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SOQUEL CREEK LAGOON MONITORING REPORT, 2008

Prepared by

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aquatic biology

Prepared for the

CITY OF CAPITOLA
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January 2009 **Project # 106-18**

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ACKNOWLEDGMENTS

We appreciate the efforts of the Capitola Public Works Department with Matt Kotila as heavy equipment operator and Ed Morrison as Field Supervisor in forming and maintaining the lagoon in 2008. 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. We appreciated efforts of all Begonia Festival participants in avoiding wading in the lagoon during the parade. The Begonia Festival organizers, volunteers and students effectively dismantled the floats and removed flowers by boat after the Begonia Festival. The begonia-covered sea turtle was very beautiful and fluid as it skimmed across the surface of the lagoon during the Festival. There were much fewer flowers in the lagoon after the Festival in 2008. We thank Nels and Susan Westman again for the loan of their boat for fish censusing and their lagoon observations. We appreciated Ed Morrison's daily attention to managing the flume inlet as streamflow lessened through the summer and his preparation for storm events and recovery efforts after early stormflows. We greatly appreciated the close monitoring of stormflow and lagoon levels by Steve Jesberg, Public Works Director, and his and Matt Kotila's great efforts to preserve the sandbar and lagoon as long as possible in the middle of the night of 1-2 November.

We were grateful to the volunteers who assisted in the annual fish censusing at the lagoon. Some were local residents, students and innocent bystanders who happened along. Biologists from NOAA Fisheries also helped sample both weekends (David Swank and Mike), looking for tagged fish from their study. Volunteers also came from the Coastal Watershed Council (Nancy Scarborough included) and Web of Life Field School (WOLF) in Aptos (Desiree Gant and Kate Howard). It was Desiree Gant who detected tidewater gobies in a seine haul, the first since 1997. Volunteers are 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 winter with little rain, 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 4–5 cubic feet per second and emptied into the Monterey Bay at the jetty. The flume had been mostly cleared of sand the previous week. With so little streamflow, the lateral channel was not blocked off until we had seined most of the lateral channel. The channel was blocked off at 0800 hr to allow fish rescue at the upper end of the lateral channel. Eleven seine hauls were made in the lateral channel with a beach seine that was 30 ft x 4 feet with 1/8-inch mesh. There was considerable kelp near the jetty but not elsewhere, making seining less difficult than in some years. 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. The overflow from the lagoon ran through a narrow channel cut adjacent to but not immediately alongside the flume. Fish captured included 9 young-of-the-year (YOY) steelhead (*Oncorhynchus mykiss*) (all less than 70 mm FL) and 21 staghorn sculpins (*Leptocottus armatus*), 10 of which were YOY. No other fish species were detected in the lateral channel. Rescued fish were relocated to the main lagoon/ estuary. It was unusual to find steelhead in the lateral channel, though it had occurred a few times in the past. It was unusual to have only two fish species in the lateral channel.

Four additional seine hauls were made along the western margin of the lagoon near Venetian Court in an effort to detect any tidewater gobies (*Eucyclogobius newberryi*) in that location, it being subject to dewatering during lagoon draw down. No tidewater gobies were detected. More than 50 staghorn sculpins and 6 very small YOY *Cottus spp.* (prickly sculpin (*Cottus asper*) and coastrange sculpin (*Cottus aleuticus*)) were captured instead. These fish were released back into the estuary/ lagoon.

The winter storms had been very minimal after January 2008, and streamflow was only an estimated 4.5 cfs at the stream gage in Soquel Village at the time of sandbar construction. The lagoon had experienced a flushing flow in early January but not much stormflow since, leaving decomposing kelp and seagrass in the estuary for much of the winter. The thickest organic debris was adjacent and under the Esplanade Restaurants.

The flume inlet was fully prepared for the dry season on 22 May, and the sandbar was closed for the season. Fish passage through the flume could not be maintained during the sandbar construction due to low stream inflow that slowed lagoon filling overnight during the 4-day construction period. However, the lagoon had filled and fish passage was obtained by 24 May for the duration of the smolt out-migration period.

As required in the permit, a fisheries biologist (Donald Alley) was present during all activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was our eighteenth year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first 17 years are available at the City

(**Alley 1991-2007**). 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 2 November, by 1900 hr on 1 November the streamflow had risen to 30 cfs at the Soquel Village stream gage after steady rain. However, the rain stopped at 2100 hr and the lagoon level remained stable. The flume was completely submerged and draining maximally with one side of the flume outlet closed. Kotila then opened the other side of the flume outlet to increase flow through the flume. Alley left the lagoon with the sandbar still intact at 2230 hr and the lagoon level at least 6 inches below the piling bolt. Jesberg and Kotila left the lagoon at 2300 hr with the notch dug up to a narrow inner berm at the lagoon margin. The outer berm near the surf was also in place. By 0000 hr on 2 November, the flow had increased to 65 cubic feet per second (cfs), at which time Jesberg returned to the beach. Upon arriving, Jesberg noted that the lagoon surface had risen 7-8 inches and was just below the lowest bolt on the piling, but it was not raining. He verified that the lagoon was only inches below the headwall protecting the houses along Riverview Avenue. The lagoon level again stabilized, and it was not raining. So, Jesberg returned to his office at 0115 hr. The gage at Soquel Village had not updated the flow, making it difficult to predict how the lagoon level would change.

Jesberg returned to the beach at 0140 hr. He observed that the lagoon had risen and breached the inner berm and flooded the area between the inner and outer berm near the surf. Jesberg then created a small outlet in the outer berm to release the water. By 0145 hr, 2 November, the outer berm was breached and the creek was flowing freely to the bay. By 0215 hr, the creek had reached 40 feet width through the beach. The water level in the creek had dropped and the top of the flume was again visible. Streamflow at the gage reached more than 120 cfs from this storm (**Figure 21**), which overwhelmed the flume that could pass approximately 30 cfs. On Monday morning, 3 November, Jesberg notified the Department of Fish and Game of the emergency breaching.

After sandbar breaching in early November until approximately 25 December, streamflows were generally low in the 2-3 cfs range, allowing a sandbar berm to form at high tide and temporarily close the sandbar for 1-2 day periods. There might be tidal overwash during these periods. Then the lagoon would fill and eventually breach the bar. Ed Morrison estimated that the sandbar was closed approximately half of the time. During especially high tides, the estuary with partial berm reached near flood stage but never required artificial cutting of the sandbar.

Stream Inflow to the Lagoon. Habitat conditions in the 2008 lagoon followed a second winter with few storms, with a baseflow at the time of sandbar closure of only approximately 4.5 cfs (**Table 9; Figure 19**). This was the lowest June baseflow since 1994, another dry year. However, the baseflow did not decline as drastically as in other dry years, presumably because of good aquifer recharge during the wet winter of 2005-2006. Baseflow did decline more through the 2008 summer than it had in 2007. The early summer inflow as of 1 June 2008 (3.8 cfs) was less than in 2007 (4.7 cfs) and much less than in 2006 (28 cfs), as estimated at the USGS gage in

Soquel Village. By 1 September 2008 prior to any fall rainfall, streamflow had declined to 0.7 cfs compared to 1.3 cfs in 2007 and 6.6 cfs in 2006 at the USGS gage. The September 2008 baseflow was the 4th lowest in the last 18 years.

Water Temperature. In 2008, the lagoon was substantially warmer near the bottom (1.5 to 2° C) in morning and afternoon than in 2007 at 3 of 6 monitoring times before 1 September and once in late September out of 4 monitoring times after 1 September (**Table 3, Figures 3a-d; Appendix A**). The warmest water temperature measured near the bottom in the morning in 2008 was 22.5° C (72.5°F) in early July due to a stagnant saline layer under the Stockton Bridge and at the railroad trestle. This happened again in early August at the bridge. At most other monitoring stations and at times without a saline layer, morning water temperatures were less than 21° C. In 2008 for two-week monitoring data at four lagoon stations, 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 except for "poor" ratings at Stockton Bridge when a saline layer was present (7 July, 3 August and 30 August). Warmer lagoon water temperatures near the bottom in early July and early August were most caused by a stagnant saline layer on the bottom at those times. Warmer lagoon temperatures near the bottom in June, early July and late September in 2008 were also consistent with warmer stream inflow temperatures compared to 2007 (**Figure 3e**). The warmest afternoon water temperatures recorded near the bottom at the monitoring stations during two-week monitoring was 24.6° C, under the bridge in early July.

The cooler 2008 water temperatures near the bottom in mid-July and mid-October were consistent with cooler stream inflows compared to 2007. The high lagoon water temperatures in early July, early August and late September were consistent with summer air temperatures in the region being generally warmer in 2008, based on the average maximum daily temperature being at least 6° F warmer in 2008 than 2007 in July, August and September at the Watsonville airport (no data available for June 2007 for comparison) (**Table 4**).

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 2008 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 cooler water temperature in the morning and afternoon at Station 4 than the other three lagoon stations some of the time.

Comparisons of 7-day rolling averages generated from continuous data loggers near the railroad trestle between 2008 and 2007 indicated that juvenile steelhead experienced slightly warmer water near the bottom in June and July 2008 but experienced slightly warmer water in August and early September in 2007. There were extreme fluctuations in water temperature at 0.5 ft from the bottom in both years, but saltwater was responsible only in 2008. The range in the 7-day rolling average for 27 May to 29 September 2008 near the bottom was slightly less than for 29 May to 29 September 2007 and spanned slightly warmer temperatures. In 2008, the 7-day rolling average at 0.5 ft from the bottom ranged from **17.9° C** (64.2° F) for 28 May – 4 June to

22.3° C (72.1° F) for 6 – 13 July.). In 2007, the 7-day rolling average at 0.5 ft from the bottom ranged from **16.7° C** (62.0° F) for 22 – 29 September to **22.1° C** (72.1° F) for 19 – 26 July.

As in past years, no thermocline was detected by the data loggers or at any of the 4 monitoring stations during the summer in 2008, with complete mixing of the water column on a diurnal cycle except for stagnant saline layers in deeper pockets of the lagoon. The lagoon was likely 7-8 feet deep at most and subject to daily inland breezes. Water temperature was somewhat cooler at depth compared to nearer the surface by afternoon, being cooler near the bottom in the afternoon in 2008 except when a saline layer was present. Each night, water temperature cooled to the bottom of a completely freshwater water column.

Aquatic Vegetation. In 2008 at the time of sandbar construction, the thickest deposit of kelp and seagrass was located in the deep thalweg near the restaurants in the estuary. Much of this decaying plant matter was raked out before sandbar closure, unlike in 2007. The suspended phytoplankton bloom was light two weeks after sandbar closure and less thick than the previous year. By 4 weeks after sandbar closure (21 June), filamentous algae covered 40% of Reach 3 and was more than 4 feet long in places (**Table 5**). In Reaches 1 and 2 it was up to a foot thick but averaged only 0.3-0.4 feet thick and covered 80% of Reach 2. In 2008, the algae thickness was similarly low at all stations until August, after which thickness increased throughout the lagoon except at the mouth of Noble Gulch (**Table 5**). From mid-August onward, bottom algae was consistently thicker in 2008 than 2007 except at the mouth of Noble Gulch.

Pondweed was first observed on 20 July under the railroad trestle, 8 weeks after sandbar closure (**Table 5**). Pondweed propagates best on sandy substrate. The lagoon bottom has become progressively coarser each year with more cobbles, thus discouraging pondweed. The abundance of organic ooze on the bottom in 2007 may have encouraged pondweed. Pondweed was much less abundant in 2008 than 2007 (**Tables 5 and 6**). In 2008 the largest coverage of pondweed with associated algae was 15% (Reach 3). In 2007, pondweed with associated algae covered as much as 60% (Reach 3). In most years, the pondweed became most abundant in September and continued into October.

Surface algae in 2008 varied between 0 and 10% in the different reaches but was often absent in all three reaches except at the mouth of Noble Gulch (**Table 5**). The average surface algae coverage for Reaches 1−3 were 0.15%, 0.65% and 0.8%, respectively. The mouth of Noble Gulch averaged 2.9%.

Oxygen Levels. Critical oxygen levels are 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 was the time that oxygen levels were most importantly measured and rated. 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 2008, 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 monitorings (**Tables 2 and 3, Figure 6a and Appendix A**). After early storms 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. Therefore, oxygen concentration near the bottom at dawn stayed above 5 mg/l at all stations at two-week monitorings throughout the lagoon period.

Salinity Monitoring. Saltwater was detected several times during our two-week monitorings in the 2008 lagoon. However, it was not sufficient to stress steelhead because it was only in localized deep pockets that steelhead could avoid. There was a deep hole adjacent to the Venetian Court wall that collected the heavy saline layer. Salinity was immediately detected on 26 May after sandbar closure in that hole and under the Stockton Bridge and remained on 7 June and 21 June in the hole only (**Appendix A**). It was present in the hole and under the bridge again on 6 July. It was gone from under the bridge on 20 July but reappeared in dilute amounts on 3 August.

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, 31 August, was initially sunny and remained so through the day. The lagoon depth was maintained at an excellent gage height of 2.47–2.50 ft. There were 8 floats in the nautical parade and 21 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 (6) and kayaks (2). Thus, the lagoon bottom was not disturbed and increased turbidity was negligible. There were very few flower petals left in the lagoon. 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 729 before to 737 umhos after the parade, as was the pattern at 2 other measured sites (**Appendix A**). The highest conductivity was at the mouth of Noble Gulch at 754 umhos and was 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 11.97 and 13.01 mg/l near the bottom before 1500 hr (**Appendix A**). Water temperatures were warm between 20.9 and 21.6° C near the bottom at 3 stations and likely to warm further later on.

Fish Sampling. Our steelhead population estimate based on mark and recapture for fall 2008 was 7,071 compared to 6,064 in 2007, 992 juveniles in 2006 and 1,454 juveniles in 2005 (**Table 10, Figure 8**) (methods in **Ricker 1971**). This was the largest estimate thus far and well above our 16-year average of 1,836 juveniles. 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 and 2008 population estimates for Soquel Creek, the lagoon population of larger smolt-sized fish was likely a significant percent of the total watershed population in both of these dry years. Thus, the lagoon provides valuable steelhead nursery habitat through proper management.

On 11 October 2008, 26 young-of-the-year and 7 yearling tidewater gobies were captured with a small, fine-meshed seine. It was the first detection of this endangered species since 1997. Threespine sticklebacks were moderately abundant. The low number of 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 recently reported in adjacent lagoons (Moran Lake and Aptos) (**J. Smith, pers. Comm.**). Tidewater gobies from up-coastal-current in Moran Lake likely re-colonized Soquel Lagoon.

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. Gulls 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. 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. All of the refuse cans on the beach were equipped with gull-proof lids since 2006 (**Ed Morrison, pers. comm.**). 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 (**S. 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.

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 storm drain on the east side of Stockton Avenue Bridge (just upstream) and storm drains at the pier and Venetian Court.

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

3. 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.

4. 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.

5. 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.

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

7. 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.

8. 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.

9. 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.

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

11. 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.

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

13. 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.

14. 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.

15. 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.

16. 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.

17. 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.

18. 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.

19. 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

19 May 2008. The Creek flowed laterally across the beach at approximately 4–5 cubic feet per second and emptied into the Monterey Bay at the jetty. The flume had been mostly cleared of sand the previous week. With so little streamflow, the lateral channel was not blocked off until we had seined most of the lateral channel. The channel was blocked off at 0800 hr to allow fish rescue at the upper end of the lateral channel. Eleven seine hauls were made in the lateral channel with a beach seine that was 30 ft x 4 feet with 1/8-inch mesh. There was considerable kelp near the jetty but not elsewhere, making seining less difficult than in some years. 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. The overflow from the lagoon ran through a narrow channel cut adjacent to but not immediately alongside the flume. Fish captured included 9 young-of-the-year (YOY) steelhead (*Oncorhynchus mykiss*) (all less than 70 mm FL) and 21 staghorn sculpins (*Leptocottus armatus*), 10 of which were YOY. No other fish species were detected in the lateral channel. Rescued fish were relocated to the main lagoon/ estuary. It was unusual to find steelhead in the lateral channel, though it had occurred a few times in the past. It was unusual to have only two fish species in the lateral channel.

Four additional seine hauls were made along the western margin of the lagoon near Venetian Court in an effort to detect any tidewater gobies (*Eucyclogobius newberryi*) in that location, it being subject to dewatering during lagoon draw down. No tidewater gobies were detected. More than 50 staghorn sculpins and 6 very small YOY *Cottus spp.* (prickly sculpin (*Cottus asper*) and coastrange sculpin (*Cottus aleuticus*)) were captured instead. These fish were released back into the estuary/ lagoon. The fish rescue was completed by 0930 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 eighteenth year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Annual monitoring reports for the first 17 years are available at the City (**Alley 1991-2007**). 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.

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 very minimal after January, and streamflow was only an estimated 4.5 cfs at the stream gage in Soquel Village. The lagoon had experienced a flushing flow in early January but not much stormflow since, leaving decomposing kelp and seagrass in the estuary for much of the winter. 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.

19 May 2008. The biologist arrived at 0630 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. On 19 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 0720 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. Flume boards on the eastern restaurant side of the flume inlet had been previously removed. The western side was left boarded up. Before sandbar closure of the auxiliary channel at 1130 hr, 2 boards were added to the east side of the flume inlet with a 4-inch spacer between the second board and a third to allow smolt passage. A 6-inch spacer was placed under one steel plate at the flume exit to allow smolt passage out. The auxiliary channel had not been dug deep that day, and the lower estuary had some ponded water prior to closure. The estuary width was from bank to bank and had not narrowed during the construction activities. Three mergansers (two females and one male) were observed in the upper 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. If the flume filled with sand, sandbar construction would be delayed while the sand was cleared out of the flume, with possibly several more days being needed to ultimately close the sandbar for the summer season. After consultation with the biologist, it was decided that two boards would be placed in the flume inlet, with a spacer for passage above that and then a third board. An approximate 6-inch gap was provided at the base of the metal plate covering the flume outlet. 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 down to the jetty. All tractor work was performed above the tidal action and water contact was avoided.

20 May 2008. The biologist arrived at 0630 hr as the sandbar was being opened. The lagoon had partially filled overnight, and had spilled over the lower 2 boards 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. The sandbar was opened at 0630 hr adjacent to the flume. Four Public Works staff and the biologist raked kelp and seagrass out of the lagoon primarily near the restaurants and two-thirds of the way to the Stockton Avenue Bridge. At 0745 hr, the biologist surveyed upstream for potentially stranded fish along the estuary margin. A total of 16 threespine stickleback (*Gasterosteus aculeatus*) and one steelhead smolt were relocated to the main channel. A green heron and two mergansers (with diversionary behavior from a possible nest) were observed in the upper estuary. The water velocity created from the breach declined rapidly with the partially full lagoon and low streamflow prior to sandbar breaching. The auxiliary channel had been dug deeper this day to promote more drawdown. Raking was halted due to

poor water quality after the biologist returned to the lower estuary, and the sandbar was closed at approximately 0900 hr. The same flume inlet-outlet configuration was used as the day before with the flume outlet open.

YOY steelhead were observed in the lower lagoon after sandbar closure. The lagoon basin was deepened on the Venetian Court side to create better lagoon habitat during the summer. All grading was done outside the watered area. The stream channel upstream of Noble Gulch was straight, uniform and mostly bowl shaped, with mostly fine substrate. The estuary was stream-like with meanders around bars downstream of Noble Gulch, with considerable cobble 3-6 inches in diameter on the hard streambed. A sand and cobble bar existed directly out from the mouth of Noble Gulch. The stream ran along the eastern bulkhead, as well as on the west side with a mid-channel bar in the middle, down to the Stockton Avenue Bridge and widened. Then it flowed to the west around a wide sand deposit located adjacent to the upstream-most restaurants. Then the thalweg went back east along the restaurants in the lower lagoon. The downed cottonwood remained across from Noble Gulch. One large redwood stump was situated in the middle of the estuary, just upstream of Noble Gulch. The estuary bottom, downstream of the Stockton Avenue Bridge, consisted of sand and mostly decomposing vegetative material.

21 May 2008. The biologist arrived at 0630 hr. The lagoon had filled to a lower height overnight than the previous night because the exit channel had cut more deeply the previous day than two days before. The water had not overtopped the boards in the flume inlet, thus preventing passage to the bay. The sandbar was re-opened at 0650 hr. Again, 4 Public Works staff and the biologist raked kelp and seagrass out of the lagoon. Six YOY steelhead and one large prickly sculpin were observed downstream of the Stockton Bridge after raking. The biologist walked up the creek channel at 0800 hr, looking for stranded fish. Four sticklebacks were relocated to the main channel. Two mergansers were observed. The sandbar was closed at 0930 hr. Matt Kotila continued to deepened the Venetian side of the lower lagoon, grading outside the inundated area. The gap in the boards in the flume inlet was lowered to a position above the first board in order to facilitate fish passage.

22 May 2008. The biologist arrived at 0645 hr, just as the sandbar was being opened. The water level had not risen to the gap above the first inlet board, thus preventing fish passage overnight with the outlet open. Raking of kelp was focused near the Stockton Bridge. A log was re-positioned from under the bridge to a deep pocket adjacent to the Venetian Court wall. During the survey upstream, the biologist relocated one stickleback to the main channel at 0830 hr. One green heron and 3 mergansers were observed.

The area around the flume was compacted with the tractor. Clear visquine was laid around the flume. Sandbags were laid against the visquine around the flume inlet and elsewhere to secure the visquine. The visquine was covered with hand-shoveled sand. The sandbar was closed for the season during low tide at 1017 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. A large notch, 6 inches wide was left in the upper 4”x 4” flashboard for fish passage, with a gap between the upper board and the grate on the top of the flume. Approximately 60% of the kelp and seagrass that had deposited in the lower lagoon had been raked out, downstream of Stockton Bridge.

23 May 2008. 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 notch over the top board on the flume inlet during the night. However, kelp and sand had lodged in the flume overnight to prevent water from flowing out. The kelp plug was removed and water flowed out the flume. Grading work was done along the Venetian Court area to maintain the sand level below the drains in the wall along the walkway. The area along the east side of the lagoon was shored up with another layer of sand. Low-lying areas along the beach were filled to prepare the beach for weekend visitors. The sheet metal plates were placed under the sidewalk grates on the Esplanade.

24 May 2007. The lagoon had filled to within 2 inches of the top of the flume this day, and water flowed unimpeded through the flume to provide fish passage.

26 May 2008. The lagoon was full, with water spilling through the notch at the top of the boards. Water quality measurements were taken through the water column in the thalweg at the center of the Stockton Avenue Bridge, as well as in the deep area adjacent to the Venetian Court wall on the west. Near the wall, the lowermost 0.25 meter was saline at between 22 and 26 ppt. At the bridge, only the bottom was slightly saline at 5 ppt. Between 1400 and 1430 hr, water temperature through the freshwater portion of the water column was between 16.8 and 17.2°C near the wall and between 16.4 and 17.2°C at the bridge. The saline layer was 20.8 to 21.1°C. Oxygen was ample at more than 9.5 mg/l through the water column except at the bottom, where it was only 0.4 mg/l. The biologist contacted Ed Morrison and recommended that a shroud be placed over the flume inlet until at least the first lagoon monitoring in two weeks. He agreed to do this the next day.

Water temperature probes were launched on 26 May in the lagoon as required by the permit, as well as upstream of the lagoon near Nob Hill.

Effect of Sandbar Construction on Tidewater Gobies in 2008

It was likely that tidewater gobies used freshwater habitat upstream of the construction area, where there was less tidal fluctuation and salinity. No mortality of tidewater goby was observed during the construction activities. Seining along the estuary margin adjacent to Venetian Courts did not retrieve any tidewater gobies. However, artificial water level fluctuations were created during sandbar construction activities. Three sandbar breaches were required during sandbar preparation in 2008, with 3 breaches allowed by the permit without regulatory consultation. In 2008, there was considerable decomposing kelp and sea grass in the estuary because of the low winter runoff. 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 as water surface receded in the upper estuary. Later fall sampling indicated that a small tidewater goby population had re-established itself in the lagoon after two relatively mild winters. No tidewater gobies were detected during the previous fall 2007 lagoon sampling or since 1997. The channel lacked sheltered backwaters for fish to escape high water velocity during high stormflows that presumably had eliminated the population in 1998.

Effect of Sandbar Construction on Steelhead in 2008

Potentially negative impacts to steelhead were detected for a short period in 2008. YOY steelhead were observed swimming near the surface during raking on 20 May, and raking had to be curtailed. Steelhead access through the flume was not possible for 3 days during the sandbar construction period. The flume outlet was open during the entire period, but there was insufficient lagoon filling at night to provide passage because of the unusually low streamflow (approximately 4.5 cfs). Steelhead smolt emigration may have been delayed slightly during these 3 days for late smolts. This delay was probably insignificant, though predatory birds were observed in the lagoon at the time of sandbar construction. 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 changing of the underwater adult portal to a larger notch at the top of the flashboards of the flume inlet appeared to provide adequate adult access to the flume without sacrificing lagoon depth. This is only necessary in drier years.

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. In 2008, much of the lower lagoon basin was filled with sand. 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 young-of-the-year (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-migration of smolts into the flume inlet as they enter 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 in the sandbar adjacent to the flume. 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 so that the 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 2008-2009 Rainy Season.

1−2 November 2008. It had rained on Friday, 31 October. Two flume inlet boards had been removed in preparation for that rainfall. Another two boards were removed in anticipation for more rain. By 1900 hr on 1 November, according to the gage reading in Soquel Village, the streamflow had risen to 30 cfs. Alley called Jesberg and Kotila. Jesberg was at the lagoon already, and Kotila was in transit to the lagoon. Alley was called to view the likely artificial breaching at 1945 hr. He arrived at the lagoon at approximately 2030 hr. However, the rain stopped at 2100 hr and the lagoon level remained stable. The flume was completely submerged and draining maximally with one side of the flume outlet closed. Kotila then opened the other side of the flume outlet to increase flow through the flume. Alley left the lagoon with the sandbar still intact at 2230 hr and the lagoon level at least 6 inches below the piling bolt. Jesberg and

Kotila left the lagoon at 2300 hr with the notch dug up to a narrow inner berm at the lagoon margin. The outer berm near the surf was also in place. However, when Jesberg arrived home, he noted that the gage reading in Soquel Village had increased to 50 cfs. By 0000 hr on 2 November, the flow had increased to 65 cfs, at which time he returned to the beach. Upon arriving, Jesberg noted that the lagoon surface had risen 7-8 inches and was just below the lowest bolt on the piling, but it was not raining. He walked up the creek path and verified that the lagoon was only inches below the headwall protecting the houses along Riverview Avenue. The lagoon again stabilized, and it still was not raining. So, Jesberg returned to his office at 0115 hr. The gage at Soquel Village had not updated the flow, making it difficult to predict how the lagoon level would change.

Jesberg returned to the beach at 0140 hr. He observed that the lagoon had risen and breached the inner berm and flooded the area between the inner and outer berm near the sur. Jesberg then created a small outlet in the outer berm to release the water. By 0145 hr, 2 November, the outer berm was breached and the creek was flowing freely to the bay. Streamflow at the gage reached more than 120 cfs from this storm (**Figure 21**), which overwhelmed the flume that could pass approximately 30 cfs. By 0215 hr, the creek had reached 40 feet width through the beach. The water level in the creek had dropped and the top of the flume was again visible. On Monday morning, 3 November, Jesberg notified the Department of Fish and Game of the emergency breaching the previous morning.

After sandbar breaching in early November until approximately 25 December, streamflows were generally low, allowing a sandbar berm to form at high tide and temporarily close the sandbar for 1-2 day periods. There might be tidal overwash during these periods. Then the lagoon would fill and eventually breach the bar. Ed Morrison estimated that the sandbar was closed approximately half the time. During especially high tides, the estuary with partial berm reached near flood stage but never required artificial cutting of the sandbar.

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 2008

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. 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**). 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 2008, 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 2008, 6 HOBO temperature loggers were launched on 26 May 2008 just downstream of the railroad trestle in Reach 2 at 1-foot intervals through the water column beginning at 0.5 feet above the bottom and ending 5.5 feet from the bottom, as required by the CDFG permit. The previously used location, just upstream of the trestle had filled in at least a foot. The 2008 monitoring location was shifted downstream from the 2007 location because it was deeper. Another logger was placed in Soquel Creek near the Nob Hill Shopping Center. All 7 loggers were removed on 3 October 2008, prior to 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 2008, 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 2008, 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 remainder of the summer and during the Begonia Festival, except on in mid-October when lagoon levels had been reduced to allow photosynthesis to the bottom. The lagoon level was monitored 14 times in 1 to 2-week intervals from 26 May to 26 October 2008, plus on 31 August, the day of the Begonia Festival. For 2008, the measurements of lagoon level as measured on the staff gage were rated "good" (**Table 2**) on 10 occasions, "fair" on 3 occasions, "poor" on 1 occasion and "critical" on 1 occasion (**Table 3; Figure 2a**). The poor and critical levels on 9 and 13 October were after an early fall storm on 3 October, and the lagoon level had been lowered to allow light to penetrate to the bottom for plant-life after turbidity had been created by stormflow. The biologist had recommended the removal of boards to maintain plant-life in the lagoon and 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 26 October. However, the storm on 1-2 November required an emergency breach of the sandbar.

Maintenance of lagoon gage height was higher in 2008 than 2006, and similar to 2007 except in July and October (**Figure 2**). Lower stream inflow in 2008, 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 3 October and persistent turbidity afterwards required that inlet boards be removed to maintain light penetration through much of October. 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. However, either saltwater backwashed through the flume due to low freshwater outflow or tidal overwash went undetected, with salinity being detected in deep pockets again on 21 June and 6 July, requiring shroud placement on the lagoon inlet. Saltwater was again absent on 20 July, but returned by 3 August. From 16 August until sandbar breaching on 2 November, no saltwater was detected in the lagoon. Presence of the grated hole in the top of the flume for the 6th year allowed for more secured flashboards than previously, but saltwater apparently backwashed through gaps in the boards.

No vandalism of the flume inlet was detected in 2008. The plywood protected against both back-pressure and vandalism for most of the lagoon season. However, with the several early, small storms, the plywood was 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 2008. However, flume outlet boards were left in place for 4 days during sandbar construction to allow lagoon filling overnight, thus preventing smolt access to the bay during this period. Two days after

sandbar construction, the lagoon had sufficiently filled by 24 May to maintain an open flume for the duration of the dry season, allowing steelhead smolt out-migration in late spring and early summer (**Table 3**). The baffle near the flume inlet remained from 2007. A 4x6-inch notch was provided in the top flashboard for adult emigration out of the lagoon. There was insufficient stream inflow to allow an underwater portal in 2008, as was also the case in 2007. Plywood was nailed to the flashboards to bring the lagoon level up. The lagoon level was well into the "good" range by 26 May.

After the 3 October storm, multiple boards were left out on the Esplanade side of the flume inlet. This created a large gap at the top of the flume inlet. No screens were in place. This was deemed adequate for adult steelhead and coho salmon passage, assuming that early immigrants would be small male adults (jacks). An approximately 18-inch adult steelhead was observed near the Stockton Bridge by Morrison shortly after the sandbar was breached in early November.

Table 3. 2008 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)
26May08	open	2.40 good	good good - -	- good - -	- good - -	
07June08	open	2.40 good	good*	good	good	4 cfs
21June08	open	2.32 good	fair fair fair good	good	good	2 cfs
07Jul08	open	2.19 fair	fair poor fair good	good fair good fair	good	1.75 cfs
20Jul08	open	2.07 fair	fair fair good good	good	good	2.0 cfs
03Aug08	open	2.39 good	fair poor fair good	good fair good good	good	1.5 cfs
16Aug08	open	2.51 good	fair fair fair good	good	good	1.25 cfs

Table 3. 2008 Water Quality Ratings in Soquel Lagoon (continued).

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salin-ity	Lagoon In-flow Visual est. (cfs)
30Aug08	open	2.44 good	poor poor fair fair	good	good	1 cfs
31Aug08 Begonia Festival (morning)	open	2.47 good	fair fair fair good	good	good	
31Aug08 (afternoon)	open	2.50 good	- poor poor fair	- good good good	- good good good	
13Sep08	open	2.51 good	good	good good fair good	good	0.75 cfs
28Sep08	open	2.40 good	good	good	good	1 cfs
09Oct08	open	1.53 Poor	- good - -	- good - -	- good - -	
13Oct08	open	1.24 critical (turbidity after rain)	good	good good good fair	good	0.8 cfs
26Oct08	open	2.10 fair	good	good good fair fair	good	1.1 cfs

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

Water Temperature Results from Two-Week Monitoring. In 2008, the lagoon was substantially (1.5 to 2° C) warmer near the bottom in morning and afternoon than in 2007 at 3 of 6 monitoring times before 1 September and once in late September out of 4 monitoring times after 1 September (**Table 3, Figures 3a-d; Appendix A**). There was one relatively warm monitoring time in late July 2007 that was much warmer than in 2008 due to higher water temperature of the stream inflow (**Figure 3e**). The warmest water temperature measured near the bottom in the morning was 22.5° C (72.5°F) in early July due to a stagnant saline layer under the Stockton Bridge and at the railroad trestle. This happened again in early August at the bridge. At most other monitoring stations and at times without a saline layer, morning water temperatures were less than 21° C. In 2008, 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 except for "poor" ratings at Stockton Bridge when a saline layer was present (7 July, 3 August and 30 August). Warmer lagoon water temperatures near the bottom in early July and early August were

most caused by a stagnant saline layer on the bottom at those times. Warmer lagoon temperatures near the bottom in June, early July and late September in 2008 were also consistent with warmer stream inflow temperatures compared to 2007 (**Figure 3e**). The cooler 2008 water temperatures near the bottom in mid-July and mid-October were consistent with cooler stream inflows compared to 2007. The high lagoon water temperatures in early July, early August and late September were consistent with summer air temperatures in the region being generally warmer in 2008, based on the average maximum daily temperature being at least 6° F warmer in 2008 than 2007 in July, August and September at the Watsonville airport (no data available for June 2007 for comparison) (**Table 4**). The warmest afternoon water temperatures recorded near the bottom at the monitoring stations during two-week monitoring was 24.6° C, under the bridge in early July.

Table 4. Monthly Statistics for Air Temperature in Capitola in 2007 and at the Watsonville Airport in July through September in 2007 and 2008.

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**
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**
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**
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**	**19**

Unlike in previous years, the 2008 water temperature at dawn within 0.25 m of the bottom of the

lagoon did not become warmer as the monitoring stations progressed down the lagoon from the Trestle to the flume (**Figure 3f**). When a stagnant saline layer at the Stockton Bridge in early July and early August, it was the warmest station. 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 2008 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 cooler water temperature in the morning and afternoon at Station 4 than the other three lagoon stations some of the time. In the afternoon near the lagoon bottom, Station 1 at the flume was often the warmest (except when the saline layer ant Station 2 made it the warmest), and Station 4 at the mouth of Noble Gulch was the coolest as in previous years until October (**Figure 3g**). In late September 2008, the morning and afternoon temperatures were most similar for the lagoon season because that monitoring day was lightly foggy in the morning and still overcast in the afternoon.

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 18 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-g**).

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 2008, as in past years. Daily temperature *minima* in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2008. However, the much warmer spike in lagoon water temperature during the period 6 July – 13 July in 2008 at 0.5 and 1.5 ft from the bottom was probably caused by a stagnant saline layer that had warmed up on the bottom (**Figures 4a-d; 5a-b**). Daily temperature *maxima* near the bottom were warmer in the lagoon than the stream in 1999 and 2001-2004 and 2007-2008, but were cooler in 2000 and 2005 (**Alley 2006**). In 2007 and 2008, the daily lagoon minima and maxima were usually more than 2º C warmer than the minima and daily maxima of stream inflow temperatures (**Figures 4a-b and 5a-b**). The daily stream temperature fluctuated more than the daily lagoon temperature near the bottom.

As in past years, in 2008 no thermocline was detected (with its warm, well-mixed, oxygen-rich

epilimnion above the thermocline and a cool, non-circulated, oxygen-poor hypolimnion below) by the data loggers at the deep area near the trestle or at any of the 4, two-week monitoring stations. There was complete, diurnal (daily) mixing of the water column except in deeper pockets when a temporary, heavy and stagnant saline layer developed. During those periods in the stagnant saline layers, the diurnal fluctuation in water temperature was at a minimum. The lagoon was likely 7−8 feet deep at most and subject to daily inland breezes that circulated the water, surface to bottom. Water temperature was somewhat cooler at depth in 2008 compared to nearer the surface by afternoon, except when the saline layer formed, such as during the 6 July – 13 July period (salinity confirmed on 6 July under the Stockton Bridge and near the Venetian Court wall) when water temperatures at 0.5 ft from the bottom were as warm or warmer than 5.5 ft from the bottom near the surface (**Figures 4a-b; 4k-l; 4o; Appendix A**). Water temperatures were even warmer at 1.5 ft from the bottom during the saline layer stagnation (**Figures 4c-d**). A saline layer may have also been present during a period that included 30 June (not confirmed), when the daily maximum was also warmer at 0.5 ft from the bottom than at 5.5 ft from the bottom (**Figure 4o**).

The range in the 7-day rolling average for 27 May to 29 September 2008 near the bottom was slightly less than for 29 May to 29 September 2007 and spanned slightly warmer temperatures. In 2008, the 7-day rolling average at 0.5 ft from the bottom ranged from **17.9° C** (64.2° F) for 28 May – 4 June to **22.3° C** (72.1° F) for 6 – 13 July.). In 2007, the 7-day rolling average at 0.5 ft from the bottom ranged from **16.7° C** (62.0° F) for 22 – 29 September to **22.1° C** (72.1° F) for 19 – 26 July.

Comparisons of 7-day rolling averages between 2008 and 2007 indicated that juvenile steelhead experienced slightly warmer water near the bottom in June and July 2008 but experienced slightly warmer water in August and early September in 2007. There were extreme fluctuations in water temperature at 0.5 ft from the bottom in both years, but saltwater was responsible only in 2008. The fluctuation in 2008 was between 18 June and 20 July due to two episodes of warm saline layers, with relatively cool water in between these episodes. The 7-day rolling average reflected these 2008 fluctuations with a range of approximately **18.3 to 22.3° C** (**Figure 4a**). In 2007, water temperature at 0.5 ft from the bottom showed a more gradually wide fluctuation between 18 June and 31 July without saltwater entering the lagoon, during which the 7-day rolling average ranged between **18.5 and 22.2° C** (**Figure 4n**).

From 20 July to 5 September 2008, the 7-day rolling average at 0.5 ft from the bottom remained between approximately **19.4 and 21.1° C** (**Figure 4a**). For 1 August to 5 September 2007, the 7-day rolling average remained between approximately **19.6 and 21.6° C** (**Figure 4n**). In contrast, the range in 7-day rolling averages in 2006 at 0.5 ft from the bottom was narrower and cooler. The 2006 range was between approximately **17.2 and 20.8° C** from 18 June to 5 September, with smaller fluctuations than in 2007 and 2008 (**Alley 2008**). Salinity was not an issue in 2006.

The range in 7-day rolling average near the surface was slightly cooler in 2008 than 2007 from late May to the end of September. In 2008, the 7-day rolling average at 5.5 ft from the bottom (near the surface) ranged from **16.4° C** (63.9° F) for 27 May – 3 June to **21.3° C** (70.3° F) for 10 – 17 July. In 2007, the 7-day rolling average at 5.5 ft from the bottom ranged from **17.2° C** (63.0° F) for 22 – 29 September to **21.8° C** (71.3° F) for 18 – 25 July.

In 2008, the daily maximum water temperature *near the lagoon surface* ranged between **17.5° C** (63.5° F) on 27 May and **23.2° C** (73.8° F) on 21 August (**Figures 4k-1**). In 2007, the daily maximum ranged between **17.1° C** (62.8°F) on 30 May and **24.0° C** (75.2ºF) on 23 July (**Figure 4m**). The daily maximum water temperature in 2006 ranged from **15.6° C** (60.1°F) on 29 September–1 October to **22.9° C** (73.2ºF) 23 and 25 July. Daily maxima near the surface were similar in June and July of 2007 and 2008 but generally warmer in August and September 2008.

In 2008, the maximum daily water temperature *near the lagoon bottom* ranged between **18.3° C** (64.9° F) on 31 May and **22.7°C** (73.2° F) on 10 July (**Figures 4a and 4b**). In 2007, it ranged between **16.8°C** (62.2°F) on 30 May and **23.2°C** (73.8°F) on 22-24 July (**Figure 4n**). In 2006, it ranged between **15.2°C** (59.4°F) on 1 October and **22.5°C** (72.5°F) on 12 July (**Alley 2006**). The daily maxima near the lagoon bottom were warmer in 2008 than 2007 in June and July and similar in August and September between years. Water temperature graphed at 10-day intervals indicated that lagoon daily maxima were warmer in 2008 than 2007 near the bottom and near the surface, with water temperatures warmer in 2008 at 9 of 13 occasions (**Figure 4o**). The graph also indicated that in 2006 when stream inflow was much higher, the lagoon was considerably cooler in August and September than in 2008 on all 6 occasions and in 2007 on 5 of 6 occasions between 8 August and 27 September (**Figure 4o**). However, comparisons at 10-day intervals did not provide a clear comparison for 2008 and 2007. Comparisons of the 7-day rolling averages provided the best comparison, as described earlier.

