D.W. ALLEY & Associates aquatic biology

SOQUEL CREEK LAGOON MONITORING REPORT, 2000

June, 2001
Project #106-10

Prepared for

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ACKNOWLEDGMENTS

We appreciate the efforts of the Capitola Public Works Department and Bill Casalegno and his, Grandson, Matt Kotila, heavy equipment operators, in forming and maintaining the lagoon. In normal fashion, Nels Westman and other volunteers effectively removed flowers after the Begonia Festival in September. We thank Nels and Susan Westman for the loan of their boat for fish censusing in October.

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 such as Gary Quail, Rosalind Alley, the Heady family, the Timmerman family, UCSC students and innocent bystanders. This was the ninth year of sampling, providing a valuable index of steelhead abundance in the lagoon. Volunteers are very welcome on the first two Sunday mornings in October for sampling. It is a religious experience of sorts.

REPORT SUMMARY

When the estuary periphery and lateral channel across the beach were sampled before sandbar construction, the fish captured in the lateral channel included 17 juvenile staghorn sculpin (Leptocottus armatus), 1 juvenile starry flounder (Platichthys stellatus) and 2 large threespine stickleback Gasterosteus aculeatus). Along the shallow west margin of the lagoon near the Venetian Courts, the following species and numbers were captured; 26 juvenile staghorn sculpin, 13 juvenile prickly sculpin (Cottus asper) 6 juvenile starry flounders and two juvenile topsmelt (Atherinops affinis) (best guess). No tidewater gobies (Eucyclogobius newberryi) were found in 2000. The diversity of fish species and fish density in the lower 2000 estuary were higher than the previous year (2 species), but similar to the 4 species that had been present in 1998. Interestingly, no juvenile Sacramento suckers (Catostomus occidentalis) were detected, though they were caught in October during sampling.

Passage for steelhead smolts (Oncorhynchus mykiss) was excellent during the out-migration season in 2000. Our steelhead population estimate for fall 2000 was 875 juveniles +/- 156. Other species captured in October were staghorn sculpin, prickly sculpin, starry flounder, Sacramento sucker and threespine stickleback. No tidewater gobies were detected in 2000.

Habitat conditions in the 2000 lagoon followed another moderate rainfall winter. Sandbar construction was completed in early June. Algae did not became dense until August instead of early July as usual, but remained dense until October. Surface algae was maximized during the mid-August monitoring, with 15% of Reach 3 covered. In mid-August, bottom algae was 0.5 –3 feet thick in Reaches 1 and 2 and 1-3 feet thick in Reach 3. In early October, pondweed and algae were 3-4 feet thick in 10% of Reach 1, 2-3 feet thick in 15% of Reach 2 and 3-5 feet thick in the deepest 15% portion of Reach 3, with just algae 0.5-3 feet thick over the remainder of the lagoon. Pondweed was not noticed until 14 August 2000, which was similar to its first notice on 20 August 1999. The warmest lagoon conditions during another relatively cool summer, occurred early on in mid-June, although after tidal overwash in early July, bottom water temperature increased to its maximum under the Stockton Avenue Bridge.

Lagoon water temperature was "good" throughout most of the summer within 0.25 meters of the bottom, except the week after sandbar closure and in early July under the Stockton Avenue Bridge after tidal overwash. (**Table 3**). This was consistent with mostly good water temperatures in 1998 and 1999, which were better than 1997 conditions. Results from the 2000 temperature data logger stationed in Reach 3 of the lagoon (near the trestle) from late June to mid-September indicated that diurnal (daily) water temperature fluctuated approximately 1.5 to 6° F (1 to 3.5° C) (**Figures 4a-b**), which was less than in 1999 when fluctuations were approximately 4-8° F (2-4.5° C) (**Figure 6a**). The maximum water temperature recorded in 2000 was 70.4° F (21.3° C) at 5:22 p.m. on 8 July, after a minimum morning temperature of 64.2° F (17.9° C) at 10:22 a.m. The water temperature that day was above 68° F (20° C) for 8.5 hours. Temperatures above 20 C are considered limiting to juvenile coho salmon, and temperatures below 16 C are preferred (**J. Smith, personal. comm.**). Lagoon water temperatures were well within the tolerance of juvenile steelhead in 2000.

Data from the 2000 temperature logger located above the lagoon near Nob Hill indicated that the lagoon was cooler than the stream entering the lagoon, unlike in 1999. The presence of fog in the lagoon prevented maxima from being as high, and diurnal fluctuations were also less. Daily minima in the lagoon were consistently warmer in the lagoon than the stream above in both years. The diurnal water temperature in the stream fluctuated approximately 3-9° F (2-5° C) each day compared to 1.5-6° F in the lagoon (**Figures 5a-b**). The maximum recorded temperature was 71.2° F compared to 70.4° F in the lagoon. During the 83 days of monitoring, 8 days had temperatures greater than 70° F compared to one in the lagoon. A total of 45 days had temperatures above 68° F (54%) compared to 27 days (33%) in the lagoon. It was obvious that considerably more stream shading will be required to make lower Soquel Creek habitable for coho salmon.

Stream conditions in 1999 and 2000 had been much cooler than in 1998, despite the reduced baseflow. 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.

In comparing data from stream inflow to the lagoon and in the lower lagoon near the trestle, maximum daily water temperature at the bottom of the lagoon was generally 1 degree Farenheit cooler than that of the inflow in 2000.

Water quality for aquatic life in the lagoon was generally rated "good" or "fair" with regard to oxygen, salinity and conductivity throughout the water column (**Table 3**), except on the lagoon bottom. During 8 of 10 monitoring days in 2000, at least one station had a poor or critical rating for oxygen at the lagoon bottom. However, within 0.25 meters of the bottom where steelhead typically hold positions, oxygen ratings in 2000 were fair or good at every station through the summer and fall except on 7 July under the Stockton Avenue Bridge after a previous tidal overwash. Salinity was not an issue in summer, except after tidal overwash in early July. The saltwater detected on 7 July was flushed out by 14 July. Conductivity was low in the 2000 lagoon. It remained less than 630 umhos at monitoring times, except after tidal overwash in early July. (**Appendix B**).

Stream inflow to the lagoon ranged from 8 cubic feet per second (cfs) visually estimated in late June to approximately 3.5 cfs in early October (**Table 3**). On 23 October 2000, we measured 2.32 cfs at the Grange in Soquel Village.

Noble Gulch continued to pollute the lagoon in 2000, as indicated by periodic filamentous algal blooms at its mouth. Gray water or soap suds were observed during 2 of 8 monitorings in 2000, compared to 5 of the 7 monitorings in 1999, indicating a possible reduction in 2000.

Ideally, all storm drains leading to the lagoon would be re-directed away from the lagoon in summer, including the culvert draining Noble Gulch. 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.

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. A better method of refuge disposal is needed. The refuge cans situated on the beach have no lids. The gulls have excellent access to refuse that they drag onto the beach. Refuse cans with lids that were gull-proof and user-friendly for beach-goers may reduce gull numbers. Regarding roosting, methods are available to make buildings' roofs inhospitable to gulls.

Another source of bird pollution is the rock dove (pigeon) population that circulates between the wharf and the railroad trestle over Soquel Creek Lagoon. As stated in the original Management Plan, the trestle could be screened so that roosting areas were eliminated. This would likely reduce bird pollution.

Regarding pollution from urban runoff, maintenance of existing 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.

Inflow to the lagoon ranged from 8 cubic feet per second (cfs) visually estimated in late June to approximately 3.5 cfs in early October (**Table 3**). On 23 October 2000, we measured 2.32 cfs at the Grange in Soquel Village. Streamflow was somewhat higher in 1999, when inflow to the lagoon ranged from 8-10 cfs visually estimated in mid-June to a measured 3.7 cfs on 24 October 1999 (**Table 3**). By comparison, on 17 June and 29 June 1998, streamflow was measured at Nob Hill to be 31.2 and 22.6 cubic feet per second (cfs), respectively. On 19 September 1998, the Coastal Watershed Council measured streamflow with a flowmeter at Nob Hill to be 6.91 cfs (**Alley 1999**). Water quality worsens at the end of the dry season in most years, when stream inflow is at a minimum. However, summer of 1999 was relatively cool, and the worst water quality was experienced in early August. The lowest estimated summer baseflows in 1995, 1996 and 1997 had been approximately 2.5 cfs, 2.25 cfs and 1 cfs, respectively. In 1994, in-flow declined below 1 cfs by late July and dropped to an estimated 0.05 cfs by late September.

The sandbar was artificially breached relatively early on 26 October 2000 to prevent flooding during a sizeable storm event that affected much of the central Coast. The sandbar remained open afterwards.

Important Recommendations Not Yet Implemented

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

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

3. Repair the cracked flume. Its integrity is jeopardized, and the beach craters created by flume underflow are a safety hazard. (We understand that grant money has been secured to repair the flume.)

4. We continue to recommend that an insert be designed for at least one side of the flume entrance that will allow easy manipulation of water volume through the flume. A design with louvers that may be actuated independently would allow quick and easy opening of the flume entrance. The other side of the flume entrance may be filled with flashboards as before, if secured against vandals. In this way, vandalism would be prevented, and flooding may be more easily prevented before the sandbar breaches. Also, with this louver system the early, small stormflows of fall would be less likely require premature sandbar breaching to prevent flooding. With the louver design, the lagoon level may be easily maintained in summer, thus preventing the lagoon level from fluctuating into the "critical or poor" range as occurs with the old flashboard system when boards are not been added quickly as streamflow declines in summer. If the louver system could be designed as an insert, it could be removed after sandbar opening in the fall to minimize corrosion and damage from winter stormflows and tidal action. (It is our understanding that grant money has been obtained to design and construct a new flume insert.)

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, 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 floats in one direction only, presumably downstream and then to the dismantling location near the Stockton Avenue Bridge. In the past, floats were taken down the lagoon and then back up through the lagoon before dismantling back at the lower end near the bridge.

LAGOON AND ESTUARY FORMATION

Results of Fish Sampling Prior to Construction Activities

On 5 June 2000, Ed Morrison of the City of Capitola Public Works Department assisted Don Alley in making 5 seine hauls in the lateral channel leading southeast from the main estuary across the beach and 10 seine hauls around the periphery of the estuary below the Stockton Avenue Bridge. The seine was 30 feet x 4 feet x 1/8-inch mesh. We decided again this year to have the lateral channel blocked off from the main estuary with a sand berm prior to fish rescue because streamflow was too great to allow effective seining. The lateral channel was allowed to partially dewater before seining began. The entire lateral channel was seined. The fish captured in the lateral channel included 17 juvenile staghorn sculpin (Leptocottus armatus), 1 juvenile starry flounder (Platichthys stellatus) and 2 large threespine stickleback Gasterosteus aculeatus). Along the shallow west margin of the lagoon near the Venetian Courts, the following species and numbers were captured; 26 juvenile staghorn sculpin, 13 juvenile prickly sculpin (Cottus asper) 6 juvenile starry flounders and two juvenile topsmelt (Atherinops affinis) (best guess). No tidewater gobies (Eucyclogobius newberryi) were found in 2000. The diversity of fish species and fish density in the lower 2000 estuary were higher than the previous year (2 species), but similar to the 4 species that had been present in 1998. Interestingly, no juvenile Sacramento suckers (Catostomus occidentalis) were detected as had been in previous years.

Fishes were placed in a live car after each seine haul. Fishes captured in the lateral channel and along the shallow margin near Venetian Courts were relocated under the Stockton Avenue Bridge. The lateral channel was checked several times as it became dewatered. No more fish were seen.

No tidewater gobies were found in the lower estuary in 2000. If tidewater goby had been found, they would have been transported even further upstream where cover existed. It was concluded that tidewater goby were absent from the lower lagoon area in early June, 2000. No tidewater gobies had been captured in the lower lagoon since fall, 1997.

As required in the permit, the fisheries biologist, Don Alley, was present during activities that could affect the fish habitat in the lagoon/estuary during sandbar construction. This was the tenth year of monitoring and assisting in activities associated with sandbar construction at Soquel Creek Lagoon. Reports for the first 9 years are available at the City (**Alley 1991-2000**). 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 Sandbar Construction

5 June 2000. The first activity accomplished on Monday, 5 June, was the construction of channel along the east side of the flume. Then a berm was constructed across the upstream end

of the lateral channel. The estuary then began to drain and fill with the tides along the new channel. It drained more after the new channel was constructed. Puddles and the base of the bulkhead were searched as the estuary drained. No fish were observed. After the lateral channel was seined and dewatered, the equipment operator began to cover the lateral channel with sand to increase the beach area. The sand that had filled the concrete flume during the winter was partially flushed out to make it passable to out- migrating steelhead before the sandbar was closed for the night. One portal was left open in the event that the flume plugged up and water needed to escape. One side of the flume inlet was fully screened. There was more kelp and sea grass present that the previous year.

6 June 2000. The sandbar was re-opened in early morning. It drained partially, leaving considerable kelp and sea grass. No fish were stranded adjacent the bulkhead. A deep thalweg existed on the restaurant side of the estuary. The western Venetian Court side was very shallow. During the day, the west side was deepened and contoured after the water receded. More juvenile staghorn sculpins and small starry flounders were seen than previous years. No juvenile steelhead were observed. Plant material was raked out of the estuary until sandbar closure at 1200 hr. At the end of the day, the flume was 80% free of sand. A full screen was placed on one side of the flume inlet, with a half screen on the other. The baffle was still intact within the flume from the previous year.

7 June 2000. The lagoon level had filled halfway up overnight. Considerable kelp still existed under the bridge and upstream. There were 5 City staff raking plus Don Alley. The sand was smoothed on the Venetian Court side. Sheets of visquine and filter cloth were placed around the flume to prevent water from leaking out of the lagoon along the flume. A thick layer of sand was put over them. The sandbar was closed at 1140 hr to prevent saltwater from entering. With the sandbar closed for the summer, 95% of the plant material had been cleared out, downstream of the Stockton Avenue Bridge. About 70% of the plant material had been cleared out, upstream of the bridge. More cobble was present in the lagoon than previous years. No steelhead were observed at the mouth of Noble Gulch. The downed cottonwood was still in place across the lagoon from Noble Gulch.

In 2000, two artificial sandbar closings and openings occurred before the lagoon was closed permanently for the remaining summer.

Effects of Sandbar Construction on Tidewater Gobies in 2000

It did not appear that tidewater gobies used the lower estuary in early June. If they were present in the estuary, it was likely that 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. The estuary receded after the lateral channel was blocked and the new channel was constructed along the flume. This would require tidewater gobies 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. The channel lacked sheltered backwaters for fish to escape high water velocity during high

stormflows. However, tidewater gobies have been detected recently in Aptos Lagoon after years of no detection, and they may repopulate Soquel Lagoon in the future from adjacent populations.

The seasonal effect of removing organic material and constructing the sandbar is to create cooler, freshwater conditions with reduced potential for eutrophication and biological oxygen demand. 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. 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. 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.

2. Continue to rake as much kelp and sea grass out of the lagoon as possible before final closure, including plant material trapped under the restaurants, in depressions around the bridge and at the mouth of Noble Gulch. 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.

3. 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 this method so long as kelp is spread over a wide area (**J. Ricker, personal comm.**).

