SOQUEL CREEK LAGOON MONITORING REPORT, 2004

Prepared by

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Prepared for

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ACKNOWLEDGMENTS

We appreciate the efforts of the Capitola Public Works Department with Matt Kotila, heavy equipment operator, in forming and maintaining the lagoon. We thank Cary Oyama for helping with seining for fish to relocate during sandbar construction (**Photographs, Appendix D**). He has been a key man in preparing the flume and lagoon for the summer since our monitoring began in 1990. We appreciate the efforts of the Begonia Festival participants to avoid wading in the lagoon during the procession. The Begonia Festival organizers and other volunteers, under the supervision of Ed Garcia of the City staff, effectively removed flowers after the Begonia Festival in September. We thank Nels and Susan Westman again for the loan of their boat for fish censusing in October. We appreciated Ed Morrison's daily attention to managing the flume inlet as streamflow lessens through the summer and in preparation for storm events. He did his best in maximizing the longevity of the sandbar in fall, 2004.

We would also like to acknowledge our appreciation of Red Hayford, former Capitola State Beach Manager and long time Capitola resident. He was an ever-familiar site as he walked the lagoon and village each day. He was a great historical resource with many interesting stories and insights about the people and animals associated with the lagoon. He was a keen observer and loved the lagoon. His perspective was much appreciated, and he will be missed.

We are grateful to the volunteers who do the annual fish censusing at the lagoon. They come mainly from Friends of Soquel Creek and Earth Links, with other interested volunteers and innocent bystanders who join in to lend a hand. Ed Morrison lent a much-appreciated hand this year. We worked with two fishery biologists from NOAA Fisheries in this, the fourteenth year of fish sampling, providing a valuable index of steelhead abundance in the lagoon. Volunteers are very welcome to help on the first two Sunday mornings in October. The fun usually ends by 1:00 pm, in time for the 49er game.

REPORT SUMMARY

Sandbar Construction and Breaching. In 2004, the flume was cleared of sand on 18-20 May. Sandbar construction began on 24 May and sandbar closure was completed on 26 May. Three artificial breaches were required. A lateral channel did not cross the beach to the jetty, as normally occurs. A few shallow isolated pools were seined in front of the sea wall to the east of the flume. No fish were found, necessitating no fish relocation. The sandbar was fully constructed and closed for the summer on 27 May. On 19 October 2004, the lagoon sandbar breached, with required facilitation, through the pre-cut notch due to lagoon filling during the second storm event of the winter season. The flume was moving water at full capacity at the time. The sandbar remained open at the time of this writing.

Stream Inflow to the Lagoon. Habitat conditions in the 2004 lagoon followed a winter with few storm events, with lower initial summer baseflow than the 6 previous years, it being similar to that in 1997. Lagoon inflow in 2004 remained much higher than in drought conditions. The early summer inflow was similar to that in 1994. However, in that year, baseflow declined to an estimated 0.05 cfs. Streamflow just above the lagoon was measured at 1.33 cubic feet per second (cfs) on 1 October 2004 at Nob Hill, compared to 1.92 cfs there in 2003, 1.28 cfs near the Grange in 2002 and 1.58 cfs in 2001 near the Grange. Lagoon water temperature was somewhat warmer in 2004 than in 2003 during short episodes, but was also somewhat cooler for short episodes presumably due to persistent fog. Stream inflow was slightly cooler in 2004 than in 2003. In 2004, the lagoon was 2 feet deeper under the Stockton Avenue Bridge and 1 foot deeper upstream of the railroad trestle compared to 2003. This deepening was due to scour that returned lagoon depth to 2002 levels in these locations. Tidal overwash occurred on 19 July 2004, causing a short, 4-day spike in lagoon water temperature at a time when stream temperature also increased. The elevated temperature was short-lived due to quick installation of the flume shroud and opening of the flume's underwater portal to rapidly draw saltwater out of the lagoon.

Water Temperature. In analyzing temperature data from the 6 data loggers throughout the water column just upstream of the railroad trestle, results were consistent with temperature data collected at monitoring stations over the past 14 years. There was no thermocline, with complete mixing of the water column. Water temperature warmed somewhat through the water column through the day, with it being coolest near the bottom except when a warm saltwater layer was trapped below freshwater in mid-July 2004. The daily difference for the maximum temperature between the near bottom and near top of the water column in 2004 ranged from zero to 1.15°C (2.06°F), as was the case in 2002 and 2004 (**Tables 4-6**). The daily difference for the minimum temperature between the near bottom and the near top of the water column was much less, ranging from zero to 0.76°C (1.37°F). Juvenile steelhead likely spent most of their time near the bottom, except when feeding on emerging aquatic insects.

Water temperatures in the lagoon closely mirrored temperatures in the stream inflow in 2004 as in 2003. Daily *minimán* the lagoon were consistently warmer than the stream above in 1999 -

2004. The daily *maxima* were warmer in the lagoon than the stream in 1999 and 2001-2004, but not in 2000. The daily stream temperature fluctuated more in the stream than the lagoon. Days when lagoon water temperatures exceeded 22°C were probably stressful for juvenile steelhead in 2004. This occurred near the bottom for 5 days after tidal overwash on 19 July, 4 days in August (2 days at a time in early and late August) and 2 days in early September (**Figure 4a**).

In the 2004 lagoon, 27% of the days measured (34 of 125 days – 1 April- 3 October) failed to meet the management goal of early morning temperatures less than 20°C near the bottom.

In 2004, the greatest daily increase in water temperature within 0.25 m of the bottom (where fish usually inhabit) from morning to afternoon measured at two-week intervals was on 6 August. The increase at Station 1 (flume) was 3.0°C (5.4°F) (**Figure 3a; Appendix A**). This was also the case on the same day at Stations 2 and 3, with increases of 3.2 and 2.4°C (**Figures 3b and 3c**). The greatest measured increase near the bottom at Station 4 (near Noble Gulch) was 1.4°C on September 3 (**Figure 3d**). The warmest afternoon water temperatures measured near the bottom in 2004 at Stations 1-4 occurred on 6 August. At Stations 1-4 they were 22.5, 22.0, 22.7 and 21.3°C (**Figures 3a-d**), respectively. The afternoon temperatures on 6 August at the surface at Stations 1-4 were 22.9 23.2, 23.3, and 23.9°C, respectively (**Appendix A**).

At the creek site near Nob Hill in 2004, 9 of 125 monitored days (**7%**; June-early October) failed to meet the management goal of *no more than 4 hours a day at greater than 20°C (68°F)* (**Figure 5i**). September was unusually cool in 2004.

Aquatic Vegetation. Filamentous algae was first noted on 27 June 2004, 4.5 weeks after sandbar closure (**Appendix A**). Pondweed was first noted on 6 August 2004, 10 weeks after sandbar closure. In 2004, pondweed became most abundant in September and continued until the sandbar breach in mid October. Pondweed was less abundant in 2004 than in 2003.

In 2004, surface algae occurred relatively early, 4 weeks after sandbar closure. It varied between 0 and 3% coverage in Reaches 1-3 until October, when it ranged between 5 and 15% coverage in Reach 1 (**Appendix A**). Surface algae was 3% at most in Reaches 2 and 3. At the mouth of Noble Gulch, surface algae ranged from 5 to 15% coverage through the summer, with it collecting on and around the submerged fence placed at the mouth to corral water hyacinths that had been placed there.

Oxygen Levels. Critical oxygen levels are lowest in the early morning after oxygen has been depleted by cell respiration and before plant photosynthesis can produce much oxygen. This was the time that oxygen levels were most importantly measured and rated. In 2004, oxygen levels for steelhead were either "fair" or "good" *near the bottom at dawn* at all stations during monitorings except at Station 2 (at Stockton Avenue Bridge) on 18 August. On that day, oxygen concentration fell to 4.64 mg/l (**Table 3, Figure 9a; Appendix A**). Otherwise, oxygen stayed above 5 mg/l at all other stations throughout the summer within 0.25 m of the bottom.

During the two-week monitorings in 2004, oxygen levels were higher in the afternoon than in the morning at all stations throughout the lagoon season except at the flume on the last monitoring day, 15 October (**Figures 9d-g**). That day, it was foggy in the morning and cloudy all day. The daily oxygen rise was least in early summer before aquatic vegetation became well established.

Begonia Festival Observations and Water Quality Findings. The lagoon depth was maintained at maximum levels of 2.52 throughout the nautical parade on Sunday, 5 September. There were 5 floats in the nautical parade. Each float was propelled differently. Only one float was pulled by waders. The secchi depth was to the bottom before and after the parade. There were 22 additional rowboats in the water after the parade. Floats were dismantled on Monday, and begonias were cleaned out of the lagoon on Tuesday. More than 90% of the begonias were collected. Water temperature and oxygen levels were within normal ranges before and after the parade on 5 September. Water quality samples taken in Reaches 1 and 2 before and immediately after the parade indicated a slight increase in sulfide in the water column in Reach 2 (from 0.2 mg/l before to 0.3 mg/l after) and no change in Reach 1 (0.2 mg/l before and after). There was no odor of hydrogen sulfide, and no fish mortality observed. Water quality measurements and observations on 8 September detected no oxygen depletion resulting from decomposing begonias or trampled aquatic vegetation. With only one float propelled by waders, there was no evidence of former wading by 8 September observations.

Fall Steelhead Sampling. Our sampling of lower Soquel Creek in fall, 2004, indicated the highest juvenile density in the 12 years of mark and recapture efforts that began in 1993. It was more than 4 times the density estimated in 2003. The steelhead population estimate based on mark and recapture for fall 2004 was 3,869 juveniles +/- 1,009 compared to 849 juveniles +/- 198 in 2003, 1,042 juveniles +/- 84 in 2002 and 454 juveniles +/-27 in 2001 (**Table 7, Figure 17**) (**Ricker 1971**). Other species captured were 4 starry flounders, one prickly sculpin and abundant threespine sticklebacks. No tidewater gobies were captured. Sampling by NOAA Fisheries in mid-November indicated that a substantial portion of the lagoon population remained in the estuary and were still growing rapidly.

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 in the lagoon. They roost 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. A better method of refuge disposal is needed. Some of the refuge cans on and around the beach had no lids. Gulls had access to refuse that they dragged onto the beach. Refuse containers with gull-proof lids may reduce gull numbers. The City has 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. 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 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 has obtained grant money to install silt and grease traps on 4 storm drains that empty into the lagoon.

Ideally, all storm drains leading to the lagoon would be re-directed away from the lagoon in summer, including the culvert draining Noble Gulch. The City is currently seeking grant funding to improve the drainage system, repairing broken pipes and redirecting summer flow where feasible. By minimizing stream inflow from Noble Gulch, there would be reduced nutrients and bacteria entering the lagoon and reduced algal production. 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. It is our understanding that grant money has been obtained to put grease and silt traps on several of these storm drains.

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.

New Recommendations and Those Not Yet Implemented

1. Replace all the open, lid-less refuse containers on the beach with gull-proof lids that are convenient to use. Use enough refuse containers to satisfy the demand for refuse disposal.

2. Look into installing gull sweeps on restaurant roofs.

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

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

5. 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 of the streamflow conditions so that direct water pumping from the stream may be reduced or discontinued until flow returns. Loss of surface flow should be prevented.

6. Regarding the Begonia Festival, continue to recommend surfboard paddling for float propulsion rather than wading. If participants choose wading, recommend that the organizers set a limit of 3 waders per float. Allow passage of these floats in one direction only, presumably downstream, and then to the dismantling location near the Stockton Avenue Bridge.

7. If wading during the Begonia Festival is requested, continue to perform more detailed water quality monitoring before and after the Begonia Festival to determine the effects of wading. Continue to measure hydrogen sulfide levels.

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

9. 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.

10. 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.

11. 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.

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

13. 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.

14. The City should seek funding and volunteers to remove invasive Arundo 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.

LAGOON AND ESTUARY FORMATION

Results of Fish Seining Prior to Construction Activities

24 May 2004. The Creek flowed parallel to the flume and did not flow laterally along the beach to the jetty. The backwater that had formed along the sea wall was seined for fish. Three small pools were present. Kelp was removed prior to seining by Don Alley and City personnel. No fish were captured or observed in 5 seine hauls. The seine was 30 ft x 4 ft with 1/8-inch mesh. The backwater area was closed off with a berm after seining to prevent inundation of this area.

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 the fourteenth year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Reports for the first 13 years are available at the City (**Alley 1991-2003**). As stated in the Soquel Lagoon Management and Enhancement Plan (**1990**), 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 could traverse the area adjacent to the flume.

Monitoring of Flume Maintenance and Sandbar Construction

18 May 2004. The Creek was flowing out to the bay in a channel parallel to the flume. In most past years, the channel had passed laterally along the sea wall east to the jetty. Personnel from the City of Capitola Public Works Department began work on clearing the flume of sand. The intent was to make it passable to out-migrating steelhead smolts prior to sandbar construction. Water was pumped from the stream channel passing through the beach into the flume portals to flush out sand. The intake pipe was screened with 1/8 inch seining material. The upstream half of the flume was the focus of work on this day. All portals were located and uncovered. The old internal weir was removed for repositioning to better create a less turbulent pool for fish to drop into from the flume inlet. When work finished for the day, all portals were covered.

19 May 2004. Public Works personnel worked on both ends of the flume this day. The outlet was opened. The screened pump intake was placed in a screened milk crate to prevent clogging with kelp and to improve pump rate. Water was flowing through the entire flume by the end of the day. The flume was approximately 2/3 full of sand. Planks were placed into the flume outlet at the end of the day. The lower third of the flume inlet was open.

20 May 2004. There was a large swell overnight. The sandbar had closed. The flume outlet had plugged with sand overnight. The lagoon was very full and about to breach through the sandbar. The flume outlet was then opened by City personnel. Water flowed out of the flume, flushing out the remaining sand. The sandbar was gently breached to allow a slow water elevation drop so that the flume could be sealed up until the following week of sandbar construction.

24 May 2004. The sandbar construction began. A sandbar had developed this year prior to the City's sandbar preparation, for the first time since the initiation of the lagoon plan in 1990. In previous years, the sandbar had not formed prior to City sandbar construction. On 23 May the sandbar had been open, however.

The sandbar was breached in the morning. The backwater that had formed along the sea wall was seined for fish as discussed above. Beach near Venetian Court was partially excavated to deepen lagoon. No work was done in the active channel. City personnel raked seagrass from upstream of the Stockton Avenue Bridge. Kelp was largely absent this year.

The biologist surveyed the Creek, looking for stranded fish. None were observed. An isolated pool was located upstream of the riffle near the trestle. No fish were observed in the pool. The sandbar dam was constructed to close the lagoon at 1120 hr in response to discovery of the isolated pool. Based on photo comparisons between estuary levels at low tide on 18 May and photos on 24 May when the isolated pool was discovered, it was evident that this pool became isolated naturally at each low tide prior to sandbar construction activities.

The flume outlet had been excavated to insure fish passage. Three planks were left in the flume outlet to insure lagoon depth overnight. The lower third of the flume inlet was open.

25 May 2004. At 0715 hr the sandbar dam was intact, with a secondary sandbar closer to the surf. The flume was open and passing water. The sandbar was opened. Sand was further excavated adjacent to Venetian Court on the west side of the estuary. Sand was moved up the beach on the east side of the exit channel. The estuary bottom was very firm this year without much ooze, unlike in 2003. Most of the seagrass was raked out of the lower estuary, downstream of Stockton Avenue Bridge this day. Five City personnel and Don Alley did the raking.

The biologist surveyed the Creek upstream and discovered the same isolated pool that had been noted the previous day. Two fish were present in the pool, one of which was a young-of-the-year steelhead. The other fish was unidentified. The pool had a maximum depth of 0.7 feet, averaging 0.3 feet. It was 50 ft by 10 ft and situated under overhanging oak and willow, making it well shaded. The pool was in no danger of drying up. The estuary channel had a less clearly scoured thalweg than previous years because of the increasingly greater cobble that was present this year. No other stranded fish were observed in the survey up the Creek. The sandbar dam was constructed between 1115 hr and 1130 hr due to the discovery of the isolated pool.

Later, Ed Morrison of the City pointed out the isolated pool to CDFG personnel (Kristine Atkinson and Jennifer Nelson), who were walking the Creek. Ms. Atkinson observed the pool and determined that it had permanence as the estuary was drained. She did not see a problem with the City delaying the sandbar damming the next day so that the excavation of the Venetian Court side could be completed, as well as preparation around the flume to prevent summer leakage.

26 May 2004. The sandbar dam was breached at 0700 hr. Kristine Atkinson of CDFG was present to observe the water draining out and noting if any fish went out with the breach. None were observed either by her or the City's fishery biologist. As instructed by CDFG, Ed Morrison of the City had placed stakes downstream from Nob Hill in flat areas of the estuary/ lagoon (not the thalweg, necessarily) to monitor the rate at which the lagoon receded after breaching.

Excavation of the sand was completed adjacent to Venetian Court. The high sandbar was constructed on that side. The interior weir was replaced in the flume. An 8-inch x 8-inch portal was cut in the lower planks of the flume inlet. The cover to the flume grate was removed. The planks were installed in the flume inlet and shimmed to prevent removal. The flume was surrounded by filter fabric and visquine. It was secured with sandbags to prevent leakage around the flume. The visquine was covered with sand. Three planks still remained in the flume exit on 26 May.

A plumbing crew repaired a sewage leak under the Beach House Restaurant prior to lagoon filling.

The sandbar dam was constructed immediately after the pad around the flume inlet was completed. The sandbar was closed for the season at 1420 hr, although the City continued to contour the beach until 3 June.

The deepest portion of the estuary was under and just downstream of the trestle, adjacent to the bedrock outcrop. There was an approximately 100 ft long section 20 feet wide that averaged 2 feet in depth and had a maximum depth of 2.7 feet. A survey of the Creek up to the Rispin Mansion parcel yielded no observed stranded fish and no juvenile steelhead observed.

27 May 2004. Water quality measurements off the Stockton Avenue Bridge at 0950 hr indicated a dilute saline layer in the lower 0.25 meters of the lagoon. The salinity ranged from 1.8 to 2.4 ppt in this layer. The lagoon level was not to the top board. City personnel were informed to install one shroud on the flume inlet. The adult passage portal was partially covered to increase lagoon level. The shroud was installed by 1240 hr with a V-notch in the top plank for juvenile fish passage. All but the lowermost plank were removed from the flume outlet.

28 May 2004. The lagoon level had increased and water was flowing into the grate on top. The adult portal was completely uncovered. The lagoon gage height was 2.64.

30 May 2004. Water temperature sensors were placed in the lagoon and upstream of the lagoon as required by the permit. Water depth at the lagoon monitoring station was approximately 1 foot deeper than in 2002 and similar to the 2001 depth.

13 June 2004. Bi-monthly lagoon monitoring indicated no detection of saltwater. The sidewalk grates were in place. The cap was installed on the stormdrain along the Esplanade.

Effects of Sandbar Construction on Tidewater Gobies in 2004

It was likely that if tidewater gobies were present, they used 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. However, artificial water level fluctuations were created during sandbar construction activities. Three sandbar breaches were required during sandbar preparation in 2004, with 3 breaches allowed by the permit without regulatory consultation. In 2004, the artificial 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. There were likely few, if any tidewater gobies left in Soquel Creek after the past torrential stormflows of the 1997-98 winter. No tidewater gobies were detected during the fall 2003 lagoon sampling. The channel lacked sheltered backwaters for fish to escape high water velocity during high stormflows. However, tidewater gobies have been detected recently in Moran Lake and Aptos Lagoon after years of no detection, and they may repopulate Soquel Lagoon in the future from adjacent populations.

Effects of Sandbar Construction on Steelhead in 2004

No negative impacts to the steelhead population were detected in 2004. Access through the flume was maintained throughout the sandbar construction period. Water quality was diminished in the rake zone during the kelp and sea grass removal. However, shaded habitat under the bridge was not disturbed, and water depth near the trestle averaged approximately 2 feet with a maximum of 2.7 feet at the estuary's shallowest. In 2004, the only juvenile steelhead observed in the main estuary during sandbar construction was a young-of-the-year (YOY) in an isolated pool on one of the days above the riffle near the trestle. When we walked the upper estuary during the 3 daily draw-downs, only the one steelhead was observed. The Creek was surveyed as far as the downstream end of the Rispin parcel. However, earlier sampling by NOAA Fisheries indicated that juvenile steelhead, both YOY's and smolts, were present in early May primarily under the Stockton Avenue Bridge. Unlike in 2002, no adult steelhead were observed in our initial observations of the lagoon.

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, freshwater conditions, with reduced potential for eutrophication and associated increased biological oxygen demand from plant decomposition and night respiration by live algae. Kelp and sea grass removal and sandbar closure create better fish habitat for tidewater goby and steelhead than if the sandbar was allowed to close naturally. Natural closure would allow considerable kelp and sea grass to become trapped in the lagoon to decompose. Under natural sandbar formation, much more saltwater would also be trapped to create an unmixed, anoxic lagoon bottom, which would collect heat and raise lagoon

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 San Lorenzo River in 1987 and 1988 by Don Alley and Stafford Lehr (now of CDFG) indicated that a few YOY steelhead were down-migrating in May, but the number greatly increased in June.

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

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 in depressions around the bridge piers. 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 quickly rake out decomposing kelp and clear the sand-filled flume. The three days of artificial breaching in 2004 required for sandbar construction was typical. However, raking time and grading time were severely reduced in 2004 because of the requirement of avoiding isolated pool formation. Fortunately, below normal amounts of seagrass and kelp were in the estuary this year.

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 comm.**).

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.)

7. 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.

8. 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.

9. Maintain the 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.

10. 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.

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. The management goal is to pass stormflow through the flume from the first small storm events in the fall. This is done by the City removing boards from the flume inlet prior to and during increased stormflow. Water also flows through the top grate constructed in the flume inlet in 2003. The wooden cover of the first flume portal may also be removed.

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 facilitates 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 2004-2005 Rainy Season.

17 October 2004. This was a Sunday after rain overnight. Boards were removed by Morrison from the flume inlet on both sides, creating an 8-inch gap on one side and a 6-inch gap on the other. The flume outlet was plugged initially on 17 October and was manually opened. The lagoon level increased one foot. The metal grate on the flume inlet was fouled with debris as water passed through. It was cleaned. Two weeks previously a wide notch had been prepared with berms formed near the flume outlet and inlet to prevent tidal overwash.

18 October 2004. The lagoon was turbid, making the bottom invisible. Morrison removed more boards so that the bottom became visible and photosynthesis could occur. Heavy rain was anticipated on Monday night and Tuesday. Steve Jesberg (in response to a complaint) required that the sandbar be lowered somewhat to prevent flooding on River View that occurred for 30 minutes in 2003. A 2-bucket load notch was cut in the sandbar near the flume inlet to prevent flooding. But some sand was put back into the notch later to prevent further tidal overwash.

19 October 2004. At 0730 hr sand was removed from the berm near the flume inlet. More boards were removed to allow the flume full flow capacity. However, the low tide was to be at around 0811 hr at 3.3 ft, preventing the flume from working at full capacity. The biological monitor and Fish and Game were notified of an impending breach, with a prediction of late morning. The sandbar was breached between 0900 and 0930 hr to prevent flooding, although the lagoon level increased above the bulkhead near the railroad trestle. The cap on the Esplanade storm drain was removed. The biologist arrived at 1000 hr. The channel width through the sandbar was 20 feet on the east side of the flume at 1000 hr. The high point of the lagoon level was 14 inches above our original piling bolt and 2-3 inches above the new center bolt. The low point of the lagoon is now at the bulkhead under the railroad trestle. A bathtub ring was observed on the fence at the new residence just downstream of the trestle. It was approximately 1 foot above the path. Morrison and Jesberg discussed placement of another bolt lower on the piling to match the elevation of the bulkhead at this flooding point.

By 1030 hr, the flume was fully exposed and the lagoon had drained to nearly the level of the floor of the flume. The water in the estuary was still pond-like, however. Wind was blowing inland with small waves moving inland. Our van was shaking in the wind. Two cormorants were floating in the estuary. A high tide of about 5.6 ft was expected this day at 1428 hr, preventing the estuary from draining completely. Juvenile steelhead could remain in the estuary if they chose. Sampling by NOAA Fisheries in mid-November indicated that a substantial portion of the lagoon population remained in the estuary and were still growing rapidly.

Recommendations Regarding Sandbar Breaching

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

2. 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.

3. Just as the first storm of the fall season begins, remove one board from each side of the flume if a small storm is anticipated. 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. Clear the sand away from the top of the flume back to the first portal cover. 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 and the opening of the first flume portal behind the flume inlet. The portal must be screened and isolated from human access to prevent a hazard to public safety. 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. Remove the first flume portal cover and screen it if the entrance of the flume cannot handle the volume of the stormflow in October and early November. There is now a grated opening on top of the flume inlet. After the stormflow subsides, replace the cover until the next storm.

4. 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.

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

6. 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.

7. 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 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 2004

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 22° C (72° 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. Based on 1988 monitoring, steelhead appear to survive in Soquel Lagoon at water temperatures of 23-25°C for 1-2 hours toward the end of the day (**Habitat Restoration Group 1990**). Water temperature may rise as much as 3-5°C during a sunny day from a minimum at dawn.

Oxygen levels critical to steelhead 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 20° C were rated "good" while those 20-21.5° C were rated "fair." Temperatures between 21.5 and 23° C were rated "poor," while those greater than 23° 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.

Locations and Timing of Water Quality Monitoring

As required under the CDFG permit for 2004, 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. The first station was at the flume inlet (**Figure 1; Photographs in Appendix D**). The second station was on the downstream side of the Stockton Avenue Bridge in the deepest thalweg area.

The third was just downstream of the railroad trestle on the east side. The fourth station was at the mouth of Noble Gulch. A fifth station was monitored in the morning in Soquel Creek near the Nob Hill shopping center, just upstream of where it entered the lagoon. The data at the stream location was used as a point of comparison with lagoon conditions when oxygen levels would be at a minimum.

In 2004, 6 HOBO temperature loggers were placed just upstream of the railroad trestle in Reach 3 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. This was a deeper portion of the lagoon. These loggers were launched on 31 May. Another logger was placed in Soquel Creek near the Nob Hill Shopping Center. All 6 loggers were removed on 3 October 2004.

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. If it had, then the shrouds would be placed on the flume inlet to suck the heavier saltwater off the lagoon bottom to hasten the freshwater conversion in the lagoon. In 2004, the CDFG permit required that monitoring occur in the early morning and late afternoon. In the past, water quality had been measured in the early morning after dawn because the most limiting factor, oxygen concentration, is at a minimum at that time.

Table 1. Temperature Conversions From Degrees Celsius to Degrees Farenheit.

Degrees Celsius	Degrees Farenheit
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. Water Quality Criteria for Measurements Within 0.25 Meters Off the Bottom at Dawn and 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

In 2004, a total of 4 water samples were collected before and immediately following the Begonia Festival Procession on 5 September. The two sampling locations were located in Reach 1, approximately 25 feet downstream of the bridge, and in Reach 2, midway between the trestle and the Stockton Avenue Bridge (**Figure 1**). Water samples were taken near the water surface.

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 20°C (68°F) at dawn within 0.25 m of the bottom and the afternoon maximum below 22°C (71.6°F) near the bottom. This early morning goal coincides with a "good" rating at monitoring sites (**Table 2**). This management goal is somewhat higher than the enhancement goal we established for Soquel Creek, where the goal was to maintain water temperature below 20°C. Maximum daily water temperature should not reach 26.5°C (79.5°F). Although Coche (**1967, cited in Kubicek and Price 1976**) determined that temperatures between 20 and 24°C 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 2003b**), with nearly all young-of-the-year juveniles in the lagoon reaching smolt size the first summer. This indicates that higher water temperature has not prevented relatively rapid growth of juveniles in the lagoon.

Water temperatures above 20°C (68°F) are considered limiting to juvenile coho salmon in the presence of steelhead (depending on food abundance), and lagoon temperatures below 16°C (60.8°F) 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 20°C (68°F). 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 20°C (68°F) in April and May when baseflow still remains above summer low-flow and juvenile salmonids are feeding and growing rapidly. From Junel to September 1, the water temperature should not rise above 20°C (68°F) more than 4 hours a day (15% of the month) and preferably the maximum daily temperature, averaged weekly, should not rise above 21°C (70°F). 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 15-18°C, 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 15-18°C, 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 16-18°C. 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 20°C average daily temperature and 25°C daily maximum as providing acceptable habitat conditions for steelhead in the Santa Ynez River (**SYRTAC 2000**) further south. The SYRTAC (**2000**) decided that a mean daily temperature of 22°C 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 23°C.

The management goal regarding water temperature prior to re-introduction of coho salmon to Soquel Creek should be that water temperatures in specified reaches meet the criteria that average daily water temperature (averaged weekly) during summer/fall months (June 1 to October 1) be 16.7°C (62°F) or less in the warmest week and that the weekly maximum temperature be 18.0°C (64°F) 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. 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 data on water quality. **Table 3** rates habitat conditions. The lagoon level was monitored 15 times in 1 to 2-week intervals from 28 May to 15 October 2004, including September 5, the day of the Begonia Festival. For 2004, the measurements of lagoon level as measured on the staff gage were rated "good" (**Table 2**) on all occasions (**Table 3; Figure 2a**). Maintenance of lagoon gage height has improved since the pre-1996 summers, particularly late in the dry season (**Figures 2a-c**). In 2004, the gage height was higher than in 2002 and 2003 early in the summer and similarly high with past years for the remainder of the summer. In the past, back pressure through the flume has likely dislodged boards to allow leakage through the flume, resulting in reduced water surface elevation. However, there was no indication that this occurred in 2004, with the use of plywood nailed to the boards to hold them together. There was need for use of the shrouds in 2004 initially after sandbar closure and for several days after 19 July, when tidal overwash occurred. The shroud remained on the flume until early July, was removed, and then put back on 19 July. Presence of the grated hole in the top of the flume for the second year allowed for better secured flashboards.

No vandalism of the flume inlet was detected in 2004. The plywood protected against both back pressure and vandalism. Wedges were used to secure the top boards, as well. A better method is still needed to secure the flashboards against vandalism, on the one hand, while allowing convenient adjustment or removal of boards by City staff when necessary. While the wedges discourage all but the most determined vandals, they do not allow easy, temporary 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 presence of a hole in the top of the flume alleviates the need for rapid board removal and replacement under some circumstances.

Flume Passability. According to the Management Plan (**1990**), fish passage is to be maintained until July 1. A flume depth of 12 inches or deeper was desired at the entrance until that time. The flume had been mostly cleared of sand the week prior to the onset of sandbar manipulation to speed the sandbar construction process. Thus, the flume was cleared completely before final sandbar closure, to insure steelhead smolt passage during and after sandbar construction. Sufficient baseflow in 2004 resulted in excellent passage for steelhead smolts until 28 June when it first closed from tidal action (**Table 3**). Throughout the remainder of the summer, the outlet was manually opened daily if it closed on its own. The baffle near the flume entrance was in place at the beginning of the summer but was dislodged on 23 July after the tidal overwash. It could not be re-secured on 26 July with the lagoon maintained. Since it was after July 1, it was left in ill repair. The sandbar breached with assistance on 19 October 2004. The flume was flowing at near full capacity and the channel through the beach was 20-30 feet wide within an hour of breaching.

Water Temperature

Results from Bi-monthly Monitoring. In 2004, lagoon water temperature was rated either "good" or "fair" at the four stations throughout the summer within 0.25 meters of the bottom except at the flume on 23 July, 4 days after the tidal overwash (**Table 3, Figures 3a-c; Appendix A**). Of the early morning monitorings, Station 1 at the flume was rated "good" 64% of the time, "fair" 27% of the time and "poor" 9% of the time. Station 2 at Stockton Avenue Bridge was rated "good" 62% and "fair" 38% of the time. Station 3 near the railroad trestle was rated "good" 50% of the time and "fair" 50% of the time. Station 4 at the mouth of Noble Gulch was rated "good" 91% of the time and "fair" 9% of the time.

Maintaining a deep lagoon for most of the summer helped to minimize water temperature. Stations 1 and 3, the shallowest, are generally warmer than the other two stations near the bottom. The 2004 temperatures were generally cooler through the summer near the bottom than in 2003 at Stations 1 (flume), 2 (Stockton Avenue Bridge) and 4 (mouth of Noble Gulch) except in June (**Figures 3a, 3b and 3d**). Stations 2 and 4 were deeper in 2004 while Stations 1 and 3 were shallower compared to 2003. Station 1 (flume) registered warmer temperature in 2004 than 2003 in June, late July (after tidal overwash in the morning) and mid-October, but was cooler through August and September (**Figure 3a**). At Station 3 (railroad trestle) in 2004, water temperature near the bottom was warmer than in 2003 in June, after the tidal overwash on 19 July and in early September at Begonia Festival time when there were several fogless days in a row (**Figure 3c**).

Lagoon water temperatures were generally cooler in the years immediately prior to the drier year 1997, except during the dry year of 1994 (**Figure 3a-c**). There was more tree canopy over the stream prior to a large storm in the 1996-97 winter and the El Niño stormflows of winter 1997-98, allowing cooler stream inflow to the lagoon in the wetter years of 1993, 1995 and 1996.

In 2004, the greatest daily increase in water temperature within 0.25 m of the bottom (where fish usually inhabit) from morning to afternoon during two-week intervals was on 6 August. The increase at Station 1 (flume) was 3.0°C (5.4°F) (**Figure 3a; Appendix A**). This was also the case on the same day at Stations 2 and 3, with increases of 3.2 and 2.4°C (**Figures 3b and 3c**). The greatest measured increase near the bottom at Station 4 (near Noble Gulch) was 1.4°C on September 3 (**Figure 3d**). The warmest afternoon water temperatures measured near the bottom in 2004 at Stations 1-4 occurred on 6 August. At Stations 1-4 they were 22.5, 22.0, 22.7 and 21.3°C (**Figures 3a-d**), respectively. The afternoon temperatures on 6 August at the surface at Stations 1-4 were 22.9 23.2, 23.3, and 23.9°C, respectively (**Appendix A**). By comparison, the warmest afternoon water temperatures measured during two-week intervals in 2003 was on 4 August. Near the bottom, the afternoon water temperatures at Stations 1-4 had been 22.8, 22.6, 22.3 and 22.0°C, respectively (**Figures 3a-d**). The afternoon temperatures on 4 August at the surface at Stations 1-4 were 23.5, 23.5, 23.0, and 24.2°C, respectively (**Alley 2003**).

Results from Continuous Data Loggers. In analyzing temperature data from the 6 data loggers

throughout the water column just upstream of the railroad trestle, results were consistent with temperature data collected through the water column at monitoring stations over the past 14 years. However, the following analysis pertains to the vicinity of these data loggers only. Our monitoring at the 4 sites indicated that Station 2 at Stockton Avenue Bridge and Station 4 near the mouth of Noble Gulch usually had cooler water temperatures near the bottom than Site 3 near the trestle (**Figures 3b-d**).

Lagoon water temperatures (**Figures 4a- 4l**) closely mirrored temperatures in the stream inflow (**Figures 5i- 5j**) in 2004. Daily temperature *minima* in the lagoon were consistently warmer near the bottom than the stream inflow in 1999-2004. Daily temperature *maxima* were warmer in the lagoon than the stream in 1999 and 2001-2004, but not in 2000. The daily stream temperature fluctuated more than the lagoon temperature.

No thermocline was detected by the data loggers or at any of the 4 monitoring stations during the summer, with complete mixing of the water column on a diurnal cycle. 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 coolest near the bottom except when warm saltwater layer was trapped below freshwater after tidal overwash. Each night, water temperature cooled to the bottom, with the surface commonly being slightly cooler than deeper layers at dawn (**Figures 4a- 4l**).

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

From 31 May through 2 October 2004, the daily maximum water temperature of the stream inflow ranged from **15.2°C** (59.4°F) on 20 September to **22.1°C** (71.8°F) on 20 July (**Figures 5i and 5j**). The daily maximum water temperature in 2004 near the lagoon surface ranged from **17.1°C** (62.8°F) on 30 September to **24.0°C** (75.2°F) on 20 July (**Figures 4k and 4l**). Near the lagoon bottom, maximum temperature ranged between **17.5°C** (63.5°F) on 30 September and **24.0°C** (75.2°F) on 20 July (**Figures 4a and 4b**). The greatest increase in water temperature recorded from morning to afternoon near the bottom in 2004 was 2.3°C (4.1°F) on 8 June (**Figures 4a-b**). The greatest increase near the lagoon surface was 2.3°C (4.1°F) on 8 June and 20 July (**Figure 4k-l**).

Days when lagoon water temperatures exceeded 22°C were probably stressful for juvenile steelhead in 2004. This occurred near the bottom for 5 days after tidal overwash on 19 July, 4 days in August (2 days at a time in early and late August) and 2 days in early September (**Figure 4a**). But conditions were stressful than in 2001 when there had been two major tidal overwashes. In 2001 for 14 days, daily temperatures near the bottom fluctuated between approximately 23 and 26°C (73.4- 78.8°F) (**Alley 2003c**).

The 2004 lagoon was somewhat warmer than the 2003 lagoon for short episodes, while it was cooler for others. This was likely partially due to the stream inflow being less in 2004 than in 2003 (**Table 3 and Alley 2003c**) and partially due to tidal overwash in 2004. Stream inflow was somewhat cooler in 2004 than 2003 (**Figures 5g- 5j**). In the 2004 lagoon, 27% of the days measured (34 of 125 days – 1 April- 3 October) failed to meet the management goal of early morning temperatures less than 20°C near the bottom. This was compared to 19% in 2003 and 10% in 2002. A total of 8.8% of the days (11 of 125 days in 2004) did not meet the management goal of maximum daily temperatures below 22°C. This was compared to 7.1% in 2003 and 2% in 2002.

The most significant water temperature differences from one day to the next likely resulted from differences in water temperature of the stream inflow on those days and differences in air temperature/ solar insolation, along with recovery from tidal overwash. The lagoon quickly cooled down once the saltwater left the lagoon, with the daily maximum being 24°C at the surface and bottom on 20 July and 21°C on the bottom on 23 July and 21.3°C at the surface by 24 July. There were also two other conspicuous cooling incidents around 18 June and 8 July, presumably caused by fog and cloudy days, when daily maxima declined between 2 and 3°C.

Detailed water temperature measurements expressed at 10-day intervals showed that the difference between maximum daily temperatures in the late afternoon at 0.5 feet from the bottom and 5.5 feet from the bottom (less than 1 foot from the surface) varied between zero and 1.15°C (2.06°F) in warming from bottom to top (**Table 4**; **Figures 4a-b and 4k-l**). This range was the same as in 2002 and 2003 (**Tables 5 and 6**). The average maximum temperature increase from bottom to top was 0.41°C (0.74°F) for the 14 days analyzed in 2004 (**Table 4**), compared to 0.60°C (1.07°F) for the 14 analyzed days in 2003 (**Table 5**) and 0.72°C (1.31°F) for the 10 days considered in 2002 (**Table 6**).

The minimum daily temperature difference through the water column in the morning was less than the maximum daily temperature difference, ranging from zero to 0.76 °C (1.37°F) in 2004 (**Table 4**). It ranged from zero to 0.38°C (0.69°F) in both 2003 and 2002 (**Tables 5 and 6**).

At the creek site near Nob Hill in 2004, 9 of 125 monitored days (**7%**; June-early October) failed to meet the management goal of *no more than 4 hours a day at greater than 20°C (68°F)* (**Figure 5i**). September was unusually cool in 2004. At the Creek site near Nob Hill in 2003, 22 of 127 monitored days (**17%**; June-early October) failed to meet the management goal (**Figure 5g**). For comparisons with 2002, beginning in July 2003, 16 of 96 days (**17%**) of the days failed to meet the management goal of no more than 4 hours a day at greater than 20°C (**Figures 5e-f**), indicating warmer stream water temperatures than in 2002. At the 2002 creek site for the same 96 days, only 4 days (**4%**) failed to meet the management goal.

With a water temperature goal of having the average weekly temperature of 16.7° C (62° F) or cooler for coho salmon, considerably more stream shading will be required to make lower Soquel Creek habitable for this species.

Table 3. Morning Water Quality Ratings in Soquel Creek Lagoon, 2004, Within 0.25 M of Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salin-ity	Lagoon In-flow Visual est. (cfs)
27 May04	open	-	- good - -		- good - -	
28 May04	open	2.64 good				
09June04	open	2.55 good	good*	good	good	4-4.5 cfs
21June04	open	2.55 good				
27June04	open	2.41 good	fair fair fair good	good	good	3.5 cfs
29June04	closed	2.90 good				
11July04	open	2.51 good	good	good	good	3.25 cfs
23July04	open	2.54 good	poor fair fair good	good fair good fair	good	
06Aug04	open	2.55 good	good good fair fair	good good good fair	good	2.5 cfs
18Aug04	open	2.53 good	fair fair fair good	good poor fair fair	good	
03Sep04	open	2.52 good	good	good	good	1 cfs
05Sep04 Begonia Festival	open	2.51 good	fair fair fair good	good	good	
05Sep04 (afternoon)	open	2.52 good				
08Sept04	open	2.47 good	- fair fair -	- good good -	-	
17Sept04	closed	2.62 good	good	good good good fair	good	1 cfs
01Oct04	open	2.54 good	good	good fair fair fair	good	1-1.25 cfs (visual) (1.33 cfs measured by flowmeter)
15Oct04	closed	2.77 good	good	good	good	1 cfs
19Oct04	Sandbar breached.					

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

Table 4. 2004 Maximum and Minimum Water Temperatures from Continuous Data Loggers at 0.5 Feet and 5.5 feet from the Bottom (Near Surface) in the Water Column Upstream of the Railroad Trestle, Reach 3 of Soquel Lagoon.

Depth Above Bottom>>>>	Max/Min Temp °C(°F)/ °C(°F) **5.5 ft**	Max/Min Temp °C(°F)/ °C(°F) **0.5 ft**	Daily Temp. Difference of Max/ Min Temp. for 0.5 to 5.5 ft from Bottom **°C(°F) / °C(°F)**
1 June	20.19 (68.33)/ 18.28 (64.91)	19.04 (66.28)/ 17.9 (64.22)	1.15 (2.05)/ 0.38 (0.69)
10 June	20.57 (69.02)/ 18.66 (65.59)	19.42 (66.96)/ 18.66 (65.59)	1.15 (2.06)/ 0 (0)
20 June	20.57 (69.02)/ 18.28 (64.91)	20.19 (68.33)/ 18.28 (64.91)	0.38 (0.69)/ 0 (0)
30 June	20.57 (69.02)/ 19.04 (66.28)	19.81 (67.65)/ 18.66 (65.59)	0.76 (1.37)/ 0.38 (0.69)
9 July	19.42 (66.96)/ 17.9 (64.22)	18.66 (65.59)/ 17.14 (62.85)	0.76 (1.38)/ 0.76 (1.37)
19 July	23.63 (74.53)/ 21.71 (71.08)	22.86 (73.15)/ 21.71 (71.08)	0.77 (1.38) 0 (0)
29 July	20.57 (69.02)/ 19.42 (66.96)	20.59 (69.02)/ 18.66 (65.59)	0 (0)/ 0.76 (1.37)
8 August	22.09 (71.77)/ 20.57 (69.02)	22.09 (71.77)/ 20.57 (69.02)	0 (0)/ 0 (0)
18 August	21.33 (70.39)/ 20.57 (69.02)	21.33 (70.39)/ 20.57 (69.02)	0 (0)/ 0 (0)
28 August	21.71 (71.08)/ 20.95 (69.71)	21.71 (71.08)/ 20.95 (69.71)	0 (0)/ 0 (0)
7 September	22.48 (72.46)/ 20.57 (69.02)	22.09 (71.77)/ 20.57 (69.02)	0.38 (0.69)/ 0 (0)
17 September	19.42 (66.96)/ 19.04 (66.28)	19.42 (66.96)/ 19.04 (66.28)	0 (0)/ 0 (0)
27 September	18.66 (65.59)/ 17.52 (63.54)	18.66 (65.59)/ 17.52 (63.54)	0 (0)/ 0 (0)
2 October	17.9 (64.22)/16.38 (61.48)	17.52 (63.54)/16.38 (61.48)	0.38 (0.68)/0 (0)

Table 5. 2003 Maximum and Minimum Water Temperatures from Continuous Data Loggers at 0.5 feet and 4.5 feet from the Bottom (Near Surface) in the Water Column Upstream of the Railroad Trestle, Reach 3 of Soquel Lagoon.

Depth Above Bottom>>>>		Max/Min Temp °C(°F)/ °C(°F) **4.5 ft**				Max/Min Temp °C(°F)/ °C(°F) **0.5 ft**	Daily Temp. Difference of Max/ Min Temp. for 0.5 to 4.5 ft from Bottom **°C(°F) / °C(°F)**
1 June		18.66 (65.59)/ 16.38 (61.48)				18.66 (65.59)/ 16.38 (61.48)	0 (0)/ 0 (0)
10 June		16.76 (62.17)/ 15.62 (60.11)				16.76 (62.17)/ 15.62 (60.11)	0 (0)/ 0 (0)
20 June		19.81 (67.65)/ 16.76 (62.17)				18.66 (65.59)/ 16.76 (62.17)	1.15 (2.06)/ 0 (0)
30 June		20.95 (69.71)/ 18.66 (65.59)				20.57 (69.02)/ 18.66 (65.59)	0.38 (0.69)/ 0 (0)
9 July		20.95 (69.71)/ 18.28 (64.91)				20.19 (68.33)/ 18.28 (64.91)	0.76 (1.38)/ 0 (0)
19 July		19.81 (67.65)/ 19.04 (66.28)				19.42 (66.96)/ 18.66 (65.59)	0.39 (0.69) 0.38 (0.69)
29 July		20.95 (69.71)/ 19.42 (66.96)				20.95 (69.71)/ 19.42 (66.96)	0 (0)/ 0 (0)
8 August		23.24 (73.84)/ 20.95 (69.71)				22.09 (71.77)/ 20.57 (69.02)	1.15 (2.07)/ 0 (0)
18 August		21.71 (71.08)/ 19.81 (67.65)				20.95 (69.71)/ 19.81 (67.65)	0.76 (1.37)/ 0 (0)
28 August		21.71 (71.08)/ 20.19 (68.33)				20.95 (69.71)/ 19.81 (67.25)	0.76 (1.37)/ 0.38 (0.69)
7 September		20.95 (69.71)/ 19.04 (66.28)				20.19 (68.33)/ 18.66 (65.59)	0.76 (1.38)/ 0.38 (0.69)
17 September		20.95 (69.71)/ 19.04 (66.28)				19.81 (67.65)/ 18.66 (65.59)	1.14 (2.06)/ 0.38 (0.69)
27 September		18.66 (65.59)/ 17.90 (64.22)				18.28 (64.91)/ 17.52 (63.54)	0.38 (0.68)/ 0.38 (0.68)
4 October		18.66 (65.59)/17.14 (62.85)				18.28 (64.91)/17.14 (62.85)	0.38 (0.68)/0 (0)

Table 6. 2002 Maximum and Minimum Water Temperatures at One Foot Intervals Through the Water Column Upstream of the Railroad Trestle, Reach 3 of Soquel Lagoon.

