MORRO BAY WATERSHED STEELHEAD RESTORATION PLANNING PROJECT

STREAM INVENTORY REPORT

CHORRO CREEK, 2001

Prepared to:
Coastal San Luis Resource Conservation District

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STREAM INVENTORY REPORT

CHORRO CREEK

INTRODUCTION

A stream inventory was conducted during the summer of 2001 on Chorro Creek. The survey began approximately 8500 feet from the confluence of Chorro Creek and Morro Bay and extended upstream 8.5 miles to the Chorro Reservoir dam. The objective of the inventory was to document the habitat available to anadromous salmonids in Chorro Creek.

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

WATERSHED OVERVIEW

Chorro Creek is a tributary to Morro Bay, which is a tributary to the Pacific Ocean. Chorro Creek is located in San Luis Obispo County, California (Map 1). Chorro Creek's legal description at the confluence with Morro Bay is T30S R11E S6. Its location at the mouth is 35°20′28″ north latitude and 120°50′21″ west longitude. Chorro Creek is a fifth order stream and has approximately 14.2 miles of blue line stream according to the USGS San Luis Obispo, Morro Bay South, Morro Bay North, and Atascadero 7.5 minute quadrangles. Chorro Creek drains a watershed of approximately 43.2 square miles. Elevations range from sea level at the mouth of the creek to 1400 feet in the headwater areas. Valley grassland, coastal scrub and oak savanna dominate the watershed, with mixed conifer forest and oak woodlands dominating the upper elevations of the watershed.

The watershed is privately and publicly owned. Private portions are primarily managed for urban development and livestock rangeland. Public ownership primarily includes the National Guard (Camp San Luis Obispo), the County of San Luis Obispo Parks and Recreation Department, the California Men's Colony (CMC), and California Polytechnic State University (CalPoly). Public portions are managed for rangeland, park recreation, military operations, and prison facilities. The CMC also manages a wastewater treatment plant with an outfall on Chorro Creek.

Vehicle access to the mouth of Chorro Creek exists via Colusa Avenue, located off Highway 1 North and Hollister Avenue.

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METHODS

The habitat inventory conducted in Chorro Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). California Conservation Corps (CCC) members and a volunteer from Central Coast Salmon Enhancement (CCSE) conducted the inventory and were trained in standardized habitat inventory methods by the California Department of Fish and Game (CDFG). This inventory was conducted by a three to four person team. Quality assurance was provided by CDFG trained members of the CCC, the Coastal San Luis Resource Conservation District (CSLRCD), Morro Bay National Estuary Program (MBNEP), and consultation with CDFG habitat inventory specialists.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach (Hopelain, 1994). All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest, dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are further measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

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 Chorro Creek to record measurements and observations. There are nine components to the inventory form.

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. Flow information was provided by MBNEP staff.

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2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1985 rev. 1994). 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. Channel dimensions were measured using a clinometer, hand level, tape measure, and a stadia rod.

3. Temperatures:

Both water and air temperatures are measured and recorded at every tenth habitat unit. The time of the measurement is also recorded. Both temperatures are taken in degrees Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

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". Chorro 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. Channel dimensions were measured using Global Positioning System (GPS), hip chains, tape measures, and stadia rods. All units were measured for mean length; additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were sampled for all features on the sampling form (Hopelain, 1995). Pool tail crest depth at each pool unit was measured in the thalweg. 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 Chorro Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations.

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6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide salmonids protection from predation, reduced water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Chorro Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. 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 described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two respectively. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Chorro Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every tenth unit in addition to every fully-described unit, giving an approximate 10% sub-sample. However, canopy readings in Chorro Creek were taken in 53% of the total number of units in the survey. In addition, the area of canopy was estimated ocularly into percentages of coniferous or deciduous trees.

9. Bank Composition and Vegetation:

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 Chorro Creek, the dominant composition type and the dominant vegetation type of both the right and left banks, looking downstream, for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation was estimated and recorded.

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GPS Data Collection:

In addition to the nine components of the habitat inventory, a variety of other stream characteristics were located using a Global Positioning System (GPS). Locations included: the creek thalweg, bank erosion sites, pool tail crests, fish species seen in pools, log jams, culverts, drain pipes, invasive plants, barriers to steelhead passage, and landmarks such as bridges, trails, and fences. A more detailed list of attributes to each layer is attached to the end of this report. A Trimble ® Pathfinder Pro-XR GPS unit was used to record locations. Latitude and longitude measurements recorded with this unit are accurate to within one meter. The Quality Assurance Project Plan for the Morro Bay Watershed GPS Survey provides a detailed description of device settings and other information related to the GPS data collection methods (Close, 2001).

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat 8.4, a dBASE 4.2 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 six tables:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Dominant substrates by habitat types
- Mean percent shelter by habitat types

Graphics are produced from the tables using Corel. Graphics developed for Chorro Creek include:

- Riffle, flatwater, pool habitats by percent occurrence
- Riffle, flatwater, pool habitats by total length
- Total habitat types by percent occurrence
- Pool types by percent occurrence
- Total pools by maximum depths
- Embeddedness
- Pool cover by cover type
- Dominant substrate in the pool tail outs
- Percent canopy
- Bank composition by composition type
- Bank vegetation by vegetation type

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HABITAT INVENTORY RESULTS

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

The habitat inventory of August 16, 20, 21, 22, 23, 27, 28, 29, 30, 2001 was conducted by a team of three to four members including Stacey Smith (CCC), Paul Corsi (CCC), Charley Jonck (CCC), Bobby Jo Close (CCC), Matt Mosher (CCC), Freddy Otte (CCSE Volunteer), and Ann Huber (CSLRCD). The total length of the stream surveyed was 44,834 feet with an additional 21,792 feet of side channel.

Stream flow was measured at the bottom of the survey reach with a Gurley flowmeter at 3.357 cfs on August 21st, and 3.685 cfs on September 4th.

The first 8,448 feet of Chorro Creek were not surveyed due to marsh (7,392 feet) and non-wadeable depths (1,056 feet). Thus, habitat inventory began 8,448 feet upstream of the mouth.

