D.W. ALLEY & Associates aquatic biology

DRAFT SOQUEL CREEK LAGOON MONITORING REPORT– 2009

Photos by Jared Chandler, Jaredphoto.com

Fish Seining at Soquel Lagoon– 2009

Prepared by D.W. ALLEY & Associates, Aquatic Biology for

CITY OF CAPITOLA
420 Capitola Avenue
Capitola, California 95010

December 2009 **Project # 106-19**

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TABLE OF CONTENTS

List of Tables

List of Figures

List of Figures (cont'd)

List of Figures (cont'd)

List of Figures (cont'd)

List of Figures (cont'd)

SOQUEL CREEK LAGOON MONITORING REPORT, 2009

ACKNOWLEDGMENTS

The Capitola Public Works Department did another fine job of creating and maintaining the lagoon in 2009. Matt Kotila as heavy equipment operator and Ed Morrison as Field Supervisor teamed to daily observe the lagoon and adjust to its needs. Every year is different, and we are grateful for their adaptiveness. Cary Oyama was ready for action, as he always is, to help us move the fish prior to sandbar closure and was a pleasure to work with. 2009 was the final year of Tim Callahan's time at the lagoon as he retired from Capitola Public Works. We will miss him and his special sense of humor, as will many Capitola residents. He was a friendly soul and took the time to talk with so many of us in his caring manner. We hope his new life in Oregon goes well. We thank Cary Oyama in assisting in seining the fish to relocate them during sandbar construction. Cary has been a positive force in preparing the flume and lagoon for the summer. We appreciated Gary Quail's continuing help and good humor in censusing the fish. Regarding the Begonia Festival, the organizers, volunteers and students effectively dismantled the floats and removed flowers by boat after the Begonia Festival. They had their hands full after one of the floats capsized. We thank Nels and Susan Westman again for the loan of their boat for fish censusing and their lagoon observations. We marveled at their animated biplane created for the Festival. We greatly benefitted from the observations and hospitality of lagoon-side residents, Dick and Anita Arthur. The lagoon inhabitants (wildlife and humans alike) were the benefactors of Ed Morrison's daily attention to managing the flume inlet as streamflow lessened through the summer of the third year of drought, his quick response to turbidity caused by the small September storm and his carefully planned responses to larger fall storms. We greatly appreciated the close monitoring of weather conditions and rainfall patterns by Steve Jesberg, Public Works Director, as he teamed with his staff. He was there with Morrison, Kotila and Alley for the emergency sandbar breach in mid-October.

We were grateful to the volunteers who assisted in the annual fish censusing at the lagoon. Some were local residents (a family with two sons) and students from UCSC, Cabrillo and local high schools (community services credits). Biologists from NOAA Fisheries also helped sample on both weekends (Su Sogard and Noah Parker), looking for tagged fish from their study. Volunteers also came from the Coastal Watershed Council (Nancy Scarborough included in blue pullover in cover photo) and the Friends of Soquel Creek (Steve Leinau, Carla Mader and Tom Mader) and Gabriel Wolff's family (him, his wife and two sons). Biologist Inger-Marie Laurson also volunteered her positive energies (orange pullover in the cover photo), with her husband, Jared Chandler, who professionally photo-documented the fish sampling as evidenced by his cover photo, Chad Steiner (cover photo), Walter Heady (cover photos) and Dawn Reis were our valuable and reliable fish-crew members.

Volunteers are always very welcome to help 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. After a third winter with below-average rainfall, sandbar construction began on 19 May, prior to Memorial Day weekend. 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. The Creek flowed laterally across the beach at approximately 7–8 cubic feet per second and emptied into the Monterey Bay at the jetty. The flume had been mostly cleared of sand the previous week. The lower lateral channel was seined before it was blocked off at 0800 hr. The channel was blocked off to allow fish rescue at the upper end of the lateral channel. Fourteen seine hauls were made in the lateral channel from 0730 to 0930 hr with a beach seine that was 30 ft x 4 feet with 1/8-inch mesh. There was considerable kelp near the entrance to the lateral channel, making seining difficult in that area as is sometimes the case. The lateral channel was narrow (approximately 15 feet wide) and flat. Cary Oyama of the Capitola Public Works Department assisted Don Alley in the fish relocation. Unlike in most previous years, adult prickly sculpin were present in the upper lateral channel. They did not do well with presumably low oxygen levels, and rapid relocation was necessary to prevent their mortality. Numbers of fish relocated were, therefore, less precisely counted than previous years. Fish captured included 6 adult prickly sculpin (Cottus asper), approximately 100 staghorn sculpins (*Leptocottus armatus*), approximately 50 threespine sticklebacks (*Gasterosteus aculeatus*), approximately 8 young-of-the-year starry flounders (*Platichthys stellatus*) and one adult tidewater goby (*Eucyclogobius newberryi*). No other fish species were detected in the lateral channel. Rescued fish were relocated to the main lagoon/ estuary.

Six additional seine hauls were made along the western margin of the lagoon from the flume to the sea wall at Venetian Court in an effort to detect any tidewater gobies (*Eucyclogobius newberryi*) in that location. The six seine hauls yielded 2 adult tidewater gobies, 29 juvenile staghorn sculpins, 28 young-of-the-year starry flounders (about half-dollar-sized), with no threespine sticklebacks captured. The lagoon was deep along this margin and remained watered during the daily draw-downs during sandbar closure construction. Seining was completed by 1030 hr.

As required in the permit, a fisheries biologist was present during all activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was our nineteenth year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first 18 years are available at the City (**Alley 1991-2008**). 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 accomplished without the use of heavy equipment in the stream channel except within 25 feet of the flume. The bulldozer/tractor could traverse the area adjacent to the flume.

Sandbar Breaching. An emergency breaching that was required on 13 October, the earliest in 19 years of monitoring. A large storm developed from a typhoon in the western Pacific, bringing 8–10 inches of rainfall to the Santa Cruz Mountains that resulted in a stormflow of 3,920 cfs as

measured at the Soquel Village USGS gage. On 12 October, Matt Kotila had cut a notch 6 inches above the top of the flume in the mini-berm that spanned the 30-foot wide notch across the sandbar in anticipation of forecasted storm. No boards were removed from the flume inlet because at least 1-3 inches of rain were forecasted, which would cause stormflow to exceed the capacity of the flume (approximately 30 cfs). At 1845 hr on 13 October, the sandbar breached through the pre-constructed notch. Morrison, Jesberg and Kotila were present. The biologist arrived at 1850 hr, just after breaching. The channel was 10 feet wide, and the tide was incoming.

Stream Inflow to the Lagoon. Habitat conditions in the 2009 lagoon followed a third successive winter with few storms, with a baseflow at the time of sandbar closure of only approximately 6.5 cfs (**Table 8; Figures 20 and 21**). Only 5 of the last 19 years had lower baseflow at the time of sandbar closure, and two of those were the previous two years. By 1 September, prior to any fall rainfall, streamflow had declined to 1.2 cfs at the Soquel Village USGS gage, compared to 0.7 cfs in 2008, 1.3 cfs in 2007 and 6.6 cfs in 2006. The 1 September 2009 baseflow was the 5th lowest in the last 19 years. After the large stormflow of nearly 4,000 cfs on 14 October, baseflow rapidly dropped back to below 10 cfs and declined to 5 cfs by the end of November before the next significant storm occurred in mid-December (**Appendix A; Figure 21**). The sandbar remained open after 13 October, however.

Water Temperature. In 2009, the lagoon was substantially cooler (2 to 3° C) near the bottom in morning and afternoon than in 2008 at 3 of 6 monitoring times before 1 September and similar to 2008 after that except for warmer conditions in mid-September and mid-October prior to stormflow (**Table 3, Figures 3a-d; Appendix A**). The cooler water temperatures in early and mid-summer 2009 than 2008 were consistent with cooler air temperatures in June and July at the Watsonville Airport (**Table 4**), cooler inflow to the lagoon (**Figure 3f and Alley 2009**), especially in June, and the lack of a saline layer on the bottom that had existed periodically in 2008 at Stockton Bridge. Air temperatures were warmer in August and September 2009 than previous months, with water temperatures peaking in mid-August. Air temperatures in 2009 were also warmer than August and September 2008 at Watsonville Airport. The warmer lagoon temperatures in 2009 in mid-September and mid-October were consistent with warmer inflow in 2009. The warmest water temperature measured near the bottom in the morning was 21° C (69.8° F) on 15 August at the Stockton Bridge. Typically, at most other monitoring stations and at times without a saline layer, morning water temperatures near the bottom are less than 21° C. In 2009, water temperatures near the lagoon bottom in the morning were rated "good" (<20° C) or "fair" (20−21.5° C) at all stations throughout the lagoon season. The warmest afternoon water temperatures recorded near the bottom at the monitoring stations during two-week monitoring was 21.9° C in late August compared to 24.6° C, under the bridge in early July 2008.

At the mouth of Noble Gulch, a slightly cooler layer of water was detected near the bottom in early morning, and the largest decrease in water temperature through the water column of all the monitoring stations was detected there on afternoon monitorings (**Appendix A**). This resulted from slightly cooler water entering from Noble Gulch during the lagoon period. For example, on one of the warmest water temperature monitoring days in 2009 (15 August), the surface and bottom temperature readings near dawn were 19.6 and 19.1° C, respectively (**Appendix A**). In the afternoon at 1510 hr they were 22.7 and 21.0° C, respectively.

With cooler water emptying in from Noble Gulch, Station 4 was always cooler than the other 3

stations. Although the station at Noble Gulch was sometimes cooler than other stations, the other three stations were similar when saltwater was absent. Water temperature of the stream inflow was cooler in the morning than the lagoon, with 2-week fluctuations in lagoon inflow temperature mirrored in early-morning lagoon temperatures except when the saline layer caused the Stockton Bridge station to be warmer (**Figure 3f**). The correspondence between inflow fluctuations and lagoon temperature fluctuations indicated that the inflow temperature influenced the lagoon temperature in 2009 as in previous years. Stream inflow temperatures were typically 3−4° C cooler in the morning than lagoon water temperature at the 3 lower lagoon stations. The cool inflow from Noble Gulch maintained substantially cooler lagoon water temperature in the morning and afternoon at Station 4 near the bottom than the other three lagoon stations (**Figure 3f and 3g-1**). Usually, morning water temperature was 3-4° C cooler at Station 4 than Station 1. In the afternoon, the difference was usually 1-1.5° C.

Comparisons of 7-day rolling averages generated from continuous data loggers near the railroad trestle in 2009 indicated that lagoon water temperatures (**Figures 4a- 4l**) closely mirrored temperatures in the stream inflow (**Figures 5a-b**), as in past years. Daily temperature *minima* in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2009, as substantiated in **Table 5**. The 7-day rolling average temperature was 1 – 3.5° C cooler in the stream than 0.5 ft from the bottom in the lagoon near the trestle, as substantiated by seasonal minima (17.6° C) and maxima (21.0° C) in **Table 5**. Stream inflow in 2009 was generally more than a degree C cooler in 2009 than 2008 in the last half of June and more than a degree C warmer in late August and early September. We see from comparisons of 7-day rolling averages between years that near the lagoon surface, water temperatures were cooler in the first half of the 2009 lagoon period compared to 2008, consistent with differences in stream inflow temperatures (**Figures 4k and 4m; 5a-c**). The warmer 2008 inflow temperature was consistent with the lower streamflow in 2008 and warmer air temperatures in the first half of the summer compared to 2009. But lagoon water temperatures near the bottom were cooler in 2009 during the same period because saltwater influx in 2008 heated up the bottom, and no saltwater lens was present in 2009 (**Figures 4a and 4n**). Stream inflow temperatures were consistently warmer in latter 2009, with 2009 lagoon temperatures near the surface and bottom being periodically warmer than in 2008, although there were periodic cooling periods in 2009 that were absent in 2008.

As in past years, no lagoon thermocline (with its warm, well-mixed, oxygen-rich epilimnion above the thermocline and a cool, non-circulated, oxygen-poor hypolimnion below) was detected in 2009 by the data loggers at the deep area near the trestle or at any of the 4, two-week monitoring stations. 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. Each night, water temperature cooled to the bottom of a completely freshwater water column. During the short period of less than two weeks after sandbar closure a stagnant saline layer developed in the deep hole adjacent to the Venetian Court wall. For the remainder of the season, lagoon water temperature was slightly warmer near the surface than near the bottom, as seasonal maxima and minima of temperatures and 7-day rolling averages indicated (**Table 5**).

Aquatic Vegetation. In 2009 at the time of sandbar construction, the thickest deposit of kelp and seagrass was located in the deep thalweg near the restaurants and at the beginning of the lateral channel that passed the streamflow through the beach. Only about 40% of the area downstream of Stockton Bridge, and nearest the flume, was raked out. Approximately 70% of the decaying plant material was removed from the area downstream of Stockton Bridge prior to sandbar closure. Thus, there was more decaying material left in the 2009 lagoon than many previous years, including 2008. This material provided considerable nutrients for future algae production in the summer lagoon. By 4 weeks after sandbar closure (21 June), filamentous algae covered 40% of Reach 1, 70% of Reach 2 and 80% of Reach 3. The coverage and thickness of algae was greater in 2009 than 2008 at this same date and until mid-August (**Tables 6 and 7**). After that, average thickness was similar in Reach 1 between the years, but thicker in Reaches 2 and 3 in 2008. However, the average thickness for the season was higher in all reaches in 2009 due to the early rapid growth in 2009. Pondweed was most prominent in Reach 1, as was usually the case.

Surface algae in 2009 varied between 0 and 5% in Reach 1, 0 and 25% in Reach 2, 0 and 3% in Reach 3 and 0 and 25% at the mouth of Noble Gulch (**Table 6**). It was much more prevalent in 2009 than most years, with the average and maximum surface coverage being more than double that of 2008 in Reaches 1 and 2 and at the mouth of Noble Gulch (**Tables 6 and 7**). The average surface algae coverage for Reaches 1−3 and mouth of Noble Gulch were 2%, 4%, 0.6% and 8.2%, respectively.

Oxygen Levels. Oxygen concentration in the lagoon is lowest at dawn, or soon after, because oxygen has been depleted by cell respiration over night before plant photosynthesis can begin producing oxygen with the light. This is the time when oxygen concentrations are most importantly measured and rated. In 2009, oxygen levels for steelhead were either "fair" (between 5 and 7 mg/l) or "good" (greater than 7 mg/l) *near the bottom at dawn* at all stations during two-week monitorings (**Tables 2 and 3, Figure 6a and Appendix A**). After an early September storm that caused turbidity that restricted light penetration, the lagoon depth was reduced quickly to allow light to penetrate through the entire water column. This encouraged photosynthesis and oxygen production. However, on 19 September, oxygen was still depressed after the 13-14 September storm to 3.6 mg/l near the bottom in early afternoon, with it above 6 mg/l in the upper 1 meter of the water column (**Appendix A**).

Salinity Monitoring. In 2009, saline conditions were only detected for a short time after sandbar closure on 25 May in the deeper lagoon area along the wall at Venetian Court (**Appendix A**). This resulted from a small amount of saltwater being trapped in the lagoon at the time of sandbar closure on 21 May. Shrouds were installed on the sandbar inlet to draw the heavier saltwater off the bottom early on, as was recommended in the original lagoon management plan and update (**Alley et. al 2004a**). By our first 2-week monitoring on 7 June, saltwater had dissipated from this location through the flume and sandbar. Then the shrouds were removed. Water temperature had become slightly elevated in the saline layer on the bottom adjacent to the Venetian Court wall, but steelhead could avoid this area, if need be, to avoid any thermal stress. Unlike in 2008, there was apparently sufficient lagoon outflow through the flume in 2009 to prevent saltwater from periodically being flushed back into the lagoon through the flume on certain high tides.

Begonia Festival Observations and Water Quality Findings. The City's fishery biologist (Donald Alley) was present before, during and after the Begonia Festival. The day of the Festival, 6 September, was initially foggy and overcast until 1000 hr, after which it was sunny only until 1110 hr, after which it was overcast for the remainder of the day. Water temperatures were relatively warm in the morning (warmer than the previous week), but oxygen levels were high (not as high as the previous week. The lagoon depth was maintained at an adequate gage height of 2.24–2.26 ft. There were 9 floats in the nautical parade and 22 other boats, canoes and rafts in the water. In conformance with the permit requirements from the California Department of Fish and Game, no floats were propelled by waders. Thus, the lagoon bottom was not disturbed and increased turbidity was negligible until one float capsized downstream of the Stockton Bridge after the parade had ended. Refer to **Appendix A** for details of the mishap. Even with the capsizing and disturbance that followed, the secchi depth at the Stockton Bridge was to the bottom after the parade. Conductivity near the bottom increased very slightly at the Stockton Avenue Bridge from 719 before to 730 umhos after the parade, as was the pattern at the mouth of Noble Gulch in the upper 0.75 m, where it increased from 725 to 746 (**Appendix A**). The measured levels of conductivity were not stressful to steelhead. There was no odor of hydrogen sulfide, and no fish mortality was observed. Oxygen concentrations in the afternoon following the nautical parade were very high, ranging between 10.75 and 11.02 mg/l near the bottom before 1500 hr (**Appendix A**). Water temperatures was warm (21.9° C) near the bottom at this time at both monitored sites and likely became warmer later in the day.

Fish Sampling. Our steelhead population estimate based on mark and recapture for fall 2009 was only 449, compared to 7,071 in 2008, to 6,064 in 2007, 992 juveniles in 2006 and 1,454 juveniles in 2005 (**Table 9, Figure 7**) (methods in **Ricker 1971**). This was the third lowest estimate thus far and well below our 17-year average of 1,755 juveniles. The other species captured in fall 2009 were tidewater gobies, threespine sticklebacks, starry flounders, prickly sculpins and staghorn sculpins. One PIT-tagged juveniles from 2008 NOAA Fisheries tagging was captured. This large yearling was first tagged in September 2008 as a YOY at the Spanish Ranch site on East Branch Soquel Creek (**Noah Parker, NOAA Fisheries, pers. comm**.).

Though we do not have 2007–2009 population estimates for the entire Soquel Creek watershed, the lagoon population of larger smolt-sized fish was likely a significant percent of the total watershed population in these dry years. Thus, the lagoon provides valuable steelhead nursery habitat through proper management.

On 11 October 2009, 4 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 8 tidewater gobies were captured. This was the second consecutive year of their detection since their absence in 1998-2007. Threespine sticklebacks were moderately abundant, and a small starry flounder were also captured.

Pollution Sources. 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. The City had received funding to deter gull use on restaurant roofs, to redirect restaurant gutter systems away from the lagoon and to provide waste cans with gull-proof lids. However, attempts at partnership between the City and Esplanade restaurants for adding gull deterrents to their roofs has, thus far, been unsuccessful. However, conditions of future remodeling will require addition of roof deterrents (**Steve Jesberg, 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.

The staff at Margaritaville routinely washed their patio and the walkway containing refuse dumpsters off into the lagoon on a daily basis. The fish biologist notified the City of this problem, but no change in behavior was observed. A raft of floating algae developed adjacent to Margaritaville in September. This may have resulted from nutrient inputs from staff activities.

Regarding pollution from urban runoff, 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. The City redirected dry-weather runoff to the constructed wetland on the west side of the Stockton Avenue Bridge (just upstream) from the drain on the east side of Stockton Avenue Bridge (just upstream) and the drains at the pier and Venetian Court. Water quality measurements taken at the outlet of the wetland indicated only slight differences compared to those taken at the Stockton Bridge, with no impact to steelhead habitat conditions (**Appendix A**). Oxygen levels near dawn at the wetland outlet were usually very slightly higher than at Stockton Bridge and water temperatures were very slightly cooler.

Ideally, all storm drains leading to the lagoon should be re-directed away from the lagoon in summer. Included in these is the culvert that drains Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch until 2001, and again in 2005 and 2006 (**Alley 1995; 1996b; 1997-2000; 2005; 2006**). There was improvement noted in 2008 with no gray water observations and in 2007 with only one instance. By comparison, these plumes were observed on 8 of 12, two-week monitorings in 2006. This improvement may have resulted from replacement of sewage pipes along Riverview Road in the vicinity of Noble Gulch in fall of 2006.

There has been a pollution problem and high flashiness in streamflow in the past after the first small storms of the fall. At times, the lagoon required breaching prematurely because the flume could not accept all of the stormflow, and flooding was 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.

Continuing and New Recommendations and Those Not Yet Fully Implemented

1. Require that Margaritaville staff discontinue washing their patio and adjacent walkway (containing refuse dumpsters) off into the lagoon.

2. Consider restricting the number/weight of float participants allowed to ride on the floats to a safe level.

3. Recommend to the Begonia Festival organizers that floats be more 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 once they have cleared the bridge.

4. Recommend to the Begonia Festival organizers to discourage alcohol consumption by float participants and rowdy behavior on their floats.

5. Contact the USGS and request that they update the streamflow measurements at their Soquel Village gage (11160000) regularly and preferably every 15 minutes. Updating was slow and erratic during the emergency sandbar breaching period of 1-2 November 2008, making it difficult to predict the fluctuation of lagoon level during stormflow.

6. Repair the cracked flume. Its integrity is jeopardized, and the beach sinkholes created by flume underflow are a safety hazard.

7. Use wedges 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.

8. 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.

9. 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.

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

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

12. 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.

13. 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.

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

15. 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.

16. Continue to retain large woody material in the lagoon for fish cover.

17. 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.

18. In anticipation of a sandbar breach in the fall, the notch in the sandbar should be cut slightly lower than the piling bolt. *Continue to make the notch a 20-30 foot wide swath across the beach to maximize the possibility of maintaining an estuary with some depth after the breach.* Continue to place secondary berms near the flume exit and entrance to prevent tidal overwash through this swath. 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.

19. 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.

20. 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.

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

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

23. 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

Results of Fish Seining Prior to Construction Activities

18 May 2009. The Creek flowed laterally across the beach at approximately 7–8 cubic feet per second and emptied into the Monterey Bay at the jetty. The flume had been mostly cleared of sand the previous week. The lower lateral channel seined before it was blocked off at 0800 hr. The channel was blocked off to allow fish rescue at the upper end of the lateral channel. The overflow from the lagoon ran through a narrow channel cut adjacent to but not immediately alongside the flume. Fourteen seine hauls were made in the lateral channel from 0730 to 0930 hr with a beach seine that was 30 ft x 4 feet with 1/8-inch mesh. There was considerable kelp near the entrance to the lateral channel, making seining difficult in that area as is sometimes the case. The lateral channel was narrow (approximately 15 feet wide) and flat. Cary Oyama of the Capitola Public Works Department assisted Don Alley in the fish relocation. Unlike in most previous years, adult prickly sculpin were present in the upper lateral channel. They did not do well with presumably low oxygen levels, and rapid relocation was necessary to prevent their mortality. Numbers of fish relocated were, therefore, less precisely counted than previous years. Fish captured included 6 adult prickly sculpin (Cottus asper), approximately 100 staghorn sculpins (*Leptocottus armatus*), approximately 50 threespine sticklebacks (*Gasterosteus aculeatus*), approximately 8 young-of-the-year starry flounders (*Platichthys stellatus*) and one adult tidewater goby (*Eucyclogobius newberryi*). No other fish species were detected in the lateral channel. Rescued fish were relocated to the main lagoon/ estuary.

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Monitoring of Flume Maintenance and Sandbar Construction

Sandbar construction was done prior to Memorial Day weekend, as is preferred by the City. The winter storms had been minimal, although a storm that brought streamflow up to nearly 40 cfs at the Soquel Village gage occurred in early May. Streamflow was estimated between 7 and 8 cfs at the gage during sandbar construction. The estuary had not experienced much daily tidal action for the previous few weeks due to the absence of extreme high and low tides and the greater depth of the estuary behind an elevated berm before the lateral channel. Filamentous algae was observed on the bottom in places, and a light green-yellow cloud of phytoplankton existed above the decomposing plant material in patches of the lower lagoon. This was likely due to a reduction in tidal influence this year. The thickest organic debris was adjacent and under the Esplanade Restaurants. Therefore, raking was focused on the lower lagoon within approximately 50 meters of the flume inlet. Like in most years, the thalweg of the lower lagoon below Stockton Bridge was on the east side (Esplanade side) near the restaurants. Low tide during the construction week came after 1200 hr each day, delaying the time of daily sandbar opening and the period of raking of material out of the lagoon. Nearly all of the estuary downstream of Stockton Bridge remained watered throughout the daily draw-downs. Gull mortality was higher this spring, with approximately 5 observed the previous week. Three adult tidewater gobies were found in the lower lagoon and no young-of-the-year. Three artificial openings and closing were necessary for sandbar construction, with minimal change in wetted area in the lower estuary. Approximately 40% of the estuary was raked downstream of Stockton Bridge, and approximately 70% of the plant material was removed there. The more shallow margins of the estuary were avoided so as not to disturb habitat. Interestingly, a large redwood rootmass that had been near Noble Gulch in 2008 was now approximately 300 meters upstream.

18 May 2009. The biologist arrived at 0645 hr. Sand grading on the beach began this day. As in most years, Soquel Creek was flowing out to the Monterey Bay in a channel that laterally crossed the beach to the eastern jetty. The flume had been mostly cleared of sand the previous week by Public Works staff, with adequate screening of the intake hose for water pumped into the flume. Less sand than usual was trapped in the flume over the winter (Ed Morrison personal communication). On 18 May, a narrow channel was cut through the beach adjacent to the flume, but not immediately alongside, to bypass flow after the lateral channel was blocked off for fish rescue. The sand from the auxiliary channel was used to block off the lateral channel. The fish removal from the lateral channel began at approximately 0730 hr and ended at approximately 0930 hr. By 0800 hr, the lateral channel was blocked off from the estuary. Fish were rescued from it before the channel was covered over with sand. Fish were relocated to the main estuary/lagoon. A sick gull was picked up among the large boulders alongside the lateral channel and taken to animal rescue facilities by City staff. Flume boards on the eastern restaurant side of the flume inlet were removed except for the lowermost one. The eastern side of the flume outlet was also opened. The estuary was drawn down approximately 1.5 feet during the day's activities. The estuary width was from bank to bank and had not narrowed more than 2 feet during the construction activities. Two cormorants were observed in the lower estuary.

The lagoon began to slowly fill after sandbar closure. There was concern by Public Works that if they opened the flume outlet completely, the lagoon would not fill overnight and/or the flume

would fill with sand overnight because of the low streamflow. However, fortunately there was sufficient streamflow to prevent this. Matt Kotila, the equipment operator, began to cover over the lateral channel with sand after sandbar closure. By the end of the day, the lateral channel was covered over with sand along the restaurant patio down to the jetty. All tractor work was performed above the tidal action and water contact was avoided.

19 May 2009. The biologist arrived at 0630 hr. The lagoon had partially filled overnight, and had spilled over the lower board in the flume inlet and exited the flume to allow fish passage. No steelhead were observed in the lower lagoon prior to sandbar opening this day. A dead gull was lying in the sand near the Esplanade. A raft of 31 cormorants floated in the Bay beyond the flume outlet. Low tide was not to occur until 1300 hr. The sandbar dam across the auxiliary channel was opened between 0830 and 0900 hr. The estuary was shallow enough to begin raking of plant material at 0930 hr. Five City staff and the biologist took part in the raking. The sandbar was opened at 0630 hr adjacent to the flume. They raked kelp and seagrass out of the lagoon primarily near the restaurants in the lower 1/3 of the estuary downstream of the Stockton Avenue Bridge. No fish were observed during raking. At 1045 hr, the biologist surveyed upstream for potentially stranded fish along the estuary margin. This year, the side-pools were below the elevation of the main channel. The biologist deepened the side channels into these side-pools to insure that they remained watered during the daily draw-downs. As a precautionary effort, we dipnetted perhaps 100 very small YOY threespine stickleback out of the smallest side-channel pool. As it turned out, this pool did not become dewatered, nor did any other side-pool during drawdown. Only one juvenile steelhead was observed in the largest side-channel pool downstream of the Shadowbrook restaurant. The sandbar was closed at 1415 hr after cloudy water was allowed to evacuate the estuary. The same flume inlet-outlet configuration was used as the day before with the flume outlet open.

The stream ran along the eastern bulkhead until just below the trestle, where it switched to the western side. Then it entered a wide deep area just below the Stockton Bridge, with the deepest thalweg near the Beach House on the Esplanade. The estuary bottom, downstream of the Stockton Avenue Bridge, consisted of sand with some cobble. The decomposing vegetative material was mostly in the lower half of Reach 1 below the bridge.

20 May 2009. The biologist arrived at 0700 hr. The lagoon had filled sufficiently overnight to overtop the board in the flume inlet, allowing steelhead passage through the flume. The sandbar dam was opened at approximately 1000 hr. Again, 6 Public Works staff and the biologist raked kelp and sea grass out of the lagoon, beginning at 1045 hr. No fish were observed during raking. The exit channel was deepened to allow greater drawdown and water velocity. However, this made little noticeable difference. The biologist walked up the creek channel at 1200 hr to check the side pools. None were becoming dewatered. No fish required relocation. Raking ended at 1400 hr with the lower half of Reach 1 raked. Considerable material had settled on the west side near the estuary opening, however. No deepening of the Venetian Court side of the lower lagoon was necessary. Kotila flattened the area around the flume inlet before the The one board was left in the flume inlet as before sandbar was closed at 1500 hr.

21 May 2009. The biologist arrived at 0930 hr, anticipating a late lagoon opening. Water was flowing over the flume inlet board, allowing steelhead passage through the flume. The sandbar

was opened at 1100 hr. Seven City staff and the biologist began raking as soon as conditions became shallow enough. Work was focused on the lower ½ of Reach 1 below the Stockton Bridge, with as many staff as could be freed up for the work. An estimated 70% of the plant material in this reach had been raked out by the time raking ceased at 1300 hr. The biologist went upstream to check on the previously stable side-pools at 1300 hr. The side-pools remained watered as in previous days. One great blue heron was observed flying down the lagoon.

The area around the flume was compacted with the tractor. Clear visquine was laid around the flume. Sandbags were laid against the visquine all around the flume inlet and elsewhere to hold the visquine down. The visquine was covered with sand shoveled by hand. The sandbar was closed for the season during low tide at 1435 hr. The wooden baffle was still intact inside the flume to maintain water depth on the floor of the flume inlet. The plan was to add one board each night to the flume inlet to provide fish passage and gradually raise the lagoon water level. An underwater portal, 8"x 8" square, was to be constructed and maintained if there was sufficient flow to raise the lagoon above it.

From this day onward until project completion, the beach preparation was monitored by Ed Morrison, the city staff person in charge of field operations. Water flowed through the flume each night thereafter. However, kelp and sand had lodged in the flume overnight to prevent water from flowing out. The sheet metal plates were placed under the sidewalk grates on the Esplanade on 22 May.

25 May 2009. The lagoon had filled to within 2 inches of the top of the flume this day with a gage reading of 2.24, and water flowed unimpeded through the flume to provide fish passage. Water temperature probes were launched in the lagoon as required by the permit, as well as upstream of the lagoon near Nob Hill. Saltwater was detected in the lagoon only in a deep hole near the Venetian Court wall. It was 23 ppt near the bottom at 2.5 meters depth with a water temperature of 19.9 C. We recommended that a shroud be placed on the flume for two weeks. Saltwater was not detected under the Stockton Bridge or in the deeper area near the trestle. Water temperature under the bridge was cool at 16.5−16.8 C, and oxygen levels were good at above 9.3 mg/l except at the bottom where it was 6.45 mg/l.

Effect of Sandbar Construction on Tidewater Gobies in 2009

It was likely that most tidewater gobies used habitat upstream of the construction area, where there was less tidal fluctuation and salinity. Only three adult individuals were detected. No mortality of tidewater goby was observed during the construction activities. No evidence of young-of-the-year production was noted in the lower estuary. However, artificial water level fluctuations were created during sandbar construction activities. These breaches left the lower estuary margins unchanged because they were especially deep. Three sandbar breaches were required during sandbar preparation in 2009, with 3 breaches allowed by the permit without regulatory consultation. The 3 breaches closely mimicked normal tidal fluctuations of an estuary. With each lowering of the water in the estuary, tidewater gobies would have to retreat to deeper water in the upper estuary as water surface receded in the upper estuary. The channel lacks sheltered backwaters for gobies to escape high water velocity during high stormflows, and the

population first discovered again in fall 2008 after an 11-year absence and may be transitory.

Effect of Sandbar Construction on Steelhead in 2008

No negative impacts to steelhead were detected in 2009. The flume outlet was open during the entire period, and smolts had access to the ocean nightly. Only one smolt was observed during estuary surveys, indicating that smolt emigration was mostly over. It was beneficial to promote lagoon filling each night.

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 closure would allow considerable kelp and sea grass to become trapped in the lagoon to decompose. Under natural sandbar formation, 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. 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 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 Don Alley and Stafford Lehr (now with CDFG) indicated that a few YOY steelhead were down-migrating in May, but the number greatly increased in June.

2. 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.

3. 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.

4. 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**).

5. 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.

6. Annually evaluate the structural integrity of the flume and its supports. Repair cracks and supports as necessary. (A grant has been secured for flume repair.) This will prevent sinkholes from forming and reduce water leaking from the lagoon along the flume.

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

8. 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.

9. 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.

10. 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 and 2008, when stream inflow is insufficient to fill an underwater portal and allow lagoon filling, opt for a larger notch in the upper boards to accommodate adult kelts and smolts instead of a deeper underwater portal for kelts.

11. Maintain the 1-foot high baffle inside the flume until July 1 for safe entrance of out-migrating smolts into the flume inlet as they travel to the Monterey Bay.

12. 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.

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 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. 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.

Sandbar Breaching During the 2009-20010 Rainy Season.

12 October 2009. Kotila cut a notch 6 inches above the top of the flume in the mini-berm that spanned the 30-foot wide notch across the sandbar in anticipation of forecasted storm. No boards were removed from the flume inlet because at least 1-3 inches of rain were forecasted, which would cause stormflow to exceed the capacity of the flume (approximately 30 cfs). As it turned out, the Santa Cruz Mountains received 8-10 inches from an unusual early storm caused by an earlier typhoon in Asia.

13 October 2009. At 1845 hr, the sandbar breached through the pre-constructed notch. Morrison, Jesberg and Kotila were present. The biologist arrived at 1850 hr, just after breaching. The channel was 10 feet wide, and the tide was incoming. Later in the night, the Soquel USGS gage registered a stormflow of 3,920 cfs. In the San Lorenzo Valley, Brookdale received 8 inches of rain overnight, while Boulder Creek received 10 inches. The rain was apparently more intense in the Soquel watershed because the San Lorenzo watershed, with approximately twice the area produced only 5,000 cfs at the Big Trees gage. This was the earliest breach observed in the past 20 years.

16 October 2009. Morning streamflow was 9.1 cfs, as indicated by the Soquel Village USGS gage.

29 November 2009. Morning streamflow was 5 cfs, as indicated by the Soquel Village USGS gage, with the channel having migrated laterally south since the initial breach. The sandbar had remained open to the Bay despite no significant precipitation since 13-14 October.

10-11 December 2009. The next significant stormflow occurred.

Recommendations Regarding Sandbar Breaching

1. Contact the USGS and request that they update the streamflow measurements at their Soquel Village gage (11160000) regularly and preferably every 15 minutes. Updating was slow and erratic during the emergency sandbar breaching period of 1-2 November 2008, making it difficult to predict the fluctuation of lagoon level during stormflow.

2. 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.

3. The notch in the sandbar should be cut slightly lower than the piling bolt. *Make the notch at least 20-30 foot wide across the beach to 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.

4. 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. 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. After the stormflow subsides, replace the cover until the next storm.

5. 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.

6. Notify the California Department of Fish and Game 12 hours before the possibility of a

sandbar breach and immediately after the breach occurs.

7. 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.

8. 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 2009

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. Water temperatures above 22º C (72º F) (**Table 1**) and oxygen levels below 5 parts per million (mg/L) are thought to stress steelhead. However, steelhead have been 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 1996**). Based on 1988 monitoring, steelhead appear to survive 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 3-5º 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." 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, being 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 2009, 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. 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 in Soquel Creek near the Nob Hill shopping center, just upstream of the lagoon. The stream data were compared to lagoon conditions of water temperature and oxygen levels in early morning.

In 2009, as required by the CDFG permit, 6 HOBO temperature loggers were launched on 25 May 2009 just downstream of the railroad trestle in Reach 2 (as in 2008) at 1-foot intervals through the water column beginning at 0.5 feet above the bottom and ending 5.5 feet from the bottom. The previously used location, just upstream of the trestle had filled in at least a foot over the 2007-2008 winter. The 2008 monitoring location was shifted downstream from the 2007 location because it was deeper, and this location was used again in 2009. Another logger was placed in Soquel Creek near the Nob Hill Shopping Center. All 7 loggers were removed on 4 October 2009, prior to any forecasted rain.

Water quality in terms of oxygen concentration, temperature, conductivity and salinity was measured at each lagoon station at two-week intervals after the sandbar was constructed until the sandbar breached in the fall. Prior to the first full monitoring, salinity was measured in deeper portions of the lagoon to determine if saltwater had been trapped during sandbar construction. Saltwater was detected in 2009, and a shroud was placed on the flume inlet to draw the heavier saltwater off the lagoon bottom to hasten the freshwater conversion in the lagoon. In 2009, the CDFG permit required that monitoring occur in the early morning and late afternoon. Prior to 2003, water quality had been measured only in the early morning after dawn because the most limiting factor, oxygen concentration, is at a minimum at that time.

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 and for Rating Gage Height Readings.

MORNING RATING	MORNING TEMPERATURE (Celsius)	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). Although 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, our annual sampling of juvenile steelhead in Soquel Lagoon indicates that growth rate in the lagoon has been greater than in the upstream stream reaches (**Alley 2008a; 2008b**), with nearly all young-of-the-year juveniles rearing in the lagoon reaching smolt size the first summer each year. This indicates that higher water temperature has not prevented relatively rapid growth of juveniles in the lagoon, where 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). However, we do not believe that Soquel Creek Lagoon may be cooled sufficiently to support juvenile coho salmon.

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 remains above summer low-flow and juvenile salmonids are feeding and growing rapidly. From June1 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. 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." 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 (**SYRTAC 2000**), further south of Soquel Creek. 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 by NOAA Fisheries biologists and D.W. ALLEY & Associates in Reach 9 in Fall 2008, supporting the potential for coho recovery in Soquel Creek. We do not believe that the mainstem Reaches 1-6, downstream of the Moores Gulch confluence can become sufficiently shaded to reach this goal.

Results of Water Quality Monitoring of the Lagoon After Sandbar Closure

Lagoon Level. **Appendix A** provides detailed water quality data. **Table 3** rates habitat conditions. The lagoon level was maintained mostly in the good range for the summer and during the Begonia Festival, except in the fair range in mid-June and late September and a period between 12 and 4 October when lagoon levels had been reduced to allow photosynthesis after turbidity was caused by a small stormflow 13-14 September. The lagoon level was monitored 11 times in 1 to 2-week intervals from 25 May to 10 October 2009, plus on 6 September, the day of the Begonia Festival, and on 19 September after a small stormflow. For 2009, the measurements of lagoon level as measured on the staff gage were rated "good" (**Table 2**) on 10 occasions and "fair" on 3 occasions (**Table 3; Figure 2a**). By 4 October, the day of the first fish sampling, all boards had been replaced. The biologist had recommended the removal of boards to maintain plant-life in the lagoon and to avoid a low oxygen problem. The turbidity persisted due to the especially low stream inflow to the lagoon. When water clarity returned, the lagoon level was brought back up by 4 October. However, the storm on 13 October required an emergency breach of the sandbar.

Maintenance of lagoon gage height was higher in 2009 than 2006, and similar to 2008 except being higher in late July and lower in late September after the early storm **Figure 2**). 2007 had the best gage height throughout the summer/fall, it being higher in early summer than in either 2008 or 2009. (Lower stream inflow in 2008 and 2009, combined with leakage under the flume early on, required increased maintenance to seal the flume inlet boards with visquine/plywood and added sandbags to reduce leakage. The early storm on 13 September and persistent turbidity afterwards required that inlet boards be removed to maintain light penetration through the latter half of September. Saltwater was trapped in the lagoon in deep pockets near the Venetian Court wall at the time of sandbar closure, requiring shroud installation on the flume inlet. This saltwater was flushed through the sandbar within two weeks.

No vandalism of the flume inlet was detected in 2009. The plywood protected against both back-pressure and vandalism for most of the lagoon season. 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 (**1990; 2004**), steelhead smolt passage is to be maintained until July 1. A flume depth of 12 inches or deeper was desired at the entrance until July 1. The flume was cleared of sand prior to sandbar construction in 2009. One side of the flume outlet was opened on the first day of sandbar construction, and one board was left in the flume inlet each night to allow some lagoon filling. Water spilled over the inlet board each night, allowing steelhead smolt access to the Bay throughout the sandbar construction period in 2009 (**Table 3**). This was an improvement over 2008, when streamflow was even lower than in 2009. The baffle near the flume inlet remained from 2008. An adult steelhead portal was installed 6 inches below the top of the inlet boards. It was removed prior to the 19 July monitoring. The lagoon level was in the "good" range by 25 May, 4 days after sandbar closure.

After the 13-14 September storm, 2 boards were removed from the Esplanade side of the flume inlet. This created a gap at the top of the flume inlet. No screens were in place. One board was added back prior to 19 September, and both boards were in place by 4 October. The sandbar was breached on 13 October during a large stormflow and remained open for adult passage for the winter.

Water Temperature Results from Two-Week Monitoring. In 2009, the lagoon was substantially cooler (2 to 3° C) near the bottom in morning and afternoon than in 2008 at 3 of 6 monitoring times before 1 September and similar to 2008 after that except for warmer conditions in mid-September and mid-October prior to stormflow (**Table 3, Figures 3a-d; Appendix A**). The cooler water temperatures in early and mid-summer 2009 than 2008 were consistent with cooler air temperatures in June and July at the Watsonville Airport (**Table 4**), cooler inflow to the lagoon (**Figure 3f and Alley 2009**), especially in June, and the lack of a saline layer on the bottom that had existed periodically in 2008 at Stockton Bridge. Air temperatures were warmer in August and September 2009 than previous months, with water temperatures peaking in mid-August. Air temperatures in 2009 were also warmer than August and September 2008 at Watsonville Airport. The warmer lagoon temperatures in 2009 in mid-September and mid-October were consistent with warmer inflow in 2009. The warmest water temperature measured near the bottom in the morning was 21° C (69.8° F) on 15 August at the Stockton Bridge. Typically, at most other monitoring stations and at times without a saline layer, morning water temperatures near the bottom are less than 21° C. In 2009, water temperatures near the lagoon bottom in the morning were rated "good" (<20° C) or "fair" (20–21.5° C) at all stations throughout the lagoon season. The warmest afternoon water temperatures recorded near the bottom at the monitoring stations during two-week monitoring was 21.9° C in late August compared to 24.6° C, under the bridge in early July 2008.

At the mouth of Noble Gulch, a slightly cooler layer of water was detected near the bottom in early morning, and the largest decrease in water temperature of all the monitoring stations was detected there on afternoon monitorings (**Appendix A**). This resulted from slightly cooler water entering from Noble Gulch during the lagoon period. For example, on one of the warmest water temperature monitoring days in 2009 (15 August), the surface and bottom temperature readings near dawn were 19.6 and 19.1° C, respectively (**Appendix A**). In the afternoon at 1510 hr they were 22.7 and 21.0° C, respectively.

Table 3. 2009 Morning Water Quality Ratings in Soquel Creek Lagoon, Within 0.25 m of Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salin-ity	Lagoon In-flow Visual est. (cfs)
25May09	open	2.24 good	- good - -	- good - -	- good - -	
07June09	open	2.28 good	good*	good	good	6.5 cfs
21June09	open	2.07 fair	good	good	good	6 cfs
02Jul09	open	2.24 good	good	good fair fair good	good	3.5 cfs
19Jul09	open	2.56 Good	fair fair fair good	good good good fair	good	3.25 cfs
01Aug09	open	2.55 good	fair fair good good	good	good	3 cfs
15Aug09	open	2.49 good	fair fair fair good	good	good	2.5 cfs
29Aug09	open	2.46 good	fair fair fair fair	good	good	1.5 cfs
06Sep09 Begonia Festival	open (morning)	2.24 good	- fair - fair	- good - good	- good - good	
06Sep09	open (afternoon)	2.26 good	- poor - poor	- good - good	- good - good	
12Sep09	open	2.44 good	fair fair good good	good good good fair	good	1.25 cfs
19Sep09	open	2.19 Fair	- good - -	- poor - -	- good - -	
26Sep09	open	2.14 fair	good	fair fair fair good	good	1.25 cfs
10Oct09	open	2.55 good	good	good	good	1.25 cfs

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

Table 4. Monthly Statistics for Air Temperature in Capitola in 2007 and at the Watsonville Airport in July through September in 2007 – 2009.