The greatest increase in water temperature recorded from morning to afternoon near the bottom in 2008 was **1.9° C** (3.4° F) on 1 June compared to **3.0°C** (5.5°F) on 20 June 2007 (**Figures 4a-b; 4n**). The greatest increase near the lagoon surface in 2008 was **2.3° C** (4.1° F) on 6 June compared to **5.4°C** (9.7°F) on 16 August 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 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 2008 lagoon did not meet the steelhead management goal of early morning minimum temperature of less than 20°C near the bottom on 54 of 130 (42%) measured days (27 May−3 October) (**Figure 4a**) compared to 35 of 124 (28%) measured days (29 May–30 September) in 2007 (**Figure 4n)**. 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; 1 June–3 October) 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 69% of the days measured (90 of 130 days) compared to 66% of the days measured 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 failed to cool to 16°C in 2008.

At the creek site near Nob Hill in 2008, water temperature failed to meet the management goal of *no more than 4 hours a day at greater than 20ºC (68ºF)* on only 1 day of 130 days (0.8%; 27May−3 October) (**Figure 5a**). In 2007, water temperature failed to meet this management goal on 5 of 124 days (4%; 29 May–30 September) (**Figure 5c**) compared to 14 days in 2006 (**12%**; 19 June–8 October) (**Figure 5e**). At the creek site in 2005, water temperature failed to meet the management goal on 6 of 120 monitored days (**5%**; 10 June–8 October) (**Alley 2005**). In 2004, 9 of 125 monitored days (**7%**; June-early October) did not meet the goal. September was unusually cool in 2004 and 2005 (**Alley 2005**). At the Creek site in 2003, 22 of 127 monitored days (**17%**; June to early October) 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 2008, the average weekly temperature went as high as 18.2ºC (64.7ºF) on 9 July and was higher than 16.7° C for 20 continuous days in late June and July (**Figure 5a**).

Water temperatures in the lagoon closely mirrored temperatures in the stream inflow in 2003-2008. Daily *minima* in the lagoon near the bottom were consistently warmer than the stream above in 1999-2008 (2-3° C warmer in 2008) (**Figures 4a-b, 4m, 5a-c and Alley 2006**). The daily *maxima* near the bottom of the lagoon were also warmer than in the stream in 2008 (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 2008 than 2007, based on graphical representations of the 7-day rolling average, despite the reduced baseflow in 2008 and generally warmer air temperatures in 2008 (based on data from the Watsonville airport) (**Table 4; Figures 4a-b and 5a-b**). However, water temperatures did not drop off in the latter half of September 2008 the way they did in 2007, with late September air temperatures in Watsonville remaining high in 2008. Unfortunately, the website for Capitola air temperatures was discontinued.

Creek water temperatures in 1999-2008 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 2008 at the time of sandbar construction, the thickest deposit of kelp and seagrass was located in the deep thalweg near the restaurants in the estuary. Much of this decaying plant matter was raked out before sandbar closure, unlike in 2007. The suspended phytoplankton bloom was light two weeks after sandbar closure and less thick than the previous year. By 4 weeks after sandbar closure (21 June), filamentous algae covered 40% of Reach 3 and was more than 4 feet long in places (**Table 5**). In Reaches 1 and 2 it was up to a foot thick but averaged only 0.3-0.4 feet thick and covered 80% of Reach 2. Filamentous algae was also noted during monitoring on 24 June 2007, approximately 4 weeks after sandbar closure (**Table 6**); compared to 30 June 2006, 16 days after sandbar closure (**Table 7**); compared to 1 July 2005, 3.0 weeks after sandbar closure in 2005 (**Table 8**); compared to 27 June 2004, 4.5 weeks after sandbar closure in 2004 (**Alley 2004**); and compared to 7 July 2003, 6 weeks after sandbar closure in 2003 (**Alley 2003**). In 2008, the algae thickness was similarly low at all stations until August, after which thickness increased throughout the lagoon except at the mouth of Noble Gulch (**Table 5**). From mid-August onward, bottom algae was consistently thicker in 2008 than 2007 except at the mouth of Noble Gulch.

Pondweed was first observed on 20 July under the railroad trestle, 8 weeks after sandbar closure (**Table 5**). Pondweed was first observed in 2007, 6 weeks after sandbar closure (**Alley 2008a**). Pondweed was possibly observed in 2006 in Reach 2, 8 weeks after sandbar closure. However, the identification was uncertain. It was not positively identified after that. Pondweed propagates best on sandy substrate. The lagoon bottom has become progressively coarser each year with more cobbles, thus discouraging pondweed. The abundance of organic ooze on the bottom in 2007 may have encouraged pondweed. Pondweed was much less abundant in 2008 than 2007 (**Tables 5 and 6**). In 2008 the largest coverage of pondweed with associated algae was 15% (Reach 3). In 2007, pondweed with associated algae covered as much as 60% (Reach 3). In most years, the pondweed became most abundant in September and continued into October.

In 2008, surface algae was present in all three reaches and as high as 10% coverage at the mouth of Noble Gulch just 4 weeks after sandbar closure (**Table 5**). In 2007, surface algae was also first observed in Reaches 2 and 3 one month after sandbar closure (**Table 6**). In 2006, surface algae was first observed in all reaches on 28 July after a warm month and 5 weeks after sandbar closure (**Table 7**). In 2005, surface algae was observed 4.5 weeks after sandbar closure on 15 July (**Table 8**). In 2004, surface algae occurred 4 weeks after sandbar closure (**Alley 2004**).

Surface algae in 2008 varied between 0 and 10% in the different reaches but was often absent in all three reaches except at the mouth of Noble Gulch (**Table 5**). The average surface algae coverage for Reaches 1−3 were 0.15%, 0.65% and 0.8%, respectively. The mouth of Noble Gulch averaged 2.9%. Surface algae in 2007 varied between 0 and 10% coverage in the different reaches, with a maximum of 30% coverage observed at the mouth of Noble Gulch on 18 August (**Table 6**). Average surface algae coverage in 2007 was similar to 2008 except for the high incidence on18 August. Surface algae in 2006 varied between 0 and 5% coverage, with the most being present in Reach 3 and near Noble Gulch (**Table 7**). 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%) (**Table 8**).

Table 5. 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**

Table 6. Visually Estimated Algae Coverage and Thickness in the 2007 Lagoon (pondweed with attached algae included).

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month-Day	Avg. Bottom Thickness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thickness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thickness (ft)	% Bottom Cover	% Surf. Cover	Avg. Bottom Thickness (ft)	% Bottom Cover	% Surf. Cover
5-30	0	0	0	-	-	-	-	-	-	-	-	
6-10	0	0	0	0	0	0	0	0	0	0	0	0
6-24	? Phyto-plankton too thick	-	0	1.0	100	1	1.0	100	1	1.0	60	7
7-09	? Phyto-plankton too thick	-	0	2.5	100 (some Pond-Weed)	0	2.5	100 (some Pond-Weed)	0	? Phyto-plankton too thick	-	0
7-22	? Phyto-plankton too thick	-	0	? Phyto-plankton too thick	100 (20% Pond-Weed)	0	2	100 (some Pond-Weed)	0	? Phyto-plankton too thick	-	0
8-05	2.0	75	0	2.5	100 (some Pond-Weed)	0	2.5	100 (10% Pond-Weed)	0	? Phyto-plankton too thick	100	0
8-18	1.5	90 (10% Pond-Weed)	<1	1.5	70 (30% Pond-Weed)	7	0.5	50 (some Pond-Weed)	10	3.5	80	30
9-01	0 (all pondweed with algae)	- (50% Pond-Weed)	0	1.0	70 (30% Pond-Weed)	0	1.0	40 (60% Pond-Weed)	0	0 (70% pond-weed)	0	15
9-16	? Glare too great	- (15% Pond-Weed)	1	1.0	70 (30% Pond-Weed)	2	2.0	50 (50% Pond-Weed)	2	1.0	20	2
9-30	? High turbidity	-	0	? High turbidity	-	0	? High turbidity	-	0	? High turbidity	-	0
10-13	? High turbidity	-	0	? High turbidity	-	0	? High turbidity	-	0	? High turbidity	-	0
10-27	? Low light	-	<1	? Low light	-	<1	? Low light	-	0	0.2	70	1
11-10	? Low light	-	0	? Low light	-	0	? Low light	-	0	? Low light	-	0
11-26	? Low light	-	0	? Low light	-	0	? Low light	-	0	? Low light	-	0
12-08	? Low light	-	0	? Low light	-	0	? Low light	-	0	? Low light	-	0

Avg-Rch 1 8-05–9-01 Rch 2, 3 and Noble Gulch 6-24–9-16	**1.2**	**55**	**0.1**	**1.6**	**87**	**1.3**	**1.6**	**77**	**1.9**	**1.4**	**52**	**7.7**

Table 7. Visually Estimated Algae Coverage and Thickness in the 2006 Lagoon (pondweed with attached algae not included).

Date	**Reach 1**			**Reach 2**			**Reach 3**			**Mouth of Noble Gulch**		
Month-Day	**Avg. Bottom Thickness (ft)**	**% Bottom Cover**	**% Surf. Cover**	**Avg. Bottom Thickness (ft)**	**% Bottom Cover**	**% Surf. Cover**	**Avg. Bottom Thickness (ft)**	**% Bottom Cover**	**% Surf. Cover**	**Avg. Bottom Thickness (ft)**	**% Bottom Cover**	**% Surf. Cover**
6-18	0	0	0	-	-	-	-	-	-	-	-	-
6-30	0.3	20	0	0.3	20	0	0.3	10	0	0.3	5	0
7-14	0.3	80	0	0.3	80	0	0.2	70	0	0.2	60	0
7-28	0.5	95	3	0.4	95	5	0.5	95	1	0.8	95	5
8-12	0.8	70	0	3.0	90	0	2.0	90	0	1.0	100	3
8-25	1.5	50	0	1.0	50	0	0.8	35	5	1.5	100	5
9-10	**0.2**	**100**	**0**	**0.8**	**90**	**2**	**1.0**	**90**	**5**	**2.0**	**60**	**5**
9-23	1.0	50	<1	1.5	-	2	1.3	-	5	1.0	60	1
10-5	Brown turbidity	-	0	Brown turbidity	-	0	Brown turbidity	-	1	Brown turbidity	-	0
10-26	0.4	70	<1	0.3	70	0	0.6	90	<1	0.4	Gray turbidity	0
11-09	-	-	0	-	-	0	-	-	0	-	-	0
11-22	<0.2	-	0	-	-	0	0.15	-	0	-	-	0
Avg-6-30 to 9-23	**0.4**	**65**	**0.5**	**1.0**	**70**	**1.5**	**0.9**	**65**	**2.3**	**1.0**	**70**	**3.2**

Table 8. Visually Estimated Algae Coverage and Thickness in the 2005 Lagoon (pondweed with attached algae not included).

Date	Reach 1			Reach 2			Reach 3			Mouth of Noble Gulch		
Month-Day	Ave. Bottom Thickness	% Bottom Cover	% Surf. Cover	Ave. Bottom Thickness	% Bottom Cover	% Surf. Cover	Ave. Bottom Thickness	% Bottom Cover	% Surf. Cover	Ave. Bottom Thickness	% Bottom Cover	% Surf. Cover
6-19	0	0	0	0	0	0	0	0	0	0	0	0
7-01	0.33	80	0	0.33	100	0	0.7	100	0	0.25	100	0
7-15	-	-	0	0.5	100	0	0.5	100	5	0.5	90	3
7-29	1.0	80	0	1.0	90	0	0.5	80	10	0.4	60	<1
8-14	-	-	0	-	85	0	-	60	0	2.0	95	0
8-27	1.0	35	0	1.0	95	0	1.5	100	0	4.0	100	0
9-10	-	-	0	1.5	100	<1	2.5	99	<1	2.0	60	2
9-25	**2.0**	**100**	**2**	**2.0**	**100**	**2**	**3.0**	**99**	**20**	**3.0**	**60**	**60**
10-8	-	-	0	-	-	<1	-	-	<1	3.0	100	20
10-18	-	-	0	-	-	10	-	-	15	0.5	50	3
11-03	-	-	0	-	-	0	-	-	0	-	-	0
11-17	0.15	100	0	0.3	70	0	-	-	0	0.15	60	0
Avg-7-01 to 9-25	**1.1**	**75**	**0.3**	**1.0**	**95**	**0.3**	**1.4**	**90**	**5.8**	**1.7**	**80**	**10.8**

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 2008, 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 monitorings (**Tables 2 and 3, Figure 6a and Appendix A**). After early storms 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. Therefore, oxygen concentration near the bottom at dawn stayed above 5 mg/l at all stations at two-week monitorings throughout the lagoon period.

Of the early morning oxygen monitorings, Station 1 at the flume was rated "good" 100% of the time (11, 2-week monitorings) (**Figure 6b**). Station 2 at Stockton Avenue Bridge was rated "good" 82% of the time (9 of 11 monitorings) and "fair" 18% of the time (2 of 11 monitorings) (**Figure 6c**). Station 3 near the railroad trestle was rated "good" 82% of the time (9 of 11 monitorings) and "fair" 18% of the time (2 of 11 monitorings) (**Figure 6d**). Station 4 at the mouth of Noble Gulch was rated "good" 73% of the time (8 of 11 monitorings) and "fair" 27% of the time (3 of 11 monitorings) (**Figure 6e**).

Unlike in 2003-2005 and 2007, the lowest morning oxygen concentrations near the bottom were not near the mouth Noble Gulch (Station 4) much of the time (only 36% of the time in 2008) (**Figure 6a and Appendix A**). Lower oxygen concentration at dawn is usually associated with more algae present and a cloudy/foggy previous day or a stagnant saline layer along the bottom. In 2008, the algae thickness was similarly low at all stations until August, after which thickness increased throughout the lagoon except at the mouth of Noble Gulch. On average, the algae

thickness in declining amount occurred in Reach 1, Reach 2, Reach 3 and mouth of Noble Gulch (**Table 5**). From mid-August onward, bottom algae was consistently thicker in 2008 than 2007 except at the mouth of Noble Gulch. As in 2006 and 2007, the flume station in 2008 generally had the highest oxygen concentration at dawn of the 4 lagoon sites and higher concentrations than the stream site (**Figure 6a**). Only on 1 of 11 monitorings (9%) did the stream site have higher morning oxygen concentrations than the lagoon sites. On 3 of 11 monitorings (27%), it had the lowest oxygen concentration in early morning.

Oxygen concentrations near the bottom at dawn were generally higher in 2008 than 2007 during the lagoon period, without drops into the "poor" range as occurred in 2007 and without the high incidence of "fair" ratings as occurred in 2006 (**Figures 6a, 6f and 6g**). Thus, with the algae thickness less in 2008, there was still enough to generate high levels of oxygen on sunny days to maintain oxygen levels on following mornings, while after overcast or foggy days, oxygen levels did not go as low in 2008 as in 2007. Apparently, greater oxygen production during sunny days at these algal densities more than compensated for the respiration loss of oxygen overnight. This phenomenon was also observed in 2005−2008 (**Alley 2006**).

On all monitoring days except 6 July at Stockton Bridge (Station 2) (where there was a warm saline layer), 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 cloudy days. Oxygen levels increased the least through the day on 21 June at Stations 2 and 4 (because it had been cloudy and misty) and on 28 September at all stations because it was overcast (**Figures 6b-e; Appendix A**). Oxygen levels on the sunny afternoon of the Begonia Festival (31 August) were similarly high to the previous monitoring day (30 August).

Salinity Results. Saltwater was detected several times during our two-week monitorings in the 2008 lagoon. However, it was not sufficient to stress steelhead because it was only in localized deep pockets that steelhead could avoid. There was a deep hole adjacent to the Venetian Court wall that collected the heavy saline layer. Salinity was immediately detected on 26 May after sandbar closure in that hole and under the Stockton Bridge and remained on 7 June and 21 June in the hole only (**Appendix A**). It was present in the hole and under the bridge again on 6 July. It was gone from under the bridge on 20 July but reappeared in dilute amounts on 3 August. With 10-12 parts per thousand (ppt) salinity thought to be stressful from sudden exposure, the highest concentrations of 17-26 ppt were detected in the Venetian Court's wall-hole for two weeks after sandbar closure. However, the highest concentration under the Stockton Bridge that was detected at that time was 4.3 ppt. On 6 July a concentration of 7.1 ppt was detected under the bridge, the highest for the summer at that station. When salinity was present near the bottom, water temperatures increased and oxygen levels decreased in the saline layers. These layers were generally 0.25 – 0.5 meters thick. Based on elevated water temperatures in the deep area near the trestle where the HOBO temperature loggers were deployed, saltwater also collected there in June and July.

From 16 August onward, no salinity was detected at monitoring stations. According to Matt Kotila who maintained the beach through the summer, there was no obvious evidence of tidal overwash. He constructed a berm around the lagoon margin early on to prevent tidal overwash.

He suspected that saltwater was back-flushing through the flume on high tides and entered the lagoon from time to time. This normally did not happen in earlier years because sufficient freshwater outflow was present to prevent back-flushing. However, in 2008, stream inflow to the lagoon and overflow through the flume was less than usual after two relatively dry winters.

Conductivity Results. Conductivity remained low throughout 2008, except in the Venetian Court's wall-hole. The highest conductivity detected under the Stockton Bridge was 11,710 umhos on 6 July at the bottom. This location would have been stressful to juvenile steelhead and was likely avoided. At just 0.20 m above the bottom, though, conductivity was down to 2,111 umhos, which would not be stressful (**Appendix A**). At times when a saline layer was present near the bottom, conductivity was slightly elevated throughout the water column in the 800-1,000 umhos range. As in 2007, general conductivity was also higher than usual in the 2008 lagoon, with it remaining above 700 umhos at most stations the entire lagoon period.

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 salinity 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. The year 2001 was most affected by tidal overwash in the last 9 years. 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 2008 lagoon followed a second successive winter with few storms, with a baseflow at the time of sandbar closure of only approximately 4.5 cfs (**Table 9; Figures 19 and 20**). This was the lowest June baseflow since 1994, another dry year. However, the baseflow did not decline as drastically as in other dry years such as 1991 and 1992, presumably because of good aquifer recharge during the wet winter of 2005-2006. However, baseflows were lower than in 2007. The early summer inflow as of 1 June 2008 (3.8 cfs) was less than in 2007 (4.7 cfs) and much less than in 2006 (28 cfs), as estimated at the USGS gage in Soquel Village. By 1 September prior to any fall rainfall, streamflow had declined to 0.7 cfs in 2008 compared to 1.3 cfs in 2007 and 6.6 cfs in 2006 at the USGS gage. The September 2007 baseflow was the 4th lowest in the last 18 years. Except for an early November storm when streamflow went to approximately 120 cfs, streamflow remained in the 2-3 cfs range until mid-December, and the sandbar reformed on a regular basis followed by lagoon filling and natural breaching at 2-3 day intervals.

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, 31 August, was initially sunny and remained so through the day. The lagoon depth was maintained at an excellent gage height of 2.47–2.50 ft. There were 8 floats in the nautical parade and 21 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 (6) and kayaks (2). Thus, the lagoon bottom was not disturbed and increased turbidity was negligible. There were very few flower petals left in the lagoon. 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 729 before to 737 umhos after the parade, as was the pattern at 2 other measured sites (**Appendix A**). The highest conductivity was at the mouth of Noble Gulch at 754 umhos and was 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 11.97 and 13.01 mg/l near the bottom before 1500 hr (**Appendix A**). Water temperatures were warm between 20.9 and 21.6° C near the bottom at 3 stations and likely to become 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 fewer petals in the water in 2008 after the parade than usual. Water quality measurements on 13 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.

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.

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.

Table 9. Daily Mean Discharge Recorded at the USGS Stream Gage (11160000) in Soquel Village, At One Month Intervals from 1 June to 1 October, 1991-2008 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

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 with no gray water observed in 11, 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 the majority of monitorings (**Figure 6g**) and other years, with usually lower oxygen readings at that station (**Alley 2005**). However, in 2008 and 2006 oxygen depletion at dawn was not consistently greatest at the mouth of Noble Gulch (**Figures 6a and 6f**).

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. 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. 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.

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

3. 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.

4. 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.

5. 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.

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

7. If the lagoon bottom becomes invisible due to turbidity for more than one day 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.

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

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

10. 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.

11. 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.

12. "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**).

13. 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.

14. 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.

15. 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 2008, as was the case in 2003–2007. CDFG allowed juvenile planting only in streams where planted juveniles were descendents of captured adult steelhead brood stock from those streams (San Lorenzo River and Scott Creek). No adult steelhead were captured from Soquel Creek for hatchery propagation. Therefore, no juveniles were planted there.

Fish Sampling Results. Our steelhead population estimate based on mark and recapture for fall 2008 was 7,071 compared to 6,064 in 2007, 992 juveniles in 2006 and 1,454 juveniles in 2005 (Table 10, Figure 8) (methods in Ricker 1971). This was the largest estimate thus far and well above our 16-year average of 1,836 juveniles. The other species captured in fall 2008 were tidewater gobies, threespine sticklebacks and staghorn sculpins. Thirty-five PIT-tagged juveniles from 2008 NOAA Fisheries tagging were captured on 27 September, the first day of sampling. All but one of these tagged fish were first tagged in the lagoon. One juvenile steelhead had been tagged at a stream site just downstream of the Soquel Grange (**D. Swank, NOAA Fisheries, pers. communication**), approximately 0.6 miles from the upper end of the lagoon. No steelhead were scanned on 11 October. We expected more juveniles to use the lagoon in 2008 and 2007 than 2006 because there were lower adult passage flows late in the spawning season in 2007 and 2008 (**Figures 19 and 22**), encouraging more spawning in the lower creek to seed the lagoon with more young-of-the-year steelhead. 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 and 2008 population estimates for Soquel Creek, 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 morning 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. 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 1-3. 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 27 September and 11 October 2008, from just upstream of the Stockton Avenue Bridge, downstream. Two weeks passed between samplings because rain occurred with first flush just prior to the 4 October weekend, and water quality was a concern. 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 551 juvenile steelhead were clipped on 27 September and 231 fish were captured on 11 October (with 18 recaptures) for a total of 744 unclipped fish captured on the 2 days (compared to 559 in 2007, 300 in 2006, 294 in 2005, 447 in 2004, 204 in 2003 and 509 in 2002) ranging from 90 to 254 cm Standard Length (SL) on 27 September. A total of 339 juveniles from 2 effective seine hauls were marked on 27 September. On 11 October, 213 unmarked (unclipped) steelhead and 18 marked (clipped) steelhead were recaptured from 1 effective seine haul. The lagoon level had been lowered to allow light to penetrate to the lagoon bottom, which apparently made our seine more effective than usual. The median size of juvenile steelhead captured the first day in 2008 was 115-119 mm SL (**Figure 9**) compared to 125-129 mm SL in 2007 (**Figure 10**) (155-159 mm SL in 2006 (**Figure 11**)). No fish were measured on the second weekend of sampling in 2008. The median size of captured steelhead on 14 October was 125-129 mm SL in 2007 (145-149 mm SL (unclipped only) in 2006).

We concluded from the size distributions of juveniles captured that steelhead grew slower in 2008 than in 2007 in the summer lagoon and much slower than in 2006, consistent with more competition from a much larger juvenile population in 2007 and 2008 than 2006 (**Table 10; Figure 8**). 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 2008, 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 26 YOY and 7 yearling tidewater gobies were captured. This was the first detection of this endangered species since 1997. Threespine sticklebacks were moderately abundant. Five staghorn sculpins and 5 juvenile steelhead were captured with the small seine. The low number 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, 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 2008, 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 2008 lagoon level increased in August to 2007 levels. Water depth had to be reduced in early October 2008 to allow light penetration to the bottom after an early storm. With the turbidity remaining for an extended period due to low stream inflow, water depth could not be raised above a gage height of 2.0 for 3+ weeks (3 October – 26 October). In 2008, piscivorous birds, including 1−4 mergansers, 1−4 cormorants, 1−2 pied-billed grebes, a greenback heron and a black crown night heron were observed roosting on instream wood at the lagoon on most two-week monitorings (**Appendix A**). In 2007, a group of 1-7 cormorants roosted on redwood stumps in the lagoon from mid-September onward, and 1-2 mergansers and 1-3 grebes were observed throughout the summer. Maintenance of lagoon depth is important to make feeding more difficult for these fish-eating birds.

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 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 10. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2008.

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

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.

LITERATURE CITED

Alley, D.W. 1992. Soquel Creek Lagoon Monitoring Report, 1990- 91. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1993. Soquel Creek Lagoon Monitoring Report, 1991- 92. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1994. Soquel Creek Lagoon Monitoring Report, 1992- 93. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1995. Soquel Creek Lagoon Monitoring Report, 1993- 94. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1996a. Summary Report Regarding Development, Implementation and Monitoring of the Soquel Creek Lagoon Management and Enhancement Plan, 1996. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1996b. Soquel Creek Lagoon Monitoring Report, 1994- 95. Prepared by D.W. ALLEY & Associates for the City of Capitola and the Coastal Conservancy.

Alley, D.W. 1997. Soquel Creek Lagoon Monitoring Report, 1995- 96. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 1998. Soquel Creek Lagoon Monitoring Report, 1996- 97. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 1999. Soquel Creek Lagoon Monitoring Report, 1997- 98. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2000. Soquel Creek Lagoon Monitoring Report, 1998-1999. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2000. Soquel Creek Lagoon Monitoring Report, 1999-2000. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2001. Determination of Juvenile Steelhead Densities in Soquel Creek, Santa Cruz County, California; With a 2000 Estimate of Juvenile Production and Index of Expected Adult Returns. Prepared by D.W. ALLEY & Associates for the Soquel Creek Water District.

LITERATURE CITED (continued)

Alley, D.W. 2002. Determination of Juvenile Steelhead Densities in Soquel Creek, Santa Cruz County, California; With a 2001 Estimate of Juvenile Production and Index of Expected Adult Returns. Prepared by D.W. ALLEY & Associates for the Soquel Creek Water District.

Alley, D.W. 2003a. Soquel Creek Lagoon Monitoring Report, 2002. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2003b. Determination of Juvenile Steelhead Densities in Soquel Creek, Santa Cruz County, California; With a 2002 Estimate of Juvenile Production and Index of Expected Adult Returns. Prepared by D.W. ALLEY & Associates for the Soquel Creek Water District and Santa Cruz County Environmental Planning.

Alley, D.W. 2003c. Soquel Creek Lagoon Monitoring Report, 2003. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley D.W., K Lyons and S Chartrand. 2004 Soquel Creek Lagoon Management and Enhancement Plan Update. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2004. Soquel Creek Lagoon Monitoring Report, 2004. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2005. Soquel Creek Lagoon Monitoring Report, 2005. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2006. Soquel Creek Lagoon Monitoring Report, 2006. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2008a. Soquel Creek Lagoon Monitoring Report, 2007. Prepared by D.W. ALLEY & Associates for the City of Capitola.

Alley, D.W. 2008b. 2007 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California, With Trend Analysis in the San Lorenzo and Soquel Watersheds, 1997-2007.

Baltz, D.M., B. Vondracek, L. R. Brown, and P.B. Moyle. 1987. Influence of temperature on microhabitat choice by fishes in a California stream. Trans. Am. Fish. Soc. 116:12-20. (Cited in Moyle 2002).

Brett, J.R. 1959. Thermal requirements of fish – three decades of study, 1940-1970. In: Biological problems in Water Pollution. USPHS Tech. Rept. W60-3, 110 Cincinnati, Ohio. pp. 110-117. (Cited by Kubicek and Price 1976).

LITERATURE CITED (continued)

Coche, A.G. 1967. Production of juvenile steelhead trout in a freshwater impoundment. Ecol. Monographs 37: 201-228. (Cited by Kubicek and Price 1976).

Dettman, David. 1991. Personal Communication. Senior Fishery Biologist. Monterey Peninsula Water Management District.

Hokanson, K.E.F., C.F. Kleiner and T.W. Thorslund. 1977. Effects of constant temperatures and diel temperature fluctuations on specific growth and mortality rates and yield of juvenile rainbow trout, Salmon Gairdneri. J. Fish. Res. Board Can. 34:639-648. (Cited in Santa Ynez River Technical Advisory Committee 2000).

Kubicek, P.F. and D.G. Price. 1976. An evaluation of water temperature and its effect on juvenile steelhead trout in geothermally active areas of Big Sulphur Creek. Pacific Gas and Electric Company Department of Engineering Research.

Moyle, P.B. 2002. Inland Fishes of California. Revised and Expanded. Univ. of Calif. Press. Berkeley, Los Angeles and London. ISBN: 0-520- 22754-9.

Ricker, W.E. (ed.) 1971. Methods for Assessment of Fish Production in Fresh Waters. Blackwell Scientific Publications. Oxford and Edinburgh. ISBN: 0-632-08490-1. 2nd edition. 543pp.

Santa Ynez River Technical Advisory Committee (SYRTAC). 2000. Lower Santa Ynez River Fish Management Plan. Volume II Appendices. *Prepared for* Santa Ynez River Consensus Committee. *Prepared by* Santa Ynez River Technical Advisory Committee. October 2, 2000.

Sherman, Y. 2002. Personal Communication. Editorial Services. San Diego, California.

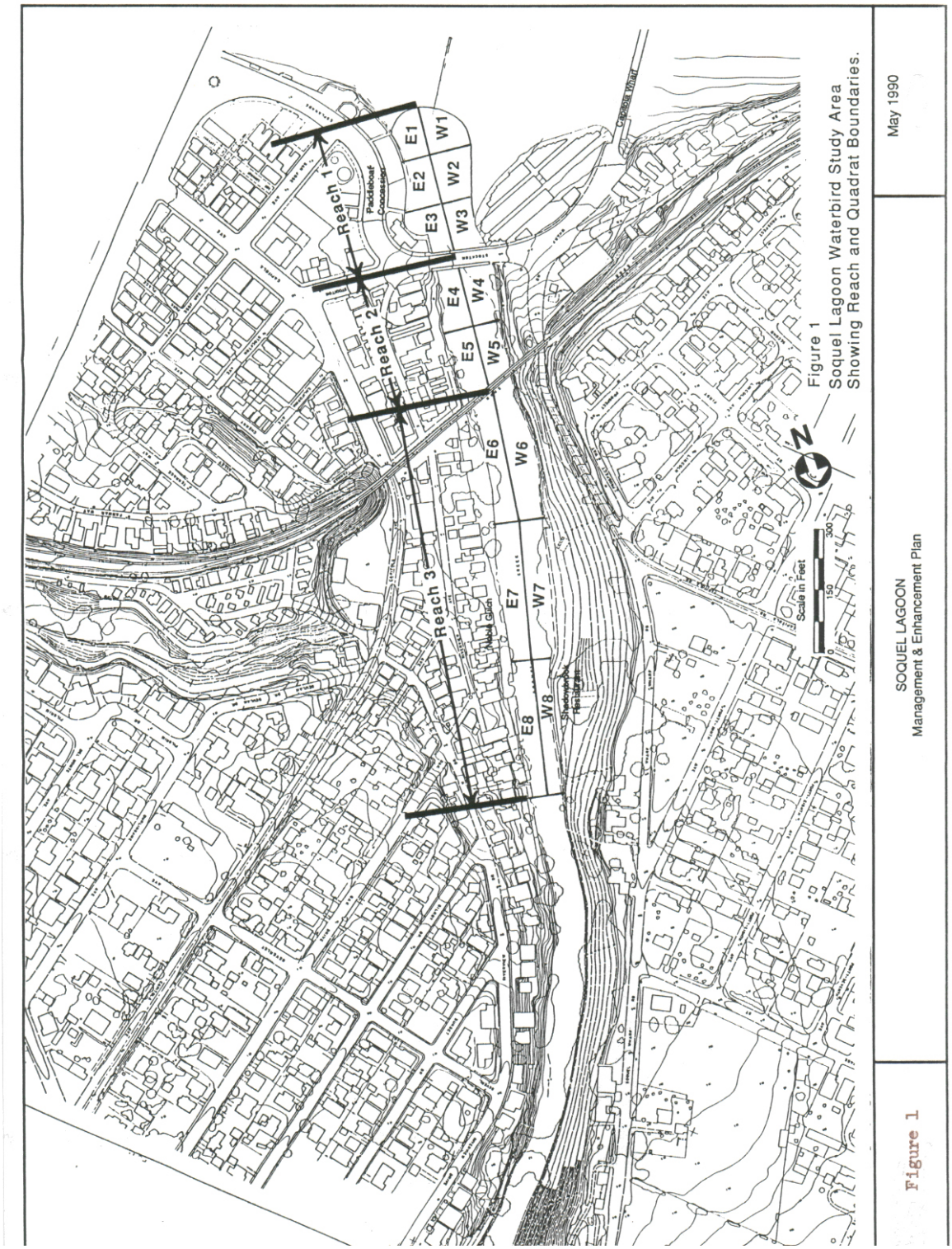
Smith, J.J. 1999. Personal Communication. San Jose State University.

Snyder, G.R. and T.H. Blahm. 1971. Effects of increased temperature on cold water organisms. J. Water Poll. Control Fed. 43: 890-899. (Cited by Kubicek and Price 1976).

Soquel Creek Lagoon Management and Enhancement Plan. 1990. Donald Alley, Project Manager. Prepared by the Habitat Restoration Group for the City of Capitola and the Coastal Conservancy.

Welsh, H.H., G.R. Hodgson, B.C. Harvey and M.F. Roche. 2001. Distribution of juvenile coho in relation to water temperatures in tributaries of the Mattole River, California. N. Am. J. Fisheries Mgmt. 21: 464-470.

FIGURES


Reach 1
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Paddleboat Concession
Capitola Mkt
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 2005 - 2008.

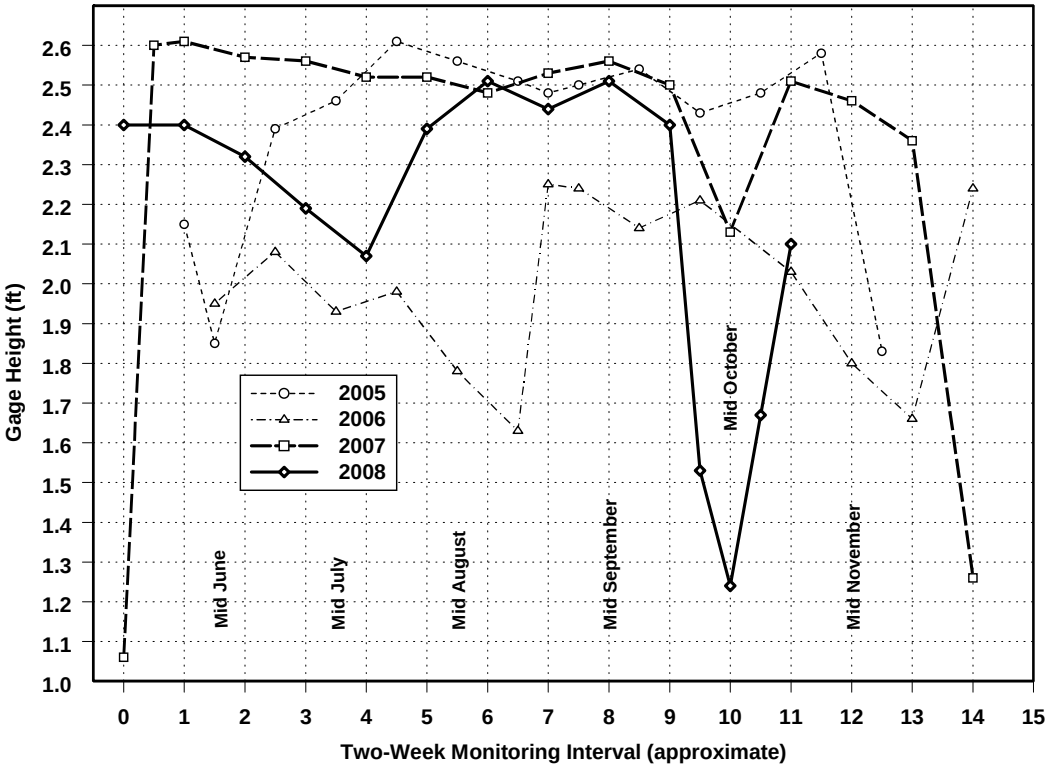


Figure 3a. 2007 and 2008 Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn and in the Afternoon after 1500 hr from 7 June to 8 December.

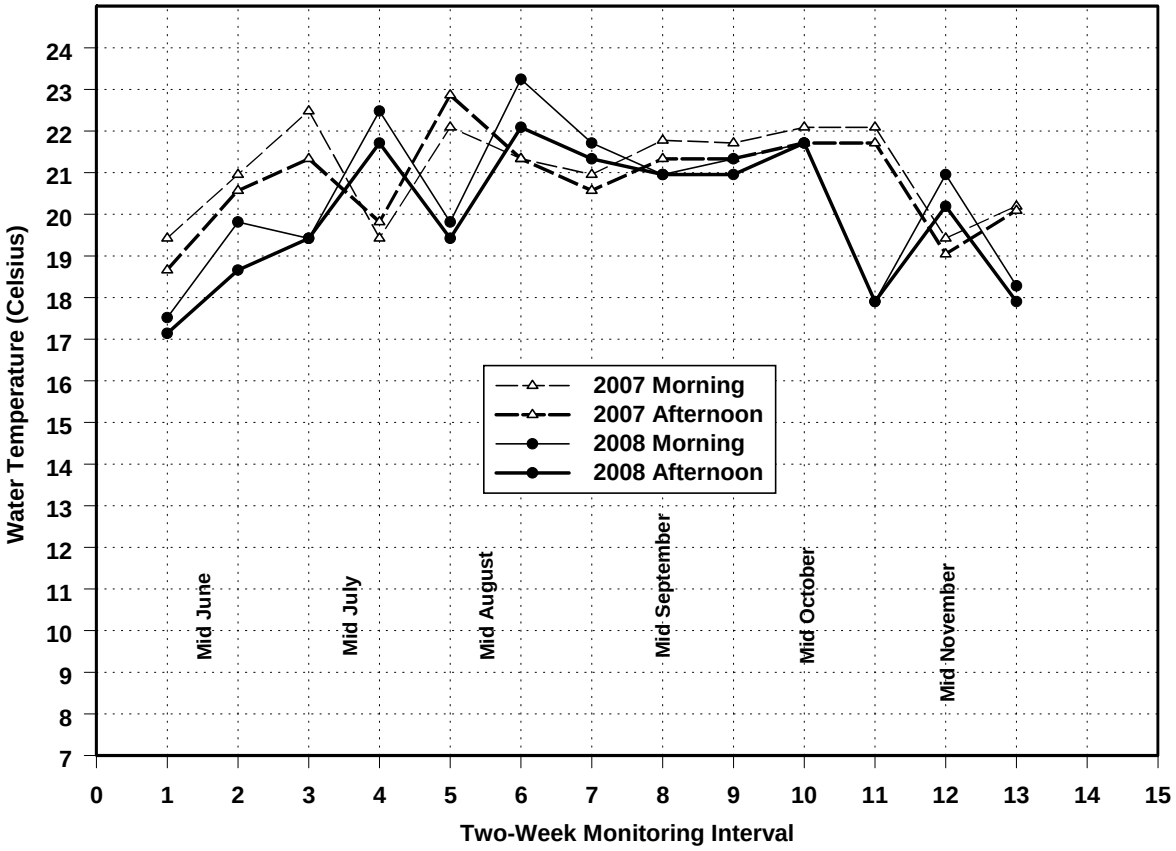


Figure 3b. 2007 and 2008 Soquel Lagoon Water Temperature at Stockton Avenue Bridge Near the Bottom at Dawn and in the Afternoon after 1500 hr from 26 May to 8 December.

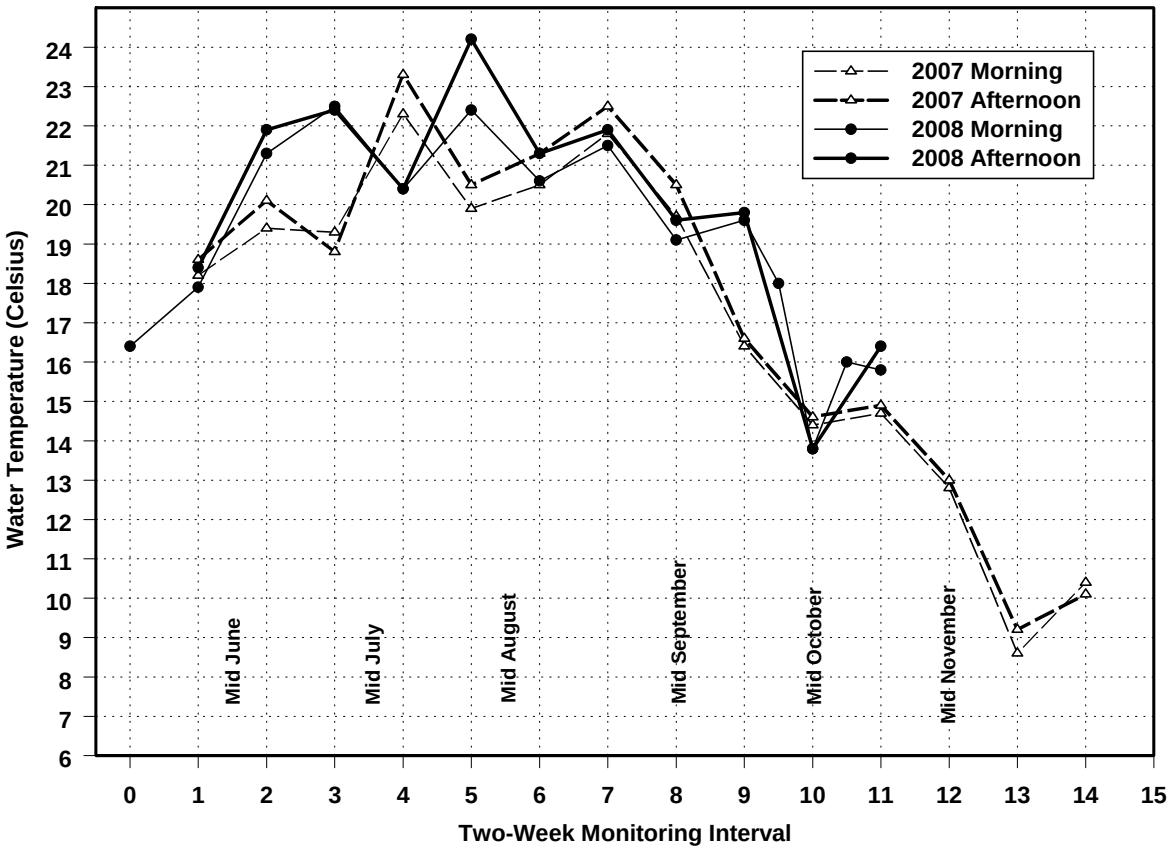


Figure 3c. 2007 and 2008 Soquel Lagoon Water Temperature at the Railroad Trestle (Station 3) Near the Bottom at Dawn and in the Afternoon after 1500 hr from 7 June to 8 December.