Chorro Creek is a F4 channel type for the first 13,038 feet of stream surveyed (Reach 1). F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. Of note are several sections within Reach 1 which fall within the C channel type description, but they are not long enough to be separated out from the predominant F channel type morphology. These intermediate sections are in the lower sections of Reach 1, such as in the Chorro Flats area. According to the habitat inventory protocol, the minimum length for a channel type is at least 20 times as long as the average bankfull width of the stream. Reach 1 includes a 16,368 foot section which was not surveyed due to lack of access on private property. This section is located between Chorro Flats and CalPoly property, beginning approximately 2.65 miles upstream from the mouth of Chorro Creek to the San Bernardo Creek confluence. No barriers to anadromous fish passage are believed to be located within this unsurveyed stretch (Bill Hoffman, personal communication 2001). Spot checks were conducted of the unsurveyed reach from public access areas. These observations indicated that this section appeared to be a F4 channel type also.

The next 2,006 feet of stream is a C4 channel type (Reach 2). C4 channels are low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplains and gravel-dominant substrates.

The next 12,164 feet of stream surveyed is a F3 channel type (Reach 3). Chorro Creek is a F1 for the next 2,104 feet (Reach 4), and then returns to a F4 for the next 7,724 feet (Reach 5). F3 and F1 channels are morphologically similar to F4 channel types, but F3 channels have cobble-dominant substrates and F1 channels have bedrock-dominant substrates. Reach 5 included 2,846 feet of dry channel which appeared to include a C4 channel type section (approximately 2,349 feet long). However, the CDFG channel typing protocol does not apply to dry channels so this assumption cannot be made at this time.
Upstream of Reach 5, Chorro Creek becomes a B4 channel type for the next 2,314 feet (Reach

6), and then returns to a F3 for the next 1,381 feet (Reach 7). B4 channels are moderately entrenched, moderate gradient, riffle dominated channels with infrequently spaced pools; very stable plan and profiles; stable banks and gravel-dominant substrates.

The last 759 feet of stream surveyed is a B1 channel type (Reach 8). B1 channels are morphologically similar to B4 channel types, but have bedrock-dominant substrates.

Water temperatures taken during the survey period ranged from 56 to 75 degrees Fahrenheit. Air temperatures ranged from 54 to 81 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 20% riffle units, 37% flatwater units, and 40% pool units (Graph 1). Based on total length of Level II habitat types there were 14% riffles, 43% flatwater units, and 33% pools (Graph 2).

Fifteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 30%; run units, 29%; and low gradient riffle units, 18% (Graph 3). Based on percent total length, run units made up 20%, mid-channel pool units 17%, and glide units 8%.

A total of 241 pools were identified (Table 3). Main-channel pools were most frequently encountered at 74% and comprised 82% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. One hundred and twenty-nine of the 241 pools (54%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 239 pool tail-outs measured, 36 had a value of 1 (15%); 41 had a value of 2 (17%); 35 had a value of 3 (14%); 94 had a value of 4 (39%) and 33 had a value of 5 (14%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate and a value of 5 indicates the tail-out is not suitable for spawning. In Chorro Creek, five of the 241 pool tail-outs which were valued at 5 had silt/clay/sand or gravel too small to be suitable for spawning as the substrate. The other 28 tail-outs, valued at 5, were unsuitable for spawning due to the tail-outs being comprised of large cobble, boulder, bedrock or wood.

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. Riffle habitat types had a mean shelter rating of 17, flatwater habitat types had a mean shelter rating of 26, and pool habitats had a mean shelter rating of 9 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 23. Scour pools had a mean shelter rating of 14 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation was the dominant cover type in Chorro Creek. Boulders were the next common cover types. Large woody debris was the least common cover type and was lacking in all but three habitat types, of which were encountered relatively infrequently. Graph 7 describes the pool cover in Chorro Creek. Boulders and terrestrial vegetation were also the dominant cover types in pools.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 shows the dominant substrate observed in pool tail-outs. Gravel was the dominant substrate observed in 70% of the pool tail outs; small cobble was the next most frequently observed substrate type at 13%.

The mean percent canopy density for the surveyed length of Chorro Creek was 66%. The mean percentages of deciduous and coniferous trees were 87% and 13%, respectively. Graph 9 describes the canopy in Chorro Creek.

For the stream length surveyed, the mean percent right bank vegetated was 35%. The mean percent left bank vegetated was 34%. The dominant elements composing the structure of the stream banks consisted of 12% bedrock, 3% boulder, 16% cobble/gravel, and 68% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 66% of the units surveyed. Additionally, 17% of the units surveyed had brush as the dominant vegetation type, and 15% had grass as the dominant vegetation (Graph 11). Areas of eroded banks along Chorro Creek were mapped using a global positioning device and are shown on Map 1.

Frequent observations of the Sacramento pike minnow, a predatory species of steelhead juveniles, were sighted in pools and flatwater throughout the surveyed length of Chorro Creek. The largest Sacramento pike minnow were found in relatively high concentrations from the CMC to the end of the survey near the Chorro Reservoir. The first sighting of pike minnow was within the first 357 feet of the habitat inventory (Reach 1), approximately 8,805 feet upstream of the mouth of Chorro Creek.

The last steelhead sighting was observed in Reach 4, approximately 52,387 feet from the mouth of Chorro Creek. No barriers to anadromous fish passage were found until Reach 8.

A barrier to anadromous fish passage was found in Reach 8, 67,117 ft or 12.7 miles upstream of the mouth of Chorro Creek. Dave Highland, the local CDFG fisheries habitat specialist, observed the site and agreed that it would not be passable to steelhead. The site consists of a 130 foot long bedrock sheet with steep eroded banks; 17% overall slope with a 12 foot high section of 45% slope on the downstream end; and no opportunities for steelhead to rest within the bedrock sheet. The site is located approximately 440 feet downstream of the Chorro Reservoir dam.

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DISCUSSION

Chorro Creek is predominantly a F channel type, with a short section of C channel type near the lower reaches and sections of B channel types farther upstream. The table on the next page summarizes the progressive series of channel types starting at the beginning of the survey and following the creek upstream to the survey end.

Reach #	Channel Type	Stream Length (feet)
1	F4	13,038
2	C4	2,006
3	F3	12,164
4	F1	2,104
5	F4	7,724
6	B4	2,314
7	F3	1,381
8	B1	759

The suitability of these channel types for fish habitat improvement structures is as follows: F4 channels are good for bank placed boulders, plunge weirs, single and opposing wing deflectors, channel constrictors and log cover. C4 channels are good for bank-placed boulders, plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover. F3 channels are good for bank-placed boulders, single and opposing wing-deflectors, plunge weirs, boulder clusters, channel constrictors and log cover. F1 channels are good for bank-placed boulders, single wing-deflectors and log cover. B4 channels are good for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover. B1 channel are good for bank-placed boulders and log cover.

