STREAM INVENTORY REPORT

Fort Ross Creek and Unnamed Tributary

INTRODUCTION

A stream inventory was conducted beginning June 3 and ending June 5, 2003 on Fort Ross Creek. The survey began at the confluence with the Pacific Ocean and extended upstream 8,184 feet. A stream inventory was conducted June 9, 2003 on an unnamed tributary to Fort Ross Creek. The survey began at the confluence with Fort Ross Creek and extended upstream 801 feet.

The Fort Ross Creek inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Fort Ross Creek.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for 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

Fort Ross Creek is a tributary to the Pacific Ocean in Sonoma County, California (Map 1). Its location is 38°30′43″ north latitude and 123°14′33″ west longitude. Fort Ross Creek is a second order stream and has approximately 12,274 feet of solid blue line stream according to the USGS Fort Ross 7.5 minute quadrangle. Fort Ross Creek drains a watershed of approximately 1.9 square miles. Elevations range from about 0 feet at the mouth of the creek to 1,603 feet in the headwater areas. Vehicle access exists via Highway 1.

METHODS

The habitat inventory conducted in Fort Ross Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al., 1998). This inventory was conducted by a two-person team from California Department of Parks and Recreation trained by the Department of Fish and Game.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. 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 (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are 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 Fort Ross 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 a Marsh-McBirney Model 2000 flow meter.

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 characteristics are measured using a clinometer, hand level, hip chain, 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". Fort Ross 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 measurements are in feet to the nearest tenth. Habitat characteristics are measured using a clinometer, hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Fort Ross 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, bedrock, 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. 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 Fort Ross 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 Fort Ross 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 ocularly into percentages of evergreen 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 Fort Ross Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in Fort Ross Creek. Sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

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 seven tables:

- Summary of riffle, flatwater, and pool habitat types
- Summary of habitat types and measured parameters
- Summary of pool types
- Summary of maximum pool depths by pool habitat types
- Summary of shelter by habitat types
- Summary of dominant substrates by habitat types
- Summary of fish habitat elements by stream reach

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Fort Ross Creek include:

- Level II habitat types by % occurrence
- Level II habitat types by % total length
- Level IV habitat types by % occurrence
- Level I pool habitat types by % occurrence
- Maximum depth in pools
- Percent embeddedness estimated in pool tail-outs
- Mean percent cover types in pools
- Substrate composition in pool tail-outs
- Mean percent canopy
- Dominant bank composition in survey reach
- Dominant bank vegetation in survey reach

HABITAT INVENTORY RESULTS

Fort Ross Creek

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

The habitat inventory of month June 3 to June 5, 2003, was conducted by M. Terry and S. Smith-Heisters (DFG/WSP). The total length of the stream surveyed was 8,184 feet.

Stream flow was not measured on Fort Ross Creek.

Fort Ross Creek is a C3 channel type for 3,183 feet of the stream surveyed, a B3 channel type for 3,433 feet of the stream surveyed, and an F3 channel type for 1,566 feet of the stream surveyed. C3 channels are low gradient, meandering, point-bar, riffle/pool, alluvial channels with a broad well defined floodplain and cobble-dominant substrates. B3 channels are moderately entrenched, have a moderate gradient, riffle dominated with infrequently spaced pools; very stable plan and profile; stable banks and cobble-dominant substrates. F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 52 to 60 degrees Fahrenheit. Air temperatures ranged from 54 to 56 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 44% riffle units, 19% flatwater units, and 36% pool units (Graph 1). Based on total length of Level II habitat types there were 67% riffle units, 16% flatwater units, and 16% pool units (Graph 2).

Thirteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffles, 36%; mid-channel pools, 25%; and runs, 13% (Graph 3). Based on percent total length, low gradient riffles made up 57%, mid-channel pools 10%, and high gradient riffles 10%.

A total of 44 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 73%, and comprised 66% 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. Twenty seven of the 43 measured pools (63%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 44 pool tail-outs measured, 0 had a value of 1 (0%); 16 had a value of 2 (36%); 23 had a value of 3 (52%); 4 had a value of 4 (9%); and 1 had a value of 5 (2%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate.

Riffle habitat types had a mean shelter rating of 22, flatwater habitat types had a mean shelter rating of 7, and pool habitats had a mean shelter rating of 41 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 43. Main channel pools had a mean shelter rating of 40 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Fort Ross Creek. Graph 7 describes the pool cover in Fort Ross Creek. Large woody debris is the dominant pool cover type, followed by undercut banks.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Small cobble was the dominant substrate observed in 55% of pool tail-outs while gravel was the next most frequently observed substrate type, at 43%.

The mean percent canopy density for the surveyed length of Fort Ross Creek was 73%. The mean percentages of evergreen and deciduous trees were 50% and 23%, respectively with 27% of the canopy open. Graph 9 describes the mean percent canopy in Fort Ross Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 14%. The mean percent left bank vegetated was 12%. The dominant elements composing the structure of the stream banks consisted of 2% bedrock, 4% boulder, 55% cobble/gravel, and 39% sand/silt/clay (Graph 10). Coniferous trees were the dominant vegetation type observed in 42% of the units surveyed. Additionally, 26% of the units surveyed had brush as the dominant vegetation type, and 21% had deciduous trees as the dominant vegetation (Graph 11).

Fort Ross Creek Tributary

The habitat inventory of June 9, 2003, was conducted by B. O'Neil (State Parks) and M. Terry (DFG). The total length of the stream surveyed was 801 feet.

Stream flow was not measured on Fort Ross Creek Tributary.

Unnamed Tributary is a C3 channel type for the entire 801 feet of the stream surveyed. C3 channels are low gradient, meandering, point-bar, riffle/pool, alluvial channels with a broad well defined floodplain and cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 54 to 55 degrees Fahrenheit, while air temperatures were 57 degrees Fahrenheit

Based on frequency of occurrence there were 64% riffle units and 36% pool units. Based on total length of Level II habitat types there were 94% riffle units and 6% pool units.

Three Level IV habitat types were identified. The most frequent habitat types by percent occurrence were low gradient riffle, 36%; mid-channel pool, 36%; and high gradient riffle, 27%. Based on percent total length, low gradient riffle made up 52%, high gradient riffle 42% and mid-channel pool 6%.

A total of 4 pools were identified. All pools encountered were main channel pools.

Pool quality for salmonids increases with depth. One of the 4 measured pools (25%) had a depth of two feet or greater.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 4 pool tail-outs measured, 0 had a value of 1 (0%); 1 had a value of 2 (25%); 2 had a value of 3 (50%); 1 had a value of 4 (25%); and 0 had a value of 5 (0%). On this scale, a value of 1 indicates the highest quality of spawning substrate.

Riffle habitat types had a mean shelter rating of 55 and pool habitats had a mean shelter rating of 29.

Large woody debris is the dominant cover type in Fort Ross Creek Tributary. Large woody debris is the dominant pool cover type followed by boulders.

Gravel and small cobble were the dominant substrate types observed in pool tail-outs. Both gravel and small cobble were observed in 50% of pool tail-outs.

The mean percent canopy density for the surveyed length of the unnamed tributary was 71%. The mean percentages of evergreen and deciduous trees were 65% and 6%, respectively with 29% of the canopy open.

For the stream reach surveyed, the mean percent right bank vegetated was 8%. The mean percent left bank vegetated was 19%. The dominant elements composing the structure of the stream banks consisted of 70% cobble/gravel, and 30% sand/silt/clay. Coniferous trees and brush were the dominant vegetation type, each was observed in 40% of the units surveyed.

Additionally, 20% of the units surveyed were not dominated by any vegetation.

BIOLOGICAL INVENTORY RESULTS

Young of the year salmonids were observed via bank observation methods 7,657 feet up from the Pacific Ocean. Unidentified fish were observed up to 707 feet on the unnamed tributary. No other biological inventory was conducted on Fort Ross Creek or the unnamed tributary.

DISCUSSION

Fort Ross Creek

Fort Ross Creek is a C3 channel type for 3,183 feet, a B3 channel type for 3,433 feet, and an F3 channel type for 1,566 feet of the stream surveyed. The suitability of C3 channel types for fish habitat improvement structures is as follows: Excellent for bank-placed boulders; good for plunge weirs, boulder clusters, single and opposing wing deflectors and log cover. The suitability of B3 channel types for fish habitat improvement structures is as follows: Excellent for plunge weirs, boulder clusters and bank placed boulders, single and opposing wing-deflectors and log cover. The suitability of F3 channel types for fish habitat improvement structures is as follows: Good for bank-placed boulders, single and opposing wing-deflectors and fair for plunge weirs, boulder clusters, channel constrictors and log cover.

The water temperatures recorded on the survey days June 3 to June 5, 2003, were within the suitable range for salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Riffle habitat types comprised 67% of the total length of this survey, pools 16%, and flatwater 16%. The pools are relatively deep, with 27 of the 43 (63%) measured 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. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

Sixteen of the 44 pool tail-outs measured had embeddedness ratings of 1 or 2. Twenty-seven of the pool tail-outs had embeddedness ratings of 3 or 4. One of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Fort Ross Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Forty-three of the forty-four pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for flatwater was 7. The mean shelter rating for pools was 41. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by large woody debris in most habitat types. Additionally, small woody

debris, undercut banks, and boulders contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats would enhance 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.