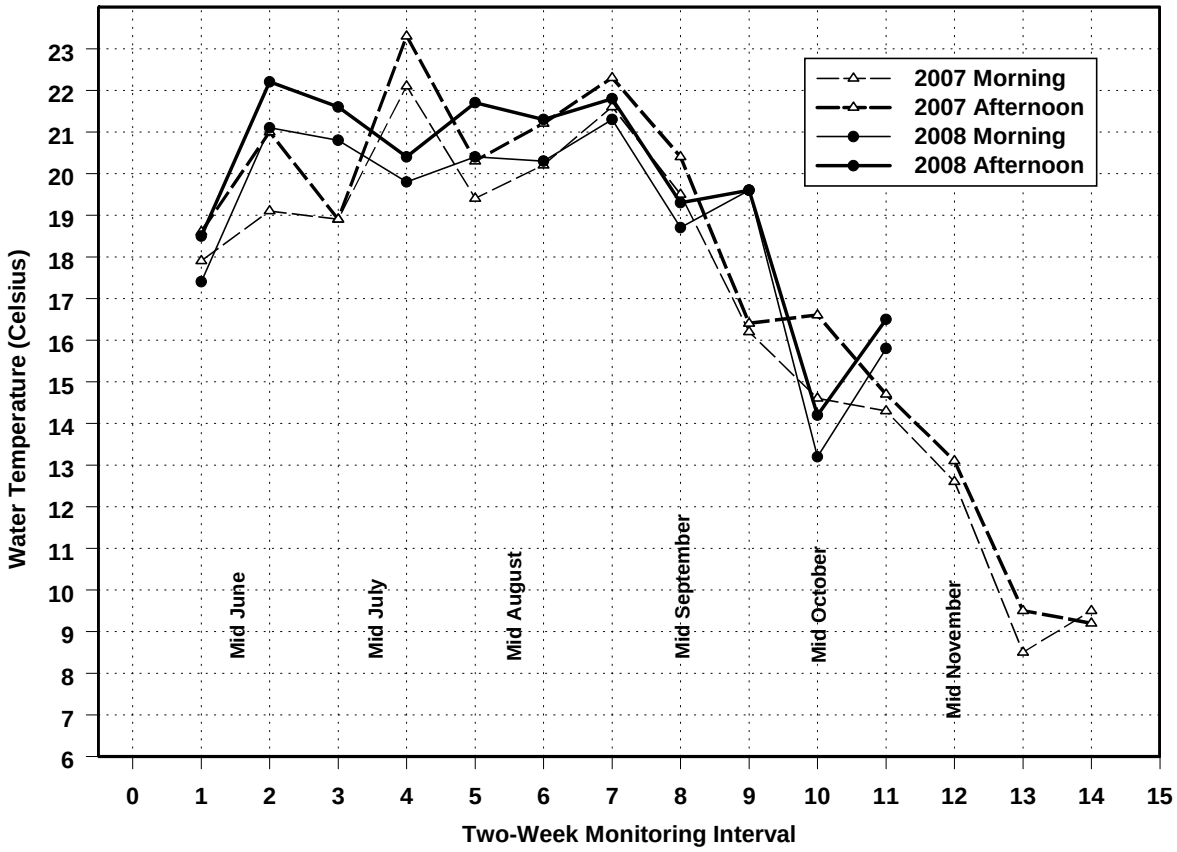


Figure 3d. 2007 and 2008 Soquel Lagoon Water Temperature at Noble Gulch Near the Bottom at Dawn (Station 4) and in the Afternoon after 1500 hr from 7 June to 8 December.

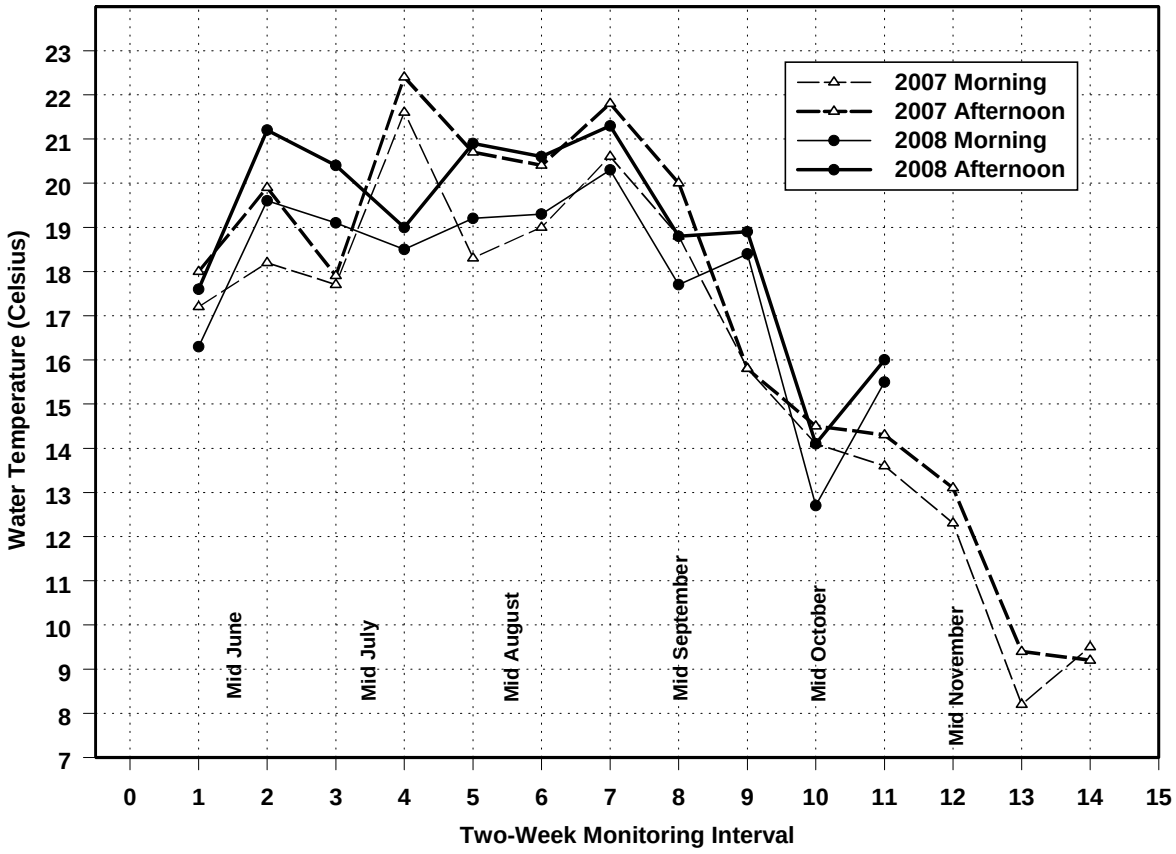


Figure 3e. Soquel Creek Water Temperature at Nob Hill Above the Lagoon in 2005 - 2008, Measured Between 0800 hr and 0930 hr from 7 June to 8 December.

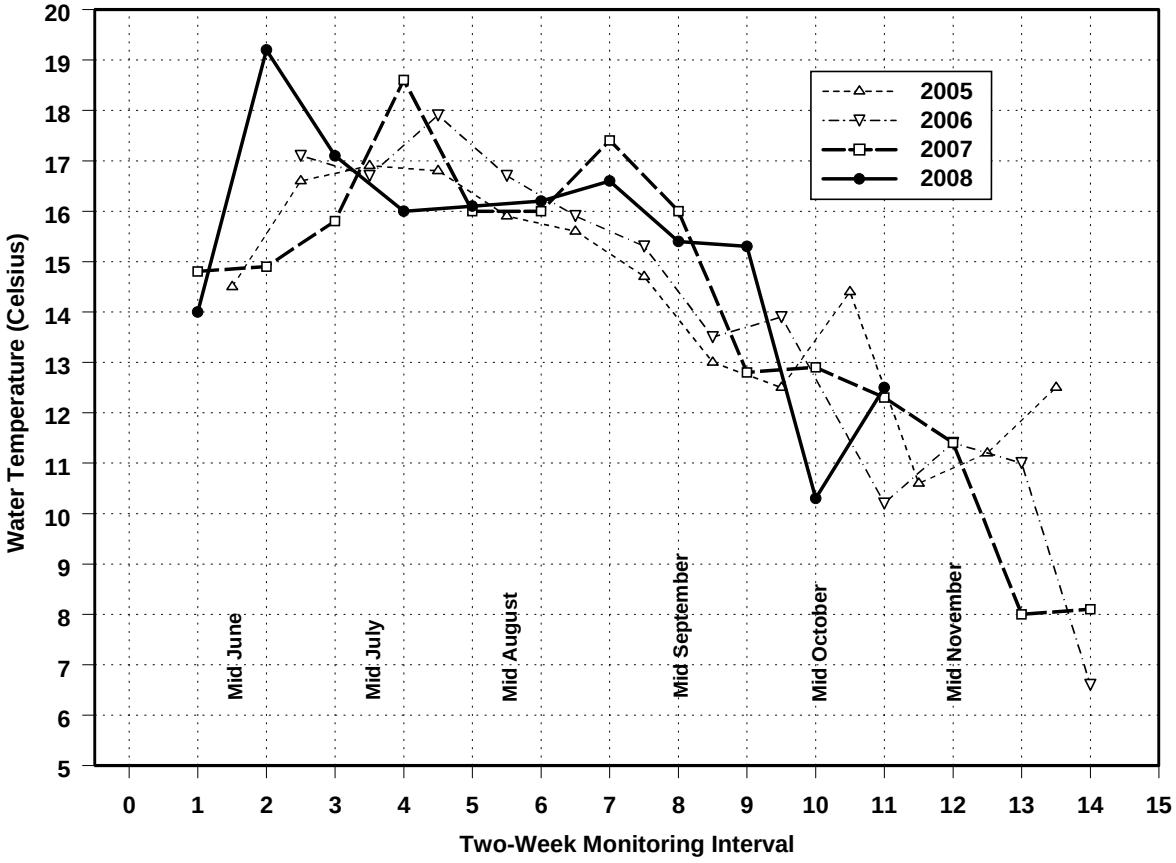


Figure 3f. Water Temperature at Dawn at Four Lagoon Stations Near the Bottom and Upstream in Soquel Creek from 7 June to 26 October 2008.

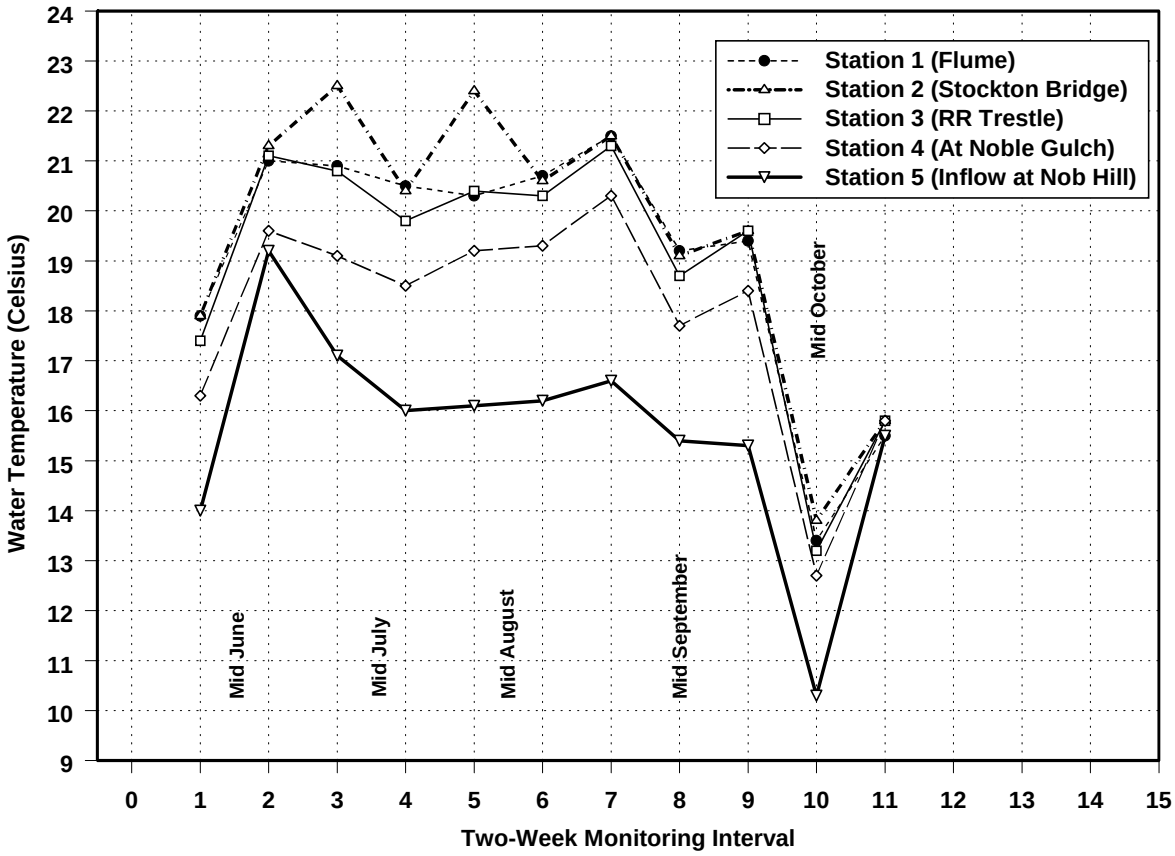


Figure 3g. Water Temperature in the Afternoon at 4 Lagoon Stations Near the Bottom Between 1430 hr and 1630 hr from 7 June to 26 October 2008.

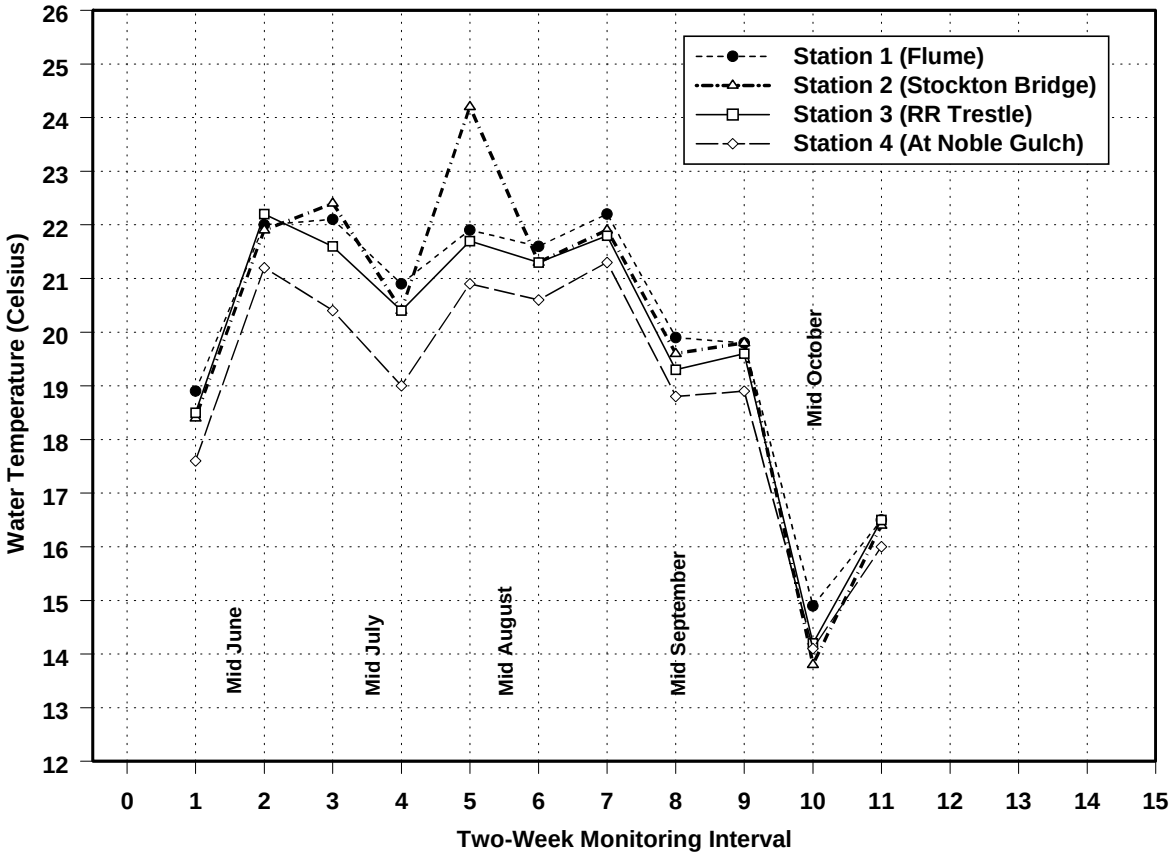


Figure 3h. Water Temperature in the Afternoon at 4 Lagoon Stations Near the Bottom Between 1500 and 1630 hr from 10 June to 8 December 2007.

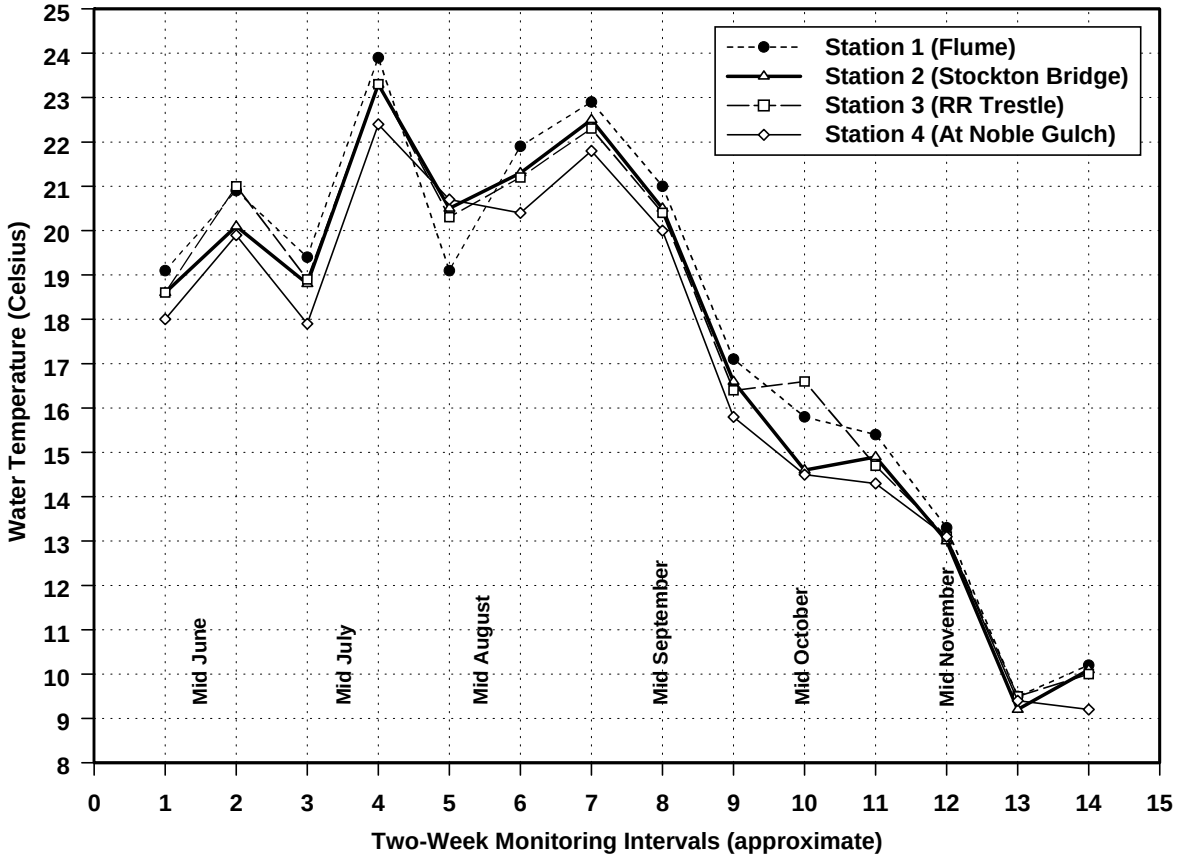
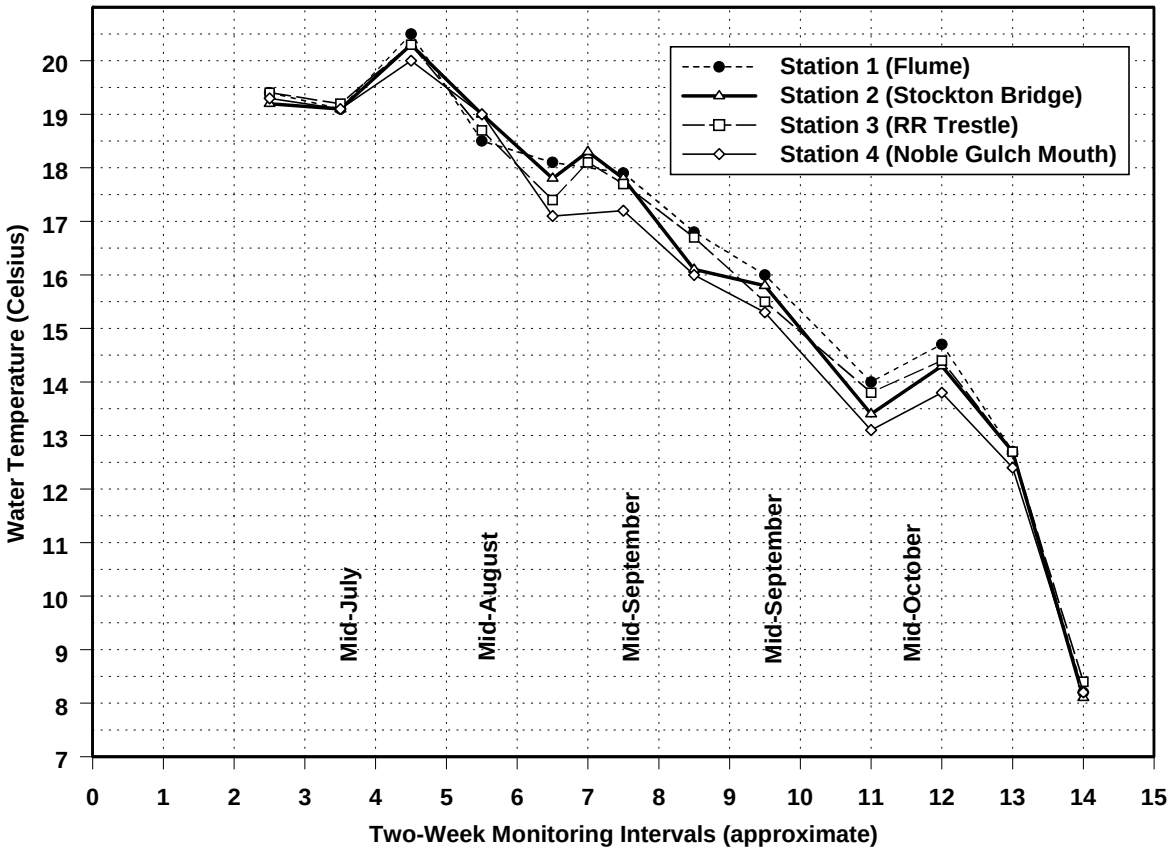


Figure 3i. Water Temperature at Four Lagoon Stations Near the Bottom Between 1500 and 1630 hr in the Afternoon from 30 June to 6 December 2006.



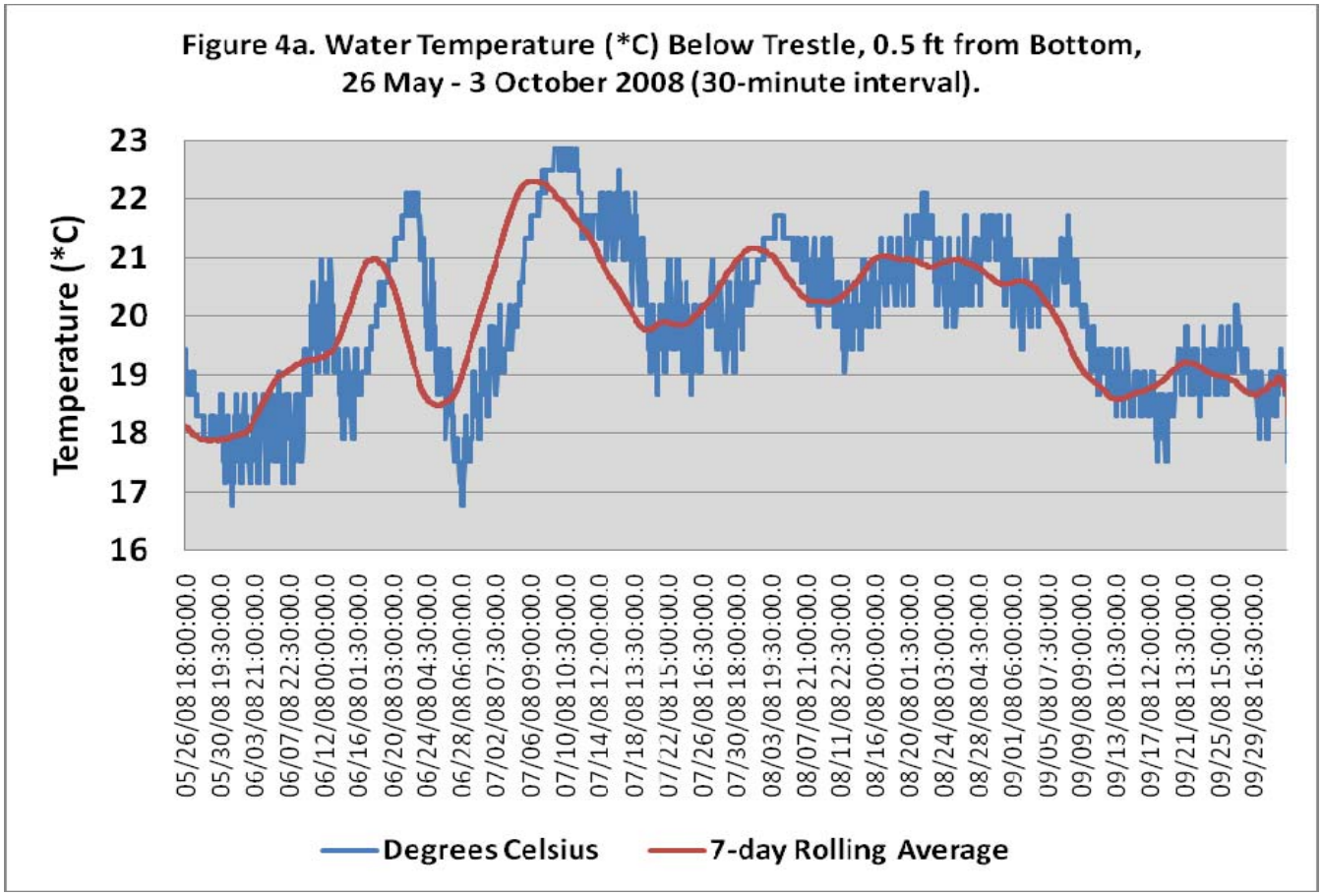


Figure 4a. Water Temperature (*C) Below Trestle, 0.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Temperature (*C)
23
22
21
20
19
18
17
16
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Celsius
7-day Rolling Average

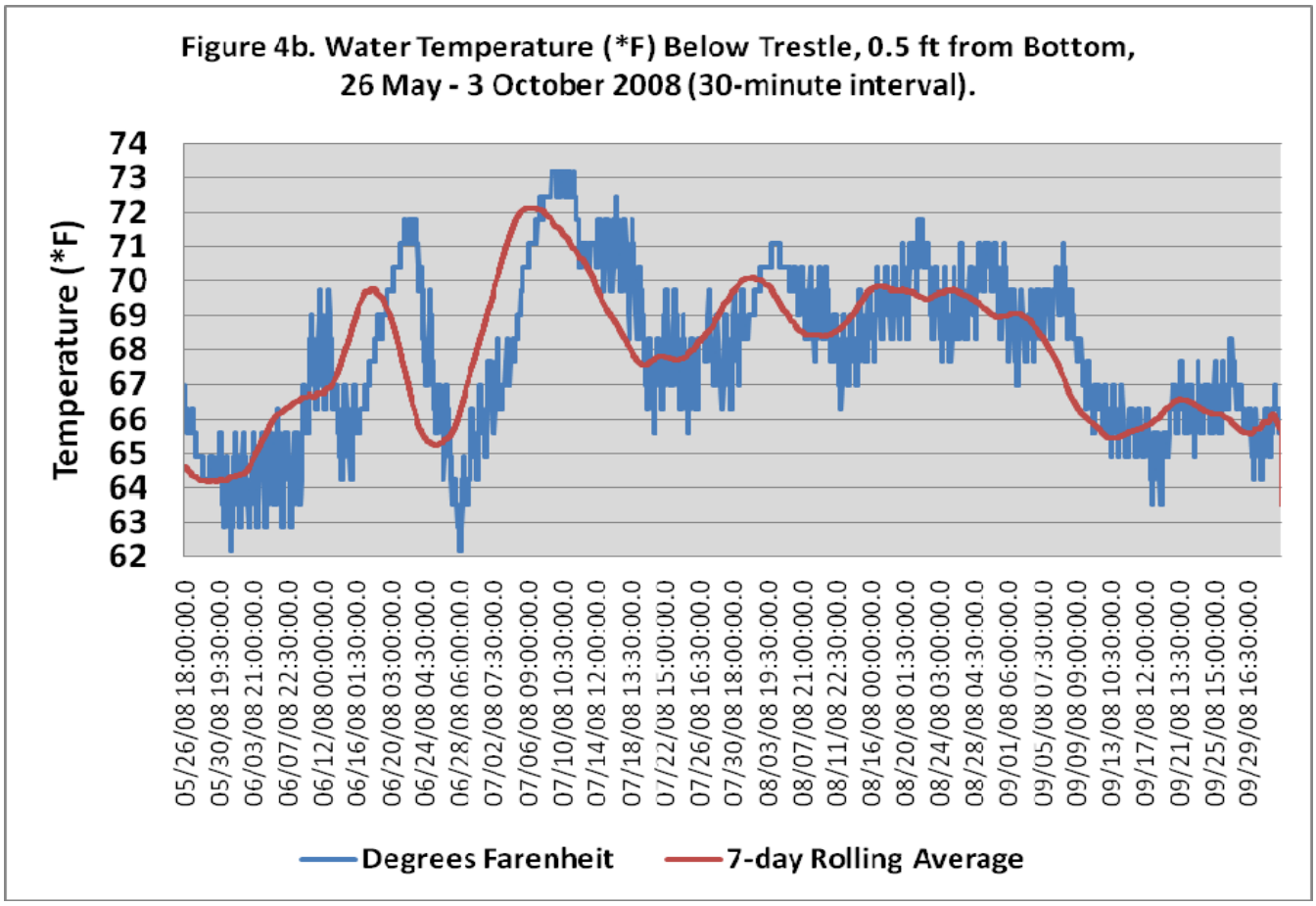


Figure 4b. Water Temperature (*F) Below Trestle, 0.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Temperature (*F)
74
73
72
71
70
69
68
67
66
65
64
63
62
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Farenheit
7-day Rolling Average

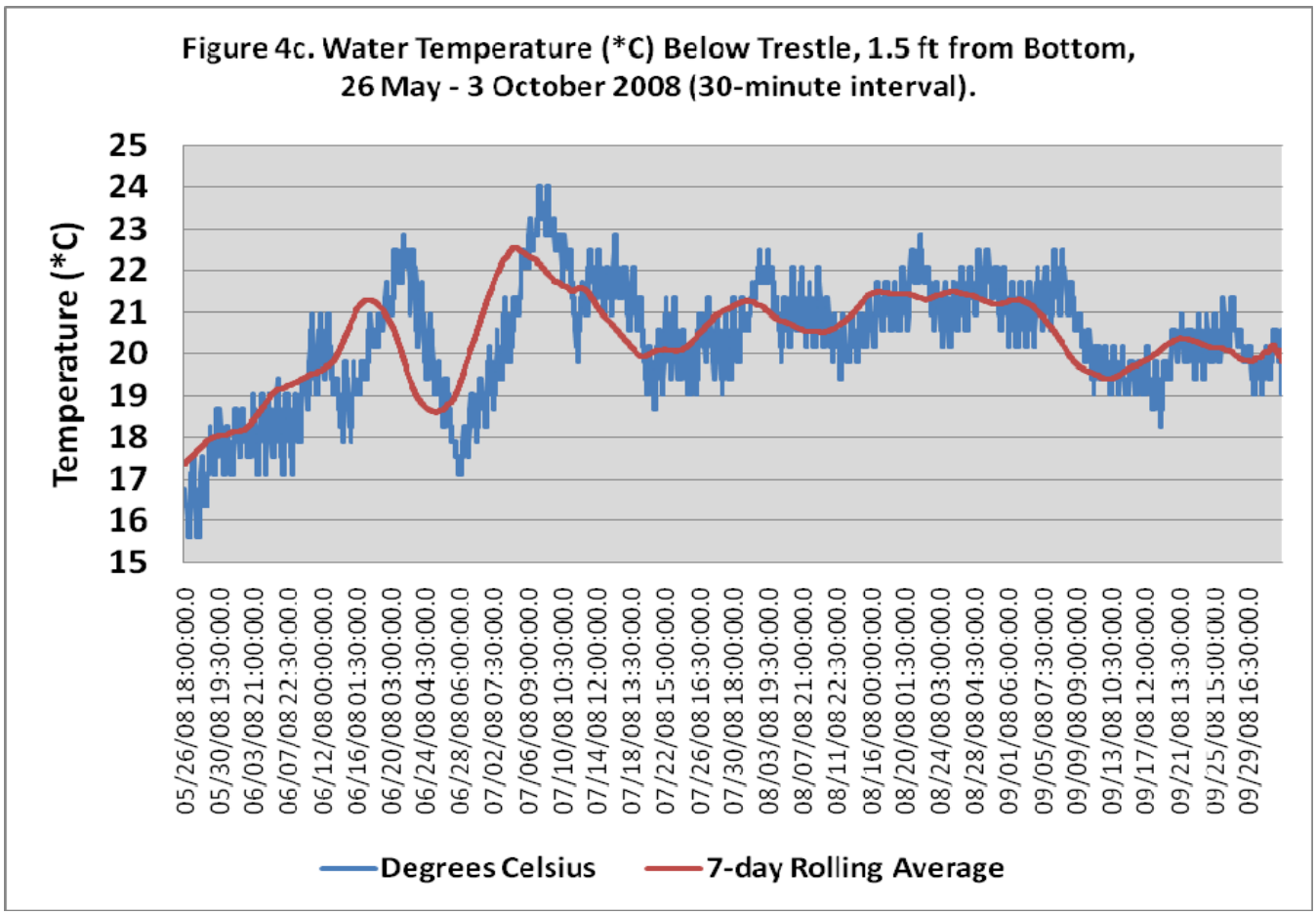


Figure 4c. Water Temperature (*C) Below Trestle, 1.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Temperature (*C)
25
24
23
22
21
20
19
18
17
16
15
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Celsius
7-day Rolling Average

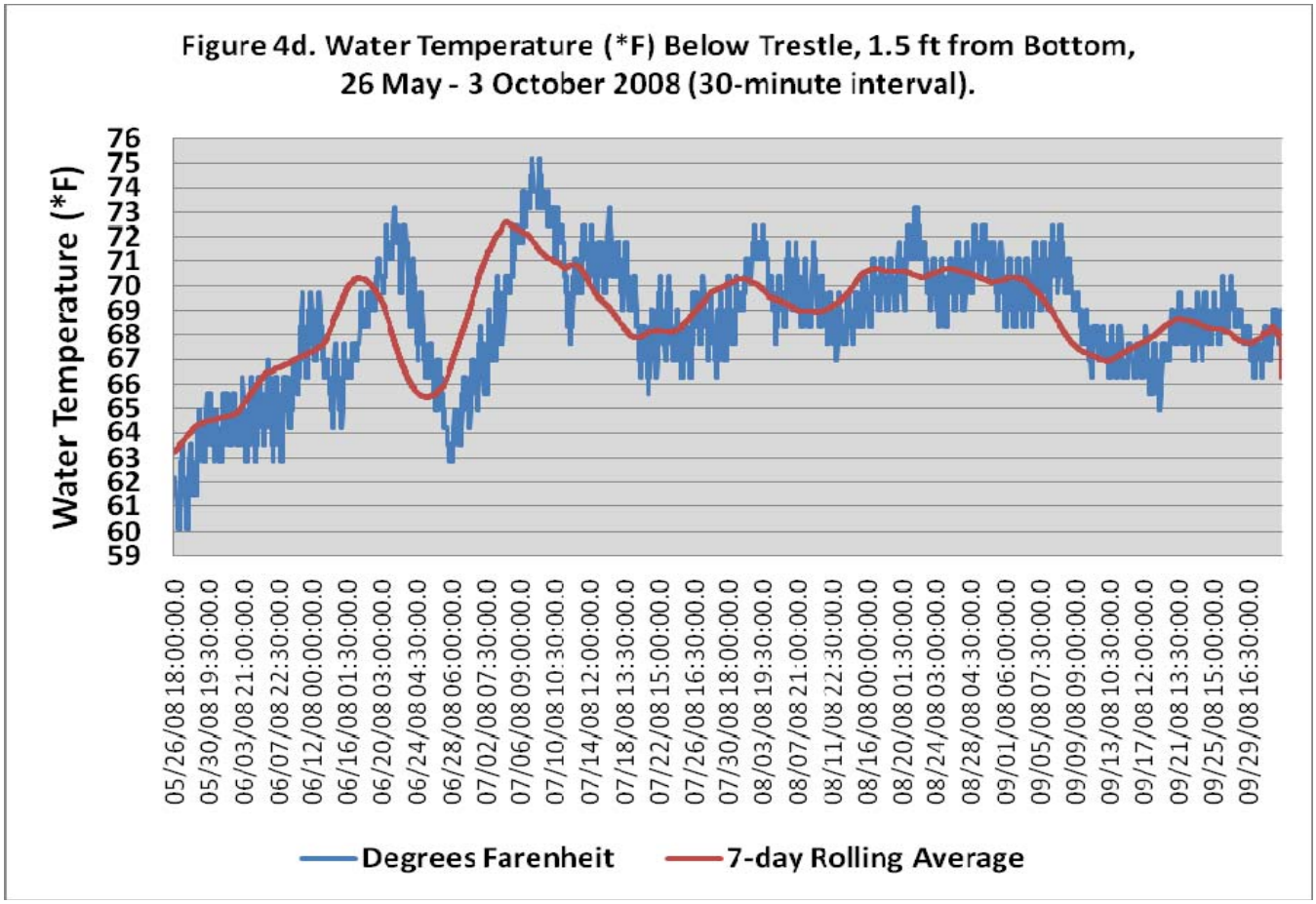


Figure 4d. Water Temperature (*F) Below Trestle, 1.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Water Temperature (*F)
76
75
74
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Farenheit
7-day Rolling Average

