

# STREAM INVENTORY REPORT

## Brush Creek

### INTRODUCTION

A stream inventory was conducted from June 28 to October 25, 2005 on Brush Creek. The survey began at the confluence with the Pacific Ocean and extended upstream 13.3 miles. A stream inventory and subsection to this report was also completed for one tributary to Brush Creek.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Brush Creek.

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

Brush Creek is located in Mendocino County, California (Map 1). Brush Creek's legal description at the confluence with the Pacific Ocean is T13N R16W S23. Its location is 38°58'32" north latitude and 123°42'41" west longitude. Brush Creek is a third order stream and has approximately 3.4 miles of blue line stream according to the USGS Point Arena 7.5 minute quadrangle. Brush Creek drains a watershed of approximately 15.3 square miles. Elevations range from sea level at the mouth of the creek to 2,290 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is primarily privately owned and is managed for timber production and rangeland. Vehicle access exists via Mountain View Road and Highway 1.

### METHODS

The habitat inventory conducted in Brush Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Department of Fish and Game (DFG) personnel and Watershed Stewards Project/AmeriCorps (WSP) members that conducted the inventory were trained in standardized habitat inventory methods by the 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 crest (measured in the thalweg), dominant substrate composing the pool tail crest, and

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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 Brush 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". Brush 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 Brush Creek, embeddedness was

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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 Brush 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 Brush 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 Brush 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.

### 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

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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.

## DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat , 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

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Brush 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

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- 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 June 28 to October 25, 2005 was conducted by Sarah Ganas (WSP), Scott Monday (DFG) and Shaun Thompson (DFG). The total length of the stream surveyed was 70,286 feet with an additional 1,073 feet of side channel.

Stream flow was measured 9,172 feet upstream from the confluence with the Pacific Ocean with a Marsh-McBirney Model 2000 flowmeter at 4.2 cfs on September 6, 2005.

Brush Creek is an F4 channel type for first 47,689 feet of the stream surveyed (Reach 1), an F2 channel type for the next 6,263 feet (Reach 2), an A2 channel type for the next 483 feet (Reach 3), and a B4 channel type for the remaining 16,924 feet of the stream surveyed (Reach 4). F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. F2 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios 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. B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 47 to 62 degrees Fahrenheit. Air temperatures ranged from 48 to 68 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 35% riffle units, 34% pool units, 30% flatwater units, and 1% dry units (Graph 1). Based on total length of Level II habitat types there were 36% flatwater units, 33% riffle units, 19% pool units, 11% unsurveyed units, and 1% dry units (Graph 2).

Seventeen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units, 33%; mid-channel pool units, 25%; and step run units, 15% (Graph 3). Based on percent total length, low gradient riffles made up 32%, mid-channel pool units 14%, and step run units 24%.

A total of 239 pools were identified (Table 3). Main channel pools were the most frequently encountered at 77% (Graph 4), and comprised 80% 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. One hundred fourteen of the 239 pools (48%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 240 pool tail-outs measured, 38 had a value of 1 (16%); 81 had a value of 2 (34%); 57 had a value of 3 (24%); 9

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had a value of 4 (4%); 55 had a value of 5 (23%); (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 24, flatwater habitat types had a mean shelter rating of 27, and pool habitats had a mean shelter rating of 50 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 64. Main channel pools had a shelter rating of 46 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Brush Creek. Graph 7 describes the pool cover in Brush 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. Gravel was the dominant substrate observed in 51% of the pool tail-outs. Small cobble and boulders were the next most frequently observed dominant substrate types; both occurred in 20% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Brush Creek was 86%. Of the canopy present, the mean percentages of hardwood and coniferous trees were 63% and 23%, respectively. 14% of the canopy was open. Graph 9 describes the mean percent canopy in Brush Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 81%. The mean percent left bank vegetated was 82%. The dominant elements composing the structure of the stream banks consisted of 45% cobble/gravel, 25% sand/silt/clay, 21% bedrock, and 8% boulder (Graph 10). Hardwood trees were the dominant vegetation type observed in 62% of the units surveyed. Additionally, 30% of the units surveyed had coniferous trees as the dominant vegetation type, and 6% had brush as the dominant vegetation type (Graph 11).

## **DISCUSSION**

Brush Creek is an F4 channel type for the first 47,689 feet of stream surveyed, an F2 channel type for the 6,263 feet, an A2 channel type for the 483 feet, and a B4 channel type for the remaining 16,924 feet. The suitability of F4, F2, A2, and B4 channel types for fish habitat improvement structures is as follows: F4 channel types are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. F2 channel types are fair for plunge weirs, single and opposing wing-deflectors, and log cover. A2 channels are generally not suitable for fish habitat improvement projects. B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey June 28 to October 25, 2005 ranged from 47 to 62 degrees Fahrenheit. Air temperatures ranged from 48 to 62 degrees Fahrenheit. To make any

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further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 36% of the total length of this survey, riffles 33%, and pools 19%. The pools are relatively deep, with 114 of the 239 (47%) pools having a maximum residual depth greater than three feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum residual depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. 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 hundred nineteen of the 240 pool tail-outs measured had embeddedness ratings of 1 or 2. Sixty-six of the pool tail-outs had embeddedness ratings of 3 or 4. Fifty-five 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 Brush Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

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

The mean shelter rating for pools is 50. The shelter rating in the flatwater habitats was 27. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Brush 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 structures 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 86%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 81% and 82%, 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) Brush Creek should be managed as an anadromous, natural production stream.
- 2) 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.

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- 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.
- 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) There are several log debris accumulations present on Brush Creek that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.
- 6) 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

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 the Pacific Ocean. Most of the flow is subsurface. Not surveyed.
1015	0002.00	Start of 6,885 foot long unsurveyed section.
7900	0003.00	End of unsurveyed section below Highway 1 bridge.
7913	0005.00	Left bank tributary.
8133	0007.00	Right bank erosion site measures 516' long x 10' high.
8465	0009.00	ATV tracks in stream and on right bank.
8780	0010.00	Steelhead young-of-the-year (YOY) and yearling observed.
9031	0013.00	Fence lying in stream. ATV tracks continue up stream.
9079	0014.00	Left bank erosion site above concrete fence.
9172	0015.00	Highway 1 crosses the channel.