The mean percent canopy density for the stream was 73%. Reach 1 had a canopy density of 77% while Reaches 2, 3, 4, and 5 had canopy densities of 79%, 67%, 73% and 78% respectively. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 14% and 12%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic trees species, in conjunction with bank stabilization, is recommended.

Fort Ross Creek Tributary

Unnamed Tributary is a C3 channel type for the entire 801 feet of the stream surveyed. The suitability of C3 channel types for fish habitat improvement structures is as follows: Excellent for bank-placed boulders; good for plunge weirs, boulder clusters, single and opposing wing deflectors and log cover.

The water temperatures recorded on the survey day June 9, 2003, were within the suitable range for salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Riffle habitat types comprised 94% of the total length of this survey and pools 12%. The pools are relatively shallow, with only 1 of the 4 (25%) measured 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 for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

One of the 4 pool tail-outs measured had embeddedness ratings of 1 or 2. Three of the pool tail-outs had embeddedness ratings of 3 or 4. None of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Fort Ross Creek Tributary should be mapped and rated according to their potential sediment yields, and control measures should be taken.

All four of the pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 29. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by large woody debris in all habitat types. Additionally, boulders contribute a small amount.

The mean percent canopy density for the stream was 71%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 8% and 19%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic trees species, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Fort Ross Creek and unnamed tributary should be managed as an anadromous, natural production streams.

2) The limited water temperature data available suggest that maximum temperatures are above the 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.

3) 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.

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) 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.

6) Increase the canopy on Fort Ross Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

7) There are sections where the stream is being impacted from cattle trampling the riparian zone. Alternatives should be explored with the grazier and developed if possible.

COMMENTS AND LANDMARKS

Fort Ross Creek

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

Position (ft.)	Habitat Unit #	Comments:
0	0001.00	Start of Survey: Begin survey after a debris jam. Yoy present on other side of jam.
44.5	0002.00	Access Points / Location: (Bridge) Pedestrian bridge.
136.6	0004.00	Bio Sample: (Bank Observation) Yoy present.
182.2	0006.00	General Comment: Channel splits in this unit.
274.6	0009.00	Bio Sample: (Bank Observation) Yoy present.
509.8	0013.00	General Comment: Debris jam at end of unit.
509.8	0013.00	Bio Sample: (Bank Observation) Yoy present.
595.8	0014.00	General Comment: Channel type taken in this unit; B3. Lots of ferns.
595.8	0014.00	Bio Sample: (Bank Observation) Yoy present.
860.9	0017.00	General Comment: Two foot log across and above the stream.
892.4	0018.00	General Comment: Possible channel type change. Cross section location in unit 29, reach 2 starts this unit. Three logs across the creek, no debris jam.
1109.8	0021.00	Erosion Site: (Bank) Erosion on right bank.
1302.1	0023.00	General Comment: Log across and above creek.
1457.5	0024.00	Access Points / Location: (Bridge) Highway 1 bridge on right bank.
1518.5	0025.00	General Comment: Left bank shotgun culvert, 50 feet above creek. Cement rip-rap in creek causing erosion.
1864.5	0026.00	General Comment: Rock weir before culvert.
1885.4	0027.00	General Comment: Highway 1 bridge crossover, 42".
1985.4	0028.00	General Comment: Two inch pipe holding log up creating debris jams.
2398.4	0029.00	General Comment: Channel type taken; F3.
2458.8	0031.00	General Comment: Channel type change to B3. Log debris jam at beginning of unit.
2458.8	0031.00	Tributaries: Right bank wet tributary in unit. Temperature is 53 degrees F.
2659.8	0032.00	General Comment: Debris jam at end of unit.
2679.8	0033.00	General Comment: Split channel, debris jam in the entire unit.
2794.8	0034.00	General Comment: Two foot jump up plunge pool. Salamanders present.
2814.8	0035.00	General Comment: Debris jam.
2814.8	0035.00	Erosion Site: (Bank) Right bank erosion.
2936.8	0036.00	General Comment: Debris jam and 3 foot jump at end of unit.
2936.8	0036.00	Bio Sample: (Bank Observation) Yearling salmonid present.

3109.8	0038.00	General Comment: Debris jam with 4 foot jump at end of unit.
3143.3	0039.00	General Comment: Two foot jump up to next unit.
3203.8	0040.00	General Comment: Water is diverting around debris jam.
3422.6	0044.00	General Comment: Three foot jump at beginning.
3611.2	0048.00	General Comment: Debris jam at end of unit, 6 foot jump up to next unit.
3645.2	0049.00	Erosion Site: (Bank) Erosion on right bank.
3801.9	0051.00	Bio Sample: (Bank Observation) Yearling salmonid.
3899.2	0053.00	Bio Sample: (Bank Observation) Yearling salmonid.
4002.2	0055.00	Fish Passage: (Other) Ten foot jump to next unit.
4189.8	0060.00	General Comment: Debris jam.
4215.8	0061.00	Tributaries: Wet gully on right bank.
4234.3	0062.00	General Comment: Debris jam.
4255.1	0063.00	General Comment: Channel type change to C3. Cross section located in unit 72.
4302.1	0064.00	General Comment: Debris jam.
4390.1	0065.00	General Comment: Two foot jump into next unit.
4433.9	0067.00	General Comment: Three foot jump with debris jam.
4453.5	0068.00	Erosion Site: (Bank) Right bank erosion 100' high x 50' wide. Debris jam within the entire unit. Creek may be changing path due to the debris jam.
4545	0070.00	Erosion Site: (Bank) Right bank debris jam continues through this unit.
4545	0070.00	Bio Sample: (Bank Observation) One salmonid yoy observed.
4615	0071.00	General Comment: Iron oxide present in channel.
4652	0072.00	General Comment: Channel type taken in this unit; C3.
4718.5	0073.00	General Comment: Unit covered by debris jam.
4743	0074.00	Erosion Site: (Bank) Erosion on left bank, small debris jam.
4896.4	0077.00	General Comment: Log is the pool tail crest.
4896.4	0077.00	Bio Sample: (Bank Observation) Yearling salmonid.
4955.6	0079.00	General Comment: Algae bloom covers most rocks.
5097.9	0081.00	General Comment: Bad algae bloom.
5097.9	0081.00	Bio Sample: (Bank Observation) Yearling salmonids.
5179.4	0082.00	Erosion Site: (Bank) Right bank erosion and debris jam.
5273.1	0083.00	General Comment: Debris jam covers most of unit, splitting channel.
5286.5	0084.00	General Comment: Channel is split.
5454.1	0088.00	General Comment: Debris jam is 58' long x 50' wide x 10' high.
5569.1	0089.00	General Comment: Cattle presence observed and fence across creek.
5569.1	0089.00	Access Points / Location: (Road) Wet road crossing.
5648.1	0090.00	General Comment: Cattle observed.
5769.6	0092.00	General Comment: Pool enhanced by root mass.
5769.6	0092.00	Bio Sample: (Bank Observation) Yearling salmonids observed.
5801.2	0093.00	General Comment: Iron oxide patch out of constant flow.
5829.6	0094.00	General Comment: Cattle present.
5964.8	0098.00	Erosion Site: (Bank) Right bank erosion.
6109.2	0101.00	Access Points / Location: (Road) Road along left bank.
6138.2	0102.00	General Comment: Cattle trail down to creek.
6179.2	0103.00	Bio Sample: (Bank Observation) More than 10 yearling salmonids.

6259.2	0105.00	General Comment: Left bank debris jam with sediment being retained.
6476.3	0108.00	Erosion Site: (Bank) Right bank erosion with debris jam.
6714.3	0110.00	General Comment: Fence on left bank with cattle trail down to creek.
6926.3	0111.00	General Comment: Debris jam covers entire unit.
6945.3	0112.00	Tributaries: Left bank tributary at 386', water temperature is 54 degrees F.
6945.3	0112.00	Erosion Site: (Bank) Right bank erosion 50' L x 30' W x 7' H.
7409.3	0113.00	General Comment: Two foot jump to next unit.
7438.3	0114.00	General Comment: Stream becoming highly vegetated by pampas grass.
7438.3	0114.00	Erosion Site: (Bank) Left bank erosion 150' H x 50' W x 5' L.
7548.7	0115.00	Erosion Site: (Bank) Left and right bank erosion.
7548.7	0115.00	Bio Sample: (Bank Observation) Salmonid yoy.
7657.9	0116.00	General Comment: erosion on right and left bank with debris jam.
7657.9	0116.00	Bio Sample: (Bank Observation) Last young of the year salmonids seen in this unit.
7848.9	0118.00	Erosion Site: (Bank) Left bank erosion is 45' long x 30' wide x 25' high, retaining sediment in stream. Water is seeping through.
7893.9	0119.00	General Comment: Salamander present.
8183.6	0122.00	End of Survey: No fish seen above last debris jam.

Fort Ross Creek Tributary

Position (ft.)	Habitat Unit #	Comments:
0	0001.00	Start of Survey: Start at confluence with Fort Ross Creek.
0	0001.00	Erosion Site: (Bank) Right bank erosion with debris jam. Logging cable in stream and a 5 ' jump to next unit.
93	0002.00	General Comment: Most of unit covered by debris jam.
101	0003.00	General Comment: Four foot jump up to next unit. Salamanders present in unit.
450	0008.00	General Comment: Six foot jump to next unit. Channel type taken in this unit; C3.
551	0009.00	General Comment: Water flowing over log across creek. Boulders are retaining sediment along right bank.
551	0009.00	Tributaries: Left bank wet cascading tributary with 55 degree F water.
707	0011.00	Bio Sample: (Bank Observation) Unidentified fish.
801	0011.00	End of Survey: End of survey due to large debris jam.

LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE				
Low Gradient Riffle	(LGR)	[1.1]		{ 1}
High Gradient Riffle	(HGR)	[1.2]		{ 2}
CASCADE				
Cascade	(CAS)	[2.1]		{ 3}
Bedrock Sheet	(BRS)	[2.2]		{24}
FLATWATER				
Pocket Water	(POW)	[3.1]		{21}
Glide	(GLD)	[3.2]		{14}
Run	(RUN)	[3.3]		{15}
Step Run	(SRN)	[3.4]		{16}
Edgewater	(EDW)	[3.5]		{18}
MAIN CHANNEL POOLS				
Trench Pool	(TRP)	[4.1]		{ 8}
Mid-Channel Pool	(MCP)	[4.2]		{17}
Channel Confluence Pool	(CCP)	[4.3]		{19}
Step Pool	(STP)	[4.4]		{23}
SCOUR POOLS				
Corner Pool	(CRP)	[5.1]		{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]		{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]		{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)		[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]		{20}
Plunge Pool	(PLP)	[5.6]		{ 9}
BACKWATER POOLS				
Secondary Channel Pool	(SCP)	[6.1]		{ 4}
Backwater Pool - Boulder Formed	(BPB)	[6.2]		{ 5}
Backwater Pool - Root Wad Formed	(BPR)	[6.3]		{ 6}
Backwater Pool - Log Formed	(BPL)	[6.4]		{ 7}
Dammed Pool	(DPL)	[6.5]		{13}
ADDITIONAL UNIT DESIGNATIONS				
Dry	(DRY)	[7.0]		
Culvert	(CUL)	[8.0]		
Not Surveyed	(NS)	[9.0]		
Not Surveyed due to a marsh	(MAR)	[9.1]		

TABLES AND GRAPHS (*Fort Ross Creek*)

Table 1 - Summary of Riffle, Flatwater, and Pool Habitat Types

Stream Name: Ross Creek Drainage: Gualala River

Survey Dates: 6/3/2003 to 6/5/2003

Confluence Location: Quad: FORT ROSS Legal Description: T000R000S00 Latitude: 38:30:43.0N Longitude: 123:14:33.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Percent Total Length	Mean Width (ft.)	Mean Depth (ft.)	Mean Max 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
1	0	CULVERT	0.8	100	100	1.2									
23	11	FLATWATER	18.9	56	1278.5	15.6	7.5	0.6	1.2	385	8854	227	5222		7
44	43	POOL	36.1	31	1344.4	16.4	11.9	0.8	2.2	342	15044	382	16828	284	41
54	18	RIFFLE	44.3	101	5460.7	66.7	7.7	0.4	1.1	639	34522	291	14842		22

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
122	72	8183.6	58420.27	36893.01

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Ross Creek Drainage: Gualala River

Survey Dates: 6/3/2003 to 6/5/2003

Confluence Location: Quad: FORT ROSS Legal Description: T000R000S00 Latitude: 38:30:43.0N Longitude: 123:14:33.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Max 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	Mean Canopy (%)
44	11	LGR	36.1	106	4664	57.0	8	0.4	1.6	763	33564	359	14341		11	70
9	6	HGR	7.4	87	787	9.6	8	0.4	2.1	513	4615	224	2013		38	76
1	1	CAS	0.8	10	10	0.1	4	0.5	1	40	40	20	20		20	
2	2	GLD	1.6	52	104	1.3	10	0.6	1	535	1070	300	600		0	85
16	6	RUN	13.1	43	695	8.5	7	0.6	1.6	324	5188	200	3197		5	65
5	3	SRN	4.1	96	480	5.9	6	0.6	1.6	406	2031	233	1164		15	83
31	30	MCP	25.4	27	843	10.3	12	0.9	3.3	306	9489	370	11474	285	40	76
1	1	STP	0.8	45	45	0.5	12	1.1	2.4	378	378	567	567	416	40	40
1	1	CRP	0.8	79	79	1.0	10	0.3	1.3	632	632	379	379	190	15	75
5	5	LSL	4.1	27	136	1.7	15	0.8	3.5	392	1962	494	2470	362	74	76
5	5	LSR	4.1	45	225	2.8	11	0.5	2.6	477	2384	352	1762	223	23	83
1	1	PLP	0.8	16	16	0.2	10	0.7	1.7	164	164	164	164	115	20	95
1	0	CUL	0.8	100	100	1.2										100

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
122	72	8183.601	61516.54	38151.76

Table 3 - Summary of Pool Types

Stream Name: Ross Creek Drainage: Gualala River

Survey Dates: 6/3/2003 to 6/5/2003

Confluence Location: Quad: FORT ROSS Legal Description: T000R000S00 Latitude: 38:30:43.0N Longitude: 123:14:33.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Residual Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Residual Pool Vol (cu.ft.)	Estimated Total Resid.Vol. (cu.ft.)	Mean Shelter Rating
32	31	MAIN	73	28	888	66	11.6	0.9	308	9869	289	9257	40
12	12	SCOUR	27	38	457	34	12.4	0.6	428	5141	269	3231	43

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
44	43	1344.4	15010.83	12487.78

Table 4 - Summary of Maximum Residual Pool Depths By Pool Habitat Types

Stream Name: Ross Creek Drainage: Gualala River

Survey Dates: 6/3/2003 to 6/5/2003

Confluence Location: Quad: FORT ROSS Legal Description: T000R000S00 Latitude: 38:30:43.0N Longitude: 123:14:33.0W

Habitat Units	Habitat Type	Habitat Occurrence (%)	< 1 Foot Maximum Residual Depth	< 1 Foot Percent Occurrence	1 < 2 Feet Maximum Residual Depth	1 < 2 Feet Percent Occurrence	2 < 3 Feet Maximum Residual Depth	2 < 3 Feet Percent Occurrence	3 < 4 Feet Maximum Residual Depth	3 < 4 Feet Percent Occurrence	>= 4 Feet Maximum Residual Depth	>= 4 Feet Percent Occurrence
30	MCP	70	1	3	10	33	15	50	4	13	0	0
1	STP	2	0	0	0	0	1	100	0	0	0	0
1	CRP	2	0	0	1	100	0	0	0	0	0	0
5	LSL	12	0	0	3	60	1	20	1	20	0	0
5	LSR	12	0	0	0	0	5	100	0	0	0	0
1	PLP	2	0	0	1	100	0	0	0	0	0	0

Total Units	Total 1 Foot Max Resid. Depth	< Total 1 Foot % Occurrence	Total 1< 2 Foot Max Resid. Depth	Total 1< 2 Foot % Occurrence	Total 2< 3 Foot Max Resid. Depth	Total 2< 3 Foot % Occurrence	Total 3< 4 Foot Max Resid. Depth	Total 3< 4 Foot % Occurrence	Total >= 4 Foot Max Resid. Depth	Total >= 4 Foot % Occurrence
43	1	2	15	35	22	51	5	12	0	0

Mean Maximum Residual Pool Depth (ft.): 2.2

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Ross Creek Drainage: Gualala River
Survey Dates: 6/3/2003 to 6/5/2003 Dry Units: 0
Confluence Location: Quad: FORT ROSS Legal Description: T000R000S00 Latitude: 38:30:43.0N Longitude: 123:14:33.0W

Habitat Units	Units Fully Measured	Habitat Type	Mean % Undercut Banks	Mean % SWD	Mean % LWD	Mean % Root Mass	Mean % Terr. Vegetation	Mean % Aquatic Vegetation	Mean % White Water	Mean % Boulders	Mean % Bedrock Ledges
44	9	LGR	10	13	18	0	11	0	1	13	0
9	6	HGR	0	25	48	20	0	0	3	3	0
1	1	CAS	0	0	100	0	0	0	0	0	0
54	16	TOTAL RIFFLE	6	17	34	8	6	0	2	9	0
2	2	GLD	0	0	0	0	0	0	0	0	0
16	7	RUN	14	29	13	1	0	0	0	0	0
5	3	SRN	17	17	23	0	0	0	3	40	0
23	12	TOTAL FLAT	13	21	13	1	0	0	1	10	0
31	31	MCP	17	13	44	5	0	0	3	18	0
1	1	STP	0	10	40	0	0	0	0	50	0
1	1	CRP	100	0	0	0	0	0	0	0	0
5	5	LSL	0	30	52	0	2	0	2	14	0
5	5	LSR	46	0	0	50	0	0	0	4	0
1	1	PLP	0	0	70	0	0	0	30	0	0
44	44	TOTAL POOL	20	13	39	9	0	0	3	16	0
1	0	CUL									
122	72	TOTAL	15	15	34	7	2	0	3	13	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Ross Creek Drainage: Gualala River
Survey Dates: 6/3/2003 to 6/5/2003 Dry Units: 0
Confluence Location: Quad: FORT ROSS Legal Description: T000R000S00 Latitude: 38:30:43.0N Longitude: 123:14:33.0W