Month/ Year	Max. Temp. ˚ F Capitola	Avg. Daily Max. Temp. ˚ F Watson-ville	Avg. Temp. ˚ F Capitola	Min. Temp. ˚ F Capitola	Avg. Daily Min. Temp. ˚ F Watson-ville	Avg. Temp. ◦F Watson-ville	Days with Fog at Watsonville Airport
June 2007	NA	NA	NA	NA	NA	NA	NA
June 2008	NA	74	NA	NA	53.4	61.8	17
June 2009	**NA**	**70.9**	**NA**	**NA**	**51.9**	**61.4**	**11**
July 2007	80.9 (13 July)	65	61.4	48.3	54	NA	22
July 2008	NA	71.9	NA	NA	53.4	62.6	25
July 2009	**NA**	**72.6**	**NA**	**NA**	**51.9**	**62.2**	**23**
August 2007	83.2 (16 Aug)	66	61.3	49.2	55	NA	22
August 2008	NA	73	NA	NA	53.2	63.1	23
August 2009	**NA**	**75.3**	**NA**	**NA**	**53.7**	**64.5**	**24**
September 2007	89.9 (26 Sep)	69	61.5	44.8	54	NA	18
September 2008	NA	75.4	NA	NA	52.1	63.8	18
September 2009	**NA**	**77.7**	**NA**	**NA**	**52.4**	**65**	**20**

Like most years when no saline layer develops later in the summer from overwash, water temperature at dawn within 0.25 m of the bottom of the lagoon became warmer as the monitoring stations progressed down the lagoon from Noble Gulch to the flume, at least for June and July (**Figure 3f**). However in August through October monitoring, morning water temperatures were very similar at Stations 1-3, with the deep Station 2 at the Bridge sometimes

being cooler than the other two. With cooler water emptying in from Noble Gulch, Station 4 was always cooler than the other 3 stations. Although the station at Noble Gulch was sometimes cooler than other stations, the other three stations were similar when saltwater was absent. Water temperature of the stream inflow was cooler in the morning than the lagoon, with 2-week fluctuations in lagoon inflow temperature mirrored in early-morning lagoon temperatures except when the saline layer caused the Stockton Bridge station to be warmer (**Figure 3f**). The correspondence between inflow fluctuations and lagoon temperature fluctuations indicated that the inflow temperature influenced the lagoon temperature in 2009 as in previous years. Stream inflow temperatures were typically 3–4° C cooler in the morning than lagoon water temperature at the 3 lower lagoon stations. The cool inflow from Noble Gulch maintained substantially cooler lagoon water temperature in the morning and afternoon at Station 4 near the bottom than the other three lagoon stations (**Figure 3f and 3g-1**). Usually, morning water temperature was 3-4° C cooler at Station 4 than Station 1. In the afternoon, the difference was usually 1-1.5° C.

Water Temperature Results from Continuous Data Loggers. In analyzing temperature data from the 6 data loggers throughout the water column 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 19 years. However, the following analysis pertains to the vicinity of these continuous data loggers only. Keep in mind that our 2-week monitoring at the 4 sites indicated that Station 4 near the mouth of Noble Gulch had cooler water temperatures near the bottom than Site 3 near the trestle where these continuous data loggers were deployed (**Figures 3f and 3g-1**).

Juvenile steelhead likely spend most of their time near the bottom, except when feeding on emerging aquatic insects at dusk and dawn. This assumption is based on years of underwater observations of salmonids. Therefore, the water temperature recorded near the lagoon bottom (within 0.25 m) has greatest relevance to assessing habitat quality.

Lagoon water temperatures (**Figures 4a- 4l**) closely mirrored temperatures in the stream inflow (**Figures 5a-b**) in 2009, as in past years. Daily temperature *minima* in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2009, as substantiated in **Table 5**. In 2009, the 7-day rolling average temperature was 1 – 3.5° C cooler in the stream than 0.5 ft from the bottom in the lagoon near the trestle, as substantiated by seasonal minima (17.6° C) and maxima (21.0° C) in **Table 5**. Stream inflow in 2009 was generally more than a degree C cooler in 2009 than 2008 in the last half of June and more than a degree C warmer in late August and early September. We see from comparisons of 7-day rolling averages between years that near the lagoon surface, water temperatures were cooler in the first half of the 2009 lagoon period compared to 2008, consistent with differences in stream inflow temperatures (**Figures 4k and 4m; 5a-c**). The warmer 2008 inflow temperature was consistent with the lower streamflow in 2008 and warmer air temperatures in the first half of the summer compared to 2009. But lagoon water temperatures near the bottom were cooler in 2009 during the same period because saltwater influx in 2008 heated up the bottom, and no saltwater lens developed in 2009 (**Figures 4a and 4n**). Stream inflow temperatures were consistently warmer in latter 2009, with 2009 lagoon temperatures near the surface and bottom being periodically warmer than in 2008, although there were periodic cooling periods in 2009 that were absent in 2008.

Table 5. Water Temperature Statistics for Continuous Water Temperature Probes with Readings at 30-minute Intervals in Soquel Lagoon and Stream Inflow Immediately Upstream, 1 June – 15 September.

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
2009	MaximumWater Temperature °C	19.1	22.5	22.1
2009	Minimum Water Temperature °C	14.1	15.9	15.3
2009	Maximum 7-Day Rolling Average	17.5	21.5	21.0
2009	Minimum 7-Day Rolling Average	15.7	18.0	17.6
2009	Average 7-Day Rolling Average	16.7	20.1	19.8
2008	MaximumWater Temperature °C	21.0	23.3	22.8
2008	Minimum Water Temperature °C	15.6	17.5	17.2
2008	Maximum 7-Day Rolling Average	18.2	21.7	22.4
2008	Minimum 7-Day Rolling Average	15.3	18.7	17.9
2008	Average 7-Day Rolling Average	16.6	20.4	20.2
2007	MaximumWater Temperature °C	20.9	21.0	23.2
2007	Minimum Water Temperature °C	13.3	16.6	15.6
2007	Maximum 7-Day Rolling Average	19.2	21.8	22.2
2007	Minimum 7-Day Rolling Average	16.5	17.5	17.2
2007	Average 7-Day Rolling Average	17.1	20.1	20.2

As in past years, no lagoon thermocline (with its warm, well-mixed, oxygen-rich epilimnion above the thermocline and a cool, non-circulated, oxygen-poor hypolimnion below) was detected in 2009 by the data loggers at the deep area near the trestle or at any of the 4, two-week

monitoring stations. 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. During the short period of less than two weeks after sandbar closure a stagnant saline layer developed in the deep hole adjacent to the Venetian Court wall. Lagoon water temperature was slightly warmer near the surface than near the bottom, as seasonal maxima and minima of temperatures and 7-day rolling averages indicated (**Table 5**).

The greatest increase in water temperature recorded from morning to afternoon near the bottom in 2009 was **2.7° C** (4.8° F) on 18 June compared to **1.9° C** (3.4° F) on 1 June in 2008 and **3.0°C** (5.5°F) on 20 June 2007 (**Figures 4a-b; 4n**). The greatest increase near the lagoon surface in 2009 was **4.6° C** (8.2° F) compared to **2.3° C** (4.1° F) on 6 June in 2008 and **5.4°C** (9.7°F) on 16 August in 2007 (**Figures 4k-l; 4m**).

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 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 2006 (**Alley 2006**). In 2005, water temperature near the bottom never reached this threshold. 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**).

The 2009 lagoon did not meet the steelhead management goal of early morning minimum temperature of less than 20°C near the bottom on 16 of 131 days (12%) (**Figure 4a**) compared to 54 of 130 days (42%) measured days in 2008 (**Figure 4n**) and 35 of 124 (28%) measured days in 2007 (**Figure 4o)**. In 2005 and 2006, 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.

The coho management goal of keeping maximum water temperatures below 20ºC (68ºF) near the bottom in the presence of steelhead was not met 57% of the days measured (75 of 131 days) compared to 69% in 2008, 66% in 2007 and 17% in 2006. However, coho prefer to have temperatures below 16°C (depending on food abundance) (**J. Smith pers. communication**), and the lagoon temperature near the bottom went below 16° C on 9 days but the daily maximum was always more. The 2008 lagoon failed to cool to 16°C.

At the creek site near Nob Hill in 2009, all days met the management goal of *no more than 4 hours a day at greater than 20ºC (68ºF)* (**Figure 5a**) and failed on only 1 day (**0.8%**) in 2008 (**Figure 5c**). In 2007, water temperature failed to meet this management goal on **4%** of the days (**Figure 5d**) compared to **12%** in 2006 (**Figure 5e**). 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**).

With a Soquel Creek water temperature goal of having the *average weekly temperature* (7-day rolling average) of 16.7º C (62º F) or cooler for coho salmon, considerably more stream shading will be required to make lower Soquel Creek habitable for this species. From late May to the end of September 2009, the average weekly temperature went as high as 17.5° C and was higher than 16.7° C for a 13-day period and a 15-day period (**Figure 5a**). From late May to the end of September 2008, the average weekly temperature went as high as 18.2ºC (64.7ºF) on 9 July and was higher than 16.7° C for a 20-day period (**Figure 5c**).

Water temperatures in the lagoon closely mirrored temperatures in the stream inflow in 2003-2009. Daily *minima* in the lagoon near the bottom were consistently warmer than the stream above in 1999-2009 (2-3° C warmer in 2008 and 2009) (**Figures 4a-b, 4m, 5a-e and Alley 2006**). The daily *maxima* near the bottom of the lagoon were also warmer than in the stream in 2009 (1-3ºC) (**Figures 4a-4b and 5a-5b**). The daily stream water temperature fluctuated more than the daily lagoon water temperature, as was typically the case in previous years. The maximum daily lagoon water temperature typically occurred between 1700 and 2100 hr each day.

Creek water temperatures were cooler in 2009 than 2008, which was cooler than 2007, based on graphical representations of the 7-day rolling averages. 2009 had the highest baseflow of the three years (**Table 11**), and air temperatures were cooler in June and July but not August and September compared to 2008 (based on data from the Watsonville airport) (**Table 4; Figures 5a-c**). Water temperatures dropped off in the latter half of September 2009 as occurred in 2007. However, water temperatures did not drop off in the latter half of September 2008 the way they did in 2007 and 2009. Unfortunately, the website for Capitola air temperatures was discontinued.

Creek water temperatures in 1999-2009 were much cooler than 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 the warm stream temperatures, lagoon water temperatures in 1998 were relatively cool with the high stream inflow compared to other years (**Alley 2003**).

Aquatic Vegetation Monitoring. In 2009 at the time of sandbar construction, the thickest deposit of kelp and seagrass was located in the deep thalweg near the restaurants and at the beginning of the lateral channel that passed the streamflow through the beach. Only about 40% of the area downstream of Stockton Bridge, and nearest the flume, was raked out. Approximately 70% of the decaying plant material was removed from the area downstream of Stockton Bridge prior to sandbar closure. Thus, there was more decaying material left in the 2009 lagoon than many previous years, including 2008. This material provided considerable nutrients for future algae production in the summer lagoon. By 4 weeks after sandbar closure (21 June), filamentous algae covered 40% of Reach 1, 70% of Reach 2 and 80% of Reach 3. The coverage and thickness of algae was greater in 2009 than 2008 at this same date and until mid-August (**Tables 6 and 7**). After that, average thickness was similar in Reach 1 between the years, but thicker in Reaches 2 and 3 in 2008. However, the average thickness for the season was higher in all reaches in 2009 due to the early rapid growth in 2009. Pondweed was most prominent in Reach 1, as was usually the case. Filamentous algae was first noted during monitoring on 24 June 2007, approximately 4 weeks after sandbar closure; compared to 30 June 2006, 16 days after sandbar closure; compared to 1 July 2005, 3 weeks after sandbar closure in 2005; compared to 27 June 2004, 4.5 weeks after sandbar closure in 2004; and compared to 7 July 2003, 6 weeks after sandbar closure in 2003 (**Alley 2003 - 2009**).

Surface algae in 2009 varied between 0 and 5% in Reach 1, 0 and 25% in Reach 2, 0 and 3% in Reach 3 and 0 and 25% at the mouth of Noble Gulch (**Table 6**). It was much more prevalent in 2009 than most years, with the average and maximum surface coverage being more than double that of 2008 in Reaches 1 and 2 and at the mouth of Noble Gulch (**Tables 6 and 7**). The average surface algae coverage for Reaches 1−3 and mouth of Noble Gulch were 2%, 4%, 0.6% and 8.2%, respectively. Surface algae coverage in 2007 and 2008 varied between 0 and 10% in the different reaches, with similar 2-week estimates between the two years except for a higher amount in mid-August 2007. In 2007, the average coverage at the mouth of Noble Gulch was similar to 2009 due to 30% and 15% coverage mid August and early September 2007 (**Alley 2008**). Surface algae in 2006 varied between 0 and 5% coverage, with the most being present in Reach 3 and near Noble Gulch (**Alley 2007**). By contrast, surface algae in 2005 varied between 0 and 20% coverage of Reach 3, with very little in the lower 2 reaches (maximum was 2%) (**Alley 2006**).

Table 6. Visually Estimated Algae Coverage and Thickness in the 2009 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 Cover	% Surf. Cover	Avg. Bottom Thick-ness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thick-ness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thick-ness (ft)	% Bottom Cover	% Surf. Cover
6-07	–	–	5	–	–	2		–	<1	0.4	60	2
6-21	1.1	40	3	0.3	70	10	0.5	80	2	0.5	60	20
7-02	–	–	0	0.5	100	0	0.5	100	0	0.8	70	5
7-19	1.0	70	<1	1.5	100 (1 pond-weed)	25	0.5	100 (1 pond-weed)	3	1.0	95	2
8-01	2.0	100	0	2.0	100 (2 pond-weed)	<1	1.5	100 (2 pond-weed)	<1	1.2	70	25
8-15	2.0	95 (20 pond-weed)	0	0.5	90	0	1.0	100 (1 pond-weed)	0	2.0	90	1
8-29	2.0	90	5	1.5	95	3	1.0	98	<1	2.0	70	7
9-12	2.0	100	<1	2.0	80 (<1 pond-weed)	<1	1.5	100 (1 pond-weed)	1	3.0	60	20
9-26	Turbid	Turbid	0	Turbid	Turbid	0	Turbid	Turbid	<1	Turbid	Turbid	0
10-10	Dark	Dark	5	Dark	Dark	0	Dark	Dark	0	Dark	Dark	0
Avg-6-07 – 9-12	**1.7**	**83**	**2.0**	**1.2**	**91**	**4.0**	**0.9**	**97**	**0.6**	**1.4**	**72**	**8.2**

Table 7. Visually Estimated Algae Coverage and Thickness in the 2008 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 Cover	% Surf. Cover	Avg. Bottom Thick-ness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thick-ness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thick-ness (ft)	% Bottom Cover	% Surf. Cover
6-7	0 Light Phyto-Plank-ton	0	0	0 Light Phyto-Plank-ton	0	0	0 Light Phyto-Plank-ton	0	0	0 Light Phyto-Plank ton	0	0
6-21	0.3	40	1	0.4	80	3	0.3	40	3	-	-	10
7-06	0.5	30	<1	0.4	25	<1	0.3	40	<1	0.4	50	<1
7-20	0.5	30	0	0.4	99 (1 pond-weed)	0	0.4	100	0	0.5	30	0
8-03	1.0	95 (5 pond-weed)	0	1.0	95 (5 pond-weed)	0	0.6	99	<1	0.6	60	5
8-16	2.0	95 (5 pond-weed)	0	2.0	97 (3 pond-weed)	0	2.0	100	0	0.6	70	1
8-30	3.0	95 (5 pond-weed)	0	1.75	95 (5 pond-weed)	<1	1.0	99	1	0.2	40	5
9-13	2.0	70 (20 pond-weed)	<1	2.0	93 (7 pond-weed)	2	2.0	50	2	1.0	20	2
9-28	Glare	Glare	0	2.0	95 (5 pond-weed)	0	2.0	85 (15 pond-weed)	0	Glare	Glare	0
10-13	Turbid – phyto-plank-ton Bloom	Turbid - (15 pond-weed)	0	Turbid – phyto-plank-ton Bloom	-	2	Turbid – phyto-plank-ton Bloom	-	0	Turbid – phyto-plank-ton Bloom	-	0
10-26	Turbid	-	0	Turbid	-	0	Turbid	-	0	Turbid	0	0
Avg-6-07 – 9-13	**1.2**	**57**	**0.15**	**1.0**	**73**	**0.65**	**0.8**	**66**	**0.8**	**0.5**	**39**	**2.9**

Dissolved Oxygen Results. Oxygen concentration in the lagoon is lowest at dawn, or soon after, because oxygen has been depleted by cell respiration over night before plant photosynthesis can begin producing oxygen with the light. This is the time when oxygen concentrations are most importantly measured and rated. In 2009, oxygen levels for steelhead were either "fair" (between 5 and 7 mg/l) or "good" (greater than 7 mg/l) *near the bottom at dawn* at all stations during two-week monitorings (**Tables 2 and 3, Figure 6a and Appendix A**). After an early September storm that caused turbidity that restricted light penetration, the lagoon depth was reduced quickly to allow light to penetrate through the entire water column. This encouraged photosynthesis and oxygen production. However, on 19 September, oxygen was still depressed after the 13-14 September storm to 3.6 mg/l near the bottom in early afternoon, with it above 6 mg/l in the upper 1 meter of the water column (**Appendix A**).

Of the early morning oxygen monitorings, Station 1 at the flume was rated "good" 90% of the time (9 of 10, 2-week monitorings) and "fair" the other time (**Table 3; Figure 6b**). Station 2 at Stockton Avenue Bridge was rated "good" 70% of the time (7 of 10 monitorings) and "fair" the remainder of the monitoring (**Figure 6c**). Station 3 near the railroad trestle was rated "good" 80% of the time (8 of 10 monitorings) and "fair" the remainder of the monitoring (**Figure 6d**), as was Station 4 at the mouth of Noble Gulch (**Figure 6e**).

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. At dawn after a previously sunny day, oxygen levels are higher because the water became supersaturated with oxygen from high photosynthetic rates of the lagoon algae and pondweed the previous day. In 2009, oxygen levels were generally lower from June to mid-July and September (just before and after the small September storm that caused turbidity). The lower oxygen levels early in the season were likely a result of less algae and less oxygen production during sunny days. Apparently, greater oxygen production during sunny days at lagoon algal densities more than compensated for the algal respiration loss of oxygen overnight. This phenomenon was also observed in past years, such as in 2005−2008 (**Alley 2006–2009**).The lower oxygen levels in September were due to cloudiness and turbidity that inhibited photosynthesis.

On all monitoring days except 1 August at Stockton Bridge (Station 2) (which was a foggy, overcast day), the oxygen concentration near the bottom and throughout the water column was higher in the afternoon than in the morning at all stations (**Figures 6b-6e**). This occurred despite higher afternoon water temperature, and even on most cloudy days. Oxygen levels increased the least in September and October when the sun angle seasonally diminished and the time of direct sunlight on the lagoon became reduced due to the steep western slope adjacent to the lagoon (**Figures 6b-e; Appendix A**). Oxygen levels on the afternoon of the Begonia Festival (6 September) were supersaturated at Stockton Bridge despite limited clear skies that day (**Appendix A**).

Salinity Results. In 2009, saline conditions were only detected for a short time after sandbar closure on 25 May in the deeper lagoon area along the wall at Venetian Court (**Appendix A**). This resulted from a small amount of saltwater being trapped in the lagoon at the time of sandbar

closure on 21 May. Shrouds were installed on the sandbar inlet to draw the heavier saltwater off the bottom early on, as was recommended in the original lagoon management plan and update (**Alley et. al 2004a**). By our first 2-week monitoring on 7 June, saltwater had dissipated from this location through the flume and sandbar. Then the shrouds were removed. Water temperature had become slightly elevated in the saline layer on the bottom adjacent to the Venetian Court wall, but steelhead could avoid this area, if need be, to avoid any thermal stress. Unlike in 2008, there was apparently sufficient lagoon outflow through the flume in 2009 to prevent saltwater from periodically being flushed back into the lagoon through the flume on certain high tides.

Conductivity Results. Conductivity remained low throughout 2009, except in the Venetian Court's wall-hole early on. It ranged between 650 and 720 umhos at monitoring stations throughout the lagoon period (**Appendix A**). Conductivity was typically slightly lower near the bottom as slightly cooler water entered the lagoon from Noble Gulch.

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. In 2008 there were repeated problems with apparent saltwater back-flushes through the flume at high tides. This was not a problem in 2009 with higher streamflow than in 2008 (**Table 8**). The year 2001 was most affected by tidal overwash in the last 10 years (**Alley 2002a**). In recent years, the sandbar around the periphery of the lagoon has been maintained at a higher elevation to prevent 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.

Habitat conditions in the 2009 lagoon followed a third successive winter with few storms, with a baseflow at the time of sandbar closure of only approximately 6.5 cfs (**Table 8; Figures 20 and 21**). Only 5 of the last 19 years had lower baseflow at the time of sandbar closure, and two of those were the previous two years. By 1 September, prior to any fall rainfall, streamflow had declined to 1.2 cfs at the Soquel Village USGS gage, compared to 0.7 cfs in 2008, 1.3 cfs in 2007 and 6.6 cfs in 2006. The 1 September 2009 baseflow was the 5th lowest in the last 19 years. After the large stormflow of nearly 4,000 cfs on 14 October, baseflow rapidly dropped back to below 10 cfs and declined to 5 cfs by the end of November before the next significant storm occurred in mid-December (**Appendix A; Figure 21**). The sandbar remained open after 13 October, however.

Table 8. Daily Mean Discharge Recorded at the USGS Stream Gage (11160000) in Soquel Village, At One Month Intervals from 1 June to 1 October, 1991-2009 from Graphical Representations.

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

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**.

Begonia Festival Observations and Water Quality Findings. The City's fishery biologist (Donald Alley) was present before, during and after the Begonia Festival. The day of the Festival, 6 September, was initially foggy and overcast until 1000 hr, after which it was sunny only until 1110 hr, after which it was overcast for the remainder of the day. Water temperatures were relatively warm in the morning (warmer than the previous week), but oxygen levels were high (not as high as the previous week. The lagoon depth was maintained at an adequate gage height of 2.24–2.26 ft. There were 9 floats in the nautical parade and 22 other boats, canoes and rafts in the water. In conformance with the permit requirements from the California Department of Fish and Game, no floats were propelled by waders. Means of propulsion included electric motor (8) and pedal kayaks (1). Thus, the lagoon bottom was not disturbed and increased turbidity was negligible until one float capsized downstream of the Stockton Bridge after the parade had ended. Refer to **Appendix A** for details of the mishap. Even with the capsizing and disturbance that followed, the secchi depth at the Stockton Bridge was to the bottom after the parade. Conductivity near the bottom increased very slightly at the Stockton Avenue Bridge from 719 before to 730 umhos after the parade, as was the pattern at the mouth of Noble Gulch in the upper 0.75 m, where it increased from 725 to 746 (**Appendix A**). Conductivity near the bottom at the mouth of Noble Gulch actually decreased during the Festival, with the influence of the Noble Gulch inflow of cooler water near the bottom. The measured levels of conductivity were not stressful to steelhead. There was no odor of hydrogen sulfide, and no fish mortality was observed.

Oxygen concentrations in the afternoon following the nautical parade were very high, ranging between 10.75 and 11.02 mg/l near the bottom before 1500 hr (**Appendix A**). Water temperatures was warm (21.9° C) near the bottom at this time at both monitored sites and likely became warmer later in the day.

Floats were dismantled the following week, and flowers were gathered from the lagoon, using a boat. More than 90% of the petals were retrieved. There were much more petals in the water in 2009 after the parade than usual, due to the Cal-Poly float capsizing. Water quality measurements on 12 September detected no oxygen depletion resulting from decomposing begonias (**Appendix A**).

Pollution Sources. 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. The City had received funding to deter gull use on restaurant roofs, to redirect restaurant gutter systems away from the lagoon and to provide waste cans with gull-proof lids. However, attempts at partnership between the City and Esplanade restaurants for adding gull deterrents to their roofs has, thus far, been unsuccessful. However, conditions of future remodeling will require addition of roof deterrents (**Steve Jesberg, 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.

The staff at Margaritaville routinely washed their patio and the walkway containing refuse cans off into the lagoon on a daily basis. The fish biologist notified the City of this problem, but no change in behavior was observed. A raft of floating algae developed adjacent to Margaritaville in September. This may have resulted from nutrient inputs from staff activities.

Regarding pollution from urban runoff, 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. The City redirected dry-weather runoff to the constructed wetland on the west side of the Stockton Avenue Bridge (just upstream) from the drain on the east side of Stockton Avenue Bridge (just upstream) and the drains at the pier and Venetian Court. Water quality measurements taken at the outlet of the wetland indicated only slight differences compared to those taken at the Stockton Bridge, with no impact to steelhead habitat conditions (**Appendix A**). Oxygen levels near dawn at the wetland outlet were usually very slightly higher than at the Stockton Bridge and water temperatures were very slightly cooler.

Ideally, all storm drains leading to the lagoon should be re-directed away from the lagoon in summer. Included in these is the culvert that drains Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch until 2001, and again in 2005 and 2006 (**Alley 1995; 1996b; 1997-2000; 2005; 2006**). There was improvement noted in 2008 with no gray water observations and in 2007 with only one instance. By comparison, these plumes were observed on 8 of 12, two-week monitorings in 2006. This improvement may have resulted from replacement of sewage pipes along Riverview Road in the vicinity of Noble Gulch in fall of 2006.

There has been a pollution problem and high flashiness in streamflow in the past after the first small storms of the fall. At times, the lagoon required breaching prematurely because the flume could not accept all of the stormflow, and flooding was 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.

Discussion of Options to Improve Water Quality

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 until 2001, and gain in 2005 and 2006 (**Alley 1995; 1996b; 1997-2000; 2005**). There was improvement noted in 2007 with only one instance (30 September) of an observed gray water plume issuing from Noble Gulch out of 14, 2-week monitorings. There was continued improvement in 2008 and 2009, with no gray water observed during the 2-week monitorings. By comparison, these plumes were observed on 8 of 12, 2-week monitorings in 2006. This improvement may have resulted from replacement of sewage pipes along Riverview Road in the vicinity of Noble Gulch in fall of 2006. In 2005, gray water plumes and sometimes oil slicks were observed on 7 of 13, 2-week monitorings. The gray water problem occurred particularly in late September and October in 2005 and was correlated with the highest surface algae estimates. By contrast, gray water plumes were observed in 2004 on only 1 of 11, 2-week monitorings. As further history of the problem, in 2001 and 2002, no gray water was observed during monitorings, but in 2003, the water was murky on 2 of 12 monitorings. In 2000, gray water plumes were observed on 5 of the 7 monitorings.

Stimulation of algal growth has annually occurred at the mouth of Noble Gulch, with consistently greater growth there compared to elsewhere in the lagoon in most years except 2001. Increased algal growth indicates elevated nutrient inputs probably associated with bacteria and retention of decomposing kelp and seagrass in the lagoon at the time of sandbar closure. Oxygen depletion noted at dawn has been greater at the mouth of Noble Gulch in 2002-2005, 2007 for the majority of monitorings (**Figure 6g**) and other years, with usually lower oxygen readings at that station (**Alley 2005**). However, in 2006, 2008 and 2009 oxygen depletion at dawn was not consistently greatest at the mouth of Noble Gulch (**Figures 6a, 6f and 6h**).

Usually, when cloudy water enters the lagoon from Noble Gulch, the water is clear upstream in Noble Gulch at the park beyond Bay Street. This indicates that pollutants enter Noble Gulch from the lower village near Soquel Creek. There are ducks living at the mobile home park up that drainage that could be removed to reduce nutrient influxes and coliform bacterial inputs. A flashboard dam could be constructed in Noble Gulch at Bay Street to impound water to be pumped out for irrigation purposes, provided that lagoon depth is being adequately maintained. Coliform counts greater than 200/ 100 ml are considered a hazard to human health.

By minimizing the summer stream inflow from Noble Gulch, nutrients and bacteria entering the lagoon would be reduced. Algae production may be reduced. However, the benefit of slight reduction in lagoon water temperature at the mouth of Noble Gulch would be eliminated. Another drain into the lagoon is situated under the railroad trestle, where slight oxygen depletion has been detected in recent years. This drain could be capped if summer runoff was re-directed into the sewer.

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 in the lagoon. They roost on the buildings surrounding the lagoon. Restaurant goers and others feed them. Reducing the gull population at Soquel Creek Lagoon would be a major step in reducing pollution. It is likely that the gull population is artificially high because of the artificial food source and artificial roosting areas. If these were reduced, then the gull population would probably decline, and pollution

would be reduced at Soquel Lagoon. All of the refuse cans on the beach were equipped with gull-proof lids in 2006 (**Ed Morrison, pers. comm.**). Regarding roosting, there are methods available to make buildings' roofs inhospitable to gulls. Gull sweeps are an effective option. Parallel wires covered the roof of the Paradise Grill in 2006 and were effective in keeping gulls off since then. The remainder of the restaurants would benefit from this application.

Another source of bird pollution is the rock dove (pigeon) population that circulates between the wharf and the railroad trestle over the lagoon. As stated in the original management plan, the trestle could be screened so that roosting areas were eliminated and bird pollution reduced.

Regarding urban runoff, installation and maintenance of silt and grease traps on storm drains is critical to reducing pollution by petrochemicals. All existing and new drainage systems from new development and parking lots should include installation of effective traps and percolation basins to increase percolation of storm runoff. The City redirected dry-weather runoff to the constructed wetland on the west side of the Stockton Avenue Bridge (just upstream) from the drain on the east side of Stockton Avenue Bridge (just upstream) and the drains at the pier and Venetian Court.

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.

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

1. Require that Margaritaville staff discontinue washing their patio and adjacent walkway (containing refuse dumpsters) off into the lagoon.

2. Consider restricting the number/weight of float participants allowed to ride on the floats to a safe level.

3. Recommend to the Begonia Festival organizers that floats be more 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 once they have cleared the bridge.

4. Recommend to the Begonia Festival organizers to discourage alcohol consumption by float participants and rowdy behavior on their floats.

5. 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.

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

7. 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.

8. 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 notch for steelhead smolts on one side of the flume because of the hole for adult steelhead after June 1, close the underwater portal for adults. If there is plenty of flow to maintain lagoon depth with the adult portal open, leave it open throughout the summer. If adult steelhead are seen in the lagoon after June 1 and the adult portal has been closed, then open the portal for a week to allow out-migration.

9. 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.

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

11. 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.

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

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

14. 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.

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

16. "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**).

17. 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.

18. 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.

19. 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 2009, as was the case in 2003–2008. CDFG 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). In winter 2009-2010, smaller juveniles were planted in the San Lorenzo River and Scott Creek in fear that the Big Creek hatchery would be jeopardized by mudslides resulting from fires the previous summer. No adult steelhead were captured from Soquel Creek for hatchery propagation. Therefore, no juveniles were planted there.

Fish Sampling Results. Our steelhead population estimate based on mark and recapture for fall 2009 was only 449, compared to 7,071 in 2008, to 6,064 in 2007, 992 juveniles in 2006 and 1,454 juveniles in 2005 (**Table 9, Figure 7**) (methods in **Ricker 1971**). This was the third lowest estimate thus far and well below our 17-year average of 1,755 juveniles. The other species captured in fall 2009 were tidewater gobies, threespine sticklebacks, starry flounders, prickly sculpins and staghorn sculpins. One PIT-tagged juveniles from 2008 NOAA Fisheries tagging was captured. This large yearling was first tagged in September 2008 as a YOY at the Spanish Ranch site on East Branch Soquel Creek (**Noah Parker, NOAA Fisheries, pers. comm**.).

We expected more juveniles to use the lagoon in 2007–2009 more than 2006 because there were lower adult passage flows late in the spawning season in 2007–2009 (**Figures 20 and 23; Alley 2009**), encouraging more spawning in the lower creek to seed the lagoon with more young-of-the-year steelhead. The 2008-2009 winter was the wettest of the last three, encouraging more spawning in the upper watershed. However, it is likely that the low 2009 lagoon population size was a result of generally low adult returns and spawning throughout the Santa Cruz Mountains over the past winter. Preliminary findings indicated that juvenile numbers sampled by us at stream sites in 2009 in 4 watersheds, including Soquel Creek, indicated that most sites had less than half those detected in 2008. Low numbers resulted from much fewer YOY. The likely poor adult returns would have resulted from three consecutive years of poor food conditions in the ocean (**Jerry Smith, pers. comm**.).

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 2007–2009 population estimates for the entire Soquel Creek watershed, the lagoon population of larger smolt-sized fish was likely a significant percent of the total watershed population in both of these dry years. The lagoon provides valuable habitat through proper management.

Even with a freshwater lagoon created by the City of Capitola, the water temperature sometimes approaches the upper tolerance limit of steelhead for 1-2 hours per day when fog is absent and stream inflow is warm. If sufficient saltwater were present in the lagoon, water temperatures could become lethal for steelhead. Although tidal overwash occurred in 2001 and 2004, it was

prevented in 2007 except for slight overwash in early December. Saltwater apparently back-flushed through the flume in 2008 with the low freshwater outflow. No tidal overwash or back-flushed seawater was detected in 2009. In 2004, lagoon water temperature reached 24º C (75.2º F) on 20 July after tidal overwash on 19 July. However, the elevated condition lasted only 4 days with quick flume management. The shroud was installed on the flume inlet in 2001 and the adult portal was opened to encourage draining of saltwater from the lagoon. However, due to 2 tidal overwashes in July 2001, daily water temperature near the bottom fluctuated between approximately 23 and 26º C for 14 days in Reaches 1 through 3. This likely forced juveniles higher in the water column or further upstream where water depth was less. This would increase vulnerability to predation. Also, the higher temperature increased fish metabolic rate, possibly reducing growth rate in 2001.

Fall sampling for steelhead occurred on 4 and 11 October 2009, from just upstream of the Stockton Avenue Bridge, downstream. One week passed between samplings. 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 114 juvenile steelhead were captured and clipped on 4 October after 6 seine hauls. 67 juvenile steelhead were captured on 11 October after 6 seine hauls, with 17 recaptures. There were no steelhead mortalities detected on either day. The median size of juvenile steelhead captured the first day in 2009 was 155-159 mm SL (**Figure 8**) compared to 115-119 mm in 2008 (**Figure 9**), 125-129 mm SL in 2007 (**Figure 10**) and 155-159 mm SL in 2006 (**Figure 11**). The median size of captured steelhead on 11 October 2009 was again 155-159 mm SL.

A prominent bimodal histogram was evident in 2009, which was unusual (**Figure 8**). Scale samples have not been aged yet from lagoon fishes. So, size/age relationships are not presently forthcoming. However, it could be that the lagoon population consisted more of larger yearlings and fewer YOY in 2009 than in other years. We suspect from the size distributions of juveniles captured that steelhead grew faster in 2009 than either 2007 or 2008 and similar to 2006, consistent with less competition from a much smaller juvenile population in 2006 and 2009 (**Table 9; Figure 7**). 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 sampled a week earlier in 2008 than 2007, weakening the growth rate comparison. Comparison of size distributions of captured juvenile steelhead and the median size in each of the last 11 years, young-of-the-year growth rate was similarly lower in 2002-2005 and 2008, with intermediate growth rates in 1998-1999 and 2001 and 2007, with faster growth rates in 2000 and 2006.

On 11 October 2009, 4 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 8 tidewater gobies were captured. This was the second consecutive year of their detection since their absence in 1998-2007. Threespine sticklebacks were moderately abundant, and a small starry flounder were also captured. The low number of tidewater gobies captured in 1992-1997, and their absence since the El Niño stormflows in winter 1997-98 until 2008, 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 last drought of the late 1980's and early 1990's. Tidewater gobies

have been reported in recent years in adjacent lagoons (Moran Lake and Aptos) by Jerry Smith (**pers. communication**). Tidewater gobies from up-coastal-current in Moran Lake likely re-colonized Soquel Lagoon in 2008, where Soquel Creek had experienced two mild winters in a row.

In order to maintain good steelhead nursery habitat in Soquel Creek Lagoon, the sediment input from the watershed must be reduced. Stream shading must be increased to provide cooler stream inflow. 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. After the seepage was stopped, the 2009 lagoon level increased in mid July and August and early September. However, the lagoon level was lowered after the 13-14 September storm, and was not raised to maximal levels until early October. With the turbidity remaining for an extended period due to low stream inflow, water depth could not be raised above a gage height of about 2.0 for 3+ weeks (14 September – 10 October).

In 2009, piscivorous birds, including 1−7 mergansers, 1−2 cormorants and 1−2 pied-billed grebes were observed roosting on instream wood at the lagoon or in the water nearby on most two-week monitorings (**Appendix A**). Other occasional piscivorous birds included a horned grebe, a greenback heron and a great blue heron. Piscivorous western pond turtles regularly basked on the instream cottonwood log. Maintenance of lagoon depth is important to make feeding more difficult for these animals.

If the lagoon becomes too shallow, steelhead habitat in the upper lagoon is lost. This is another reason to keep the lagoon as deep as possible during summer. The flume's flashboards must be secured against vandal's who are intent on draining the lagoon and against tidal backpressure that may dislodge the boards.

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. After sandbar breaching on 2 November 2008, the sandbar reformed repeatedly with lagoon filling and then breaching again from early November until mid-December due to low streamflow. Minimizing pollutant input from early fall storms is also important for reducing biological oxygen demand and avoiding fish kills.

Table 9. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2009.

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.

Recommendations Regarding Fish Management

1. 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.

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

3. 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 doing the same thing, as occurred in 2007. 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.

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

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

6. Remove flume boards as the first small storms begin in fall and replace the boards after the stormflow has subsided. The effort should be to minimize lagoon fluctuation until the sandbar actually breaches. 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 and then fail to re-install the flume board afterwards.

7. 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.

8. Contact the USGS and request that they update the streamflow measurements at their Soquel Village gage (11160000) regularly and preferably every 15 minutes. Updating was slow and erratic during the emergency sandbar breaching period of 1-2 November 2008, making it difficult to predict the fluctuation of lagoon level during stormflow.

9. 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.

10. 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 bay.

11. 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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Photo by Jared Chandler

Fish Sampling in Soquel Lagoon, 2009

FIGURES

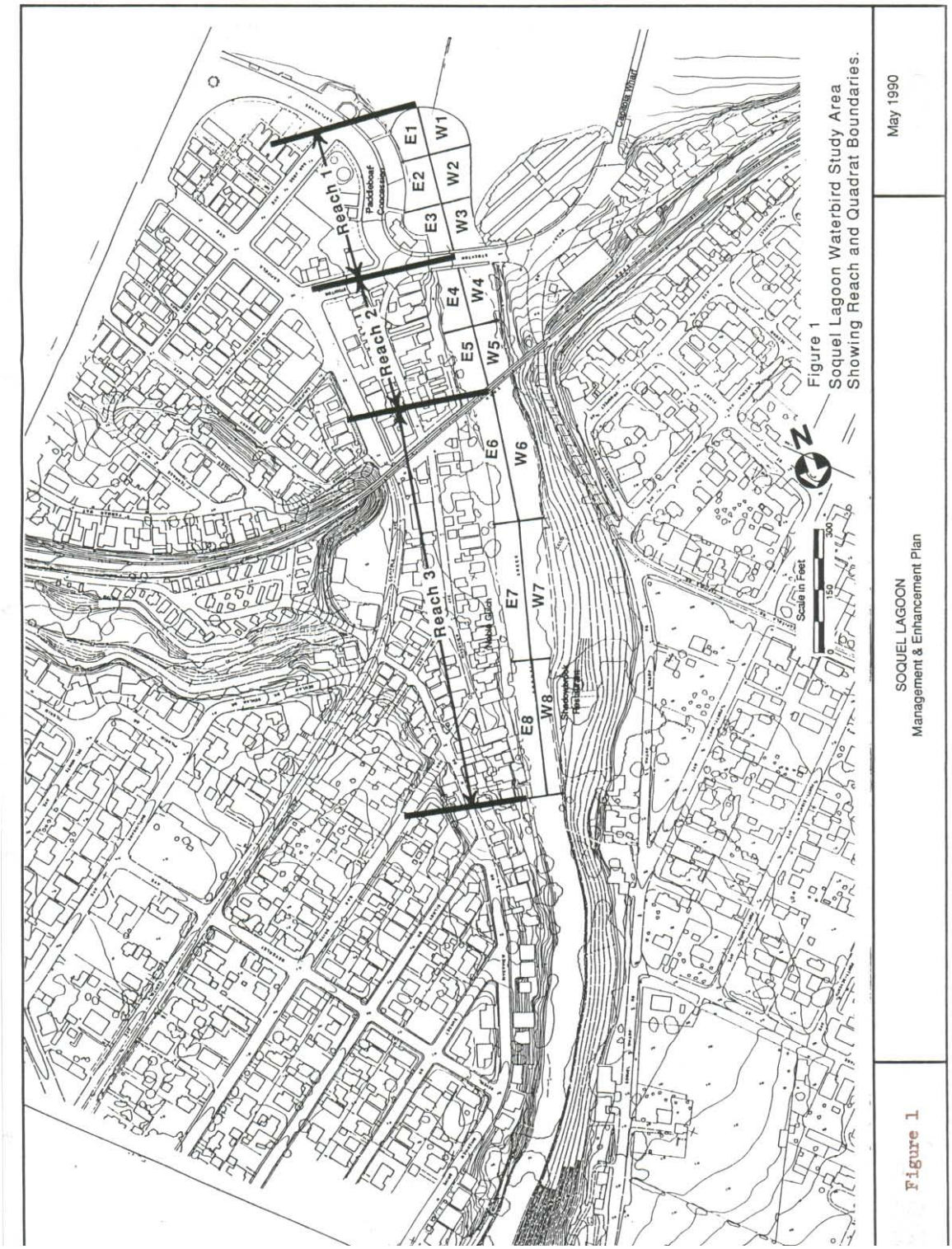

Reach 1
Reach 2
Reach 3
E1
W1
E2
W2
E3
W3
E4
W4
E5
W5
E6
W6
E7
W7
E8
W8
Paddleboat Concession
Capitola Wharf
Shadowbrook Restaurant
Scale in Feet
0
150
300
N
Figure 1
Soquel Lagoon Waterbird Study Area
Showing Reach and Quadrat Boundaries.
May 1990
SOQUEL LAGOON
Management & Enhancement Plan
Figure 1

Figure 2. Soquel Lagoon Gage Height at Stockton Avenue Bridge, From 24 May to 8 December 2006-2009.

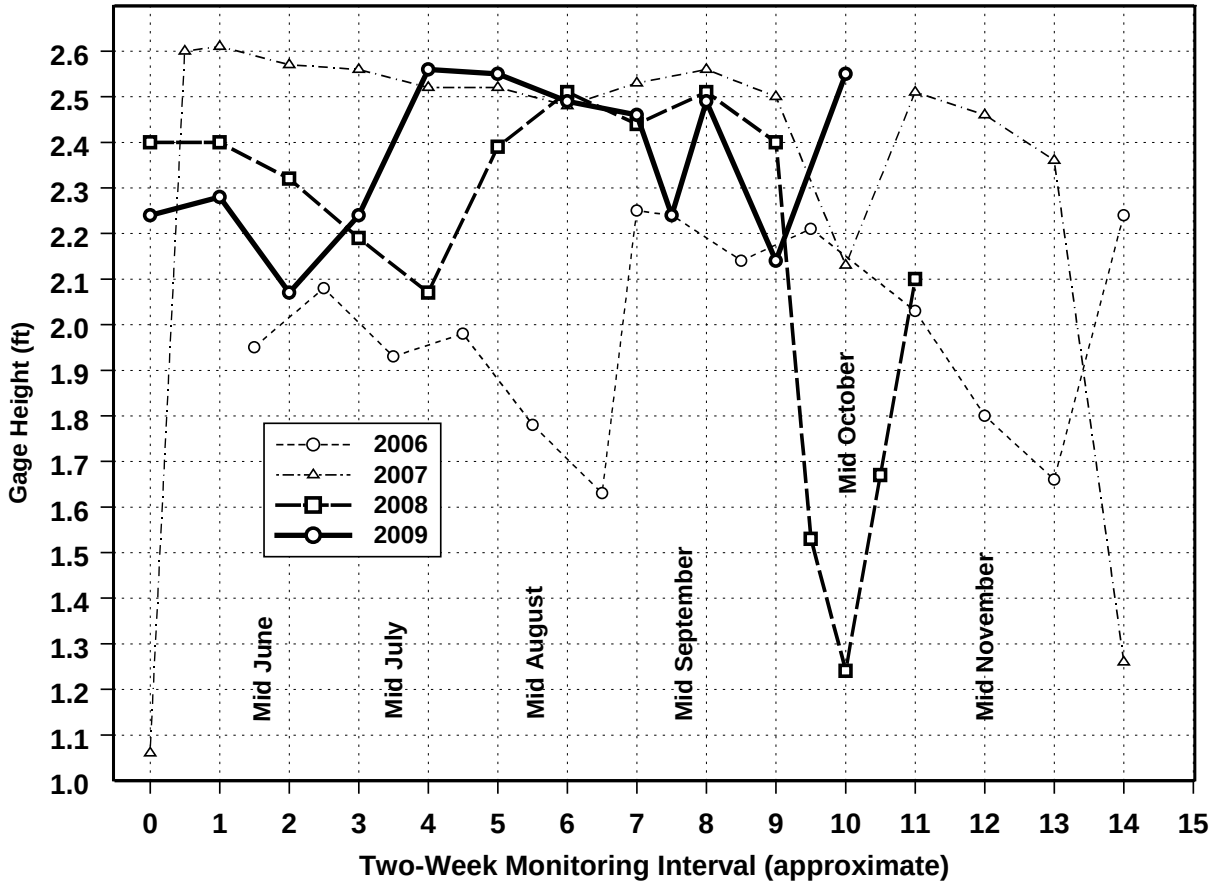


Figure 3a. 2008 and 2009 Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn and in the Afternoon after 1500 hr from 7 June to 26 October.

