CALIFORNIA DEPARTMENT OF FISH AND GAME
STREAM INVENTORY REPORT
Maacama Creek
Report Revised April 14, 2006
Report Completed 1998
Assessment Completed 1996

INTRODUCTION

A stream inventory was conducted during the summer of 1996 and the summer of 1997 on Maacama Creek. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the amount and condition of available habitat to fish, and other aquatic species with an emphasis on anadromous salmonids in Maacama Creek. The objective of the biological inventory was to document the salmonid and other aquatic species present and their distribution.

The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for Chinook salmon, coho salmon and steelhead trout. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Maacama Creek is a tributary of the Russian River, located in Sonoma County, California (see Maacama Creek map, page 2). The legal description at the confluence with the Russian River is T9N, R8W, S20. Its location is 38E36'50" N. latitude and 122E46'57" W. longitude. Year round vehicle access exists from highway 128 and private roads via highway 128, near Calistoga.

Maacama Creek and its tributaries drain a basin of approximately 45 square miles. Maacama Creek is a fifth order stream and has approximately 5.5 miles of blue line stream, according to the USGS Mt. St. Helena, Healdsburg, and Jimtown 7.5 minute quadrangles. Major tributaries include Franz Creek, Briggs Creek, and McDonnell Creek, and each are described in separate stream reports. Elevations range from about 140 feet at the mouth of the creek to 3,060 feet in the headwaters.

The upper section of Maacama Creek lies in a wide U-shaped canyon predominantly bedrock by nature. In the lower section of the creek, the stream bed begins to widen for about 2.5 to 3 miles before narrowing and entering a steep-sided valley for approximately 1 mile. Near the mouth, the canyon is more open and

the creek runs through a small valley to enter the Russian River. The creek survey was divided into sections (upper and lower) due to these morphological and land use differences. The watershed is dominated by an oak-grass association, with the exception of the headwaters where vegetation consists of a digger pine, oak, and grass association. The riparian vegetation is generally abundant with alders and willows. The major land uses in the watershed are urban development, vineyards and cattle grazing.

METHODS

The habitat inventory conducted in Maacama Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 1998). The AmeriCorps Volunteers that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). This inventory was conducted by a two person team and was supervised by Bob Coey, Russian River Basin Planner (DFG).

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the California Salmonid Stream Habitat Restoration Manual. This form was used in Maacama Creek to record measurements and observations. There are nine components to the inventory form: flow, channel type, temperatures, habitat type, embeddedness, shelter rating, substrate composition, canopy, and bank composition.

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated. Flows were also measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1996). This methodology is described in the California Salmonid Stream Habitat Restoration Manual. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity.

3. Temperatures:

Water and air temperatures, and time, are measured by crew members with hand held thermometers and recorded at each tenth unit typed. Temperatures are measured in Fahrenheit at the middle of the habitat unit and within one foot of the water surface.
Temperatures are also recorded using remote Temperature recorders which log temperature every two hours, 24 hours/day.

4. Habitat Type

Habitat typing uses the 24 habitat classification types defined by McCain and others (1988). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled "DRY". Maacama Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. All unit lengths were measured, additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were completely sampled (length, mean width, mean depth, maximum depth and pool tail crest depth). All measurements were in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Maacama Creek, embeddedness was visually estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3), 76 - 100% (value 4). Additionally, a rating of "not suitable" (NS) was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All shelter is then classified according to a list of nine shelter types. In Maacama Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the shelter. The shelter rating is calculated for

each habitat unit by multiplying shelter value and percent covered. Thus, shelter ratings can range from 0-300, and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully measured habitat units, dominant and sub-dominant substrate elements were visually estimated using a list of seven size classes.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the California Salmonid Stream Habitat Restoration Manual, 1998. Canopy density relates to the amount of stream shaded from the sun. In Maacama Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated visually into percentages of evergreen or deciduous trees.

9. Bank Composition:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Maacama Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully measured unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. Biological inventory is conducted using one or more of three basic methods: 1) stream bank observation, 2) underwater observation, 3) electrofishing. These sampling techniques are discussed in the California Salmonid Stream Habitat Restoration Manual.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat, a dBASE IV data entry program developed by Tim Curtis, Inland Fisheries Division, California Department of Fish and Game. This program processes and summarizes the data, and produces the following tables and appendices:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Shelter by habitat types
- Dominant substrates by habitat types
- Vegetative cover and dominant bank composition
- Fish habitat elements by stream reach

Graphics are produced from the tables using Lotus 1,2,3. Graphics developed for Maacama Creek include:

- Level II Habitat Types by % Occurrence and % Total Length
- Level IV Habitat Types by % Occurrence
- Pool Habitat Types by % Occurrence
- Maximum Depth in Pools
- Pool Shelter Types by % Area
- Substrate Composition in Low Gradient Riffles
- Percent Cobble Embeddedness by Reach
- Mean Percent Canopy
- Mean Percent Canopy by Reach
- Percent Bank Composition and Bank Vegetation

HISTORICAL STREAM SURVEYS:

The Department of Fish and Game conducted surveys of Maacama Creek in August 1953, September 1962, April/May 1965, August 1965, March 1973, April 1973, and August 1973. In the September 1962 survey, The flow was intermittent in all sections. The air temperatures ranged from 65-75EF and the water temperatures were in the 60's.

Spawning areas were considered to be good to excellent throughout the creek, except for the upper forks area. The substrate consisted predominantly of bedrock, boulder, cobble, and gravel. Pools were found throughout the mid and upper sections of the creek, and also on the forks. Shelter was very good to excellent in the upper sections of the creek. Pools formed by boulders and large rocks provided most of the shelter.

Spring development was poor throughout the drainage. Diversions in the form of wells and well sumps were numerous in the lower section of the creek. Several diversions were also observed in the upper mid-section of the creek. No barriers were observed but several sumps were in the process of being built in the lower stretches of Maacama.

In the August 1965 survey, The flow was approximately 2.9 cfs at 0.5 miles upstream from the beginning of Briggs Road. The air temperatures ranged from 82-86EF and the water temperatures ranged from 72-74EF.

Spawning areas were considered to be good to excellent, with the spawning grounds covering 6.5 miles. The substrate consisted of 30% fine gravel, 40% coarse gravel, 28% fine cobble, and 2% coarse cobble. The frequency of pools was considered good. The pools were caused by the digging action of the current, rock jams, and undercut banks. Shelter ranged from poor in 15% of the stream's length, good in 36% of the stream's length, and excellent in 51% of the stream's length. Shelter consisted mostly of large rocks and overhanging vegetation.

No pollution, springs, or barriers were observed. The diversions observed consisted of three pumping stations. Two of the diversions were being used for sprinklers, and the use of the third diversion was unknown.

The March 28, 1973 survey was a partial survey that started at Chalk Hill Bridge and ended at the confluence of Maacama Creek and the Russian River. The flow was 1-3'/sec. The water temperature was 51EF and the air temperature was 64EF. Spawning areas were considered fair to poor. The substrate consisted of silt and sand. Cobble and gravel were not abundant in the area. Narrow pools were formed by undercut banks, with shelter consisting of abundant willows and oaks growing along the creek. No pollution or barriers were observed during the survey.

The March 30, 1973 survey was a partial survey that started at the Maacama Creek Ranch Bridge and ended at Camp Maacama. The water temperature was 53EF on an overcast rainy day. The substrate ranged from sand to cobble. The top half of the area surveyed was a continuous pool-riffle area. The bottom half of the surveyed area was a sluggish channel (1/2'/sec.) with a sandy bottom. Pools were considered good with shelter consisting of fallen or overhanging willows and oaks growing along the creek.

Pollution observed consisted of turbid water coming from Redwood Creek. The water was colorless upstream, but from the confluence of Maacama Creek and Redwood Creek downstream, the water was light brown. Two barriers were observed during the survey. One barrier was located at Camp Maacama and consisted of a bridge-type concrete barrier. The other barrier was located 1/4 mile downstream from Camp Maacama and consisted of a summer dam-type structure.

The April 1, 1973 survey was a partial survey that started at the Maacama Creek Ranch Bridge and ended at the Chalk Hill Bridge. The water temperature was 51°F at 1600 hrs in a shaded riffle. Spawning areas were considered good. The substrate consisted of sand with abundant gravel and cobble. Pools were formed by undercut banks and digger logs. Shelter consisted of trees (oak, conifers, and willows) that lined most of the edge of the stream. Diversions observed consisted of one large irrigation pump (6-8" diameter pipe) that was located 1/2 mile upstream from Chalk Hill Bridge. Domestic well pumps were also seen lining most of the stream. No pollution was observed during the survey.

The April 2, 1973 survey was a partial survey that started at the Maacama Creek Bridge and ended at the cable bridge on the LaFranchi's Ranch. The flow ranged from 1' to 5'/sec and the water temperature was 52°F. Spawning areas were considered good with large gravel and cobble available. The substrate was sand, but gravel and cobble were also abundant. The pool-riffle ratio was 1:1. The shelter consisted of oak and willow trees lining the stream. The one barrier seen consisted of a log jam with a cable holding the logs. The pollution observed consisted of the cattle from LaFranchi's Ranch using the creek for water defecating in the creek. No diversions were observed during the survey.

The August 1973 survey was a survey of the entire creek. The intermittent summer flows varied between 1.28 cfs to less than 0.1 cfs, and ended approximately three miles above the mouth. The average air temperature was 74°F and the average water temperature was 66°F.

Spawning areas consisted of approximately 80% of the lower three miles, 10% of the middle two miles, and 50% of the upper five miles. The substrate in the lower section of the creek consisted of 70% fine gravel and 30% sand. The substrate of the middle two miles consisted of 40% boulder, 40% gravel, and 20% silt. The substrate in the upper five miles of the creek consisted of 3% bedrock, 12% sand and silt, 50% fine gravel, 20% coarse gravel, and 15% boulders. Stagnant Pools were present in the lower three miles of the creek during the summer. One-half of the remaining creek was pool area. A minimum amount of shelter was provided by a few

undercut banks and boulders in the creek.

Fifteen diversions were observed along the creek, the majority of which were located in the lower three miles. The pollution observed was caused by livestock grazing. Several springs and a variety of barriers were also noted. Two earth dams were located in the upper five miles and according to the owner, they were washed away during the winter. A removable wooden dam with a concrete base was located at Camp Maacama. A torn down concrete bridge was also located at Camp Maacama.

HABITAT INVENTORY RESULTS - UPPER SECTION (Above HWY 128 Bridge)

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of Upper Maacama Creek was conducted October 14-29, 1996 by Sarah Nossaman, Stephanie Carey, and John Campo (AmeriCorps) and data analyzed by Ken Bunzel (DFG). The survey began immediately upstream of the Hwy 128 bridge (about 0.2 miles upstream of the confluence with Redwood Creek), and ended at the confluence with McDonnell Creek and Briggs Creek. The total length of the stream surveyed was 13,455 feet, with an additional 1432 feet of side channel. A flow of 0.77 cfs was measured on 10/30/96 at a pool just below the rope foot bridge (habitat unit 78, Reach 2), using a Marsh-McBirney Model 2000 flowmeter.

This section of Upper Maacama Creek has two channel types: from Hwy 128 Bridge to 5,259 feet a D4 (Reach 3) and the upper 8,196 feet an F4 (Reach 4).

D4 channel types are multiple channels with longitudinal and transverse bars. They have a very wide low gradient (<2%) channel with eroding banks and a predominantly gravel substrate. F4 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly gravel substrate.

Water temperatures ranged from 52-64°F and air temperatures ranged from 52-80°F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 35% pool units, 32% riffle units, 32% flatwater units, and 1% dry streambed units. Based on total **length** there were 34% riffle units, 33% pool units, 32% flatwater units, and 1% dry streambed units (Graph 1).

One hundred, fifty-five habitat units were measured and 14% were completely sampled. Thirteen Level IV habitat types were

identified. The data is summarized in Table 2. The most frequent habitat types by percent **occurrence** were low gradient riffles at 30%, runs 23%, mid-channel pools 15% and root wad scour pools 10% (Graph 2). By percent total **length**, low gradient riffles made up 33%, runs 24%, mid-channel pools 15%, and root wad scour pools 9%.

Fifty-five pools were identified (Table 3). Scour pools were most often encountered at 56%, and comprised 53% of the total length of pools (Graph 3). No backwater pools were identified. Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Twenty-three of the 55 pools (42%) had a depth of three feet or greater (Graph 4). These deeper pools comprised 18% of the total length of stream habitat.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Pool types had the highest shelter rating at 26. Riffles had the lowest rating with 6 and flatwater rated 9 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 32, and main channel pools rated 19 (Table 3). Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were root masses at 48%, and boulders at 22%. Graph 5 describes the pool shelter in Maacama Creek.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 6 of the 8 low gradient riffles measured. Small cobble was dominant in none of the low gradient riffles (Graph 6). The depth of cobble embeddedness was estimated at pool tail-outs. Of the 53 pool tail-outs measured, 2 had a value of 1 (4%); 39 had a value of 2 (74%); 7 had a value of 3 (13%); and 5 had a value of 4 (9%). On this scale, a value of one is best for fisheries.

The mean percent canopy density for the stream reach surveyed was 53%. The mean percentages of deciduous and evergreen trees were 76% and 23%, respectively. Graph 8 describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 59% and the mean percent left bank vegetated was 53%. For the habitat units measured, the dominant vegetation types for the stream banks were: 57% deciduous trees, 27% evergreen trees, 9% grass, 4% brush and 4% bare soil. The dominant substrate for the stream banks were: 46% silt/clay/sand, 45% cobble/gravel, 9% bedrock and 0% boulder (Graph 10).

HABITAT INVENTORY RESULTS - LOWER SECTION (Mouth to HWY 128 Bridge)

* ALL TABLES AND GRAPHS ARE LOCATED AT THE END OF THE REPORT *

The habitat inventory of Lower Maacama was conducted 08/27/97 to 09/04/97 by Sarah Nossaman & Stephanie Carey (AmeriCorps/DFG). The survey began at the confluence with the Russian River and extended up Maacama to the confluence with Redwood Creek and the end of landowner access. The total length of the stream surveyed was 24531 feet, with an additional 858 feet of side channel.

Flow was estimated to be 0.5 cfs during the survey period. Flow measurements were taken at Bridge #4 on 9/9/97.

This section of Lower Maacama has 3 channel types: from the mouth to 20014 feet a D4 (Reach 1); next 1864 feet an F4 (Reach 2) and the next 2653 feet a D4 (Reach 3).

D4 channel types are multiple channels with longitudinal and transverse bars. They have a very wide low gradient (<2%) channel with eroding banks and a predominantly gravel substrate.

F4 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly gravel/ substrate.

Water temperatures ranged from 63°F to 79°F. Air temperatures ranged from 63°F to 92°F. Summer temperatures were also measured using remote temperature recorders placed in pools (see Temperature Summary graphs at end of report). A recorder upstream of Chalk Hill Road Bridge (near Culbert property) logged temperatures every 2 hours from July 1 - September 27, 1997. The highest temperature recorded was 79°F in July and the lowest was 63°F in September.

Based on frequency of **occurrence** there were 49% flatwater units, 33% pool units, 12% riffle units, and 5% dry streambed units. Based on total **length** there were 56% flatwater units, 23% pool units, 16% dry streambed units, and 5% riffle units (Graph 1b and Table 1b).

One hundred fifty six habitat units were measured and 15% were completely sampled. Thirteen Level IV habitat types were identified. The data is summarized in Table 2b. The most frequent habitat types by percent **occurrence** were runs at 33%, glides 14%, low gradient riffles 12% and bedrock scour pools 12% (Graph 2b). By percent total **length**, runs made up 36%, dry streambed 16%, glides 15%, and bedrock scour pools 9%.

Fifty two pools were identified (Table 3b). Scour pools were most often encountered at 77%, and comprised 84% of the total length of pools (Graph 3b).

Pool quality for salmonids increases with depth. Twenty nine of the 52 pools (56%) had a depth of three feet or greater (Graph 4b and Table 4b). These deeper pools comprised 14% of the total length of stream habitat.

Flatwater types had the highest shelter rating at 33. Riffle had the lowest rating with 0 and pool rated 24 (Table 1b). Of the pool types, the backwater pools had the highest mean shelter rating at 55, scour pools rated 24, and main channel pools rated 22 (Table 3b).

By percent area, the dominant pool shelter types were terr. vegetation at 33%, small woody debris 27%, root masses 21%, and large woody debris 9%. Graph 5b and Table 5b describes the pool shelter in Lower Maacama.

Gravel was the dominant substrate observed in one of the two low gradient riffles measured. Small cobble was dominant in one of the low gradient riffles (Graph 6b and Table 6b).

Of the 51 pool tail-outs measured, three had a value of 1 (6%); sixteen had a value of 2 (31%); nineteen had a value of 3 (37%); and thirteen had a value of 4 (25%). Graph 7b describes percent embeddedness by reach.

The mean percent canopy density for the stream reach surveyed was 49%. The mean percentages of deciduous and evergreen trees were 63% and 37%, respectively. Graph 8b describes the canopy for the entire survey and graph 9b describes the canopy by reach.

For the entire stream reach surveyed, the mean percent right bank vegetated was 88% and the mean percent left bank vegetated was 67%. For the habitat units measured, the dominant vegetation types for the stream banks were: 66% deciduous trees, 27% evergreen trees, 5% grass, 2% brush and 0% bare soil. The dominant substrate for the stream banks were: 82% silt/clay/sand, 14% bedrock, 2% boulder and 2% cobble/gravel (Graph 10b).

BIOLOGICAL INVENTORY

In the August 1953 electro-fishing survey, 33 0+ to 2+ steelhead were observed along with 26 Sacramento suckers, 13 hardhead, 44 Sacramento pikeminnow, 147 California roach, 3 green sunfish, 1 Russian River Tule Perch, and 1 sculpin. Crayfish and juvenile

Pacific lampreys were also abundant during the survey.

In the September 1962 survey, cyprinids (California roach, Sacramento pikeminnow, or hardhead) were observed at a rate of 50/100' in the mid and upper sections of Maacama Creek. Snakes and frogs were also observed during the survey.

In the April/May 1965 fish trapping survey, 22 adult steelhead, 70 yearling steelhead, and 1020 0+ steelhead were trapped along with 72 bluegill, 125 California roach, 5 three-spine stickleback, 4 adult Sacramento pikeminnow, 1 Sacramento sucker, and 1 lamprey.

In the August 1965 survey, there were no fish present in the lower section of the creek. In the middle section of the creek, 0+ and 1+ steelhead were observed at a rate of 120/100' along with 500 juvenile California roach. In the upper section of the creek, fingerling steelhead were observed at a rate of 75/100' along with several 2+ steelhead. Sculpin were also observed in the upper section of the creek at a rate of 70/100'. There were also many frogs observed in the upper and middle sections of the creek. Approximately 400-600 head of cattle were also observed in the upper section of the creek.