Reach 1, although highly entrenched, includes short sections of C channel type morphology, which would be expected for the lower reaches of a stream the size of Chorro Creek. It is likely that, historically, the active floodplain of this area extended beyond the stream channel banks and allowed the creek to deposit more sediment outside of the stream channel. Increased flows due to stream channel straightening and other impediments to sinuosity such as roads and bridges confine the stream channel, overtime resulting in increased downcutting and higher channel entrenchment. The transitioning within Reach 1 between a predominantly highly entrenched F channel to short sections of low entrenchment C channel type reflect this dynamic.

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The water temperatures recorded on the survey days August 16, 20, 21, 22, 23, 27, 28, 29, 30, 2001, ranged from 59 to 75 degrees Fahrenheit. Air temperatures ranged from 54 to 81 degrees Fahrenheit. This is a warm water temperature range for salmonids. Water temperatures in Chorro Creek are also monitored throughout the year by the Regional Water Quality Control Board. Maximum temperatures from 1995 to 1999, respectively, were as follows: 71°F, 76°F, 70°F, 75°F, 64°F (Regina Wilson, personal communication). These maximum temperatures are within the tolerance range of salmonids. Reaches 1 and 8 had higher water temperatures and amount or algae in the creek than the other reaches. To make any further conclusions, temperatures should be monitored in these areas throughout the warm summer months, and biological sampling would need to be conducted.

Flatwater habitat types comprised 43% of the total length of this survey, riffles 14%, and pools 33%. The pools are relatively deep, with 129 of the 241 pools (54%) pools having a maximum depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended in the B4 channel type.

Thirty-six of the 239 pool tail-outs measured had an embeddedness rating of 1. Forty-one of the pool tail-outs had embeddedness rating of 2, and 129 pool tail-outs had ratings of 3 or 4. Thirty-three of the pool tail-outs had a rating of 5 or were considered unsuitable for spawning. Five of the 239 were unsuitable for spawning due to the dominant substrate being silt/sand/clay or gravel. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In Chorro Creek, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken. An effort to map sediment sources is currently underway by the Morro Bay National Estuary Program.

The mean shelter rating for pools was very low with a rating of 9. The shelter rating in the flatwater habitats was slightly better, but still low, at 26. A pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by terrestrial vegetation and boulders in all habitat types. Log and root wad cover structures in the pool and flatwater habitats are needed to improve both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

One hundred and ninety-nine of the 239 pool tail outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

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The mean percent canopy density for the stream was 66%. This is a relatively low percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%. Each reach in Chorro Creek had less than 80% mean percent canopy density (Table 8) . A planting project has already been implemented in Reach 2 at the Chorro Flats section, which should eventually increase canopy cover in this area. Reaches 6 and 7 have the lowest relative canopy levels, and also visually appear to have the longest stretches of little to no canopy. Therefore, these areas should be given high priority for revegetation projects.

The percentage of right and left bank covered with vegetation was low at 35% and 34%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended. Eroded banks along Chorro Creek are also likely contributing sediment to spawning gravels. Map 1, which shows locations of eroded banks and their maximum height classes, can help prioritize stream bank stabilization projects in the future. Of note also is a large bank failure 38,274 feet upstream of the mouth of Chorro Creek (Reach 1) caused by fallen Eucalyptus and willow trees. A log jam is also located at this site (see comments). Although the bank failure is likely contributing sediment, it also allows the creek channel to increase sinuosity, which overtime can reduce flow velocities and prevent further downcutting and erosion downstream. The downed trees are good for providing shelter to salmonids (Dave Highland, personal communication).

Frequent sightings of the Sacramento pike minnow suggest a predatory impact on the juvenile steelhead population in Chorro Creek. A biological survey of fisheries species abundance and distribution would provide more complete data to assess the threat to steelhead in the creek. However, due to the high numbers of large Sacramento pike minnow sighted in pools near the CMC, removal measures are recommended in conjunction with habitat improvement practices which favor steelhead habitat conditions. Habitat improvement projects would include planting riparian species along the banks where canopy is lacking in Reaches 6-8 to reduce water temperatures, and adding log and root wad cover structures in the pool and flatwater habitats to provide more shelter for steelhead. Cover is necessary to protect predation from predatory birds as well.

The last steelhead sighting was observed in Reach 4. No barriers to anadromous fish passage were found until Reach 8, near the end of the survey. A biological survey of fisheries species distribution would provide more complete data to determine the actual distribution of steelhead in Chorro Creek Within the dry section of Reach 5, there is a 9.5 ft drop in elevation of the thalweg, but during times of the year when water is flowing in the creek it is unlikely that this would pose as a complete barrier to steelhead. However, it may be a causing a partial barrier, especially when stream flows are low, and could benefit from a barrier improvement project (D. Highland, personal communication).

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A possible barrier to anadromous fish passage was found in Reach 8, 67,117 ft or 12.7 miles upstream of the mouth of Chorro Creek. Dave Highland, the local CDFG fisheries habitat specialist, observed the site and agreed that it would not be passable to steelhead. The site consists of a 130 foot long bedrock sheet with steep eroded banks; 17% overall slope with a 12 foot long jump on the downstream end; and no opportunities for steelhead to rest within the bedrock sheet. The site is located approximately 440 feet downstream of the Chorro Reservoir dam. It is unclear whether this barrier existed before construction of the reservoir. Bill L'hommedieu, a long-time trout fisherman in the area, was contacted but did not have knowledge of this area prior to construction of the dam. Old CDFG reports do not mention the presence of a barrier in this area.

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RECOMMENDATIONS

1) Chorro Creek should be managed as an anadromous, natural production stream.

2) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from terrestrial vegetation. Adding high quality complexity with woody cover is desirable.

4) Inventory and map sources of stream bank 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.

5) Conduct a biological inventory of fisheries populations to assess the threat of predatory fish species such as the Sacramento pike minnow. Take measures to directly or indirectly reduce their population in Chorro Creek. Such measures would include removing the fish; planting riparian vegetation along the banks to lower water temperatures; and increase woody cover in pools to provide more shelter for juvenile steelhead. Lowering water temperatures in this area would help to improve the habitat conditions for steelhead.