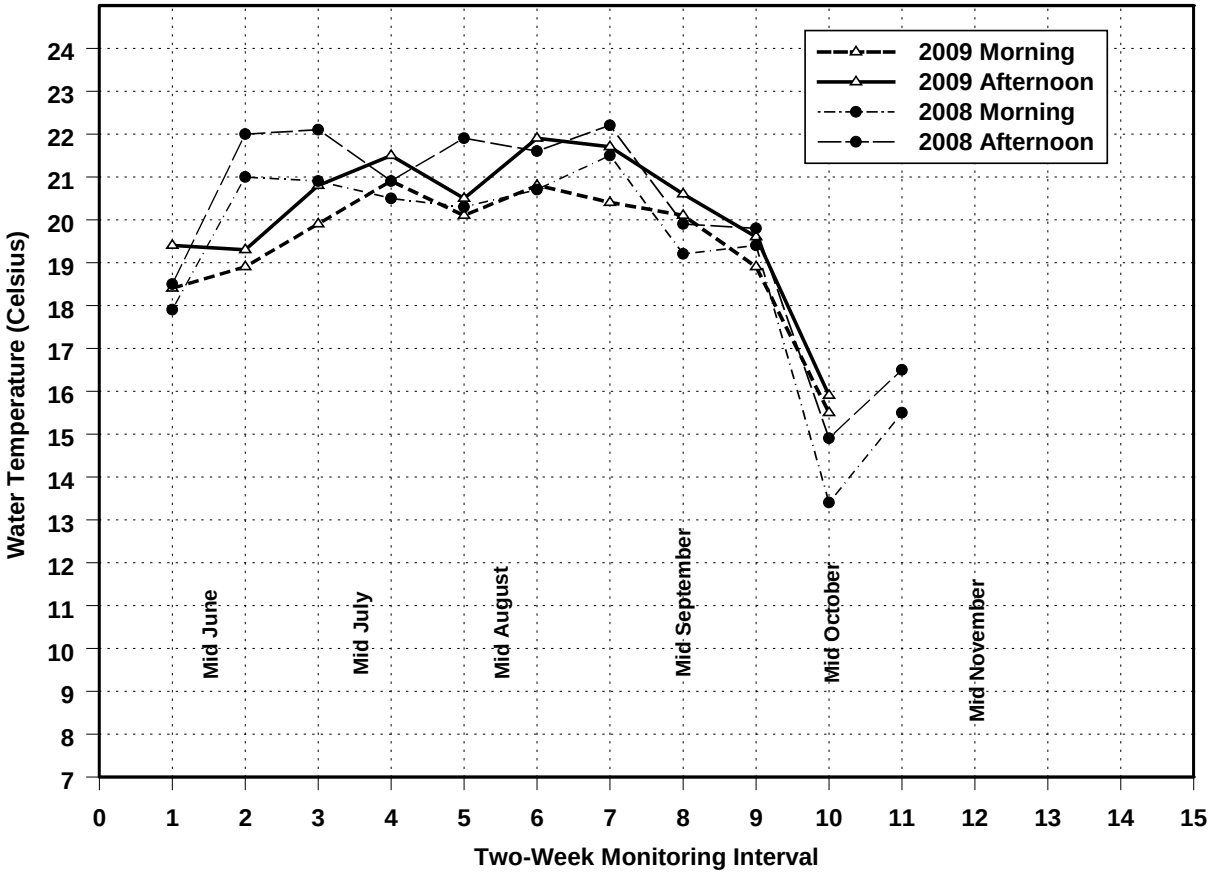


Figure 3b. 2008 and 2009 Soquel Lagoon Water Temperature at Stockton Avenue Bridge Near the Bottom at Dawn and in the Afternoon after 1500 hr from 26 May to 26 October.

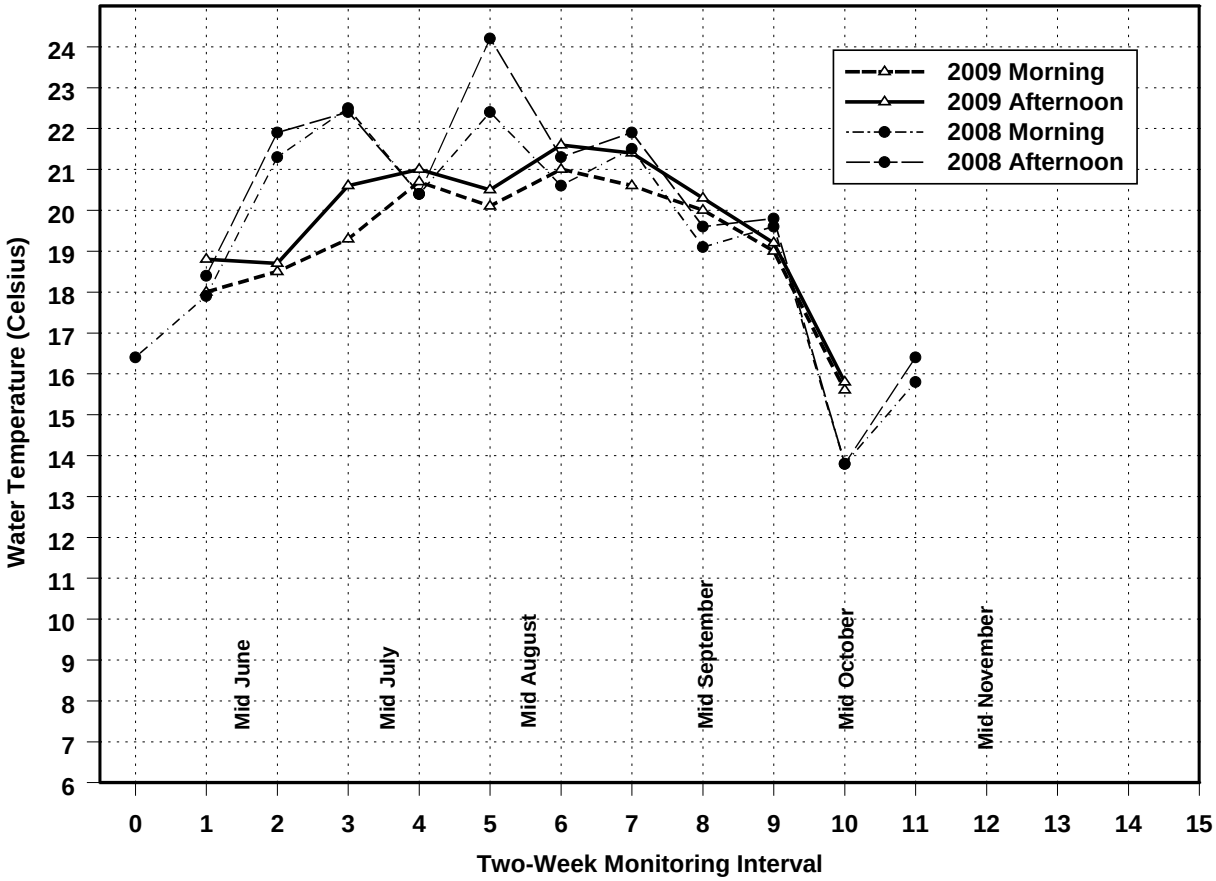


Figure 3c. 2008 and 2009 Soquel Lagoon Water Temperature at the Railroad Trestle (Station 3) Near the Bottom at Dawn and in the Afternoon after 1500 hr from 7 June to 26 October.

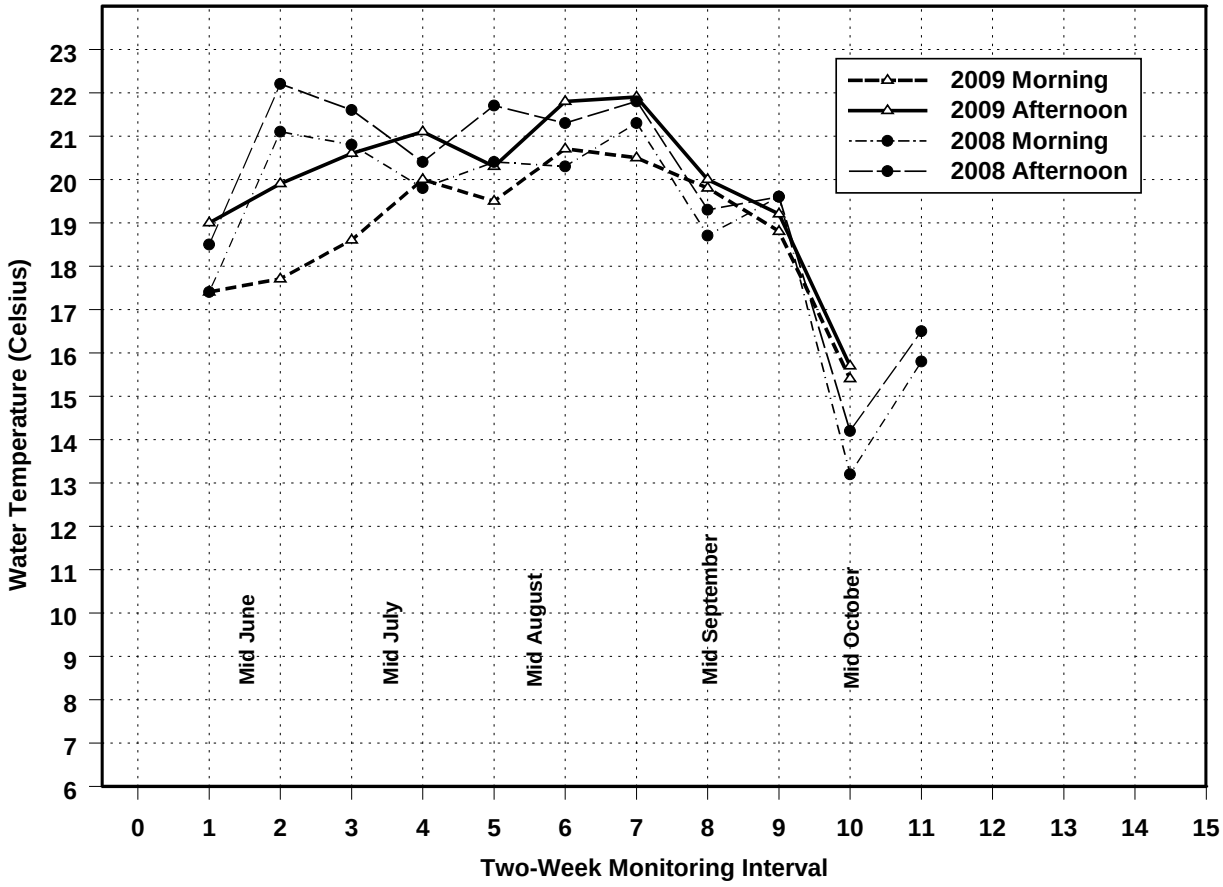


Figure 3d. 2008 and 2009 Soquel Lagoon Water Temperature at Noble Gulch Near the Bottom at Dawn (Station 4) and in the Afternoon after 1500 hr from 7 June to 26 October.

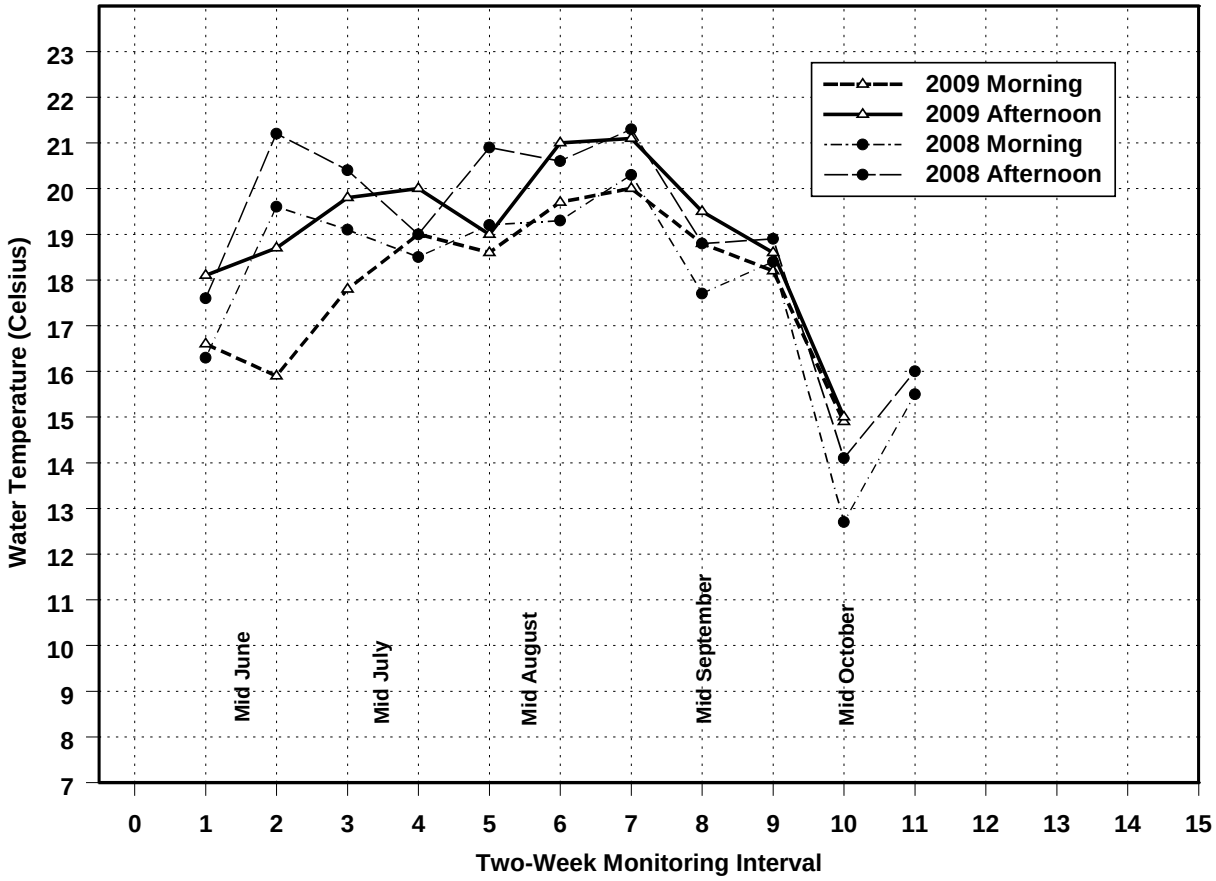


Figure 3e. Soquel Creek Water Temperature at Nob Hill Above the Lagoon in 2006 - 2009, Measured Between 0800 hr and 0930 hr from 7 June to 8 December.

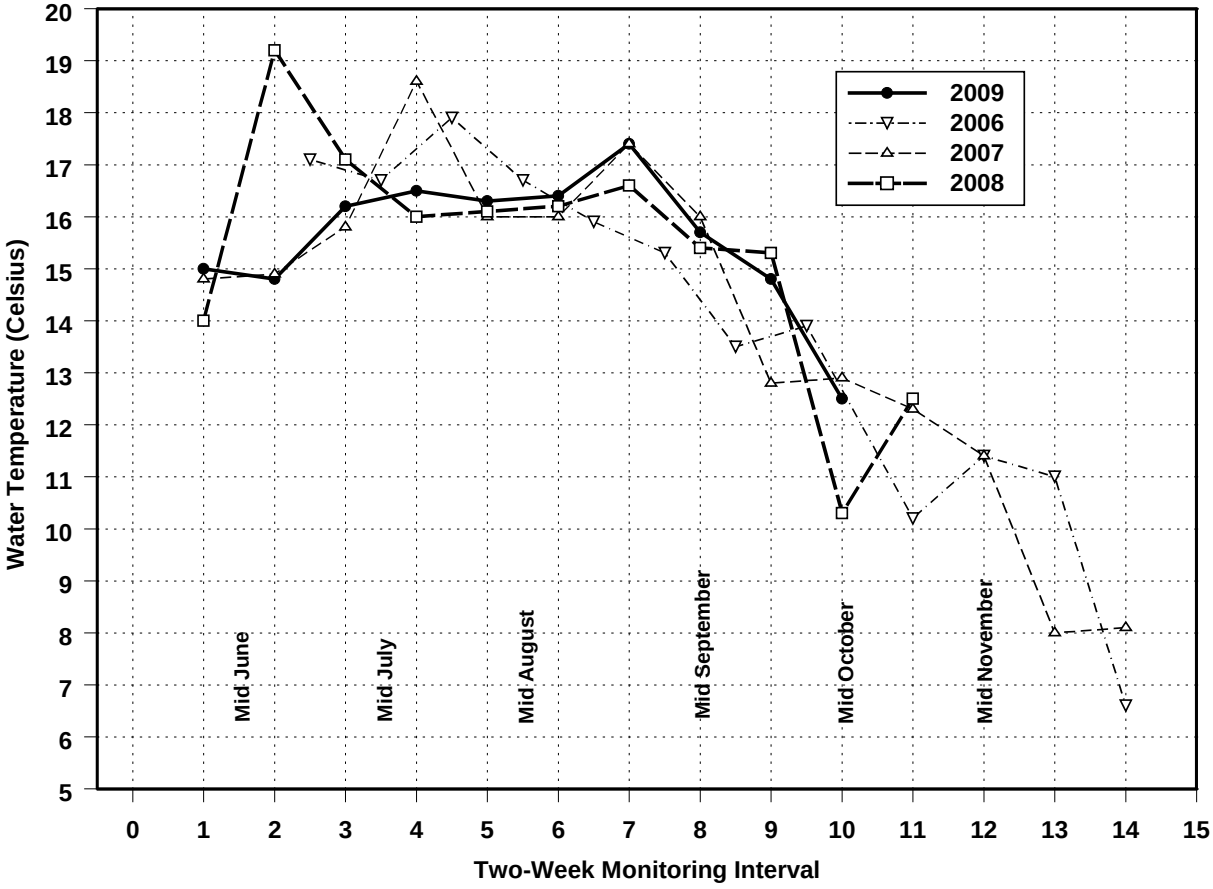


Figure 3f. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream in Soquel Creek from 7 June to 10 October 2009.

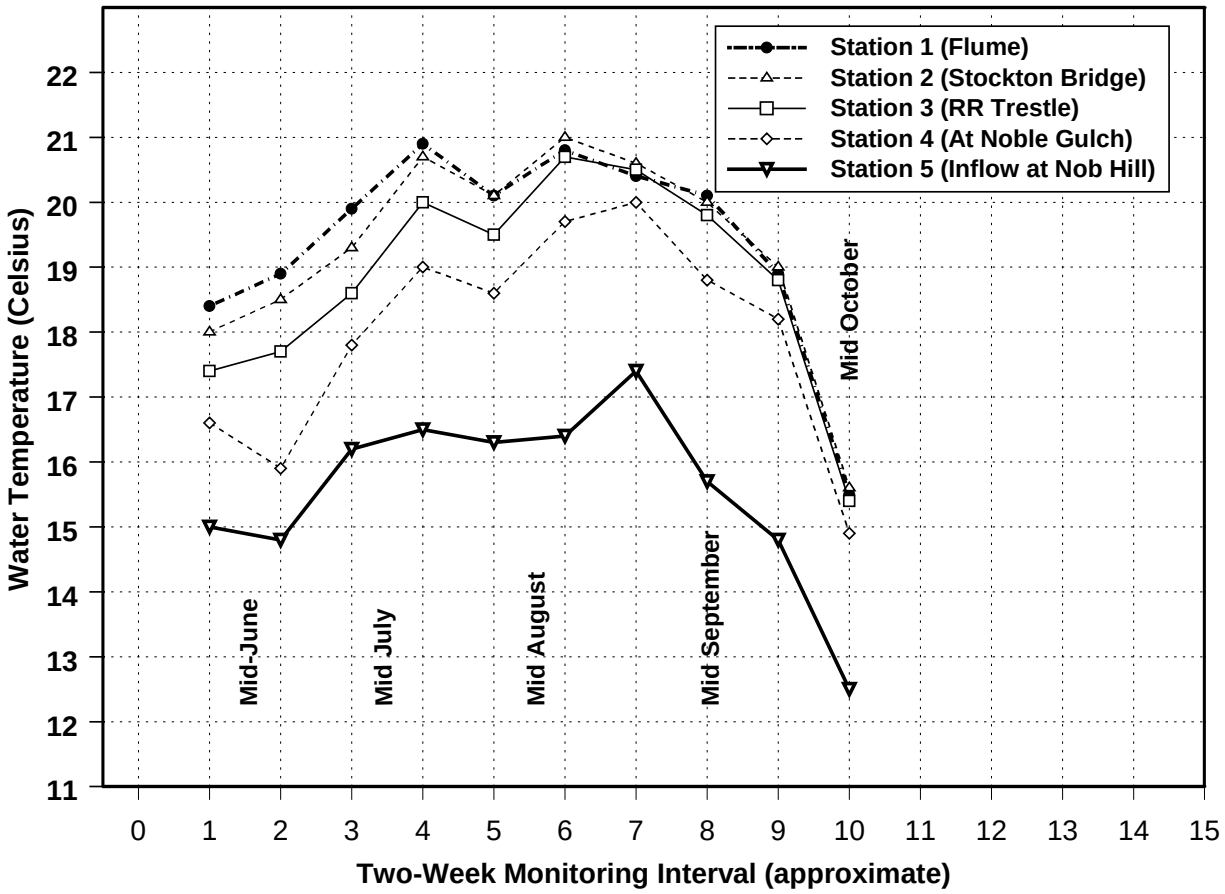


Figure 3g-1. Water Temperature in the Afternoon at 4 Lagoon Stations Near the Bottom Between 1430 hr and 1630 hr from 7 June to 10 October 2009.

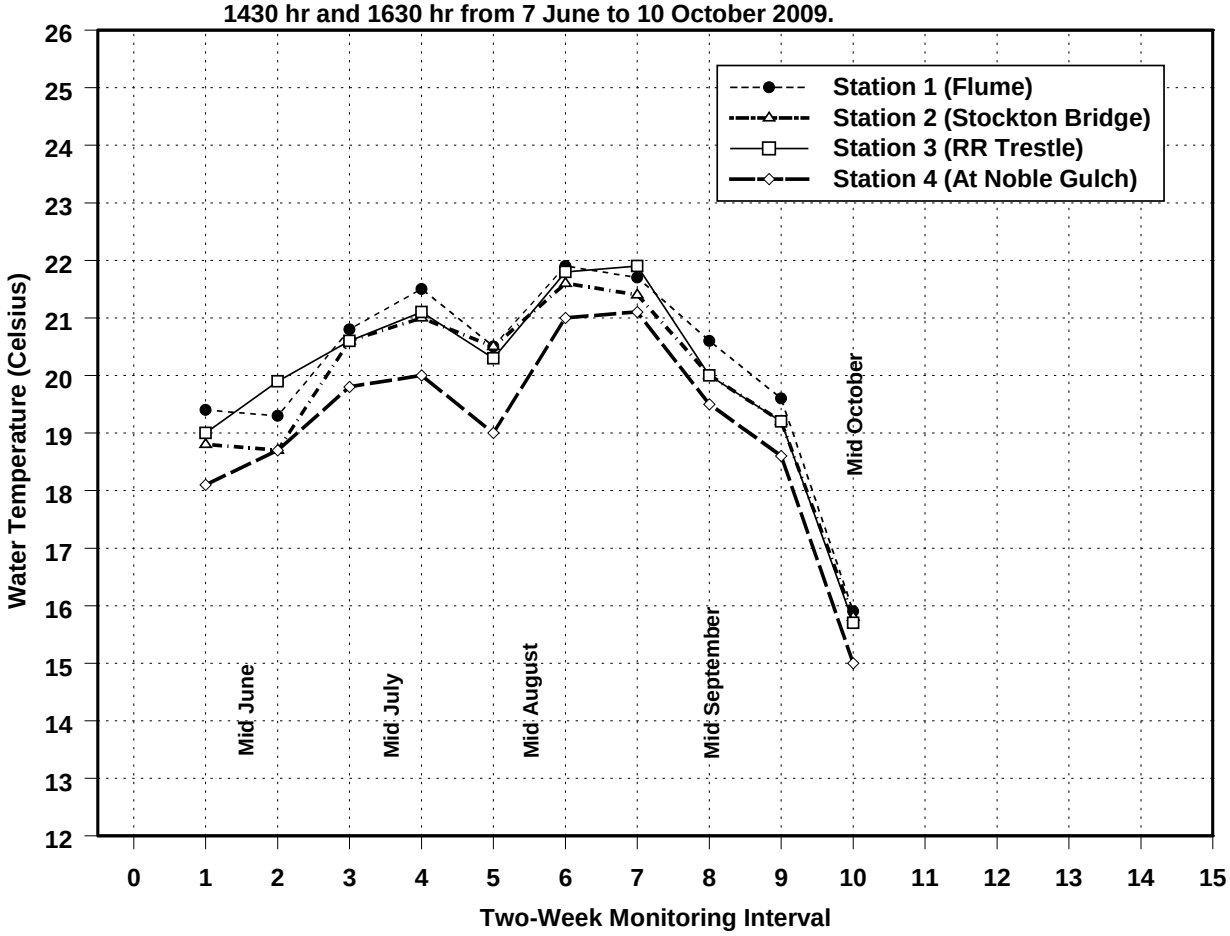


Figure 3g-2. Water Temperature in the Afternoon at 4 Lagoon Stations Near the Bottom Between 1430 hr and 1630 hr from 7 June to 26 October 2008.

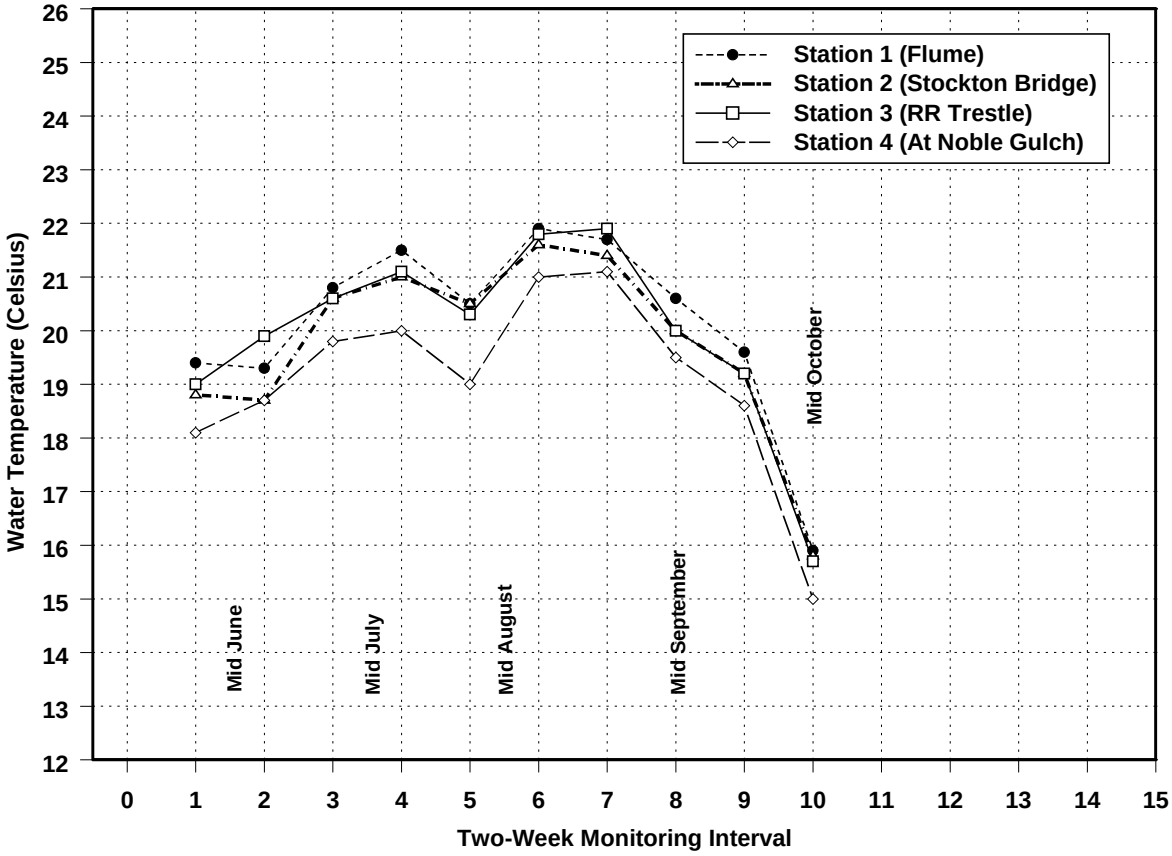


Figure 3h. Water Temperature in the Afternoon at 4 Lagoon Stations Near the Bottom Between 1500 and 1630 hr from 10 June to 8 December 2007.

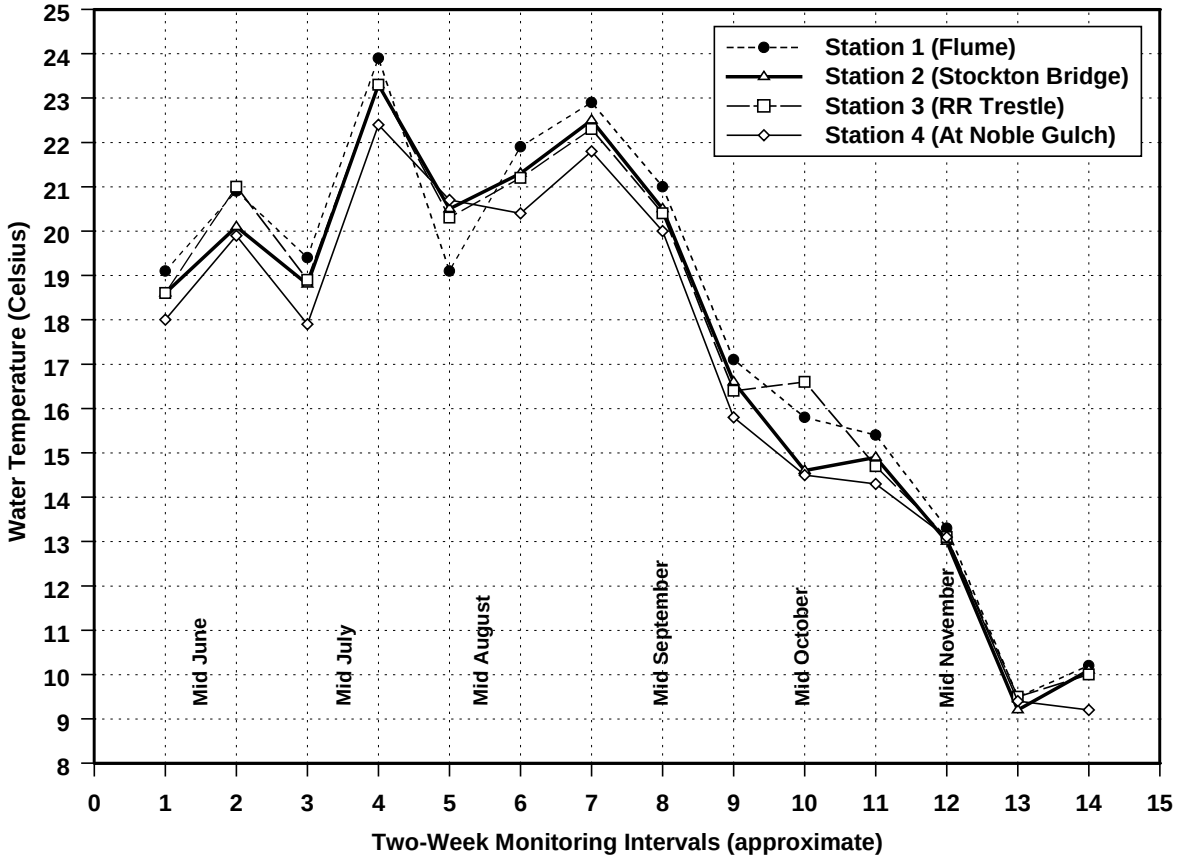
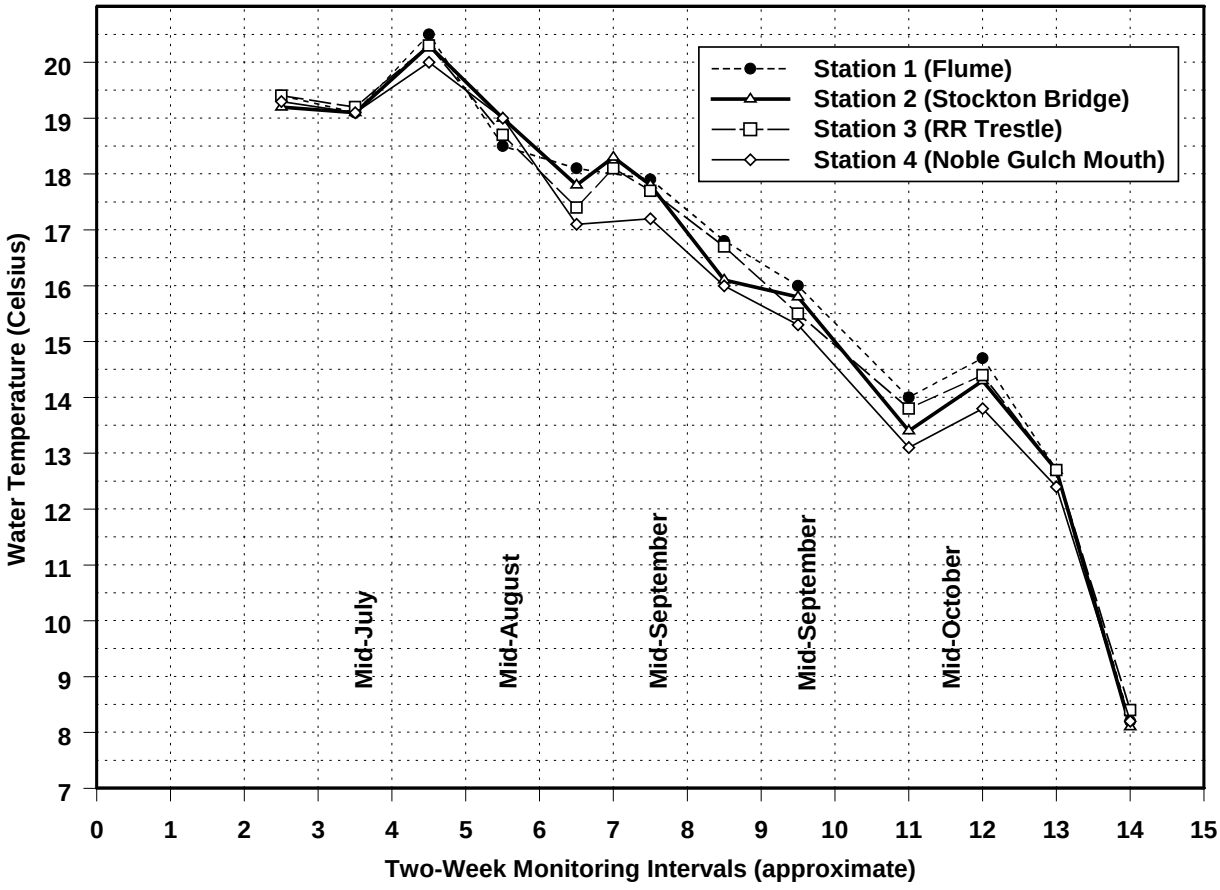


Figure 3i. Water Temperature at Four Lagoon Stations Near the Bottom Between 1500 and 1630 hr in the Afternoon from 30 June to 6 December 2006.



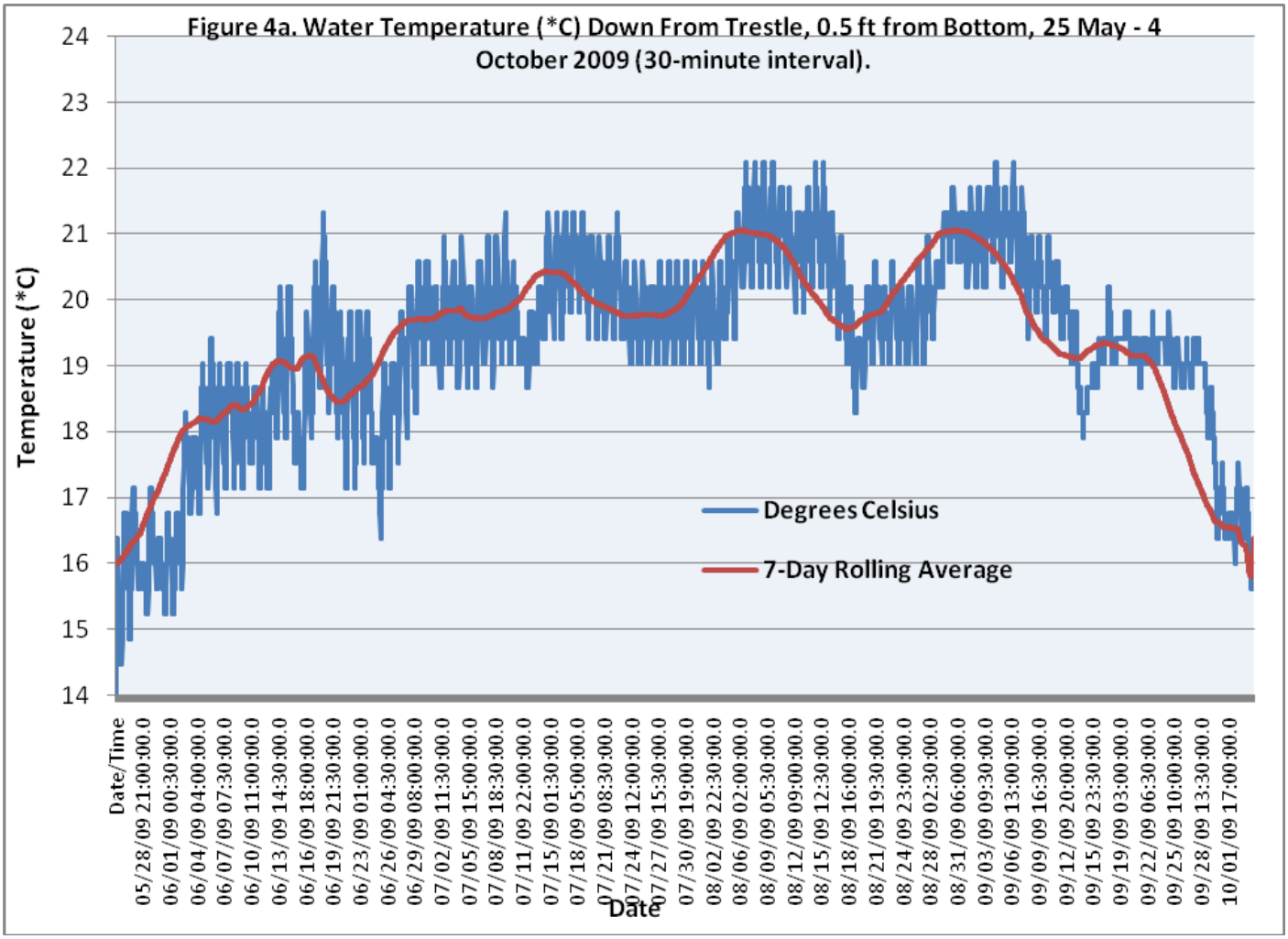


Figure 4a. Water Temperature (*C) Down From Trestle, 0.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Temperature (*C)
24
23
22
21
20
19
18
17
16
15
14
Degrees Celsius
7-Day Rolling Average
Date/Time
05/28/09 21:00:00.0
06/01/09 00:30:00.0
06/04/09 04:00:00.0
06/07/09 07:30:00.0
06/10/09 11:00:00.0
06/13/09 14:30:00.0
06/16/09 18:00:00.0
06/19/09 21:30:00.0
06/23/09 01:00:00.0
06/26/09 04:30:00.0
06/29/09 08:00:00.0
07/02/09 11:30:00.0
07/05/09 15:00:00.0
07/08/09 18:30:00.0
07/11/09 22:00:00.0
07/15/09 01:30:00.0
07/18/09 05:00:00.0
07/21/09 08:30:00.0
07/24/09 12:00:00.0
07/27/09 15:30:00.0
07/30/09 19:00:00.0
08/02/09 22:30:00.0
08/06/09 02:00:00.0
08/09/09 05:30:00.0
08/12/09 09:00:00.0
08/15/09 12:30:00.0
08/18/09 16:00:00.0
08/21/09 19:30:00.0
08/24/09 23:00:00.0
08/28/09 02:30:00.0
08/31/09 06:00:00.0
09/03/09 09:30:00.0
09/06/09 13:00:00.0
09/09/09 16:30:00.0
09/12/09 20:00:00.0
09/15/09 23:30:00.0
09/19/09 03:00:00.0
09/22/09 06:30:00.0
09/25/09 10:00:00.0
09/28/09 13:30:00.0
10/01/09 17:00:00.0
Date

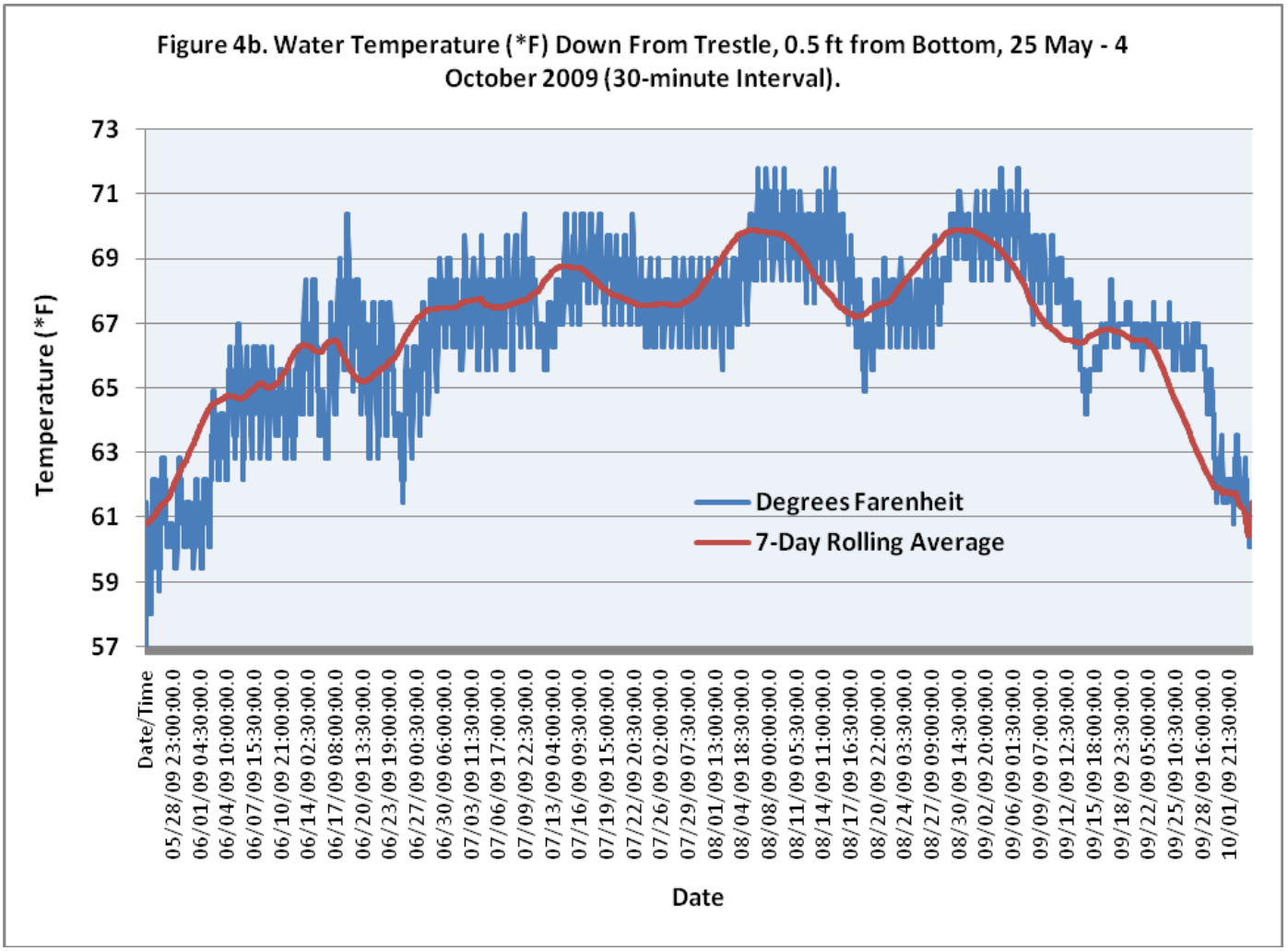


Figure 4b. Water Temperature (*F) Down From Trestle, 0.5 ft from Bottom, 25 May - 4 October 2009 (30-minute Interval).
Temperature (*F)
73
71
69
67
65
63
61
59
57
Degrees Farenheit
7-Day Rolling Average
Date/Time
05/28/09 23:00:00.0
06/01/09 04:30:00.0
06/04/09 10:00:00.0
06/07/09 15:30:00.0
06/10/09 21:00:00.0
06/14/09 02:30:00.0
06/17/09 08:00:00.0
06/20/09 13:30:00.0
06/23/09 19:00:00.0
06/27/09 00:30:00.0
06/30/09 06:00:00.0
07/03/09 11:30:00.0
07/06/09 17:00:00.0
07/09/09 22:30:00.0
07/13/09 04:00:00.0
07/16/09 09:30:00.0
07/19/09 15:00:00.0
07/22/09 20:30:00.0
07/26/09 02:00:00.0
07/29/09 07:30:00.0
08/01/09 13:00:00.0
08/04/09 18:30:00.0
08/08/09 00:00:00.0
08/11/09 05:30:00.0
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08/17/09 16:30:00.0
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08/24/09 03:30:00.0
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08/30/09 14:30:00.0
09/02/09 20:00:00.0
09/06/09 01:30:00.0
09/09/09 07:00:00.0
09/12/09 12:30:00.0
09/15/09 18:00:00.0
09/18/09 23:30:00.0
09/22/09 05:00:00.0
09/25/09 10:30:00.0
09/28/09 16:00:00.0
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Date