Depth Above Bottom>>>>	Max/Min Temp °C(°F)/ °C(°F) **5.5 ft**	Max/Min Temp °C(°F)/ °C(°F) **4.5 ft**	Max/Min Temp °C(°F)/ °C(°F) **3.5 ft**	Max/Min Temp °C(°F)/ °C(°F) **2.5 ft**	Max/Min Temp °C(°F) /°C(°F) **1.5 ft**	Max/Min Temp °C(°F)/ °C(°F) **0.5 ft**	Temp. Diff. of Max/ Min Temp. for 0.5 to 5.5 ft from Bottom **°C(°F) / °C(°F)**
3 July					20.57 (69.71)/ 19.04 (66.28)	20.19 (68.33)/ 19.04 (66.28)	
10 July	22.48 (72.46)/ 20.19 (68.33)	22.48 (72.46)/ 20.19 (68.33)	22.48 (72.46)/ 20.19 (68.33)	22.09 (71.77)/ 20.19 (68.33)	22.68 (73.15)/ 20.19 (68.33)	22.09 (71.77)/ 20.19 (68.33)	0.39 (0.69)/ 0 (0)
20 July	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 17.9 (64.22)	19.42 (66.96)/ 17.9 (64.22)	0 (0)/ 0.38 (0.69)
30 July	21.33 (70.39)/ 19.42 (66.96)	21.33 (70.39)/ 19.42 (66.96)	21.33 (70.39)/ 19.42 (66.96)	21.33 (70.39)/ 19.42 (66.96)	20.95 (69.71)/ 19.42 (66.96)	20.95 (69.71)/ 19.42 (66.96)	0.38 (0.68)/ 0 (0)
9 August	21.71 (71.08)/ 19.42 (66.96)	21.71 (71.08)/ 19.42 (66.96)	21.71 (71.08)/ 19.42 (66.96)	21.33 (70.39)/ 19.42 (66.96)	20.95 (69.71)/ 19.42 (66.96)	20.95 (69.71)/ 19.42 (66.96)	0.76 (1.37)/ 0 (0)
19 August	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 17.9 (64.22)	18.66 (65.59)/ 17.9 (64.22)	18.66 (65.59)/ 17.9 (64.22)	0.76 (1.37)/ 0.38 (0.69)
29 August	19.04 (66.28)/ 18.28 (64.91)	19.04 (66.28)/ 18.28 (64.91)	19.04 (66.28)/ 18.28 (64.91)	18.66 (65.59)/ 18.28 (64.91)	18.28 (64.91)/ 17.9 (64.22)	18.28 (64.91)/ 17.9 (64.22)	0.76 (1.37)/ 0.38 (0.69)
8 September	20.19 (68.33)/ 18.28 (64.91)	19.81 (67.65)/ 18.28 (64.91)	19.81 (67.65)/ 18.28 (64.91)	19.81 (67.65)/ 18.28 (64.91)	19.42 (66.91)/ 18.28 (64.91)	19.42 (66.91)/ 18.28 (64.91)	0.77 (1.42)/ 0 (0)
18 September	20.19 (68.33)/ 18.28 (64.91)	19.81 (67.65)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.42 (66.96)/ 18.28 (64.91)	19.04 (66.28)/ 17.9 (64.22)	19.04 (66.28)/ 17.9 (64.22)	1.15 (2.05)/ 0.38 (0.69)
28 September	18.28 (64.91)/ 16.76 (62.17)	18.28 (64.91)/ 16.76 (62.17)	17.52 (63.54)/ 16.76 (62.17)	17.52 (63.54)/ 16.76 (62.17)	17.14 (62.85)/ 16.76 (62.17)	17.14 (62.85)/ 16.76 (62.17)	1.14 (2.06)/ 0 (0)
5 October	17.9 (64.22)/16.0 (60.8)	17.52 (63.54)/16.0 (60.8)	17.14 (62.86)/16.0 (60.8)	16.76 (62.17)/16.0 (60.8)	16.76 (62.17)/15.62 (60.11)	16.76 (62.17)/15.62 (60.11)	1.14 (2.05)/0.38 (0.69)

Creek conditions in 1999-2004 had been 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 21° C (69.8° F) for several hours each day in the stream above the lagoon, with a maximum of approximately 23.5° C (74.3° F) on 3 August 1998 (**Figure 6c**). Daily maxima were still approaching 21°C 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 compared to other years (**Alley 2003**).

Aquatic Vegetation. Filamentous algae was first noted on 27 June 2004, 4.5 weeks after sandbar closure (**Appendix A**), compared to 7 July 2003, 6 weeks after sandbar closure in 2003 (**Alley 2003**). Pondweed was first noted on 6 August 2004, 10 weeks after sandbar closure, compared to 4 August 2003, 10.5 weeks after sandbar closure in 2003. In 2004, pondweed became most abundant in September and continued until the sandbar breach in mid October. In 2000-2003, pondweed became prominent earlier in mid- to late August 2003, and remained so into late October. Pondweed was not noticed until 14 August in 2000 and not until 20 August in 1999. The year, 2003, was unusual in that two species of pondweed were detected, one with ovate leaves and one with filamentous leaves. Pondweed was less abundant in 2004 than in 2003.

In 2004, surface algae occurred relatively early, 4 weeks after sandbar closure. It varied between 0 and 3% in reaches 1-3 until October, when it ranged between 5 and 15% in Reach 1 (**Appendix A**). Surface algae was 3% at most in Reaches 2 and 3. For comparison in 2003, surface algae reached 5% in August, late September and early October in Reaches 2 and 3. It was 5% in Reach 2 and 10% in Reach 3 in late October.

At the mouth of Noble Gulch, surface algae ranged from 5 to 15% through the summer, with it collecting on and around the submerged fence placed at the mouth to corral water hyacinths that had been placed there. In 2003, surface algae at the Gulch reached 20% by late October. In 2002 the most surface algae coverage was 5% of the surface in Reaches 2 and 3 just before the Begonia Festival on 1 September and in those Reaches and at Noble Gulch in mid-September. Surface algae never really developed in 2001, with only 1-2% coverage appearing in September after the Begonia Festival. In 2000 the most coverage was 15% in Reach 3 in mid-August. In 1999, surface algae had reached a maximum during the two July monitorings, with as much as 25% of certain reaches being covered.

Dissolved Oxygen. Critical oxygen levels are lowest in the early morning after oxygen has been depleted by cell respiration and before plant photosynthesis can produce much oxygen. This was the time that oxygen levels were most importantly measured and rated. In 2004, oxygen levels for steelhead were either "fair" or "good" *near the bottom at dawn* at all stations during monitorings except at Station 2 (at Stockton Avenue Bridge) on 18 August. On that day, oxygen concentration fell to 4.64 mg/l (**Table 3, Figure 9a; Appendix A**). Otherwise, oxygen stayed above 5 mg/l at all other stations throughout the summer within 0.25 m of the bottom. The one "poor" rating in 2003 was also on 18 August, but at Station 3 under the railroad trestle. In 2003

and 2004, morning oxygen concentrations near the bottom were usually least near Noble Gulch (Station 4), followed by the trestle location (Station 3), then by the Stockton Avenue Bridge and at the flume. The lower oxygen at Noble Gulch was perhaps due to the higher density of algae and pondweed in that vicinity and more cell respiration through the night to depress oxygen levels. Station 3 under the trestle is subject to pigeon droppings that encourage algae production and decomposition that lead to higher oxygen depletion at night. In 2002, oxygen was rated "fair" or "good" near the bottom (**Figure 8**). In 2001 they had been rated "good" near the bottom on all monitorings except at the railroad trestle in October (**Figure 7**).

Oxygen concentration in the stream above the lagoon (Station 5) in the morning was often higher than at Stations 2-4 near the bottom, but not always and particularly not in September and October. Station 1 at the flume often had higher morning oxygen levels than the creek. Similar trends were observed in 2003. (**Figures 9a-b; Appendix A**).

During the two-week monitorings in 2004, oxygen levels were higher in the afternoon than in the morning at all stations throughout the lagoon season except at the flume on the last monitoring day, 15 October (**Figures 9d-g**). That day, it was foggy in the morning and cloudy all day. The daily increase in oxygen was least early in the season before aquatic vegetation became well established. Higher oxygen levels were also measured in the afternoons in 2003 except a Station 2 (Stockton Bridge) early in the season in June before filamentous algae and pondweed began to develop (**Figure 9b-c; Alley 2003c**).

Salinity. Slight salinity was detected immediately after sandbar construction. However, with installation of the flume shroud and the underwater portal operating for adult out-migration, remaining saltwater was absent 2 weeks after sandbar closure. Salinity was a concern during and after the tidal overwash on 19 July, and lagoon water temperature was elevated to a seasonal high. However, by 23 July, it could not be detected on our original salinity meter (**Appendix A**), and lagoon water temperature was back down to normal (**Figures 4a-4l**).

Conductivity. Conductivity remained low throughout most of the summer/fall in 2004 (**Appendix A**). Conductivity was only slightly elevated at Stations 1 and 2 closest to the beach on the fourth day after the tidal overwash that occurred on 19 July (**Appendix A**). Conductivity was not measured immediately after the tidal overwash, when it may have been stressful to steelhead near the lagoon bottom. The highest lagoon conductivity measured during 2-week monitorings was 920 umhos at the flume on 23 July. Conductivity in the creek was generally lower than in the lagoon. The highest conductivity detected in the creek was 656 umhos on the morning of 18 August, which was lower than any lagoon readings that day.

Stream In-Flow to the Lagoon. The lagoon water quality is generally best when more summer baseflow occurs. When tidal overwash occurs or saltwater back-flushes into the lagoon, with more summer baseflow the saltwater is flushed out of the lagoon more quickly to reduce lagoon heating. The year 2001 was most affected by tidal overwash in the last 6 years. With proper flume management and the new grated flume ceiling, it should be easier to maintain lagoon

depth and prevent fluctuations in lagoon level when the summer begins with high baseflow. An improvement in the early summer was seen in 2004 (**Figure 2a**). To maximize summer baseflow, water percolation into the aquifer must be maximized and surface runoff must be minimized during the rainy season. 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.

Water quality worsens at the end of the dry season in most years, when stream inflow is at a minimum. Shortly after sandbar closure, streamflow into the lagoon was visually estimated in June at 4- 4.5 cfs (2004) (**Table 3**), 10-12 cfs (2003), 8 cfs (2000), 8-10 cfs (1999) and 31.2 cfs (1998) (measured with flowmeter in 1998) (**Alley 1999-2003**). Data were lacking 2001 and 2002 in June. At the end of the dry season, inflow to the lagoon at Nob Hill was 1.33 cubic feet per second (cfs)(measured by flowmeter) on 1 October 2004 compared to 1.91 cfs (2003), 1.28 cfs (2002), 1.58 cfs (2001), 2.32 cfs (2000) and 3.7 cfs (1999) at the Soquel Village Grange (0.6 miles upstream of lagoon) in late September and October. In 1998, the Coastal Watershed Council measured streamflow at Nob Hill to be 6.91 cfs in mid-September. The lowest visually estimated summer baseflows in 1995, 1996 and 1997 had been 2.5 cfs, 2.25 cfs and 1 cfs, respectively (**Alley 1996-1998**). In 1994, lagoon in-flow declined below 1 cfs by late July and to an estimated 0.05 cfs by late September, even though the visually estimated baseflow in June had been similar to 2004 at 3.5- 4 cfs (**Alley 1995**).

Drain Line Test for Restaurants Contiguous with Soquel Creek Lagoon. The restaurants contiguous with the Soquel Creek Lagoon that had accessible plumbing systems were tested for leaks and repaired as necessary. Confirmation is contained in **Appendix B**.

Begonia Festival Observations and Water Quality Findings. The City's fishery biologist was present during and after the Begonia Festival. The day of the Festival, 5 September, was fogless and warm. The lagoon depth was maintained at maximum levels of 2.52. There were 5 floats in the nautical parade. Each float was propelled differently. One used 3 surfers on boards. One used 3 waders. One used 2 kayaks. One used a canoe. One used an electric motor and propeller. The secchi depth was to the bottom before and after the parade. There were 22 additional row boats in the water after the parade. Children on the floats were throwing begonias into the water after the parade. However, they were instructed to stop, and they did so. Floats were dismantled on Monday, and begonias were cleaned out of the lagoon on Tuesday. More than 90% of the begonias were collected. Water temperature and oxygen levels were within normal ranges before and after the Parade on 5 September. Water quality samples taken in Reaches 1 and 2 before and immediately after the Parade indicated a slight increase in sulfide in the water column in Reach 2 (from 0.2 mg/l before to 0.3 mg/l after) and no change in Reach 1 (0.2 mg/l before and after). There was no odor of hydrogen sulfide, and no fish mortality was observed. Water quality measurements and observations on 8 September detected no oxygen depletion resulting from decomposing begonias or trampled aquatic vegetation. With only one float propelled by waders, there was no evidence of former wading on 8 September.

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 (**Alley 1995; 1996b; 1997-2000**). In 2001 and 2002, no gray water was observed during monitorings, but in 2003, the water was murky on 2 of 12 monitorings and in 2004 there was one occurrence in 11 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. Oxygen depletion has been consistently greater at the mouth of Noble Gulch in 2002-2004 (**Figures 8, 9a and 9d**) and other years, although oxygen concentration was in the good range 6 times and "fair" 6 times (**Table 3; Figure 9d**). Oxygen was in the "good" range throughout 2001 (**Figure 7**) and 2002 (**Figure 8**). Adjacent to Noble Gulch in 2003, the oxygen rating in the morning was "good" 6 times and "fair" 6 times (**Figure 9a**). 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 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.

A temporary submerged fence spanned the mouth of Noble Gulch in 2004, and water hyacinths were placed inside the fence by a member of the City Council. These plants may help reduce nutrient inputs to the lagoon in the future. However, the water hyacinths floated into the culvert soon after placement and were lost. A secondary fence or netting would be necessary to keep the plants in the sunlight.

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. 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 be reduced, then the gull population would probably decline and pollution would be reduced at Soquel Lagoon. Better refuge disposal is needed. Some of the refuge cans currently on the beach have no lids.

The gulls have excellent access and commonly drag refuge out of these cans. Refuse containers with lids that were gull-proof and user-friendly to beach-goers may reduce gull numbers. Regarding roosting, there are methods available to make buildings' roofs inhospitable to gulls. Gull sweeps are an effective option.

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.

A large Arundo (giant reed) invasion has occurred below Highway 1. These invasive plants reduce stream shading by eliminating riparian trees, may restrict fish feeding with their overhanging and reduce wildlife habitat by reducing plant species diversity. The Friends of Soquel Creek and the Santa Cruz County RCD removed Arundo upstream of Highway 1 in 2004.

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

1. Replace the open, lid-less refuse cans on the beach with those with gull-proof lids and convenience in use. Use enough refuse cans 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. Do not allow the pedal boat operator to dictate lagoon level.

5. Maximize lagoon depth throughout the dry season, while maintaining passage through the flume for adult steelhead until June 1 and 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 on the other side after June 1, close the underwater portal for adults. Close the adult portal by July 1 in any event. If adult steelhead are seen in the lagoon after June 1 and the adult portal has been closed, then open the hole for a week, allowing them to out-migrate.

6. After July 1, leave the flume exit closed once it closes, unless flooding is eminent. Install visquine 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.

7. Secure the flume boards to prevent their lifting by vandals to drain the lagoon.

8. 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 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.

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

10. Do not reduce the lagoon level for the Begonia Festival

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. Regarding the Begonia Festival, we recommend that float propulsion by surfboard paddling or row boat or electric outboard motor continue to be encouraged rather than pulling and pushing by waders. If wading is allowed, set a limit of 3 waders per float. 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.

14. If wading during the Begonia Festival is requested, continue to perform more detailed water quality monitoring before and after the Begonia Festival to determine the effects of wading. Continue to measure hydrogen sulfide levels.

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

16. 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.

17. The City should seek funding and volunteers to remove invasive Arundo 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 in Soquel Creek

As in 2001-2003, no steelhead were planted in Soquel Creek in 2004. It appears that CDFG allowed planting in streams where the juvenile's parents were captured in those streams (San Lorenzo River and Scott Creek). No adult steelhead were captured from Soquel Creek for the hatchery. Therefore, no juveniles were planted.

Results of Fish Sampling in Soquel Creek Lagoon

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. Tidal overwash was an issue in 2004, as it had been in 2001. In 2004, lagoon water temperature reached 24°C (75.2°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 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 fluctuated between approximately 23 and 26°C for 14 days near the bottom 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 increased temperature increased fish metabolic rate, possibly reducing growth rate in 2001.

Fall sampling for steelhead occurred on 3 and 10 October 2004, from just upstream of the Stockton Avenue Bridge, downstream. A bag-seine with dimensions 106-foot long by 6- feet high by 5/16-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. On 3 and 10 October, a total of 447 unclipped juvenile steelhead (compared to 204 in 2003 and 509 in 2002) ranging from 65 to 199 mm Standard Length (SL). A total of 281 juveniles from 4 effective seine hauls were marked on 3 October. On 10 October, 166 unmarked (unclipped) steelhead and 13 marked steelhead were captured from 5 effective seine hauls. The median size of steelhead captured on both days was just barely 115-119 mm in 2004 compared to 110-114 mm in 2003, 105-109 mm SL in 2002 and 125-129 mm SL in 2001 (**Figures 10-13**). In 2000, the median size increment was 135-139 mm SL (**Figure 14**). In 1999 it had been 120-125 mm SL (**Figure 15**). In 1998, the most popular size

increment was 115-119 mm SL (**Figure 16**). Comparison of size distributions and the median size in each of the last 6 years, young-of-the-year growth rate was similar in 2002-2004, with faster growth rates in 1998 2001.

More juveniles were captured and marked on the first weekend in 2004 than in 2003, though a much smaller portion of the estimated 2004 population of 3,869 juveniles (**Figure 7**). On 3 October the sky was overcast and may have not stimulated as many steelhead to seek shelter from the shade under the bridge.

Our steelhead population estimate based on mark and recapture for fall 2004 was 3,869 juveniles +/- 1,009 compared to 849 juveniles +/- 198 in 2003, 1,042 juveniles +/- 84 in 2002 and 454 juveniles +/-27 in 2001 (**Table 7, Figure 17**) (**Ricker 1971**). Other species captured with the 106-foot seine on the two days combined were 4 starry flounders, one prickly sculpin and abundant threespine sticklebacks.

Our sampling of lower Soquel Creek in fall, 2004, indicated the highest juvenile density in the 12 years of mark and recapture efforts that began in 1993. It was more than 4 times the density estimated in 2003. 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, when lagoon production reached 2,800 fish, it likely represented as much as 10% of the smolt production in the entire 16.6 miles of steelhead habitat in the mainstem, East and West Branches. Thus, the lagoon provides valuable habitat through proper management.

On 3 October 2004, a total of five 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. This was adjacent to Venetian Court, around to the flume and between the flume and the restaurants. This is the only location where a seine could be adequately beached to capture tidewater gobies. Threespine sticklebacks were abundant with no tidewater gobies captured. The last capture of tidewater gobies was one in fall, 1997. The low number captured in 1992-1997, and their absence since the El Niño stormflows in winter 1997-98, 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, by Jerry Smith (**pers. communication**). They may re-populate Soquel Lagoon in the future from these sources.

Table 7. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2003.

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; 4 effective seine hauls.
2000-	875 +/-156 (standard error).185 fish were marked; 4 effective seine hauls.
2001-	454 +/- 27 (standard error). 186 fish were marked; 4 effective seine hauls.
2002-	1,042 +/-84 (standard error). 363 fish were marked; 4 effective seine hauls.
2003-	849 +/-198 (standard error). 109 fish were marked; 5 effective seine hauls.
2004-	3,869 +/- 1009 (standard error). 281 fish were marked; 4 effective seine hauls.

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). However, prior to the placement of the ceiling grate on the flume inlet, the City Public Works Department had an easier time of maximizing water depth in years with intermediate streamflows, such as 1999-2002, rather than 1998, with the previous inlet design to the flume. 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. 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 vandals intent on draining the lagoon and against tidal back-pressure that may dislodge the boards.

Maintenance of the lagoon in the fall after the first small storms is important. Minimizing pollutant input from early fall storms is also important to avoid fish kills.

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

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

5. Do not remove flume boards for the Begonia Festival 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 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 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. The goal should be to maintain the lagoon until approximately Thanksgiving in late November, before allowing stormflow to breach the sandbar.

8. If sufficient turbidity occurs after the first storm 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.

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.

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).

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

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.

LITERATURE CITED (continued)

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.

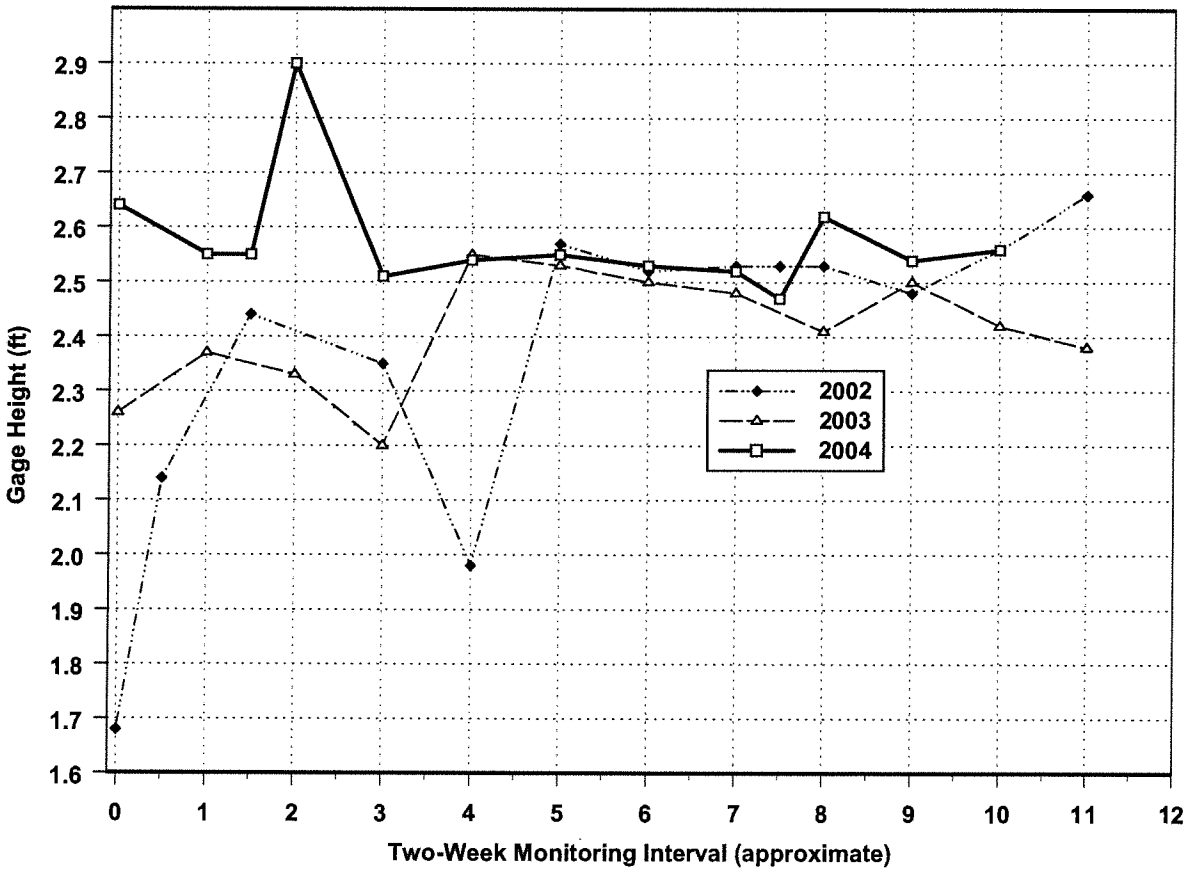
Snyder, G.R. and T.H. Blahm. 1971. Effects of increased temperature on cold water organisms. J. Water Poll. Control Fed. 43: 890-899. (Cited by Kubicek and Price 1976).

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

Figure 2a. Soquel Lagoon Gage Height Near Stockton Avenue Bridge, From Approximately 25 May to 1 November, 2002-2004.



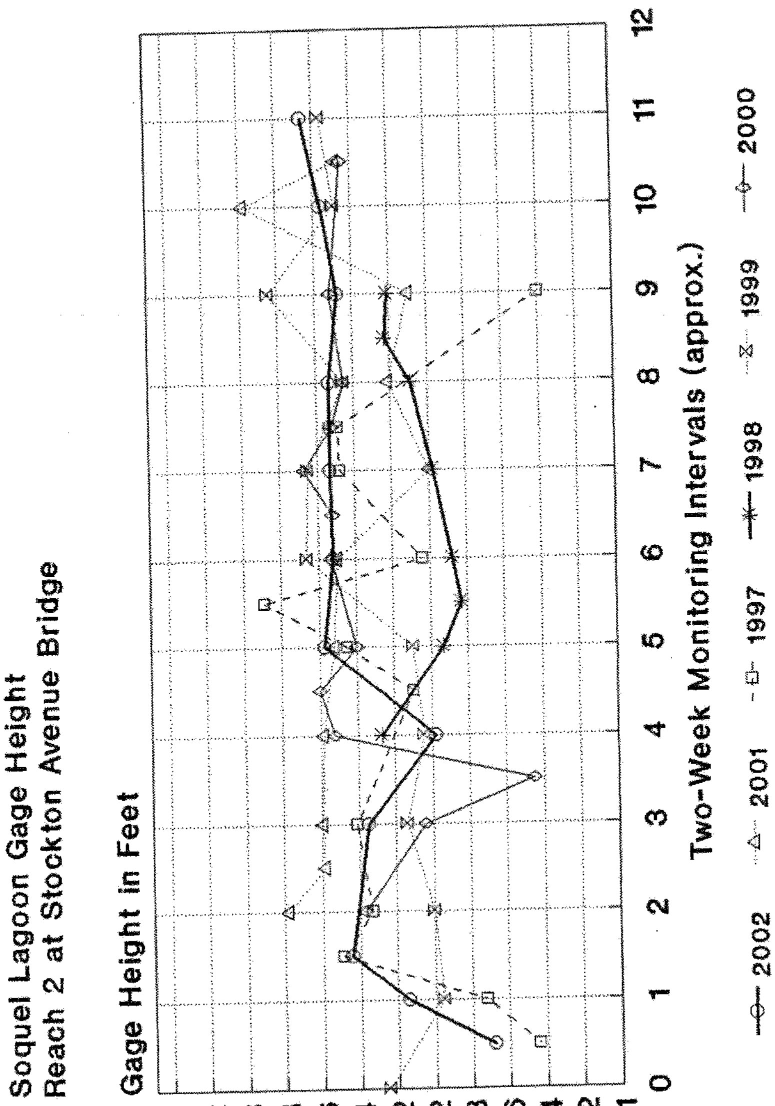


Figure 2b. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Mid-May to Late October, 1997-2002.

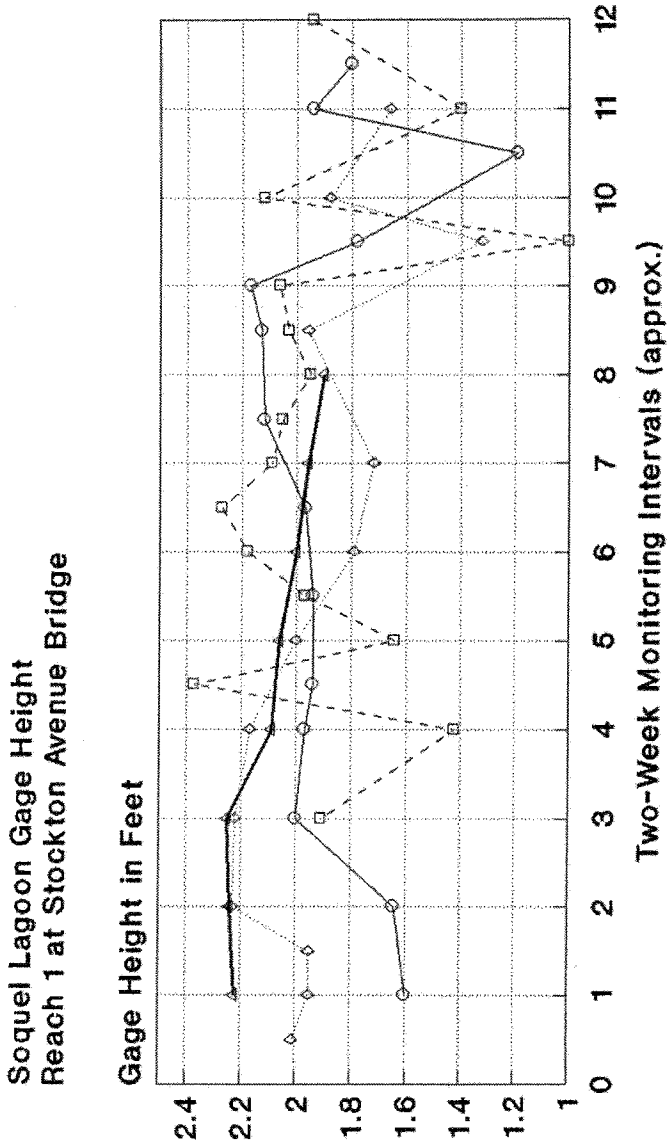


Figure 2c. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Late May to Late October, 1993-96.

Figure 3a. 2003-2004 Soquel Lagoon Water Temperature at the Flume (Station 1) Near the Bottom at Dawn and in the Afternoon after 1500 hr From Approximately 10 June to 1 November.

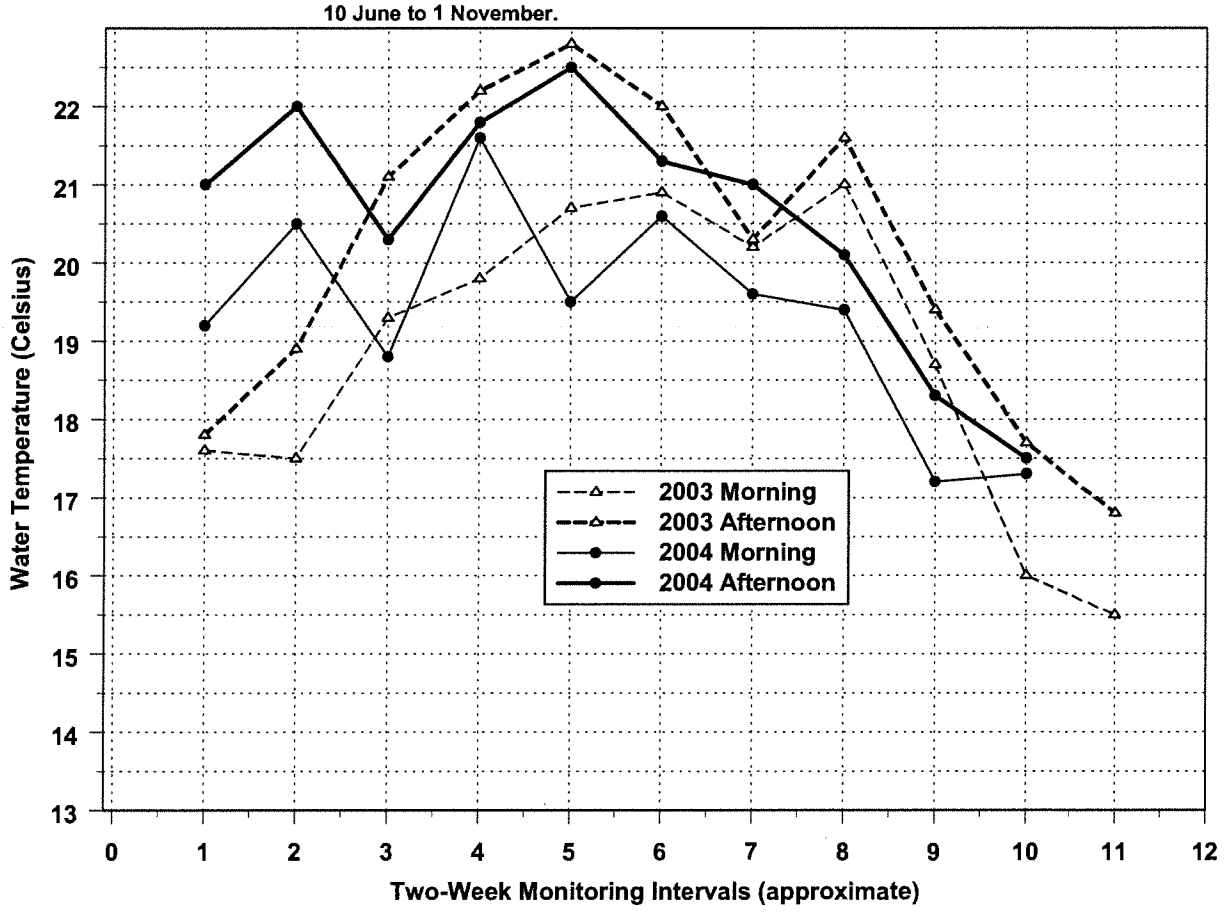


Figure 3b. 2003-2004 Soquel Lagoon Water Temperature at Stockton Avenue Bridge Near the Bottom at Dawn and in the Afternoon after 1500 hr From Approximately 10 June to 1 November.

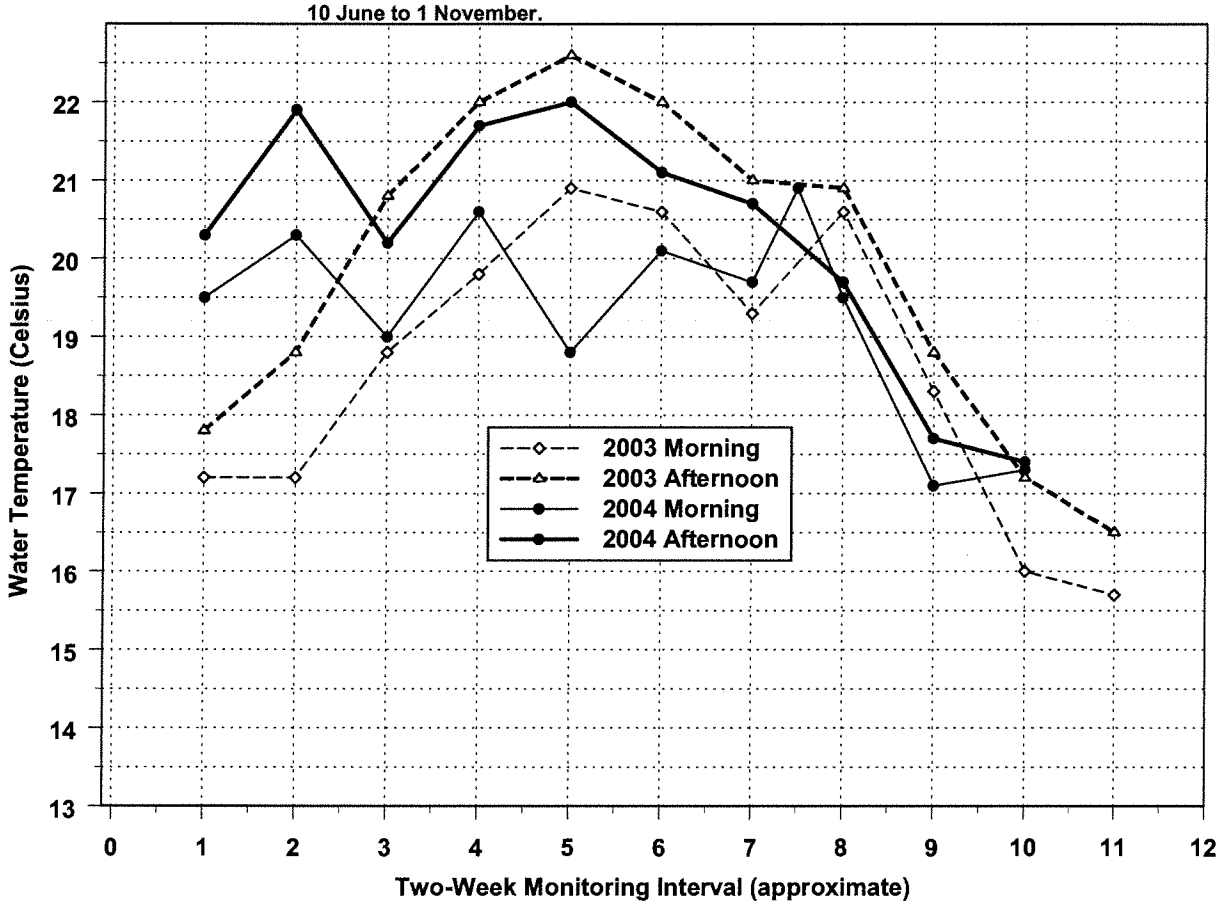


Figure 3c. 2003-2004 Soquel Lagoon Water Temperature at the Railroad Trestle Near the Bottom at Dawn and in the Afternoon after 1500 hr From Approximately 10 June to 1 November.

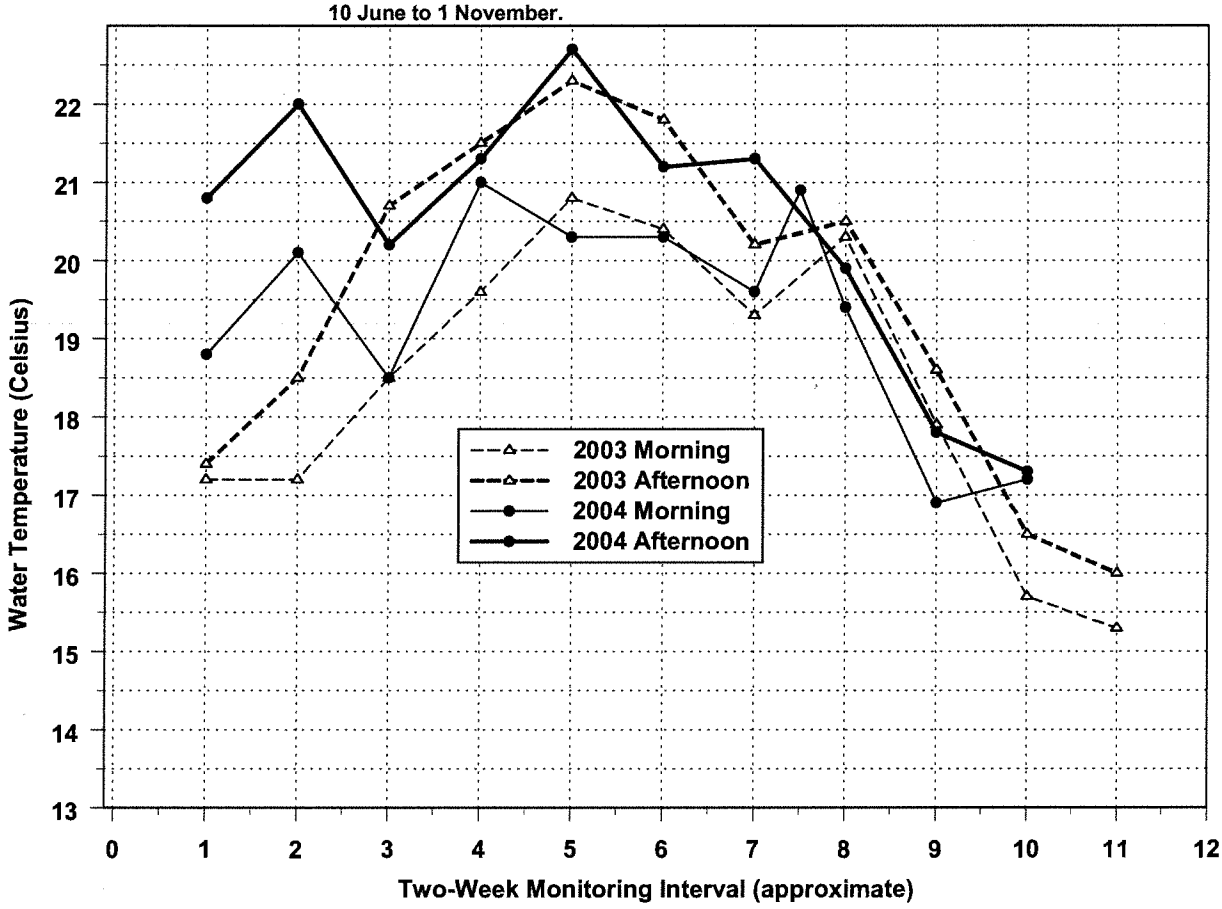


Figure 3d. 2003-2004 Soquel Lagoon Water Temperature at the Mouth of Noble Gulch Near the Bottom at Dawn and in the Afternoon after 1500 hr From Approximately 10 June to 1 November.

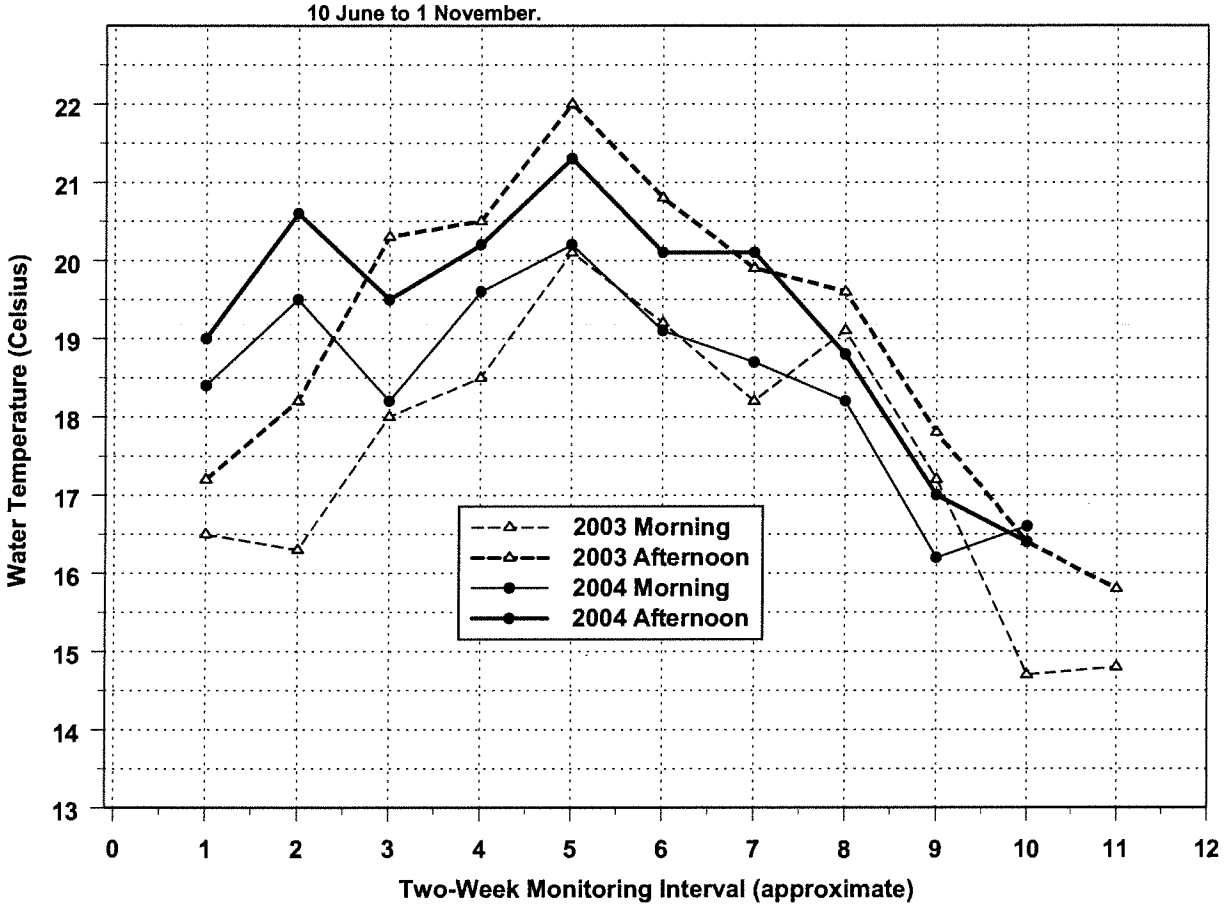
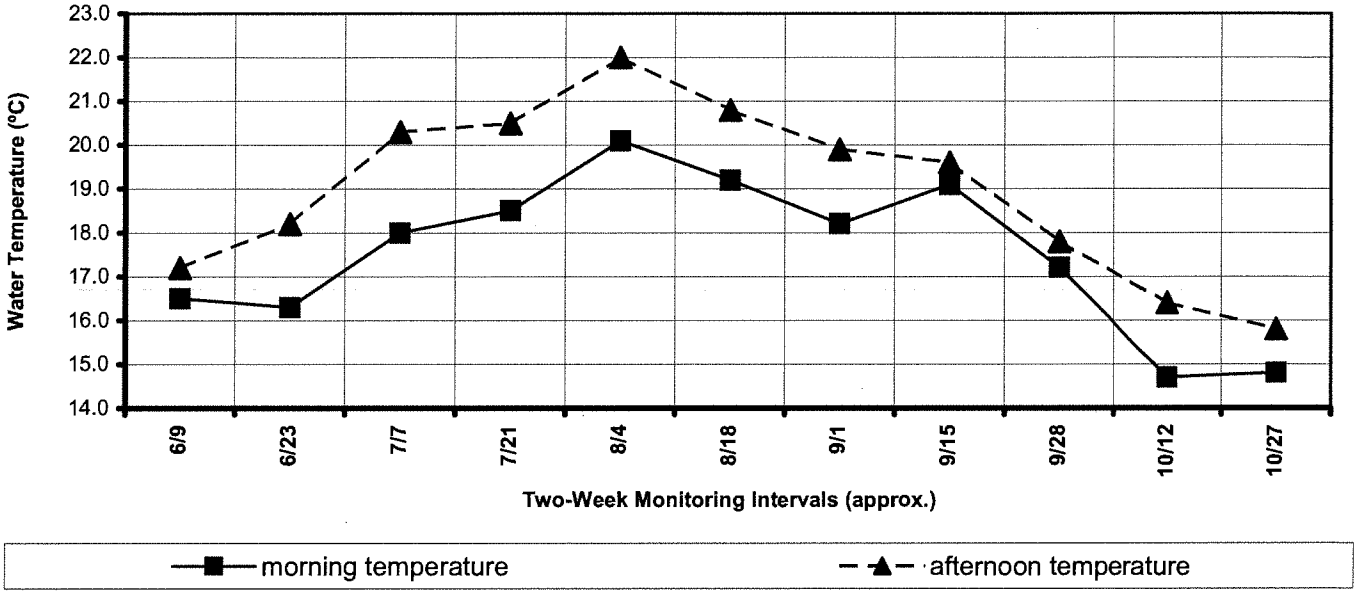


Figure 3e. Soquel Lagoon Water Temperature in the Morning and Afternoon, 9 June - 27 October 2003, Within 0.25 Meters of the Bottom Station 4, Mouth of Noble Gulch.