4. Bring back the wide rakes that were used in previous years.

5. 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.)

6. 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 at low tide to drain out more kelp.

7. Search under the 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.

8. Seal off storm drains on the west side of the street in front of the Esplanade. This should occur from May 15 to the time of sandbar breaching in the fall. Remind restaurant owners that sidewalk cleaning during the summer is to be done by steam cleaning rather than by water hose. Seal sidewalk grates along the Esplanade during the same period. This will reduce pollution from restaurant clean-up. Many smokers leave cigarette filters on sidewalks, which are then swept or washed into storm drains. These filters are mistaken as food by fish and ingested if they reach the water. This may cause serious digestive problems and potential fish mortality.

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. Re-install 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.

11. Continue to maintain a 6 to 8-inch depth at the outlet of the flume until July 1. Install 4"x 4" planks in the outlet, if necessary, as George Heise (CDFG passage expert) originally recommended.

Procedure for Emergency Sandbar Breaching at Soquel Creek 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. 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 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 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 2000-2001 Rainy Season.

26 October 2000. A rainstorm was underway on 25 October 2000. With the lagoon level approaching the bolt and rain continuing, the sandbar was notched to facilitate a breach at 0500 hr on 26 October. This was a large rainstorm that affected streamflow throughout the central Coast region.

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. Street sweepers with water and suction may be necessary. In addition, road work such as repaving and application of fresh petrochemicals to pavement should be done early in the summer to allow sufficient time for penetration and drying before the rainy season. These chemicals can be lethal to fish.

2. The notch in the sandbar should be cut slightly lower than the piling bolt. 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 hole 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. After the stormflow subsides, replace the cover until the next storm.

4. 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.

5. 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 in the lagoon and unable to migrate upstream because of insufficient streamflow.

6. We continue to recommend, as we did in the 1996 and 1997 reports, that an insert be designed for at least one side of the flume entrance that will allow easy manipulation of water volume through the flume. A louvered design allowing independent actuation of louvers would allow quick and easy opening and closing of the flume entrance. The other side of the flume entrance may have secured wooden flashboards, as is presently the case. Flashboards may be removed to remove sand from the flume at the beginning of the summer season or at the end to maximize flume capacity during small, fall storms. With the louvers in place, flooding may be more easily prevented before the sandbar breaches. Also, early, small stormflows would be less likely to breach the sandbar prematurely with this louver design. During the summer months, operation of the louvers would make it easy to maximize the lagoon height as the streamflow declined through the summer. As the streamflow dropped, the louvers could be progressively closed. The present effort of removing screens and replacing them with smaller screens and boards as the streamflow declines could be much reduced, thus saving many hours of labor and doing a better job of maximizing lagoon water depth.

WATER QUALITY MONITORING, 2000

Rating Criteria

Water quality parameters were rated according to the tolerances of steelhead. This was because other fishes were more tolerant to low oxygen, higher salinity and higher temperatures than steelhead. 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 the survival of 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**). Early morning oxygen 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 ppm 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 that exist in Soquel Creek Lagoon, carbon dioxide is poorly dissolved and is believed not to be a problem (**Jerry 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 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 that is not directly under control by the City is change in streambed elevation resulting from scour or fill during the winter. The lagoon shallowed in 1995 due to sedimentation during the winter and apparent sand movement after the sandbar was closed in June.

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

Locations of Water Quality Monitoring

Water quality was monitored in early morning near first light at four stations. The first station was at the flume inlet (**Figure 1**). The second station was reached off 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.

In 2000 as in 1999, two temperature data loggers were installed. One was placed on the bottom of a run in Soquel Creek, upstream of the lagoon from 26 June to 16 September.

Results of Water Quality Monitoring After Sandbar Closure

Appendix B provides detailed data on water quality. **Table 3** rates habitat conditions.

Table 3. Water Quality Ratings in Soquel Creek Lagoon, 1999, Within 0.25 Meters Of the Bottom.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salinity	Lagoon In-flow Visual est. (cfs)
15Jun00	open	good 2.37	fair fair fair good	good good good fair	good	8 cfs
7Jul00	open	fair 2.04	good critical good good	good critical good good	good poor good good	6-8 cfs
10Jul00	open	critical 1.45	(Problems after tidal overwash.Plywood installed.)			
14Jul00	open	good 2.52	good	good	good	4-5 cfs
17Jul00	open	good 2.65				
19Jul00	open	good 2.60				
30Jul00	open	good 2.40	good	good	good	3-4 cfs
1Aug00	open	fair 2.10	(Plywood dislodged by tidal back pressure.)			
14Aug00	open	good 2.53	good	good	good	3.5 cfs
21Aug00	open	good 2.52				
1Sep00	open	good 2.67	good	fair fair fair good	good	4 cfs
5Sep00	open	good 2.38	good	good	good	-
10Sep00	Begonia Fest.	good 2.52				
17Sep00	open	good 2.45	good	good	good	-
20Oct00	open	good 2.52	good	good fair good fair	good	3.5 cfs
4Oct00	open	good 2.54	- good good	- good good	- good good	
23Oct00	open	good 2.45	- good	- good	- good	

* Four ratings refer to Reaches 1-3 and at Noble Gulch. One rating refers to all stations.

Lagoon Level. The lagoon level was monitored 17 times within no more than 2-week intervals from 15 June to 23 October, 2000. For 2000, the measurements of lagoon level as measured on the staff gage were rated "good" on 14 occasions (82%), "fair" on 2 occasions and "critical" on one occasion (Table 3; Figure 2). The lagoon remained deep during the Begonia Festival. The one fair reading on 7 July followed by the critical reading on 10 July resulted from problems related to tidal overwash. Back pressure through the flume may dislodge boards and allow leakage through the flume, resulting in reduced water surface elevation. By 14 July, plywood was installed to prevent boards from being dislodged and to reduce leakage between the boards. However, the fair rating on 1 August resulted from the plywood being dislodged from back pressure. Despite these episodes of reduced water depth, the water level in 2000 was consistently good at other times and remained high through August, September and October. Installation of a louvered insert at the flume inlet should prevent negative effects of tidal back pressure and vandalism.

No vandalism was detected in 2000. The plywood protected against both back pressure and vandalism. Wedges were used to secure the top boards, as well. Vandalism had been a problem in 1995-1998. A 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. During much of the summer, 1997, the shrouds were placed over the inlet to remove saltwater. This also prevented vandalism. However, after a small storm in early October, the shrouds had been removed, and the vandalism occurred.

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 baffle that had been replaced in May 1999, remained in place in June 2000 to insure water depth inside the flume entrance. The flume was partially cleared of sand before the sandbar was closed the first day of construction activity and cleared completely before final sandbar closure, to insure steelhead smolt passage during and after sandbar construction. Sufficient baseflow in 2000 resulted in excellent passage for steelhead smolts. The sandbar was artificially breached relatively early on 26 October 2000 to prevent flooding during a sizeable storm event that affected much of the central Coast. The sandbar remained open afterwards.

Water Temperature. Lagoon water temperature was "good" throughout most of the summer within 0.25 meters of the bottom, except the week after sandbar closure and in early July under the Stockton Avenue Bridge after tidal overwash. (**Table 3**). This was consistent with mostly good water temperatures in 1998 and 1999, which were better than 1997 conditions. In 1997, saltwater had entered the lagoon repeatedly. Lagoon depth had fluctuated more that year, and there was less streamflow to flush out the saltwater, leading to a "poor" rating for at least one station during each of 6 summer monitorings.

Lagoon water temperatures were well within the limits of juvenile steelhead in 1999 and 2000.

However, water temperatures above 20° C (68° F) are considered limiting to juvenile coho salmon (depending on food abundance), and temperatures below 16° C (60.8° F) are preferred (**J. Smith, personal comm.**). Although lagoon water temperatures were substantially cooler in the 2000 compared to 1999, they were very near or above the limit for coho salmon for a major portion of the monitoring period in both years. In 2000, afternoon water temperature rose above 68° F on 27 of the 83 days (33%) of monitoring from 26 June to 16 September and went above 70° on one day. In 1999, afternoon water temperatures went above 68 F (20 C) on 31 of 47 days (66%) from 16 July to 31 August and went above 70 F (21.1 C) on only 4 days during that period.

Results from the 2000 temperature data logger stationed in Reach 3 of the lagoon (near the trestle) from late June to mid-September indicated that diurnal (daily) water temperature fluctuated approximately 1.5 to 6° F (1 to 3.5° C) (**Figures 4a-b**), which was less than in 1999 when fluctuations were approximately 4-8° F (2-4.5° C) (**Figure 6a**). The maximum water temperature recorded in 2000 was 70.4° F (21.3° C) at 5:22 p.m. on 8 July, after a minimum morning temperature of 64.2° F (17.9° C) at 10:22 a.m. The water temperature that day was above 68° F (20° C) for 8.5 hours.

The maximum temperature recorded in 1999 had been 71.8 F (22.1 C) on 3 August 1999, after a minimum morning temperature of 64.9 F (18.3 C) at 10:28 a.m.

Data from the 2000 temperature logger located above the lagoon near Nob Hill indicated that the lagoon was cooler than the stream entering the lagoon, unlike in 1999. The presence of fog in the lagoon prevented maxima from being as high, and diurnal fluctuations were also less. Daily minima in the lagoon were consistently warmer in the lagoon than the stream above in both years. The diurnal water temperature in the stream fluctuated approximately 3-9° F (2-5° C) each day compared to 1.5-6° F in the lagoon (**Figures 5a-b**). The maximum recorded temperature was 71.2° F compared to 70.4° F in the lagoon. During the 83 days of monitoring, 8 days had temperatures greater than 70° F compared to one in the lagoon. A total of 45 days had temperatures above 68° F (54%) compared to 27 days (33%) in the lagoon. During the 47-day period from mid-July to the end of August 1999 at the stream location near Nob Hill, water temperature went above 68 F (20 C) 26 days (55% of the days) and went above 70 F on only 3 days (**Figure 6b**). Thus, the inflow to the 2000 lagoon was at times warmer than in 1999. It was obvious that considerably more stream shading will be required to make lower Soquel Creek habitable for coho salmon.

Stream conditions in 1999 and 2000 had been much cooler than in 1998, despite the reduced baseflow. 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.

In 1999, the maximum daily water temperature long the lagoon bottom ranged from less than 1 to as much as 2° F warmer than the stream inflow. However, in 2000, the daily lagoon maximum water temperature was usually up to 1° F cooler than in the stream above.

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 measured and rated. Algae and pondweed did not become dense until early August, 2000, but remained so until early October. In 1999, algae became dense in early July, 1999, and remained so until the end of July. Surface algae never really developed in 2000, with the most being 15% coverage 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. Pondweed was not noticed 14 August in 2000 and not until 20 August in 1999.

Water quality for aquatic life in the lagoon was generally rated "good" or "fair" with regard to oxygen, salinity and conductivity throughout the water column (**Table 3**), except on the lagoon bottom. During 8 of 10 monitoring days in 2000, at least one station had a poor or critical rating for oxygen at the lagoon bottom. However, within 0.25 meters of the bottom where steelhead typically hold positions, oxygen ratings in 2000 were fair or good at every station through the summer and fall except on 7 July under the Stockton Avenue Bridge after a previous tidal overwash. In 1998 and 1999 within 0.25 meters of the bottom, oxygen levels were in the "fair" to "good" range all summer and fall (**Table 3; Figure 7**) and did not reach the poor level.

Salinity. Salinity was not an issue in summer, except after tidal overwash in early July. The saltwater detected on 7 July was flushed out by 14 July.

Conductivity. Conductivity was low in the 2000 lagoon. It remained less than 630 umhos at monitoring times, except after tidal overwash in early July. (**Appendix B**).

Stream In-Flow to the Lagoon. Inflow to the lagoon ranged from 8 cubic feet per second (cfs) visually estimated in late June to approximately 3.5 cfs in early October (**Table 3**). On 23 October 2000, we measured 2.32 cfs at the Grange in Soquel Village. Streamflow was somewhat higher in 1999, when a visually estimated 8-10 cfs was recorded in mid-June and a measured 3.7 cfs was recorded on 24 October 1999 (**Alley 2000**). By comparison, on 17 June and 29 June 1998, streamflow was measured at Nob Hill to be 31.2 and 22.6 cfs, respectively. On 19 September 1998, the Coastal Watershed Council measured streamflow with a flowmeter at Nob Hill to be 6.91 cfs (**Alley 1999**). Water quality worsens at the end of the dry season in most years, when stream inflow is at a minimum. However, summer of 2000 was relatively cool as had been the case in 1999, and the warmest water temperature occurred in late June and July. The lowest visually estimated summer baseflows in 1995, 1996 and 1997 had been 2.5 cfs, 2.25 cfs and 1 cfs, respectively. In 1994, lagoon in-flow declined below 1 cfs by late July and to an estimated 0.05 cfs by late September.

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 (**Figure 3; 1997 was the driest year and 1998 was the wettest**). With proper flume management, it should be easier to maintain lagoon depth and prevent fluctuations with more baseflow. However, this potential has not been fully realized (**Figure 2**). 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.

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 C**.

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 culvert draining Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch (**Alley 1995; 1996b; 1997-2000**). In 2000, gray water plumes were observed on 5 of the 7 monitorings (**Appendix B**). Stimulation of algal growth has annually occurred at the mouth of Noble Gulch, with consistently greater growth there compared to elsewhere in the lagoon. This indicates elevated nutrient inputs probably associated with bacteria. Oxygen depletion is consistently registered there. 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.

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.

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. The refuge cans currently on the beach have no lids. The gulls have excellent access and commonly drag refuge out of the cans. Refuse cans 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.

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

Regarding urban runoff, maintenance of existing silt and grease traps on storm drains is critical to reducing pollution by petrochemicals. All new drainage systems from new development and parking lots should include installation of effective traps and percolation basins to increase percolation of storm runoff.

Recommendations to Maintain Good Water Quality and Fish Habitat in the Summer 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. Look into screening the railroad trestle in order 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.

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 hole for adults. Close the adult hole by July 1 in any event. If adult steelhead are seen in the lagoon after June 1 and the adult hole 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. We continue to recommend that an insert be designed for at least one side of the flume entrance that will allow easy manipulation of water volume through the flume. A design with louvers that may be actuated independently would allow quick and easy opening of the flume entrance. The other side of the flume entrance may be filled with flashboards as before, if secured against vandals. In this way, vandalism would be prevented, and flooding may be more easily prevented before the sandbar breaches. Also, with this louver system the early, small stormflows of fall would be less likely require premature sandbar breaching to prevent flooding. With the louver design, the lagoon level may be easily maintained in summer, thus preventing the lagoon level from fluctuating into the "poor" range as occurs with the old flashboard system when boards are not been added quickly as streamflow declines in summer.

13. We recommend that "Gull Sweeps" sold by West Marine Products ($32.00 each and 6 feet across) 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."

14. Regarding the Begonia Festival, we recommend that float propulsion by surfboard paddling 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 take down the lagoon and then back up before dismantling back at the bridge.

15. We recommend that the City 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. We recommend that the City request from the responsible flood control district that sediment and grease traps leading into lower Soquel Creek be annually inspected and cleaned.