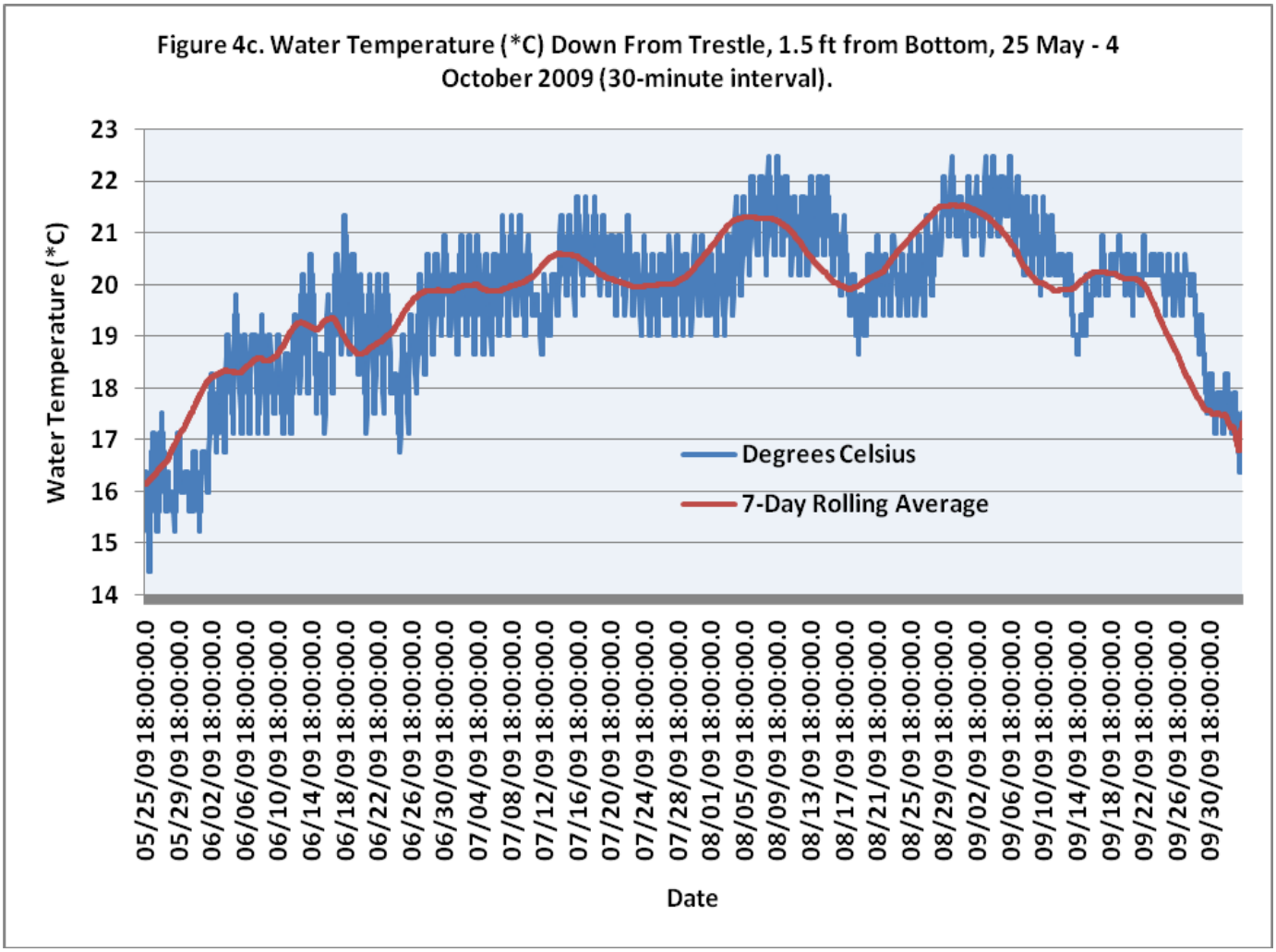


Figure 4c. Water Temperature (*C) Down From Trestle, 1.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Water Temperature (*C)
23
22
21
20
19
18
17
16
15
14
Degrees Celsius
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

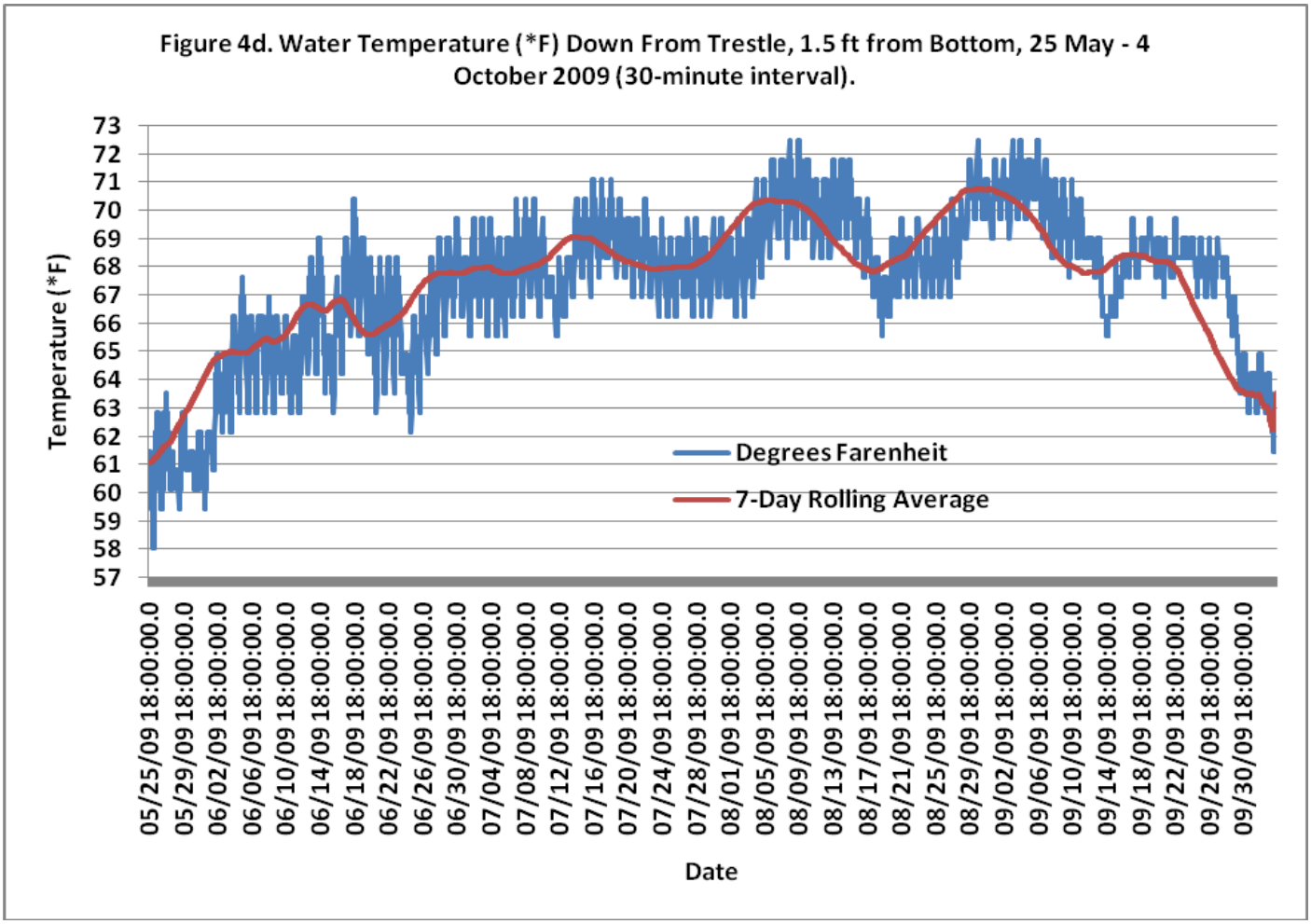


Figure 4d. Water Temperature (*F) Down From Trestle, 1.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Temperature (*F)
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
58
57
Degrees Farenheit
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

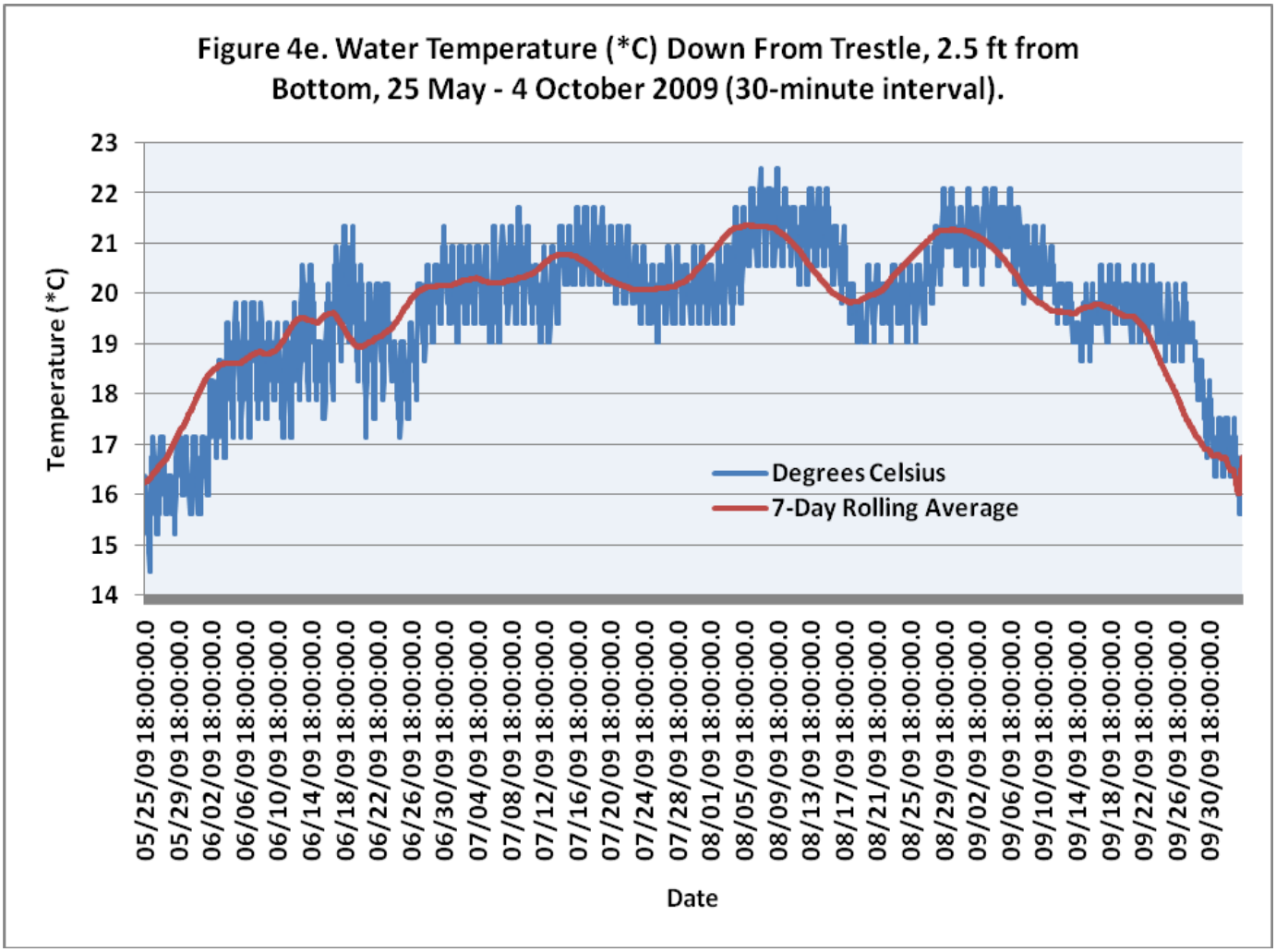


Figure 4e. Water Temperature (*C) Down From Trestle, 2.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Temperature (*C)
23
22
21
20
19
18
17
16
15
14
Degrees Celsius
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

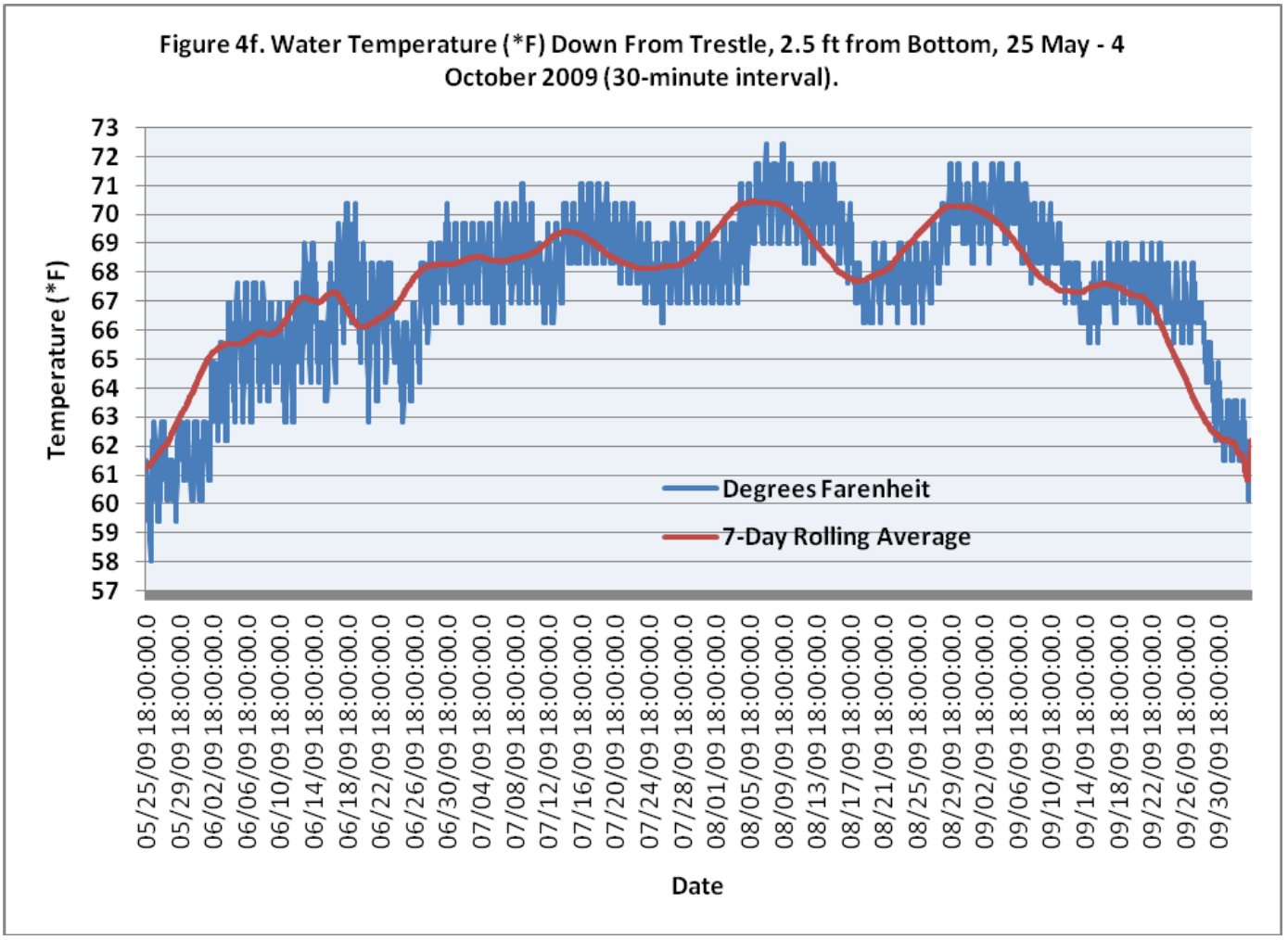


Figure 4f. Water Temperature (*F) Down From Trestle, 2.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Temperature (*F)
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
58
57
Degrees Farenheit
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

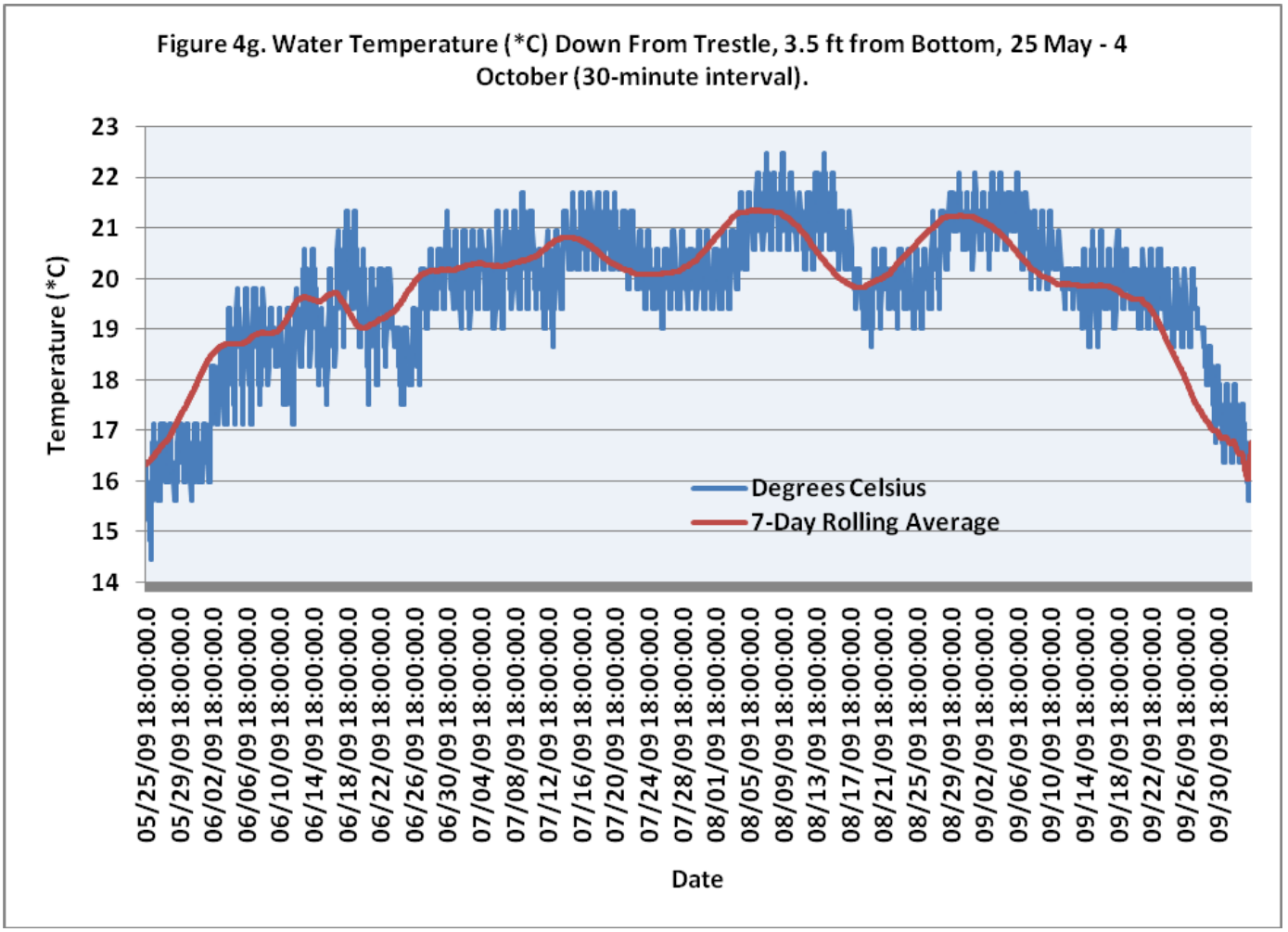


Figure 4g. Water Temperature (*C) Down From Trestle, 3.5 ft from Bottom, 25 May - 4 October (30-minute interval).
Temperature (*C)
23
22
21
20
19
18
17
16
15
14
Degrees Celsius
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

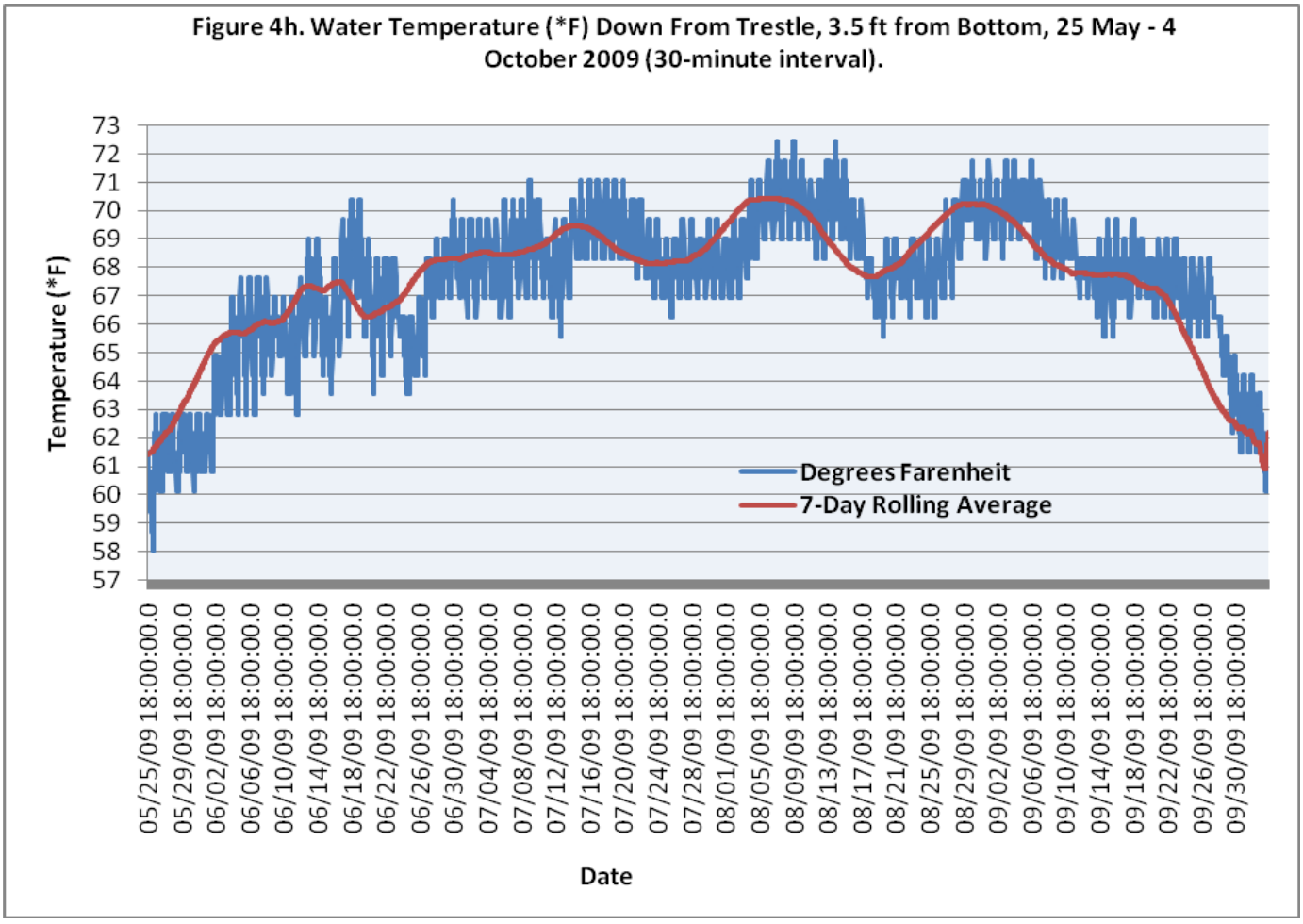


Figure 4h. Water Temperature (*F) Down From Trestle, 3.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Temperature (*F)
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
58
57
Degrees Farenheit
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

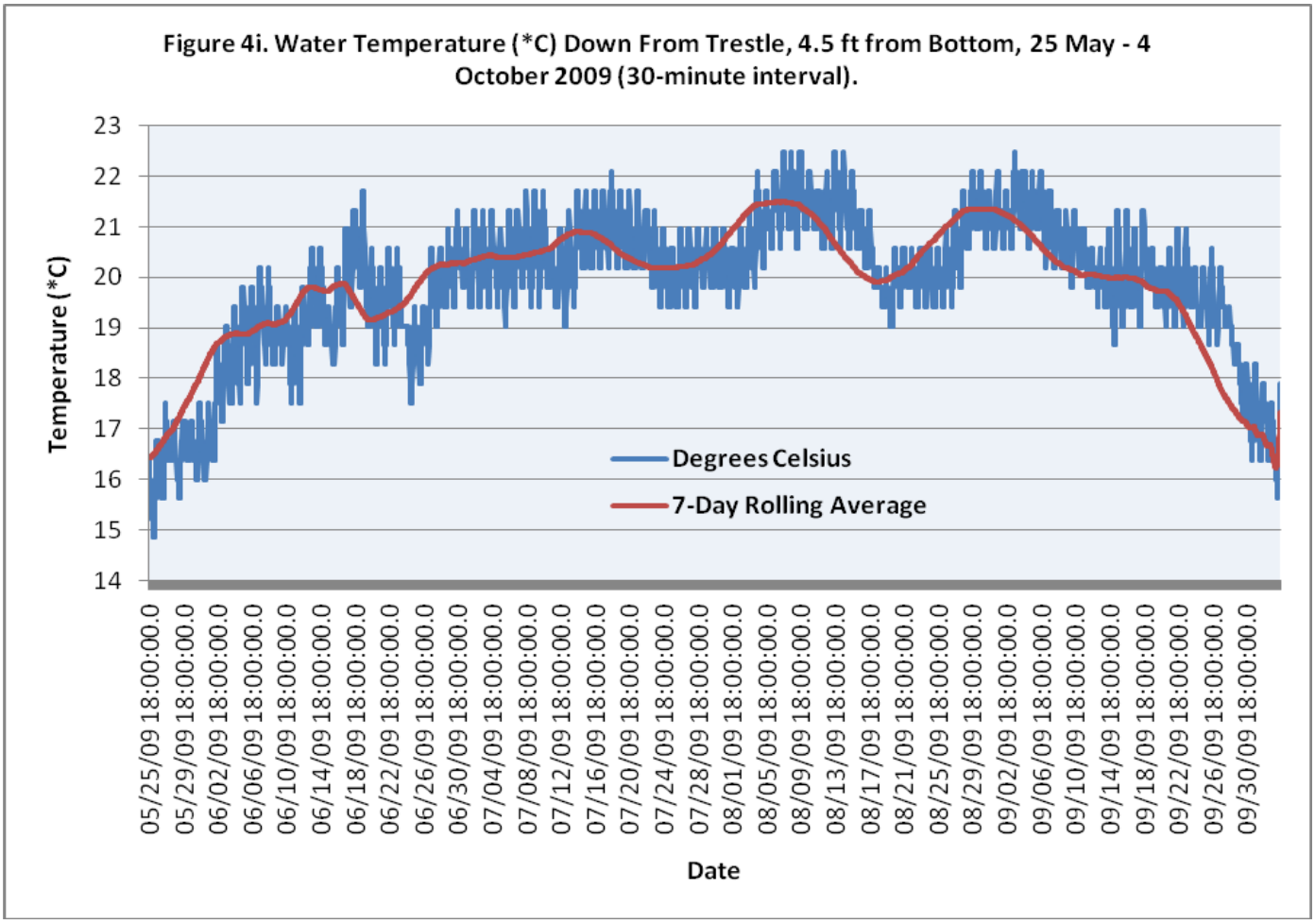


Figure 4i. Water Temperature (*C) Down From Trestle, 4.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Temperature (*C)
23
22
21
20
19
18
17
16
15
14
Degrees Celsius
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

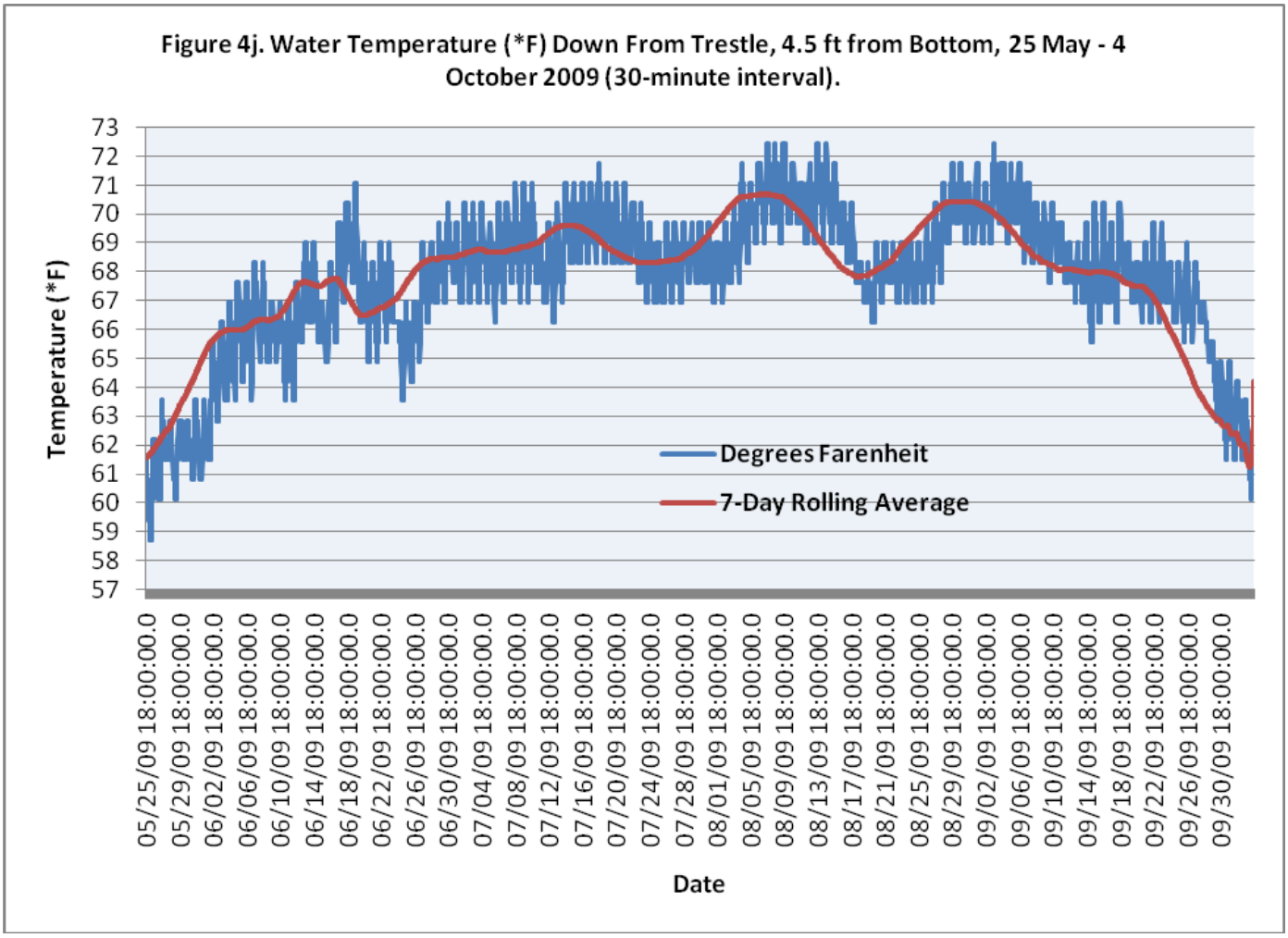


Figure 4j. Water Temperature (*F) Down From Trestle, 4.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Temperature (*F)
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
58
57
Degrees Farenheit
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

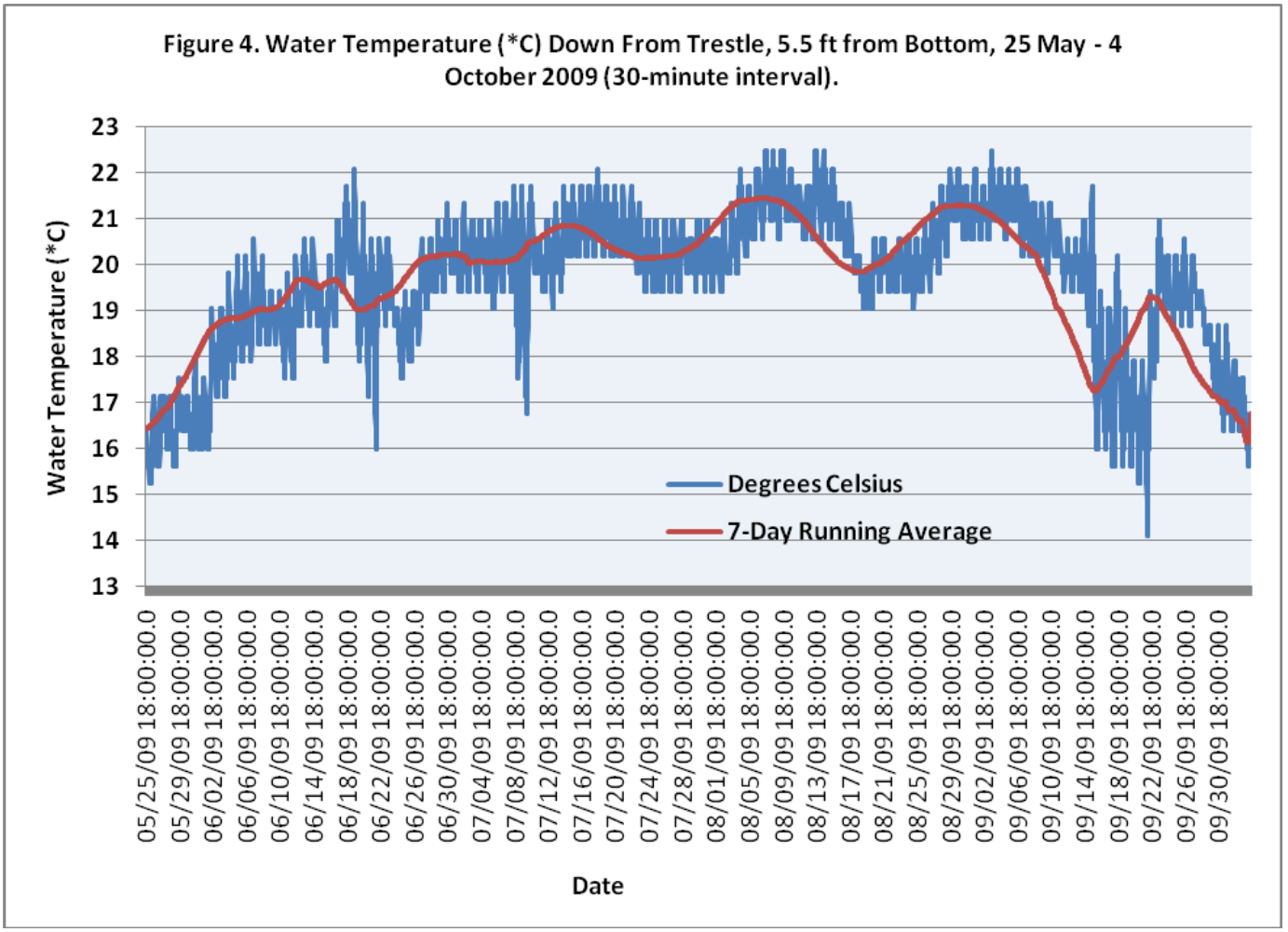


Figure 4. Water Temperature (*C) Down From Trestle, 5.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Water Temperature (*C)
23
22
21
20
19
18
17
16
15
14
13
Degrees Celsius
7-Day Running Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

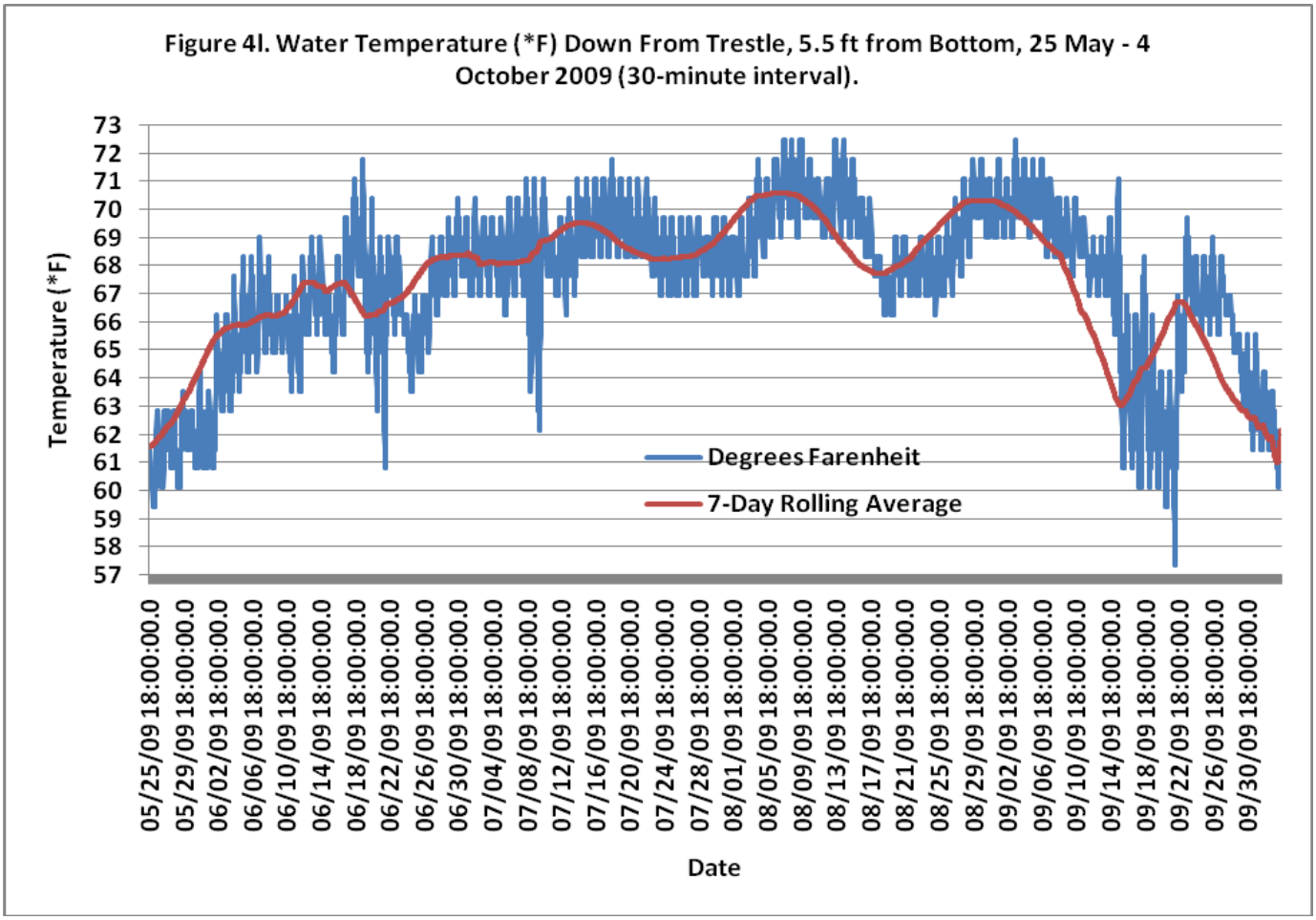


Figure 4l. Water Temperature (*F) Down From Trestle, 5.5 ft from Bottom, 25 May - 4 October 2009 (30-minute interval).
Temperature (*F)
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
58
57
Degrees Farenheit
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

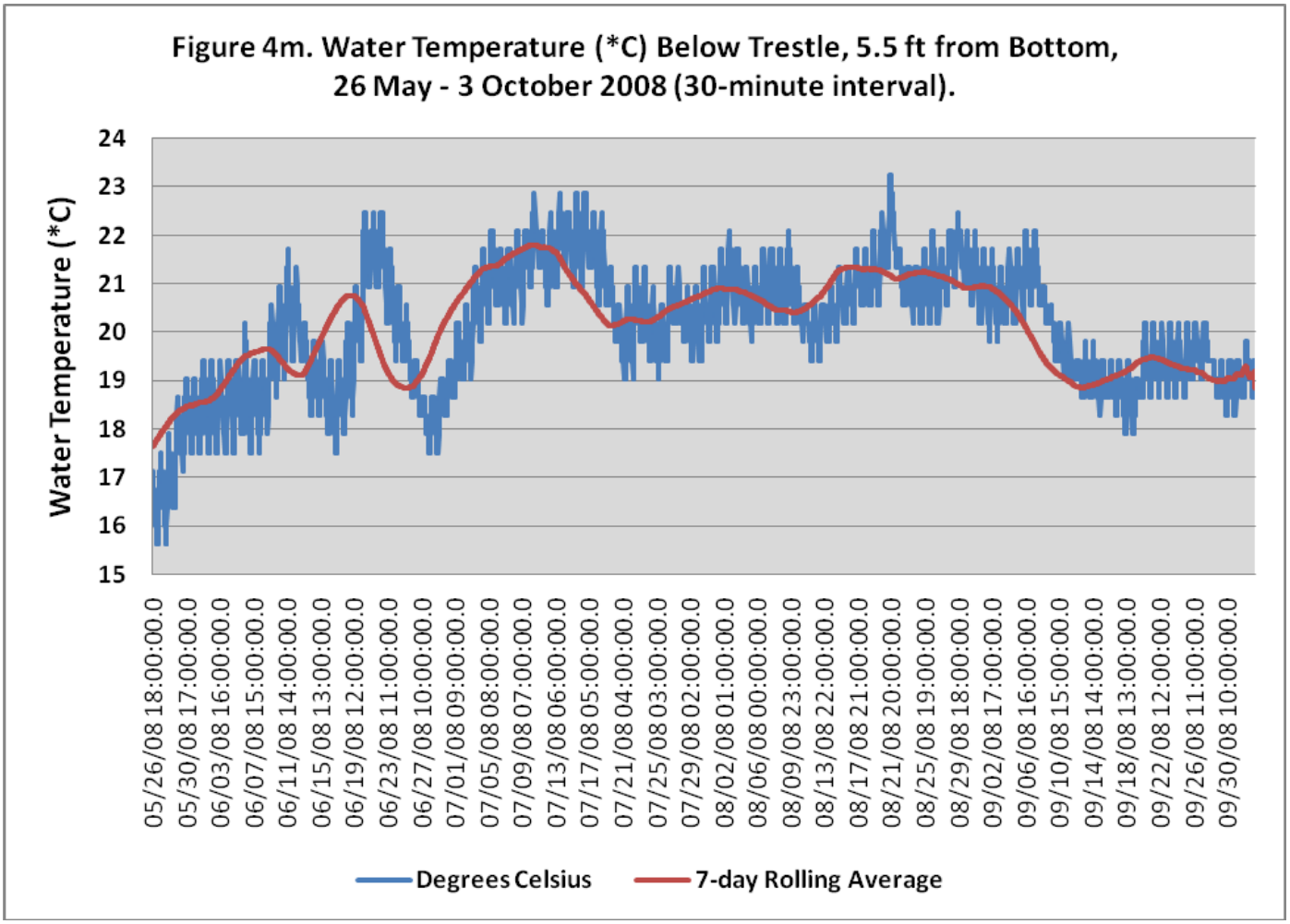


Figure 4m. Water Temperature (*C) Below Trestle, 5.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Water Temperature (*C)
24
23
22
21
20
19
18
17
16
15
05/26/08 18:00:00.0
05/30/08 17:00:00.0
06/03/08 16:00:00.0
06/07/08 15:00:00.0
06/11/08 14:00:00.0
06/15/08 13:00:00.0
06/19/08 12:00:00.0
06/23/08 11:00:00.0
06/27/08 10:00:00.0
07/01/08 09:00:00.0
07/05/08 08:00:00.0
07/09/08 07:00:00.0
07/13/08 06:00:00.0
07/17/08 05:00:00.0
07/21/08 04:00:00.0
07/25/08 03:00:00.0
07/29/08 02:00:00.0
08/02/08 01:00:00.0
08/06/08 00:00:00.0
08/09/08 23:00:00.0
08/13/08 22:00:00.0
08/17/08 21:00:00.0
08/21/08 20:00:00.0
08/25/08 19:00:00.0
08/29/08 18:00:00.0
09/02/08 17:00:00.0
09/06/08 16:00:00.0
09/10/08 15:00:00.0
09/14/08 14:00:00.0
09/18/08 13:00:00.0
09/22/08 12:00:00.0
09/26/08 11:00:00.0
09/30/08 10:00:00.0
Degrees Celsius
7-day Rolling Average

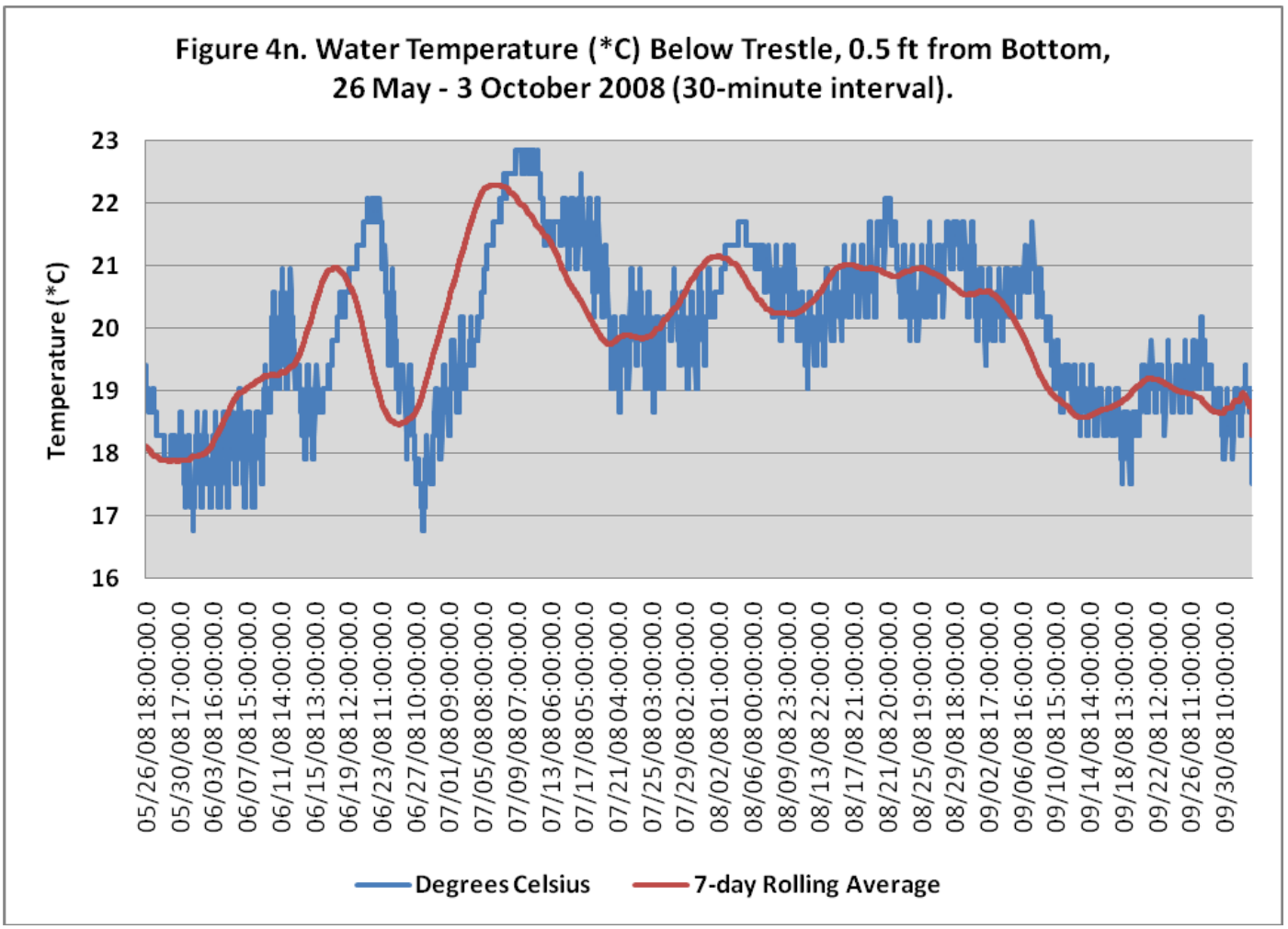


Figure 4n. Water Temperature (*C) Below Trestle, 0.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Temperature (*C)
23
22
21
20
19
18
17
16
05/26/08 18:00:00.0
05/30/08 17:00:00.0
06/03/08 16:00:00.0
06/07/08 15:00:00.0
06/11/08 14:00:00.0
06/15/08 13:00:00.0
06/19/08 12:00:00.0
06/23/08 11:00:00.0
06/27/08 10:00:00.0
07/01/08 09:00:00.0
07/05/08 08:00:00.0
07/09/08 07:00:00.0
07/13/08 06:00:00.0
07/17/08 05:00:00.0
07/21/08 04:00:00.0
07/25/08 03:00:00.0
07/29/08 02:00:00.0
08/02/08 01:00:00.0
08/06/08 00:00:00.0
08/09/08 23:00:00.0
08/13/08 22:00:00.0
08/17/08 21:00:00.0
08/21/08 20:00:00.0
08/25/08 19:00:00.0
08/29/08 18:00:00.0
09/02/08 17:00:00.0
09/06/08 16:00:00.0
09/10/08 15:00:00.0
09/14/08 14:00:00.0
09/18/08 13:00:00.0
09/22/08 12:00:00.0
09/26/08 11:00:00.0
09/30/08 10:00:00.0
Degrees Celsius
7-day Rolling Average

Figure 4o. Water Temperature (*C) Above Trestle, 5.5 ft from Bottom, 29 May- 30 September 2007 (30-minute interval).

