

STREAM INVENTORY REPORT

Squaw Creek

INTRODUCTION

A stream inventory was conducted from July 6 to July 27, 2010 on Squaw Creek. The survey began at the confluence with Bull Creek and extended upstream 2.7 miles.

The Squaw 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 Squaw Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

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

Squaw Creek is a tributary to Bull Creek, tributary to South Fork Eel River, tributary to Eel River, which drains to the Pacific Ocean, located in Humboldt County, California (Map 1). Squaw Creek's legal description at the confluence with Bull Creek is T01S R02E S30. Its location is 40.3489 north latitude and 123.9883 west longitude, LLID number 1239870403490. Squaw Creek is a first order stream and has approximately 3.5 miles of blue line stream according to the USGS Weott 7.5 minute quadrangle. Squaw Creek drains a watershed of approximately 4.7 square miles. Elevations range from about 230 feet at the mouth of the creek to 1,700 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely within the Humboldt Redwoods State Park and is managed for recreation. Vehicle access exists via Highway 101 near Weott. Take Mattole Road west to the confluence with Bull Creek.

METHODS

The habitat inventory conducted in Squaw Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flossi et al, 1998). The Watershed Stewards Project/AmeriCorps (WSP) Members 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.

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

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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 Squaw Creek to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) near 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 (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 (1990). 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". Squaw 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.

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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 Squaw 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 like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile 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 for prey. 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 Squaw 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 Squaw 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 coniferous or hardwood 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 Squaw 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.

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10. Large Woody Debris Count:

Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

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 Squaw Creek. In addition, underwater observations were made at 31 sites using techniques discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.19, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

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

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

HABITAT INVENTORY RESULTS

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

The habitat inventory of July 6 to July 27, 2010, was conducted by B. Williams, B. Leonard, A. Glasgow (WSP), C. Saeland (CCC), and S. McSmith (DFG). The total length of the stream surveyed was 14,481 feet with an additional 54 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.74 cfs on July 26, 2010.

Squaw Creek is a F3 channel type for 2,516 feet of the stream surveyed (Reach 1), a B2 channel type for 6,327 feet of the stream surveyed (Reach 2), and an A2 channel type for 5,638 feet of the stream surveyed (Reach 3). F3 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates. B2 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and boulder-dominant substrates. A2 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and boulder-dominant substrates.

Water temperatures taken during the survey period ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 58 to 76 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 38% pool units, 33% riffle units, 28% flatwater units, and 1% no survey units (Graph 1). Based on total length of Level II habitat types there were 35% riffle units, 33% pool units, and 32% flatwater units (Graph 2).

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Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 35%; low gradient riffle units, 18%; and high gradient riffle units, 15% (Graph 3). Based on percent total length, mid-channel pool units made up 31%, high gradient riffle units 18%, and low gradient riffle units 17%.

A total of 130 pools were identified (Table 3). Main channel pools were the most frequently encountered at 95% (Graph 4), and comprised 97% of the total length of all pools (Table 3).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Fifty of the 129 pools (39%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 129 pool tail-outs measured, 29 had a value of 1 (22.5%); 67 had a value of 2 (51.9%); 16 had a value of 3 (12.4%); 17 had a value of 5 (13.2%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

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 21, flatwater habitat types had a mean shelter rating of 19, and pool habitats had a mean shelter rating of 36 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 37. Scour pools had a mean shelter rating of 18 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Squaw Creek. Graph 7 describes the pool cover in Squaw Creek. Boulders are the dominant pool cover type followed by large woody debris.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Boulders were the dominant substrate observed in 40% of the pool tail-outs. Gravel was the next most frequently observed dominant substrate type and occurred in 34% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Squaw Creek was 95%. Five percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 63% and 37%, respectively. Graph 9 describes the mean percent canopy in Squaw Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 93%. The mean percent left bank vegetated was 93%. The dominant elements composing the structure of the stream banks consisted of 66% sand/silt/clay, 28% boulder, 5% cobble/gravel, and 2% bedrock (Graph 10). Deciduous trees were the dominant vegetation type observed in 60.8% of the units surveyed. Additionally, 29.4% of the units surveyed had coniferous trees as the dominant vegetation type, and 9.5% had brush as the dominant vegetation type (Graph 11).

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BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 31 sites for species composition and distribution in Squaw Creek on July 26 and July 28, 2010. Water temperatures taken during the survey period ranged from 57 to 59 degrees Fahrenheit. Air temperatures ranged from 57 to 72 degrees Fahrenheit. The sites were sampled by S. McSmith (DFG), and B. Williams (WSP).

In reach 1, which comprised the first 2,516 feet of stream, 9 sites were sampled. The reach sites yielded 70 young-of-the-year steelhead/rainbow trout (SH/RT), and 5 age 1+ SH/RT.

In reach 2, 10 sites were sampled starting approximately 2,516 feet from the confluence with Bull Creek and continuing upstream 3,365 feet. The reach sites yielded 82 young-of-the-year SH/RT, 10 age 1+ SH/RT, and 5 age 2+ SH/RT.

In reach 3, 12 sites were sampled starting approximately 13,430 feet from the confluence with Bull Creek and continuing upstream 1,051 feet. The reach sites yielded 28 young-of-the-year SH/RT, 5 age 1+ SH/RT, and 3 age 2+ SH/RT.

The following chart displays the information yielded from these sites:

2010 Squaw Creek underwater observations.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Coho	
					YOY	1+	2+	YOY	1+
Reach 1: F3 Channel Type									
07/26/10	1	007	Pool	315	10	1	0	0	0
	2	010	Pool	558	18	0	0	0	0
	3	012	Pool	790	8	1	0	0	0
	4	016	Pool	977	3	0	0	0	0
	5	018	Pool	1,077	2	0	0	0	0
	6	019	Pool	1,139	2	1	0	0	0
	7	021	Pool	1,251	2	0	0	0	0
	8	034	Pool	2,087	12	1	0	0	0
Reach 2: B2 Channel Type									
07/26/10	9	044	Pool	2,548	13	1	0	0	0
	10	051	Pool	2,952	9	0	1	0	0
	11	053	Pool	3,078	5	2	1	0	0
	12	067	Pool	3,881	11	1	1	0	0
	13	077	Pool	4,353	15	0	0	0	0
	14	083	Pool	4,670	3	0	0	0	0

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	15	096	Pool	5,100	9	0	1	0	0
	16	101	Pool	5,299	10	6	1	0	0
	17	104	Pool	5,413	5	0	0	0	0
	18	108	Pool	5,657	8	0	0	0	0
	19	112	Pool	5,881	7	1	0	0	0
Reach 3: A2 Channel Type									
07/28/10	20	313	Pool	13,460	3	0	0	0	0
	21	316	Pool	13,620	1	1	0	0	0
	22	320	Pool	13,705	8	0	0	0	0
	23	324	Run	13,850	5	0	0	0	0
	24	326	Pool	13,912	7	0	0	0	0
	25	328	Pool	13,993	1	1	0	0	0
	26	330	Pool	14,103	1	0	0	0	0
	27	334	Pool	14,209	0	1	0	0	0
	28	336	Pool	14,274	2	0	0	0	0
	29	338	Riffle	14,481	0	0	0	0	0
	30	Above Survey			0	0	0	0	0
	31	Above Survey			0	0	0	0	0

DISCUSSION

Squaw Creek is an F3 channel type for the first 2,516 feet of stream surveyed, a B2 channel type for the next 6,327 feet, and an A2 channel type for the remaining 5,638 feet. The suitability of F3, B2, and A2 channel types for fish habitat improvement structures is as follows: F3 channel types are good for bank-placed boulders, single and opposing wing-deflectors and fair for plunge weirs, boulder clusters, channel constrictors and log cover. B2 channel types excellent for plunge weirs, single and opposing wing-deflectors, and log cover. A2 channels are generally not suitable for fish habitat improvement projects.