6) The water temperature data available suggest that maximum temperatures are near the upper acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years. Planting with native riparian species in areas with less than desirable canopy levels is recommended to lower stream water temperatures, especially in Reaches 6 and 7.

7) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

8) Active and potential sediment sources need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries. Sediment sources related to the road system should be included in this effort, since roads are a common source of sediment.

9) There is one log debris accumulation present on Chorro Creek that is retaining large quantities of fine sediment. The modification of this debris accumulation is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.

10) Good water temperature and flow regimes exist in the stream and it offers good conditions for rearing fish. Fish passage should be monitored and improved where possible.

Chorro Creek

COMMENTS AND LANDMARKS

*COMMENTS LOCATED AT THE END OF THE REPORT.

REFERENCES

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd edition. California Department of Fish and Game, Sacramento, California.

Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

Valentine, B. 1995. Stream substrate quality for salmonids: guidelines for sampling, processing, and analysis, unpublished manuscript. California Department of Forestry and Fire Protection, Santa Rosa, California.

PERSONAL COMMUNICATIONS

Dave Highland, California Department of Fish and Game, communicated by phone and in person in September and October, 2001.

Bill Hoffman, Morro Bay National Estuary Program, communicated by phone in September 2001.

Bill L'hommedieu, local longtime trout fisherman, communicated by phone in September 2001.

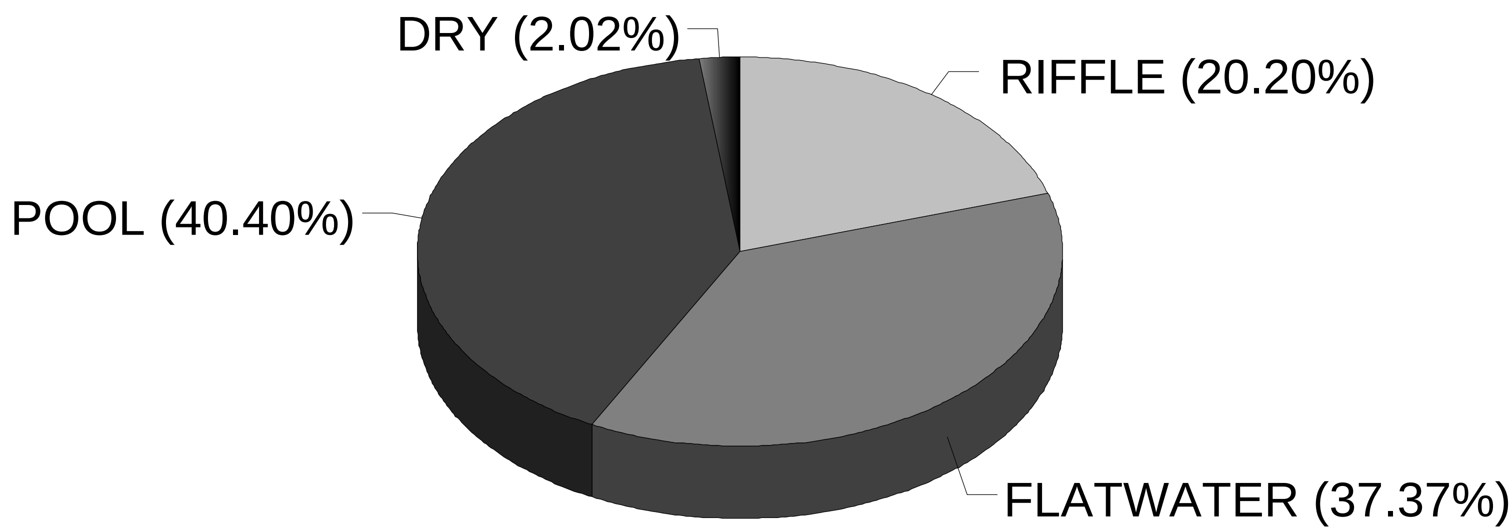
Regina Wilson, Morro Bay National Estuary Program, communicated by email in October 2001.

LEVEL III and LEVEL IV HABITAT TYPE KEY

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6
BACKWATER POOLS		
Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5