Habitat Units	Units Fully Measured	Habitat Type	% Total Silt/Clay Dominant	% Total Sand Dominant	% Total Gravel Dominant	% Total Small Cobble Dominant	% Total Large Cobble Dominant	% Total Boulder Dominant	% Total Bedrock Dominant
44	11	LGR	0	0	64	36	0	0	0
9	6	HGR	0	17	83	0	0	0	0
1	1	CAS	0	0	100	0	0	0	0
2	2	GLD	0	100	0	0	0	0	0
16	8	RUN	0	63	38	0	0	0	0
5	3	SRN	0	33	33	33	0	0	0
31	30	MCP	0	70	27	3	0	0	0
1	1	STP	0	0	100	0	0	0	0
1	1	CRP	0	100	0	0	0	0	0
5	5	LSL	0	80	20	0	0	0	0
5	5	LSR	0	80	20	0	0	0	0
1	1	PLP	0	100	0	0	0	0	0

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: Ross Creek | Drainage: Gualala River

Survey Dates: 6/3/2003 to 6/5/2003 | Survey Length (ft.): 8183.6 | Main Channel (ft.): 8183.6 | Side Channel (ft.): 0

Confluence Location: Quad: FORT ROSS | Legal Description: T000R000S00 | Latitude: 38:30:43.0N | Longitude: 123:14:33.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: B3
Reach Length (ft.): 892.39996337
Riffle/Flatwater Mean Width (ft.): 6.9
BFW:
Range (ft.): 11 to 11
Mean (ft.): 11
Std. Dev.: 0
Base Flow (cfs.): 0.0
Water (F): 55 - 56 Air (F): 57 - 60
Dry Channel (ft): 0

Canopy Density (%): 77
Coniferous Component (%): 2
Deciduous Component (%): 98
Dominant Bank Vegetation: Deciduous Trees
Vegetative Cover (%): 20
Dominant Shelter: Undercut Banks
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 12
Pool Frequency (%): 18
Residual Pool Depth (%):
< 2 Feet Deep: 0
2 to 2.9 Feet Deep: 100
3 to 3.9 Feet Deep: 0
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 2.3
Mean Pool Shelter Rating: 20

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 100 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 0
Embeddedness Values (%): 1. 0 2. 0 3. 100 4. 0 5. 0

STREAM REACH: 2

Channel Type: F3
Reach Length (ft.): 1566.4000244
Riffle/Flatwater Mean Width (ft.): 7.8
BFW:
Range (ft.): 11 to 14
Mean (ft.): 13
Std. Dev.: 1
Base Flow (cfs.): 0.0
Water (F): 55 - 55 Air (F): 57 - 59
Dry Channel (ft): 0

Canopy Density (%): 79
Coniferous Component (%): 66
Deciduous Component (%): 34
Dominant Bank Vegetation: Evergreen Trees
Vegetative Cover (%): 23
Dominant Shelter: Large Woody Debris
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 17
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 5
Pool Frequency (%): 23
Residual Pool Depth (%):
< 2 Feet Deep: 67
2 to 2.9 Feet Deep: 33
3 to 3.9 Feet Deep: 0
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 2.0
Mean Pool Shelter Rating: 12

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 0 Sm Cobble: 100 Lg Cobble: 0 Boulder: 0 Bedrock: 0
Embeddedness Values (%): 1. 0 2. 0 3. 100 4. 0 5. 0

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: B3
Reach Length (ft.): 1796.2999267
Riffle/Flatwater Mean Width (ft.): 7.3
BFW:
Range (ft.): 16 to 16
Mean (ft.): 16
Std. Dev.: 0
Base Flow (cfs.): 0.0
Water (F): 53 - 56 Air (F): 56 - 58
Dry Channel (ft): 0

Canopy Density (%): 67
Coniferous Component (%): 75
Deciduous Component (%): 25
Dominant Bank Vegetation: Evergreen Trees
Vegetative Cover (%): 24
Dominant Shelter: Large Woody Debris
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 50
LWD per 100 ft.:
Riffles: 0
Pools: 9
Flat: 0

Pools by Stream Length (%): 25
Pool Frequency (%): 47
Residual Pool Depth (%):
< 2 Feet Deep: 20
2 to 2.9 Feet Deep: 53
3 to 3.9 Feet Deep: 27
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 2.4
Mean Pool Shelter Rating: 43

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 53 Sm Cobble: 47 Lg Cobble: 0 Boulder: 0 Bedrock: 0
Embeddedness Values (%): 1. 0 2. 33 3. 53 4. 13 5. 0

STREAM REACH: 4

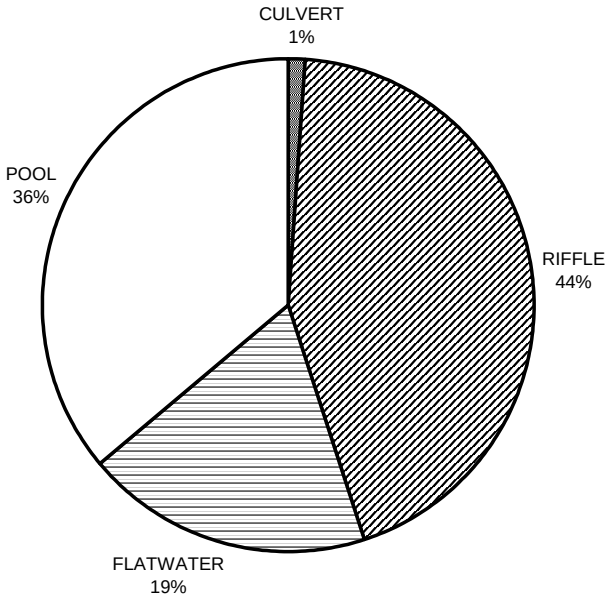
Channel Type: C3
Reach Length (ft.): 3183.1999511
Riffle/Flatwater Mean Width (ft.): 8.7
BFW:
Range (ft.): 13 to 13
Mean (ft.): 13
Std. Dev.: 0
Base Flow (cfs.): 0.0
Water (F): 52 - 56 Air (F): 54 - 59
Dry Channel (ft): 0

Canopy Density (%): 73
Coniferous Component (%): 88
Deciduous Component (%): 12
Dominant Bank Vegetation: Brush
Vegetative Cover (%): 14
Dominant Shelter: Large Woody Debris
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 37
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 19
Pool Frequency (%): 39
Residual Pool Depth (%):
< 2 Feet Deep: 50
2 to 2.9 Feet Deep: 45
3 to 3.9 Feet Deep: 5
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 2.1
Mean Pool Shelter Rating: 49

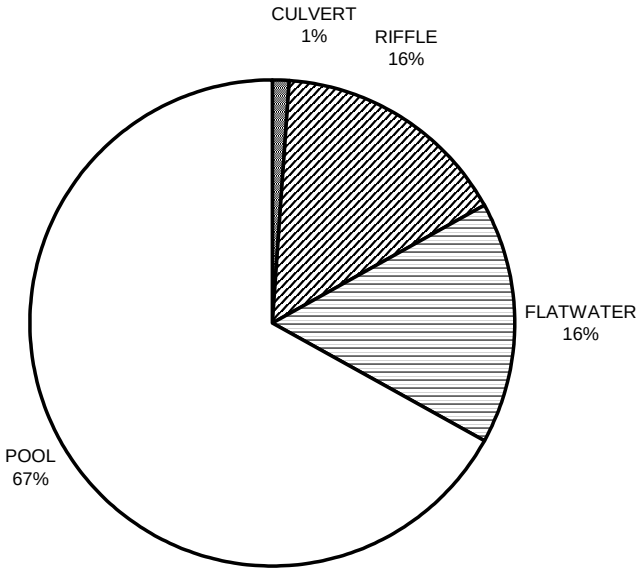
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 40 Sm Cobble: 55 Lg Cobble: 0 Boulder: 0 Bedrock: 5
Embeddedness Values (%): 1. 0 2. 45 3. 40 4. 10 5. 5

