State of California
The Resources Agency
Department of Fish and Game

ALAMEDA CREEK, ALAMEDA COUNTY

Stream Inventory Report

by

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SPORT FISH RESTORATION

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INTRODUCTION

Alameda Creek, a tributary to the San Francisco Bay, once supported a native population of resident rainbow trout (*Oncorhynchus mykiss*), and its anadromous form, steelhead (Skinner 1962). Alameda Creek also contains a variety of native non-game warm water fish species. Today, some of these populations have declined due to urban development, water diversions, migrational barriers, and stochastic events.

There is a growing interest by conservation groups and resource agencies to improve instream habitat conditions in Alameda Creek for a biodiverstiy of native fish species. The San Francisco Water Department (SFWD) is exploring the feasibility of a conjunctive use program in which water may be released from Calaveras Reservoir to improve aquatic habitat conditions in Calaveras and Alameda Creeks, which could also be recaptured at a downstream location for distribution to SFWD customers.

A recent study completed by BioSystems Analysis, Inc., for the SFWD, recommends a water release and recapture program that would improve the aquatic habitat conditions for both cold water fish, such as rainbow trout, and warm water non-game fish species in Alameda Creek below Calaveras Reservoir. The water released would be recaptured at a facility constructed near the Sunol Water Treatment plant for distribution to SFWD customers.

Because of the possible establishment of increased perennial stream flow to Alameda and Calaveras Creeks below Calaveras Reservoir to the Sunol Water Treatment Plant, the Department of Fish and Game (DFG) conducted a stream inventory study in this reach of Alameda Creek during July, 1995. The purpose of the study was to provide baseline data on the current habitat conditions and identify fish species presence and relative abundance. The assessment will help DFG and others in developing a habitat restoration plan for the aquatic resources in Alameda Creek between Calaveras Dam and the Sunol Water Treatment Plant.

