

SOQUEL CREEK LAGOON
MONITORING REPORT,
1996

April, 1997
Project #106-06



Prepared for

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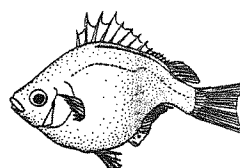


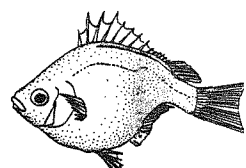
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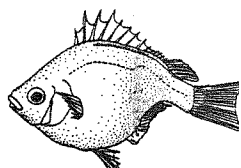
SOQUEL CREEK LAGOON MONITORING REPORT, 1996

ACKNOWLEDGMENTS

We wish to acknowledge the two funding agencies for the sixth year of lagoon monitoring. They were the Coastal Conservancy, with Jim King as project analyst, and the City of Capitola. This monitoring complied with U.S. Army Corps and California Coastal Commission permits to construct the sandbar across Soquel Creek. These permits were obtained thanks to Ed Morrison's efforts and the knowledge gained about lagoon management in recent years.

The monitoring was greatly assisted by the many observant and diligent Public Works personnel, including Ed Morrison, Ed Garcia and Tim Calahan. Sandbar closure in 1996 again offered challenges to the City and Bill Casalegno, the sandbar builder. A late, large stormflow in mid-May caused postponement of sandbar construction that was under way when the storm hit. In typical form, Nels Westman and the Begonia Festival organizers were effective in the flower clean-up afterwards. In finishing the Coastal Conservancy contract, we developed a fourth educational unit on watershed management in relation to logging impacts upon fish and wildlife habitat in the riparian corridor (Alley 1997). We thank Yehudit Sherman for her illustrations of lagoon and stream organisms and their habitat. Jim King directed us in preparing a summary report after five years of monitoring (Alley 1996a). It summarized aspects learned about developing, implementing and monitoring the success of a lagoon enhancement and management plan.

We are grateful to the intrepid volunteers of the Soquel Creek watershed during fish censusing from Friends of Soquel Creek- the Maders (Tom, Dylan and Carla), the Forests (Karl, Amie and Teal), and Barbara Graves; Steve Leinau of Earth Links; members of Citizens for Responsible Forest Management (the Morgenthalers-Mark, Bojana and Adam and Russian guests); and other concerned volunteers, including Jennifer Tate, Ana Lopez and Mark Quail. Carla's photographs enliven this report's cover and captured scenes from the annual fish sampling "event" (Appendix D).



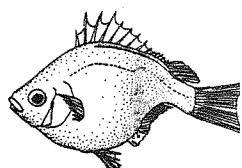
EXECUTIVE SUMMARY

Habitat conditions in the 1996 lagoon followed a relatively high rainfall winter and spring, as was the case in 1995. Again in 1996 as in 1995, there was less algae and pondweed than previous years, except at the mouth of Noble Gulch. Algae was densest in September. Surface algae was non-existent until August. The most surface algae was noted in mid-September. Pondweed was absent except for a small patch of approximately 1% of Reach 1 that appeared in mid-August. The Begonia Festival had no detectable impact on submerged algal density or water quality in the lagoon, though surface algae increased in late September, after the Festival.

Noble Gulch continued to be a source of pollution in 1996, as indicated by the periodic filamentous algal blooms at its mouth. Gray water was noted on 6 of 9 monitorings at the mouth of Noble Gulch, with a brown deposit on 20 August and an oil slick on 17 September. In 1995 and 1996, the Noble Gulch pollution appeared worse than in previous years.

Water quality for aquatic life in the lagoon was generally good with regard to oxygen, salinity and conductivity. Many of the willows were overhanging nicely to enhance fish cover, and should be left for that purpose. Oxygen levels were lowest at the bottom, with morning oxygen concentrations in the "poor" range (between 4 and 5 mg/L) on three occasions at the railroad trestle, 3 occasions at the mouth of Noble Gulch and once under the Stockton Avenue Bridge. Oxygen levels at dawn were rated "fair" to "good" within 0.25 meters of the bottom (greater than 5 mg/L) at all monitoring sites throughout the summer and fall.

A forced sewer main was accidentally ruptured in Capitola Village during maintenance activities on 14 August 1996. A resulting sewage spill of an estimated 30,000 gallons of untreated material entered the lagoon through drains under the Stockton Avenue Bridge and adjacent restaurants. The resulting influx of undecomposed organic waste and nutrients had no detectable impact on the lagoon's oxygen concentrations or other measured water



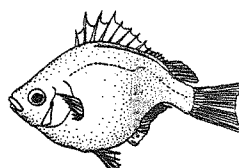
quality parameters. Our partial draining of the lagoon later in the afternoon of the spill was apparently sufficient to reduce the biological oxygen demand. The estimated total lagoon volume of 16.1 acre-feet was drained by an estimated 4 acre-feet in four hours. This drew down the lagoon by 0.6 feet before the biologist re-secured the boards in early evening. The lagoon had regained 0.4 feet of its lost depth by early the next morning. No fish mortality was observed in the days following the spill.

There was a noticeable decline in the number of piles of dog excrement along the lagoon path after the installation of plastic bag dispensers and refuse cans at either end of the path.

A "poor" rating for the lagoon water level occurred early on for 3 June before the boards were properly adjusted to accommodate the high streamflow. On 2 July the lagoon level had dropped 0.6 feet due to probable vandalism of the boards, but the problem was quickly remedied before more volume was lost. The lagoon was intentionally drawn down 0.6 feet on 14 August to remove sewage.

Passage for steelhead smolts was adequate throughout most of the summer to early August, 1996. The wooden baffle inside the flume had blown out in winter 1995, and had not yet been replaced. However, even without it, water depth at the flume inlet began at more than 18 inches on 10 June and did not drop below the 12-inch desired minimum until sometime between 23 July and 5 August, well after the steelhead smolt out-migration. In 1996, the estimated streamflow was 12-15 cfs on 10 June and dropped to a minimum estimated 2.25 cfs on 2 September, after which streamflow increased to an estimated 3.25 cfs on 17 September. By comparison, after the dry winter of 1993-94, in-flow declined below 1 cfs in late July, 1994, and fell to an estimated 0.05 cfs by late September.

When the estuary periphery was sampled before sandbar construction, species and numbers captured included 100+ juvenile starry flounders about 1 inch in total length, 200+ juvenile sculpins (prickly and staghorn) and 1,000+ small threespine stickleback. These fishes were moved upstream to a deep area under the Stockton Avenue Bridge. Our steelhead population



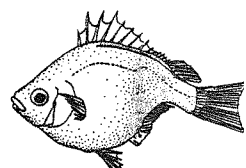
estimate for fall 1996 was 255 juveniles +/- 20, based on a mark and recapture effort on the first two weekends in October. There were two steelhead mortalities with 225 juveniles being handled. Other captured species were Sacramento sucker (Catostomus occidentalis), staghorn sculpin (Leptocottus armatus), starry flounder (Platichthys stellatus) and threespine stickleback (Gasterosteus aculeatus). No tidewater gobies were captured in fall, 1996.

Though no bird inventory was budgeted in 1996, several species of piscivorous birds were observed, including 2-3 pied-billed grebes each monitoring, a greenback heron, a great blue heron, a snowy egret and a family of mergansers (12 and then 10) feeding on fish in the lagoon. This was the largest population of mergansers observed in 6 years of monitoring. In 1995 only one merganser had been observed. The three geese were still present. The California coots returned again in September.

In 1996, sandbar breaching was artificially facilitated on 20 October to prevent flooding due to an estimated stormflow of 50 cfs from an early storm. This early storm caused lagoon depth to increase 2 feet in two hours by 0900 hr, and flume boards had been removed under difficult conditions. Before the lagoon level subsided, water flowed over the bulkhead and flooded the lagoon path for a few minutes between the Stockton Avenue Bridge and the railroad trestle.

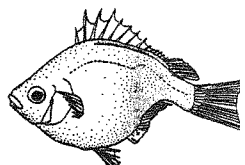
New Recommendations

1) We 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 vertical louvers that may be actuated independently would allow quick and easy opening of the flume entrance. The other side of the flume entrance may have a secured wooden sheet or boards, as is presently the case, that may also be removed if necessary. In this way, 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. With the louver design, the



lagoon level may be easily maintained and vandalism may be prevented. This will prevent the lagoon level from lowering into the poor range because sufficient boards have not been added to the flume inlet as streamflow declines in summer.

2. Better maps and more cautious excavation are needed to prevent future sewage spills. Minimize the amount of sewage reaching the lagoon in the event of a sewage spill by making sure that the storm drain under the restaurants is capped at the time of lagoon formation, as previously intended. If another sewage spill should occur, the lagoon may be lowered approximately one foot without a significant increase in fish predation when the lagoon may refill overnight. In the future, the City's fishery biologist and the California Department of Fish and Game should be notified immediately after a sewage spill, and the lagoon should be partially drained immediately after the sewage spill, with the Department's approval.



LAGOON AND ESTUARY FORMATION

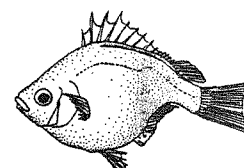
Sandbar Construction in 1996.

The City utilized a 1996 Fish and Game Permit (Appendix A) and a U.S. Army Corps Permit to close the sandbar. The Army Corps permit and conditions are contained in our 1995 monitoring report (Alley 1996a). In 1996, a management problem developed when initial efforts to construct the sandbar were negated by a storm on 16 May. The work was redone in late May after Memorial Day weekend. Similarly, in 1993, rain on 24-25 May required breaching of the recently constructed sandbar and delayed final sandbar construction. A storm on 5 June 1993 came close to breaching the recently constructed sandbar.

In 1996, the Creek was flowing east of the flume across the beach to the rock jetty, as in 1992, 1993 and 1995. The stream went laterally east from the flume and parallel to the coastline for approximately 150 meters, then bent abruptly south at the jetty to empty into the surf. The fish in the east-coursing channel across the beach were herded back into the lagoon before the sandbar was constructed around the lagoon.

14 May, 1996. Six seine hauls were made by Alley and Morrison with the 30-foot goby seine (1/8-inch mesh) in the lateral channel without capture of any fish. Streamflow was estimated at 15-20 cfs. Ten seine hauls were made around the periphery of the estuary in Reach 1. No tidewater gobies were found. Species and numbers captured included 100+ juvenile starry flounders about 1 inch in total length, 200+ juvenile sculpins (prickly and staghorn) and 1,000+ threespine stickleback. These fishes were moved upstream to a deep area under the Stockton Avenue Bridge.

Sand had been stockpiled the day before. We raked kelp out of the lateral channel before it was closed off. High tide was at 0830 hr, requiring that the sandbar be closed off. No exit to the ocean was present, but a notch was present. The flume had been cleared of sand down to the last manhole cover by late evening, but it did not completely clear.



15 May, 1996. The sandbar was opened next to the flume between 0500 and 0530 hr. the sandbar had breached during the night on the west side with considerable loss of beach sand, and not through the intended notch. The lagoon level had risen to approximately 1 foot below the piling bolt before breaching. The breached swath was closed of by 0600 hr. There was less sea grass than previous years in the estuary and more logs (which were left in place for cover). The flume was cleared of sand.

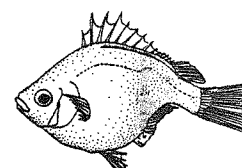
16 May, 1996. It had rained the night before, which brought 200+ cfs of stormflow. This breached the sandbar with a channel 50-60 feet wide. It had rained 5+ inches in 12 hours in Brookdale and 4-4.5 inches in the upper Soquel Creek watershed (Brook Kraeger, pers. comm.).

28 May 1996. This was the day after Memorial Day. There was insufficient sand to close the sandbar. Sand was being stockpiled on the beach. I raked some kelp out of the estuary, with an absence of sea grass.

29 May 1996. Geofabric and visquine were spread around the flume and buried. Both sides of the lagoon were graded above the waterline. The May storm had deposited 2-3 feet of sand on the restaurant side of the lagoon. The sandbar was closed. The flume had a short plug of sand that was blown out by 2100 hr with a streamflow of 15-20 cfs.

30 May 1996. The height of the sandbar was built up around the lagoon to prevent tidal overwash. The flume was functioning with screens partially installed. The entrance was checked for woody debris through the day. The screens were fully installed for the night. No salinity was detected in the lagoon with a gage height of 2.08. There was no requirement to install the shrouds for pulling saltwater off the bottom.