During the March 1973 surveys, three-spine stickleback, California roach, juvenile steelhead, and Sacramento suckers were observed. From the Chalk Hill Bridge to the confluence with the Russian River, water turtles, raccoons, and deer tracks were observed. From Maacama Creek Ranch Bridge to Camp Maacama, newts, turtles, and deer were observed.

During the April 1, 1973 survey, one adult steelhead and 8-10 juvenile steelhead were observed along with three-spine sticklebacks, California roach, and 20+ Sacramento suckers. Pacific newts, turtles, and deer were also observed.

During the April 2, 1973 survey, one juvenile steelhead and more than 200 alevin steelhead were observed along with suckers, three-spine stickleback, and roach. Newts, frogs, turtles, a kingfisher, deer, and the LaFranchi's cattle were also observed during the survey.

In the August 1973 survey, four juvenile steelhead were observed in the upper reaches of the creek. Juvenile and adult Sacramento pikeminnow were present throughout the entire stream and were observed at a rate of 100/100'. Sacramento suckers and California roach were also observed throughout the entire stream. Bluegills were observed in deep pools and were estimated to occur at a rate of 2/100'. Frogs and turtles were also observed during the survey.

JUVENILE SURVEYS - UPPER MAACAMA:

On October 31, 1996 a biological inventory was conducted in two sites of Maacama Creek - upper section to document fish species composition and distribution. Each site was single pass electrofished using one Smith Root Model 12 electrofisher. Fish from each site were counted by species, and returned to the stream. The air temperature ranged from 58-60°F. The observers were Nossaman (AmeriCorps) and Campo (AmeriCorps).

The inventory of Reach 3 started at the pull out near the old "no hunting" sign on Highway 128 (habitat unit 45) and ended approximately 2,170 feet upstream in habitat unit 63. In riffle, run, and pool habitat types two 0+ steelhead were observed along with 630+ California roach, 76 Sacramento suckers, 5 sculpin (Cottus Sp.), 3 green sunfish, 2 Sacramento pikeminnow, and 1 crayfish.

The inventory of Reach 4 started at Stone's road crossing and ended approximately 1,675 feet upstream at the old barn in habitat units 102-111. In pool and riffle habitat types three 0+ and one 2+ steelhead were observed along with 307+ California roach, 17 Sacramento pikeminnow, 8 Sacramento suckers, 1 sculpin, and 2 pond turtles. The visibility was poor in most pools and some were too deep to access.

On October 21, 1997 a biological inventory was conducted in one site of Maacama Creek - upper section to document fish species composition and distribution. Each site was single pass electrofished using one Smith Root Model 12 electrofisher. Fish from each site were counted by species, and returned to the stream. The air temperature was 52°F. The observers were Coey (DFG), Carey, and Tarbel (AmeriCorps).

The inventory of Reach 4 started 718' downstream of the cement road crossing (habitat unit 078) and continued for 785'. In riffle and pool habitat types four 0+ and three 1+ steelhead were observed along with 39 Sacramento pikeminnow, 29 Sacramento sucker, many California roach, 8 sculpin, 1 green sunfish, 7 crayfish, 4 polliwogs, and 1 toad. Some of the pools in this section were too deep to access.

JUVENILE SURVEYS - LOWER MAACAMA:

On October 20, 1997 a biological inventory was conducted in three sites of Maacama Creek - lower section to document fish species composition and distribution. Each site was single pass

electrofished using one Smith Root Model 12 electrofisher. Fish from each site were counted by species, and returned to the stream. The water temperatures ranged from 57EF to 59EF and the air temperatures ranged from 61°F to 67°F. The observers were Coey (DFG), Carey, Parlato, and Tarbel (AmeriCorps).

The inventory of Reach 1 started 3,610' downstream of Chalk Hill Road Bridge and continued to Chalk Hill Road Bridge. In riffle and pool habitat types no steelhead were observed along with 12 Sacramento pikeminnow, 8 sculpin, over 40 California roach, over 60 Sacramento sucker, 1 crayfish, 3 hardhead, 1 small mouth bass, and 3 polliwogs.

The inventory of Reach 3 started at Moonie Bridge and continued for approximately 760'. In riffle and pool habitat types seven 0+ steelhead were observed along with 45 Sacramento pikeminnow, 8 sculpin, 26 Sacramento sucker, 1 yellow-legged frog, 2 green sunfish, 1 hardhead, 1 California roach, 6 stickleback, 2 polliwogs, and 1 Russian River Tule perch.

A summary of historical and recent data collected appears in the table below.

Species Observed in Historical and Recent Surveys

YEARS	SPECIES	SOURCE	Native/Introduced
1953,1965,1973,1996,1997	Steelhead Trout	DFG	N
1953,1962,1965,1973,1996,1997	Sacramento Pikeminnow	DFG	N
1953,1962,1965,1973,1996,1997	California Roach	DFG	N
1953,1962,1997	Hardhead	DFG	N
1953,1965,1973,1996,1997	Sacramento Sucker	DFG	N
1953,1965,1996,1997	Sculpin (Cottus sp.)	DFG	N

1953,1965	Pacific Lamprey (juvenile)	DFG	N
1965,1973,1997	Three-spine Stickleback	DFG	N
1953,1997	Russian River Tule Perch	DFG	N
1953,1996,1997	Green Sunfish	DFG	I
1997	Small Mouth Bass	DFG	I
1965,1973	Bluegill	DFG	I
1996,1997	Crayfish	DFG	N
1997	Yellow-legged frog	DFG	N

Historical records reflect that steelhead fingerlings were transferred to Maacama Creek on various occasions from 1958-1986 (Table 1.). Steelhead fingerlings were rescued/transferred from Maacama Creek on various occasions between 1955 and 1971 (Table 2.).

Table 1. Summary of fish transfers into Maacama Creek

YEAR	SOURCE	SPECIES	#	SIZE
1958	Sausal Creek	SH	2,750	FING
1959	Sausal Creek	SH	10,969	FING
1960	Dry Creek	SH	2,376	FING
1982	Dry Creek	SH	14,560	FING
1983	Dry Creek	SH	12,600	FING
1984	Dry Creek	SH	19,890	FING
1986	Dry Creek	SH	36,800	FING

Table 2. Summary of fish rescues/transfers from Maacama Creek				
YEAR	**RELEASE LOCATION**	**SPECIES**	**#**	**SIZE**
1955	Russian River	SH	1,848	FING
1956	Russian River	SH	5,646	FING
1957	Russian River	SH	16,330	FING
1958	Big Sulphur Creek	SH	1,548	FING
1959	Big Sulphur Creek	SH	6,429	FING
1959	Ingalls Creek	SH	13,715	FING
1960	Little Sulphur Creek	SH	3,006	FING
1960	Sausal Creek	SH	2,737	FING
1961	Little Sulphur Creek	SH	3,941	FING
1962	Big Sulphur Creek	SH	2,889	FING
1962	Little Sulphur Creek	SH	6,379	FING
1964	Russian River	SH	6,885	FING
1966	Russian River	SH	13,262	FING
1967	Russian River	SH	20,994	FING
1968	Russian River	SH	5,370	FING

Table 2. Summary of fish rescues/transfers from Maacama Creek				
YEAR	**RELEASE LOCATION**	**SPECIES**	**#**	**SIZE**
1969	Russian River	SH	14,274	FING
1970	Russian River	SH	3,318	FING
1971	Russian River	SH	2,240	FING

SH = steelhead
FING = fingerling

DISCUSSION - UPPER AND LOWER MAACAMA

Maacama has four channel types: Reach 1, D4 (20014 ft.), Reach 2, F4 (1864 ft.), Reach 3, D4 (7,912 ft.) and Reach 4, F4 (8,196 feet).

There are 22,667 feet of D4 channel type in Reach 1 and 3. There are 10,060 feet of F4 channel type in Reaches 2 and 4. According to the DFG Salmonid Stream Habitat Restoration Manual,

D4 channel types are fair for bank-placed boulders, single and opposing wing-deflectors and channel constrictors. Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

F4 channel types are good for bank-placed boulders and fair for low-stage weirs, single and opposing wing-deflectors, channel constrictors and log cover. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter.

The water temperatures recorded on the lower reach from 08/27/97 to 09/04/97 ranged from 63°F to 79°F. Air temperatures ranged from 63°F to 92°F. The water temperatures recorded on the upper reaches from October 14-29, 1996 ranged from 52-64°F and air temperatures ranged from 52-80°F. The warmer water temperatures were recorded in Reach 1. These temperatures, if sustained, are above the threshold stress level (65°F) for salmonids.

Summer temperatures measured using remote temperature recorders placed in pools ranged from 63° to 79°F for Reach 1. The Temperature Summary graph shows that for much of the summer (July through September) the lower watershed exhibited temperatures above the optimal for salmonids. In general, large numbers of warm water and exotic species were found here and very few salmonids. This is largely due to warm water temperatures and algae blooms which inhibit salmonid rearing conditions

It is unknown if this thermal regime is typical, but our electrofishing samples found steelhead more frequently in the upper, cooler sample sites. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and more extensive biological sampling conducted.

Pools comprised 23% of the total **length** of the lower reaches surveyed. In Lower Maacama, the pools are relatively shallow with 56% having a maximum depth of at least 3 feet. These pools comprised 14% of the total length of stream habitat. Pools comprised 33% of the total **length** of the upper reaches. In third and fourth order streams a primary pool is defined to have a maximum depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. In upper Maacama Creek, the pools are relatively deep with 42% having a maximum depth of at least 3 feet. These pools comprised 18% of the total length of stream habitat. In coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat length.

In the lower reaches, mean shelter rating for pools was 24. The relatively small amount of pool shelter that now exists is being provided primarily by terr. vegetation (33%), small woody debris (27%), root masses (21%), and large woody debris (9%). In upper reaches, mean shelter rating for pools was 26. However, a pool shelter rating of approximately 80 is desirable. The relatively small amount of pool shelter that now exists is being provided primarily by root masses and boulders. Log and root wad cover in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Log cover provides rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

In lower reaches, two of the two low gradient riffles measured (100%) had either gravel or small cobble as the dominant substrate. However, 63% of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 6% had a rating of 1. In upper

reaches, seventy-five percent of the low gradient riffles measured had either gravel or small cobble as the dominant substrate. Twenty-three percent of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 4% had a rating of 1. In a reach comparison, Reach 1 had the best ratings and Reaches 3 and 4 had the poorest ratings.

Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. The higher the percent of fine sediment, the lower the probability that eggs will survive to hatch. This is due to the reduced quantity of oxygenated water able to percolate through the gravel, or because of fine sediment capping the redd and
preventing fry emergence.

The mean percent canopy for the survey was only 51%. This is a very low percentage of canopy, since 80 percent is generally considered desirable. Cooler water temperatures are desirable in Maacama. Elevated water temperatures could be reduced by increasing stream canopy in the upper reaches where the stream channel narrows. The large trees required for adequate stream canopy would also eventually provide a long term source of large woody debris needed for instream structure and bank stability.

SUMMARY - UPPER MAACAMA

Biological surveys were conducted to document fish distribution and are not necessarily representative of population information. Steelhead were documented consistently during each past survey year while coho were not found during any of the surveys (although coho have been found in Redwood Creek, a tributary, and coho have been seen occasionally by long-term landowners). This is likely because physiological and environmental requirements for coho are more stringent than for steelhead, or coho were absent or present only in small numbers in some years. Overall, large numbers of warm water species such as Sacramento Pikeminnow, Sacramento Sucker, and California Roach were observed during past surveys. Steelhead were only observed in large numbers during the 1965 fish trapping survey. The 1996 fall survey documented very few 0+ fish indicating poor spawning conditions in Upper Maacama Creek. Large numbers of warm water species were observed including Green Sunfish, an introduced species. No 1+ and only one 2+ steelhead were observed indicating poor spawning conditions and/or poor rearing conditions the year before and poor holding-over conditions in general. Overall, habitat conditions for steelhead and coho have declined poor over time.

Although water temperatures taken during the fall survey were

relatively cool, summer temperatures are likely to be high due to the low stream shade canopy. The dominance of warm water species during most of the surveys indicates temperatures are typically high in this stream. Both reaches (Reach 3 & 4) have adequate spawning gravel with low levels of silt. However, the lack of 0+ fish observed during surveys indicates very little spawning is occurring. In addition, there is a lack of deep pools and shelter needed for juvenile rearing habitat.

SUMMARY - LOWER MAACAMA

Overall, very few steelhead and no coho were observed during the 1997 electro-fish surveys. Few 1+ steelhead were observed indicating poor spawning conditions the year before or poor rearing -over conditions in general. Overall, habitat conditions for both steelhead and coho have declined over time.

In general, Reaches 1-3 of Maacama Creek are in poor condition for salmon and steelhead habitat. Some long, deep sections of the stream occur which may be used as rearing habitat, however, shelter is lacking and stream temperatures are very high. Little riffle habitat exists for spawning, and what does exist is unsuitable for spawning due to high gravel embeddedness. The unstable banks in Reaches 1 and 3 limits instream habitat improvement alternatives, although some opportunity exists. Any work considered in these reaches will require careful design, placement, and construction that must include protection for the unstable banks and high stream velocities. In Reach 2 bank protection, and riparian planting is recommended. Reach 2 is good for bank-placed boulders and single and opposing wing-deflectors. They are fair for low-stage (low profile) weirs, boulder clusters and channel constrictors. Log cover structures can be used to increase instream shelter.

GENERAL RECOMMENDATIONS

Maacama Creek should be managed as an anadromous, natural production stream. A major refugia basin, the Brigss Creek Watershed, exists upstream of the mainstem of Maacama Creek. Currently, Maacama Creek mainly serves as a migration corridor to better habitat upstream. Maacama Creek could be restored to provide better habitat throughout.

Recent storms brought down many large trees and other woody debris into the stream, which increased the number and quality of pools since the date of this survey. This woody debris, if left undisturbed, will provide fish shelter and rearing habitat, and offset channel incision. Many signs of recent and historic tree and log removal were evident in the active channel during our survey. Efforts to increase flood

protection or improve fish access in the short run, have led to long term problems in the system. Landowners should be sensitive about the natural and positive role woody debris plays in the system, and encouraged not to remove woody debris from the stream, except under extreme buildup and only under guidance by a fishery professional.

SPECIFIC FISHERY ENHANCEMENT RECOMMENDATIONS

1) Reach 3 of this stream is being impacted from livestock in the riparian zone. Livestock in streams generally inhibit the growth of new trees, exasperate erosion, and reduce summertime survival of juvenile fish by defecating in the water. Alternatives to limit cattle access, control erosion and increase canopy, should be explored with the landowner, and developed if possible.

2) In Maacama Creek, active and potential sediment sources related to the road system need to be mapped, and treated according to their potential for sediment yield to the stream and its tributaries. Maintenance of ditches, culverts, and inboard cutbank slides should be improved to decrease the potential of sediment delivery Maacama Creek. During storms, surface runoff over the road causes outboard cutbank slides, delivering sediment and threatening the road integrity. This is primarily due to the existing conditions of the road drainage network.

3) Increase the canopy on Maacama Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels (portions of Reaches 1, 2, and 3). A potential bank erosion problem occurs in Reach 4 (habitat unit 107). In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

4) Map sources of upslope and in-channel erosion, and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream. Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffering against agricultural, grazing and urban runoff.

5) Increase woody cover in the pool and flatwater habitat units where feasible. Most of the existing shelter is from vegetation and undercut banks in Lower Maacama Creek and root masses and boulders in Upper Maacama Creek. Adding high

quality complexity with larger woody cover is desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion. In some areas the material is at hand.

6) If riparian areas are not improved in Reaches 1,2 and 3, temperatures in these lower sections of Maacama Creek, should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

PROBLEM SITES AND LANDMARKS - UPPER MAACAMA CREEK SURVEY COMMENTS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

HABITAT UNIT #	STREAM LEN (FT.)	COMMENTS
1.00	76	UPPER SECTION BEGINS IMMEDIATELY UPSTREAM FROM HWY 128 BRIDGE AND EXTENDS TO THE CONFLUENCE WITH MCDONNEL CREEK SM. WATER DIVERSION ON RT BANK
2.00	161	CONCRETE ABUTMENT ON LF BANK
3.00	210	DOZENS OF PIKEMINNOW, SEVERAL SUCKERS
12.00	709	DRAINAGE TRIB RT BANK
12.10	709	SAND BAR SEPARATING CHANNEL- 95% VEG
13.00	751	DRY SIDE CHANNEL RT BANK
15.00	919	7" SUCKERS MANY AQUATIC INSECTS IN GRAVEL
18.00	1181	COWS ON RT BANK
24.00	1525	AT SECOND TURNOUT PAST THE BRIDGE MANY PIKEMINNOW
25.00	1590	DRY SIDE CHANNEL RT BANK
27.20	1649	MANY PIKEMINNOW
29.00	1880	DRY SIDE CHANNEL RT BANK
30.00	1913	BARBED WIRE FENCE CROSSES CREEK
33.40	2095	DRY SIDE CHANNEL LF BANK
36.00	2351	SIGNS OF CATTLE GRAZING IN CREEK
37.00	2423	CRAWFISH
46.00	3142	DRY SIDE CHANNEL RT BANK
47.00	3182	DRY SIDE CHANNEL CONTINUES ON LF BANK
50.00	3306	DRY TRIB LF BANK ROAD RT BANK
51.00	3412	ROAD CROSSES MAIN CHANNEL