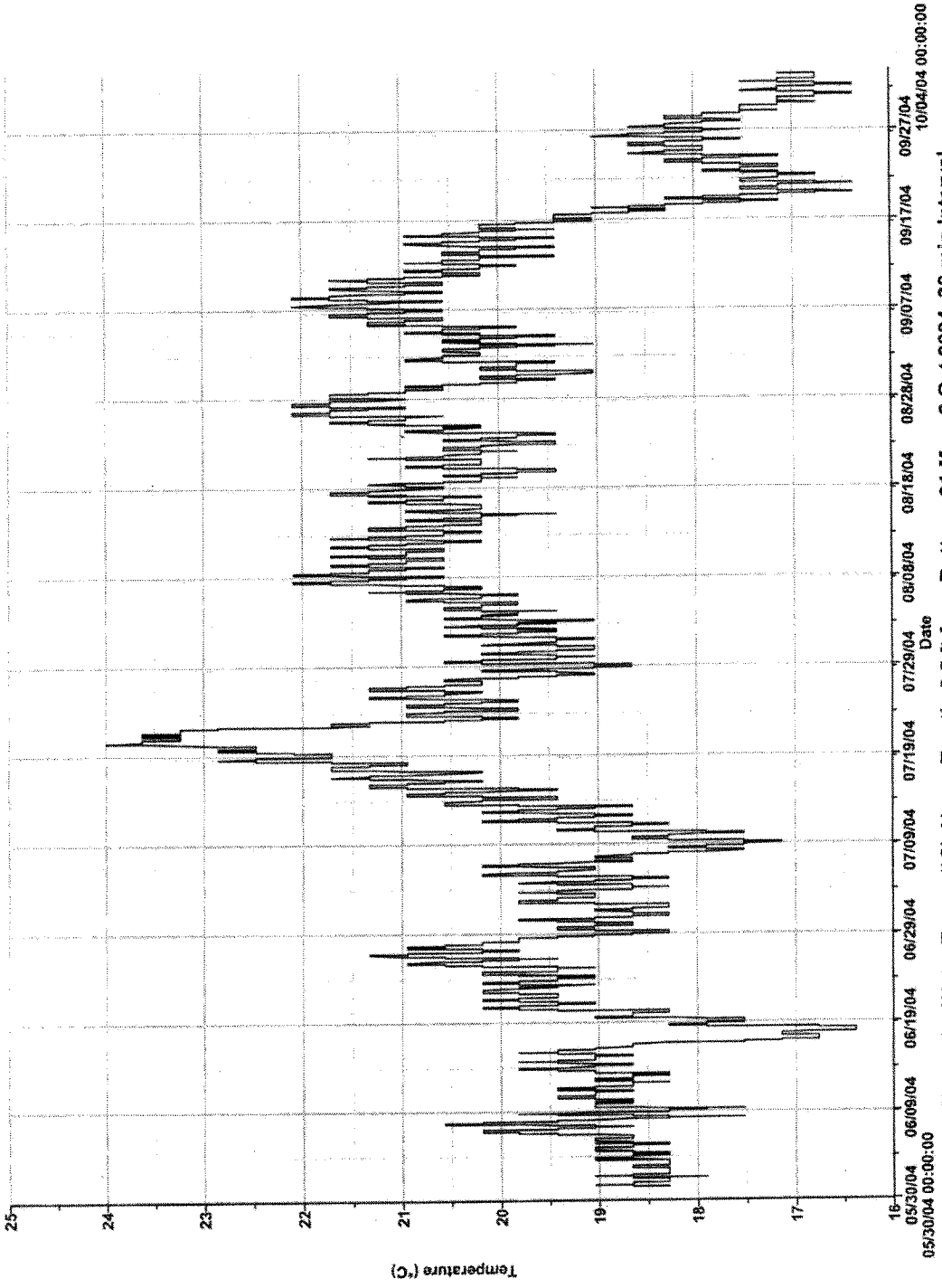


Figure 4a. Water Temp. (*C) Above Trestle 0.5 ft from Bottom, 31 May- 3 Oct 2004, 30-min Interval

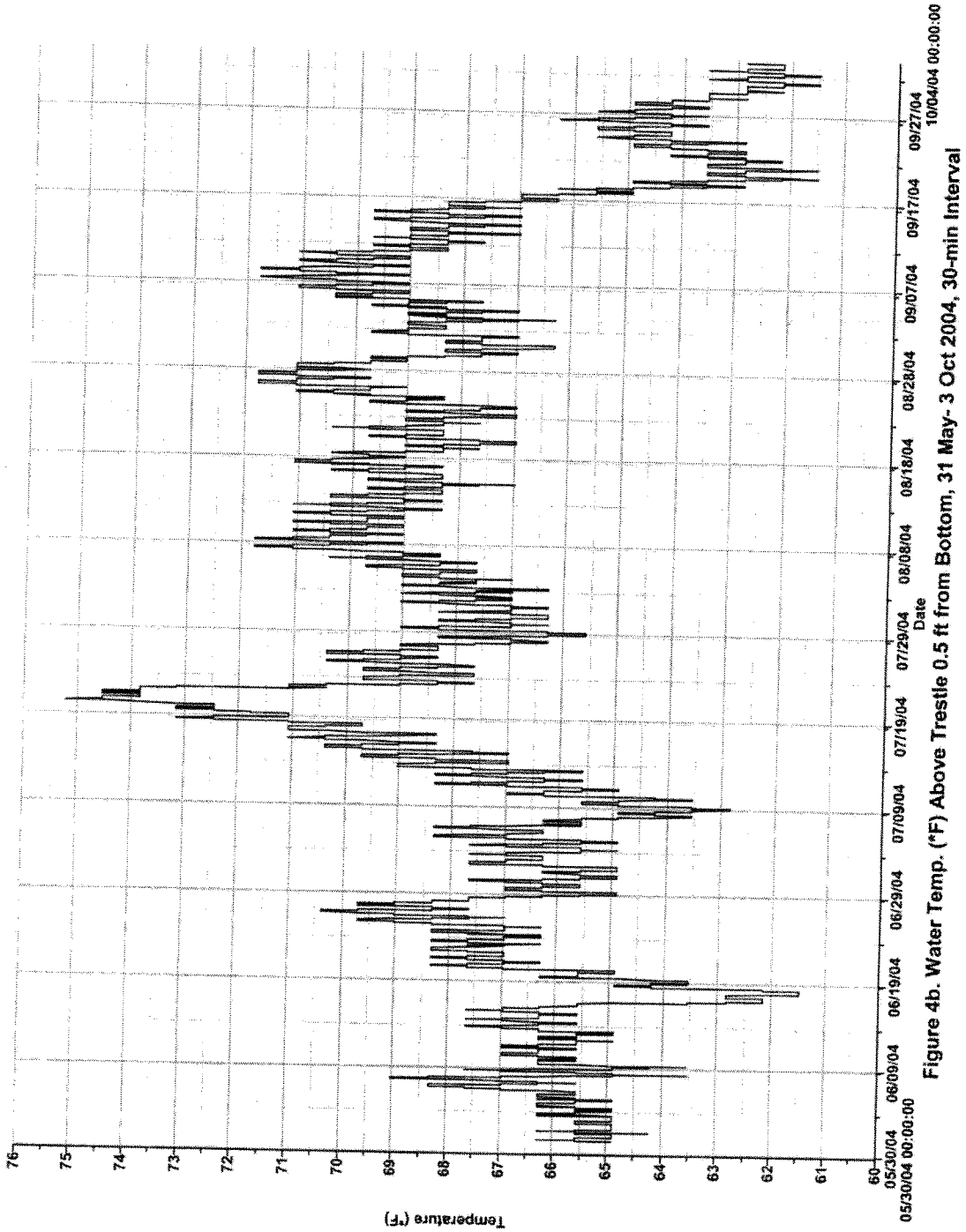


Figure 4b. Water Temp. (°F) Above Trestle 0.5 ft from Bottom, 31 May- 3 Oct 2004, 30-min Interval

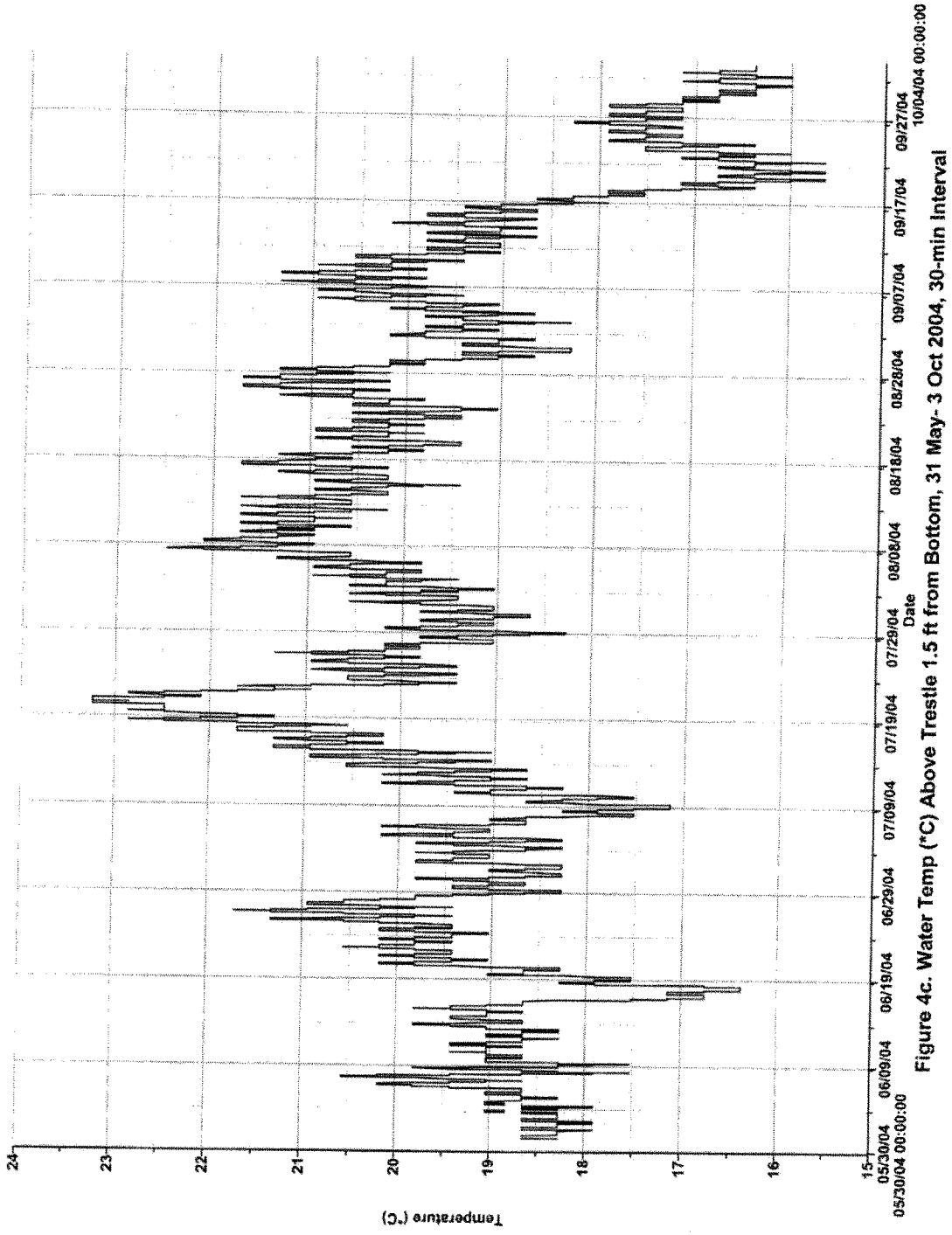


Figure 4c. Water Temp (°C) Above Trestle 1.5 ft from Bottom, 31 May- 3 Oct 2004, 30-min Interval

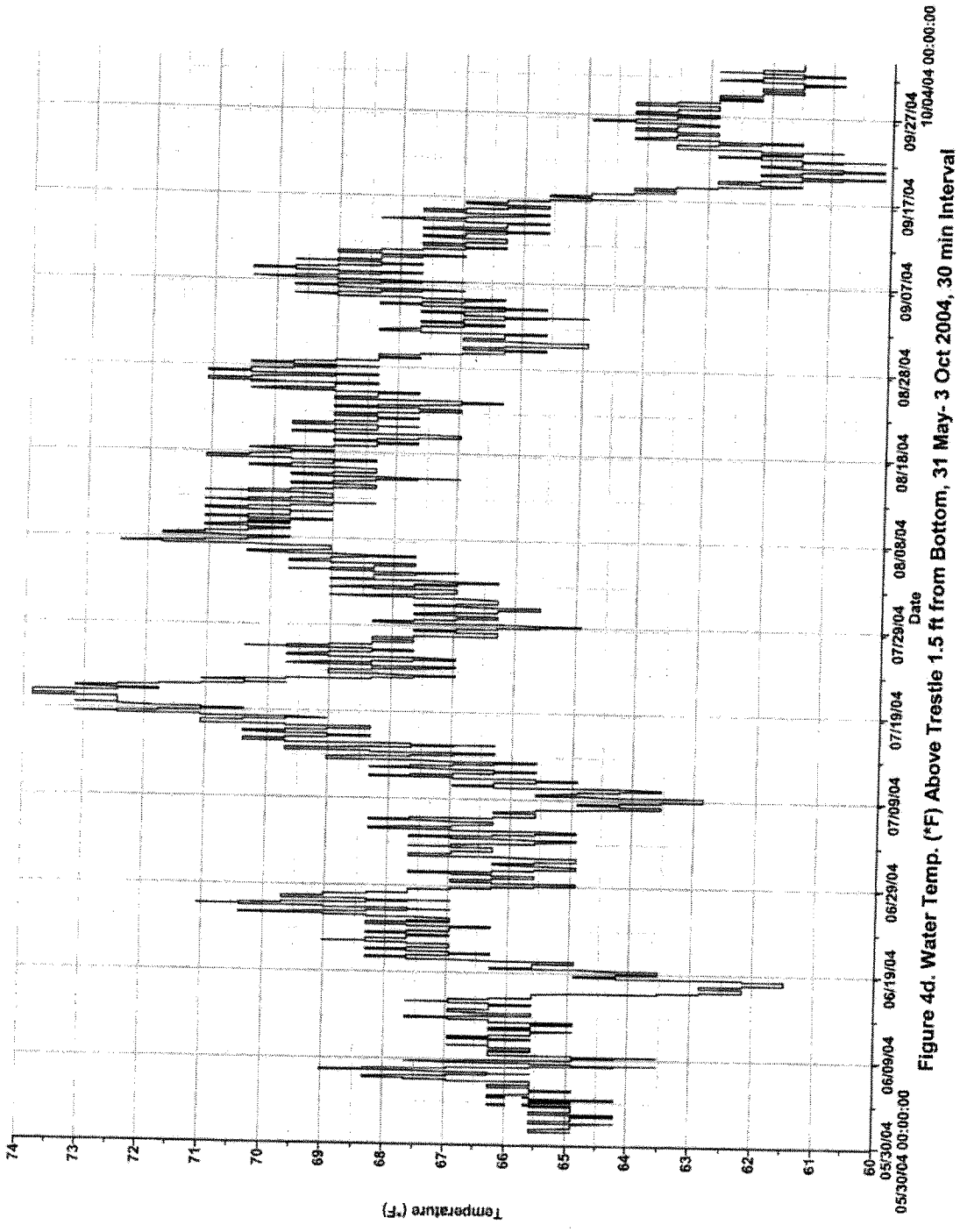


Figure 4d. Water Temp. (°F) Above Trestle 1.5 ft from Bottom, 31 May- 3 Oct 2004, 30 min Interval

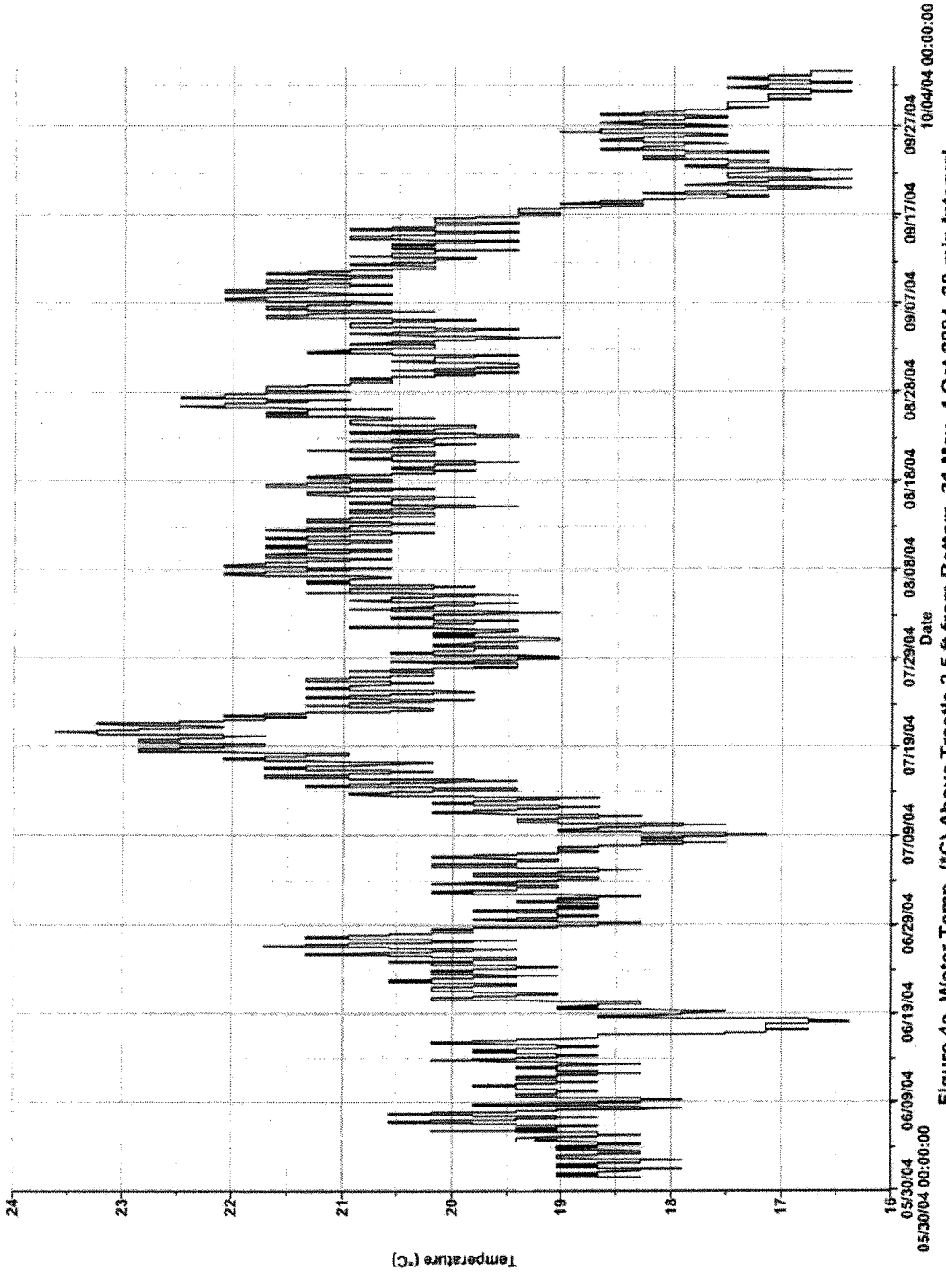


Figure 4e. Water Temp. (°C) Above Trestle 2.5 ft from Bottom, 31 May- 4 Oct 2004, 30-min Interval

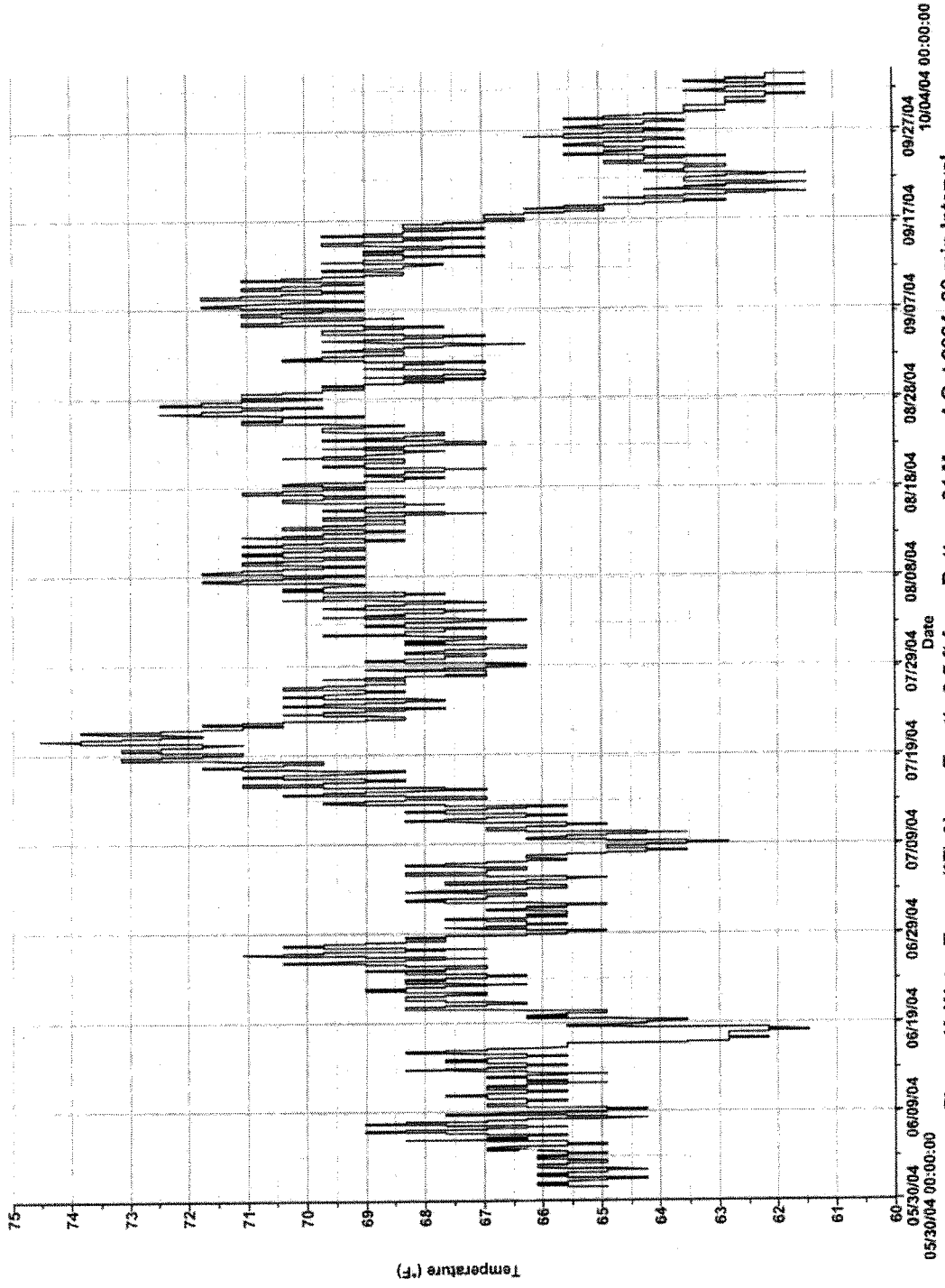


Figure 4f. Water Temp. (°F) Above Trestle 2.5 ft from Bottom, 31 May- 4 Oct 2004, 30-min Interval

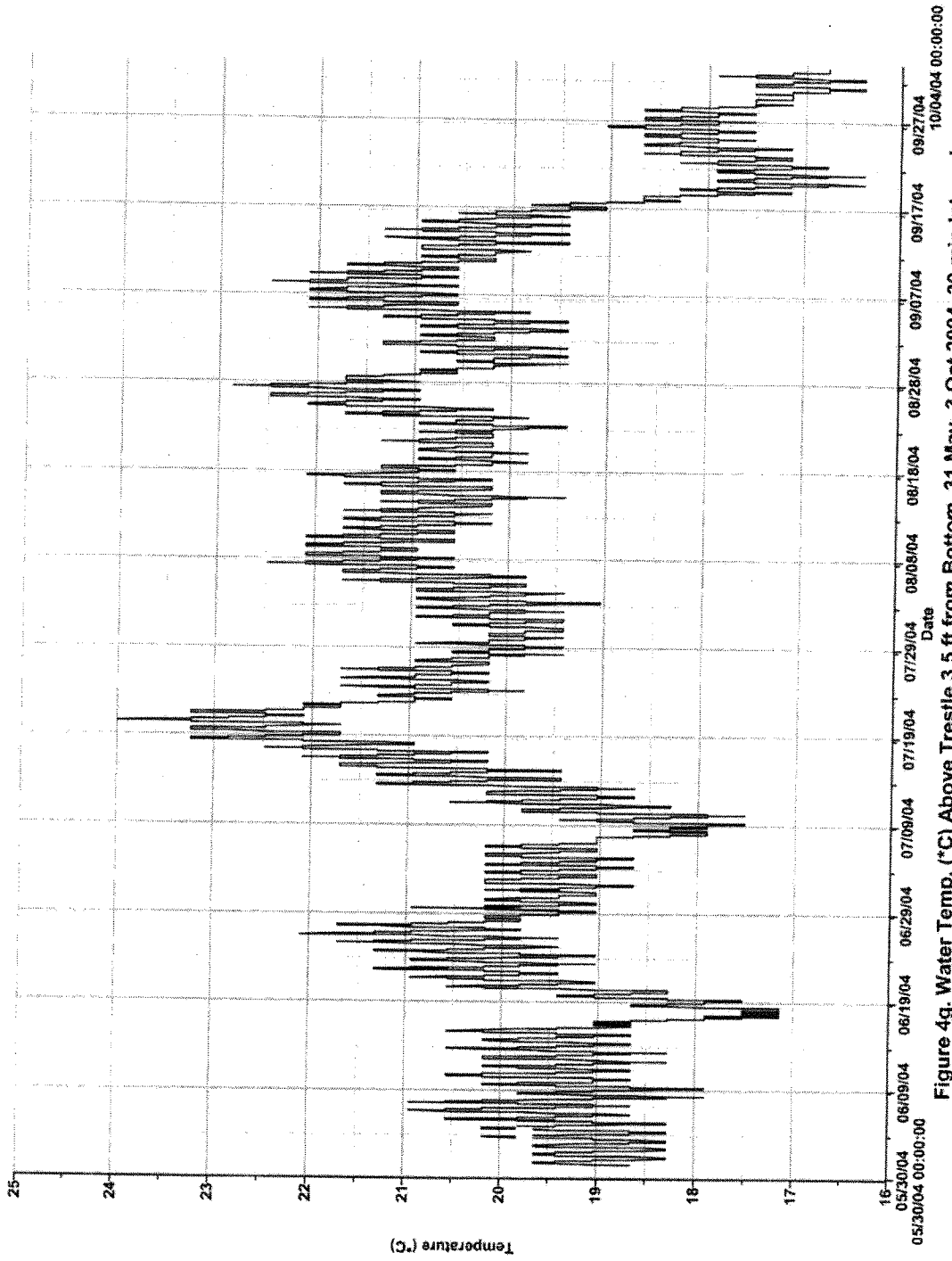


Figure 4g. Water Temp. (°C) Above Trestle 3.5 ft from Bottom, 31 May- 3 Oct 2004, 30-min Interval

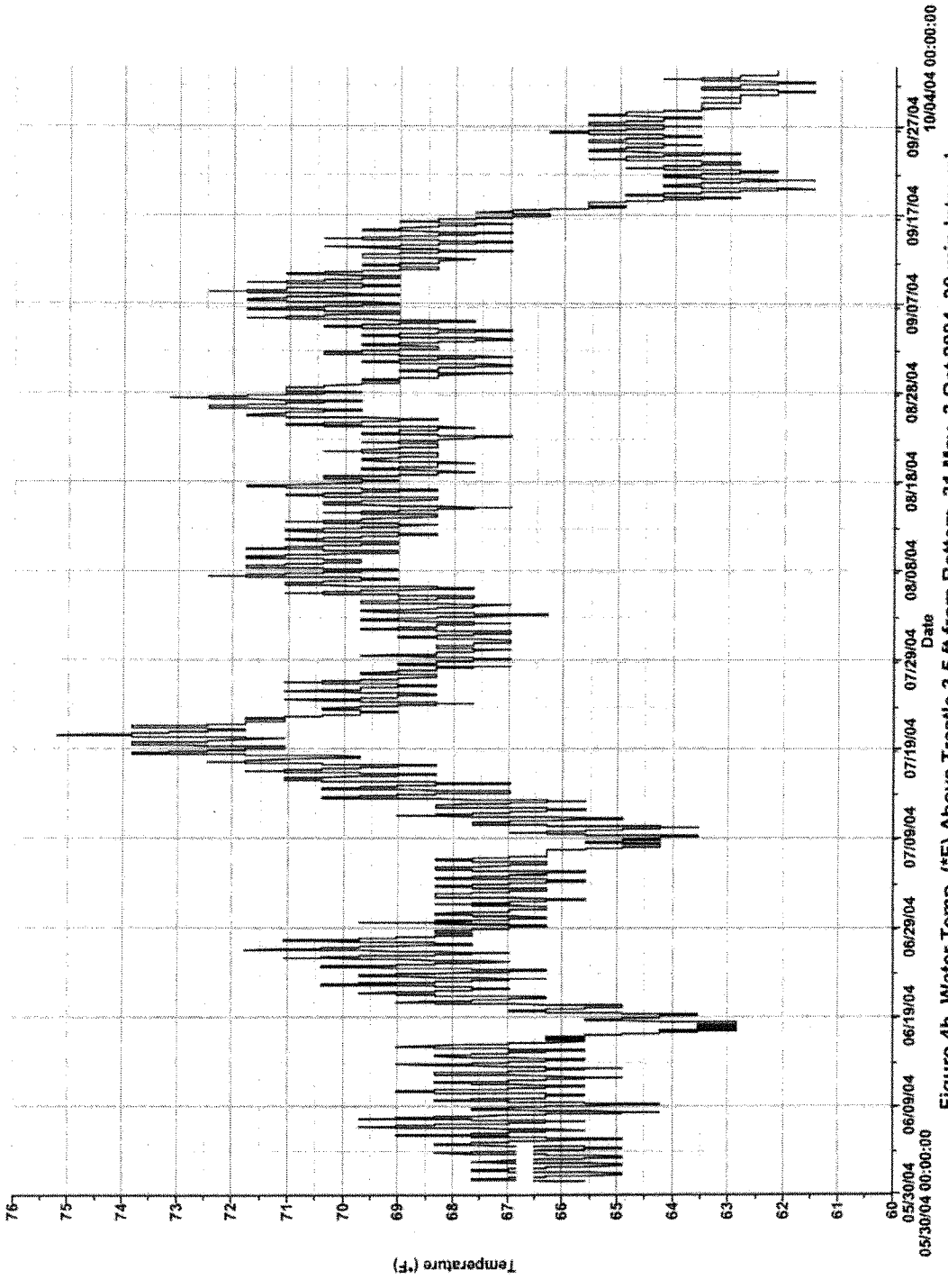


Figure 4h. Water Temp. (°F) Above Trestle 3.5 ft from Bottom, 31 May- 3 Oct 2004, 30-min Interval

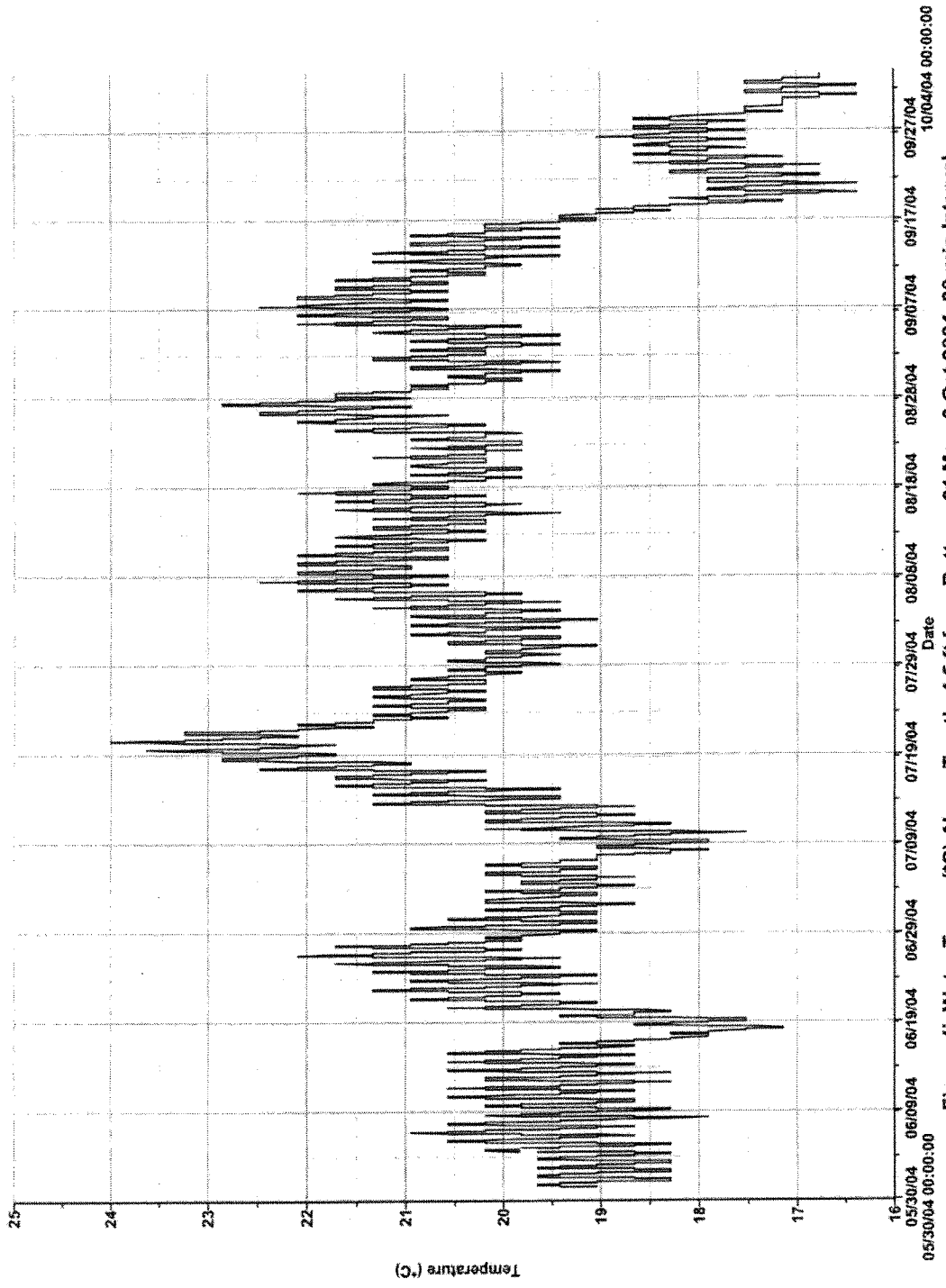


Figure 4i. Water Temp. (°C) Above Trestle 4.5 ft from Bottom, 31 May- 3 Oct 2004, 30-min Interval

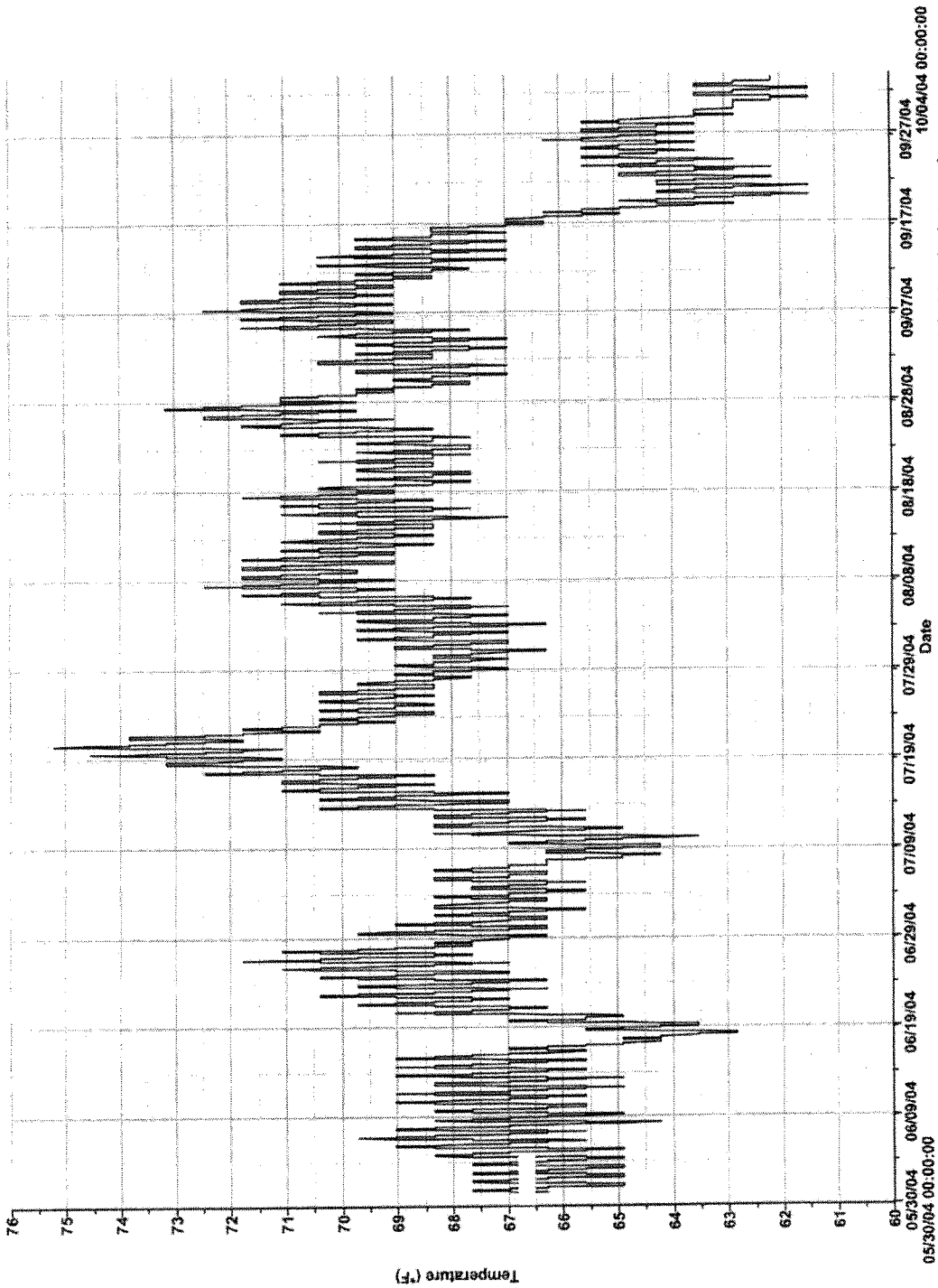


Figure 4j. Water Temp. (°F) Above Trestle 4.5 ft from Bottom, 31 May- 3 Oct 2004, 30-min Interval

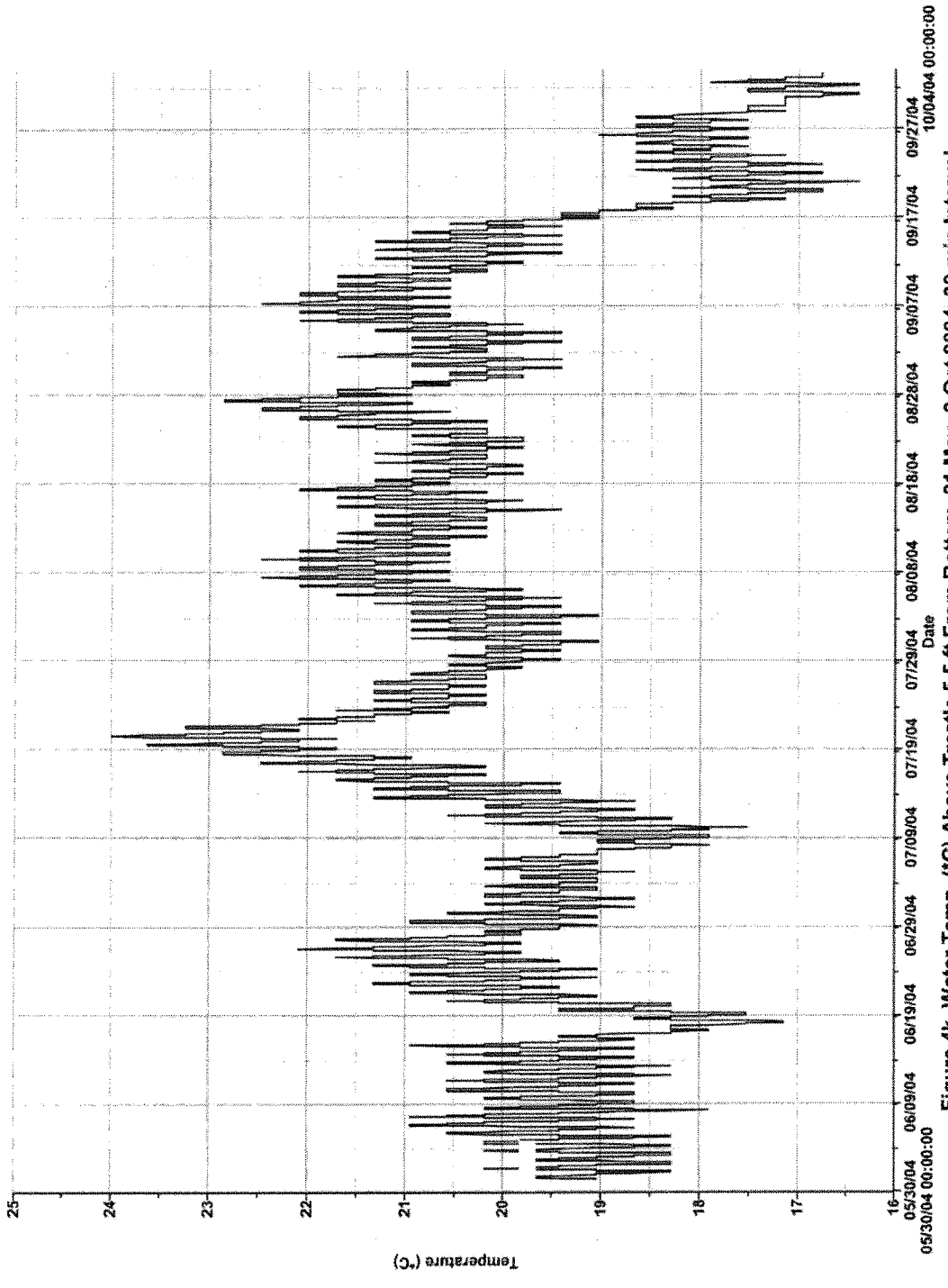


Figure 4k. Water Temp. (°C) Above Trestle 5.5 ft From Bottom, 31 May- 3 Oct 2004, 30-min Interval

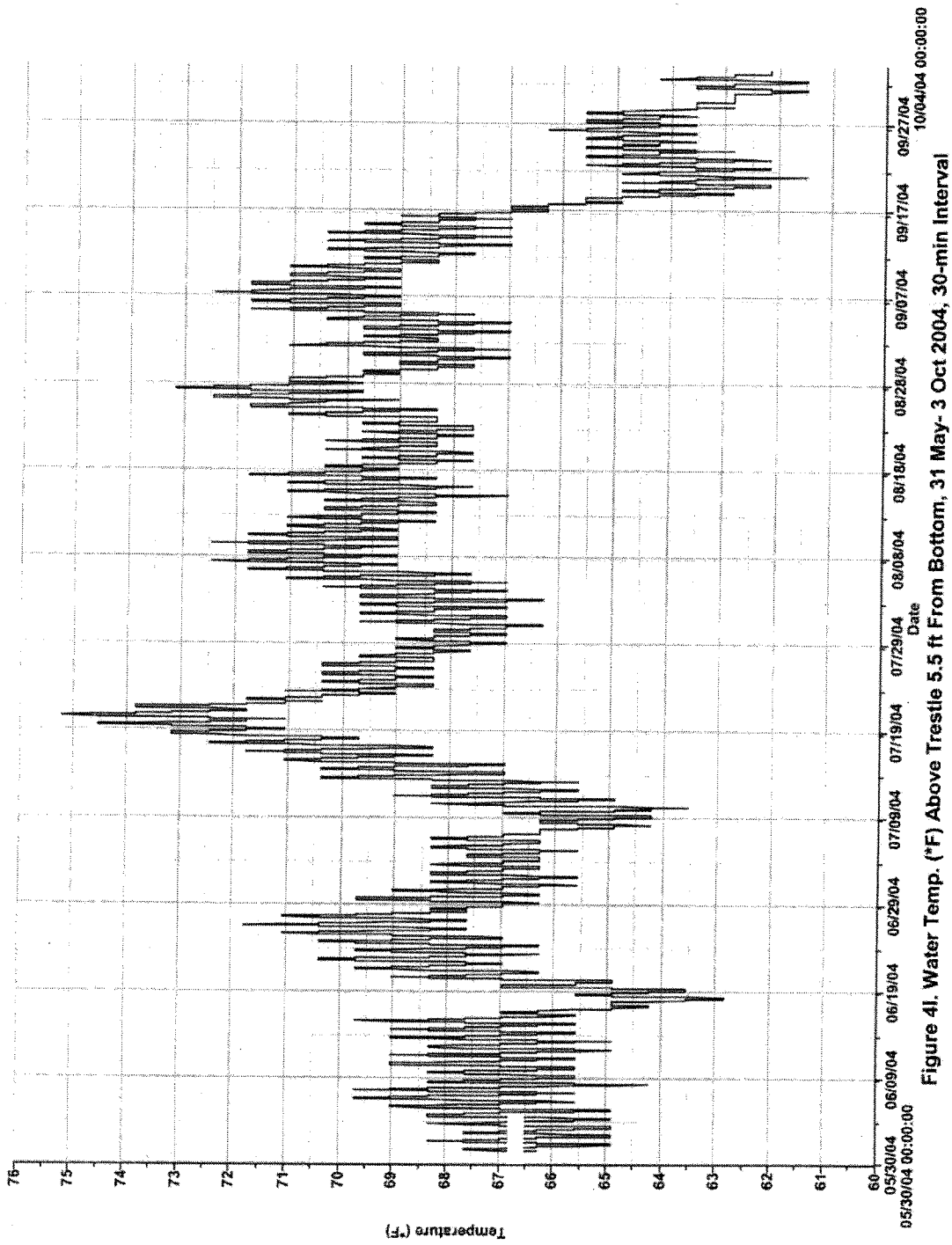


Figure 4l. Water Temp. (°F) Above Trestle 5.5 ft From Bottom, 31 May- 3 Oct 2004, 30-min Interval

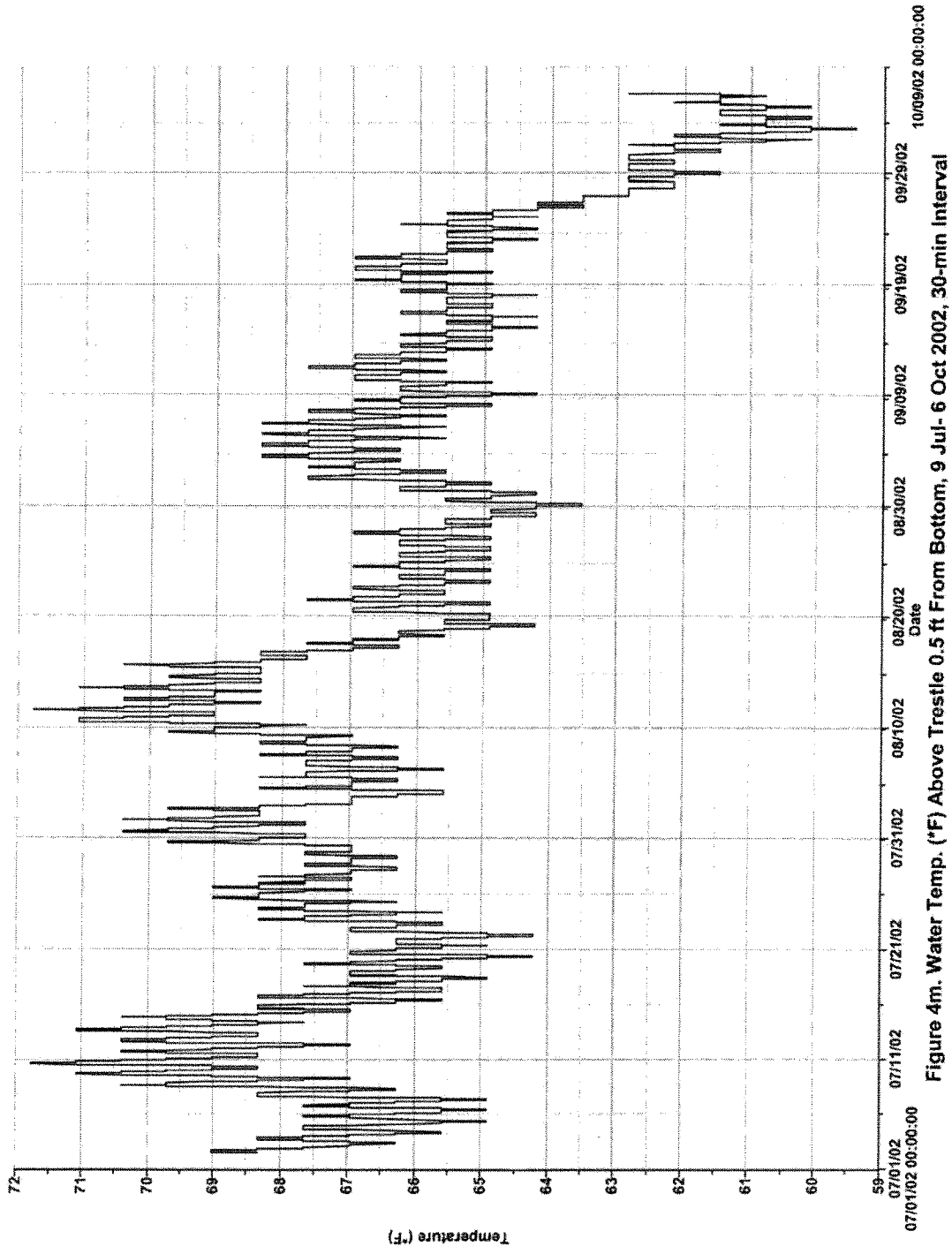


Figure 4m. Water Temp. (°F) Above Trestle 0.5 ft From Bottom, 9 Jul- 6 Oct 2002, 30-min Interval