FISH CENSUSING

Steelhead Plantings in Soquel Creek

In late March 2000, an estimated 2,531 juvenile steelhead (175 pounds @ 8.6 fish to the pound from San Lorenzo River stock; 180 pounds @ 5.7 fish to the pond from Scotts Creek stock) were

planted into lower Soquel Creek from the hatchery facility at Scott Creek. These smolt-sized fish presumably out-migrated soon after. No fingerlings were planted in upper Soquel Creek as had been done in 1997. No hatchery steelhead were detected during sampling in fall, 2000.

Results of Fish Sampling in Soquel Creek Lagoon

Even with a freshwater lagoon created by the City of Capitola, the water temperature sometimes reaches to near the upper tolerance limit of steelhead for 1-2 hours per day when morning fog is absent. If sufficient saltwater was present in the lagoon, water temperatures could become lethal for steelhead.

On 1 October 2000, 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. Only threespine sticklebacks were captured. No tidewater gobies were captured.

In fall, 1992, two tidewater gobies were captured during sampling. In fall, 1994, 35 tidewater gobies had been captured after four seine hauls. In fall, 1993, 1995, 1996, 1998 and 1999, no tidewater gobies were captured. In fall, 1997, one tidewater goby was captured. The low number captured in 1992-2000 probably indicated a lack of backwater areas to be used as refuges during high winter stormflows.

Fall sampling for steelhead was undertaken on 1 and 8 October 2000, from just upstream of the Stockton Avenue Bridge and downstream. The 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 the Bridge. Juvenile steelhead congregate in the shade under the Bridge. The seine was pulled into the beach in front of Venetian Court. With this larger, coarser-meshed seine, no tidewater gobies were captured. On 1 and 8 October, a total of 267 unclipped juvenile steelhead ranging from 95 to 286 mm Standard Length (SL) were measured, having 185 marked from four good seine hauls on 1 October (**Figure 8**). The 5 mm increment with the most young-of-the-year steelhead was 135-139 mm SL in 2000. In 1999, the most popular young-of-the-year steelhead size increment was 120-124 mm SL (**Figure 9**). In 1998, the most popular size increment was 115-119 mm SL (**Figure 9b**). There were no steelhead mortalities on 1 October 2000. On 8 October, 104 juvenile steelhead (22 previously clipped), were captured from 3 seine hauls. There were no steelhead mortalities on 8 October.

Our steelhead population estimate for fall 2000 was 875 juveniles +/-156. Other species captured with the 106-foot seine were 18 staghorn sculpin, 16 prickly sculpin, 4 starry flounders, 29 juvenile Sacramento suckers, one adult Sacramento sucker and threespine sticklebacks. Refer to **Table 4 and Figure 10** for a summary of juvenile steelhead estimates for the last 8 years.

Slightly fewer juvenile steelhead moved in to the lagoon from the lower Creek in 2000 compared to 1999, though higher numbers were estimated in the 1993 and 1994 lagoons. Probably, limited spawning occurred in lower Soquel Creek in 2000 because of adequate spawning access to the

upper watershed and a preponderance of sand and poor spawning conditions in the lower Creek. Our sampling of lower Soquel Creek in fall, 1997-2000, indicated very low densities of juvenile steelhead in the lower 2 miles of stream habitat above the lagoon. Our monitoring of Soquel Creek, upstream of the lagoon in 2000, indicated that lagoon steelhead production was equivalent to smolt-sized production from more than 4.1 miles of habitat upstream. In 1999, lagoon production equaled smolt-sized production for 4.5 miles of stream habitat upstream. 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 years 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.

Table 4. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-2000.

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 (95% confidence interval.) 1,046 fish marked from two seine hauls.

1994- 1,140 +/- 368 (95% confidence interval.) 76 fish were marked from two seine hauls.

1995- 360 +/- 60 (95% confidence interval.) 59 fish were marked from 4 seine hauls.

1996- 255 +/- 20 (95% confidence interval). 105 fish were marked from 3 seine hauls.

1997- 560 +/- 182 (95% confidence interval). 53 fish were marked from 3 effective seine hauls.

1998- 671 +/- 74 (95% confidence interval). 164 fish were marked from 3 effective and one snagged seine haul.

1999- 928 +/- 55 (95% confidence interval). 397 fish were marked from 4 effective seine hauls.

2000- 875 +/- 156 (95% confidence interval). 185 fish were marked from 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, and 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 with higher streamflow into the lagoon in summer (known as summer baseflow). However, Public Works has an easier time of maximizing water depth in years with intermediate streamflows, such as 1999 and 2000 rather than 1998. 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.

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 with surface diversions upstream 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. Complete loss of surface flow should be avoided.

2. Maximize lagoon depth by adding boards to the flume 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. As recommended in the 1997-99 reports, we again recommend that an insert be designed and installed for at least one side of the flume entrance that will allow easy manipulation of water volume through the flume. This will prevent the lagoon level from declining into the poor range because sufficient boards have not been added to the flume inlet as streamflow declines. A design with louvers that may be actuated independently would allow quick and easy closing of the flume entrance. The other side of the flume entrance may have boards, as is presently the case. In this way, the lagoon level may be easily maintained and vandalism may be prevented. Furthermore, sustaining lagoon habitat until later in fall when storm frequency and streamflows increase, will maximize the lagoon's benefit to juvenile steelhead. It is our understanding that the City has obtained grant money to design and construct a new insert for the flume entrance, as well as for repair of the cracked flume.

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FIGURES

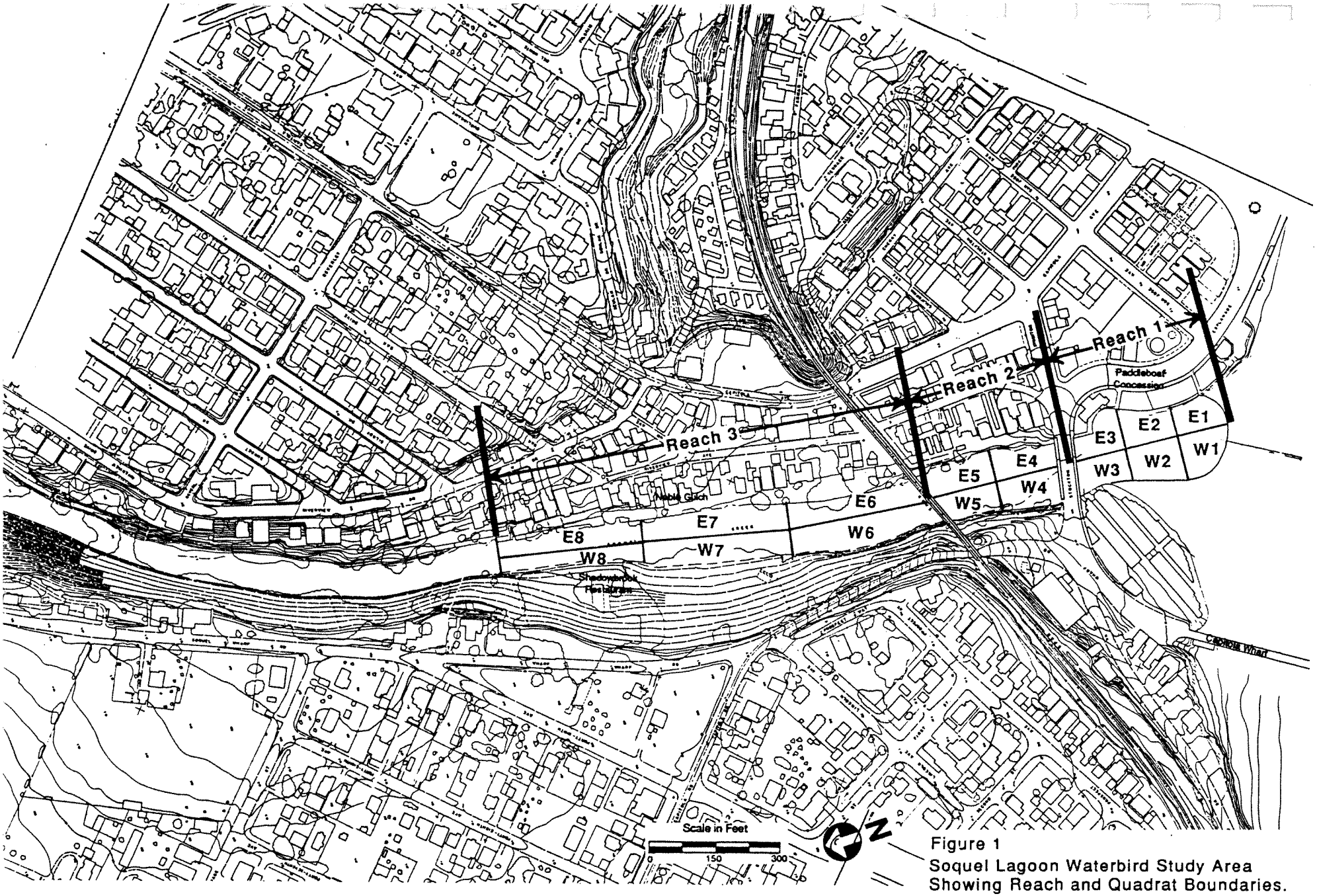


Figure 1
Soquel Lagoon Waterbird Study Area
Showing Reach and Quadrat Boundaries.

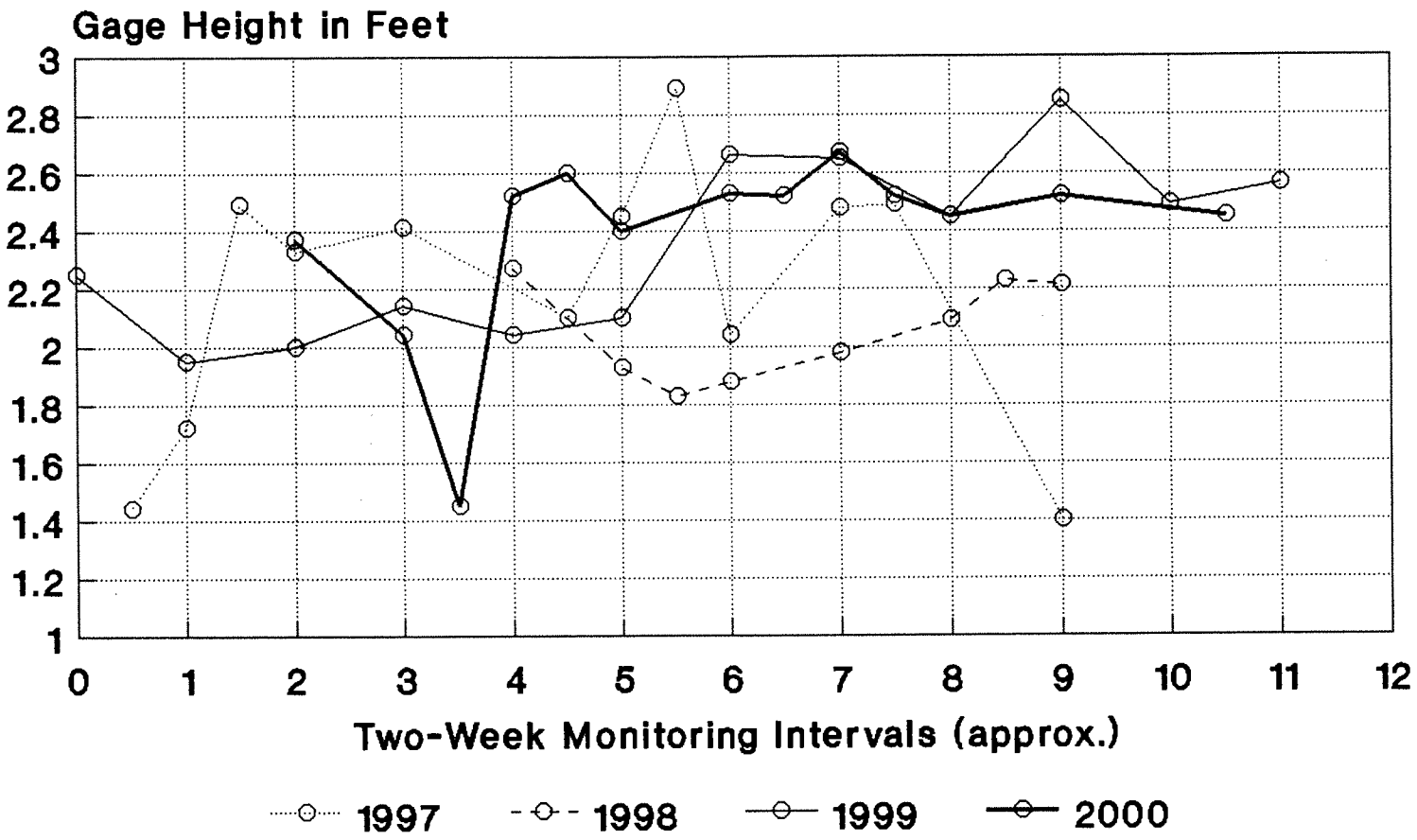


Figure 2. Soquel Lagoon Gage Height
Near Stockton Avenue Bridge
Mid-May to Late October, 1997-2000.

Soquel Lagoon Water Temperature
Reach 1 & 2 Boundary-Stockton Ave Bridge
Within 0.25 M of Bottom, 1997-2000.

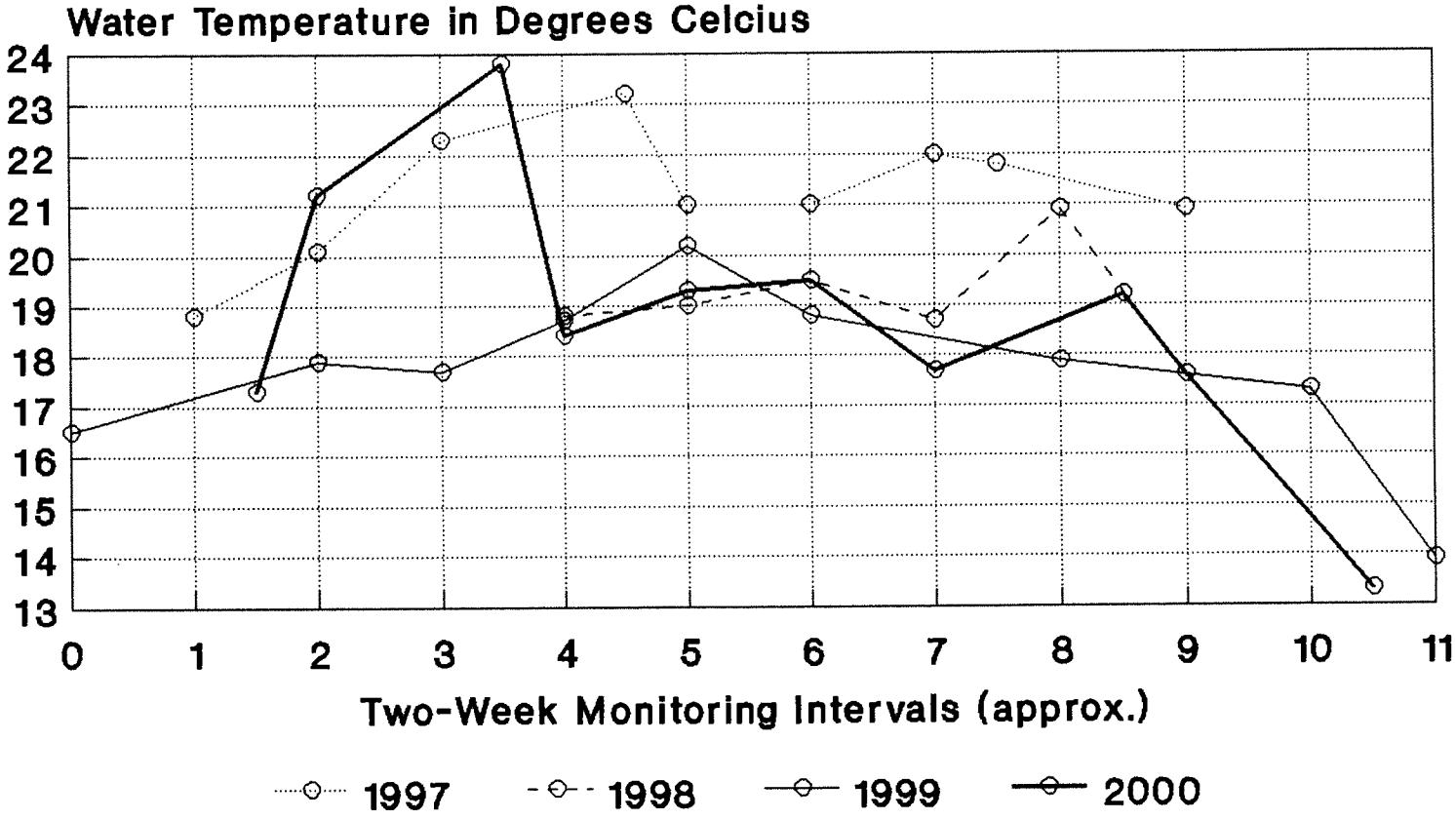


Figure 3. Soquel Lagoon Water Temp. Near Bottom at Dawn; Stockton Avenue Bridge, Mid-May to Late October 1997-2000.