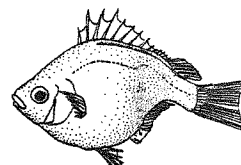
31 May 1996. Morrison cleared the flume screens of debris at 0300 hr. The internal baffle that had been lost in 1995 was not re-installed due to difficulty of working with such a high volume of water.



3 June 1996. The gage height had dropped to 1.70. Morrison installed steel plate on one side of flume exit. He would install a half screen on each side of flume entrance, if necessary, to raise lagoon height. By 6 June the height had raised to 1.98.

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.
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.
3. Dispose of kelp from the lagoon during sandbar closure in the bay rather than bury it in the sandbar. Disperse it up and down the beach so as to spread it out. Continue to include this in the Fish and Game permit for sandbar construction. County environmental health has no problem with this so long as kelp is spread out over a wide area (J. Ricker, County Environmental Health, pers. comm.).
4. Bring back the wide rakes that were used in 1996.
5. Evaluate the structural integrity of the flume and its supports. Repair cracks and supports as necessary.
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.



8. Seal off storm drains on the west side of the street in front of the Esplanade. This should be the case from May 15 to after the clean-up from the Wine Festival in mid-September. Seal off any storm drain pipes leading from the street to the lagoon in front of the restaurants. This will reduce pollution from restaurant clean-up.

9. Attempt to make the area around the flume the deepest part of the lagoon so that heavy salt water will collect there and be pulled out easily by the shroud.

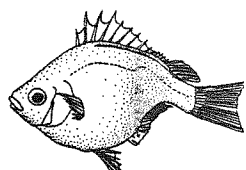
10. Continue to maintain the underwater portal in the flume for out-migration of adult steelhead until June 1, while maintaining a notched top plank for out-migration of smolts until 1 July.

11. 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 travel through the flume to the ocean.

12. Continue to maintain a 6 to 8-inch depth at the outlet of the flume until July 1. Install two 4"x 4" planks in the outlet if necessary as the Fish and Game expert, George Heise, recommended.

Sandbar Breaching During the 1995-96 Rainy Season.

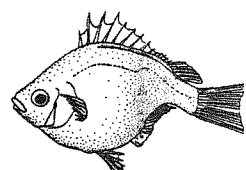
29 October 1996. Rain began at 0200 hr on this Tuesday morning, with more rain occurring near the coast than in the mountains. At 0630 hr the water level was 2 inches above the flume. The flume boards were pulled with screens installed. Between 0800 and 0830 hr, the biologist was notified of a likely breach. The beach was being notched. Between 0830 and 0900 hr the sandbar began to breach, with the water level 3 inches below the piling bolt as reported by Morrison. Alley arrived at 0930 hr. The sandbar was breaching with an 8-foot wide channel on the west side of the flume. The piling bolt was underwater. At 0945 hr it was noted that the lagoon bulkheads had overtopped with standing water on the lagoon path. The Creek had risen 2 feet in two hours, with an estimated 50 cfs at 1007 hr.



Regarding sandbar breaching in the fall, in general, there is room for improvement in preventing the first, relatively small October stormflows from breaching the sandbar. From observation, the flume can probably pass up to approximately 25-30 cubic feet per second, assuming that the tide is low enough not to obstruct the flume outlet. Streamflows greater than this will probably require sandbar breaching, no matter how open the flume's inlet. However, the desire is to maintain an intact sandbar and lagoon until middle to late November, when the size and frequency of storms increase. The intent is to delay sandbar breaching until streamflow has increased sufficiently to provide adequate, sustained passage flows for migrating steelhead and coho salmon to reach spawning grounds without becoming stranded. Elevated streamflow also keeps the sandbar open with free circulation of water as the estuary fills and empties with the daily tidal fluctuations. Thus, a lagoon full of stagnating water with trapped kelp and seagrass is prevented. This plant material decays to create foul odors and poor water quality.

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



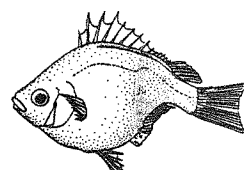
anticipated. Remove two boards from either side if a large storm is anticipated. Clear the exit to the flume by removing the plate from one side of the exit. Clear the sand away from the top of the flume back to the first hole cover. As stated in the 1993 monitoring report, management options to delay 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 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 vertical louvers that may be actuated independently would allow quick and easy opening of the flume entrance. The other side of the flume entrance may



have a secured wooden sheet or boards, as is presently the case, that may also be removed if necessary. In this way, 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.

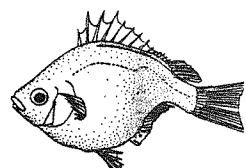
WATER QUALITY MONITORING, 1996

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) 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 ppm 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 3-4 degrees C by the end of a sunny day.

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. Morning oxygen levels below 2 mg/L were rated critical. Morning oxygen levels below 5 mg/L were rated poor. Morning oxygen levels of 5 to 7 mg/L were rated fair with above 7 ppm rated as good. 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 above 21.5 C were rated poor.

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 believed not to be a problem (Jerry Smith, pers. comm.). Therefore, monitoring of carbon dioxide was unnecessary.

Lagoon water level was monitored with the staff gage on the eastern bulkhead, upstream of the Stockton Avenue Bridge (Figure 1.) Readings less than 1.85 were rated poor. 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.

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 upstream 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.

Results of Water Quality Monitoring After Sandbar Closure

Appendix B provides detailed data on water quality. Table 1 summarizes conditions at each monitoring time, based on the rating criteria.

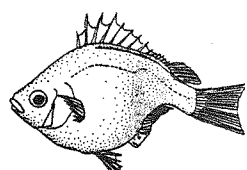
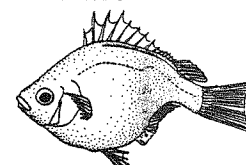


Table 1. Water Quality Ratings in Soquel Creek Lagoon, 1996.

Date	Flume Passage	Gage Height	Water Temperature	Oxygen	Salinity	Lagoon In-flow (cfs) (visual)
30May96	open	fair 2.08	good		good	15-20 (visual)
3June96	open	<u>poor</u> 1.70				
6Jun96	open	fair 1.98				
10Jun96	open	good 2.22	good	good	good	12-15 (visual)
11Jun96	open	good 3.30				
12Jun96	open	good 2.52				
17Jun96	open	good 2.22				
23Jun96	open	good 2.24	good	good	good	10-11 (visual)
24Jun96	open	fair 2.02				
1Jul96	open	fair 1.90				
2Jul96	open	<u>poor</u> 1.40 (partial draining by vandalism?)				
8Jul96	open	good 2.25	good	good	good	7-9 (visual)
23Jul96	open	fair 2.09	good fair good	good* good fair good	good	5-6 (visual)
5Aug96	open	fair 2.06	good	good	good	
12-13Aug96	open	fair 2.00				
14Aug96	open	<u>poor</u> 2.00	A sewage spill had occurred. to 1.40 (partial, intentional draining)			
15Aug96	open	<u>poor</u> 1.80	fair -	good -	good	
16Aug96	open	fair 1.94	fair	good	good	3.25 (visual)
20Aug96	open	fair 2.00	good	good good good fair good	good	
2Sep96	open	fair 1.96	fair good good		good	2.25 (visual)
3Sep96	open	<u>poor</u> 1.82				
8Sep96	Begonia Festival.					
10Sep96	open	fair 1.92				
16Sep96	open	fair 2.05				
17Sep96	open	fair 1.90	good	good	good	3.25 (visual)

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

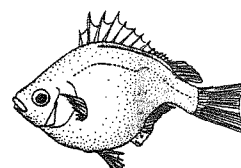


Lagoon Level. The lagoon level was monitored 24 times from 30 May to 17 September, which included during the 10 water quality monitorings, often times by Ed Morrison. In 1996, lagoon level was rated good on 6 occasions, fair on 13 occasions and poor on 5 occasions (Table 1).

The instance of poor lagoon level in early June, 1996, resulted in difficulty in manipulating flume water volume with boards and exit plates with high streamflow conditions. The poor lagoon level on 2 July occurred when flume boards were raised by apparent vandalism. Fortunately, the problem was detected. The poor lagoon levels on 14-15 August were due to intentional lifting of the flume boards to partially drain the lagoon after a sewage spill on 14 August. The poor level on 3 September was due to insufficient boards in the flume.

With the dry season ending in 1996, the flume inlet remained vulnerable to vandalism. In 1995 and 1996, vandals created gaps between the flashboards in the flume inlet at night to cause partial draining of the lagoon. In 1995 the lagoon nearly drained before the problem was reported to police by a concerned resident. This undoubtedly resulted in substantial steelhead mortality. A method is needed to secure the flashboards against vandalism on the one hand while allowing convenient adjustment or removal of boards when necessary. In the past, wooden wedges have been driven into the gaps between the boards and the concrete slots to secure the boards. While securing the boards against all but the most determined vandals, this method does not allow convenient adjustment or removal of boards when surface algae and debris needs to be drained out or sandbar breaching is to be prevented.

Flume Passability. According to the Management Plan (1990), fish passage was to be maintained until July 1. The desire is to maintain the flume depth at the entrance at 12 inches or deeper until that time. Passage for steelhead smolts was adequate throughout this period in 1996. The wooden baffle inside the flume had blown out in winter 1995. However, even without it, water depth at the flume inlet began at greater than 18 inches on 10 June and was still greater than 12 inches in late July



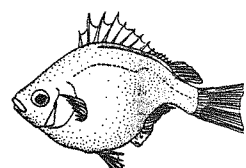
(Appendix B). It had dropped to near 6 inches between 23 July and 5 August, well after the smolt down-migration was complete.

The sandbar breached early in 1996, and the Creek was passable to adults without the use of the flume.

Water Temperature. Lagoon water temperature was fair or good all summer and fall, 1996 (Table 1). Morning temperatures were low, as in 1995 (Figure 2), due to high streamflow into the lagoon.

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 levels were measured and rated. Oxygen levels were lowest at the bottom, with them being rated fair-to-good within 0.25 meters of the bottom with oxygen levels greater than 5 mg/L at dawn at all monitoring sites throughout the summer (Table 1; Figure 3). At the bottom the morning oxygen concentration went into the poor range between 4 and 5 mg/L on three occasions at the railroad trestle, 3 occasions at the mouth of Noble Gulch and once under the Stockton Avenue Bridge.

We have recommended in the past that all of the storm drains leading to the lagoon be redirected away from the lagoon in summer. Included in these is underground culvert draining Noble Gulch. Significant quantities of gray water and oily slicks have consistently emptied into the lagoon from Noble Gulch (Alley 1995; 1996b). 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. A degree of 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. This water could be pumped out for irrigation



purposes, provided that lagoon depth is being adequately maintained. By minimizing the stream inflow from Noble Gulch, there may be a reduction of nutrients and bacteria entering the lagoon. Algae production may be reduced.

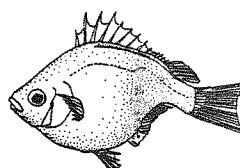
Another drain into the lagoon is situated under the railroad trestle, where slight oxygen depletion has been detected in recent years. This drain could be capped if runoff could be redirected into the sewer system during the summer.

A forced sewer main was accidentally ruptured in Capitola Village on 14 August 1996. The resulting sewage spill of an estimated 30,000 gallons of untreated sewage in to the lagoon through drains under the bridge and under the restaurants had no negative impact on the lagoon's oxygen concentration or other measured water quality parameters. Our partial draining of the lagoon later that afternoon was apparently sufficient to reduce the biological oxygen demand. The estimated total lagoon volume of 16.1 acre-feet was drained by an estimated 4 acre-feet. This drew the lagoon level down by 0.6 feet by early evening before the biologist re-secured the boards. No fish mortality was observed after the sewage spill, and the lagoon had regained 0.4 feet of its lost depth by early the next morning.

The partial draining was delayed by 4 hours after the spill. The fishery biologist had not been notified until 3.5 hours after the spill. The boards were replaced at 2100 hr to allow refilling of the lagoon overnight. In the future, the lagoon may be lowered approximately one foot without a significant increase in fish predation when refilling may occur overnight. In the future, the California Department of Fish and Game should be notified immediately after the spill, and the lagoon should be partially drained immediately after the sewage spill, with the Department's approval.

There was a noticeable decline in the number of piles of dog excrement along the lagoon path after the installation of plastic bag dispensers and refuse cans at either end of the path.

Salinity. Salinity was not a problem all summer in 1996.



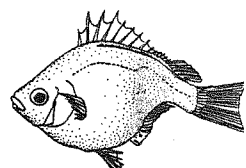
Conductivity. Conductivity was not a problem in 1996.