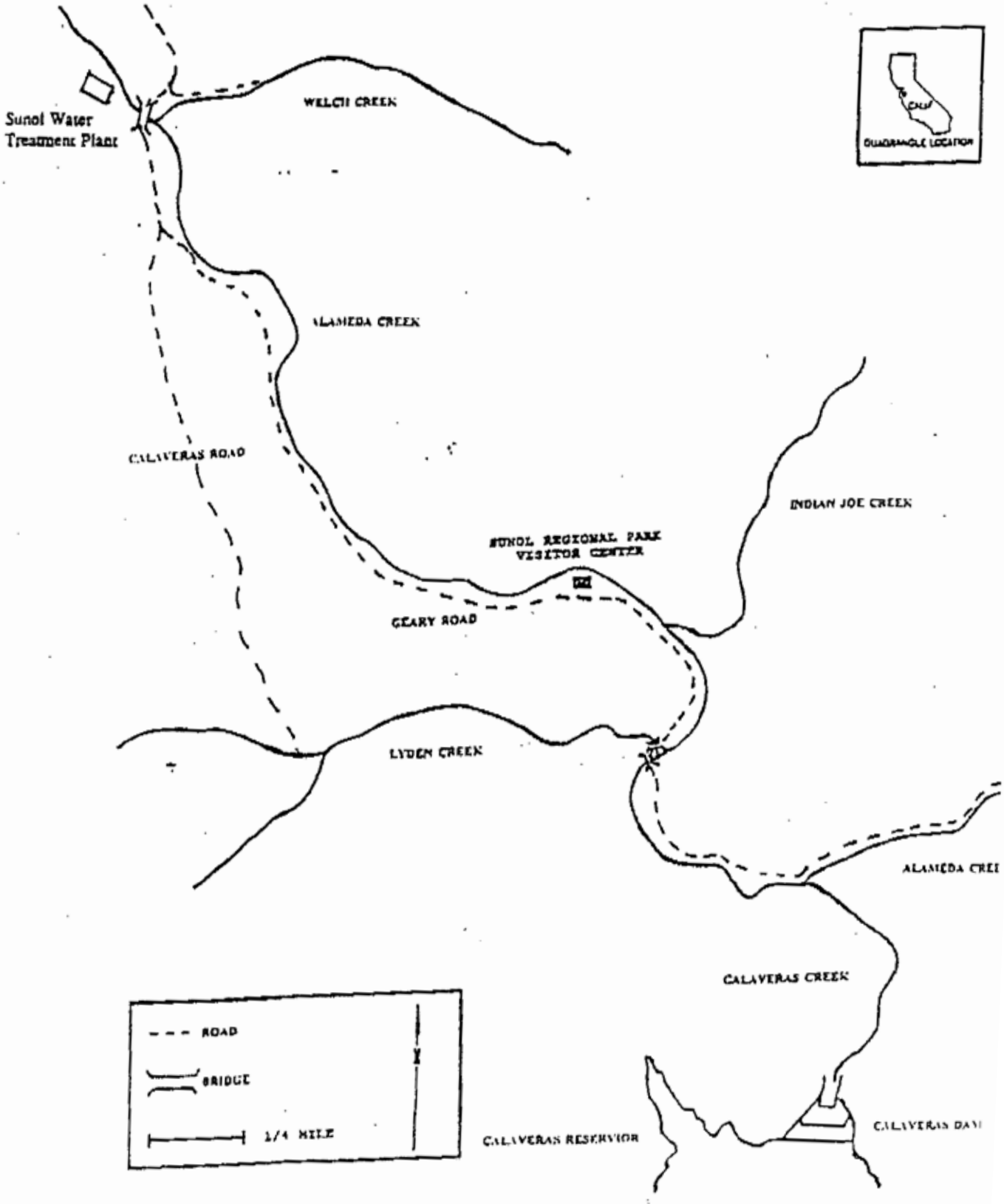
STUDY AREA

The stream inventory began, survey mile 0 (SM 0), in Alameda Creek at the Calaveras Road bridge crossing (T5S R1E S3), just upstream from the Sunol Water Treatment Plant and extended upstream to the Alameda and Calaveras Creeks confluence (Figure 1). A reconnaissance of Calaveras Creek from the Alameda Creek confluence upstream to the Calaveras Dam concluded that this reach of Calaveras Creek was unsuitable for the reestablishment of a trout population, because of the steep channel gradient and the channel substrate dominated by very large boulders. Therefore, Calaveras Creek was not included as part of the survey described in this report.

METHODS

The stream inventory followed methodology described in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds, 1994). The habitat inventory was done July 7-13, 1995, by Kyle Murphy, Fishery Biologist, and Scientific Aids, Andrew Boydstun and Nader Sidhom. A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the restoration manual. This form was used in Alameda Creek to record measurements and observations. Habitat units within each reach were separated into Level 2 groupings; Riffle-Flatwater-Pool. Approximately 10% of the units were randomly designated and habitat typed plus the first riffle, flatwater, and pool units encountered in each channel type. In addition, all side channel units were habitat typed. A maximum depth was recorded for all pool units. The habitat typing data was summarized using the Fish Habitat Type Data Manipulation Program (Curtis, 1995).

Figure 1. Location of study reach for stream inventory conducted on Alameda Creek, Alameda County, July 7-13, 1995.



The biological inventory was conducted July 18-20, 1995. This inventory was conducted with Smith-Root Type VII P.O.W. backpack electroshockers and the 3-pass depletion method for estimating fish populations was used. Mainstem habitat units were randomly selected and sampled. All fish captured were identified to species, measured to the nearest millimeter fork length, and usually weighed to the nearest gram. A sub-sample of weights was collected for a species when an abundance of any one species were collected. Weights for fish with unknown weights were estimated by length-weight regression of known weights for that species. Every effort was made to return all fish to the stream alive. Water chemistry parameters, pH, total alkalinity, and water temperature were collected in each unit electrofished.

Stream flows were measured with a Marsh-McBirney Model 2000 flowmeter at the beginning of the study reach (SM 0) and in Alameda Creek, immediately upstream of the confluence with Calaveras Creek. Stream flow for Calaveras Creek was estimated by subtracting the two flow measurements taken in Alameda Creek.

HABITAT INVENTORY RESULTS

***All tables and figures are located in Appendix A ***

The habitat inventory was conducted on July 7-13, 1995. The total length of Alameda Creek surveyed was 22,795.5 feet (4.3 miles), and included 3,122 feet of side channels.

The surveyed reach of Alameda Creek was classified as a C3 channel. A C3 channel is described as a low gradient (<2%) alluvial channel with a well-defined floodplain and a predominantly cobble substrate (Flosi and Reynolds, 1994).

A stream flow of 3.0 cfs was measured at the beginning of the survey reach on July 14, 1995. A flow of 1.5 cfs was measured on July 14, 1995, in Alameda Creek immediately upstream

of the confluence with Calaveras Creek. Stream flow in Calaveras Creek was estimated at 1.5 cfs.

Water temperatures collected throughout each day ranged from 64 to 75 °F. Air temperatures ranged from 63 to 85 °F.

In the mainstem, pools comprised 44% of the habitat units by percent occurrence, flatwater 35%, and riffle 21%. Pools made up 47% of the total survey length in the mainstem, flatwater 40%, and riffles 13% (Figure 2). In the side channels, pools made up 32% of the habitat units by percent occurrence, flatwater 56%, riffle 7%, and 5% of the side channel units were dry. Pools made up 20% of the total stream length in side channels, flatwater 75%, riffles 3%, and 2% of the side channel units were dry (Figure 3).

Figure 4 presents the maximum depth for pool units. Depth is one indicator used in evaluating pool quality. Fifty-one of the 57 main channel pools measured had a depth 2 foot or greater. The majority of the side channel pools had a maximum depth of 1-2 feet.

A shelter rating was calculated for each unit habitat typed and expressed as a mean value for each habitat type within the survey. Pool habitats had an average rating in both main channel and side channel units with ratings of 29 and 22, respectively. Flatwater and riffle habitats had poor ratings of 15 and 13, respectively, for main channel units, and 13 and five, respectively, for side channel units. A pool shelter rating closer to 100 is desirable.

Table 1 summarizes the mean percent instream cover by habitat type. In all mainstem habitat types, boulders and aquatic vegetation (filamentous algae) were the dominant forms of shelter for fish. Vegetation, aquatic or terrestrial, was the dominant type of instream cover in all side channel units.

Table 2 summarizes the dominant substrate by habitat type. Gravel and small cobble were the dominant substrates in main

channel units, while gravel was the dominant substrate in 50% or more of the side channel habitat types.

The depth of gravel embeddedness was estimated at pool tail-outs. Of the seven main channel pools examined, five had a value of 1 (< 25%); one had a value of 2 (25-50%), and one had a value of 3 (51-75%). In the 14 side channel pools measured, 11 had a value 1 and three had a value of 2 (Figure 5). An embeddedness value of 1 is best for fisheries.