52.00	3563	2 DRY SIDE CHANNELS 80' FROM RT BANK
53.00	3793	SEVERAL ADULT PIKEMINNOW AND SUCKERS OLD CAR. BODIES RT BANK
58.00	4103	CAR BODY IN DRY TRIB. RT BANK 2 OPPOSING GRAVEL WEIRS IN CHANNEL
59.00	4175	ROAD LF BANK
61.00	4312	EVIDENCE OF CATTLE GRAZING
62.00	4478	DOZENS OF LG. POLLIWOGS PROBABLY BULLFROGS (BLACK SPOTS ON TOP YELLOW/WHITE ON BELLY)
68.00	4965	CATTLE IN THE CREEK
70.00	5269	ROAD CROSSES CREEK CHANNEL CHANGE FROM D4 TO F4 (F4 #071 - END)
72.00	5519	WATER DIVERSION LEFT BANK , FROG BULLFROG?
73.00	5619	CRAYFISH
77.00	5880	ROAD CROSSING CREEK TO LAFRANCHI'S PROPERTY
78.00	6058	FOOT BRIDGE OVER CREEK
79.00	6234	SM. WET TRIB RT BANK(2'W,TEMP=50EF) 53EF @ CONFLUENCE DRY TRIB LF BANK
87.00	6803	CATTLE FENCE RT BANK ROAD RUNS ALONG CREEK LF BANK
89.00	6980	MANY PIKEMINNOW
91.00	7094	OLD WATER DIVERSION PIPES RT BANK
92.00	7226	CATTLE FENCE ACROSS CREEK (MCMICKING/LAFRANCHI PROPERTY LINE)
97.00	7909	WATER PIPE OVERHANGING 20'/ OVER CREEK
98.00	8121	DRY TRIB LF BANK. CATTLE FENCE CROSSING CREEK
99.00	8186	MANY SQUAWS AND SUCKERS
102.00	8444	ROAD CROSSES CREEK DRY TRIB LF BANK
104.00	8734	FOOT BRIDGE ABOVE CREEK
105.00	9068	WET TRIB RT BANK 54EF, POND TURTLE 56EF @ CONFLUENCE
106.00	9372	DRY TRIB LF BANK
107.00	9596	ERODED SCARP RT BANK 100'H X 10'L X 5'W. POSSIBLE FUTURE EROSION PROBLEM. 2 0+ FISH, CRAYFISH
108.00	9713	RIVER OTTER
109.00	9769	QUAIL
111.00	10031	PIKEMINNOW
112.00	10508	DRY TRIB RT BANK
119.00	11050	RD RUNS NEXT TO CREEK LF BANK. DRY TRIB RT BANK

120.00	11230	NEW BRIDGE OVER CREEK
121.00	11470	ROAD CROSSING CREEK
126.00	11897	SQUAWS & SUCKERS
128.00	12048	DRY TRIB LF BANK
130.00	12304	DRY SIDE CHANNEL ALONG HIGHLY ERODED RT BANK. SQUAWS. 2+ STEELHEAD SEEN IN POOL IN AUG
132.00	12426	DRY DRAINAGE TRIB LF BANK
133.00	12739	DRY SIDE CHANNEL RT BANK
134.00	13123	DRY TRIB; RT BANK FENCED ALONG ENTIRE UPSTREAM SIDE W/ I-BEAMS AND CHAIN LINK FENCING
137.00	13475	CONFLUENCE WITH BRIGGS; END SURVEY

PROBLEM SITES AND LANDMARKS - LOWER MAACAMA CREEK SURVEY COMMENTS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

The Maacama habitat survey began at the mouth of Maacama

HABITAT UNIT #	STREAM LEN(FT.)	COMMENTS
1.00	143	Temp of Russian River at mouth= 71EF 100's of cottonwood saplings.
2.00	281	Dozens of suckers 1-2". 10' x 10' patch of Arrundo.
3.00	1150	200' of rip rap w/young trees, LB, backfilled & grown over old 15'h blowout. Dry side channel (DSC).
4.00	1210	Dozens of suckers. Blowout (see form). Multiple side channels: Multiple channels throughout creek bed(units #1-10). Tried to stay on what seemed like main channel or what had wet spots. Channel width 200-400' from mouth to unit #007. Poor canopy due to width of channel-banks are vegetated
5.00	2753	Channel width approx. 200'. Vineyards RB, but good riparian. Dry trib LB.
6.00	2892	Water temp= 65. Tire tracks in bed. 100, of roach and suckers.

		RB 200'+ away from pool.
		Franz Creek confluence-dry.
7.00	4064	40'l x 2'h Gabion baskets being built w/cobble rip rap on LB below creekside house 900' into unit.
		Poor attempt.
		Piece of old rock wall LB.
8.00	4150	Water diversion pipe.
		1000's of tadpoles.
9.00	4238	DSC
11.00	4972	Small wet trib LB. Too small for temp. Creek dry at conf. DSC
12.00	5028	K.J. property LB. Frogs
14.00	5368	Bridge #1(see form)
16.00	5687	6" pikeminnow.
		Multiple DSC's LB & RB.
17.00	5723	2 DSC's RB.
18.00	5877	Pikeminnow; Adult sunfish.
		Huge walnut tree fallen across channel.
		Otter scat.
25.00	7280	Water diversion pipe RB.
		DSC LB.
26.00	7406	DSC LB.
27.00	7459	DSC LB.
28.00	7649	DSC LB.
29.00	7828	Culvert RB.
		DSC LB
		Aquatic snails
30.00	7885	DSC LB & LB.
31.00	7937	DSC LB.
		Small man-made cobble dam at end of unit.
34.00	8202	High amount of algae growth in water.
		DSC LB.
36.00	8595	HOBO TEMP
		Polliwogs; 20+ polliwogs.
		Bridge #2
		DSC LB.
37.00	8681	DSC LB.
38.00	8803	Juv, squaw, suckers & roach.
		(3)9" squaw
		DSC LB.
39.00	8827	DSC LB.
40.00	8870	DSC LB & RB.
		Juv. squaw & roach.
		(2) 9" squaw.

41.00	9143	Small 1'h man-made cobble dam across creek. Water diversion pipe LB. DSC RB.
42.00	9327	Arrudo patch RB. DSC RB.
44.00	9642	Juv. squaw & suckers- 300+.
45.00	10018	Juv. roach- 500+.
46.00	10223	Concrete block rip rap w/blown out chain link fence: 30'l x 25'h LB. Water diversion pipe LB.
49.00	10520	Concrete block rip rap LB: 20'l x 30'h.
51.00	10650	Water diversion pipe LB. House perched on bedrock bank LB. Juv. squaw; (6) 1' squaw; 2 sunfish.
52.00	10799	DSC RB.
53.00	10880	DSC LB.
55.00	11083	DSC LB
56.00	11385	Dry trib LB DSC LB
57.00	11525	DSC LB
59.00	11948	Concrete bolck rip rap w/clumps of metal fencing:15'l x 10'h LB.
60.00	12008	Dry trib RB. DSC RB.
61.00	12113	Water diversion RB.
62.00	12284	2 DSC LB. Dozen 9" squaw and suckers. Tree house RB.
63.00	12536	DSC RB. Electrical Box (?) LB.
64.00	12703	2 DSC's RB.
65.00	12799	Flagging in creek for riparian reveg. project.
66.00	12944	DSC LB.
67.00	13265	DSC LB.
68.00	13465	Erodible RB. DSC LB.
69.00	13550	Several DSC LB.
70.00	13659	Vineyard fencing RB. DSC LB.
71.00	13742	Old water diversion pipe, concrete block RB. Vineyard fence RB. DSC LB. Lot of silt.

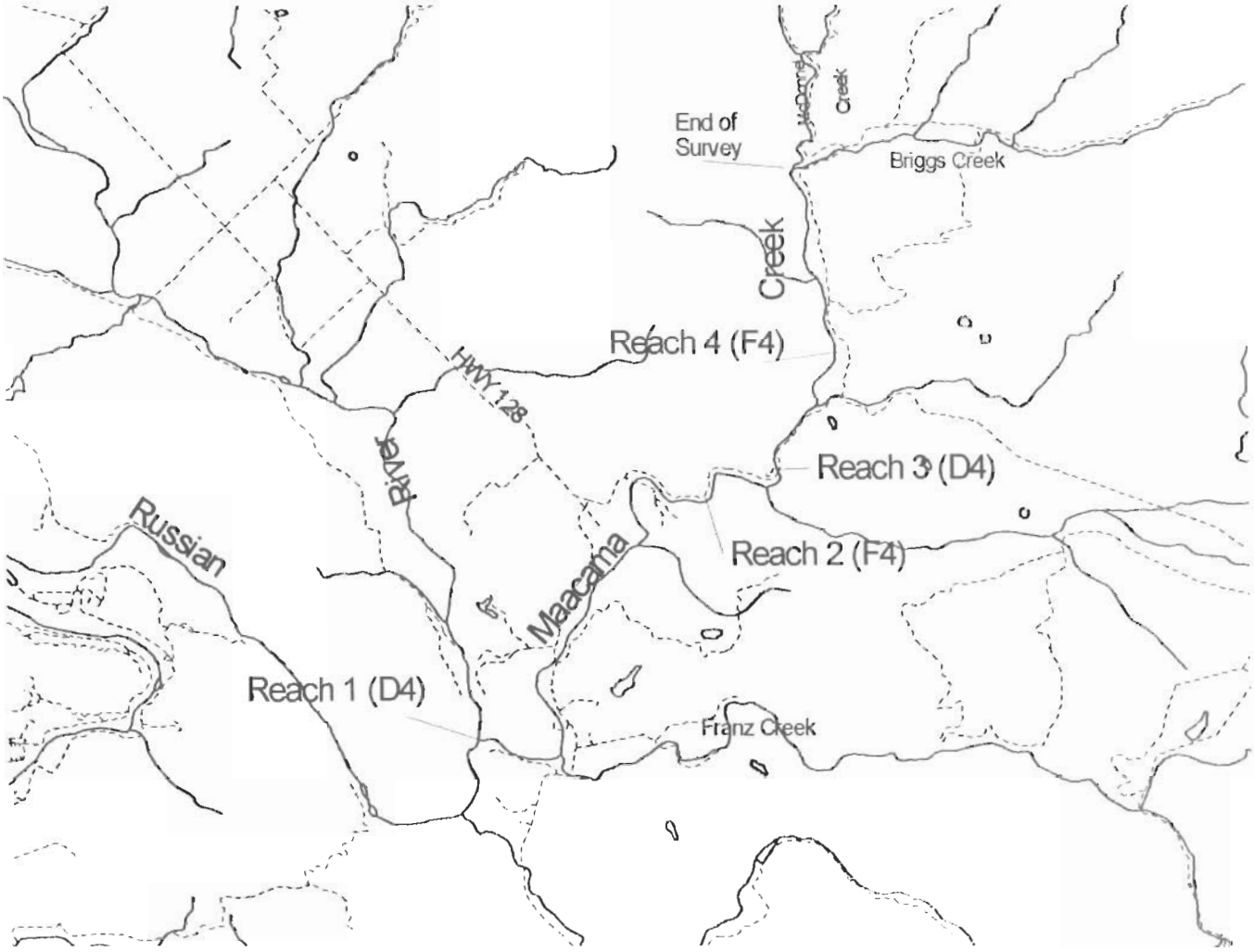
72.00	13835	Water somewhat cloudy. DSC LB.
73.00	13880	DSC LB. Silt 3" deep.
74.00	14245	Simi vineyard road crossing. 2 DSC LB. Car body and cobble rip rap LB: 20'h x 30'l.
75.00	14409	Vineyard fence and water pipe LB. Dry trib LB.
76.00	14495	DSC RB.
77.00	14695	DSC RB. 100's of roach.
78.00	14871	Upwelling of cold water: temp= 64EF DSC LB & RB.
81.00	15172	100's of roach, squaw, & suckers.
82.00	15305	DSC LB & RB.
83.00	15454	DSC LB. Vineyard fence RB.
87.00	15792	Smells like sulfur.
89.00	15927	LB lacking riparian vegetation. (see erosion form)
90.00	16039	LB lacking riparian vegetation.
91.00	16226	LB lacking riparian vegetation.
92.00	16394	LB lacking riparian vegetation fro first 150'.
97.00	17059	Suckers & squaw.
99.00	17240	Bridge #3. (3)1' squaw; turtle; crawdad; 10" suckers & squaw;100+polliwogs. Drainage pipe RB.
101.00	17383	DSC RB
102.00	17420	DSC RB
103.00	17533	DSC RB
106.00	18002	Old brick wall 6'h x 150'l RB. Hwy 128 RB. Trash dumped RB. Old car RB. DSC LB. Squaw, roach.
107.00	18072	DSC LB
109.00	18416	DSC LB
110.00	18671	DSC LB
111.00	18784	Culvert RB (12") DSC LB
112.00	18821	DSC LB/RB
113.00	18917	DSC LB/RB
114.00	19011	DSC RB Roach, squaw, suckers, sunfish.

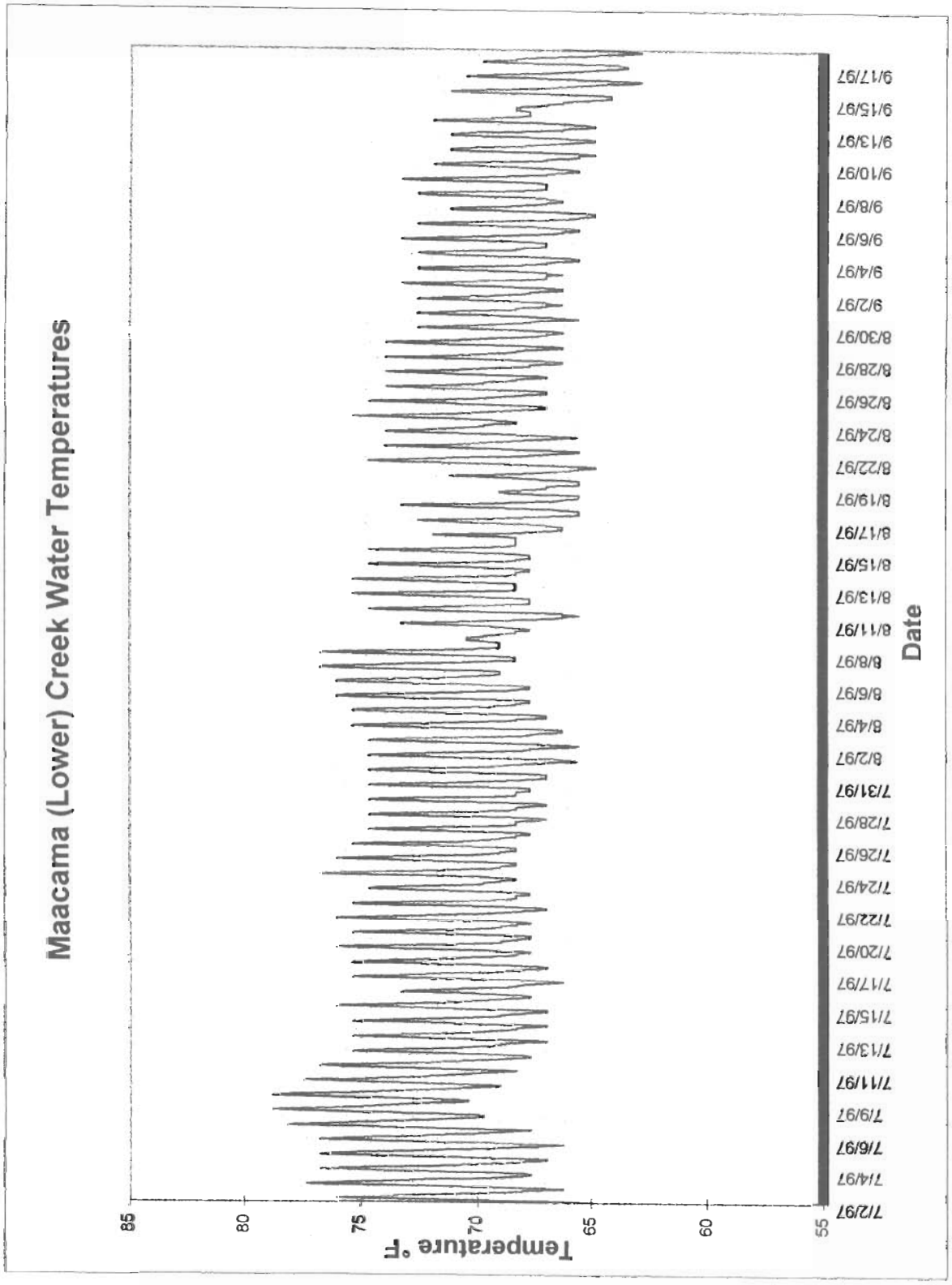
115.00	19294	DSC RB
116.00	19368	DSC RB
117.00	19682	2" of silt on stream bottom.
118.00	20026	Hwy 128 RB.
		Failed rip rap along 128: sediment source
		DSC LB
		Dry trib LB
		Culvert (12") RB
119.00	20162	Algae on stream bottom.
		Erosion/slide LB (see form)
124.00	20898	Dry trib LB
		Algae on stream bottom.
125.00	21290	Dry trib RB
		1" culvert RB.
		Concrete & wood posts from old dam 250' into unit.
		Rip rap RB 30'l below 128.
128.00	21536	Below Hwy 128:
		Boulder rip rap RB.
		Sandbags & concrete rip rap RB.
		House LB.
129.00	21786	Boulder rip rap RB.
		Gabbion wall LB; 100'l x 20'h.
130.00	21856	Cobble gabbion wall LB.
		Deer
131.00	21891	Old concrete road crossing.
132.00	21924	Bridge #4
		Water pump in creek.
133.00	21981	Cobble gabbion wall 15'l x 10'h.
		Many 9" squaw.
135.00	22165	Culvert (12") RB.
137.00	22365	Large dry trib RB, culvert (see form).
138.00	22464	Old concrete wall (dam?).
139.00	22557	Cabin LB
140.00	22671	Footbridge, cabin LB.
142.00	23363	DSC LB.
143.00	23405	DSC RB
144.00	23757	Ferrari/Carano Bridge.
		End of Access.
		End of Survey at Redwwod Creek
145.00	24544	NO ACCESS - MAP WHEEL 787'

END SURVEY

The lower Maacama Creek habitat survey ended due to no access on private land.