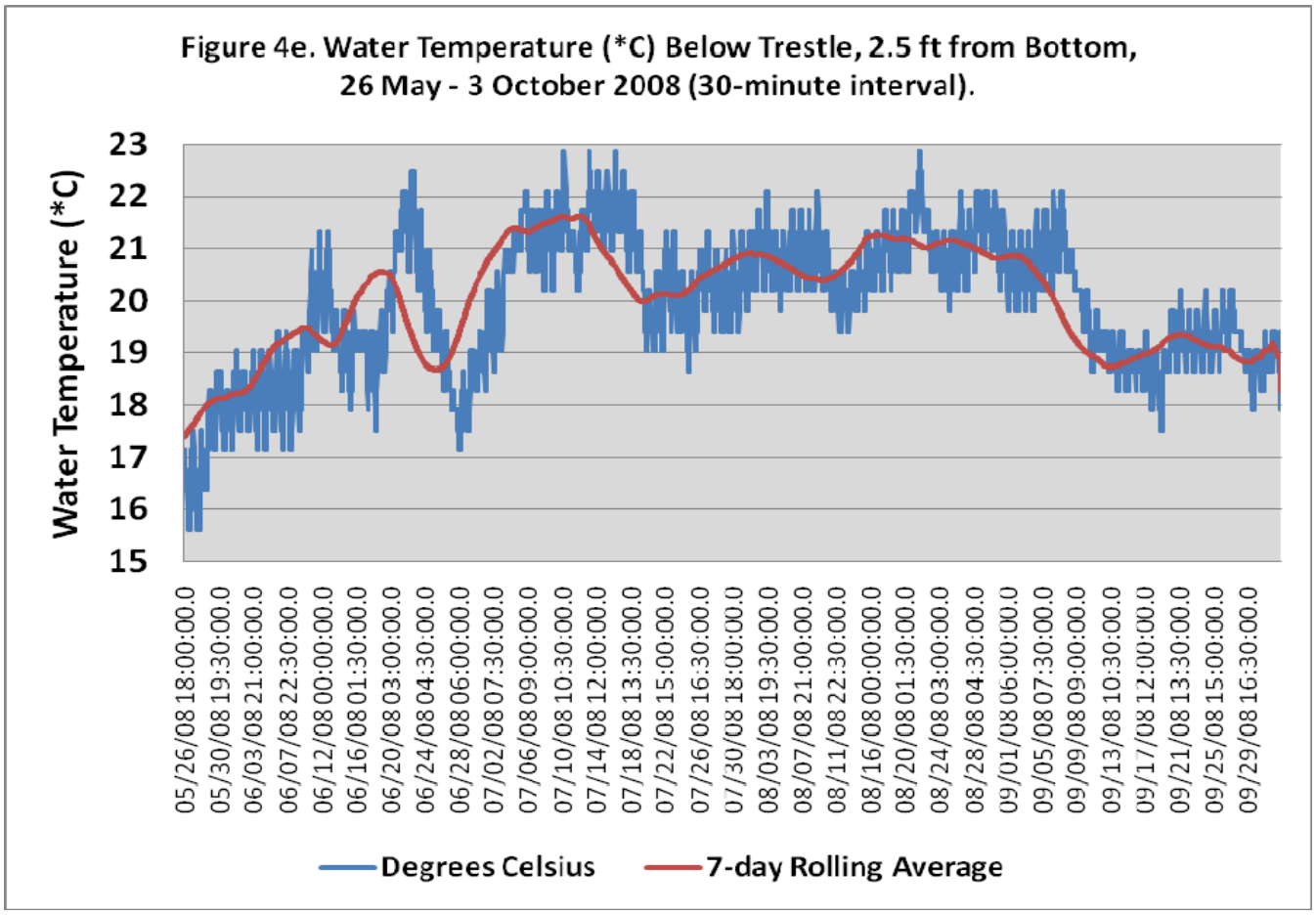


Figure 4e. Water Temperature (*C) Below Trestle, 2.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Water Temperature (*C)
23
22
21
20
19
18
17
16
15
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Celsius
7-day Rolling Average

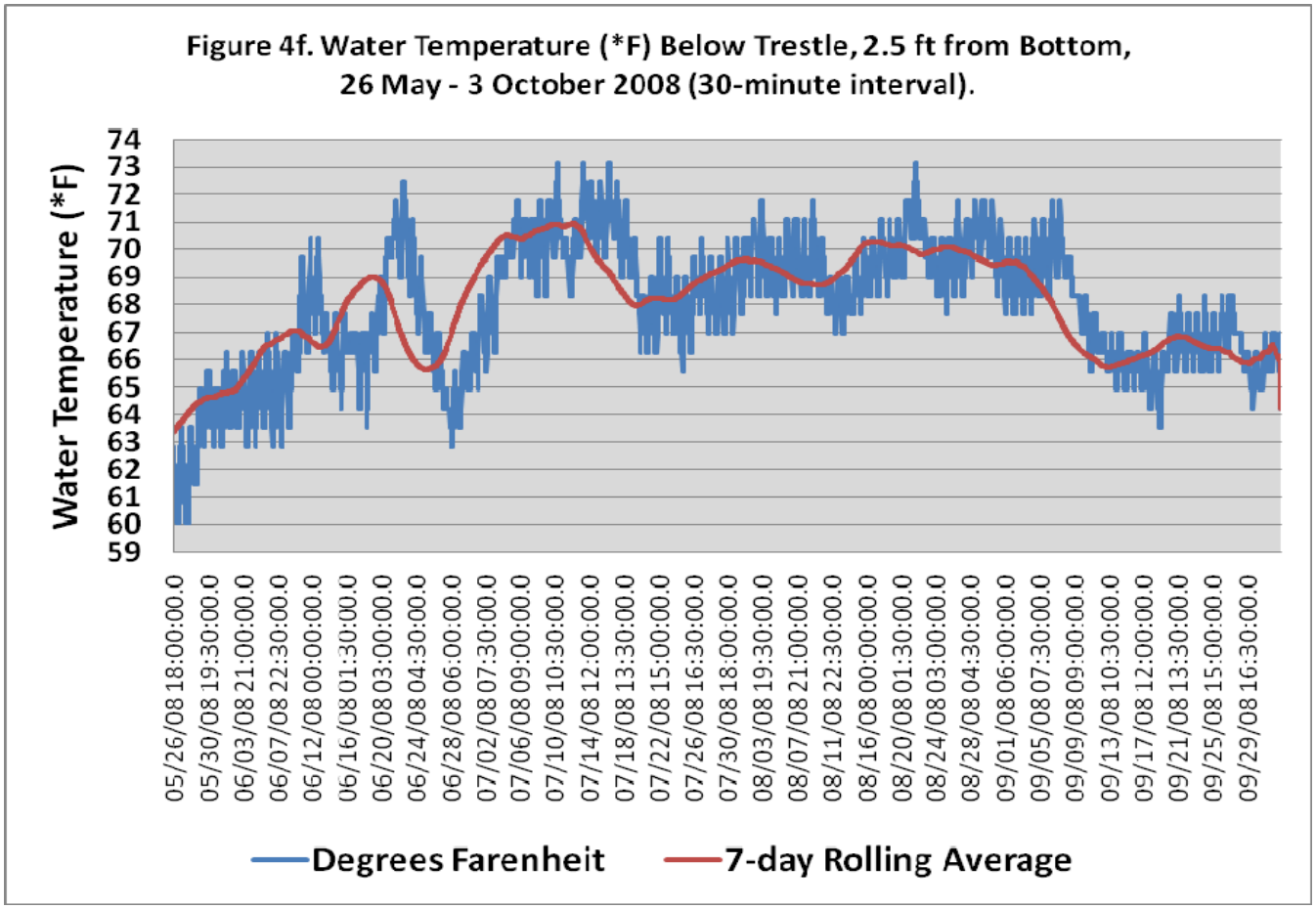


Figure 4f. Water Temperature (*F) Below Trestle, 2.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Water Temperature (*F)
74
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Farenheit
7-day Rolling Average

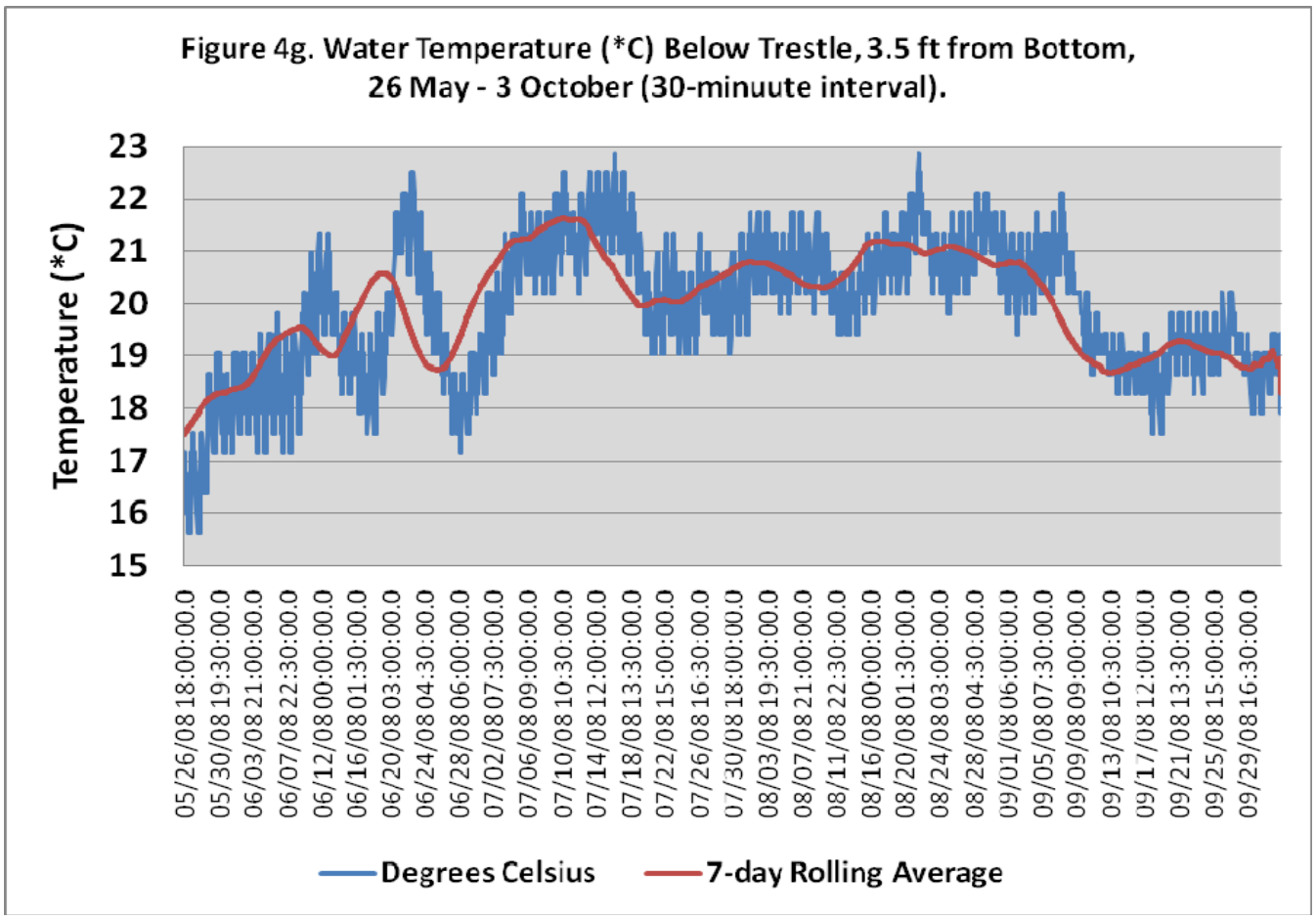


Figure 4g. Water Temperature (*C) Below Trestle, 3.5 ft from Bottom,
26 May - 3 October (30-minuute interval).
Temperature (*C)
23
22
21
20
19
18
17
16
15
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Celsius
7-day Rolling Average

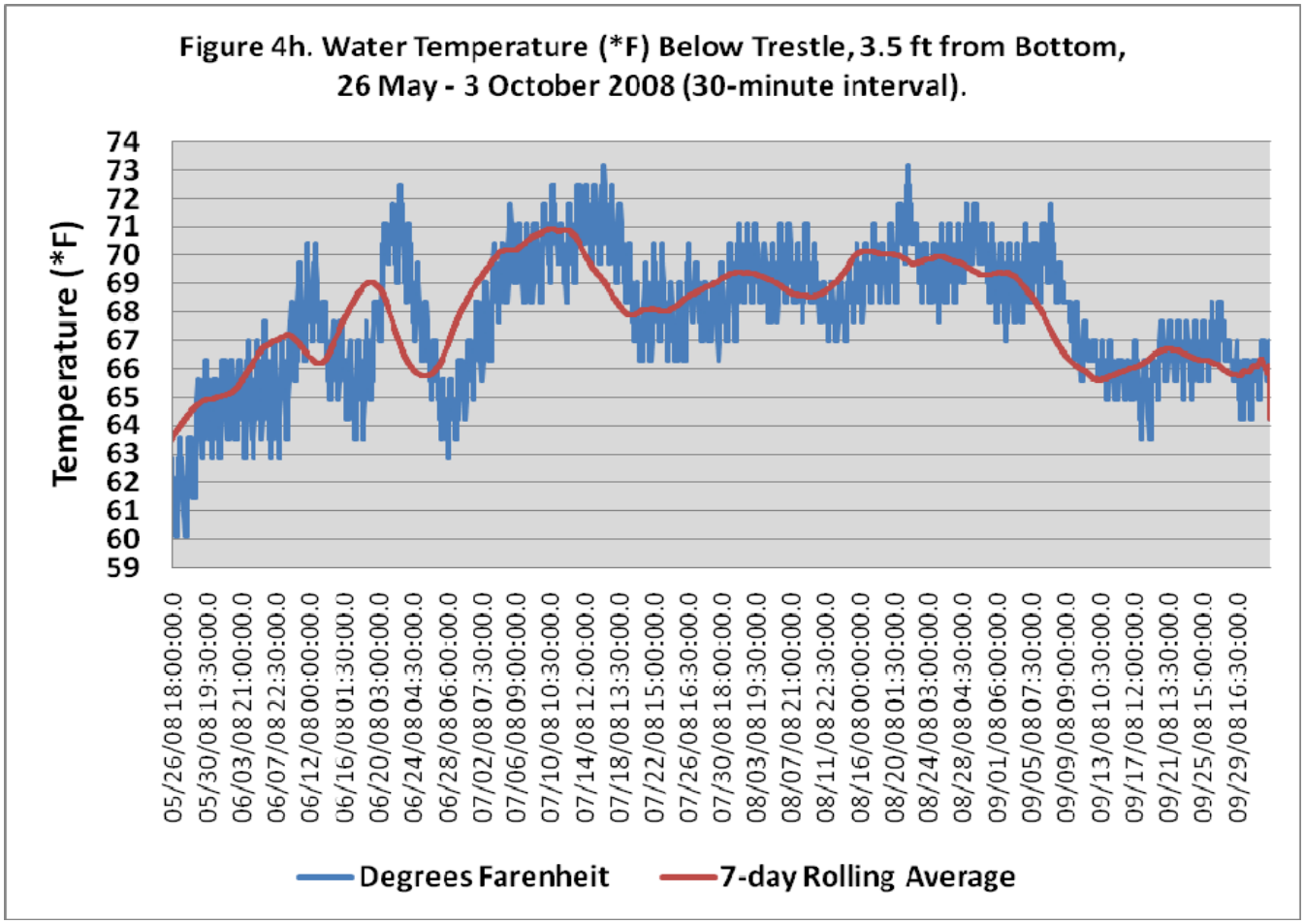


Figure 4h. Water Temperature (*F) Below Trestle, 3.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Temperature (*F)
74
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Farenheit
7-day Rolling Average

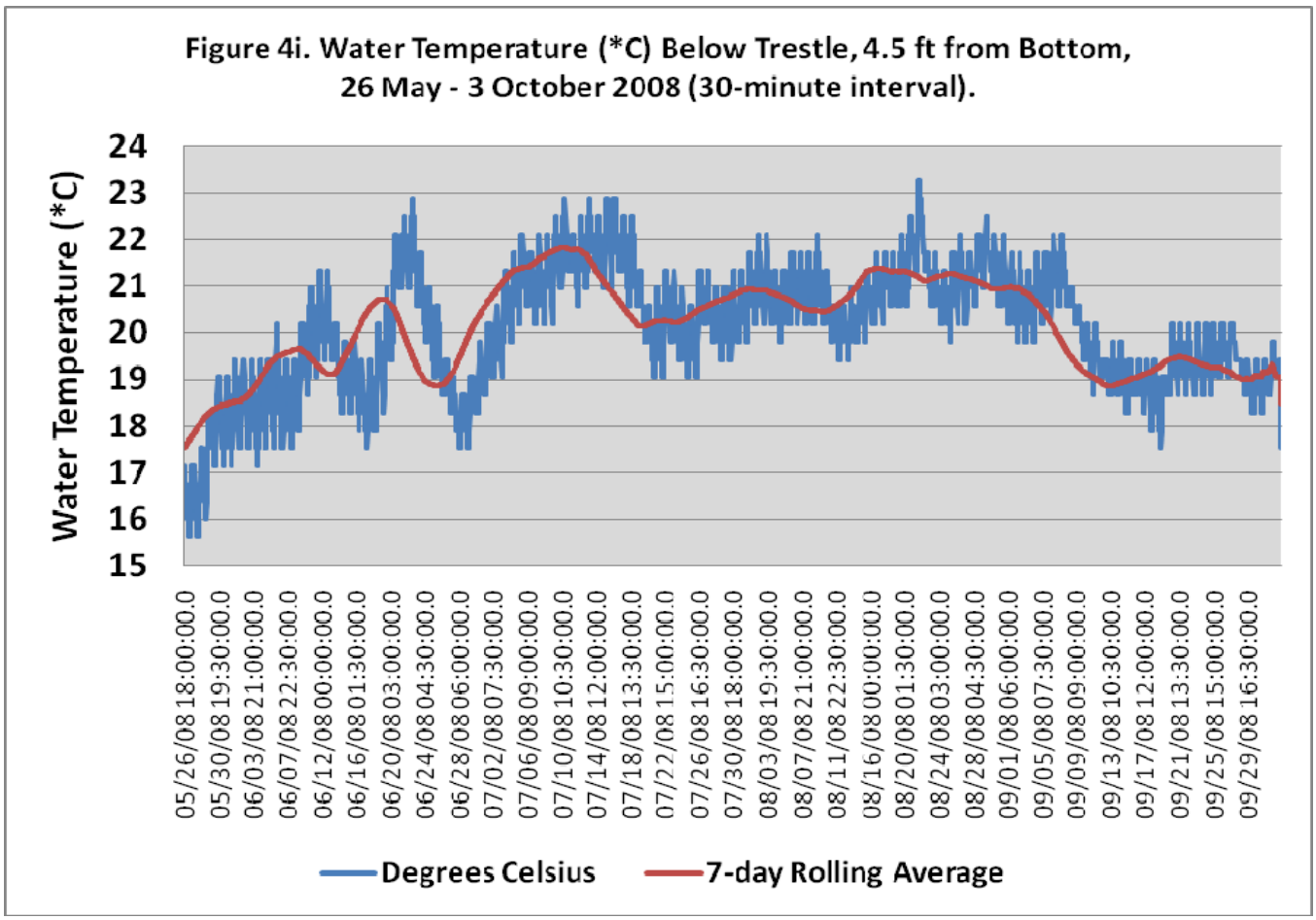


Figure 4i. Water Temperature (*C) Below Trestle, 4.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Water Temperature (*C)
24
23
22
21
20
19
18
17
16
15
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Celsius
7-day Rolling Average

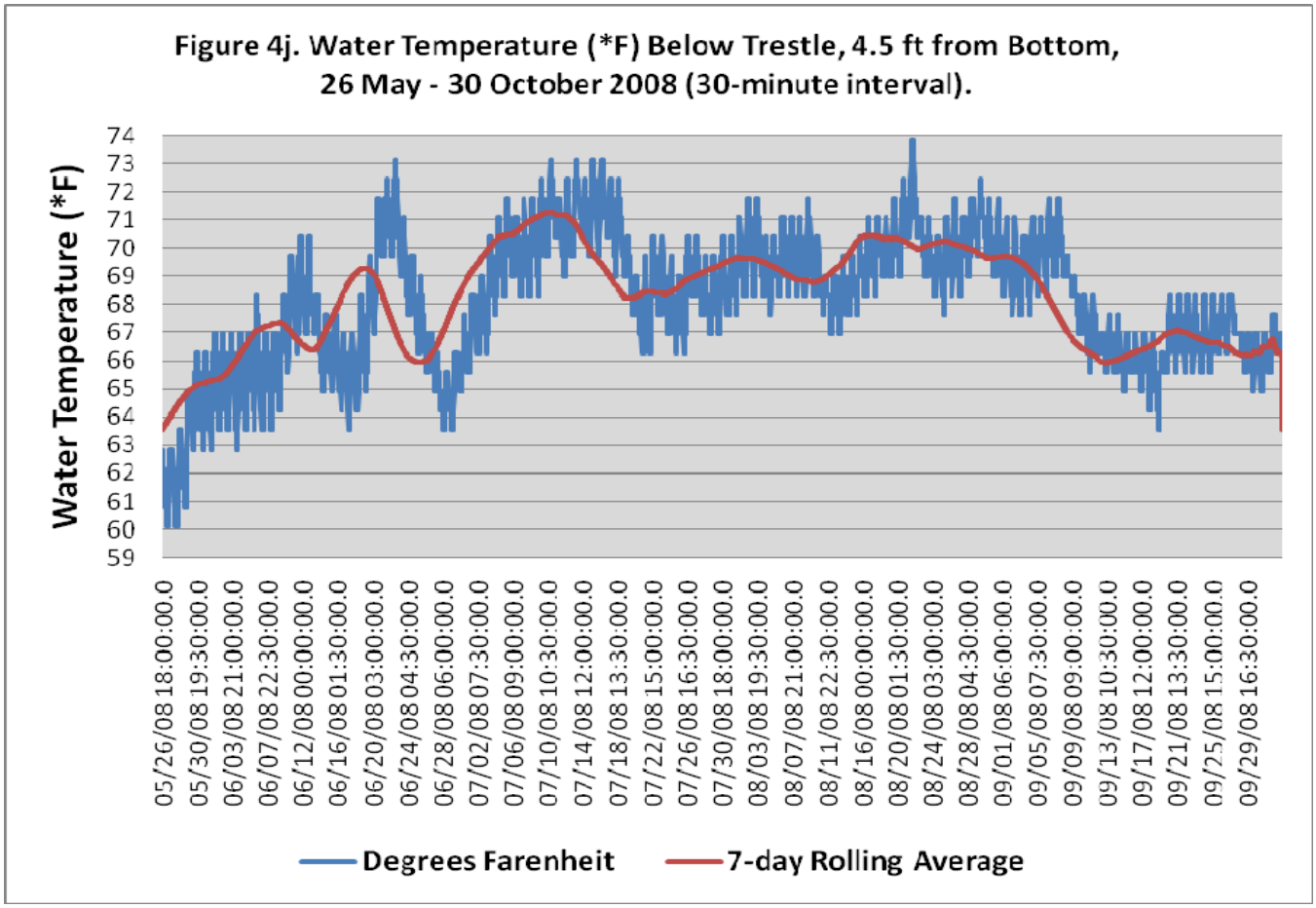


Figure 4j. Water Temperature (*F) Below Trestle, 4.5 ft from Bottom,
26 May - 30 October 2008 (30-minute interval).
Water Temperature (*F)
74
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Farenheit
7-day Rolling Average

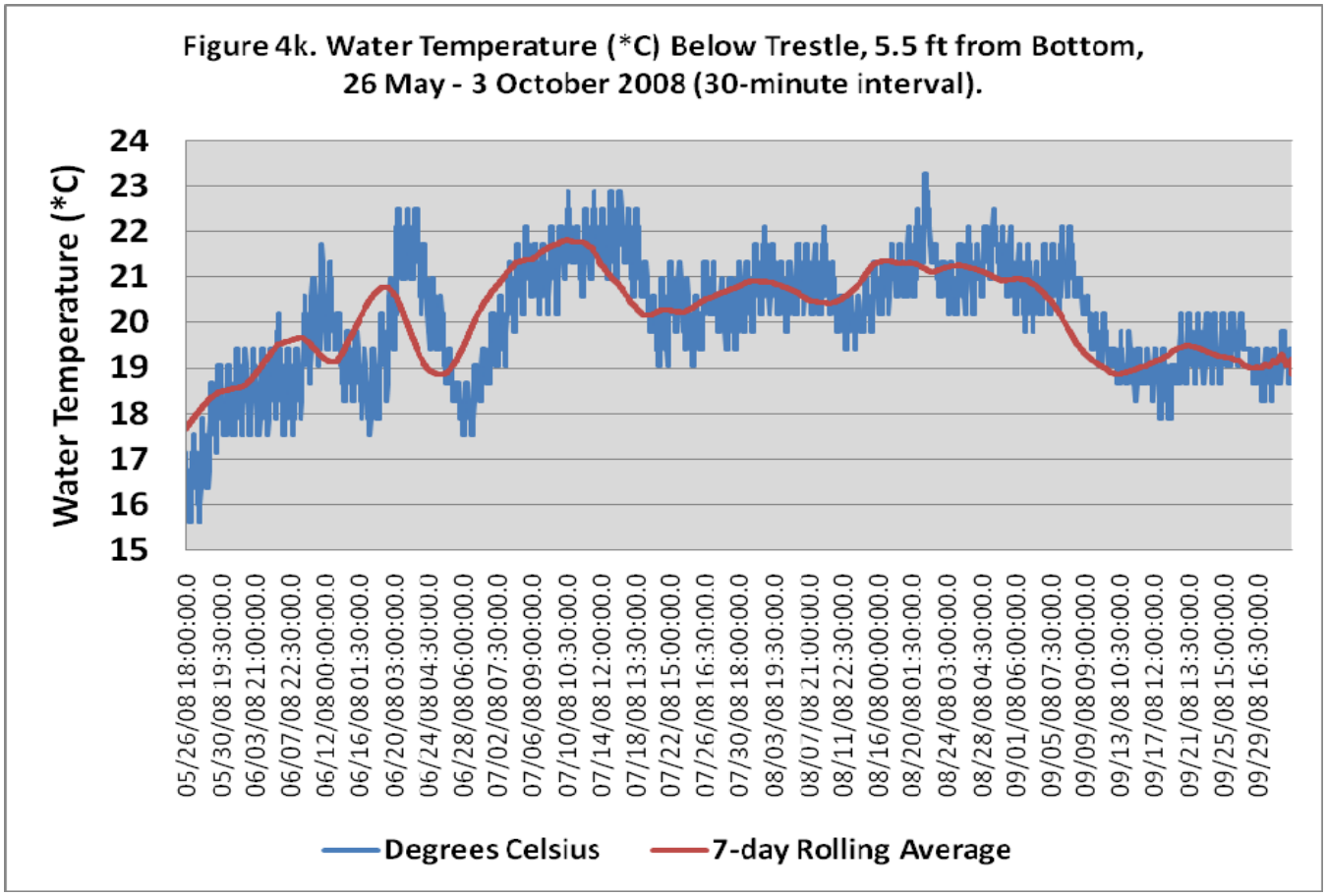


Figure 4k. Water Temperature (*C) Below Trestle, 5.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Water Temperature (*C)
24
23
22
21
20
19
18
17
16
15
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Celsius
7-day Rolling Average

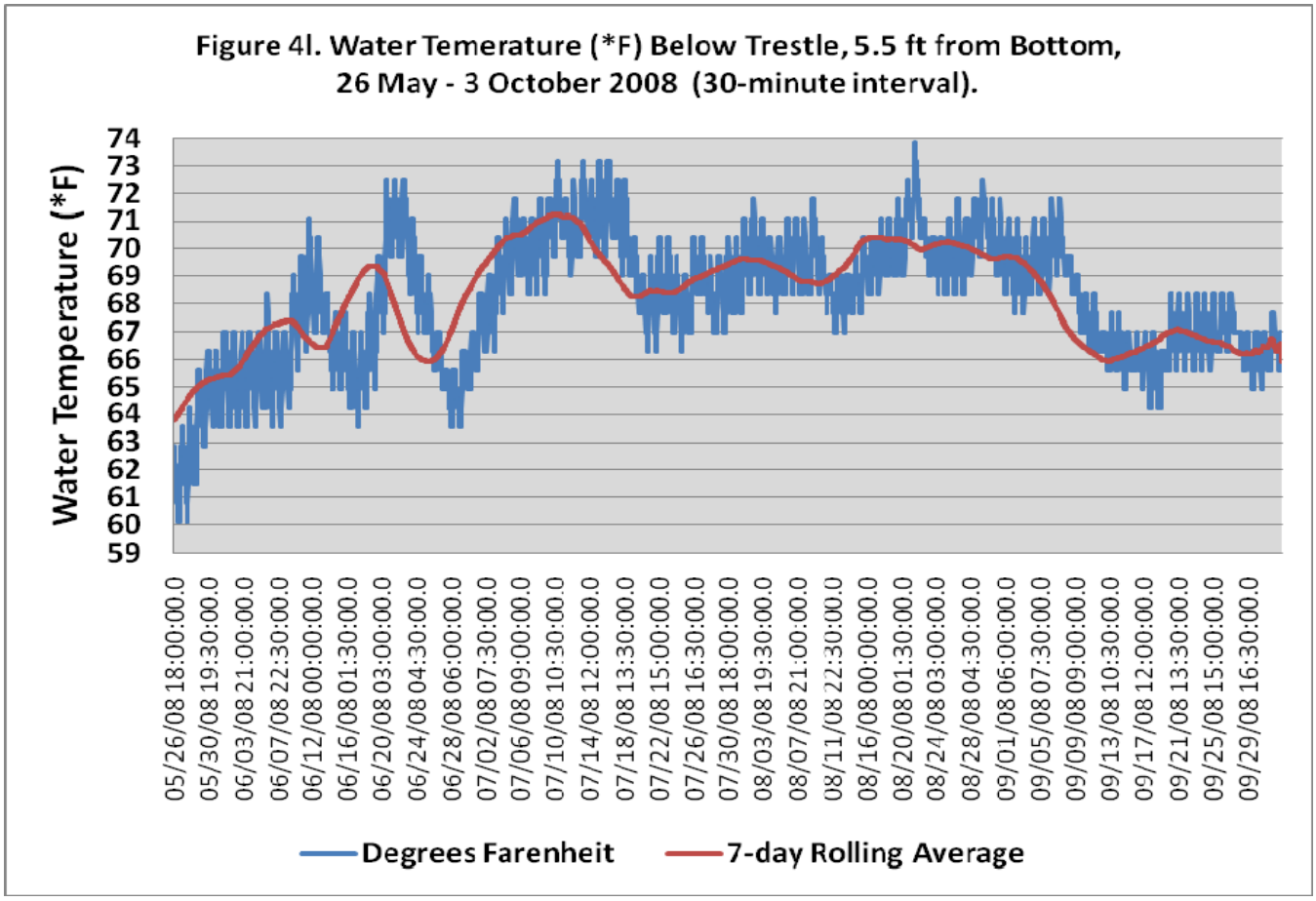


Figure 4l. Water Temerature (*F) Below Trestle, 5.5 ft from Bottom,
26 May - 3 October 2008 (30-minute interval).
Water Temperature (*F)
74
73
72
71
70
69
68
67
66
65
64
63
62
61
60
59
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Farenheit
7-day Rolling Average

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

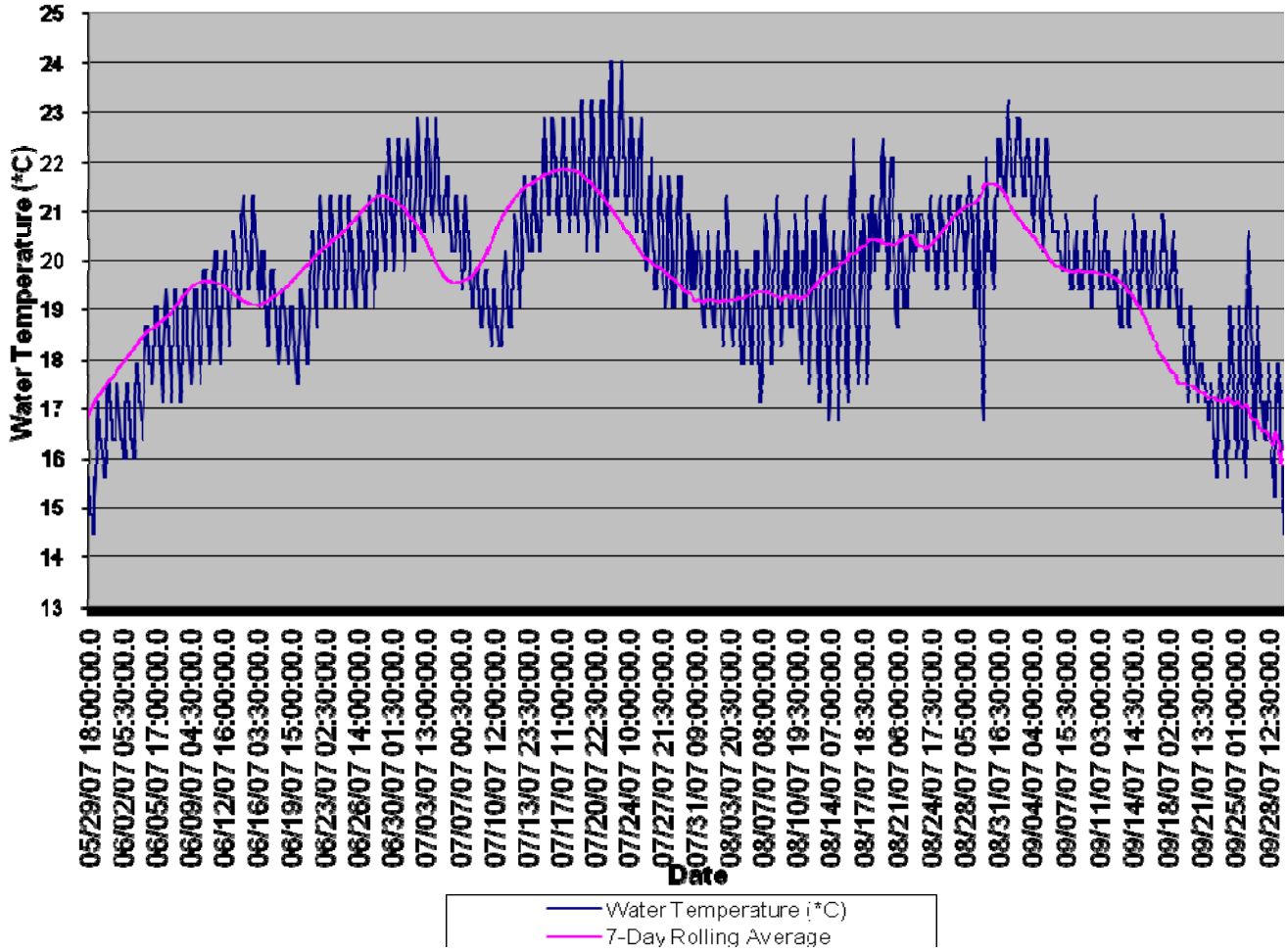


Figure 4n. Water Temperature (*C) Above Trestle, 0.5 ft from Bottom. 29 May- 30 September 2007 (30-minute Interval).

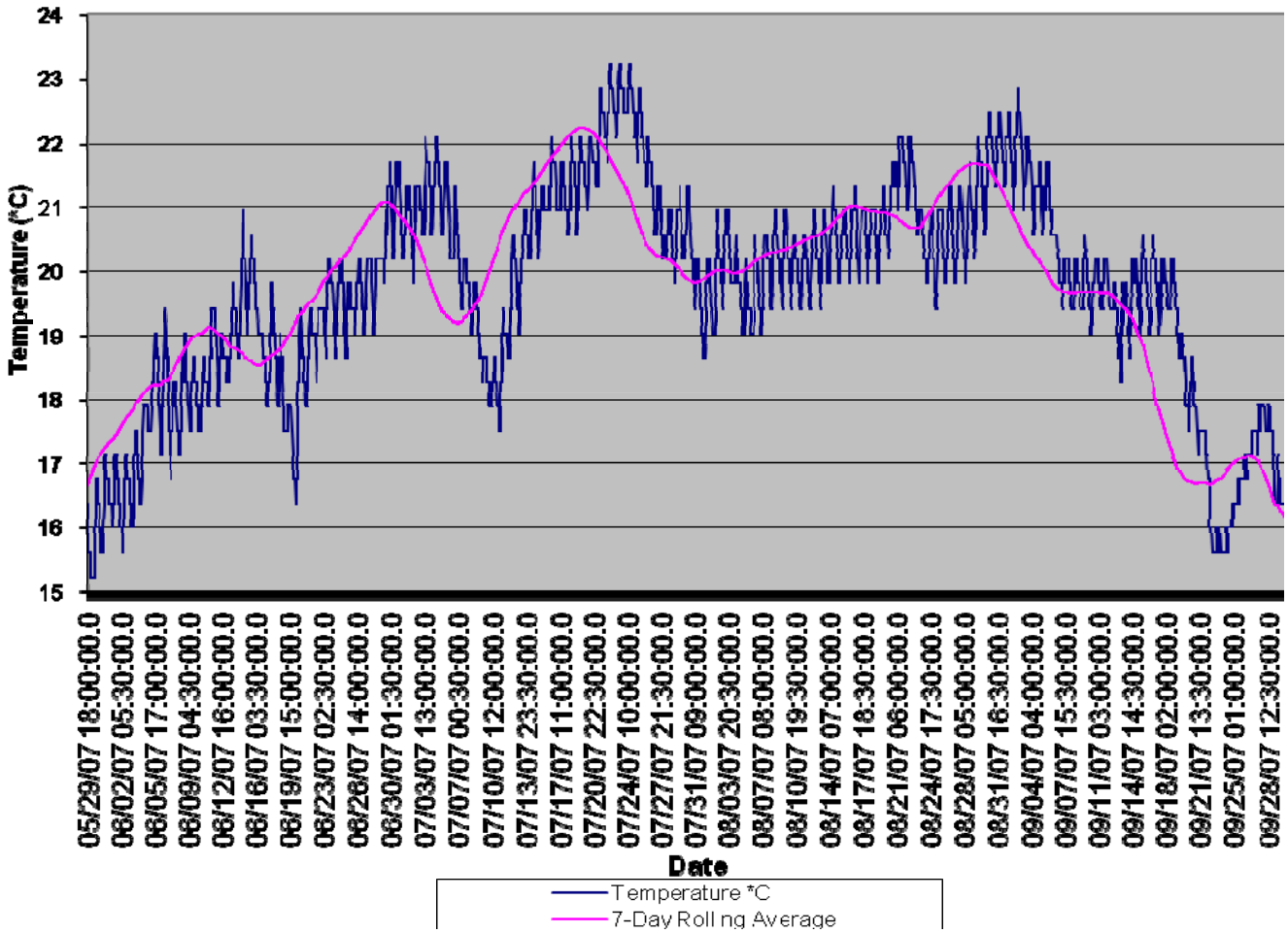
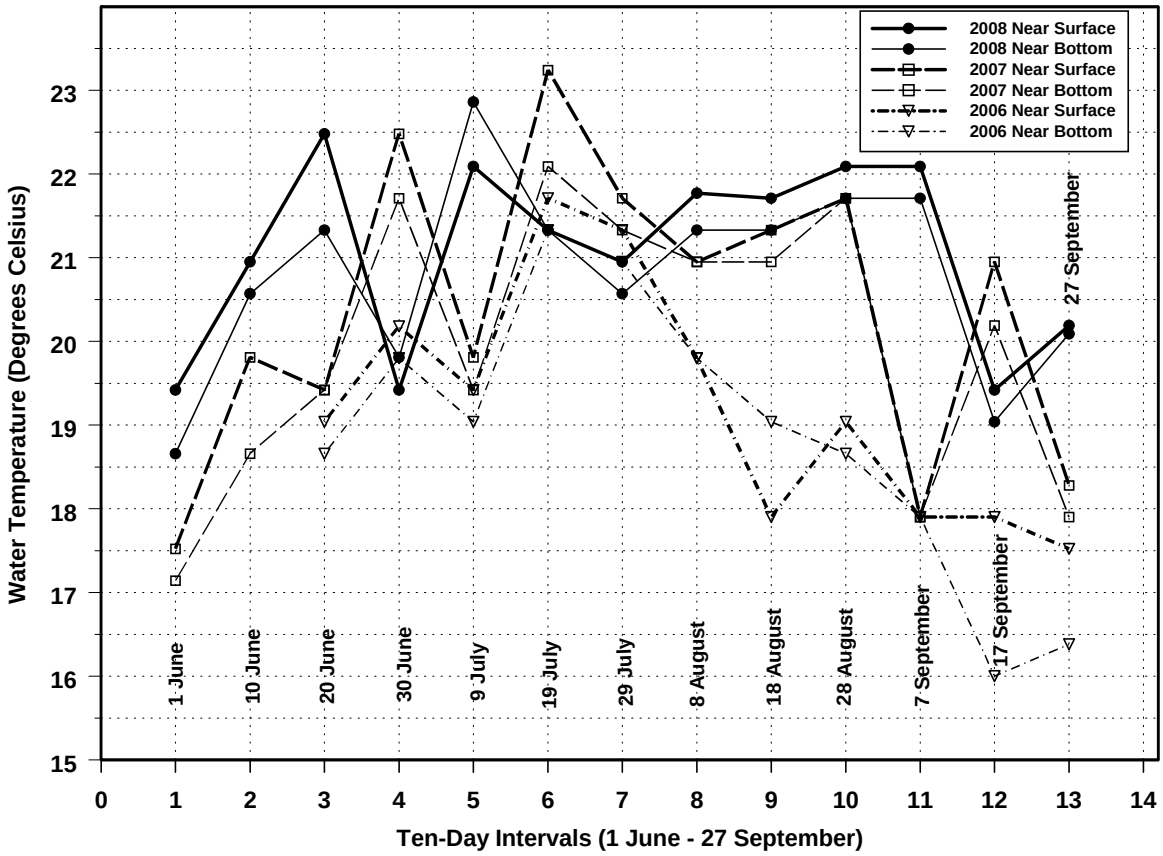


Figure 4o. Soquel Lagoon Water Temperature Maxima at 0.5 ft and 5.5 ft from the Bottom Near the Railroad Trestle in 2006, 2007 and 2008 at 10-day Intervals (from HOBO data loggers).