CHORRO CREEK

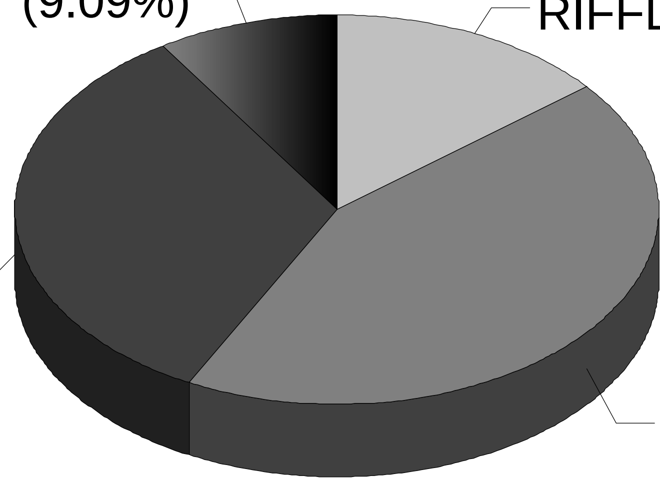
HABITAT TYPES BY PERCENT OCCURRENCE



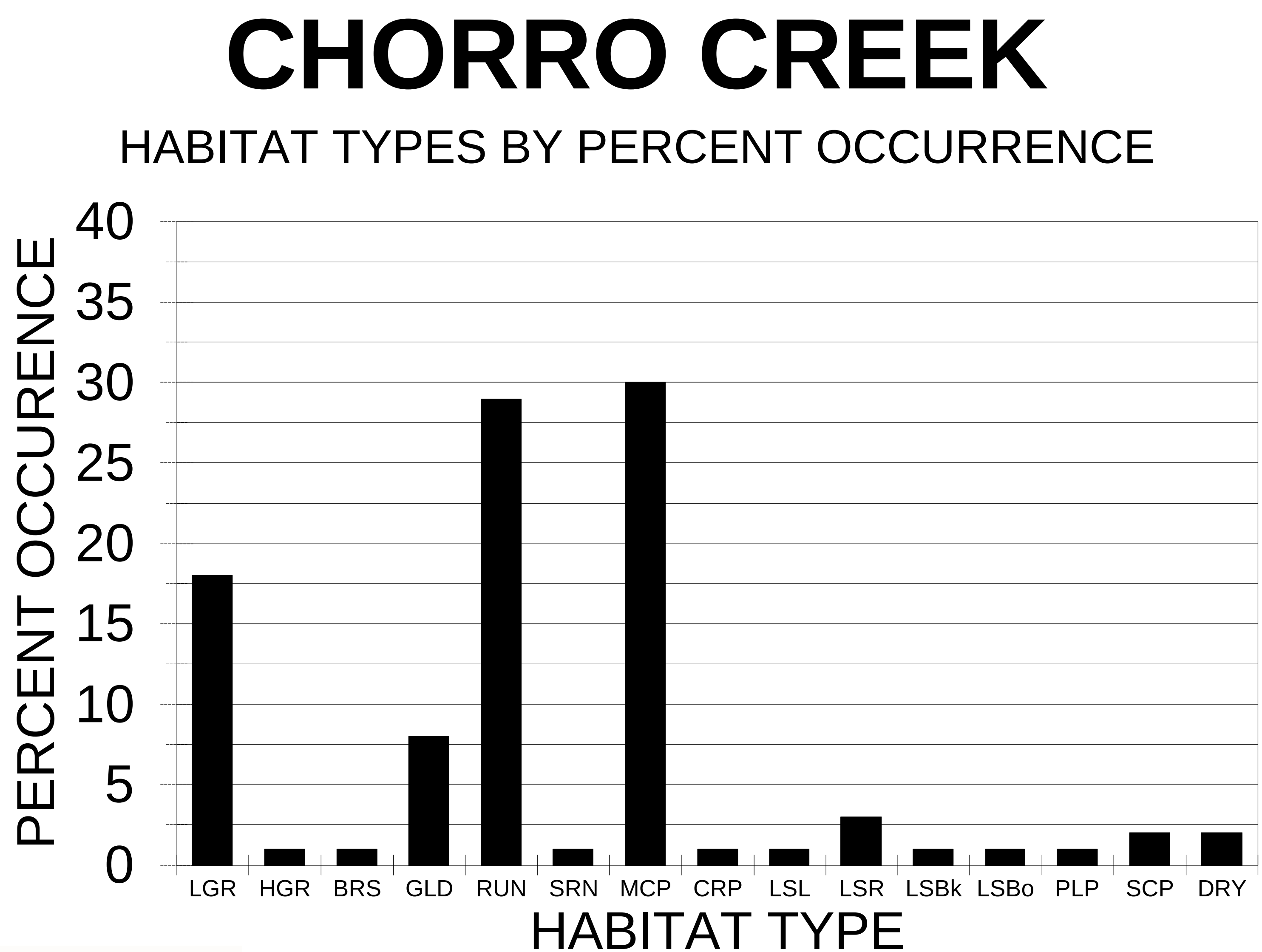
GRAPH 1

CHORRO CREEK

HABITAT TYPES BY PERCENT TOTAL LENGTH

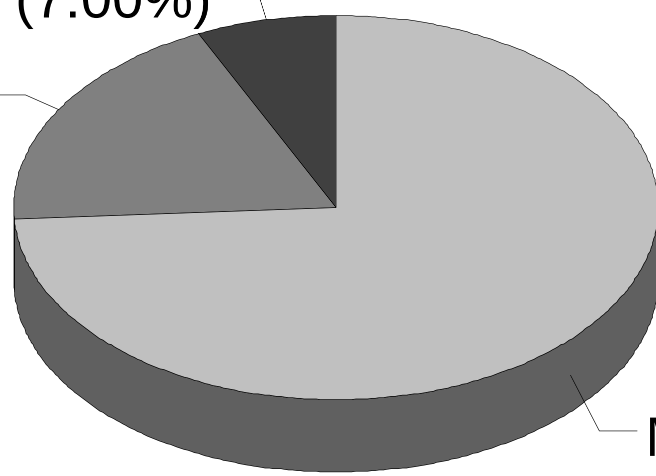


GRAPH 2


CHORRO CREEK
HABITAT TYPES BY PERCENT OCCURRENCE
PERCENT OCCURENCE
0
5
10
15
20
25
30
35
40
LGR
HGR
BRS
GLD
RUN
SRN
MCP
CRP
LSL
LSR
LSBk
LSBo
PLP
SCP
DRY
HABITAT TYPE
GRAPH 3