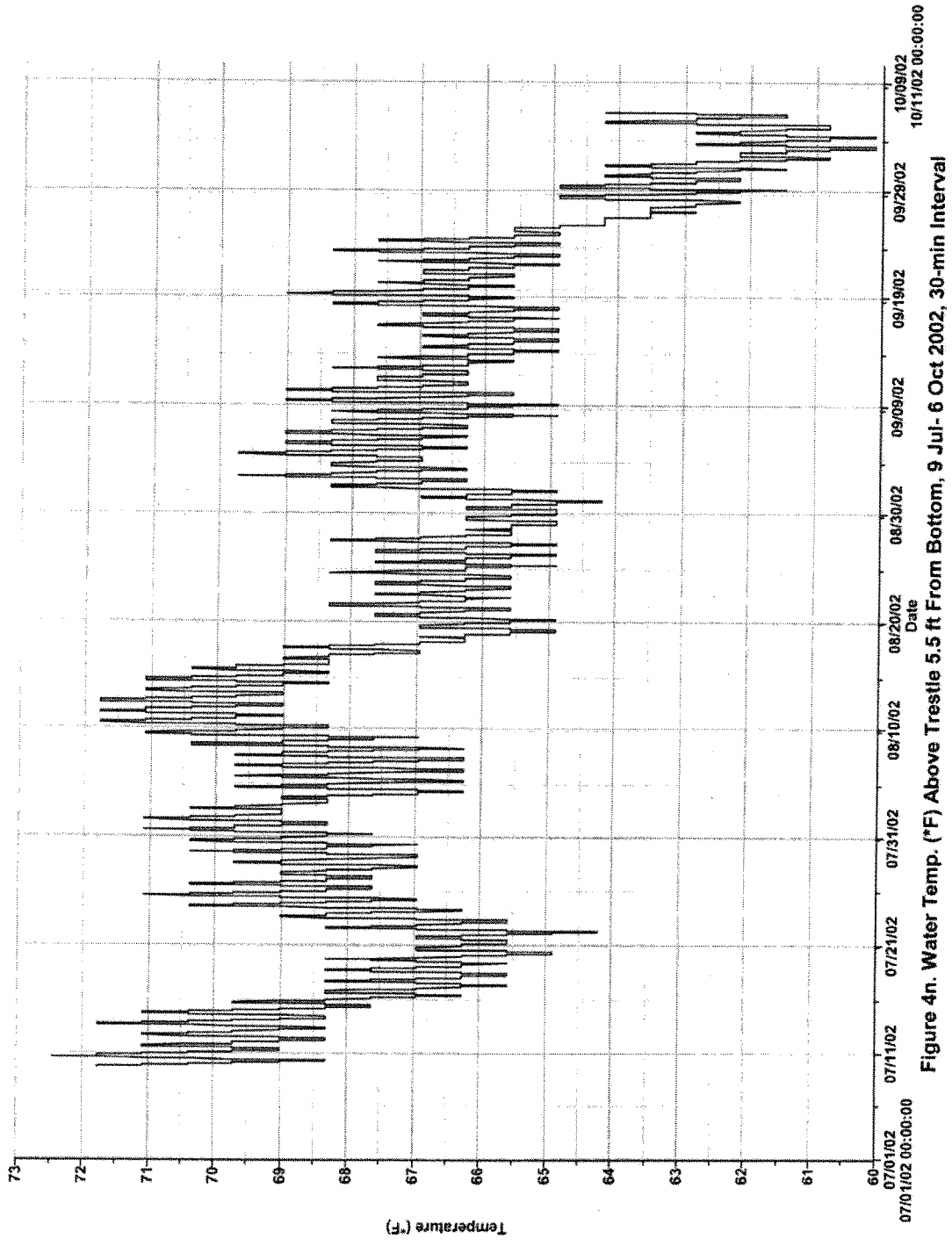


Figure 4n. Water Temp. (°F) Above Trestle 5.5 ft From Bottom, 9 Jul- 6 Oct 2002, 30-min Interval

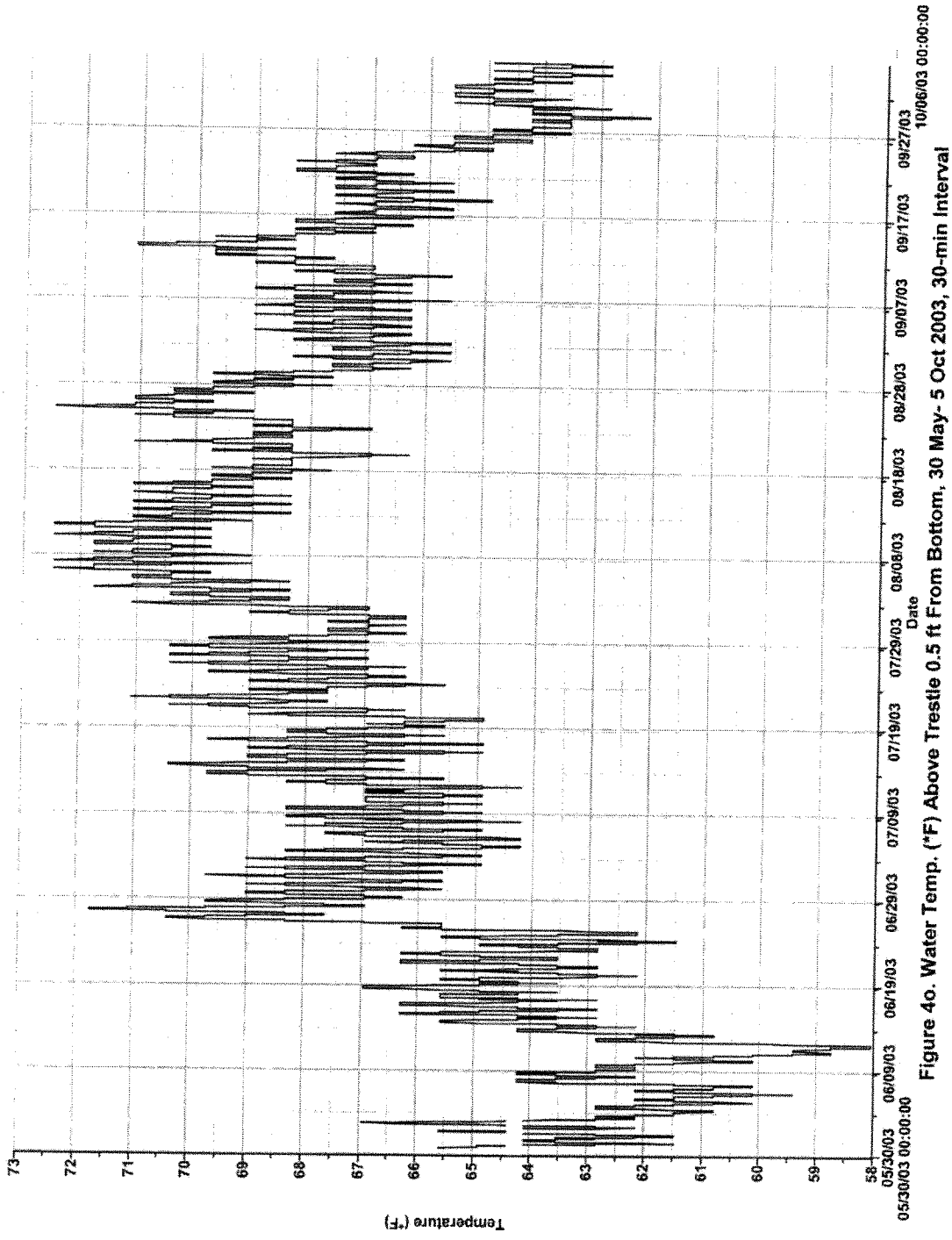


Figure 4o. Water Temp. (°F) Above Trestle 0.5 ft From Bottom, 30 May- 5 Oct 2003, 30-min Interval

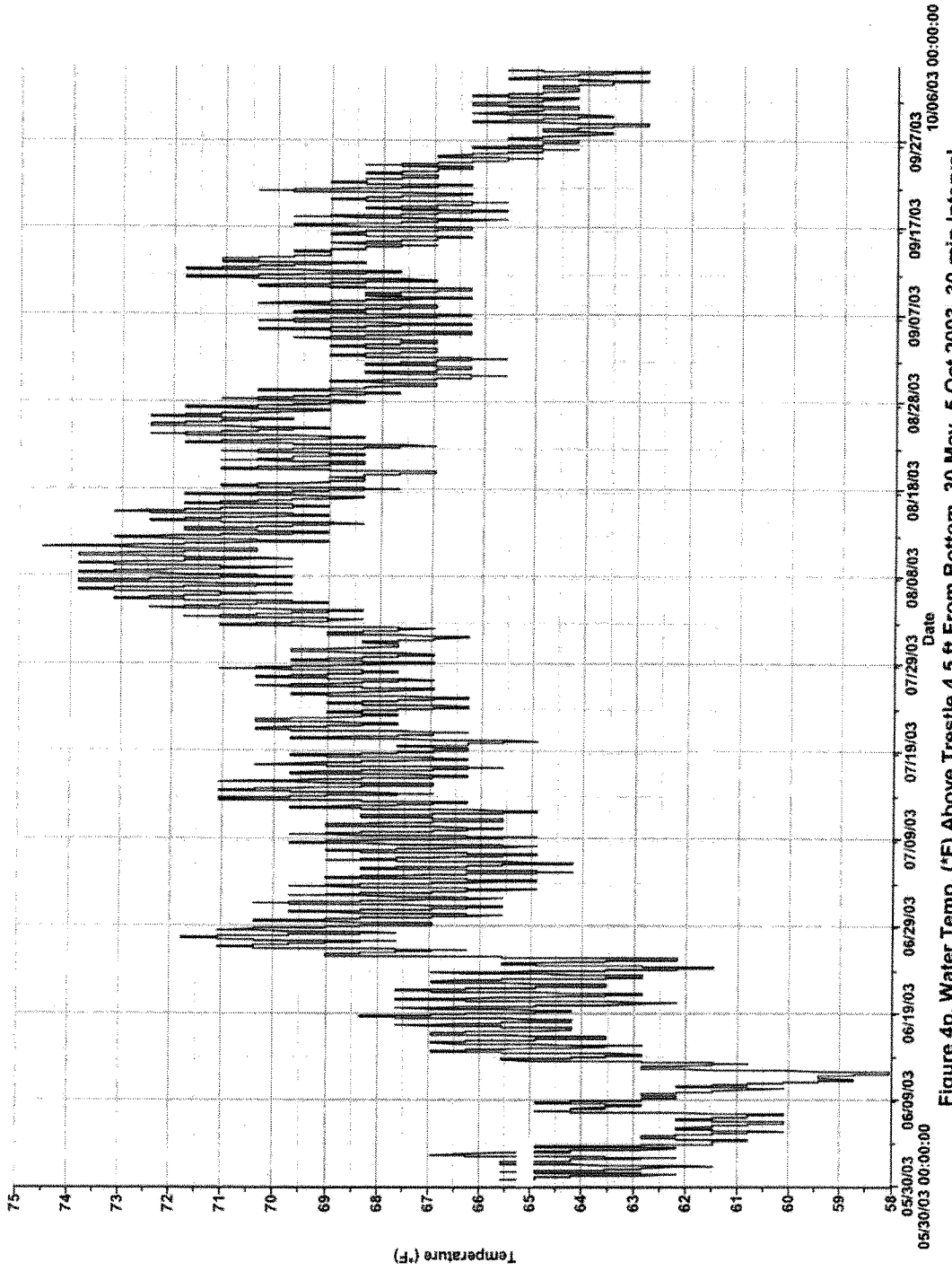


Figure 4p. Water Temp. (°F) Above Trestle 4.5 ft From Bottom, 30 May- 5 Oct 2003, 30-min Interval

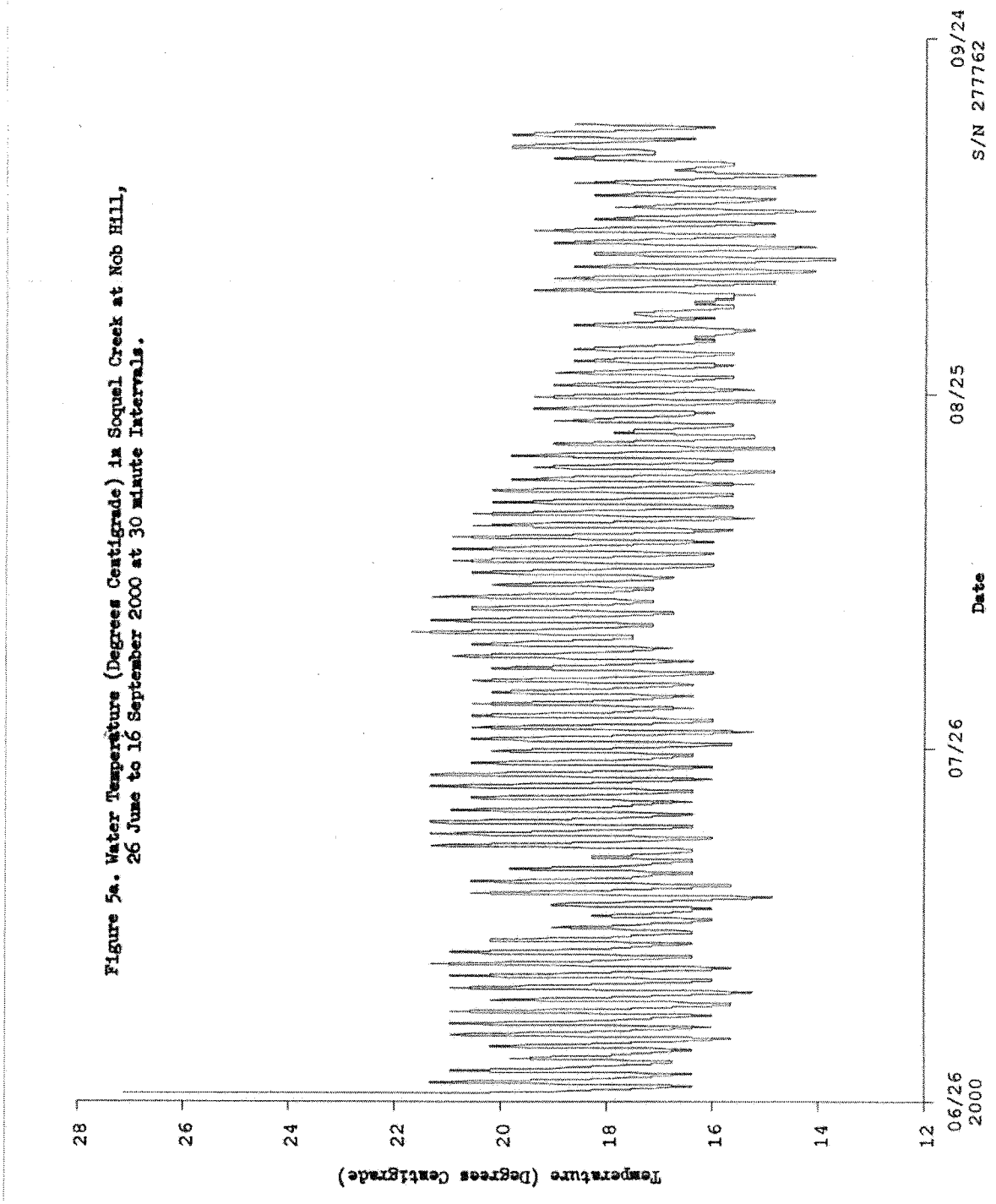


Figure 5a. Water Temperature (Degrees Centigrade) in Soquel Creek at Nob Hill,
26 June to 16 September 2000 at 30 minute Intervals.
Temperature (Degrees Centigrade)
28
26
24
22
20
18
16
14
12
06/26
2000
07/26
08/25
09/24
Date
S/N 277762

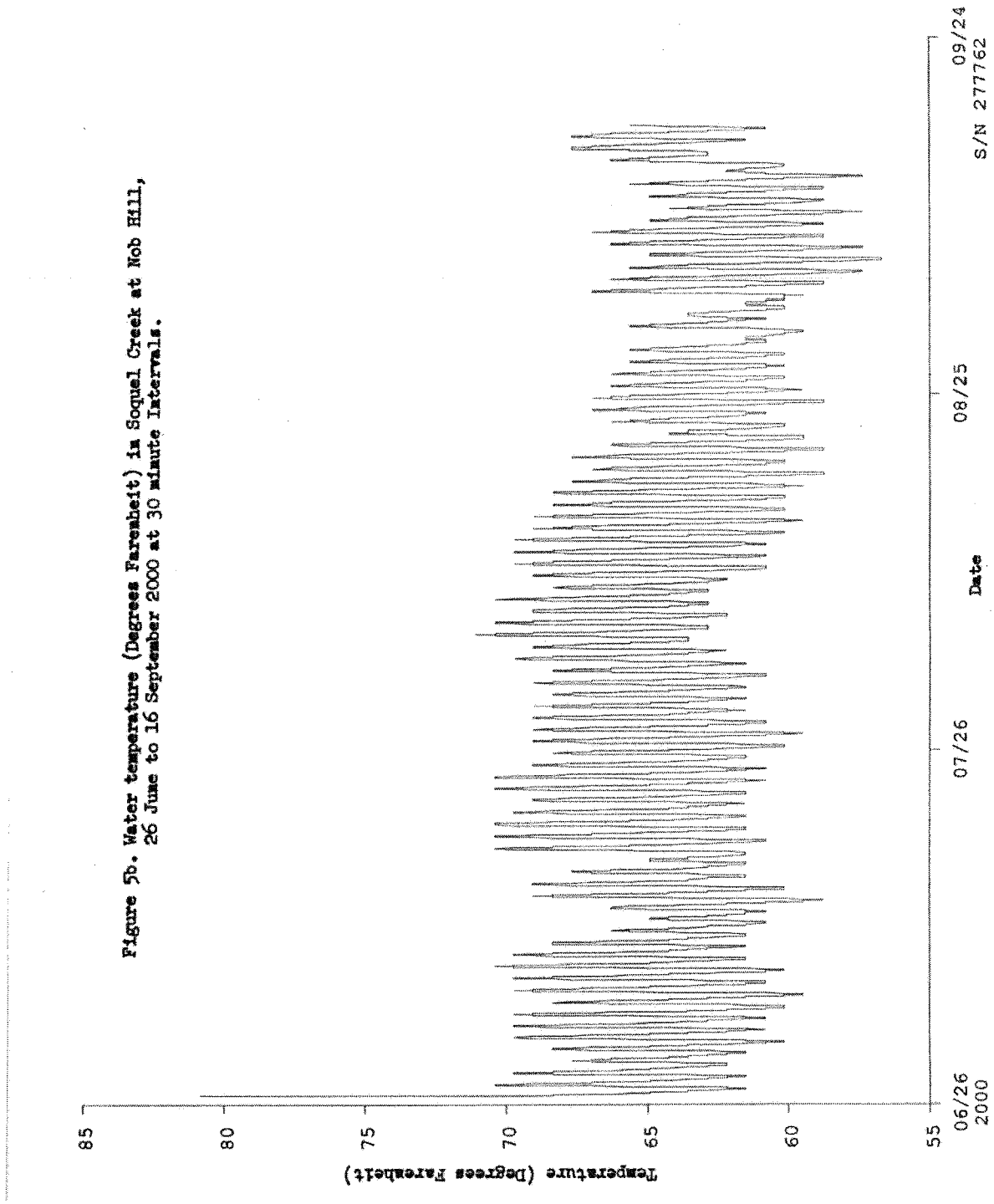


Figure 5b. Water temperature (Degrees Farenheit) in Soquel Creek at Nob Hill, 26 June to 16 September 2000 at 30 minute Intervals.

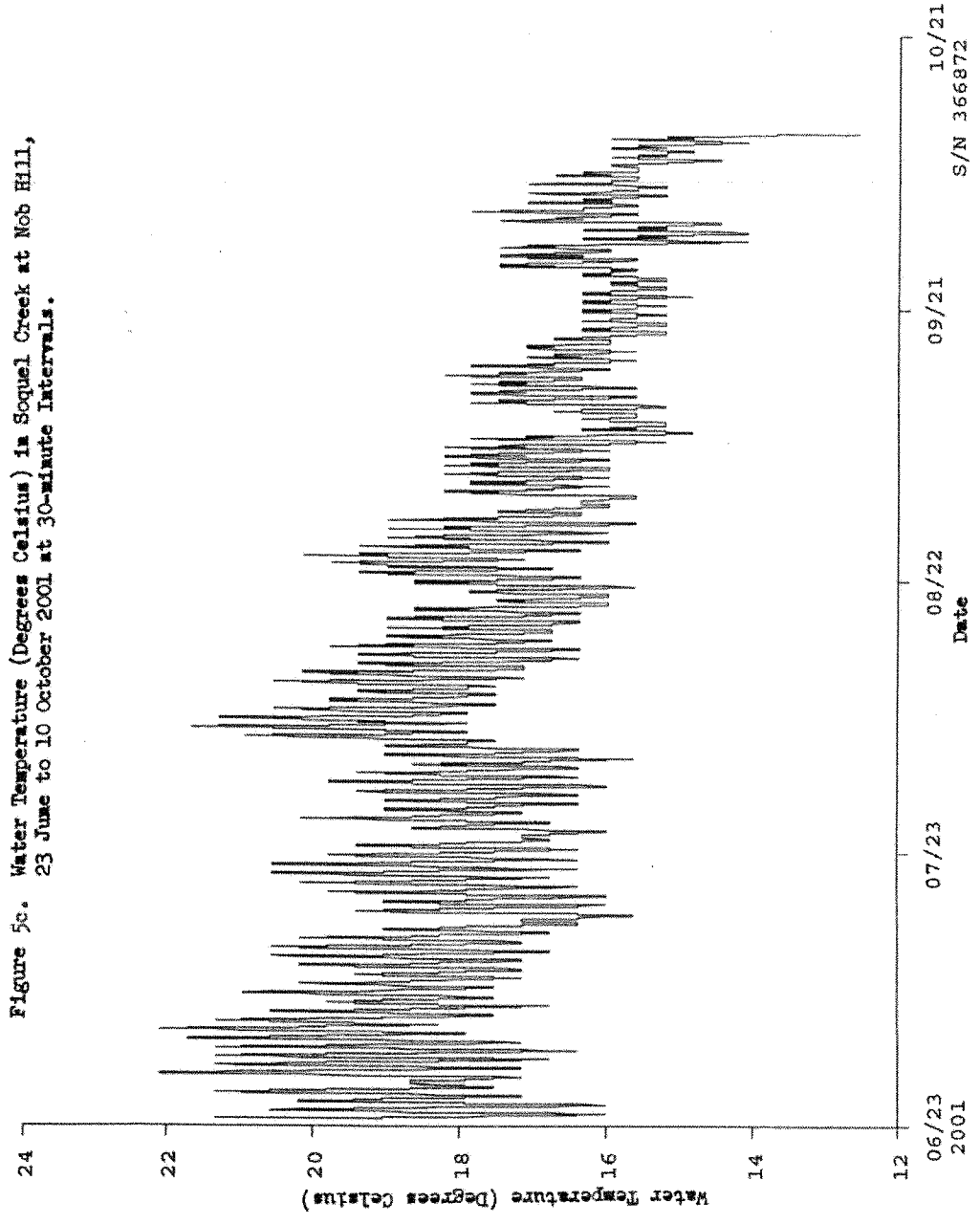


Figure 5c. Water Temperature (Degrees Celsius) in Soquel Creek at Nob Hill,
23 June to 10 October 2001 at 30-minute Intervals.
Water Temperature (Degrees Celsius)
24
22
20
18
16
14
12
06/23
2001
07/23
08/22
09/21
10/21
Date
S/N 366872

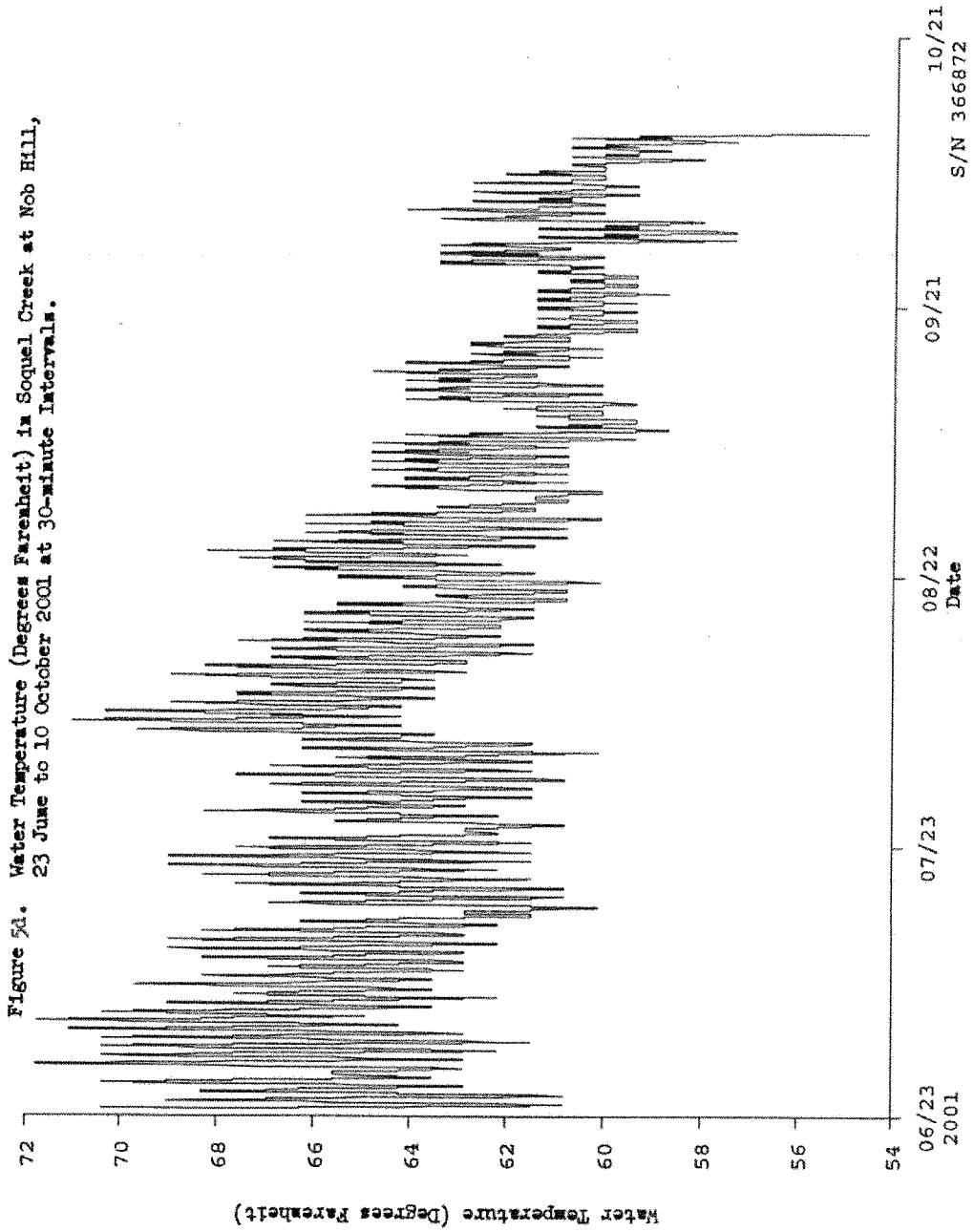


Figure 5d. Water Temperature (Degrees Farenheit) in Soquel Creek at Nob Hill, 23 June to 10 October 2001 at 30-minute Intervals.

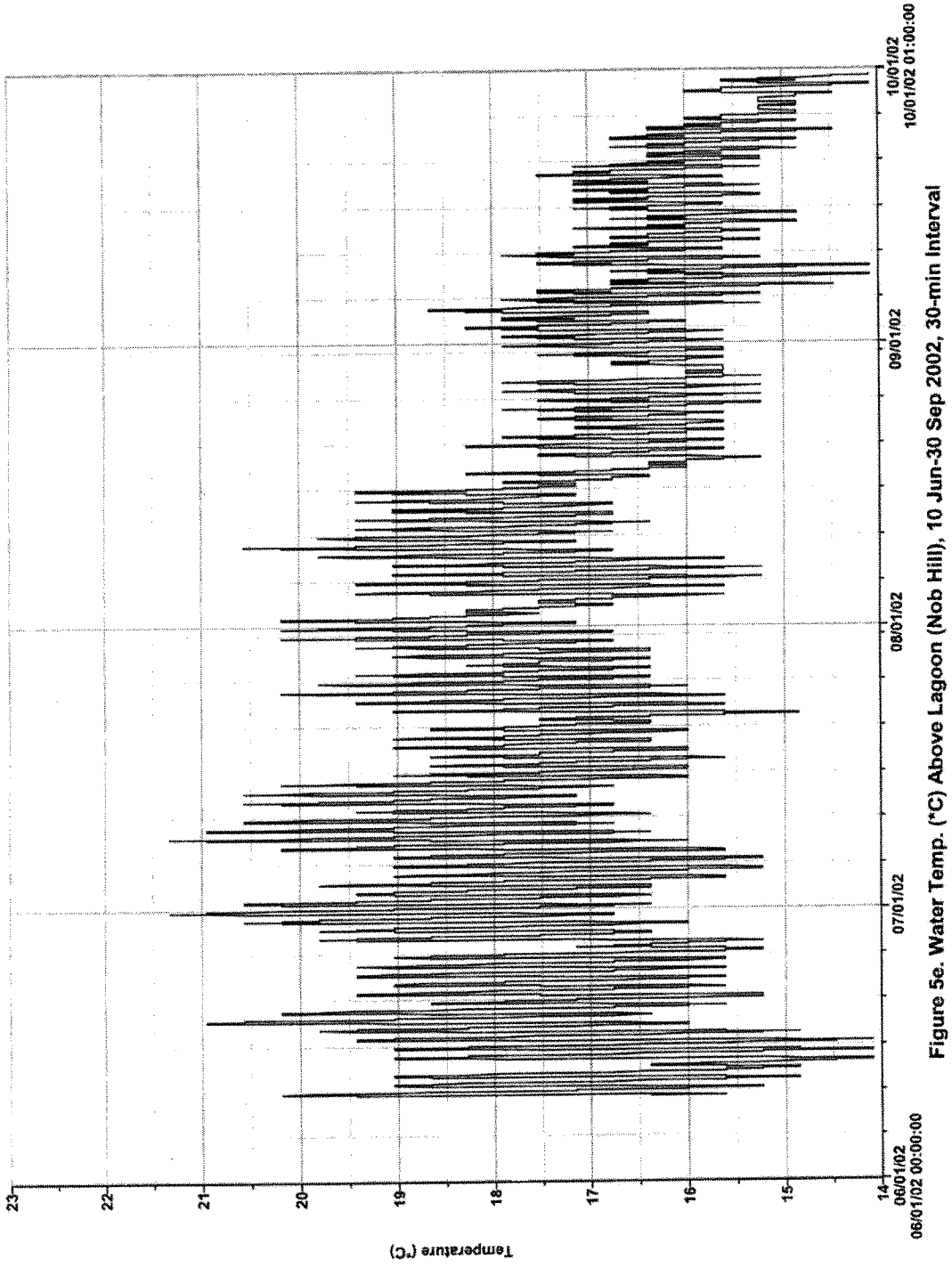


Figure 5e. Water Temp. (°C) Above Lagoon (Nob Hill), 10 Jun-30 Sep 2002, 30-min Interval

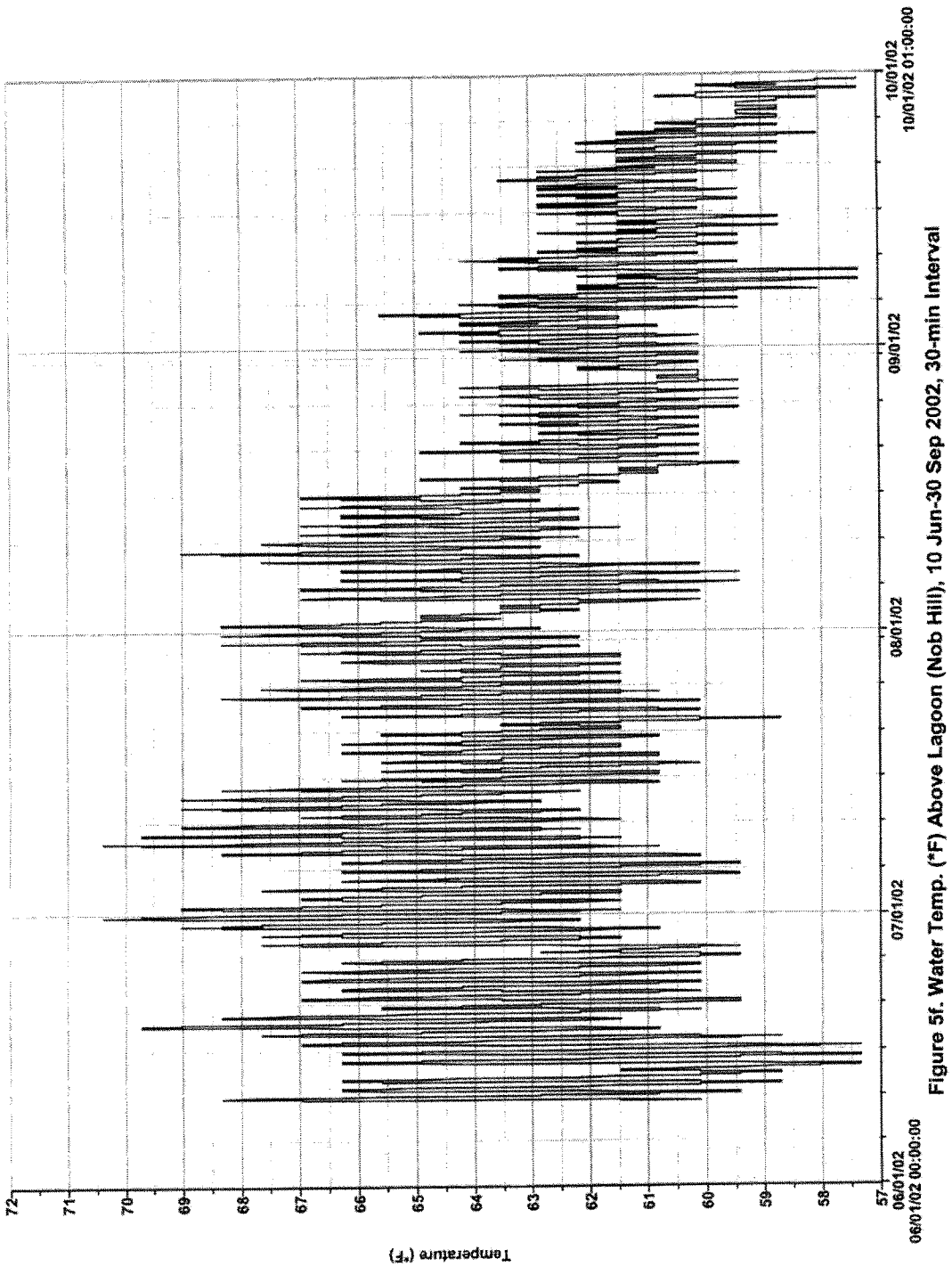


Figure 5f. Water Temp. (°F) Above Lagoon (Nob Hill), 10 Jun-30 Sep 2002, 30-min Interval

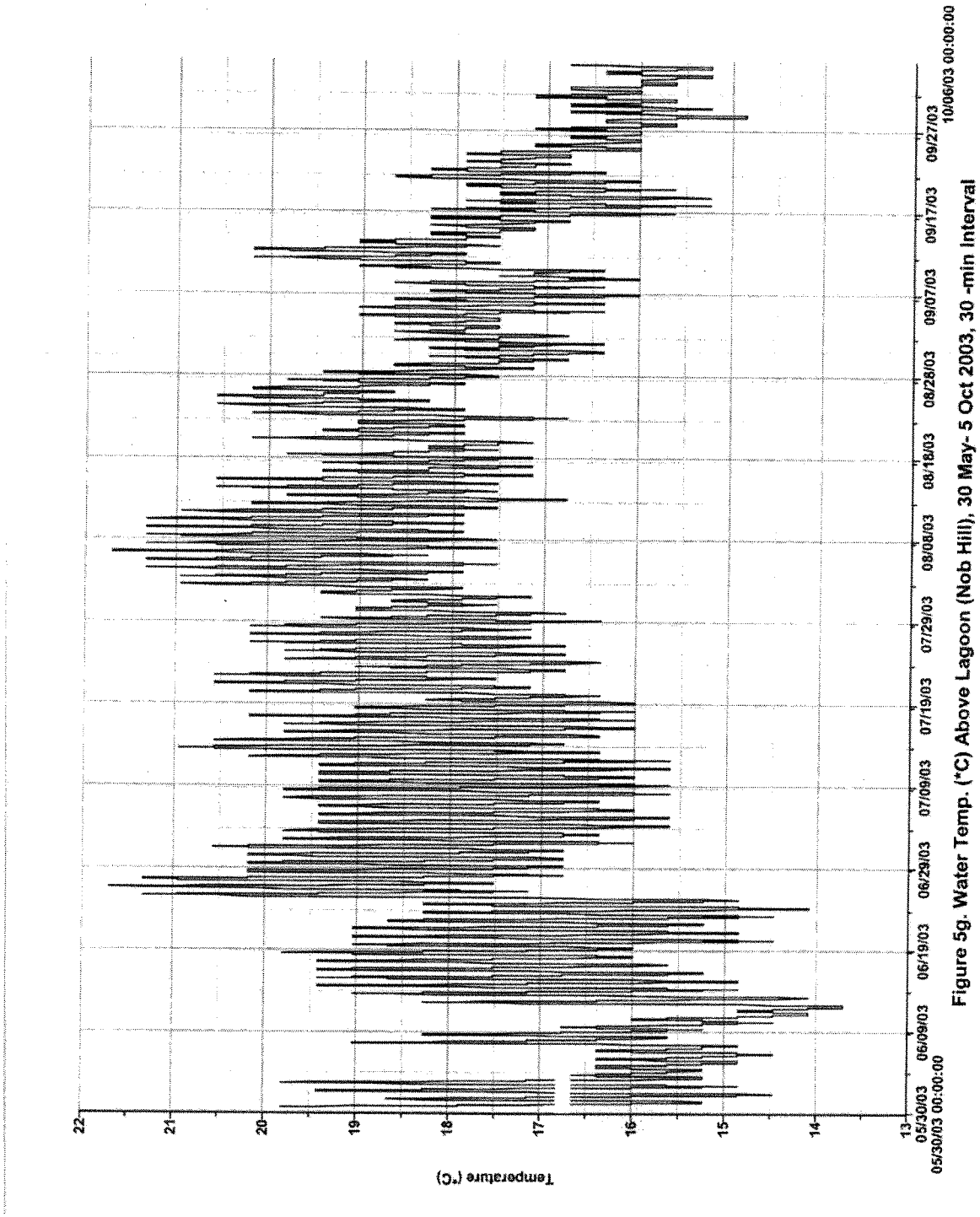


Figure 5g. Water Temp. (°C) Above Lagoon (Nob Hill), 30 May- 5 Oct 2003, 30 -min Interval

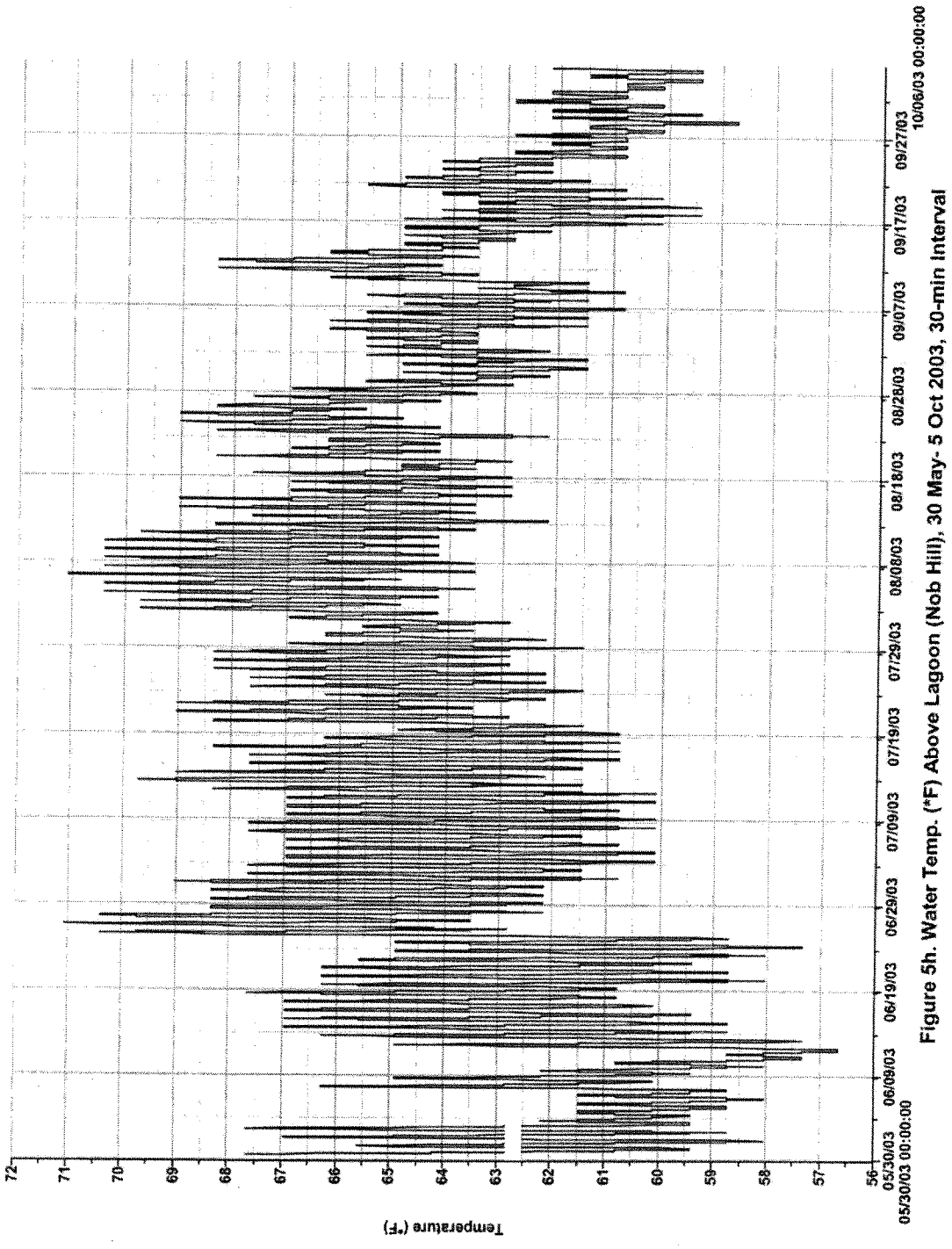


Figure 5h. Water Temp. (°F) Above Lagoon (Nob Hill), 30 May- 5 Oct 2003, 30-min Interval

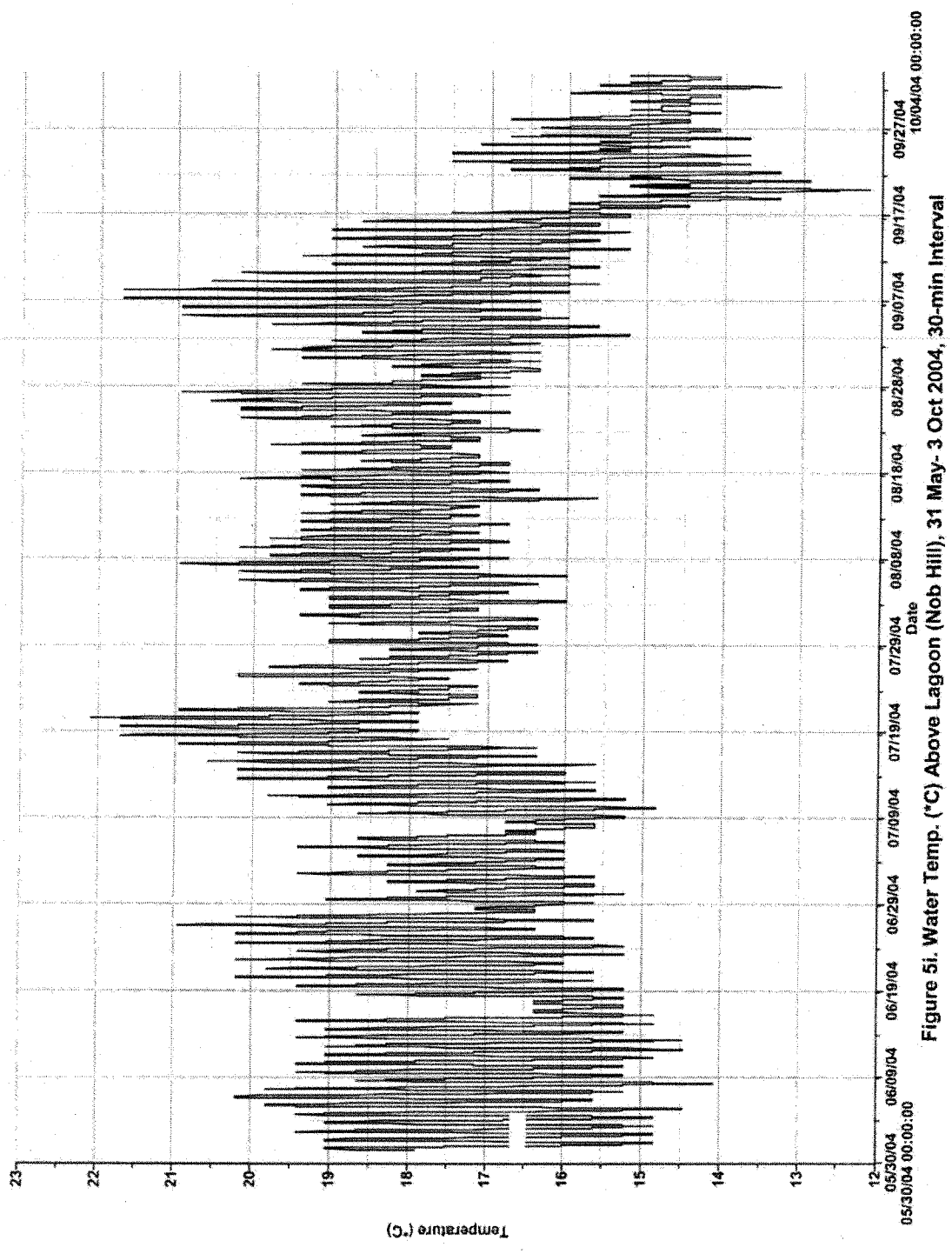


Figure 5i. Water Temp. (°C) Above Lagoon (Nob Hill), 31 May- 3 Oct 2004, 30-min Interval

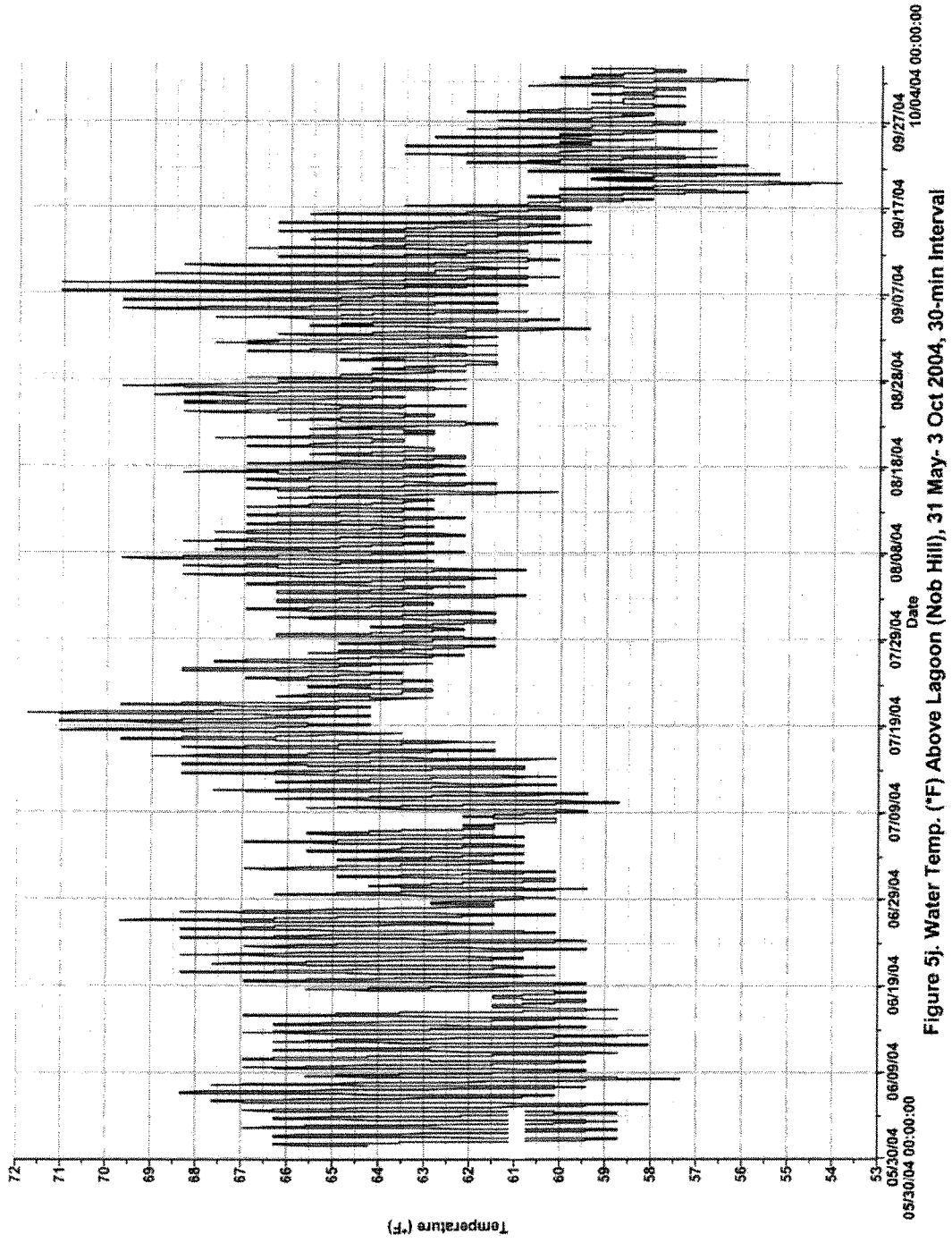


Figure 5j. Water Temp. (°F) Above Lagoon (Nob Hill), 31 May- 3 Oct 2004, 30-min Interval