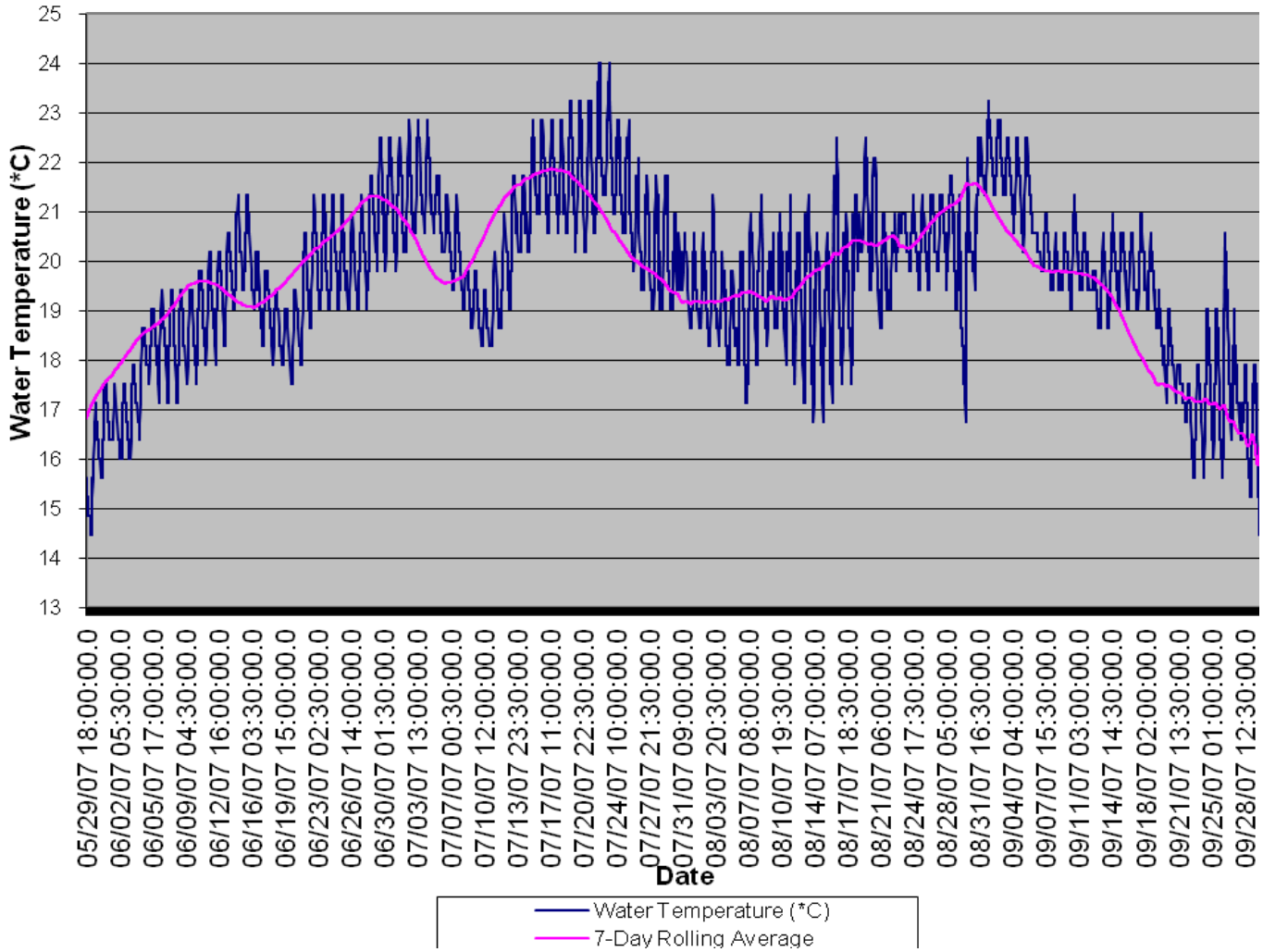
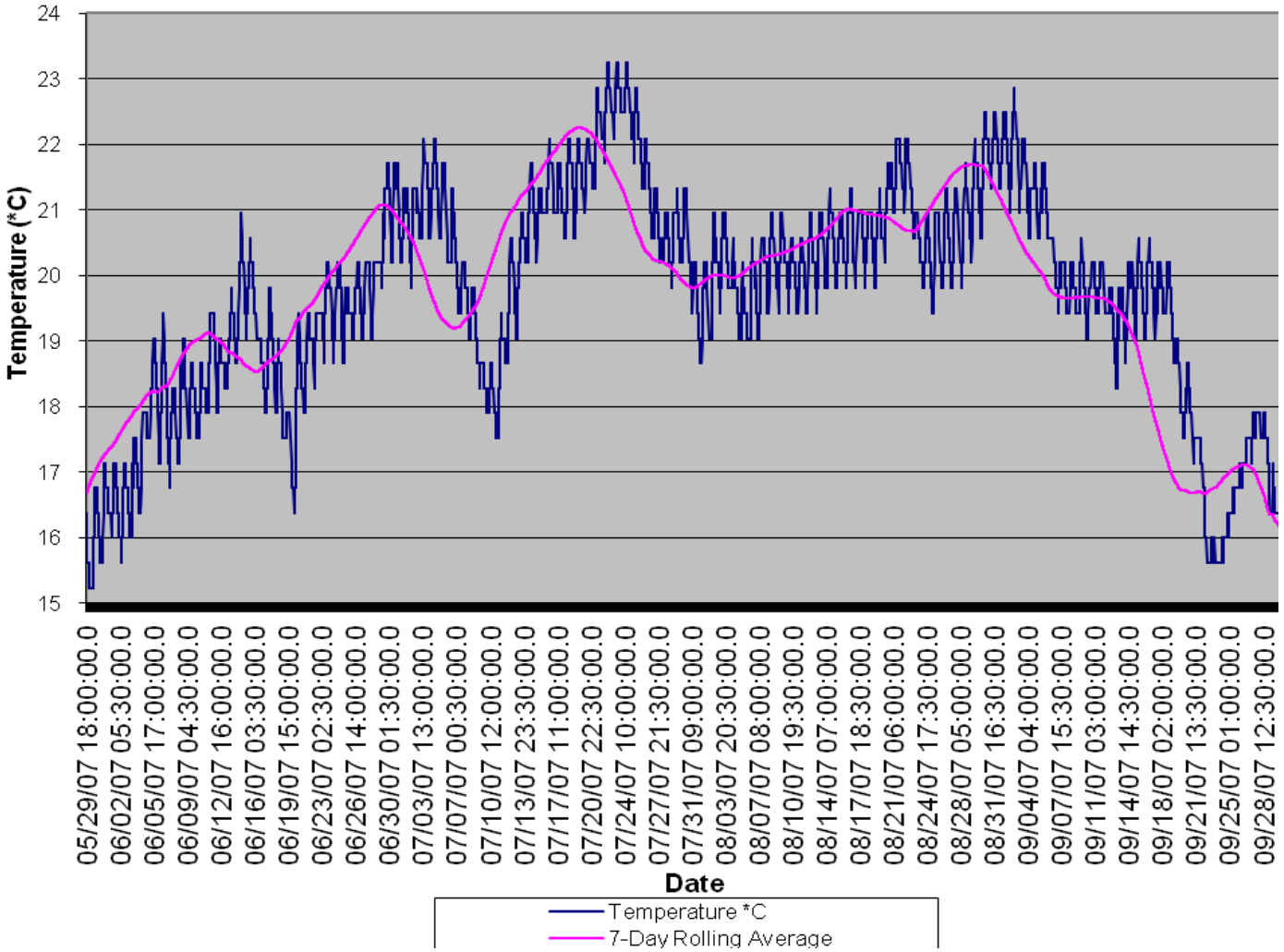


Figure 4p. Water Temperature (*C) Above Trestle, 0.5 ft from Bottom, 29 May- 30 September 2007 (30-minute interval).



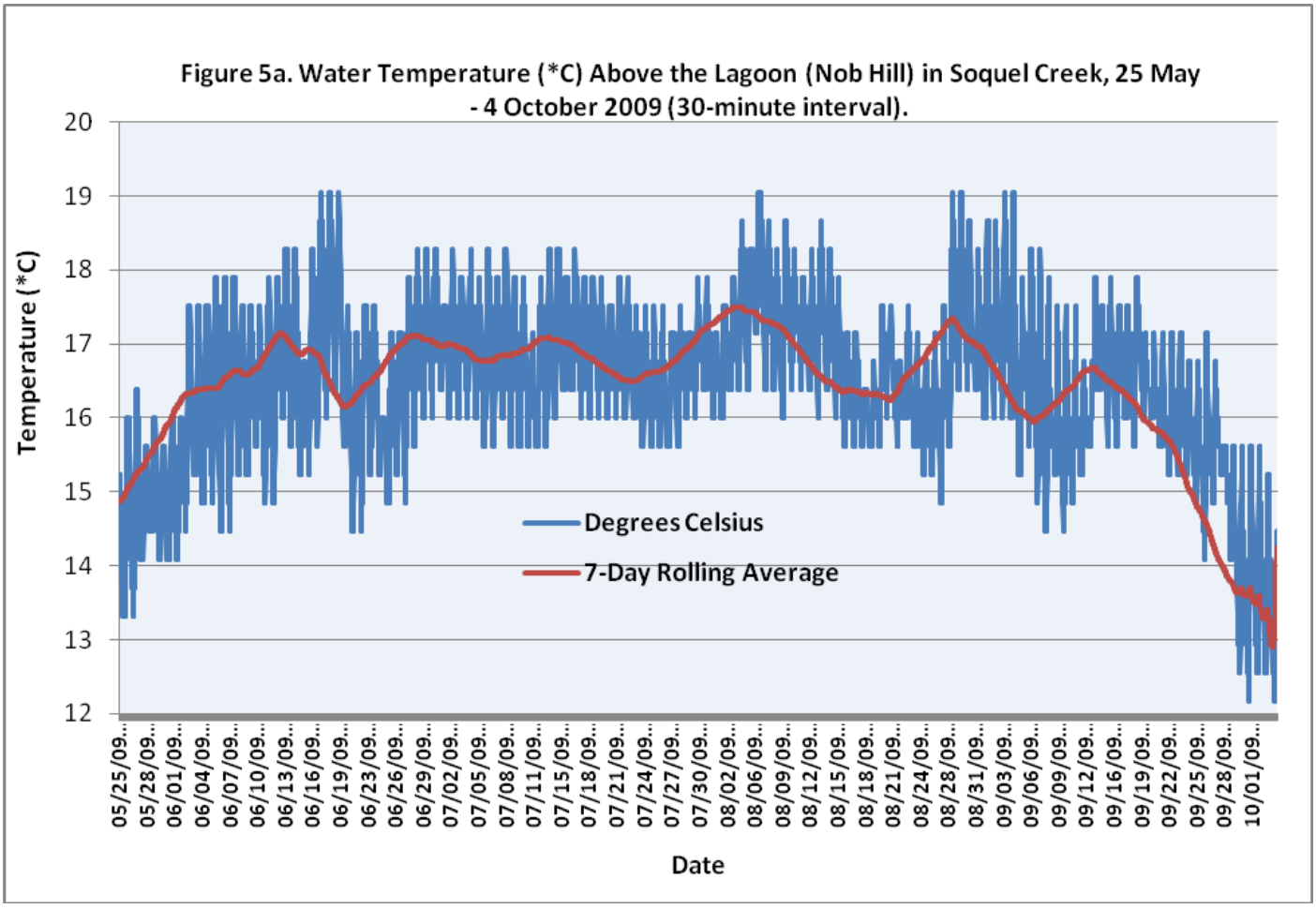


Figure 5a. Water Temperature (*C) Above the Lagoon (Nob Hill) in Soquel Creek, 25 May - 4 October 2009 (30-minute interval).
Temperature (*C)
20
19
18
17
16
15
14
13
12
Degrees Celsius
7-Day Rolling Average
05/25/09...
05/28/09...
06/01/09...
06/04/09...
06/07/09...
06/10/09...
06/13/09...
06/16/09...
06/19/09...
06/23/09...
06/26/09...
06/29/09...
07/02/09...
07/05/09...
07/08/09...
07/11/09...
07/15/09...
07/18/09...
07/21/09...
07/24/09...
07/27/09...
07/30/09...
08/02/09...
08/06/09...
08/09/09...
08/12/09...
08/15/09...
08/18/09...
08/21/09...
08/24/09...
08/28/09...
08/31/09...
09/03/09...
09/06/09...
09/09/09...
09/12/09...
09/16/09...
09/19/09...
09/22/09...
09/25/09...
09/28/09...
10/01/09...
Date

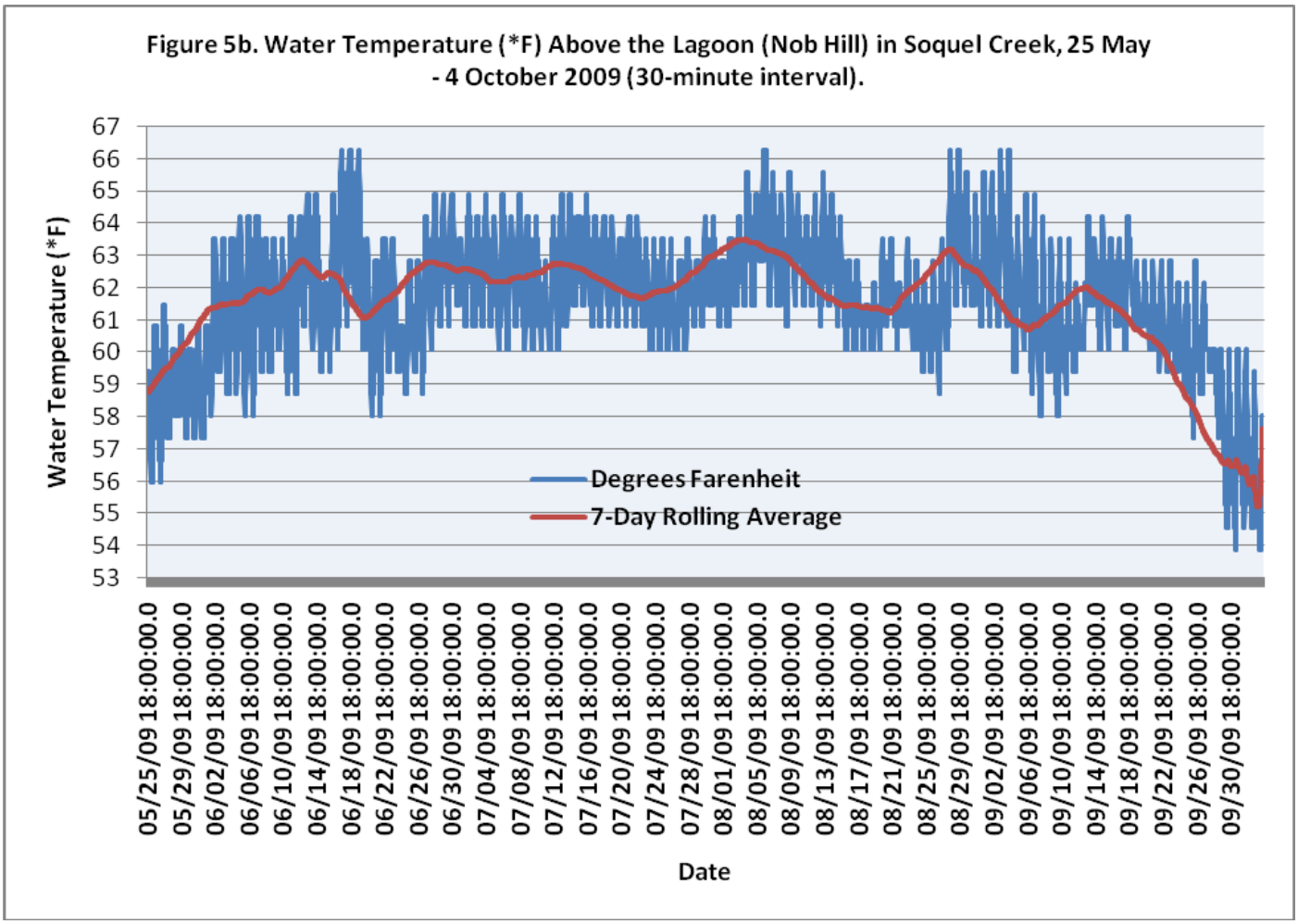


Figure 5b. Water Temperature (*F) Above the Lagoon (Nob Hill) in Soquel Creek, 25 May - 4 October 2009 (30-minute interval).
Water Temperature (*F)
67
66
65
64
63
62
61
60
59
58
57
56
55
54
53
Degrees Farenheit
7-Day Rolling Average
05/25/09 18:00:00.0
05/29/09 18:00:00.0
06/02/09 18:00:00.0
06/06/09 18:00:00.0
06/10/09 18:00:00.0
06/14/09 18:00:00.0
06/18/09 18:00:00.0
06/22/09 18:00:00.0
06/26/09 18:00:00.0
06/30/09 18:00:00.0
07/04/09 18:00:00.0
07/08/09 18:00:00.0
07/12/09 18:00:00.0
07/16/09 18:00:00.0
07/20/09 18:00:00.0
07/24/09 18:00:00.0
07/28/09 18:00:00.0
08/01/09 18:00:00.0
08/05/09 18:00:00.0
08/09/09 18:00:00.0
08/13/09 18:00:00.0
08/17/09 18:00:00.0
08/21/09 18:00:00.0
08/25/09 18:00:00.0
08/29/09 18:00:00.0
09/02/09 18:00:00.0
09/06/09 18:00:00.0
09/10/09 18:00:00.0
09/14/09 18:00:00.0
09/18/09 18:00:00.0
09/22/09 18:00:00.0
09/26/09 18:00:00.0
09/30/09 18:00:00.0
Date

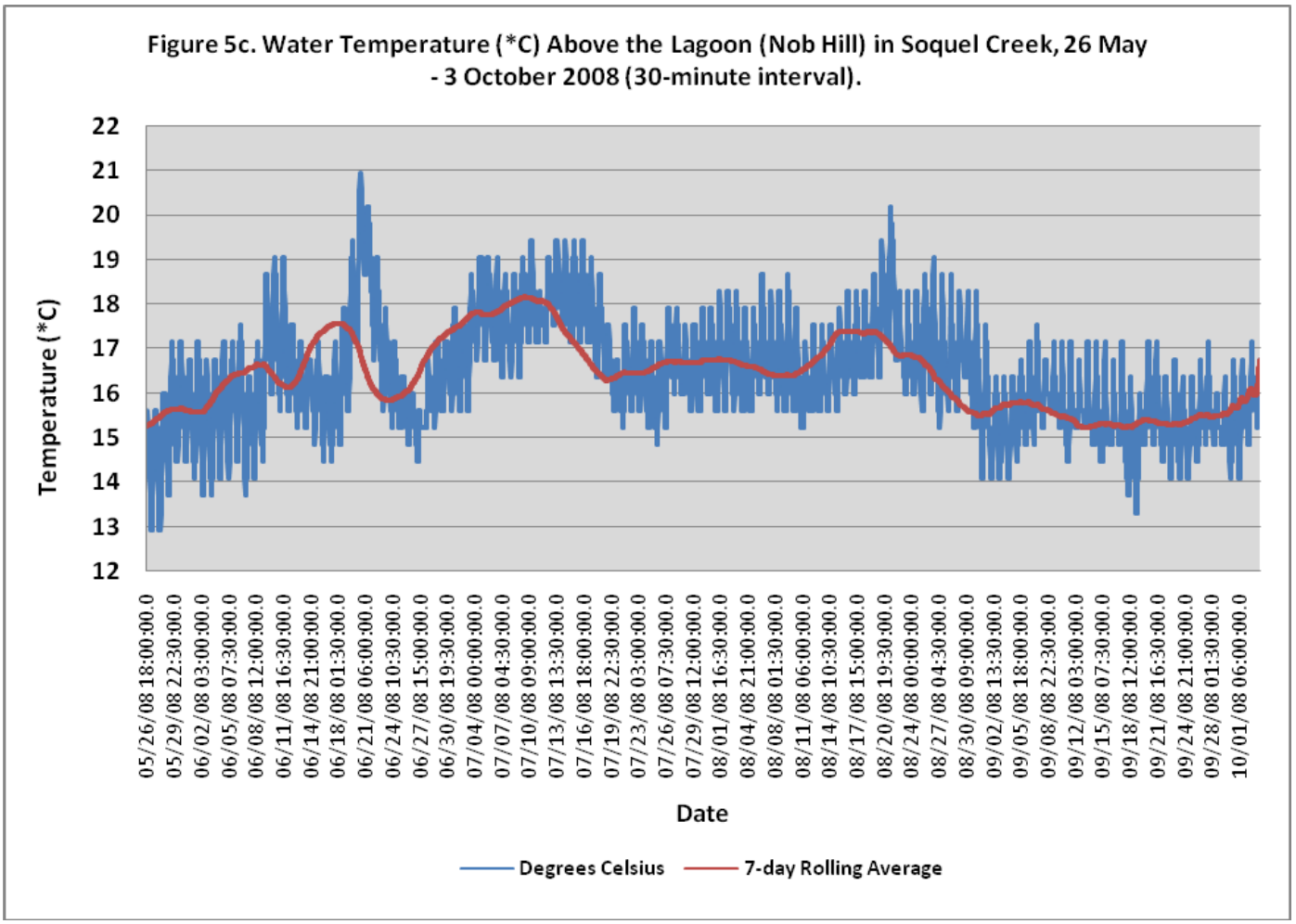


Figure 5c. Water Temperature (*C) Above the Lagoon (Nob Hill) in Soquel Creek, 26 May - 3 October 2008 (30-minute interval).
Temperature (*C)
22
21
20
19
18
17
16
15
14
13
12
05/26/08 18:00:00.0
05/29/08 22:30:00.0
06/02/08 03:00:00.0
06/05/08 07:30:00.0
06/08/08 12:00:00.0
06/11/08 16:30:00.0
06/14/08 21:00:00.0
06/18/08 01:30:00.0
06/21/08 06:00:00.0
06/24/08 10:30:00.0
06/27/08 15:00:00.0
06/30/08 19:30:00.0
07/04/08 00:00:00.0
07/07/08 04:30:00.0
07/10/08 09:00:00.0
07/13/08 13:30:00.0
07/16/08 18:00:00.0
07/19/08 22:30:00.0
07/23/08 03:00:00.0
07/26/08 07:30:00.0
07/29/08 12:00:00.0
08/01/08 16:30:00.0
08/04/08 21:00:00.0
08/08/08 01:30:00.0
08/11/08 06:00:00.0
08/14/08 10:30:00.0
08/17/08 15:00:00.0
08/20/08 19:30:00.0
08/24/08 00:00:00.0
08/27/08 04:30:00.0
08/30/08 09:00:00.0
09/02/08 13:30:00.0
09/05/08 18:00:00.0
09/08/08 22:30:00.0
09/12/08 03:00:00.0
09/15/08 07:30:00.0
09/18/08 12:00:00.0
09/21/08 16:30:00.0
09/24/08 21:00:00.0
09/28/08 01:30:00.0
10/01/08 06:00:00.0
Date
Degrees Celsius
7-day Rolling Average

Figure 5d. Water Temperature (*C) Above the Lagoon (Nob Hill) in Soquel Creek, 29 May- 30 September 2007 (30-minute interval).

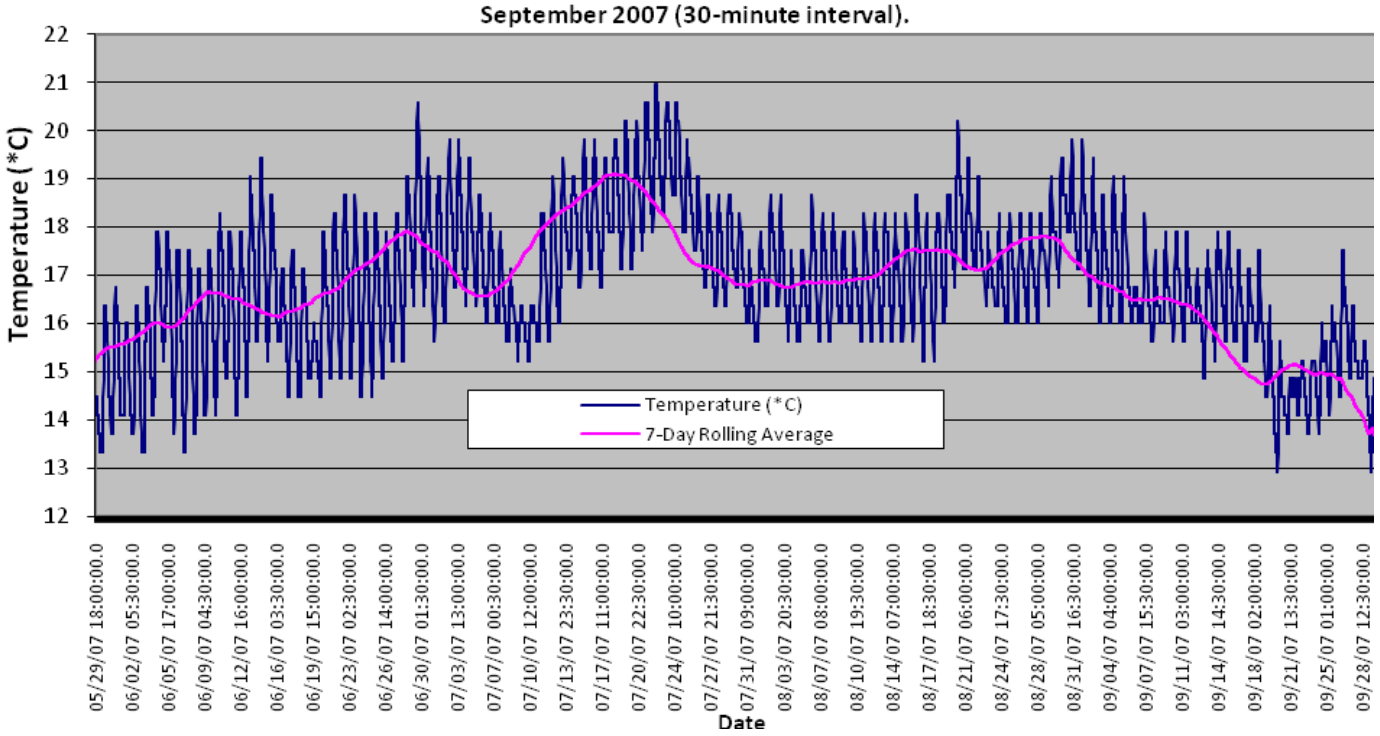


Figure 5e. Water Temperature (*C) Above the Lagoon (Nob Hill) in Soquel Creek, 8 June- 12 September 2006 (30-minute interval).

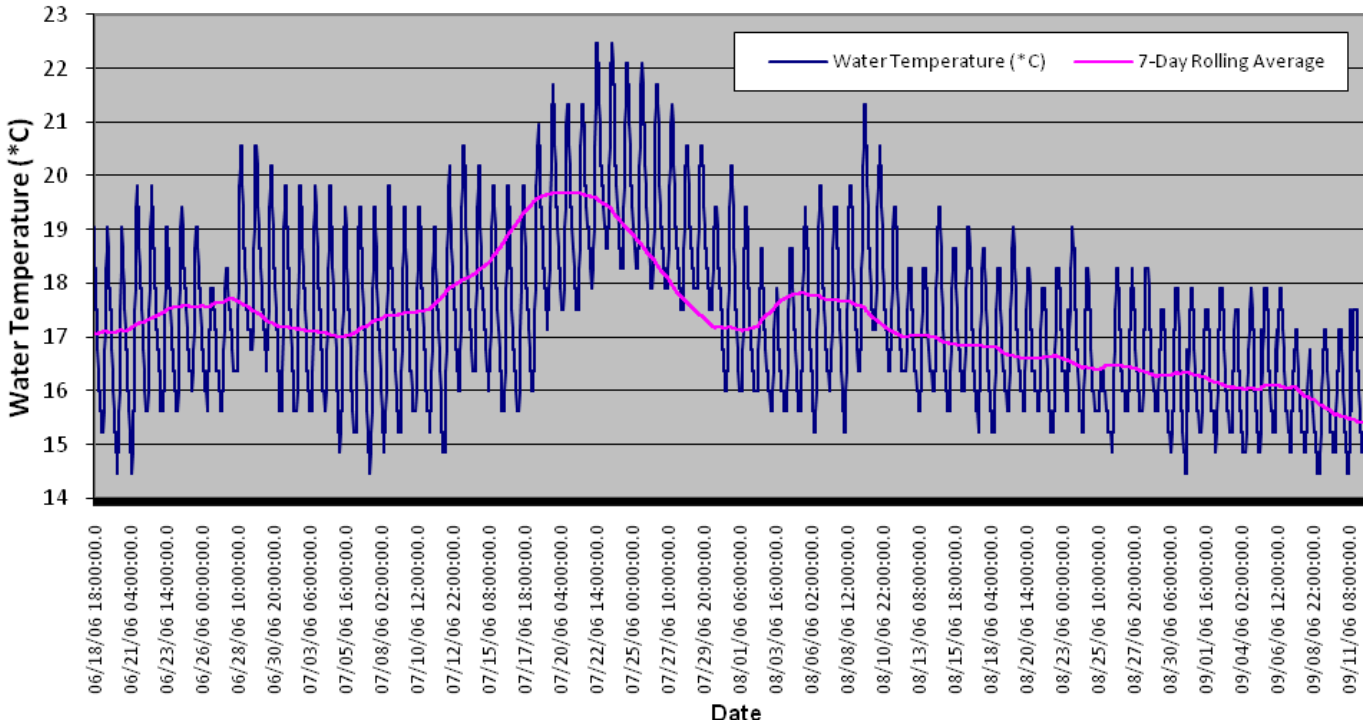


Figure 6a. Soquel Lagoon/Stream Oxygen Concentrations at Dawn Within 0.25 Meters of the Bottom at Five Monitoring Stations, 7 June - 10 October 2009.

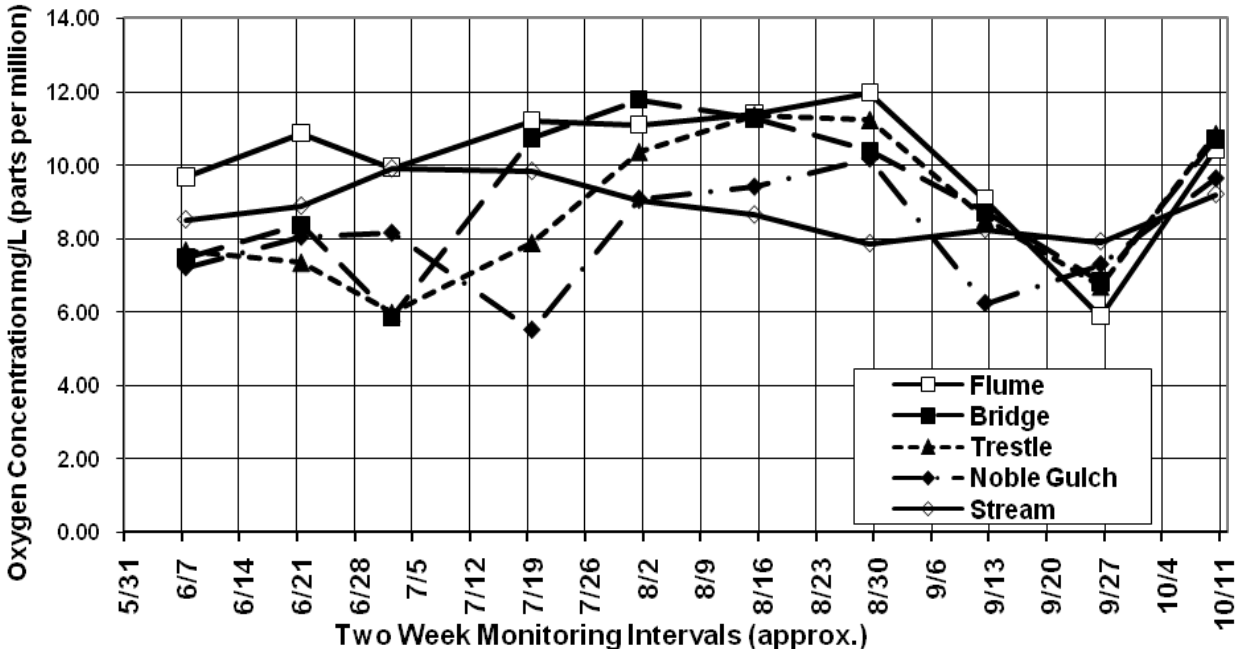


Figure 6b. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 1, the Flume, 7 June - 10 October 2009.

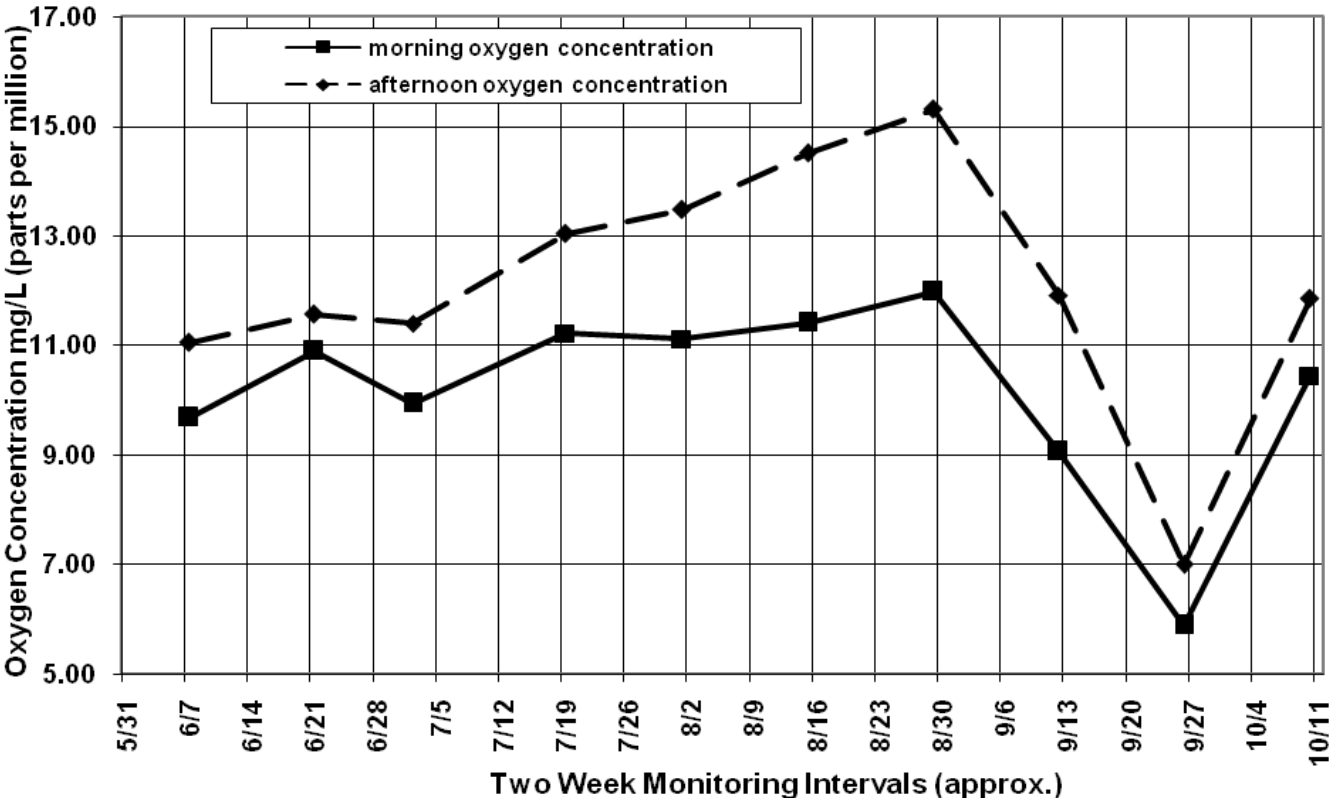


Figure 6c. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 2, the Stockton Avenue Bridge, 7 June - 10 October 2009.

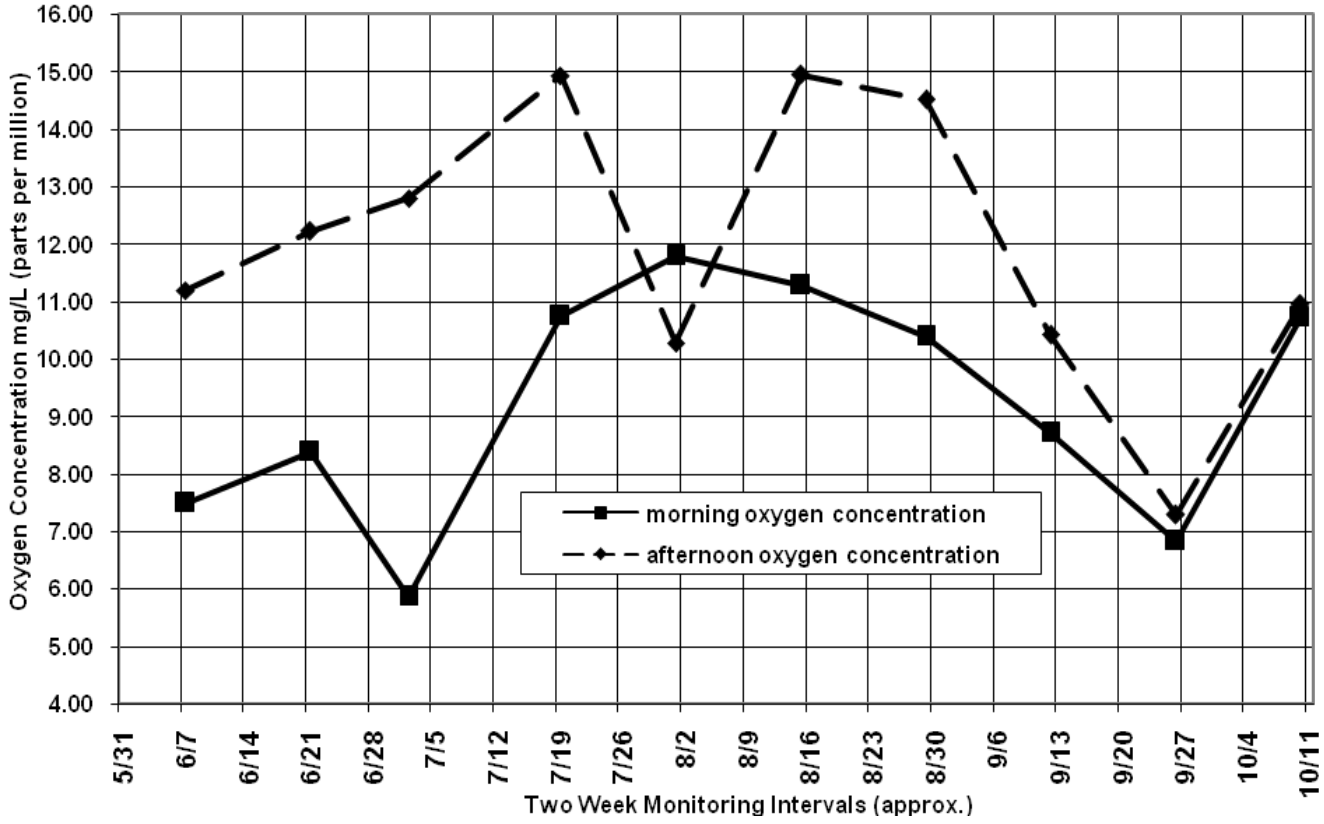


Figure 6d. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 3, the Railroad Trestle, 7 June - 10 October 2009.

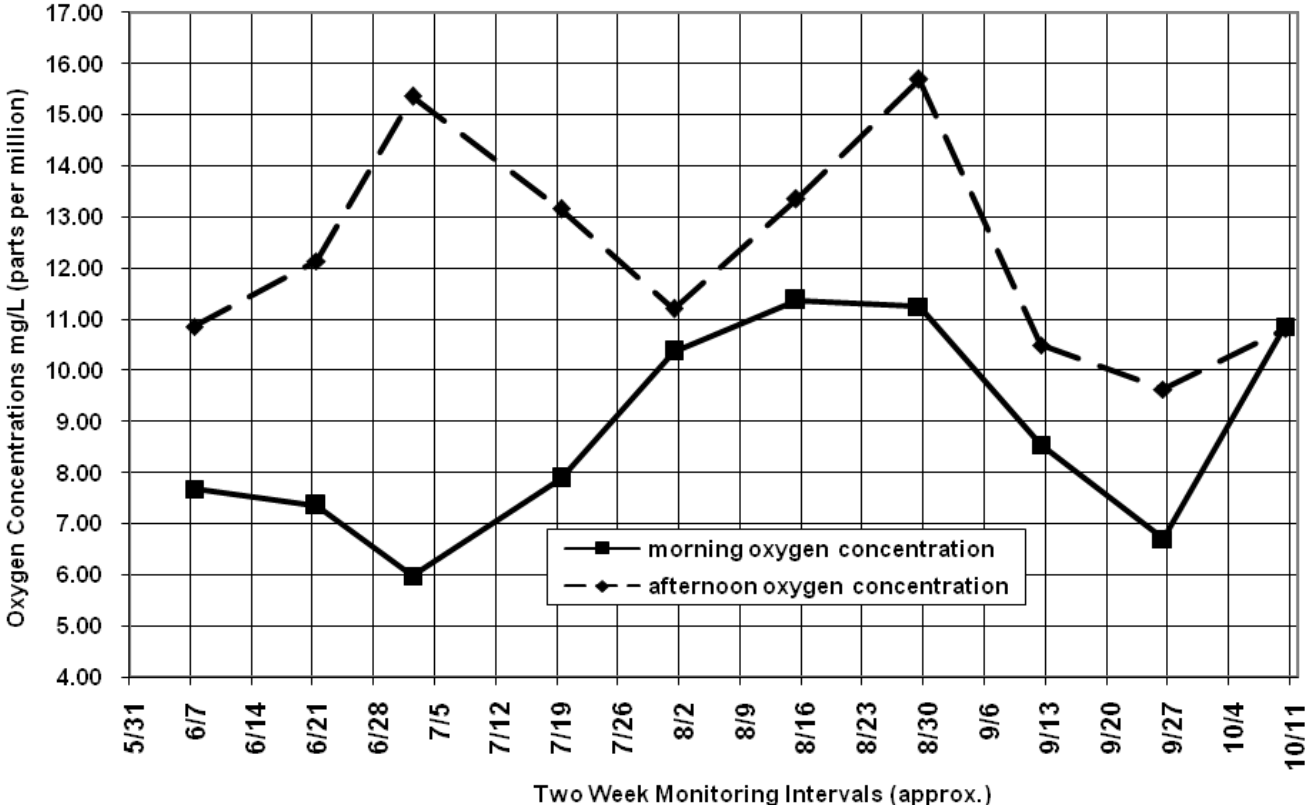


Figure 6e. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 4, the Mouth of Noble Gulch, 7 June - 10 October 2009.