Figure 4a. Water Temperature (Degrees Centigrade) in Reach 3 of Soquel Creek Lagoon at 30-minute Intervals, 26 June to 16 September 2000.

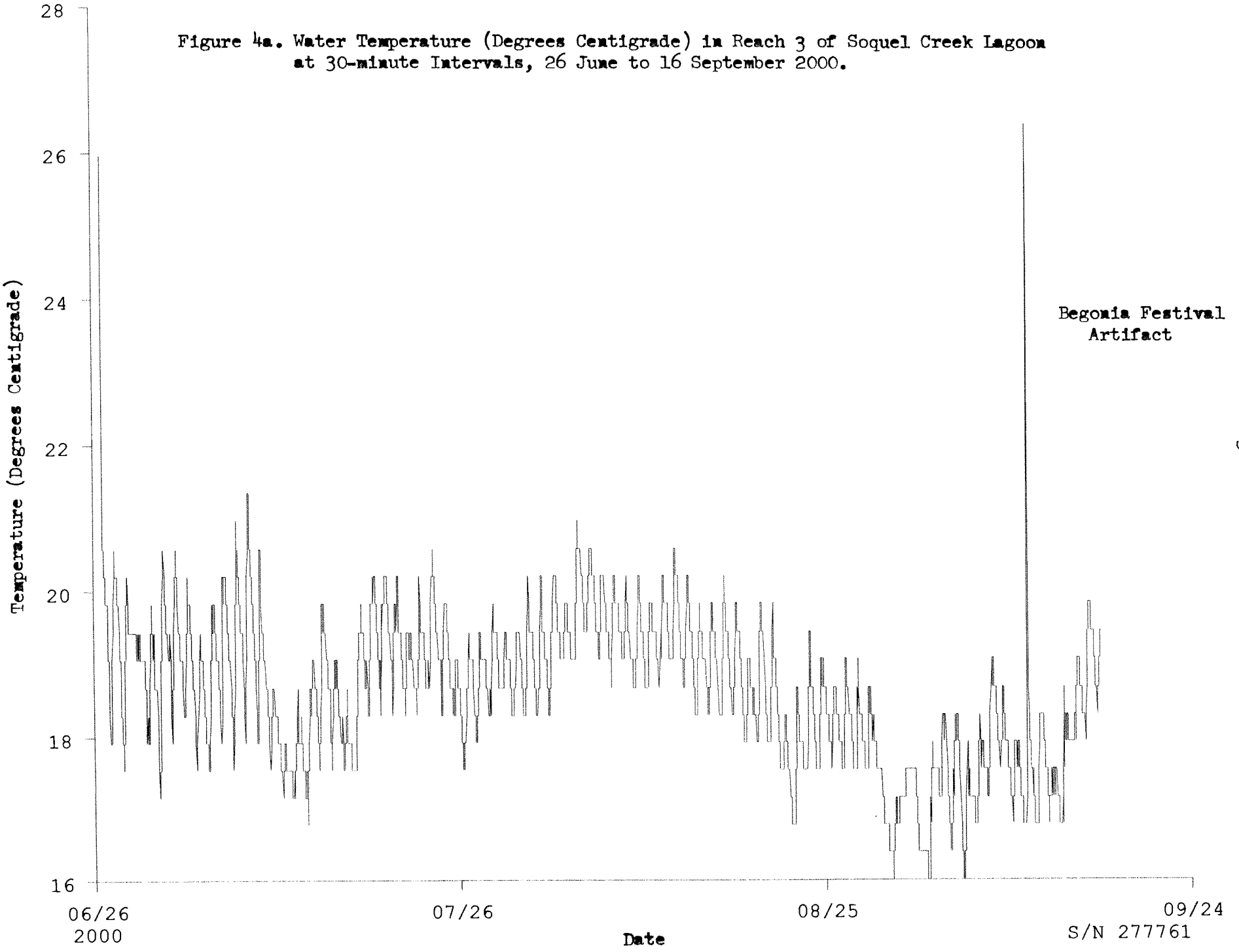


Figure 4b. Water temperature (Degrees Farenheit) in Reach 3 of Soquel Creek Lagoon at 30-minute intervals, 26 June to 16 September, 2000.

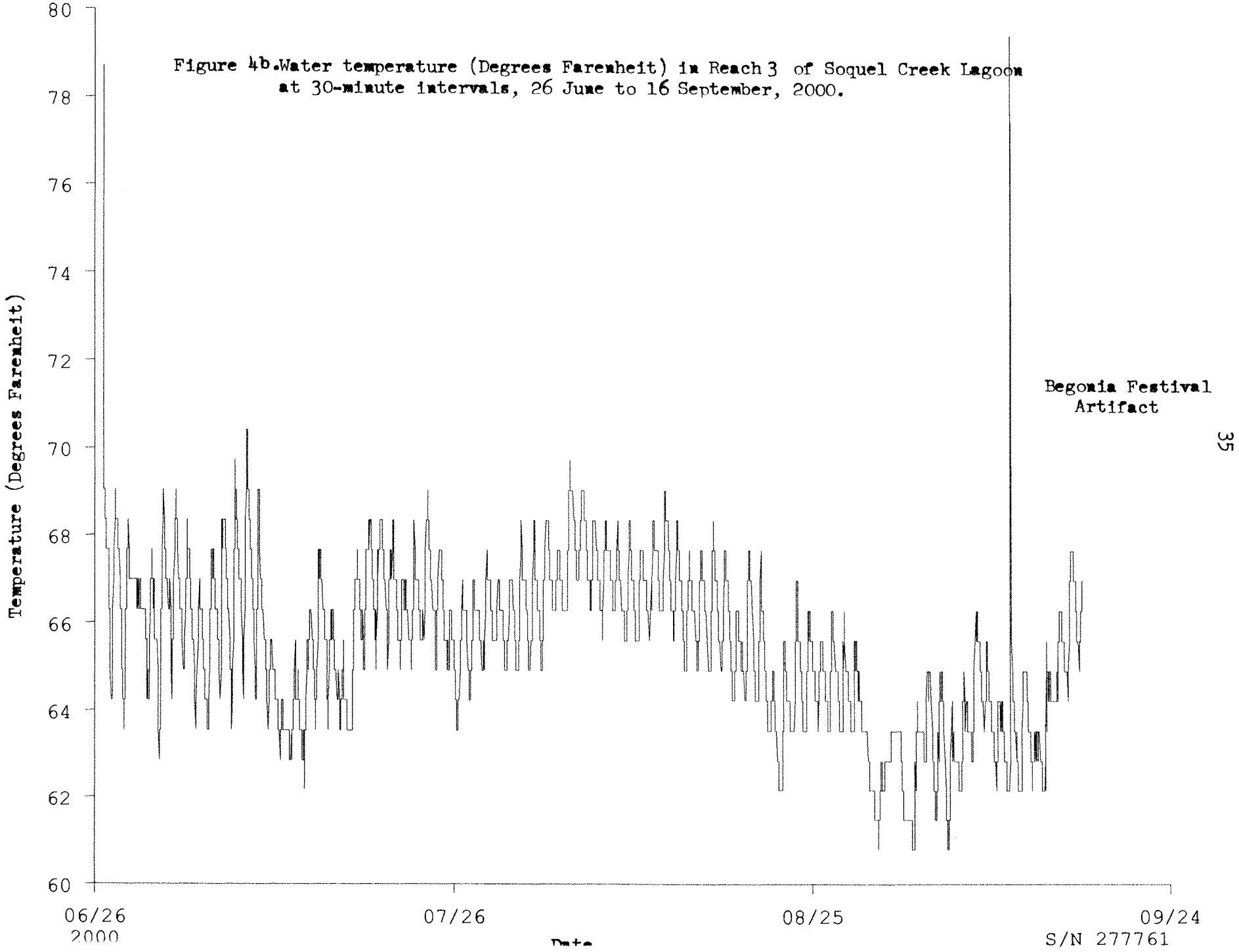


Figure 5a. Water Temperature (Degrees Centigrade) in Soquel Creek at Nob Hill, 26 June to 16 September 2000 at 30 minute Intervals.

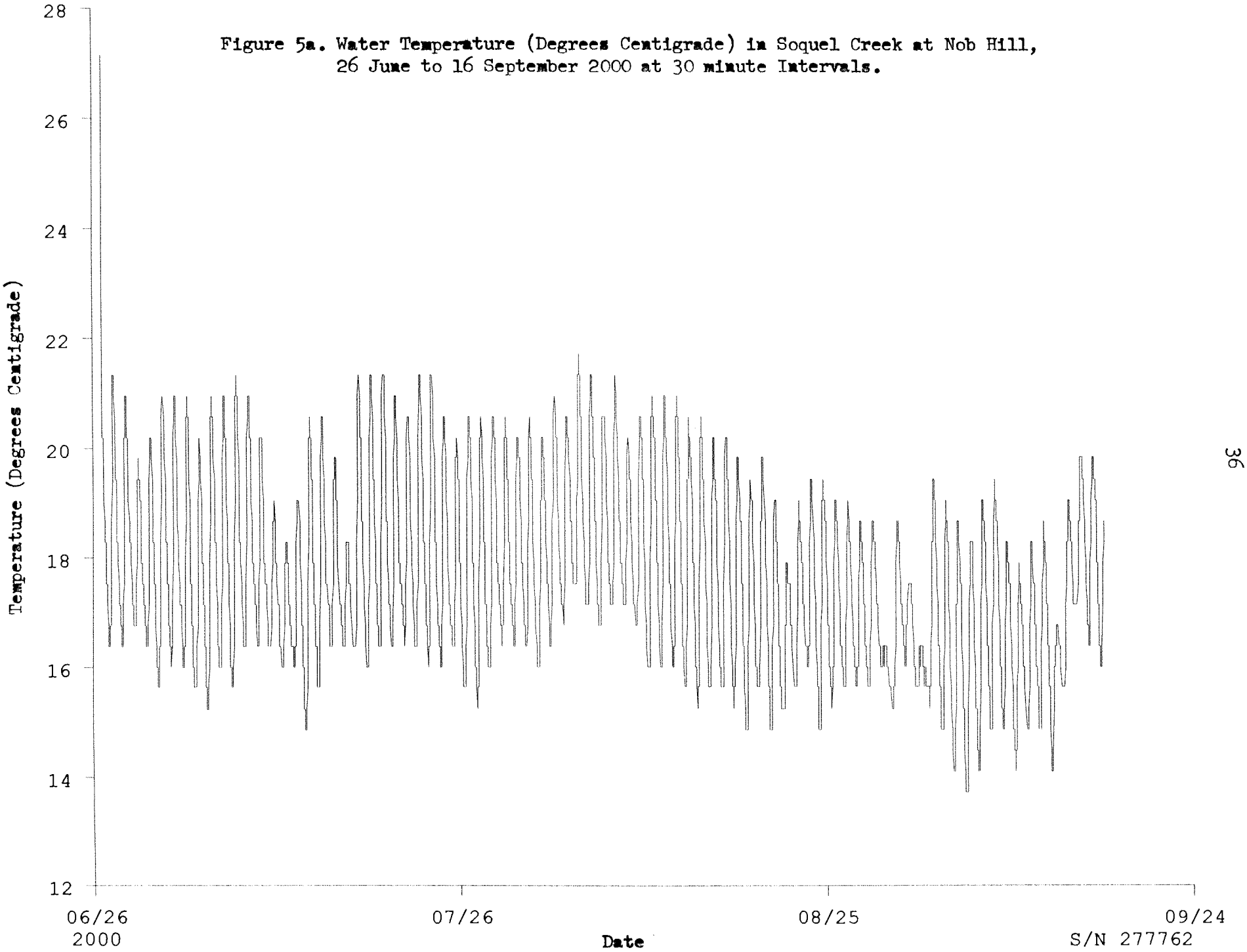


Figure 5b. Water temperature (Degrees Farenheit) in Soquel Creek at Nob Hill, 26 June to 16 September 2000 at 30 minute Intervals.