CHORRO CREEK

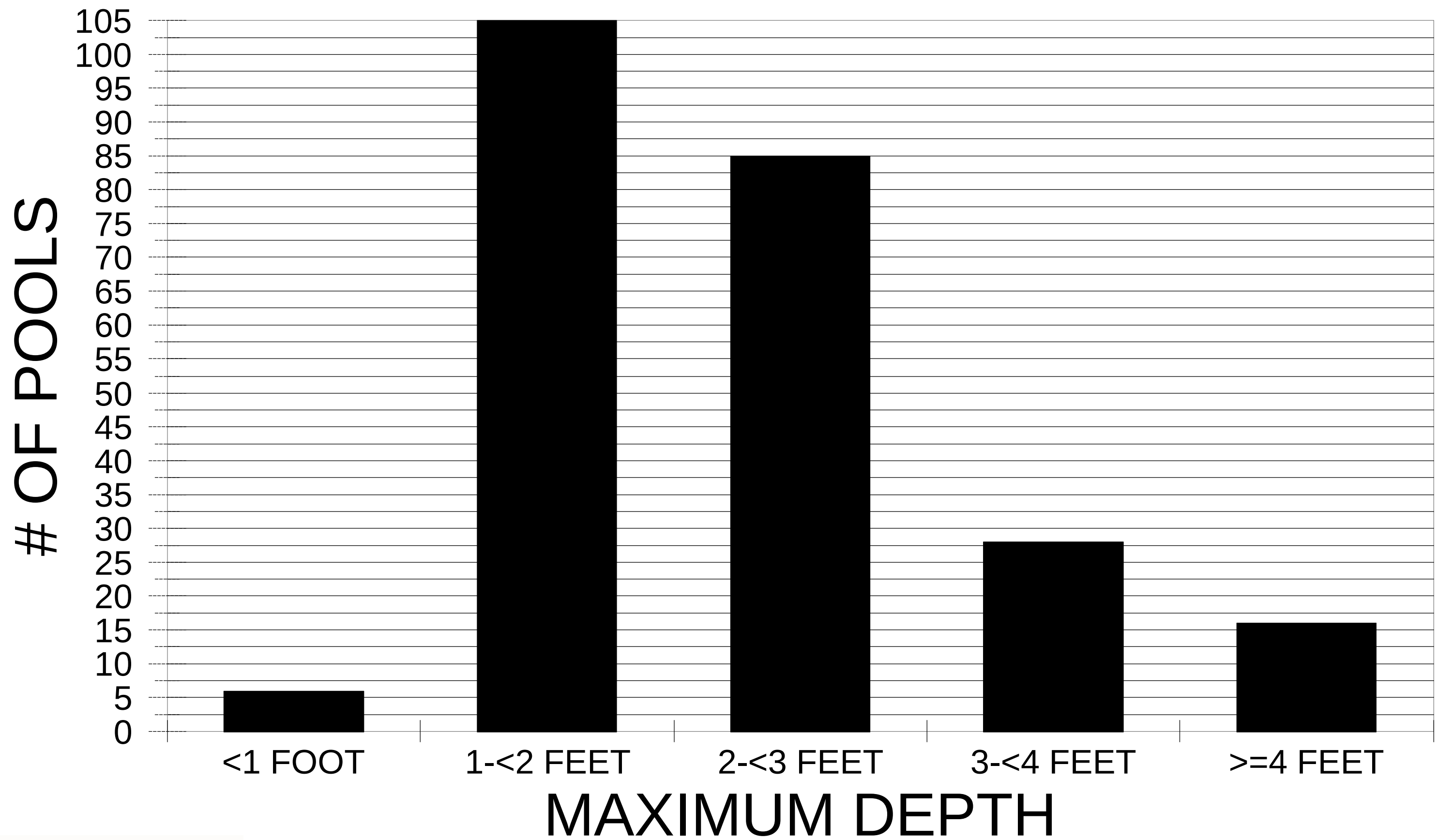
POOL HABITAT TYPES BY % OCCURRENCE



GRAPH 4

CHORRO CREEK

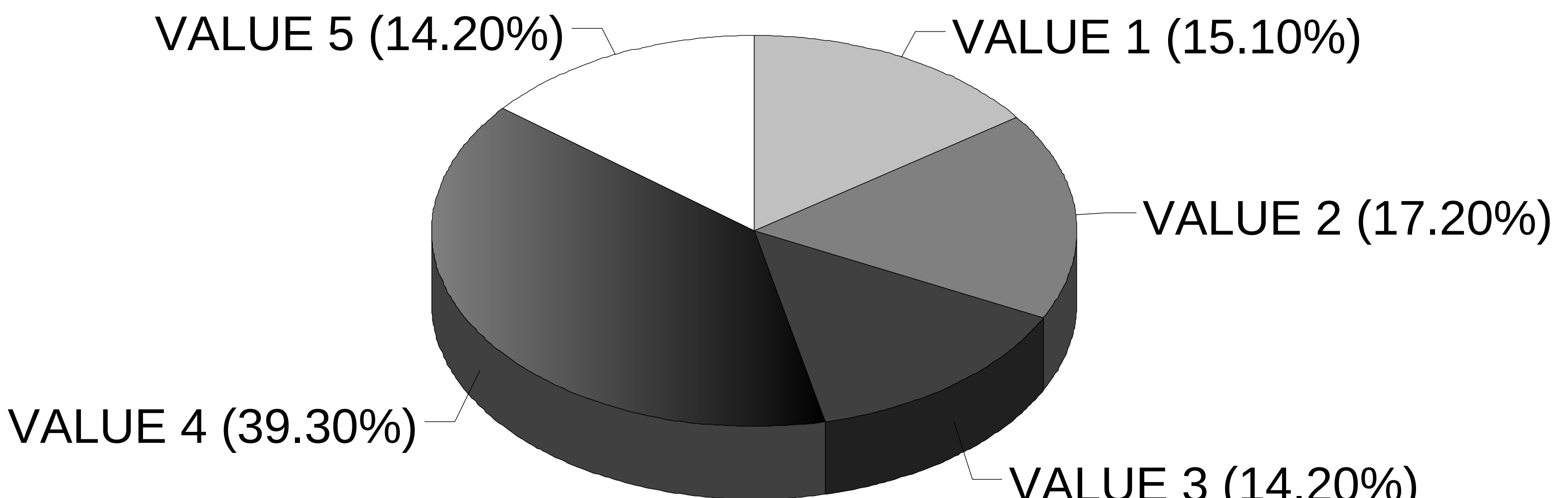
MAXIMUM POOL DEPTHS



GRAPH 5

CHORRO CREEK

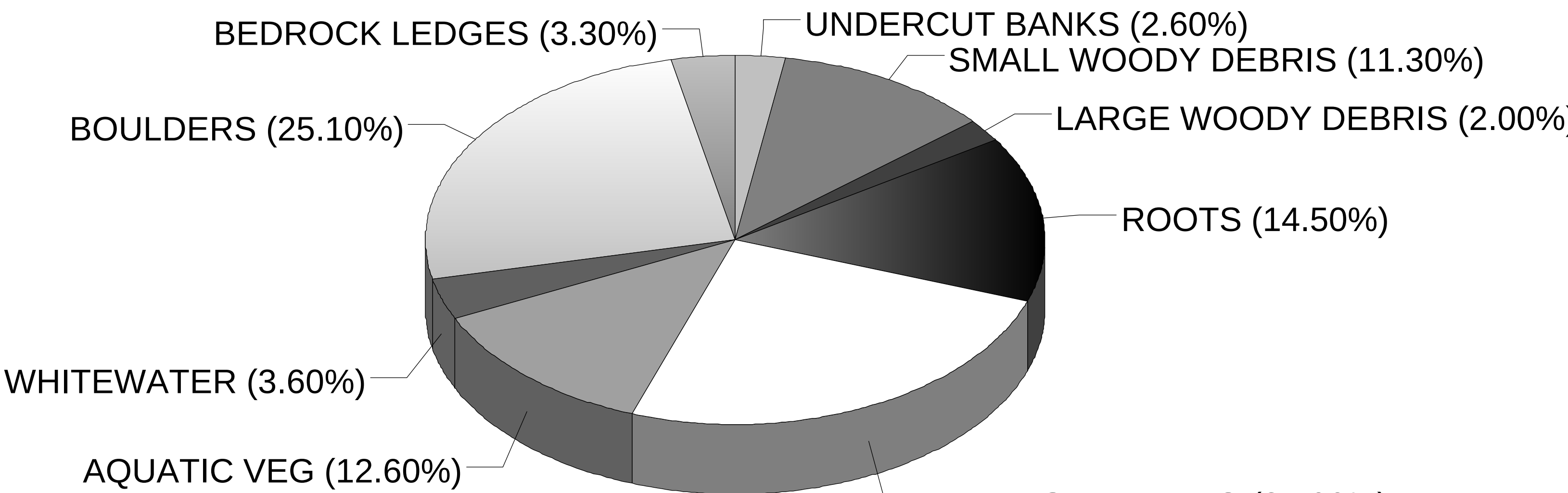
PERCENT EMBEDDEDNESS