The dominant element composing the structure of the stream banks was cobble/gravel (Figure 6). The mean percentage of the right and left stream banks covered with vegetation was 32% and 38%, respectively. Sixty-nine percent of the stream bank's dominant vegetative cover consisted of deciduous trees.

The mean percent canopy for the entire stream was 36%. The canopy present was composed entirely of deciduous trees.

BIOLOGICAL INVENTORY RESULTS

Eight habitat units were sampled on July 18-20, 1995. Six different fish species were identified: rainbow trout (*Oncorhynchus mykiss*), California roach (*Hesperoleucus symmetricus*), Sacramento sucker (*Catostomus occidentalis*), sculpin (*Cottus sp.*), Sacramento squawfish (*Ptychochelius grandis*), and threespine stickleback (*Gasterosteus aculeatus*). Sacramento sucker and California roach were the most abundant fish in the stream, comprising 57.3% and 38.7% of the total sample, respectively. The average lengths of fish sampled are presented in Table 3. Numerous small fish, assumed to be young-of-the-year roach and/or suckers were present in all sampled units, but not collected because of their small size. Because of the inability to collect all the fish in a habitat unit or the small number of a species collected, no attempt was made to estimate populations for any of the fish species.

Pools:

Three pool units were sampled. Pool units had an average area of 3,153 square feet and an average volume of 2,653 cubic feet. Four hundred eighty-four fish were captured and the sample contained the following species composition: 52% sucker, 44% roach, 3% squawfish, and less than 1% stickleback and rainbow trout, respectively.

Flatwater:

Two flatwater units were sampled. Flatwater units had an average area of 1,026 square feet and an average volume of 456 cubic feet. Four hundred forty fish were captured and the sample contained the following species composition: 60% suckers, 36% roach, and 4% sculpin.

Riffles:

Three riffle units were sampled. Riffle units had an average area of 1,164 square feet and an average volume of 659 cubic feet. Eight hundred and ten fish were captured and the sample contained the following species composition of: 60% suckers, 37% roach, and 1% rainbow trout, sculpin, and stickleback, respectively.

WATER CHEMISTRY RESULTS

The pH was measured in six locations throughout the study reach of Alameda Creek. The pH values measured in Alameda Creek ranged from 8.3 and 9.1. Total alkalinity was measured in five locations in the study reach of Alameda Creek. Total alkalinity values measured in Alameda Creek ranged between 180 and 195 milligrams/liter of $CaCO_3$.

DISCUSSION

This stream survey was conducted in July, 1995, following an unusually wet winter. Therefore, the stream flow measured during this survey is considered to above normal for this time of year.

The daily water temperatures measured during this survey ranged from 64 to 75 °F. Air temperatures ranged from 63 to 85 °F. Although the daily surface water temperatures were within the range of trout tolerance, the optimum water temperature for the growth and completion of most life history stages is between 55 and 69 °F (Moyle, 1976). A regulated summer flow of 7 cfs, proposed as the preferred fishery restoration plan in the Alameda Creek Watershed Preliminary Restoration Plan, is estimated to provide for an average daily stream temperature of 68 °F or less from Calaveras Dam downstream to the Sunol Regional Park (upper reach) during the peak heating period (Hager et. al, 1993). The proposed regulated summer flow is also designed to provide suitable stream temperatures for an assemblage of native warmwater non-game fish species from the Sunol Regional Park downstream the Sunol Water Treatment Plant (lower reach)(Hagar et. al, 1993). While the results of this study show that the proposed stream temperature may be obtainable, a monitoring program should be set up to ensure the temperature goals are met and maintained for both upper and lower project reaches.

The mean percent canopy in the study reach was estimated at 36%. The canopy protects the stream from solar warming and is important in maintaining cool water temperatures trout need. A stream that is 40 to 60 percent shaded is considered excellent (Hunter, 1991). Increasing the mean percent canopy in the upper reaches by the planting of native riparian vegetation would help in maintaining cool stream temperatures, especially during the peak heating periods of the summer. The riparian vegetation would also provide overhead cover for trout.

Pool units had an average shelter rating while flatwater and riffle units rated poor. The instream fish cover present in all

habitat unit types was provided primarily by boulders and filamentous algae. If cooler stream temperatures are maintained during the summer months in the upper reach, by regulated water releases from Calaveras Reservoir, the presence of algae should be minimal if not eliminated in this reach. Therefore, the cover ratings for the habitats in the upper reach would be less than measured during this survey. Consideration should be given to the placement of cover, such as woody debris (logs and root balls), in some habitat units. The placement of log and root ball structures in pool and flatwater units would improve both summer and winter salmonid habitat. These types of structures would provide trout and other fish species with protection from predation, rest from water velocity, and the division of territorial units to reduce density related competition. In streams where water quality or quantity are not limiting, cover is often positively correlated with fish density or biomass (Fausch et al., as referenced by Orth and White, 1993).

Pool units comprised 47% of the total length in the mainstem and 20% in side channels of the study reach. Pool units provide important rearing habitat for all fish species, especially during the summer low flow periods. The average depth of mainstem pools was 1.2 feet even though over 70% of the mainstem pools had a maximum depth of 2.0 feet or greater. Side channel pools were considered fair for fish habitat with an average depth of 0.7 feet. Placement of habitat structures that would create deeper pool habitats in both mainstem and side channels would be beneficial in providing more rearing area for fish.