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11896	0051.00	Twenty percent of shelter is from an old vehicle in stream creating shelter.
12656	0060.00	Fenced area for cattle to access stream on the left bank.
12809	0062.00	Spanish Creek enters on right bank.
13028	0063.00	Wet crossing.
14335	0076.00	Possible red-legged frog observed.
14767	0080.00	Right bank erosion site measures 70' long x 15' high x 5' deep.
15010	0083.00	20 or more young alders fell across the channel from the right bank.
15084	0084.00	Large debris accumulation (LDA), not retaining sediment, measures 50' wide x 10' high x 40' long. There are approximately 10 pieces of large woody debris (LWD) within the wetted width.
15771	0089.00	Cattle fencing around a section of creek for a watering hole.
19124	0123.00	LDA, not retaining sediment, measures 12' long x 40' wide x 4' high.
19405	0128.00	Right bank erosion site measures 7' high x 12' long.
19441	0129.00	Mill Creek enters on right bank.
20797	0141.00	Steelhead YOY observed.
21792	0150.00	Bank failure measures 15' long x 8' high x 4' wide.
22140	0154.00	Wet crossing: road to Mountain View.
23136	0166.00	Six or more old cars instream and on the left bank.
24243	0177.00	Large, open area. Bank is unstable and eroding, contributing silt into the stream. Restoration site.
25166	0183.00	CBS at beginning of unit. Road to Mountain View Road.
26626	0194.00	Steelhead YOY observed.
27238	0203.00	Former logging road along the right bank.
28275	0216.00	Steelhead YOY and yearling observed.
29609	0228.00	Salmonid YOY observed.

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30033	0234.00	Three huge rootwads on pool.
30485	0241.00	LDA measures 15' wide x 10' high x 50' long.
31634	0255.03	LDA separates main channel from side channel. Measures 40' long x 5' wide x 6' high.
33262	0271.00	Steep left bank tributary.
34052	0276.00	Left bank erosion site measures 90' long x 10' high.
34685	0284.00	Multiple steelhead YOY observed.
35781	0289.00	Left bank tributary.
35964	0291.00	Steelhead YOY and yearling observed.
36645	0295.00	Right bank tributary.
38110	0307.00	Dry right bank tributary.
38446	0310.00	Steep left bank tributary.
39419	0316.00	Right bank tributary.
39738	0320.00	Salmonid YOY observed.
39911	0321.00	Right bank tributary. High gradient bedrock sheet at mouth.
40688	0329.00	Dry tributary on left bank.
40853	0332.00	Salmonid YOY observed.
41979	0342.00	Steelhead yearling observed.
42465	0346.00	Large, deep, gorge with bedrock walls. Had to ride boat through it in order to pass.
43166	0353.00	High gradient right bank tributary. Foot bridge connects to ATV trail to Mountain View Road.
44939	0372.00	Dry tributary on left bank.
45347	0376.00	Left bank tributary. Two smaller tributaries enter as well.
46438	0390.00	Approx. 4' high plunge.

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46460	0391.00	Old bridge on left bank. Steelhead YOY observed.
46970	0399.00	High gradient right bank tributary.
47596	0402.00	Left bank erosion site measures 70' wide x 100' high.
48725	0410.00	Wet crossing.
48753	0411.00	Left bank tributary. High gradient at the mouth, then becomes low gradient.
49462	0422.00	Dry gully on right bank. Steelhead YOY observed.
49606	0424.00	Left bank tributary.
49922	0427.00	Steelhead YOY observed.
50771	0434.00	Small cascade, less than 3' high plunge.
50846	0437.00	Steelhead YOY observed.
52549	0461.00	Right bank erosion site measures 50' long x 50' high.
53262	0471.00	LDA measures 25' wide x 15' high x 7' long.
54444	0485.00	Dry left bank tributary.
55510	0502.00	Former road crossing, old wooden bridge that has collapsed.
56215	0511.00	South Fork Brush Creek enter on left bank. The tributary is dry 20' upstream from the mouth. Contributes less than 5% of mainstem's flow.
56338	0512.00	West crossing.
56404	0513.00	Wooden bridge crosses, connects to trail along creek.
56683	0517.00	Salmonid YOY observed.
57138	0525.00	Left bank scoured out, a large rootwad has fallen, creating a large pool.
57241	0527.00	Steelhead YOY observed.
57959	0540.00	Small left bank tributary, delivering silt to the mainstem.
58026	0542.00	3' high cascade.

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58190	0545.00	Boulders and large woody debris cause 4' high waterfall.
58285	0547.00	Dry right bank tributary.
58321	0548.00	Salmonid YOY observed.
58347	0549.00	Right bank landslide measures 70' high.
58863	0556.00	Two logs and boulders cause subterranean flow.
58888	0557.00	3' high waterfall.
59003	0559.00	Salmonid YOY observed.
59415	0565.00	Landslides on both banks measure 100' long x 50'-70' high. Four conifers slid into stream channel.
59503	0567.00	LDA measures 30' wide x 7' high x 5' long. Retained sediment causes subterranean flow above the LDA.
59840	0574.00	High gradient left bank tributary.
59982	0578.00	Left bank tributary with subterranean flow at the mouth. Wet crossing.
60214	0581.00	Dry right bank tributary.
60377	0584.00	LDA measures 20' wide x 3' high x 30' long.
60732	0589.00	Erosion site measures 75' long x 15' high. Salmonid YOY observed.
61272	0594.00	Dry left bank tributary.
61625	0598.00	Yearling steelhead observed.
62141	0602.00	LDA measures 30' wide x 10' high x 15' long. Retained sediment creating subterranean flow above the LDA.
63233	0612.00	LDA measures 25' wide x 12' high x 10' long. It is retaining sediment.
63975	0618.00	Salmonid YOY and 1+ observed.
64412	0623.00	Dry right bank tributary.
65808	0639.00	Dry right bank tributary.
66181	0642.00	LDA measures 15' long x 40' wide x 12' high.

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66396	0643.00	Salmonid YOY observed.
66913	0650.00	LDA measures 15' wide x 10' high x 10' long. LWD is caught in boulders and retaining some sediment.
67159	0656.00	Salmonid YOY, 1+, 2+ observed. LDA retaining sediment creating subterranean flow above. Possible fish barrier.
67218	0658.00	Steelhead YOY observed.
67969	0670.00	LDA measures 30' wide x 7' high x 8' long. Retaining sediment.
67998	0671.00	LDA measures 40' wide x 15' high x 20' long, retaining sediment. There are approximately 75-125 pieces of LWD in a 1/5 acre area. Two YOY observed.
68019	0672.00	Evidence of cattle on both banks and instream throughout the entire unit.
68068	0673.00	More cattle damage along entire unit. Two salmonid YOY observed.
68320	0674.00	Right bank erosion site measures 15' long x 10' high, contributing silt to the channel.
68350	0675.00	LDA measures 35' wide x 10' high x 5' long, retaining sediment.
68643	0677.00	Abandoned shack.
68855	0680.00	Salmonid YOY observed.
68878	0681.00	Left bank tributary. Channel choked with wood. 3' high cascade.
69143	0683.00	Wet crossing at the end of the unit.
69581	0684.00	Signs of livestock in the stream. Riparian vegetation cleared out, starting from the wet crossing of the previous unit.
70286	0693.00	End of survey. Stream mostly dry beyond this point. No fish observed in the last 1,400 feet.