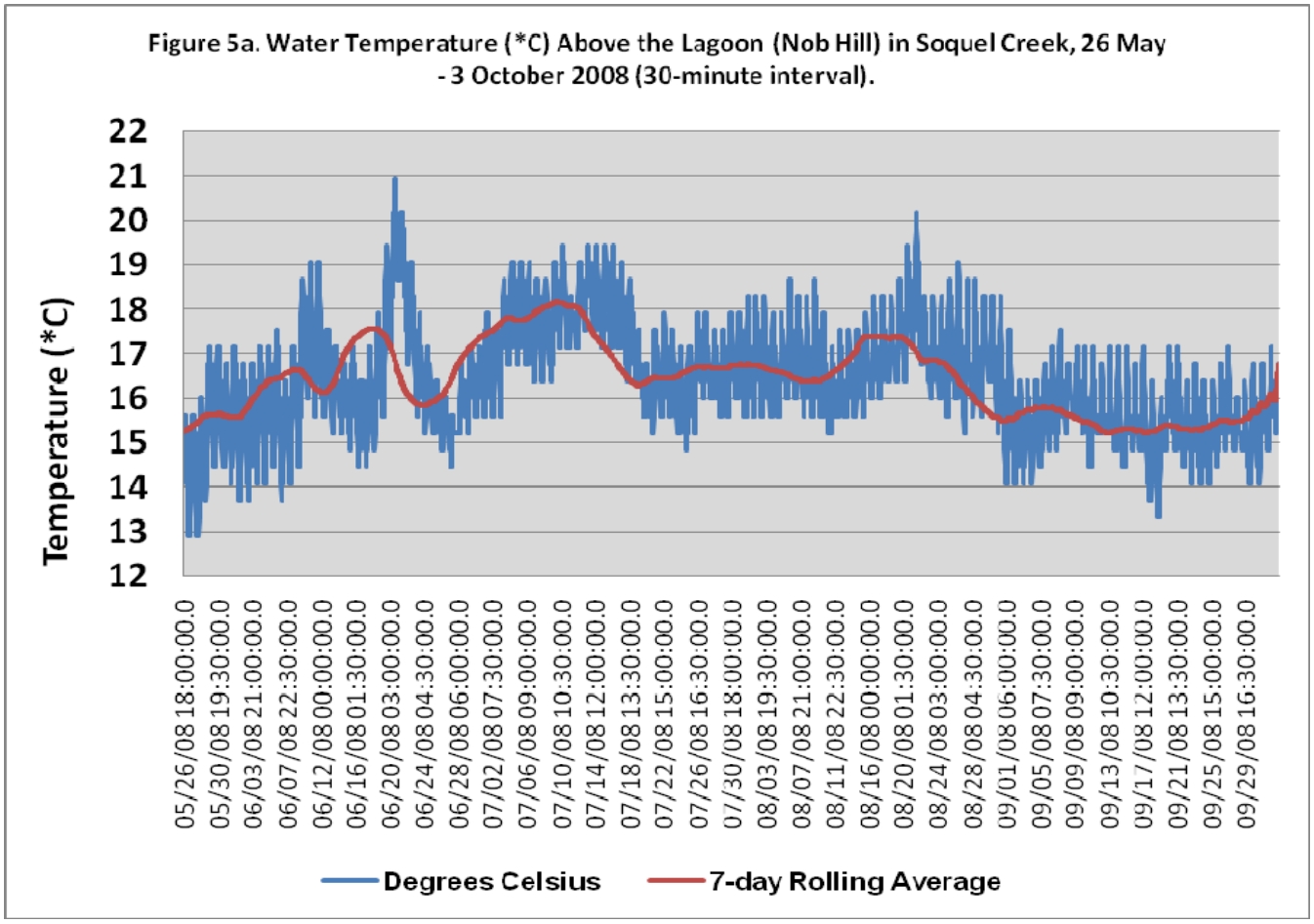


Figure 5a. Water Temperature (*C) Above the Lagoon (Nob Hill) in Soquel Creek, 26 May - 3 October 2008 (30-minute interval).
Temperature (*C)
22
21
20
19
18
17
16
15
14
13
12
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Celsius
7-day Rolling Average

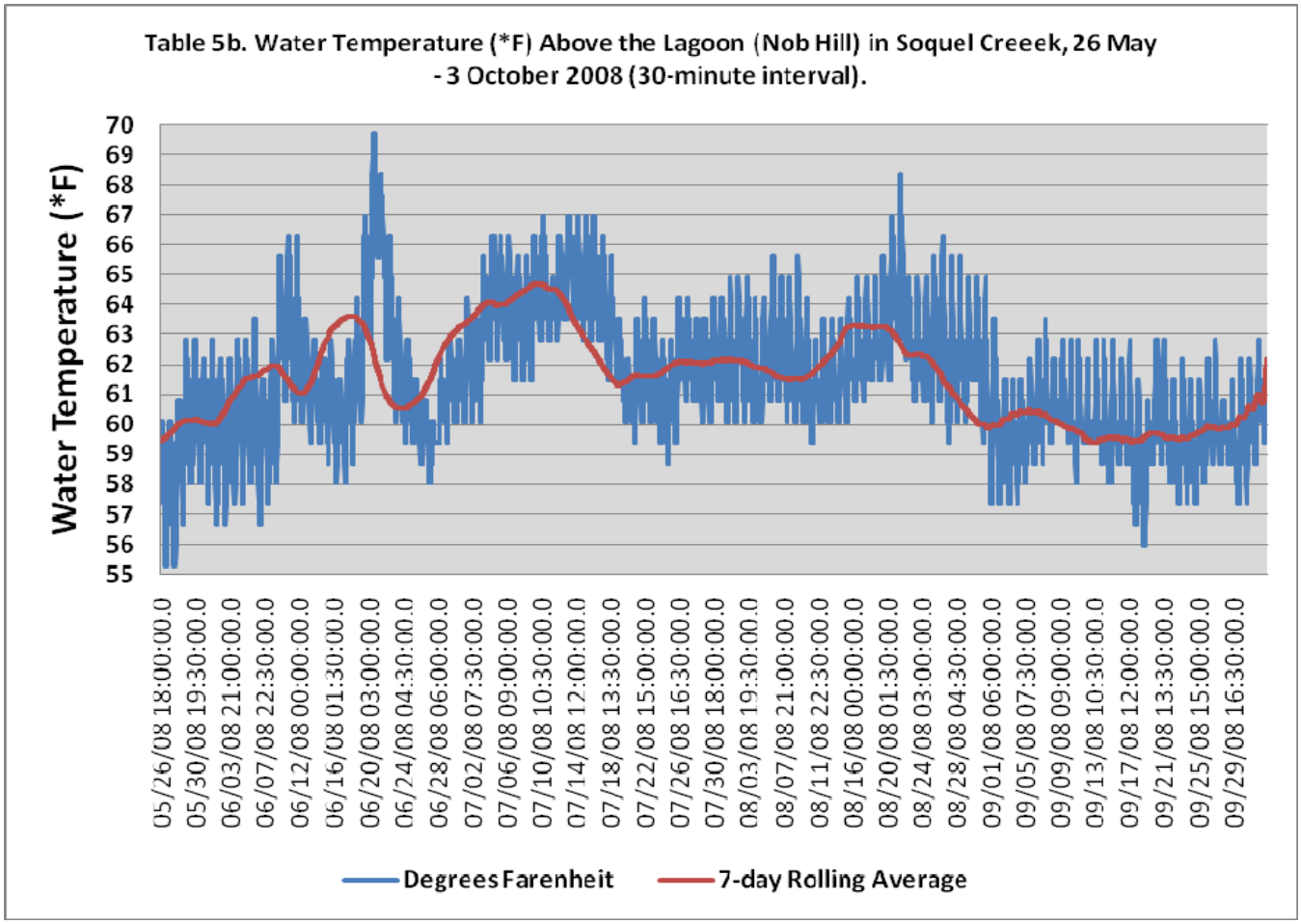


Table 5b. Water Temperature (*F) Above the Lagoon (Nob Hill) in Soquel Creeek, 26 May - 3 October 2008 (30-minute interval).
Water Temperature (*F)
70
69
68
67
66
65
64
63
62
61
60
59
58
57
56
55
05/26/08 18:00:00.0
05/30/08 19:30:00.0
06/03/08 21:00:00.0
06/07/08 22:30:00.0
06/12/08 00:00:00.0
06/16/08 01:30:00.0
06/20/08 03:00:00.0
06/24/08 04:30:00.0
06/28/08 06:00:00.0
07/02/08 07:30:00.0
07/06/08 09:00:00.0
07/10/08 10:30:00.0
07/14/08 12:00:00.0
07/18/08 13:30:00.0
07/22/08 15:00:00.0
07/26/08 16:30:00.0
07/30/08 18:00:00.0
08/03/08 19:30:00.0
08/07/08 21:00:00.0
08/11/08 22:30:00.0
08/16/08 00:00:00.0
08/20/08 01:30:00.0
08/24/08 03:00:00.0
08/28/08 04:30:00.0
09/01/08 06:00:00.0
09/05/08 07:30:00.0
09/09/08 09:00:00.0
09/13/08 10:30:00.0
09/17/08 12:00:00.0
09/21/08 13:30:00.0
09/25/08 15:00:00.0
09/29/08 16:30:00.0
Degrees Farenheit
7-day Rolling Average

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

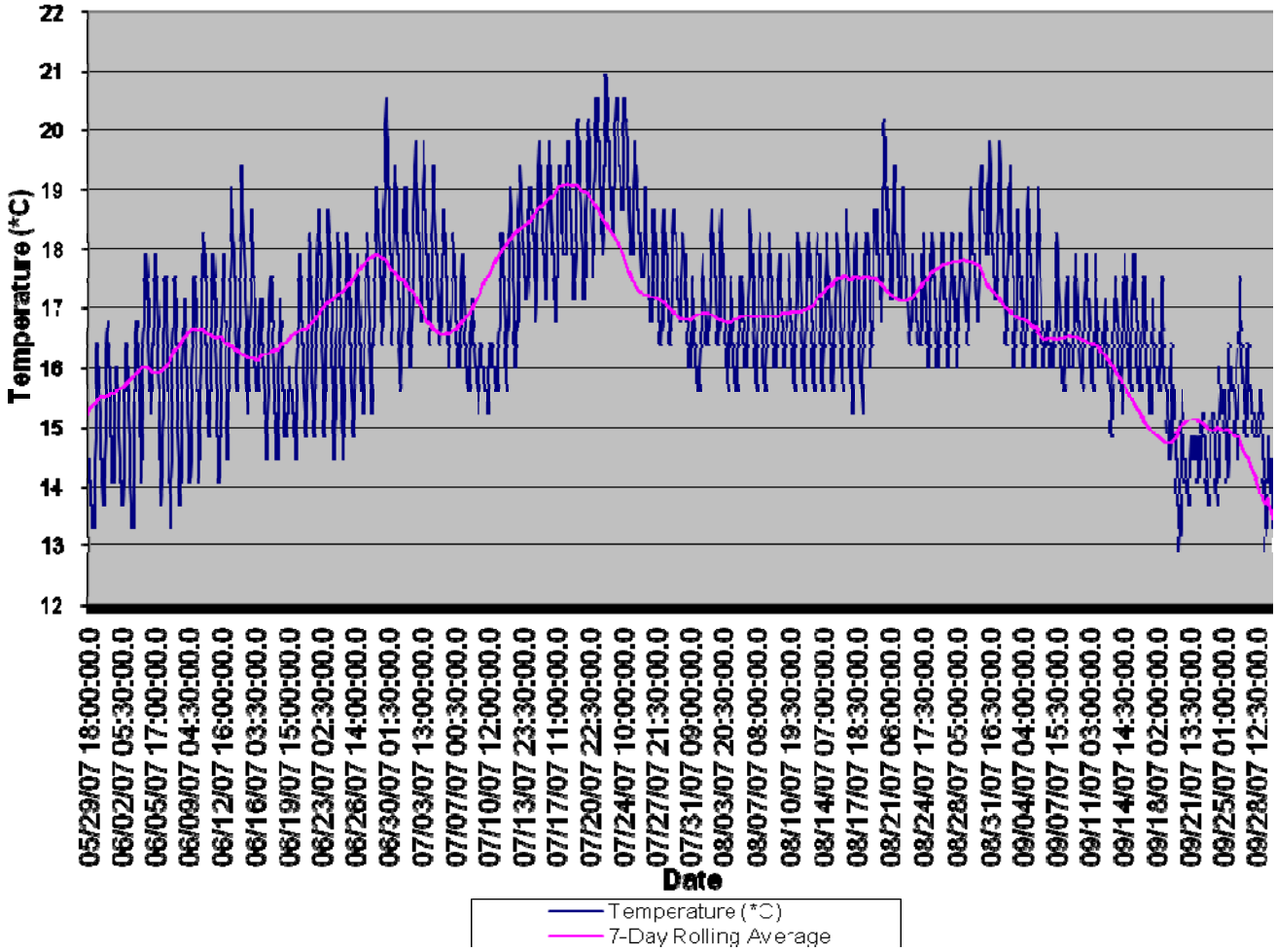


Figure 5d. Water Temperature (*F) Above the Lagoon (Nob Hill) In Soquel Creek. 29 May- 30 September 2007 (30-minute interval).

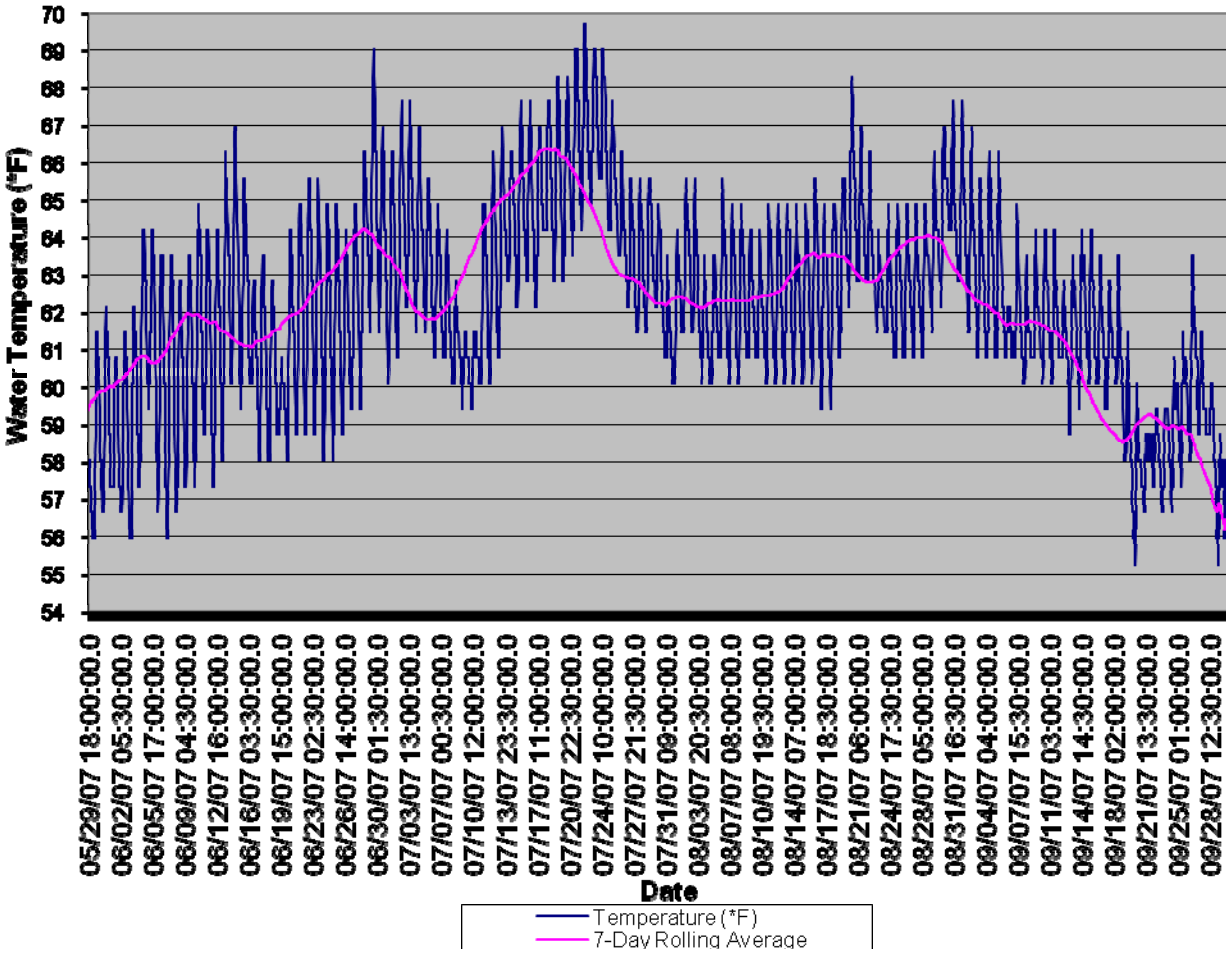


Figure 5e. Water Temperature (*C) Above the Lagoon (Nob Hill) in Soquel Creek, 8 June- 12 September 2006 (30-minute interval).

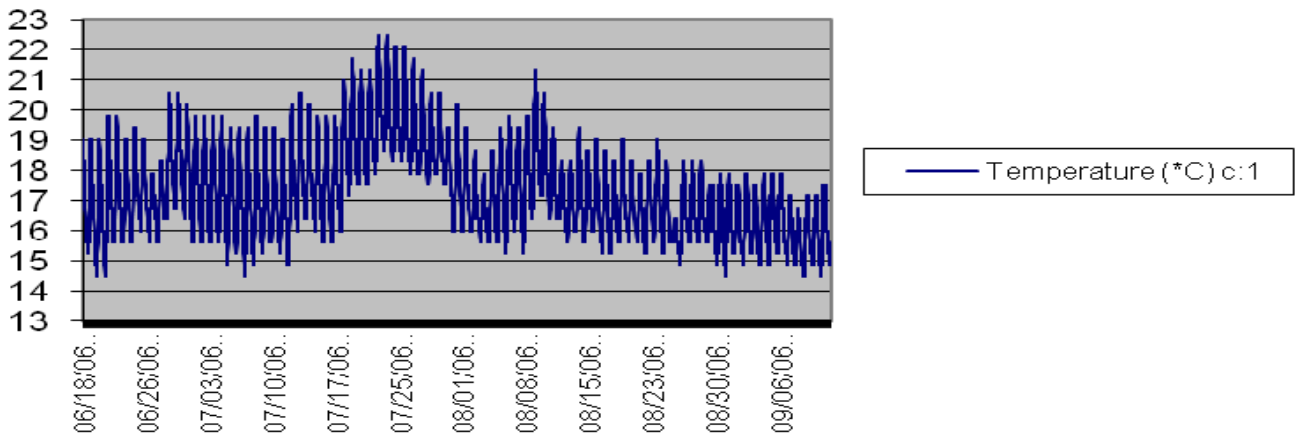


Figure 6a. Soquel Lagoon/Stream Oxygen Concentrations at Dawn Within 0.25 Meters of the Bottom at Five Monitoring Stations. 7 June - 26 October 2008.

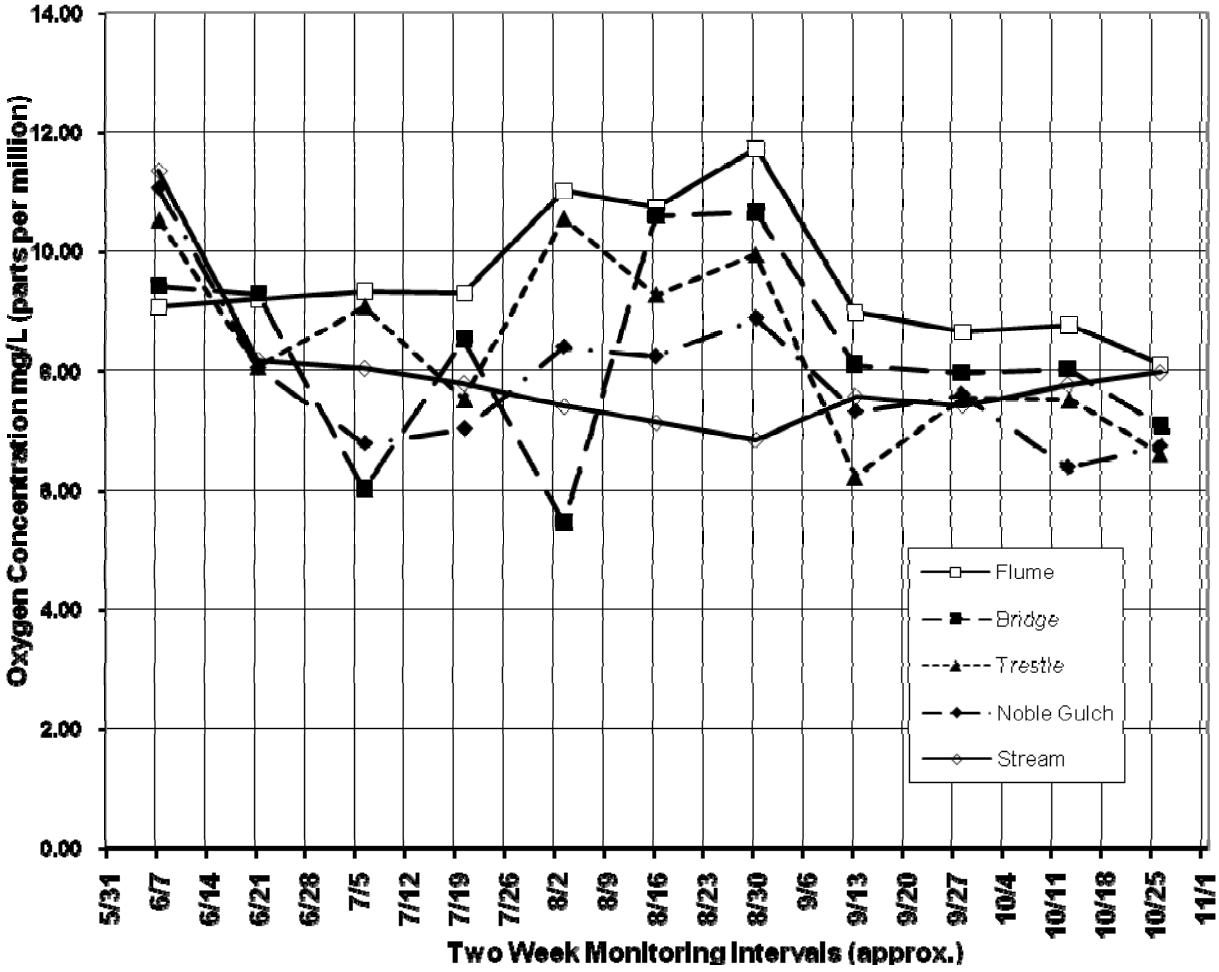


Figure 6b. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 1, the Flume. 7 June - 26 October 2008.

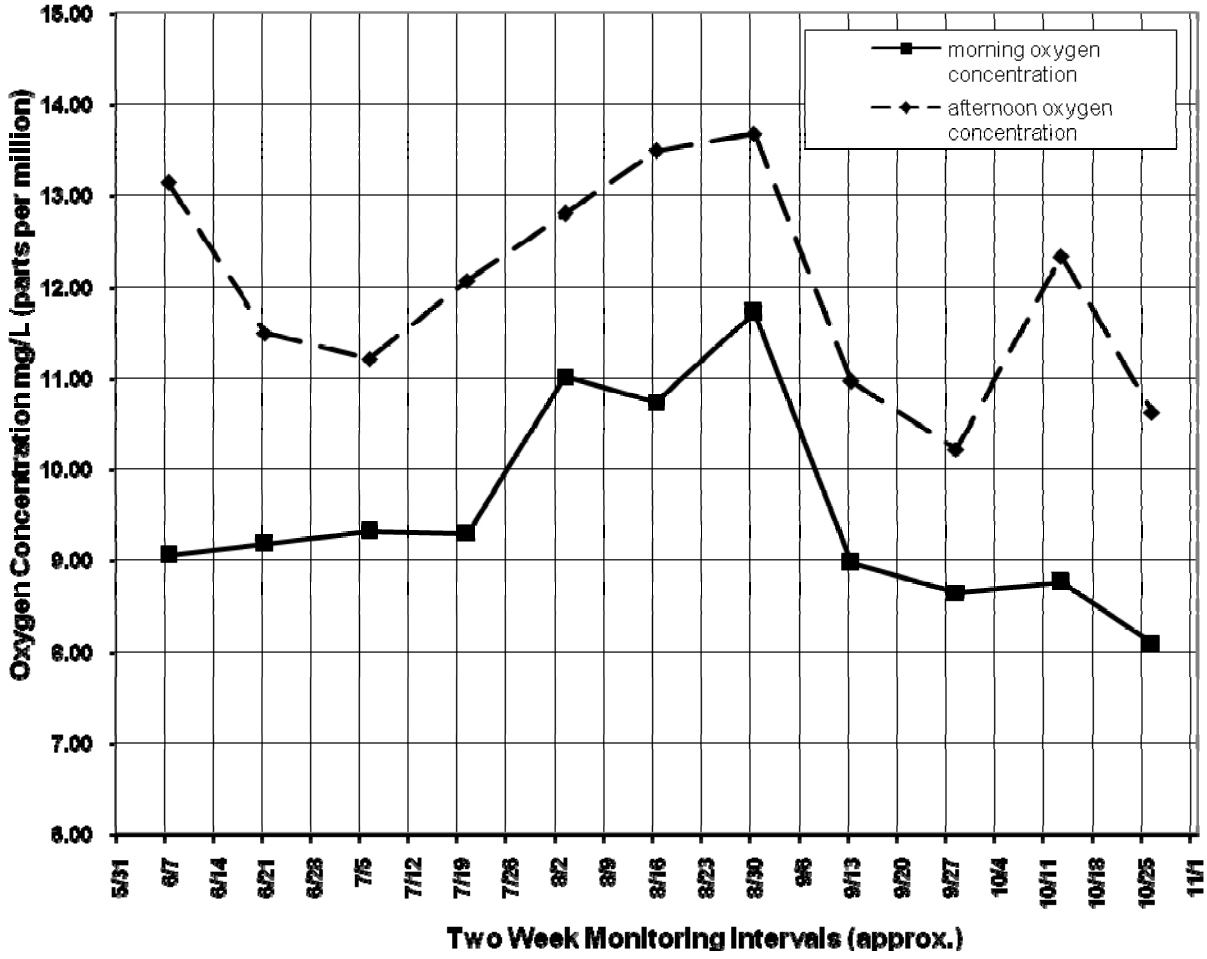


Figure 6c. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 2, the Stockton Avenue Bridge. 7 June - 26 October 2008.

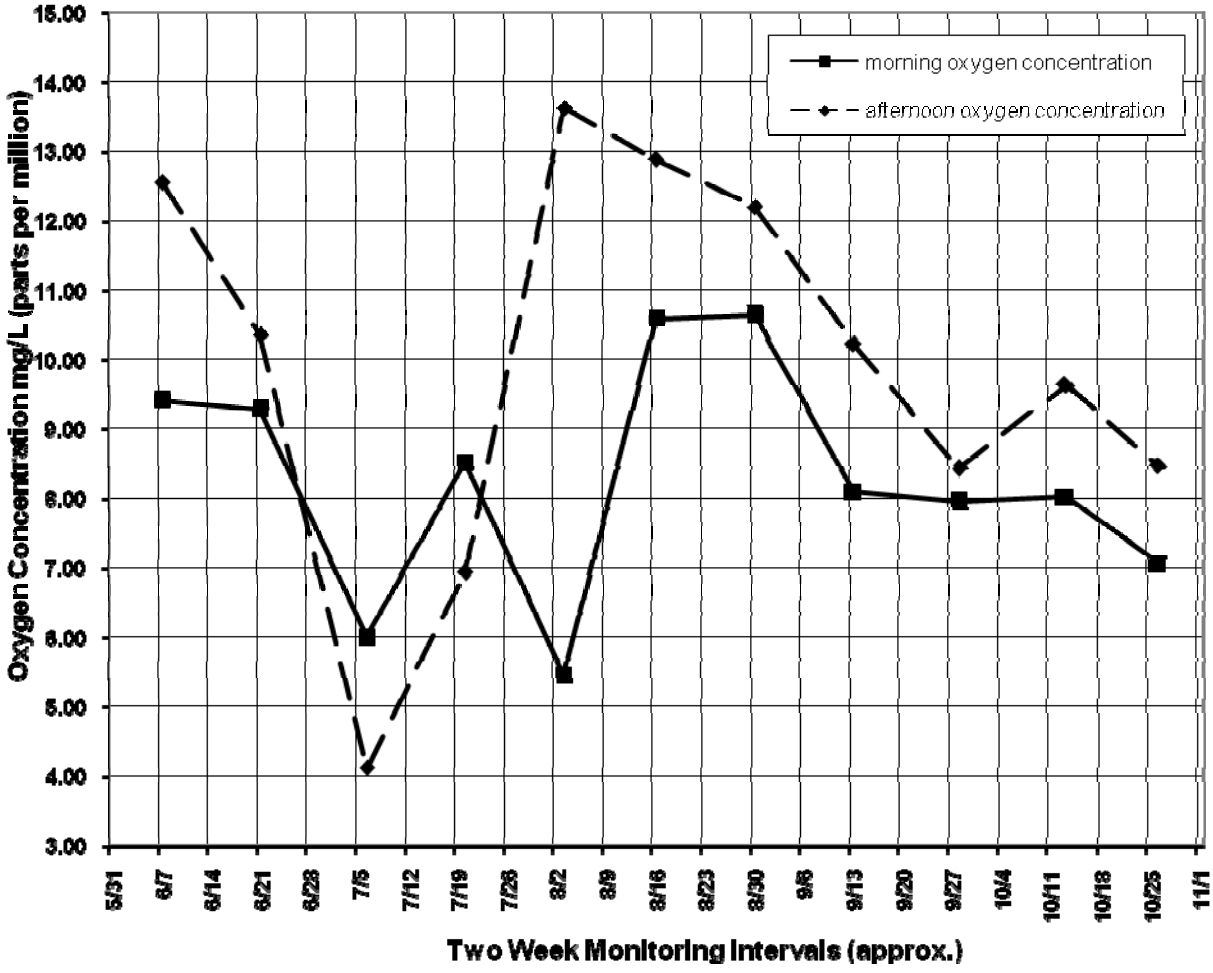


Figure 6d. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon Within 0.25 Meters of the Bottom at Station 3, the Railroad Trestle, 7 June - 26 October 2008.

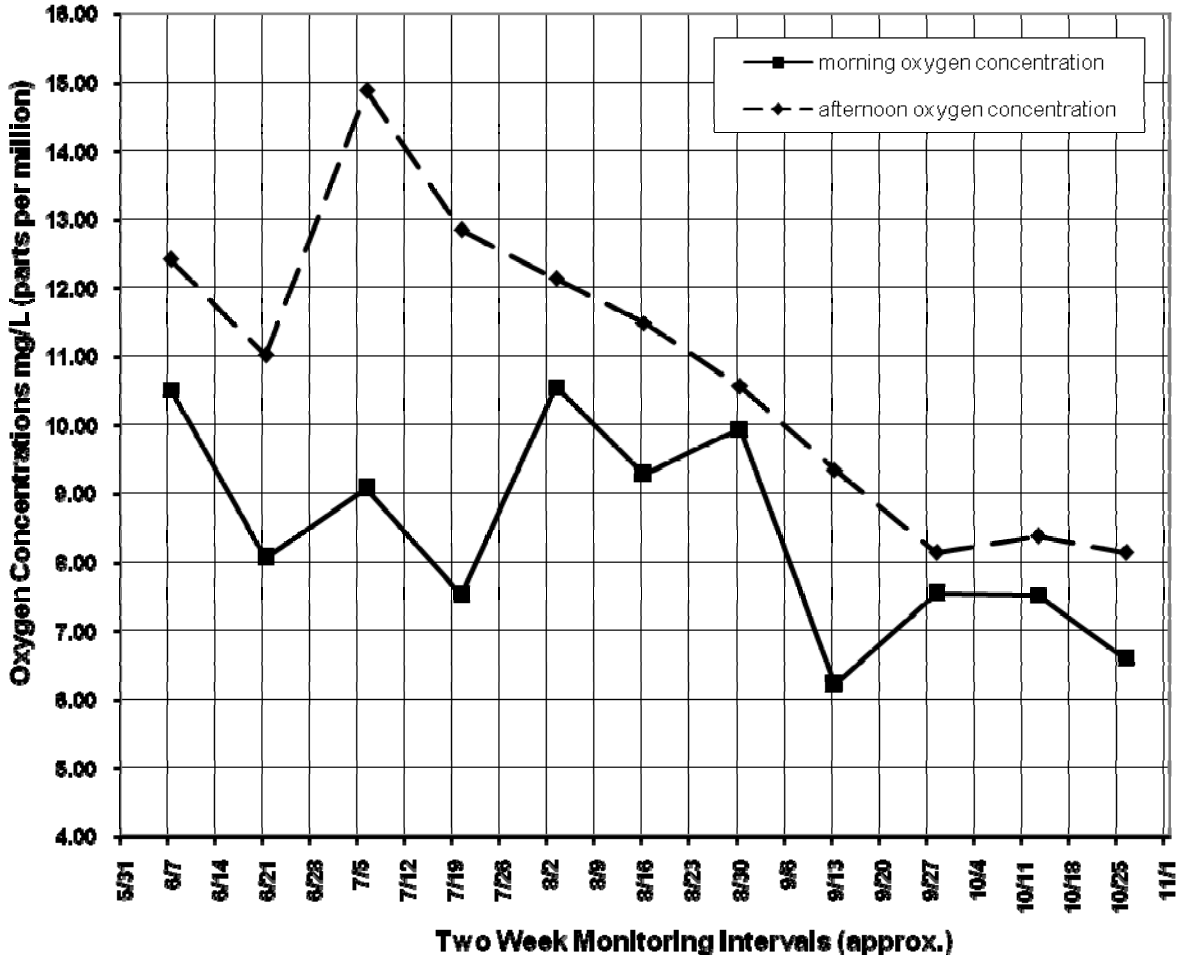


Figure 6e. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon within 0.25 Meters of the Bottom at Station 4, the Mouth of Noble Gulch. 7 June - 26 October 2008.

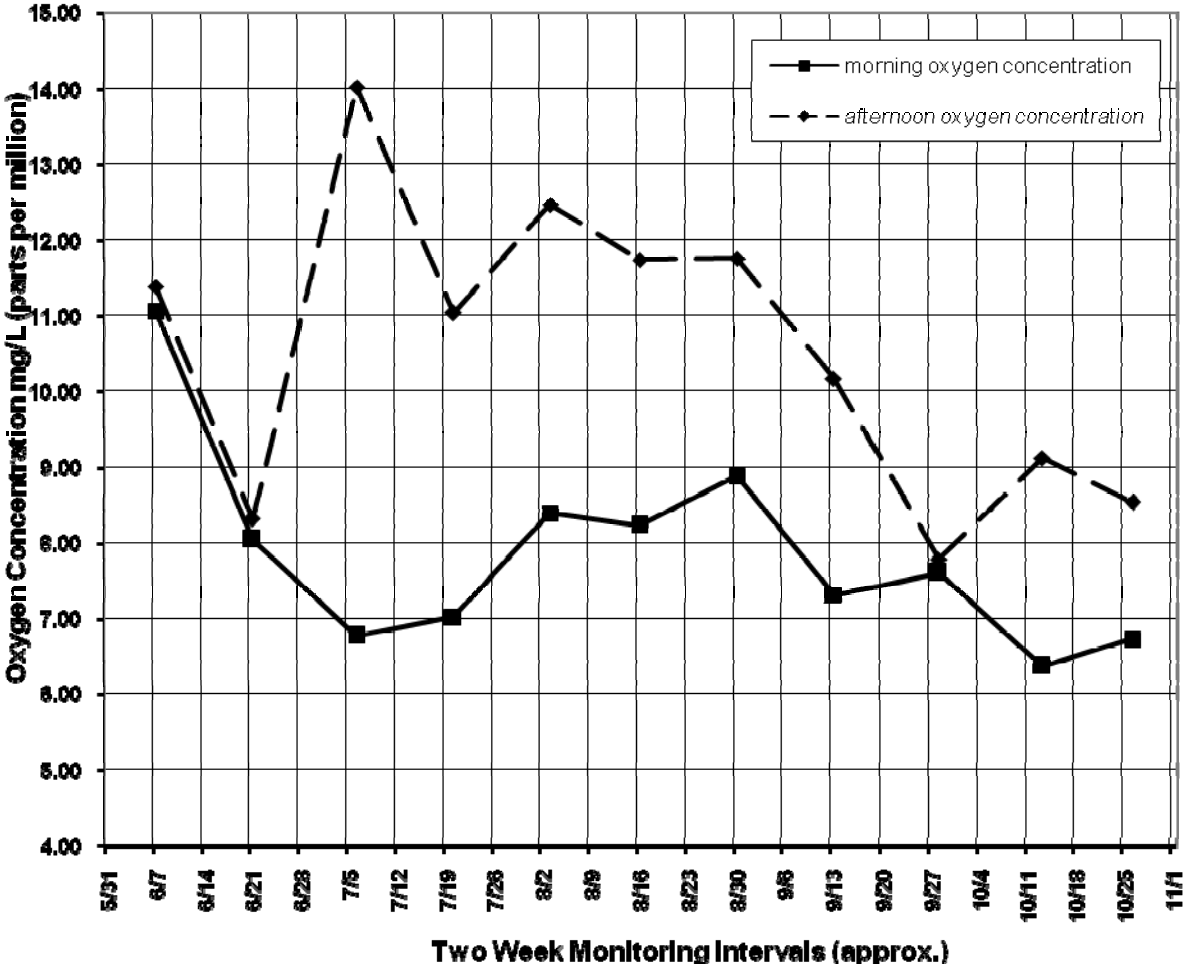


Figure 6f. Soquel Lagoon/Stream Oxygen Concentrations at Dawn Within 0.25 Meters of the Bottom at 5 Stations, 30 June - 6 December 2006

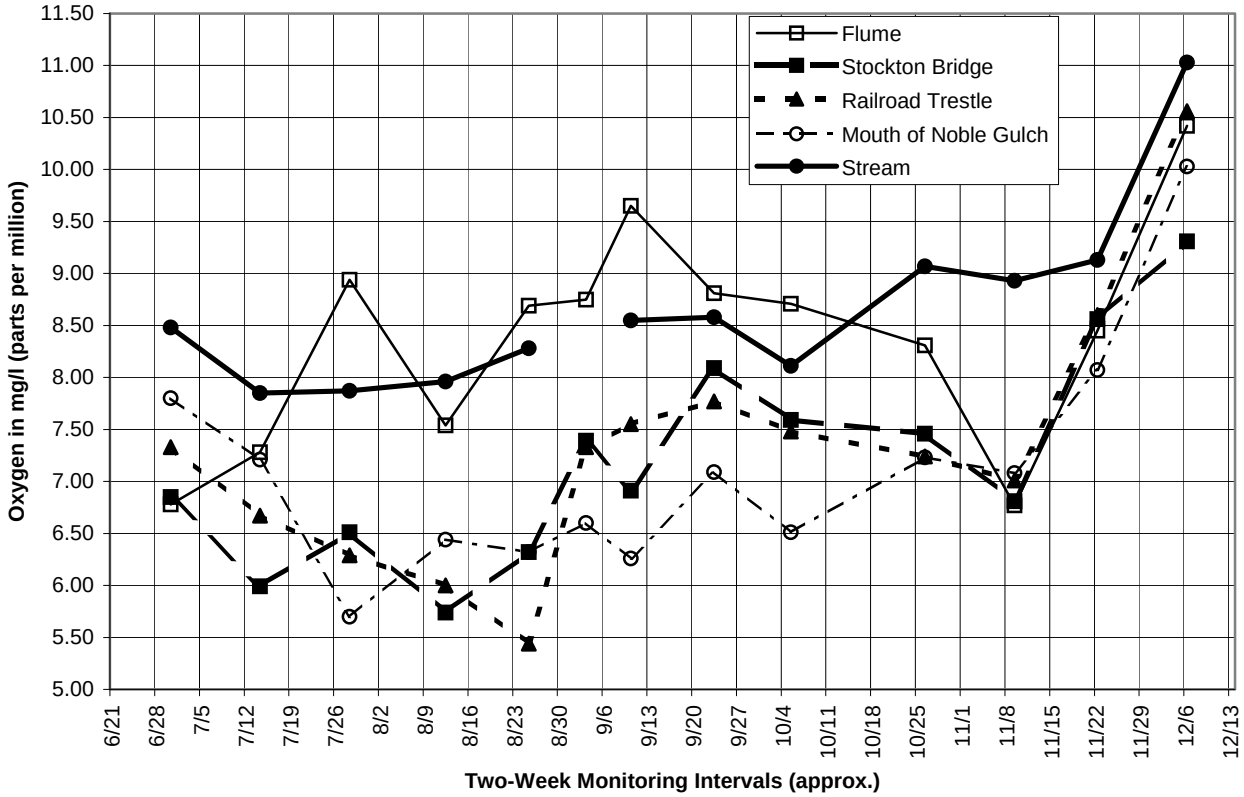


Figure 6g. Soquel Lagoon/Stream Oxygen Concentrations at Dawn within 0.25 Meters of the Bottom at Five Stations. June 10 - December 8, 2007.