The water temperatures recorded on the survey days July 6 to July 27, 2010, ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 58 to 76 degrees Fahrenheit. This is a suitable water temperature range for salmonids. To make any conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 32% of the total length of this survey, riffles 35%, and pools 33%. Fifty of the 129 (39%) pools had a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40%

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of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual 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 large wood that will increase or deepen pool habitat is recommended.

Ninety-six of the 129 pool tail-outs measured had embeddedness ratings of 1 or 2. Sixteen of the pool tail-outs had embeddedness ratings of 3 or 4. Seventeen 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.

Sixty-three of the 129 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 is 36. The shelter rating in the flatwater habitats is 19. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Squaw Creek. Boulders are the dominant cover type in pools followed by large woody debris. 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 95%. Reach 1 had a canopy density of 92%, Reach 2 had a canopy density of 94%, and Reach 3 had a canopy density of 95%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 93% and 93%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

- 1) Squaw Creek should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are within 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) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from boulders. Adding high quality complexity with woody cover in the pools is desirable.

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COMMENTS AND LANDMARKS

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

Position (ft):	Habitat unit #:	Comments:
0	0001.00	Start of survey at the confluence with Bull Creek.
1990	0034.00	Log debris accumulation (LDA) #01 contains 20 pieces of large woody debris (LWD) and measures 11' high x 50' wide x 26' long. Water flows through it and there are visible gaps in the LDA. The LDA is not retaining sediment. Fish are present above the LDA.
3364	0060.00	Tributary #01 enters on the right bank. It contributes to less than 5% of Squaw Creek's flow. The water temperature downstream and upstream of the tributary is 55 degrees Fahrenheit; the water temperature of the tributary is 54 degrees Fahrenheit. The slope of the tributary is approximately 8%. The tributary is accessible to salmonids, but no fish were observed.
4851	0090.00	An erosion site on the right bank measures 30' high x 30' long. It is not contributing sediment to the channel.
4921	0092.00	LDA #02 contains 26 pieces of LWD and measures 10' high x 49' wide x 56' long. Water flows through it and there are visible gaps in the LDA. Retained sediment ranges from silt to gravel and measures 40' wide x 35' long x 5' deep. Fish are present above the LDA.
5616	0108.00	Tributary #02 enters on the left bank. It contributes to approximately 5% of Squaw Creek's flow. The water temperature downstream and upstream of the tributary is 56 degrees Fahrenheit; the water temperature of the tributary is 57 degrees Fahrenheit. The slope of the tributary is approximately 20%. A 7' high bedrock plunge with no jump pool below it makes the tributary inaccessible to fish.
6525	0134.00	Tributary #03 enters on the right bank. It contributes to approximately 15% of Squaw Creek's flow. The water temperature downstream and upstream of the tributary is 57 degrees Fahrenheit; the water temperature of the tributary is 57 degrees Fahrenheit. The slope of the tributary is approximately 25%, making it inaccessible to salmonids.
6983	0144.00	An erosion site on the left bank measures 70' long x 25' high. It is not contributing sediment to the channel.

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7420	0156.00	LDA #03 contains 10 pieces of LWD and measures 10' high x 55' wide x 24' long. Water flows through it and there are visible gaps in the LDA. Retained sediment ranges from sand to gravel and measures 20' wide x 20' long x 2.5' deep. Fish are present above the LDA.
7783	0165.00	Tributary #04 enters on the left bank. It contributes to less than 5% of Squaw Creek's flow. The water temperature downstream and upstream of the tributary is 58 degrees Fahrenheit; the water temperature of the tributary is 60 degrees Fahrenheit. The slope of the tributary is approximately 10%. The tributary is accessible to salmonids, but no fish were observed.
8584	0189.00	An erosion site on the right bank measures 40' long x 30' high.
9545	0216.00	Tributary #05 enters on the right bank. It contributes to approximately 10% of Squaw Creek's flow. The water temperature downstream and upstream of the tributary is 57 degrees Fahrenheit; the water temperature of the tributary is 57 degrees Fahrenheit. The slope of the tributary is approximately 40%, making it inaccessible to salmonids.
10039	0229.00	LDA #04 contains 10 pieces of LWD and measures 13' high x 37' wide x 36' long. Water flows through it and there are visible gaps in the LDA. Retained sediment ranges from silt to large cobble and measures 30' wide x 25' long x 3' deep. Fish are present above the LDA.
10141	0231.00	LDA #05 contains 31 pieces of LWD and measures 15' high x 26' wide x 91' long. Water flows through it and there are visible gaps in the LDA. Retained sediment ranges from silt to boulders and measures 30' wide x 100' long x 7' deep. Fish are present above the LDA.
10166	0232.00	An erosion site on the right bank measures 35' high x 35' long. It is not contributing sediment to the channel.
11000	0255.00	LDA #06 contains 16 pieces of LWD and measures 9' high x 22' wide x 24' long. Water flows through it and there are visible gaps in the LDA. Retained sediment ranges from silt to boulders and measures 20' wide x 3' deep. Fish are present above the LDA. A landslide on the left bank is contributing sediment ranging in size from silt to cobble to the channel.
12373	0285.00	An erosion site on the right bank measuring 65' long x 40' high in contributing sediment ranging in size from silt to cobble to the channel.
12456	0287.00	Tributary #06 enters on the left bank. It contributes to less than 5% of Squaw Creek's flow. The water temperature downstream and upstream of the tributary is 54 degrees Fahrenheit; the water temperature of the

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tributary is 54 degrees Fahrenheit. The slope of the tributary is approximately 50%, making it inaccessible to salmonids.

12643	0293.00	There is a 7' high plunge with a 2.5' deep pool below it. It is a possible end of anadromy.
13240	0308.00	Tributary #07 enters on the left bank. It contributes to approximately 15% of Squaw Creek's flow. The water temperature downstream and upstream of the tributary is 54 degrees Fahrenheit; the water temperature of the tributary is 54 degrees Fahrenheit. The slope of the tributary is approximately 50%, making it inaccessible to salmonids.
13392	0312.00	Grasshopper Road crosses the channel. The railcar bridge measures 13.7' wide x 14 high x 50' long.
14093	0330.00	Tributary #08 enters on the right bank. It contributes to approximately 20% of Squaw Creek's flow. The water temperature downstream and upstream of the tributary is 56 degrees Fahrenheit; the water temperature of the tributary is 55 degrees Fahrenheit. The slope of the tributary is approximately 75%, making it inaccessible to salmonids.
14481	0338.00	End of survey due to a cascade with a 20% slope over 130'. There is an LDA with a 3' high jump and a 6' high jump, neither of which have pools below them. No fish were observed above the cascade.

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.