Large areas of bank erosion were noted which are actively depositing sediment into the stream, especially in the lower reaches. Many of these areas are the result of the presence of cattle in and near the stream. Numerous stream banks have been broken down as the direct result of cattle entering the stream. The exclusion of cattle from the stream by fencing and replanting of native riparian vegetation would stabilize stream banks and reduce sediment deposition.

Spawning areas suitable for resident trout were present throughout the study reach. The substrate in most of the pool tail-outs was considered good for trout spawning. Gravel substrate in over 50% of the pool-tails surveyed were surrounded by less than 25% fine sediment. This could be a result of the high stream flows that resulted from the late winter and early spring storm events. A concern is that if erosion controls are not implemented, such as the exclusion of cattle and the restoration of stream banks, then spawning areas could become significantly embedded by fine sediment and useable spawning habitat limiting.

No significant water quality concerns were identified during this study, although the pH values were slightly higher than preferred by rainbow trout. The pH values measured in the stream ranged between 8.3 and 9.1. Rainbow trout can live in a pH range of 5.8 to 9.6, but experience the best growth within a pH range of 7.0 to 8.0 (Moyle, 1976).

Filamentous algae grew profusely throughout the study area. The large amounts of algae reflect an abundance of organic nutrients in the stream, as well as the lack of stream canopy shading. The lack of stream canopy increases the amount of solar radiation to the stream on which the algae thrives. The presence of algae is not completely detrimental to the stream. It also provides a direct food source to the native Sacramento sucker, and sustenance to a plethora of aquatic microorganisms and macro-invertebrates which are essential to the food web. Aquatic plants (including filamentous algae), however, are uncommon in the typical stream habitats suited to rainbow trout (Moyle, 1976).

Aquatic invertebrates were diverse and found throughout the survey reach providing a variety of food for resident fish. The main invertebrates identified to order included trichoptera, ephemeroptera, diptera, plecoptera, and odonata.

A review of the biological inventory data revels that the current fish species assemblage is comprised mainly of native warm water non-game species. Riffle habitat units, comprising

only 21% of the habitat units by percent occurrence, contained the majority of the fish collected including the four rainbow trout collected.

Several man made structures, which are considered barriers to fish migration at the measured flow (3.0 cfs), were noted:

1.) At survey mile 2.5, adjacent to the campground, a concrete dam was built across the channel. This dam is a barrier to fish during periods of low stream flow.

2.) At survey mile 3.0, below a bridge crossing at the upper end of the campground, a gravel/cobble road crossed the stream. Combined with the heavy growth of cattails adjacent to the road, this road crossing is a passage barrier to fish during periods of low stream flow.

3.) Many temporary rock dams were built with stream substrate to create pools. These dams are believed to be for recreational use as they are located primarily in areas adjacent to the campgrounds. These dams, if left intact, often create barriers to fish passage during periods of low stream flow.

RECOMMENDATIONS

1.) Provide perennial stream flow in Alameda Creek from the Calaveras Confluence downstream to the proposed recapture facility site, near the Sunol Water Treatment Facility, to provide for water temperatures best suited for the growth and survival of all native fish species.

2.) Repair fencing to prevent damage to stream banks by cattle on Alameda Creek throughout the area surveyed.

3.) Improve fish passage at the concrete dam at SM 2.5 for all proposed regulated stream flows.

4.) Improve fish passage at the gravel/cobble road which crosses the stream at SM 3.0. Remove the dense growth of cattails adjacent to the road.

5.) Plant native riparian trees in order to increase the canopy in areas where lacking and to stabilize stream banks.

6.) Plant native riparian vegetation in areas of stream bank erosion to improve bank stability and decrease sediment deposition to the stream.

7.) Increase overhead fish cover in the pool and flatwater habitat units. Adding complexity to the available fish cover with large woody debris is desirable.

PROBLEM SITES AND LANDMARKS

The following landmarks and possible problem sites were noted. The distances were measured using a hip chain from the beginning of the survey:

0'	Begin survey on Alameda Creek at the bridge crossing of Calaveras road.
43'	10" diameter pipe on left bank contributed less than 1% to the flow of the stream (estimated).
50'	Welch Creek enters on the right bank. Tributary was dry at time of survey.
658'	Cattle crossing at the tail of a pool, causing erosion.
1012'	280' long median in the stream with large amounts of cow manure on it. The median was wet and the pollutants were leaching into the stream.
2338'	Broken 14' fiberglass boat on the left bank.
3562'	Small tributary enters from the right bank, contributing an estimated 1% to the flow. Water temperature was 61 °F @ 1315 h.
3876'	Seep on right bank.
4457'	Tributary on right bank entered at a gradient of 30 degrees, contributing an estimated 2% to the flow. Water temperature of 74 °F @ 1340 h.
4740'	Dirt road crossing causing stream bank degradation in immediate area of use.
6243'	Tributary on left bank contributing an estimated

5-6% to the flow. Water temperature of 65 °F @ 1455 h. It flows through a 4' diameter culvert which passes under Geary Road.

6666' Tributary on left bank contributing an estimated 2% to the flow. Water temperature of 60 °F @ 0900 h, mostly sub-surface flow. It flowed through a 4' diameter culvert which passed under Geary Road.