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. The inspection report is contained in **Appendix C**.

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

1. Re-install the 12-inch high wooden baffle inside the flume prior to directing water through it during sandbar construction.
2. Do not allow the pedal boat operator to dictate the lagoon level.
3. 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.
4. After July 1, do not open the flume exit if it closes, unless flooding is eminent. Install plastic sheeting on the outside of the flume boards to prevent leakage into the flume. Put as many boards as possible into the flume entrance to raise the lagoon level as much as possible.
5. Secure the flume boards so that vandals may not raise the boards and drain the lagoon.
6. If the lagoon bottom becomes invisible due to turbidity for



more than one day after the first rain of the season that does 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.

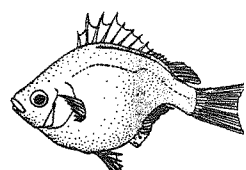
7. Road repaving and application of petro-chemicals should be done early in the summer. This will allow these substances to penetrate and dry before fall rains.

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

9. 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.

10. Better maps and more cautious excavation are needed to prevent future sewage spills. Minimize the amount of sewage reaching the lagoon in the event of a sewage spill by making sure that the storm drain under the restaurants is capped at the time of lagoon formation, as previously intended. If another sewage spill should occur, the lagoon may be lowered approximately one foot without a significant increase in fish predation if refilling may occur overnight. In the future, the City's fishery biologist and the California Department of Fish and Game should be notified immediately after the spill, and the lagoon should be partially drained immediately after the sewage spill, with the Department's approval.

11. As recommended for improving the sandbar breaching process, we 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. This will prevent the lagoon level from lowering into the poor range because sufficient boards have not been added to the flume inlet as streamflow declines. With a vertical louver system, the lagoon level may be easily maintained and vandalism may be prevented.



FISH CENSUSING

Steelhead Plantings in Soquel Creek

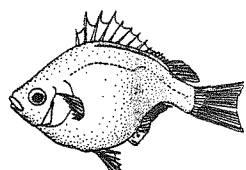
In March 1996, 650 pounds (4,095 steelhead) were planted at Tiedemann's Nursery (David Strieg, Monterey Bay Salmon and Trout Restoration Project, pers. comm.).

Results of Fish Sampling in Soquel Creek Lagoon

On 5 October 1996 the biologist made 6 seine hauls 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 lower lagoon, downstream of the Stockton Avenue Bridge, is the only location where a seine could be adequately beached to capture tidewater gobies. After 6 seine hauls, no tidewater gobies were captured.

In fall, 1994, 35 tidewater gobies had been captured after four seine hauls. In fall, 1992, two tidewater gobies were captured during sampling. In fall, 1993 and 1995, no tidewater gobies were captured. The low number captured in 1992-96 probably indicates the lack of backwater areas in Soquel Lagoon, which would be used as refuges during high winter stormflows.

Fall sampling for steelhead was undertaken on 5 and 12 October, 1996, in the same vicinity as the tidewater goby sampling. Refer to Appendix D for action-packed photographs of fish sampling activities. With the larger, coarser-meshed seine, no tidewater gobies were captured. A total of 106 juvenile steelhead were marked from three seine hauls on 5 October. There were two steelhead mortalities that day. On 12 October, 119 juvenile steelhead were captured with 49 being clipped recaptures from the previous week, with no mortalities. Our steelhead population estimate for fall 1996 was 255 juveniles +/- 20. Other number and other species captured were four Sacramento suckers (Catostomus occidentalis), one staghorn sculpin (Leptocottus

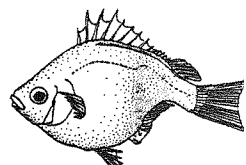


armatus), three starry flounder (Platichthys stellatus) and uncommon threespine stickleback (Gasterosteus aculeatus). Refer to Table 2 for a summary of juvenile steelhead estimates through the years of monitoring.

Table 2. Estimates of Juvenile Steelhead Numbers in Soquel Creek Lagoon for the Years 1988 and 1992-96.

YEAR	STEELHEAD POPULATION ESTIMATE FOR SOQUEL CREEK LAGOON
1988-	<u>Rough estimate of a few hundred.</u> No mark/recapture activity was done. 157 juveniles were captured in 5 seine hauls.
1992-	<u>Rough estimate of a few hundred.</u> No mark/recapture activity was done. 60 juveniles were captured in 4 seine hauls.
1993-	<u>2,787 +/- 306 (95% confidence interval.)</u> 1,046 fish were marked from two seine hauls.
1994-	<u>1,140 +/- 368 (95% confidence interval.)</u> 76 fish were marked from two seine hauls.
1995-	<u>360 +/- 60 (95% confidence interval.)</u> 59 fish were marked from 4 seine hauls. The lagoon had been drained to just 1 foot depth on 23 September due to vandalism of the flume.
1996-	<u>255 +/- 20 (95% confidence interval.)</u> 105 fish were marked from 3 seine hauls. A resident had reported 26 mergansers feeding in the lagoon the previous week. 10-12 mergansers had been at the lagoon much of the summer. It was a mother and her clutch.

There may be several reasons for the low density of steelhead found in October, 1996. There may have been fewer young steelhead moving into the lagoon from the lower Creek because little spawning may have occurred in lower Soquel Creek. There



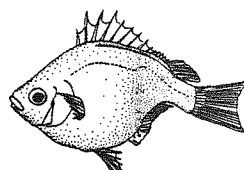
was good spawning access to the upper watershed and a preponderance of sand and poor spawning conditions in the lower Creek that may have discouraged spawning in the lower reaches. In addition, the late stormflow in May could have flushed young fish out of the lower Creek into the ocean, so that there were few to enter the lagoon.

The lagoon may have offered less habitat than in former years. The extensive pondweed forest that was present in some years did not develop in 1996. Pondweed provides escape cover and plant life to support insect larvae that steelhead feed upon. The lagoon depth was deeper than 1995, thanks to the May storm that scoured it out. However, it was not as deep as some previous years. In 1993, when steelhead densities were highest of the past 6 years, the water depth was 1.65 meters (5.3 feet) or greater under the bridge throughout the summer. In 1996, the depth under the bridge was 1.5 meters at most in a narrow thalweg. Much of the channel width was less than 1 meter deep when depth was measured outside the thalweg (15-16 August).

The lagoon underwent two episodes of large water depth fluctuations, with a reduction of 0.6 feet twice. However, these were short in duration and probably did not significantly affect predation rate. There were 10-12 mergansers in the lagoon (a mother and her clutch) for most of the summer. These may have removed considerable numbers of steelhead, though they eat other species of fish as well.

In order to maintain good steelhead nursery habitat in Soquel 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. If the lagoon becomes too shallow, habitat in the upper lagoon is lost for steelhead use. This is another reason to keep the lagoon as deep as possible during summer. The flume boards must be secure so that vandals cannot drain the lagoon.

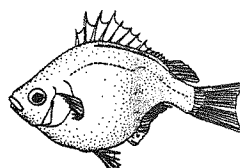
In 1996, the lowest estimated in-flow to the lagoon was 2.25 cfs on 2 September (Appendix B). It increased after that, presumably due to reduced water diversion and leaf fall along the riparian



corridor. On 10 June we estimated 12-15 cfs coming in (Table 1). The summer baseflow was nearly as high as the previous year, 1995, which was a high inflow year. the lowest estimated in-flow to the lagoon was 1 cfs in September. In 1994, in-flow declined below 1 cfs in late July and fell to an estimated 0.05 cfs by late September.

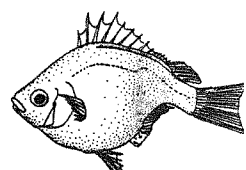
Recommendations Regarding Fish Management

1. If the streamflow in Soquel Creek in the vicinity of Soquel Village approaches the point of losing surface flow, notify 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.
2. Maximize lagoon depth after 1 July by adding boards to the flume as streamflow declines and by sealing them with plastic.
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.
4. Look into better ways of sealing the cracks between the boards in the flume inlet. Sandwiching rubber strips between the boards may solve the problem.
5. Do not unplug the flume exit after 1 July.
6. Do not remove flume boards for the Begonia Festival or prior to taking fall vacation time.
7. 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 and tidewater goby to drop the lagoon level in anticipation of a storm that fails to develop and then not re-install the flume board afterwards.



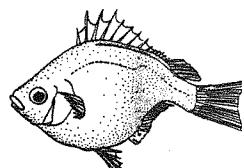
8. Maintain the lagoon in fall until streamflow has increased enough (20-25 cfs) to prevent stranding of spawning adult steelhead or coho salmon and to prevent osmotic stress in lagoon-inhabiting steelhead. If necessary, install a perimeter fence with 2"x 4" mesh with 6-foot panels around the flume entrance 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.

9) As recommended for improving the sandbar breaching process and preventing drawdown of the lagoon, we 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. 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 vertical 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 a secured wooden sheet or boards, as is presently the case, that may also be removed if necessary. In this way, the lagoon level may be easily maintained and vandalism may be prevented. Furthermore, sustaining a maximum time for lagoon habitat until later in fall when storm frequency and streamflows increase, will maximize the lagoon's benefit to juvenile steelhead.