MAACAMA CR


End of Survey
Briggs Creek
Creek
Reach 4 (F4)
HWY 128
Reach 3 (D4)
Reach 2 (F4)
Russian
Maacama
Reach 1 (D4)
Franz Creek
2
0
2
4 Miles
N
W
E
S
Roads
Streams


Maacama (Lower) Creek Water Temperatures
Temperature °F
85
80
75
70
65
60
55
Date
7/2/97
7/4/97
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7/9/97
7/11/97
7/13/97
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9/2/97
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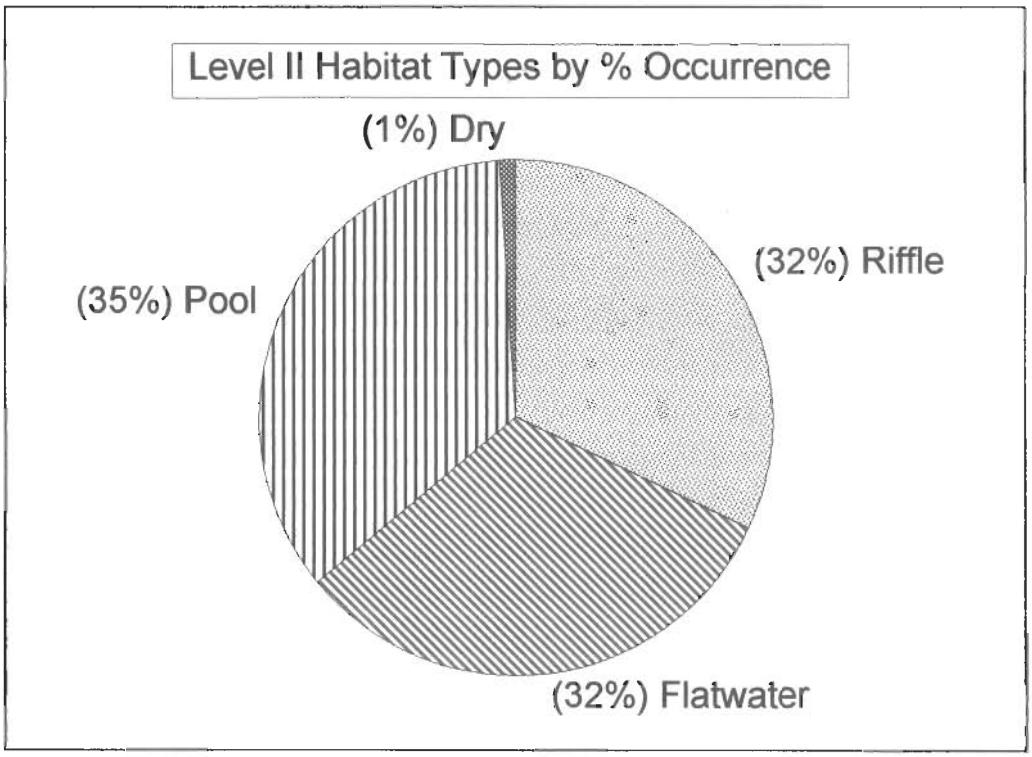
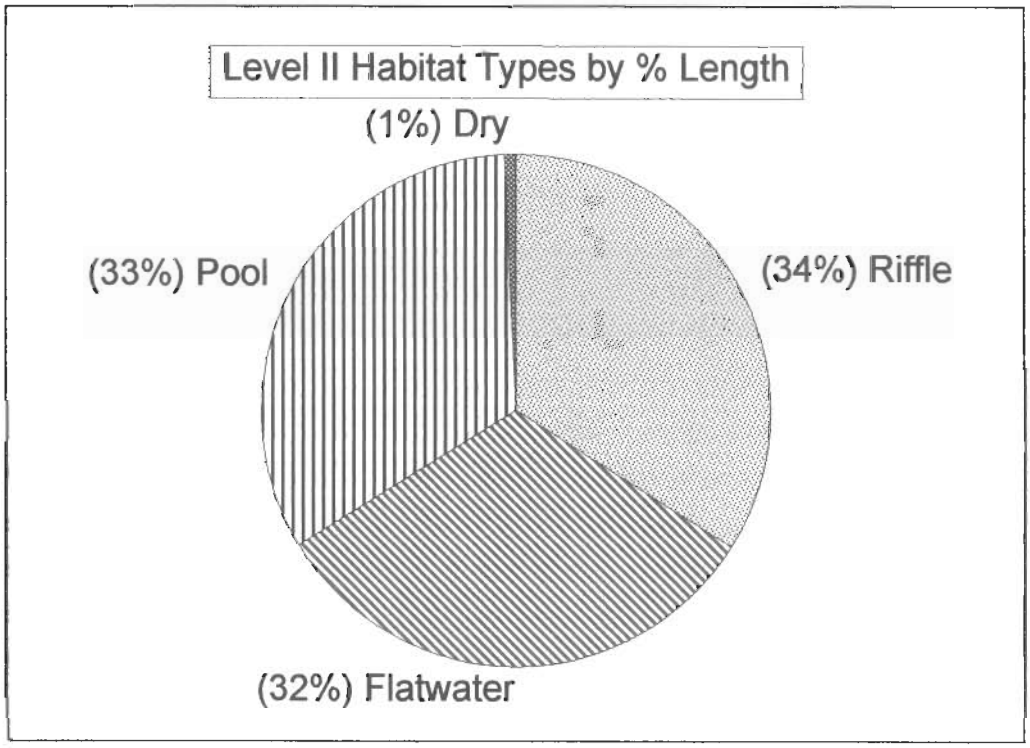
Upper Maacama Creek