8338' Cattle trail along right bank next to stream cause of stream bank erosion.

8488' Dirt road present on the right bank.

8660' Masses of plastic fencing material were present on the right bank.

10435' Metal T-posts and plastic fencing material in stream.

10795' Sunol Regional Park boundary, marked by barbed wire fencing across the stream.

11268' Campground begins to parallel the stream.

11380' Channel banks have been degraded by trail crossings and recreational use.

12102' Foot bridge crossed stream from the campground.

12231' Dirt road crosses channel, causing bank erosion.

12560' 45' wide seep emerged from a steep bedrock wall on the left bank.

13340' Cement dam across the channel. A barrier to fish passage at low flows.

14587' Seep on right bank emerged from an entrenched

channel in the floodplain.

15081' Lyden Creek enters from the left bank, contributing an estimated 15-20% to the flow. Water temperature of 59 °F @ 1110 h.

15495' A vehicle bridge crossed the stream. This was the upper end of the campground and the road was closed to public vehicles beyond this point.

15595' A gravel/cobble road crossed the stream. Combined with dense growth of cattails, it creates a passage barrier under low stream flows.

17394' Erosion was present on the right bank next to a dirt road.

18026' Seep created two 2-3' deep pools in the left flood plain.

18141' Tributary entered on the left bank, contributing an estimated 2% to the flow. Water temperature of 65 °F @ 1445 h. Mostly subsurface flow.

19548' Confluence of Alameda and Calaveras creeks. Calaveras contributed an estimated 30% to the flow of Alameda Creek, at a temperature of 65 °F @ 1040 h.

END OF SURVEY

ACKNOWLEDGMENTS

The Department of Fish and Game would like to thank the Coyote Creek Riparian Station volunteers: Clifford Tom, Jeff Sicklesteel, and Janelle Johnson for their help in electrofishing, Dan Reasor from the East Bay Regional Park District's Sunol Regional Park for accommodations, and the San Francisco Water Department for access to Calaveras Creek.

REFERENCES

Hager, J., C. Marzuola, E. Bianchi, and J. Yoon. 1993. Alameda Creek Watershed Study Fishery Restoration Feasiblely Evaluation and Preliminary Restoration Plan. BioSystems Analysis, Inc. Final Report.

Curtis, T. 1995. Fish Habitat Type Data Manipulation Program. State of Calif., Resources Agency, DF&G Version 1.1.

Flosi, G., F.L. Reynolds. 1994. California Salmonid Stream Habitat Restoration Manual, State of Calif., Resources Agency, DF&G. 2nd Edition.

Hunter, C.J. 1991. Better Trout Habitat: A Guide to Stream Restoration and Management. Montana Land Reliance, Island Press, Washington D.C..

Moyle, P. B. 1976. Inland Fishes of California. University of Berkeley Press, Berkeley and Los Angles, California.

Orth, D.J. and J.R. White. 1993. Stream Habitat Management, Pages 205-228 *in* C.C. Kohler and W.A. Hubert, editors. Inland fisheries management in North America, American Fisheries Society, Bethesda, Maryland.

Skinner, J.W. 1962. An historical review of the fish and wildlife resources of the San Frahcisco Bay Area. Water Projects Branch Report No. 1. Calif. Dept. Of Fish and Game, Water Projects Branch, Sacramento, CA.

Figure 2. Percent of habitat types in the mainstem of Alameda Creek, Alameda County.