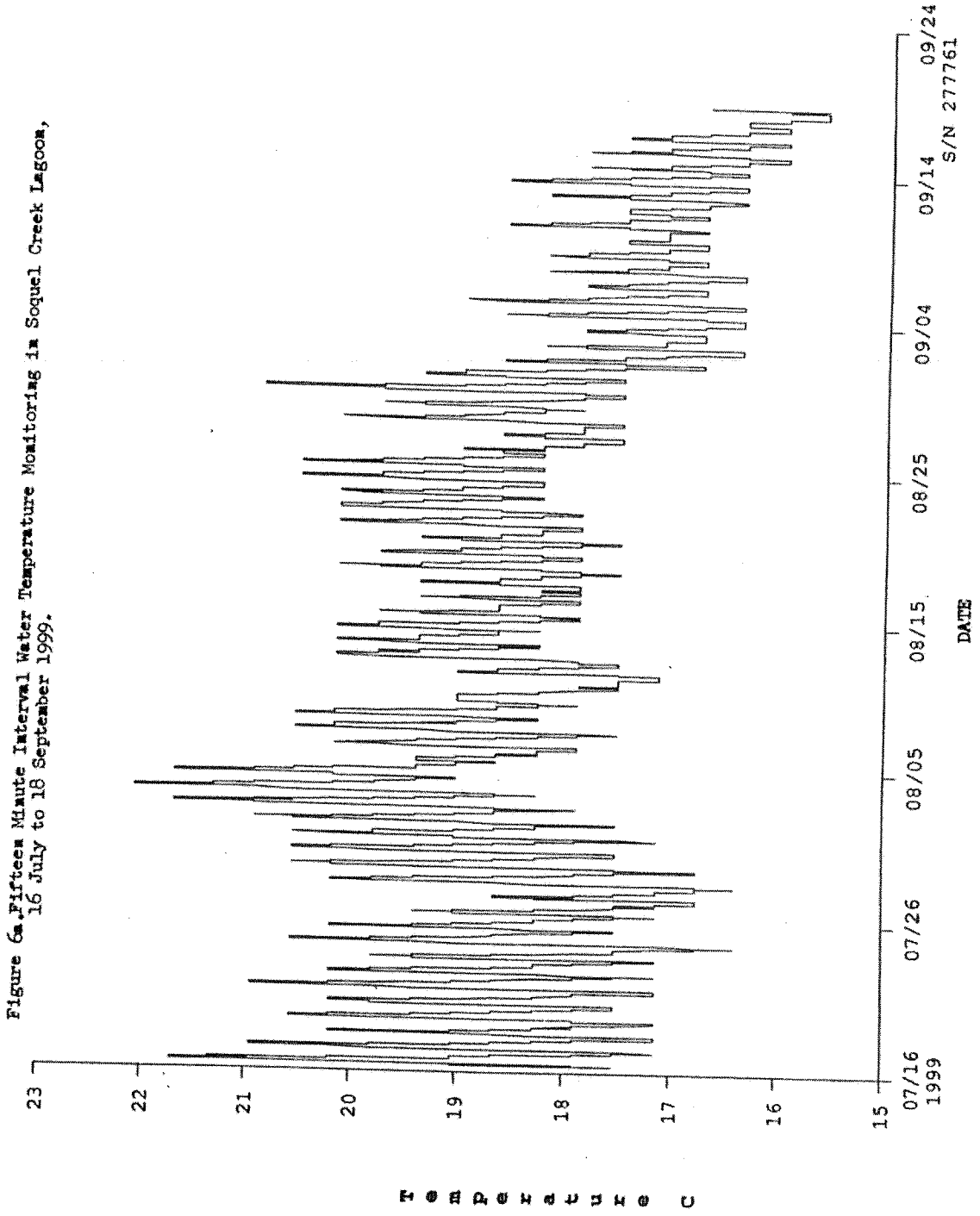


Figure 6a. Fifteen Minute Interval Water Temperature Monitoring in Soquel Creek Lagoon,
16 July to 18 September 1999.
Water Temperature C
23
22
21
20
19
18
17
16
15
07/16
1999
07/26
08/05
08/15
08/25
09/04
09/14
09/24
DATE
S/N 277761

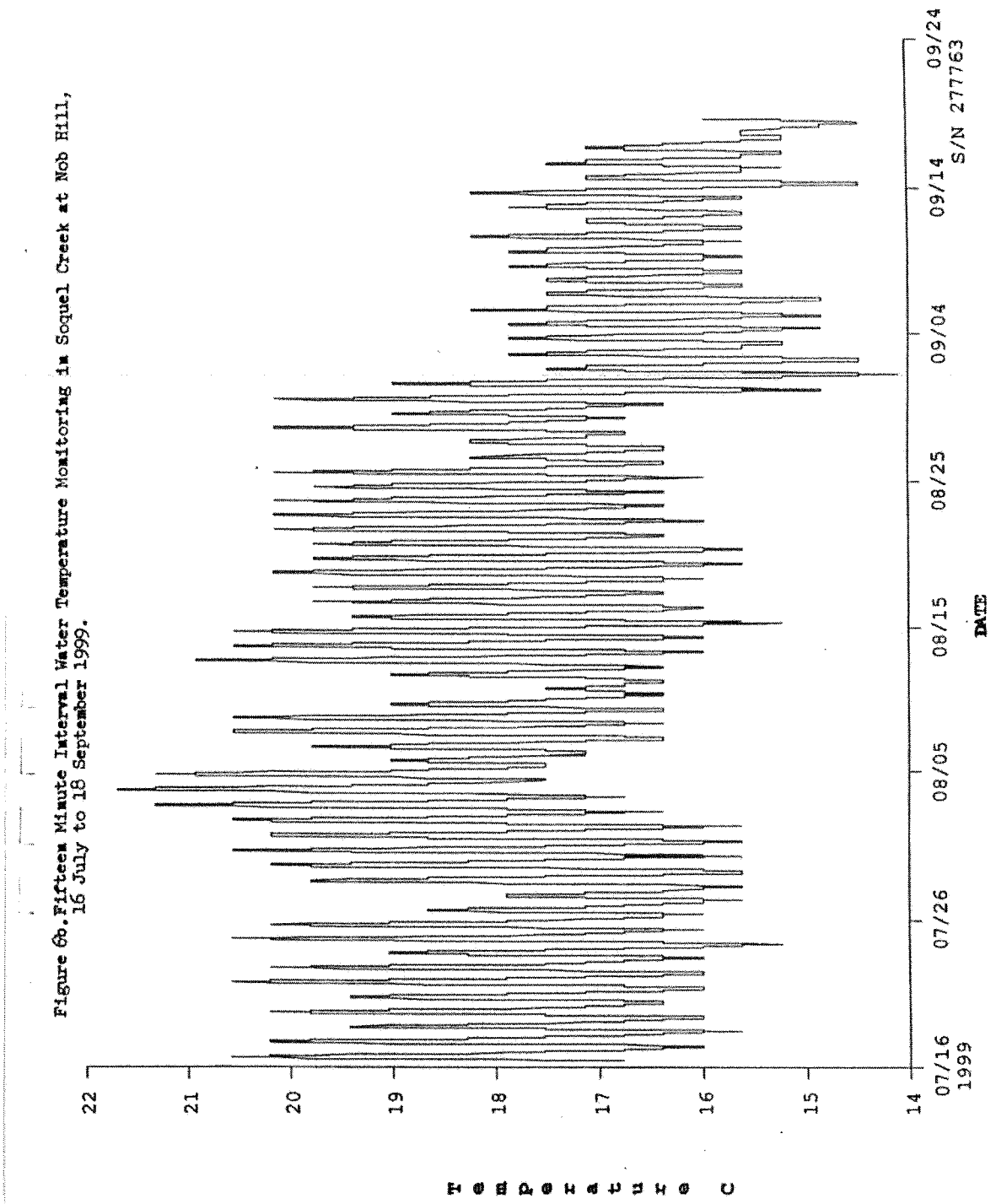


Figure 6b. Fifteen Minute Interval Water Temperature Monitoring in Soquel Creek at Nob Hill,
16 July to 18 September 1999.
Temperature C
22
21
20
19
18
17
16
15
14
07/16
1999
07/26
08/05
08/15
08/25
09/04
09/14
09/24
S/N 277763
DATE

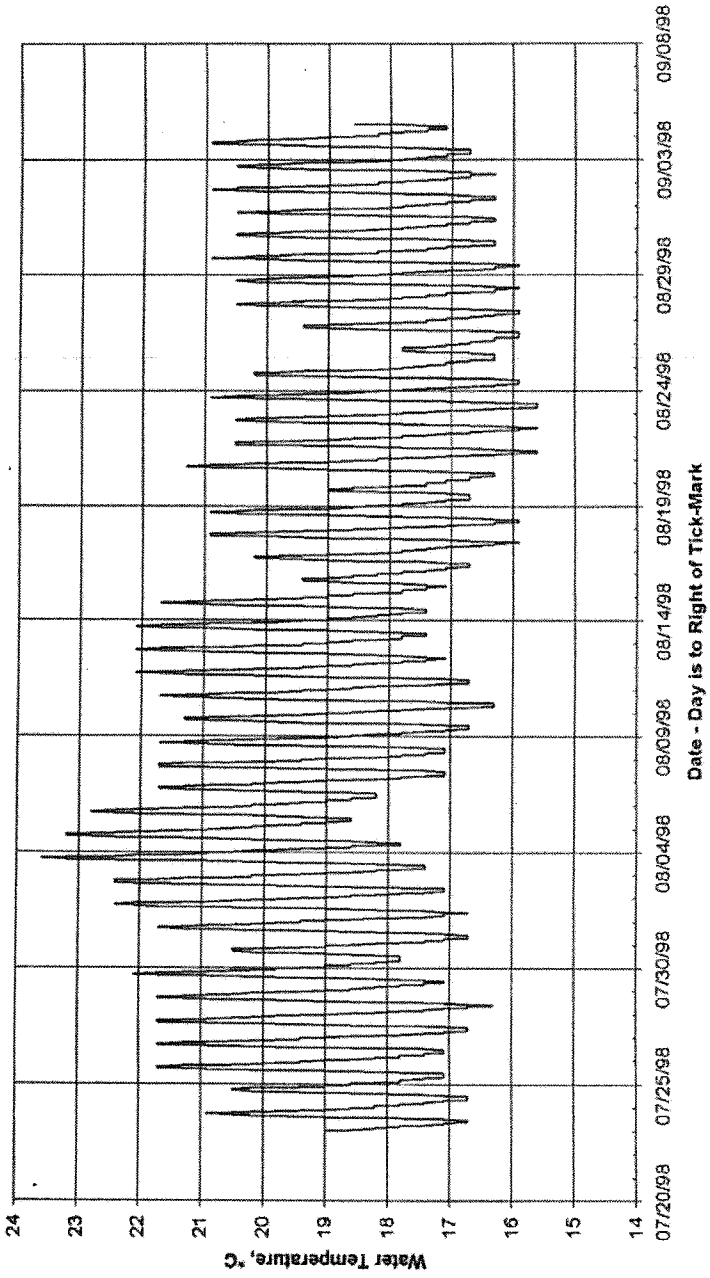


Figure 6c. Hourly Water Temperature Monitoring at Nob Hill on Soquel Creek, July 23 - September 4, 1998.

Figure 8. Soquel Lagoon Oxygen Concentration at Dawn, 10 June - 25 October 2002, Within 0.25 Meters of the Bottom at 4 Stations.

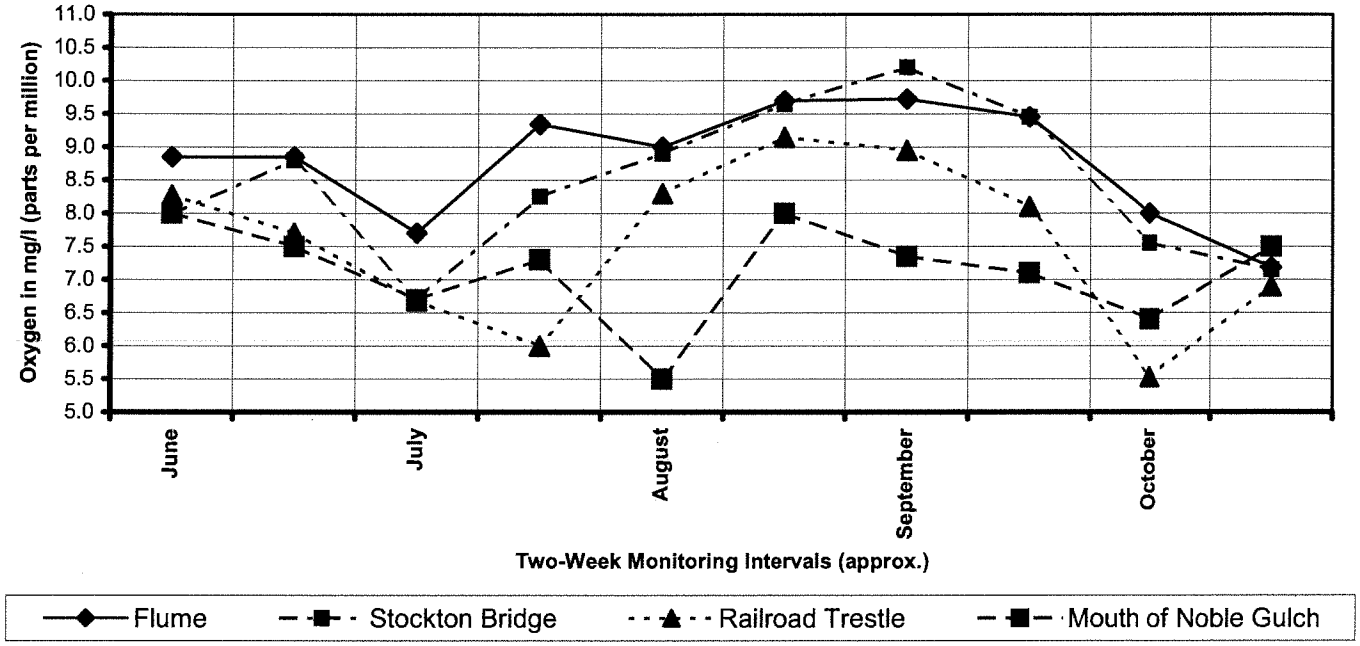


Figure 9a. Soquel Lagoon/Stream Oxygen Concentration at Dawn, 9 June - 27 October 2003, Within 0.25 Meters of the Bottom at 5 Stations.

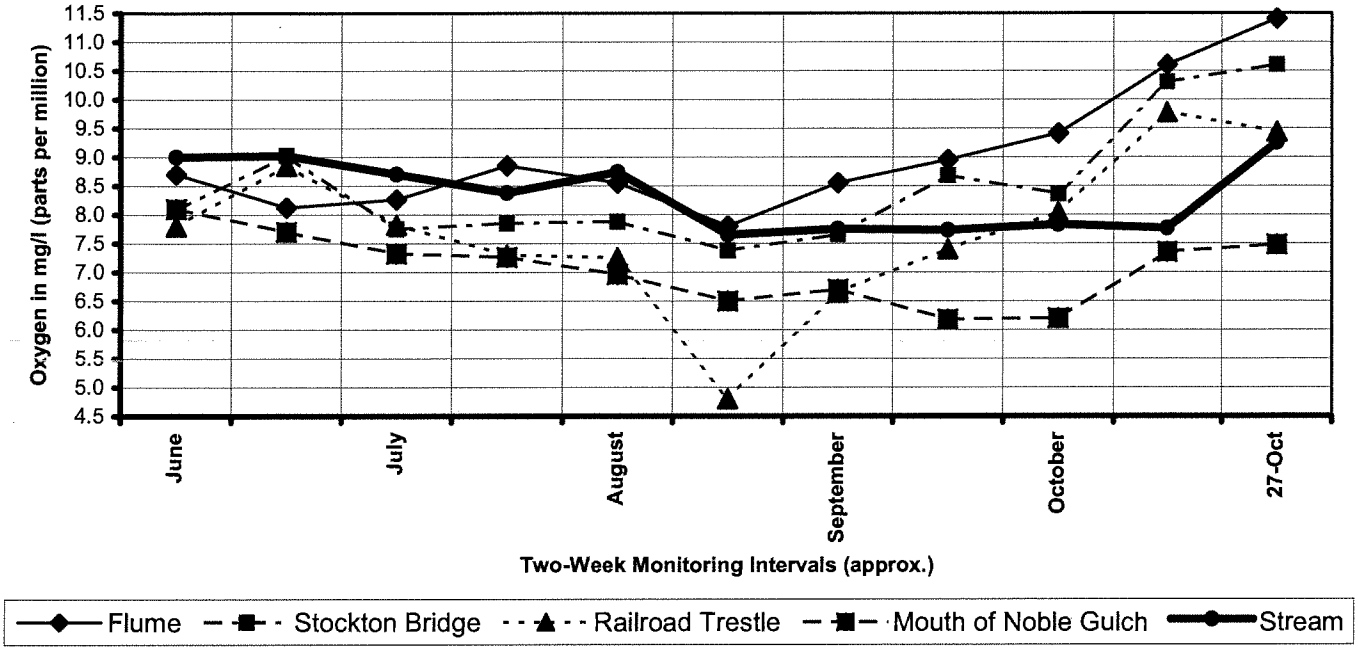


Figure 9b. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon, 9 June - 27 October 2003, Within 0.25 Meters of the Bottom Station 2, Stockton Avenue Bridge.

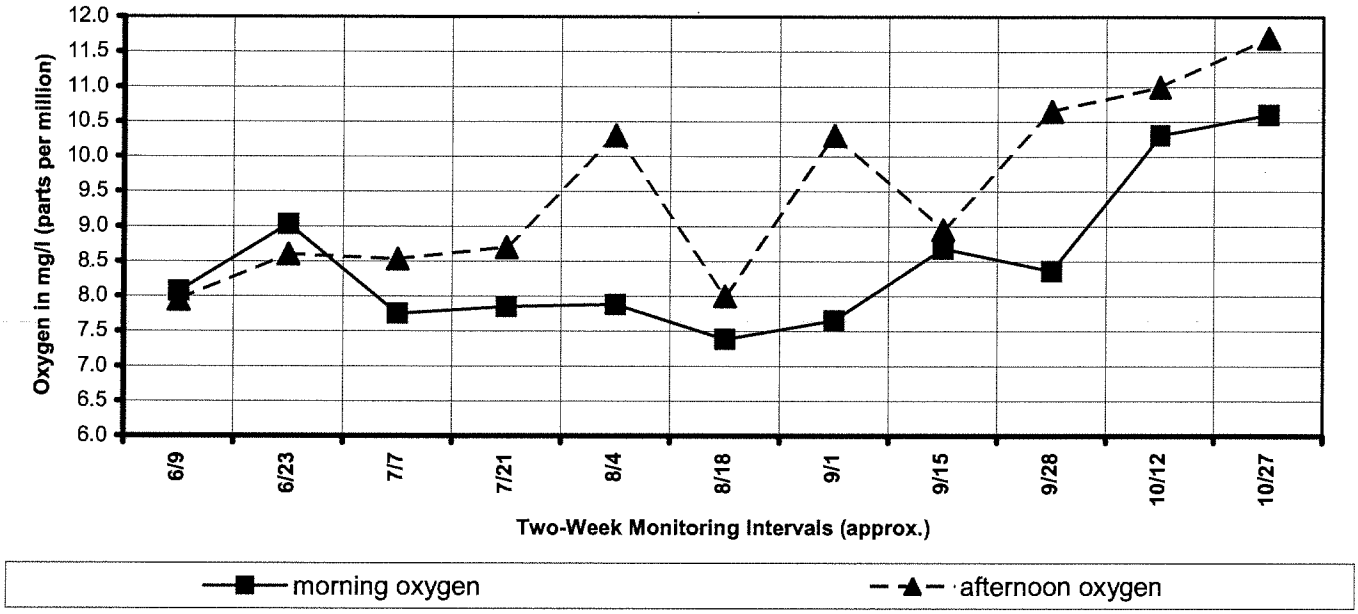


Figure 9c. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon, 9 June - 27 October 2003, Within 0.25 Meters of the Bottom Station 4, Mouth of Noble Gulch.

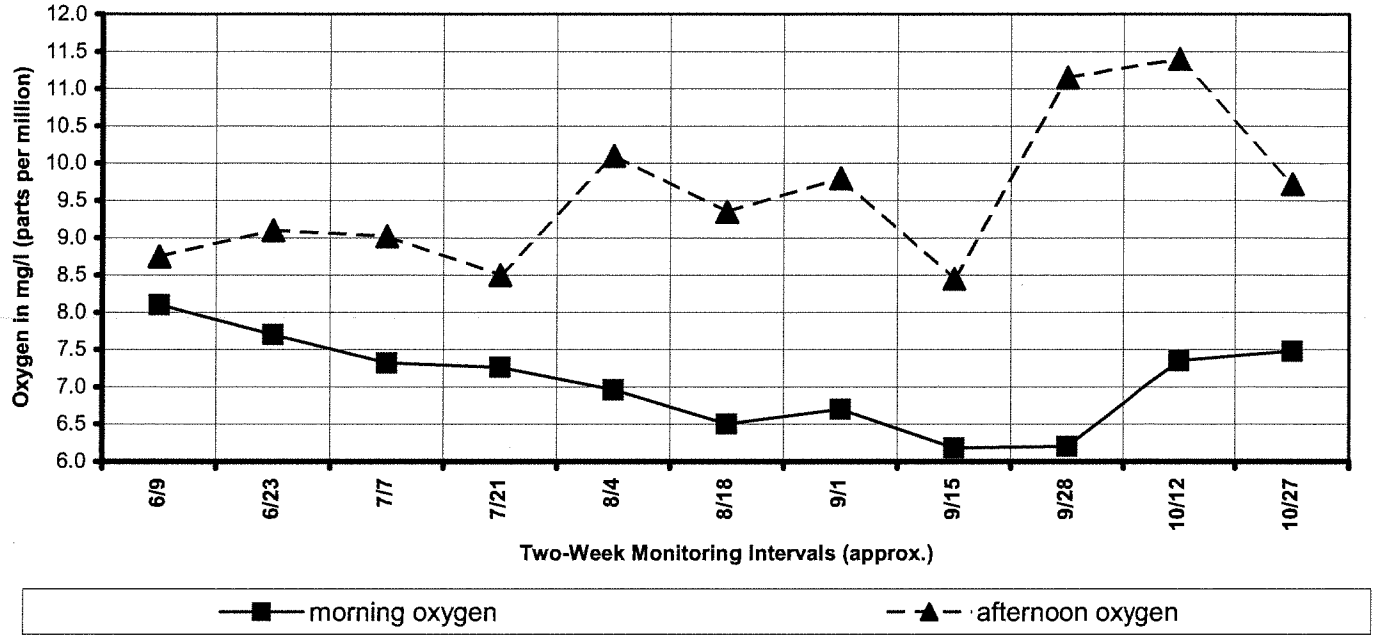


Figure 9d. Soquel Lagoon/Stream Oxygen Concentration at Dawn, 13 June - 15 October 2004, Within 0.25 Meters of the Bottom at 5 Stations.

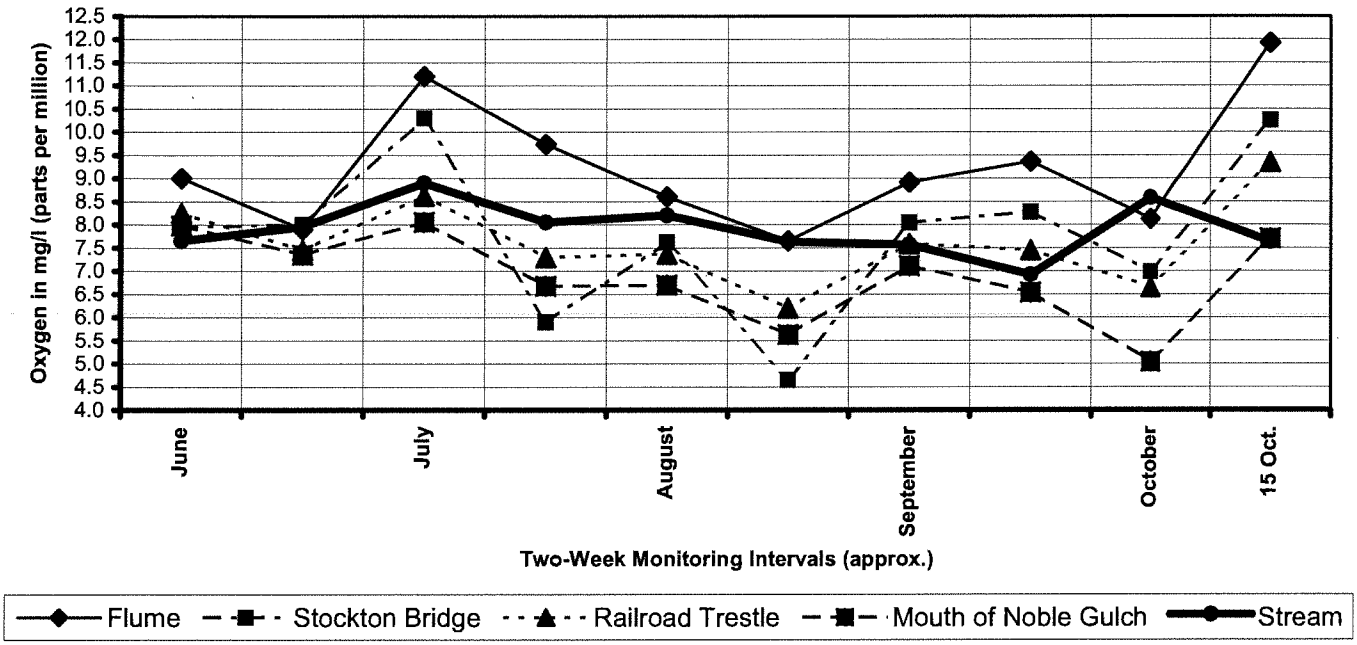


Figure 9e. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon, 13 June - 15 October 2004, Within 0.25 Meters of the Bottom at Station 2, Stockton Avenue Bridge.

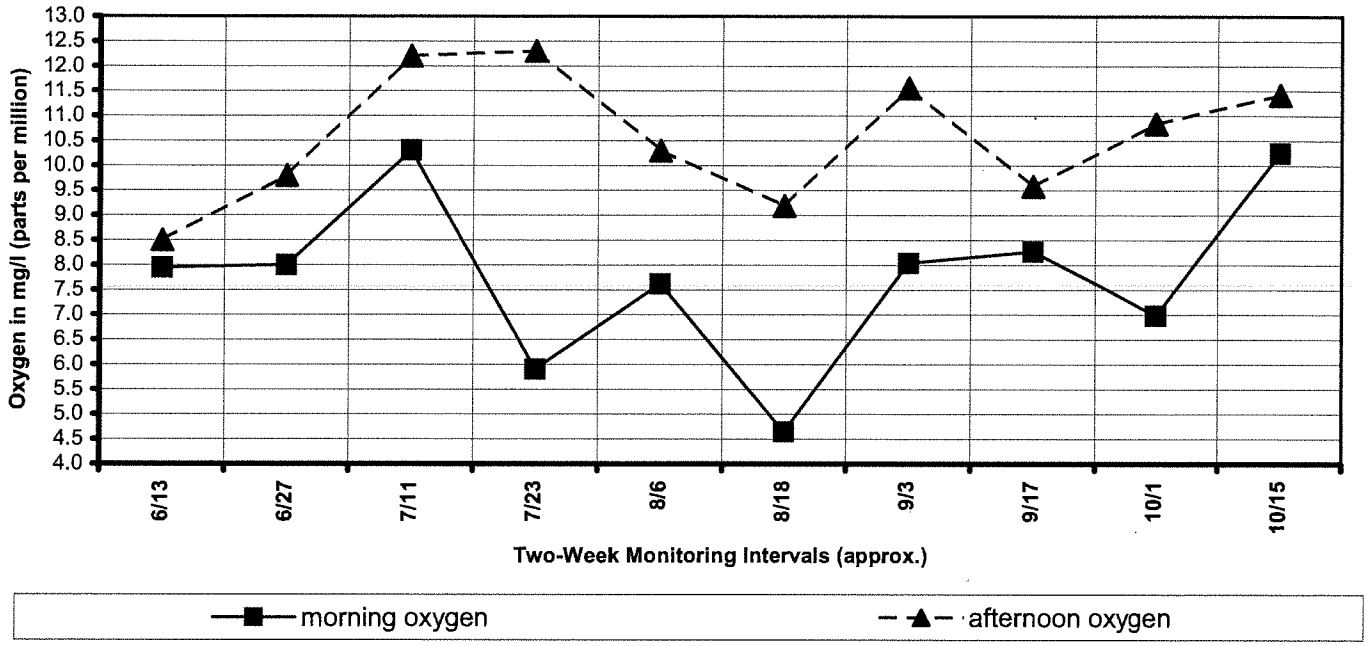


Figure 9f. Soquel Lagoon Oxygen Concentration in the Morning and Afternoon, 13 June - 15 October 2004, Within 0.25 Meters of the Bottom at Station 4, Mouth of Noble Gulch.

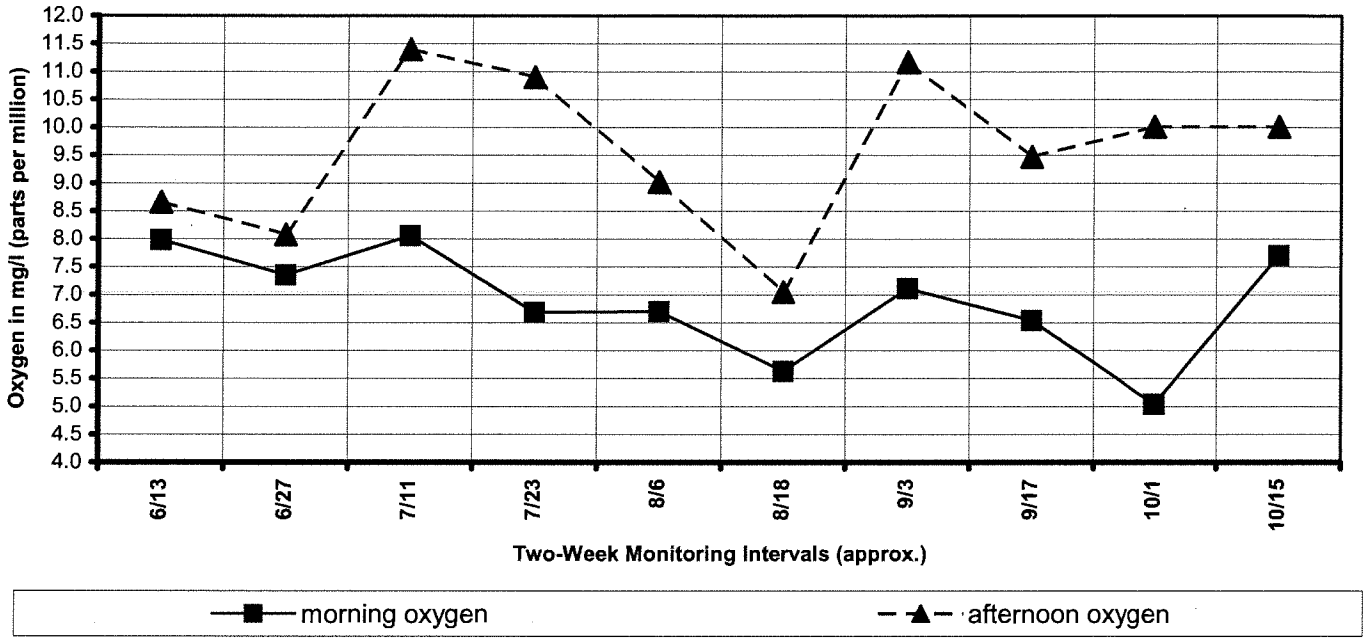


Figure 10. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 and 12 October 2004 in Soquel Lagoon.

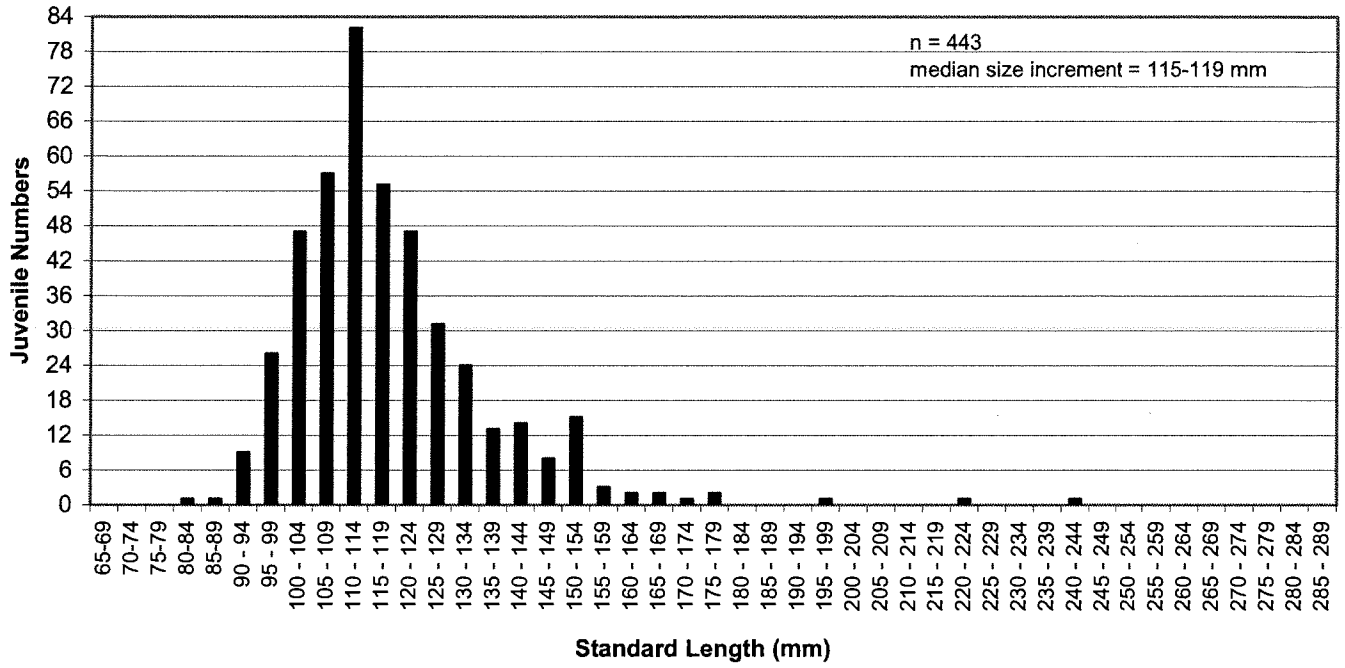


Figure 11. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 5 and 12 October 2003 in Soquel Lagoon.

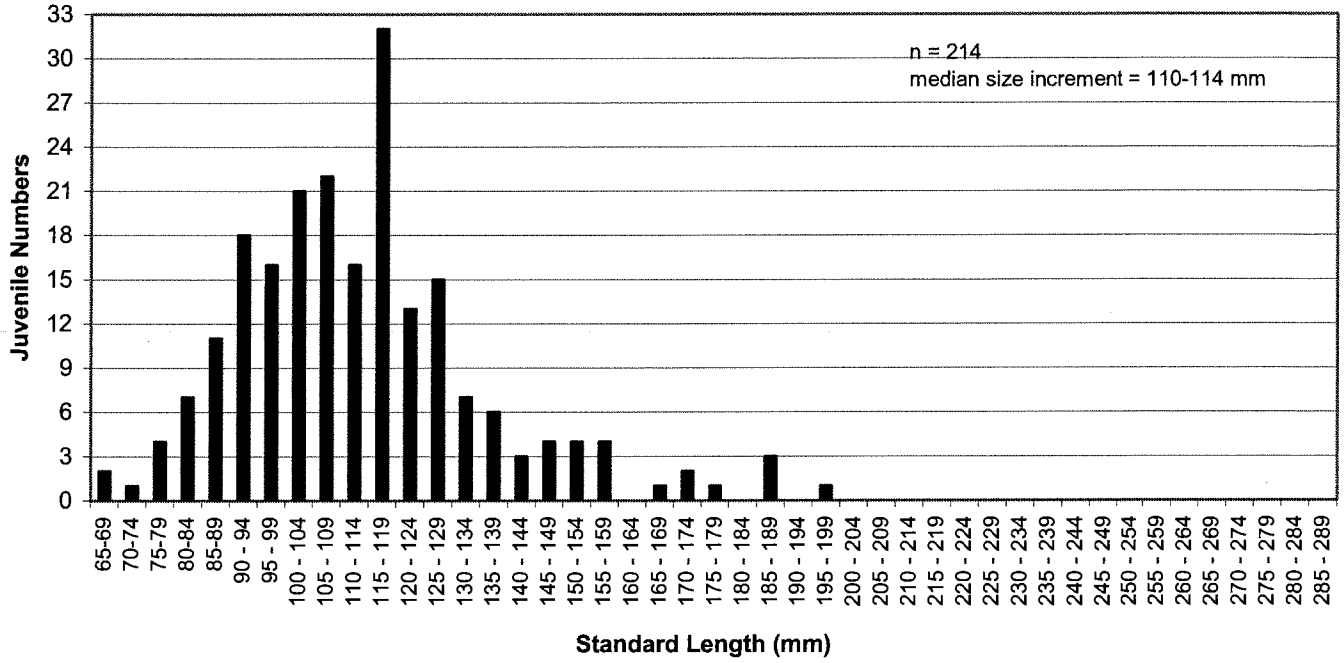


Figure 12. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 6 and 13 October 2002 in Soquel Lagoon.

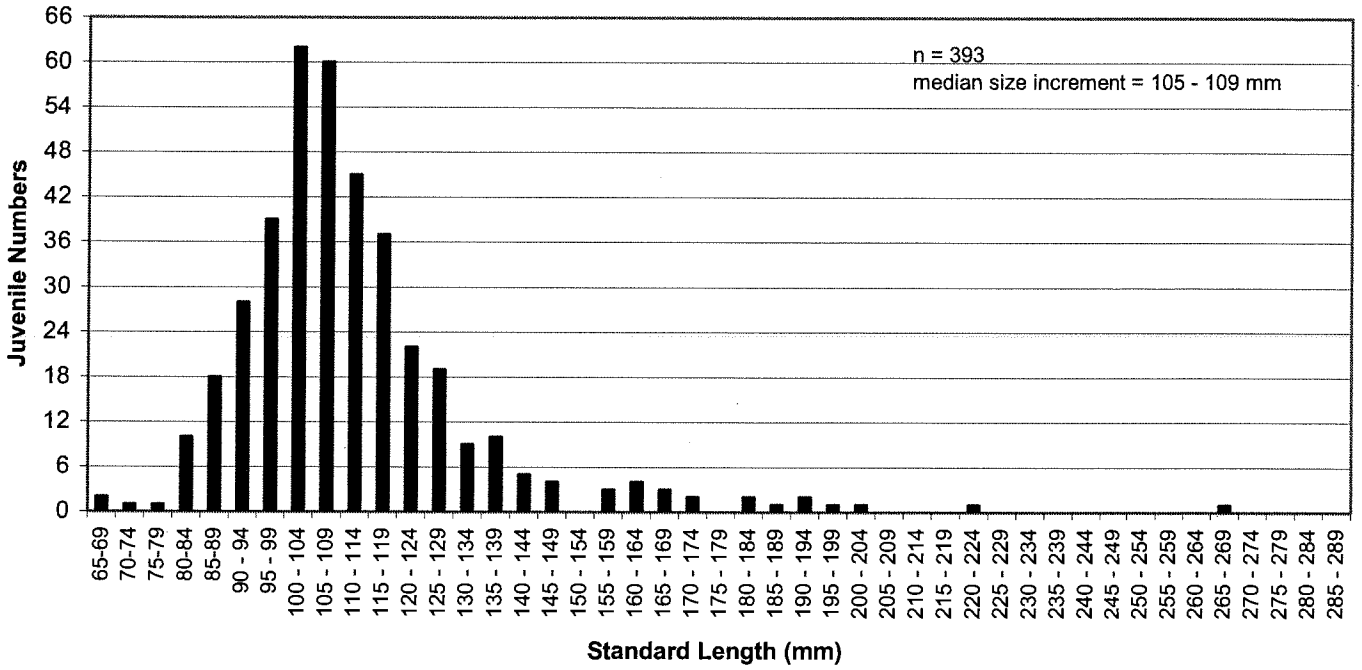


Figure 13. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 7 and 14 October 2001 in Soquel Lagoon.

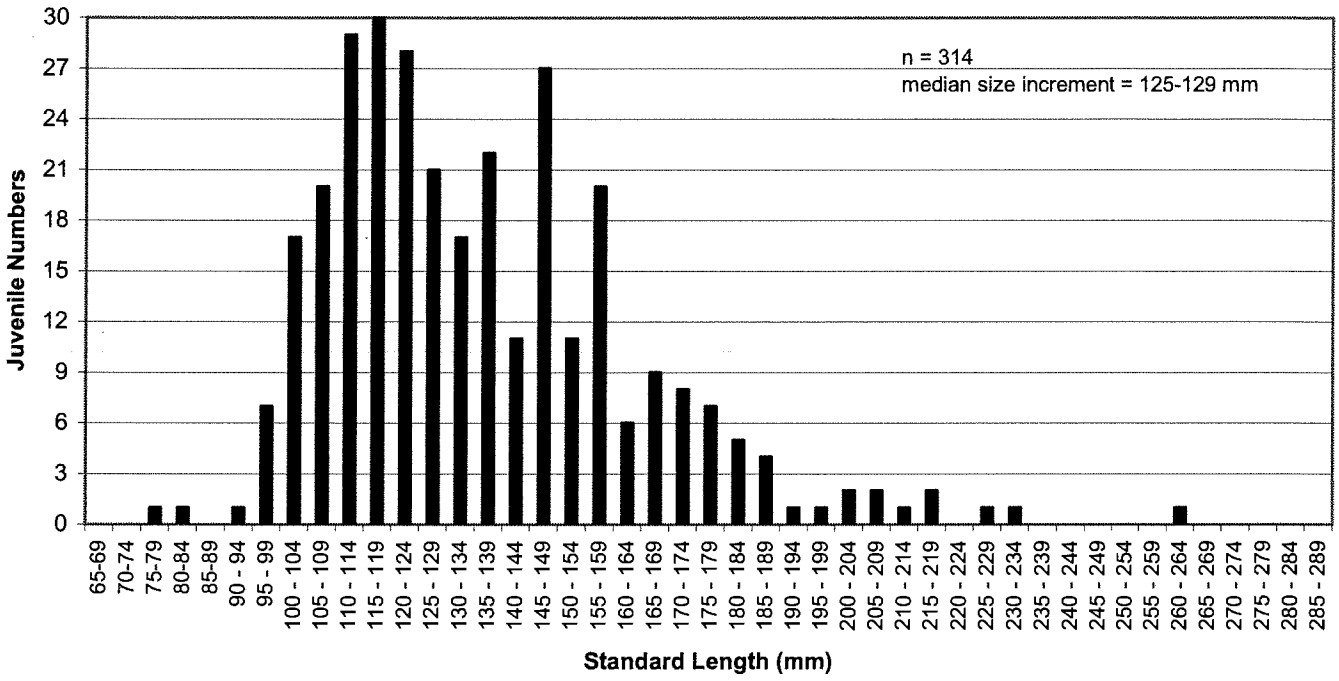


Figure 14. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 1 and 8 October 2000 in Soquel Lagoon.

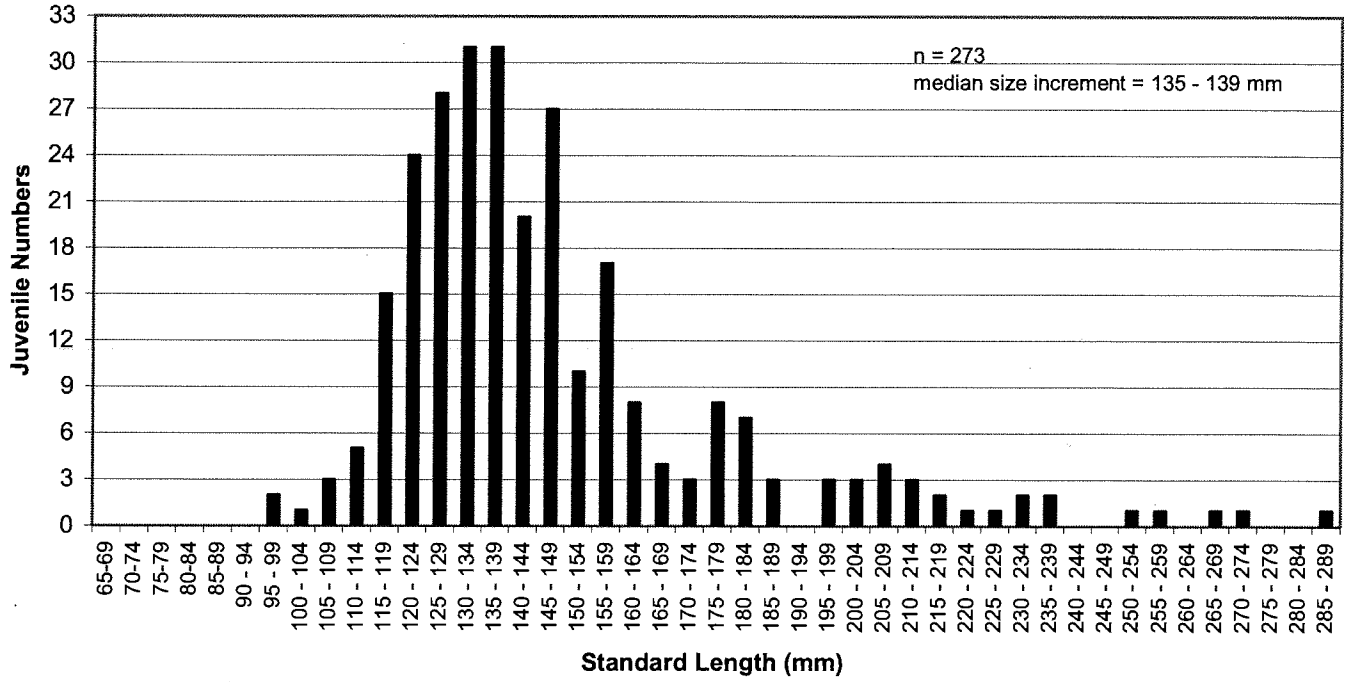


Figure 15. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 October 1999 (only) in Soquel Lagoon.