Level II Habitat Types

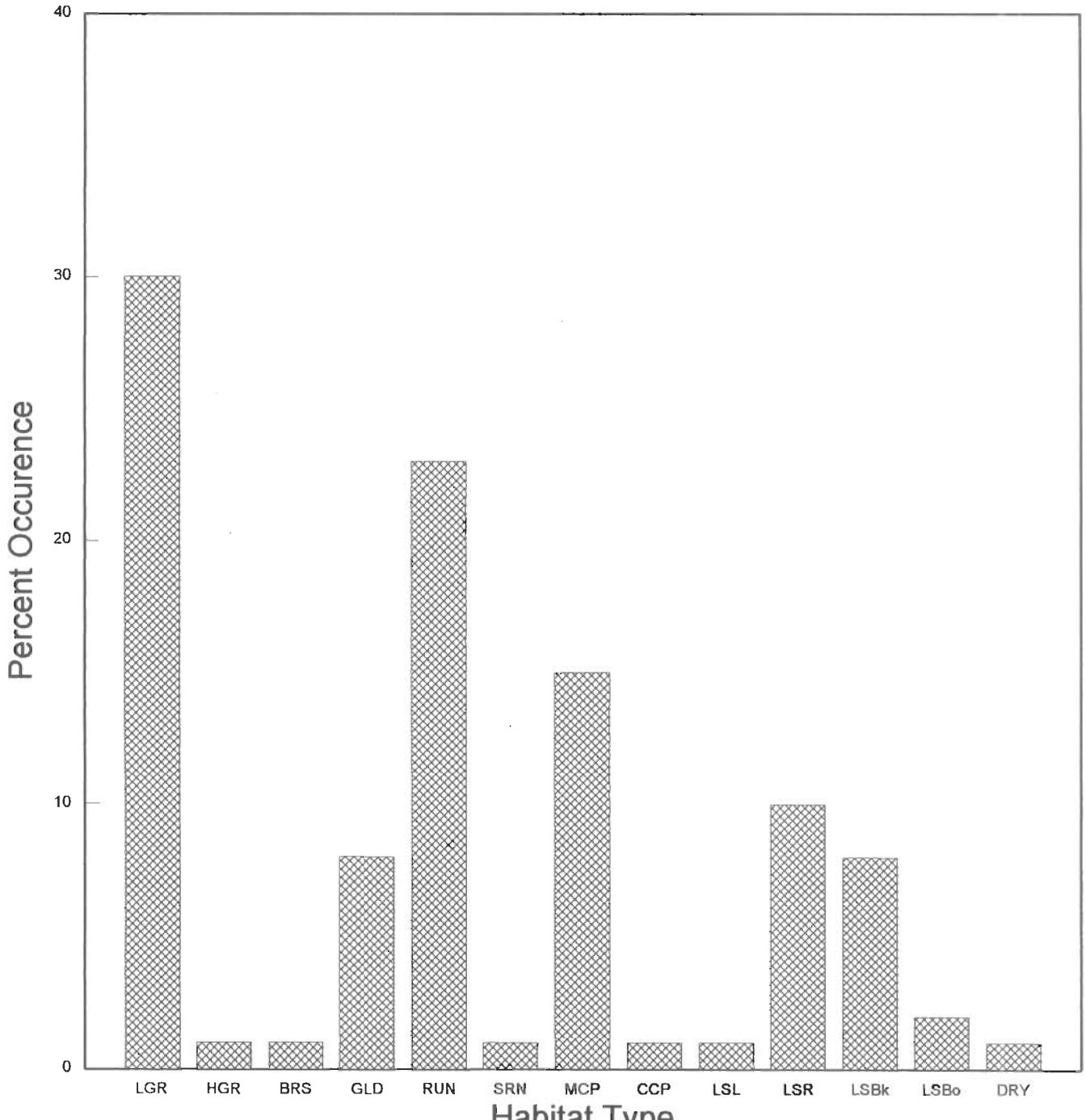




Graph 1

Upper Maacama Creek

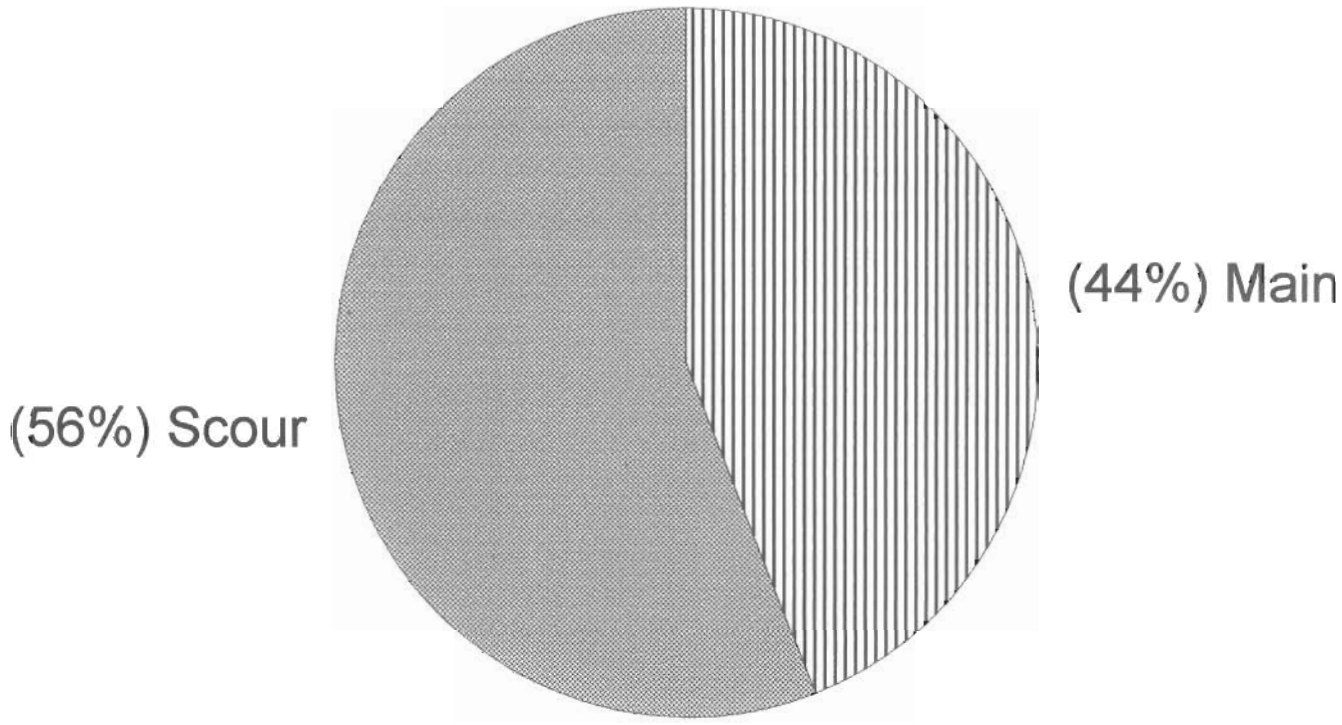
Level IV Habitat Types by % Occurrence



Graph 2

Upper Maacama Creek

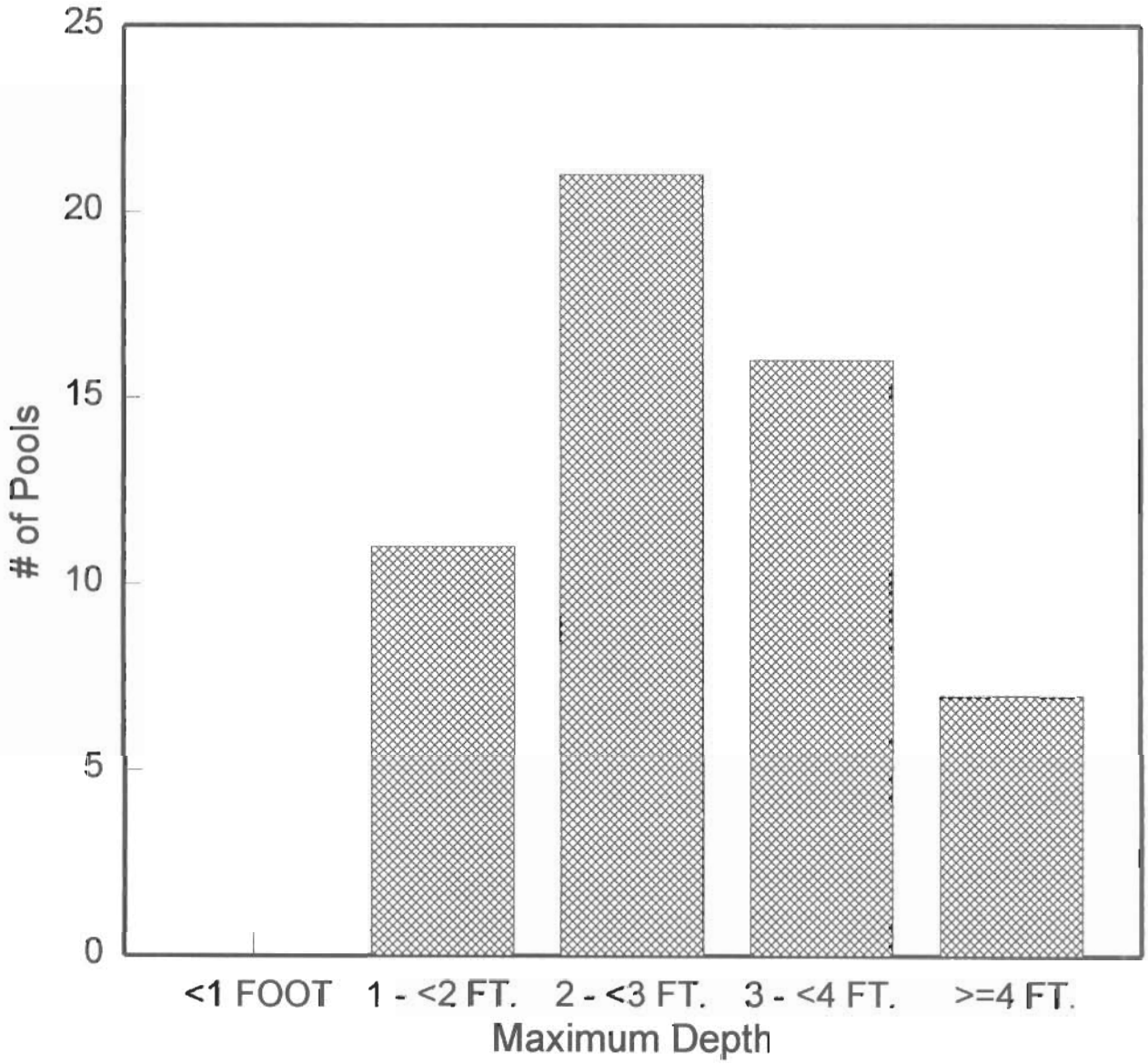
Pool Habitat Types by % Occurrence



Graph 3

Upper Maacama Creek

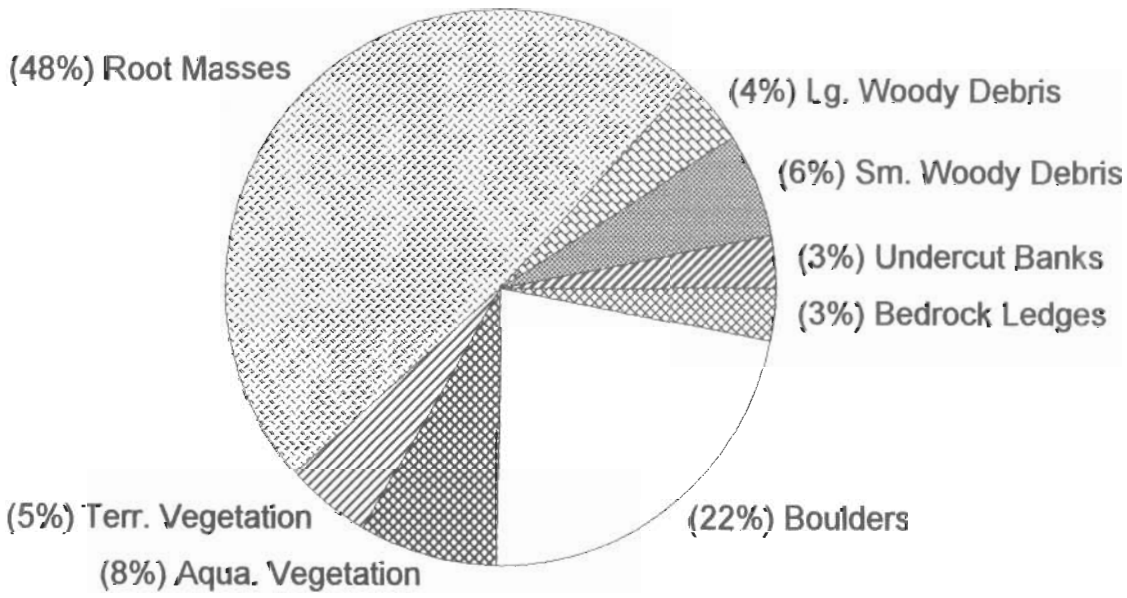
Maximum Depth in Pools



Graph 4

Upper Maacama Creek

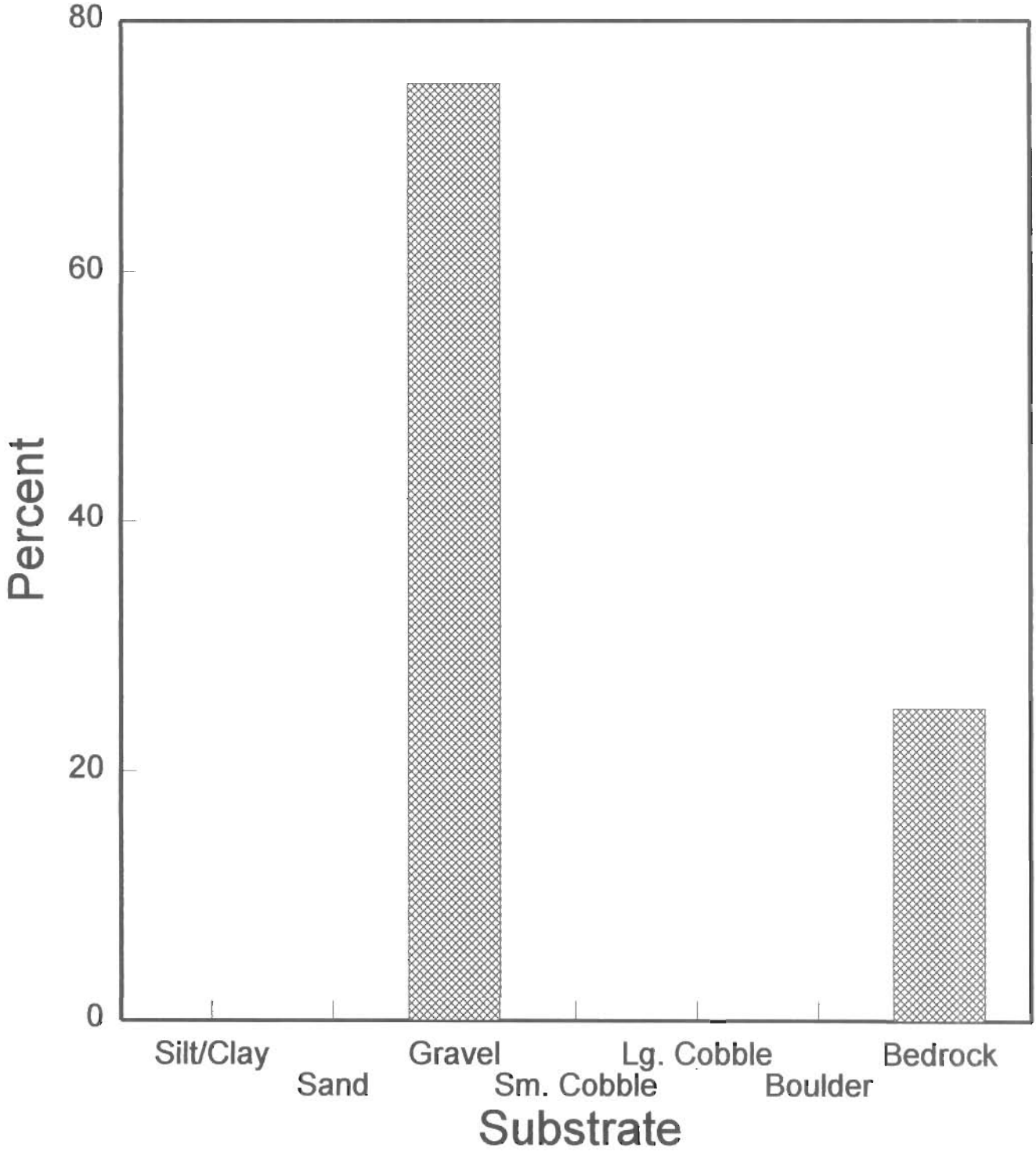
Pool Shelter Types by % Area



Graph 5

Upper Maacama Creek

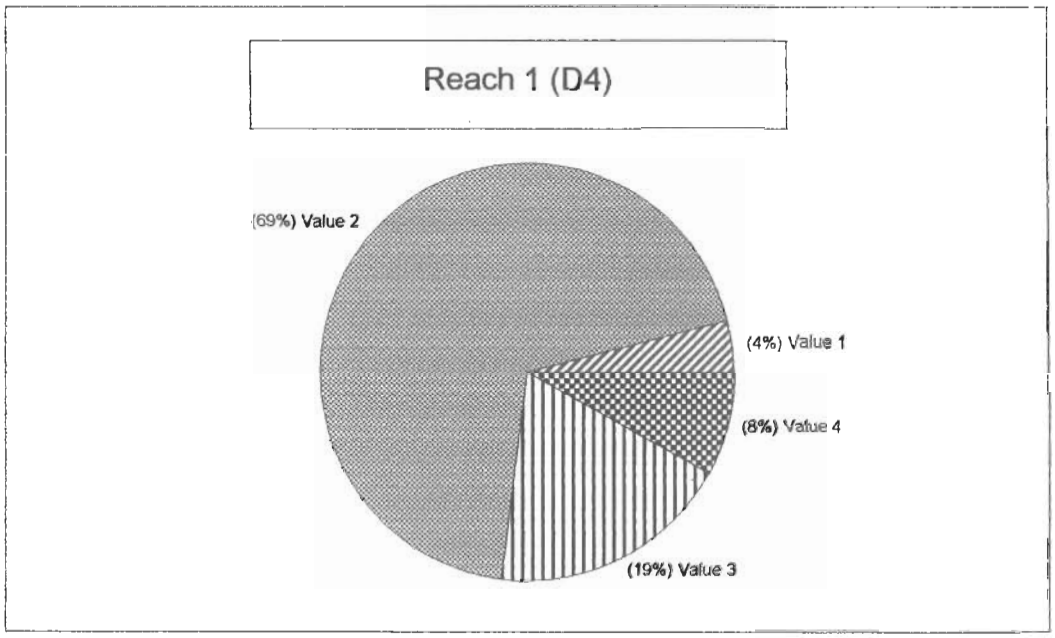
Substrate Composition in Low Gradient Riffles