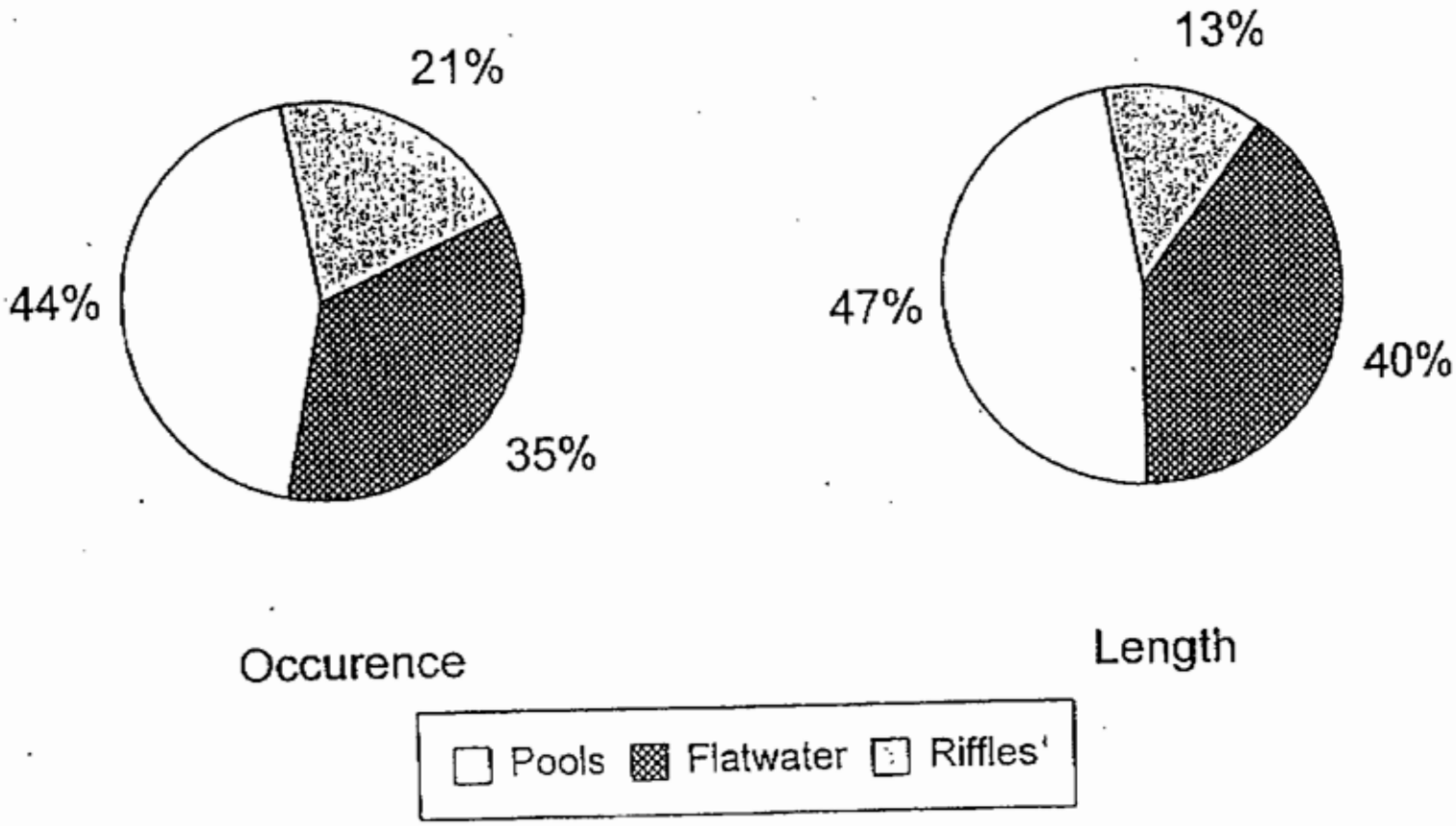


Figure 3. Percent of habitat types in side channels of Alameda Creek, Alameda County.

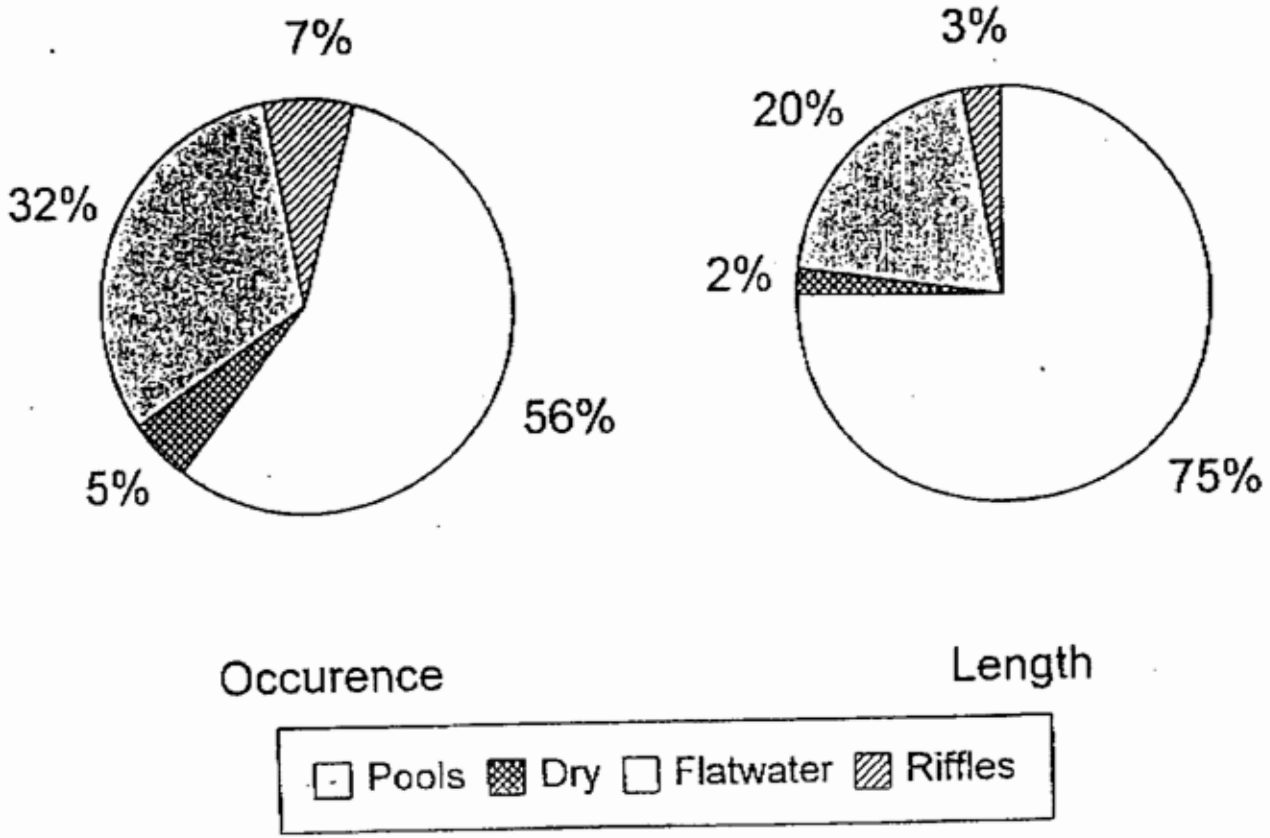


Figure 4. Maximum pool depths in Alameda Creek, Alameda County.