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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]	

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

Stream Name: Squaw Creek

LLID: 1239870403490

Drainage: Eel River - South Fork

Survey Dates: 7/6/2010 to 7/27/2010

Confluence Location: Quad: BULL CREEK

Legal Description: T01SR02ES30

Latitude: 40:20:56.0N

Longitude: 123:59:13.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	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
96	11	FLATWATER	28.2	48	4585	31.5	14.8	0.8	1.6	709	68065	586	56291		19
2	0	NOSURVEY	0.6	22	44	0.3									
130	130	POOL	38.2	37	4789	32.9	16.9	0.7	2.0	621	80780	919	118493	594	36
112	13	RIFFLE	32.9	46	5117	35.2	15.1	0.6	1.3	486	54484	347	38882		21
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
340	154				14535					203329			213666		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Squaw Creek

LLID: 1239870403490

Drainage: Eel River - South Fork

Survey Dates: 7/6/2010 to 7/27/2010

Confluence Location: Quad: BULL CREEK

Legal Description: T01SR02ES30

Latitude: 40:20:56.0N

Longitude: 123:59:13.0W

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 (%)
62	10	LGR	18.2	41	2527	17.4	16	0.7	2.3	510	31624	392	24311		18	95
50	3	HGR	14.7	52	2590	17.8	14	0.5	1.5	408	20390	197	9866		32	92
17	5	POW	5.0	34	575	4.0	13	0.8	1.9	412	7012	326	5537		25	96
46	2	RUN	13.5	36	1671	11.5	18	0.7	1.4	651	29953	359	16510		0	91
33	4	SRN	9.7	71	2339	16.1	16	0.9	2.2	1109	36585	1026	33856		21	95
119	119	MCP	35.0	38	4473	30.8	17	0.8	5.5	644	76646	964	113715	630	36	95
5	5	STP	1.5	35	175	1.2	16	0.7	2.3	496	2482	650	3248	370	59	94
2	2	LSL	0.6	22	43	0.3	16	0.3	1.6	323	646	308	616	95	15	95
1	1	LSR	0.3	22	22	0.2	11	0.7	1.4	230	230	207	207	161	30	97
3	3	LSBo	0.9	25	76	0.5	14	0.4	1.6	259	777	236	708	103	15	97
2	0	NS	0.6	22	44	0.3										

Total Units
340

Total Units Fully Measured
154

Total Length (ft.)
14535

Total Area (sq.ft.)
206344

Total Volume (cu.ft.)
208573

Table 3 - Summary of Pool Types

Stream Name: Squaw Creek LLID: 1239870403490 Drainage: Eel River - South Fork
Survey Dates: 7/6/2010 to 7/27/2010
Confluence Location: Quad: BULL CREEK Legal Description: T01SR02ES30 Latitude: 40:20:56.0N Longitude: 123:59:13.0W

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
124	124	MAIN	95	37	4648	97	17.0	0.8	638	79127	619	73012	37
6	6	SCOUR	5	24	141	3	13.8	0.4	275	1653	110	659	18
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
130	130				4789					80780		73672	

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

Stream Name: Squaw Creek

LLID: 1239870403490

Drainage: Eel River - South Fork

Survey Dates: 7/6/2010 to 7/27/2010

Confluence Location: Quad: BULL CREEK

Legal Description: T01SR02ES30

Latitude: 40:20:56.0N

Longitude: 123:59:13.0W

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
118	MCP	91	1	1	69	58	34	29	7	6	7	6
5	STP	4	0	0	3	60	2	40	0	0	0	0
2	LSL	2	0	0	2	100	0	0	0	0	0	0
1	LSR	1	0	0	1	100	0	0	0	0	0	0
3	LSBo	2	0	0	3	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
129	1	1	78	60	36	28	7	5	7	5

Mean Maximum Residual Pool Depth (ft.): 2

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Squaw Creek

LLID: 1239870403490

Drainage: Eel River - South Fork

Survey Dates: 7/6/2010 to 7/27/2010

Dry Units: 0

Confluence Location: Quad: BULL CREEK

Legal Description: T01SR02ES30

Latitude: 40:20:56.0N

Longitude: 123:59:13.0W

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
62	10	LGR	1	10	8	0	0	0	0	82	0
50	3	HGR	0	0	0	0	8	0	0	92	0
112	13	TOTAL RIFFLE	1	7	5	0	3	0	0	85	0
17	5	POW	8	0	0	2	0	0	1	89	0
46	2	RUN	0	0	0	0	0	0	0	0	0
33	4	SRN	0	25	0	0	0	0	1	74	0
96	11	TOTAL FLAT	4	11	0	1	0	0	1	82	0
119	118	MCP	16	12	19	7	0	0	6	39	0
5	5	STP	6	5	11	1	0	0	7	70	0
2	2	LSL	25	28	20	13	0	0	0	15	0
1	1	LSR	5	50	0	30	0	0	0	15	0
3	3	LSBo	0	5	2	0	0	0	10	82	2
130	129	TOTAL POOL	15	12	19	7	0	0	6	41	0
2	0	NS									
340	153	TOTAL	14	12	17	6	0	0	6	46	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Squaw Creek

LLID: 1239870403490

Drainage: Eel River - South Fork

Survey Dates: 7/6/2010 to 7/27/2010

Dry Units: 0

Confluence Location: Quad: BULL CREEK

Legal Description: T01SR02ES30

Latitude: 40:20:56.0N

Longitude: 123:59:13.0W

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
62	10	LGR	0	0	0	20	30	50	0
50	3	HGR	0	0	0	0	0	100	0
17	5	POW	0	0	20	0	0	80	0
46	2	RUN	0	0	50	50	0	0	0
33	4	SRN	0	0	0	25	25	50	0
119	118	MCP	2	27	18	8	4	39	2
5	5	STP	0	0	0	20	0	80	0
2	2	LSL	0	0	100	0	0	0	0
1	1	LSR	0	0	0	0	0	100	0
3	3	LSBo	0	0	33	0	0	67	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Squaw Creek

LLID: 1239870403490

Drainage: Eel River - South Fork

Survey Dates: 7/6/2010 to 7/27/2010

Confluence Location: Quad: BULL CREEK

Legal Description: T01SR02ES30

Latitude: 40:20:56.0N

Longitude: 123:59:13.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
95	37	63	0	93	93

Note: Mean percent conifer and hardwood for the entire reach are means of canopy components from units with canopy values greater than zero.

Open units represent habitat units with zero canopy cover.

Stream Name: Squaw Creek	LLID: 1239870403490	Drainage: Eel River - South Fork
Survey Dates: 7/6/2010 to 7/27/2010	Survey Length (ft.): 14535	Main Channel (ft.): 14481
		Side Channel (ft.): 54
Confluence Location: Quad: BULL CREEK	Legal Description: T01SR02ES30	Latitude: 40:20:56.0N
		Longitude: 123:59:13.0W

STREAM REACH: 1									
Channel Type: F3			Canopy Density (%): 92.9				Pools by Stream Length (%): 47.3		
Reach Length (ft.): 2516			Coniferous Component (%): 70.5				Pool Frequency (%): 41.9		
Riffle/Flatwater Mean Width (ft.): 22.5			Hardwood Component (%): 29.5				Residual Pool Depth (%):		
BFW:			Dominant Bank Vegetation: Coniferous Trees				< 2 Feet Deep: 50		
Range (ft.): 24 to 31			Vegetative Cover (%): 95.6				2 to 2.9 Feet Deep: 28		
Mean (ft.): 28			Dominant Shelter: Large Woody Debris				3 to 3.9 Feet Deep: 0		
Std. Dev.: 2			Dominant Bank Substrate Type: Sand/Silt/Clay				>= 4 Feet Deep: 22		
Base Flow (cfs.): 0.7			Occurrence of LWD (%): 33				Mean Max Residual Pool Depth (ft.): 2.5		
Water (F): 53 - 54 Air (F): 59 - 76			LWD per 100 ft.:				Mean Pool Shelter Rating: 32		
Dry Channel (ft): 0			Riffles: 2						
			Pools: 7						
			Flat: 2						
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 28 Sm Cobble: 67 Lg Cobble: 0 Boulder: 0 Bedrock: 6									
Embeddedness Values (%): 1. 38.9 2. 50.0 3. 11.1 4. 0.0 5. 0.0									