FORT ROSS CREEK
HABITAT TYPES BY PERCENT OCCURRENCE



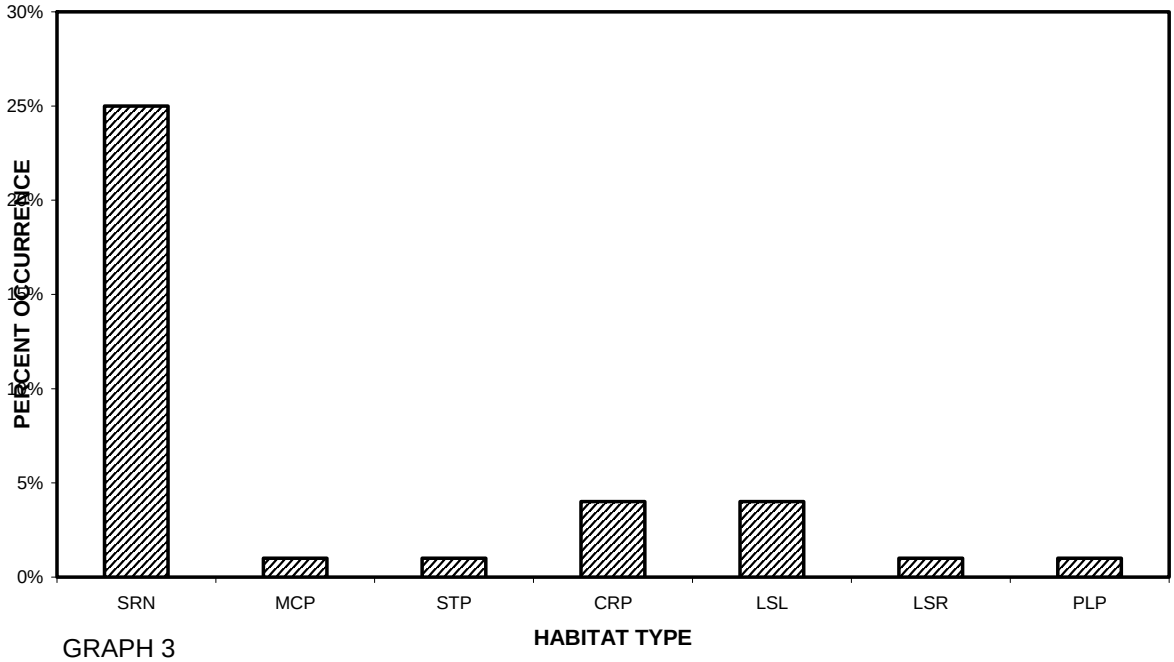
GRAPH 1

FORT ROSS CREEK
HABITAT TYPES BY PERCENT TOTAL LENGTH



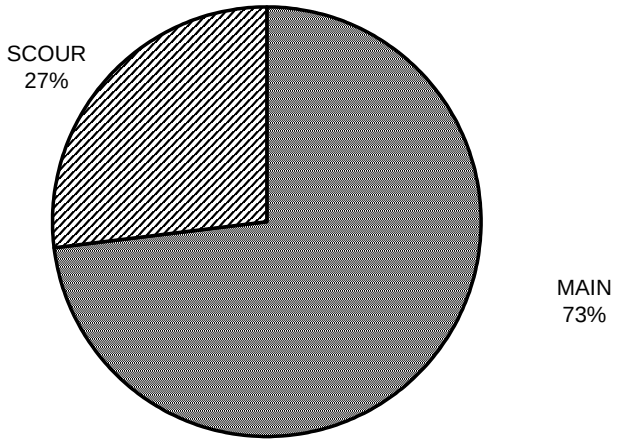
GRAPH 2

FORT ROSS CREEK
HABITAT UNIT TYPES BY PERCENT OCCURRENCE

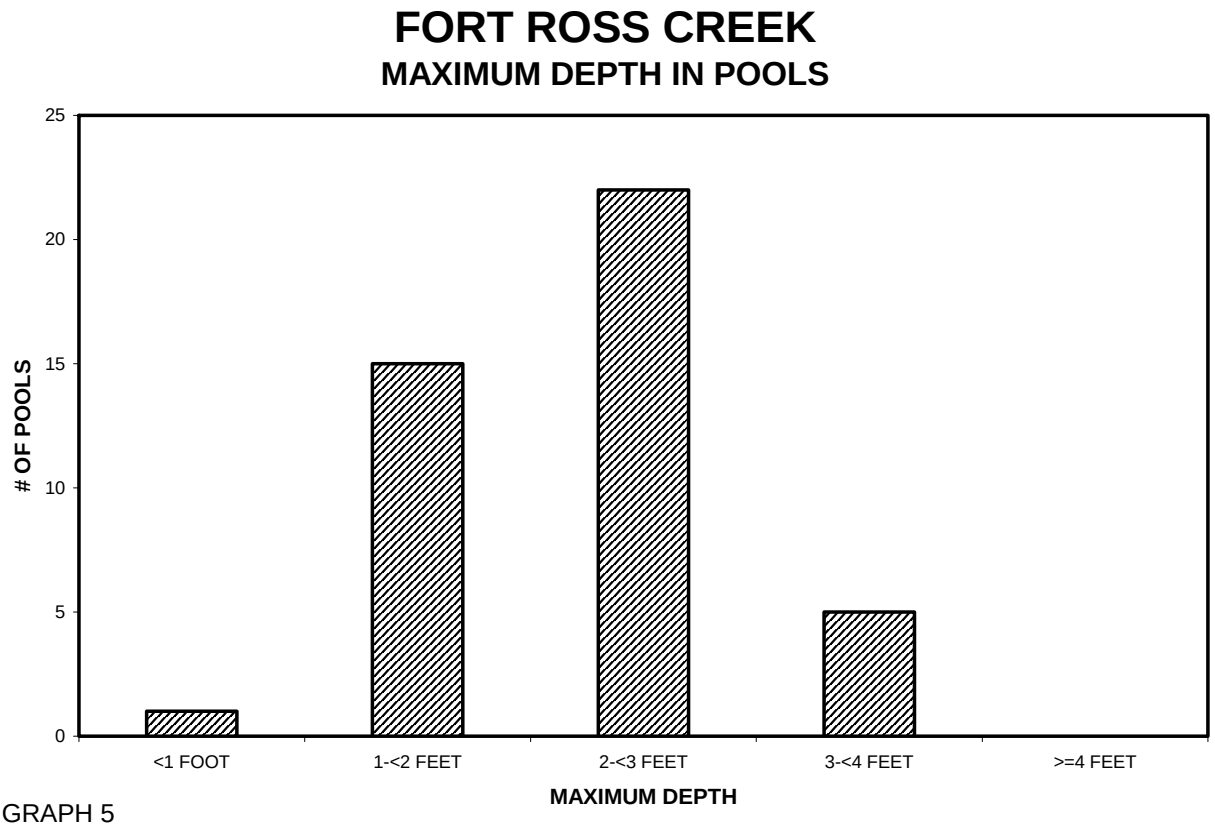


GRAPH 3

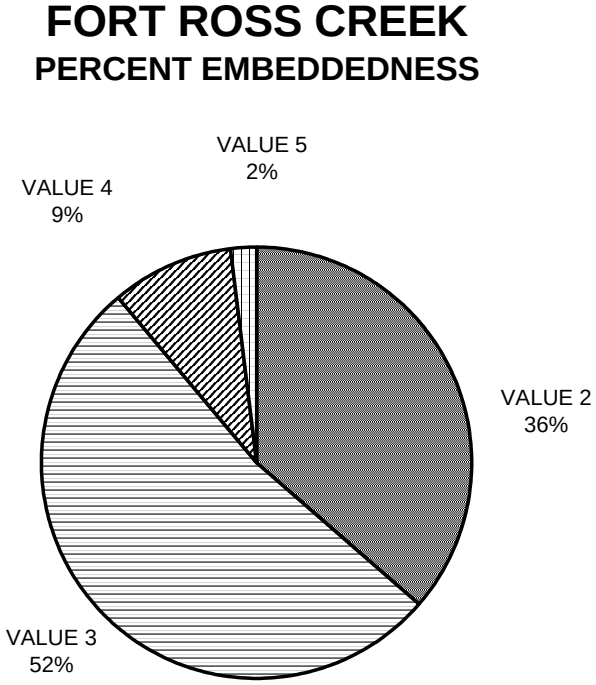
FORT ROSS CREEK
POOL HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 4