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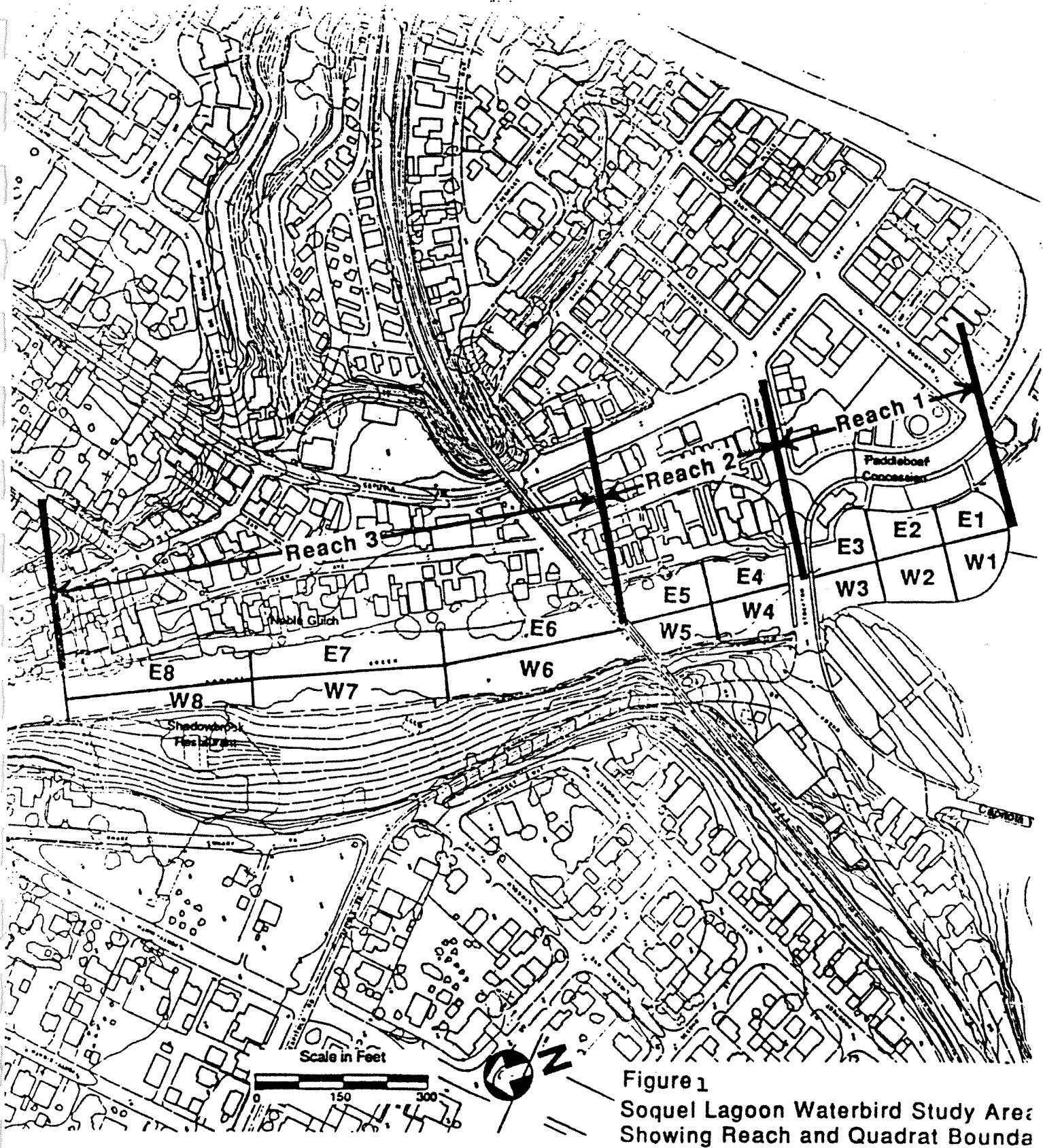
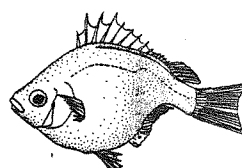
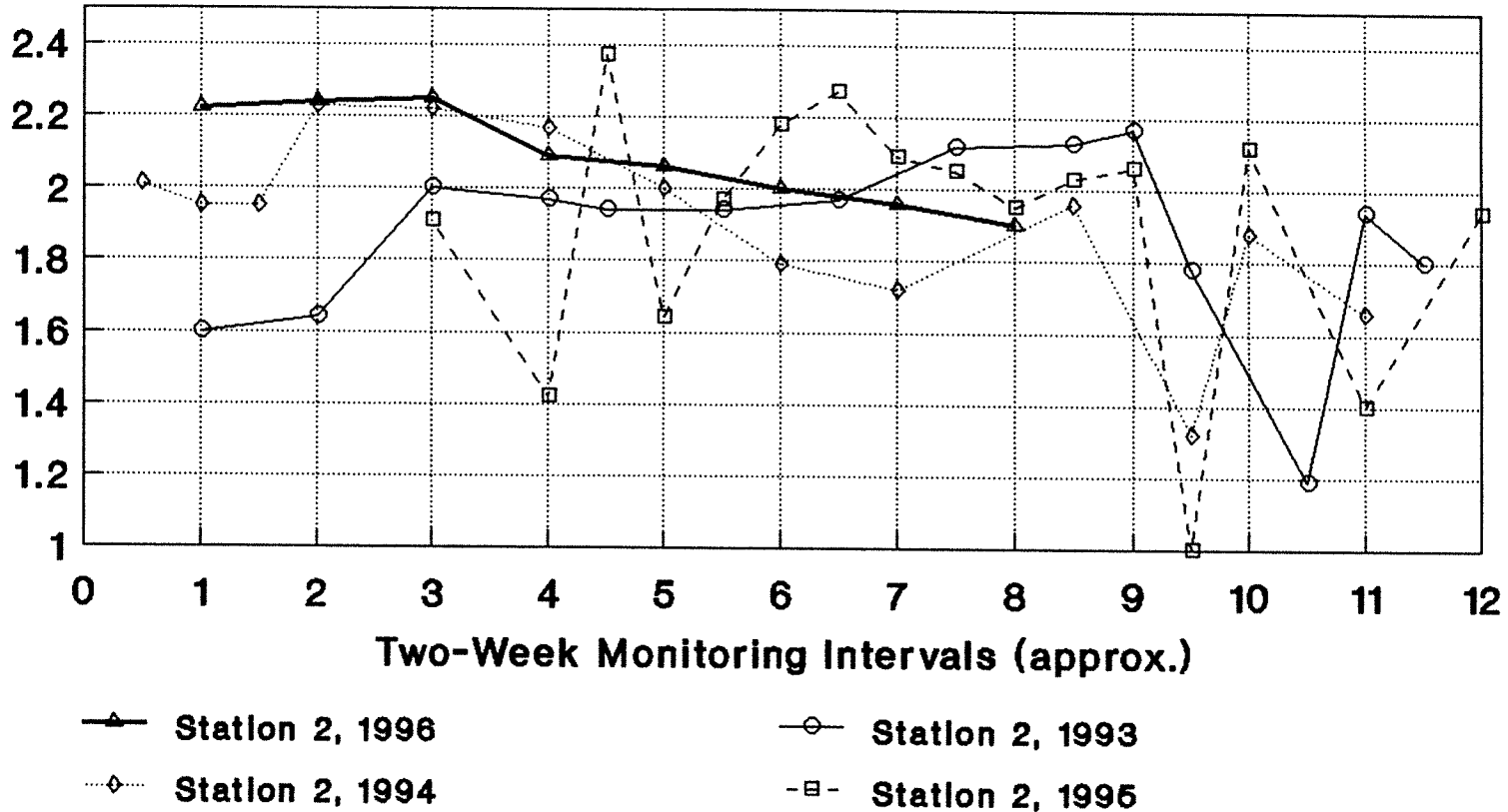


Figure 1
 Soquel Lagoon Waterbird Study Area
 Showing Reach and Quadrat Bounda

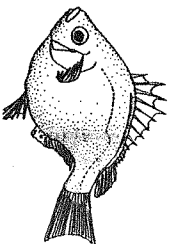


**Soquel Lagoon Gage Height
Reach 1 at Stockton Avenue Bridge**

Gage Height in Feet



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



**Soquel Lagoon Water Temperature
Reach 1 at Stockton Avenue Bridge
Within 0.25 M of Bottom, 1993-96**

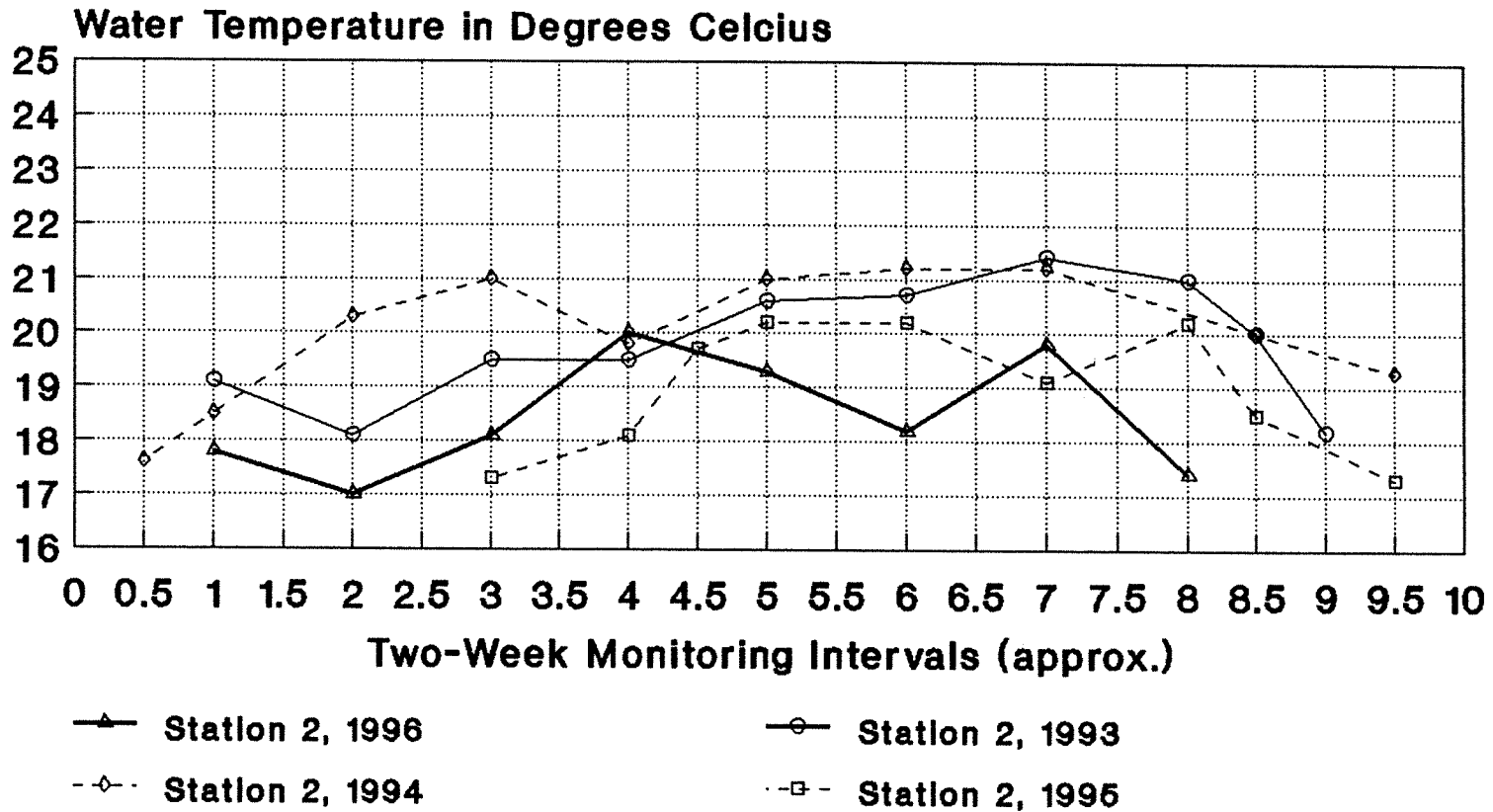
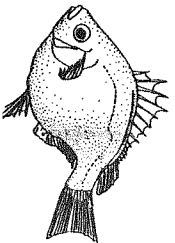
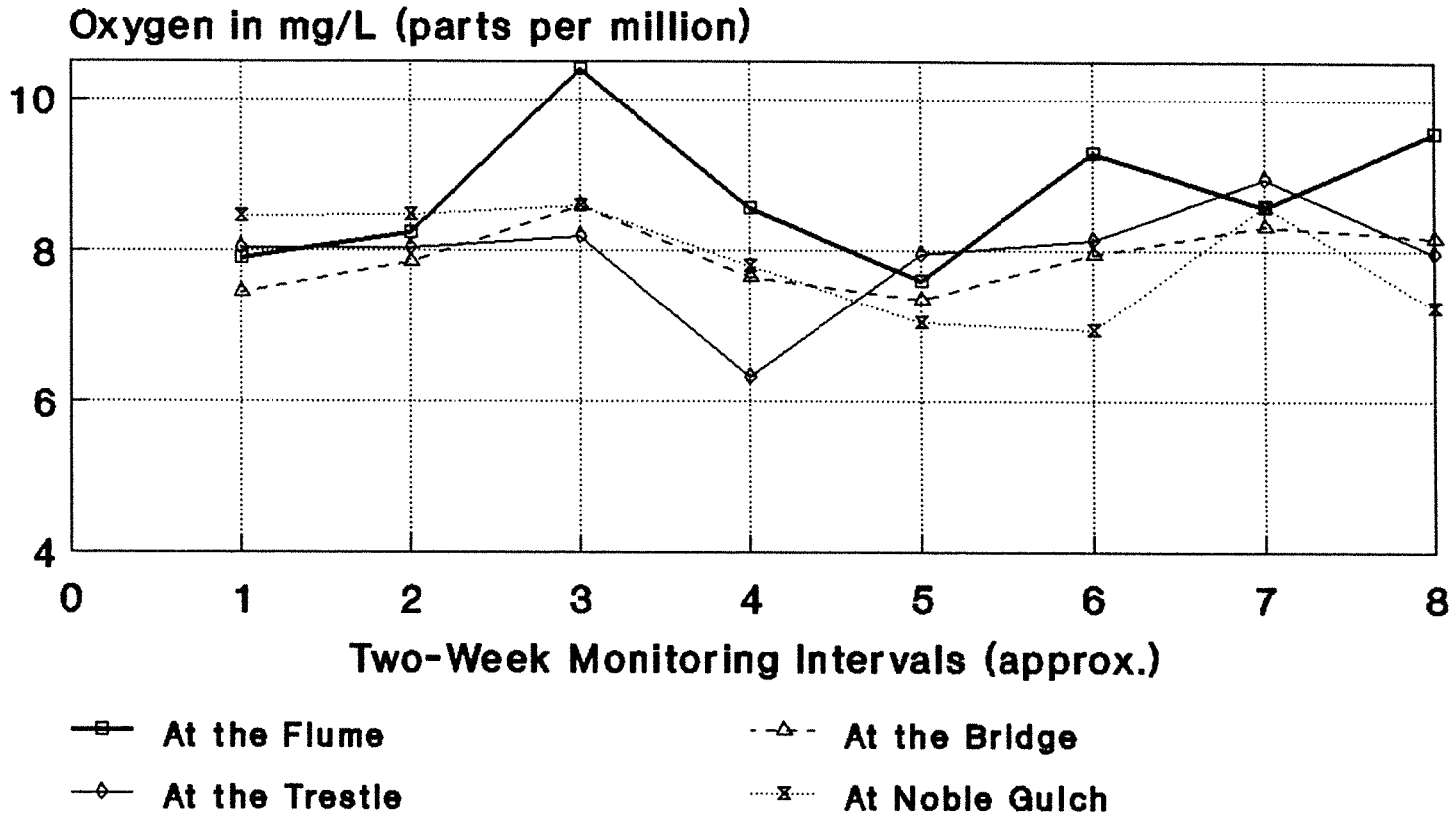


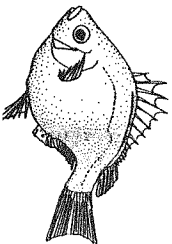
Figure 3. Soquel Lagoon Water Temp. Near Bottom at Dawn; Stockton Avenue Bridge, Late May to Late September 1993-96.