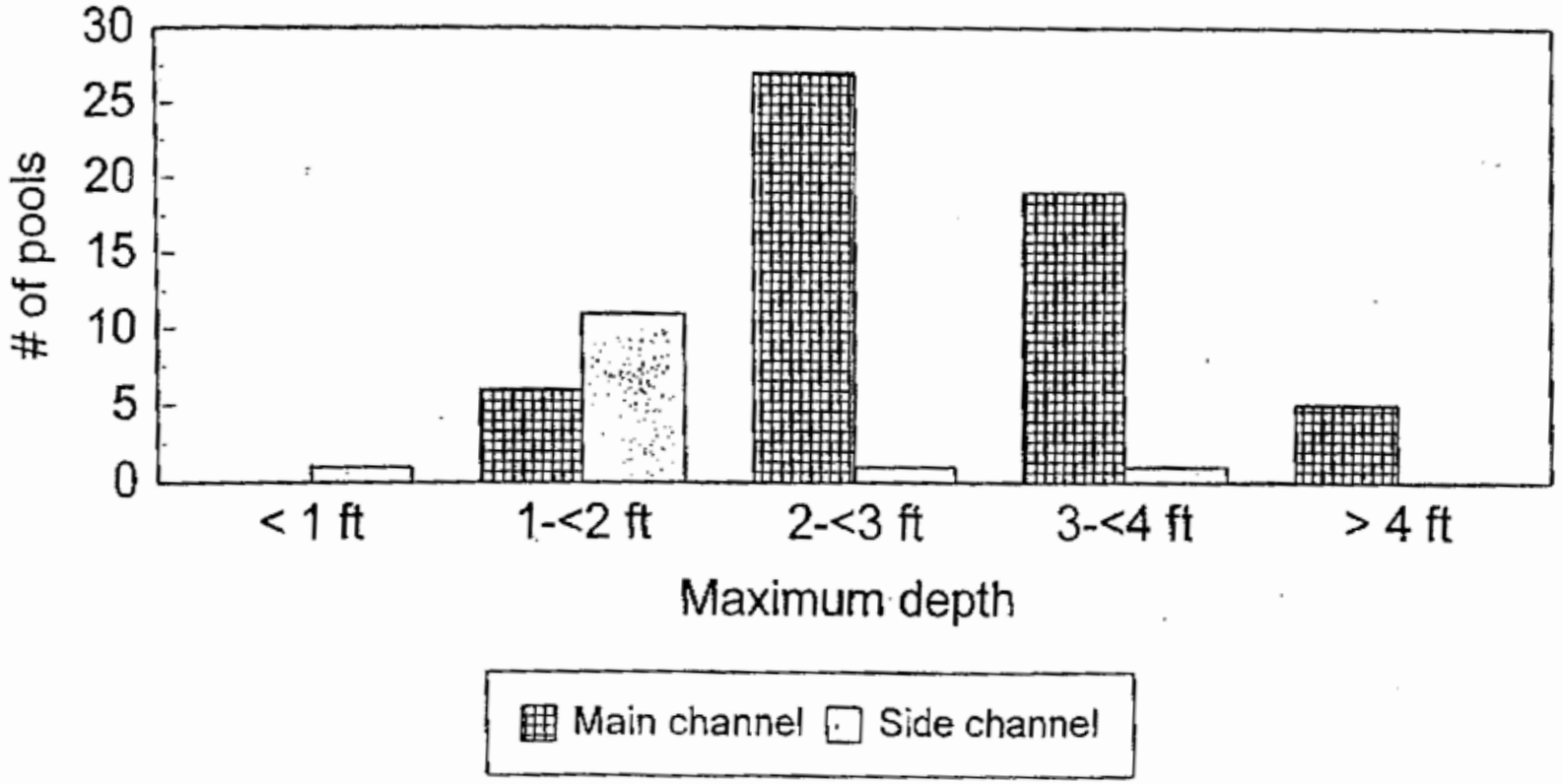


Figure 5. Percent gravel embededdness in Alameda Creek, Alameda County.