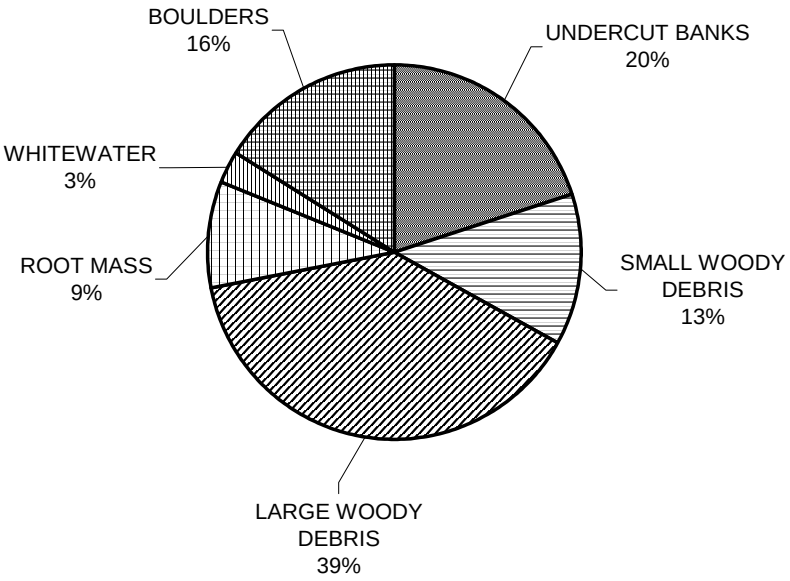


GRAPH 5



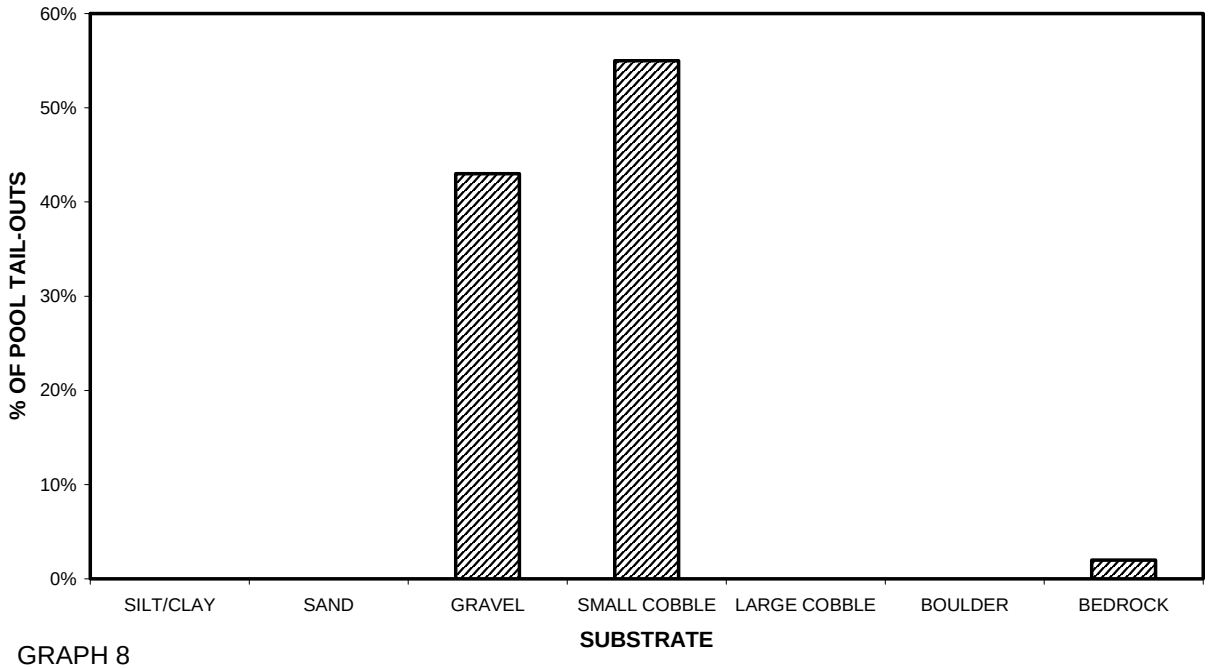
GRAPH 6

FORT ROSS CREEK
MEAN PERCENT COVER TYPES IN POOLS



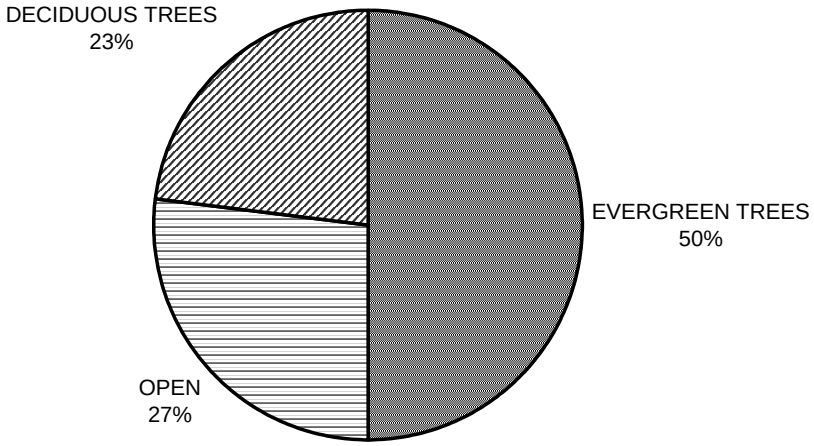
GRAPH 7

FORT ROSS CREEK
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



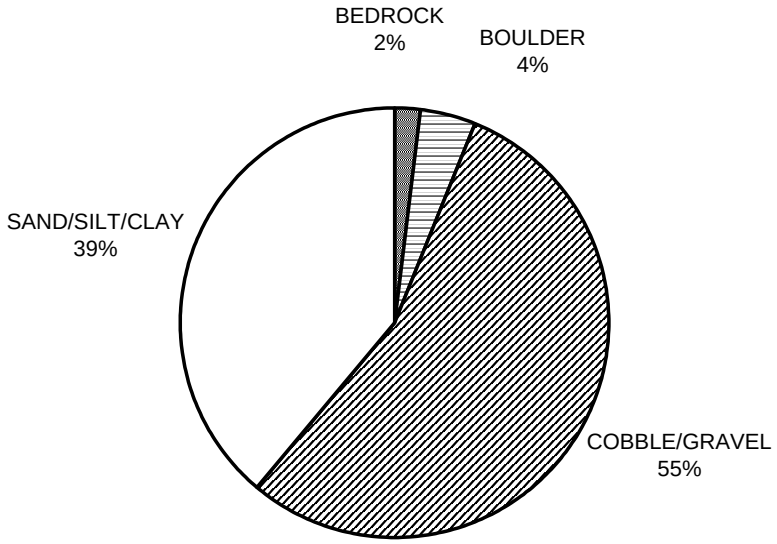
GRAPH 8

FORT ROSS CREEK
MEAN PERCENT CANOPY



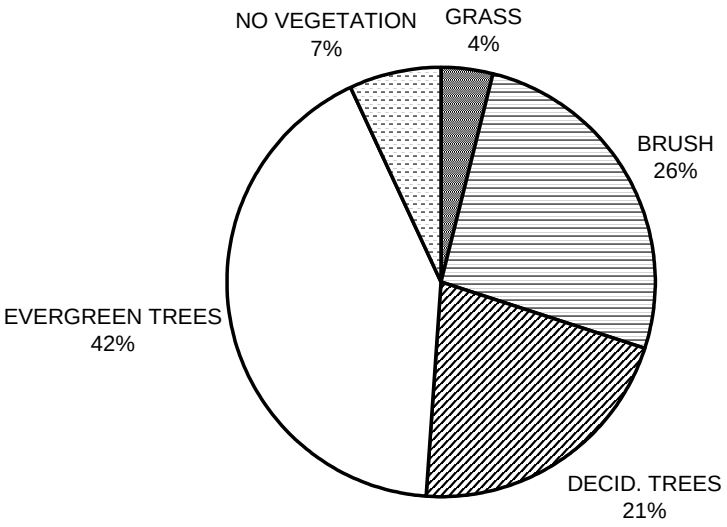
GRAPH 9

FORT ROSS CREEK
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

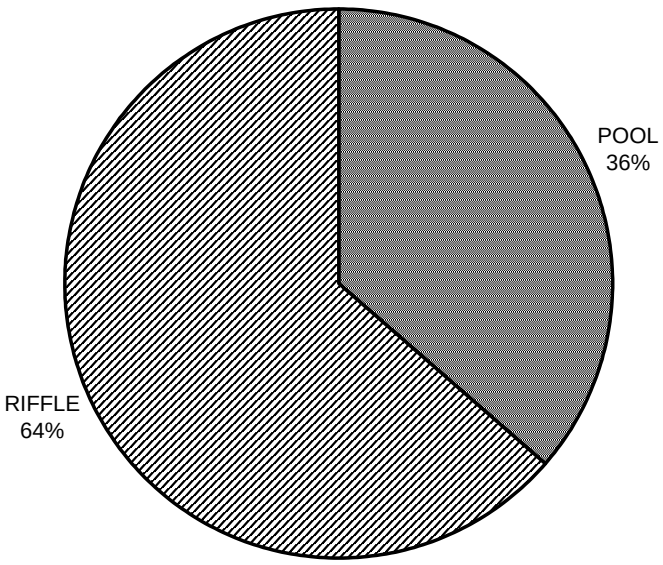
FORT ROSS CREEK
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