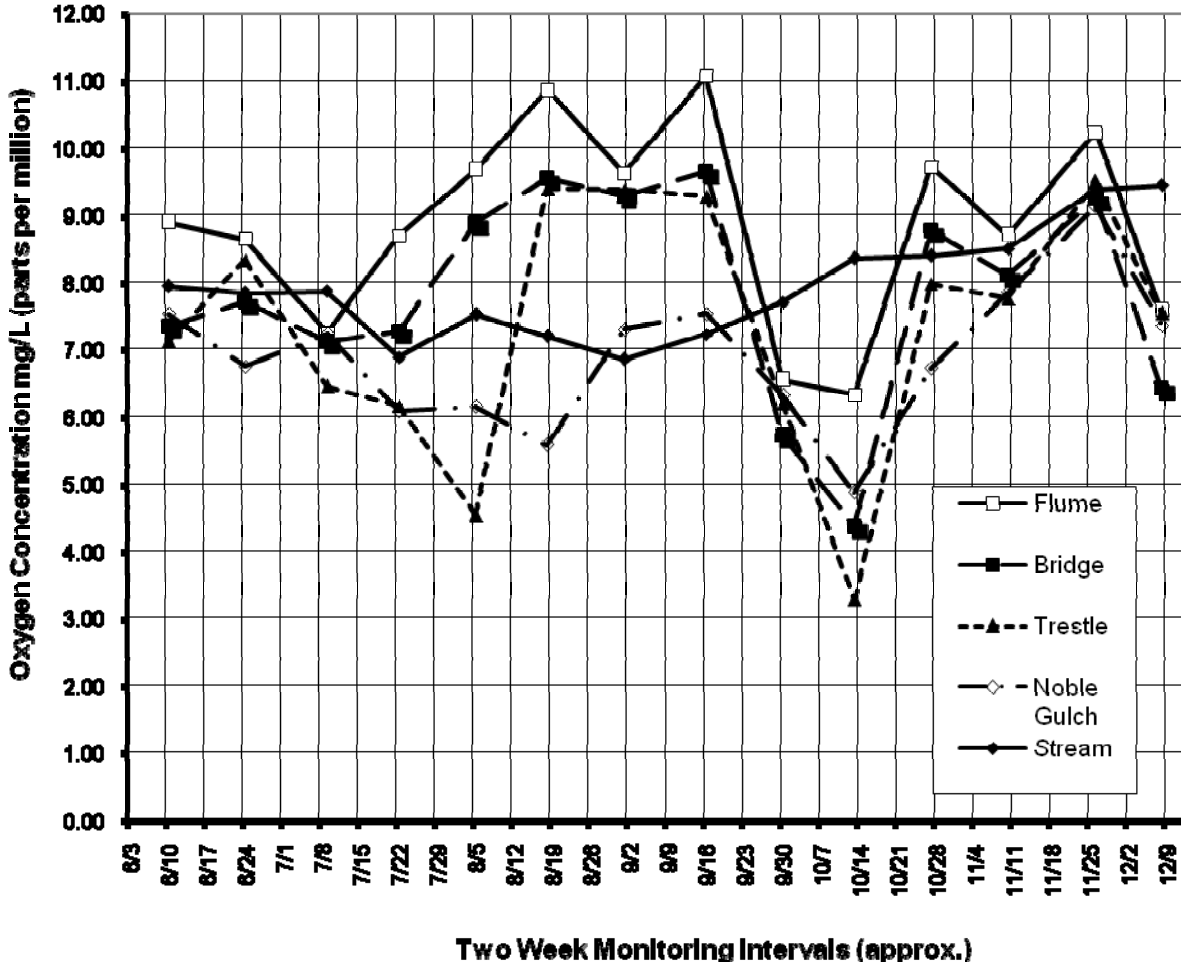


Figure 7. Juvenile Steelhead Population Estimate in Soquel Creek Lagoon. 1993 - 2008. Estimated by Mark and Recapture Experiment.

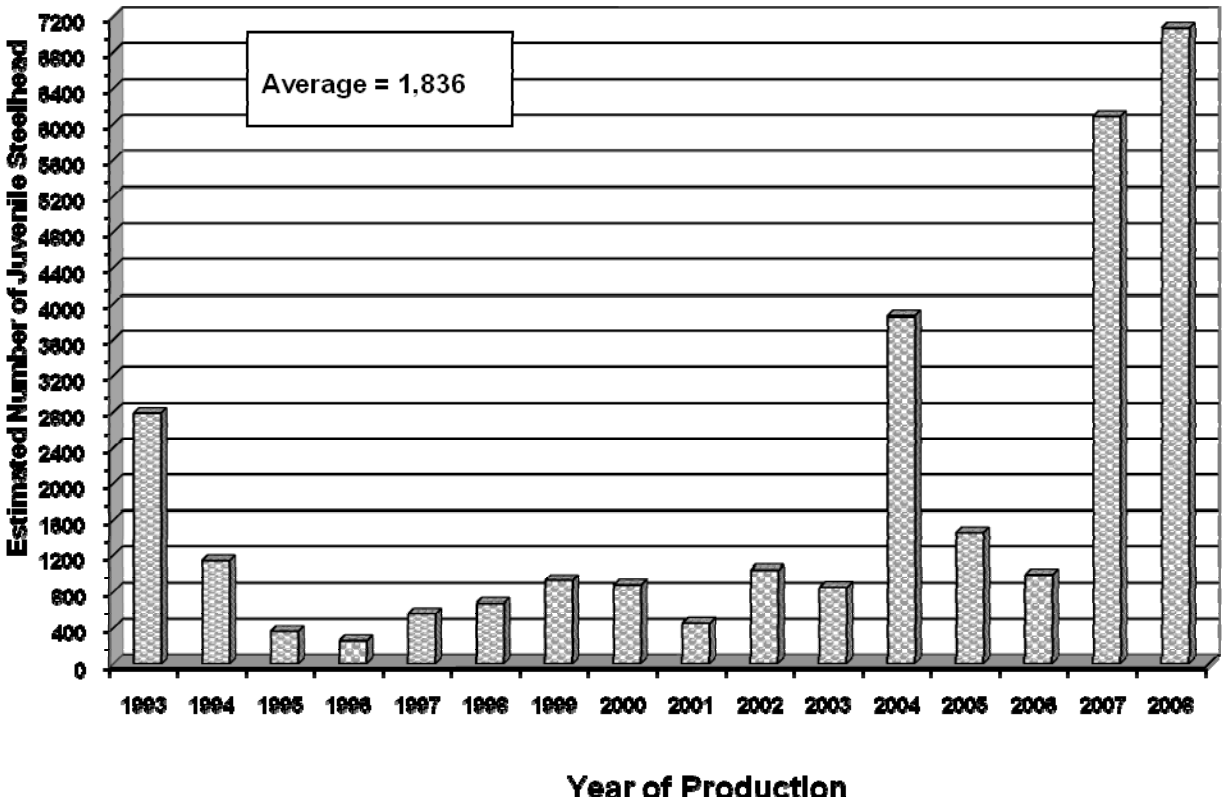


Figure 8. Size Frequency Histogram of Juvenile Steelhead Captured on 27 September 2008 in the Soquel Lagoon.

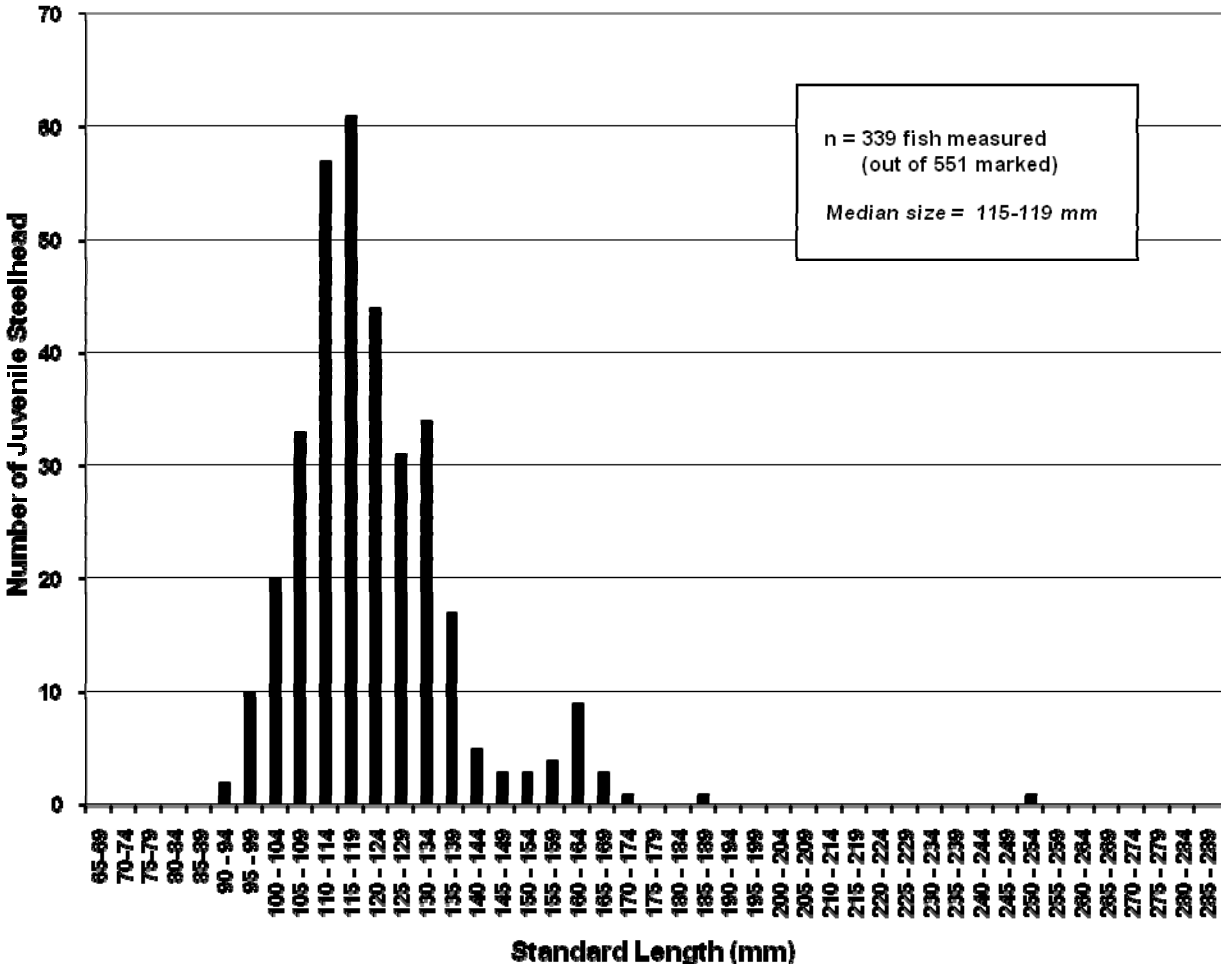


Figure 9. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 & 14 October 2007 in the Soquel Lagoon

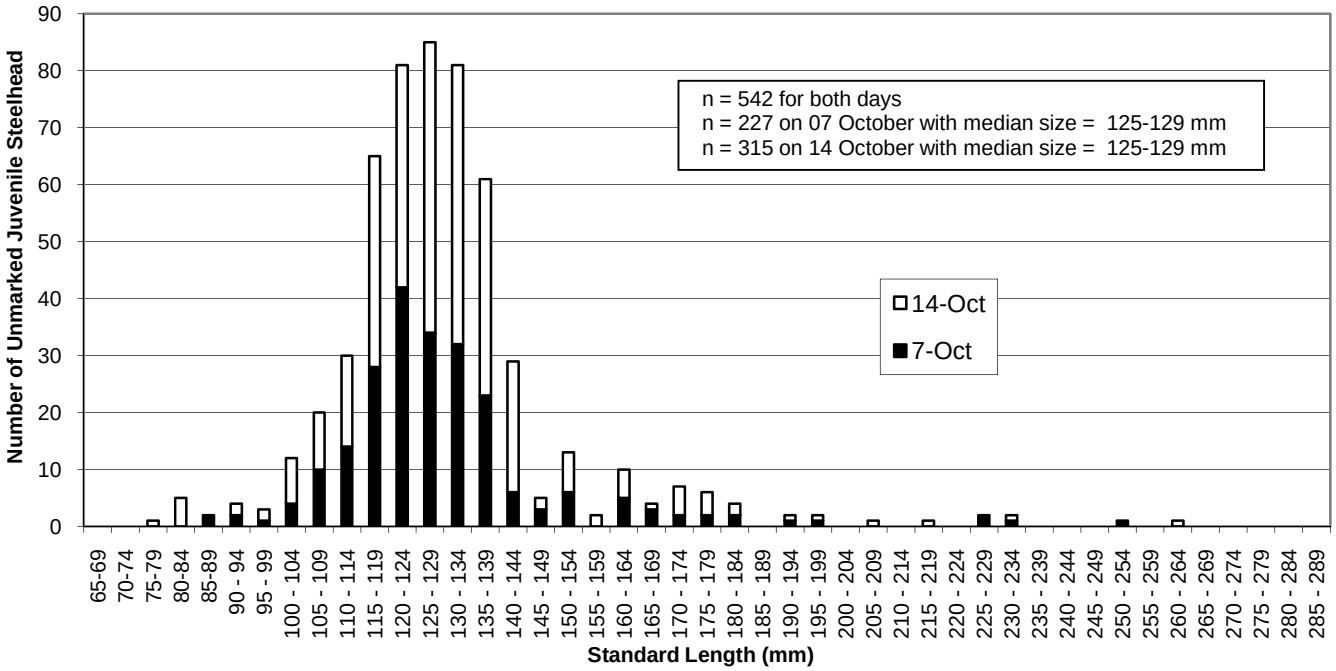


Figure 10. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 30 September and 8 October 2006 in Soquel Lagoon.

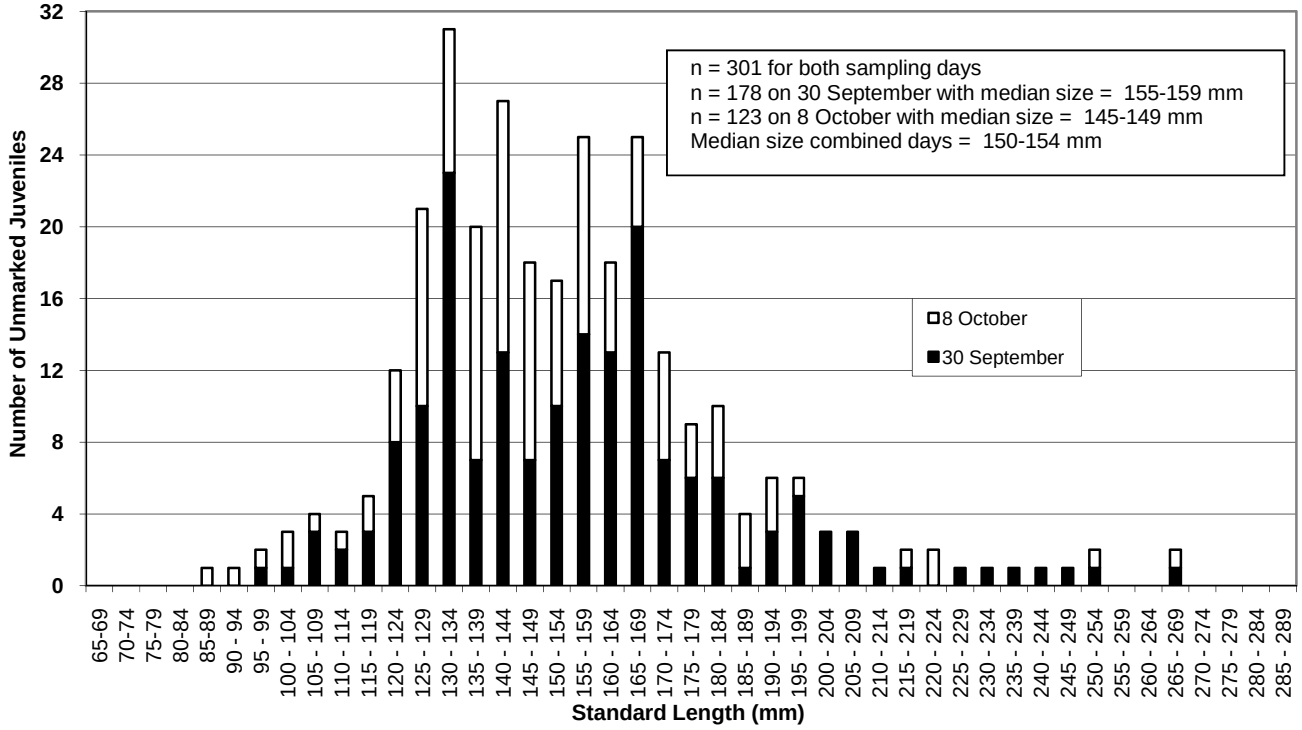


Figure 11. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 2 and 9 October 2005 in Soquel Lagoon.

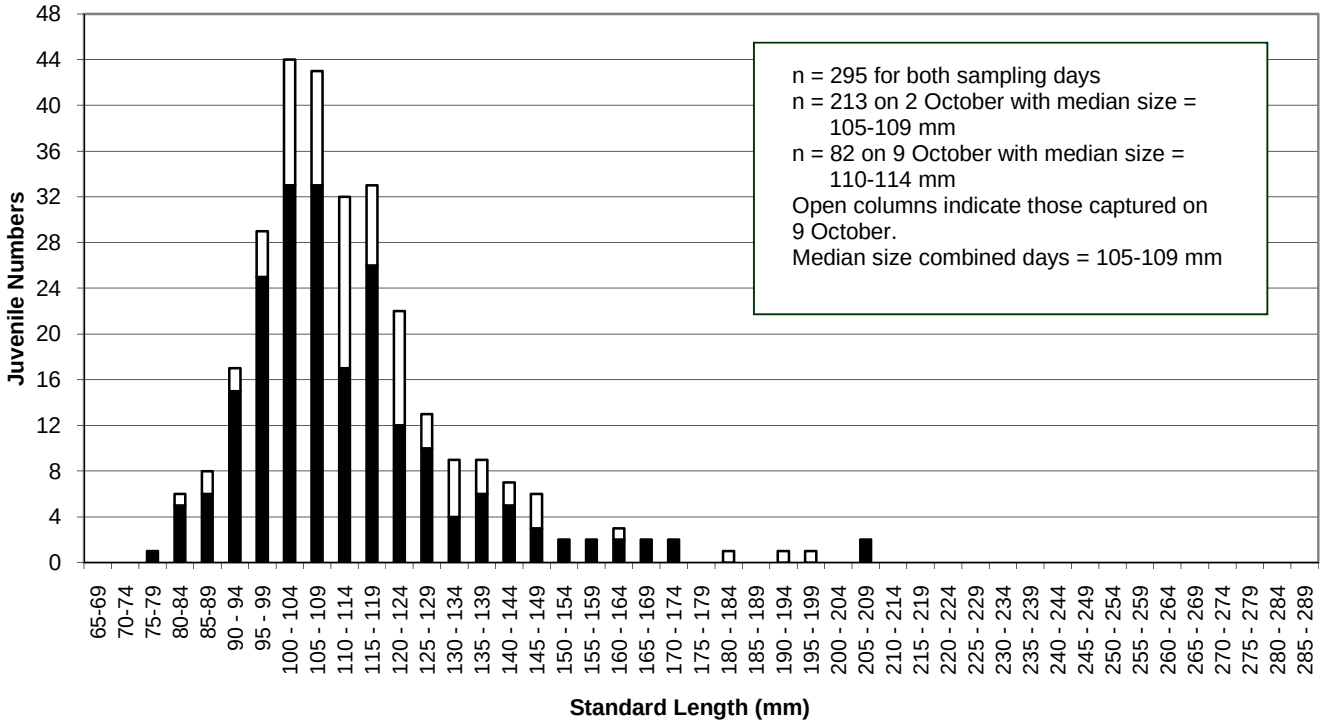


Figure 12. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

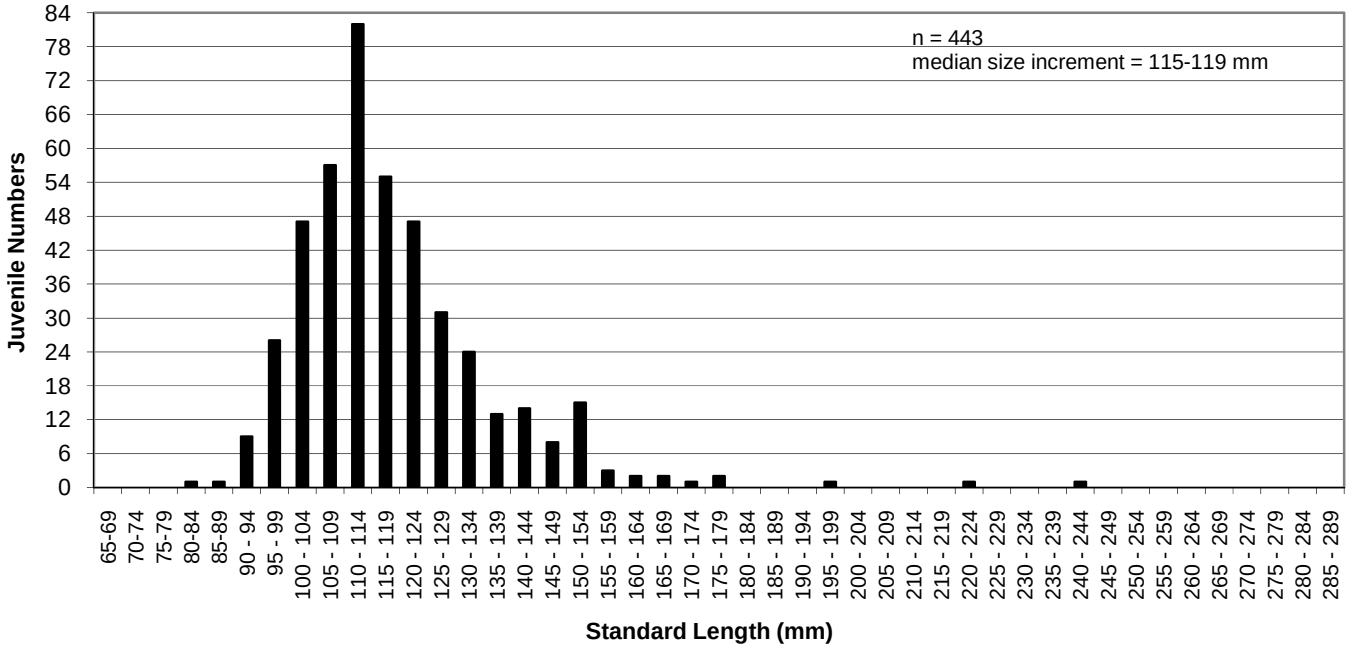


Figure 13. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

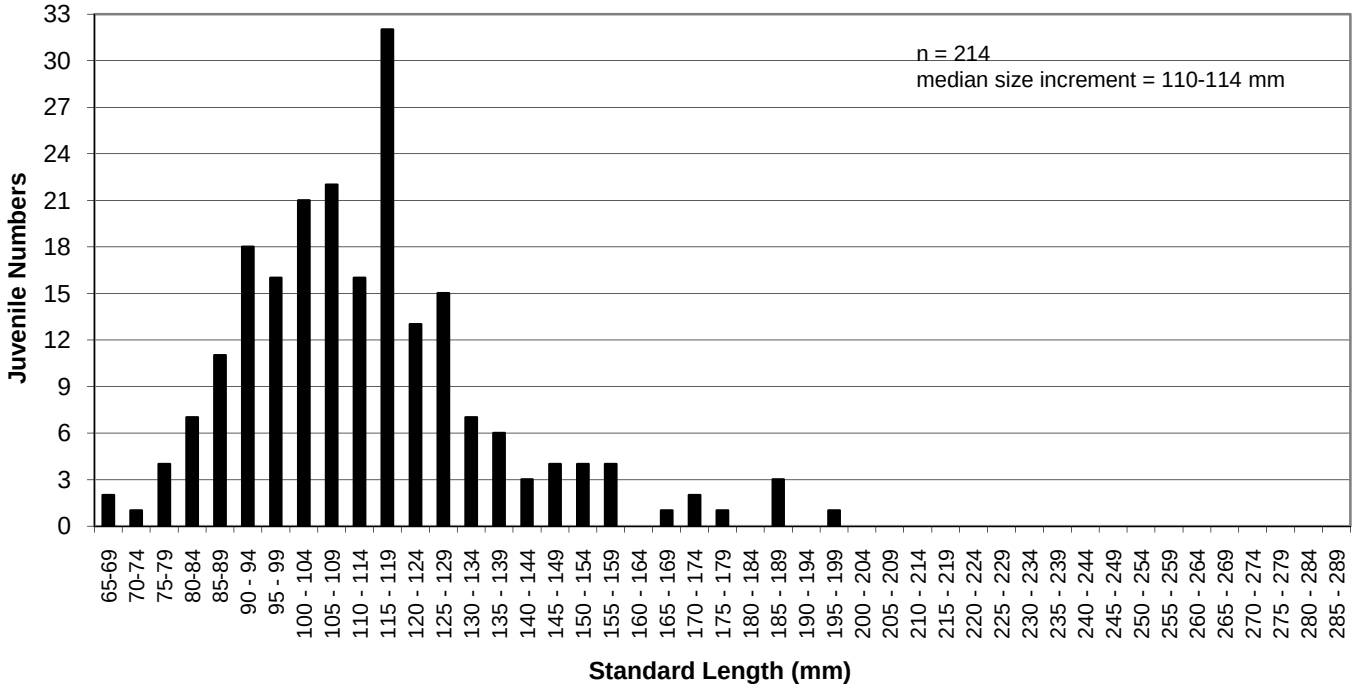


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 and 13 October 2002 in Soquel Lagoon.

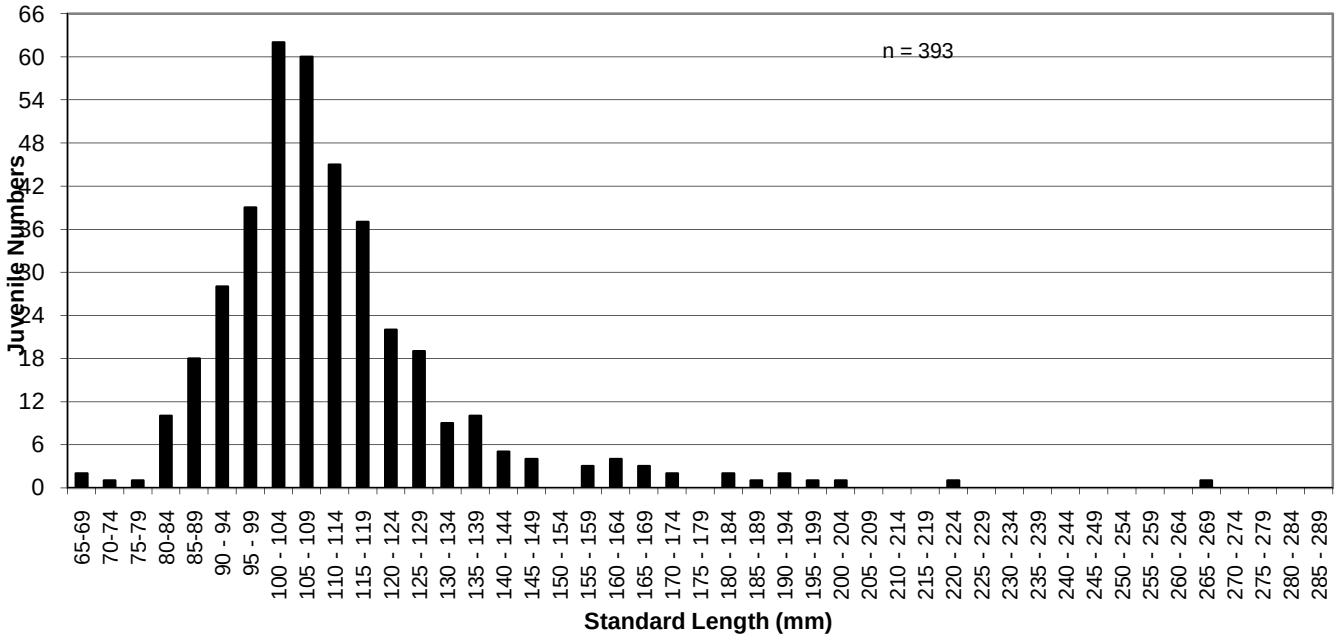


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

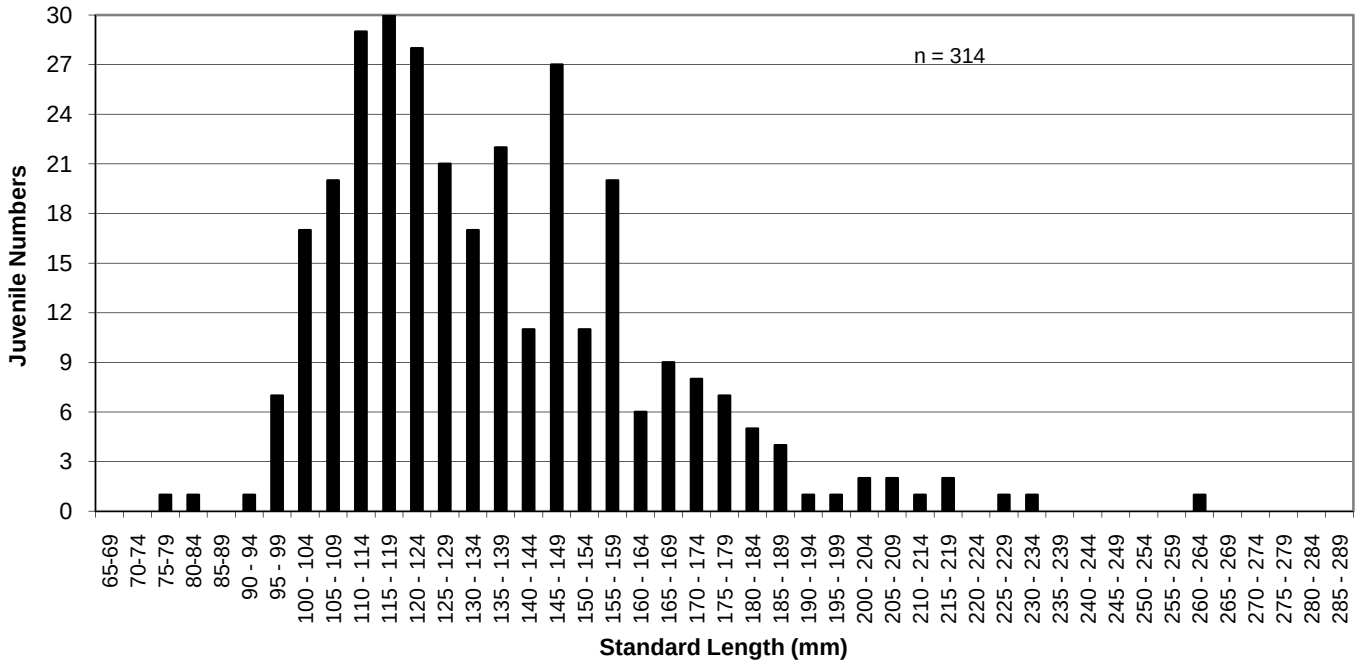


Figure 16. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

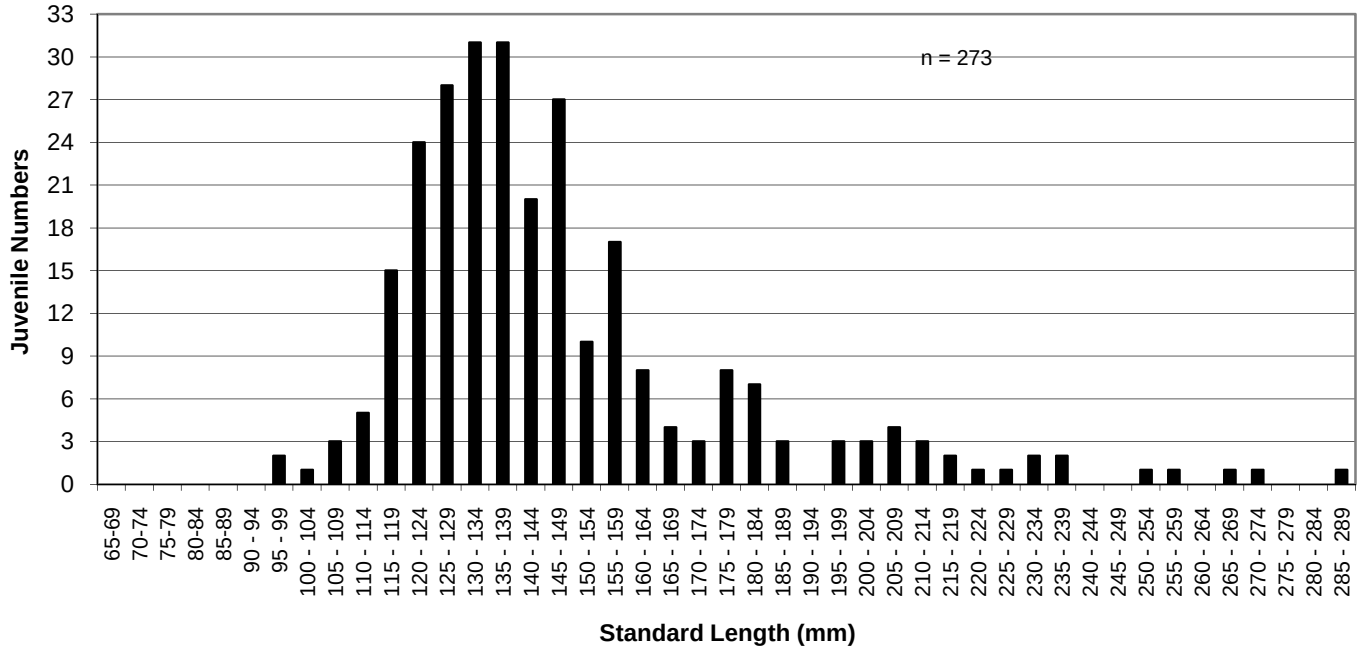


Figure 17. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 October 1999 (only) in Soquel Lagoon.

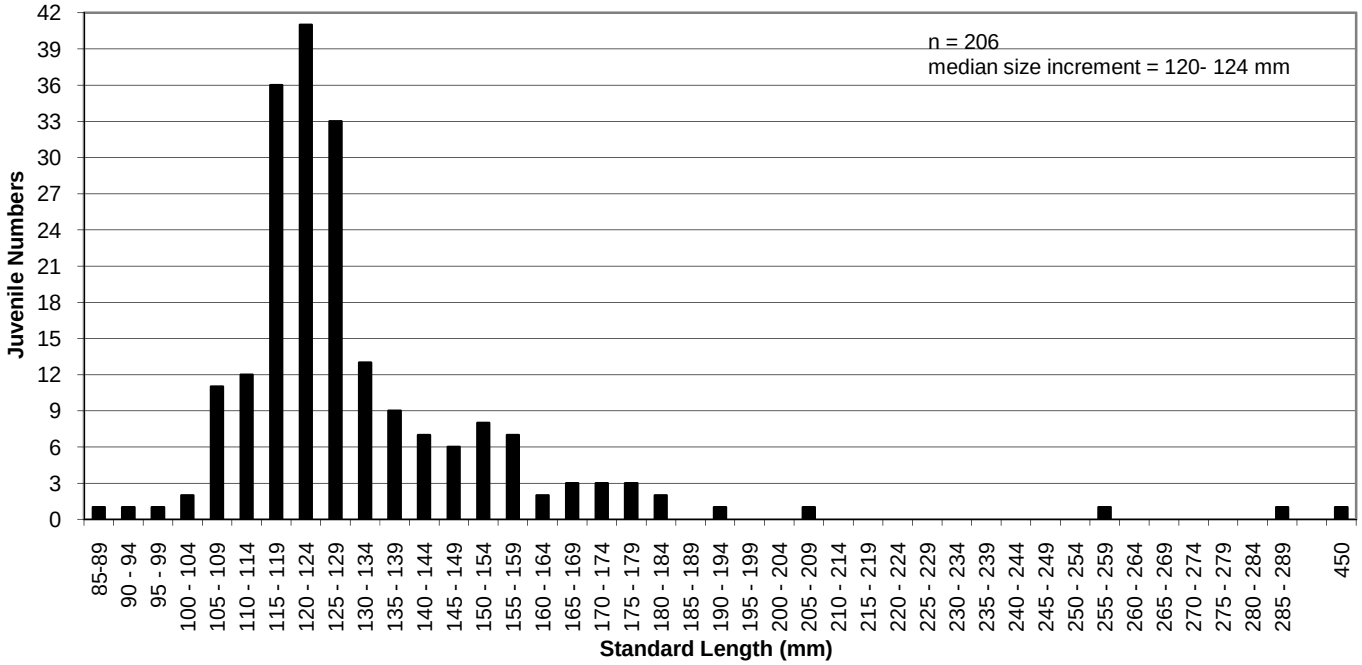


Figure 18. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

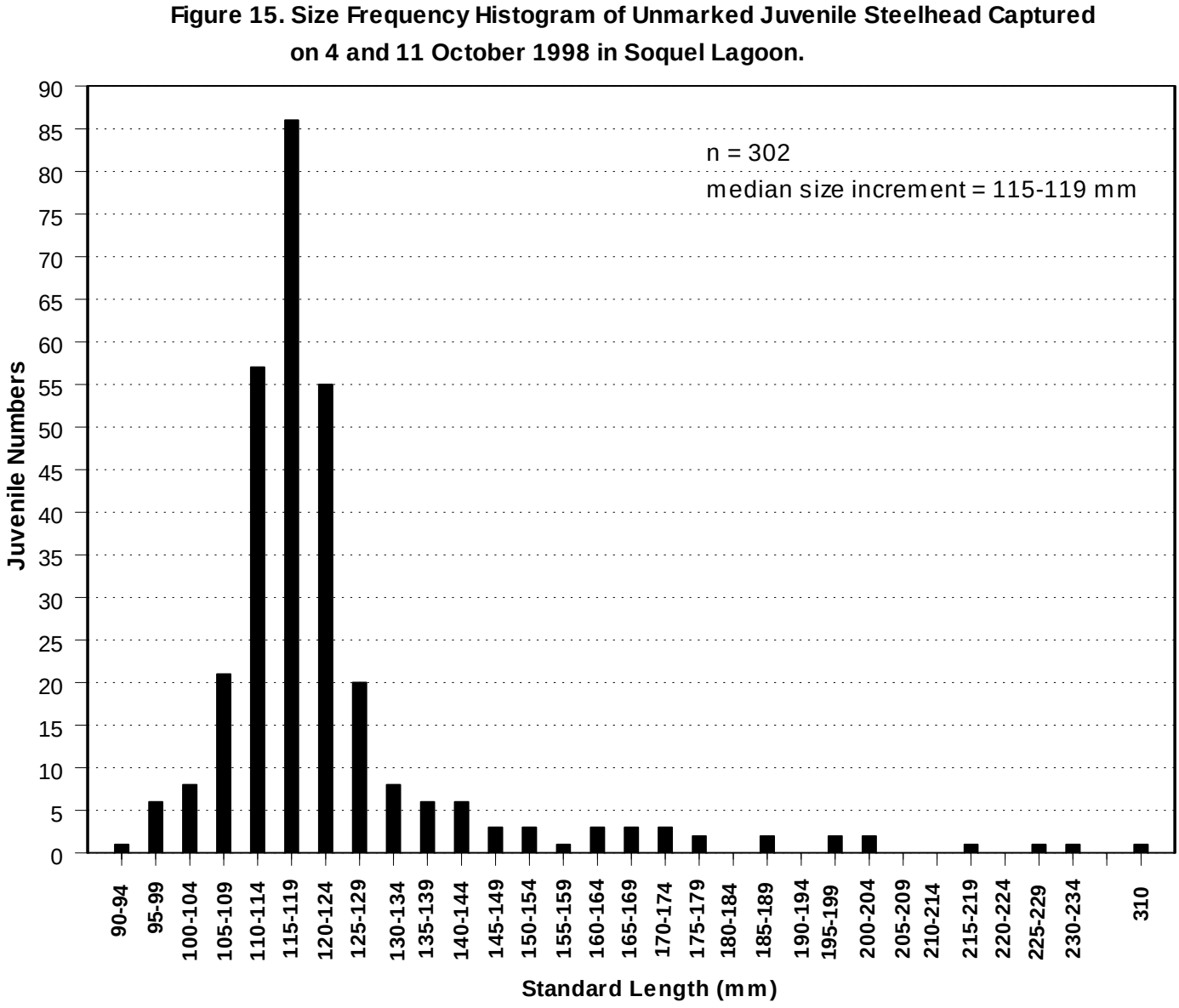


Figure 19. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage in Soquel, CA, 1 October 2007 – 30 September 2008.