Soquel Lagoon Oxygen, 1996
Within 0.25 Meters of the Bottom, At
the Flume, Bridge, Trestle and Noble G.

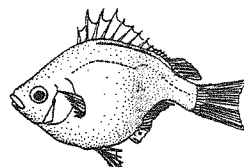


**Figure 4. Oxygen Level at Four Stations,
Soquel Lagoon Near the Bottom at Dawn;
10 June - 17 September, 1996.**



APPENDIX A.

**FISH AND GAME AGREEMENT REGARDING PROPOSED STREAM OR
LAKE ALTERATION, 1996.**



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 of Santa Cruz, 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 1st day of May, 1996, notified the Department that s/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 Santa Cruz, State of California. S__T__R

WHEREAS, the Department (represented by C. Babich has made an inspection of subject area and) has determined that such operations may substantially adversely affect existing fish and wildlife resources including: Salmon, steelhead, nongame fish, tidewater gobies, riparian habitat and it's related species, reptiles, amphibians, birds, etc.

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/her work: Numbers 4, 7, 10, 20, 21, 22, from the list of recommendations attached to this page and the following special recommendations:

- A. All work in or near the stream shall be confined to the period 5-13-96 through 10-15-96.
- B. This agreement is limited to the damming of Soquel Creek at the mouth as per submitted application.
- C. A new straight line breach may 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 the filling of any holes along the edge of the lagoon, these areas shall be seined and netted of to prevent fish from re-entering the area.
- D. The Operator shall put the flume in operation during all construction and during all daily closures during construction.
- E. All seaweed shall be removed from the channel bottom before damming occurs.
- F. The steel shroud put in place in 1992, 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 7-1-96. After final damming, no draw down will be allowed without prior Department approval. The Operator shall contact the Department prior to breaching, unless flooding is imminent.
- G. The Operator shall keep the lagoon as deep as possible throughout the summer. Once the boards are in place they shall not be removed without prior Department approval. In addition, the Operator shall make the boards vandal proof so they are not removed accidentally.

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.

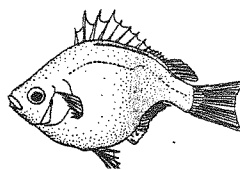
Nothing in this agreement authorizes the operator to trespass on any land or property, nor does it relieve the operator of responsibility for compliance with applicable federal, state, or local laws or ordinances.

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 when signed by both parties.

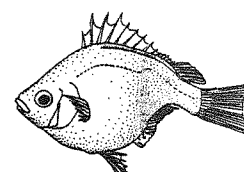
Operator Ed Morrison
 Title Ward Supervisor
 Organization City of Capitola
 Date 5/13/96

Department Representative C. Babich Babich
 Title Fish and Game Warden
 Department of Fish and Game, State of CA
 Date 5-12-96



APPENDIX B.

WATER QUALITY DATA 10 JUNE - 17 SEPTEMBER, 1996.



10 June, 1996. It was Monday morning. Gray water was entering from Noble Gulch on the surface. Woody debris was plugging up the flume inlet screens. Streamflow was 12-15 cfs at Nob Hill. One pile of dog excrement existed next to the path. No surface algae on the lagoon.

Station: Flume at 0635 hr, clear. Depth at flume entrance > 18 inches. Depth at flume exit = 28 inches. Gage Height= 2.22. Air temperature of 12.2 C.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	18.0	0.00	8.08	560
0.25	18.0	0.00	8.00	560
0.50	18.0	0.00	7.92	560
0.75	18.0	0.00	7.90	560
0.90(bot)	18.2	0.00	6.50	550

Station: Stockton Ave Bridge, right side bridge thalweg, 0652hr. Secchi depth to bottom.

surf	17.7	0.00	7.80	540
0.25	17.8	0.00	7.68	540
0.50	17.8	0.00	7.65	540
0.75	17.8	0.00	7.65	540
1.00	17.8	0.00	7.65	540
1.25	17.8	0.00	6.45	540
1.40(bot)	17.8	0.00	4.70	540

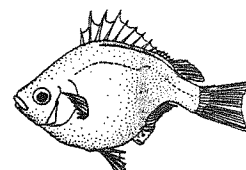
Station: Railroad trestle, 0720 hr. Water clarity to bottom.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf	16.8	0.00	8.15	550
0.25	17.0	0.00	8.05	550
0.50	17.0	0.00	8.05	550
0.75	17.0	0.00	8.05	550
1.00	17.0	0.00	8.05	550
1.12(bot)	17.1	0.00	6.70	540

Station: Mouth of Noble Gulch, 0740 hr. Water clarity to bottom.

surf	16.0	0.00	8.75	520
0.25	16.0	0.00	8.70	520
0.50	16.0	0.00	8.35	520
0.75	16.0	0.00	8.40	520
1.00	16.0	0.00	8.46	520
1.20	16.0	0.00	6.72	530

Conclusion: In 12 days after final sandbar closure, the lagoon was flushed of salt water. The lagoon had been closed on May 29, and no saltwater was detected on May 30. Water quality was good for aquatic organisms regarding oxygen in the upper water column and fair near the bottom at Stockton Avenue Bridge It was



poor at the bottom at the Bridge. Conductivity was typical of a freshwater lagoon and less than the previous year. Water quality was good with cool enough water temperature (<18.2 C). Some oxygen depletion was observed at the bottom at all monitoring sites. The gray water appeared not to cause an oxygen problem at Noble Gulch.

23 June 1996. It was Sunday. The gage height was still rated good at 2.24. Gage height on 24 June was 2.08 as reported by Morrison. Streamflow was still high at 10-11 cfs at Nob Hill. Three geese were seen. The geese numbers are not increasing, indicating that the remaining geese are males. It was warm the day before. The baffle was not in place. Gray water was present at Noble Gulch.

Station: Flume at 0650 hr, Clear. Gage Height= 2.24. Flume entrance at >12 inches depth. Flume exit at 18 inches. Air temperature 13.0 C at 0650 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
surf.	17.7	0.0	8.30	580
0.25	17.7	0.0	8.10	580
0.50	17.8	0.0	8.26	580
0.75	17.8	0.0	8.25	580
1.00	17.8	0.0	8.12	580
1.05	17.9	0.0	7.70	580

Station: Stockton Ave Bridge, 0706 hr. Secchi depth to bottom.

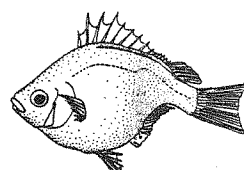
surf	17.2	0.00	8.13	580
0.25	17.2	0.00	8.02	580
0.50	17.2	0.00	7.88	580
0.75	17.0	0.00	7.95	580
1.00	17.0	0.00	7.92	580
1.25	17.0	0.00	7.86	580
1.50(bot)	17.2	0.00	6.60	580

Station: Railroad trestle, 0724 hr.

surf.	16.5	0.0	8.20	560
0.25	16.5	0.0	8.00	560
0.50	16.5	0.0	8.00	560
0.75	16.5	0.0	8.00	560
1.00	16.5	0.0	8.05	560
1.20(bot)	16.5	0.0	6.22	560

Station: Mouth of Noble Gulch, 0738 hr.

surf	15.3	0.00	9.00	550
0.25	15.3	0.00	8.85	550
0.50	15.5	0.00	8.70	550
0.75	15.8	0.00	8.70	550
1.00	15.9	0.00	8.48	550
1.12(bot)	15.8	0.00	4.18	560



Conclusion: Water quality conditions were good for steelhead in all reaches except for oxygen below 5 ppm at the bottom at Noble Gulch for a poor rating and fair at the Stockton Avenue Bridge and the trestle. Water temperature was quite cool due to high streamflow.

8 July 1996. It was Monday. Lagoon level at 2.25 feet. Surface algae present. Morrison observed considerable surface algae the previous day. It had been foggy on the previous Saturday and Sunday. Slightly murky water at Noble Gulch. Streamflow estimated at 7-9 cfs. Steelhead redd observed above a partial artificial rock dam within 100 meters of Nob Hill. It was not there two weeks previously. Only 2 geese observed. A mother mallard and two ducklings observed near trestle.

Station: Flume at 0646 hr, foggy. Gage Height= 2.25
Flume entrance at >12 inches in depth. Flume exit at 18 inches.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond.
surf.	17.8	0.00	10.4	620
0.25	17.8	0.00	10.4	620
0.50	17.8	0.00	10.4	620
0.75	17.8	0.00	10.4	620
1.00(bot)	17.8	0.00	9.02	600

Station: Stockton Ave Bridge, 0710 hr.

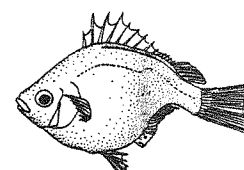
surf	17.8	0.00	9.15	670
0.25	18.0	0.00	9.10	670
0.50	18.0	0.00	8.90	670
0.75	18.1	0.00	8.85	670
1.00	18.1	0.00	8.78	670
1.25	18.1	0.00	8.60	670
1.50	18.1	0.00	5.35	620

Station: Railroad trestle, 0730 hr.

surf.	17.6	0.00	8.25	600
0.25	17.7	0.00	8.20	600
0.50	17.7	0.00	8.25	600
0.75	17.7	0.00	8.30	600
1.00	17.7	0.00	8.20	600
1.17(bot)	17.7	0.00	5.00	600

Station: Mouth of Noble Gulch, 0748 hr.

surf	17.3	0.00	8.20	580
0.25	17.3	0.00	8.13	590
0.50	17.3	0.00	8.06	590
0.75	17.3	0.00	8.50	590
1.00	17.3	0.00	8.60	590
1.20	17.0	0.00	7.40	600



Conclusions: Water temperature was about the same at the trestle as two weeks previous, but upper sites were warmer. Oxygen levels were even higher than in June, except at Noble Gulch, with the lowest ratings of fair at the Bridge and trestle at the bottom.

23 July 1996. It was Tuesday. Surface algae was gone except for 2% on surface in Reach 3. Thin layer of algae in tufts on the bottom. Gray water at Noble Gulch. Bread crumbs were on the bulkhead at the trestle. Observed only 2 geese. Streamflow of 5-6 cfs at Nob Hill. Construction of walk bridge at Perry Park has begun. Intent was to be finished by late October. Steep road cut on west bank needing proper revegetation.

Station: Flume; 0658 hr. Foggy and overcast. Gage height = 2.09
Flume entrance > 12 inches in depth. Flume exit = 16 inches.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	19.8	0.00	8.70	660
0.25	19.7	0.00	8.66	660
0.50	19.7	0.00	8.60	660
0.75	19.7	0.00	8.57	660
1.00	19.7	0.00	8.48	660
1.05(bot)	19.7	0.00	7.20	670

Station: Stockton Avenue Bridge, 0720hr. Secchi depth to bottom.

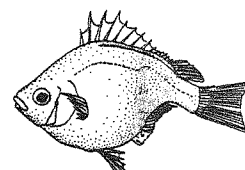
surf.	19.8	0.00	8.60	660
0.25	20.0	0.00	8.51	660
0.50	20.0	0.00	8.52	660
0.75	20.0	0.00	8.55	660
1.00	20.0	0.00	8.06	660
1.25	20.0	0.00	7.65	660
1.50(bot)	20.0	0.00	6.97	650

Station: Railroad trestle, 0745 hr.

surf.	19.7	0.00	8.73	640
0.25	19.7	0.00	8.66	650
0.50	19.8	0.00	8.70	650
0.75	19.8	0.00	7.20	630
1.00	19.4	0.00	6.32	630
1.07(bot)	19.4	0.00	4.60	630

Station: Mouth of Noble Gulch, 0800 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	18.8	0.00	7.90	620
0.25	18.9	0.00	7.70	620
0.50	18.9	0.00	7.70	610
0.75	18.3	0.00	8.06	600
1.00	18.2	0.00	7.80	600
1.20(bot)	18.0	0.00	5.65	600



Conclusions: Water temperatures were noticeably warmer than the previous monitoring, but cooler than the previous year and in the good to fair range. Oxygen levels were less than two weeks before, with fair to good ratings near the bottom and a poor rating at the bottom at the trestle.