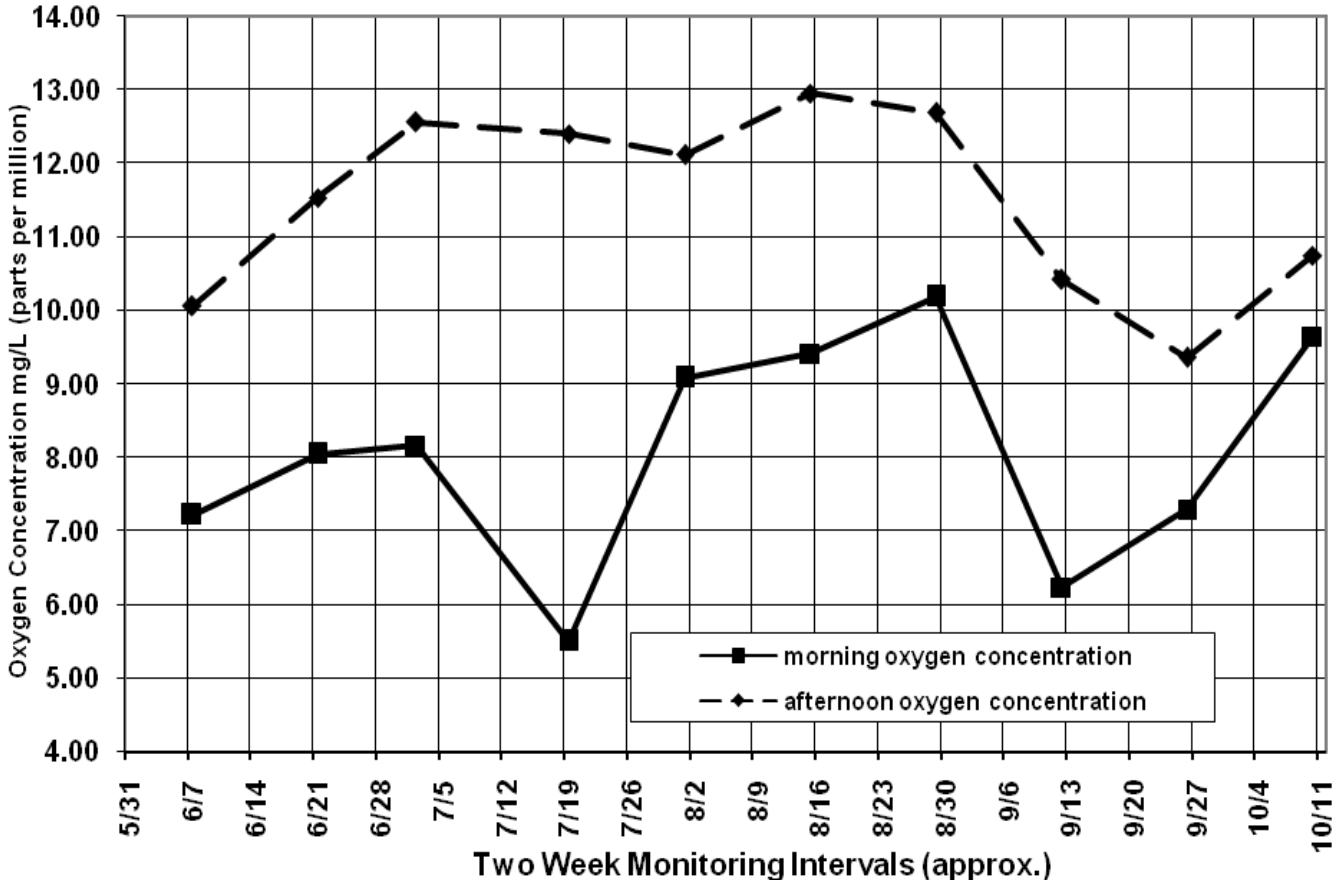


Figure 6f. Soquel Lagoon/Stream Oxygen Concentrations at Dawn Within 0.25 Meters of the Bottom at 5 Stations, 30 June - 6 December 2006

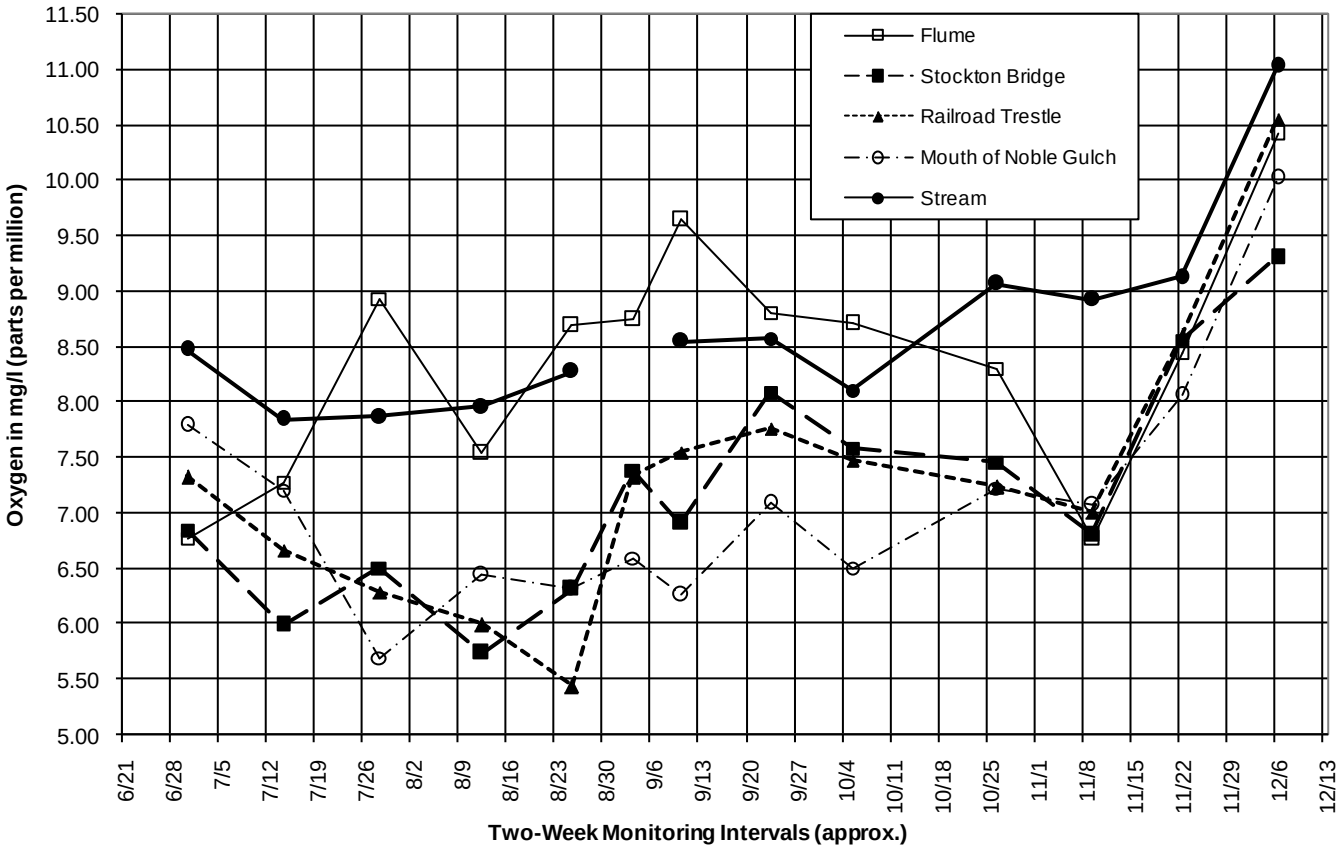


Figure 6g. Soquel Lagoon/Stream Oxygen Concentrations at Dawn within 0.25 Meters of the Bottom at Five Stations, June 10 - December 8, 2007.

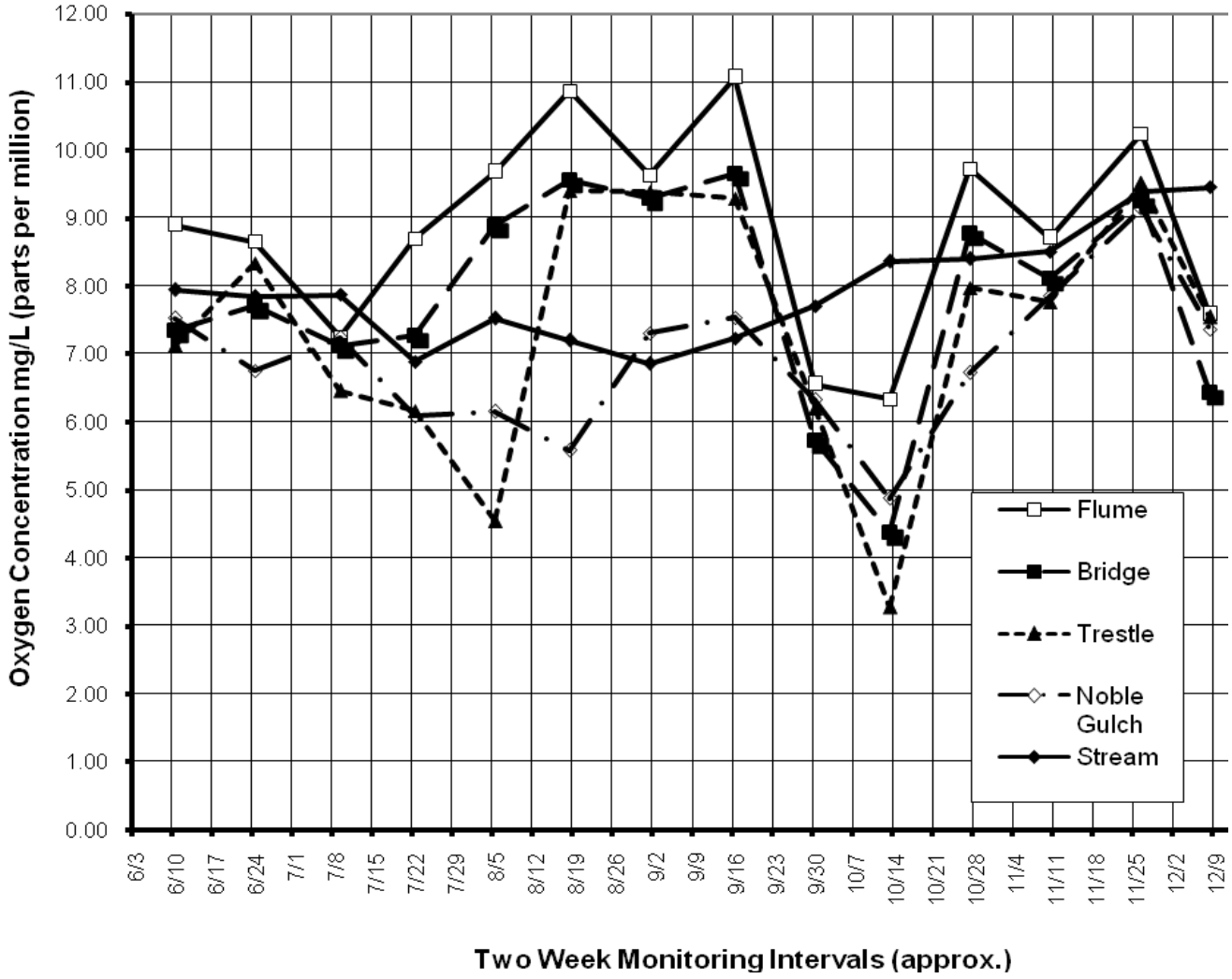
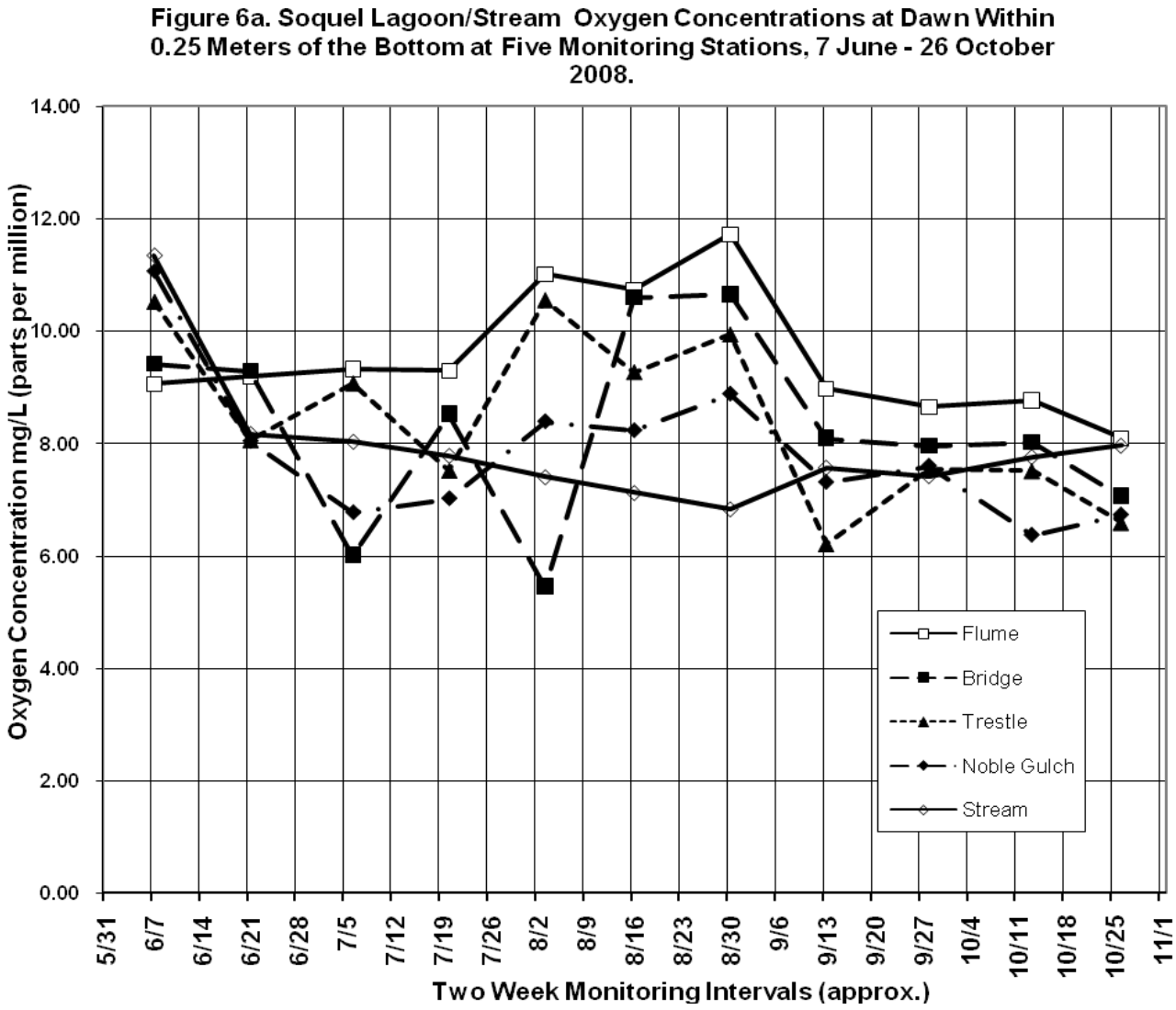


Figure 6h. Soquel Lagoon/Stream Oxygen Concentrations at Dawn Within 0.25 Meters of the Bottom at Five Monitoring Stations, 7 June – 26 October 2008.



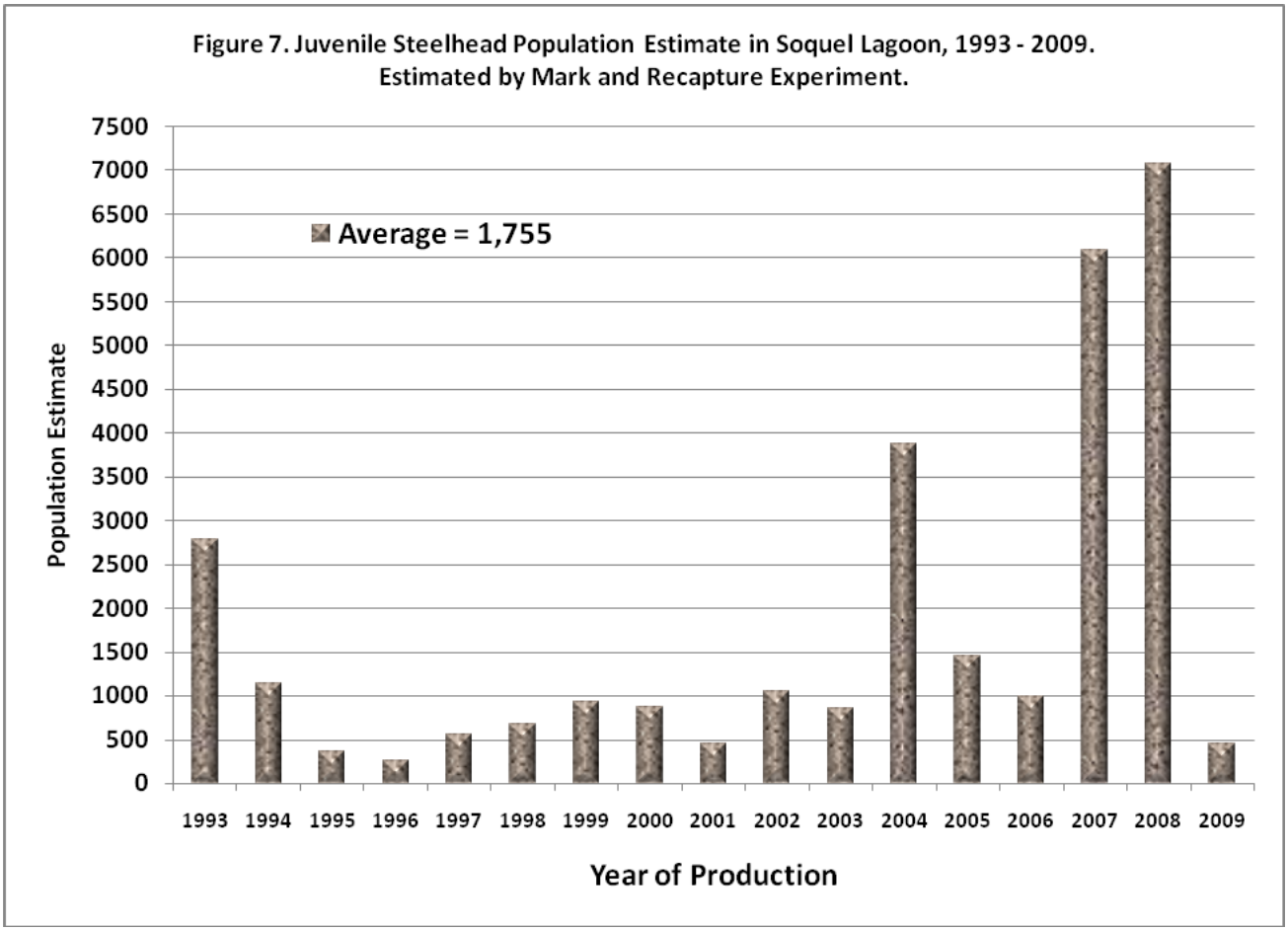


Figure 7. Juvenile Steelhead Population Estimate in Soquel Lagoon, 1993 - 2009.
Estimated by Mark and Recapture Experiment.
Average = 1,755
Population Estimate
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Year of Production

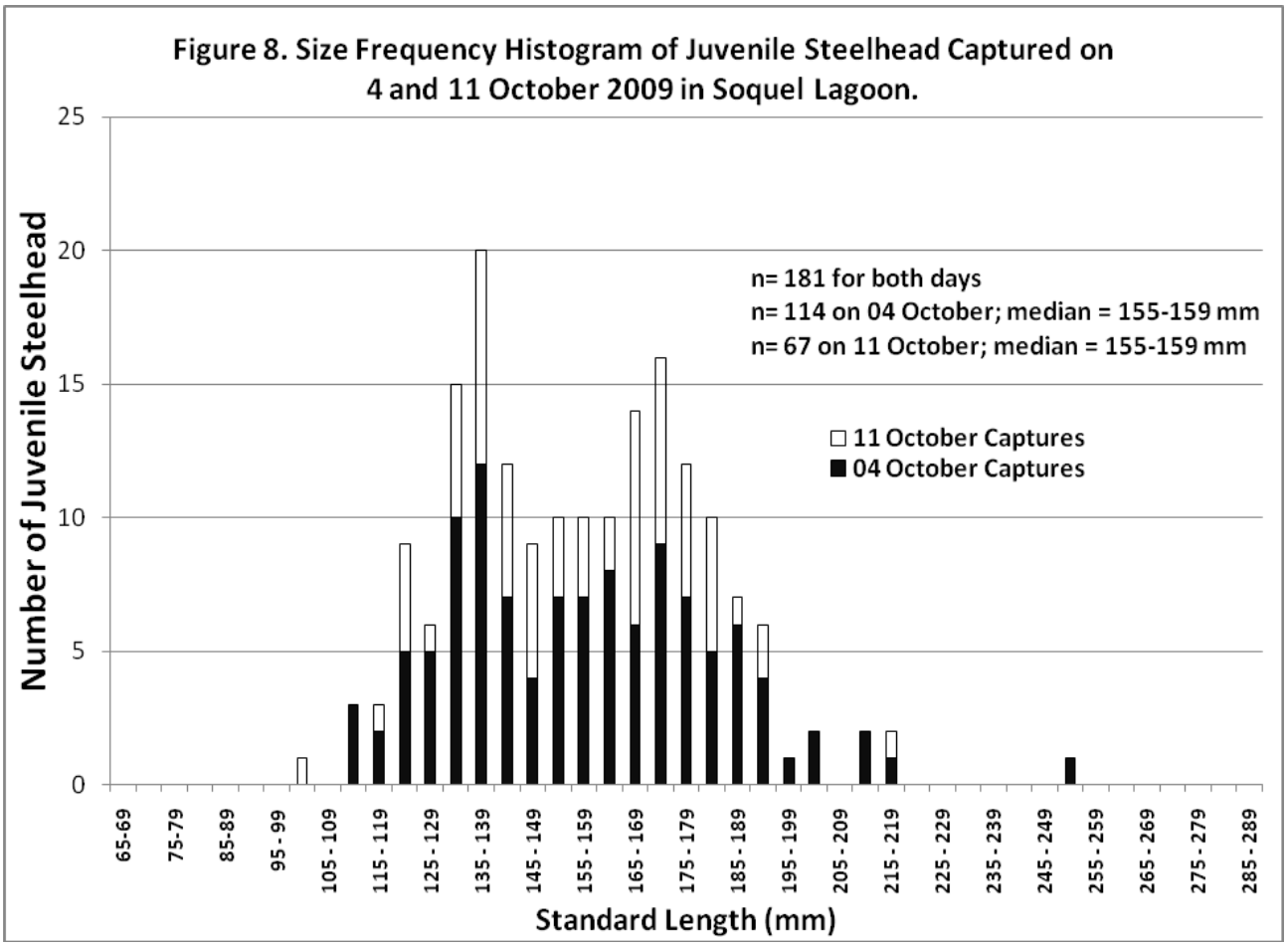


Figure 8. Size Frequency Histogram of Juvenile Steelhead Captured on 4 and 11 October 2009 in Soquel Lagoon.
Number of Juvenile Steelhead
25
20
15
10
5
0
n= 181 for both days
n= 114 on 04 October; median = 155-159 mm
n= 67 on 11 October; median = 155-159 mm
11 October Captures
04 October Captures
65-69
75-79
85-89
95 - 99
105 - 109
115 - 119
125 - 129
135 - 139
145 - 149
155 - 159
165 - 169
175 - 179
185 - 189
195 - 199
205 - 209
215 - 219
225 - 229
235 - 239
245 - 249
255 - 259
265 - 269
275 - 279
285 - 289
Standard Length (mm)

Figure 9. Size Frequency Histogram of Juvenile Steelhead Captured on 27 September 2008 in the Soquel Lagoon.

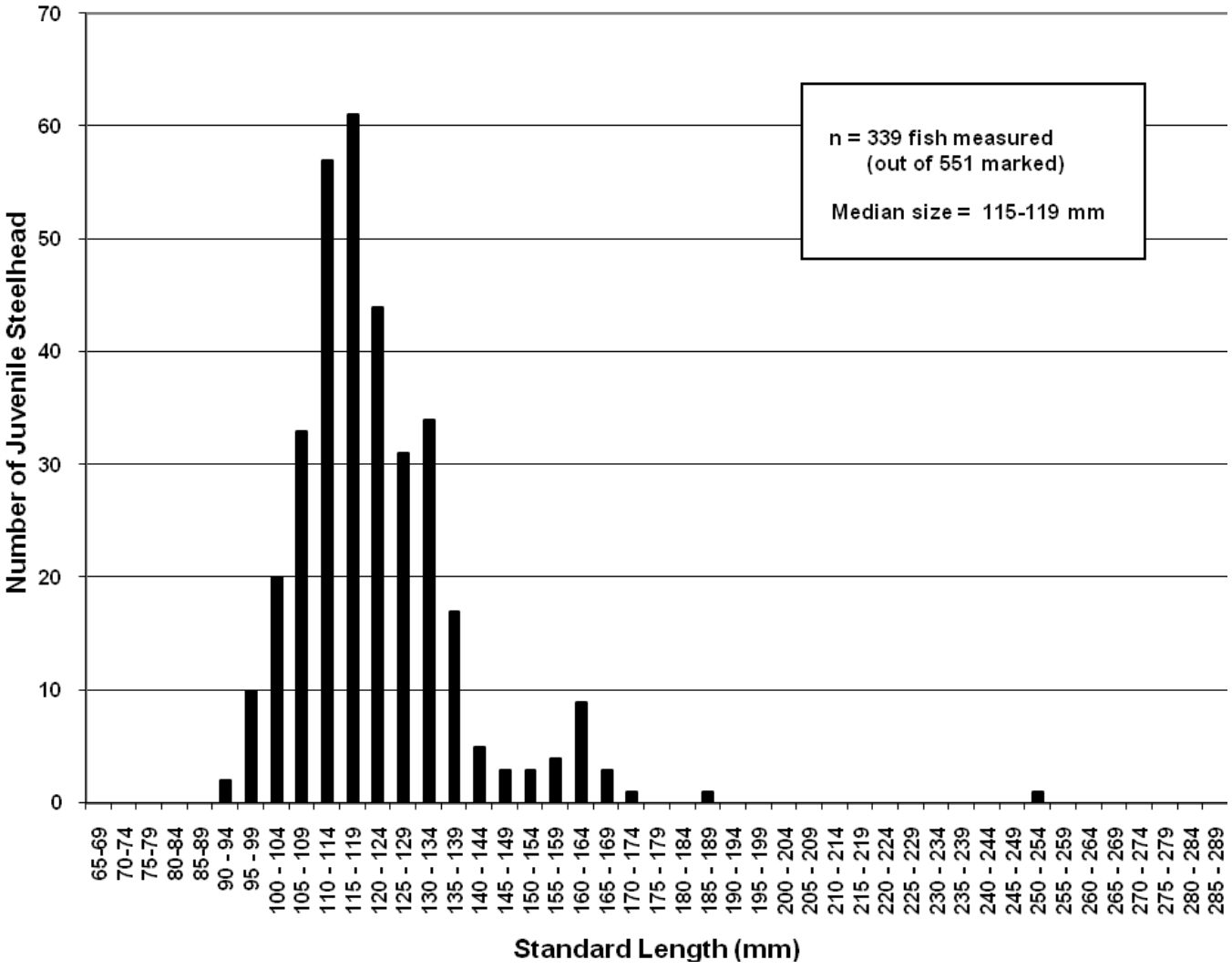


Figure 10. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 & 14 October 2007 in the Soquel Lagoon

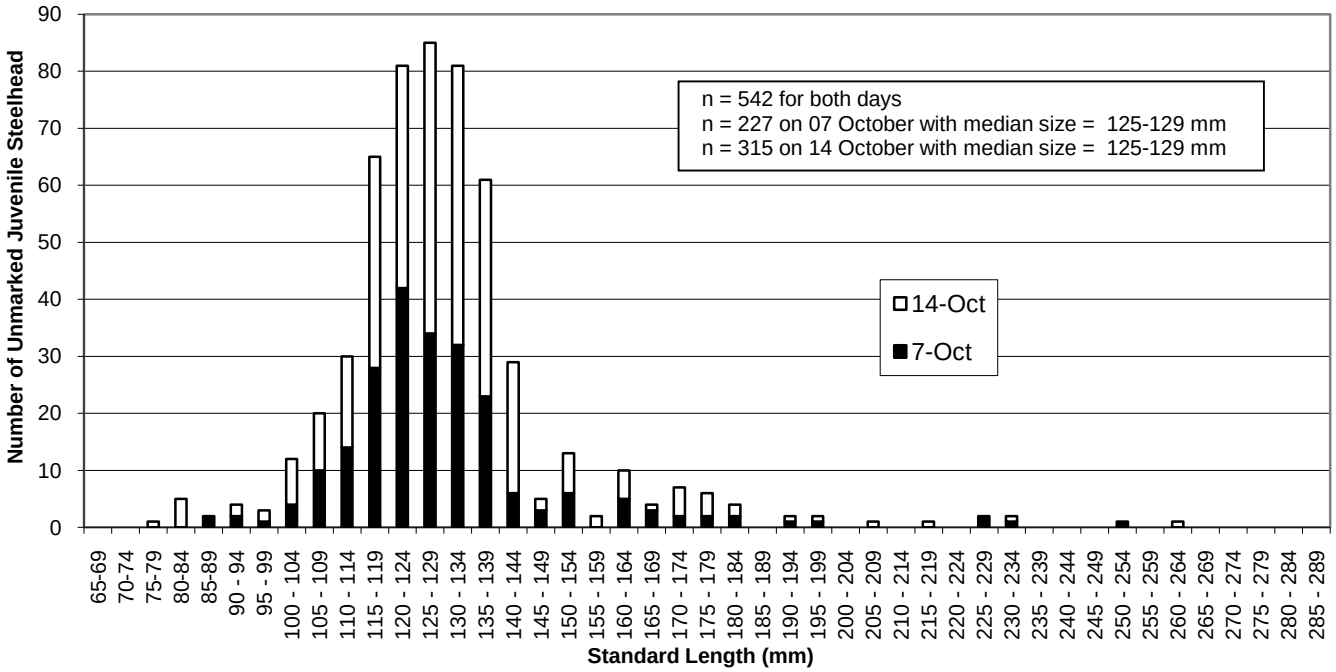


Figure 11. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 30 September and 8 October 2006 in Soquel Lagoon.

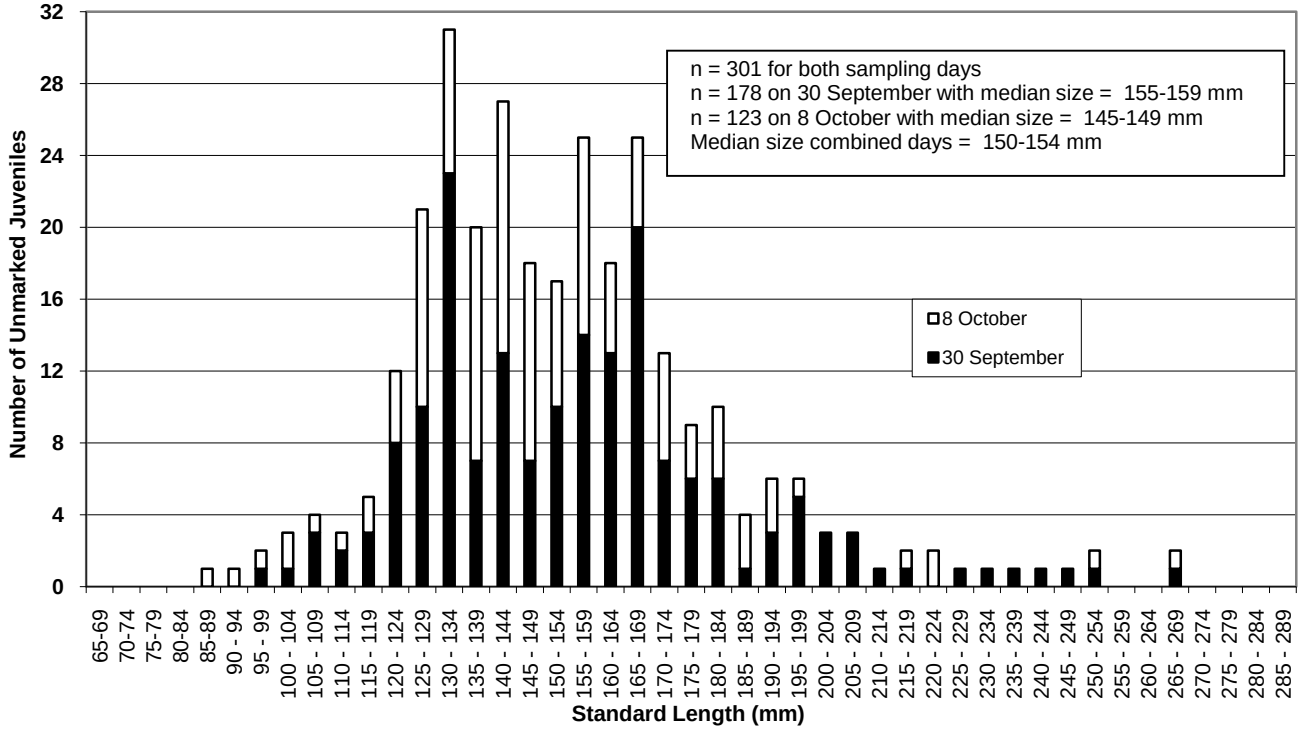


Figure 12. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 2 and 9 October 2005 in Soquel Lagoon.

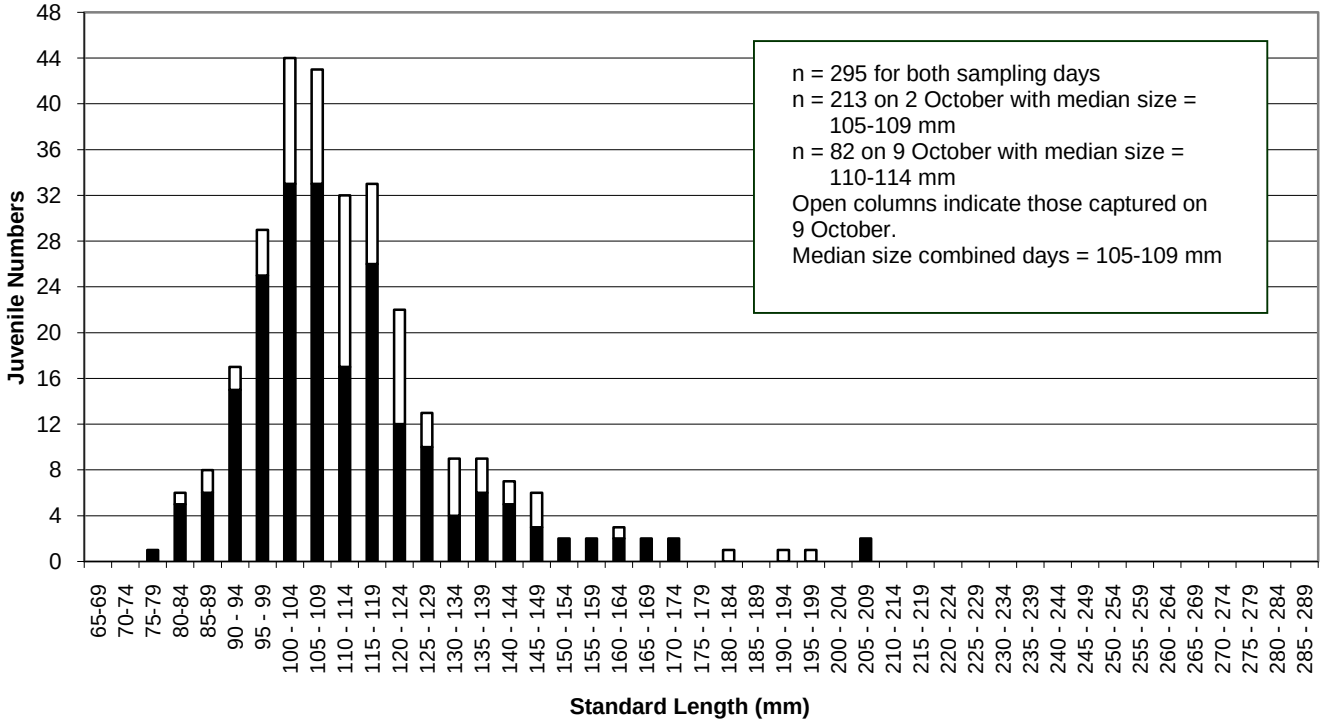


Figure 13. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

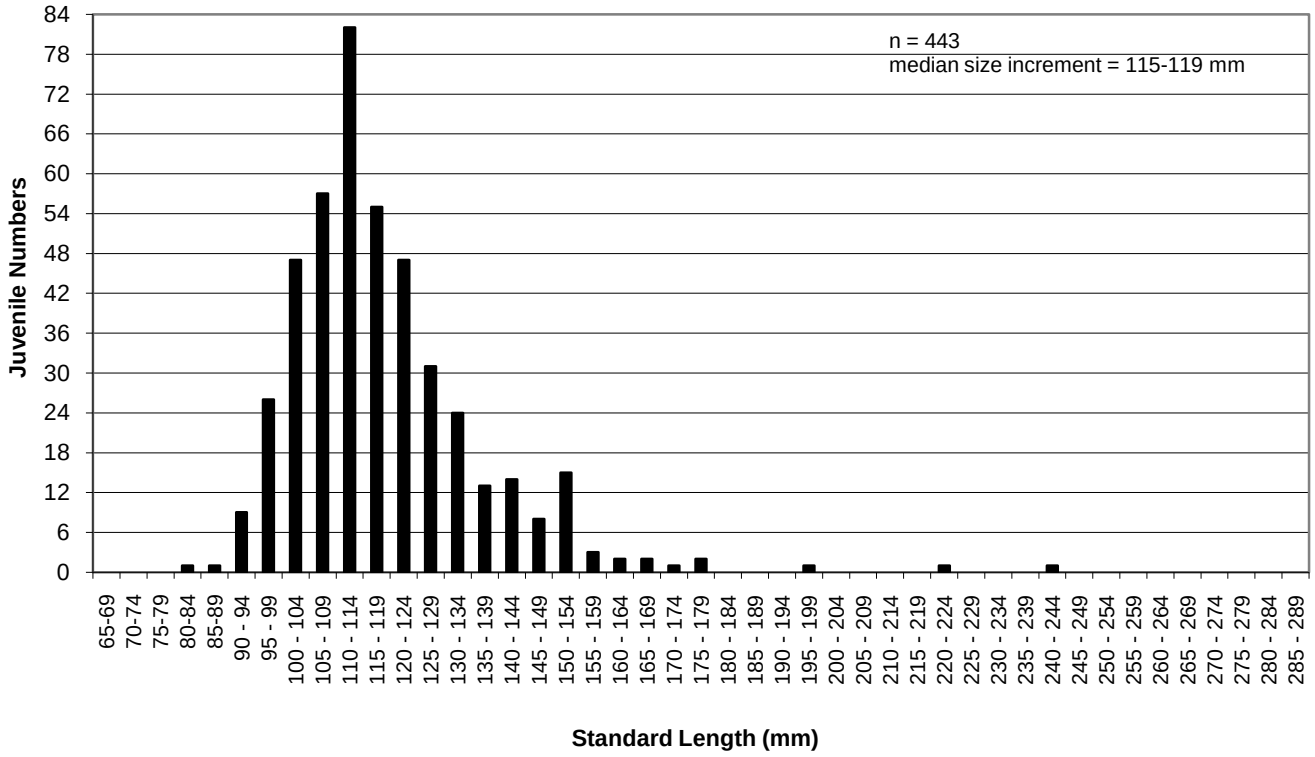


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

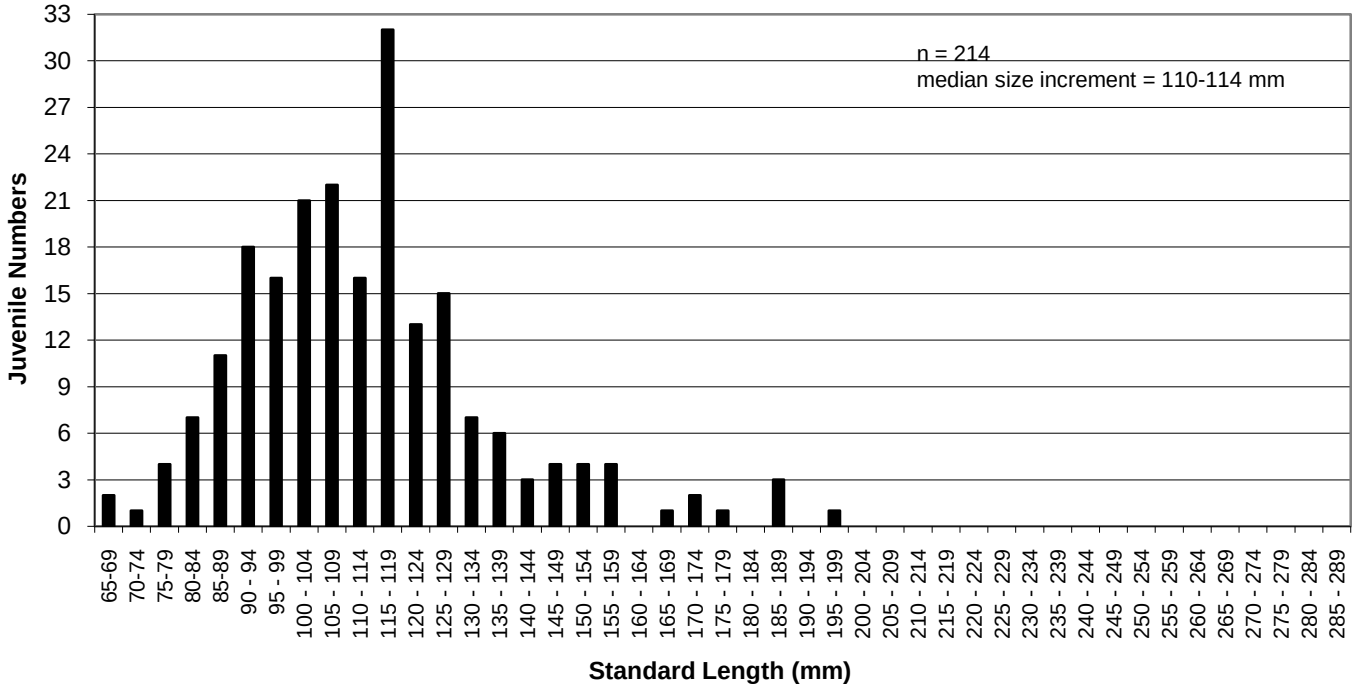


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 and 13 October 2002 in Soquel Lagoon.