Channel Type:	B2			Canopy Density (%):			94.4			Pools by Stream Length (%):			34.5			
Reach Length (ft.):	6327			Coniferous Component (%):			32.6			Pool Frequency (%):			39.1			
Riffle/Flatwater Mean Width (ft.):	14.6			Hardwood Component (%):			67.4			Residual Pool Depth (%):						
BFW:				Dominant Bank Vegetation:			Hardwood Trees			< 2 Feet Deep:			57			
Range (ft.):	17	to 36		Vegetative Cover (%):			92.4			2 to 2.9 Feet Deep:			30			
Mean (ft.):	23			Dominant Shelter:			Boulders			3 to 3.9 Feet Deep:			8			
Std. Dev.:	5			Dominant Bank Substrate Type:			Sand/Silt/Clay			>= 4 Feet Deep:			5			
Base Flow (cfs.):	0.7			Occurrence of LWD (%):			16			Mean Max Residual Pool Depth (ft.):			2.0			
Water (F):	54	- 58	Air (F):	60	- 76	LWD per 100 ft.:			Mean Pool Shelter Rating:			29				
Dry Channel (ft):	0			Riffles:			4									
				Pools:			7									
				Flat:			2									
Pool Tail Substrate (%):	Silt/Clay:	0	Sand:	2	Gravel:	39	Sm Cobble:	7	Lg Cobble:	15	Boulder:	38	Bedrock:	0		
Embeddedness Values (%):	1.	21.3	2.	60.7	3.	11.5	4.	0.0	5.	6.6						

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: A2	Canopy Density (%): 95.6	Pools by Stream Length (%): 24.8
Reach Length (ft.): 5638	Coniferous Component (%): 29.8	Pool Frequency (%): 36.2
Riffle/Flatwater Mean Width (ft.): 12.3	Hardwood Component (%): 70.2	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 70
Range (ft.): 15 to 28	Vegetative Cover (%): 93.1	2 to 2.9 Feet Deep: 26
Mean (ft.): 19	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 4
Std. Dev.: 3	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.7	Occurrence of LWD (%): 10	Mean Max Residual Pool Depth (ft.): 1.8
Water (F): 53 - 57 Air (F): 58 - 72	LWD per 100 ft.:	Mean Pool Shelter Rating: 45
Dry Channel (ft): 0	Riffles: 5	
	Pools: 8	
	Flat: 5	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 30 Sm Cobble: 6 Lg Cobble: 8 Boulder: 56 Bedrock: 0		
Embeddedness Values (%): 1. 18.0 2. 42.0 3. 14.0 4. 0.0 5. 26.0		

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Squaw Creek

LLID: 1239870403490

Drainage: Eel River - South Fork

Survey Dates: 7/6/2010 to 7/27/2010

Confluence Location: Quad: BULL CREEK

Legal Description: T01SR02ES30

Latitude: 40:20:56.0N

Longitude: 123:59:13.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Bedrock	5	1	2.0
Boulder	37	48	27.8
Cobble / Gravel	7	7	4.6
Sand / Silt / Clay	104	97	65.7

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	0	0	0.0
Brush	12	17	9.5
Hardwood Trees	94	92	60.8
Coniferous Trees	47	43	29.4
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values:

2

Table 10 - Mean Percent of Shelter Cover Types For Entire Stream

StreamName: Squaw Creek

LLID: 1239870403490

Drainage: Eel River - South Fork

Survey Dates: 7/6/2010 to 7/27/2010

Confluence Location: Quad: BULL CREEK

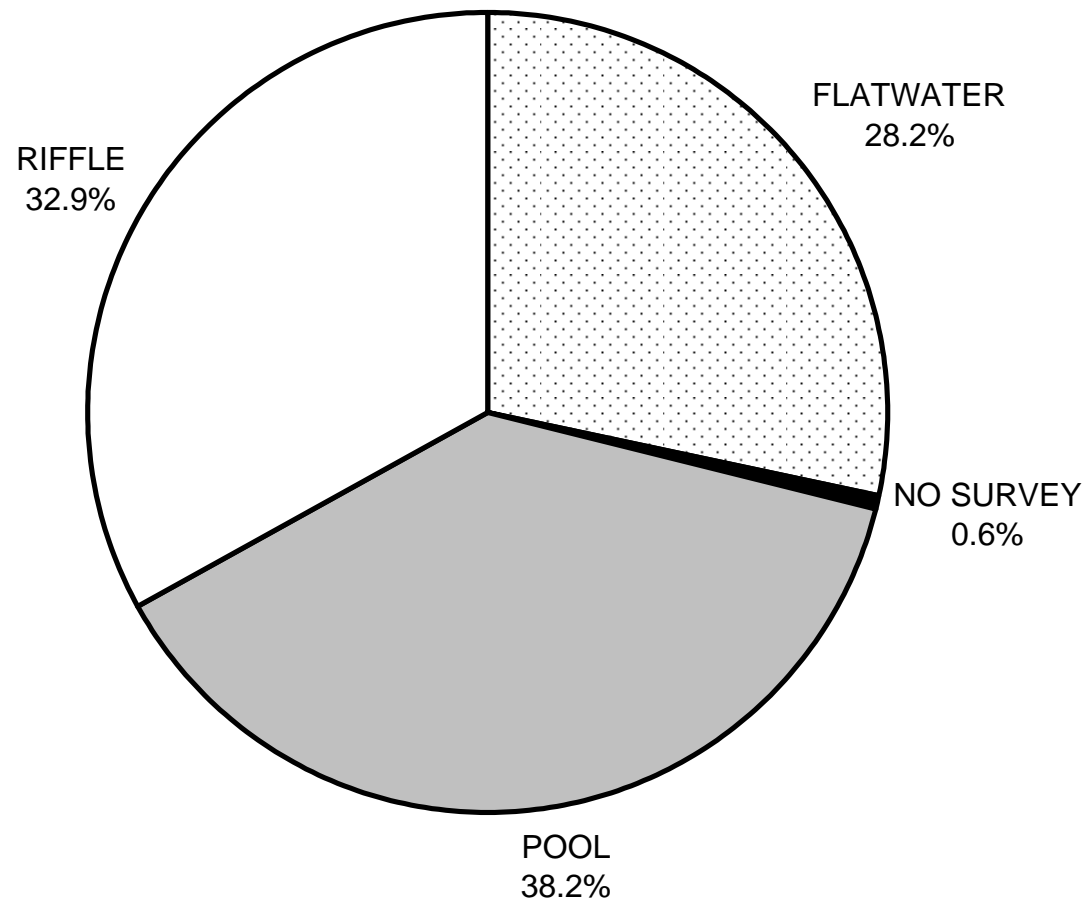
Legal Description: T01SR02ES30

Latitude: 40:20:56.0N

Longitude: 123:59:13.0W

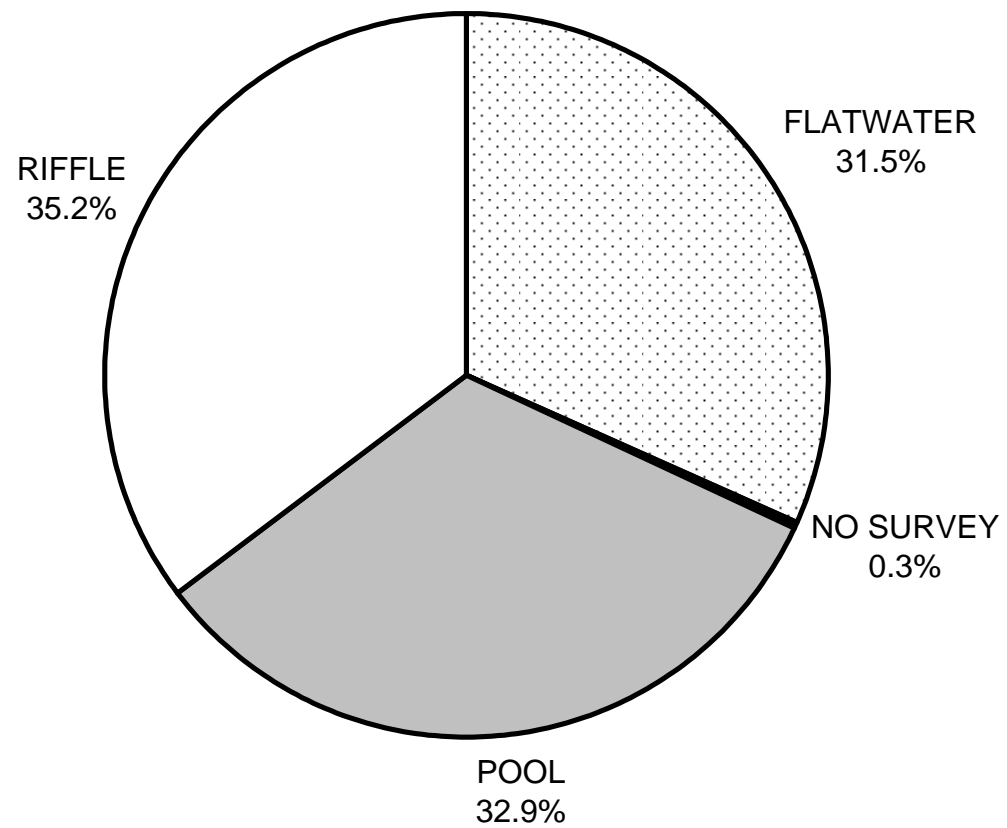
	Riffles	Flatwater	Pools
<hr/>			
UNDERCUT BANKS (%)	1	4	15
SMALL WOODY DEBRIS (%)	7	11	12
LARGE WOODY DEBRIS (%)	5	0	19
ROOT MASS (%)	0	1	7
TERRESTRIAL VEGETATION (%)	3	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	1	6
BOULDERS (%)	85	82	41
BEDROCK LEDGES (%)	0	0	0

SQUAW CREEK 2010 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

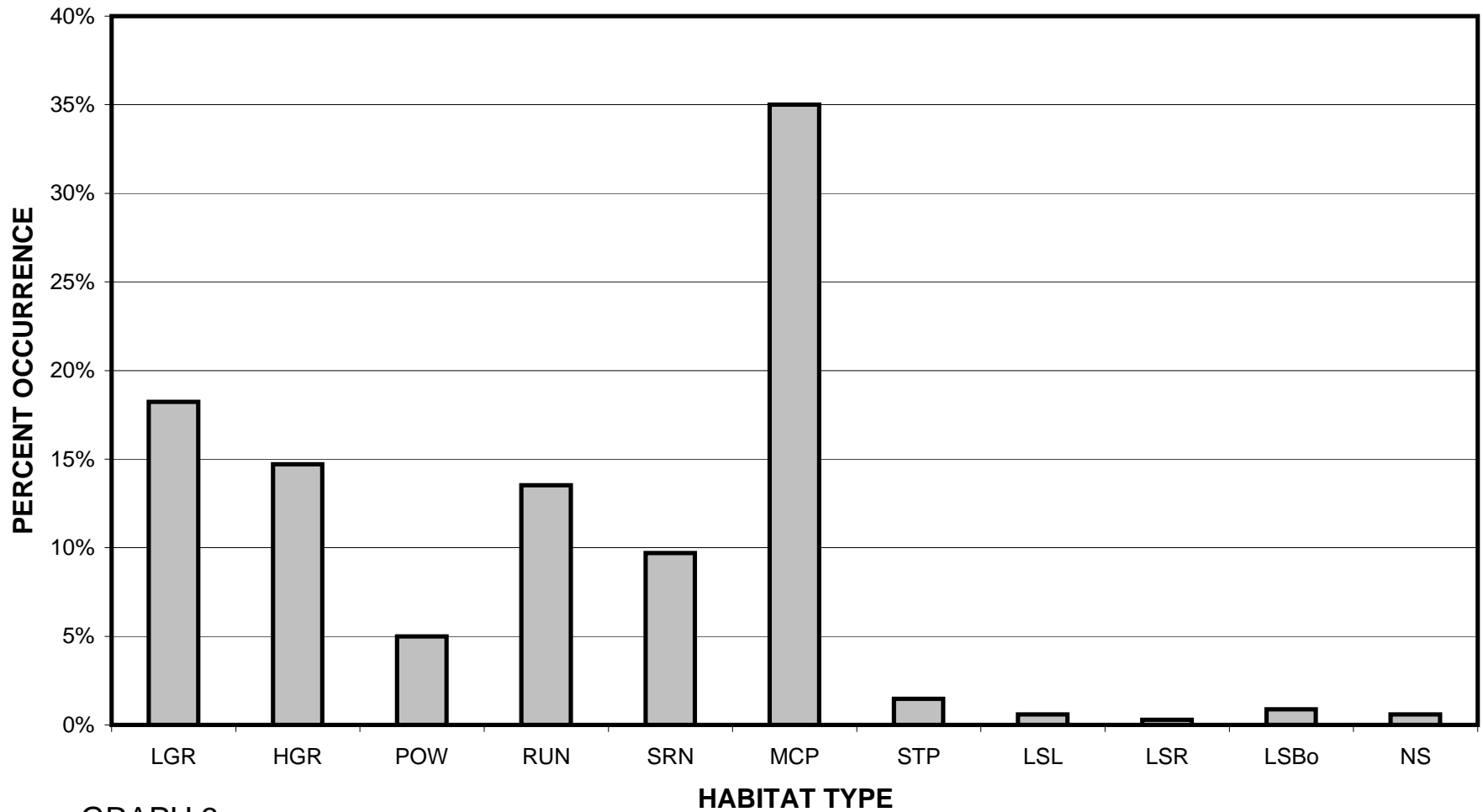
SQUAW CREEK 2010
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