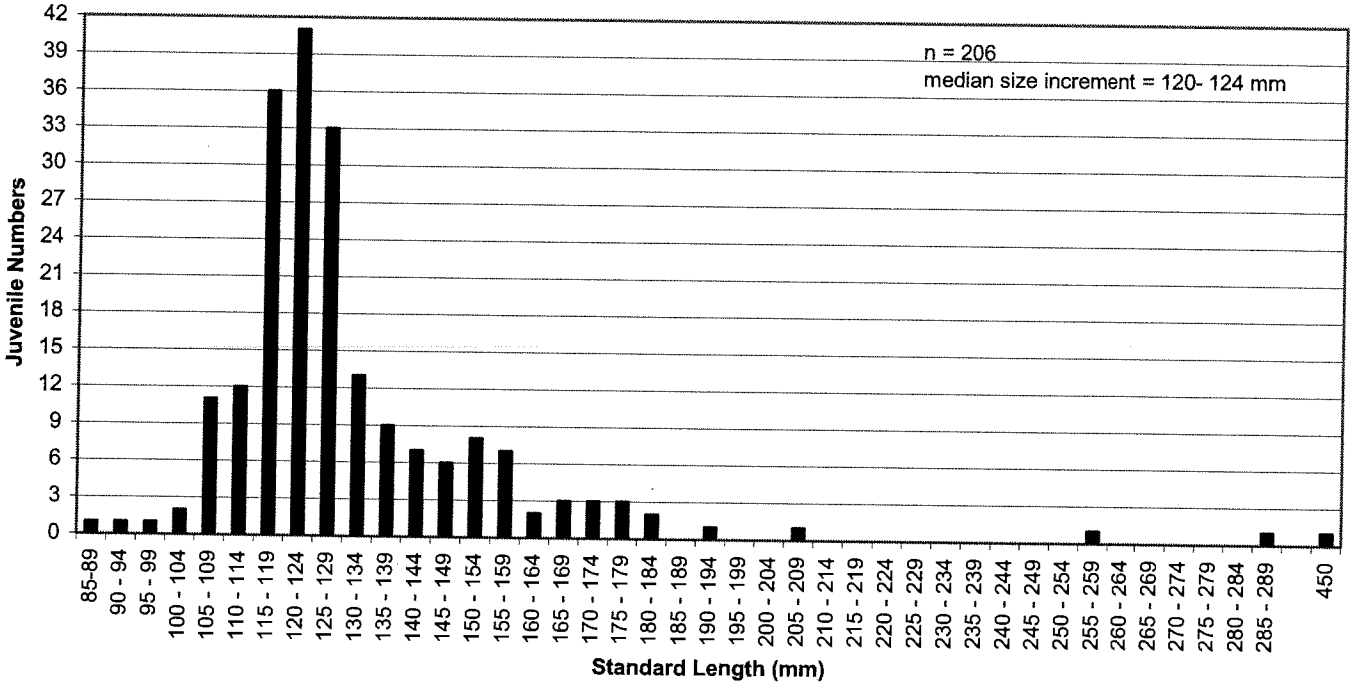


Figure 16. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998 in Soquel Lagoon.

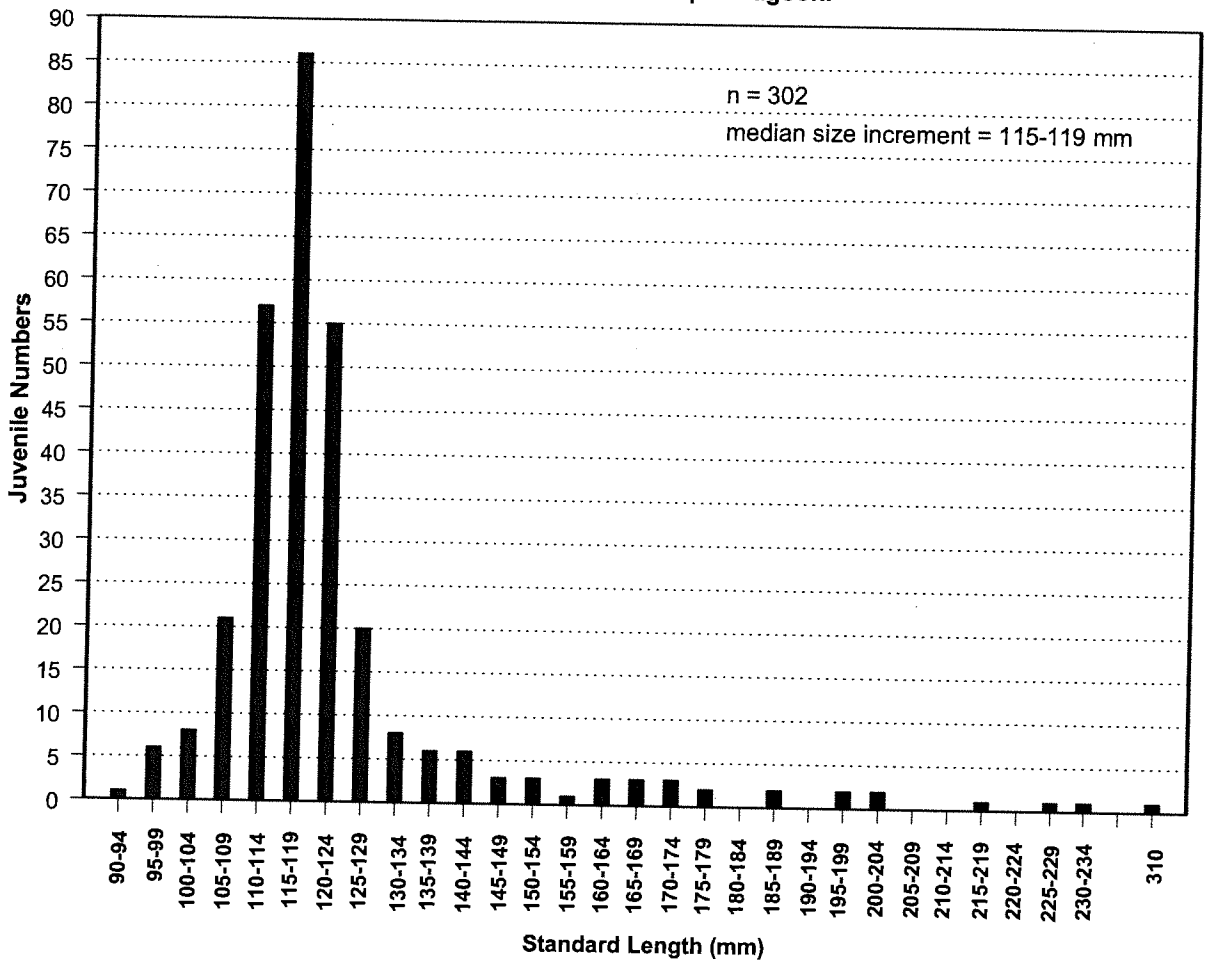
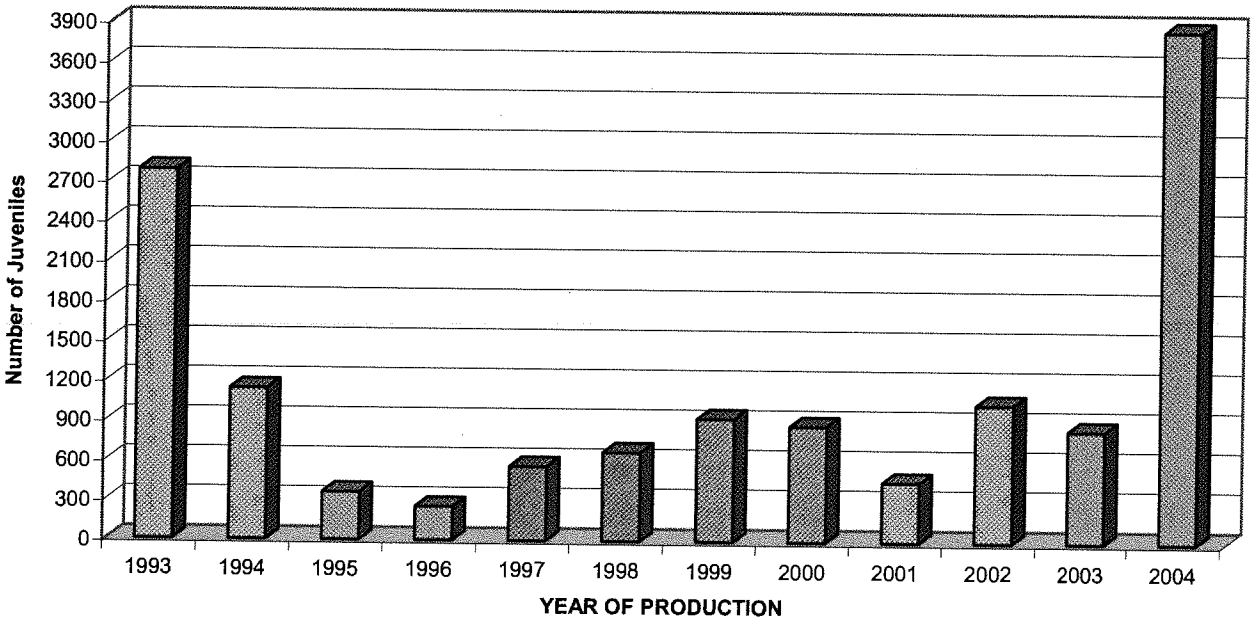


Figure 17. Juvenile Steelhead Production in Soquel Creek Lagoon, 1993-2004, Estimated by Mark and Recapture Experiment.



APPENDIX A.

WATER QUALITY DATA AND GENERAL OBSERVATIONS OF BIRDS AND AQUATIC VEGETATION 27 MAY – 19 OCTOBER 2004.

27 May 2004. Water level was not to top board of flume inlet. Boards still present in the flume inlet. Shroud installed at 1240 hr as a result of water quality data indicating saltwater still present.

	27-May-04							
	Near Bridge Abutment				**Stockton Ave Bridge Thalweg**			0950hr
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 Umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**
0.00					18.2	0.02		480
0.25					18.2	0.02		480
0.50					18.1	0.02		480
0.75					18.1	0.02		480
1.00					17.8	1.8		480
Bottom1.25					18.6	2.4		480
1.50								
1.75								
2.00								

	Railroad Trestle				**Mouth of Noble Gulch**			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00								
0.25								
0.50								
0.75								
1.00								
1.25								
1.50								

28 May 2004. Gage height of 2.64.

7 June 2004. Gage height of 2.60.

					13-Jun-04				
	Flume			0735 hr	**Stockton Avenue Bridge**			0757 hr	
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 umhos**	
0.00	18.8	0.0	9.40	600	19.2	0.0	8.78	600	
0.25	18.9	0.0	9.25	580	19.3	0.0	8.40	600	
0.50	18.9	0.0	9.20	580	19.2	0.0	8.70	600	
0.75	19.2	0.0	9.00	580	19.2	0.0	8.58	610	
1.00	19.3	0.0	8.40	580	19.2	0.0	8.50	620	
1.25					19.2	0.0	8.23	610	
1.50					19.5	0.0	7.95	620	
1.55					19.5	0.0	6.16	580	
2.00									
2.25									

	Railroad Trestle			0824 hr	**Mouth of Noble Gulch**			0840 hr
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 umhos**
0.00	18.5	0	8.75	600	18.2	0	7.73	580
0.25	18.6	0	8.80	600	18.5	0	7.98	580
0.50	18.8	0	8.55	600	18.5	0	7.60	580
0.75	18.8	0	8.42	600	18.6	0	7.65	580
1.00	18.8	0	8.25	600	18.5	0	7.60	580
1.20	18.8	0	4.85	620				
1.25					18.4	0	7.65	550
1.50					17.9		4.82	550

13 June 2004. Gage height of 2.55. Clear today and yesterday. Air temperature of 13.9°C at 0735 hr. Flume inlet greater than 1 ft. Flume outlet 1.2 ft with tide out.

Station 1: Flume at 0735 hr. Reach 1- no surface algae, phytoplankton bloom in all three reaches. Contaminated water sign up.
Station 2: Stockton Avenue Bridge at 0757 hr. Secchi depth to bottom. Reach 2- no surface algae, film on bottom.
Station 3: Railroad Trestle at 0824 hr. Reach 3- no surface algae, film on bottom.
Station 4: Mouth of Noble Gulch at 0825 hr. No surface algae, film on bottom. Turtle on cottonwood log across lagoon.
Station 5: Nob Hill at 0937 hr. Water temperature 15.3°C. Conductivity 550 umhos. Oxygen 9.25 mg/l. Visible streamflow estimate of 4-4.5 cfs.

13-Jun-04

	Flume			1653 hr	Stockton Avenue Bridge			1630 hr
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 umhos
0.00	21.2	0.0	9.50	630	21.0	0.0	9.18	630
0.25	21.2	0.0	9.35	630	21.0	0.0	8.90	630
0.50	21.2	0.0	9.50	630	21.0	0.0	8.65	630
0.75	21.0	0.0	9.40	630	20.9	0.0	8.40	630
1.00	21.0	0.0	9.70	630	20.8	0.0	8.60	630
1.25					20.7	0.0	8.45	630
1.50					20.3	0.0	8.50	630
1.55					20.0	0.0	5.90	630
2.00								
2.25								

	Railroad Trestle			1559 hr	Mouth of Noble Gulch			1535 hr
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 umhos
0.00	20.8	0	8.75	630	21.5	0.0	8.80	600
0.25	20.8	0	8.30	630	21.5	0.0	8.65	620
0.50	20.8	0	7.85	630	20.8	0.0	8.30	620
0.75	20.8	0	7.50	630	20.8	0.0	8.10	610
1.00	20.8	0	8.43	630	20.0	0.0	8.75	590
1.20	20.8	0	6.22	640				
1.25					19.0	0.0	8.66	590
1.50					19.0	0.0	7.58	590

13 June 2004. Gage height of 2.56 in afternoon. Sunny. Air temperature of 19.8°C at 1542 hr. Sidewalk grates covered with sheetmetal. Esplanade stormdrain cap in place and water level above the cap.

21 June 2004. Gage height of 2.55.

0705hr					27-Jun-04				0725hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 umhos	
0.00	19.8	0	9.25	620	19.8	0.0	8.20	630	
0.25	20.2	0	8.35	620	20.1	0.0	8.33	640	
0.50	20.2	0	8.42	630	20.2	0.0	8.06	640	
0.75	20.5	0	7.90	610	20.2	0.0	8.16	640	
0.95	20.4	0	6.45	590					
1.00					20.2	0.0	8.05	640	
1.25					20.3	0.0	8.00	650	
1.50					20.3	0.0	5.40	650	
1.75									
2.00									

0758hr					27-Jun-04				0814hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 umhos	
0.00	19.8	0.0	7.30	630	19.2	0.0	7.48	610	
0.25	20.0	0.0	7.60	630	19.2	0.0	7.25	620	
0.50	20.1	0.0	7.60	630	19.5	0.0	7.30	620	
0.75	20.1	0.0	7.70	640	19.5	0.0	7.43	620	
1.00	20.1	0.0	7.45	640	19.5	0.0	7.43	620	
1.13/1.25	20.1	0.0	4.70	640	19.5	0.0	7.25	590	
1.48					19.0	0.0	4.82	600	

27 June 2004. Gage height of 2.41. Overcast. Air temperature of 14.3°C. Shroud in place.

Station 1: Flume at 0705 hr. Reach 1- 2 mergansers.

Station 4: Mouth of Noble Gulch at 0814 hr. Water hyacinths fenced in. 2 mergansers roosting on redwood stump Reach 3 with 8 mallards roosting on cottonwood log. 12 allards swimming (5 ducklings and mother). 1 goose swimming.

Station 5: Nob Hill at 0855 hr. Water temperature 16.2°C. Conductivity 580 umhos. Oxygen 7.95 mg/l. Streamflow visually estimated at 3.5 cfs.

1705hr					27-Jun-04				1642hr
	Flume					Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos		Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 umhos
0.00	22.0	0.0	9.70	650		22.0	0.0	9.85	660
0.25	22.0	0.0	9.80	660		22.0	0.0	9.80	660
0.50	22.0	0.0	9.83	660		22.2	0.0	9.80	680
0.75	22.0	0.0	10.1	660		22.2	0.0	9.70	680
0.95/1.00	22.0	0.0	8.65	660		22.5	0.0	9.70	680
1.25						21.9	0.0	9.45	680
1.50						21.9	0.0	9.80	650
1.55						21.9	0.0	7.05	660
2.00									

1620hr					27-Jun-04				1550hr
	Railroad Trestle					Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos		Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 umhos
0.00	22.5	0.0	9.35	660		22.8	0.0	8.62	660
0.25	22.5	0.0	9.35	660		22.8	0.0	8.45	660
0.50	22.5	0.0	9.40	660		22.8	0.0	8.23	660
0.75	22.2	0.0	9.35	660		22.1	0.0	7.65	650
1.00	22.0	0.0	10.8	660		20.8	0.0	8.18	650
1.25	22.0	0.0	6.50	660		20.6	0.0	8.08	620
1.50						20.6	0.0	5.75	620

27 June 2004. Gage height of 2.40 at 1640 hr. Sunny. Air temperature of 25°C at 1556 hr. Flume inlet greater than 2 ft. Flume outlet 8 in deep at top of outlet with remainder filled with sand. We advised Morrison to remove shroud on flume inlet.

Station 1: Flume at 1705 hr. Reach 1- 1% surface algae, 60% bottom algae 0.2-0.6 feet, averaging 0.3 ft, with remainder a film.

Station 2: Stockton Avenue Bridge at 1642 hr. Secchi depth to bottom. Reach 2- no surface algae, phytoplankton a green soup, 30% bottom algae 2-6 feet thick, averaging 0.3 ft, with remainder a film.

Station 3: Railroad Trestle at 1620 hr. Reach 3- no surface algae, 60% bottom algae 0.2-0.6 ft thick, averaging 0.3 ft, with remainder a green film

Station 4: Mouth of Noble Gulch at 0825 hr. 5% surface algae, 50% bottom algae 0.3-1.0 thick, averaging 0.6 ft, with remainder film on bottom.

28 June 2004. Flume outlet closed overnight and opened manually the next day.

29 June 2004. Gage height 2.90.

0715hr					11-Jul-04				0737hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos	
0.00	18.5	0.0	11.3	620	18.5	0.0	10.5	620	
0.25	18.6	0.0	11.3	620	18.6	0.0	10.5	620	
0.50	18.8	0.0	11.2	620	18.8	0.0	10.5	620	
0.75	18.8	0.0	11.2	610	19.0	0.0	10.4	620	
0.95/1.00	19.0	0.0	9.78	580	19.0	0.0	10.4	620	
1.25					19.0	0.0	10.35	620	
1.50					19.0	0.0	10.3	620	
1.55					19.0	0.0	6.30	620	

0802hr					11-Jul-04				0818hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos	
0.00	18.2	0.0	8.63	620	17.8	0.0	8.30	600	
0.25	18.3	0.0	8.45	620	18.0	0.0	8.30	590	
0.50	18.3	0.0	8.56	620	18.2	0.0	8.13	590	
0.75	18.4	0.0	8.72	620	18.3	0.0	7.98	590	
1.00	18.5	0.0	8.62	620	18.3	0.0	8.00	580	
1.13/1.25	18.5	0.0	5.43	630	18.2	0.0	8.06	570	
1.50					18.0	0.0	5.37	580	

11 July 2004. Gage height of 2.51 morning and afternoon. Air temperature of 12.8°C at 0715 hr. Flume inlet 0.9 ft depth. Esplanade storm drain still capped. Shroud still in place.

Station 1: Flume at 0715 hr. Reach 1- 2% surface algae.

Station 4: Mouth of Noble Gulch at 0818 hr. 2% surface algae. Water hyacinth gone and fence still in place. Hyacinths migrated into the box culvert and disappeared.

Station 5: Nob Hill at 0850 hr. Water temperature 15.7 °C. Conductivity 570 umhos. Oxygen 8.90 mg/l. Streamflow visually estimated at 3.25 cfs.

1631 hr			11-Jul-04					1607 hr
	Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos
0.00	20.5	0.0	8.75	650	21.0	0.0	11.6	630
0.25	20.4	0.0	8.75	630	20.8	0.0	11.7	630
0.50	20.3	0.0	8.65	630	20.8	0.0	11.6	630
0.75	20.3	0.0	8.65	630	20.6	0.0	11.7	630
0.95/1.00	20.3	0.0	8.50	630	20.5	0.0	11.6	630
1.25					20.3	0.0	12.4	630
1.50					20.2	0.0	12.2	630
1.55					20.2	0.0	6.30	630

1552hr			11-Jul-04					1528hr
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos
0.00	21.0	0.0	8.80	630	22.2	0.0	11.1	660
0.25	21.0	0.0	8.61	630	21.9	0.0	11.3	660
0.50	21.0	0.0	8.50	630	21.6	0.0	11.1	640
0.75	20.8	0.0	8.45	630	19.9	0.0	11.2	620
1.00	20.2	0.0	9.25	630	19.6	0.0	11.6	620
1.13/1.25	20.2	0.0	9.34	630	19.5	0.0	11.4	620
1.50					19.4	0.0	9.63	620

11 July 2004. Gage height of 2.51 at 1605 hr. Sunny. Air temperature of 19.2°C at 1610 hr. Flume inlet 0.9 ft. Flume outlet 0.8 ft at top of outlet with remainder filled with sand. Stormdrain cap still in place. Morrison stated that shroud was to be removed on 15 or 16 July.

Station 1: Flume at 1631 hr. Reach 1- less than 1% surface algae, 80% bottom algae 0.5- 4 feet, averaging 1.0 ft, with occasional spires and remainder film. 33 gulls bathing with 2 mallards present.

Station 2: Stockton Avenue Bridge at 1607 hr. Secchi depth to bottom. Reach 2- less than 1% surface algae. 100% bottom algae 0.4- 1 ft thick, averaging 1 ft.

Station 3: Railroad Trestle at 1552 hr. Reach 3- 3% surface algae, 100% bottom algae 0.4-1.2 ft thick, averaging 0.7 ft.

Station 4: Mouth of Noble Gulch at 0825 hr. 10% surface algae, 65% bottom algae 0.3-1.0 thick, averaging 0.5 ft, with remainder film on bottom.

19 July 2004. Morrison reported there was a tidal overwash at Venetian Court side of berm this day. Shroud reinstalled and lower adult portal opened to remove saltwater.

0712 hr					23-Jul-04				0730 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 umhos	
0.00	21.5	0.0	9.45	910	21.2	0.0	8.95	820	
0.25	21.5	0.0	9.55	910	21.2	0.0	8.72	820	
0.50	21.6	0.0	9.53	920	21.3	0.0	8.80	810	
0.75	21.6	0.0	9.73	920	21.3	0.0	8.53	790	
0.95/1.00	22.1	0.0	8.11	900	21.2	0.0	8.60	790	
1.25					21.2	0.0	8.35	770	
1.50					21.0	0.0	6.30	680	
1.75					20.6	0.0	5.90	680	
2.00					20.5	0.0	3.52	670	
0800hr					23-Jul-04				0814 hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 umhos	
0.00	20.5	0.0	7.46	720	20.3	0.0	9.20	680	
0.25	20.8	0.0	7.40	720	20.5	0.0	9.05	670	
0.50	20.9	0.0	7.42	720	20.5	0.0	9.10	670	
0.75	21.0	0.0	7.45	720	20.5	0.0	8.75	660	
1.00	21.0	0.0	7.30	720	19.6	0.0	7.45	630	
1.20/1.25	21.0	0.0	3.45	720	19.6	0.0	6.68	630	
					19.6	0.0	4.20	640	

23 July 2004. Gage height of 2.54 (morning) and 2.55 (afternoon). Overcast and misty at 0712 hr with air temperature at 16.0 °C. Air temperature 21°C at 1545 hr. Flume entrance greater than 1.0 ft. Flume exit at 1.5 ft. Tidal overwash the previous Monday. Shroud in place with lower portal open. Wooden weir inside flume had broken loose. Repair failed on **26 July** and we judged it unneeded for remainder of summer.

Station 1: Flume at 0712 hr and 1645 hr. Reach 1- no surface algae. 60% of bottom covered by algae 0.5- 2.0 ft thick, averaging 1.0 ft. 12 mallards, 1 goose and 11 gulls bathing in morning.

Station 2: Stockton Avenue Bridge at 1620 hr. Secchi depth to the bottom. Reach 2- 2% surface algae. 80% of bottom covered by algae 0.3- 2.0 ft thick; remainder film on bottom. 6 mallards in the morning.

Station 3: Railroad trestle at 1605 hr. Reach 3- no surface algae. 90% of bottom covered by algae 0.3- 3.0 ft thick, averaging 1.0 ft; remainder film.

Station 4: Mouth of Noble Gulch at 0814 and 1545 hr. 5% surface algae collecting around submerged fence. 90% of bottom covered by algae 0.3-2.5 ft thick, averaging 0.6 ft. 17 steelhead surface hits/ minute near Shadowbrook in morning with 12 mergansers around Noble Gulch.

Station 5: Nob Hill at 0902 hr. Water temperature at 17.2°C. Conductivity 610 umhos, Oxygen 8.05 mg/l.

1645 hr					23-Jul-04				1620 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos	
0.00	21.8	0.0	9.45	770	21.8	0.0	10.46	770	
0.25	21.8	0.0	10.3	750	21.8	0.0	10.25	770	
0.50	21.8	0.0	10.3	750	21.8	0.0	10.4	770	
0.75	21.8	0.0	10.4	750	21.8	0.0	10.25	770	
0.95/1.00	21.8	0.0	8.52	660	22.0	0.0	10.35	770	
1.25					22.0	0.0	10.45	770	
1.50					22.0	0.0	11.2	750	
1.75					21.7	0.0	12.3	720	
1.90					21.0	0.0	8.55	720	

1605hr					23-Jul-04				1545 hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 umhos	
0.00	21.6	0.0	9.91	725	21.8	0.0	8.98	720	
0.25	21.8	0.0	10.1	725	21.8	0.0	8.76	720	
0.50	21.6	0.0	9.80	720	21.8	0.0	8.90	700	
0.75	21.3	0.0	11.0	700	21.5	0.0	9.03	670	
1.00	21.3	0.0	11.8	710	20.5	0.0	10.7	620	
1.20/1.25	21.2	0.0	8.12	680	20.2	0.0	10.9	620	
1.50					20.2	0.0	7.40	630	

0718hr			6-Aug-04				0747hr
	Flume				Stockton Avenue Bridge		
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 umhos
0.00	19.4		8.55		18.8		8.18	
0.25	19.4		8.65		18.8		8.03	
0.50	19.4		8.60		19.0		7.90	
0.75	19.5		8.60		19.0		7.76	
1.00	19.5		6.25		19.0		7.85	
1.25					18.9		7.60	
1.50					18.9		7.65	
1.75					18.8		7.62	
1.85					18.8		4.86	

0818hr			6-Aug-04				0836hr
	Railroad Trestle				Mouth of Noble Gulch		
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 umhos
0.00	20.0		7.45		20.2		7.40	
0.25	20.2		7.55		20.3		7.28	
0.50	20.3		7.55		20.5		7.28	
0.75	20.4		7.60		20.5		7.20	
1.00	20.3		7.37		20.5		7.20	
1.18/1.25	20.3		4.20		20.2		6.70	
1.50					19.8		3.85	

6 August 2004. Gage height of 2.55 (morning) and 2.55 (afternoon). Clear. Air temperature of 14.2°C at 0718 hr and 24.5°C at 1600 hr. Flume inlet at 1.3 ft. Flume outlet at 1.2 feet and partially buried. Conductivity meter malfunction.

Station 1: Flume at 1620 hr. Reach 1- No surface algae. 15% of bottom covered with algae and pondweed. 60% algae 0.3-2 ft thick, averaging 0.6 ft; remainder thick film. Phytoplankton bloom in process.

Station 2: Stockton Avenue Bridge at 1552 hr. Secchi depth to bottom. Reach 2- no surface algae. 80% of bottom covered with algae 0.3-3 ft thick; remainder has film.

Station 3: Railroad Trestle at 1533 hr. Reach 3- 1% surface algae. 80% of bottom covered with algae 0.3- 4.0 ft thick, averaging 0.6 ft.

Station 4: Mouth of Noble Gulch at 0836 hr and 1511 hr. 1% surface algae. 80% of bottom covered by algae 0.3- 3 ft thick, averaging 1.0 ft. 21 mallards on and around cottonwood log with 1 turtle sunning in the morning.

Station 5: Nob Hill at 0929 hr. Water temperature 17.0 °C. Oxygen 8.20 mg/l. Visually estimated streamflow of 2.5 cfs.

1620hr			06-Aug-04				1552hr
	Flume				Stockton Avenue Bridge		
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 umhos
0.00	22.9		11.8		23.2		10.4	
0.25	22.8		12.0		23.2		10.65	
0.50	22.6		11.3		23.0		10.9	
0.75	22.5		11.4		22.8		10.45	
1.00	22.5		7.80		22.7		9.73	
1.25					22.6		10.8	
1.50					22.5		10.65	
1.75					22.0		10.3	
1.85					22.0		5.05	

1533hr			06-Aug-04				1511hr
	Railroad Trestle				Mouth of Noble Gulch		
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 umhos
0.00	23.3		9.70		23.9		9.50	
0.25	23.3		9.50		23.5		9.00	
0.50	23.0		9.95		23.5		9.03	
0.75	22.9		10.2		22.6		8.30	
1.00	22.7		10.4		21.8		8.95	
1.20/1.25	22.5		4.82		21.3		9.02	
1.50					21.2		8.57	

0726 hr					18-Aug-04				0746hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos	
0.00	19.6	0.2	7.82	707	20.1	0.4	8.96	702	
0.25	20.5	0.4	7.72	707	20.4	0.4	8.05	703	
0.50	20.6	0.4	7.86	707	20.4	0.4	7.79	703	
0.75	20.6	0.4	7.65	707	20.4	0.4	7.58	703	
1.00	20.6	0.4	4.25	707	20.4	0.4	7.55	703	
1.25					20.4	0.4	7.59	703	
1.50					20.3	0.4	5.97	703	
1.75					20.1	0.4	4.64	703	
1.85					20.0	0.4	2.49	703	

0810 hr					18-Aug-04				0825hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos	
0.00	20.2	0.4	6.69	703	19.7	0.0	7.74	694	
0.25	20.4	0.4	6.48	703	19.8	0.0	7.62	696	
0.50	20.3	0.4	5.89	703	19.8	0.0	7.78	696	
0.75	20.3	0.4	5.52	703	19.8	0.0	7.85	696	
1.00	20.3	0.4	6.20	703	19.8	0.0	8.16	687	
1.25	20.3	0.4	2.08	703	19.1	0.0	5.63	687	
1.50					19.1	0.0	2.40	696	

18 August 2004. Gage height of 2.53 (morning) and 2.54 (afternoon). Overcast in morning and partly cloudy in afternoon. Overcast until noon and clear for a few hours. Air temperature of 16.0 °C at 0726 hr and 18.2°C at 1643 hr. Flume entrance at 1.2 ft. Flume outlet at 1.2 feet and partially buried. Using new water quality meter.

Station 1: Flume at 0726 hr and 1625 hr. Reach 1- No surface algae. 70% of bottom covered by algae 0.6- 2.5 ft thick; 15% of bottom covered with algae and pondwood; remainder film. In morning 25 mallards standing at Venetian Court beach. In afternoon 43 gulls bathing.

Station 2: Stockton Avenue Bridge at 1619 hr. Reach 2- No surface algae. 90% of bottom covered by algae 0.5-3.0 ft, averaging 1.0 ft thick. In morning 1 coot and 8 mallards.

Station 3: Railroad Trestle at 0810 hr and 1558 hr. Reach 3- 1% surface algae. 80% of bottom covered by algae 0.5-3.0 ft, averaging 1.0 ft thick.

Station 4: Mouth of Noble Gulch at 0825 hr 1540 hr. 15% surface algae along submerged fence. 70% of bottom covered by algae 0.3-4 ft thick, averaging 2 ft. Remainder algal film. In morning, 1 merganser on redwood stump and 10 mallards near Gulch. In afternoon, 2 mergansers on cottonwood log. Very breezy.

Station 5: Nob Hill at 0933 hr. Water temperature of 17.6 °C. Conductivity of 656 umhos. Oxygen 7.63 mg/l.

1643 hr			18-Aug-04				1619 hr
	Flume				**Stockton Avenue Bridge**		
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**
0.00	21.4	0.4	9.52	716	21.4	0.4	9.06	717
0.25	21.3	0.4	10.01	715	21.4	0.4	9.06	717
0.50	21.3	0.4	9.69	715	21.4	0.4	8.92	717
0.75	21.3	0.4	10.52	712	21.4	0.4	8.82	716
1.00	21.4	0.4	6.66	712	21.3	0.4	8.85	715
1.25					21.1	0.4	9.45	713
1.50					21.1	0.4	9.17	711
1.75					21.1	0.4	9.19	711
1.85					21.1	0.4	6.12	711

1558 hr			18-Aug-04				1540 hr
	Railroad Trestle				**Mouth of Noble Gulch**		
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 Umhos**
0.00	21.3	0.4	10.41	703	21.3	0.4	9.78	718
0.25	21.3	0.4	9.69	703	21.4	0.4	9.11	717
0.50	21.3	0.4	9.64	703	21.4	0.4	8.05	710
0.75	21.2	0.4	10.21	703	20.9	0.4	7.56	704
1.00	21.2	0.4	11.02	703	20.5	0.4	8.49	693
1.25	21.2	0.4	4.43	703	20.1	0.4	7.05	673
1.50					20.1	0.4	4.59	673

0715 hr					03-Sep-04				0735 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos	
0.00	19.5	0.4	8.96	686	19.6	0.4	8.08	690	
0.25	19.6	0.4	8.91	686	19.7	0.4	8.06	690	
0.50	19.6	0.4	8.95	686	19.7	0.4	7.70	690	
0.75	19.6	0.4	8.91	686	19.7	0.4	7.64	690	
1.00	19.7	0.4	3.74	687	19.8	0.4	7.60	690	
1.25					19.7	0.4	8.10	690	
1.50					19.7	0.4	8.07	690	
1.75					19.7	0.4	8.04	690	
1.85					19.7	0.4	3.44	690	
0759 hr					03-Sep-04				0814 hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos	
0.00	19.4	0.4	7.80	689	18.9	0.4	7.04	676	
0.25	19.5	0.4	7.86	689	19.0	0.4	7.09	676	
0.50	19.5	0.4	7.78	688	19.0	0.4	6.89	676	
0.75	19.5	0.4	7.82	688	18.9	0.4	6.94	676	
1.00	19.5	0.4	7.68	688	18.9	0.4	7.13	673	
1.25	19.6	0.4	7.59	689	18.7	0.4	7.11	650	
1.30/1.50	19.6	0.4	3.12	689	18.7	0.4	3.02	649	

3 September 2004. Gage height of 2.52 (morning) and 2.52 (afternoon). Clear and cold in morning and clear in afternoon. Air temperature of 13.3 °C at 0715 hr and 21.0°C at 1557 hr. Flume entrance at 1.5+ ft. Flume outlet at 0.8 feet and mostly buried. Fewer people on beach in afternoon with more gulls on beach and fewer on restaurant roofs.

Station 1: Flume at 1654 hr. Reach 1- <1% surface algae. 80% of bottom covered by algae 0.5- 4.0 ft thick; averaging 1.5 ft with one clump of pondweed visible; remainder film. In afternoon, approximately 100 gulls bathing and one goose.

Station 2: Stockton Avenue Bridge at 1628 hr. Reach 2- 5% surface algae. 70% of bottom covered by algae 0.5-4.0 ft, averaging 1.0 ft thick. Algae very green.

Station 3: Railroad Trestle at 1600 hr. Reach 3- <1% surface algae. 80% of bottom covered by algae 1.0-4.0 ft, averaging 1.5 ft thick. Algae bright green.

Station 4: Mouth of Noble Gulch at 1541 hr. 10% surface algae mostly along submerged fence. 70% of bottom covered by algae 0.6-4 ft thick, averaging 1.0 ft. Remainder algal film. In morning, 16 mallards around and on wood near the Gulch. **Station 5:** Nob Hill at 0850 hr. Water temperature of 15.7 °C. Conductivity of 613 umhos. Oxygen 7.57 mg/l. Visually estimated streamflow 1.0 cfs.

1654 hr					03-Sep-04				1628 hr
	Flume				**Stockton Avenue Bridge**				
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**	
0.00	21.1	0.4	13.52	704	21.4	0.4	12.34	708	
0.25	21.1	0.4	13.63	704	21.4	0.4	12.10	709	
0.50	21.1	0.4	13.58	702	21.4	0.4	12.07	708	
0.75	21.0	0.4	13.63	702	21.3	0.4	12.19	708	
1.00	21.1	0.4	9.32	699	21.2	0.4	11.62	708	
1.25					21.1	0.4	11.16	707	
1.50					20.9	0.4	11.50	703	
1.75					20.7	0.4	11.56	700	
1.85					20.6	0.4	4.50	700	

1600 hr					03-Sep-04				1541 hr
	Railroad Trestle				**Mouth of Noble Gulch**				
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 Umhos**	
0.00	21.9	0.4	11.09	717	22.0	0.4	10.46	723	
0.25	21.8	0.4	11.20	716	21.9	0.4	10.03	722	
0.50	21.5	0.4	12.32	715	21.7	0.4	9.86	720	
0.75	21.4	0.4	11.65	709	21.1	0.4	9.76	707	
1.00	21.3	0.4	12.26	707	20.2	0.4	11.04	693	
1.20/1.25	21.1	0.4	5.28	708	20.1	0.4	11.17	691	
1.50					20.1	0.4	5.67	692	

0745 hr					05-Sep-04				0803 hr
	Flume					Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos		Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos
0.00	20.1	0.4	10.19	691		20.2	0.4	9.25	693
0.25	20.1	0.4	10.15	691		20.2	0.4	9.24	692
0.50	20.1	0.4	10.10	691		20.2	0.4	9.05	692
0.75	20.1	0.4	10.10	691		20.2	0.4	8.89	692
1.00	20.2	0.4	4.90	692		20.3	0.4	8.87	692
1.25						20.3	0.4	8.74	692
1.50						20.3	0.4	8.78	692
1.75						20.3	0.4	8.74	692
1.85						20.3	0.4	4.16	694
0822 hr					05-Sep-04				0835 hr
	Railroad Trestle					Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos		Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos
0.00	20.1	0.4	8.12	696		19.8	0.4	7.60	694
0.25	20.1	0.4	8.15	695		19.8	0.4	7.54	694
0.50	20.0	0.4	7.78	695		19.8	0.4	7.56	694
0.75	20.0	0.4	7.92	695		19.7	0.4	7.25	692
1.00	20.1	0.4	7.97	695		19.7	0.4	7.18	688
1.25	20.1	0.4	4.05	696		19.6	0.4	7.14	660
1.50						19.2	0.4	4.80	655

5 September 2004. Begonia Festival Day. Gage height of 2.51 (morning) and 2.52 (afternoon). Sunny. Air temperature of 16.2 °C at 0745 hr and 22.2°C at 1440 hr.
Station 1: Flume at 0745 hr. Reach 1- 3% surface algae. 85% of bottom covered by algae 0.5- 4.0 ft thick; averaging 1.0 ft. with no pondweed visible; remainder film. In afternoon, approximately 127 gulls bathing after festival.
Station 2: Stockton Avenue Bridge at 0803 hr. Reach 2- No surface algae. 85% of bottom covered by algae 0.5-4.0 ft, averaging 1.0 ft thick. Thickest algae with pondweed in thalweg. Few clumps of pondweed (5%) near Stockton Bridge and in west deep area.
Station 3: Railroad Trestle at 0822 hr. Reach 3- No surface algae. 60% of bottom covered by algae 0.5-4.0 ft, averaging 1.5 ft thick.
Station 4: Mouth of Noble Gulch at 0835 hr. Cloudy water at mouth. 10% surface algae mostly along submerged fence. 70% of bottom covered by algae 0.5-4 ft thick, averaging 1.5 ft. Remainder algal film. In morning, 13 mallards around and on wood near the Gulch with 1 merganser roosting.

			8-Sep-04					0745 hr
	Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 umhos
0.00					20.8	0.4	8.45	7.04
0.25					20.9	0.4	8.50	704
0.50					20.9	0.4	8.10	703
0.75					21.0	0.4	8.34	703
1.00					21.0	0.4	8.50	703
1.25					21.0	0.4	8.40	703
1.50					20.9	0.4	8.41	702
1.75					20.9	0.4	8.34	702
1.80					20.9	0.4	4.85	703

0807hr			8-Sep-04					
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos
0.00	20.8		7.84					
0.25	20.8		7.78					
0.50	20.9		7.53					
0.75	20.9		7.49					
1.00	20.9		7.58					
1.20	20.9		2.85					

8 September 2004. Gage height 2.47. Fifth day of 5 warm days in a row. Very few begonias in center of Reaches 2 and 3. Pondweed developing in thalweg of Reach 2. No evidence of former wading. Clean-up area looks good with removal of 95% of the petals.

0737 hr					17-Sep-04				0758 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos	
0.00	19.0	0.4	9.91	673	19.2	0.4	8.14	677	
0.25	19.4	0.4	9.59	673	19.4	0.4	7.86	676	
0.50	19.4	0.4	9.77	673	19.5	0.4	8.21	676	
0.75	19.4	0.4	9.64	673	19.5	0.4	8.19	676	
1.00	19.4	0.4	9.36	673	19.5	0.4	8.10	676	
1.07/1.25	19.4	0.4	5.60	673	19.5	0.4	8.16	676	
1.50					19.5	0.4	8.51	676	
1.75					19.5	0.4	8.27	676	
1.85					19.6	0.4	3.68	676	

0825 hr					17-Sep-04				0842 hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos	
0.00	19.3	0.4	7.89	679	18.7	0.4	6.86	672	
0.25	19.4	0.4	7.73	679	18.8	0.4	6.33	673	
0.50	19.4	0.4	7.59	679	18.8	0.4	6.16	672	
0.75	19.4	0.4	7.43	679	18.7	0.4	6.40	666	
1.00	19.4	0.4	7.45	678	18.6	0.4	6.40	639	
1.25	19.4	0.4	3.25	679	18.4	0.4	6.47	634	
1.50					18.2	0.4	6.54	636	
1.60					18.2	0.4	3.11	637	

17 September 2004. Gage height of 2.62 (morning) and 2.59 (afternoon). Overcast in morning and overcast then sunny in afternoon. Air temperature of 13.5 °C at 0737 hr and 22.1°C at 1615 hr.
Station 1: Flume at 1615 hr. Reach 1- <1% surface algae. 85% of bottom covered by algae 0.5- 2 ft thick; averaging 1.0 ft. 15% algae and pondweed 2-5 ft thick, averaging 3 feet.
Station 2: Stockton Avenue Bridge at 1545 hr. Reach 2- <1% surface algae. 90% of bottom covered by algae 0.5-3.0 ft, averaging 1.5 ft thick. 10% pondweed and algae 2-5 ft thick, averaging 3 ft.
Station 3: Railroad Trestle at 1529 hr. Reach 3- <1% surface algae. 90% of bottom covered by algae 1-3 ft, averaging 2 ft thick. 10% pondweed and algae 2-5 ft thick, averaging 3 ft.
Station 4: Mouth of Noble Gulch at 1510 hr. Cloudy water at mouth. 5% surface algae mostly along submerged fence. 60% of bottom covered by algae 1-4 ft thick, averaging 2 ft. Remainder algal film. In morning, 3 mallards, 1 goose and 1 merganser on cottonwood log. 1 black crowned night heron on downed cottonwood branches. In afternoon, 13 mallards and 1 goose roosting on wood and dock. 1 coot in water.
Station 5: Nob Hill at 0920 hr. Water temperature of 15.6 °C. Conductivity of 620 umhos. Oxygen 6.92 mg/l. Visually estimated streamflow 1.0 cfs.

1615 hr					17-Sep-04				1545 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos	
0.00	20.2	0.4	11.08	681	20.3	0.4	10.62	685	
0.25	20.2	0.4	11.30	681	20.2	0.4	10.16	684	
0.50	20.1	0.4	11.48	680	20.1	0.4	10.20	683	
0.75	20.1	0.4	11.76	680	20.0	0.4	9.72	682	
1.00	20.1	0.4	13.10	678	20.0	0.4	9.75	682	
1.25	20.4	0.4	6.65	678	19.9	0.4	9.85	681	
1.50					19.7	0.4	9.13	680	
1.75					19.7	0.4	9.58	681	
1.95					19.7	0.4	6.11	681	

1529 hr					17-Sep-04				1510 hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos	
0.00	20.0	0.4	10.53	685	20.1	0.4	8.96	685	
0.25	20.2	0.4	9.89	685	20.1	0.4	8.60	688	
0.50	20.1	0.4	9.67	685	20.0	0.4	7.82	687	
0.75	20.1	0.4	9.64	683	19.5	0.4	7.92	680	
1.00	19.9	0.4	9.62	681	19.2	0.4	8.04	674	
1.25	20.0	0.4	7.15	680	18.9	0.4	8.23	659	
1.50					18.8	0.4	9.47	653	
1.60					18.8	0.4	5.18	645	

0745 hr				1-Oct-04				0802 hr
	Flume				**Stockton Avenue Bridge**			
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**
0.00	17.1	0.4	8.01	643	17.0	0.4	7.43	639
0.25	17.2	0.4	7.98	644	17.1	0.4	7.29	642
0.50	17.2	0.4	8.27	644	17.1	0.4	7.25	643
0.75	17.2	0.4	8.12	644	17.1	0.4	7.13	643
1.00	17.3	0.4	3.10	645	17.1	0.4	7.09	643
1.25					17.1	0.4	7.15	643
1.50					17.1	0.4	7.28	643
1.75					17.1	0.4	6.98	643
1.87					17.1	0.4	3.73	643

0825 hr				1-Oct-04				0844 hr
	Railroad Trestle				**Mouth of Noble Gulch**			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 Umhos**
0.00	16.8	0.4	6.71	646	16.2	0.4	6.82	611
0.25	16.9	0.4	6.82	645	16.3	0.4	6.87	609
0.50	16.9	0.4	6.89	645	16.3	0.4	6.71	631
0.75	16.9	0.4	6.61	645	16.3	0.4	7.05	635
1.00	16.9	0.4	6.65	643	16.3	0.4	7.04	638
1.25	16.9	0.4	0.74	644	16.2	0.4	5.04	643
1.50					16.2	0.4	2.53	644

1 October 2004. Gage height of 2.54 (morning) and 2.62 (afternoon). Cloudy in morning and then sunny in afternoon. Air temperature of 13.7 °C at 0745 hr and 16.9°C at 1618 hr. Flume open in morning and plugged closed with sand in the afternoon.
Station 1: Flume at 1618 hr. Reach 1- <1% surface algae. Could not see bottom to estimate plant life. In morning, 1 pied-billed grebe, 1 cormorant (caught a stickleback), 2 mergansers and 45 gulls bathing. In afternoon, 45 gulls bathing.
Station 2: Stockton Avenue Bridge at 1555 hr. Reach 2- 1% surface algae. 80% of bottom covered by algae 1-4.0 ft, averaging 2 ft thick. 15% pondweed and algae, averaging 3 ft thick. In afternoon, cormorant floating under railroad trestle.
Station 3: Railroad Trestle at 1537 hr. Reach 3- <1% surface algae. 80% of bottom covered by algae 1-4 ft, averaging 2 ft thick. 15% pondweed and algae, averaging 3 ft.
Station 4: Mouth of Noble Gulch at 1520 hr. 5% surface algae mostly along submerged fence. 80% of bottom covered by algae 0.5-5 ft thick, averaging 2 ft. Remainder algal film. In morning, 2 mergansers roosting on cottonwood log. In afternoon, 18 mallards, 2 coots and 2 pied billed grebes. 2 monarch butterflies in adjacent garden.
Station 5: Nob Hill at 0928 hr. Water temperature of 14.6 °C. Conductivity of 610 umhos. Oxygen 8.58 mg/l. Visually estimated streamflow 1.0-1.25 cfs. Streamflow measured by flowmeter to be 1.33 cfs at 1220 hr.