## 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

**Stream Name:** Brush Creek

**LLID:** 1237115389755

**Drainage:** Point Arena

**Survey Dates:** 6/28/2005 to 10/25/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR16WS25

**Latitude:** 38:58:32.0N

**Longitude:** 123:42:41.0W

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
1	0	CULVERT	0.1	6885	6885	9.6									
8	0	DRY	1.1	99	791	1.1									0
210	21	FLATWATER	29.8	122	25698	36.0	16.7	0.9	1.8	1370	287768	1215	255205		27
1	0	NOSURVEY	0.1	1015	1015	1.4									
239	239	POOL	33.9	56	13281	18.6	18.4	1.7	3.0	1015	242483	2365	565253	1870	50
245	42	RIFFLE	34.8	97	23689	33.2	15.3	0.6	1.4	1045	256054	611	149587		24

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

**Stream Name:** Brush Creek

**LLID:** 1237115389755

**Drainage:** Point Arena

**Survey Dates:** 6/28/2005 to 10/25/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR16WS25

**Latitude:** 38:58:32.0N

**Longitude:** 123:42:41.0W

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
704	302	71359	786306	970044





## Table 2 - Summary of Habitat Types and Measured

**Stream Name:** Brush Creek

**LLID:** 1237115389755

**Drainage:** Point Arena

**Survey Dates:** 6/28/2005 to 10/25/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR16WS25

**Latitude:** 38:58:32.0N

**Longitude:** 123:42:41.0W

Total Units	Total Units Fully Measured
----------------	-------------------------------

Total Length (ft.)
-----------------------

Total Area (sq.ft.)
------------------------

Total Volume (cu.ft.)
--------------------------

704

302

71359

840412

1014972

### Table 3 - Summary of Pools

**Stream Name:** Brush Creek

**LLID:** 1237115389755

**Drainage:** Point Arena

**Survey Dates:** 6/28/2005 to 10/25/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR16WS25

**Latitude:** 38:58:32.0N

**Longitude:** 123:42:41.0W

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
183	183	MAIN	77	58	10682	80	18.8	1.7	1082	197936	2013	366453	46
56	56	SCOUR	23	46	2599	20	17.3	1.6	795	44547	1403	78565	64
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
239	239				13281					242483		445018	

### Table 4 - Summary of Maximum Residual Pool Depths By

**Stream Name:** Brush Creek

**LLID:** 1237115389755

**Drainage:** Point Arena

**Survey Dates:** 6/28/2005 to 10/25/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR16WS25

**Latitude:** 38:58:32.0N

**Longitude:** 123:42:41.0W

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
11	LSBk	5	0	0	2	18	3	27	4	36	2	18
175	MCP	73	1	1	20	11	79	45	47	27	28	16
13	CRP	5	0	0	1	8	4	31	6	46	2	15
6	STP	3	0	0	1	17	1	17	3	50	1	17
13	LSR	5	0	0	0	0	4	31	7	54	2	15
8	LSL	3	0	0	1	13	1	13	4	50	2	25
9	LSBo	4	0	0	1	11	4	44	3	33	1	11
2	TRP	1	0	0	0	0	1	50	0	0	1	50
2	PLP	1	0	0	1	50	0	0	1	50	0	0
Total Units			Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1 < 2 Feet Max Resid. Depth	Total 1 < 2 Feet % Occurrence	Total 2 < 3 Feet Max Resid. Depth	Total 2 < 3 Feet % Occurrence	Total 3 < 4 Feet Max Resid. Depth	Total 3 < 4 Feet % Occurrence	Total >= 4 Feet Max Resid. Depth	Total >= 4 Feet % Occurrence
239			1	0	27	11	97	41	75	31	39	16

Mean Maximum Residual Pool Depth (ft.): 3



### Table 6 - Summary of Dominant Substrates By Habitat

**Stream Name:** Brush Creek

**LLID:** 1237115389755

**Drainage:** Point Arena

**Survey Dates:** 6/28/2005 to 10/25/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR16WS25

**Latitude:** 38:58:32.0N

**Longitude:** 123:42:41.0W

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
233	35	LGR	3	0	71	11	9	0	6
7	4	HGR	0	0	25	0	25	50	0
3	2	CAS	0	0	0	0	0	0	100
2	1	BRS	0	0	0	0	0	0	100
1	1	GLD	0	0	100	0	0	0	0
105	13	RUN	8	0	77	0	0	8	8
104	7	SRN	0	0	57	14	29	0	0
2	2	TRP	0	0	0	0	0	0	100
175	175	MCP	16	11	57	5	2	6	3
6	6	STP	0	17	33	0	0	17	33
13	13	CRP	8	8	85	0	0	0	0
8	8	LSL	13	50	38	0	0	0	0
13	13	LSR	15	15	69	0	0	0	0
11	11	LSBk	18	18	55	0	0	0	9
9	9	LSBo	22	11	56	11	0	0	0
2	2	PLP	0	0	50	0	0	0	50
1	0	CUL	0	0	0	0	0	0	0
1	0	NS	0	0	0	0	0	0	0

## Table 7 - Summary of Mean Percent Canopy for Entire Stream

**Stream Name:** Brush Creek

**LLID:** 1237115389755

**Drainage:** Point Arena

**Survey Dates:** 6/28/2005 to 10/25/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR16WS25

**Latitude:** 38:58:32.0N

**Longitude:** 123:42:41.0W

Habitat Units	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
86	27	73	0	81	82

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.