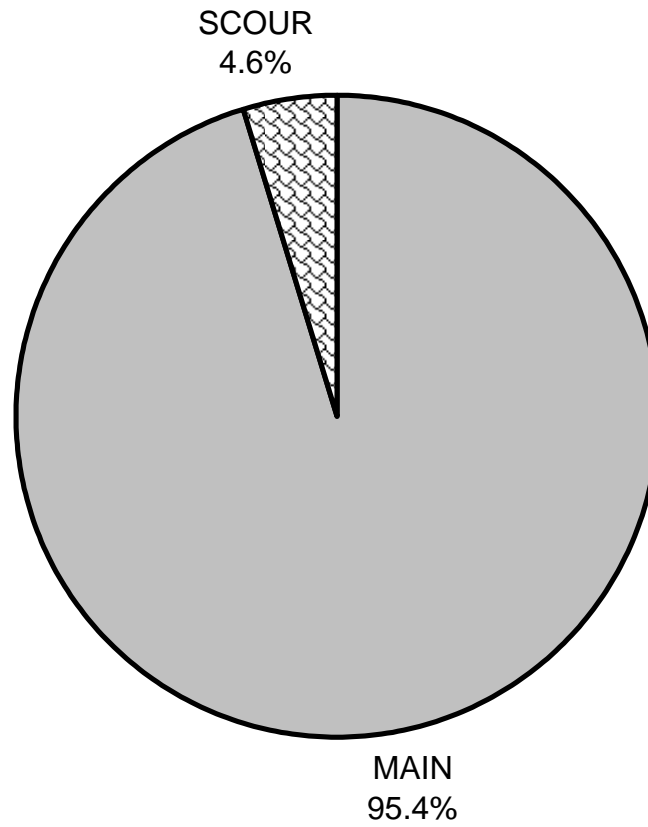
SQUAW CREEK 2010

HABITAT TYPES BY PERCENT OCCURRENCE



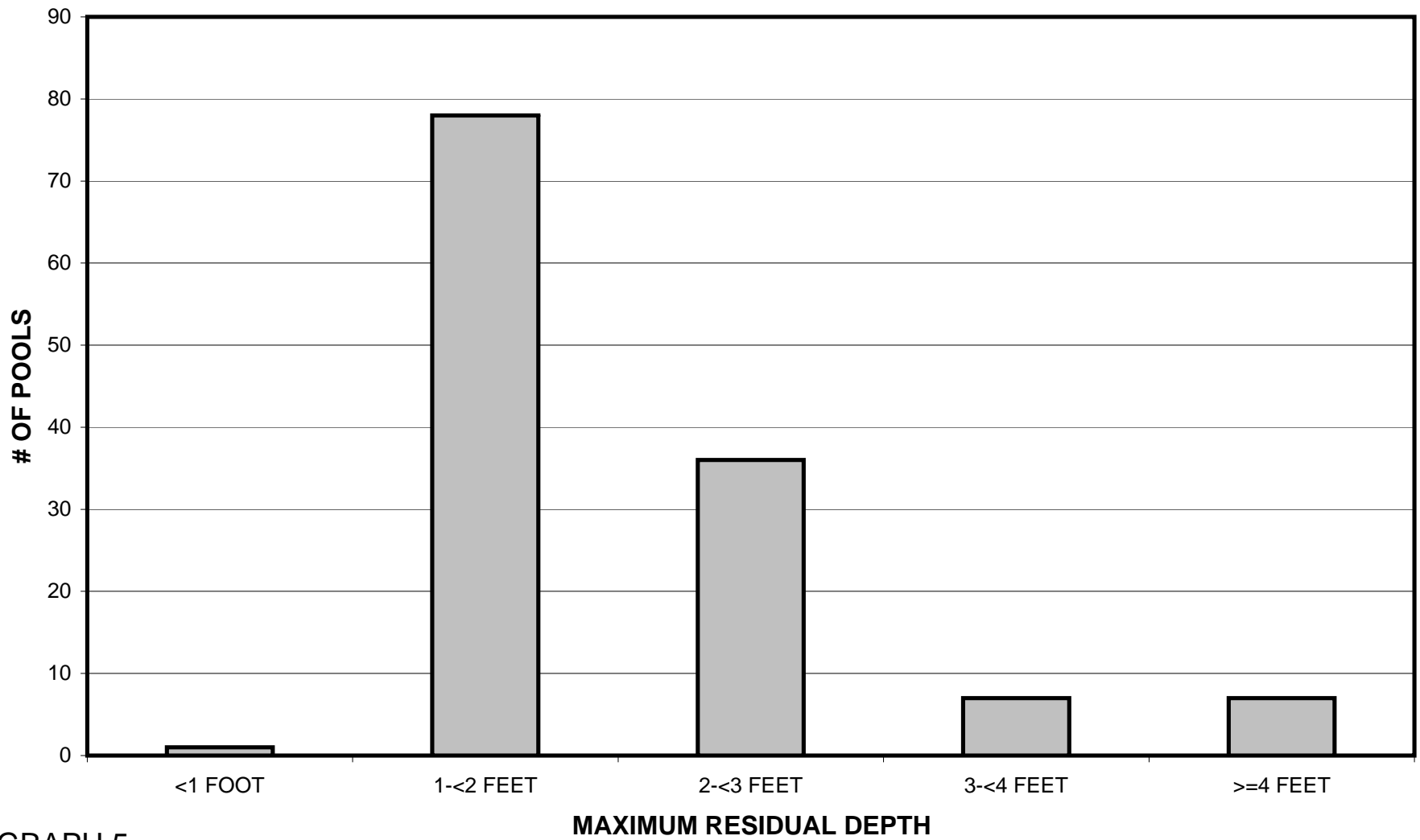
GRAPH 3

**SQUAW CREEK 2010
POOL TYPES BY PERCENT OCCURRENCE**



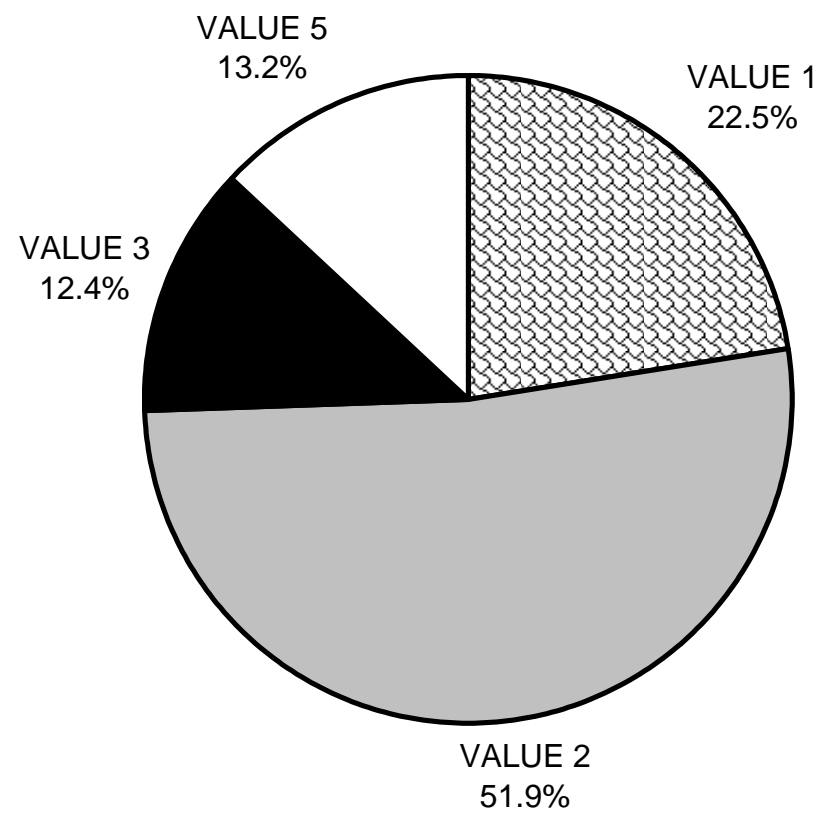
GRAPH 4

SQUAW CREEK 2010 MAXIMUM DEPTH IN POOLS



GRAPH 5

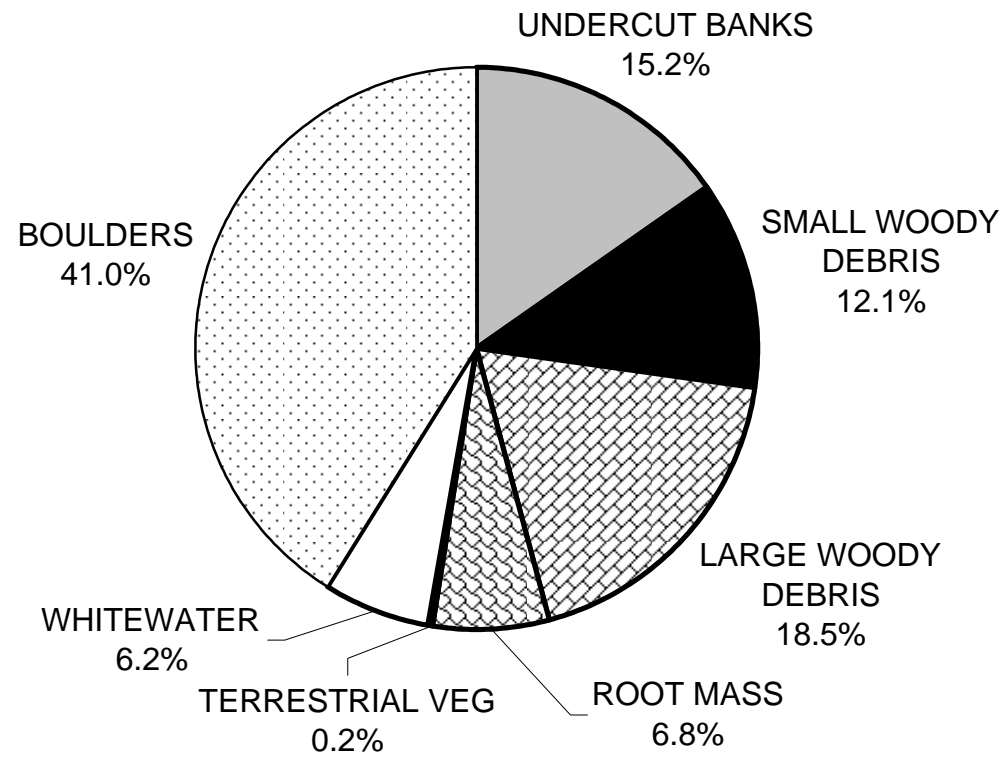
SQUAW CREEK 2010 PERCENT EMBEDDEDNESS