1618 hr					1-Oct-04				1555 hr
	Flume					**Stockton Avenue Bridge**			
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (mg/l)**	**Cond 1 umhos**		**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (mg/l)**	**Cond 2 Umhos**
0.00	18.5	0.4	10.53	655		18.2	0.4	10.07	655
0.25	18.3	0.4	10.45	655		18.1	0.4	9.90	655
0.50	18.3	0.4	10.53	655		18.1	0.4	9.62	654
0.75	18.3	0.4	10.65	654		18.1	0.4	9.38	653
1.00	18.4	0.4	5.02	655		18.0	0.4	9.15	652
1.25						17.8	0.4	10.22	650
1.50						17.7	0.4	10.11	649
1.75						17.7	0.4	10.84	648
1.90						17.7	0.4	6.01	647

1537 hr					1-Oct-04				1520 hr
	Railroad Trestle					**Mouth of Noble Gulch**			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (mg/l)**	**Cond 3 umhos**		**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (mg/l)**	**Cond 4 Umhos**
0.00	18.2	0.4	9.43	657		18.5	0.4	8.03	664
0.25	18.1	0.4	9.33	653		18.1	0.4	8.20	660
0.50	17.9	0.4	10.97	653		18.0	0.4	7.82	656
0.75	17.9	0.4	10.65	653		17.5	0.4	8.64	639
1.00	17.8	0.4	10.69	653		17.0	0.4	9.79	637
1.25	17.9	0.4	4.62	652		17.0	0.4	10.01	643
1.50						17.2	0.4	6.36	644

0730 hr					15-Oct-04				0750 hr
	Flume				Stockton Avenue Bridge				
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos	
0.00	17.2	0.4	11.96	648	17.2	0.4	10.59	650	
0.25	17.2	0.4	11.99	648	17.3	0.4	10.88	650	
0.50	17.3	0.4	12.12	648	17.3	0.4	10.54	650	
0.75	17.3	0.4	11.92	648	17.3	0.4	10.39	650	
1.00	17.3	0.4	3.35	649	17.3	0.4	10.85	650	
1.25					17.3	0.4	10.41	650	
1.50					17.3	0.4	10.28	650	
1.75					17.3	0.4	10.25	650	
2.00					17.3	0.4	6.64	650	
0813 hr					15-Oct-04				0835 hr
	Railroad Trestle				Mouth of Noble Gulch				
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos	
0.00	17.2	0.4	9.64	652	16.6	0.4	7.93	649	
0.25	17.2	0.4	9.22	653	16.7	0.4	8.18	649	
0.50	17.1	0.4	8.98	652	16.7	0.4	8.12	649	
0.75	17.1	0.4	9.13	652	16.7	0.4	8.27	649	
1.00	17.2	0.4	9.40	653	16.7	0.4	8.38	648	
1.25	17.2	0.4	9.34	653	16.6	0.4	7.75	629	
1.30/1.50	17.3	0.4	2.53	653	16.4	0.4	7.70	620	
1.62							3.05	621	

15 October 2004. Flume outlet plugged closed with sand in the morning, manually unplugged in afternoon. Gage height of 2.77 (morning) and 2.56 (afternoon). Foggy in morning and cloudy and overcast in afternoon. Air temperature of 14.0 °C at 0730 hr and 15.8°C at 1530 hr.

Station 1: Flume at 1630 hr. Reach 1- No surface algae. 15% surface algae a week ago during fish sampling. Could not observe bottom. In morning 47 gulls bathing. In afternoon 62 gulls and 1 merganser capturing a stickleback.

Station 2: Stockton Avenue Bridge at 1613 hr. Reach 2- 1% surface algae. 65% of bottom covered by algae 1-4.0 ft, averaging 2 ft thick. 10% pondweed and algae 3-5 ft thick, averaging 4 ft thick. In afternoon there were 6 coots observed, typical of fall.

Station 3: Railroad Trestle at 1558 hr. Reach 3- 3% surface algae. 65% of bottom covered by algae 1-5 ft thick, averaging 2 ft.15% pondweed and algae 3-5 ft thick, averaging 4 ft.

Station 4: Mouth of Noble Gulch at 1530 hr. 5% surface algae mostly along submerged fence. 80% of bottom covered by algae 1-4 ft thick, averaging 2 ft. Remainder algal film. In afternoon roosting on wood or in water- 11 mallards, 5 coots, 2 pied billed grebes, 1 goose, 1 domestic duck.

Station 5: Nob Hill at 0905 hr. Water temperature of 14.1 °C. Conductivity of 610 umhos. Oxygen 7.63 mg/l. Visually estimated streamflow 1.0 cfs.

1635 hr				15-Oct-04				1613 hr
	Flume				Stockton Avenue Bridge			
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (mg/l)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (mg/l)	Cond 2 Umhos
0.00	17.5	0.4	12.81	650	17.4	0.4	11.79	652
0.25	17.5	0.4	13.15	650	17.5	0.4	11.64	652
0.50	17.5	0.4	13.01	650	17.5	0.4	11.71	652
0.75	17.5	0.4	13.11	650	17.4	0.4	11.22	652
1.00	17.5	0.4	6.46	641	17.4	0.4	10.98	652
1.25					17.4	0.4	11.38	652
1.50					17.4	0.4	11.37	652
1.75					17.4	0.4	11.42	652
1.85					17.4	0.4	6.51	652

1558 hr				15-Oct-04				1530 hr
	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (mg/l)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (mg/l)	Cond 4 Umhos
0.00	17.3	0.4	11.79	652	17.2	0.4	9.78	655
0.25	17.3	0.4	11.68	652	17.2	0.4	9.57	655
0.50	17.3	0.4	11.45	652	17.1	0.4	9.29	655
0.75	17.3	0.4	11.65	651	17.0	0.4	9.05	653
1.00	17.3	0.4	11.88	651	16.9	0.4	8.80	650
1.25	17.3	0.4	0.75	652	16.8	0.4	9.48	622
1.50					16.4	0.4	10.01	611
1.57					16.5	0.4	6.04	610

17 October 2004. Sunday after rain overnight. Boards removed by Morrison from flume inlet on both sides, creating an 8-inch gap on one side and a 6-inch gap on the other. The flume outlet was plugged initially on 17 October and was manually opened. The lagoon level increased one foot. The metal grate on the flume inlet was fouled with debris as water passed through. It was cleaned. Two weeks previously a wide notch had been prepared with a berm near the flume outlet and inlet to prevent tidal overwash.

18 October 2004. Lagoon turbid, making bottom invisible. Morrison will remove more boards so that the bottom becomes visible and photosynthesis can occur. Heavy rain anticipated on Monday night and Tuesday. Jesberg required in response to complaint that sandbar be lowered somewhat to prevent flooding on River View that occurred for 30 minutes in 2003. A 2-bucket load notch cut in sandbar near flume inlet to prevent flooding. But some sand put back into notch later to prevent further tidal overwash.

19 October 2004. At 0730 hr sand was removed from the berm near the flume inlet. More boards were removed to allow flume full flow capacity. However, the low tide was to be at around 0811 hr at 3.3 ft, preventing flume from working at full capacity. The sandbar was breached between 0900 and 0930 hr. The cap on the Esplanade storm drain was removed. The biologist arrived at 1000 hr. The channel width through the sandbar was 20 feet on the east side of the flume. The high point of the lagoon level was 14 inches above our original piling bolt and 2-3 inches above the center bolt. The low point of the lagoon is

now at the bulkhead under the railroad trestle. A bathtub ring was observed on the fence at the new residence just downstream of the trestle. It was approximately 1 foot above the path. Morrison and Jesberg discussed placement of another bolt lower on the piling to match the elevation of the bulkhead at this flooding point.

By 1030 hr, the flume was exposed and the lagoon had drained to nearly the level of the floor of the flume. The water in the estuary was still pond-like. Wind was blowing inland with small waves moving inland. Our van was shaking in the wind. Two cormorants were floating in the estuary. A high tide of about 5.6 was expected this day at 1428 hr, preventing the estuary from draining completely. Juvenile steelhead could remain in the estuary if they chose.

APPENDIX B.

2004 DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK LAGOON.

DRAIN LINE TEST FOR RESTAURANTS
CONTIGUOUS WITH SOQUEL CREEK

RESTAURANT	INITIAL CONTACT	TEST DATE	COMMENTS	SIGN OFF
BEACH HOUSE 207 ESPLANADE	5/21/04 JANET 475-5846	26-May-04	RESCUE ROOTER WATER LINE REPAIRED	26-May-04 MSW
ANCHOR TAP 209 ESPLANADE	5/21/04 MARK ACHILLI 408-315-4533	26-May-04	RESCUE ROOTER NO PROBLEMS	27-May-04 MSW
PIZZA MY HEART 209-A ESPLANDE	5/21/04 LUKE 475-5714	27-May-04	LEAK REPAIRED	27-May-04 MSW
FOG BANK 211 ESPLANDE	5/21/04 LINDA	26-May-04	RESCUE ROOTER REPLACED 25 FOOT SECTION OF 2-1/2" DRAIN PIPE	26-May-04 MSW
PARADISE BAR & GRILL 215 ESPLANADE	5/21/04 AMY 476-4900	25-May-04	JIMMIE SMITH PLUMBING NO PROBLEMS	25-May-04 MSW
ZELDA'S 203 ESPLANADE	5/21/04 ED	25-May-04	JIMMIE SMITH PLUMBING NO PROBLEMS	25-May-04 MSW

APPENDIX C.

WATER QUALITY TESTING RESULTS FOR HYDROGEN SULFIDE IN THE LAGOON IMMEDIATELY BEFORE AND AFTER THE BEGONIA FESTIVAL.

ANALYTICAL CHEMISTS
and
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13 SEP 04

MATERIAL: Water samples received 08 September 2004
IDENTIFICATION: Begonia Festival, Capitola
Project 100-14, sampled 9/5/04
REPORT: Quantitative chemical analysis is as follows expressed as milligrams per liter (parts per million):

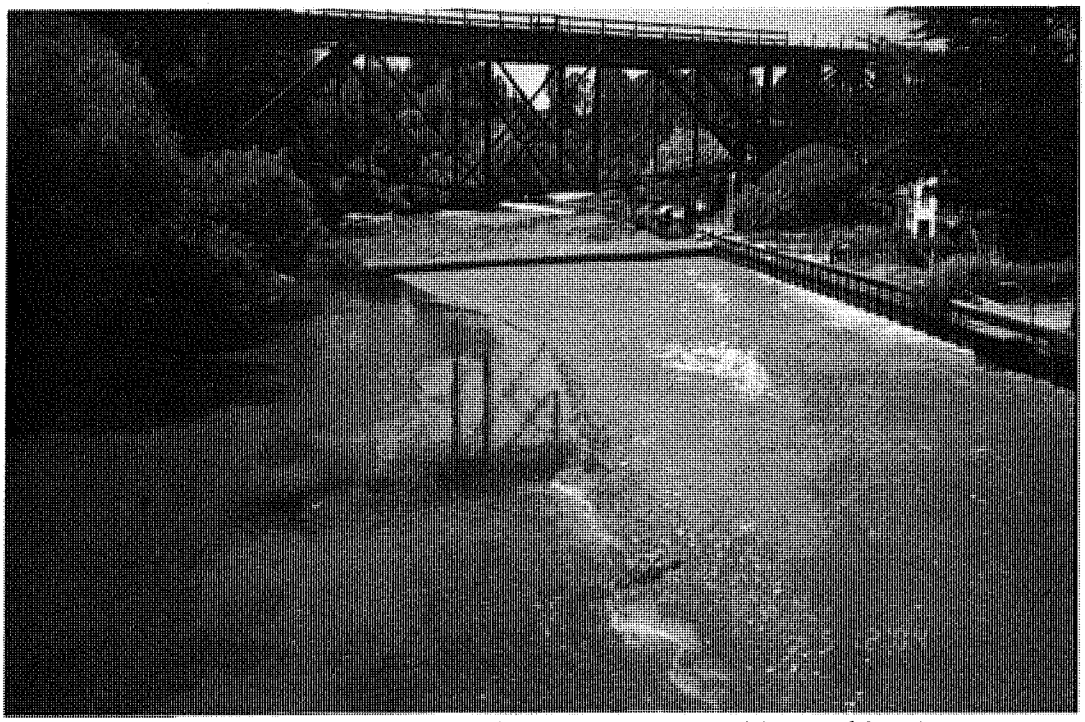
Sample Identification	Sulfide
R-1 Before (0945)	0.2
R-2 Before (0937)	0.2
R-1 After (1350)	0.2
R-2 After (1344)	0.3

A Division of Control Laboratories Inc.

APPENDIX D.

PHOTOGRAPHS.

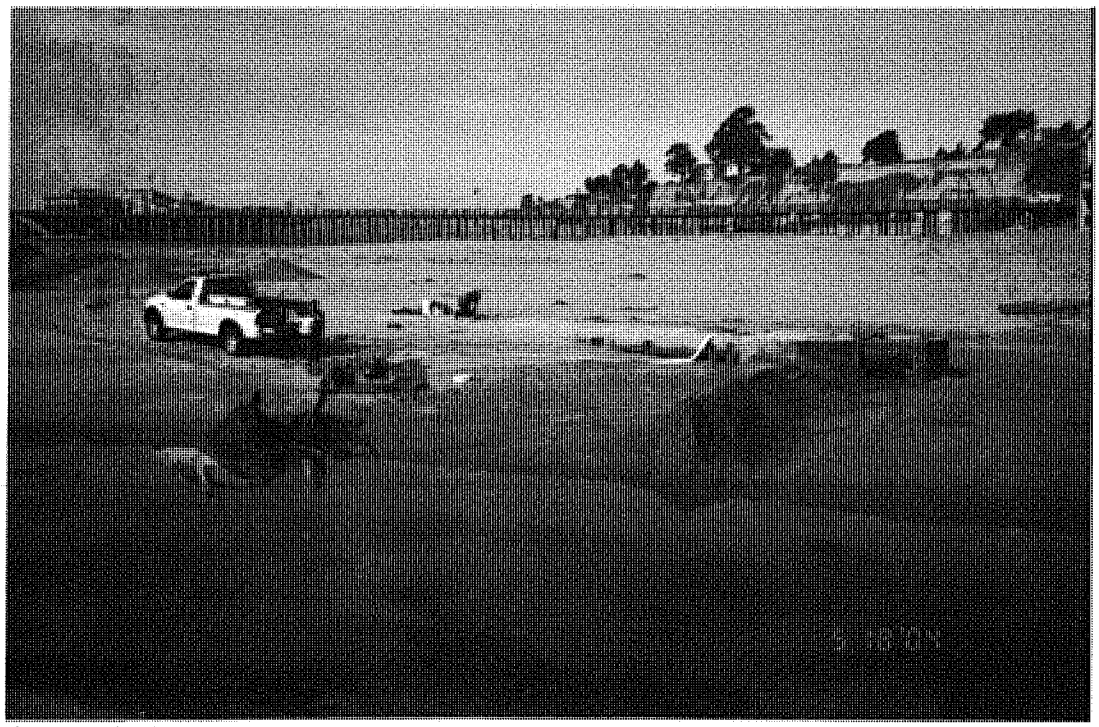
Normally Functioning Soquel Creek Estuary, Looking Downstream from Trestle 12 May 2004



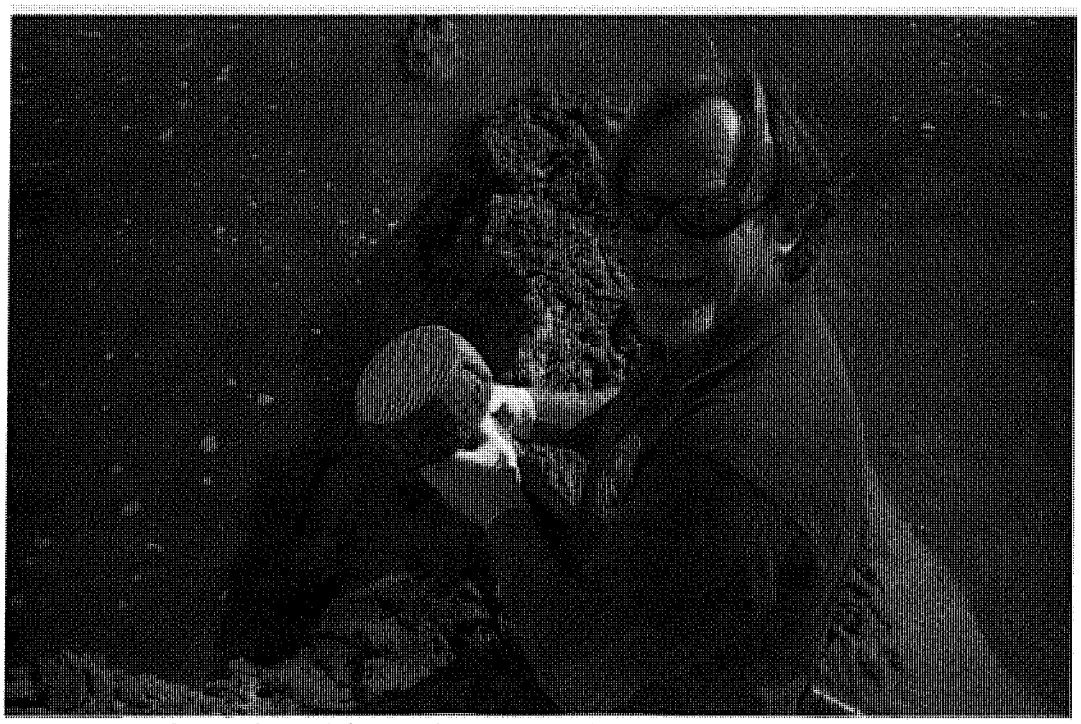
Normally Functioning Soquel Creek Estuary at Low Tide, Looking Upstream
From Stockton Avenue Bridge 12 May 2004

Normal Lateral Backwater Adjacent to Sea Wall at Low Tide 12 May 2004

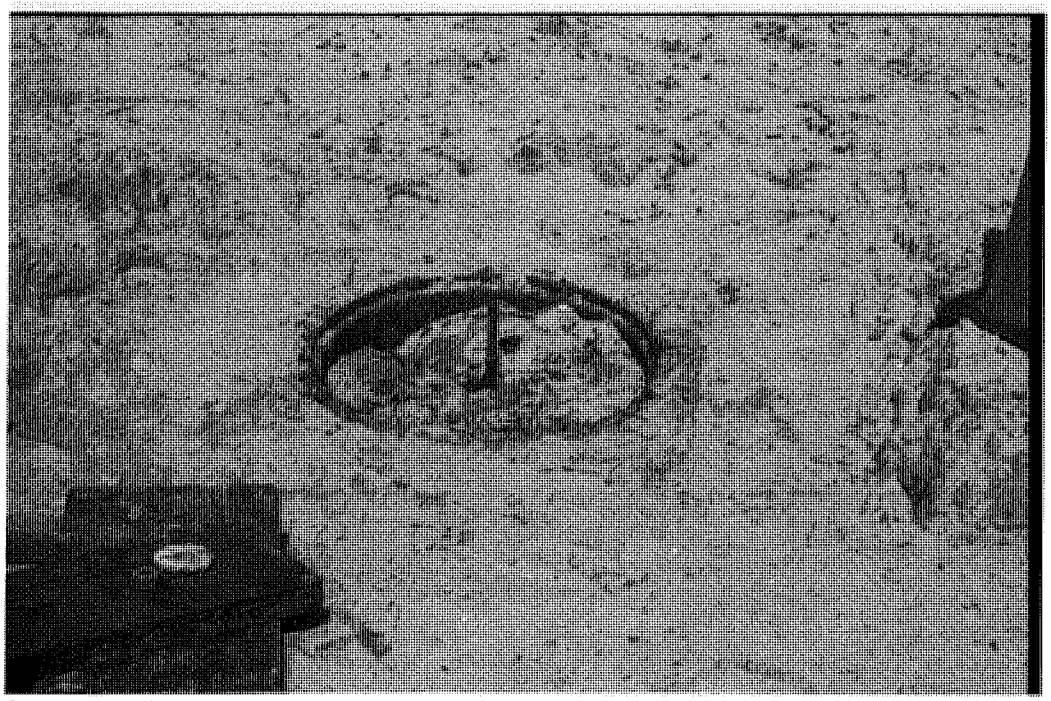
Normal Estuary Outlet to the Bay 12 May 2004



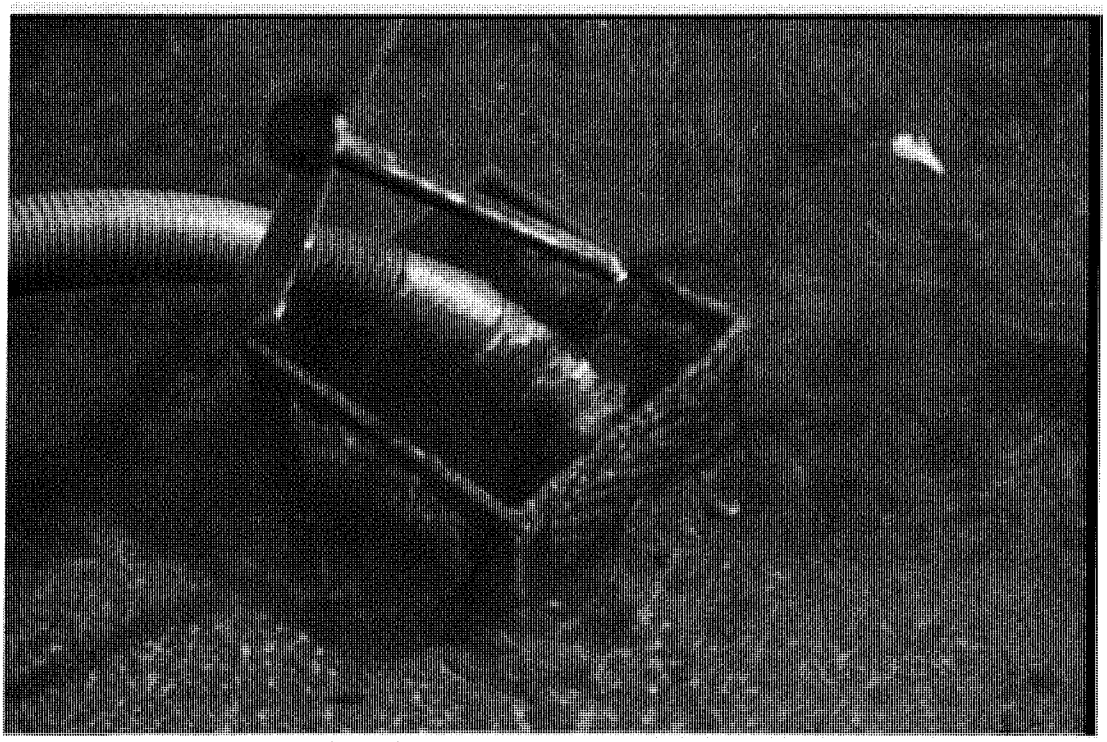
Operation to Flush Sand Out of Flume in Preparation for Sandbar Construction 18 May 2004



Screening of the Intake Hose to the Pump 18 May 2004

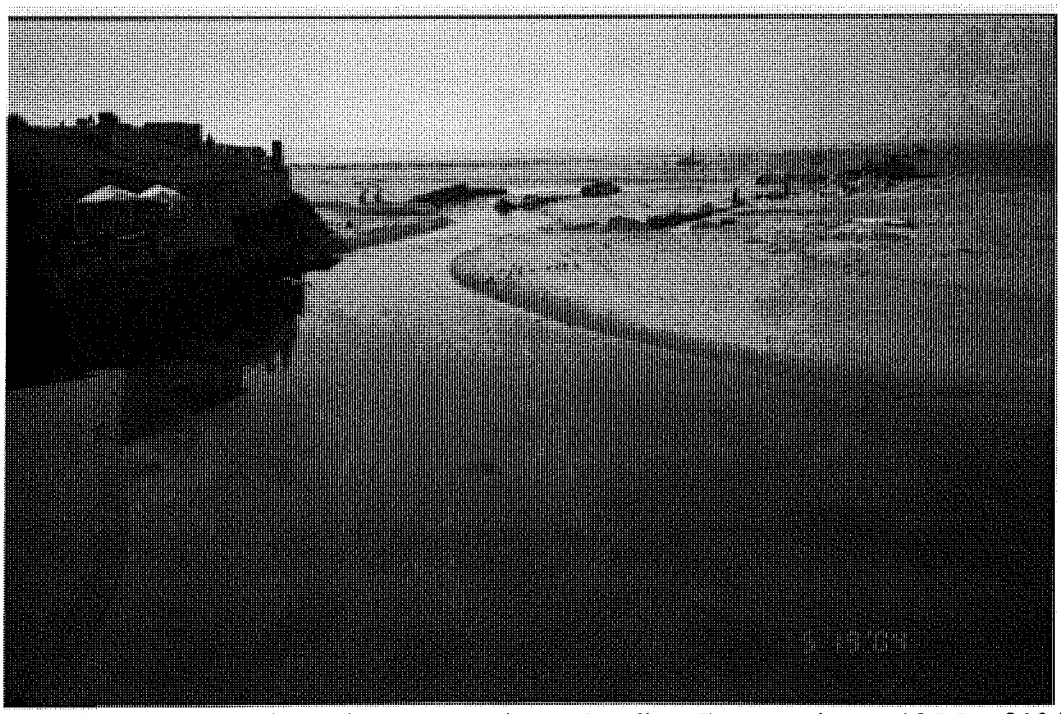


Open Portal on Top of Flume, Indicating Flume was Full of Sand 18 May 2004

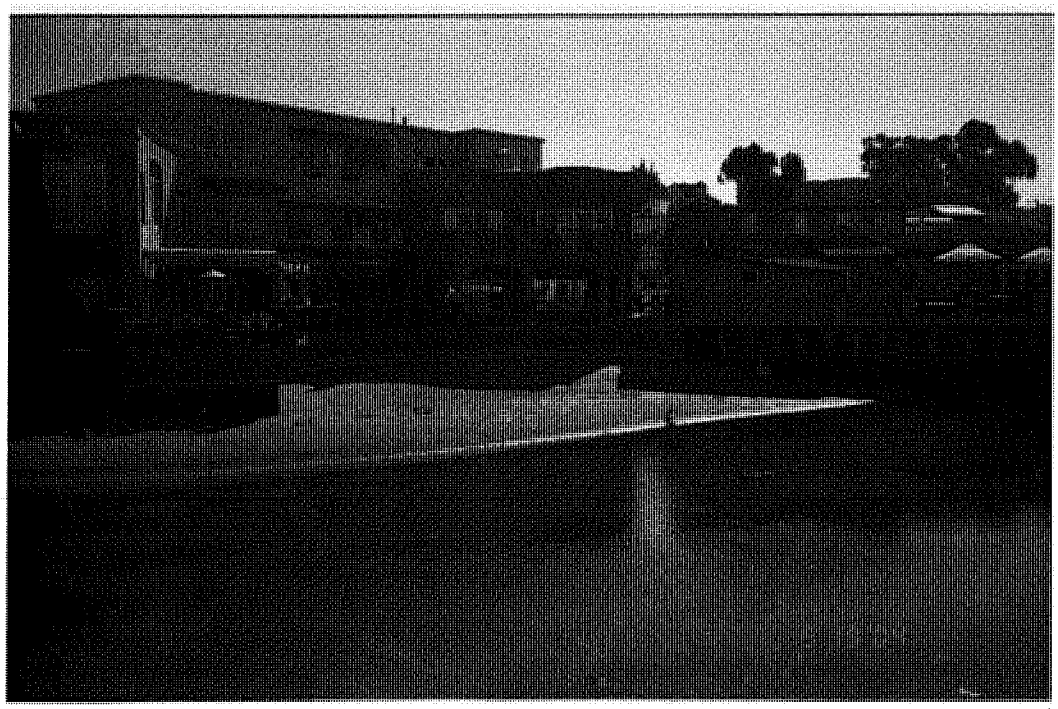


Screened Intake Hose to the Pump 19 May 2004

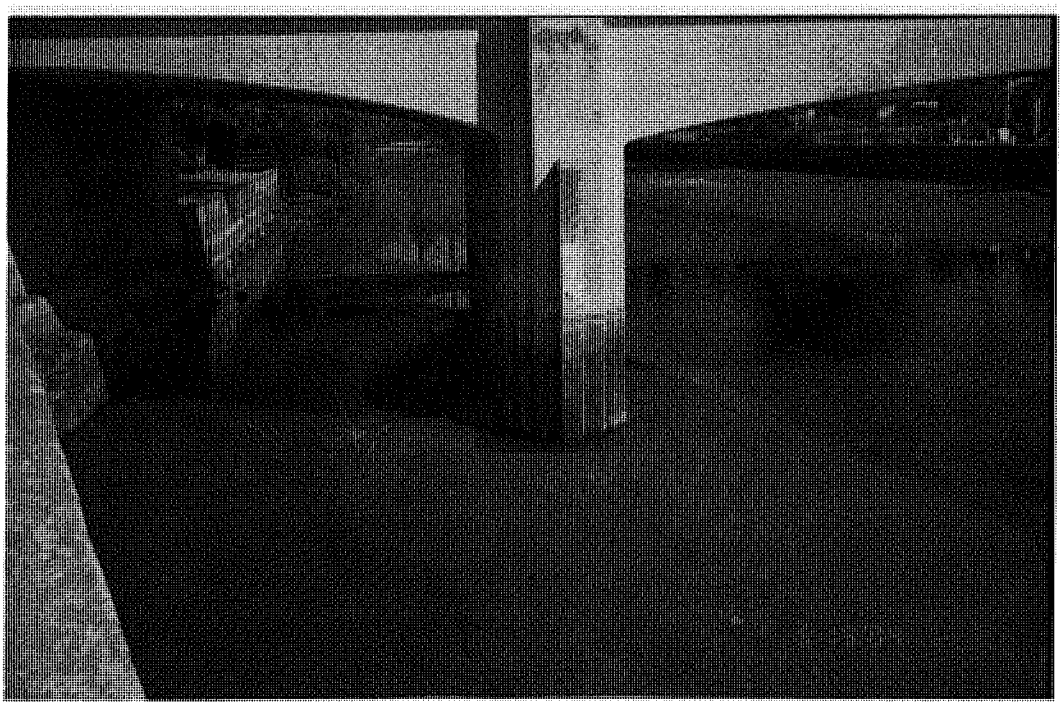
Water Pump Isolated from the Estuary 18 May 2004



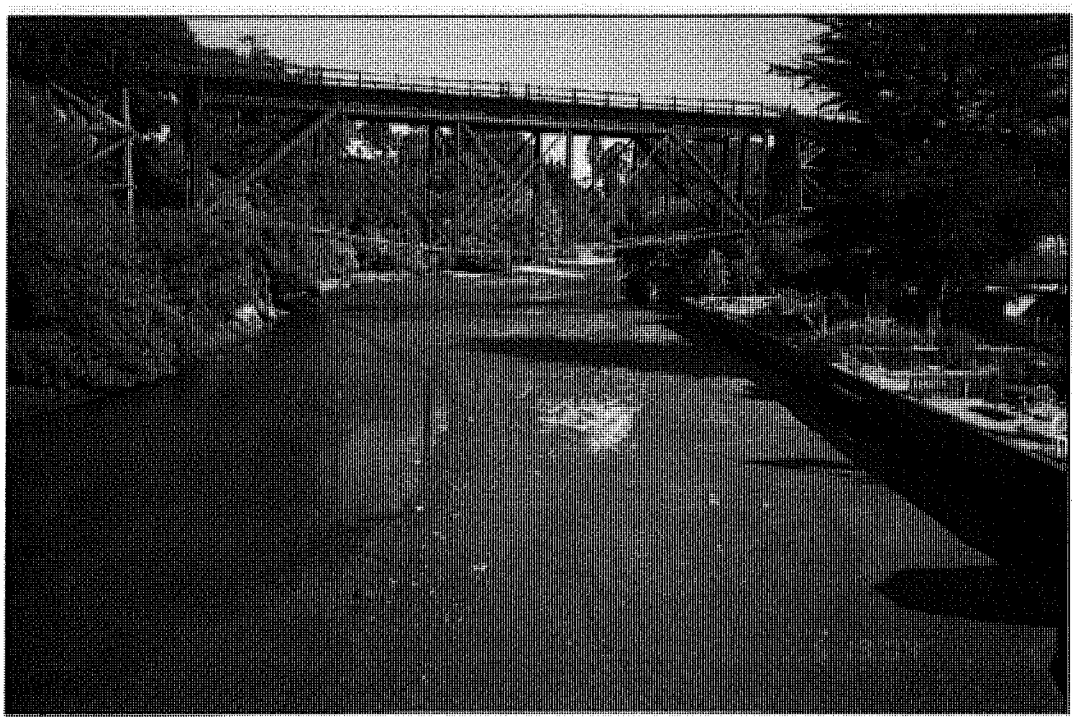
Normal Lower Soquel Creek Estuary Prior to Sandbar Construction 19 May 2004



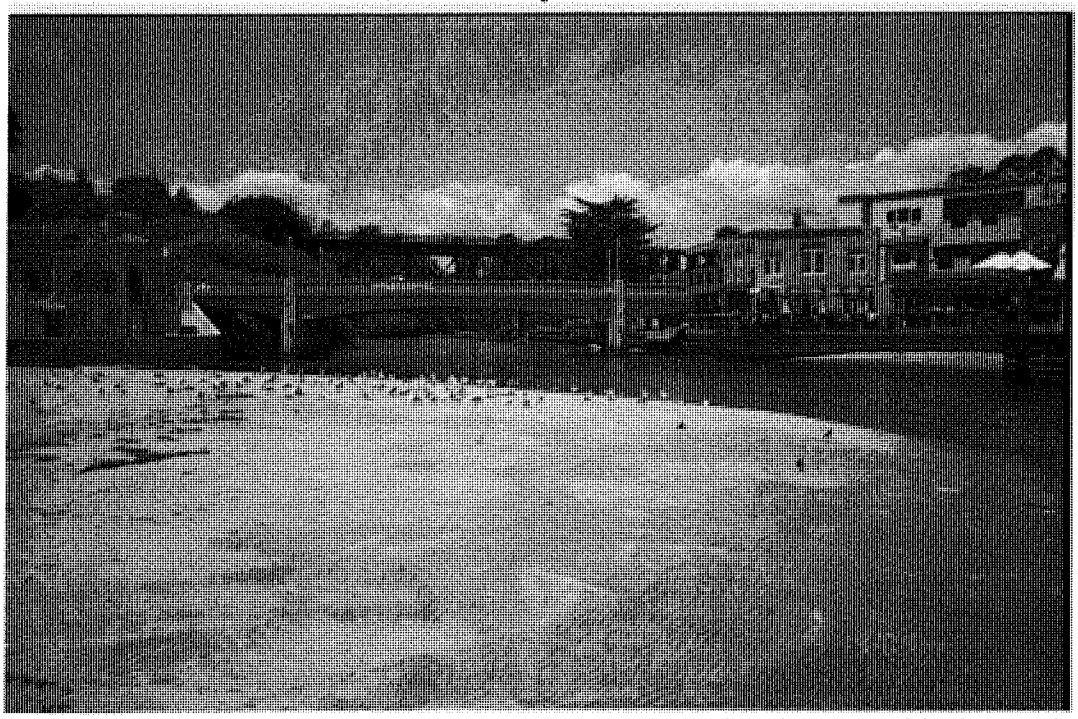
Normal Soquel Creek Estuary Downstream of Stockton Avenue Bridge 19 May 2004



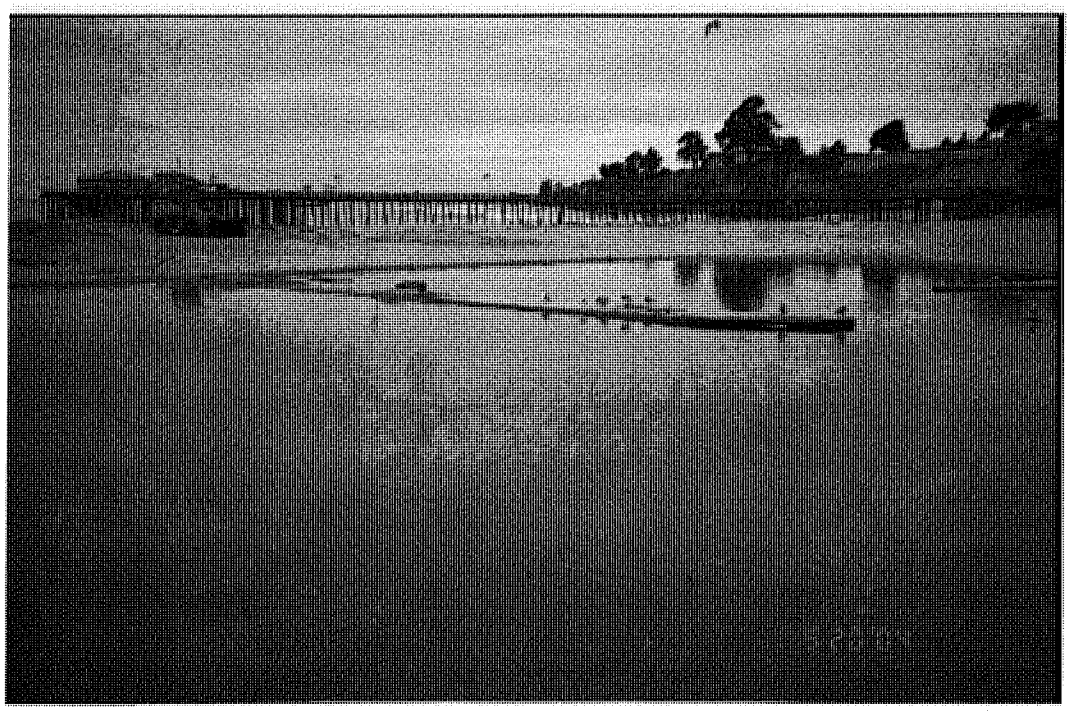
Normal Soquel Creek Estuary Under Stockton Avenue Bridge Prior to Sandbar Construction
19 May 2004



Normal Soquel Creek Estuary in Reach 2 Between the Stockton Bridge and the Railroad Trestle
19 May 2004

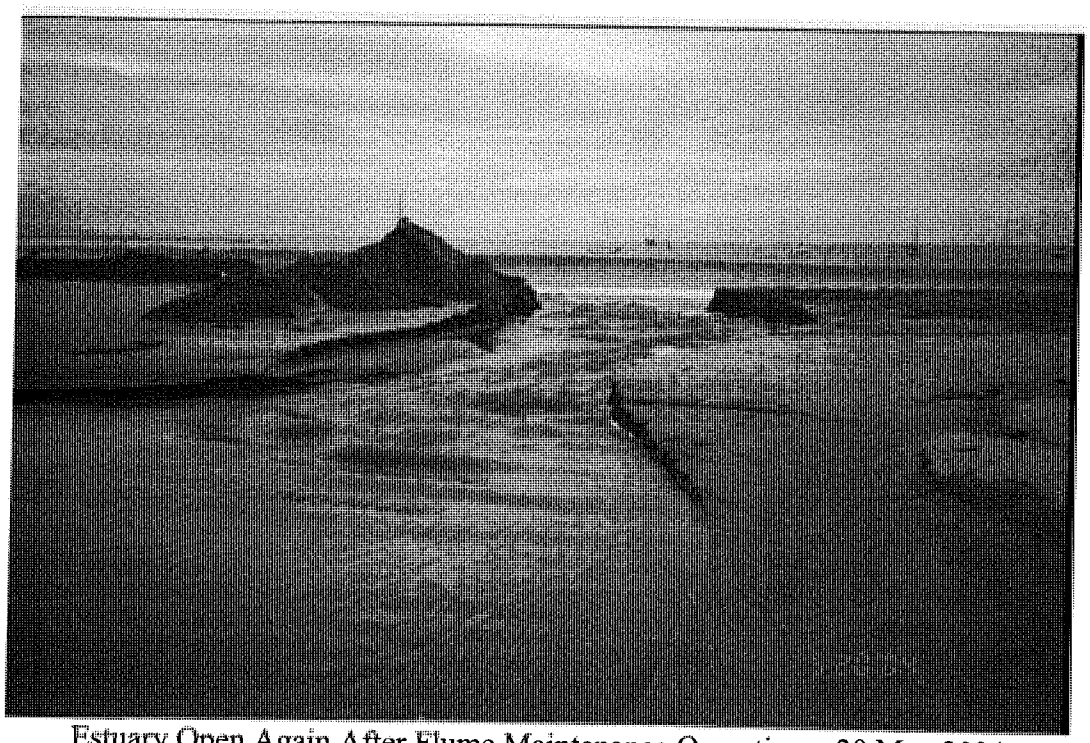


Normal Soquel Creek Estuary Looking Upstream from the Flume as Tide Comes In
19 May 2004

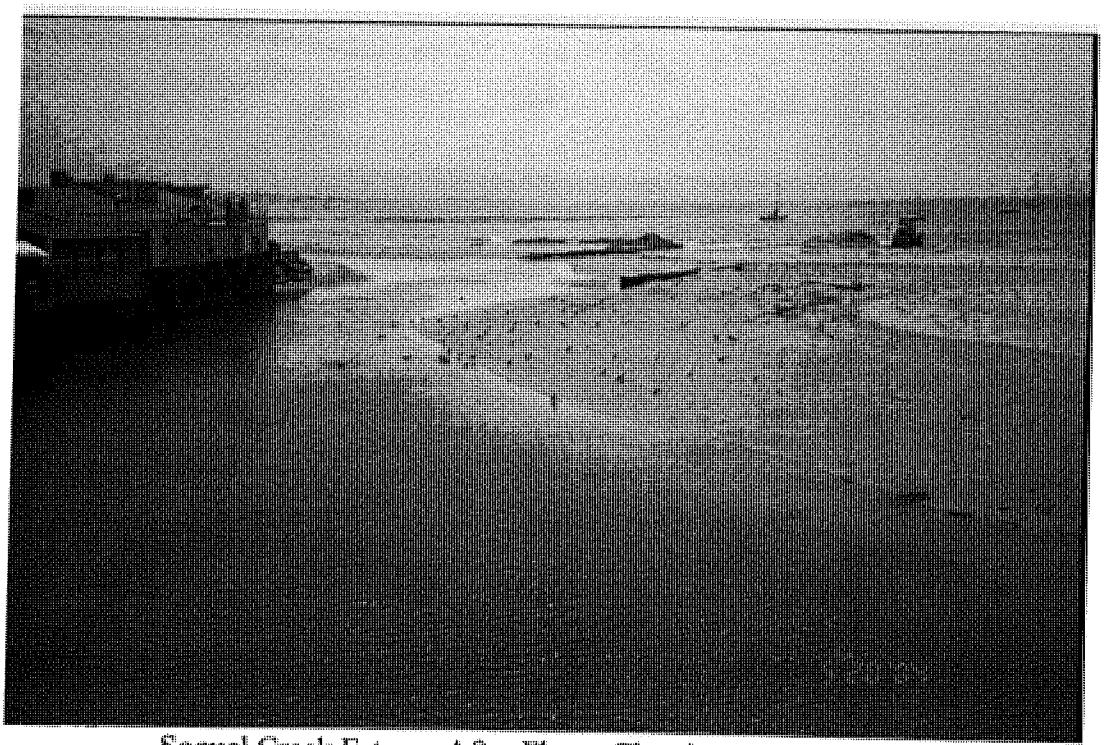


High Tide in Early Morning with Lagoon Flushing Sand from the Flume 20 May 2004

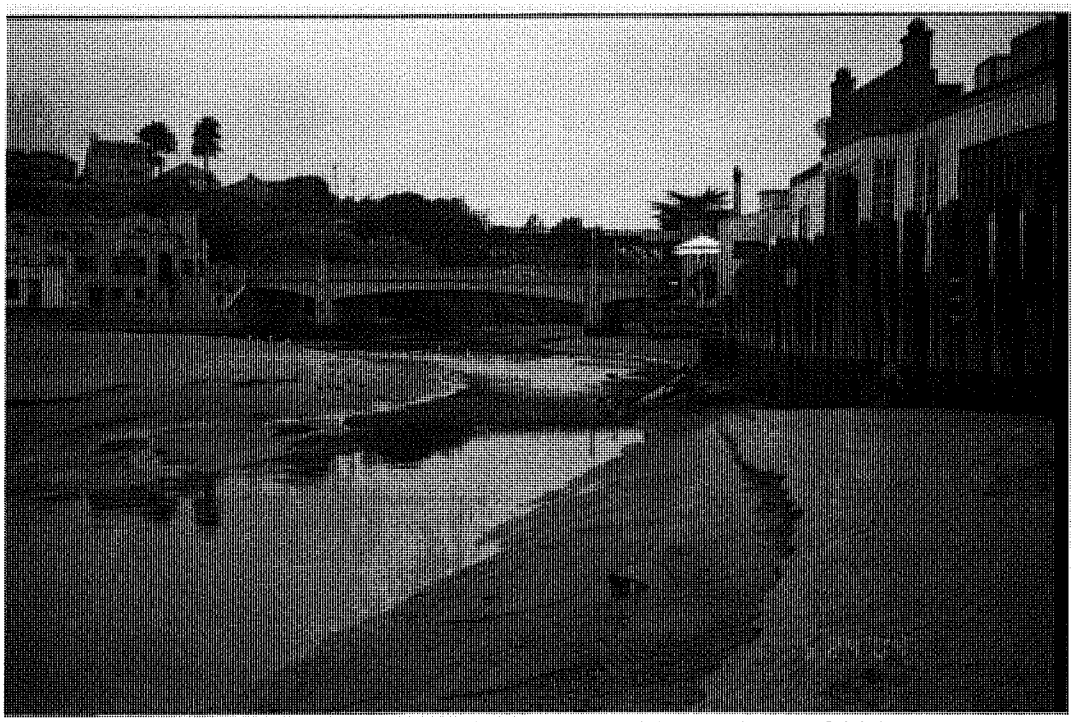
Precautionary Berm to Maintain High Water Level in Lagoon for Flushing of the Flume
20 May 2004



Estuary Open Again After Flume Maintenance Operation 20 May 2004



Soquel Creek Estuary After Flume Cleaning 20 May 2004



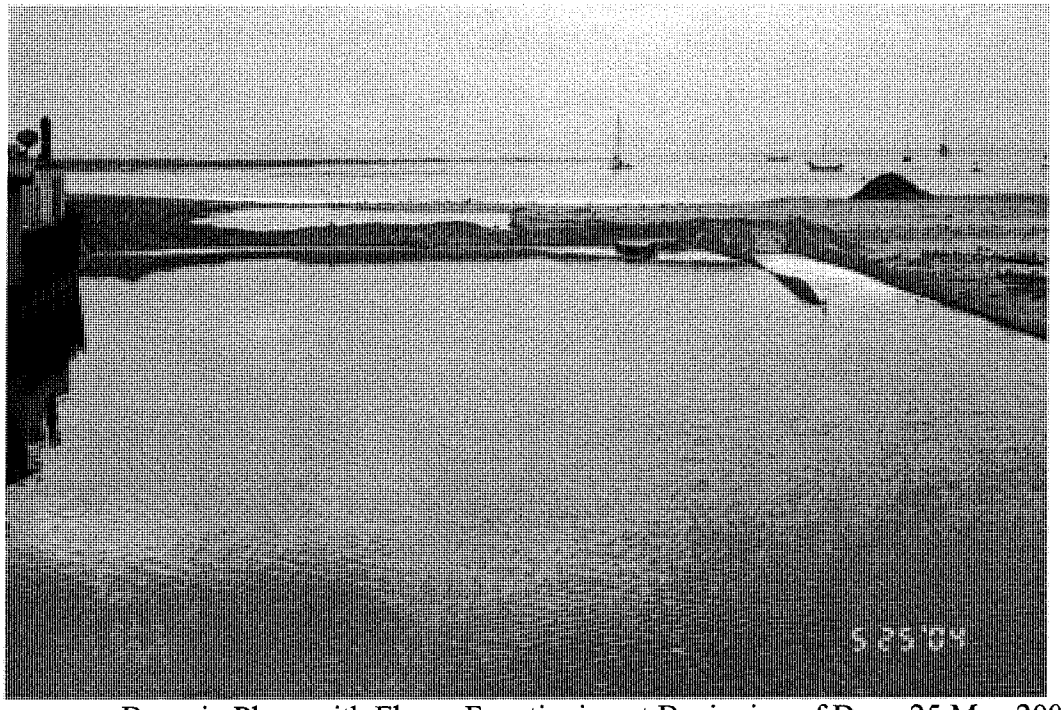
Normal Estuary Function at Low Tide 24 May 2004