5 August 1996. It was Monday. Paul Wilson had asked Ed Morrison about the source of aquazine in the lagoon. Ed knew of no use of aquazine at the lagoon. The City no longer uses aquazine to control algae. Eleven mergansers were observed in the stream above Nob Hill as they headed toward the lagoon. Three geese at Venetian Court beach. Reach 1 had no surface algae with 15% of the bottom with algae 0.2-0.4 feet thick and 85% a film 0.1 feet thick. Reach 2 had no surface algae. Reach 3 had a raft of algae 50' X 80' in dimension between Noble Gulch and the Shadowbrook and 2% surface algae in general. Gray water was present at Noble Gulch.

Station: Flume; 0730 hr. Overcast. Gage height = 2.06. Flume entrance 6-8 inches in depth. Flume exit = 9 inches. Air temp. 15.3 C.

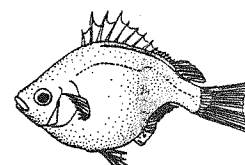
Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	19.2	0.00	7.71	660
0.25	19.3	0.00	7.60	660
0.50	19.5	0.00	7.65	660
0.75	19.5	0.00	7.60	660
1.00	19.5	0.00	7.55	660
1.05(bot)	19.5	0.00	6.38	680

Station: Stockton Avenue Bridge, 0755hr. Secchi depth to bottom.

surf.	19.0	0.00	7.70	650
0.25	19.3	0.00	7.70	650
0.50	19.3	0.00	7.60	650
0.75	19.3	0.00	7.65	650
1.00	19.3	0.00	7.60	660
1.25	19.3	0.00	7.35	660
1.45(bot)	19.2	0.00	5.15	670

Station: Railroad trestle, 0820 hr.

surf.	19.0	0.00	8.81	630
0.25	19.1	0.00	8.75	640
0.50	19.2	0.00	8.70	640
0.75	19.2	0.00	8.10	640
1.00	18.9	0.00	7.95	640
1.05(bot)	18.9	0.00	5.35	650



Station: Mouth of Noble Gulch, 0835 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	17.9	0.00	7.05	620
0.25	17.9	0.00	6.86	620
0.50	17.9	0.00	6.87	620
0.75	17.4	0.00	7.23	620
1.00	17.4	0.00	7.05	620
1.13(bot)	17.5	0.00	4.20	630

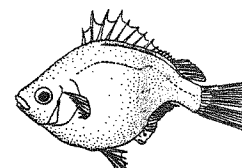
Conclusions: Water temperatures were similar to July. Oxygen levels were rated good near the bottom and poor at the bottom only at Noble Gulch. Oxygen levels were less than two weeks before. The gage height was still above 2.00, which was desirable.

14 August 1996. A forced sewer main line was ruptured on the afternoon of 14 August and sewage entered the lagoon under Stockton Avenue Bridge and under the restaurants on the Esplanade. The original estimate was that 50,000 gallons entered the lagoon. Later, Laura Brown of the Soquel Water District stated that the estimate was reduced to 30,000 gallons. The spill occurred at approximately 1430 hr. I was notified by Ed Morrison of the City between 1530 and 1600 hr of the spill. I arrived at the lagoon at 1650 hr. The highway was jammed up to slow the arrival. The gage height was 2.00. I pulled the framed screens and a board up from both sides of the flume inlet to partially drain the lagoon. I met Fish and Game personnel afterwards. They were concerned that steelhead and tidewater goby may leave the lagoon through the flume. This was unwarranted with a partial drainage. I had talked with Jerry Smith before arriving. We agreed that an effort to drain sewage out of the lagoon was advisable to reduce the biological oxygen demand and oxygen depletion following the spill. Our goal was to maintain 2 feet of depth at the mouth of Noble Gulch, which would allow a drain of approximately 1 foot of depth at the flume. I reinstalled the flume boards at 2025 hr with a gage height of 1.40. No dead fish were observed this day. Nine mergansers were observed patrolling the lagoon. No fish captures were observed.

15 August 1996. A pied-billed grebe was swimming just upstream of the Stockton Avenue Bridge. No dead fish were observed.

Station: Flume, 0703 hr. Gage height = 1.80 @ 0800hr and 1.82 @ 0855hr. Air temp.= 13.8 C.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.3	0.00	8.05	680
0.25	20.3	0.00	8.00	680
0.50	20.3	0.00	8.15	680
0.75	20.2	0.00	8.05	670
0.87(bot)	20.2	0.00	7.80	670



Station: Stockton Avenue Bridge near bulkhead, 0730 hr.

surf.	20.7	0.00	8.20	690
0.25	20.7	0.00	8.10	680
0.50	20.7	0.00	8.05	680
0.75	20.7	0.00	8.04	680
0.87(bot)	20.05	0.00	5.81	680

Station: Railroad trestle, 0743 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.1	0.00	8.05	660
0.25	20.3	0.00	8.02	670
0.50	20.2	0.00	7.94	680
0.75	20.1	0.00	7.46	670
1.00(bot)	19.7	0.00	4.37	670

Station: Venetian Court, 0804 hr.

surf.	20.4	0.00	8.30	670
0.25	20.4	0.00	8.10	670
0.50	20.4	0.00	8.11	670
0.75	20.3	0.00	8.06	670
1.00	20.2	0.00	7.87	670
1.25	20.1	0.00	7.30	670
1.50(bot)	20.1	0.00	5.78	670

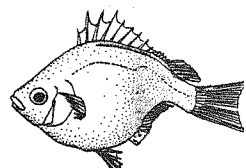
Station: Fog Bank Restaurant, 0830 hr.

surf.	20.4	0.00	7.94	-
0.25	20.4	0.00	7.90	-
0.50(bot)	20.0	0.00	5.30	-
0.65	-	-	-	670

(20 feet out from Fog Bank)

Conclusion: The gage height had not fully recovered from the partial draining the afternoon before. Oxygen levels were fair to good near the bottom and poor at the bottom at the trestle. Oxygen levels were slightly lower than before the sewage spill. This was probably due to the slightly warmer lagoon than before. Conductivity was slightly higher than before the spill. Aquatic conditions were good for steelhead on this date.

16 August 1996. On 16 August in Reach 1, 30% of bottom covered with algae tufts 0.5-0.8 feet thick and 70% of the bottom 0.2-0.5 algae layer with occasional pondweed (1%) and none on surface. Reach 2, 100% of bottom covered with algae 0.2-0.4 feet thick and none on surface. In Reach 3, 100% of bottom covered with algae 0.2-0.5 feet thick and 20% of surface with algae. At Noble Gulch 40% of bottom with algae tufts 0.3-0.6 feet. 60% of bottom with thick layer to 0.3 feet thick. 30% of surface with algae. Sewage layer visible around spill pipe near Stockton Avenue Bridge. It was a lighter, olive green layer. Streamflow at Nob Hill had



significantly declined in two weeks to a visually estimated 3.25 cfs. No dead fish were observed. A green-backed heron was observed in Reach 3.

Station: Flume, 0705 hr. Gage height = 1.94.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.3	0.00	8.95	690
0.25	20.3	0.00	8.90	680
0.50	20.2	0.00	8.85	680
0.75	20.2	0.00	8.80	680
0.87(bot)	20.1	0.00	7.20	690

Station: Stockton Avenue Bridge near bulkhead, 0725 hr.

surf.	20.4	0.00	8.15	680
0.25	20.4	0.00	8.15	680
0.50	20.4	0.00	8.1	680
0.75	20.3	0.00	8.03	680
0.90(bot)	20.2	0.00	5.85	680

Station: Railroad trestle, 0735 hr.

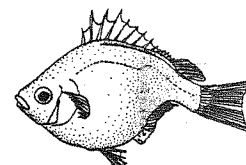
Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.1	0.00	8.20	670
0.25	20.1	0.00	8.20	670
0.50	20.1	0.00	8.18	670
0.75	20.1	0.00	8.10	670
1.00	20.1	0.00	8.05	670
1.05(bot)	20.0	0.00	4.85	670

Station: Mouth of Noble Gulch, 0750 hr.

surf.	18.9	0.00	7.2	640
0.25	18.8	0.00	7.2	640
0.50	18.8	0.00	7.2	640
0.75	18.5	0.00	7.2	630
0.95(bot)	18.2	0.00	5.35	615

Conclusion: The gage height had stabilized since the partial draining, leading to a slightly cooler lagoon than the previous day. Oxygen levels were slightly higher than the day before. The gage height had decreased into the lower fair rating since the monitoring in late August due to decreased streamflow. Water temperature was warmer and rated fair compared to early August. Oxygen levels were fair to good near the bottom with a poor rating at the trestle. Oxygen levels were as good as before the sewage spill, even though two days were given to allow sewage decomposition. Aquatic conditions were good for steelhead.

20 August 1996. It was Tuesday, cool and breezy. In Reach 1 there was 10% surface algae. Reach 2 had less than 1% surface



algae with a pied-billed grebe there and steelhead observed under the trestle. Reach 3 had two more pied-billed grebes and 2% surface algae. There was a brown deposit inside the Noble Gulch culvert, though there was no surface algae there.

Station: Flume, 0730 hr. Weather cloudy. Gage height= 2.00. Air temperature = 11.0 C.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	18.3	0.00	9.55	625
0.25	18.3	0.00	9.40	625
0.50	18.3	0.00	9.31	630
0.75	18.3	0.00	9.28	630
1.00(bot)	18.2	0.00	7.80	630

Station: Stockton Avenue Bridge, 0755 hr.

surf.	18.2	0.00	7.97	650
0.25	18.2	0.00	7.90	640
0.50	18.2	0.00	7.90	640
0.75	18.2	0.00	7.96	640
1.00	18.2	0.00	8.00	640
1.25	18.2	0.00	7.95	640
1.35(bot)	18.2	0.00	5.46	640

Station: Railroad trestle, 0812 hr.

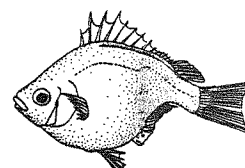
Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	17.7	0.00	8.60	620
0.25	17.7	0.00	8.40	610
0.50	17.7	0.00	8.31	600
0.75	17.7	0.00	8.31	600
1.00	17.7	0.00	8.15	580
1.05(bot)	17.7	0.00	5.25	580

Station: Mouth of Noble Gulch, 0830 hr.

surf.	16.8	0.00	6.85	620
0.25	16.8	0.00	6.80	610
0.50	16.8	0.00	6.78	600
0.75	16.7	0.00	7.17	600
1.00	16.3	0.00	6.95	580
1.05(bot)	16.3	0.00	6.52	580

Conclusion: Water temperature was substantially cooler than the previous monitoring, with fair gage height of 2.0. Oxygen levels were fair to good throughout the water column and bottom at monitoring stations. They were noticeably lower at Noble Gulch than other sites, though more than adequate for steelhead. There must have been added decomposition going on there to deplete nighttime oxygen levels somewhat.

2 September 1996. It was the Monday before the Begonia Festival.



Streamflow was holding at approximately 2.25 cfs by visual estimation. Juvenile steelhead were hitting the surface at 25 strikes/min in Reach 1. In Reach 1 the bottom was evenly distributed with tufts 0.5- 1 foot thick over 60%, and the remaining 40% had algae 0.3 feet thick. Approximately 1% of the bottom had pondweed 1-2 feet high in the center of Reach 1, with no surface algae. Reach 2 had 60% of the bottom with algal tufts 0.4-0.8 feet thick, with the remaining 40% being 0.3 feet thick. Reach 2 had no surface algae. Reach 3 had 100% of the bottom covered with algae 0.5- 1.0 feet thick, with no surface algae.

Station: Flume, 0716 hr, overcast. Gage height 1.96. Air temperature 14.7 C.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	20.0	0.00	8.67	670
0.25	20.0	0.00	8.60	670
0.50	20.0	0.00	8.60	670
0.75	20.1	0.00	8.58	670
0.95(bot)	19.8	0.00	5.60	670

Station: Stockton Avenue Bridge, 0734hr.

surf.	19.8	0.00	8.95	670
0.25	19.8	0.00	8.80	670
0.50	19.8	0.00	8.85	670
0.75	19.8	0.00	8.80	670
1.00	19.8	0.00	8.65	670
1.25	19.8	0.00	8.32	670
1.40(bot)	19.8	0.00	5.70	670

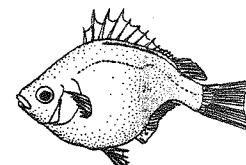
Station: Railroad trestle, 0810 hr.

Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	19.7	0.00	9.98	660
0.25	19.6	0.00	9.40	660
0.50	19.5	0.00	9.35	660
0.75	19.3	0.00	9.35	650
1.00	19.2	0.00	8.95	630
1.05(bot)	19.3	0.00	5.98	630

Station: Mouth of Noble Gulch, 0822 hr

surf.	18.3	0.00	8.71	640
0.25	18.3	0.00	8.65	650
0.50	18.3	0.00	8.55	640
0.75	18.2	0.00	8.60	620
1.00	17.8	0.00	8.60	605
1.05	17.8	0.00	7.20	600

Conclusions: Water temperature was back up as earlier in the summer as was the air temperature high. Oxygen levels were fair to good throughout the water column and at the bottom. Algae was



the densest of the summer, but not near the surface. Pondweed first became noted in Reach 1 where algae was the thickest. 8 September 1996. The Begonia Festival was observed. Lagoon height was maintained.

10 September 1996. Nearly all Begonias had been cleaned up. Only a few along the western, riparian edge remained to pose no problem with decomposition.

17 September 1996. It was Tuesday and sunny. The boards were elevated on the Venetian side of the flume entrance. I pushed them back down. An egret stood at Venetian Court beach with 3 geese. In Reach 1 there was 10% surface algae with 60% of the bottom with algae 0.5-1.0 feet thick. The remainder of the bottom had a thick film. Reach 2 had a pied billed grebe, 70% of bottom with 0.3-1.0 feet thick, and the remainder with film to 0.2 feet thick. No surface algae was in Reach 2. Reach 3 had 70% of the bottom with algae 0.3-1.0 feet thick. The surface had 15% algae coverage. Reach 3 had coots for the first time this season, along with pied-billed grebe, great blue heron in a cottonwood and 1 merganser. An oil slick and gray water plume extended from Noble Gulch, where there was 20% surface algae coverage and 70% of the bottom with algae 1 foot thick to surface. An algal bloom was occurring at Noble Gulch. Streamflow had increased to approximately 3.25 cfs at Nob Hill.

Station: Flume, 0730hr. Gage height = 1.90. Sunny.

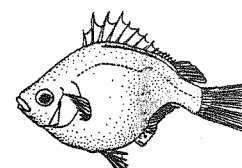
Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	17.2	0.00	9.75	620
0.25	17.2	0.00	9.65	620
0.50	17.2	0.00	9.65	620
0.75	17.2	0.00	9.55	620
0.90(bot)	17.2	0.00	7.85	630

Station: Stockton Avenue Bridge, 0750 hr

surf.	17.3	0.00	8.96	630
0.25	17.3	0.00	8.85	630
0.50	17.5	0.00	8.85	630
0.75	17.5	0.00	8.71	630
1.00	17.4	0.00	8.26	630
1.25	17.4	0.00	8.17	630
1.35	17.4	0.00	5.65	630

Station: Railroad trestle, 0810 hr.

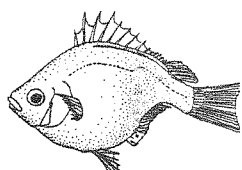
surf.	17.2	0.00	8.20	620
0.25	17.3	0.00	8.10	620
0.50	17.3	0.00	8.05	620
0.75	17.3	0.00	7.98	620
1.00	17.3	0.00	7.98	620
1.03(bot)	17.3	0.00	5.23	620



Station: Mouth of Noble Gulch, 0830 hr.

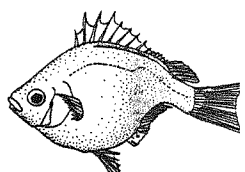
Depth(m)	Temp.(C)	Salin.(ppt)	Oxygen(ppm)	Cond. (umhos)
surf.	16.0	0.00	7.90	580
0.25	16.0	0.00	7.45	580
0.50	16.0	0.00	7.35	610
0.75	16.0	0.00	7.25	610
1.00(bot)	16.0	0.00	4.42	610

Conclusion: The oxygen levels were fair to good except at the bottom at Noble Gulch. It was remarkable that oxygen levels at the flume were so much higher than upstream. No negative habitat impacts were detected from the Begonia Festival. Algae at the bottom was at a similar level as before the Festival. Surface algae had developed. Gage height continued to decline, despite a slight increase in streamflow as leaves began to fall.




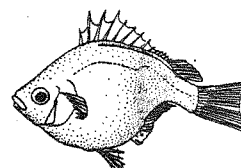
APPENDIX C.

**DRAIN LINE TEST FOR RESTAURANTS CONTIGUOUS WITH
SOQUEL CREEK LAGOON, 1996.**

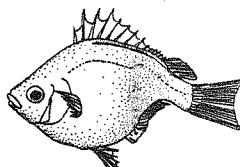


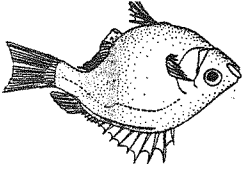
1996
DRAIN LINE TEST FOR RESTAURANTS
CONTIGUOUS WITH SOQUEL CREEK LAGOON

RESTAURANT	INITIAL CONTACT	TEST DATE	COMMENTS	SIGN OFF
Beach House 207 Esplanade Linda Simpson 475-5846	5/1/96	5/7/96	GREASE & SEWER OK	5/7/96 JK
Ocean View 209 Esplanade Perry Choy 475-0205	5/1/96	5/7/96	GREASE & SEWER OK	5/7/96 JK
Pizza My Heart 209(A) Esplanade Keith Holtaway 425-1411 426-2511	5/1/96	5/7/96	GREASE & SEWER OK	5/7/96 JK
Fog Bank 211 Esplanade Jim Williams 462-1881	5/1/96	5/7/96	GREASE & SEWER OK	5/7/96 JK
Larry's 215 Esplanade Larry 475-6215	5/1/96	5/3/96	Grease & Sewer OK	 5/3/96



APPENDIX D. PHOTOGRAPHS OF FISH CENSUSING ACTIVITIES.





Two Russians help the biologist pull in the seine.



Volunteers waiting to pull in the beach seine.

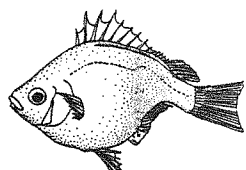


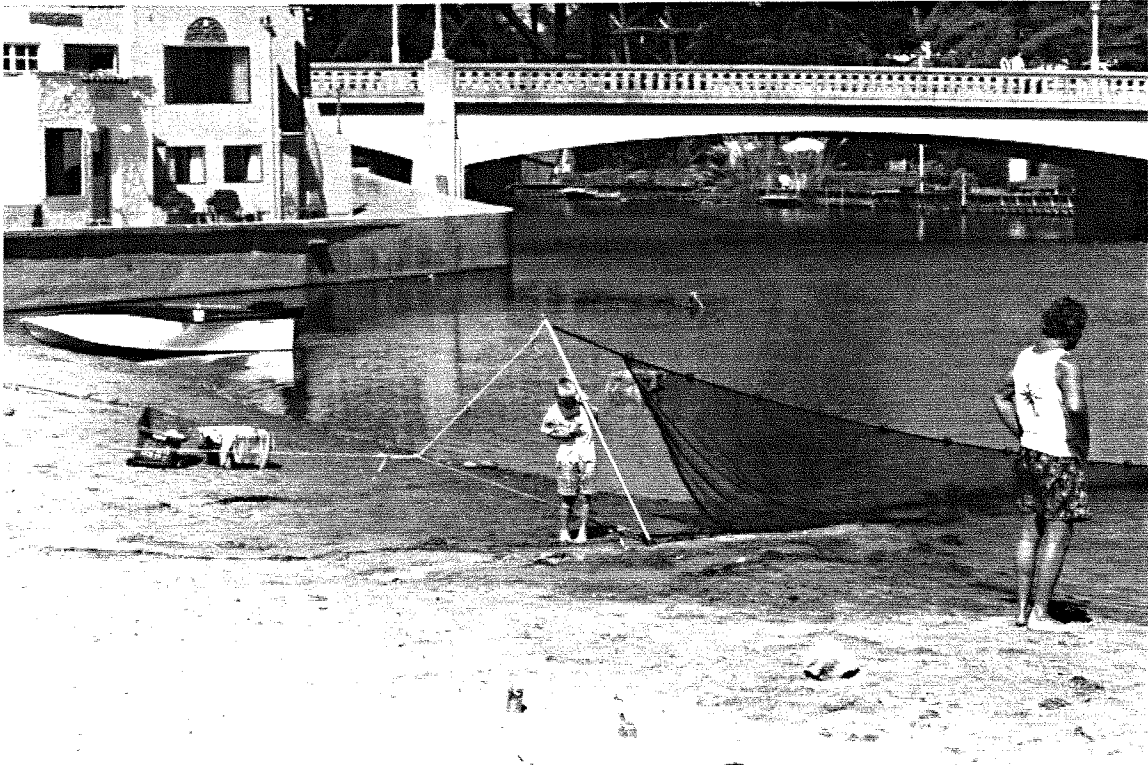


Holding the ropes while others head for the seine at the water.



The Texan does a little seine-pulling.

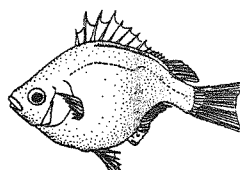




Critical job- holding the pole upright to prevent fish escape.



Raking out the algae from the seine's bag before beaching it.

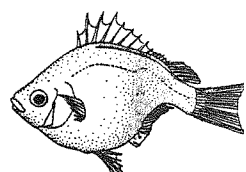




Pulling in the seine with the bottom weighted line on the bottom.



The seine is beached except for the center bag.

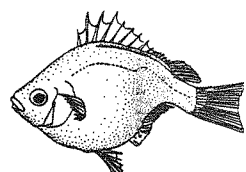


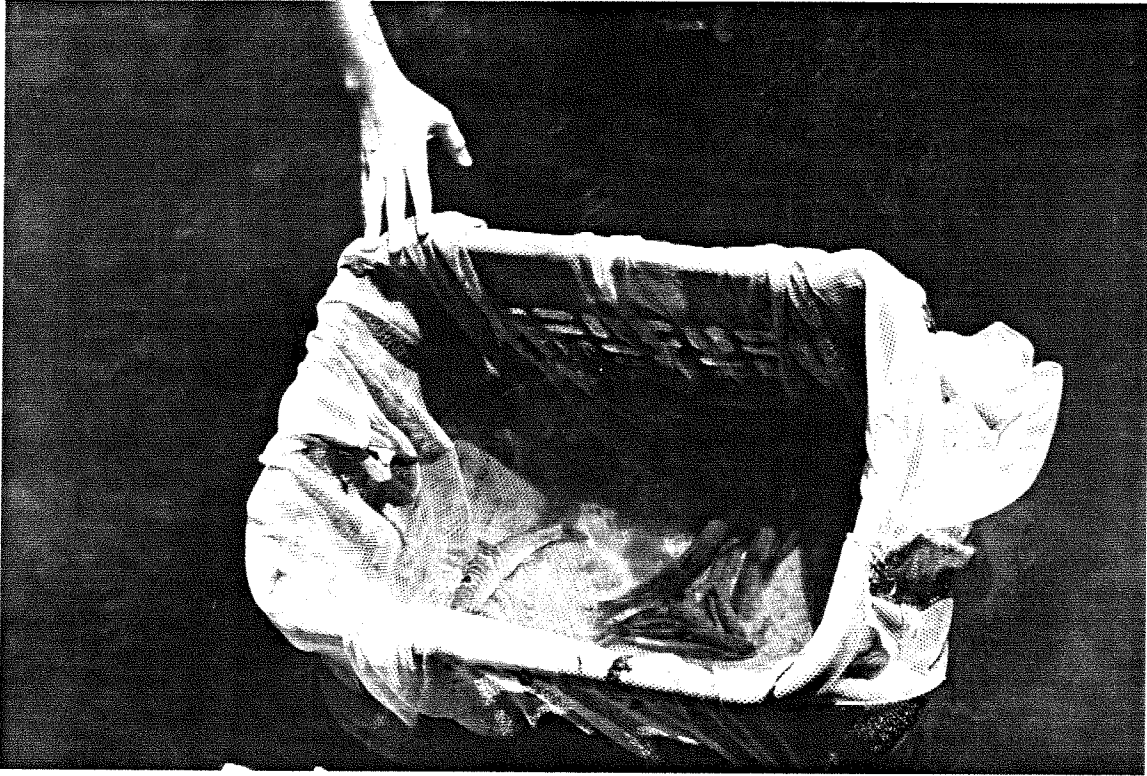


Pulling the bag onshore for more algae removal (Mader's focus) and fish removal into live cars (Alley's focus).