GRAPH 6

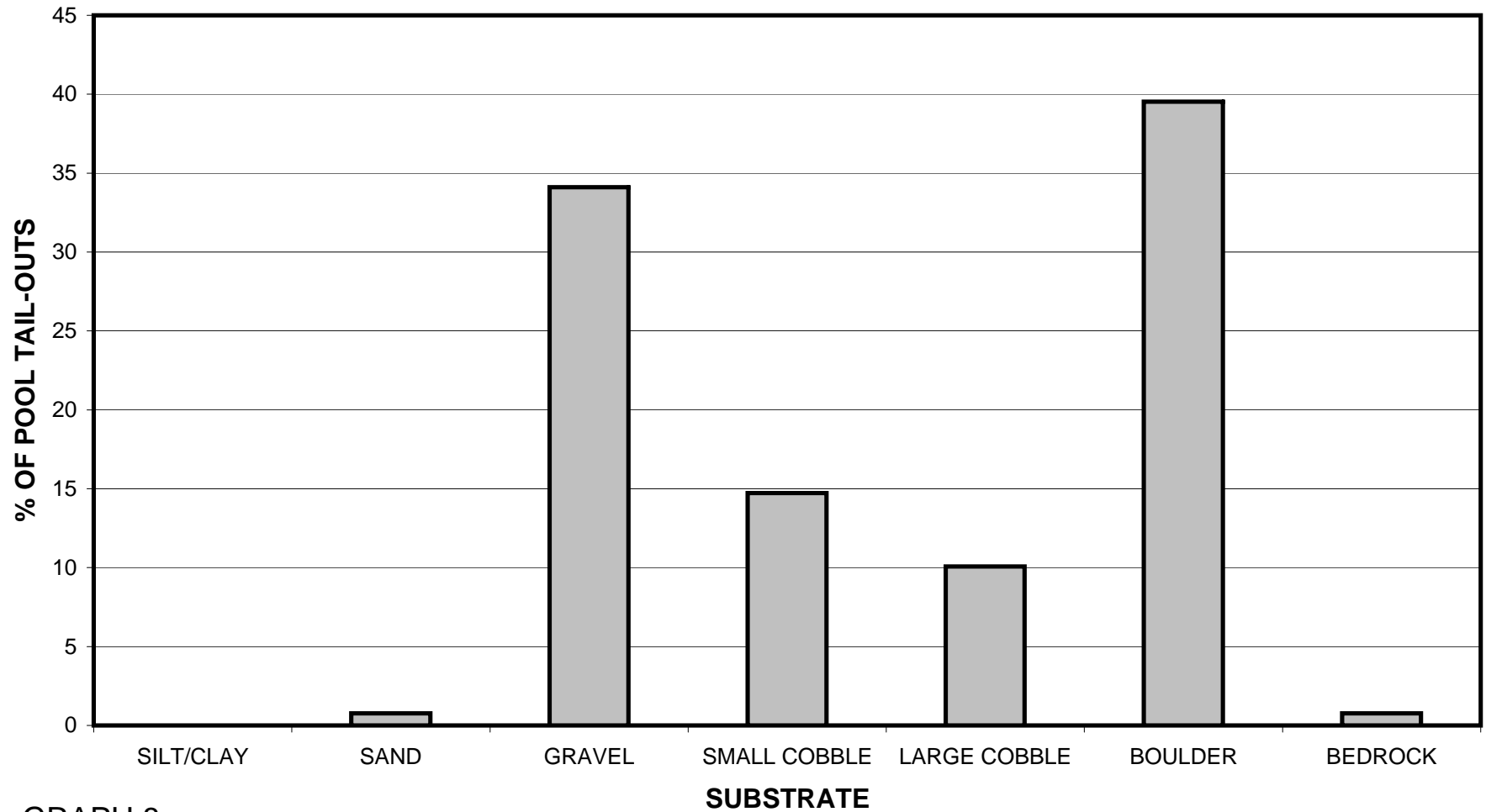
SQUAW CREEK 2010

MEAN PERCENT COVER TYPES IN POOLS



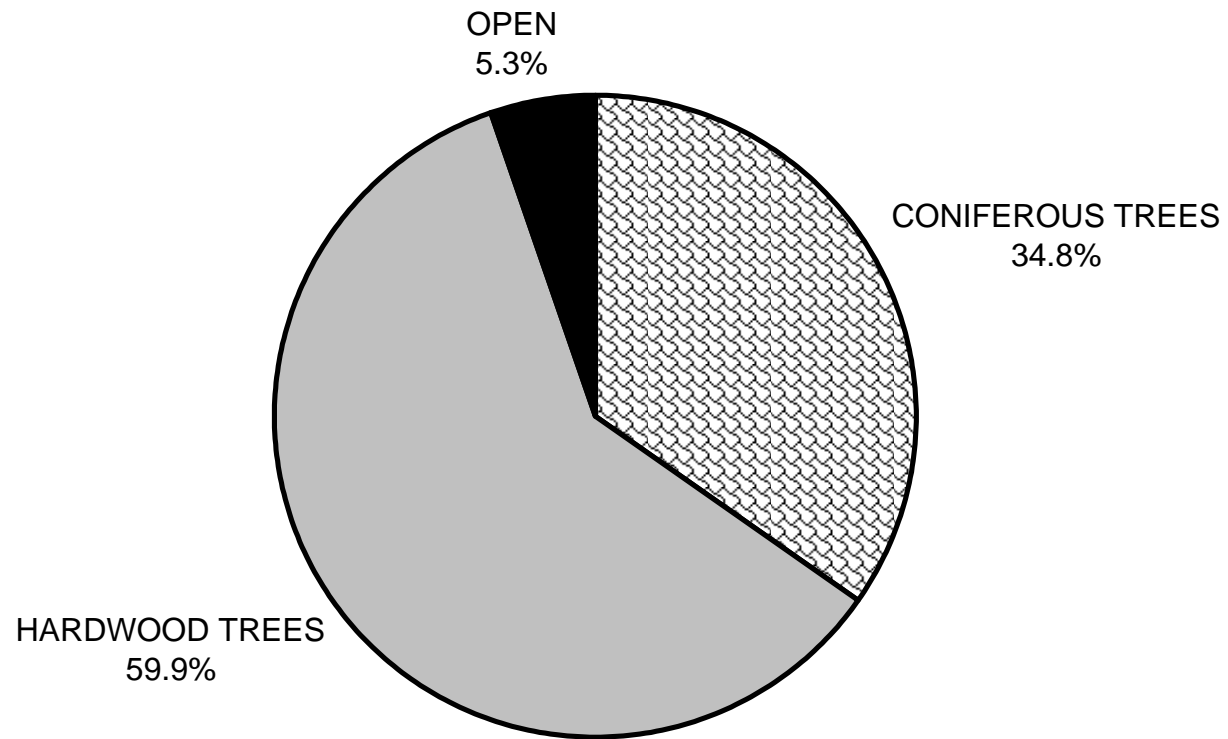
GRAPH 7

SQUAW CREEK 2010 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



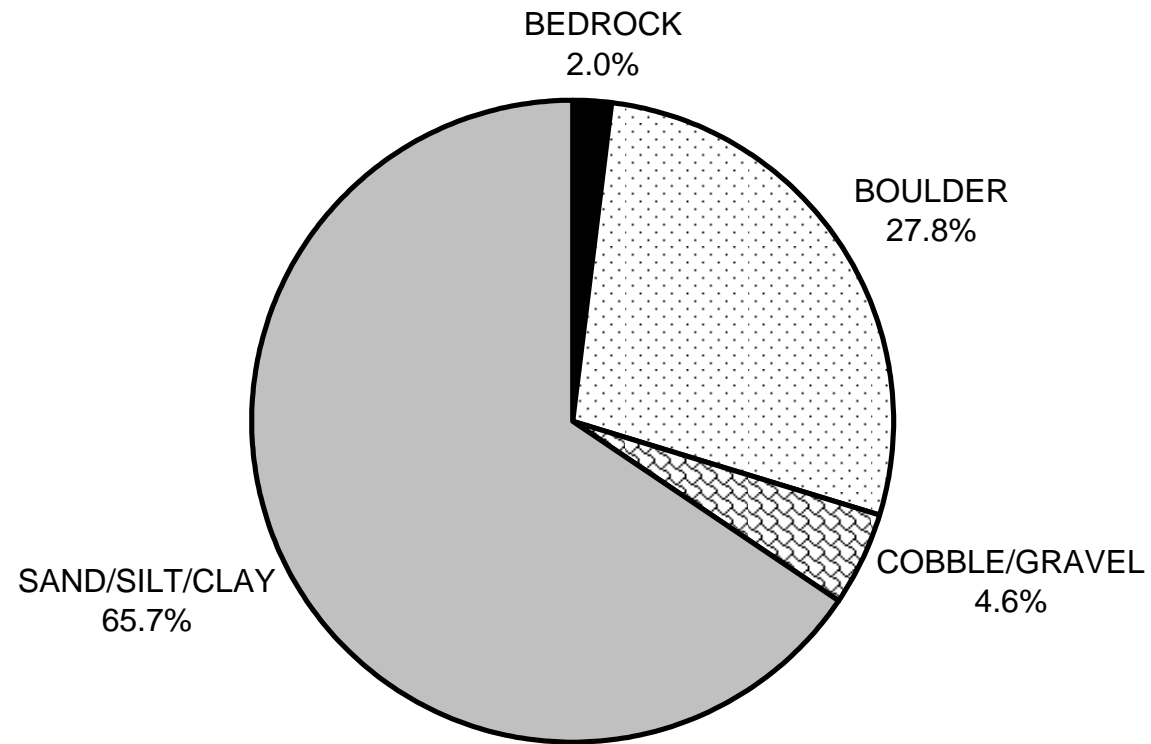
GRAPH 8

SQUAW CREEK 2010 MEAN PERCENT CANOPY



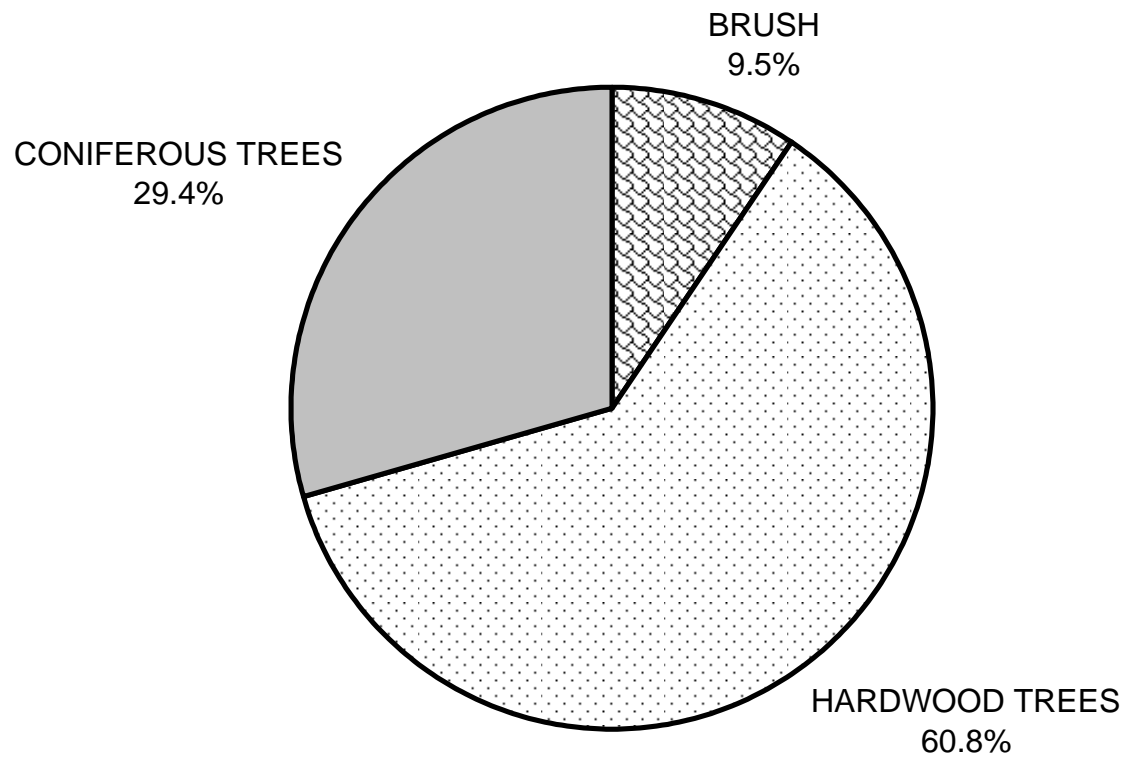
GRAPH 9

SQUAW CREEK 2010
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

SQUAW CREEK 2010
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

Map 1
Squaw Creek
South Fork Eel Watershed
Weott Quad, Humboldt County

Start of Survey

End of Survey

Legend

- Reach 1, F3 Channel Type
- Reach 2, B2 Channel Type
- Reach 3, A2 Channel Type

0 1,500 3,000 Feet