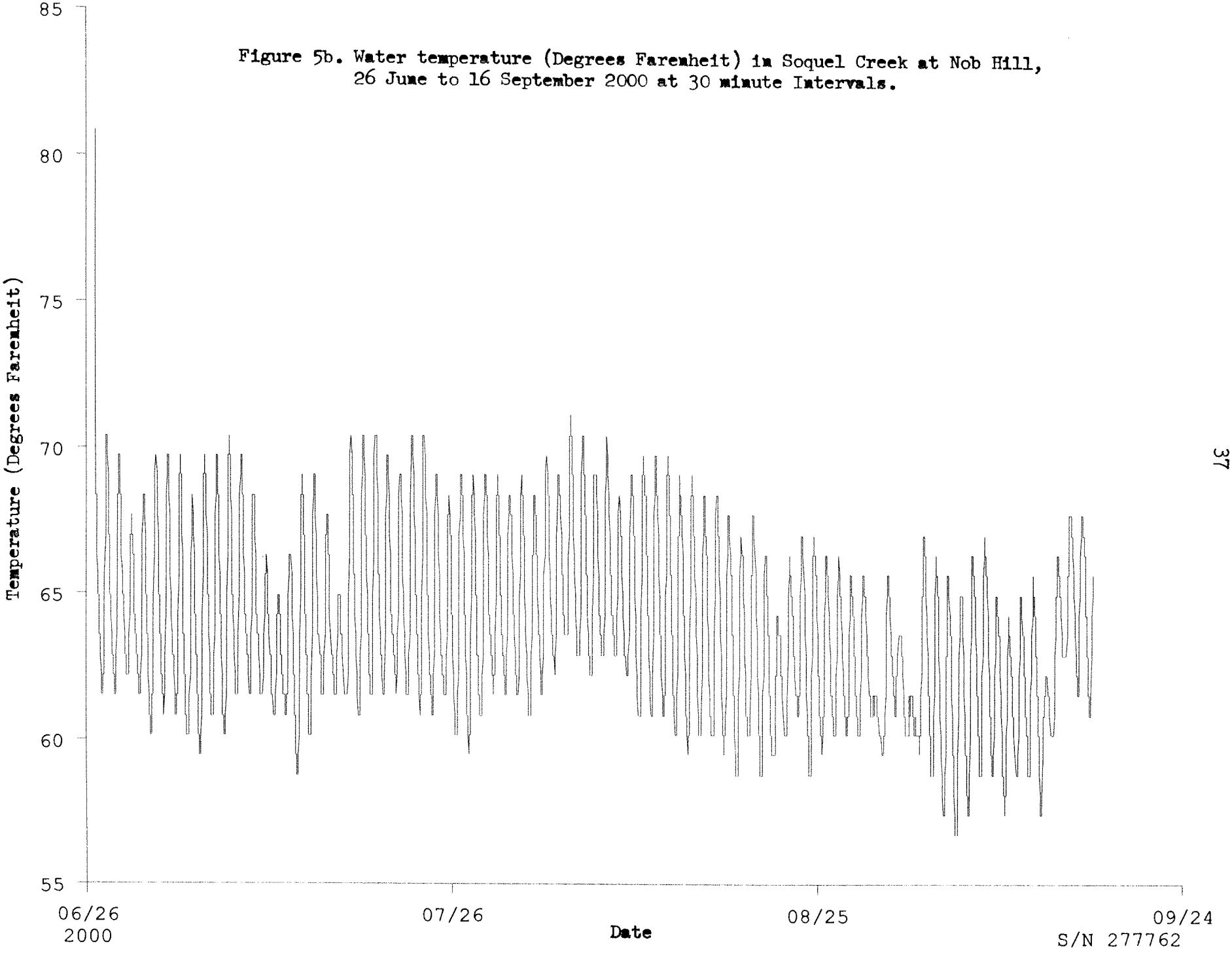


Figure 6a. Fifteen Minute Interval Water Temperature Monitoring in Soquel Creek Lagoon, 16 July to 18 September 1999.

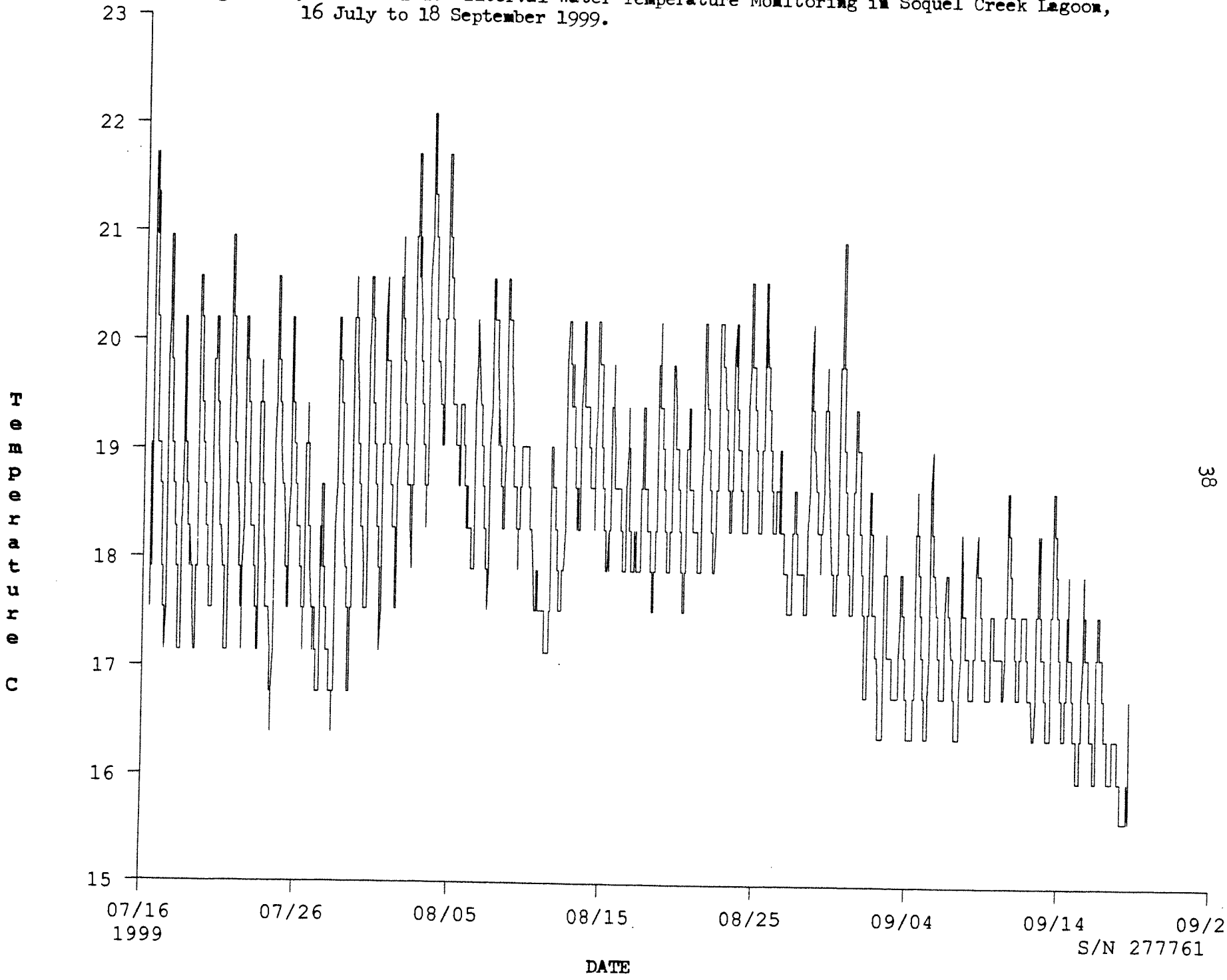
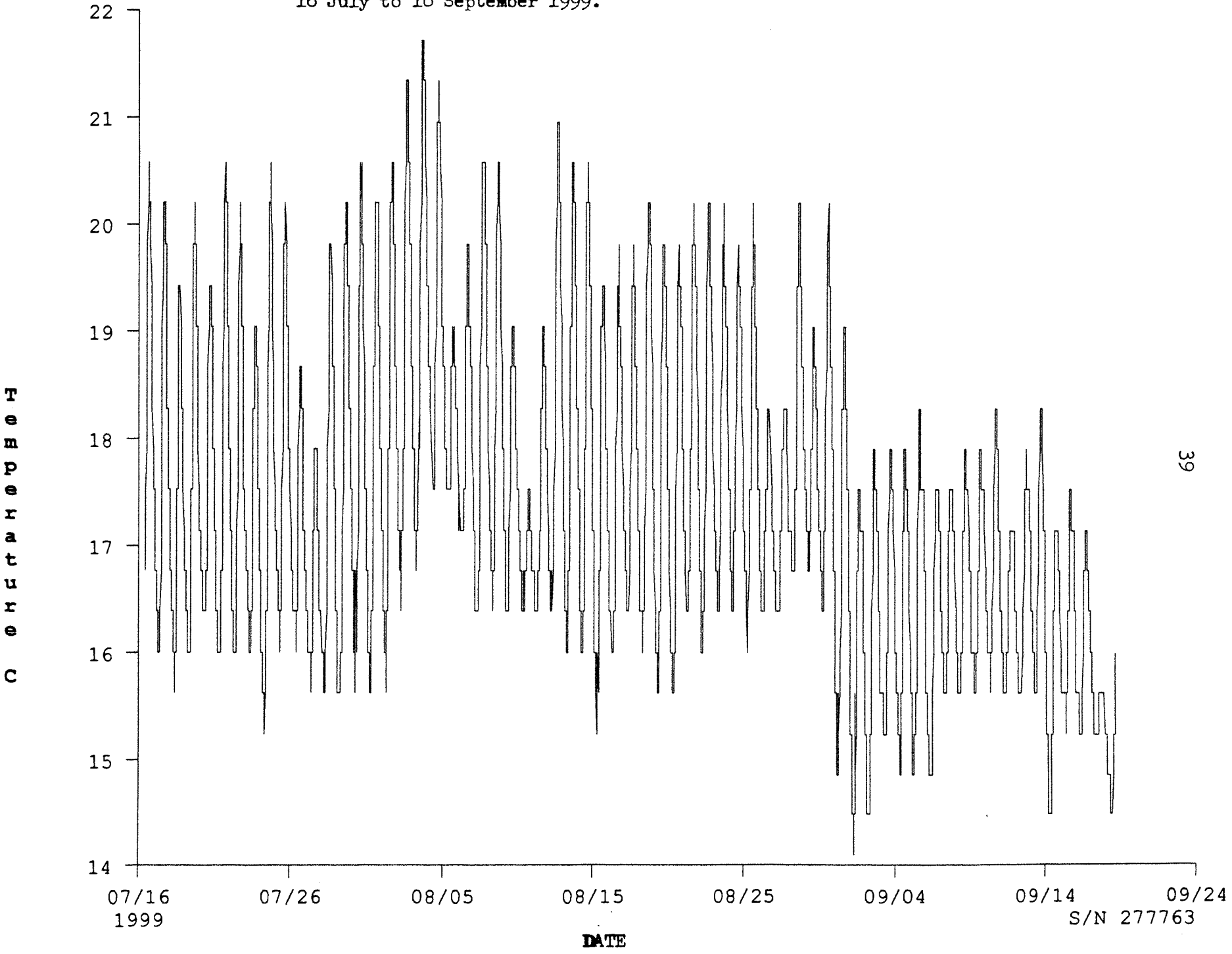


Figure 6b. Fifteen Minute Interval Water Temperature Monitoring in Soquel Creek at Nob Hill, 16 July to 18 September 1999.



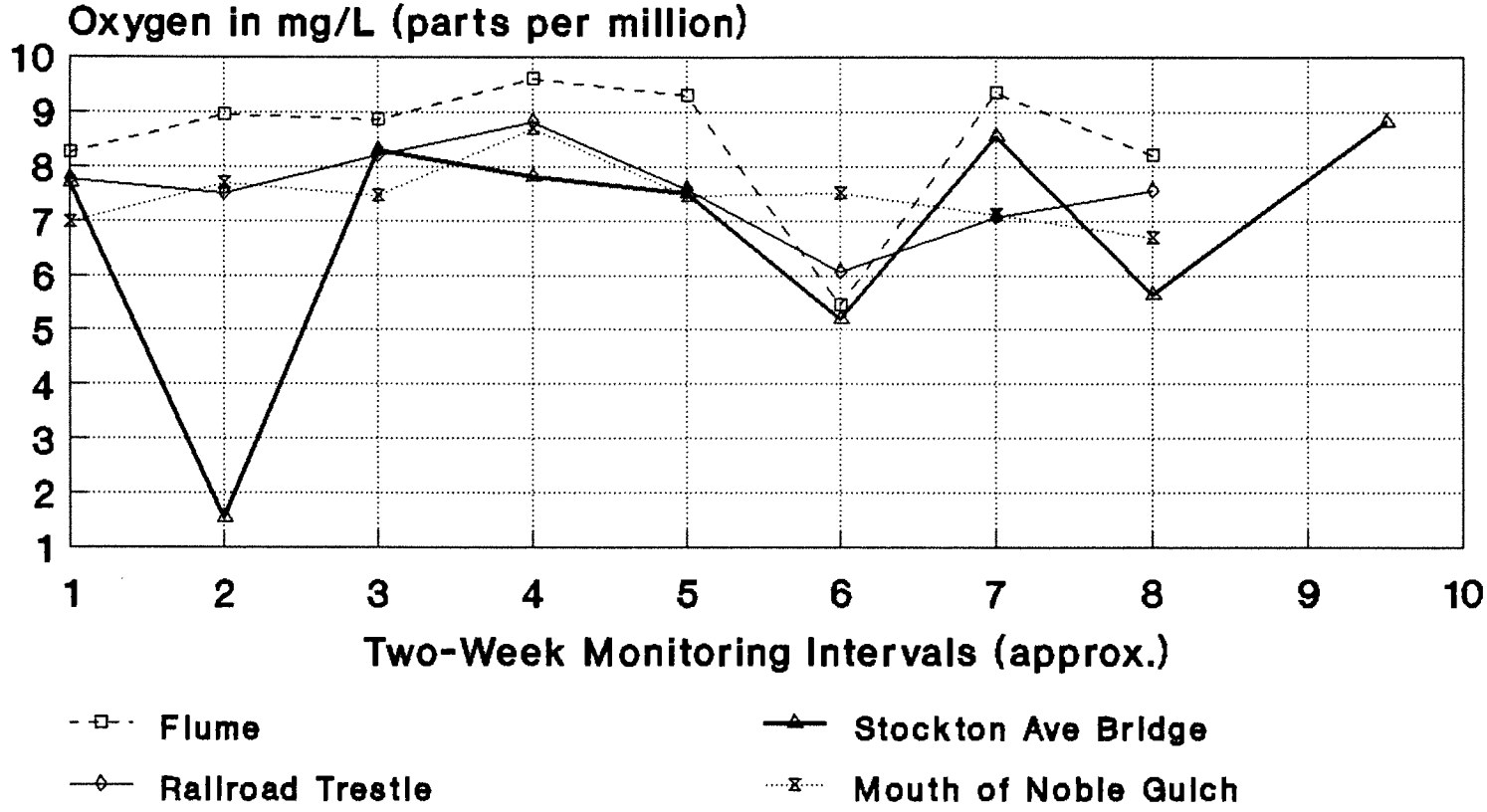


Figure 7. Oxygen Level at Monitoring Stations, Soquel Lagoon Near the Bottom at Dawn; 15 June- 23 October, 2000.