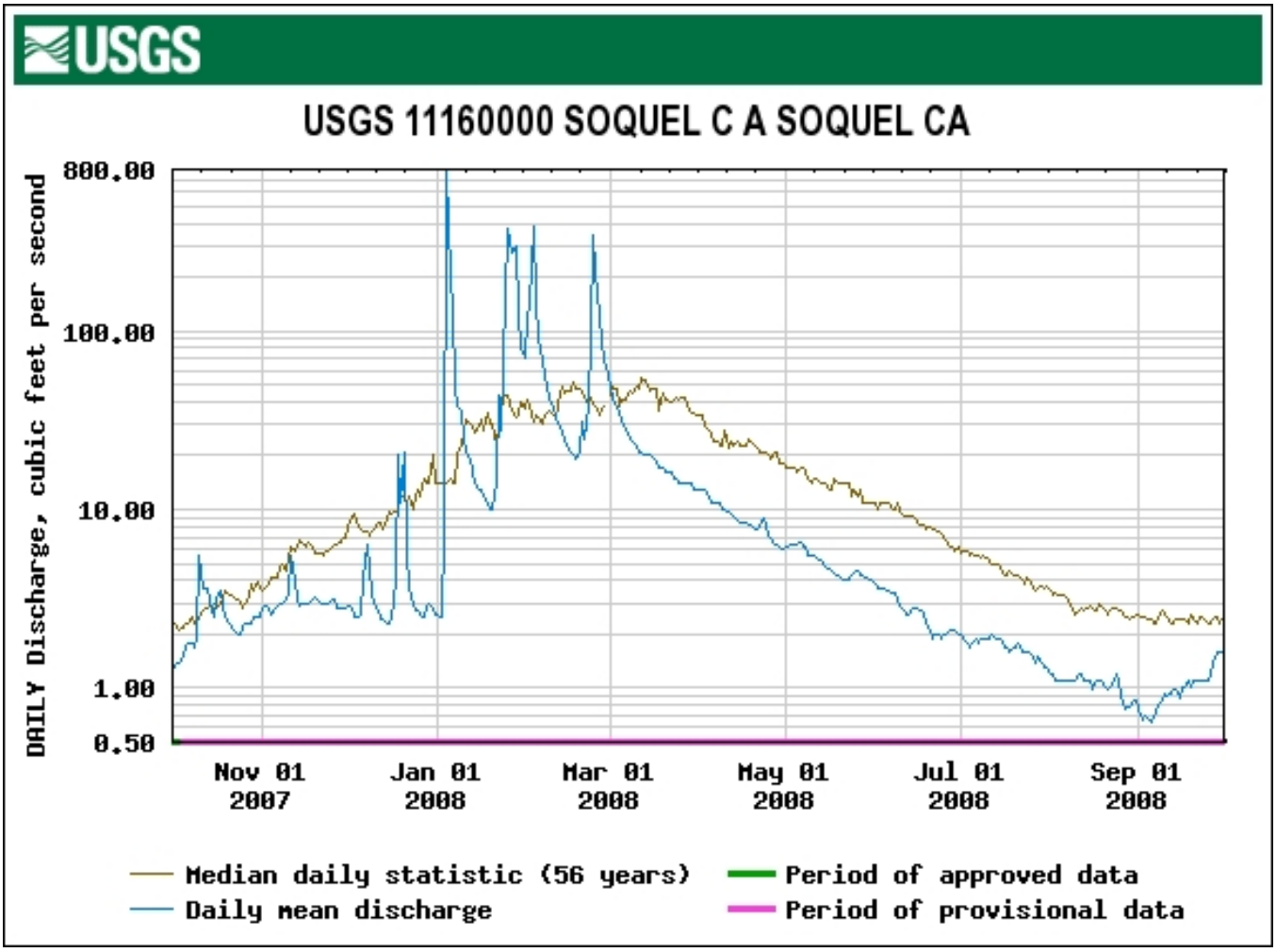


Figure 20. Soquel Creek Mean Daily Streamflow Hydrograph for the SUGS Gage at Soquel, CA, 1 June – 21 December 2008.

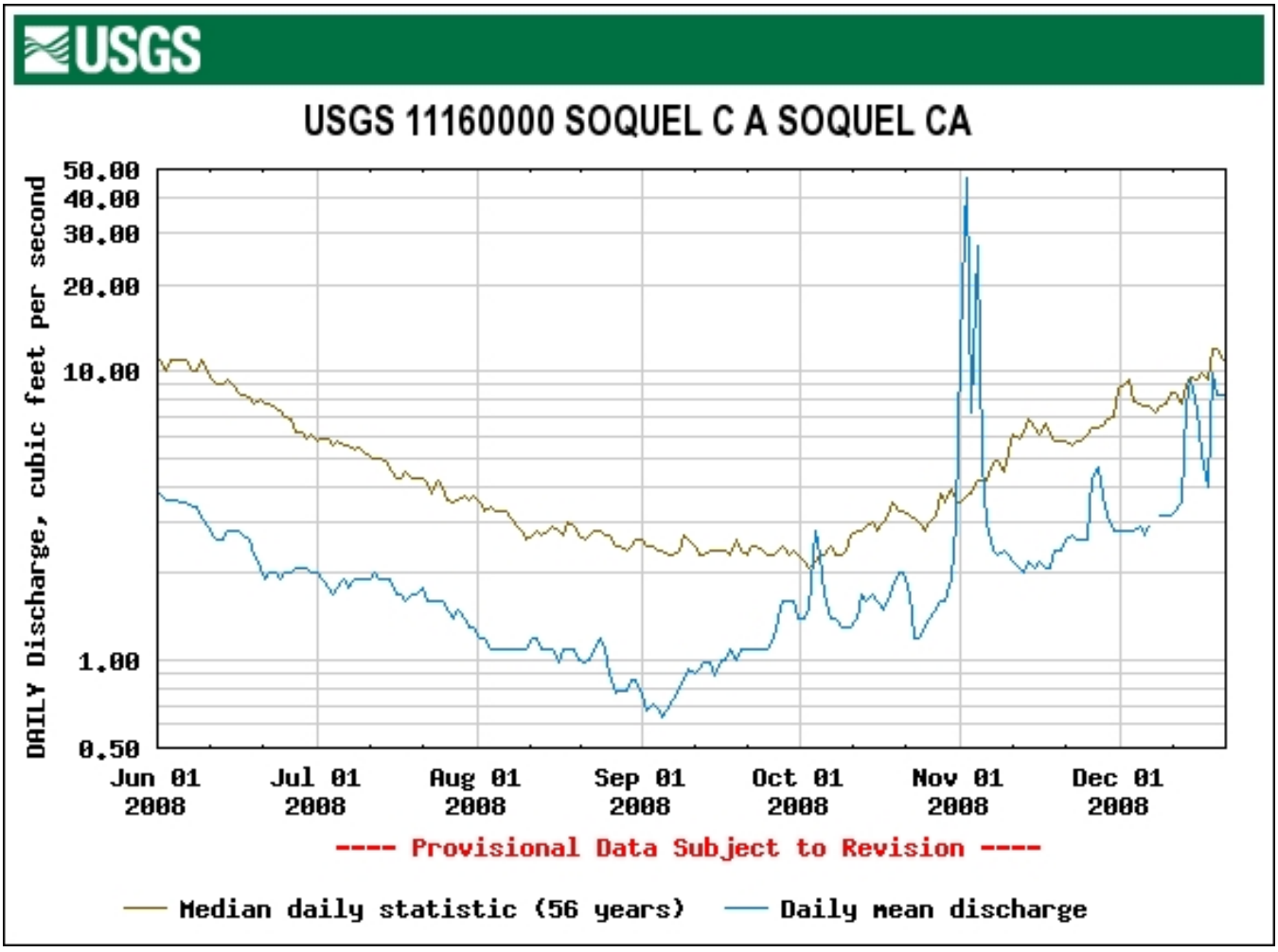


Figure 21. Soquel Creek Real-Time Streamflow Hydrograph at the USGS Gage in Soquel, CA, 25 October 2008 – 20 December 2008.

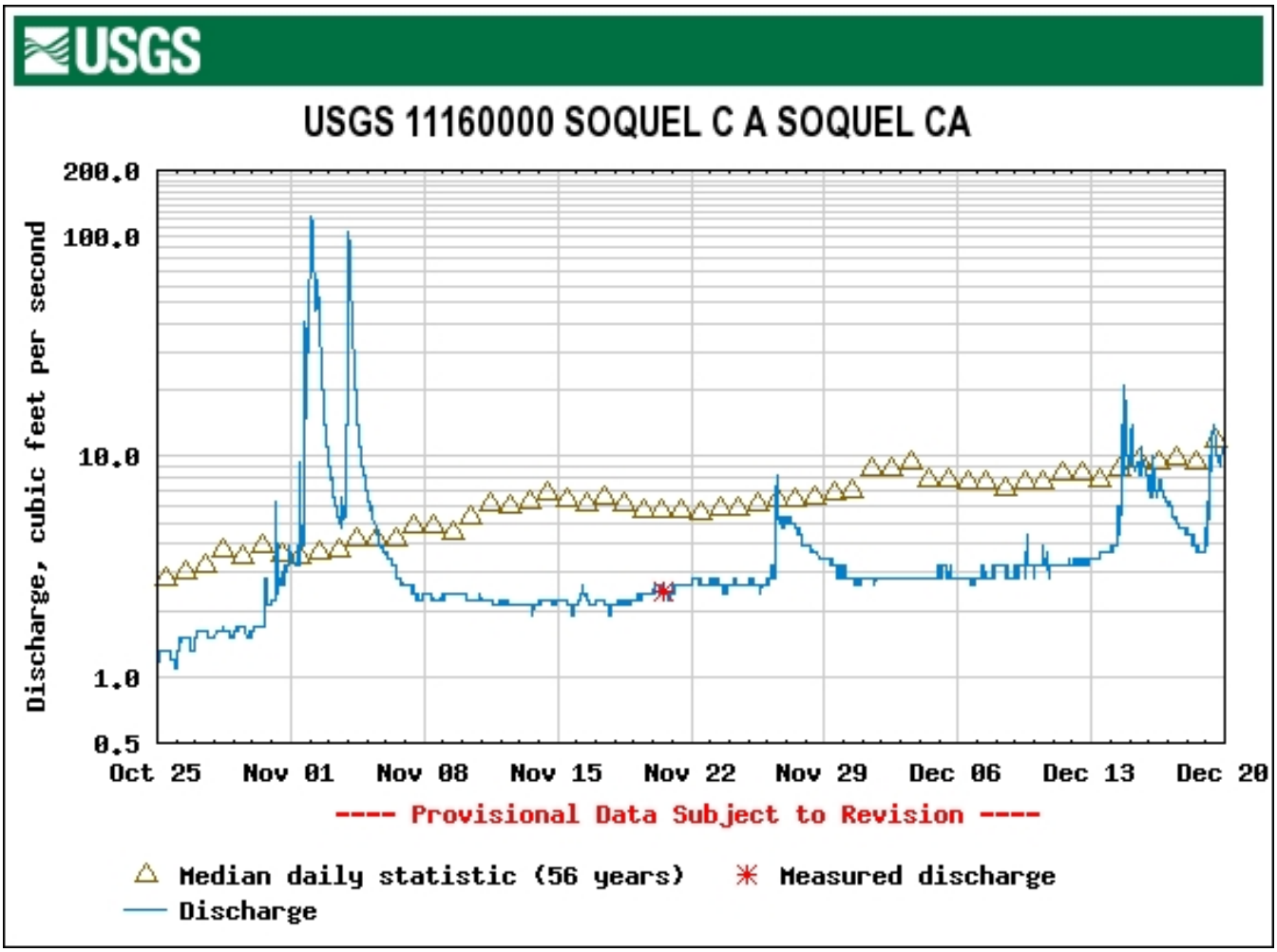


Figure 22. Soquel Creek Mean Daily Streamflow Data for the USGS Gage in Soquel, CA, 1 October 2006 – 1 July 2007.

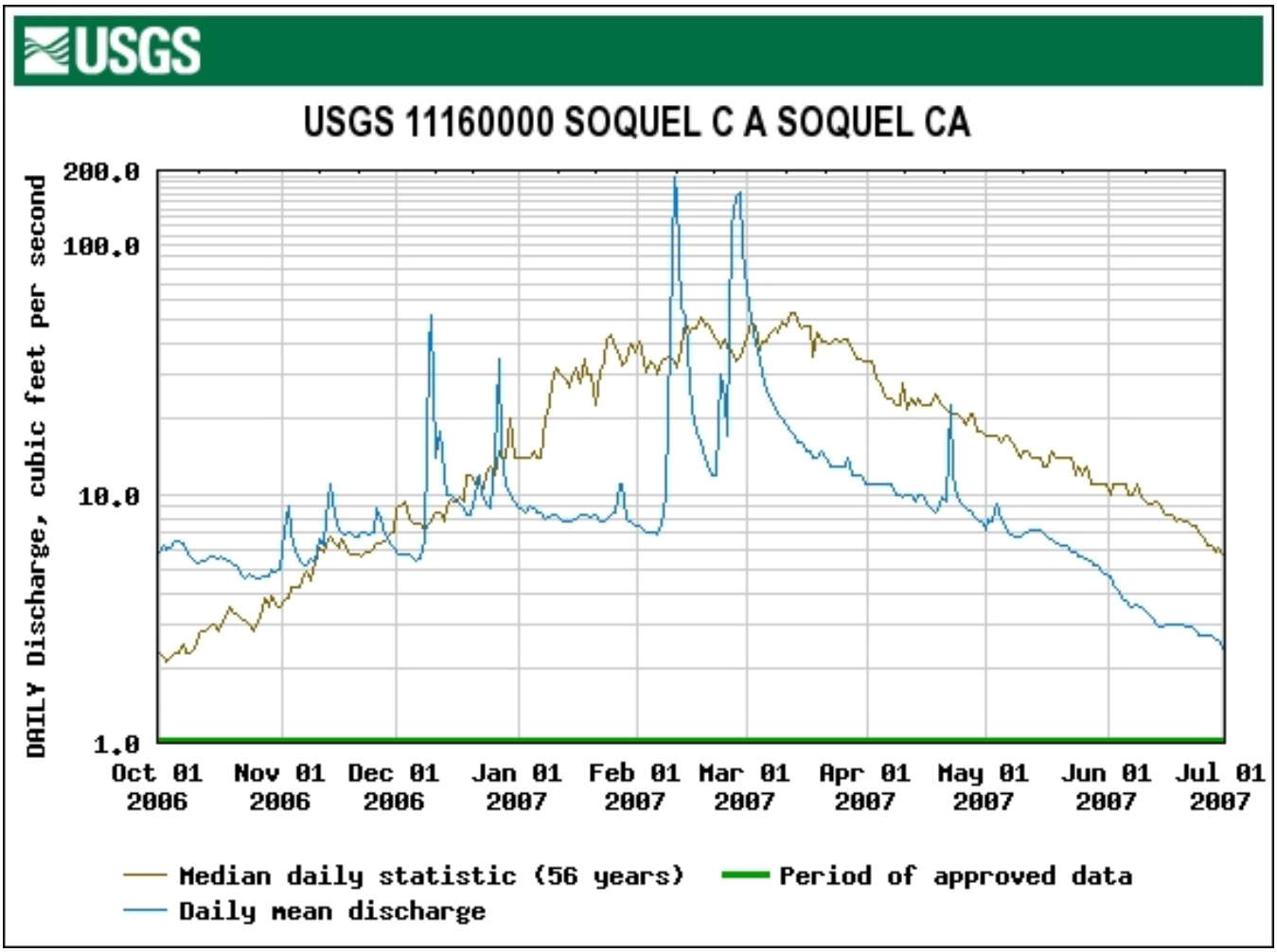


Figure 23. Soquel Creek Mean Daily Streamflow Data for the USGS Gage at Soquel, CA, 1 June – 20 December 2007.

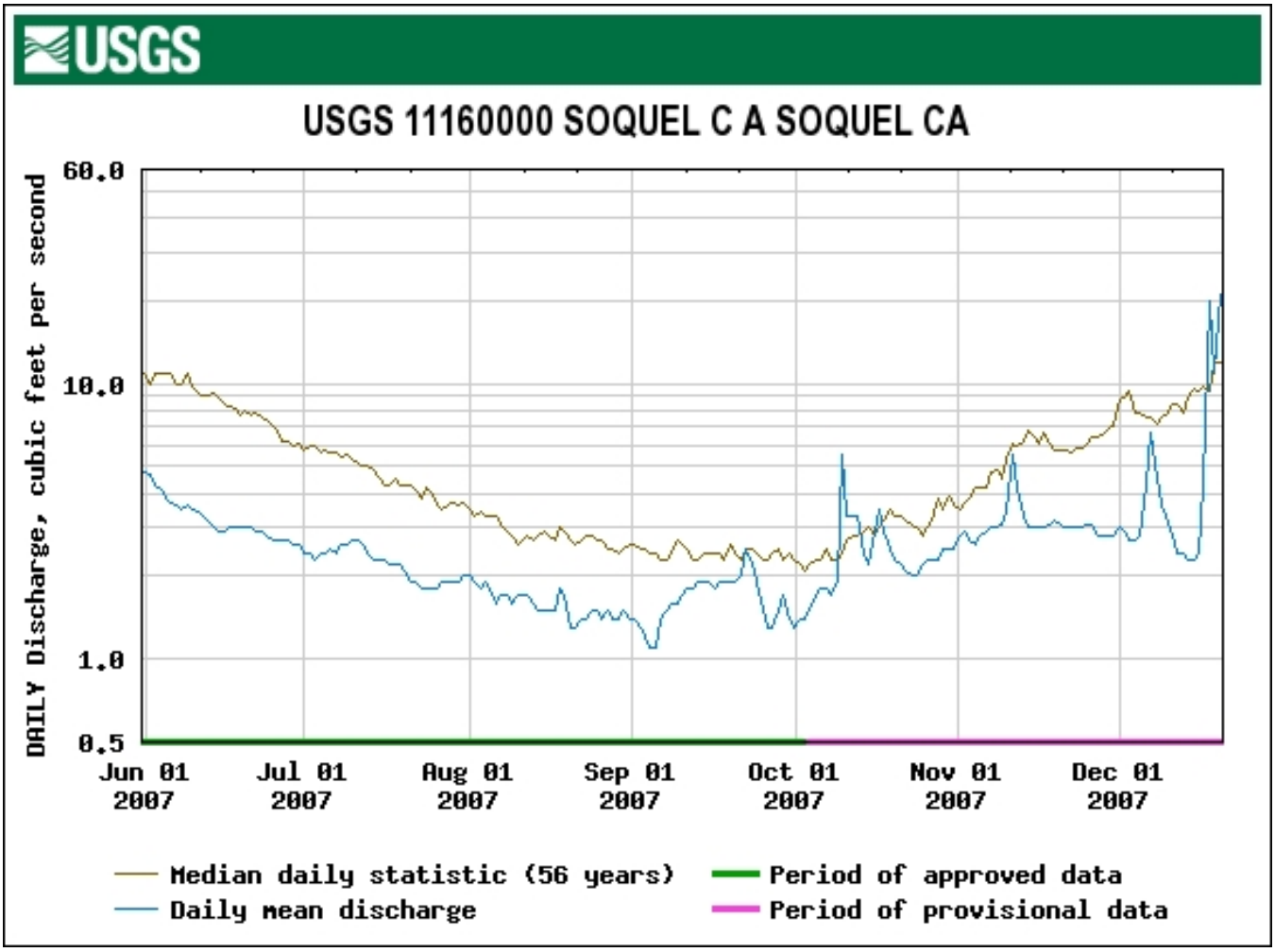
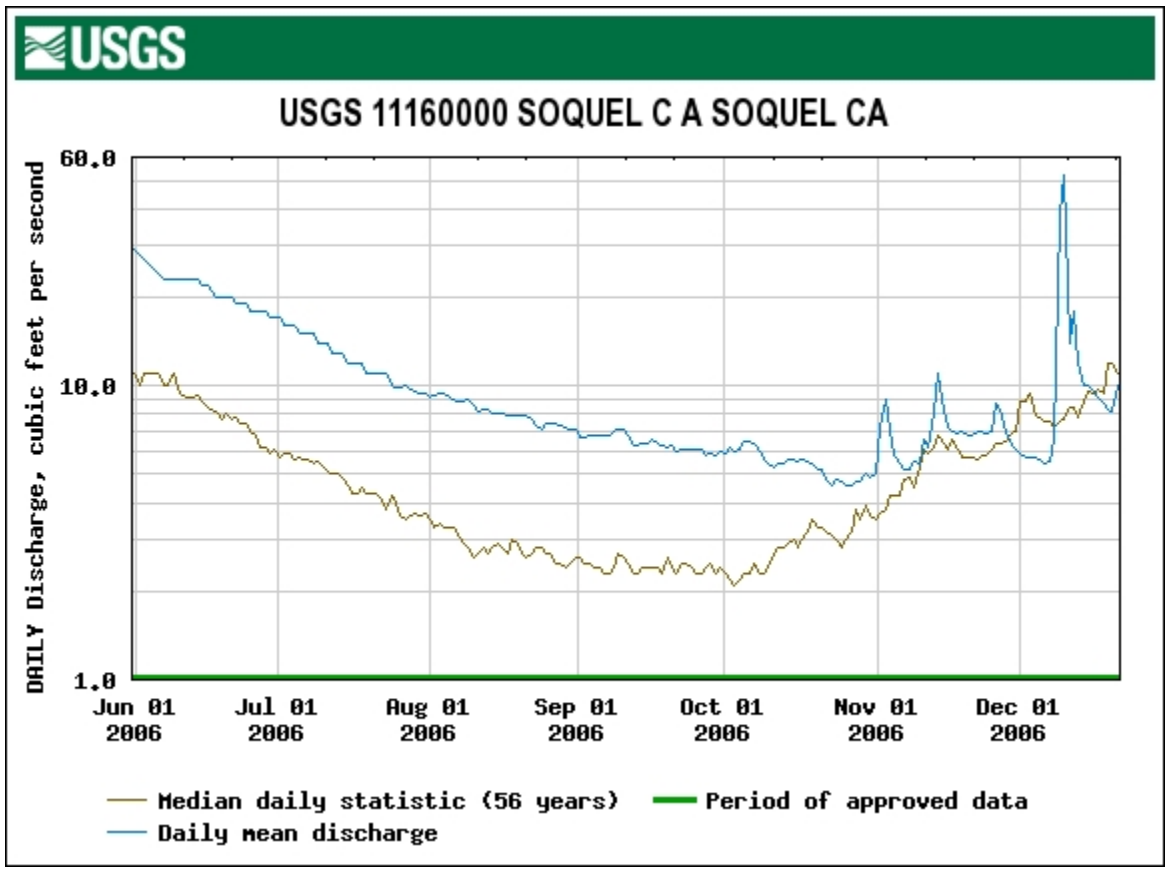


Figure 24. Soquel Creek Mean Daily Streamflow Hydrograph for the USGS Gage at Soquel, CA, 1 June – 20 December 2008.



APPENDIX A.

WATER QUALITY DATA AND GENERAL OBSERVATIONS OF BIRDS AND AQUATIC VEGETATION 26 MAY – 26 OCTOBER 2008.

26 May 2008. Launched temperature probes in the lagoon and upstream. The sandbar had been closed for the summer on 22 May. Gage height 2.40. Sunny and breezy. Saltwater present under the bridge and in the deeper hole adjacent to the Venetian Court wall. Called Morrison and recommended placement of shroud on flume inlet. It was done the next day.

			26-May-08					
	Venetian Wall 1417 hr				**Stockton Ave Bridge Thalweg**			1456 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	17.2	0.5			17.2	0.5	9.59	840
0.25	17.2	0.5			17.2	0.5	9.56	836
0.50	17.0	0.5			16.9	0.5	9.74	800
0.75	16.8	0.5			16.8	0.5	9.76	788
1.00	16.8	0.5			16.7	0.5	9.73	784
1.25	16.8	0.6			16.5	0.5	9.91	769
1.50	17.1	0.7			16.4	0.4	9.85	759
1.75	17.2	4.3			16.4	0.5	9.98	856
1.85b					20.8	4.9	0.41	8460
2.00	21.0	22.2						
2.25b	21.1	26.8						
	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-June-08					
	Flume Inlet 0722 hr/ **Venetian Wall**			0748 hr	**Stockton Ave Bridge Thalweg**			0735 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	17.7/ 18.1	0.4/ 0.4	8.87	695	17.8	0.4	9.80	696
0.25	17.8/ 18.1	0.4/ 0.4	8.86	695	17.9	0.4	9.51	696
0.50	17.9/ 18.2	0.4/ 0.4	8.96	695	17.9	0.4	9.78	696
0.75	17.9/ 18.2	0.4/ 0.4	9.05	695	17.9	0.4	9.59	696
0.85 b	17.9	0.4	8.11	695				
1.00	/ 18.1	/ 0.4			17.9	0.4	9.70	695
1.25	/ 18.1	/ 0.4			17.9	0.4	9.58	695
1.50	/ 18.2	/ 0.4			17.9	0.4	9.48	693
1.75	/ 18.3	/ 0.6			17.9	0.4	9.41	693
1.85b					17.9	0.4	7.03	692
2.00	/ 18.2	/ 0.7						
2.25	/ 19.9	/ 17.3						
2.35b	/ 20.1	/ 24.7						
	Railroad Trestle 0804 hr				**Mouth of Noble Gulch** 0830 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	17.4	0.4	10.75	685	16.6	0.4	10.87	673
0.25	17.5	0.4	10.67	685	16.7	0.4	10.79	673
0.50	17.5	0.4	10.66	684	16.6	0.4	10.86	671
0.75	17.4	0.4	10.60	684	16.5	0.4	10.58	669
1.00	17.4	0.4	10.60	683	16.4	0.4	10.80	668
1.15								
1.25	17.4	0.4	10.52	684	16.3	0.4	11.06	662
1.45 b	17.6	0.4	4.81	687	16.1	0.4	5.22	658

7 June 2008. Gage height 2.40. Sunny. Air temperature 9.7 C at 0722 hr. Reach 1- n surface algae, light planktonic algae bloom.
Station 2: Stockton Avenue Bridge at 0735 hr. Secchi depth to bottom. Reach 2
Station 3: Railroad Trestle at 0804 hr. Reach 3
Station 4: Mouth of Noble Gulch at 0830 hr. No gray water observed from Noble Gulch. 4 mallards, 2 mergansers and 1 pond turtle on downed cottonwood. 1 mallard on redwood stump. 3 mallards in lagoon upstream of Noble Gulch.
Station 5: Nob Hill at 0929 hr. Water temperature 14.0^{o}C. Conductivity 622 umhos. Salinity 0.4 ppt. Oxygen 11.34 mg/l. Estimated streamflow 4 cfs.

			07-Jun-08					
	Flume			1546 hr	**Stockton Avenue Bridge**			1518 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.3	0.4	12.45	715	19.5	0.4	11.84	719
0.25	19.1	0.4	12.93	709	19.6	0.4	11.72	719
0.50	19.0	0.4	13.01	710	19.5	0.4	11.63	718
0.75	18.9	0.4	13.14	715	19.4	0.4	11.72	717
0.85 b	19.0	0.4	11.65	711				
1.00					19.4	0.4	11.67	715
1.25					19.2	0.4	12.27	710
1.50					18.7	0.4	12.52	701
1.75					18.4	0.4	12.56	695
1.90					18.4	0.4	3.42	695
	Railroad Trestle			1505 hr	**Mouth of Noble Gulch**			1450 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	19.8	0.4	11.12	723	20.0	0.4	9.66	725
0.25	19.8	0.4	11.13	722	20.0	0.4	9.77	722
0.50	19.7	0.4	11.16	721	19.7	0.4	9.68	718
0.75	19.7	0.4	11.16	720	19.1	0.4	10.08	701
1.00	18.9	0.4	12.13	706	17.8	0.4	10.55	684
1.25	18.5	0.4	12.41	693	17.6	0.4	11.38	673
1.35b	18.3	0.4	7.82	693				
1.40b					17.1	0.4	8.45	674
1.50								

7 June 2008. Gage height of 2.63 in afternoon. Sunny.
Station 1: Flume at 1546 hr. Reach 1- 16 gulls bathing. Air temp. 16.5 C.
Station 2: Stockton Avenue Bridge at 1518 hr. Secchi depth to bottom. Reach 2- no birds.
Station 3: Railroad Trestle at 1505 hr. Reach 3- No birds below Noble Gulch. 3 mallards above Noble Gulch.
Station 4: Mouth of Noble Gulch at 1450 hr. 1 goose, 1 mallard and 3 mergansers on downed cottonwood. No gray water.

			21-June-08					
	Flume Inlet 0745 hr/ **Venetian Wall** 0815 hr				**Stockton Ave Bridge Thalweg**			0801 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/ 21.4	0.5/ 0.5	9.00	897	21.2	0.5	9.00	870
0.25	21.0/ 21.4	0.5/ 0.5	9.10	895	21.2	0.5	9.03	870
0.50	21.1/ 21.3	0.5/ 0.5	9.14	895	21.1	0.5	9.10	872
0.75	21.0/ 21.3	0.5/ 0.5	9.18	895	21.1	0.5	9.15	865
0.85b	21.0/	0.5/	0.41	895				
1.00	/ 21.3	/ 0.5			21.1	0.5	9.14	868
1.25	/ 21.3	/ 0.5			21.1	0.5	9.18	923
1.50	/ 21.2	/ 0.5			21.3	0.6	9.28	1269
1.70b					22.1	1.4	2.65	2567
1.75	/ 22.7	/ 3.0						
2.00	/ 22.0	/ 3.2						
2.25b	/ 21.6	/ 7.3						
	Railroad Trestle 0826 hr				**Mouth of Noble Gulch** 0840 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	21.2	0.4	8.98	832	21.1	0.4	8.82	787
0.25	21.2	0.4	9.06	832	21.1	0.4	8.67	786
0.50	21.2	0.4	9.08	830	21.1	0.4	8.60	785
0.75	21.2	0.4	9.04	829	20.9	0.4	8.58	780
1.00	21.1	0.4	8.06	834	20.8	0.4	8.35	762
1.25b	21.1	0.5	3.86	918	19.6	0.4	8.04	717
1.50b					19.3	0.4	4.84	710

21 June 2008. Gage height 2.32 morning. Clear. Air temperature 17.3 C at 0745 hr.
Station 1: Reach 1- Surface algae 3%- accumulated around flume. 7 mallards, 3 gulls.
Station 2: Stockton Avenue Bridge at 0804 hr. Reach 2- 1 mallard. No surface algae.
Station 3: Railroad Trestle at 00826 hr.
Station 4: Mouth of Noble Gulch at 0840 hr. Reach 3- 1 cormorant and 12 mallards. 3 mallards (1 domestic), 1 goose and 2 western pond turtles on downed cottonwood. At Gulch- 30% surface algae and the only surface algae present in Reach 3.
Station 5: Nob Hill at 0914 hr. Water temperature 19.2^{o}C. Conductivity 697 umhos. Salinity 0.4 ppt. Oxygen 8.17 mg/l. Streamflow 2 cfs.

			21-Jun-08					
	Flume			1605 hr	**Stockton Avenue Bridge**			1600 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.2	0.5	10.89	921	22.3	0.5	10.59	930
0.25	22.3	0.5	11.03	909	22.3	0.5	10.70	929
0.50	22.2	0.5	10.95	951	22.2	0.5	10.64	930
0.75	22.0	0.5	11.49	1021	22.2	0.5	10.43	928
1.00b	22.7	0.5	7.29	1028	22.2	0.5	10.12	935
1.25					22.1	0.5	10.56	987
1.50					21.9	0.7	10.35	1378
1.70b					22.5	1.9	7.18	3406
2.00								
2.25								
	Railroad Trestle			1547 hr	**Mouth of Noble Gulch**			1529 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	22.5	0.4	10.76	845	22.8	0.4	10.05	834
0.25	22.5	0.4	10.69	845	22.7	0.4	10.01	833
0.50	22.5	0.4	10.63	834	22.6	0.4	9.97	824
0.75	22.4	0.4	10.58	820	21.8	0.4	8.08	773
1.00	22.2	0.4	11.01	814	21.4	0.4	8.63	762
1.25b	22.4	0.4	6.44	819	21.2	0.4	8.31	771
1.45 b					20.3	0.4	5.06	775
1.50								

21 June 2008. Gage height of 2.30 in afternoon. Partly cloudy, sprinkles earlier, cloudy all day until late afternoon. Flume inlet 1 foot deep. Flume exit 0.8 feet depth. Air temperature 18.0 C at 1620 hr at Flume.
Station 1: Flume at 1620 hr. Reach 1- 1% surface. 40% of bottom with algae 0.1 – 0.6 ft thick; avg. = 0.3 ft.
Station 2: Stockton Avenue Bridge at 1600 hr. Secchi depth to bottom. Reach 2- 3% surface algae; bottom 80% covered with algae 0.2 - 1 ft thick, averaging 0.4 ft, remainder thin film. 2 mallards observed.
Station 3: Railroad Trestle at 1547 hr. Reach 3- 3% surface algae, 40% of bottom with algae 0.2- 0.4 ft, averaging 0.3 ft. 7 mallards dabbling.
Station 4: Mouth of Noble Gulch at 1529 hr. 10% surface algae. 5 mallard ducks and 1 goose roosting on downed cottonwood. 6 of 7 mallards in Reach 3 were above Noble Gulch.

			6-July-08					
	Flume 0702 hr / **Venetian Wall** 0755 hr				**Stockton Avenue Bridge**			0736 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.3/ 20.8	0.6/ 0.5	9.60	1234	20.9	0.5	10.71	998
0.25	21.0/ 20.8	0.6/ 0.5	9.55	1232	21.0	0.5	10.58	1000
0.50	21.0/ 20.9	0.6/ 0.5	9.49	1170	21.1	0.5	10.19	1000
0.75	20.9/ 20.9	0.6/ 0.5	9.32	1187	21.1	0.5	10.21	1000
0.80b	21.1/	0.6/	4.79	1138				
1.00	/ 20.9	/ 0.5			21.1	0.5	10.54	1004
1.25	/ 21.0	/ 0.6			21.8	0.6	10.55	1066
1.50	/ 21.7	/ 4.5			22.5	1.1	6.01	2111
1.70 b					22.3	7.1	2.60	11110
1.75	/ 22.8	/ 7.8						
2.00	/ 21.9	/ 8.1						
2.20b	/ 21.6	/ 8.2						
	Railroad Trestle 0829 hr				**Mouth of Noble Gulch**			0845 hr
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.7	0.4	9.21	833	20.0	0.4	7.66	748
0.25	20.7	0.4	9.17	832	20.0	0.4	7.73	748
0.50	20.7	0.4	9.10	831	20.0	0.4	7.02	745
0.75	20.7	0.4	9.05	843	20.0	0.4	6.85	743
1.00	20.8	0.5	9.07	900	20.0	0.4	6.44	735
1.20b	21.6	0.9	1.22	1585				
1.25					19.1	0.4	6.77	687
1.37b					18.8	0.4	2.04	676

6 July 2008. Gage height of 2.19 in morning. Foggy. Air temperature of 14.1^{o}C at 0707 hr. Reach 1- 3 merganser, 15 mallards, 8 gulls bathing. Reach 2- 1 cormorant feeding. Reach 3- no birds noted in water. 7 mallards, 1 goose and 1 green heron roosting on downed cottonwood. 1 merganser (from reach 1) and 2 mallards on redwood stump.
Station 5: Nob Hill at 0930 hr. Water temperature 17.1^{o}C. Conductivity 652 umhos. Salinity 0.4 ppt. Oxygen 8.03 mg/l. Streamflow 1.75 cfs.

			06 July-08					
	Flume			1555 hr	**Stockton Avenue Bridge**			1622 hr
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	22.2	0.6	11.22	1205	22.5	0.6	10.52	1109
0.25	22.3	0.6	11.59	1210	22.6	0.6	10.42	1107
0.50	22.2	0.6	11.64	1210	22.5	0.6	10.35	1098
0.75	22.1	0.6	11.21	1206	22.3	0.6	10.48	1070
0.85b	22.8	0.6	6.02	1205				
1.00					22.2	0.6	10.16	1060
1.25					22.2	0.9	10.63	1413
1.50					24.6	6.1	16.49	10670
1.75					22.4	6.9	4.12	
1.85					22.4	7.0	1.42	11600
	Railroad Trestle			1526 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	0.5	12.08	906	22.5	0.4	10.83	836
0.25	22.2	0.5	11.83	901	22.4	0.4	10.84	829
0.50	22.1	0.5	11.92	892	21.8	0.4	10.46	808
0.75	22.0	0.5	12.03	889	21.4	0.4	10.06	782
1.00	21.6	0.4	14.88	850	20.5	0.4	13.05	751
1.25b	21.5	0.4	6.18	844	20.4	0.4	14.02	743
1.37b					20.6	0.4	7.36	741
1.50								

06 July 2008. Gage height of 2.20 in afternoon. Sunny, breezy. Air temperature of 17.5°C at 1556 hr. Flume inlet approx. 1.0 ft depth. Flume exit depth 0.6 ft on one side.

Station 1: Flume at 1556 hr. Reach 1- less than 1% surface algae, bottom algae 30% coverage- 0.2 – 1.0 ft thick; averaging 0.5 ft. Phytoplankton bloom occurring. 35 gulls bathing in Reach 1 in afternoon with 1 pelican. Resident said 100+ pelicans in the lagoon previously.

Station 2: Stockton Avenue Bridge at 1622 hr. Secchi depth to bottom. Reach 2- less than 1% surface algae, 25% of bottom covered with algae, 0.2- 0.6 ft thick, averaging 0.4 ft, remainder film. No birds.

Station 3: Railroad Trestle at 1526 hr. Reach 3- less than 1% surface algae, 40% of bottom covered with algae 0.2- 0.5 ft thick, averaging 0.3 ft, remainder film. 20 mallards, 1 goose and 1 merganser all above Noble Gulch.

Station 4: Mouth of Noble Gulch at 1505 hr. Less than 1% surface algae, 50% of bottom algae 0.2 – 0.7 ft thick, averaging 0.4 ft and bright green. No gray water was entering lagoon from Noble Gulch. 1 mallard on downed cottonwood.

			20-Jul-08					
	Flume 0731 hr/ **Venetian Wall** 0800 hr				**Stockton Avenue Bridge**			0744
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	20.2/ 20.2	0.4/ 0.4	9.40	775	20.3	0.4	9.16	771
0.25	20.3/ 20.3	0.4/ 0.4	9.41	773	20.4	0.4	9.21	773
0.50	20.4/ 20.4	0.4/ 0.4	9.34	773	20.4	0.4	9.06	772
0.75	20.5/ 20.4	0.4/ 0.4	9.29	774	20.4	0.4	9.02	772
0.80b	20.5/	0.4/	5.12	774				
1.00	/ 20.4	/ 0.4			20.4	0.4	8.94	773
1.25	/ 20.4	/ 0.4			20.4	0.4	8.54	771
1.50	/ 20.4	/ 0.4			20.4	0.4	8.52	771
1.75b	/ 20.4	/ 0.4			20.4	0.4	2.23	771
2.00	/ 20.4	/ 0.4						
2.15b	/ 20.4	/ 0.4						
			20-Jul-08					
	Railroad Trestle 0815 hr				**Mouth of Noble Gulch**			0831 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	19.9	0.4	8.17	767	18.8	0.4	7.24	739
0.25	20.0	0.4	8.04	766	18.9	0.4	7.24	739
0.50	20.0	0.4	7.85	764	18.9	0.4	7.25	740
0.75	20.0	0.4	7.63	762	18.9	0.4	6.92	745
1.00	19.8	0.4	7.52	754	18.8	0.4	6.19	749
1.25b	19.9	0.4	1.88	755	18.5	0.4	7.02	718
1.30 b					18.3	0.4	2.76	699
1.50								

20 July 2008. Gage height of 2.07 morning. Overcast and misty. Air temperature of 13.5°C at 0731 hr.
Station 1: Flume at 0731 hr. Reach 1- 6 mallards, 11 gulls and 1 pied-billed grebe in water. **Boy feeding birds some bread.**
Station 2: Stockton Avenue Bridge at 0744 hr. Reach 2- 3 mallards.
Station 3: Railroad Trestle at 0815 hr. Reach 3- Woman feeding birds, causing congregation of 43 mallards (2 domestic) and 1 coot, with 6 others upstream.
Station 4: Mouth of Noble Gulch at 0831 hr. 1 black crown night heron and 2 mergansers on downed cottonwood. 1 mallard, 1 goose and 1 cormorant on redwood stump.

Station 5: Nob Hill at 0858 hr. Water temperature 16.0 ° C. Conductivity 625 umhos. Oxygen 7.78 mg/l. Salinity 0.4 ppt. Streamflow approx. 2.0 cfs.

