. It had stopped raining when the biologist arrived at the creekmouth. However, it was still raining in the mountains. More rain was forecasted for the next few days.

1 December 2014. The estuary remained open with flows at the gage mostly between 15 and 20 cfs at the gage in Soquel Village.

2 December 2014. More rain occurred, with streamflow reaching 71 cfs at its peak at the gage in Soquel Village. Estuary remained open.

3 December 2014. More rain occurred, with stream flow peaking at 203 cfs at the gage in Soquel Village. Estuary remained open for the season.

APPENDIX B. 2014 Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon.

2014 DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK				
RESTAURANT	**INITIAL CONTACT**	**TEST DATE**	**COMMENTS**	**SIGN OFF**
MY THAI BEACH	MOONIE 5/2/2014	5/16/2014	PASSED	5/16/2014 WHEELER
BAY BAR		5/13/2014	PASSED	5/13/2014 WHEELER
PIZZA MY HEART	BENJAMIN PAULIK 5/2/2014	5/9/2014 5/16/2014	FAILED PASSED	5/16/2014 WHEELER
FOG BANK	LINDA BENNETT 5/2/2014	5/16/2014	PASSED	5/16/2014 WHEELER
PARADISE BAR & GRILL	AMBER MACHADO 5/2/2014	5/13/14	PASSED	5/13/2014 WHEELER
ZELDA'S	ED LEIPETT 5/2/2014	5/9/2014	PASSED	5/9/2014 WHEELER