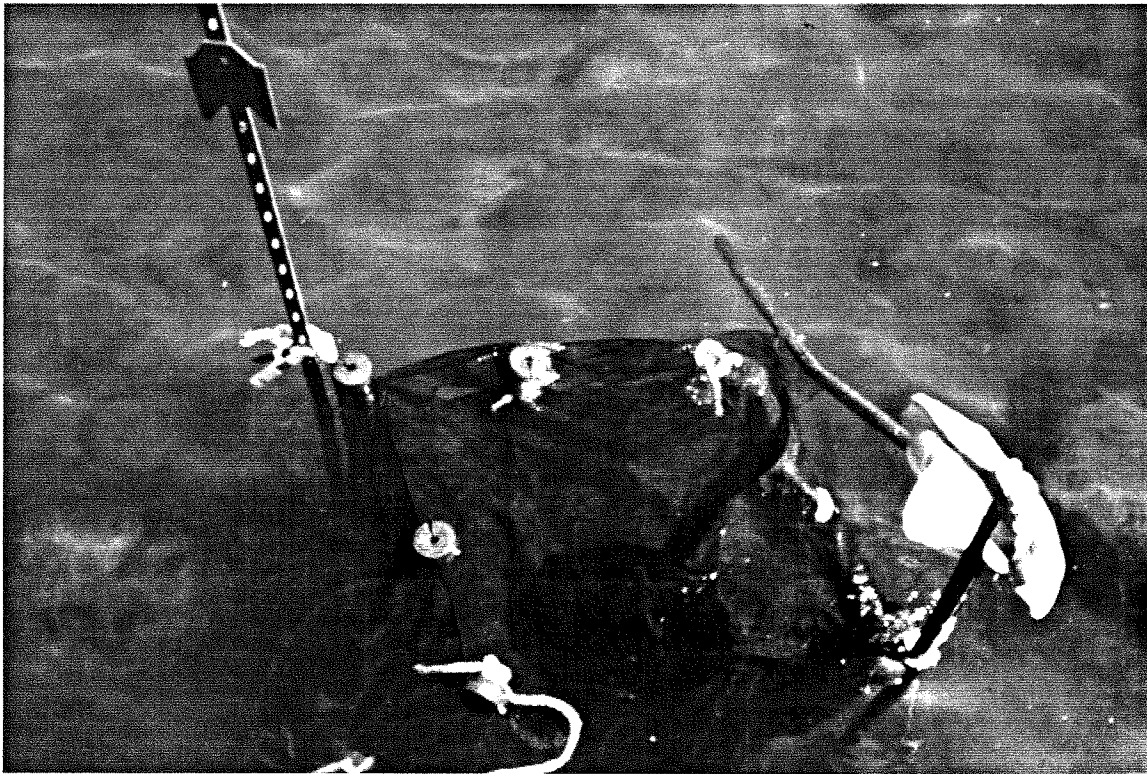


Steelhead removal from the seine's bag.

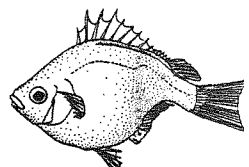




Captured steelhead in the live car.



Holding pin for steelhead during successive seine hauls.

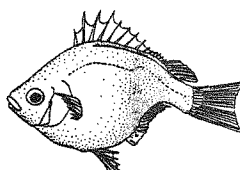


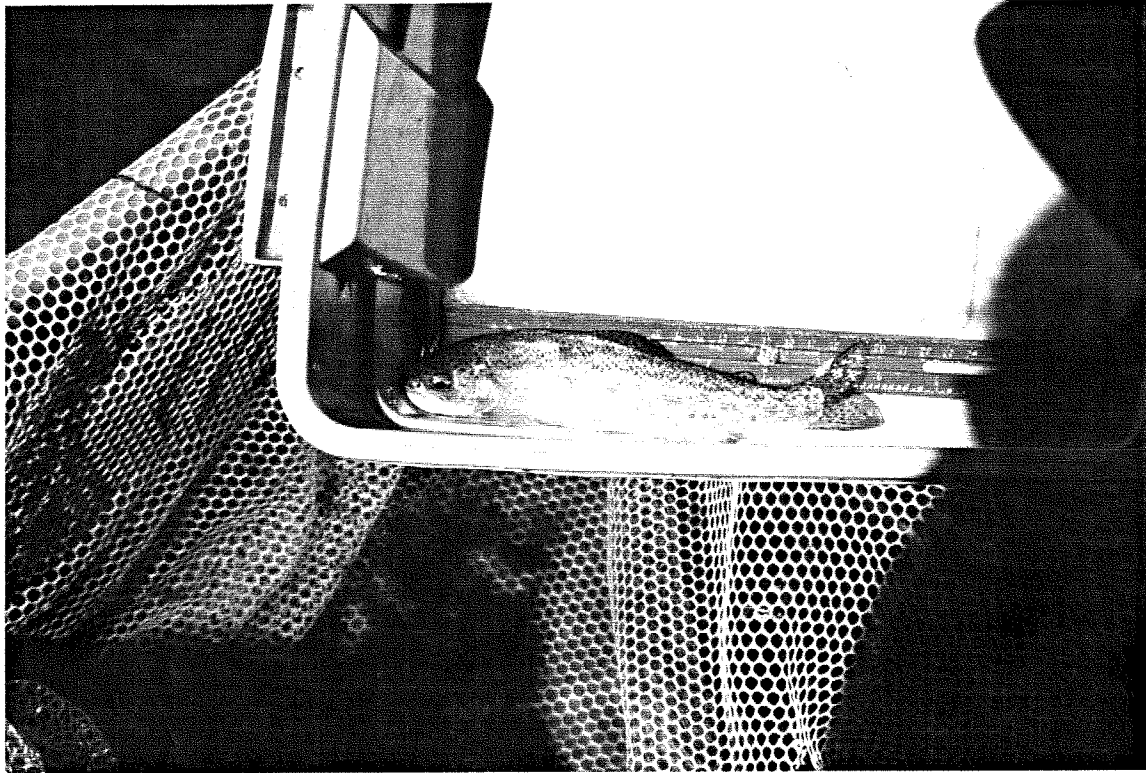


Transferring steelhead from live cars to the holding pin.



Measuring steelhead from the holding pin.

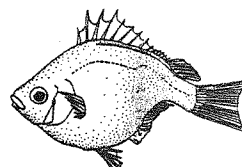


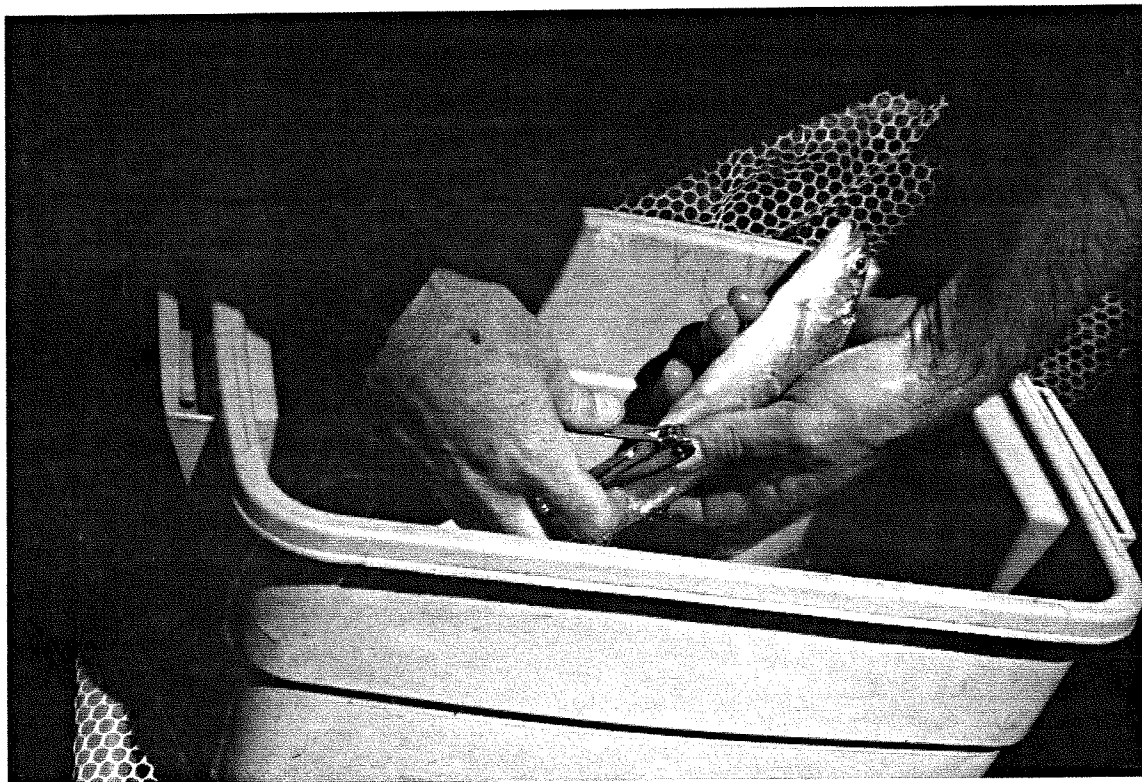


Measuring a juvenile steelhead at approximately 175 mm
Standard Length

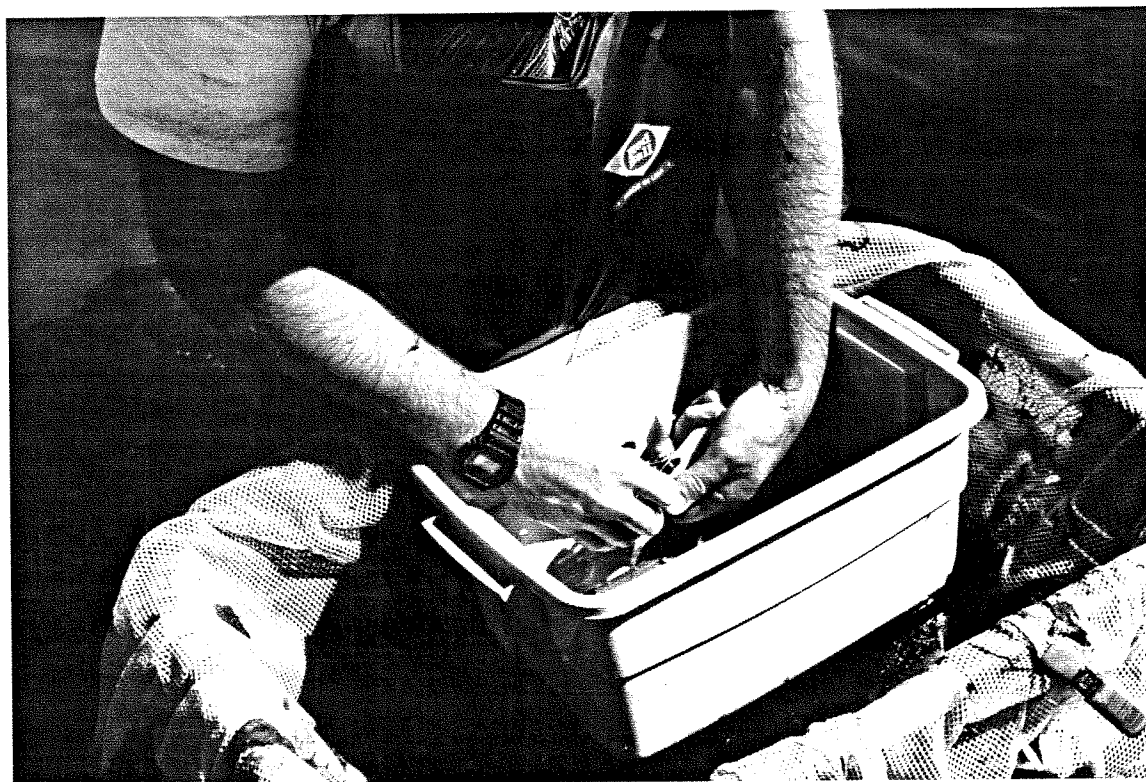


Measuring the steelhead with young helpers curiously looking on.

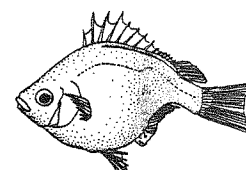




Marking a steelhead by partially clipping a pelvic fin.



Marking another steelhead after measuring and before release.





Admiring the steelhead before its release.



Releasing the steelhead.