			20-Jul-08					
	Flume 1630 hr				**Stockton Avenue Bridge** 1610 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	20.8	0.4	11.40	778	21.0	0.4	10.69	777
0.25	20.9	0.4	11.54	776	21.0	0.4	10.58	777
0.50	20.9	0.4	11.81	776	21.0	0.4	10.79	776
0.75	20.9	0.4	12.06	778	20.9	0.4	10.85	775
0.80b	20.9	0.4	7.14	779				
1.00					20.8	0.4	10.41	773
1.25					20.7	0.4	10.80	768
1.50					20.4	0.4	11.07	765
1.75					20.4	0.4	6.94	765
1.80b					20.4	0.4	4.62	765
			20 Jul-08					
	Railroad Trestle 1555 hr				**Mouth of Noble Gulch** 1540 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	20.6	0.4	10.59	767	21.1	0.4	9.70	776
0.25	20.6	0.4	10.60	767	21.0	0.4	9.57	770
0.50	20.6	0.4	10.78	766	20.2	0.4	8.73	757
0.75	20.6	0.4	10.87	764	19.6	0.4	8.97	744
1.00	20.4	0.4	12.84	759	19.3	0.4	10.96	744
1.25b	20.4	0.4	4.35	773	19.0	0.4	11.04	726
1.35b					19.1	0.4	6.20	730

20 July 2008. Gage height of 2.10. Sunny, breezy. Air temperature of 15.4°C at 1630 hr. Flume inlet 0.9 ft. Flume outlet 0.5 ft.
Station 1: Flume at 1630 hr. Reach 1- 16 gulls bathing. No surface algae. 30% of bottom covered with algae 0.3 – 1.0 ft thick, averaging 0.5 ft.
Station 2: Stockton Avenue Bridge at 1610 hr. Secchi depth to bottom. Reach 2- No surface algae. 99% of the bottom an algae 0.2 – 1.5 ft thick, averaging 0.4 ft. 1% pondweed and algae 2-3 ft thick, averaging 2.5 ft. 3 mallards and 1 merganser in water. 1 gull roosting on log.
Station 3: Railroad Trestle at 1555 hr. Reach 3- no surface algae, 100% bottom algae 0.2 – ½ ft, averaging 0.4 ft. 21 mallards and 1 coot in water.
Station 4: Mouth of Noble Gulch at 1540 hr. 8 mallards, 2 mergansers and 1 western pond turtle on downed cottonwood. 6 mallards on redwood stump. 30% of bottom covered with algae 0.3 – 1.0 ft thick, averaging 0.5 ft. No surface algae or gray water from Gulch.

			03-Aug-08					
	Flume 0706 hr				**Stockton Avenue Bridge** 0720 hr			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.2	0.5	11.14	946	20.5	0.5	10.87	864
0.25	20.3	0.5	11.24	946	20.6	0.5	10.85	862
0.50	20.4	0.5	11.21	947	20.6	0.5	10.66	863
0.75	20.4	0.5	11.06	948	20.7	0.5	10.85	870
1.00	20.3	0.5	11.01	956	20.7	0.5	10.54	892
1.20b	20.3	0.5	6.46	960				
1.25					20.9	0.5	10.47	963
1.50					21.5	1.2	9.81	1842
1.75					22.4	3.4	5.45	5930
1.87b					22.6	3.8	0.64	6600
			03-Aug-08					
	Railroad Trestle 0753 hr				**Mouth of Noble Gulch** 0806 hr			
Depth	**Temp 3**	**Salin 3**	**O2 3**	**Cond 3**	**Temp 4**	**Salin 4**	**O2 4**	**Cond 4**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**umhos**
0.00	20.2	0.4	10.45	774	19.4	0.4	9.28	729
0.25	20.3	0.4	10.59	773	19.5	0.4	9.18	729
0.50	20.3	0.4	10.67	773	19.6	0.4	9.06	729
0.75	20.4	0.4	10.64	773	19.6	0.4	8.75	728
1.00	20.4	0.4	10.62	773	19.6	0.4	8.69	725
1.25	20.4	0.4	10.55	773	19.2	0.4	8.39	703
1.30b	20.4	0.4	3.47	775				
1.45b					18.7	0.4	3.50	679

03 August 2008. Gage height of 2.39 (morning) and 2.42 (afternoon). Overcast at 0715 hr with air temperature at 14.2 °C. Air temperature 17.0ºC at 1605 hr and sunny. Flume inlet 0.9 ft. Flume outlet 0.4 ft in afternoon.

Station 1: Flume at 0706 hr. Reach 1- 26 gulls bathing and 19 mallards. 1 goose and 1 merganser standing on margin. 200 steelhead hits/ min at 0745 hr.
Station 2: Stockton Avenue Bridge at 0720 hr. Secchi depth to the bottom. Reach 2- 2 mallards in water. Steelhead hits observed on surface.
Station 3: Railroad trestle at 0753 hr. Reach 3- 12 mallards with 1 merganser (moved upstream from Reach 1?) and 1 pied billed grebe. On downed cottonwood- 9 mallards, 1 black crowned night heron and 1 coot.
Station 4: Mouth of Noble Gulch at 0806 hr. No gray water.
Station 5: Nob Hill at 0835 hr. Water temperature at 16.1°C. Conductivity 624 umhos, Oxygen 7.40 mg/l. Salinity 0.4 ppt. Visually estimated flow of 1.5 cfs.

1605 hr			03-Aug-08					1538 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	22.1	0.5	13.65	1022	22.3	0.5	12.33	986
0.25	22.0	0.5	13.20	1033	22.3	0.5	12.54	989
0.50	21.9	0.5	13.11	1036	22.2	0.5	12.28	1015
0.75	21.9	0.5	13.02	1035	22.0	0.5	12.42	1006
1.00	21.9	0.5	12.80	1035	22.1	0.5	12.19	1008
1.25b	22.1	0.5	7.36	1033	21.9	0.5	12.87	989
1.50					22.2	0.8	13.06	1556
1.75					24.2	3.0	13.63	5500
1.87					24.1	3.0	7.54	5520
1525hr			03-Aug-08					1506 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	22.2	0.4	13.61	838	22.6	0.4	12.19	822
0.25	22.2	0.4	13.46	838	22.3	0.4	12.13	815
0.50	22.2	0.4	13.50	838	22.0	0.4	11.82	799
0.75	22.2	0.4	13.41	836	21.6	0.4	11.51	798
1.00	22.0	0.4	13.39	833	21.1	0.4	12.10	774
1.25	21.7	0.4	12.13	832	20.9	0.4	12.47	754
1.30b	21.7	0.4	5.03	831				
1.40b					20.8	0.4	6.32	743

Station 1: Flume at 1605 hr. Reach 1- no surface algae. 95% of bottom covered with algae 0.1 – 2 ft thick, averaging 1 foot. 5% of bottom covered with pondweed and algae 2- 4 ft thick, averaging 3 ft. Reach 1: 87 gulls bathing, 1 pelican in water and one on margin, 6 dabbling mallards.
Station 2: Stockton Avenue Bridge at 1538 hr. Secchi depth to the bottom. Reach 2- No surface algae. 95% of bottom covered by algae 0.2 – 3 ft thick, averaging 1 ft. 5% of bottom covered with pondweed 2 – 4 ft thick, averaging 3 ft. 4 mallards roosting on trestle abutment. **29 mallards being fed near Stockton Bridge**.
Station 3: Railroad trestle at 1525 hr. Reach 3- Surface algae < 1%. 99% of bottom covered by algae 0.1- 3 ft thick, averaging 0.6 ft, remainder film. 7 mallards dabbling.
Station 4: Mouth of Noble Gulch at 1506 hr. 5% surface algae. 60% of bottom covered by algae 0.3 - 4 ft thick, averaging 0.6 ft. On downed cottonwood- 11 mallards. On redwood stump- 12 mallards.

0716hr			16-Aug-08					0740 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	10.69	769	20.5	0.4	11.10	767
0.25	20.6	0.4	10.72	769	20.6	0.4	10.90	766
0.50	20.6	0.4	10.71	769	20.6	0.4	10.93	766
0.75	20.6	0.4	10.67	769	20.6	0.4	10.85	766
1.00	20.7	0.4	10.73	769	20.6		10.63	766
1.05b	20.7	0.4	3.98	769				
1.25					20.6	0.4	10.77	766
1.50					20.6	0.4	10.79	766
1.75					20.6	0.4	10.59	767
1.80b					20.6	0.4	5.75	767
0800hr			16-Aug-08					0813hr
	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	20.3	0.4	9.80	760	19.6	0.4	10.19	739
0.25	20.4	0.4	9.83	760	19.6	0.4	10.23	739
0.50	20.4	0.4	9.64	760	19.6	0.4	10.24	738
0.75	20.4	0.4	9.68	759	19.6	0.4	10.20	736
1.00	20.4	0.4	9.48	759	19.5	0.4	9.45	736
1.25	20.3	0.4	9.27	764	19.3	0.4	8.23	724
1.32b	20.5	0.4	1.43	762				
1.47b					18.7	0.4	4.86	681

16 August 2008. Gage height of 2.51 (morning) and 2.51 (afternoon). Foggy and overcast in morning and sunny in afternoon. Air temperature of 15.4°C at 0716 hr and 17.4ºC at 1604 hr. Flume inlet at 0.9 ft. Flume outlet at 0.5 feet in afternoon.

Station 1: Flume at 0716 hr. Reach 1- 41 gulls bathing, 7 mallards and 1 goose in water. No surface algae. Flume at 1604 hr. Reach 1- No surface algae. 100% of bottom with algae 1-4.5 ft thick, averaging 2 ft thick. No pondweed observed though present. 43 gulls bathing and 4 mallards. No salinity on bottom at Venetian Wall- 0.4 ppt and 20.4 C at bottom at 0833 hr.
Station 2: Stockton Avenue Bridge at 0740 hr. 2 mallards in the water. Reach 2 at 1532 hr. Secchi depth to bottom. No surface algae. 97% of bottom covered with algae 1 - 4 ft thick, averaging 2 ft. 3% pondweed and algae 3 - 4 ft thick, averaging 3.5 ft. 8 dabbling mallards. Fog coming in.
Station 3: Railroad trestle at 0800 hr. Reach 3- 13 dabbling mallards. At 1517 hr, 16 mallards in water. Reach 3- No surface algae except at Noble Gulch; 100% of bottom covered with algae 1.0 - 5.0 ft thick, averaging 2 ft.
Station 4: Mouth of Noble Gulch at 0813 hr. On cottonwood- 7 mallards and 1 coot. On redwood stump- 13 mallards and 4 mergansers. At 1500 hr, 1% surface algae. 70% of bottom with algae 0.1- 3.5 ft thick, averaging 0.6 ft. On cottonwood- 4 mallards and 1 merganser. On redwood stump- 1 cormorant.
Station 5: Nob Hill at 0848 hr. Water temperature 16.2 °C. Oxygen 7.12 mg/l. Conductivity 613 umhos. Salinity 0.4 ppt. Visually estimated streamflow of 1.25 cfs.

1604hr			16-Aug-08					1532hr
	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	21.6	0.4	13.05	782	21.7	0.4	12.78	778
0.25	21.7	0.4	13.04	781	21.7	0.4	12.73	778
0.50	21.6	0.4	13.21	780	21.7	0.4	12.89	777
0.75	21.6	0.4	13.50	780	21.7	0.4	12.79	775
1.00	21.6	0.4	13.49	780	21.6	0.4	12.99	774
1.17b	21.6	0.4	8.63	782				
1.25					21.5	0.4	13.10	773
1.50					21.4	0.4	12.96	769
1.75					21.3	0.4	12.88	768
1.80b					21.3	0.4	5.37	768
1517hr			16-Aug-08					1500hr
	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	21.7	0.4	12.79	773	22.0	0.4	11.58	771
0.25	21.6	0.4	12.65	771	21.7	0.4	11.91	768
0.50	21.6	0.4	12.50	771	21.6	0.4	10.87	766
0.75	21.6	0.4	12.35	771	21.3	0.4	10.33	759
1.00	21.5	0.4	12.30	769	20.9	0.4	11.03	754
1.25	21.3	0.4	11.49	767	20.6	0.4	11.74	743
1.30b	21.2	0.4	4.52	766				
1.47b					20.1	0.4	4.71	718
1.50								
1.75								

0725hr			30-Aug-08					0740 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	21.3	0.4	11.80	732	21.5	0.4	11.31	735
0.25	21.4	0.4	11.64	732	21.5	0.4	11.26	736
0.50	21.4	0.4	11.73	732	21.5	0.4	11.27	736
0.75	21.5	0.4	11.77	732	21.5	0.4	11.22	736
1.00	21.5	0.4	11.72	733	21.6		11.03	736
1.10b	21.5	0.4	4.38	735				
1.25					21.6	0.4	10.89	735
1.50					21.6	0.4	10.73	736
1.75					21.5	0.4	10.65	736
1.98b					21.6	0.4	2.63	736
0814hr			30-Aug-08					0835hr
	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	10.21	741	20.7	0.4	10.16	729
0.25	21.3	0.4	10.12	740	20.7	0.4	10.25	729
0.50	21.3	0.4	10.17	739	20.7	0.4	10.13	729
0.75	21.3	0.4	10.03	739	20.7	0.4	9.96	729
1.00	21.3	0.4	10.07	740	20.7	0.4	9.75	727
1.25	21.3	0.4	9.94	739	20.3	0.4	8.88	698
1.30b	21.3	0.4	2.72	742				
1.45b					19.6	0.4	3.54	672
1.50								

30 August 2008. Gage height of 2.44 (morning) and 2.44 (afternoon). Foggy and breezy in morning and sunny in afternoon. Air temperature of 16.4ºC at 0725 hr and 16.4ºC at 1607 hr. Flume inlet at 0.9 ft and flume outlet at 0.3 feet in the afternoon.

Station 1: Flume at 0725 hr. Reach 1- 4 gulls bathing. Flume at 1607 hr. Reach 1- No surface algae. 5% of bottom with pondweed and algae 3 - 5 ft thick, averaging 4.0 ft. 95% of bottom with algae 1.5 – 5 ft thick, averaging 3 ft. 71 gulls bathing.
Station 2: Stockton Avenue Bridge at 0740 hr. 5 mallards dabbling. 1 greenback heron on overhanging willow. Reach 2 at 1545 hr. Surface algae < 1%. 95% of bottom covered with algae 1 - 5 ft thick, averaging 1.75 ft. 5% pondweed and algae 3- 5 ft thick, averaging 4 ft. 2 mallards in water.
Station 3: Railroad trestle at 0814 hr. Reach 3- 42 mallards dabbling and 1 merganser. At 1531 hr, 16 mallards and 2 mergansers in water. 1% surface algae; 99% of bottom covered with algae 0.2- 4.0 ft thick, averaging 1.0 ft. Remaining 1% with pondweed and algae 3- 4 ft thick, averaging 3.5 ft.
Station 4: Mouth of Noble Gulch at 0835 hr. On cottonwood- 5 mallards and 1 cormorant. On redwood stump- 1 cormorant, 2 mergansers and 4 mallards. At 1504 hr, 5% surface algae. 40% of bottom with algae 0.1- 3.0 ft thick, averaging 0.2 ft. On cottonwood- 7 mallards and 1 merganser.
Station 5: Nob Hill at 0905 hr. Water temperature 16.6 ºC. Oxygen 6.83 mg/l. Conductivity 620 umhos. Salinity 0.4 ppt. Visually estimated streamflow of 1.0 cfs. 4 mallards, 1 egret and 1 greenback heron in stream.

1607hr			30-Aug-08					1545hr
	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	22.3	0.4	12.96	743	22.3	0.4	12.23	746
0.25	22.3	0.4	13.01	742	22.3	0.4	12.24	746
0.50	22.2	0.4	13.13	741	22.3	0.4	12.38	746
0.75	22.2	0.4	13.40	740	22.3	0.4	12.22	743
1.00	22.2	0.4	13.68	740	22.1	0.4	12.65	742
1.10b	22.4	0.4	5.32	746				
1.25					22.0	0.4	12.69	740
1.50					21.9	0.4	12.08	740
1.75					21.9	0.4	12.21	739
2.00b					21.9	0.4	3.57	740
1531hr			30-Aug-08					1504hr
	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	22.3	0.4	12.71	748	22.3	0.4	11.29	752
0.25	22.3	0.4	12.67	748	22.1	0.4	10.49	751
0.50	22.3	0.4	12.62	748	22.0	0.4	10.26	750
0.75	22.3	0.4	12.70	745	21.8	0.4	9.85	754
1.00	22.1	0.4	12.05	744	21.3	0.4	10.85	756
1.25	21.8	0.4	10.56	743	21.3	0.4	11.76	749
1.30b	21.9	0.4	1.25	745				
1.37b					21.0	0.4	2.10	709
1.50								

1009hr	Begonia	Festival	31-Aug-08		Begonia	Festival		1024hr
	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	21.0	0.4	11.08	723	21.0	0.4	10.01	729
0.25	20.9	0.4	11.60	721	21.0	0.4	10.20	729
0.50	20.8	0.4	11.63	721	21.1	0.4	10.28	729
0.75	20.8	0.4	11.83	721	21.0	0.4	9.94	727
1.00	20.8	0.4	12.02	722	20.9	0.4	9.89	727
1.10b	20.9	0.4	6.16	720				
1.25					20.9	0.4	9.91	727
1.50					20.9	0.4	9.96	727
1.75					20.9	0.4	9.97	728
1.95b					20.9	0.4	4.09	728
1045 hr			31-Aug-08					1104hr
	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	20.7	0.4	10.01	727	20.4	0.4	8.72	732
0.25	20.7	0.4	9.92	727	20.4	0.4	8.78	732
0.50	20.7	0.4	9.93	728	20.3	0.4	8.55	731
0.75	20.7	0.4	10.00	727	20.2	0.4	8.04	729
1.00	20.7	0.4	9.90	727	20.1	0.4	8.03	737
1.25	20.6	0.4	8.65	726	19.8	0.4	8.14	735
1.30b	20.6	0.4	3.32	728				
1.45b					19.1	0.4	4.03	693

			31-Aug-08					1410hr
	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					21.8	0.4	12.84	737
0.25					21.8	0.4	12.76	736
0.50					21.8	0.4	12.51	736
0.75					21.8	0.4	12.37	736
1.00					21.7	0.4	11.83	735
1.25					21.7	0.4	11.96	734
1.50					21.6	0.4	11.78	734
1.75					21.6	0.4	13.01	734
1.95b					21.6	0.4	7.57	736
1430 hr			31-Aug-08					1445hr
	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	21.7	0.4	12.92	745	22.2	0.4	12.49	754
0.25	21.7	0.4	12.90	744	22.1	0.4	12.37	754
0.50	21.7	0.4	12.96	743	22.0	0.4	12.09	755
0.75	21.6	0.4	12.78	741	21.8	0.4	11.85	753
1.00	21.6	0.4	12.65	742	21.7	0.4	12.04	745
1.25	21.6	0.4	12.44	741	20.9	0.4	11.97	750
1.30b	21.6	0.4	5.32	741				
1.45b					20.6	0.4	5.56	699

31 August 2008. Begonia Festival Day. Gage height of 2.47 (morning) and 2.50 (afternoon). Sunny in morning and through day. Water temperatures were very warm but oxygen levels were also very high. 9 gulls were bathing in Reach 1 of the lagoon at 1009 hr. 5 ducks were roosting on the west side of the trestle concrete abutment in upper Reach 2. In Reach 3- 34 mallards (25 below Noble Gulch and 9 above), 3 mergansers (near Shadowbrook), 1 goose and 1 coot in the water at 1104 hr. 8 floats were in the procession down the lagoon. Waders were not allowed this year, and the lagoon bottom was not disturbed. 6 of the floats were propelled by electric motor, big change from the previous year. Only two floats were towed by kayaks. Twenty-one other boats were in the water. 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 2007-2008. 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. 30% of the surface around Noble Gulch was covered with floating algae after the procession. Flower petals were collected by Begonia Festival staff the following week.

0730 hr			13-Sep-08					0741 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	19.1	0.4	9.10	715	19.0	0.4	8.66	715
0.25	19.2	0.4	9.11	715	19.1	0.4	8.65	715
0.50	19.2	0.4	9.06	715	19.1	0.4	8.61	715
0.75	19.2	0.4	9.06	715	19.1	0.4	8.56	715
1.00	19.2	0.4	8.97	715	19.1	0.4	8.52	715
1.13b	19.3	0.4	2.43	729				
1.25					19.1	0.4	8.54	715
1.50					19.1	0.4	8.26	715
1.75					19.1	0.4	8.09	715
1.95b					19.2	0.4	2.72	717
0800 hr			13-Sep-08					0820 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	7.68	714	18.1	0.4	8.39	698
0.25	18.9	0.4	7.83	714	18.2	0.4	8.48	697
0.50	18.9	0.4	7.68	715	18.2	0.4	8.32	697
0.75	18.9	0.4	7.72	716	18.2	0.4	8.47	694
1.00	18.8	0.4	6.22	711	18.1	0.4	7.60	677
1.25	18.7	0.4	6.21	710	17.7	0.4	7.31	657
1.37b	18.8	0.4	7.38	711				
1.47b					17.7	0.4	2.89	657

13 September 2008. Gage height of 2.51 (morning) and 2.52 (afternoon). Overcast in the morning and sunny and windy in afternoon. Air temperature of 15.1 ^{o}C at 0730 hr and 17.1^{o}C at 1552 hr. Flume entrance at 0.9 ft; flume outlet at 0.5 feet in afternoon.

Station 1: Flume at 0730 hr. Reach 1- **Woman and child feeding birds at Venetian Court.** 14 gulls bathing, 2 mallards and 1 pied billed grebe in water. 1 merganser on Venetian Court margin.
Station 2: Stockton Avenue Bridge at 0741 hr. Reach 2- 9 mallards near trestle.
Station 3: Railroad Trestle at 0800 hr. Reach 3- 14 mallards, 1 goose, 1 pied billed grebe and 2 coots in water.
Station 4: Mouth of Noble Gulch at 0820 hr. 7 mallards roosting on downed cottonwood. 4 mallards and 1 cormorant on redwood stump.
Station 5: Nob Hill at 0855 hr. Water temperature of 15.4 ^{o} C. Conductivity of 591 umhos. Oxygen 7.57 mg/l. Salinity 0.4 ppt. Visually estimated streamflow 0.75 cfs.

1552 hr			13-Sep-08					5329 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	20.0	0.4	10.33	728	20.1	0.4	10.91	725
0.25	20.1	0.4	10.58	726	20.2	0.4	10.75	725
0.50	20.0	0.4	10.71	723	20.1	0.4	10.54	725
0.75	20.0	0.4	10.81	722	19.9	0.4	10.14	724
1.00	19.9	0.4	10.96	722	19.8	0.4	10.15	723
1.15b	20.1	0.4	5.02	722				
1.25					19.7	0.4	10.23	720
1.50					19.6	0.4	10.27	718
1.75					19.6	0.4	10.22	718
1.95b					19.7	0.4	3.74	718
1518 hr			13-Sep-08					1502 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	20.4	0.4	9.96	726	20.1	0.4	9.74	727
0.25	20.1	0.4	9.98	726	19.8	0.4	9.76	722
0.50	19.9	0.4	9.67	724	19.5	0.4	8.93	718
0.75	19.9	0.4	9.65	724	19.3	0.4	8.70	711
1.00	19.6	0.4	9.14	720	18.9	0.4	9.34	709
1.25	19.3	0.4	9.34	717	18.8	0.4	10.17	702
1.37b	19.4	0.4	4.53	716				
1.50b					19.0	0.4	4.22	698

13 September 2008.

Station 1: Flume at 1552 hr. Reach 1- Surface algae < 1%. 20% of bottom covered by pondweed and algae 2- 5 ft thick, averaging 4 ft. 70% of bottom covered by algae 1 – 3 ft thick, averaging 2 ft. 34 gulls bathing.

Station 2: Stockton Avenue Bridge at 1532 hr. Reach 2- No surface algae. 93% of bottom covered by algae 2 - 4 ft thick, averaging 3.5 ft thick. 7% of bottom covered by pondweed and algae 2-4 ft thick, averaging 4 ft. 1 mallard in Reach 2.

Station 3: Railroad Trestle at 1518 hr. Reach 3- 99% of bottom covered by algae 0.2- 3.0 ft, averaging 1.5 ft thick. 1% of bottom covered by pondweed and algae, 2-5 ft thick, averaging 4 ft. Reach 3- 2 mallards and 2 gulls near Noble Gulch.

Station 4: Mouth of Noble Gulch at 1502 hr. Surface algae < 1%. 40% of bottom covered by algae 0.2 - 1.0 ft thick, averaging 0.4 ft. On cottonwood- 4 mallards, 2 coots and 2 mergansers. Redwood stump- 1 mallard.

0803 hr			28-Sep-08					0814 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	19.2	0.4	8.73	698	19.5	0.4	8.57	703
0.25	19.3	0.4	8.72	698	19.6	0.4	8.56	704
0.50	19.4	0.4	8.67	698	19.6	0.4	8.35	704
0.75	19.4	0.4	8.64	698	19.6	0.4	8.28	704
1.00	19.4	0.4	8.64	698	19.6	0.4	8.27	704
1.13b	19.4	0.4	3.48	698				
1.25					19.6	0.4	8.24	704
1.50					19.6	0.4	8.03	704
1.75					19.6	0.4	7.95	704
1.80b					19.6	0.4	2.42	704
0835 hr			28-Sep-08					0850 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	19.5	0.4	7.83	711	19.0	0.4	7.54	705
0.25	19.6	0.4	7.91	712	19.0	0.4	7.40	705
0.50	19.6	0.4	7.73	713	19.0	0.4	7.41	704
0.75	19.6	0.4	7.66	713	19.1	0.4	7.31	703
1.00	19.6	0.4	7.76	712	19.0	0.4	7.56	700
1.25	19.6	0.4	7.54	711	18.4	0.4	7.60	669
1.37b	19.6	0.4	0.70	714				
1.45b					18.5	0.4	0.35	659

28 September 2008. Gage height of 2.40 (morning) and 2.40 (afternoon). Light fog in morning. Overcast in afternoon. Air temperature of 13.4 C at 0803 hr and 17.3ºC at 1532 hr. Flume inlet 0.8 ft deep. Flume outlet 0.1 ft at flume exit in the afternoon.
Station 1: Flume at 0803 hr. Reach 1- 3 gulls bathing.
Station 2: Stockton Avenue Bridge at 0814 hr. Reach 2- no birds.
Station 3: Railroad Trestle at 0835 hr. Reach 3- 18 mallards dabbling.
Station 4: Mouth of Noble Gulch at 0850 hr. 4 mallards and 1 great blue heron on cottonwood log. 2 cormorants on redwood stump.
Station 5: Nob Hill at 0916 hr. Water temperature of 15.3 ^{o}C. Conductivity of 598 umhos. Salinity 0.4 ppt. Oxygen 7.42 mg/l. Visually estimated streamflow 1.0 cfs.

1532 hr			28-Sep-08					1512 hr
	Flume				**Stockton Avenue Bridge**			
Depth	**Temp 1**	**Salin 1**	**O2 1**	**Cond 1**	**Temp 2**	**Salin 2**	**O2 2**	**Cond 2**
(m)	**(C)**	**(ppt)**	**(mg/l)**	**umhos**	**(C)**	**(ppt)**	**(mg/l)**	**Umhos**
0.00	19.9	0.4	9.91	704	19.8	0.4	9.17	705
0.25	19.9	0.4	9.79	703	19.9	0.4	9.38	706
0.50	19.8	0.4	9.89	701	19.9	0.4	9.08	705
0.75	19.8	0.4	10.14	701	19.8	0.4	9.20	705
1.00	19.8	0.4	10.21	701	19.8	0.4	9.12	704
1.13b	19.9	0.4	5.04	700				
1.25					19.8	0.4	8.77	705
1.50					19.8	0.4	8.59	705
1.75					19.8	0.4	8.43	705
1.80b					19.8	0.4	3.29	706
1459 hr			28-Sep-08					1445 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	8.91	710	19.8	0.4	8.52	713
0.25	19.8	0.4	8.86	710	19.8	0.4	8.40	714
0.50	19.8	0.4	8.77	710	19.7	0.4	8.34	715
0.75	19.8	0.4	8.65	711	19.4	0.4	8.07	716
1.00	19.7	0.4	8.40	711	19.3	0.4	7.39	718
1.25	19.6	0.4	8.14	711	18.9	0.4	7.78	705
1.37b	19.7	0.4	4.10	711				
1.45b					18.9	0.4	2.59	654

28 September 2008.

Station 1: Flume at 1532 hr. Reach 1- Visibility poor and I was unable to see vegetation. 37 gulls and 1 cormorant.

Station 2: Stockton Avenue Bridge at 1538 hr in Reach 2- 5% of bottom covered with pondweed and algae attached 3 – 5 ft thick, averaging 3.5 ft. 95% of bottom covered by algae, averaging 2 ft thick. Secchi depth to bottom. No birds.

Station 3: Railroad Trestle at 1459 hr- Reach 3- 15% of bottom covered with pondweed and algae attached 3 – 5 ft thick, averaging 3.5 ft. 85% of bottom covered by algae averaging 2 ft thick. 19 mallards, 1 goose and 6 coots in water.

Station 4: Mouth of Noble Gulch at 1445 hr- Bottom invisible. 1 gull and 1 cormorant on redwood stump.

Rain forecasted for Friday, October 3. Morrison removed 2 flume boards. Temperature probes were removed.

4 October 2008. Checked water clarity after the storm. Could see the bottom. Postponed fish sampling.

6 October 2008. Checked water clarity. Turbidity had increased. Asked Morrison to remove 1 more board. This was done and the bottom was visible then. No fish mortalities observed.

1523 hr			9-Oct-08					
	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	19.1	0.4	9.55	656				
0.25	19.2	0.4	9.36	656				
0.50	19.0	0.4	9.32	655				
0.75	18.6	0.4	8.95	650				
1.00	18.7	0.4	8.81	645				
1.25	18.0	0.4	8.86	643				
1.50b	17.9	0.4	1.24	644				

9 October 2008. Secchi depth 1.40 ft, 4 inches from the bottom. Asked Morrison to remove another board. It was done on 10 October.

0725 hr			13-Oct-08					0738 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	13.2	0.4	8.86	616	13.6	0.4	8.16	624
0.25	13.3	0.4	8.85	616	13.7	0.4	8.40	624
0.50	13.4	0.4	8.76	616	13.8	0.4	8.29	625
0.70b	13.4	0.4	4.45	614				
0.75					13.8	0.4	8.20	625
1.00					13.8	0.4	8.17	625
1.25					13.8	0.4	8.02	625
1.45b					13.9	0.4	1.32	629
1.50								
0802 hr			13-Oct-08					0815 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	13.2	0.4	7.67	628	12.6	0.4	6.59	682
0.25	13.2	0.4	7.63	628	12.7	0.4	6.52	693
0.50	13.2	0.4	7.57	628	12.7	0.4	6.35	695
0.75	13.2	0.4	7.51	628	12.7	0.4	6.31	697
1.00b	13.2	0.4	2.70	627	12.7	0.4	6.37	697
1.05b					12.7	0.4	2.05	699
1.25								

13 October 2008. Rained the previous day. Gage height of 1.24 (morning) and 1.25 (afternoon). Clear in morning and sunny in afternoon. Air temperature of 4.8 °C at 0725 hr, 14.1ºC at Flume at 1532 hr. Wide notch formed in beach with inner berm near lagoon and outer berm near surf.

Station 1: Flume at 0725 hr. Reach 1- 8 gulls bathing.
Station 2: Stockton Avenue Bridge at 0738 hr. Reach 2- 3 coots and 1 goose.
Station 3: Railroad Trestle at 0802 hr. Reach 3- 14 mallards (2 domestic ducks) in water and 3 coots and 1 gull, all near Noble Gulch.

Station 4: Mouth of Noble Gulch at 0815 hr. 2 cormorants on downed cottonwood. 1 gull on redwood stump. 1 greenback heron on overhanging willow. 1 black crown night heron on previously submerged limb now exposed.
Station 5: Nob Hill at 0844 hr. Water temperature of 10.3 ^{o}C. Conductivity of 557 umhos. Oxygen 7.76 mg/l. Salinity 0.4 ppt. Streamflow visually estimated at 0.8 cfs.

1532 hr			13-Oct-2008					1516 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	15.8	0.4	12.16	647	15.7	0.4	11.69	653
0.25	15.4	0.4	11.47	636	15.6	0.4	11.30	653
0.50	14.9	0.4	12.33	632	15.2	0.4	10.97	654
0.70b	14.8	0.4	6.10	630	14.6	0.4	11.48	657
1.00					14.1	0.4	10.07	664
1.25					13.8	0.4	9.63	662
1.50b					13.6	0.4	6.36	662
1503 hr			13-Oct-2008					1446 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	16.7	0.4	12.43	677	17.3	0.4	11.81	699
0.25	16.5	0.4	12.19	670	16.9	0.4	11.52	667
0.50	15.7	0.4	11.26	668	15.2	0.4	9.87	698
0.75	14.2	0.4	8.38	697	14.2	0.4	9.14	693
1.00b	14.3	0.4	3.74	699	14.1	0.4	9.12	700
1.05b					14.3	0.4	6.06	703

13 October 2008.
Station 1: Flume at 1532 hr. Reach 1- 15% of bottom covered with pondweed and algae attached, averaging 1.5 ft thick. Planktonic algae bloom occurring throughout lagoon.
Station 2: Stockton Avenue Bridge at 1516 hr. Reach 2- Secchi depth 1.35 meters (0.5 feet from bottom) at Stockton Bridge. 2% surface algae. 5% pondweed and algae attached. Remainder invisible. 2 coots.
Station 3: Railroad Trestle at 1503 hr. Reach 3- No surface algae, bottom invisible. 17 coots and 1 gull.
Station 4: Mouth of Noble Gulch at 1446 hr. On cottonwood- 1 cormorant, 2 mallards. Redwood stump- 2 cormorants. White oil sheen on water adjacent to the cottonwood and along west side- 120 ft x 10-15 ft wide.

1116 hr			20-Oct-08					
	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	16.3	0.4	9.95	747				
0.25	16.3	0.4	9.57	747				
0.50	16.3	0.4	9.63	746				
0.75	16.1	0.4	9.50	744				
1.00	16.0	0.4	9.53	742				
1.25	16.0	0.4	9.04	741				
1.50	16.0	0.4	9.27	741				
1.55b	16.0	0.4	6.12	742				

20 October 2008. Secchi depth to bottom. Requested 1 board be installed. It was added at 1120 hr by Kotila.

0723 hr			26-Oct-2008					0734 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	15.3	0.4	8.19	718	15.7	0.4	7.31	720
0.25	15.4	0.4	8.15	718	15.7	0.4	7.25	722
0.50	15.4	0.4	8.18	718	15.8	0.4	6.97	722
0.75	15.5	0.4	8.09	717	15.8	0.4	7.10	722
0.95b	15.5	0.4	3.69	717				
1.00					15.8	0.4	7.43	722
1.25					15.8	0.4	7.09	722
1.50					15.8	0.4	7.06	723
1.75b					15.8	0.4	2.32	722
0753 hr			26-Oct-2008					0806 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	15.7	0.4	6.06	720	15.3	0.4	6.92	688
0.25	15.7	0.4	6.50	720	15.4	0.4	6.80	688
0.50	15.8	0.4	6.44	720	15.5	0.4	6.89	688
0.75	15.8	0.4	6.61	720	15.5	0.4	6.80	687
1.00	15.8	0.4	6.59	720	15.5	0.4	6.87	690
1.25b	15.8	0.4	2.70	721	15.5	0.4	6.73	697
1.30b					15.5	0.4	1.14	729

26 October 2008. Gage height of 2.10 (morning) and 2.11 (afternoon). Overcast in morning and sunny in afternoon. Air temperature of 9.6 ^{o}C at 0723 hr and 14.9ºC at 1540 hr. Flume inlet 0.8 ft, flume outlet 0.2 ft in afternoon.

Station 1: Flume at 0723 hr. Reach 1- 83 gulls, 9 coots, 2 mallards, 1 cormorant that caught juvenile steelhead.

Station 2: Stockton Avenue Bridge at 0734 hr. Reach 2- 22 coots near trestle. Hole excavated beside

bridge, exposing drain pipe. Purpose is to connect this to sewer system.
Station 3: Railroad Trestle at 0753 hr. Reach 3- 19 coots, 8 mallards.
Station 4: Mouth of Noble Gulch at 0806 hr. On cottonwood- 2 coots, 1 goose and 1 pied billed grebe (first time that one was observed roosting and not in water).
Station 5: Nob Hill at 0835 hr. Water temperature of 12.5 ^{o}C. Conductivity of 582 umhos. Oxygen 7.96 mg/l. Salinity 0.4 ppt. Visually estimated streamflow 1.10 cfs.

1540 hr			26-Oct-2008					1510 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	16.6	0.4	10.26	735	16.7	0.4	9.87	736
0.25	16.6	0.4	10.50	735	16.8	0.4	9.77	736
0.50	16.5	0.4	10.55	733	16.7	0.4	9.36	734
0.75	16.5	0.4	10.62	732	16.6	0.4	8.99	733
1.00b	16.5	0.4	4.71	731	16.5	0.4	8.71	732
1.25					16.4	0.4	8.73	731
1.50					16.4	0.4	8.47	730
1.75b					16.3	0.4	5.40	727
1455 hr			26-Oct-2008					1438 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	16.9	0.4	9.17	732	17.4	0.4	9.08	735
0.25	16.8	0.4	8.91	731	17.2	0.4	8.90	731
0.50	16.7	0.4	8.81	730	16.7	0.4	8.82	722
0.75	16.6	0.4	8.66	729	16.5	0.4	8.66	703
1.00	16.5	0.4	8.14	727	16.0	0.4	8.60	715
1.25b	16.4	0.4	3.16	727	16.0	0.4	8.53	715
1.32b					16.0	0.4	1.42	716

28 October 2008.
Station 1: Flume at 1540 hr in Reach 1, 118 gulls bathing. No surface algae. Could not see vegetation in water column. Outer berm in notch compromised. Kelp collected in notch.
Station 2: Stockton Avenue Bridge at 1510 hr in Reach 2, No surface algae and submerged vegetation invisible. 18 coots and 1 gull.
Station 3: Railroad Trestle at 1455 hr. Reach 3- No surface algae and could not see other vegetation due to shading and turbidity. 20 coots (7 above Noble Gulch), 4 mallards (all above Noble Gulch), 2 gulls.
Station 4: Mouth of Noble Gulch at 1438 hr, No surface algae and submerged vegetation invisible. On cottonwood- 4 mallards and 1 unusual brown and white domestic duck. On redwood stump- 2 cormorants.

30 October 2008. Thursday. Two boards were removed in anticipation of a storm.
31 October 2008. Friday. Rain overnight and lagoon had risen to within 4 inches of top of flume, according to Kotila. Two more boards removed in anticipation of more rain. Lagoon water surface 6 inches below top of flume at 1100 hr.
1 November 2008. I called Kotila and Jesberg at 1900 hr, warning of increase to 30 cfs at Soquel Gage. Jesberg was already at lagoon. Kotila on the way.

According to a summary by Jesberg,

"I had monitored the creek in person from 1830 on Nov. 1, 2008.

Matt Kotila was on site from approximately 1900 to 2300. Don Alley was on site from 2030 to 2230.

Matt lowered the lagoon levee and also the outer levee in anticipation of a breach.

The rain stopped at 2100 and the flows had receded to 30 cfs.

At 2300 Matt and I left the site as the water level had not risen in over an hour and was still 8 inches below flood level.

I returned home and checked the flow and was alarmed when it read 50 cfs at 2300. I monitored the flow from home until the 0000 flow came in at 65 cfs at which time I returned to the beach.

Upon arriving at the beach, the water level had risen 7-8 inches and was just a fraction under the lowest white band. I walked up the creek path and verified that the creek was only inches below the headwall protecting the houses along Riverview Avenue.

Because it was still not raining I decided to continue to monitor the water height before calling Matt to assist with the breach.

It appeared that the water level was again staying constant. At 0115, I went to my office to check the river gauge. Unfortunately it hadn't updated since the midnight reading. I waited in my office until 0130 for an update, but not luck.

I returned to the beach at 0140 and noticed that the water level had risen again, and had breached the inner berm and flooded the area between the berms.

By hand I created a small outlet in the outer berm to release the water. By 0145 the outer berm had breached and the creek was running.

By 0215 the creek had developed a width of approximately 40 feet and was running full. The water level in the creek had dropped and the top of the flume was present."

On Monday, November 3, Jesberg notified CDFG personnel via email of the weekend breach as follows-

"Good Morning,

I am writing to notify you that the sand bar at Soquel Creek was breached at 0145 on Sunday November 2, 2008.

According to the USGS stream gauge the creek flow peak at 0215 that morning at 125 cfs.

At the time of the breach, the water level was right at flood stage and rising.

If you have any questions or need additional information please let me know

-Steve Jesberg"

Appendix B.

2008 Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon.

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK-2008				
RESTAURANT	**INITIAL CONTACT**	**TEST DATE**	**COMMENTS**	**SIGN OFF**
BEACH HOUSE 207 ESPLANADE	Daniel Ruhstorer 831 234-2647	5/22/2008		5/22/2008
BAY BAR & GRILL 209 ESPLANADE	Crystal Moraw 831 477-0749	5/21/2008	Jimmie Smith Plumbing	5/21/2008
PIZZA MY HEART 209-A ESPLANDE	Joe Valle 831 477-0749	5/21/2008	Jimmie Smith Plumbing	5/21/2008
FOG BANK 211 ESPLANDE	Kimberly Spence 831 462-1881	5/21/2008	Bellows Plumbing -	5/21/2008
PARADISE BAR & GRILL 215 ESPLANADE	Betsy Kniffin 831 476-4990	5/21/2008	Jimmie Smith Plumbing	5/21/2008
ZELDA'S 203 ESPLANADE	Ed Leipelt 831 475-4900	5/21/2008	Jimmie Smith Plumbing	5/21/2008