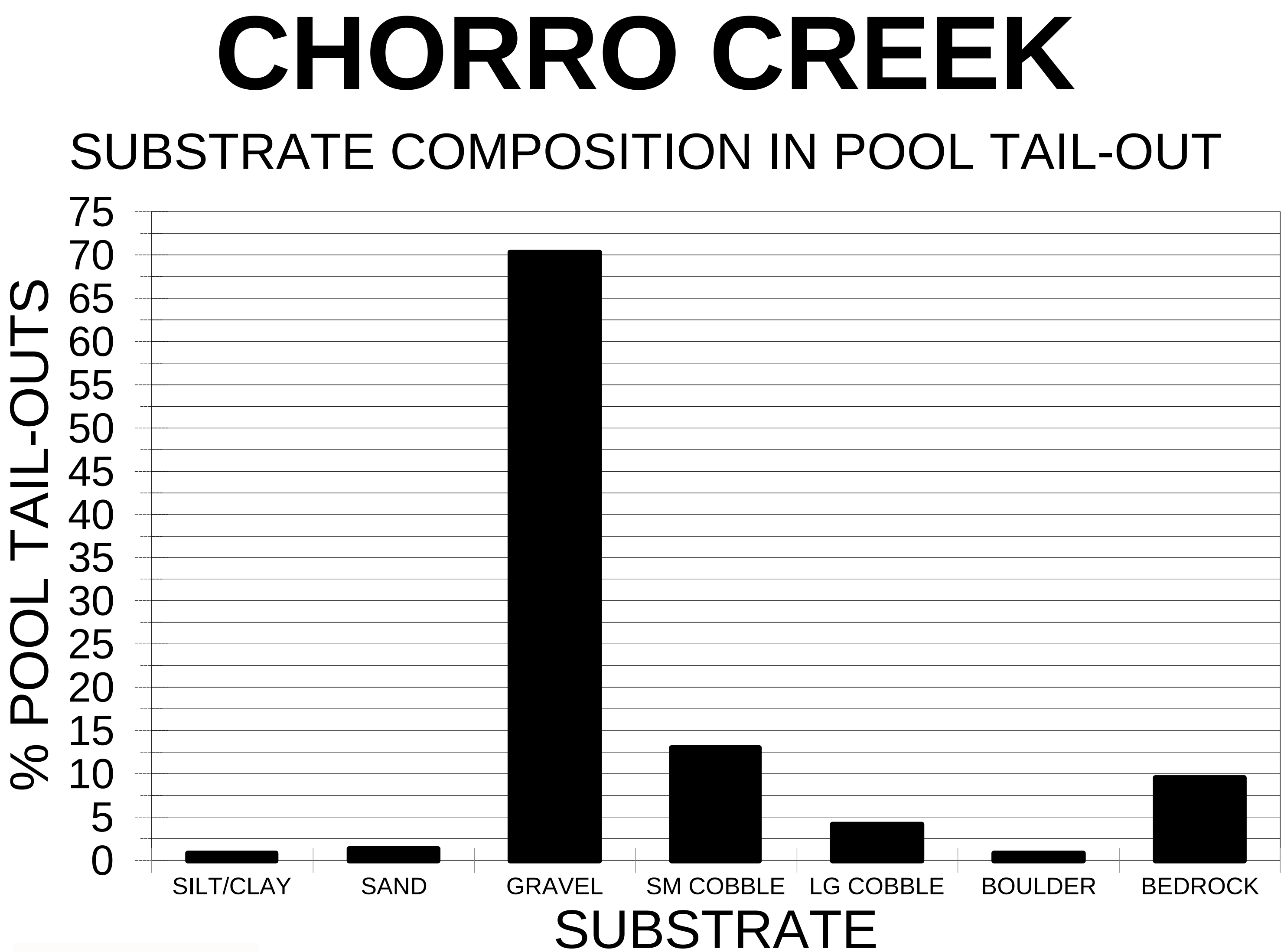
GRAPH 6

CHORRO CREEK

MEAN PERCENT COVER TYPES IN POOLS



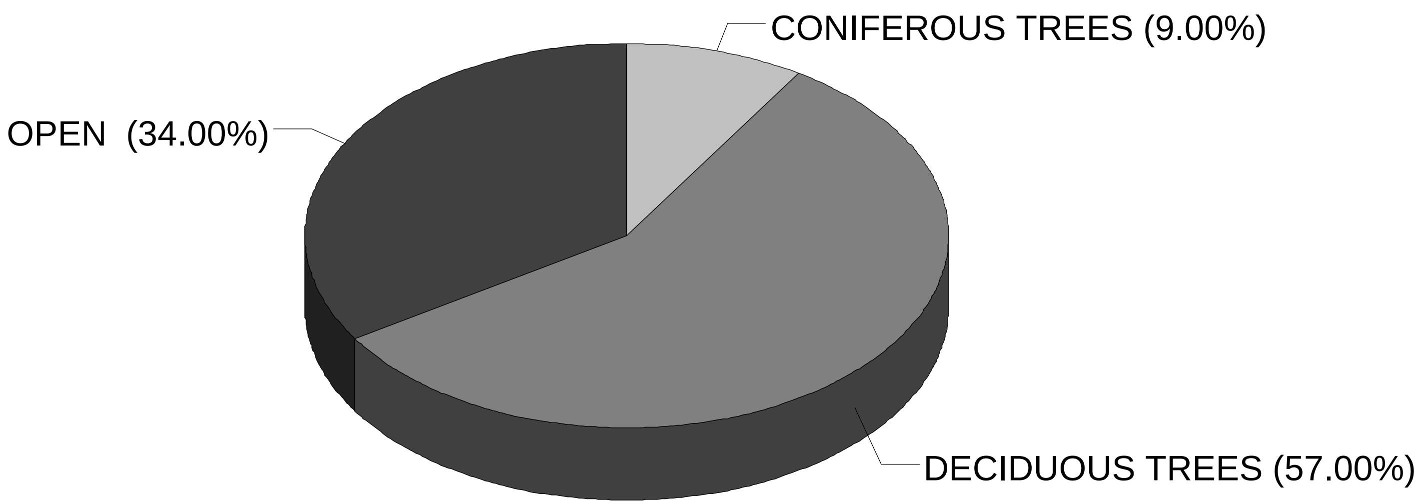
GRAPH 7


CHORRO CREEK
SUBSTRATE COMPOSITION IN POOL TAIL-OUT
% POOL TAIL-OUTS
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
SILT/CLAY
SAND
GRAVEL