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

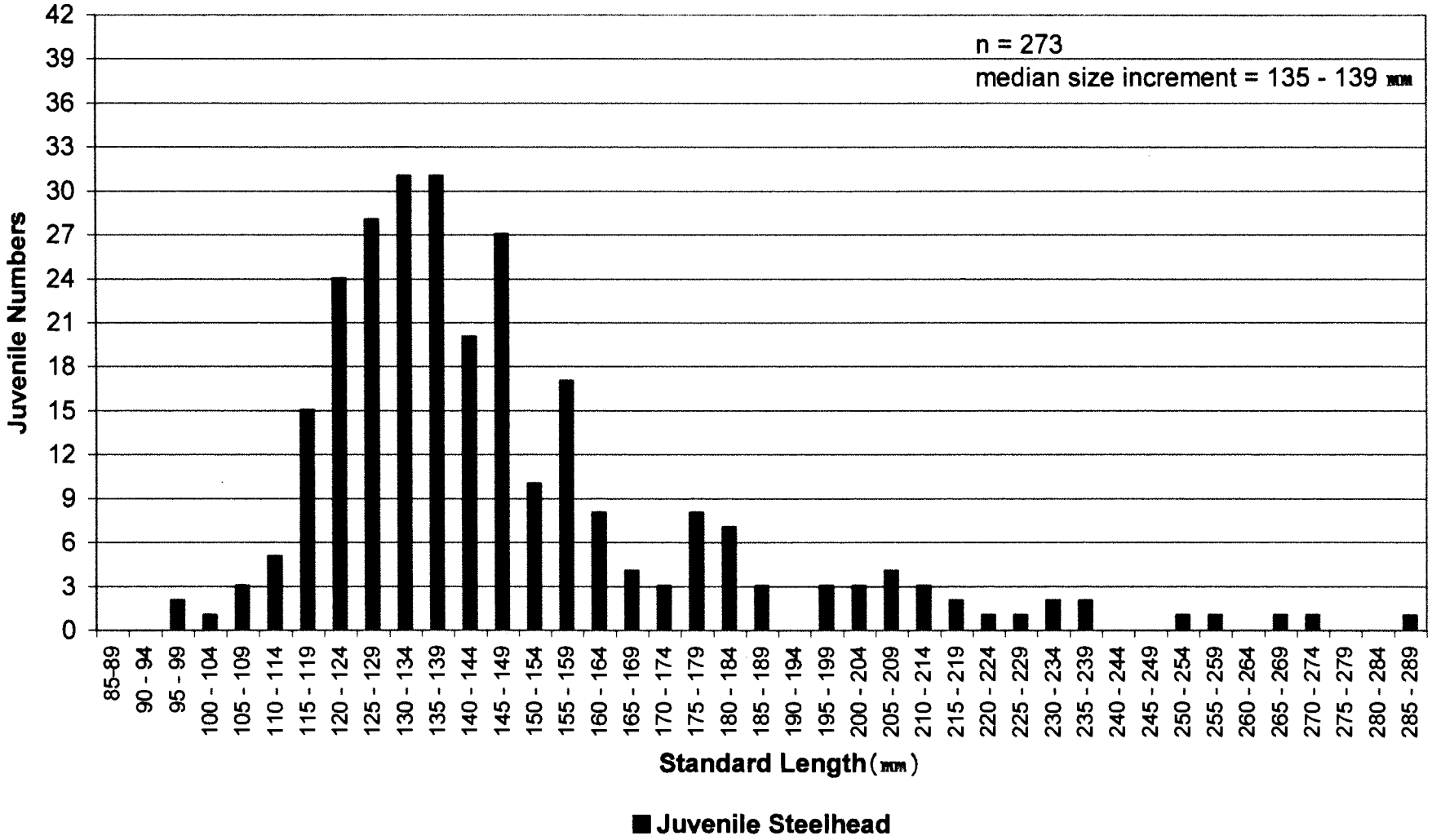
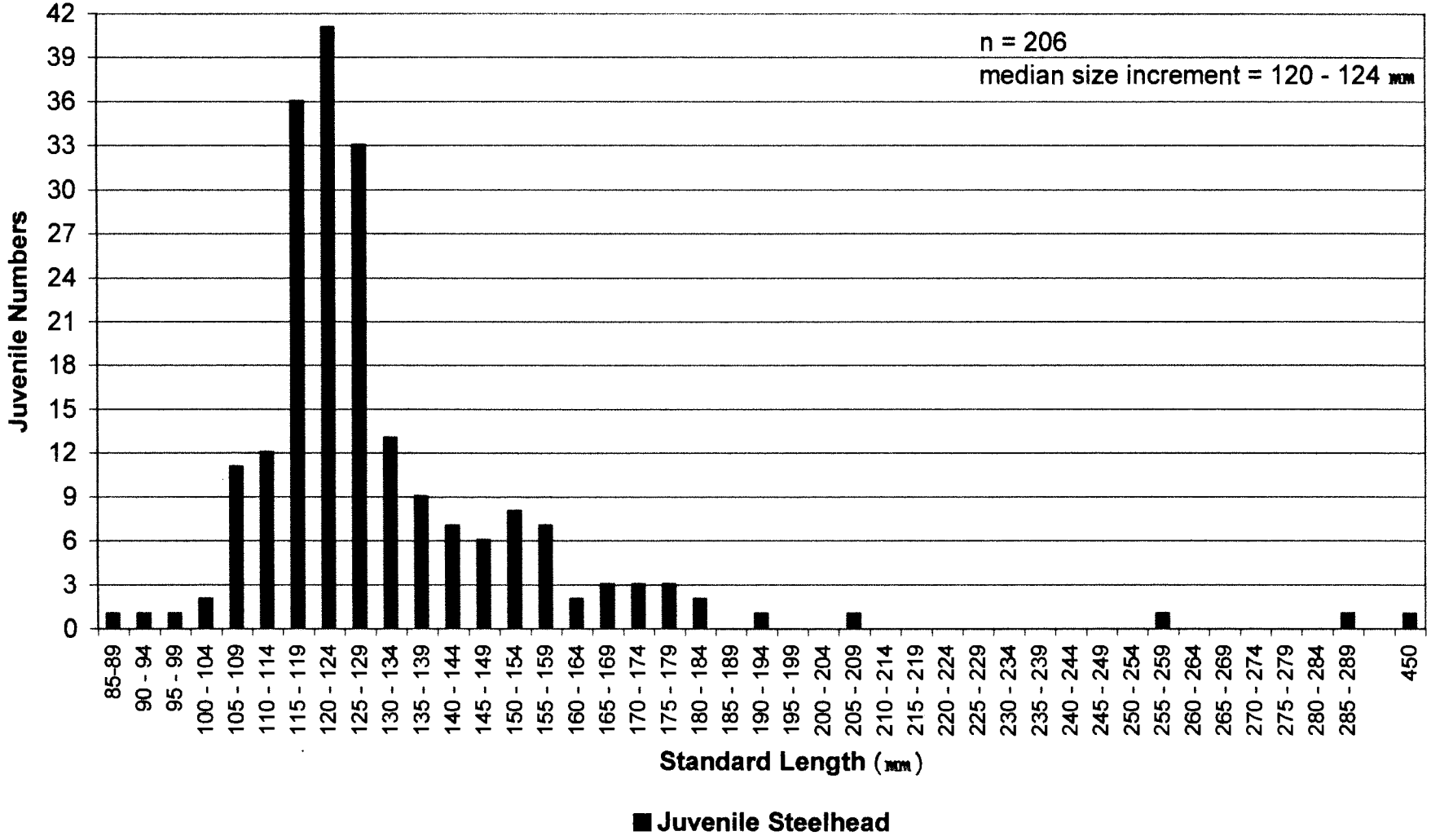


Figure 9. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 3 October 1999 in Soquel Lagoon.



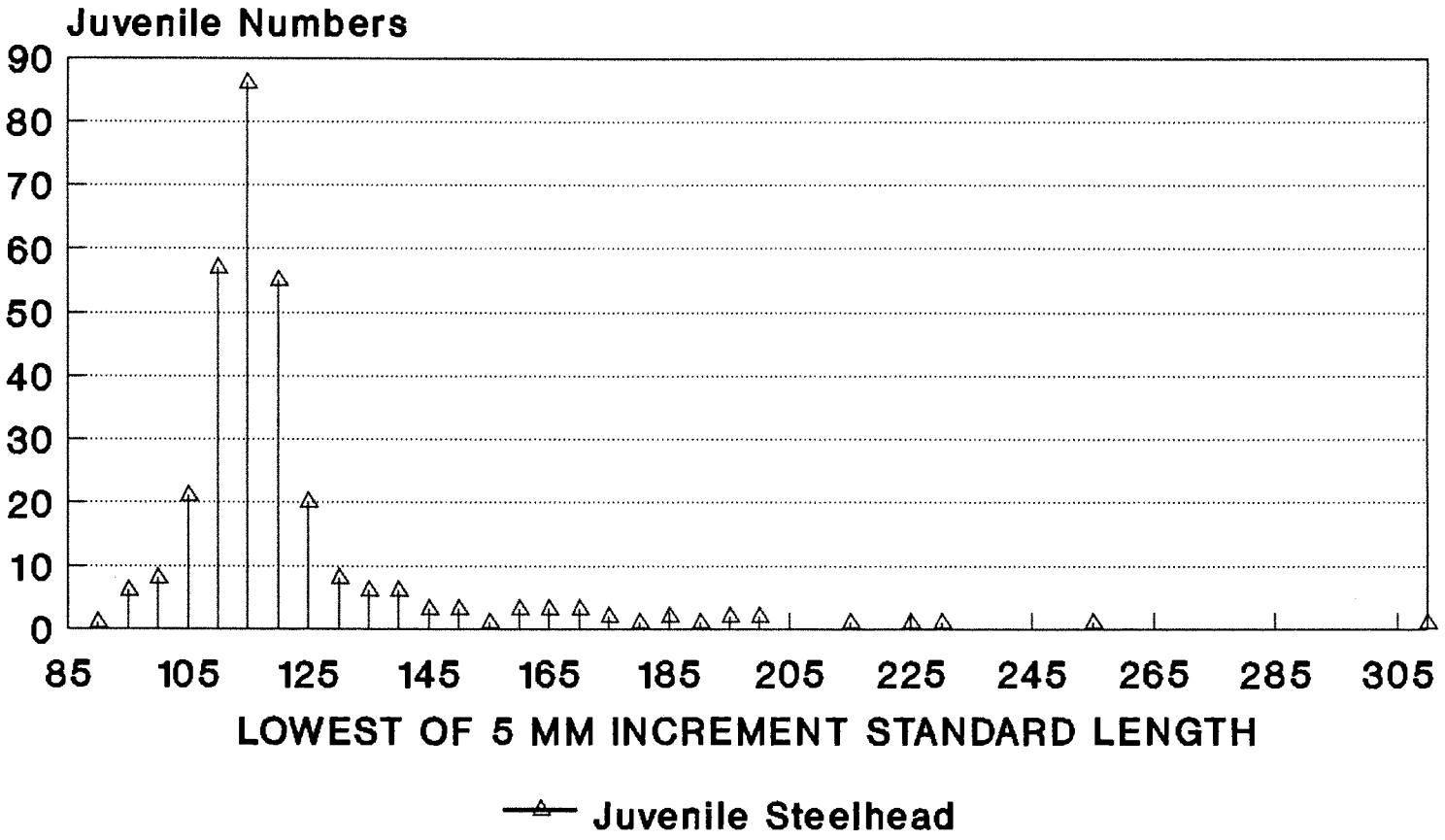
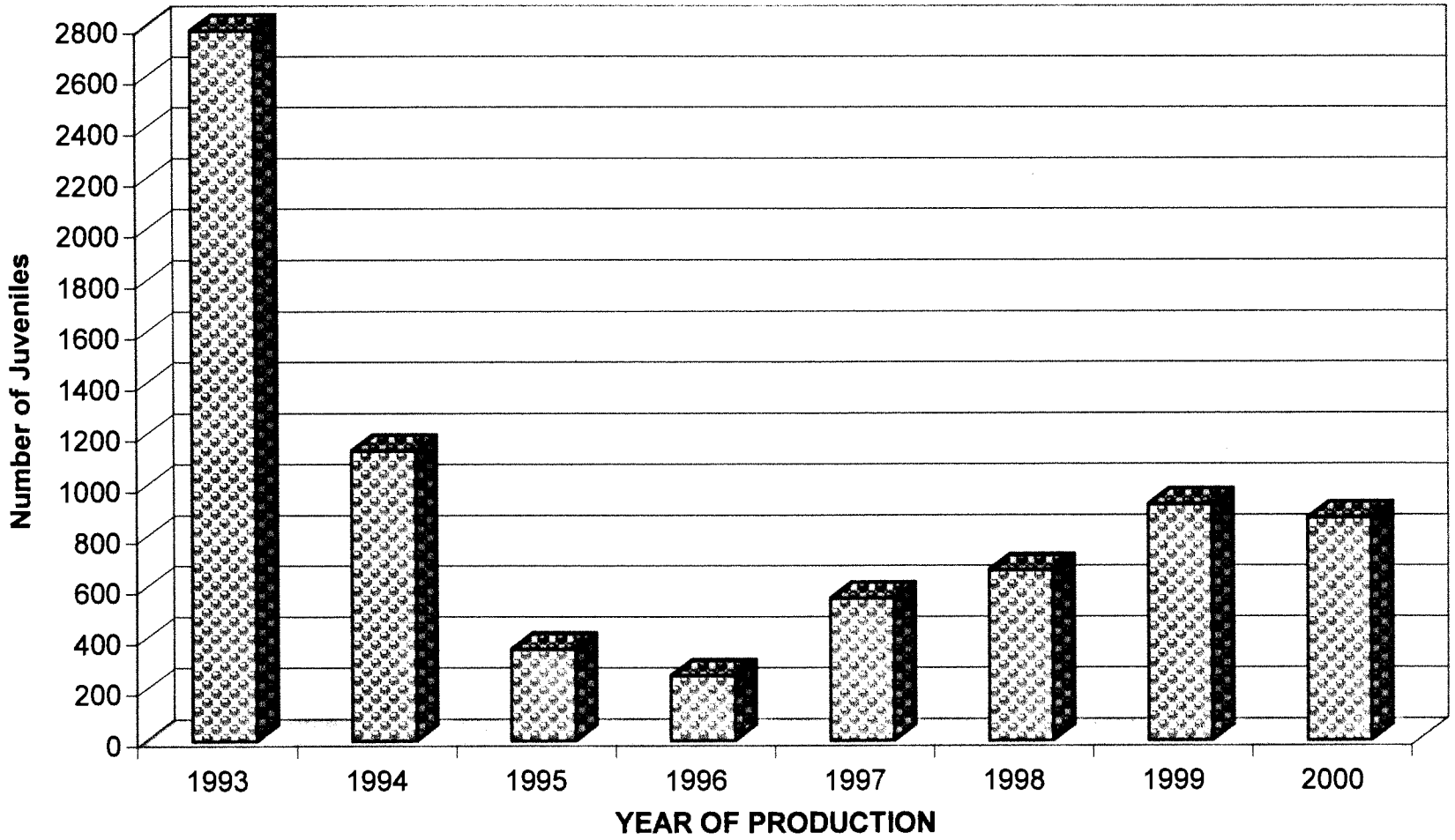


Figure 9b. Size Frequency Histogram of Unmarked Juvenile Steelhead Captured on 4 and 11 October 1998, in Soquel Lagoon.

Figure 10. Juvenile Steelhead Production in Soquel Creek Lagoon, 1993 - 2000, Estimated by Mark and Recapture Experiment



APPENDIX A.

FISH AND GAME AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION, 1999. (Verbal agreement in 2000.)

Notification No 0499-99 THP No _____

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the Department, and ED MORRISON (CITY OF CAPITOLA 420 CAPITOLA AVE, 95010) 475-7300 of CAPITOLA, State of CALIFORNIA, hereinafter called the operator, is as follows:

WHEREAS, pursuant to Division 2, Chapter 6 of California Fish and Game Code, the operator, on the 5TH day of MAY, 1999, notified the Department that he intends to substantially divert or obstruct the natural flow of, or substantially change the bed, channel, or bank of, or use material from the streambed of, the following water: SOQUEL CREEK, in the County of SANTA CRUZ, State of California, S_____ T_____ R_____.