### Table 8 - Fish Habitat Inventory Data Summary

Stream Name: Brush Creek LLID: 1237115389755 Drainage: Point Arena  
 Survey Dates: 6/28/2005 to 10/25/2005 Survey Length (ft.): 71359 Main Channel (ft.): 70286 Side Channel (ft.): 1073  
 Confluence Location: Quad: POINT ARENA Legal Description: T13NR16WS25 Latitude: 38:58:32.0N Longitude: 123:42:41.0W

### Summary of Fish Habitat Elements By Stream Reach

#### STREAM REACH: 1

Channel Type: F4	Canopy Density (%): 85.9	Pools by Stream Length (%): 20.3
Reach Length (ft.): 46817	Coniferous Component (%): 15.9	Pool Frequency (%): 36.9
Riffle/Flatwater Mean Width (ft.): 19.1	Hardwood Component (%): 84.1	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 6.0
Range (ft.): 21 to 65	Vegetative Cover (%): 83.2	2 to 2.9 Feet Deep: 36.2
Mean (ft.): 43.3009950248756	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 37.6
Std. Dev.: 10.37890124482	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 20.1
Base Flow (cfs): 4.2	Occurrence of LWD (%): 20.4	Mean Max Residual Pool Depth (ft.): 3.22
Water (F): 52 - 62 Air (F): 50 - 68	LWD per 100 ft.:	Mean Pool Shelter Rating: 47
Dry Channel (ft.): 87	Riffles: 0	
	Pools: 3	
	Flat: 1	
Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 58.4 Sm Cobble: 24.8 Lg Cobble: 6.7 Boulder: 8.7 Bedrock: 1.3		
Embeddedness Values (%): 1. 16.7 2. 39.3 3. 30.7 4. 4.0 5. 9.3		

#### STREAM REACH: 2

Channel Type: F2	Canopy Density (%): 93.1	Pools by Stream Length (%): 13.2
Reach Length (ft.): 6124	Coniferous Component (%): 25.5	Pool Frequency (%): 30.0
Riffle/Flatwater Mean Width (ft.): 19.3	Hardwood Component (%): 74.5	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 33.3
Range (ft.): 33 to 52	Vegetative Cover (%): 80.6	2 to 2.9 Feet Deep: 47.6
Mean (ft.): 42.5714285714286	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 14.3
Std. Dev.: 8.49969987465344	Dominant Bank Substrate Type: Bedrock	>= 4 Feet Deep: 4.8
Base Flow (cfs): 4.2	Occurrence of LWD (%): 1.2	Mean Max Residual Pool Depth (ft.): 2.41
Water (F): 52 - 55 Air (F): 50 - 59	LWD per 100 ft.:	Mean Pool Shelter Rating: 35
Dry Channel (ft.): 0	Riffles: 1	
	Pools: 0	
	Flat: 1	
Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 28.6 Sm Cobble: 0.0 Lg Cobble: 9.5 Boulder: 61.9 Bedrock: 0.0		
Embeddedness Values (%): 1. 4.8 2. 23.8 3. 9.5 4. 0.0 5. 61.9		



## Summary of Fish Habitat Elements By Stream Reach

### STREAM REACH: 3

Channel Type: A2	Canopy Density (%): 58.5	Pools by Stream Length (%): 19.5
Reach Length (ft.): 483	Coniferous Component (%): 58.3	Pool Frequency (%): 37.5
Riffle/Flatwater Mean Width (ft.): 10.3	Hardwood Component (%): 41.7	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 33.3
Range (ft.): 38 to 38	Vegetative Cover (%): 51.7	2 to 2.9 Feet Deep: 33.3
Mean (ft.): 38	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 33.3
Std. Dev.: 0	Dominant Bank Substrate Type: Boulder	>= 4 Feet Deep: 0.0
Base Flow (cfs): 4.2	Occurrence of LWD (%): 17.5	Mean Max Residual Pool Depth (ft.): 2.5
Water (F): 55 - 55    Air (F): 54 - 54	LWD per 100 ft.:	Mean Pool Shelter Rating: 30
Dry Channel (ft.): 0	Riffles: 2	
	Pools: 3	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: 0.0    Sand: 0.0    Gravel: 0.0    Sm Cobble: 0.0    Lg Cobble: 0.0    Boulder: 100.    Bedrock: 0.0		
Embeddedness Values (%): 1. 0.0    2. 0.0    3. 0.0    4. 0.0    5. 100.0		

### STREAM REACH: 4

Channel Type: B4	Canopy Density (%): 84.4	Pools by Stream Length (%): 15.9
Reach Length (ft.): 16862	Coniferous Component (%): 46.5	Pool Frequency (%): 29.7
Riffle/Flatwater Mean Width (ft.): 9.9	Hardwood Component (%): 53.5	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Coniferous Trees	< 2 Feet Deep: 16.7
Range (ft.): 18 to 38	Vegetative Cover (%): 80.9	2 to 2.9 Feet Deep: 48.5
Mean (ft.): 28.3468468468468	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 22.7
Std. Dev.: 4.56494318407595	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 12.1
Base Flow (cfs): 4.2	Occurrence of LWD (%): 14.2	Mean Max Residual Pool Depth (ft.): 2.78
Water (F): 47 - 57    Air (F): 48 - 63	LWD per 100 ft.:	Mean Pool Shelter Rating: 62
Dry Channel (ft.): 704	Riffles: 1	
	Pools: 6	
	Flat: 2	
Pool Tail Substrate (%): Silt/Clay: 0.0    Sand: 0.0    Gravel: 42.4    Sm Cobble: 16.7    Lg Cobble: 9.1    Boulder: 28.8    Bedrock: 3.0		
Embeddedness Values (%): 1. 18.2    2. 25.8    3. 13.6    4. 4.5    5. 37.9		

### Table 9 -Mean Percentage of Dominant Substrate and Vegetation

**Stream Name:** Brush Creek

**LLID:** 1237115389755

**Drainage:** Point Arena

**Survey Dates:** 6/28/2005 to 10/25/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR16WS25

**Latitude:** 38:58:32.0N

**Longitude:** 123:42:41.0W

#### Mean Percentage of Dominant Stream Bank

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Bedrock	51	77	21.1
Boulder	28	22	8.3
Cobble/Gravel	144	130	45.2
Sand/Silt/Clay	80	74	25.4

#### Mean Percentage of Dominant Stream Bank

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Grass	7	5	2.0
Brush	9	25	5.6
Hardwood Trees	194	181	61.9
Coniferous Trees	92	89	29.9
No Vegetation	1	3	0.7