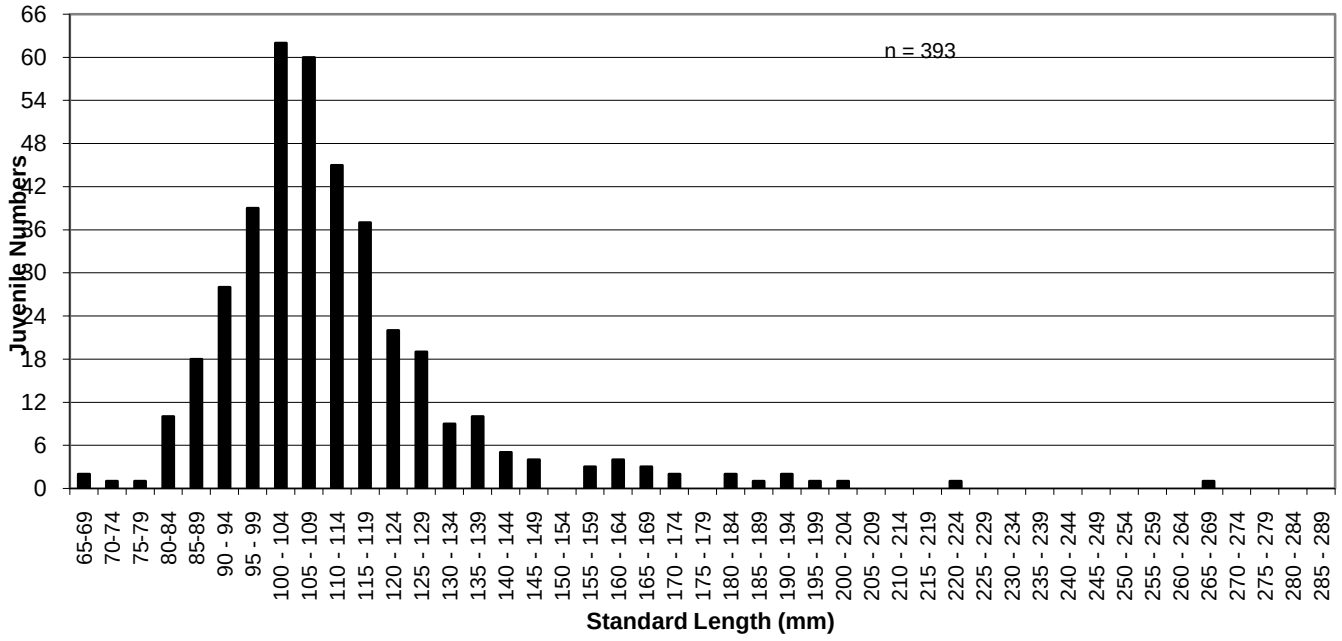


Figure 16. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

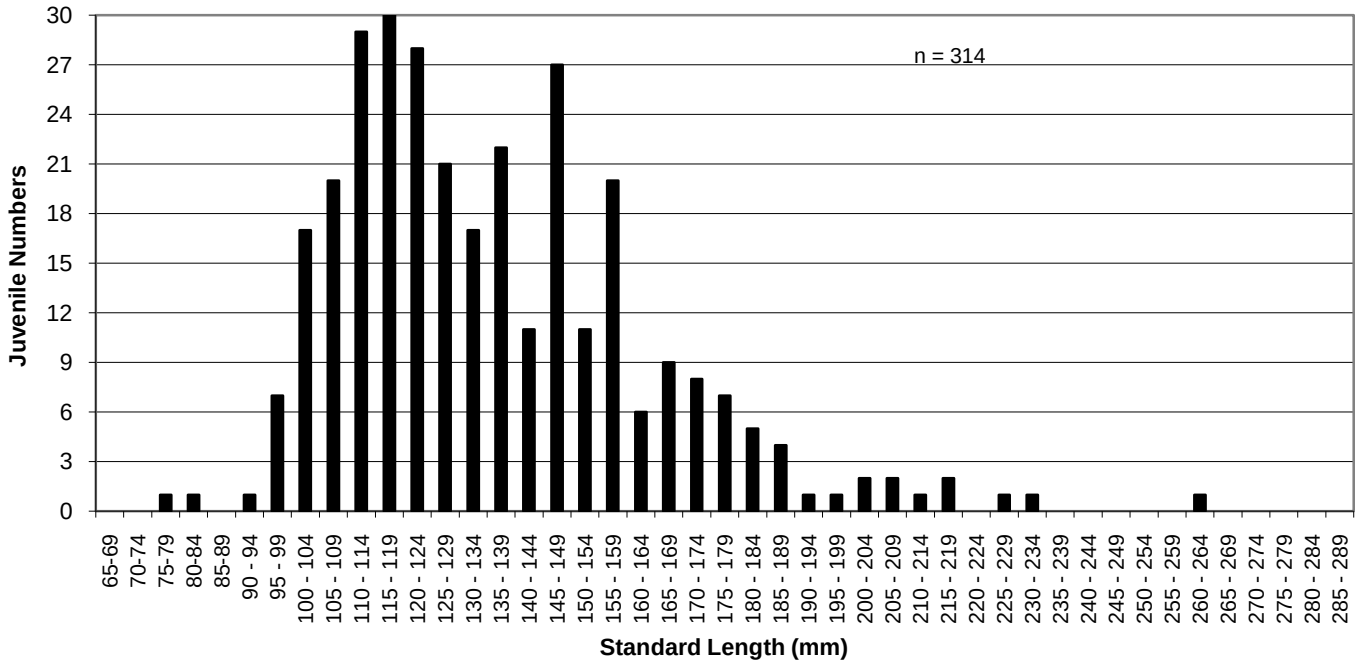


Figure 17. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

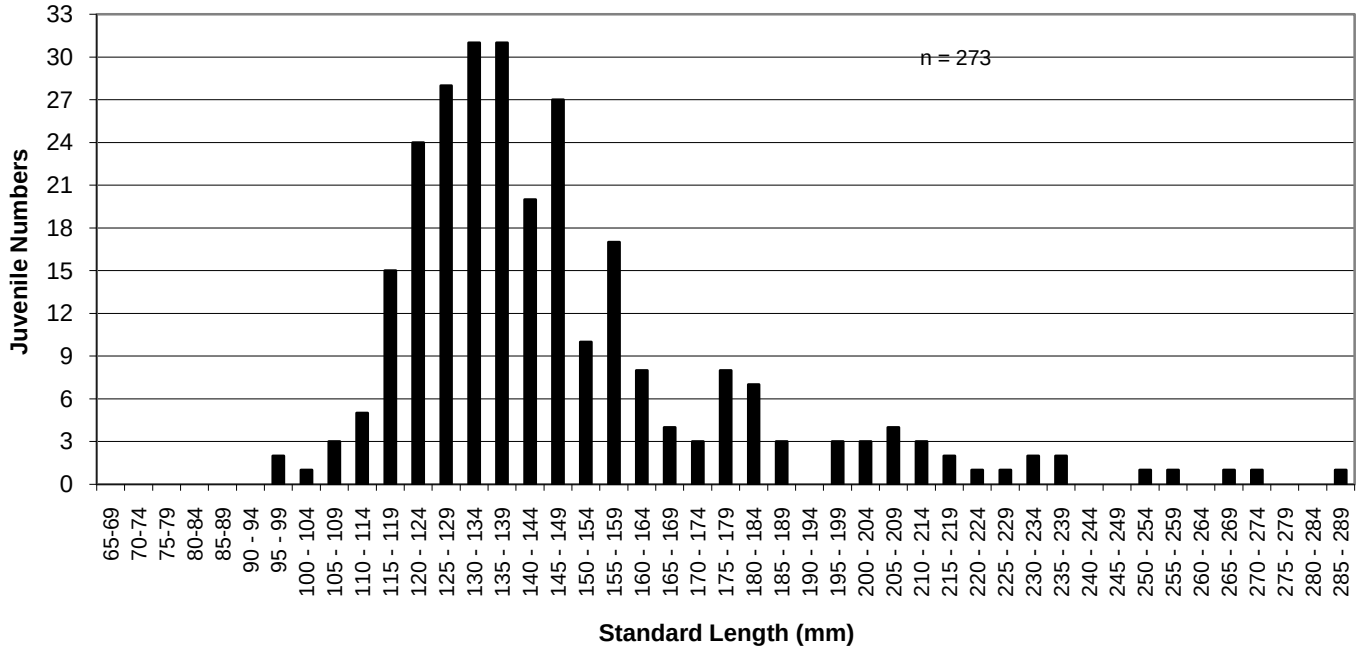


Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 October 1999 (only) in Soquel Lagoon.

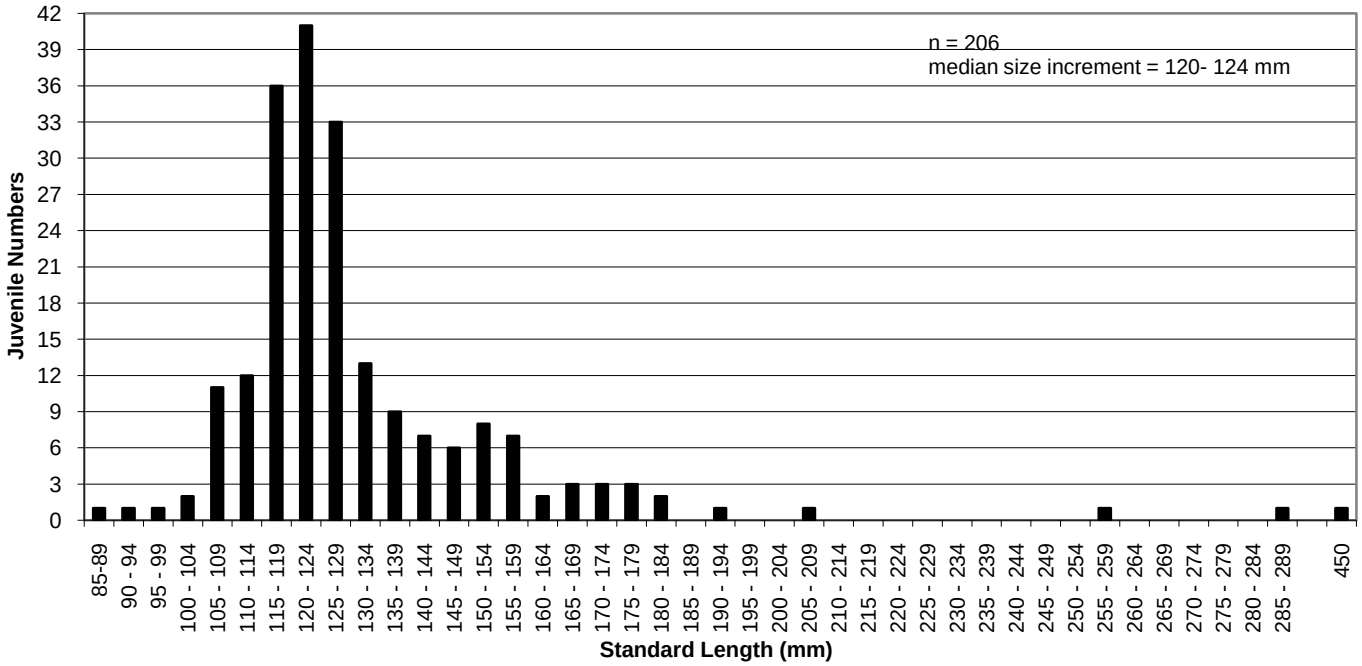


Figure 19. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

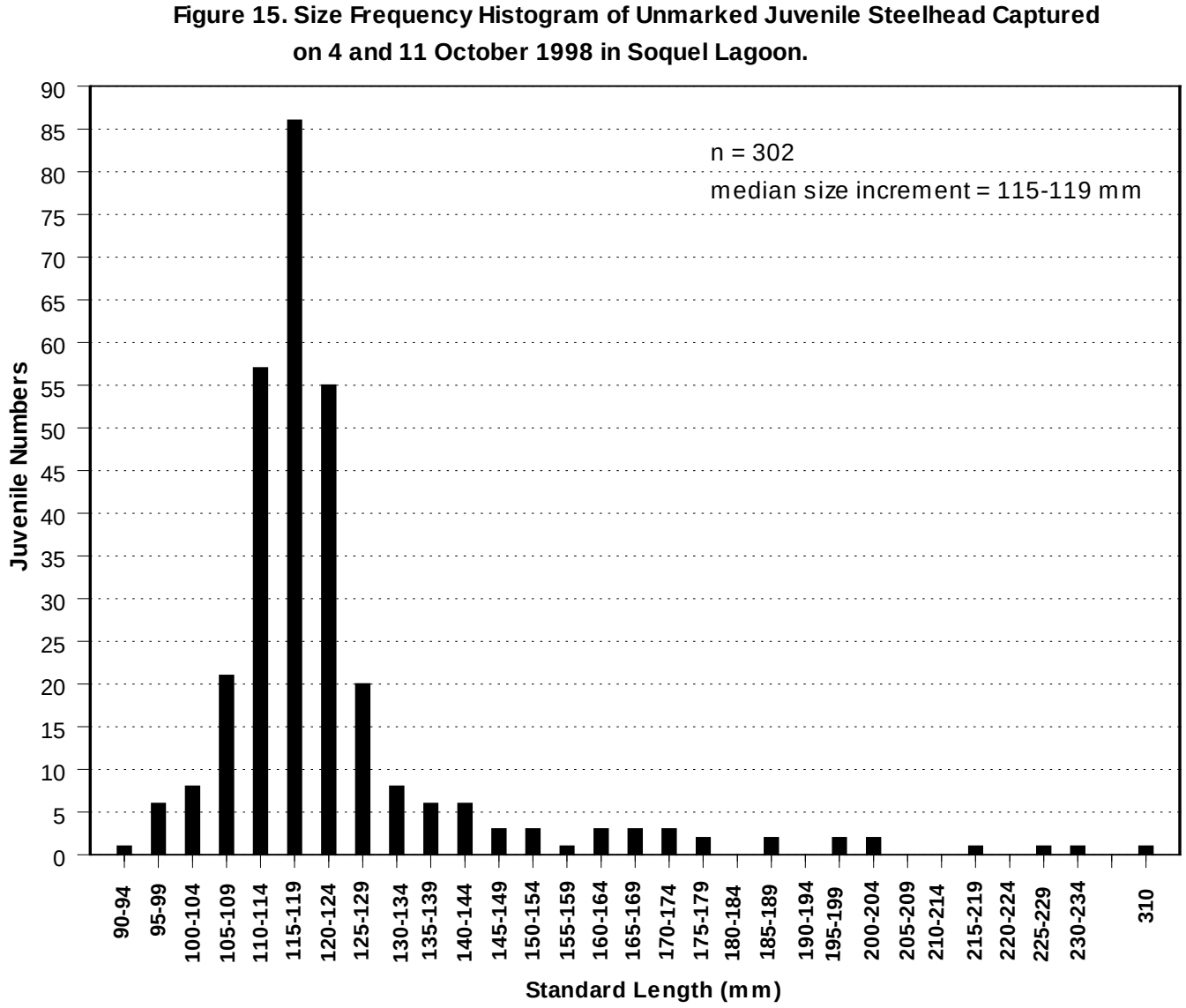


Figure 20. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 October 2008 – 30 September 2009.

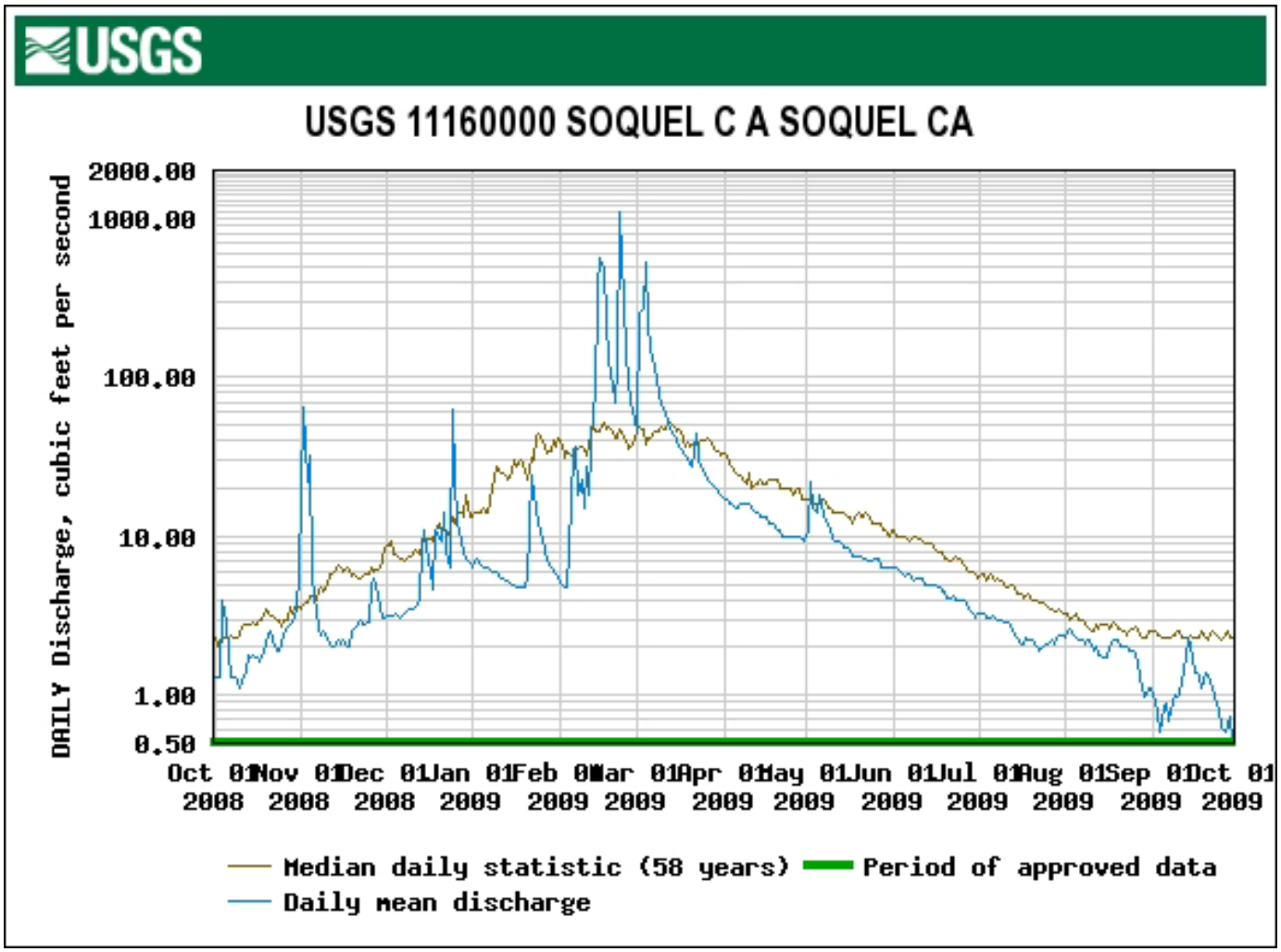


Figure 21. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 June 2009 – 21 December 2009.

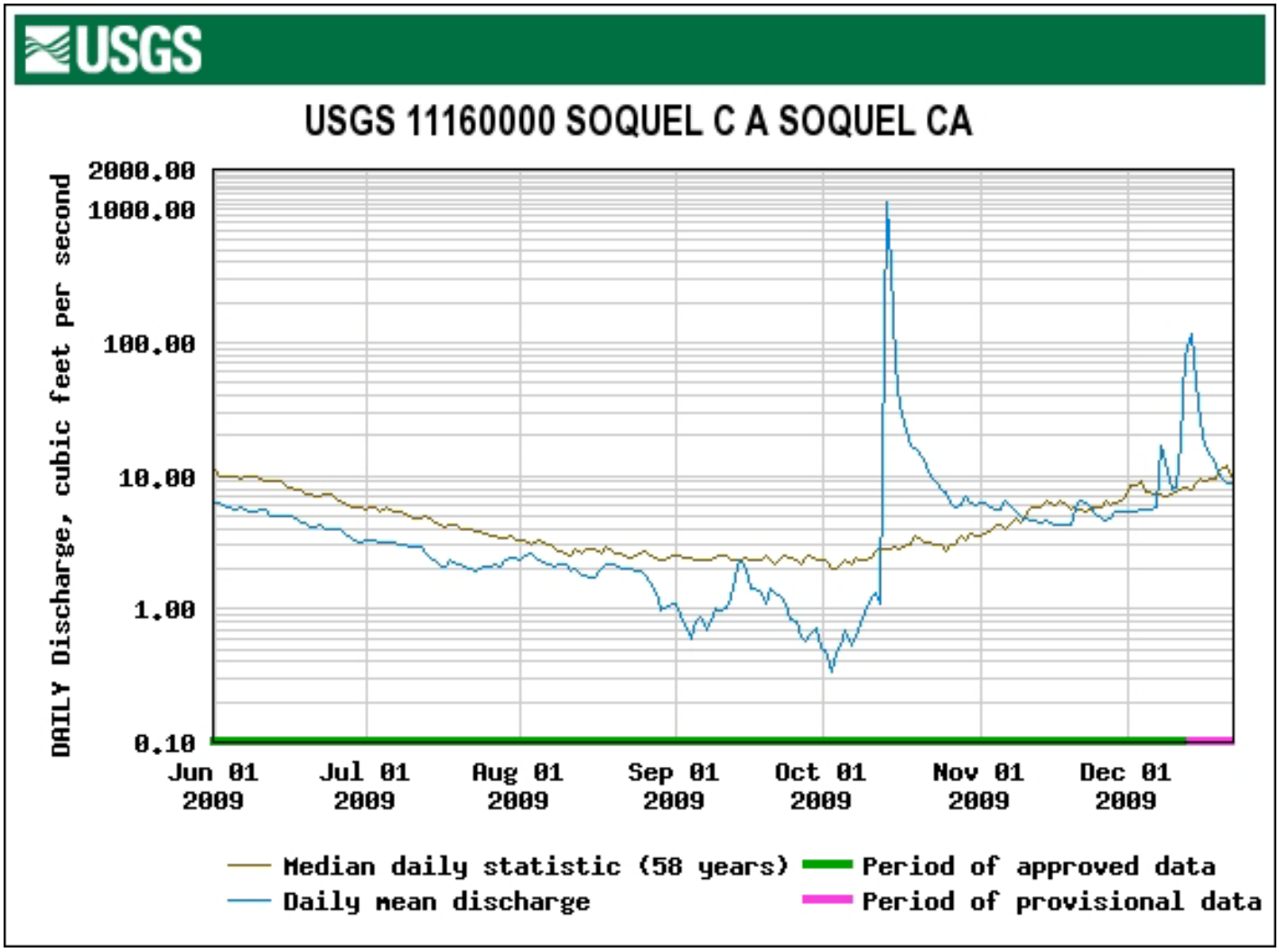


Figure 22. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 October 2009 – 31 October 2009.

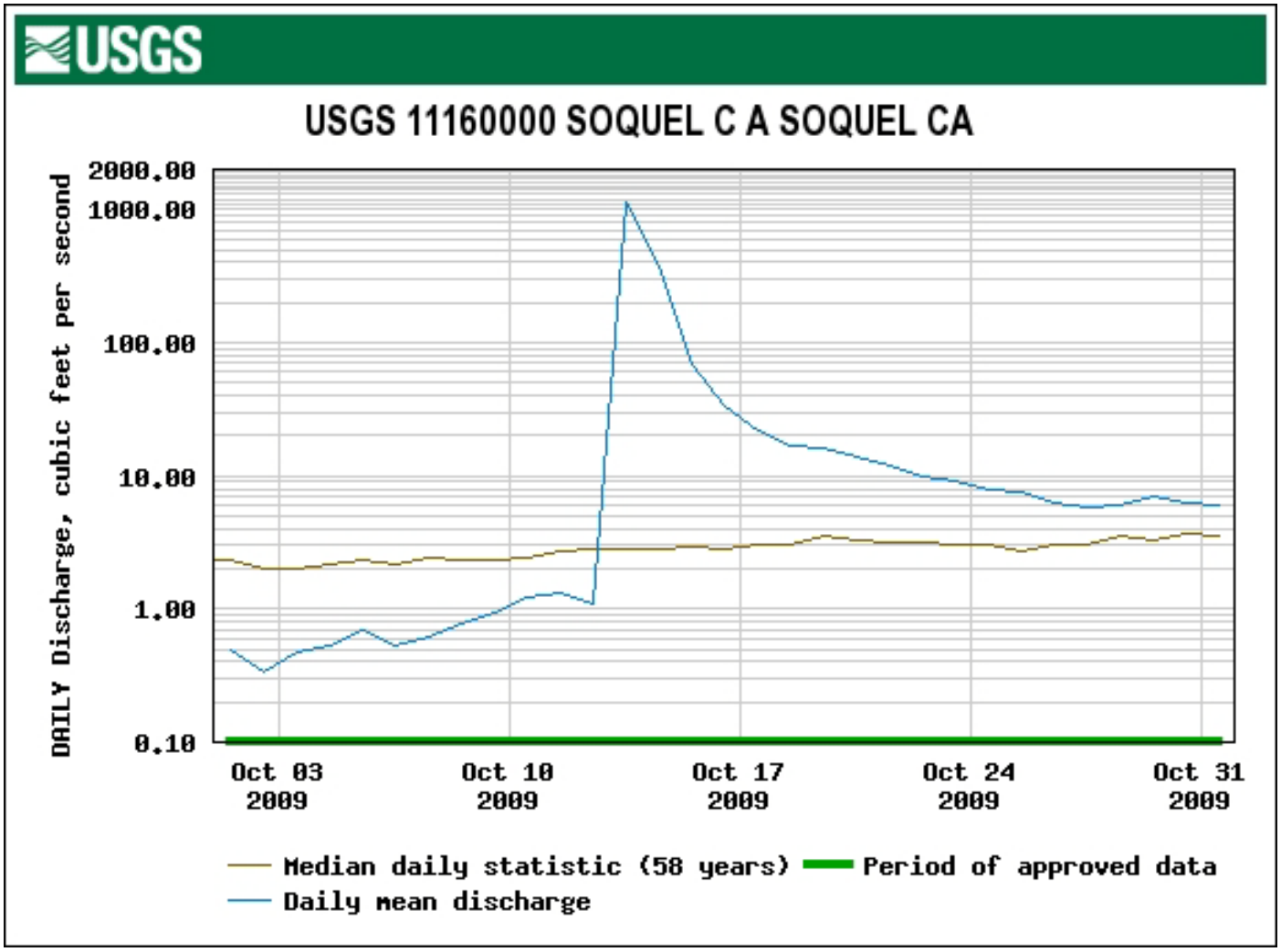


Figure 23. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 October 2007 – 30 September 2008.

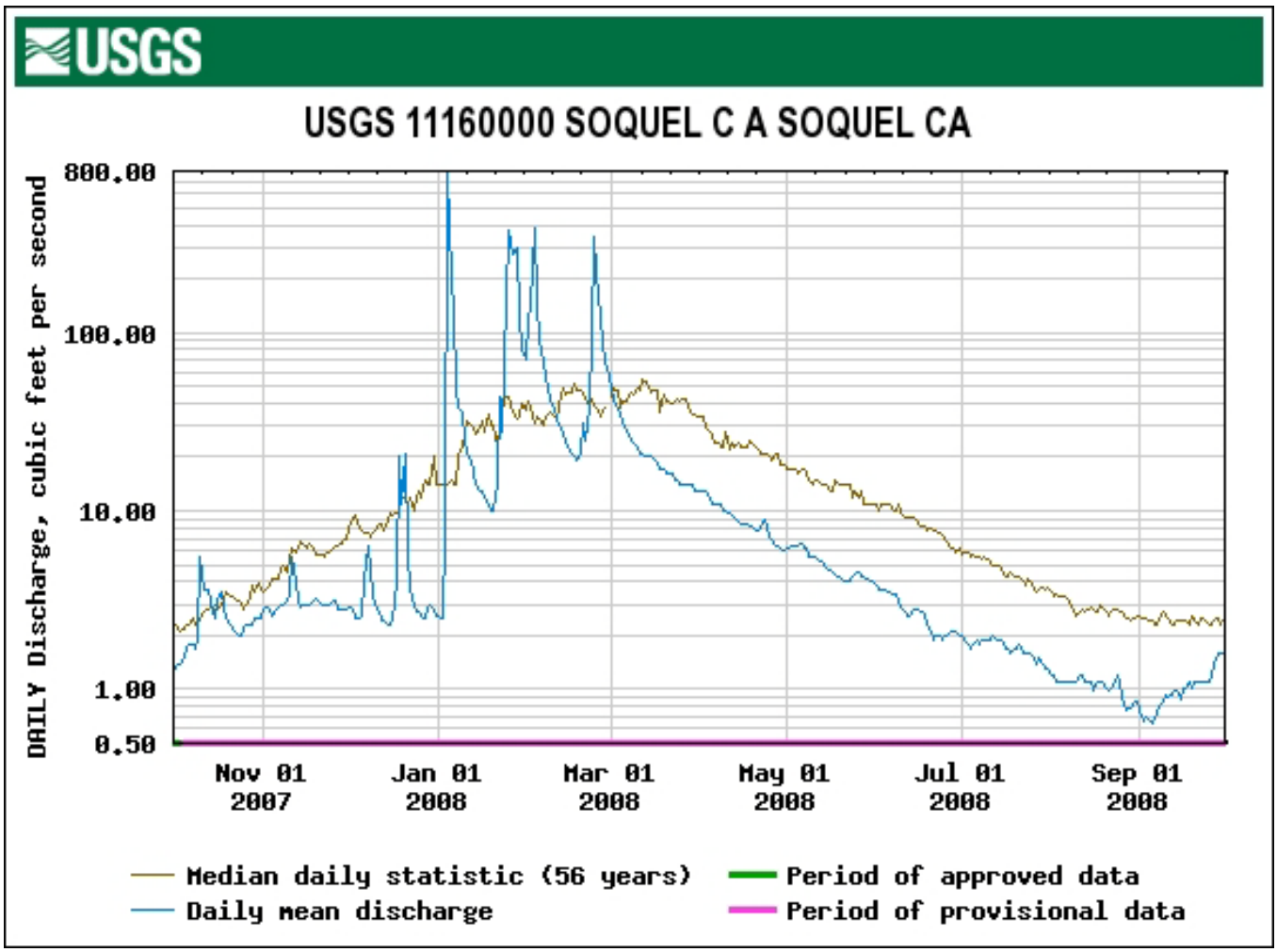
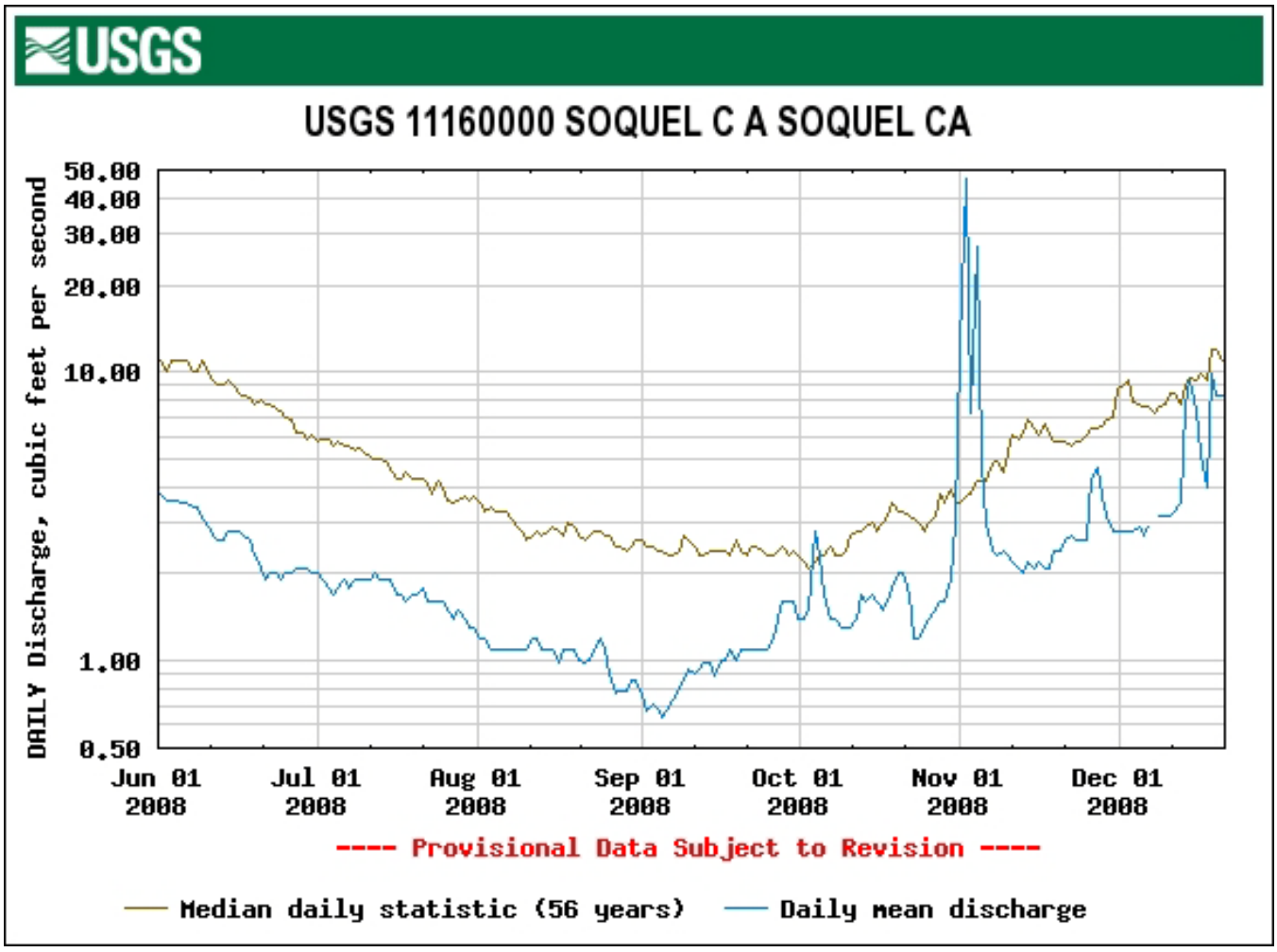


Figure 24. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage at Soquel, CA, 1 June – 21 December 2008.



APPENDIX A.

WATER QUALITY DATA AND GENERAL OBSERVATIONS OF BIRDS AND AQUATIC VEGETATION
25 MAY – 11 OCTOBER 2009.

25 May 2009. Launched temperature probes in the lagoon and upstream. The sandbar had been closed for the summer on 21 May. Gage height 2.28. Sunny. Saltwater not present under the bridge but was present in the deeper hole adjacent to the Venetian Court wall.

			25-May-09					
	Venetian Wall 1725 hr				**Stockton Ave Bridge Thalweg**			1712 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	16.6	0.4			16.7	0.4	9.64	670
0.25	16.6	0.5			16.8	0.4	9.57	667
0.50	16.6	0.5			16.7	0.4	9.74	665
0.75	16.6	0.5			16.7	0.4	9.52	664
1.00	16.6	0.5			16.7	0.4	9.52	664
1.25	16.6	0.6			16.6	0.4	9.36	663
1.50	16.6	0.7			16.6	0.4	9.56	662
1.75	16.6	4.3			16.5	0.4	9.63	663
1.88b					16.6	0.4	6.45	664
2.00	16.4	22.2						
2.25	17.4	26.8						
2.50b	19.9	23.0						
	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								
1.25								
1.50								

			07-Jun09					
	Flume Inlet 0708 hr				**Stockton Ave Bridge**		0723 hr	
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	18.0	0.4	9.62		18.3	0.4	9.12	681
0.25	18.2	0.4	9.72	686	18.3	0.4	9.25	681
0.50	18.3	0.4	9.74	686	18.3	0.4	8.86	682
0.75	18.4	0.4	9.64	686	18.3	0.4	8.72	682
1.00	18.4	0.4	9.68	686	18.2	0.4	8.57	682
1.25b	18.3	0.4	0.93	684	18.2	0.4	8.52	682
1.50					18.2	0.4	8.23	682
1.75					18.0	0.4	7.49	682
2.00b					18.7	0.4	2.31	683

	Railroad Trestle 0742hr				**Mouth of Noble Gulch** 0759 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	17.7	0.4	8.36	683	16.6	0.4	7.37	664
0.25	17.6	0.4	7.98	683	16.6	0.4	7.26	664
0.50	17.4	0.4	7.89	679	16.6	0.4	7.33	664
0.75	17.4	0.4	7.89	678	16.6	0.4	7.38	662
1.00	17.4	0.4	7.90	681	16.6	0.4	7.22	650
1.10b					16.1	0.4	3.65	625
1.25	17.4	0.4	7.68	682				
1.30 b	17.6	0.4	3.75	682				

7 June 2009. Gage height 2.28. Sunny, cool and breezy. Air temperature 12.9 C at 0708 hr. Reach 1- no surface algae.
Station 2: Stockton Avenue Bridge at 0723 hr. Secchi depth to bottom. Reach 2- 2% surface algae.
Station 3: Railroad Trestle at 0742 hr. Reach 3- <1% surface algae.
Station 4: Mouth of Noble Gulch at 0759 hr. No gray water observed from Noble Gulch. No surface algae but some in front of Shadowbrook. 4 mallards, 1 mergansers on downed cottonwood and redwood stump. 2 mallards in lagoon. No gray water.
Station 5: Nob Hill at 0831 hr. Water temperature 15.0^{o}C. Conductivity 642 umhos. Salinity 0.4 ppt. Oxygen 8.52 mg/l. Estimated streamflow 6.5 cfs.

			07-Jun-09					
	Flume		**1559 hr**		**Stockton Avenue Bridge/ Venetian Wall**			1525/1619 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	19.7	0.4	10.45	733	20.1/20.1	0.4/0.4	10.02	727
0.25	19.8	0.4	10.60	733	20.1/20.2	0.4/0.4	10.00	727
0.50	19.8	0.4	10.44	727	19.9/20.2	0.4/0.4	10.01	722
0.75	19.6	0.4	10.74	725	19.8/20.1	0.4/0.4	9.89	720
1.00	19.6	0.4	11.09	722	19.5/19.7	0.4/0.4	10.81	715
1.25	19.4	0.4	11.05	721	19.0/19.2	0.4/0.4	11.30	705
1.35b	19.6	0.4	5.63	723				
1.50					18.9/19.1	0.4/0.4	11.19	703
1.75					18.8/19.0	0.4/0.4	11.20	703
2.00b					18.7/18.8	0.4/0.4	5.54	700
2.25b					/18.8	/0.4		
	Railroad Trestle			1508 hr	**Mouth of Noble Gulch**			1455 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.0	0.4	10.35	722	20.4	0.4	9.34	730
0.25	19.9	0.4	10.28	722	20.3	0.4	9.26	727
0.50	19.9	0.4	10.09	720	19.7	0.4	8.90	717
0.75	19.8	0.4	10.17	717	18.4	0.4	9.53	695
1.00	19.7	0.4	10.13	710	18.1	0.4	10.06	691
1.10b					18.3	0.4	5.36	691
1.25	19.0	0.4	10.85	706				
1.30b	19.1	0.4	7.82	703				
1.50								

7 June 2009. Gage height of 2.32 in afternoon. Sunny.
Station 1: Flume at 1559 hr. Reach 1- 26 gulls bathing, 3 mallards. Air temp. 20.0 C.
Station 2: Stockton Avenue Bridge at 1525 hr. Secchi depth to bottom. Reach 2- no birds; no surface algae.
Station 3: Railroad Trestle at 1508 hr. Reach 3- No birds below Noble Gulch. 2 mallards above Noble Gulch. <1% surface algae.
Station 4: Mouth of Noble Gulch at 1455 hr. 1 goose, 7 mallards and 2 mergansers on downed cottonwood. No gray water. 2% surface algae; 60% of bottom 0.2-2 ft thick; avg. = 0.4 ft. No gray water.

				21-June-09				
	Flume Inlet 0721 hr/ **Venetian Wall** 0852 hr				**Stockton Ave Bridge** 0737 hr/ **Wetland Outlet** 0839 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	18.7/ 19.0	0.4/ 0.4	10.78	711/718	18.7/18.9	0.4/0.4	10.10/9.11	703/716
0.25	18.8/ 19.0	0.4/ 0.4	10.95	711/720	18.8/18.8	0.4/0.4	9.91/9.02	703/715
0.50	18.9/ 19.0	0.4/ 0.4	10.87	711/723	18.8/18.8	0.4/0.4	10.08/8.98	703/713
0.75	18.9/ 19.0	0.4/ 0.4	10.89	711/723	18.9/18.7	0.4/0.4	9.86/8.96	703/708
1.00	18.9/ 18.7	0.4/ 0.4	10.89	711/723	18.8/18.3	0.4/0.4	9.48/8.78	702/705
1.15b	19.2/-	0.7/-	1.35	1230/-				
1.25b	/ 18.6	/ 0.4		/723	18.7/18.2	0.4/0.4	9.01/4.02	702/705
1.50	/ 18.3	/ 0.4		/720	18.6/	0.4/	8.21/	702/
1.75	/ 18.3	/ 0.4		/720	18.5/	0.4/	8.38/	701/
1.90b					18.7/	0.4/	3.53/	703/
2.00	/18.3	/ 0.4		/721				
2.25	/18.5	/ 0.4		/722				
2.50b	/19.0	/0.5		/854				

	Railroad Trestle 0807 hr				**Mouth of Noble Gulch** 0822 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	17.9	0.4	9.29	695	16.0	0.4	8.82	670
0.25	18.0	0.4	9.22	694	16.0	0.4	8.67	665
0.50	18.0	0.4	9.06	694	16.0	0.4	8.60	664
0.75	17.9	0.4	7.96	694	16.0	0.4	8.58	654
1.00	17.7	0.4	7.35	692	15.9	0.4	8.35	646
1.05b					15.9	0.4	3.03	642
1.25b	17.6	0.4	2.85	694				

21 June 2009. Gage height 2.07 in morning. Clear with slight breeze. Air temperature 12.1 C at 0721 hr. Both shrouds in place on flume inlet.

Station 1: Reach 1- Surface algae 3%. 16 mallards (8 of them ducklings , 7 gulls.
Station 2: Stockton Avenue Bridge at 0737 hr. Reach 2- 10% surface algae; 1 merganser fishing.
Station 3: Railroad Trestle at 0807 hr.
Station 4: Mouth of Noble Gulch at 0822 hr. Reach 3- 2% surface algae; 6 mallards and 1 merganser (from Reach 1) in water. 2 mallards, 1 domestic duck, 2 turtles and 1 goose on downed cottonwood. 3 mergansers on redwood stump. 10% surface algae at Gulch. No gray water.
Station 5: Nob Hill at 0923 hr. Water temperature 14.8^{o}C. Conductivity 650 umhos. Salinity 0.4 ppt. Oxygen 8.89 mg/l. Streamflow estimated at 6 cfs.

			21-Jun-09					
	Flume			1559 hr	**Stockton Avenue Bridge**			1539 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	19.8	0.4	10.97	724	20.3	0.4	10.74	732
0.25	19.8	0.4	11.27	717	20.3	0.4	10.77	732
0.50	19.8	0.4	11.18	717	20.2	0.4	10.82	730
0.75	19.7	0.4	11.95	717	20.1	0.4	11.03	727
1.00	19.4	0.4	11.65	717	19.9	0.4	12.29	717
1.25	19.3	0.4	11.57	717	19.4	0.4	13.24	705
1.30b	19.5	0.4	5.51	717				
1.50					18.9	0.4	12.91	703
1.75					18.7	0.4	12.22	700
2.00b					18.6		0.62	700
2.25								
	Railroad Trestle			1520 hr	**Mouth of Noble Gulch**			1502 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.8	0.4	10.26	738	20.9	0.4	9.58	738
0.25	20.7	0.4	10.34	736	20.7	0.4	9.53	735
0.50	20.6	0.4	10.38	734	20.4	0.4	9.32	725
0.75	20.5	0.4	10.48	729	19.0	0.4	12.03	708
1.00	19.9	0.4	12.13	705	18.7	0.4	11.53	698
1.05b					19.1	0.4	6.31	696
1.25b	19.1	0.4	7.25	703				
1.50								

21 June 2008. Gage height of 2.12 in afternoon. Sunny. Flume inlet 1 foot deep. Flume exit 0.6 feet depth. Air temperature 17.4 C at 1559 hr at Flume.
Station 1: Flume at 1559 hr. Reach 1- No surface algae. 40% of bottom with algae 0.5 –2.0 ft thick; avg. = 1.0 ft. Adult passage portal in place on flume inlet 6 inches from top.
Station 2: Stockton Avenue Bridge at 1539 hr. Secchi depth to bottom. Reach 2- surface algae<1%; bottom 70% covered with algae 0.1 - 2 ft thick, averaging 0.3 ft, remainder thin film. 4 mallards observed.
Station 3: Railroad Trestle at 1520 hr. Reach 3- 2% surface algae, 80% of bottom with algae 0.2- 2.0 ft, averaging 0.5 ft. 15 mallards dabbling (8 were ducklings).
Station 4: Mouth of Noble Gulch at 1502 hr. 20% surface algae; bottom 60% covered with algae 0.3-1 ft thick, avg. = 0.5 ft. 1 goose, 3 domestic ducks and 3 mergansers roosting on downed cottonwood. 1 female mallard and 8 ducklings near Gulch. No gray water.

			2-July-09					
	Flume 0702 hr				**Stockton Avenue Bridge**1015hr/ **Wetland Outlet** 0808hr			
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	19.6	0.4	9.70	727	19.8/19.6	0.4/0.4	10.26/9.92	725/726
0.25	19.8	0.4	9.73	728	19.8/19.6	0.4/0.4	10.22/9.89	725/727
0.50	19.9	0.4	9.83	728	19.8/19.7	0.4/0.4	10.15/9.85	726/727
0.75	19.9	0.4	9.92	728	19.8/19.7	0.4/0.4	9.86/9.84	725/727
1.00	19.9	0.4	9.94	728	19.8/19.7	0.4/0.4	10.04/9.76	725/727
1.25b	20.0	0.4	5.58	728	19.8/19.6	0.4/0.4	9.89/8.04	725/729
1.30b					/19.6	/0.4	/3.28	/729
1.50					19.7/	0.4/	9.41/	725/
1.75					19.3/	0.4/	5.87/	724/
1.95b					19.4/	0.4/	0.14/	727/
	Railroad Trestle 0734 hr				**Mouth of Noble Gulch**			0750 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.4	0.4	9.91	722	18.7	0.4	10.30	706
0.25	19.5	0.4	10.15	722	18.7	0.4	10.63	705
0.50	19.5	0.4	10.55	722	18.6	0.4	10.78	700
0.75	19.4	0.4	10.04	721	18.1	0.4	7.72	675
1.00	19.1	0.4	5.59	718	17.8	0.4	8.16	671
1.15b					17.8	0.4	3.74	679
1.25	18.6	0.4	5.98	717				
1.37b	18.7	0.4	2.14	718				

2 July 2009. Gage height of 2.24 in morning. Overcast. Air temperature of 15.1°C at 0702 hr. Shrouds removed 22 June. Underwater adult portal present. Sandbags placed beyond flume inlet, indicating hole developed near flume.

Station 1: Flume 0702 hr. Reach 1- 3 mallard ducklings, 6 mallards standing on margin at Venetian Court, 7 gulls bathing. No surface algae.

Station 2: Stockton Bridge 0715 hr. Reach 2- 1 mallard; no surface algae.

Station 3: Railroad trestle 0734. Reach 3- 3 mallards plus one female mallard and 7 ducklings. No surface algae.

Station 4: Noble Gulch 0750 hr. 3 mallards, 1 goose and 6 mergansers roosting on downed cottonwood. 1 mallard and 1 gull on redwood stump. 1 merganser fishing. No gray water.

Station 5: Nob Hill at 0835 hr. Water temperature 16.2°C. Conductivity 671 umhos. Salinity 0.4 ppt. Oxygen 9.91 mg/l. Streamflow estimated 3.5 cfs.