WHEREAS, the Department (represented by JESS MITCHELL has made an inspection of subject area on the 14TH day of MAY, 1999, and) has determined that such operations may substantially adversely affect existing fish and wildlife resources including STEELHEAD TROUT, TROUT, TIDEWATER GOBY, OTHER NON GAME FISH, RIPARIAN CORRIDOR BIRD, PLANT, AND ANIMAL LIFE.

THEREFORE, the Department hereby proposes measures to protect fish and wildlife during the operator's work. The operator hereby agrees to accept the following recommendations as part of his work: Numbers 4, 7, 9, 10, 20, 21, 22 from the list of recommendations on the back of this page and the following special recommendations:

1. All work in or near the stream or lake shall be confined to the period 5-14-99 THROUGH TO FALL 1999 DEPENDING ON RAINFALL OR FLOW RATE.

(1) THIS AGREEMENT SHALL BE LIMITED TO THE DAMMING OF SOQUEL CREEK AT THE MOUTH AS PER SUBMITTED APPLICATION.
(2) A NEW STRAIGHT BREACH SHALL BE MADE. THE EXISTING CHANNEL SHALL BE SEINED WITH ALL FISH BEING PLACED IN THE LAGOON, PRIOR TO A PLUG OF SAND BEING PLACED AT THE HEAD OF THE OUTFLOW CHANNEL PRIOR TO FILLING. IF ANY HOLES ARE ALONG THE EDGE OF THE LAGOON, THESE AREAS SHALL BE SEINED AND NETTED TO PREVENT FISH FROM RE-ENTERING THE AREA.
(3) THE OPERATOR SHALL PUT THE FLUME IN OPERATION DURING ALL CONSTRUCTION AND DURING ALL DAILY CLOSURES DURING CONSTRUCTION.
(4) ALL KELP SHALL BE REMOVED FROM THE CHANNEL BOTTOM BEFORE DAMMING OCCURS.
(5) A STEEL SHROUD SHALL BE PLACED ON THE FLUME. A MINIMUM OF 8-12 INCHES OF WATER SHALL BE MAINTAINED THROUGH THE FLUME. THE FLUME SHALL BE KEPT OPEN TO THE OCEAN UNTIL AT LEAST 7-1-99. AFTER FINAL DAMMING, NO DRAW DOWN WILL BE ALLOWED WITHOUT PRIOR DEPT. APPROVAL UNLESS FLOODING IS IMMINENT.

The operator, as designated by the signature on this agreement, shall be responsible for the execution of all elements of this agreement. A copy of this agreement must be provided to contractors and subcontractors and must be in their possession at the work site.

If the operator's work changes from that stated in the notification specified above, this agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this agreement and with other pertinent Code Sections, including but not limited to Fish and Game Code Sections 5650, 5652 and 5948, may result in prosecution.

Nothing in this agreement authorizes the operator to trespass on any land or property, nor does it relieve the operator of responsibility for compliance with applicable federal, state, or local laws or ordinances.

THIS AGREEMENT IS NOT INTENDED AS AN APPROVAL OF A PROJECT OR OF SPECIFIC PROJECT FEATURES BY THE DEPARTMENT OF FISH AND GAME. INDEPENDENT REVIEW AND RECOMMENDATIONS WILL BE PROVIDED BY THE DEPARTMENT AS APPROPRIATE ON THOSE PROJECTS WHERE LOCAL, STATE, OR FEDERAL PERMITS OR OTHER ENVIRONMENTAL REPORTS ARE REQUIRED.

This agreement becomes effective on DATE SIGNED BY BOTH PARTIES

Operator Ed Morrison

Title Asst. Public Work Director

Organization City of Capitola

Date 5/14/99

JESS MITCHELL
Department Representative

Title WARDEN

Department of Fish and Game, State of California

Date 5/14/99

*If inspection was not made, cross out words within parentheses.

FG 1060 (5-87) 87 82401

Notification No. 0499-99 THP No. CONTINUING

AGREEMENT REGARDING PROPOSED STREAM OR LAKE ALTERATION

THIS AGREEMENT, entered into between the State of California, Department of Fish and Game, hereinafter called the Department, and CITY OF CAPITOLA of CAPITOLA, State of CALIFORNIA, hereinafter called the operator, is as follows:

WHEREAS, pursuant to Division 2, Chapter 6 of California Fish and Game Code, the operator, on the _____ day of _____, 19_____, notified the Department that he intends to substantially divert or obstruct the natural flow of, or substantially change the bed, channel, or bank of, or use material from the streambed of, the following water: _____, in the County of _____, State of California, S_____ T_____ R_____.

WHEREAS, the Department (represented by _____ has made an inspection of subject area on the _____ day of _____, 19 ____, and) has determined that such operations may substantially adversely affect existing fish and wildlife resources including: _____

THEREFORE, the Department hereby proposes measures to protect fish and wildlife during the operator's work. The operator hereby agrees to accept the following recommendations as part of his work: Numbers _____ from the list of recommendations on the back of this page and the following special recommendations:

1. All work in or near the stream or lake shall be confined to the period _____

(6) THE OPERATOR SHALL KEEP THE LAGOON AS DEEP AS POSSIBLE THROUGHOUT THE SUMMER. OAKE BOARDS ART IN PLACE THEY SHALL NOT BE REMOVED WITHOUT PRIOR DEPARTMENT APPROVAL. IN ADDITION, THE OPERATOR SHALL MAKE THE BOARDS VANDAL PROOF TO PREVENT UNAUTHORIZED REMOVAL.

The operator, as designated by the signature on this agreement, shall be responsible for the execution of all elements of this agreement. A copy of this agreement must be provided to contractors and subcontractors and must be in their possession at the work site.

If the operator's work changes from that stated in the notification specified above, this agreement is no longer valid and a new notification shall be submitted to the Department of Fish and Game. Failure to comply with the provisions of this agreement and with other pertinent Code Sections, including but not limited to Fish and Game Code Sections 5650, 5652 and 5948, may result in prosecution.

Nothing in this agreement authorizes the operator to trespass on any land or property, nor does it relieve the operator of responsibility for compliance with applicable federal, state, or local laws or ordinances.

THIS AGREEMENT IS NOT INTENDED AS AN APPROVAL OF A PROJECT OR OF SPECIFIC PROJECT FEATURES BY THE DEPARTMENT OF FISH AND GAME. INDEPENDENT REVIEW AND RECOMMENDATIONS WILL BE PROVIDED BY THE DEPARTMENT AS APPROPRIATE ON THOSE PROJECTS WHERE LOCAL, STATE, OR FEDERAL PERMITS OR OTHER ENVIRONMENTAL REPORTS ARE REQUIRED.

This agreement becomes effective on DATE SIGNED BY BOTH PARTIES

Operator Ed Morrison

Title Asst. Public Works Director

Organization City of Capitola

Date 5/14/99

JESS MITCHELL
Department Representative

Title WARDEN 481

Department of Fish and Game, State of California

Date 5-14-99

*If inspection was not made, cross out words within parentheses.

APPENDIX B. WATER QUALITY DATA FOR 9 JUNE – 23 OCTOBER, 2000.

Station: Railroad Trestle: 0743 hr. No algae on surface or bottom. Phytoplankton abundant.

Station: Mouth of Noble Gulch. 0800 hr. No algae on surface or bottom. Phytoplankton abundant. Soap suds on surface.

Station: Nob Hill. Water temperature 19.2 C @ 0840 hr. Conductivity of 410. Streamflow approximately 8 cfs.

15-Jun-00

6:54am	Flume				Stockton Avenue Bridge			7:18am
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (ppm)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (ppm)**	**Cond 2 umhos**
0.00	21.0	0.0	8.00	620	20.8	0.0	7.65	620
0.25	21.2	0.0	8.15	620	21.0	0.0	7.70	620
0.50	21.2	0.0	8.20	620	21.0	0.0	7.80	620
0.75	21.2	0.0	8.25	620	21.0	0.0	7.80	620
0.87	21.2	0.0	5.10	620				
1.00					21.2	0.0	7.86	620
1.25					21.2	0.0	7.86	620
1.50					21.2	0.0	7.95	620
1.75					21.2	0.0	7.70	620
1.95					20.8	0.0	4.95	620

15-Jun-00

7:43am	Railroad Trestle				Mouth of Noble Gulch			
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (ppm)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (ppm)**	**Cond 4 umhos**
0.00	20.7	0.0	7.30	600	20.2	0.0	6.60	580
0.25	20.8	0.0	7.30	600	20.2	0.0	6.65	580
0.50	21.0	0.0	7.45	600	20.3	0.0	6.73	580
0.75	21.0	0.0	7.65	600	20.0	0.0	6.80	580
1.00	21.0	0.0	7.76	600	19.8	0.0	6.95	580
1.25	21.0	0.0	7.77	600	19.6	0.0	6.96	580
1.37	21.0	0.0	6.30	600	19.0	0.0	6.20	580

7 July 2000. Gage reading = 2.04 in the morning. Three mergansers roosting across from Noble Gulch on downed cottonwood. Tidal overwash occurred the previous week. The thalweg was deep on the west side of Reach 2. Thirty mallards and the one domestic goose were gathered

around a lady feeding them in Reach 3. I left a message for Ed Morrison to install a shroud on the flume to pull saltwater off bottom.

Station: Flume at 0745 hr, partly cloudy. Air temp. 14.0° C. No surface algae in R-1. Bottom algae concentrated around restaurants. 15% of the bottom with algae 1-2.5 feet thick, averaging 2 feet. The remainder was a thick film.

Station: Stockton Avenue Bridge at 0800 hr. Secchi depth to bottom. No surface algae in R-2. 15% of bottom 1-2.5 feet thick, averaging 2 feet. Remainder is a thick film.

Station: Railroad trestle, 0825 hr. No surface algae in R-3. Bottom with 5% algae coverage, 0.5-1.5 feet thick, averaging 1 foot. Remainder was a thick film.

Station: Mouth of Noble Gulch, 0855 hr. No surface algae. 10% of bottom with algae 1-2 feet thick, averaging 1.5 feet. Remainder with thick film. No gray water.

Station: Nob Hill, 1015 hr. Water temperature 17° C, conductivity 550, streamflow 6-8 cfs.

7-Jul-00										
7:45am	**Flume**					**Stockton Avenue Bridge**				8:00am
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (ppm)**	**Cond 1 umhos**		**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (ppm)**	**Cond 2 umhos**	
0.00	18.2	0.0	8.78	670		19.2	0.0	9.03	690	
0.25	18.5	0.0	8.82	670		19.2	0.0	8.97	690	
0.50	18.5	0.0	8.85	670		19.2	0.0	9.02	690	
0.75	18.5	0.0	8.95	670		19.2	0.0	8.90	690	
0.87	18.5	0.0	8.41	670						
1.00						19.2	0.0	8.90	650	
1.25						19.2	0.0	8.80	650	
1.50						19.2	1.7	9.20	980	
1.75						23.8	7.7	1.55	12000	
2.00						25.0	9.3	0.35	13600	

7-Jul-00										
8:25am	**Railroad Trestle**					**Mouth of Noble Gulch**				8:55am
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (ppm)**	**Cond 3 umhos**		**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (ppm)**	**Cond 4 umhos**	
0.00	18.8	0.0	7.70	590		17.8	0.0	7.10	570	
0.25	18.8	0.0	7.60	590		18.5	0.0	7.05	560	
0.50	19.0	0.0	7.55	590		18.5	0.0	7.05	560	
0.75	19.0	0.0	7.53	590		18.5	0.0	7.20	560	
1.00	19.0	0.0	7.50	590		18.0	0.0	7.70	560	
1.25	19.7	0.3	4.32	1350		17.8	0.0	1.15	6.2	

10 July 2000. Gage height 1.45. Problems after tidal overwash.

14 July 2000. Overcast. Gage height 2.52. Plywood installed. The purpose was to stop leaks through the flashboards.

Station: Flume at 0715 hr. Air temperature = 13.0° C. No surface algae. In Reach 1, 15% of the bottom with algae 0.5-2.5 feet, averaging 1 foot. Remainder had thick film.

Station: Stockton Ave Bridge, 0755 hr. Secchi depth to bottom. Reach 2- no surface algae. Bottom with 15% algae at 0.5-2 feet thick, averaging 1 foot.

Station: Railroad trestle, 0815 hr. Reach 3- no surface algae. 25% of bottom algae 0.2-2 feet, averaging 0.5 feet. 23 adult-size mallards, one duckling and one goose

Station: Mouth of Noble Gulch, 0828 hr. No gray water. No surface algae. Bottom with 5% 1-2 feet thick. Remainder 0.1 foot thick.

Station: Nob Hill 0937 hr. Water temperature 15.9° C, conductivity 520, streamflow 4-5 cfs.

	14-Jul-00								
7:15am	**Flume**				**Stockton Avenue Bridge**				7:55am
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (ppm)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (ppm)**	**Cond 2 umhos**	
0.00	17.8	0.0	8.80	580	18.3	0.0	8.22	580	
0.25	18.0	0.0	8.90	580	18.4	0.0	8.25	580	
0.50	18.0	0.0	8.83	580	18.4	0.0	8.35	580	
0.75	18.0	0.0	8.85	580	18.4	0.0	8.35	580	
1.00	18.0	0.0	8.92	580	18.4	0.0	8.35	580	
1.25					18.4	0.0	8.42	580	
1.50					18.4	0.0	8.40	580	
1.75					18.4	0.0	8.30	580	
2.00					18.5	0.0	4.64	580	

	14-Jul-00								
8:15am	**Railroad Trestle**				**Mouth of Noble Gulch**				8:28am
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (ppm)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (ppm)**	**Cond 4 umhos**	
0.00	18.2	0.0	8.60	580	18.0	0.0	7.30	570	
0.25	18.3	0.0	8.86	580	18.3	0.0	7.20	570	
0.50	18.3	0.0	8.86	580	18.2	0.0	7.40	570	
0.75	18.3	0.0	8.56	580	18.3	0.0	7.35	570	
1.00	18.3	0.0	8.40	580	18.2	0.0	7.30	570	
1.25	18.3	0.0	8.21	580	18.0	0.0	7.46	570	
1.37	18.5	0.0	5.80	580	17.6	0.0	5.50	570	

Conclusion: Water quality conditions were good for steelhead in all reaches. However, just above the bottom, oxygen levels were good. The gage height was in the good range, which indicated good management that helped keep water temperatures down. Algae was not in full bloom as is typical for the lagoon in July. Water temperature at Noble Gulch was about 1 C less than stations further downstream.

17 July 2000. Gage height 2.65. (Morrison). Algae beginning to grow.

19. July 2000. Gage height 2.60. (Morrison).

30 July 2000. Overcast. Flume inlet depth 2 feet. Exit depth averaging 0.6 feet Gage height 2.40. Hydraulic fluid spill at the corner of Stockton Avenue and Esplanade. None entered the lagoon. Bottom algae was bright green.

Station: Flume at 0658 hr. Air temperature = 15.2° C. No surface algae. 60% of bottom with 0.4-1.5 feet thick algae, averaging 1 foot. Remaining 40% with thin film of algae 0.1 feet thick.

Station: Stockton Ave Bridge, 0720 hr. Secchi depth to bottom. Reach 2- no surface algae. Bottom with 80% algae at 0.5-2 feet thick, averaging 1 feet.