**Total Stream Cobble Embeddedness** 3

## Table 10 - Mean Percent of Shelter Cover Types For Entire System

**Stream Name:** Brush Creek

**LLID:** 1237115389755

**Drainage:** Point Arena

**Survey Dates:** 6/28/2005 to 10/25/2005

**Confluence Location: Quad:** POINT ARENA

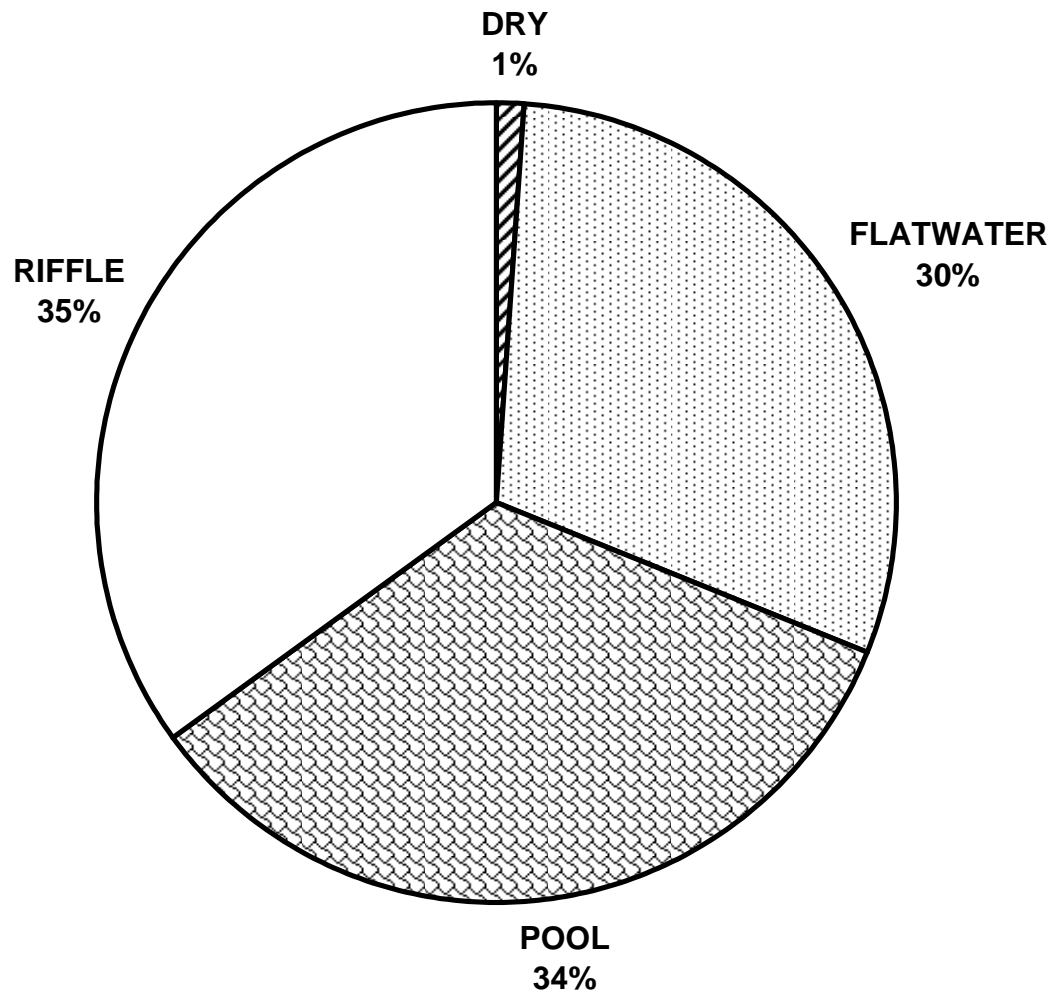
**Legal Description:** T13NR16WS25

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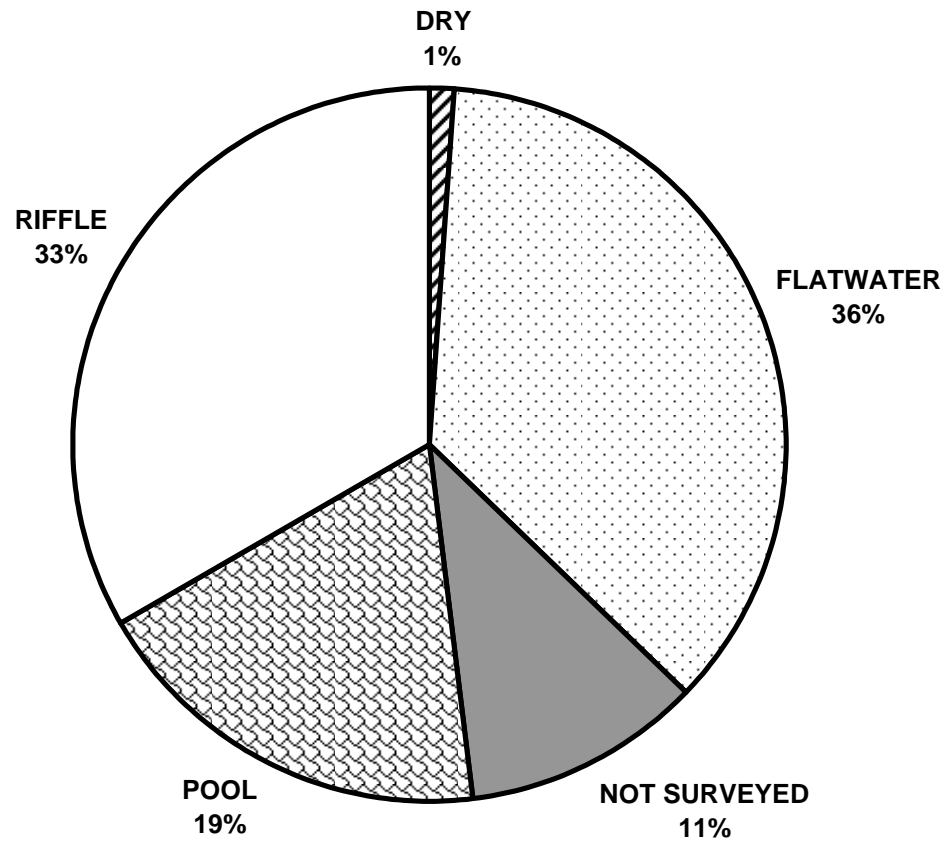
	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
UNDERCUT BANKS (%)	2	6	6
SMALL WOODY DEBRIS (%)	11	11	11
LARGE WOODY DEBRIS (%)	9	12	19
ROOT MASS (%)	3	5	12
TERRESTRIAL VEGETATION (%)	10	13	8
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	11	3	3
BOULDERS (%)	41	39	30
BEDROCK LEDGES (%)	1	1	9