SM COBBLE
LG COBBLE
BOULDER
BEDROCK
SUBSTRATE

GRAPH 8

CHORRO CREEK

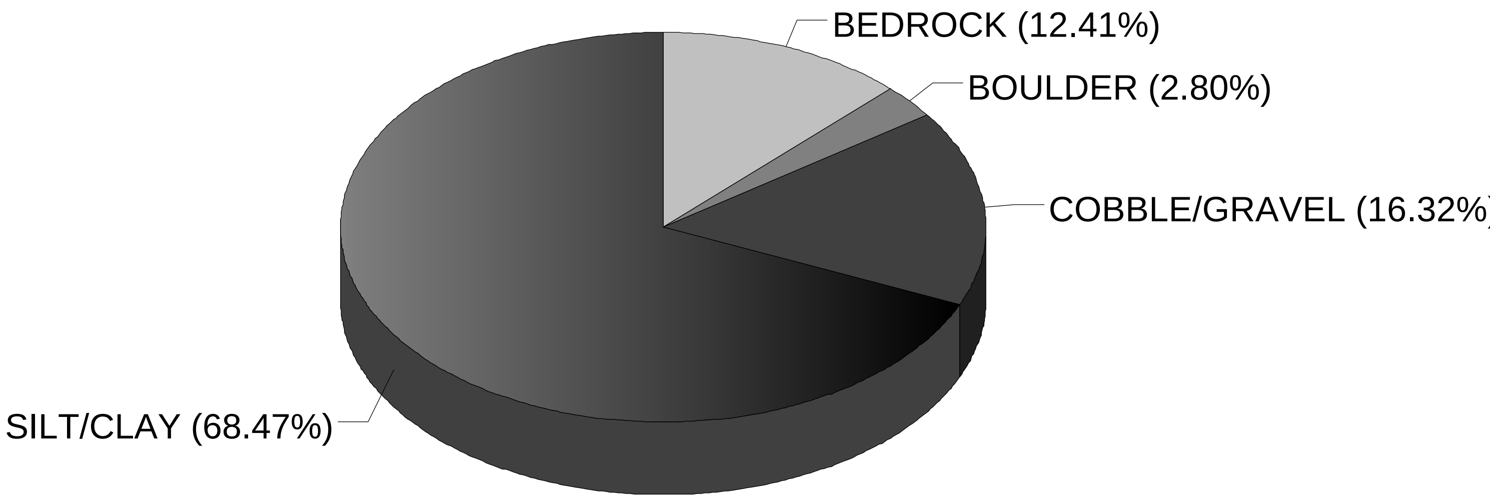
PERCENT CANOPY



GRAPH 9

CHORRO CREEK

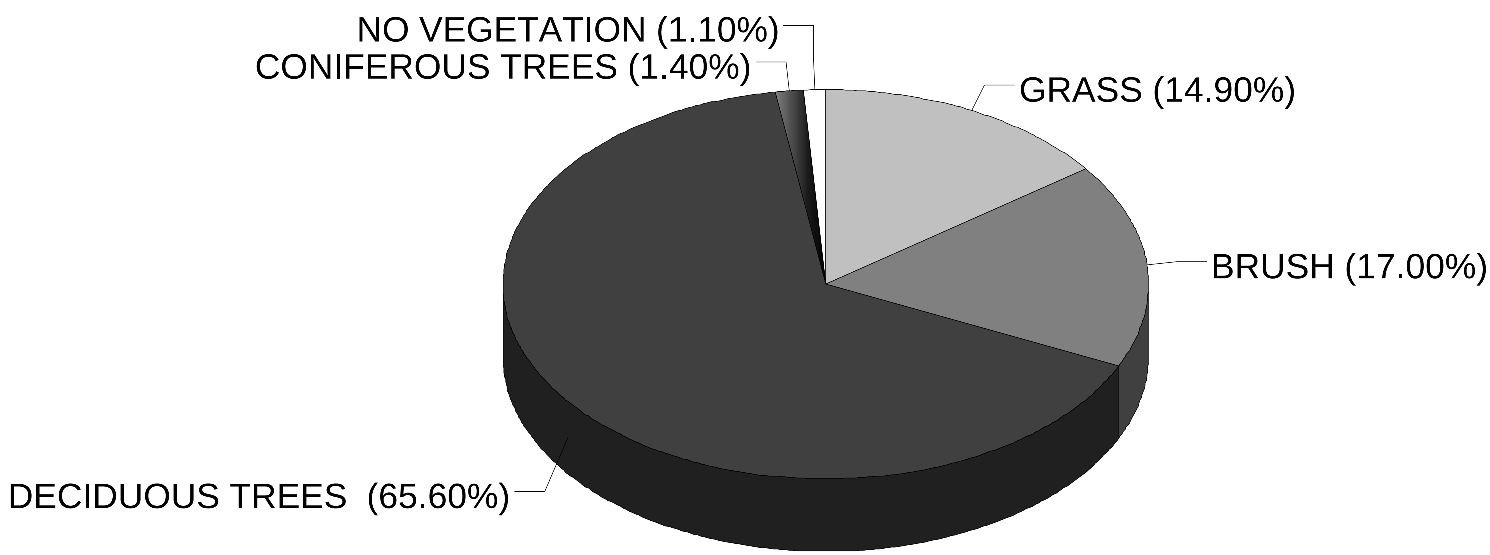
DOMINANT BANK COMPOSITION



GRAPH 10

CHORRO CREEK

DOMINANT BANK VEGETATION



GRAPH 11