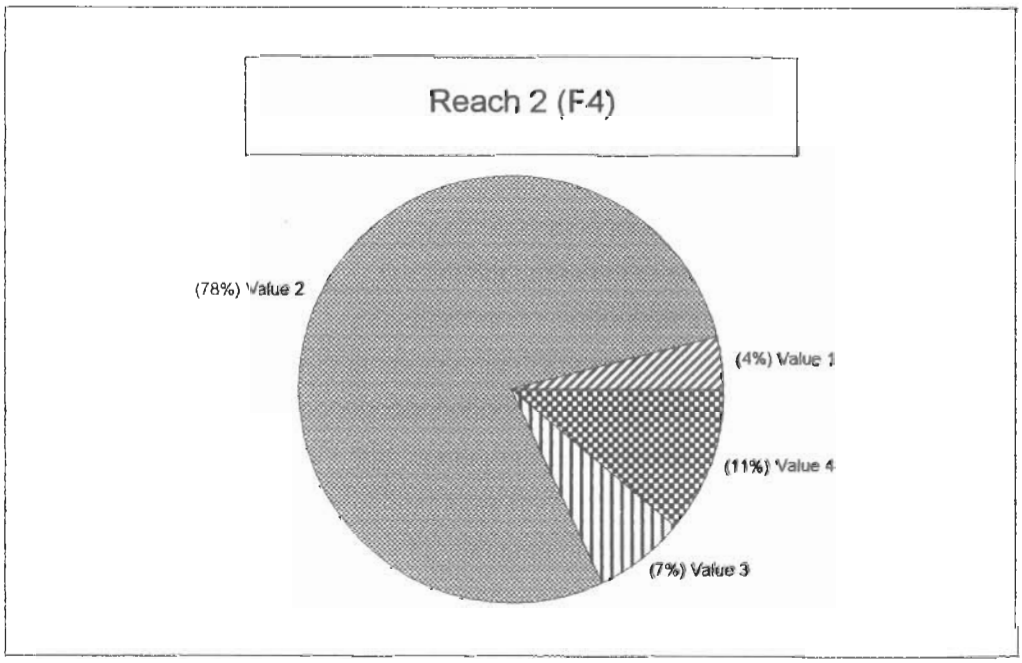


Graph 6

Upper Maacama Creek

Percent Cobble Embeddedness by Reach



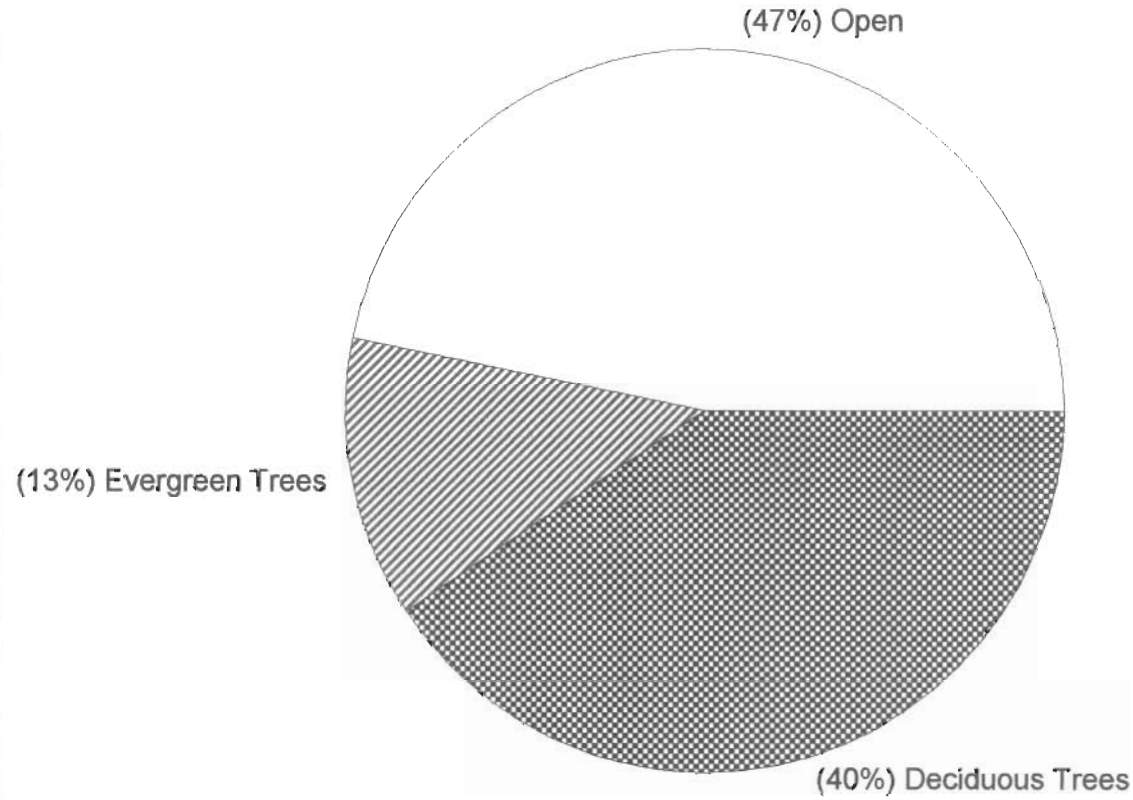


Value 1 = <25% Value 2 = 25-50% Value 3 = 51-75% Value 4 = >76%

Graph 7

Upper Maacama Creek

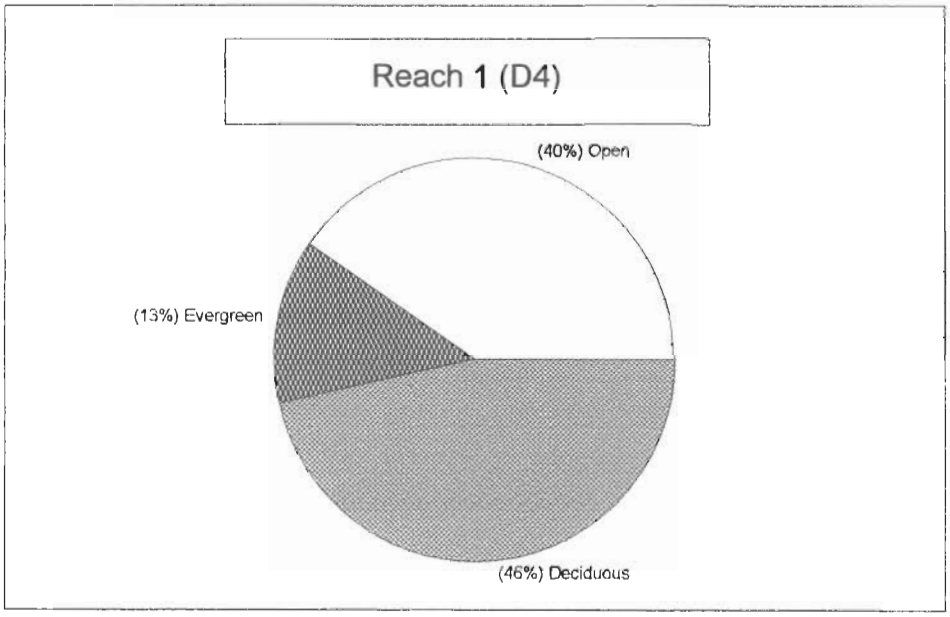
Mean Percent Canopy

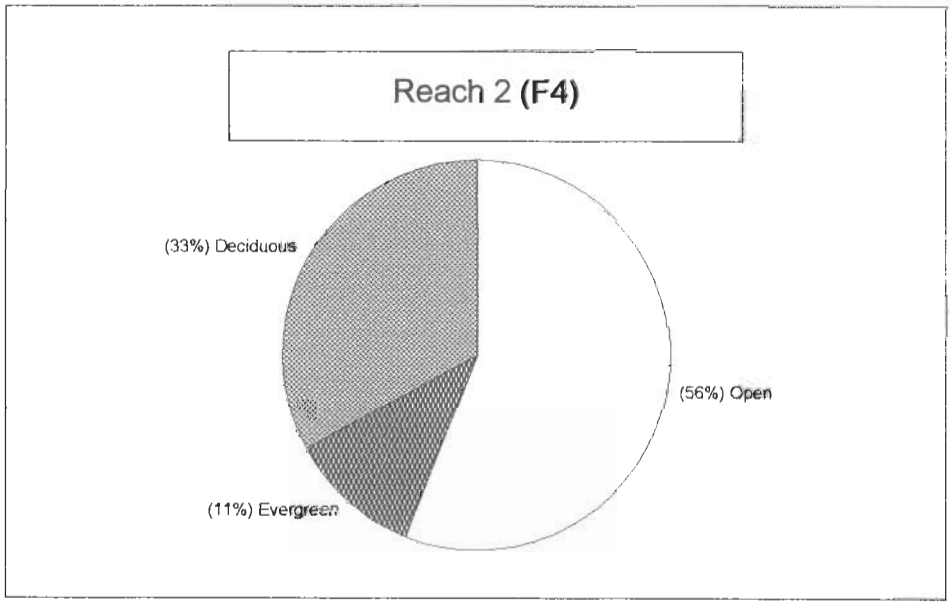


Graph 8

Upper Maacama Creek

Percent Canopy By Reach

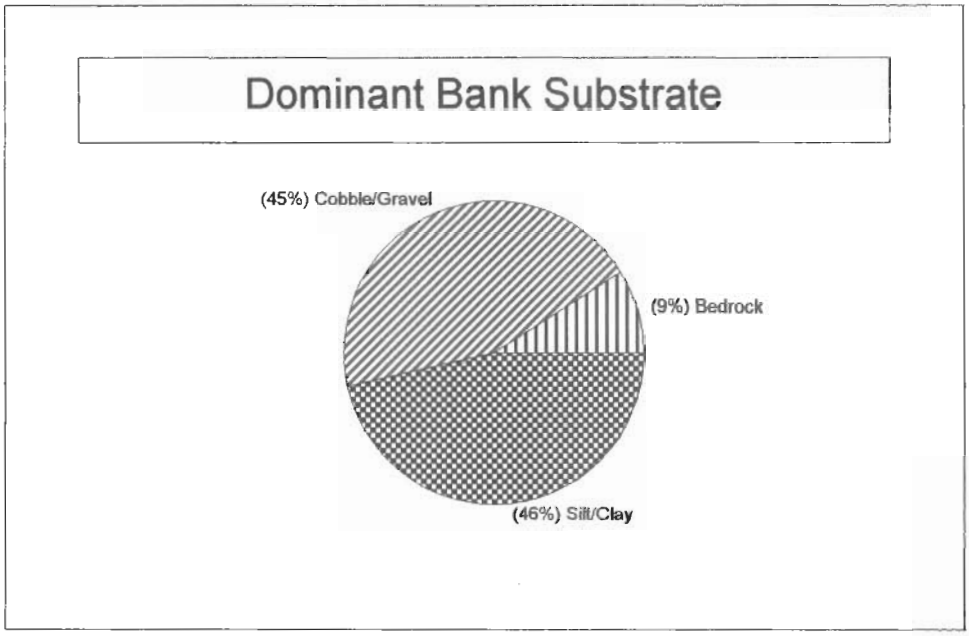


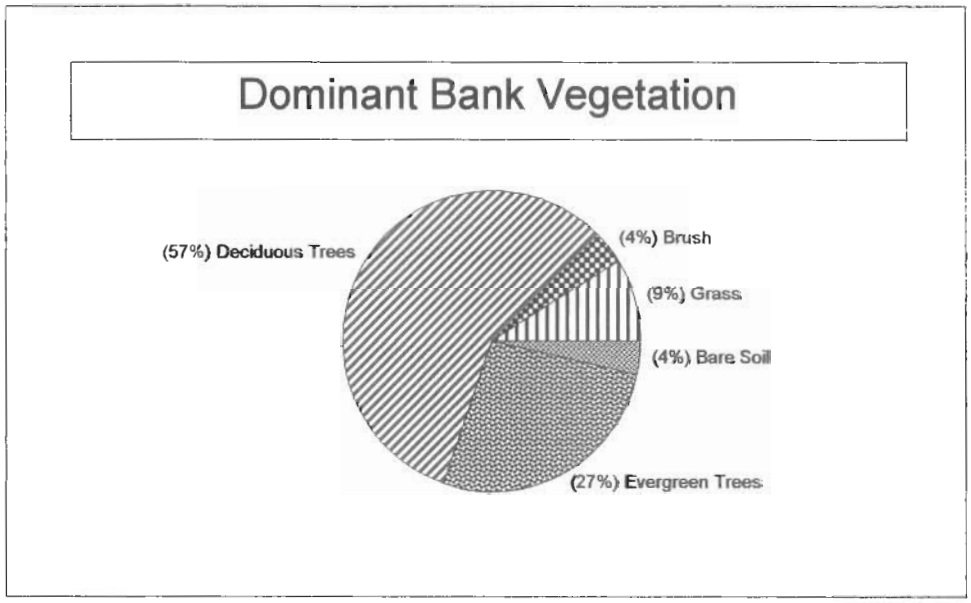


Graph 9

Upper Maacama

Percent Bank Composition

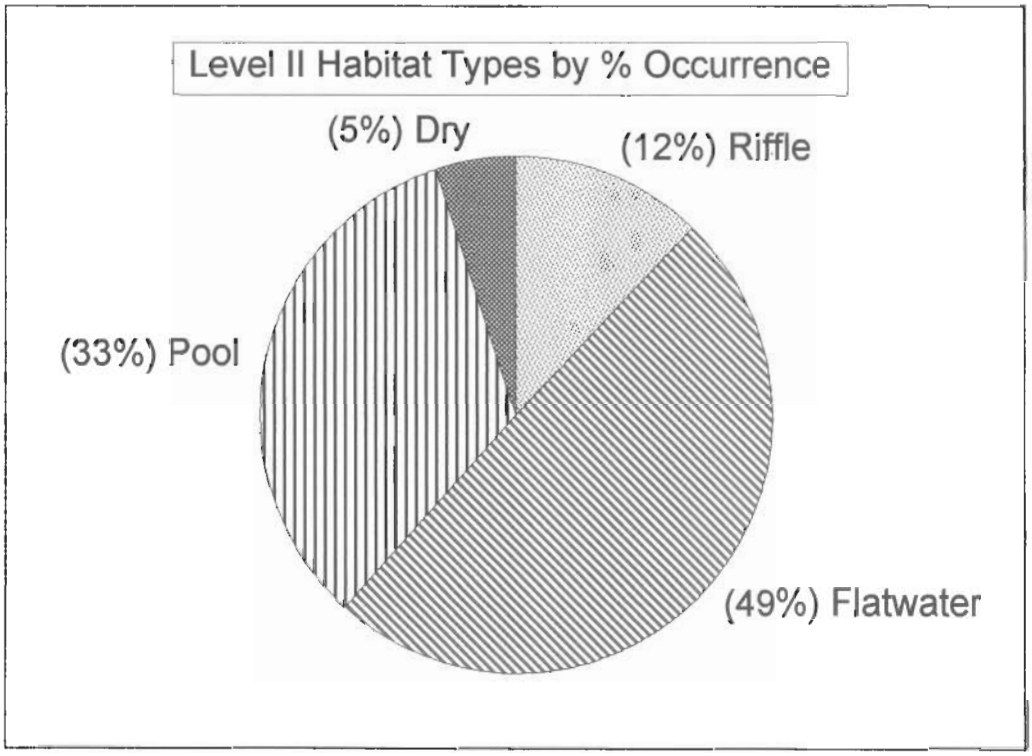


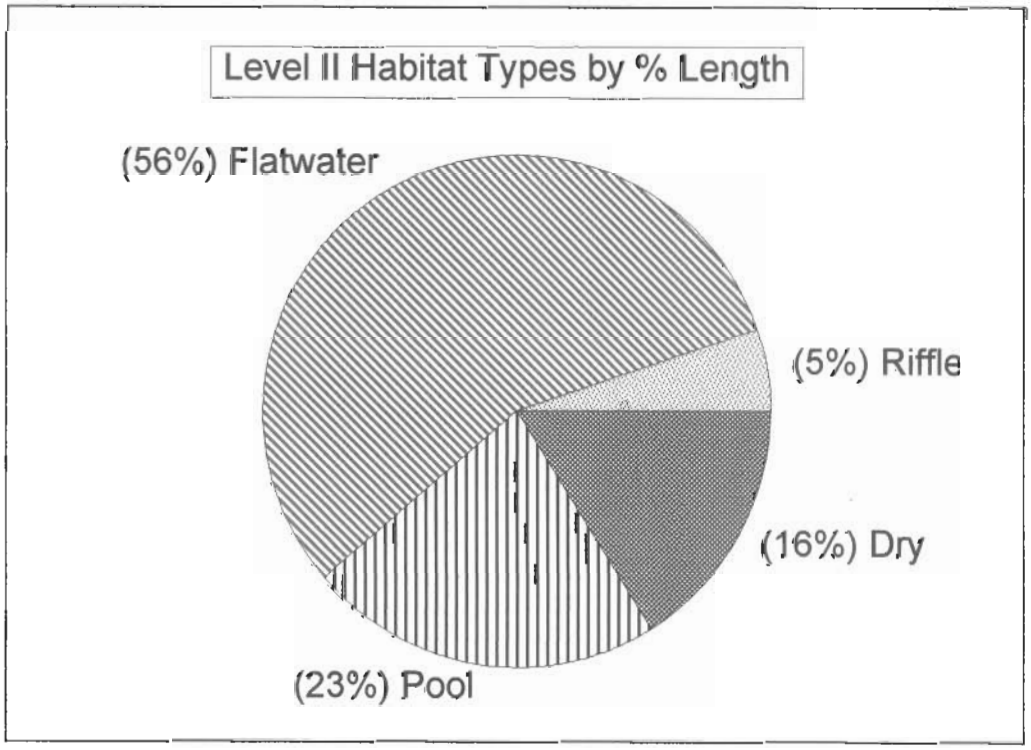


Graph 10

Lower Maacama Creek

Level II Habitat Types

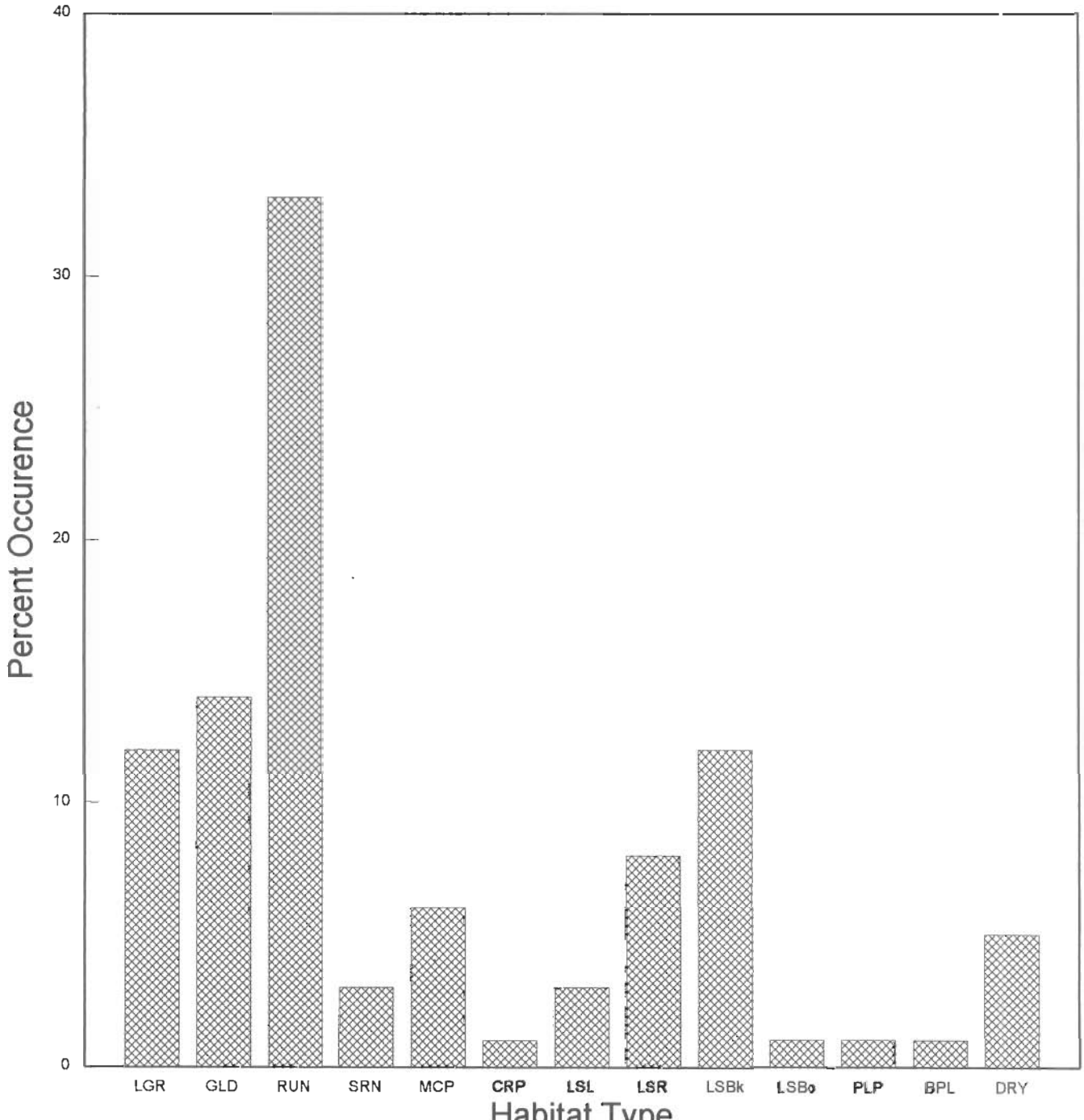




Graph 1

Lower Maacama Creek

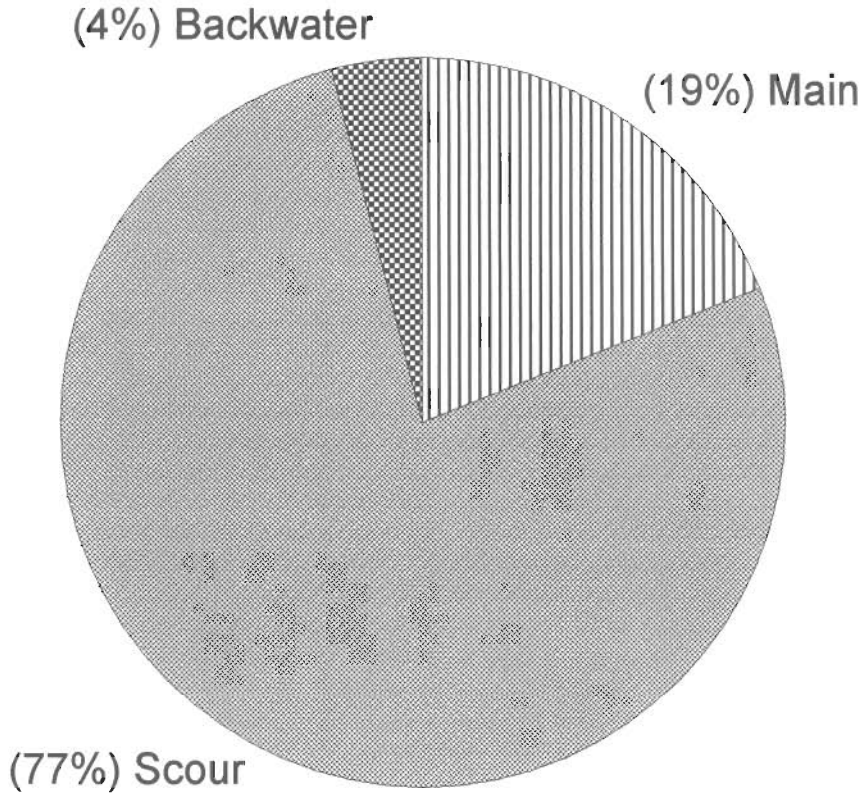
Level IV Habitat Types by % Occurrence



Graph 2

Lower Maacama Creek

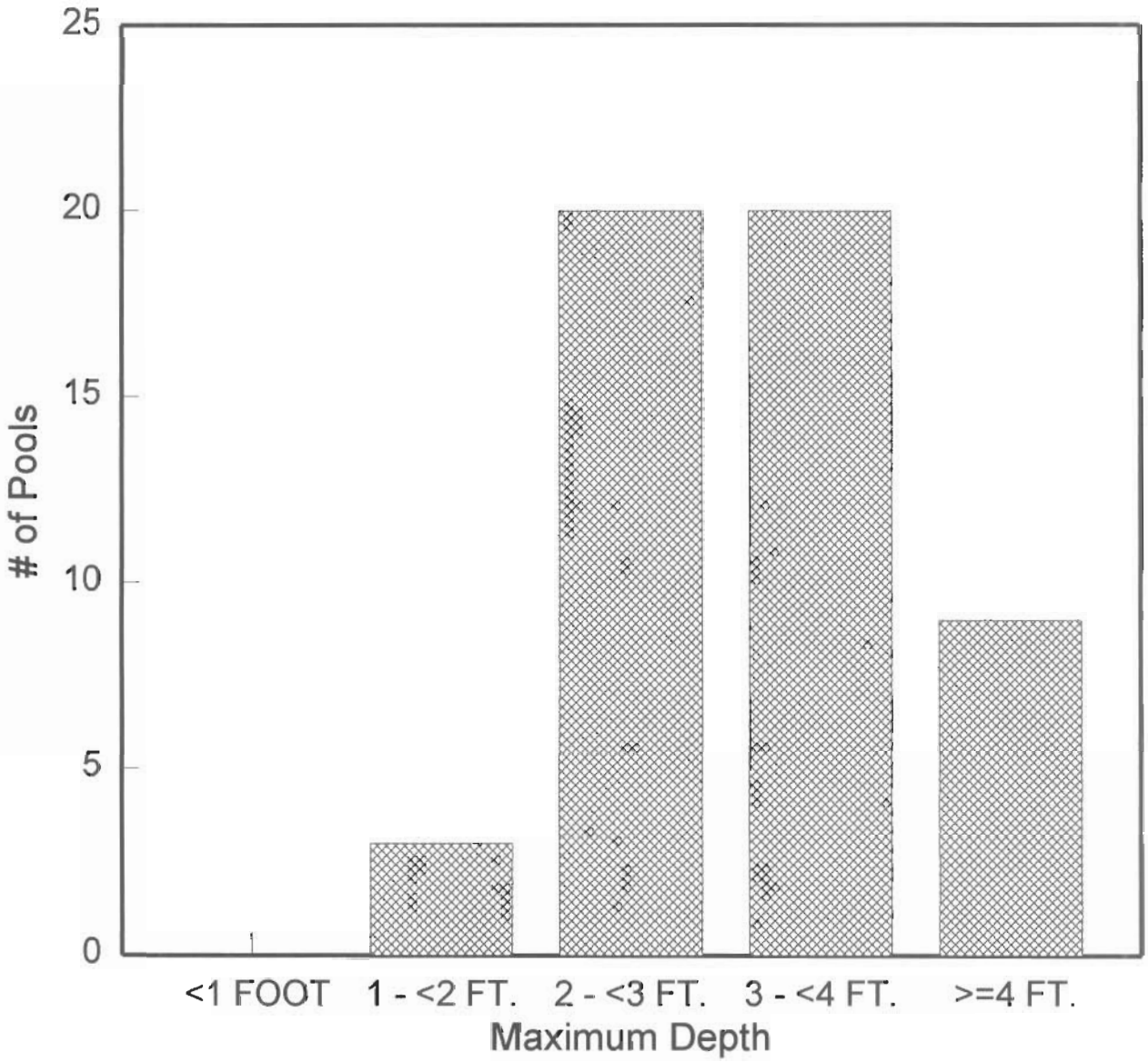
Pool Habitat Types by % Occurrence



Graph 3

Lower Maacama Creek

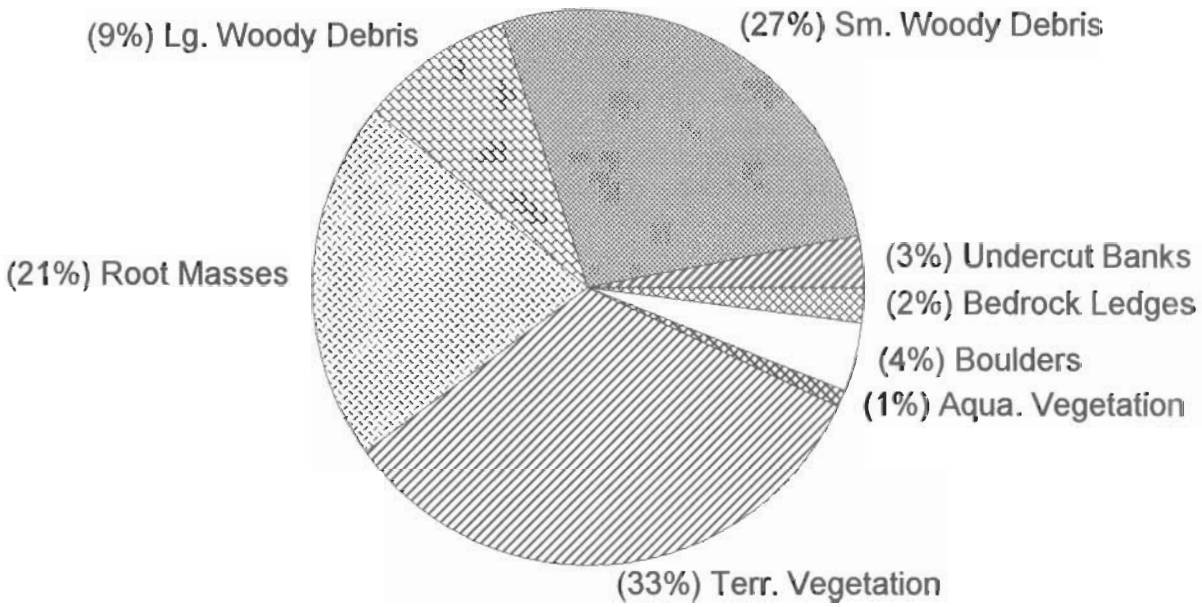
Maximum Depth in Pools



Graph 4

Lower Maacama Creek

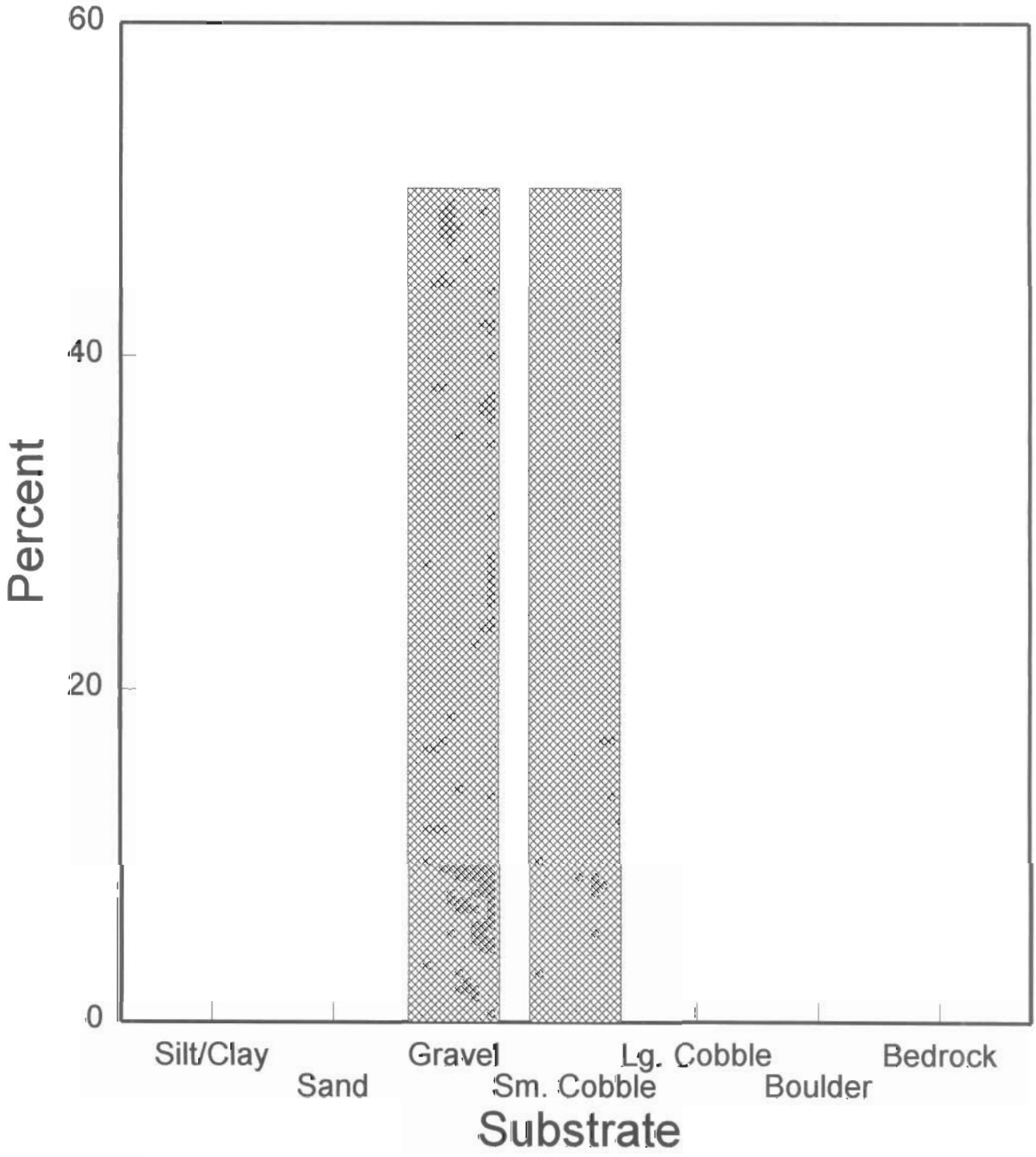
Pool Shelter Types by % Area



Graph 5

Lower Maacama Creek

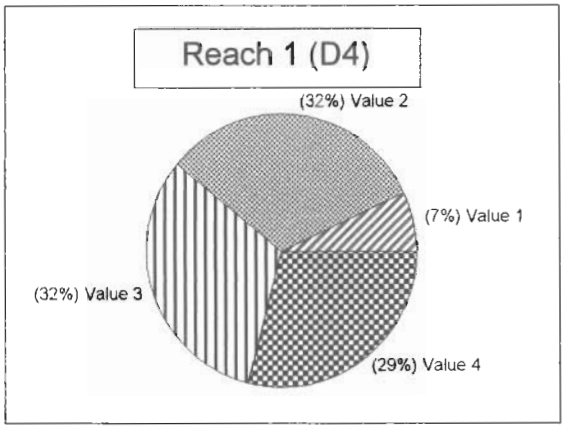
Substrate Composition in Low Gradient Riffles