# BRUSH CREEK HABITAT TYPES BY PERCENT OCCURRENCE



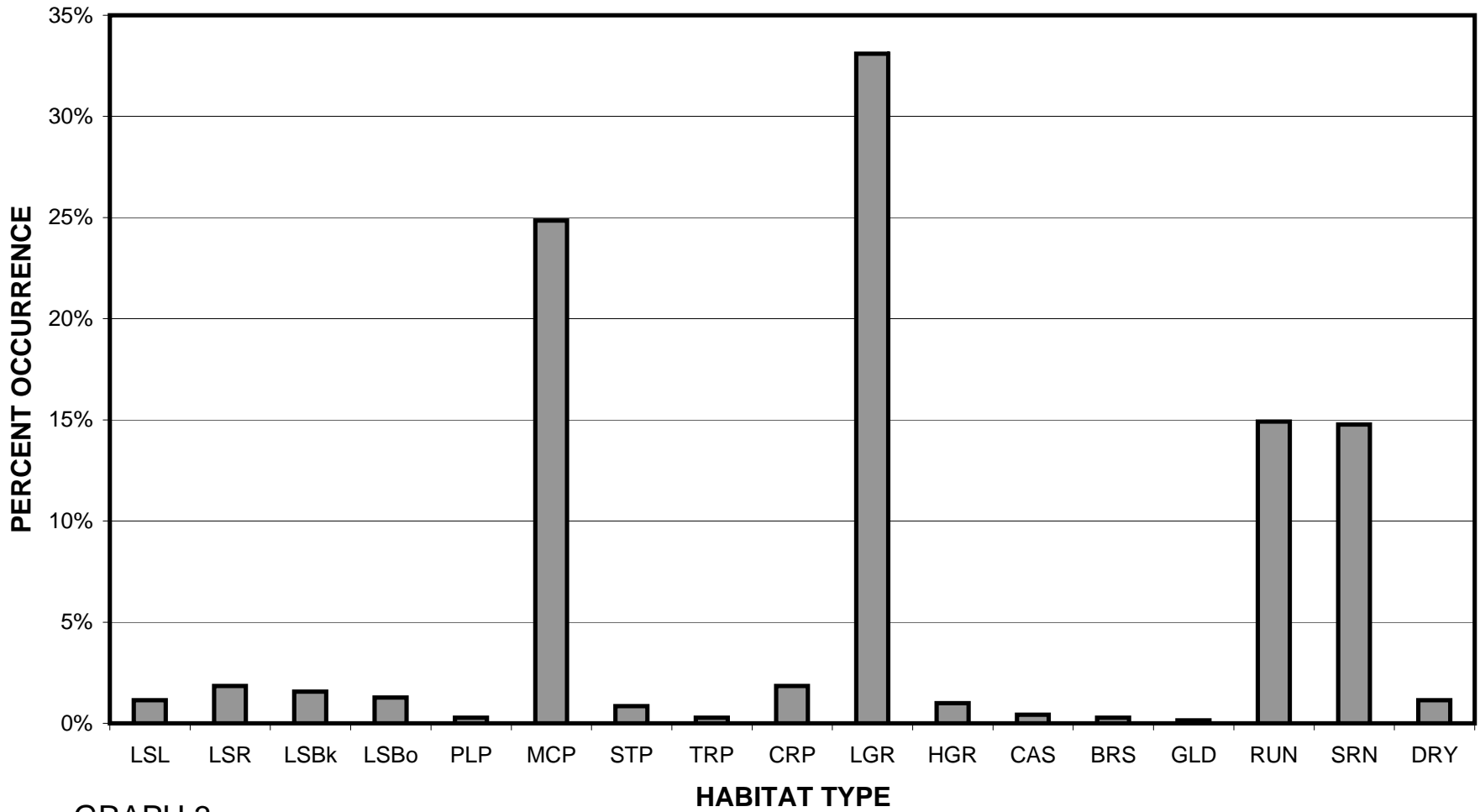
GRAPH 1

# BRUSH CREEK HABITAT TYPES BY PERCENT OCCURENCE



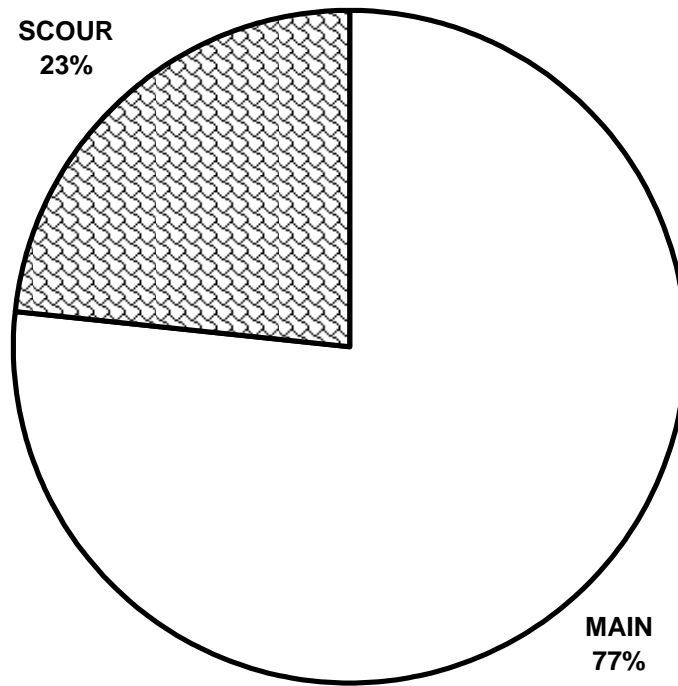
GRAPH 2