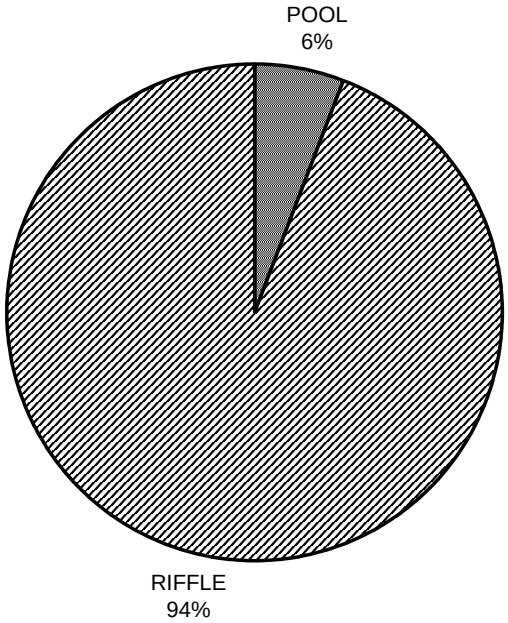
Fort Ross Creek Tributary

FORT ROSS CREEK TRIBUTARY
HABITAT TYPES BY PERCENT OCCURRENCE



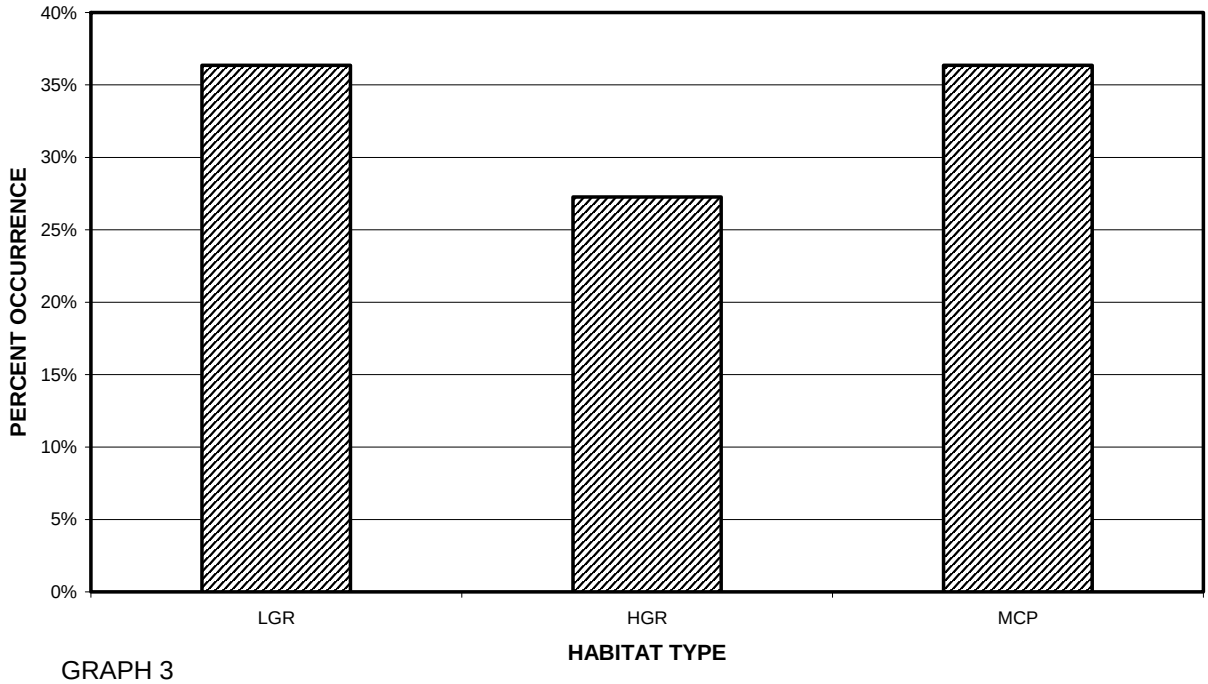
GRAPH 1

FORT ROSS CREEK TRIBUTARY
HABITAT TYPES BY PERCENT TOTAL LENGTH



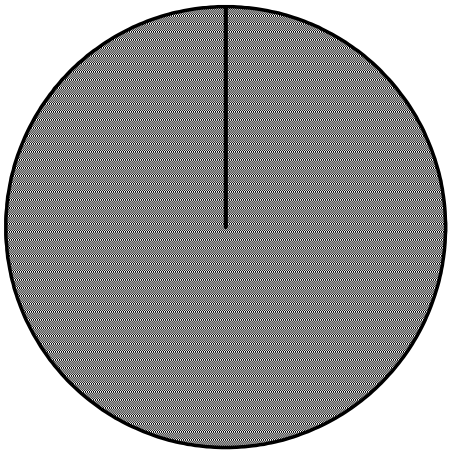
GRAPH 2

FORT ROSS CREEK TRIBUTARY
HABITAT TYPES BY PERCENT OCCURRENCE

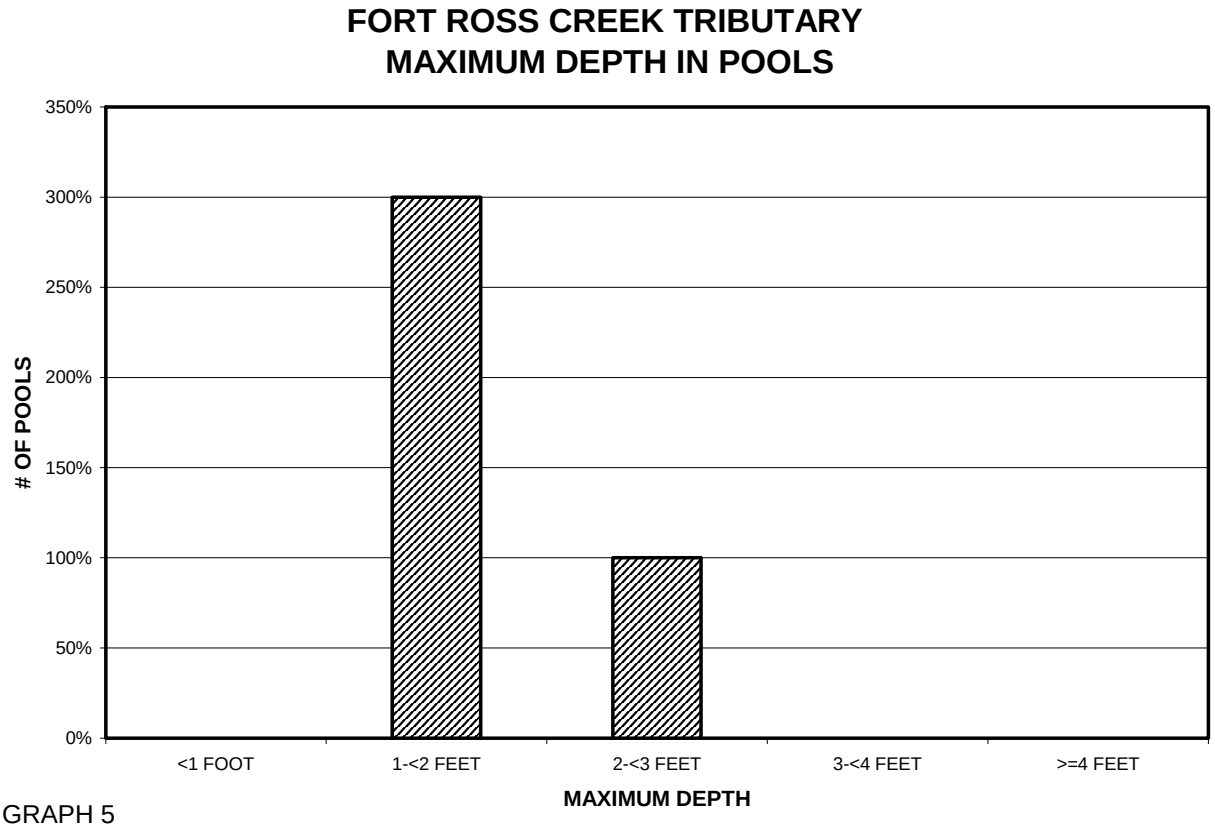


GRAPH 3

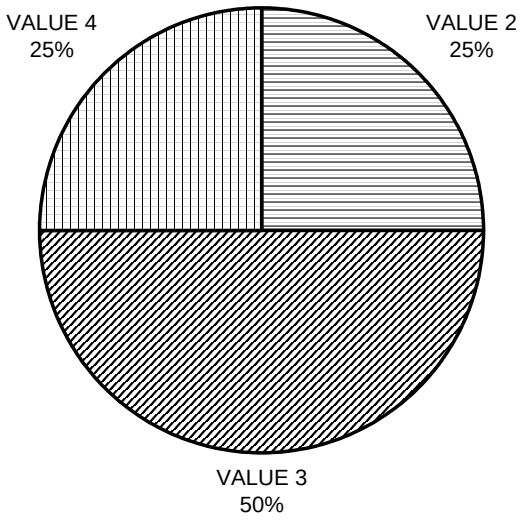
FORT ROSS CREEK TRIBUTARY
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4