Nearly Drained Lateral Backwater Adjacent to Sea Wall at Low Tide 24 May 2004

Closing Off of Lateral Backwater After Seining 24 May 2004

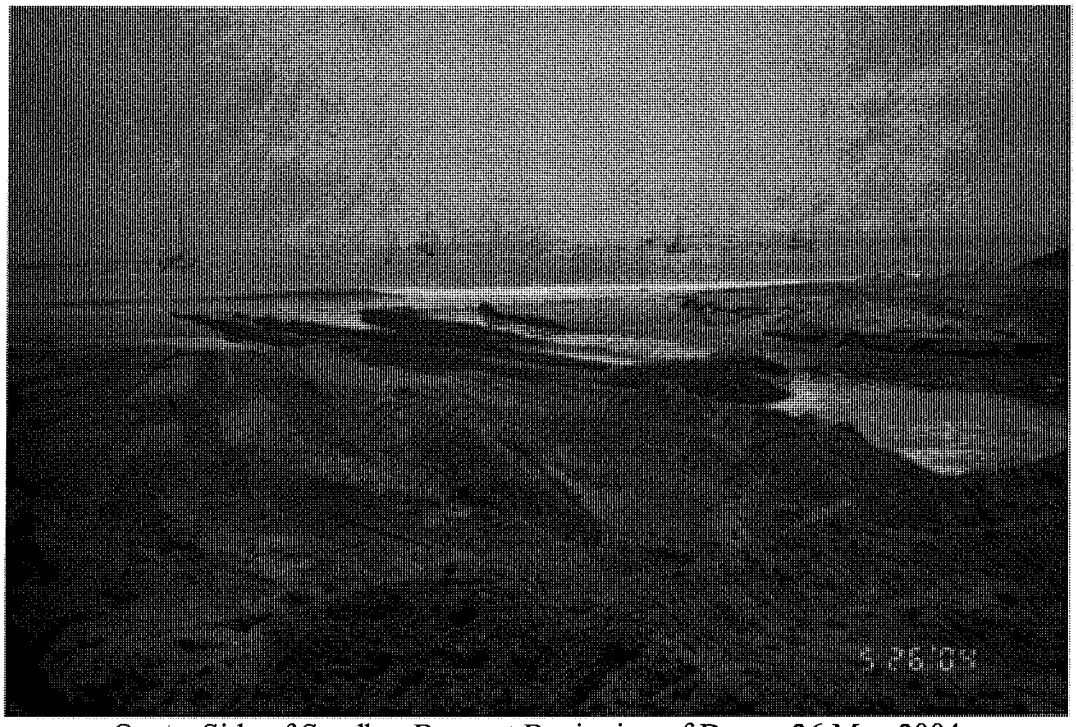
Normal Soquel Creek Estuary Prior to Sandbar Manipulation 24 May 2004

Grading Adjacent to Flume Inlet and Above Waterline 24 May 2004

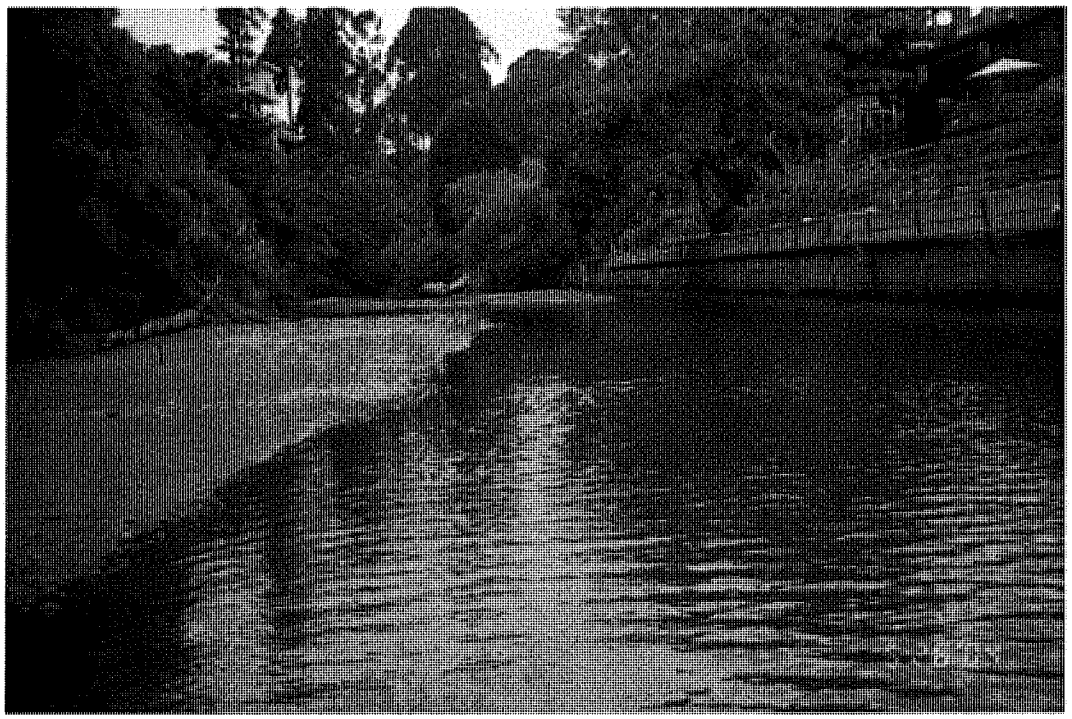


Temporary Berm in Place with Flume Functioning at Beginning of Day 25 May 2004

Sandbar Closed at End of Day 25 May 2004



Ocean Side of Sandbar Berm at Beginning of Day 26 May 2004



Reach 3 Upstream of Noble Gulch at Low Tide 26 May 2004

Upper Reach 3, Looking Downstream Toward Trestle at Low Tide 26 May 2004

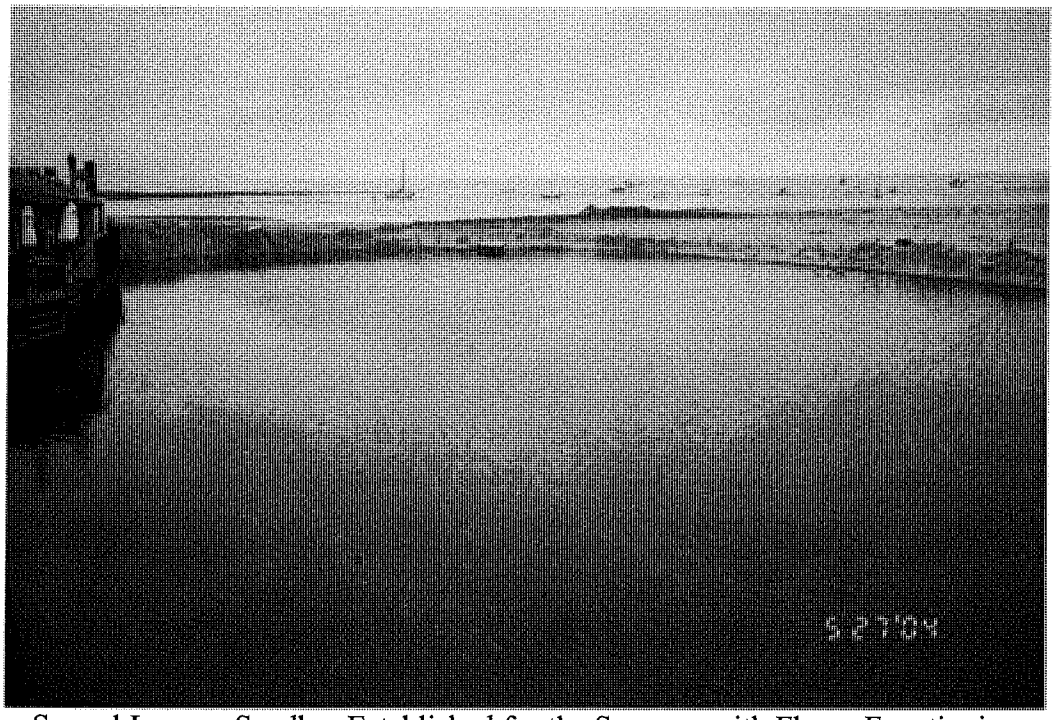
Upper End of Estuary at Low Tide 26 May 2004

Soquel Creek Estuary at Low Tide In Vicinity of Trestle with CDFG Biologists in Background
26 May 2004 (Film Date Inaccurate)

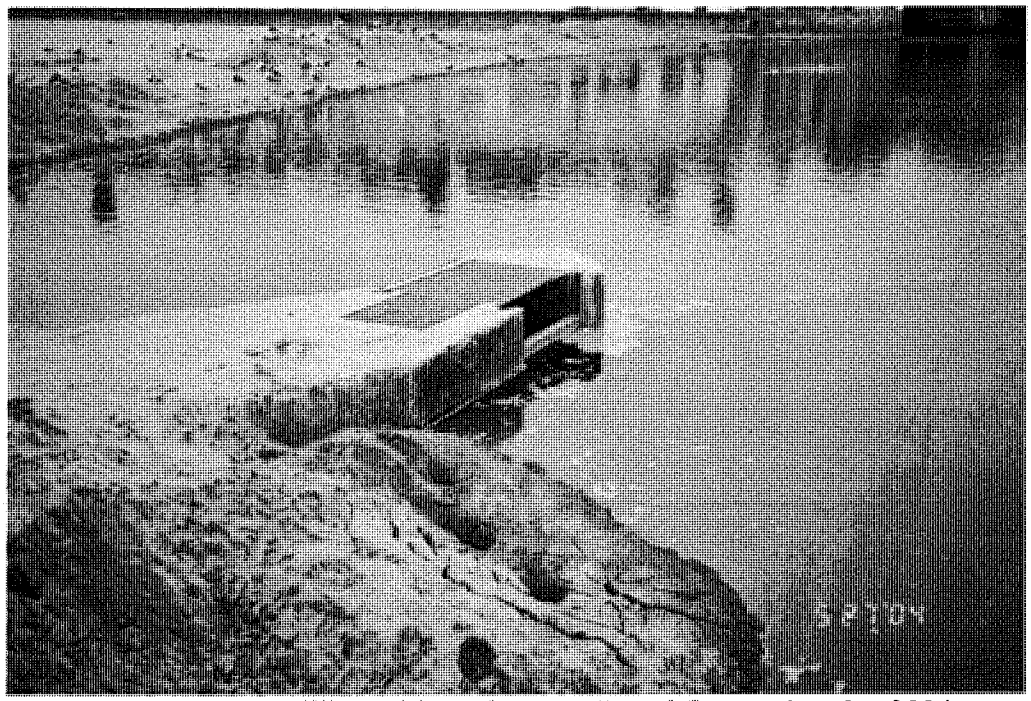
Underwater Portal for Adult Steelhead Passage Through Flume Inlet 26 May 2004
(Film Date Incorrect)

Weir Inside Flume to Maintain Depth at Flume Inlet 26 May 2004
(Film Date Incorrect)

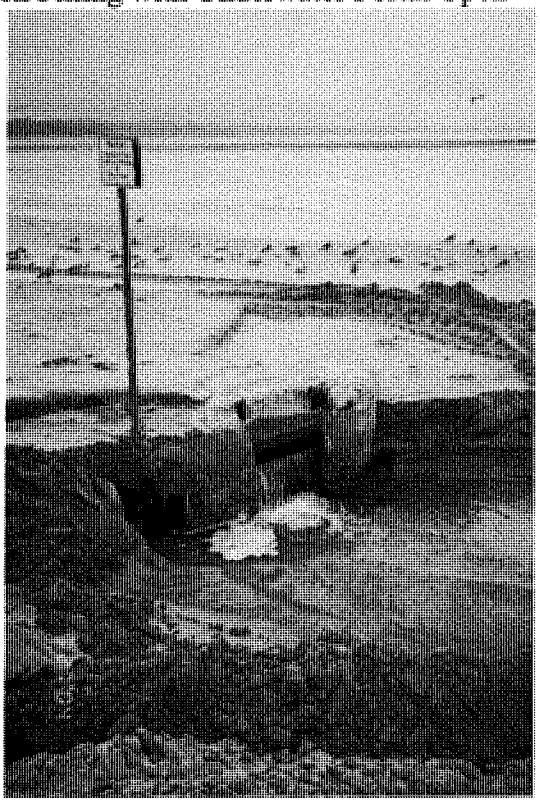
Final Sandbar Closure for the Season 26 May 2004 (Film Date Incorrect)



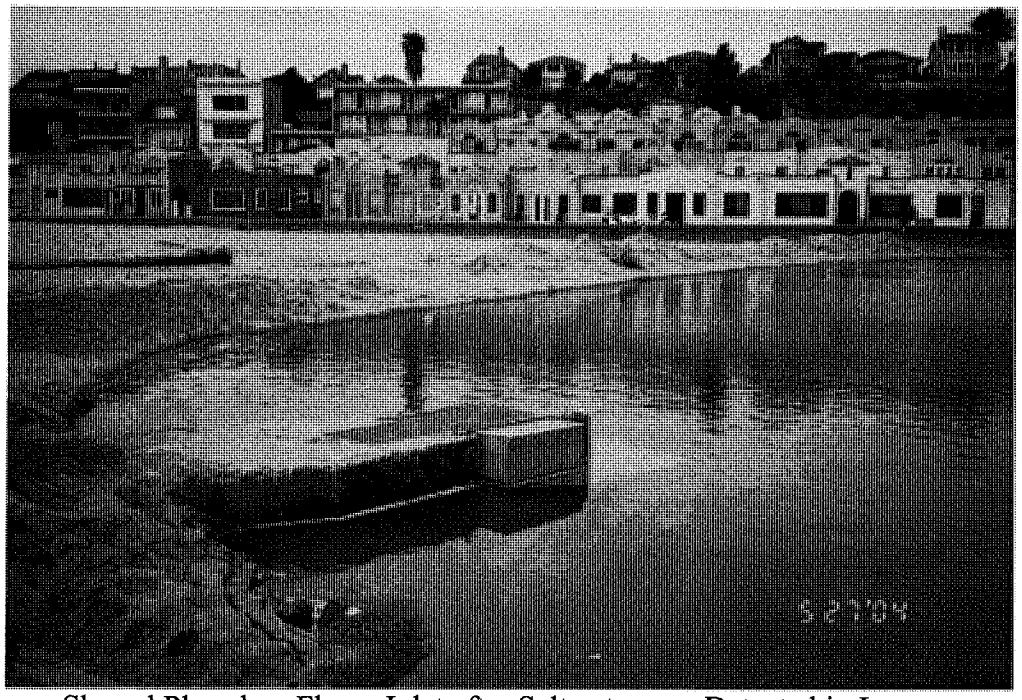
Soquel Lagoon Sandbar Established for the Summer with Flume Functioning
27 May 2004



Soquel Lagoon Filling with Underwater Portal Open 27 May 2004

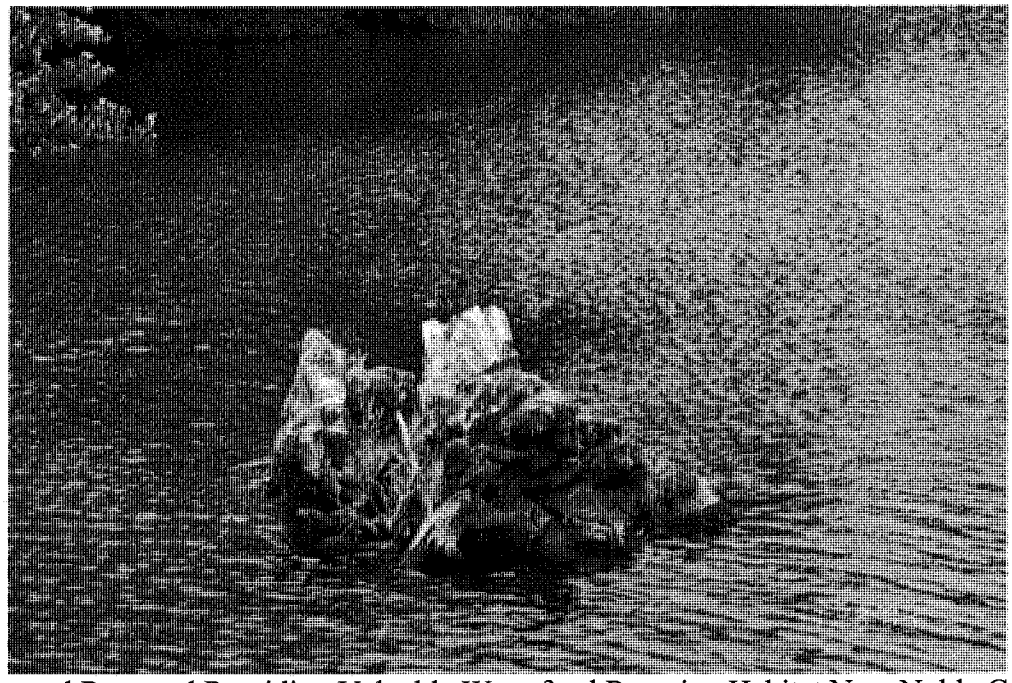


Soquel Lagoon Outlet 27 May 2004

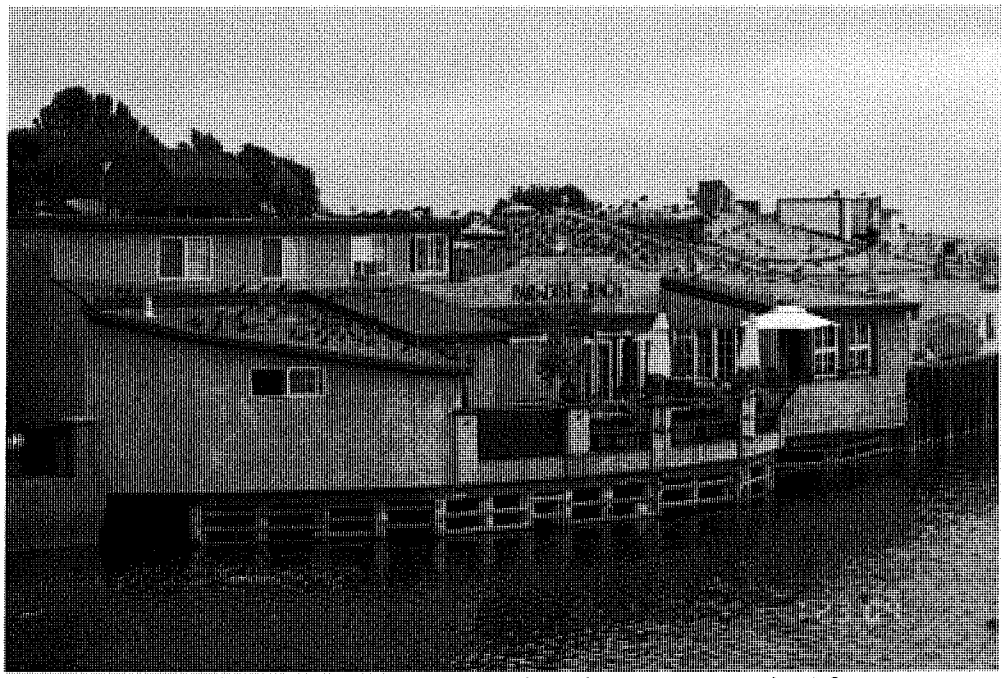


Shroud Placed on Flume Inlet after Saltwater was Detected in Lagoon
27 May 2004

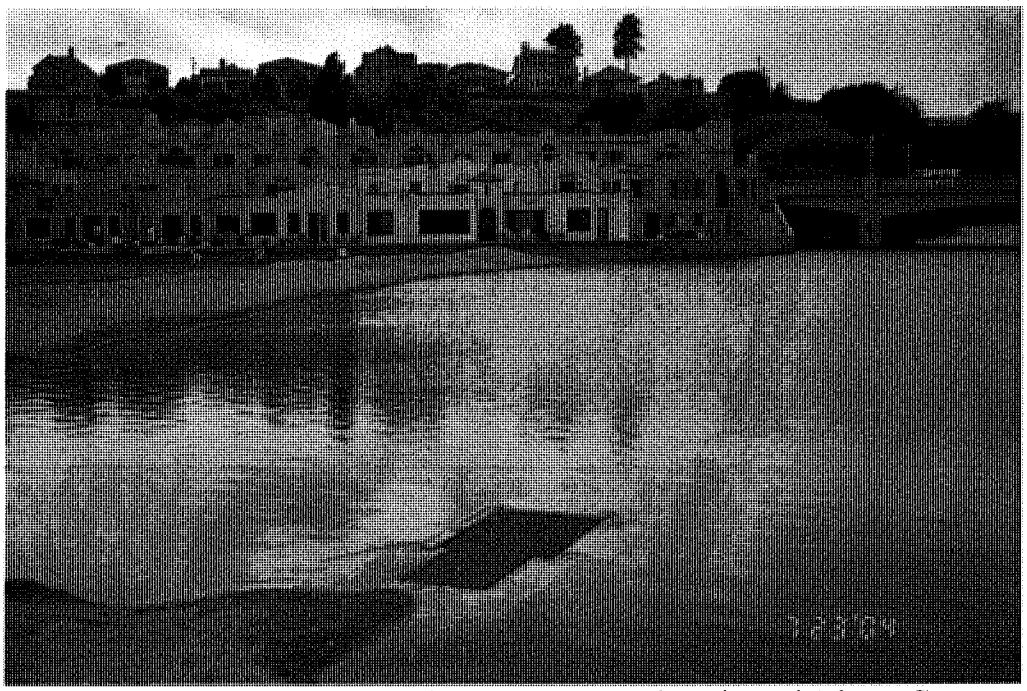
Soquel Creek Just Upstream of the Lagoon 13 June 2004



Redwood Rootwad Providing Valuable Waterfowl Roosting Habitat Near Noble Gulch
23 July 2004



Pigeons and Gulls Roosting on Esplanade Restaurants in Afternoon
23 July 2004



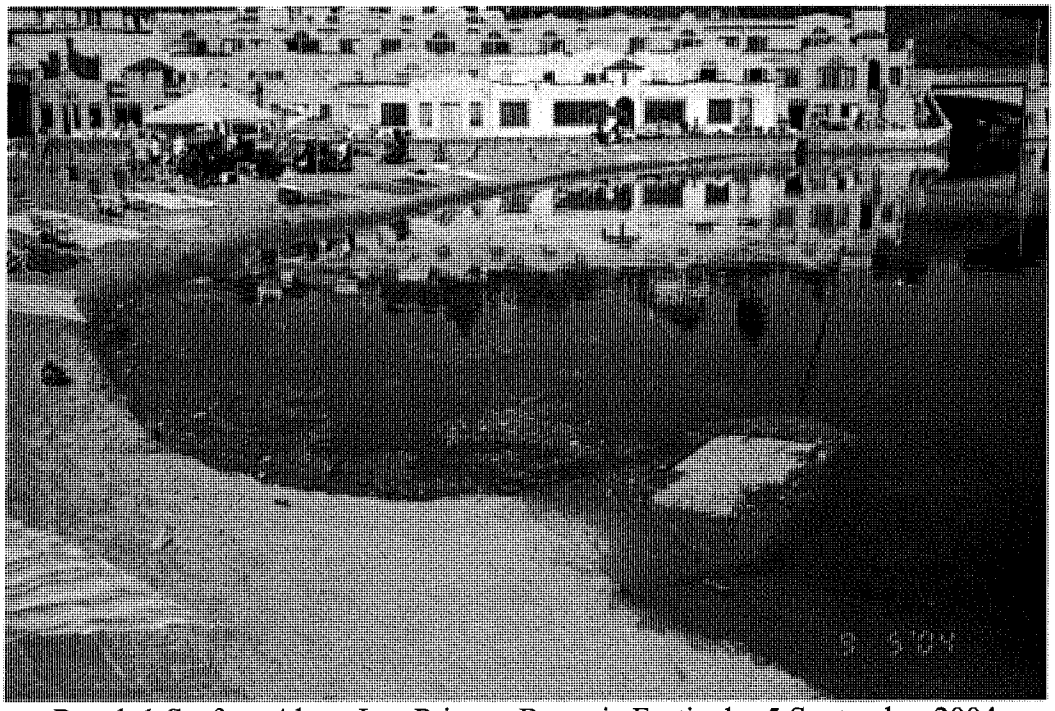
Soquel Lagoon Depth Maximized as Water Drains Through Flume Grate
23 July 2004

Soquel Lagoon Flume Outlet 23 July 2004

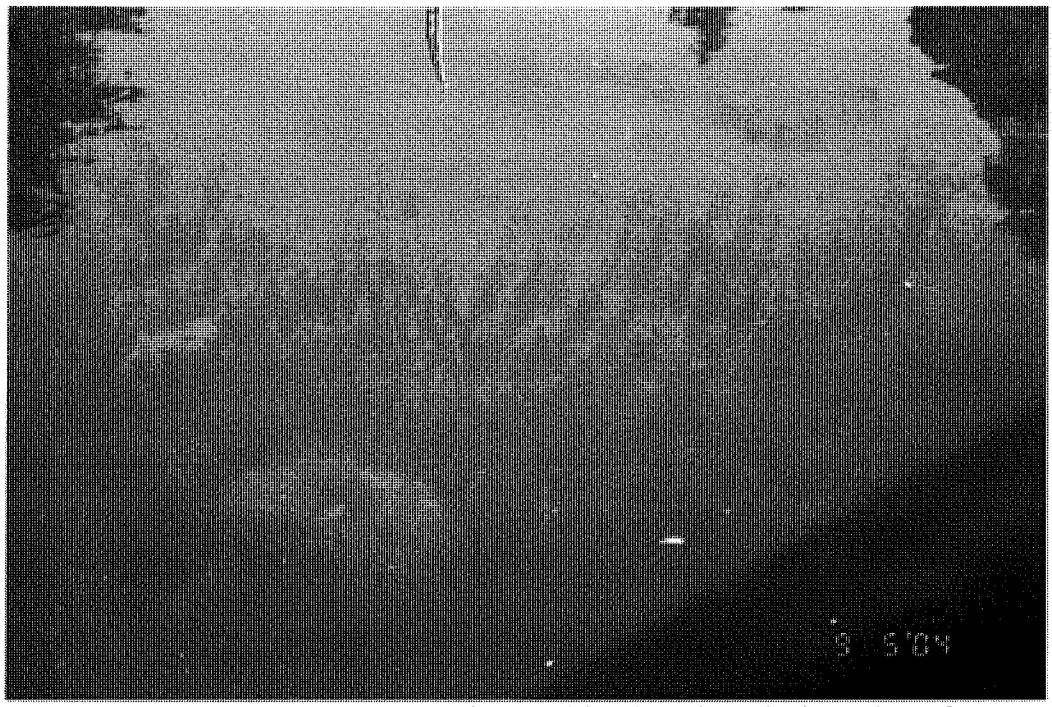
Reach 1 in Soquel Lagoon, 2 Days Prior to the Begonia Festival 3 September 2004

Reach 2 in Soquel Lagoon 3 September 2004

Reach 3 Lagoon Bottom Covered with Algae and Pondweed 3 September 2004

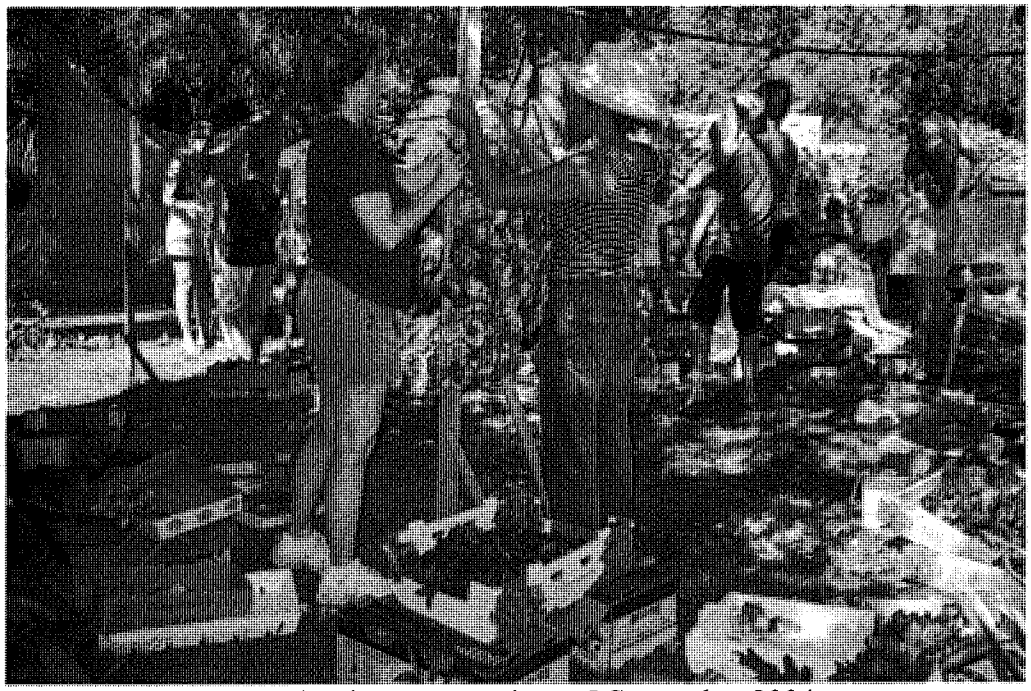


Reach 1 Surface Algae Just Prior to Begonia Festival 5 September 2004

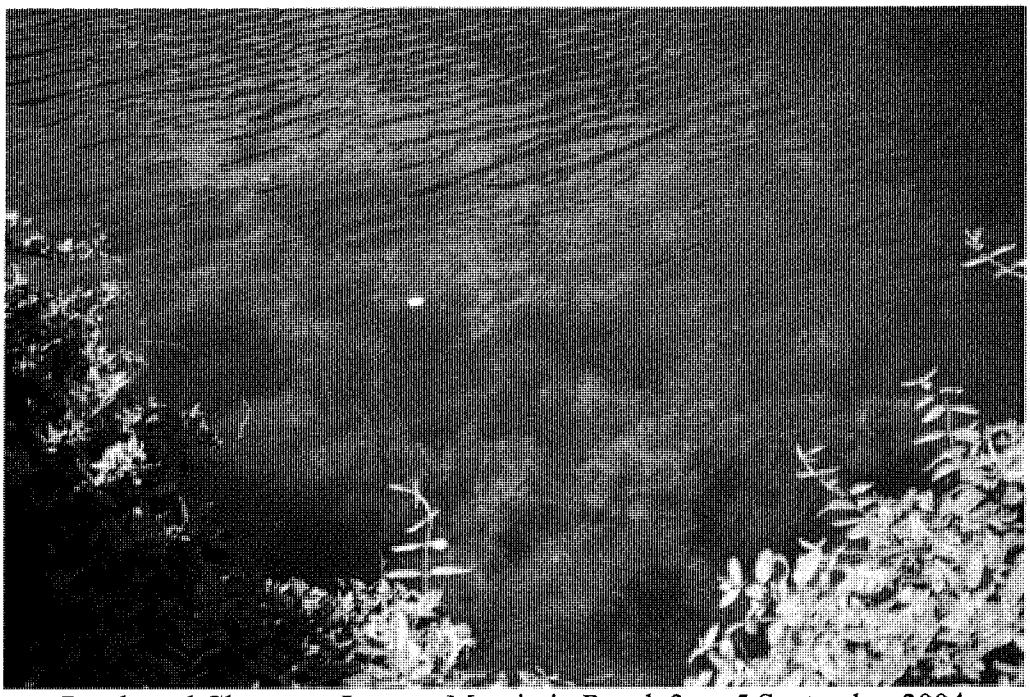


Reach 2 Lagoon Bottom Upstream of Stockton Bridge (Pondweed Clump in Left Foreground)
Prior to Begonia Festival 5 September 2004

Reach 3 Lagoon Bottom Upstream of the Trestle Prior to Begonia Festival
5 September 2004



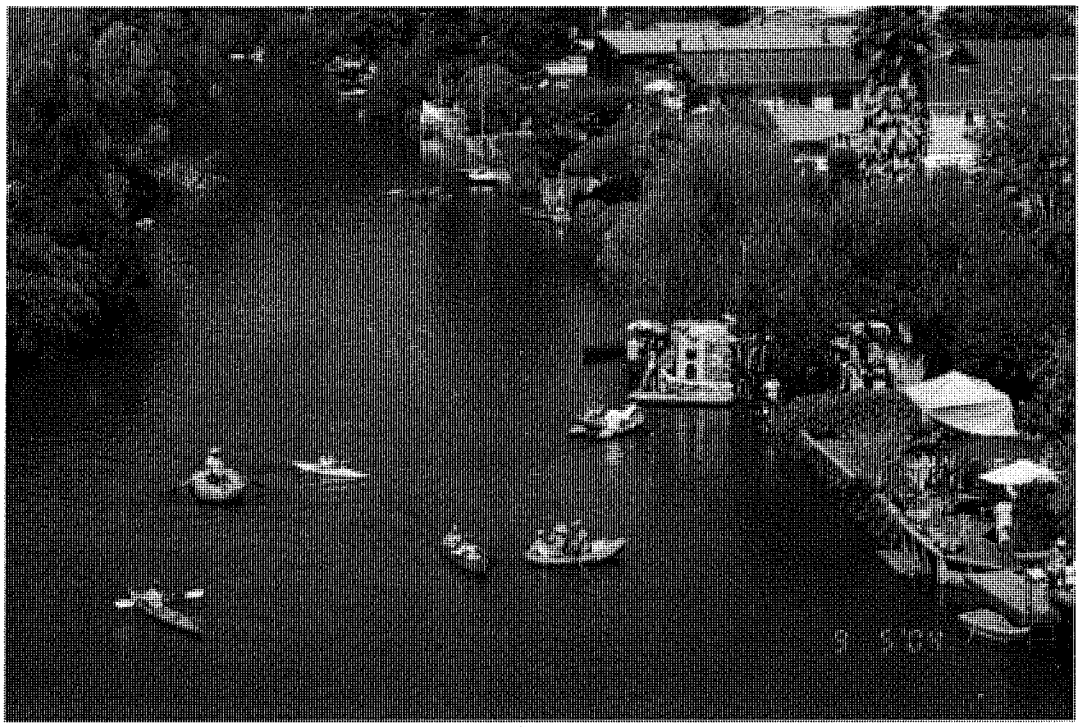
Begonia Float Preparation 5 September 2004



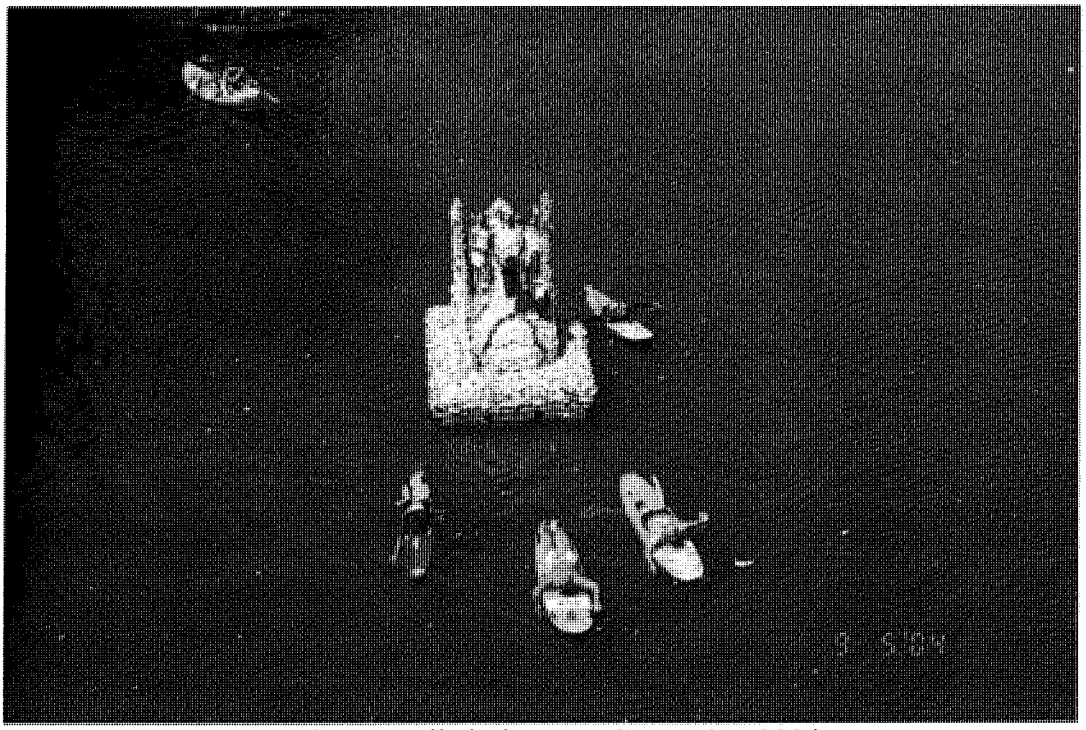
Pondweed Clumps at Lagoon Margin in Reach 3 5 September 2004

Locals Enjoying the Festivities 5 September 2004

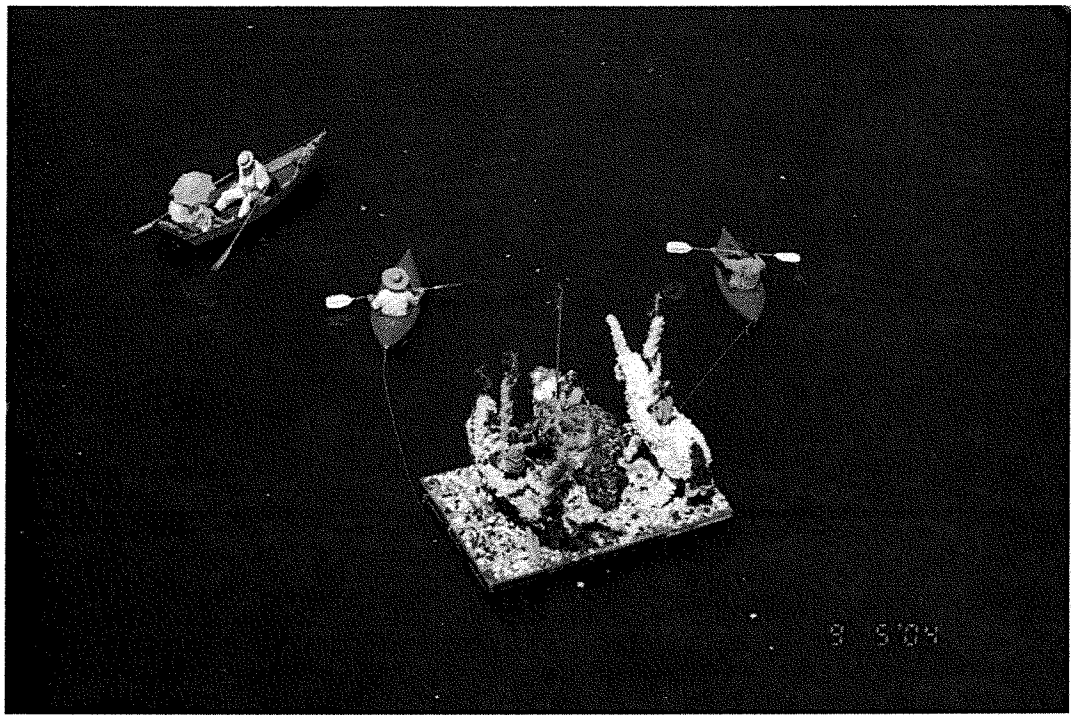
Familiar Couple in Period Dress Row Past Valuable Overhanging Fish Cover
5 September 2004



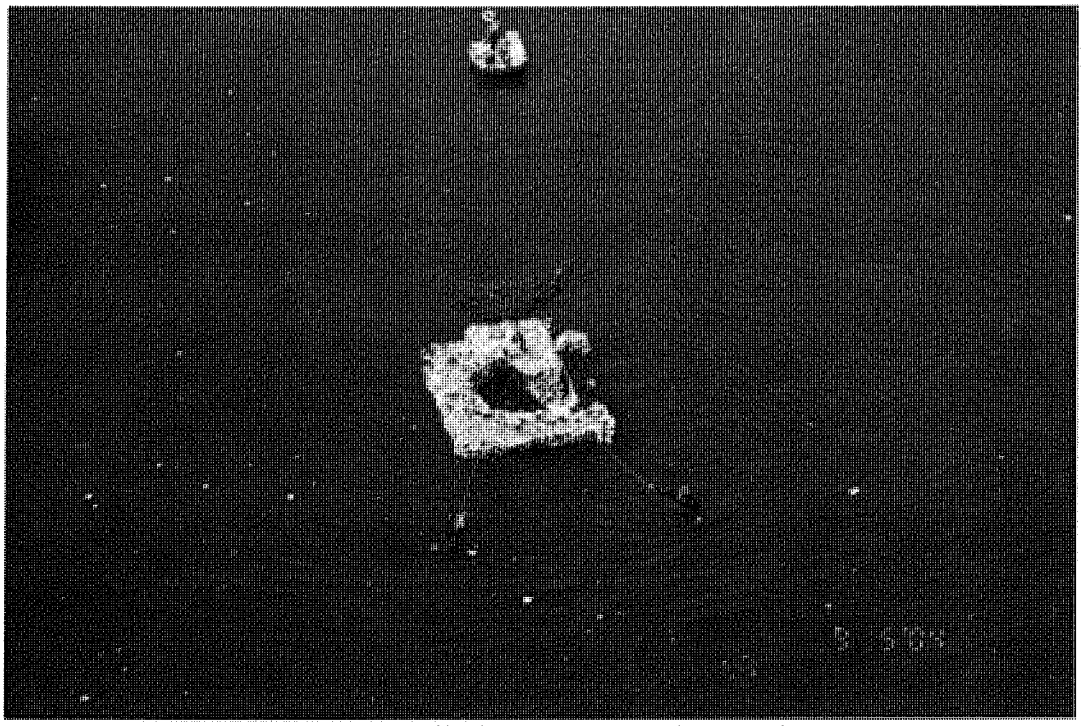
Begonia Festival Float and Boaters 5 September 2004



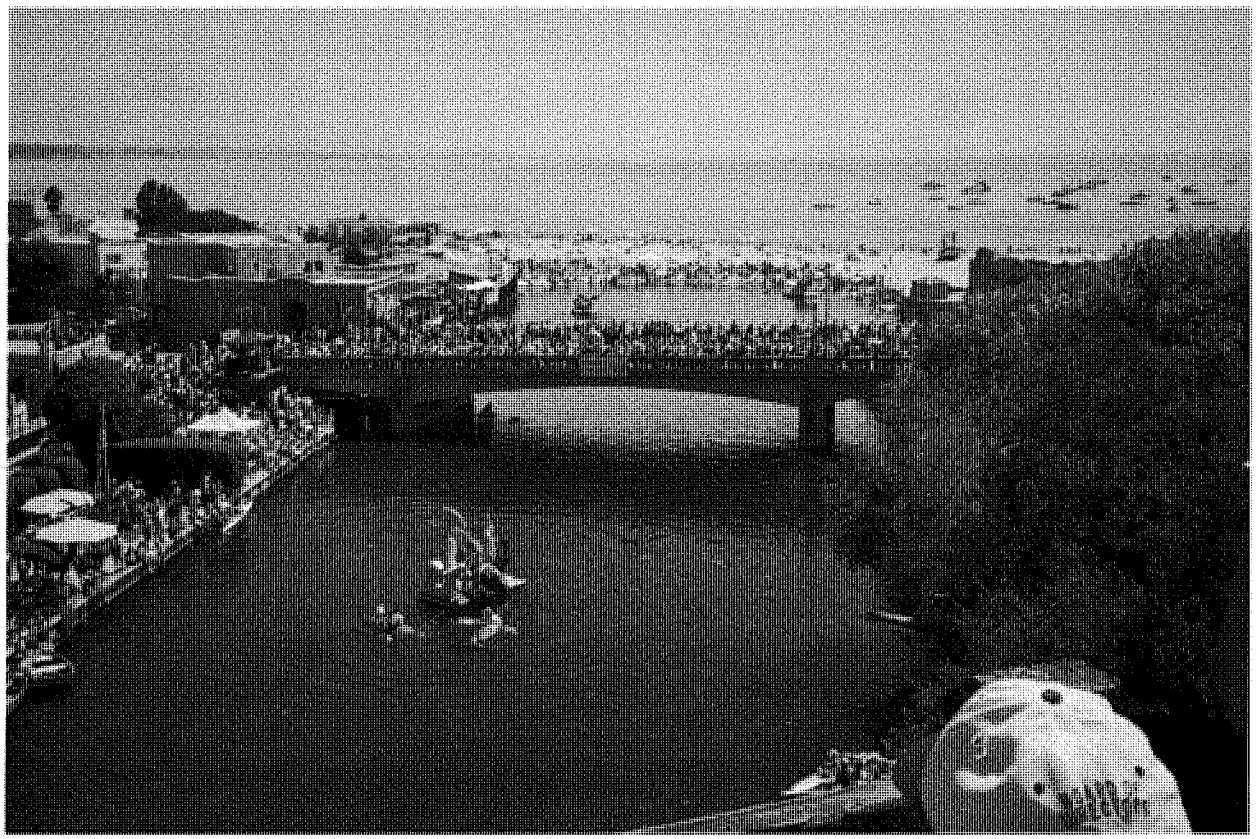
Surfer-Propelled Float 5 September 2004



Kayak-Propelled Float 5 September 2004



Waders Pull Float 5 September 2004



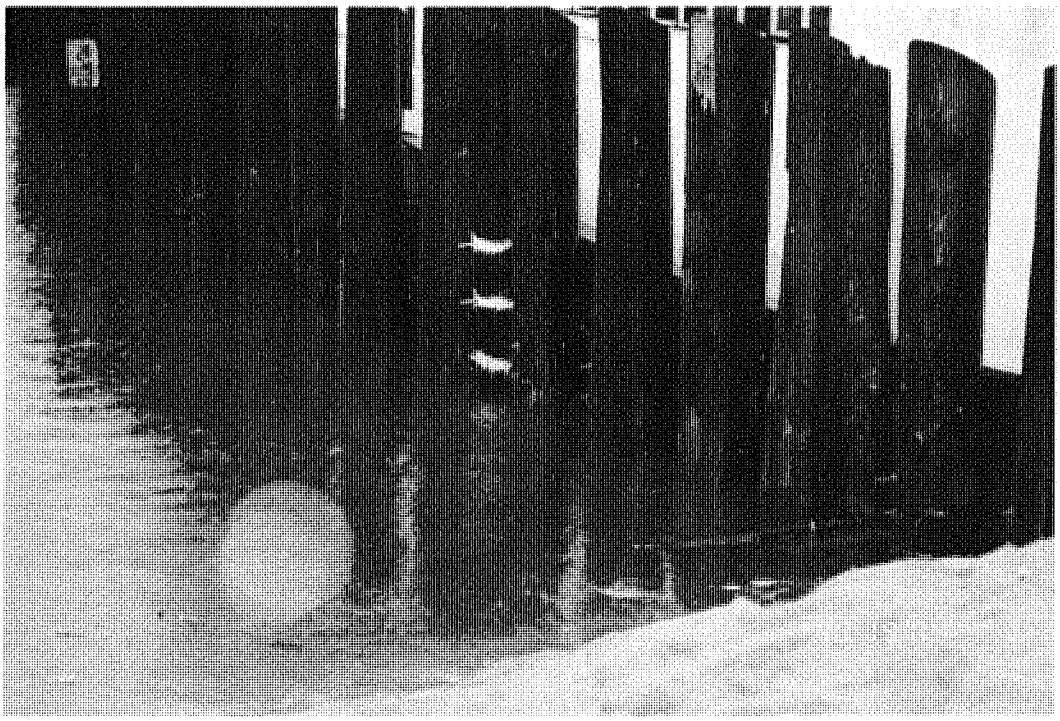
Begonia Festival Crowd 5 September 2004

Soquel Lagoon Sandbar Breach 19 October 2004

Beach Flooding During Soquel Lagoon Sandbar Breach 19 October 2004

Channel Through the Beach Resulting from Sandbar Breach 19 October 2004

Channel Widens Through Sandbar During Breach 19 October 2004



Piling Bolts Indicating Lagoon Stage Approximately One Hour After Breach
Lowermost Bolt is Original, Indicating Breach Necessary Above That Level
19 October 2004

Flooded Path With Bathtub Ring on Fence Adjacent to Lagoon at Railroad Trestle
19 October 2004

All Boards Had Been Removed from Flume Inlet to Maximize Flume Capacity Prior to Breach
19 October 2004