			02 July-09					
	Flume			1620 hr	**Stockton Avenue Bridge**			1604 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.0	0.4	11.21	748	21.2	0.4	10.26	756
0.25	21.0	0.4	11.20	746	21.2	0.4	9.93	756
0.50	21.0	0.4	11.05	746	21.2	0.4	10.10	755
0.75	20.9	0.4	11.33	745	21.2	0.4	10.06	754
1.00	20.9	0.4	11.38	745	21.1	0.4	10.18	753
1.25	20.8	0.4	11.40	745	20.8	0.4	10.86	748
1.30b	20.9	0.4	6.34	745				
1.50					20.8	0.4	12.12	744
1.75					20.6	0.4	12.80	738
1.95b					20.4	0.4	3.76	737
	Railroad Trestle			1548 hr	**Mouth of Noble Gulch**			1525 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	10.81	752	22.0	0.4	9.69	762
0.25	21.3	0.4	10.95	751	21.9	0.4	9.84	756
0.50	21.4	0.4	11.16	748	21.5	0.4	9.23	752
0.75	21.3	0.4	11.18	749	20.1	0.4	11.73	725
1.00	21.1	0.4	13.78	725	19.8	0.4	12.56	713
1.15b					19.9	0.4	7.40	715
1.25	20.6	0.4	15.35	726				
1.35b	20.8	0.4	8.75	724				
1.50								

02 July 2009. Gage height of 2.24 in afternoon. Sunny, breezy. Air temperature of 17.5°C at 1620 hr. Flume inlet approx. 1.0 ft depth. Flume exit depth 0.6 ft on one side.

Station 1: Flume at 1620 hr. Reach 1- No surface algae, bottom not visible. 27 gulls bathing in Reach 1 in afternoon with 4 mallards plus 1 female mallard and 5 ducklings. 5 mergansers fishing and a steelhead was taken.

Station 2: Stockton Avenue Bridge at 1604 hr. Secchi depth to bottom. Reach 2- no surface algae, 100% of bottom covered with algae, 0.3- 2.0 ft thick, averaging 0.5 ft. No birds.

Station 3: Railroad Trestle at 1548 hr. Reach 3- <1% surface algae, 99% of bottom covered with algae 0.2- 2.0 ft thick, averaging 0.5 ft. 6 mallards near Noble Gulch.

Station 4: Mouth of Noble Gulch at 1525 hr. 5% surface algae, 70% of bottom algae 0.2 – 2.0 ft thick, averaging 0.8 ft. No gray water was entering lagoon from Noble Gulch. 6 mallards and 4 mergansers roosting on downed cottonwood and redwood stump. Mergansers later seen in Reach 1, fishing.

			19-Jul-09					
	Flume 0715 hr				**Stockton Avenue Bridge** 0735 hr/ **Wetland Outlet** 0840 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	20.6	0.4	10.92	733	20.5/20.5	0.4/0.4	12.31/12.60	731/732
0.25	20.8	0.4	11.06	733	20.7/20.6	0.4/0.4	12.45/12.79	732/732
0.50	20.8	0.4	11.15	733	20.7/20.7	0.4/0.4	12.53/12.85	732/732
0.75	20.9	0.4	11.22	733	20.8/20.7	0.4/0.4	12.37/12.86	732/732
1.00	20.9	0.4	11.21	733	20.8/20.6	0.4/0.4	12.46/12.58	732/732
1.25	20.9	0.4	11.22	733	20.8/20.5	0.4/0.4	12.26/10.91	732/734
1.45b	20.9	0.4	5.84	734	/20.5	/0.4	/4.72	/733
1.50					20.8/	0.4/	12.01/	732/
1.75					20.7/	0.4/	11.37	733/
2.00					20.7/	0.4/	10.75/	734/
2.05b					20.8/	0.4/	4.53/	734/
			19-Jul-09					
	Railroad Trestle 0810 hr				**Mouth of Noble Gulch**			0825 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	20.4	0.4	12.31	731	19.5	0.4	11.45	716
0.25	20.5	0.4	11.24	731	19.5	0.4	11.35	717
0.50	20.6	0.4	12.08	732	19.5	0.4	11.18	717
0.75	20.5	0.4	11.81	731	19.5	0.4	11.16	716
1.00	20.2	0.4	7.43	732	19.0	0.4	5.51	719
1.22b					18.5	0.4	4.74	676
1.25	20.0	0.4	7.89	729				
1.50b	20.0	0.4	3.51	731				

19 July 2009. Gage height of 2.56 morning. Overcast and foggy. Air temperature of 14.3°C at 0715 hr. More bags in front of flume.
Station 1: Flume at 0715 hr. Reach 1- 15 gulls.
Station 2: Stockton Avenue Bridge at 0735 hr. Reach 2- 3 mallards.
Station 3: Railroad Trestle at 0810 hr. Reach 3- 10 mallards near Noble Gulch.
Station 4: Mouth of Noble Gulch at 0825 hr. 1 merganser, 15 mallards and 1 coot on downed cottonwood and redwood stump. No gray water.
Station 5: Nob Hill at 0909 hr. Water temperature 16.5 °C. Conductivity 668 umhos. Oxygen 9.84 mg/l. Salinity 0.4 ppt. Streamflow estimated 3.25 cfs.

			19-Jul-09					
	Flume 1627 hr				**Stockton Avenue Bridge** 1602 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	21.5	0.4	12.33	750	21.9	0.4	11.80	757
0.25	21.6	0.4	12.29	750	22.0	0.4	11.82	757
0.50	21.6	0.4	12.84	750	21.9	0.4	11.39	757
0.75	21.5	0.4	13.11	749	21.8	0.4	21.06	755
1.00	21.5	0.4	13.25	747	21.8	0.4	``.78	753
1.25	21.5	0.4	13.03	747	21.7	0.4	10.96	750
1.45b	21.6	0.4	9.69	741				
1.50					21.6	0.4	12.24	742
1.75					21.0	0.4	15.03	737
2.00					21.0	0.4	14.94	737
2.05b					20.9	0.4	6.60	737
			19-Jul-09					
	Railroad Trestle 1541 hr				**Mouth of Noble Gulch** 1505 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	22.2	0.4	11.94	756	22.3	0.4	10.69	754
0.25	22.2	0.4	11.87	755	22.3	0.4	10.60	752
0.50	22.2	0.4	11.75	755	21.7	0.4	10.51	743
0.75	22.1	0.4	11.37	752	20.2	0.4	12.33	718
1.00	21.5	0.4	14.10	730	20.0	0.4	12.40	705
1.25b	21.1	0.4	13.16	727	20.0	0.4	7.17	701
1.50b	21.4	0.4	5.84	727				

19 July 2009. Gage height of 2.56. Sunny, breezy. Air temperature of 14.9°C at 1627 hr. Flume inlet 1.0 ft. Flume outlet 0.5 ft.
Station 1: Flume at 1627 hr. Reach 1- 34 gulls bathing and 9 mallards. <1% surface algae. 70% of bottom covered with algae 0.5 – 5.0 ft thick, averaging 1.0 ft. 100+ gulls roosting on Mai Tai Restaurant.
Station 2: Stockton Avenue Bridge at 1602 hr. Secchi depth to bottom. Reach 2- 25% surface algae. 100% of the bottom algae 0.3 – 4.0 ft thick, averaging 1.5 ft. 5 mallards.
Station 3: Railroad Trestle at 1541 hr. Reach 3- 3% surface algae, 99% bottom algae 0.2 – 4 ft, averaging 0.5 ft. 1% pondweed and algae 2-3 ft thick, averaging 2.5 ft. 14 mallards and 3 domestic ducks.
Station 4: Mouth of Noble Gulch at 1505 hr. Air temp 21.2 C. 1 gull, 1 merganser, 1 coot, 4 mallards and 1 goose roosting on cottonwood and redwood stump. 95% of bottom covered with algae 0.2 – 2.0 ft thick, averaging 1.0 ft. 2% surface algae and no gray water from Gulch.

			01-Aug-09					
	Flume 0712 hr				**Stockton Avenue Bridge** 0725 hr/ **Wetland Outlet** 0814 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	20.0	0.4	11.06	698	20.0/19.8	0.4/0.4	12.17/12.98	695/695
0.25	20.1	0.4	11.18	698	20.1/19.9	0.4/0.4	12.14/13.09	696/696
0.50	20.1	0.4	11.27	698	20.1/19.9	0.4/0.4	12.41/13.04	696/696
0.75	20.1	0.4	11.26	698	20.1/19.9	0.4/0.4	12.21/13.02	696/696
1.00	20.1	0.4	11.25	699	20.1/19.9	0.4/0.4	12.12/13.01	696/696
1.25b	20.1	0.4	11.11	699	20.1/19.9	0.4/0.4	12.07/5.74	696/696
1.35b	20.2	0.4	4.46	700				
1.50					20.1/	0.4/	11.69/	696/
1.75					20.1/	0.4/	11.86/	696/
2.00					20.1/	0.4/	11.79/	697/
2.07b					20.1/	0.4/	6.62/	697/
			01-Aug-09					
	Railroad Trestle 0741 hr				**Mouth of Noble Gulch** 0755 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.7	0.4	12.17	695	18.6	0.4	9.17	697
0.25	19.8	0.4	12.40	695	18.6	0.4	9.29	697
0.50	19.8	0.4	12.37	696	18.6	0.4	9.17	696
0.75	19.8	0.4	11.60	696	18.6	0.4	8.98	675
1.00	19.6	0.4	10.56	700	18.6	0.4	9.09	641
1.25b	19.5	0.4	10.37	700	18.1	0.4	3.47	643
1.37b	19.5	0.4	3.72	700				

01 August 2009. Gage height of 2.55 (morning) and 2.56 (afternoon). Overcast and foggy at 0712 hr with air temperature of 15.0 ^{o}C. Air temperature 16.3^{o} C at 1555 hr and partly sunny and still slightly foggy. Flume inlet 1.0 ft. Flume outlet 1.0 ft in afternoon with incoming tide.

Station 1: Flume at 0712 hr. Reach 1- 29 gulls bathing and 4 mallards. No surface algae.
Station 2: Stockton Avenue Bridge at 0725 hr. Secchi depth to the bottom. Reach 2- no birds; no surface algae.
Station 3: Railroad trestle at 0741 hr. Reach 3- 20 mallards near Noble Gulch. **Station 4:** Mouth of Noble Gulch at 0806 hr. No gray water. On downed cottonwood and redwood stump- 6 mallards, 1 great blue heron, 3 domestic ducks and 1 merganser.

Station 5: Nob Hill at 0840 hr. Water temperature at 16.3^{o}C. Conductivity 658 umhos, Oxygen 9.05 mg/l. Salinity 0.4 ppt. Visually estimated flow of 3 cfs.

1555 hr			01-Aug-09					1535 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	20.5	0.4	12.42	709	20.7	0.4	12.20	709
0.25	20.6	0.4	12.28	708	20.7	0.4	12.35	709
0.50	20.5	0.4	13.21	708	20.7	0.4	12.20	709
0.75	20.5	0.4	13.29	706	20.6	0.4	12.29	709
1.00	20.5	0.4	13.42	705	20.6	0.4	12.22	708
1.25	20.5	0.4	13.60	705	20.6	0.4	12.14	707
1.50	20.5	0.4	13.48	705	20.6	0.4	12.13	707
1.67b	20.5	0.4	6.54	705				
1.75					20.5	0.4	12.47	703
2.00					20.5	0.4	10.28	703
2.05b					20.5	0.4	1.42	704
1520hr			01-Aug-09					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	0.4	12.26	707	20.4	0.4	10.03	715
0.25	20.6	0.4	12.27	707	20.3	0.4	10.22	713
0.50	20.6	0.4	12.25	707	20.0	0.4	10.63	710
0.75	20.6	0.4	12.47	706	19.4	0.4	11.06	702
1.00	20.6	0.4	12.43	705	19.0	0.4	12.12	686
1.25	20.3	0.4	11.20	707	19.1	0.4	6.05	687
1.37b	20.2	0.4	6.91	702				

Station 1: Flume at 1555 hr. Reach 1- no surface algae. 100% of bottom covered with algae 1.0 – 2 ft thick, averaging 1 foot. Reach 1: 56 gulls bathing, 1 cormorant and one female mallard with 3 ducklings.
Station 2: Stockton Avenue Bridge at 1535 hr. Secchi depth to the bottom. Reach 2- <1% surface algae. 98% of bottom covered by algae 1 – 3 ft thick, averaging 2 ft. 2% of bottom covered with pondweed 3 ft thick. 8 mallards.
Station 3: Railroad trestle at 1520 hr. Reach 3- Surface algae < 1%. 98% of bottom covered by algae 0.5- 4 ft thick, averaging 1.5 ft, remainder film. 7 mallards dabbling.
Station 4: Mouth of Noble Gulch at 1500 hr. 25% surface algae. 70% of bottom covered by algae 0.4 - 3 ft thick, averaging 1.2 ft. On downed cottonwood and redwood stump- 5 mallards, 3 domestic ducks, 1 gull, 1 goose and 1 pond turtle. No gray water.

0705hr			15-Aug-09					0722hr/0815hr
	Flume				**Stockton Avenue Bridge/ Wetland Outlet**			
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	20.6	0.4	10.84	710	20.9/20.9	0.4/0.4	11.12/11.64	714/718
0.25	20.7	0.4	11.08	710	20.9/21.0	0.4/0.4	11.16/11.72	715/718
0.50	20.8	0.4	11.45	710	21.0/21.0	0.4/0.4	11.15/11.62	715/718
0.75	20.8	0.4	11.43	710	21.0/21.0	0.4/0.4	11.25/11.72	715/718
1.00	20.8	0.4	11.34	712	21.0/21.0	0.4/0.4	11.33/11.87	715/718
1.25	20.8	0.4	11.41	712	21.0/21.0	0.4/0.4	11.06/11.64	715/718
1.45b					/21.0	/0.4	/4.46	/720
1.50b	20.9	0.4	5.28	711	21.0/	0.4/	10.93	715/
1.75					21.0/	0.4/	11.05	715/
2.00					21.1/	0.4/	11.29	715/
2.10b					21.0/	0.4/	5.08	715/
0742hr			15-Aug-09					0755hr
	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	0.4	11.04	713	19.6	0.4	9.46	710
0.25	20.6	0.4	11.18	714	19.7	0.4	9.45	711
0.50	20.7	0.4	11.30	713	19.7	0.4	9.45	711
0.75	20.7	0.4	11.32	714	19.8	0.4	9.35	710
1.00	20.7	0.4	11.46	715	19.7	0.4	9.42	689
1.25b	20.7	0.4	11.37	715	19.1	0.4	1.62	680
1.45b	20.9	0.4	1.00	721				

15 August 2009. Gage height of 2.49 (morning) and 2.50 (afternoon). Overcast and smokey in morning and clear and smokey in afternoon. Air temperature of 13.5°C at 0705 hr and 18.0°C at 1615 hr. Flume inlet at 0.9 ft. Flume outlet flooded with incoming tide.

Station 1: Flume at 0705 hr. Reach 1- 45 gulls bathing, 5 mallards, 1 pelican and 1 pied-billed grebe. Flume at 1615 hr. Reach 1- No surface algae. 75% of bottom with algae 1-4.0 ft thick, averaging 2 ft thick; 20% pondweed with algae 2-3 ft thick, avg. = 2.5 ft. 44 gulls bathing. **Station 2:** Stockton Avenue Bridge at 0722 hr. Reach 2- no birds. Reach 2 at 1554 hr. Secchi depth to bottom. No surface algae. 90% of bottom covered with algae 0.3 - 2 ft thick, averaging 0.5 ft. 1% pondweed and algae 2 - 3 ft thick, averaging 2.5 ft. 12 dabbling mallards and 1 gull.

Station 3: Railroad trestle at 0742 hr. Reach 3- 1 merganser fishing, 16 mallards near Noble Gulch. At 1542 hr, 29 mallards and 3 domestic ducks in water. Reach 3- <1% surface algae except at Noble Gulch; 89% of bottom covered with algae 0.2 - 3.0 ft thick, averaging 1 ft; 1% pondweed with algae 2-3 ft thick, avg. = 2.5 ft.

Station 4: Mouth of Noble Gulch at 0755 hr. On cottonwood and redwood stump- 15 mallards, 3 domestic ducks and 1 goose. At 1510 hr, 1% surface algae. 90% of bottom with algae 0.3- 4.0 ft thick, averaging 2 ft. On cottonwood and redwood stump- 6 mallards, 1 goose and 1 gull. No gray water.

Station 5: Nob Hill at 0840 hr. Water temperature 16.4 °C. Oxygen 8.65 mg/l. Conductivity 603 umhos. Salinity 0.4 ppt. Visually estimated streamflow of 2.5 cfs.

1615hr			15-Aug-09					1554hr
	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	21.9	0.4	14.11	727	22.3	0.4	12.68	736
0.25	21.8	0.4	14.30	726	22.3	0.4	13.01	735
0.50	21.9	0.4	14.34	726	22.3	0.4	13.04	735
0.75	21.9	0.4	14.27	725	22.2	0.4	13.44	735
1.00	21.8	0.4	14.44	721	22.1	0.4	12.41	734
1.25	21.9	0.4	14.61	721	22.0	0.4	12.35	734
1.50b	21.9	0.4	6.84	722	21.9	0.4	13.85	726
1.75					21.8	0.4	14.38	727
2.00					21.6	0.4	14.95	728
2.10b					21.5	0.4	7.56	728
1542hr			15-Aug-09					1510hr
	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	22.5	0.4	12.33	740	22.7	0.4	10.50	750
0.25	22.5	0.4	12.49	740	22.6	0.4	10.56	748
0.50	22.5	0.4	12.58	739	21.9	0.4	10.13	740
0.75	22.4	0.4	12.76	738	21.7	0.4	11.25	730
1.00	22.0	0.4	12.71	734	21.0	0.4	12.95	723
1.25b	21.8	0.4	13.35	729	21.0	0.4	3.10	721
1.45b	21.8	0.4	6.69	727				

0749 hr			29-Aug-09					0800 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	20.4	0.4	11.57	704	20.7	0.4	11.30	704
0.25	20.4	0.4	11.71	704	20.7	0.4	11.49	704
0.50	20.4	0.4	11.78	704	20.7	0.4	11.51	704
0.75	20.4	0.4	11.92	704	20.7	0.4	11.52	703
1.00	20.4	0.4	12.01	704	20.7	0.4	11.28	703
1.25	20.4	0.4	11.98	704	20.6	0.4	11.40	703
1.50b	20.4	0.4	6.67	705	20.6	0.4	11.31	703
1.75					20.6	0.4	10.40	704
1.87b					20.7	0.4	2.58	705
0842 hr			29-Aug-09					0900 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	20.6	0.4	11.95	709	20.3	0.4	9.84	716
0.25	20.6	0.4	12.02	709	20.3	0.4	9.94	715
0.50	20.6	0.4	11.90	708	20.2	0.4	10.10	713
0.75	20.6	0.4	11.88	710	20.1	0.4	10.20	710
1.00	20.5	0.4	11.40	710	20.0	0.4	10.19	682
1.25b	20.5	0.4	11.24	710	19.2	0.4	2.24	652
1.45b	20.5	0.4	0.96	710				
1.50								

29 August 2009. Gage height of 2.46 (morning) and 2.45 (afternoon). Clear and warm in morning and sunny in afternoon. Air temperature of 19.2°C at 0749 hr and 19.6°C at 1643 hr.

Station 1: Flume at 0749 hr. Reach 1- 22 gulls bathing; 1% surface algae. Flume at 1643 hr. Reach 1- 5% surface algae. 90% of bottom with algae 0.3 – 5 ft thick, averaging 2 ft. 82 gulls bathing and 1 merganser fishing.
Station 2: Stockton Avenue Bridge at 0800 hr. Reach 2- No surface algae; 2 mallards dabbling and 1 pond turtle. Reach 2 at 1620 hr. Surface algae 3%. 95% of bottom covered with algae 0.5 - 4 ft thick, averaging 1.5 ft. 8 mallards in water.
Station 3: Railroad trestle at 0842 hr. Reach 3- <1% surface algae; No birds noted in water. At 1545 hr, Reach 3-<1% Surface algae; 98% bottom covered with algae 0.3- 4.0 ft, avg. = 1.0 ft. 10 mallards and 1 pied-billed grebe near Noble Gulch.
Station 4: Mouth of Noble Gulch at 0900 hr. 7% surface algae. On cottonwood- 10 mallards, 4 mergansers and 1 cormorant. On redwood stump- 1 gull. At 1502 hr. 70% of bottom with algae 0.5- 4.0 ft thick, averaging 2 ft. On cottonwood- 5 mallards, 3 mergansers, 1 goose and 2 pond turtles. No gray water.
Station 5: Nob Hill at 0900 hr. Water temperature 17.4 °C. Oxygen 7.87 mg/l. Conductivity 668 umhos. Salinity 0.4 ppt. Visually estimated streamflow of 1.50 cfs.

1643hr			29-Aug-09					1620 hr/ 1640 hr
	Flume				**Stockton Avenue Bridge/ Wetland Outlet**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.9	0.4	15.12	737	21.9/22.1	0.4/0.4	13.54/15.00	728/728
0.25	21.9	0.4	14.90	736	22.0/22.1	0.4/0.4	13.68/15.09	729/728
0.50	21.8	0.4	14.94	734	21.9/22.1	0.4/0.4	13.52/15.00	728/728
0.75	21.7	0.4	15.02	734	21.9/22.2	0.4/0.4	13.48/14.98	727/728
1.00	21.7	0.4	15.25	734	21.9/22.1	0.4/0.4	13.74/14.62	727/729
1.20b					/22.0	/0.4	/6.15	/729
1.25	21.7	0.4	15.30	734	21.8	0.4/	13.64/	726/
1.50b	21.5		6.83	734	21.7	0.4/	13.53/	724/
1.75					21.4	0.4/	14.51/	721/
2.00b					21.2	0.4/	4.85/	722/
1545hr			29-Aug-09					1502hr
	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	22.6	0.4	14.54	734	23.2	0.4	12.10	746
0.25	22.6	0.4	14.41	734	23.0	0.4	11.57	742
0.50	22.6	0.4	14.40	733	22.6	0.4	11.78	734
0.75	22.5	0.4	14.34	731	21.7	0.4	11.30	724
1.00	22.4	0.4	13.93	723	21.1	0.4	12.69	722
1.25b	21.9	0.4	15.69	722	21.6	0.4	2.09	762
1.45b	21.5	0.4	5.15	725				

	Begonia	Festival	06-Sep-09		Begonia	Festival		0958hr
	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					21.2	0.4	9.42	720
0.25					21.3	0.4	9.53	720
0.50					21.2	0.4	9.49	719
0.75					21.2	0.4	9.48	719
1.00					21.2	0.4	9.02	718
1.25					21.2	0.4	9.10	718
1.50					21.2	0.4	9.18	718
1.75					21.2	0.4	9.58	719
1.87b					21.4	0.4	5.52	720
			06-Sep-09					1031hr
	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					20.8	0.4	8.59	726
0.25					20.7	0.4	8.53	724
0.50					20.6	0.4	8.33	725
0.75					20.5	0.4	8.11	724
1.00					20.0	0.4	7.80	714
1.10b					19.7	0.4	3.84	711
			06-Sep-09					1425hr
	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					22.1	0.4	11.53	732
0.25					22.1	0.4	11.57	732
0.50					22.1	0.4	11.42	732
0.75					22.1	0.4	11.63	731
1.00					22.1	0.4	11.60	729
1.25					22.0	0.4	11.27	729
1.50					22.0	0.4	11.06	730
1.75					21.9	0.4	10.75	730
2.00b					22.1	0.4	8.09	730

			06-Sep-09					1450hr
	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					22.5	0.4	11.79	747
0.25					22.4	0.4	11.78	746
0.50					22.3	0.4	11.85	744
0.75					22.3	0.4	11.73	741
1.00					21.9	0.4	11.02	704
1.10b					21.2	0.4	1.33	690

06 September 2009. Begonia Festival Day. Gage height of 2.24 (morning) and 2.26 (afternoon). Lagoon level was lower than previous year. Sunny in morning at 1000 hr but fog returned at 1110 hr. Water temperatures were very warm in the morning (warmer than previous week) but oxygen levels were also high in the morning (not as high as previous week). Water temperature did not increase much through the day while oxygen concentration increased. 9 floats were in the procession down the lagoon. Waders were not allowed again this year, but the lagoon bottom was disturbed in Reach 1 due to a float mishap (described later). 8 of the floats were propelled by electric motor, consistent with the big change to them in 2008. The Tai Restaurant float had an electric motor and paddlers on the float. One float was propelled by pedal kayaks, and it did not fit under the Stockton Bridge. This was the first float that was too tall in the 20 years of our observations. This was also the first time in the last 20 years that a float capsized, which occurred in Reach 1 downstream of the Stockton Bridge. It was the CalPoly float that capsized after it collided with another float (according to other observers since I could not observe the problem from my vantage point), causing the many people (approximately 15 adults) to shift to one side of the float and tipping it over. Everyone was tossed into the water. Considerable wading occurred in an effort to right the float by the CalPoly participants immediately after. Several floats were present in Reach 1, increasing the chance of collision. No Begonia Festival staff were in boats in the vicinity of the capsized float and no direction was given. I went to the microphone and spoke to the Festival organizer, recommending that the float be towed to the dock rather than continue the disturbance of the lagoon bottom. The organizer agreed but was unable to communicate this to the participants before the float was righted. Considerably more begonia blossoms entered the lagoon from this accident. A CalPoly participant dove afterwards in the vicinity of the float mishap to search for personal valuables. I spoke with participants on the CalPoly float who confirmed that everyone shifted to one side after a collision. I do not know who hit who. Twenty-two other boats were in the water during the festival besides the floats. Hydrogen sulfide measurements were discontinued after 2005 because city staff assumed that there would be no more waders during the Begonia Festival, as was the case in 2005. This was not the case in 2006 but was in 2007-2009. The secchi depth was to the bottom after the float procession. Oxygen levels were supersaturated in a warm lagoon. Conductivity was slightly higher after the procession than before, indicating slightly more dissolved minerals in the water. No fish mortalities were observed. Flower petals were being collected by Begonia Festival staff immediately after the procession and then continued the following week. A pair of white domestic ducks observed for the first time, located near the Shadowbrook Restaurant.

0724 hr			12-Sep-09					0740hr/0755hr
	Flume				**Stockton Avenue Bridge/ Wetland Outlet**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	19.9	0.4	9.02	706	20.0/19.9	0.4/0.4	9.27/9.37	708/708
0.25	20.0	0.4	9.10	707	20.0/20.0	0.4/0.4	9.19/9.41	708/708
0.50	20.0	0.4	9.17	707	20.0/20.0	0.4/0.4	9.24/9.39	708/708
0.75	20.0	0.4	9.20	707	20.0/20.0	0.4/0.4	8.91/9.32	708/708
1.00	20.0	0.4	9.04	708	20.1/20.0	0.4/0.4	8.89/9.26	708/708
1.25	20.1	0.4	9.06	708	20.1/20.0	0.4/0.4	8.93/9.32	708/709
1.40b					/20.0	/0.4	/3.94	708/
1.50b	20.1	0.4	4.18	709	20.0/	0.4/	8.69/	708/
1.75					20.0/	0.4/	8.72/	708/
2.00b					20.1/	0.4/	3.17/	710/
0816 hr			12-Sep-09					0835 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	19.8	0.4	9.15		19.1	0.4	8.92	699
0.25	19.9	0.4	9.24		19.1	0.4	9.02	698
0.50	19.9	0.4	9.12		19.1	0.4	8.91	695
0.75	19.9	0.4	9.07		19.0	0.4	7.70	694
1.00	19.9	0.4	8.71		18.8	0.4	6.24	686
1.21b					17.9	0.4	2.61	621
1.25	19.8	0.4	8.54					
1.50b	19.9	0.4	0.88					

12 September 2009. Weekend of Art and Wine Festival. Gage height of 2.44 (morning) and 2.51 (afternoon). Overcast in the morning and sunny and onshore breezy in afternoon. Air temperature of 15.8 ^{o}C at 0724 hr and 16.7^{o}C at 1558 hr. Flume entrance at 2.0+ ft; flume outlet flooded from incoming tide in afternoon.

Station 1: Flume at 0724 hr. Reach 1- 35 gulls bathing and 1 cormorant fishing.
Station 2: Stockton Avenue Bridge at 0740 hr. Reach 2-no birds.
Station 3: Railroad Trestle at 0816 hr. Reach 3- 2 pied billed grebes and 2 mallards (near Noble Gulch).
Station 4: Mouth of Noble Gulch at 0835 hr. 16 mallards, 2 coots and 1 cormorant (from Reach 1) roosting on downed cottonwood and redwood stump. No gray water.
Station 5: Nob Hill at 0907 hr. Water temperature of 15.7^{o} C. Conductivity of 624 umhos. Oxygen 8.25 mg/l. Salinity 0.4 ppt. Visually estimated streamflow 1.25 cfs.

1558 hr			12-Sep-09					1537 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	20.7	0.4	11.24	717	20.9	0.4	10.00	722
0.25	20.7	0.4	11.61	717	20.9	0.4	9.98	721
0.50	20.7	0.4	11.64	715	20.8	0.4	9.99	720
0.75	20.6	0.4	11.73	715	20.6	0.4	10.07	719
1.00	20.6	0.4	11.81	714	20.6	0.4	9.76	717
1.25	20.6	0.4	11.92	713	20.5	0.4	9.87	715
1.50b	20.6	0.4	5.94	715	20.3	0.4	9.92	714
1.75					20.3	0.4	10.42	713
2.00b					20.3	0.4	6.32	712
1520 hr			12-Sep-09					1501 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	21.2	0.4	10.97	725	21.2	0.4	10.70	724
0.25	21.2	0.4	10.89	724	21.0	0.4	10.6	723
0.50	20.8	0.4	10.28	722	20.8	0.4	9.93	720
0.75	20.7	0.4	10.14	720	20.0	0.4	8.82	715
1.00	20.2	0.4	8.82	715	19.5	0.4	10.42	705
1.20b					18.9	0.4	5.71	671
1.25	20.0	0.4	10.49	712				
1.45b	20.0	0.4	3.48	715				

12 September 2009.

Station 1: Flume at 1558 hr. Reach 1- Surface algae < 1%. 100% of bottom covered by algae 1- 4 ft thick, averaging 2 ft. No pondweed observed. 105 gulls bathing, 2 pelicans in water (one on margin at Venetian Court) and 2 cormorants.

Station 2: Stockton Avenue Bridge at 1537 hr. Reach 2- No surface algae. 80% of bottom covered by algae 1 - 4 ft thick, averaging 2.0 ft thick. <1% of bottom covered by pondweed and algae 3-4 ft thick. 1 gull in Reach 2.

Station 3: Railroad Trestle at 1520 hr. Reach 3- 99% of bottom covered by algae 0.5- 4.0 ft, averaging 1.5 ft thick. 1% of bottom covered by pondweed and algae under trestle. Reach 3- 3 mallards, 3 domestic ducks, 1 cormorant and 1 gull in water near Noble Gulch.

Station 4: Mouth of Noble Gulch at 1501 hr. Surface algae < 20%. 60% of bottom covered by algae 1.0 - 4.0 ft thick, averaging 3.0 ft. 1 gull, 1 goose, 3 mallards and 2 coots on downed cottonwood and redwood stump. No gray water.

			19-Sep-09					1428 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					20.8	0.4	6.30	670
0.25					20.8	0.4	6.23	671
0.50					20.4	0.4	6.32	666
0.75					20.3	0.4	6.40	664
1.00					20.2	0.4	6.16	663
1.25					19.9	0.4	4.01	664
1.50					19.9	0.4	3.60	666
1.75b					19.9	0.4	0.14	668
			19-Sep-09					
	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								
1.25								
1.50								
1.75								

19 September 2009. A small storm occurred on the evening of 13-14 September. The lagoon became turbid, preventing light to the bottom and hampering photosynthesis. On 14 September, Ed Morrison and other City staff removed 2 boards (8 inches) from the flume inlet to reduce lagoon depth until the bottom was visible. Sometime between 14 and 19 September, a board had been added back to the inlet. On 19 September, the gage height was 2.19. The water quality measurements taken on Saturday, 19 September were taken to check oxygen levels. They were found to be adequate in the upper water column, though depressed. The secchi disk was visible to the bottom. We then loaned the secchi disk to Morrison to check the lagoon for water clarity before adding boards back to the flume inlet. The final board was added to the inlet sometime prior to the 4 October fish sampling.

0725 hr			26-Sep-09					0746 hr/ 0805 hr
	Flume				**Stockton Avenue Bridge/ Wetland Outlet**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	18.7	0.4	6.36	684	18.9/19.0	0.4/0.4	7.03/6.83	688/691
0.25	18.8	0.4	6.29	685	19.0/19.0	0.4/0.4	6.92/6.80	688/691
0.50	18.8	0.4	6.13	685	19.0/19.0	0.4/0.4	6.92/6.70	688/691
0.75	18.9	0.4	6.38	685	19.0/19.0	0.4/0.4	6.86/6.74	688/691
1.00	18.9	0.4	6.37	685	19.0/19.0	0.4/0.4	6.90/6.74	688/691
1.25	18.9	0.4	5.89	684	19.0/19.0	0.4/0.4	6.76/6.60	688/691
1.30b					/19.1	/0.4	/3.05	/691
1.37b	18.9	0.4	2.86	685				
1.50					19.0/	0.4/	6.75/	688/
1.75					19.0/	0.4	6.84/	688/
1.85b					19.0	0.4/	3.50/	688/
0821 hr			26-Sep-09					0836 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	18.8	0.4	6.78	687	18.2	0.4	7.70	674
0.25	18.8	0.4	6.71	687	18.2	0.4	7.56	676
0.50	18.8	0.4	6.61	687	18.3	0.4	7.52	676
0.75	18.8	0.4	6.65	687	18.3	0.4	7.57	674
1.00	18.8	0.4	6.67	687	18.2	0.4	7.30	666
1.13b					17.7	0.4	2.32	632
1.25	18.8	0.4	6.70	687				
1.40b	18.8	0.4	2.44	687				

26 September 2009. Gage height of 2.14 (morning) and 2.14 (afternoon). Clear in morning and afternoon. Air temperature of 12.1° C at 0725 hr, 17.3° C at Flume at 1610 hr. 1 board still out, laying on the flume inlet.

Station 1: Flume at 0725 hr. Reach 1- 23 gulls bathing, 1 goose and 1 horned grebe.
Station 2: Stockton Avenue Bridge at 0746 hr. Reach 2- 2 mallards roosting on trestle abutment. Horned grebe from Reach 1 now near trestle.
Station 3: Railroad Trestle at 0821 hr. Reach 3- 2 mallards, 10 coots, 1 pied-billed grebe in water. 1 greenback heron roosting in willow.
Station 4: Mouth of Noble Gulch at 0836 hr. 5 mallards, 1 cormorant and 2 turtles on downed cottonwood and redwood stump. No gray water.
Station 5: Nob Hill at 0907 hr. Water temperature of 14.8° C. Conductivity of 622 umhos. Oxygen 7.92 mg/l. Salinity 0.4 ppt. Streamflow visually estimated at 1.25 cfs.

1610 hr			26-Sep-2009					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	20.1	0.4	8.33	710	20.9	0.4	9.02	720
0.25	20.0	0.4	8.36	708	20.8	0.4	8.52	719
0.50	19.9	0.4	8.24	705	20.3	0.4	8.13	711
0.75	19.7	0.4	8.19	705	20.1	0.4	8.33	710
1.00	19.6	0.4	7.46	703	20.1	0.4	8.32	709
1.25	19.6	0.4	7.00	704	19.9	0.4	8.86	706
1.50b	19.5	0.4	2.52	704	19.4	0.4	8.37	702
1.75					19.2	0.4	7.29	701
1.85b					19.1	0.4	3.74	701
1530 hr			26-Sep-2009					1512 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	21.4	0.4	9.90	722	22.4	0.4	9.98	734
0.25	21.6	0.4	9.66	722	22.0	0.4	9.34	727
0.50	21.0	0.4	8.62	717	21.5	0.4	8.66	717
0.75	20.6	0.4	8.39	711	18.8	0.4	8.76	702
1.00	20.2	0.4	8.02	704	18.6	0.4	9.36	698
1.05b					18.9	0.4	5.03	699
1.25	19.2	0.4	9.63	702				
1.30b	19.2	0.4	2.92	703				

26 September 2009.

Station 1: Flume at 1610 hr. Reach 1- No surface algae. Could not see submerged vegetation. 44 gulls, 1 mallard in water.

Station 2: Stockton Avenue Bridge at 1548 hr. Reach 2- Secchi disk loaned out. No surface algae. Submerged vegetation not visible. 2 gulls and 3 mallards floating next to party in progress.

Station 3: Railroad Trestle at 1530 hr. Reach 3- < 1% surface algae, bottom invisible. 4 mallards (1 near Noble Gulch), 1 pied-billed grebe and 5 coots near Noble Gulch.

Station 4: Mouth of Noble Gulch at 1512 hr. On cottonwood- 7 mallards, 1 goose, 1 turtle. No gray water.

0829 hr			04-Oct-09					1445 hr
	Stockton Avenue Bridge				**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	16.1	0.4	9.94	650	17.4	0.4	11.80	650
0.25	16.1	0.4	9.90	650	17.4	0.4	11.69	650
0.50	16.2	0.4	10.12	650	17.3	0.4	11.64	650
0.75	16.2	0.4	9.88	650	17.1	0.4	11.39	650
1.00	16.2	0.4	10.13	650	17.1	0.4	11.41	650
1.25	16.2	0.4	10.04	650	16.9	0.4	11.57	650
1.50	16.2	0.4	9.94	650	16.9	0.4	11.38	650
1.75	16.2	0.4	10.03	650	16.8	0.4	11.47	650
2.00b	16.2	0.4	5.26	650	16.8	0.4	6.39	650

04 October 2009. Water quality was checked prior to fish sampling and afterwards, indicating good water quality for sampling steelhead.

0735 hr			10-Oct-2009					0751 hr/0839 hr
	Flume				**Stockton Avenue Bridge/Wetland Outlet**			
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	15.4	0.4	10.93	641	15.6/15.5	0.4/0.4	11.16/11.11	645/646
0.25	15.5	0.4	11.06	641	15.6/15.6	0.4/0.4	11.01/11.08	645/646
0.50	15.5	0.4	11.13	641	15.6/15.6	0.4/0.4	10.82/11.31	645/646
0.75	15.5	0.4	11.07	642	15.6/15.6	0.4/0.4	10.71/11.27	645/646
1.00	15.5	0.4	11.10	642	15.6/15.6	0.4/0.4	10.87/11.22	645/646
1.25	15.5	0.4	10.44	643	15.6/15.6	0.4/0.4	10.74/10.91	645/647
1.30b					/15.5	/0.4	/6.14	/646
1.50b	15.5	0.4	5.62	643	15.6/	0.4/	10.81/	645/
1.75					15.6/	0.4/	10.72/	645/
2.00b					15.6/	0.4/	5.32/	645/
0810 hr			10-Oct-2009					0824 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	15.3	0.4	10.93	642	14.8	0.4	9.85	625
0.25	15.4	0.4	10.99	643	14.8	0.4	9.49	632
0.50	15.4	0.4	10.97	643	14.9	0.4	9.71	632
0.75	15.4	0.4	10.96	643	14.9	0.4	9.73	630
1.00	15.4	0.4	10.84	643	14.9	0.4	9.65	632
1.25b	15.4	0.4	10.86	643	14.9	0.4	4.85	633
1.50b	15.4	0.4	4.53	644				

10 October 2009. Gage height of 2.55 (morning) and 2.57 (afternoon). Overcast all day, Saturday. Air temperature of 9.9 °C at 0723 hr and 14.9ºC at 1540 hr. Flume inlet 0.8 ft, flume outlet 0.2 ft in afternoon. Notch cut in sandbar berm. Secondary berm in place near surf. Anticipating a storm on Monday or Tuesday.

Station 1: Flume at 0735 hr. Reach 1- 29 gulls and 1 horned grebe. 5% surface algae- Adjacent Margaritaville. Margaritaville still washing sidewalk and patio floors into lagoon.

Station 2: Stockton Avenue Bridge at 0751 hr. Reach 2- 3 coots from Reach 1. No surface algae.

Station 3: Railroad Trestle at 0810 hr. Reach 3- 18 coots, 3 mallards, 1 pied-billed grebe, 2 white domestic ducks.

Station 4: Mouth of Noble Gulch at 0824 hr. 1 gull on redwood stump. Nothing on cottonwood. No surface algae.

Station 5: Nob Hill at 0904 hr. Water temperature of 12.5 °C. Conductivity of 569 umhos. Oxygen 9.21 mg/l. Salinity 0.4 ppt. Visually estimated streamflow 1.25 cfs.

1616 hr			10-Oct-2009					1555 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	16.0	0.4	11.60	650	16.1	0.4	11.62	653
0.25	16.0	0.4	11.69	650	16.1	0.4	11.43	653
0.50	16.0	0.4	11.47	650	16.1	0.4	11.42	652
0.75	15.9	0.4	12.14	648	16.0	0.4	11.17	652
1.00	15.9	0.4	12.18	648	16.0	0.4	11.14	652
1.25	15.9	0.4	11.85	648	16.0	0.4	10.92	651
1.50b	15.9	0.4	6.43	648	15.9	0.4	11.07	650
1.75					15.8	0.4	10.95	649
2.00b					15.8	0.4	3.36	649
1540 hr			10-Oct-2009					1525 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	15.9	0.4	11.85	650	16.3	0.4	11.43	657
0.25	15.9	0.4	11.78	651	16.2	0.4	11.13	655
0.50	15.9	0.4	11.71	651	15.7	0.4	10.64	648
0.75	15.9	0.4	11.66	651	15.2	0.4	10.25	602
1.00	15.8	0.4	11.29	650	15.0	0.4	10.75	643
1.25b	15.7	0.4	10.81	647	15.0	0.4	5.65	644
1.50b	15.6	0.4	6.34	647				

10 October 2009.

Station 1: Flume at 1616 hr in Reach 1, 49 gulls bathing and 3 mallards. 5% surface algae- adjacent Margaritaville. Could not see bottom with low light.

Station 2: Stockton Avenue Bridge at 1555 hr in Reach 2, no surface algae and submerged vegetation invisible. No birds.

Station 3: Railroad Trestle at 1540 hr. Reach 3- No surface algae and could not see other vegetation due to shading. 24 coots, 1 mallard, 1 horned grebe and 1 pied-billed grebe (caught stickleback).

Station 4: Mouth of Noble Gulch at 1525 hr, No surface algae and submerged vegetation invisible. On cottonwood- 1 goose and 2 mallards on cottonwood.

0846 hr			11-Oct-09					1523 hr
	Stockton Avenue Bridge				**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	15.4	0.4	10.39	645	15.7	0.4	10.15	648
0.25	15.4	0.4	10.49	645	15.7	0.4	10.04	648
0.50	15.4	0.4	10.56	645	15.6	0.4	9.8	648
0.75	15.5	0.4	10.62	645	15.5	0.4	9.68	648
1.00	15.5	0.4	10.62	645	15.5	0.4	9.56	648
1.25	15.5	0.4	10.54	645	15.4	0.4	9.61	648
1.50	15.5	0.4	10.64	645	15.4	0.4	9.41	648
1.75	15.5	0.4	10.73	645	15.4	0.4	9.28	648
2.00b	15.5	0.4	5.47	645	15.3	0.4	5.84	646

11 October 2009. Water quality was checked prior to the second fish sampling and afterwards, indicating good water quality for sampling steelhead. It was overcast all day. There was a storm pending in a day or two. Uniquely, many ducks out of the water at the Golino property.

12 October 2009. Kotila cut a notch 6 inches above the top of the flume in the mini-berm that spanned the 30-foot wide notch across the sandbar in anticipation of forecasted storm. No boards were removed from the flume inlet because at least 1-3 inches of rain were forecasted, which would cause stormflow to exceed the capacity of the flume (approximately 30 cfs). As it turned out, the Santa Cruz Mountains received 8-10 inches from an unusual early storm caused by an earlier typhoon in Asia.

13 October 2009. At 1845 hr, the sandbar breached through the pre-constructed notch. Morrison, Jesberg and Kotilla were present. The biologist arrived at 1850 hr, just after breaching. The channel was 10 feet wide, and the tide was incoming. Later in the night, the Soquel USGS gage registered a stormflow of 3,920 cfs. In the San Lorenzo Valley, Brookdale received 8 inches of rain overnight, while Boulder Creek received 10 inches. The rain was apparently more intense in the Soquel watershed because the San Lorenzo watershed, with approximately twice the area produced only 5,000 cfs at the Big Trees gage. This was the earliest breach observed in the past 20 years.

16 October 2009. Morning streamflow was 9.1 cfs.

29 November 2009. Morning streamflow was 5 cfs with the channel migrated laterally south and remained open to the Bay. There had been no storms since 13-14 October.

10-11 December 2009. Next significant storm occurred.

Appendix B.

2009 Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon.

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK-2009				
RESTAURANT	**INITIAL CONTACT**	**TEST DATE**	**COMMENTS**	**SIGN OFF**
BEACH HOUSE 207 ESPLANADE	4/27/2009 VACANT BUILDING	None		18-May-09 Kostelec
BAY BAR & GRILL 209 ESPLANADE	4/27/2009 831 477-0749	18-May-09		18-May-09 Kostelec
PIZZA MY HEART 209-A ESPLANDE	4/27/2009 Georgia Tyrell 831 227-6346	18-May-09		18-May-09 Kostelec
FOG BANK 211 ESPLANDE	4/27/2009 Linda B. 831 462-1881	13-May-09		13-May-09 Wheeler
PARADISE BAR & GRILL 215 ESPLANADE	4/27/2009 Kristie Ferris 831 476-4900	15-May-09		15-May-09 Wheeler
ZELDA'S 203 ESPLANADE	4/27/2009 Shannon Stark 831 475-4900	13-May-09		13-May-09 Kostelec