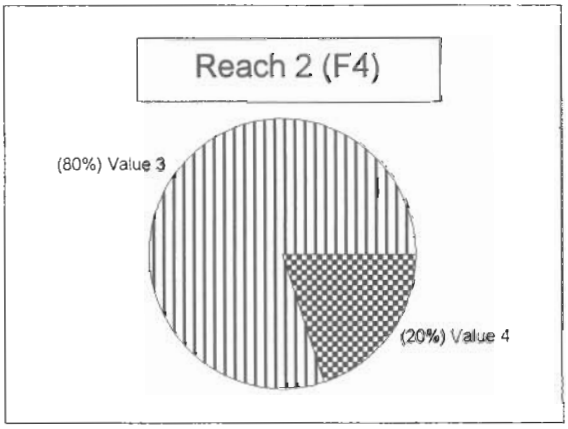


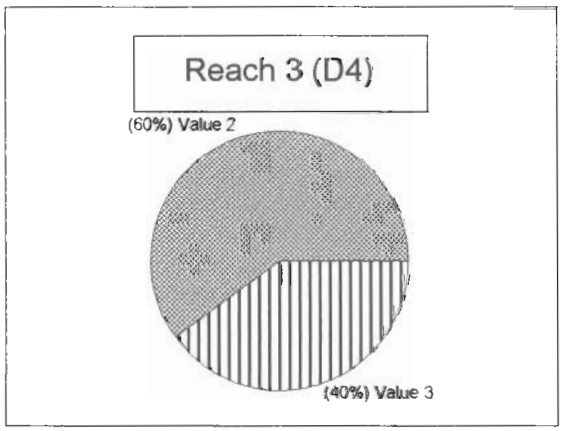
Graph 6

Lower Maacama

Percent Cobble Embeddedness by Reach





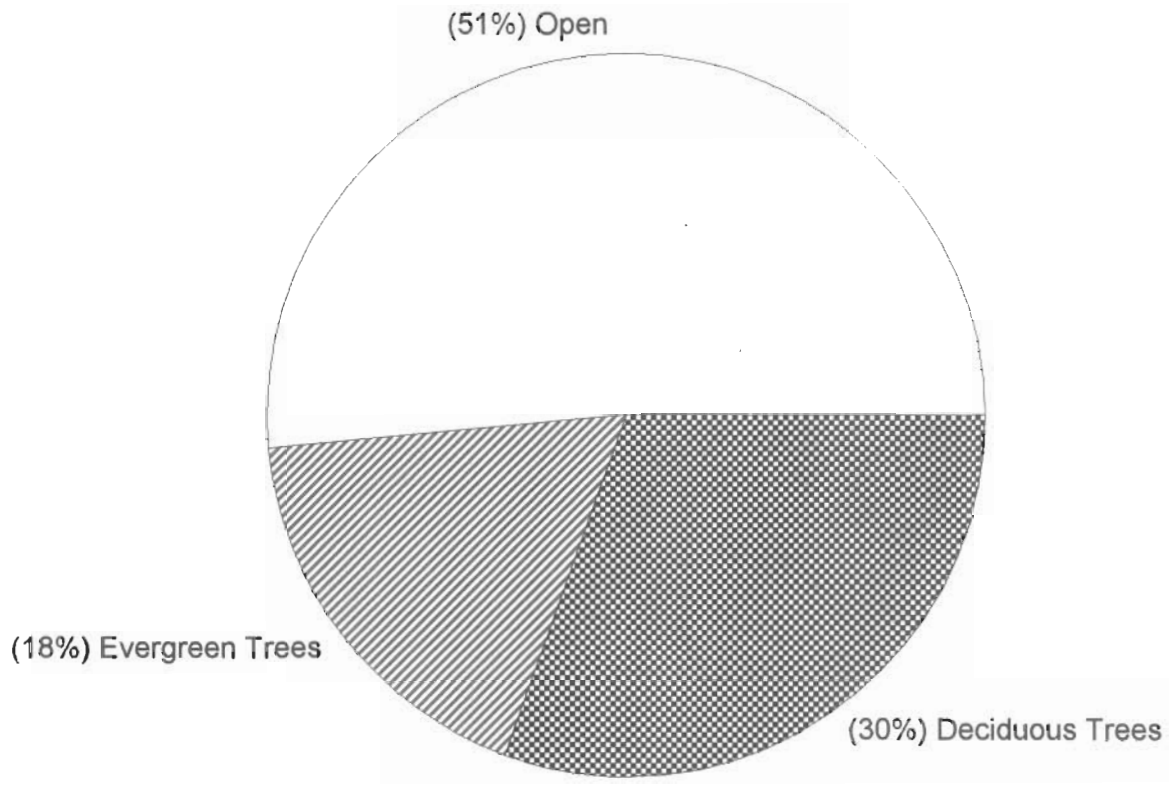


Value 1 = <25% Value 2 = 25-50% Value 3 = 51-75% Value 4 = >76%

Graph 7

Lower Maacama Creek

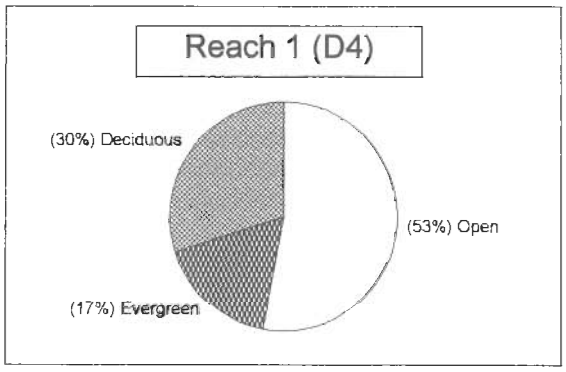
Mean Percent Canopy

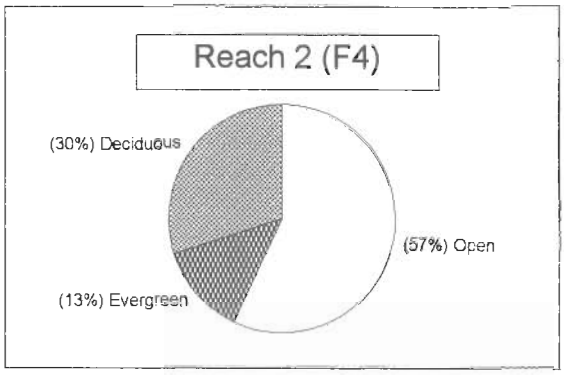


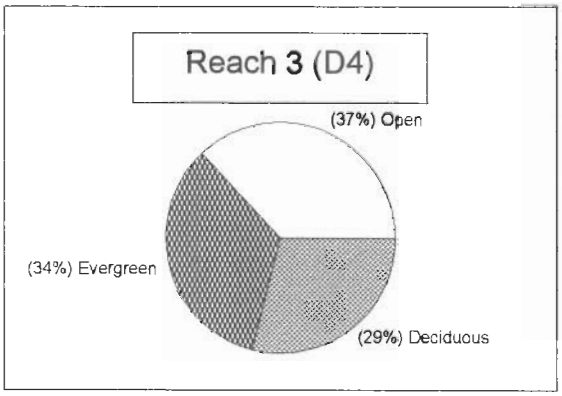
Graph 8

Lower Maacama

Percent Canopy By Reach



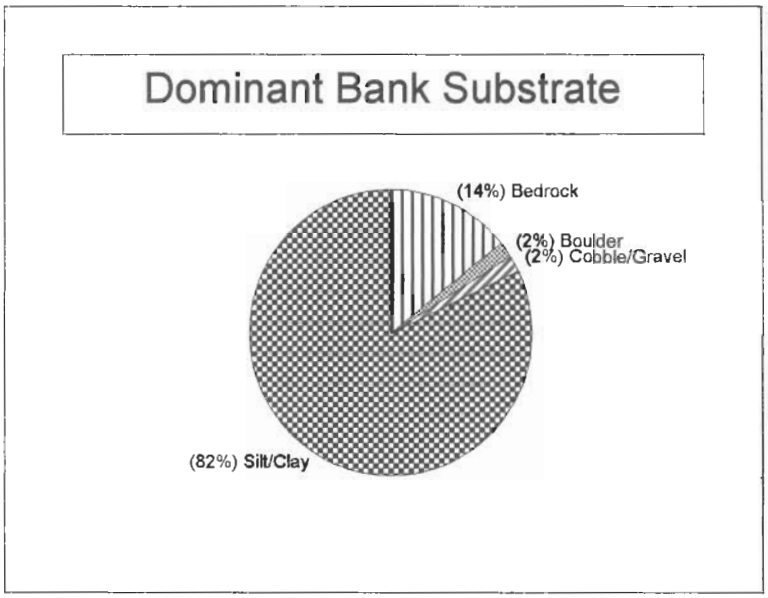


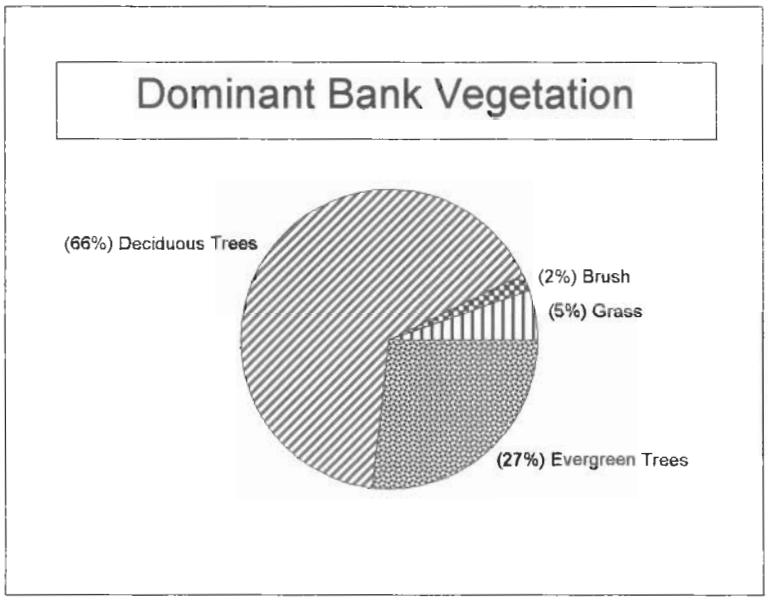


Graph 9

Lower Maacama

Percent Bank Composition





Graph 10

Maacama Creek (upper) Drainage: Russian River

Table 1 - SUMMARY OF RIFFLE, FLATWATER, AND POOL HABITAT TYPES Survey Dates: 10/14/96 to 10/29/96

Confluence Location: QUAD: MT ST HEL. LEGAL DESCRIPTION: T9NR8WS20 LATITUDE: 38°36'50" LONGITUDE: 122°46'57"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	ESTIMATED TOTAL AREA (sq.ft.)	MEAN VOLUME (cu.ft.)	ESTIMATED TOTAL VOLUME (cu.ft.)	MEAN RESIDUAL POOL VOL (cu.ft.)	MEAN SHELTER RATING
49	6	RIFFLE	32	103	5057	34	16.3	0.4	967	47362	494	24223	0	6
49	5	FLATWATER	32	98	4805	32	24.4	0.7	2102	103013	1487	72878	0	9
55	11	POOL	35	90	4925	33	24.0	1.5	2483	136557	4007	220400	3115	26
2	0	DRY	1	50	100	1	0.0	0.0	0	0	0	0	0	0

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq. ft.)	TOTAL VOL. (cu. ft.)
155	22	14887	286933	317502

Maacama Creek (upper) Drainage: Russian River

Table 2 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS Survey Dates: 10/14/96 to 10/29/96

Confluence Location: QUAD: MT ST HEL. LEGAL DESCRIPTION: T9NR8WS20 LATITUDE: 38°36'50" LONGITUDE: 122°46'57"

HABITAT UNITS #	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT OCCURRENCE %	MEAN LENGTH ft.	TOTAL LENGTH ft.	TOTAL LENGTH %	MEAN WIDTH ft.	MEAN DEPTH ft.	MAXIMUM DEPTH ft.	MEAN AREA sq.ft.	TOTAL AREA EST. sq.ft.	MEAN VOLUME cu.ft.	TOTAL VOLUME EST. cu.ft.	MEAN RESIDUAL POOL VOL cu.ft.	MEAN SHELTER RATING	MEAN CANOPY %
47	5	LGR	30	104	4888	33	10	0.4	1.0	836	39271	383	18018	0	6	51
1	1	HGR	1	82	82	1	9	0.7	1.6	554	554	388	388	0	5	35
1	0	BRS	1	87	87	1	66	0.6	2.5	2297	2297	1378	1378	0	0	30
12	1	GLD	8	85	1022	7	25	0.8	1.3	1888	22650	1510	18120	0	10	60
36	3	RUN	23	101	3629	24	25	0.6	1.7	2127	76566	1429	51448	0	8	45
1	1	SRN	1	154	154	1	19	0.8	1.2	2195	2195	1756	1756	0	10	5
23	3	MCP	15	97	2239	15	22	1.4	4.2	2538	58365	4156	95598	3257	18	61
1	1	CCP	1	54	54	0	19	1.0	1.9	1026	1026	1026	1026	513	40	20
1	1	LSL	1	27	27	0	13	1.1	3.1	351	351	386	386	281	100	85
15	3	LSR	10	89	1333	9	25	1.3	4.5	2594	38903	3838	57564	2889	34	65
12	2	LSBk	8	66	796	5	25	1.7	7.7	1636	19626	2595	31135	1990	25	56
3	1	LSBo	2	159	477	3	39	2.0	7.0	6114	18341	11614	34841	9649	23	25
2	0	DRY	1	50	100	1	0	0.0	0.0	0	0	0	0	0	0	68

TOTAL UNITS	TOTAL UNITS	LENGTH (ft.)	AREA (sq.ft)	TOTAL VOL. (cu.ft)
155	22	14887	280144	311657

Maacama Creek (upper)

Drainage: Russian River

Table 3 - SUMMARY OF POOL TYPES

Survey Dates: 10/14/96 to 10/29/96

Confluence Location: QUAD: MT ST HEL. LEGAL DESCRIPTION: T9NR8WS20 LATITUDE: 38°36'50" LONGITUDE: 122°46'57"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA EST. (sq.ft.)	MEAN VOLUME (cu.ft.)	TOTAL VOLUME EST. (cu.ft.)	MEAN RESIDUAL POOL VOL. (cu.ft.)	MEAN SHELTER RATING
24	4	MAIN	44	96	2293	47	21.7	1.4	2472	59325	4020	96487	3120	19
31	7	SCOUR	56	85	2632	53	25.7	1.5	2491	77221	3998	123925	3111	32

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq.ft.)	TOTAL VOL. (cu.ft.)
55	11	4925	136546	220413

Maacama Creek (upper) Drainage: Russian River

Table 4 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPES Survey Dates: 10/14/96 to 10/29/96

Confluence Location: QUAD: MT ST HEL. LEGAL DESCRIPTION: T9NR8WS20 LATITUDE: 38°36'50" LONGITUDE: 122°46'57"

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	<1 FOOT MAXIMUM DEPTH	<1 FOOT PERCENT OCCURRENCE	1-<2 FT. MAXIMUM DEPTH	1-<2 FOOT PERCENT OCCURRENCE	2-<3 FT. MAXIMUM DEPTH	2-<3 FOOT PERCENT OCCURRENCE	3-<4 FT. MAXIMUM DEPTH	3-<4 FOOT PERCENT OCCURRENCE	>=4 FEET MAXIMUM DEPTH	>=4 FEET PERCENT OCCURRENCE
23	MCP	42	0	0	6	26	10	43	6	26	1	4
1	CCP	2	0	0	1	100	0	0	0	0	0	0
1	LSL	2	0	0	0	0	0	0	1	100	0	0
15	LSR	27	0	0	2	13	6	40	5	33	2	13
12	LSBk	22	0	0	2	17	5	42	2	17	3	25
3	LSBo	5	0	0	0	0	0	0	2	67	1	33

TOTAL UNITS
55

Maacama Creek (upper) Drainage: Russian River

Table 5 - Summary of Shelter by Habitat Type Survey Dates: 10/14/96 to 10/29/96

Confluence Location: QUAD: MT ST HEL. LEGAL DESCRIPTION: T9NR8WS20 LATITUDE: 38°36'50" LONGITUDE: 122°46'57"