# BRUSH CREEK HABITAT TYPES BY PERCENT OCCURRENCE



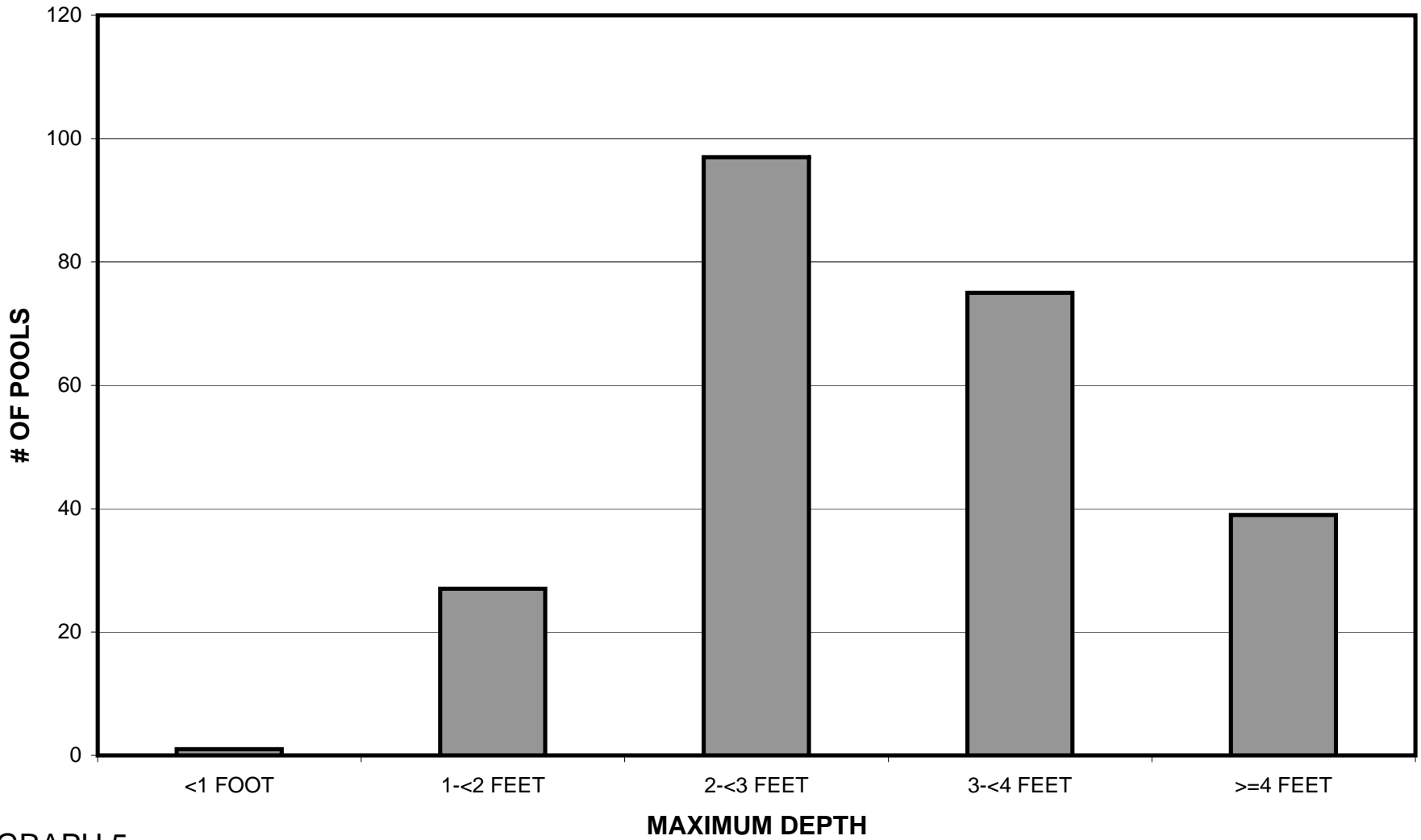
GRAPH 3

**BRUSH CREEK  
POOL HABITAT TYPES BY PERCENT OCCURRENCE**



GRAPH 4

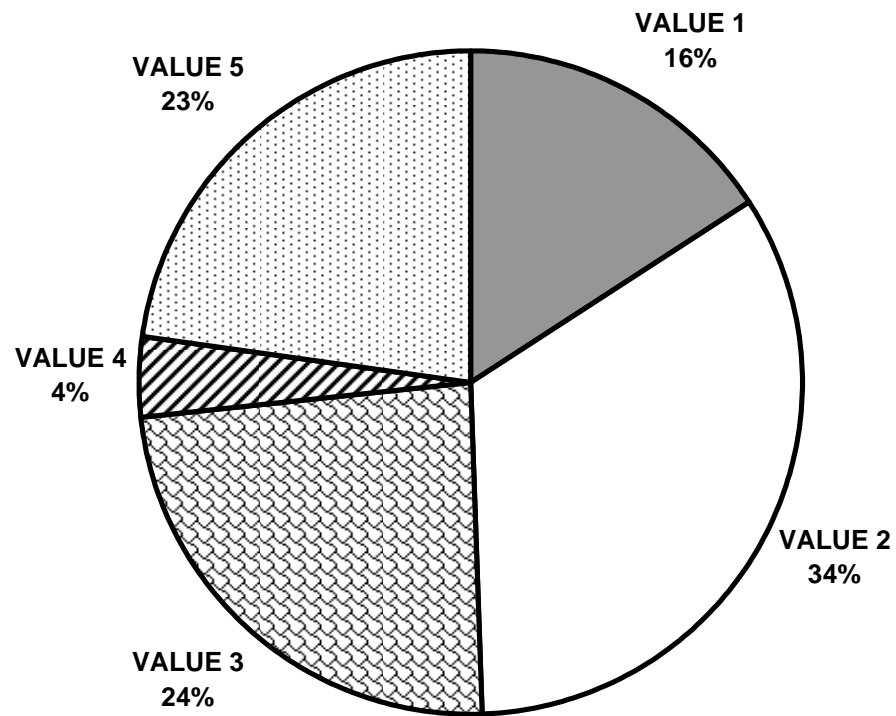