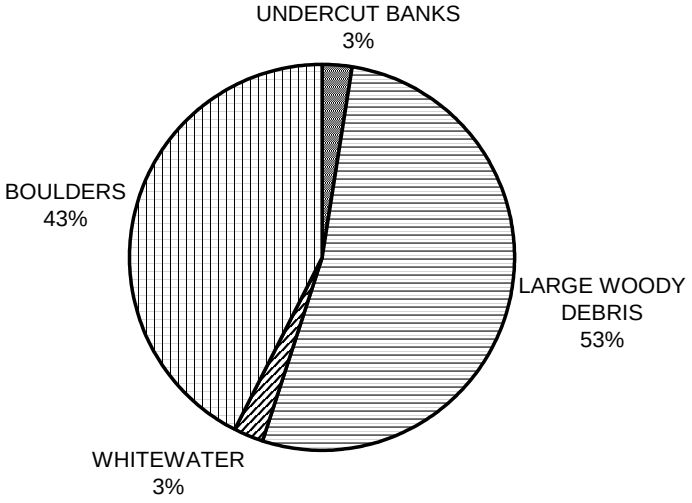


GRAPH 5



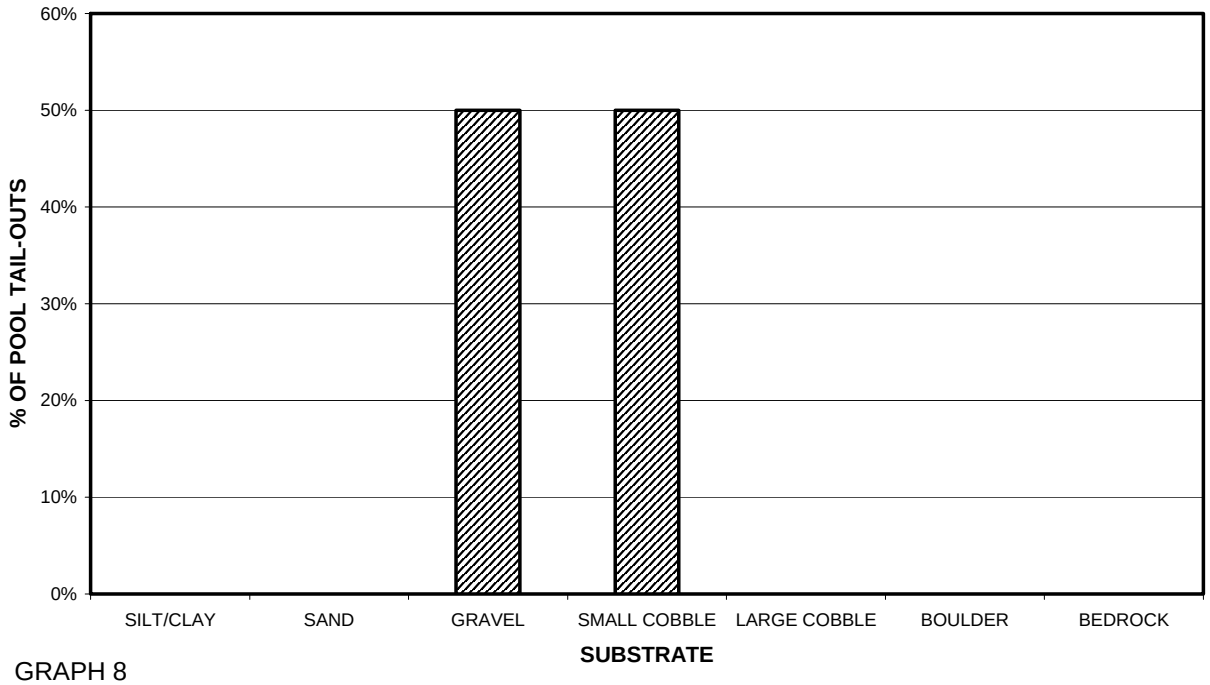
GRAPH 6

FORT ROSS CREEK TRIBUTARY
MEAN PERCENT COVER TYPES IN POOLS



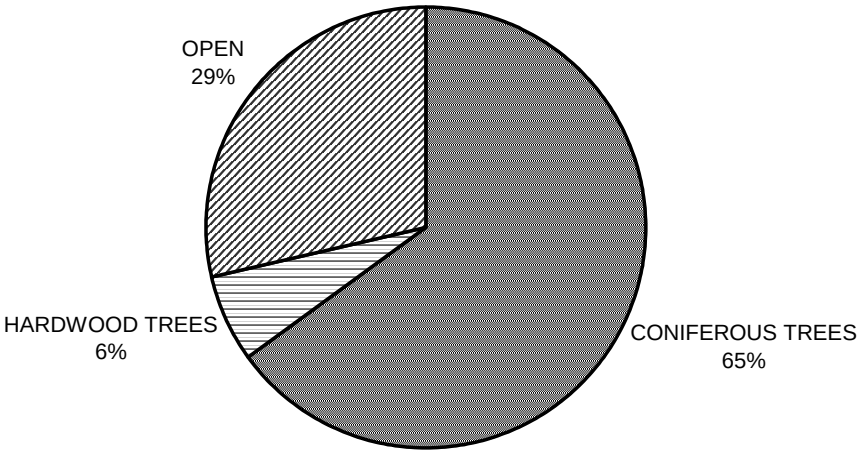
GRAPH 7

FORT ROSS CREEK TRIBUTARY
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



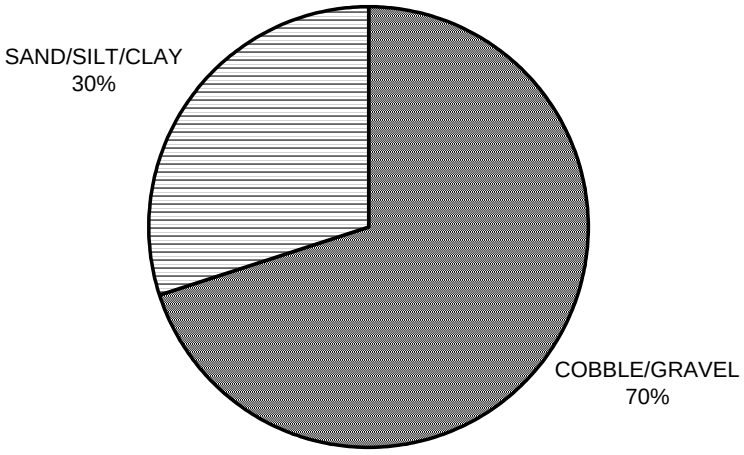
GRAPH 8

FORT ROSS CREEK TRIBUTARY
MEAN PERCENT CANOPY



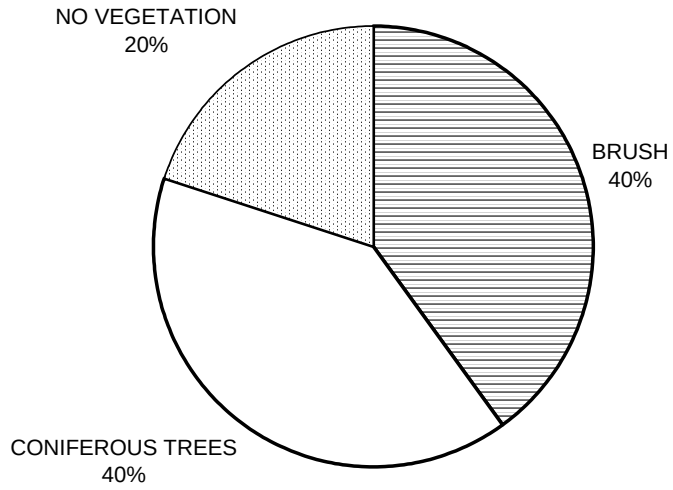
GRAPH 9

FORT ROSS CREEK TRIBUTARY
DOMINANT BANK COMPOSITION IN SURVEY REACH

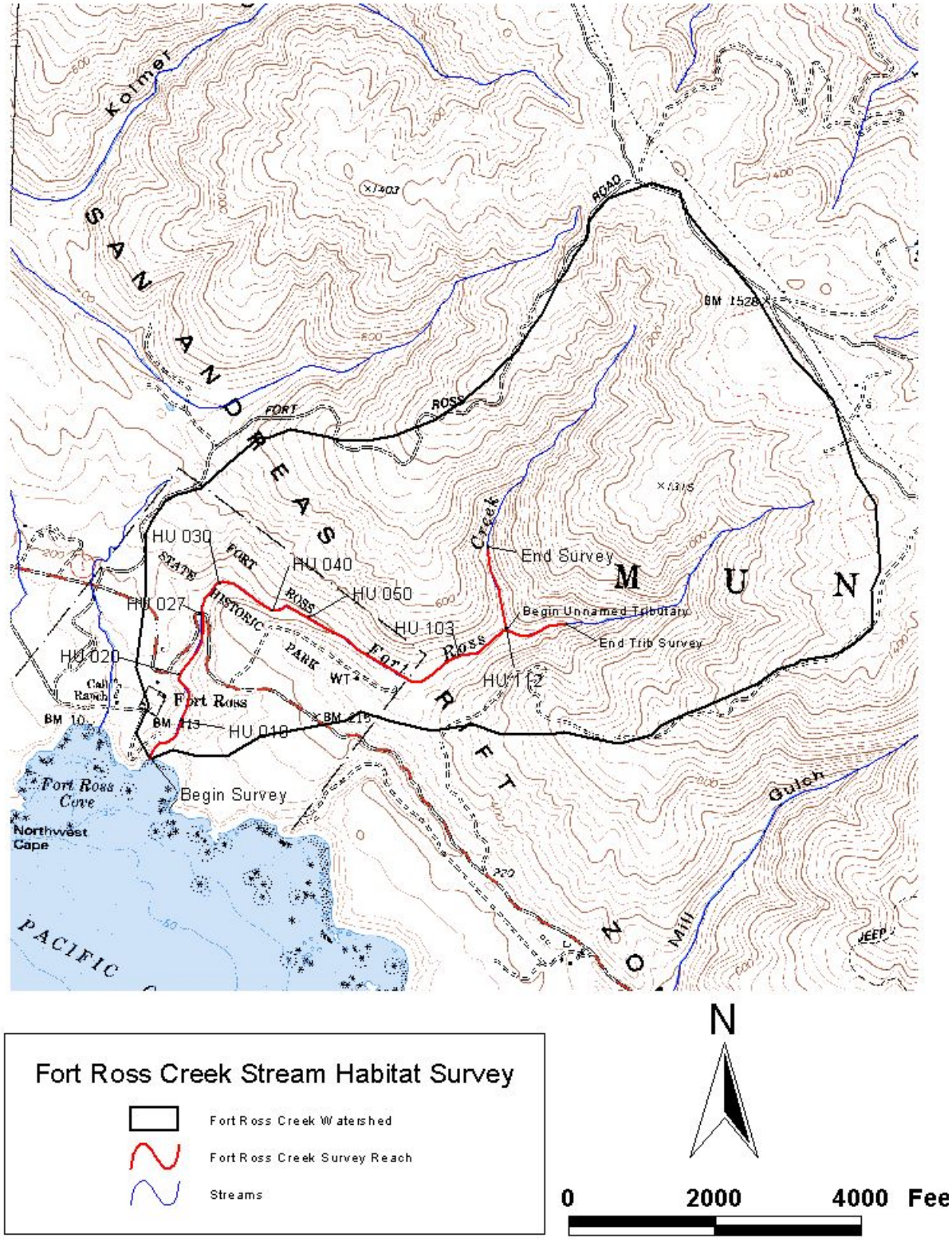


GRAPH 10

FORT ROSS CREEK TRIBUTARY
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11



Map 1. Map showing Fort Ross Creek watershed and stream habitat inventory reach.

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd edition. California Department of Fish and Game, Sacramento, California.

McCain, M., D. Fuller, L. Decker and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHC Currents. No.1. U.S. Department of Agriculture. Forest Service, Pacific Southwest Region.

Rosgen, D.L., 1994. A Classification of Natural Rivers. Catena, Vol 22: 169-199, Elsevier Science, B. V. Amsterdam.