Station: Railroad trestle, 0741 hr. Reach 3- Less than 1 % surface algae. 60% of bottom algae 0.5-1.5 feet thick, averaging 1 foot.

Station: Mouth of Noble Gulch, 0758 hr. No surface algae. No gray water. 75% of the bottom 0.2-1.2 feet thick. In upper Reach 3, I observed 22 mallards, one coot, 1 goose, and one turtle with orange line on neck.

Station: Nob Hill, 0851 hr. Water temperature 16.7 C, conductivity 550, streamflow 3-4 cfs.

30-Jul-00

6:58am	Flume				Stockton Avenue Bridge			7:20am
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (ppm)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (ppm)**	**Cond 2 umhos**
0.00	18.7	0.0	10.75	620	19.0	0.0	9.40	620
0.25	18.7	0.0	10.40	620	19.2	0.0	9.42	620
0.50	18.8	0.0	10.00	620	19.3	0.0	9.25	620
0.75	18.8	0.0	9.60	620	19.3	0.0	8.76	620
1.00	18.8	0.0	9.55	620	19.3	0.0	8.10	620
1.25					19.3	0.0	7.80	620
1.50					19.2	0.0	2.96	625
1.75								

30-Jul-00

7:41am	Railroad Trestle				Mouth of Noble Gulch			7:58am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0.00	18.7	0.0	8.40	590	18.2	0.0	8.48	580
0.25	18.7	0.0	8.23	590	18.3	0.0	8.35	580
0.50	18.7	0.0	8.49	590	18.4	0.0	8.65	580
0.75	18.7	0.0	8.73	590	18.4	0.0	8.95	580
1.00	18.8	0.0	8.90	590	18.5	0.0	8.70	580
1.25	18.8	0.0	8.80	590	18.3	0.0	3.25	600
1.35	19.0	0.0	4.33	600				

Conclusion: Water quality conditions were still good for steelhead in all reaches Algae was more prevalent than two weeks previous on the bottom. Gage height was good, indicating good lagoon management.

4 August 2000. Gage reading = 2.10 (Morrison).

14 August 2000. Gage reading = 2.53. Overcast with fog. Flume exit depth of approximately 1 foot.

Station: Flume at 0720 hr. Air temperature = 13.2 C. No surface algae in R-1. 75% of bottom with 0.5-3.0 feet thick algae, averaging 2.0 feet. Remainder with thick film.

Station: Stockton Ave Bridge, 0744 hr. Secchi depth to bottom. Reach 2- No surface algae coverage. Bottom with 95% algae at 0.5-3.0, averaging 2.5 feet. Pondweed mixed with algae.

Station: Railroad trestle, 0802 hr. Reach 3- surface algae 15% coverage. 100% of bottom algae 1-3 feet thick, averaging 2.5 feet.

Station: Mouth of Noble Gulch, 0817 hr. Gray water present. No surface algae at Mouth, but 10-15% coverage up to Shadowbrook Restaurant. A turtle was present at Mouth.

Station: Nob Hill, 0915 hr. Water temperature 15.8 C, conductivity 470, streamflow approximately 3.5 cfs.

14-Aug-00									
7:20am	Flume				Stockton Avenue Bridge				7:44am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos	
0.00	19.1	0.0	9.35	620	19.1	0.0	8.60	620	
0.25	19.3	0.0	9.50	620	19.3	0.0	8.58	620	
0.50	19.4	0.0	9.45	620	19.3	0.0	8.46	620	
0.75	19.4	0.0	9.65	620	19.5	0.0	8.30	620	
1.00	19.4	0.0	9.31	620	19.5	0.0	8.08	620	
1.13	19.5	0.0	7.79	620					
1.25					19.5	0.0	7.88	620	
1.50					19.5	0.0	7.75	620	
1.75					19.5	0.0	7.50	620	
1.95					19.6	0.0	4.73	630	

14-Aug-00									
8:02am	Railroad Trestle				Mouth of Noble Gulch				8:17am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos	
0.00	18.6		7.95	620	17.8	0.0	8.16	600	
0.25	18.8		7.84	620	18.1	0.0	7.70	615	
0.50	18.8		8.05	620	18.2	0.0	7.90	615	
0.75	18.8		8.29	620	18.2	0.0	8.30	610	
1.00	18.8		8.20	620	18.2	0.0	8.35	600	
1.25	18.9		7.58	620	18.2	0.0	7.45	590	
1.32						0.0	4.82	600	
1.50	18.9		4.35	630	18.0				

Conclusion: Water quality conditions were still good, despite algae growing at the highest degree since the sandbar was formed. Gage height was excellent, indicating good management.

1 September 2000. Gage reading = 2.67. Overcast. Could not observe bottom.

Station: Flume at 0738 hr. Air temperature = 15.2° C. Too dark to see bottom. No surface algae.

Station: Stockton Ave Bridge, 0830 hr. Secchi depth to bottom, barely. Reach 2- no surface algae.

Station: Railroad trestle, 0850 hr. Reach 3- No surface algae.

Station: Mouth of Noble Gulch, 0907 hr. No surface algae.

Station: Nob Hill, 0951 hr. Water temperature 16.2 C, dissolved oxygen 8.73 mg/L, conductivity 570, approximately 4 cfs.

1-Sep-00									
7:38am	Flume				Stockton Avenue Bridge				8:30am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos	
0.00	17.2	0.0	5.65	620	17.5	0.0	5.20	600	
0.25	17.3	0.0	5.55	620	17.6	0.0	5.05	600	
0.50	17.3	0.0	5.53	620	17.6	0.0	4.96	605	
0.75	17.3	0.0	5.45	620	17.7	0.0	4.92	610	
1.00	17.3	0.0	5.18	620	17.7	0.0	4.88	610	
1.25					17.7	0.0	4.80	610	
1.50					17.7	0.0	4.80	610	
1.75					17.7	0.0	5.20	610	
2.00					17.6	0.0	2.50	610	

1-Sep-00									
8:50am	Railroad Trestle				Mouth of Noble Gulch				9:07am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos	Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos	
0.00	17.4	0.0	5.34	620	17.5	0.0	6.90	600	
0.25	17.5	0.0	5.32	620	17.5	0.0	6.72	610	
0.50	17.5	0.0	5.50	620	17.5	0.0	7.10	610	
0.75	17.5	0.0	5.95	620	17.5	0.0	7.30	600	
1.00	17.5	0.0	6.12	620	17.3	0.0	7.25	590	
1.25	17.6	0.0	6.05	620	17.0	0.0	7.50	580	
1.30					17.0	0.0	4.05	560	
1.32	17.6	0.0	4.05	620					

Conclusion: Water quality conditions were good for water temperature, but were at their lowest for oxygen for the summer, with fair ratings at 3 stations and good at the uppermost site. Gage height was excellent.

5 September 2000. Gage reading = 2.38. This was a pre-Begonia Festival monitoring. Clear and sunny.

Station: Stockton Avenue Bridge at 0757 hr. Surface without algae in R-1. Pondweed was visible on the bottom.

5-Sep-00									
	Flume				Stockton Avenue Bridge			7:57am	
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos	
0.00					17.0	0.0	7.36	480	
0.25					17.2	0.0	7.36	480	
0.50					17.2	0.0	7.23	480	
0.75					17.2	0.0	7.27	480	
1.00					17.2	0.0	7.40	480	
1.25					17.2	0.0	7.30	480	
1.50					17.2	0.0	7.25	480	
1.75					17.2	0.0	7.05	480	
1.80					17.2	0.0	4.90	480	

Conclusion: Water quality conditions were improved from last monitoring. Water was cooler, although at the trestle and Noble Gulch the oxygen was still less than 5 mg/L at the bottom. Gage height was again excellent.

10 September 2000. After Begonia Festival, secchi depth just to bottom. Secchi depth 2.52. Five floats participated. After the festival, blossoms were all within 300 metes above the trestle and downstream. However, there was an onshore breeze. They were not dismantling floats immediately after the festival as usual. Our Hobo temperature probe was floating on the surface in Reach 3. It was repositioned on bottom.

17 September 2000. Gage reading = 2.45. Sunny. American coots back in force. Cap on Esplanade storm drain was in place.

Station: Flume at 0730 hr. Air temperature = 16.7 C. Surface without algae in R-1. Pondweed visible.

Station: Stockton Ave Bridge, 0755 hr. Secchi depth to bottom. Surface without algae.

Station: Railroad trestle, 0820 hr. Reach 3- No surface algae.

Station: Mouth of Noble Gulch at 0840 hr. Great blue heron perched on downed cottonwood across lagoon.

17-Sep-00									
7:30am	Flume					Stockton Avenue Bridge			7:55am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos		Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0.00	18.6	0.0	9.40	620		19.3	0.0	9.42	620
0.25	18.7	0.0	9.55	620		19.4	0.0	9.18	620
0.50	18.7	0.0	9.48	620		19.4	0.0	9.10	620
0.75	18.8	0.0	9.35	620		19.3	0.0	9.00	620
0.96	18.8	0.0	8.55	620					
1.00						19.3	0.0	8.95	620
1.25						19.2	0.0	8.70	620
1.50						19.2	0.0	8.60	620
1.75						19.2	0.0	8.55	620
1.95						19.2	0.0	4.40	620

17-Sep-00									
8:20am	Railroad Trestle					Mouth of Noble Gulch			8:40am
Depth (m)	Temp 3 (C)	Salin 3 (ppt)	O2 3 (ppm)	Cond 3 umhos		Temp 4 (C)	Salin 4 (ppt)	O2 4 (ppm)	Cond 4 umhos
0.00	18.7	0.0	7.35	620		18.8		6.80	
0.25	18.8	0.0	7.26	620		18.2		6.85	
0.50	18.8	0.0	7.18	620		18.3		6.83	
0.75	18.8	0.0	7.30	620		18.3		6.90	
1.00	18.8	0.0	7.26	620		18.1		7.10	
1.25	18.8	0.0	7.06	620		17.9		4.05	
1.30	18.8	0.0	4.05	620					

Conclusion: Water quality conditions were good and had improved for oxygen, though water temperature was warmer. The Begonia Festival had no noticeable water quality impacts a week afterwards. Gage height was excellent.

2 October 2000. Overcast. Gage height of 2.52. Flume exit 1.0 feet.

Station: Flume at 0804 hr. Air temperature 15.5 C. In Reach 1 there was a cormorant and no surface algae. Bottom with 10% algae and pondweed 3-4 feet thick. 60% of bottom with algae 0.5-1.5 feet thick, averaging 1 foot and remainder sand.

Station: Stockton Avenue Bridge at 0820 hr. Secchi to bottom. Reach 2 had the cormorant feeding. No surface algae. Algae and pondweed covering 15% of bottom, 2-3 feet thick. Remaining 85% was algae 1-2 feet thick, averaging 1.5 feet.

Station: Trestle at 0840 hr. Reach 3 with no surface algae. Bottom with algae and pondweed covering 15% on west side 3-5 fee thick. Remaining 85% 1-3 feet thick, averaging 2 feet.

Station: Mouth of Noble Gulch at 0855 hr. Gray water observed. No surface algae. 100% of bottom 1-2 feet thick with algae.

Station: Nob Hill at 0951 hr. Water temperature 16.9 C, conductivity 570, approximately 3.5 cfs streamflow.

2-Oct-00									
8:04am	**Flume**				**Stockton Avenue Bridge**				8:20am
Depth (m)	**Temp 1 (C)**	**Salin 1 (ppt)**	**O2 1 (ppm)**	**Cond 1 umhos**	**Temp 2 (C)**	**Salin 2 (ppt)**	**O2 2 (ppm)**	**Cond 2 umhos**	
0.00	17.3	0.0	8.35	620	17.5	0.0	7.58	620	
0.25	17.3	0.0	8.32	620	17.6	0.0	7.55	620	
0.50	17.3	0.0	8.32	620	17.6	0.0	7.50	620	
0.75	17.3	0.0	8.20	620	17.6	0.0	7.45	620	
0.90	17.3	0.0	6.60	620					
1.00					17.6	0.0	7.28	620	
1.25					17.6	0.0	6.43	620	
1.50					17.6	0.0	5.80	620	
1.75					17.6	0.0	5.63	620	
1.85					17.6	0.0	2.73	610	

2-Oct-00									
8:40am	**Railroad Trestle**				**Mouth of Noble Gulch**				8:55am
Depth (m)	**Temp 3 (C)**	**Salin 3 (ppt)**	**O2 3 (ppm)**	**Cond 3 umhos**	**Temp 4 (C)**	**Salin 4 (ppt)**	**O2 4 (ppm)**	**Cond 4 umhos**	
0.00	17.2	0.0	7.85	610	17.0	0.0	7.95	550	
0.25	17.2	0.0	8.08	610	17.1	0.0	8.05	550	
0.50	17.3	0.0	7.80	610	17.1	0.0	7.95	560	
0.75	17.3	0.0	8.05	610	17.1	0.0	7.25	580	
1.00	17.3	0.0	7.78	610	17.2	0.0	6.95	590	
1.25	17.3	0.0	7.54	610	17.2	0.0	6.70	590	
1.3/1.29	17.4	0.0	4.40	610	17.2	0.0	4.05	620	

Conclusions: Water temperature very cool. Oxygen was good at the Flume and trestle and fair at the Stockton Bridge and Noble Gulch.

23 October 2000. Clear. Gage height of 2.45.

Station: Stockton Avenue Bridge at 0944 hr. Secchi to bottom

	4-Oct-00							
	Flume				Stockton Avenue Bridge			7:40am
Depth (m)	Temp 1 (C)	Salin 1 (ppt)	O2 1 (ppm)	Cond 1 umhos	Temp 2 (C)	Salin 2 (ppt)	O2 2 (ppm)	Cond 2 umhos
0.00					14.0	0.0	8.71	630
0.25					14.0	0.0	8.70	630
0.50					14.0	0.0	8.51	630
0.75					14.0	0.0	8.50	630
1.00					14.0	0.0	8.37	630
1.25					14.1	0.0	8.22	630
1.50					14.0	0.0	8.25	630
1.60					14.2	0.0	6.48	630

Conclusion: Fall was settling in with much cooler water temperature with high oxygen levels.

APPENDIX C.

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK LAGOON, 2000.

DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH SOQUEL CREEK				
RESTAURANT	**INITIAL CONTACT**	**TEST DATE**	**COMMENTS**	**SIGN OFF**
BEACH HOUSE 207 ESPLANADE MAUREEN WILKS (831) 475-5846	28-Apr-00 CONTACTED NANCY	15-May-00		15-May-00
CALLOWAY'S 209 ESPLANADE LAURIE & MARCIE (831) 768-9220	28-Apr-00 CONTACTED OWNER	15-May-00		15-May-00
PIZZA MY HEART 209-A ESPLANDE CHUCK HAMMER (831) 426-2511	28-Apr-00 CONTACTED GUSTAF	15-May-00		15-May-00
FOG BANK 211 ESPLANDE LINDA BENNENT (831) 462-1881	28-Apr-00 CONTACTED LOIS	15-May-00		15-May-00
PARADISE BAR & GRILL 215 ESPLANADE STEVE YATES (831) 425-2625	28-Apr-00 CONTACTED JENNIFER	25-May-00	Leaks repaired at floor sink.	25-May-00