	UNITS MEASURED	UNITS SHELTER MEASURED	HABITAT TYPE	SQ. FT. UNDERCUT BANKS	SQ. FT. SWD	SQ. FT. LWD	SQ. FT. ROOT MASS	SQ. FT. TERR. VEGETATION	SQ. FT. AQUATIC VEGETATION	SQ. FT. WHITE WATER	SQ. FT. BOULDERS	SQ. FT. BEDROCK LEDGES
	47	6	LGR	0	64	0	7	0	48	0	273	0
	1	1	HGR	0	0	0	0	0	0	0	0	37
	1	0	BRS	0	0	0	0	0	0	0	0	0
	12	1	GLD	0	0	0	94	0	0	0	0	0
	36	4	RUN	0	5	0	41	0	102	0	265	0
	1	1	SRN	0	0	0	0	0	0	0	146	0
	23	22	MCP	321	354	178	1655	405	126	0	1236	114
	1	1	CCP	0	0	31	164	0	10	0	0	0
	1	1	LSL	0	70	88	18	0	0	0	0	0
	15	15	LSR	18	218	121	3193	206	355	0	218	0
	12	12	LSBk	56	47	144	811	0	322	0	342	292
	3	3	LSBo	0	128	0	609	86	287	0	1124	0
	2	0	DRY	0	0	0	0	0	0	0	0	0
TOTAL	155	67		395	886	562	6592	697	1250	0	3604	443
				3%	6%	4%	46%	5%	9%	0%	25%	3%
TOTAL POOLS	55	54		395	817	562	6450	697	1100	0	2920	406
				3%	6%	4%	48%	5%	8%	0%	22%	3%

Maacama Creek (upper) Drainage: Russian River

Table 6 - SUMMARY OF DOMINANT SUBSTRATES BY HABITAT TYPE Survey Dates: 10/14/96 to 10/29/96

Confluence Location: QUAD: MT ST HEL. LEGAL DESCRIPTION: T9NR8WS20 LATITUDE: 38°36'50" LONGITUDE: 122°46'57"

TOTAL HABITAT UNITS	UNITS SUBSTRATE MEASURED	HABITAT TYPE	% TOTAL SILT/CLAY DOMINANT	% TOTAL SAND DOMINANT	% TOTAL GRAVEL DOMINANT	% TOTAL SM COBBLE DOMINANT	% TOTAL LG COBBLE DOMINANT	% TOTAL BOULDER DOMINANT	% TOTAL BEDROCK DOMINANT
47	8	LGR	0	0	75	0	0	0	25
	1	HGR	0	0	100	0	0	0	0
	1	BRS	0	0	0	0	0	0	100
	0	GLD	0	0	0	0	0	0	0
	5	RUN	0	0	100	0	0	0	0
	1	SRN	0	0	0	0	0	0	100
	3	MCP	0	33	33	33	0	0	0
	1	CCP	0	100	0	0	0	0	0
	1	LSL	0	0	100	0	0	0	0
	3	LSR	0	0	100	0	0	0	0
	2	LSBk	0	50	0	0	0	0	50
	1	LSBo	0	100	0	0	0	0	0
	1	DRY	0	0	100	0	0	0	0

Maacama Creek

APPENDIX A. Summary of Mean Percent Vegetative Cover for Entire Stream

Mean Percent Canopy	Mean Percent Evergreen	Mean Percent Decidous	Mean Right bank % Cover	Mean Left Bank % Cover
53.44	23.45	75.53	59.04	53.04

APPENDIX B.

Mean Percentage of Dominant Substrate

Dominant Class of Substrate	Number Units Right Bank	Number Units Left Bank	Total Mean Percent
Bedrock	2	3	8.93
Boulder	0	0	0
Cobble/Gravel	12	13	44.64
Silt/clay	14	12	46.43

Mean Percentage of Dominant Vegetation

Dominant Class of Vegetation	Number Units Right Bank	Number Units Left Bank	Total Mean Percent
Grass	3	2	8.93
Brush	0	2	3.57
Deciduous Trees	15	17	57.14
Evergreen Trees	8	7	26.79
No Vegetation	2	0	3.57

APPENDIX C. FISH HABITAT INVENTORY DATA SUMMARY

STREAM NAME: Maacama Creek
SAMPLE DATES: 10/14/96 to 10/29/96
STREAM LENGTH: 13455 ft.
LOCATION OF STREAM MOUTH:
USGS Quad Map: MT ST HEL. Latitude: 38°36'50"
Legal Description: T9NR8WS20 Longitude: 122°46'57"

SUMMARY OF FISH HABITAT ELEMENTS BY STREAM REACH

STREAM REACH 1

Channel Type: D4	Canopy Density: 60%
Channel Length: 5259 ft.	Evergreen Component: 22%
Riffle/Flatwater Mean Width: 15 ft.	Deciduous Component: 76%
Total Pool Mean Depth: 1.3 ft.	Pools by Stream Length: 33%
Base Flow: 0.8 cfs	Pools >=3 ft. deep: 17%
Water: 54 - 64 °F Air: 52 - 80 °F	Mean Pool Shelter Rtn: 28
Dom. Bank Veg.: Deciduous Trees	Dom. Shelter: Root masses
Vegetative Cover: 42%	Occurrence of LOD: 31%
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 68 ft.
Embeddness Value: 1. 4% 2. 69% 3. 19% 4. 8%	

STREAM REACH 2

Channel Type: F4	Canopy Density: 44%
Channel Length: 8196 ft.	Evergreen Component: 25%
Riffle/Flatwater Mean Width: 26 ft.	Deciduous Component: 75%
Total Pool Mean Depth: 1.7 ft.	Pools by Stream Length: 37%
Base Flow: 0.8 cfs	Pools >=3 ft. deep: 68%
Water: 52 - 60 °F Air: 52 - 72 °F	Mean Pool Shelter Rtn: 20
Dom. Bank Veg.: Deciduous Trees	Dom. Shelter: Root masses
Vegetative Cover: 73%	Occurrence of LOD: 13%
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 0 ft.
Embeddness Value: 1. 4% 2. 78% 3. 7% 4. 11%	

Lower Maacama — Drainage: Russian River

Table 1 - SUMMARY OF RIFFLE, FLATWATER, AND POOL HABITAT TYPES — Survey Dates: 08/27/97 to 09/04/97

Confluence Location: QUAD: LEGAL DESCRIPTION: LATITUDE: 0°0'0" LONGITUDE: 0°0'0"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	ESTIMATED TOTAL AREA (sq.ft.)	MEAN VOLUME (cu.ft.)	ESTIMATED TOTAL VOLUME (cu.ft.)	MEAN RESIDUAL POOL VOL (cu.ft.)	MEAN SHELTER RATING
19	0	RIFFLE	12	70	1321	5	8.5	0.4	513	9738	167	3164	0	0
76	9	FLATWATER	49	177	13458	55	11.6	0.5	2420	183904	1409	107098	0	33
52	14	POOL	34	110	5734	23	19.4	1.7	2356	122528	3882	201873	3109	24
8	0	DRY	5	511	4088	17	0.0	0.0	0	0	0	0	0	0

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq. ft.)	TOTAL VOL. (cu. ft.)
155	23	24601	316171	312135

Lower Maacama — Drainage: Russian River

Table 2 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS — Survey Dates: 08/27/97 to 09/04/97

Confluence Location: QUAD: — LEGAL DESCRIPTION: — LATITUDE: 0°0'0" LONGITUDE: 0°0'0"

HABITAT UNITS #	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT OCCURRENCE %	MEAN LENGTH ft.	TOTAL LENGTH ft.	TOTAL LENGTH %	MEAN WIDTH ft.	MEAN DEPTH ft.	MAXIMUM DEPTH ft.	MEAN AREA sq.ft.	TOTAL AREA EST. sq.ft.	MEAN VOLUME cu.ft.	TOTAL VOLUME EST. cu.ft.	MEAN RESIDUAL POOL VOL cu.ft.	MEAN SHELTER RATING	MEAN CANOPY %
19	0	LGR	12	70	1321	5	9	0.4	0.7	513	9738	167	3164	0	0	49
22	1	GLD	14	171	3771	15	16	0.7	1.5	1816	39961	1272	27973	0	10	52
50	7	RUN	32	168	8406	34	10	0.5	2.0	2188	109388	1165	58271	0	39	50
4	1	SRN	3	320	1281	5	15	0.7	1.1	4647	18590	3253	13013	0	10	70
10	2	MCP	6	81	811	3	20	1.7	5.0	1628	16280	2786	27865	2218	22	41
1	1	CRP	1	176	176	1	20	2.5	5.0	3520	3520	8800	8800	7744	5	60
4	2	LSL	3	100	398	2	21	1.5	3.6	2058	8232	3414	13657	2690	50	48
13	3	LSR	8	138	1795	7	20	1.6	3.9	3546	46103	4737	61576	3522	35	47
19	4	LSBk	12	118	2248	9	19	1.9	7.0	2277	43264	4280	81323	3506	12	53
2	1	LSBo	1	69	138	1	24	1.9	3.2	1228	2455	2363	4727	1904	13	35
1	0	PLP	1	70	70	0	21	1.8	3.2	1470	1470	2646	2646	2205	20	0
2	1	BPL	1	49	99	0	11	1.4	2.6	563	1126	839	1678	277	55	50
8	0	DRY	5	511	4088	17	0	0.0	0.0	0	0	0	0	0	0	26

TOTAL UNITS	TOTAL UNITS	LENGTH (ft.)	AREA (sq.ft)	TOTAL VOL. (cu.ft)
155	23	24601	300126	304692

Lower Maacama

Drainage: Russian River

Table 3 - SUMMARY OF POOL TYPES

Survey Dates: 08/27/97 to 09/04/97

Confluence Location: QUAD: LEGAL DESCRIPTION: LATITUDE: 0°0'0" LONGITUDE: 0°0'0"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA EST. (sq.ft.)	MEAN VOLUME (cu.ft.)	TOTAL VOLUME EST. (cu.ft.)	MEAN RESIDUAL POOL VOL. (cu.ft.)	MEAN SHELTER RATING
10	2	MAIN	19	81	811	14	19.6	1.7	1628	16280	2786	27865	2218	22
40	11	SCOUR	77	121	4825	84	19.8	1.8	2635	105402	4319	172768	3419	24
2	1	BACKWATER	4	49	99	2	11.0	1.4	563	1126	839	1678	277	55

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq.ft.)	TOTAL VOL. (cu.ft.)
52	14	5734	122807	202310

Lower Maacama

Drainage: Russian River

Table 4 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPES

Survey Dates: 08/27/97 to 09/04/97

Confluence Location: QUAD: LEGAL DESCRIPTION: LATITUDE: 0°0'0" LONGITUDE: 0°0'0"

UNITS MAX DPTH MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	<1 FOOT MAXIMUM DEPTH	<1 FOOT PERCENT OCCURRENCE	1-<2 FT. MAXIMUM DEPTH	1-<2 FOOT PERCENT OCCURRENCE	2-<3 FT. MAXIMUM DEPTH	2-<3 FOOT PERCENT OCCURRENCE	3-<4 FT. MAXIMUM DEPTH	3-<4 FOOT PERCENT OCCURRENCE	>=4 FEET MAXIMUM DEPTH	>=4 FEET PERCENT OCCURRENCE
10	MCP	19	0	0	2	20	5	50	1	10	2	20
1	CRP	2	0	0	0	0	0	0	0	0	1	100
4	LSL	8	0	0	0	0	2	50	2	50	0	0
13	LSR	25	0	0	0	0	7	54	6	46	0	0
19	LSBk	37	0	0	1	5	3	16	9	47	6	32
2	LSBo	4	0	0	0	0	1	50	1	50	0	0
1	PLP	2	0	0	0	0	0	0	1	100	0	0
2	BPL	4	0	0	0	0	2	100	0	0	0	0

TOTAL UNITS
52

Lower Maacama — Drainage: Russian River

Table 5 - Summary of Shelter by Habitat Type — Survey Dates: 08/27/97 to 09/04/97

Confluence Location: QUAD: — LEGAL DESCRIPTION: — LATITUDE: 0°0'0" — LONGITUDE: 0°0'0"

UNITS MEASURED	UNITS SHELTER MEASURED	HABITAT TYPE	% TOTAL UNDERCUT BANKS	% TOTAL SWD	% TOTAL LWD	% TOTAL ROOT MASS	% TOTAL TERR. VEGETATION	% TOTAL AQUATIC VEGETATION	% TOTAL WHITE WATER	% TOTAL BOULDERS	% TOTAL BEDROCK LEDGES
19	0	LGR	0	0	0	0	0	0	0	0	0
22	1	GLD	40	0	0	15	30	15	0	0	0
50	7	RUN	0	4	0	9	81	0	0	6	0
4	1	SRN	0	10	0	20	65	0	0	5	0
10	10	MCP	4	19	4	10	60	0	0	3	0
1	1	CRP	30	0	35	0	35	0	0	0	0
4	4	LSL	2	54	29	0	15	0	0	0	0
13	13	LSR	3	24	6	32	34	0	0	1	0
19	19	LSBk	2	15	0	25	33	1	0	11	13
2	2	LSBo	0	0	0	19	6	0	0	74	0
1	1	PLP	0	0	0	50	25	0	0	10	15
2	2	BPL	0	68	0	3	12	16	0	0	0
8	0	DRY	0	0	0	0	0	0	0	0	0
ALL HABITAT TYPES 155	61		3	25	8	20	38	1	0	4	2
POOLS ONLY 52	52		3	27	9	21	33	1	0	4	2

Lower Maacama

Drainage: Russian River

Table 6 - SUMMARY OF DOMINANT SUBSTRATES BY HABITAT TYPE

Survey Dates: 08/27/97 to 09/04/97

Confluence Location: QUAD: LEGAL DESCRIPTION: LATITUDE: 0°0'0" LONGITUDE: 0°0'0"

TOTAL HABITAT UNITS	UNITS SUBSTRATE MEASURED	HABITAT TYPE	% TOTAL SILT/CLAY DOMINANT	% TOTAL SAND DOMINANT	% TOTAL GRAVEL DOMINANT	% TOTAL SM COBBLE DOMINANT	% TOTAL LG COBBLE DOMINANT	% TOTAL BOULDER DOMINANT	% TOTAL BEDROCK DOMINANT
9	2	LGR	0	0	50	50	0	0	0
1	1	GLD	0	100	0	0	0	0	0
7	7	RUN	0	57	43	0	0	0	0
1	1	SRN	0	0	100	0	0	0	0
2	2	MCP	0	100	0	0	0	0	0
1	1	CRP	0	0	100	0	0	0	0
2	2	LSL	0	100	0	0	0	0	0
2	2	LSR	0	50	50	0	0	0	0
6	6	LSBk	17	83	0	0	0	0	0
1	1	LSBo	0	100	0	0	0	0	0
1	1	PLP	0	100	0	0	0	0	0
2	2	BPL	50	50	0	0	0	0	0
1	1	DRY	0	0	100	0	0	0	0

Lower Maacama

APPENDIX A. Summary of Mean Percent Vegetative Cover for Entire Stream

Mean Percent Canopy	Mean Percent Evergreen	Mean Percent Deciduous	Mean Right bank % Cover	Mean Left Bank % Cover
48.51	37.17	62.83	87.68	66.61

APPENDIX B.

Mean Percentage of Dominant Substrate

Dominant Class of Substrate	Number Units Right Bank	Number Units Left Bank	Percent Total Units
Bedrock	0	8	14.29
Boulder	0	1	1.79
Cobble/Gravel	1	0	1.79
Silt/clay	27	19	82.14

Mean Percentage of Dominant Vegetation

Dominant Class of Vegetation	Number Units Right Bank	Number Units Left Bank	Percent Total Units
Grass	0	3	5.36
Brush	1	0	1.79
Deciduous Trees	24	13	66.07
Evergreen Trees	3	12	26.79
No Vegetation	0	0	0

APPENDIX C. FISH HABITAT INVENTORY DATA SUMMARY

STREAM NAME: Lower Maacama
SAMPLE DATES: 08/27/97 to 09/04/97
SURVEY LENGTH:
MAIN CHANNEL: 24531 ft. SIDE CHANNEL: 858 ft.
LOCATION OF STREAM MOUTH:
USGS Quad Map: Latitude: 0°0'0"
Legal Description: Longitude: 0°0'0"

SUMMARY OF FISH HABITAT ELEMENTS BY STREAM REACH

STREAM REACH 1 (Units 1-118)

Channel Type: D4	Mean Canopy Density: 47%
Main Channel Length: 20014 ft.	Evergreen Component: 36%
Side Channel Length: 484 ft.	Deciduous Component: 64%
Riffle/Flatwater Mean Width: 10.0 ft.	Pools by Stream Length: 24%
Pool Mean Depth: 1.7 ft.	Pools >=2 ft. Deep: 93%
Base Flow: 0.5 cfs	Pools >=3 ft. Deep: 55%
Water: 63-79°F Air: 63-83°F	Mean Pool Shelter Rtn: 27
Dom. Bank Veg.: Deciduous Trees	Dom. Shelter: Terrestrial Veg.
Bank Vegetative Cover: 80%	Occurrence of LOD: 23%
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 4088 ft.
Embeddness Value: 1. 7% 2. 32% 3. 32% 4. 29%	

STREAM REACH 2 (Units 119-131)

Channel Type: F4	Mean Canopy Density: 43%
Main Channel Length: 1864 ft.	Evergreen Component: 31%
Side Channel Length: 0 ft.	Deciduous Component: 69%
Riffle/Flatwater Mean Width: 22.0 ft.	Pools by Stream Length: 28%
Pool Mean Depth: 1.8 ft.	Pools >=2 ft. Deep: 100%
Base Flow: 0.5 cfs	Pools >=3 ft. Deep: 80%
Water: 72-74°F Air: 79-86°F	Mean Pool Shelter Rtn: 11
Dom. Bank Veg.: Deciduous Trees	Dom. Shelter: Boulders
Bank Vegetative Cover: 49%	Occurrence of LOD: 0%
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 0 ft.
Embeddness Value: 1. 0% 2. 0% 3. 80% 4. 20%	

STREAM REACH 3 (Units 132-145)

Channel Type: D4	Mean Canopy Density: 63%
Main Channel Length: 2653 ft.	Evergreen Component: 54%
Side Channel Length: 374 ft.	Deciduous Component: 46%
Riffle/Flatwater Mean Width: 12.0 ft.	Pools by Stream Length: 15%
Pool Mean Depth: 2.1 ft.	Pools >=2 ft. Deep: 100%
Base Flow: 0.5 cfs	Pools >=3 ft. Deep: 60%
Water: 72-72°F Air: 86-92°F	Mean Pool Shelter Rtn: 14
Dom. Bank Veg.: Deciduous Trees	Dom. Shelter: Root masses
Bank Vegetative Cover: 71%	Occurrence of LOD: 0%
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 0 ft.
Embeddness Value: 1. 0% 2. 60% 3. 40% 4. 0%	