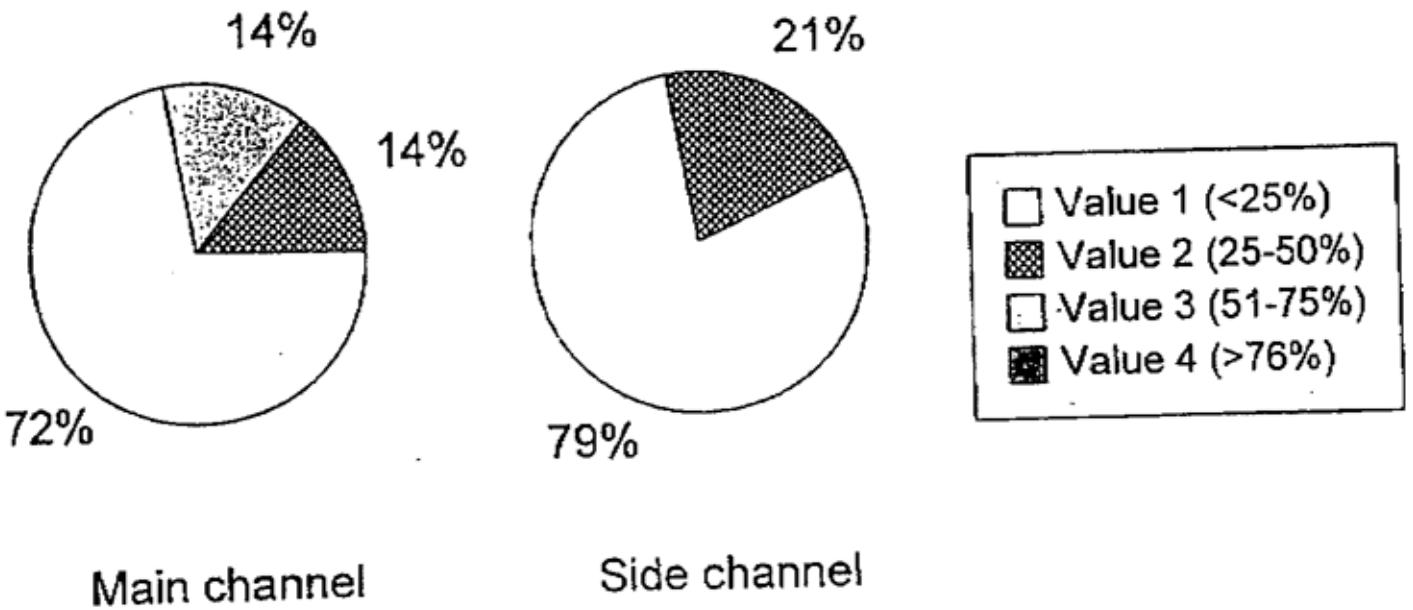


Figure 6. Dominant element composing structure of stream bank in Alameda Creek, Alameda County.

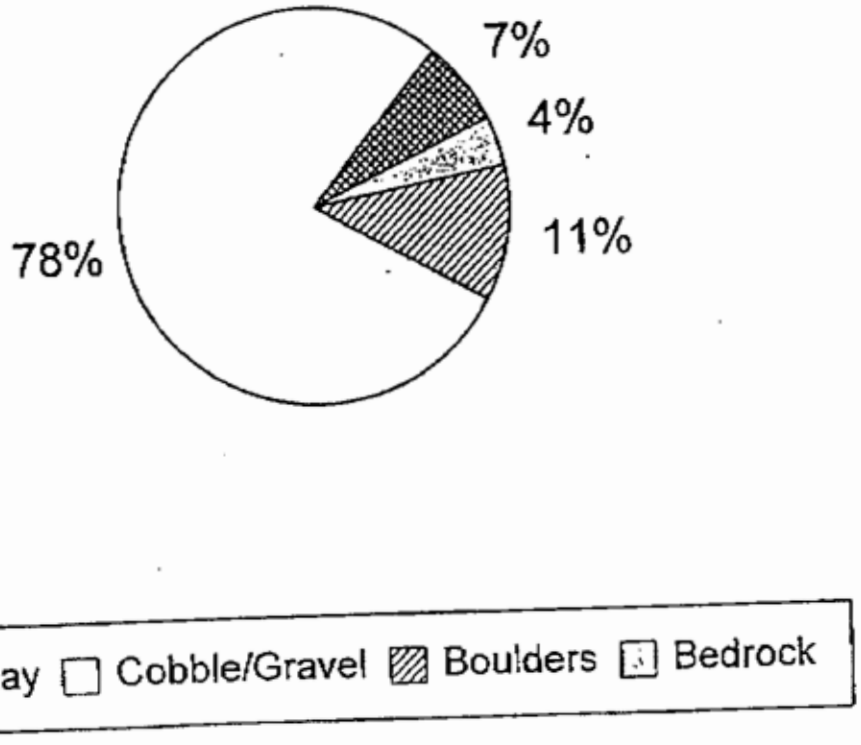


Table 1. Summary of mean percent cover by habitat type in Alameda Creek, Alameda County.

	% Undercut banks	% SWD & LWD	% Root Mass	% Terrestrial Vegetation	% Aquatic Vegetation	% White Water	% Boulders	% Bedrock Ledges
MAIN CHANNEL								
Riffles	0	0	0	7	31	7	55	0
Flatwater	5	4	5	13	48	0	6	19
Pools	5	16	11	14	17	0	31	6
SIDE CHANNEL								
Riffles	0	18	0	54	0	28	0	0
Flatwater	2	14	14	19	24	4	23	0
Pools	5	13	5	13	39	0	22	3

Table 2. Summary of dominant subtrates by habitat type in Alameda Creek, Alameda County.

	% Silt/Clay	% Sand	% Gravel	% Small Cobble	% Large Cobble	% Boulder	% Bedrock
MAIN CHANNEL							
Riffles	0	0	20	60	0	20	0
Flatwater	0	0	40	20	20	20	0
Pools	0	0	86	14	0	0	0
SIDE CHANNEL							
Riffles	0	0	67	0	33	0	0
Flatwater	4	4	50	29	13	0	0
Pools	0	14	50	29	7	0	0

Table 3. Mean length of fish sampled by species in Alameda Creek, Alameda County.

Species	Number Collected	Mean Length (mm)
Rainbow Trout	4	76 (68-79)
California Roach	675	47 (18-99)
Sacramento Sucker	1,000	58 (28-224)
Sculpin	29	51 (33-69)
Sacramento Squawfish	16	116 (99-189)
Threespine Stickleback	10	38 (37-45)