# BRUSH CREEK MAXIMUM DEPTH IN POOLS



GRAPH 5

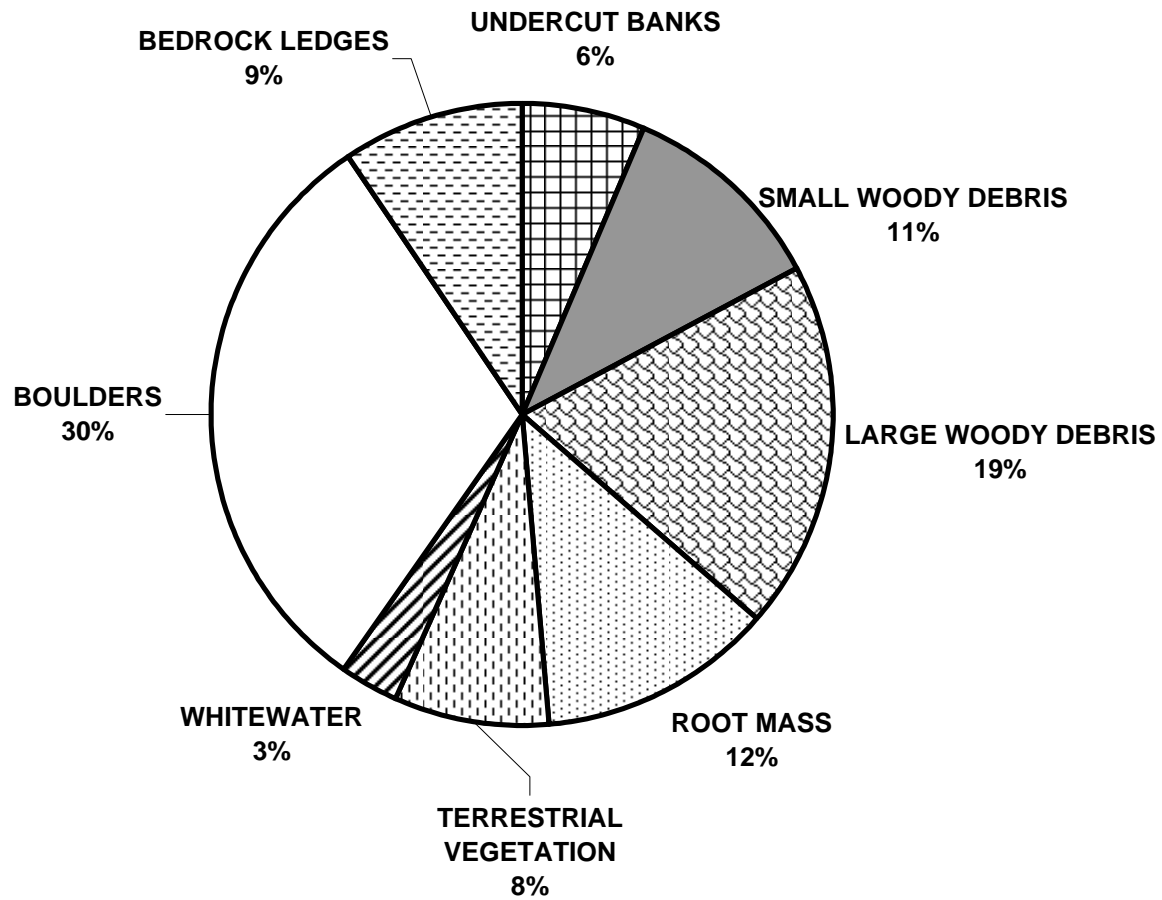


# BRUSH CREEK PERCENT EMBEDDEDNESS



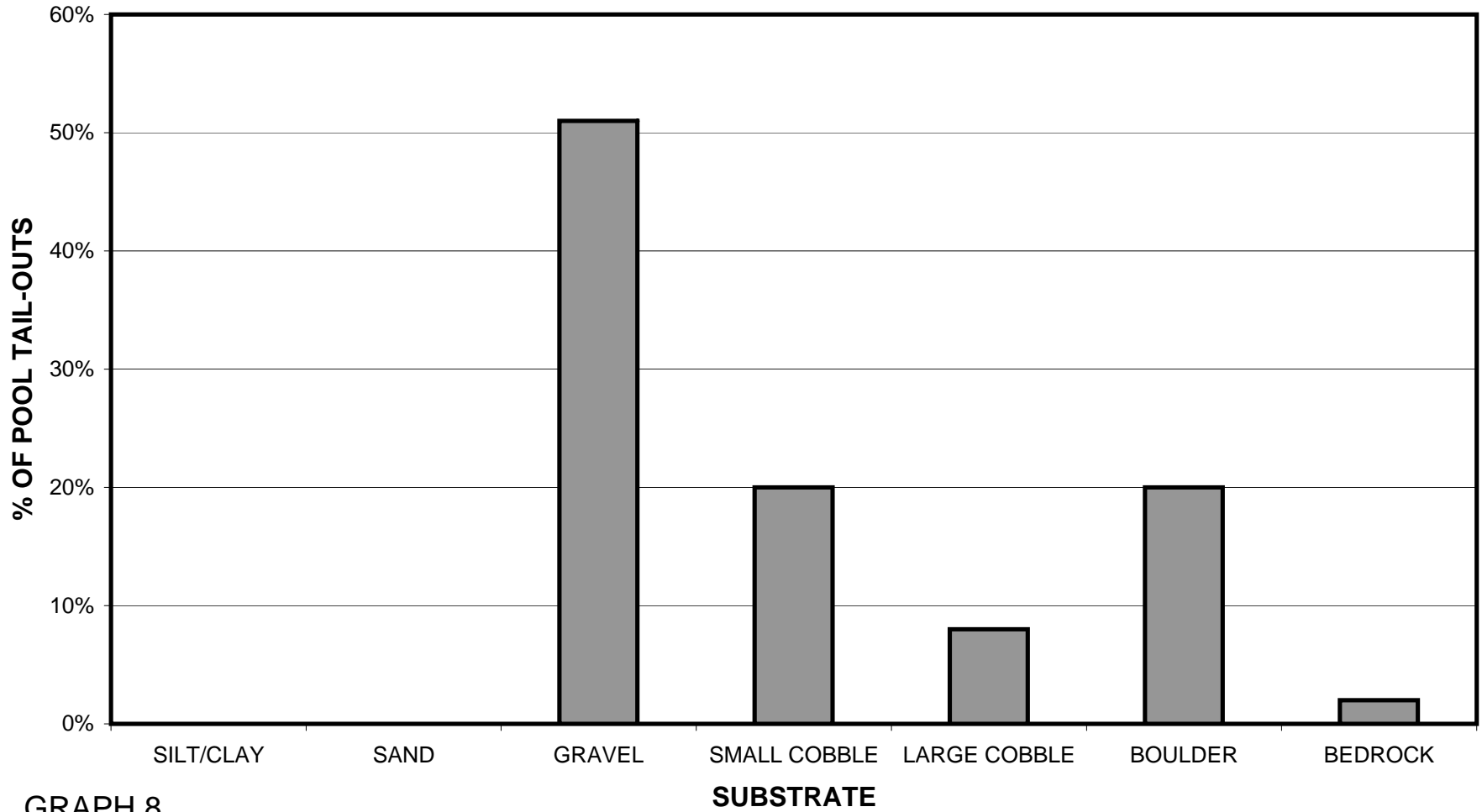
GRAPH 6

# BRUSH CREEK MEAN PERCENT COVER TYPES IN POOLS



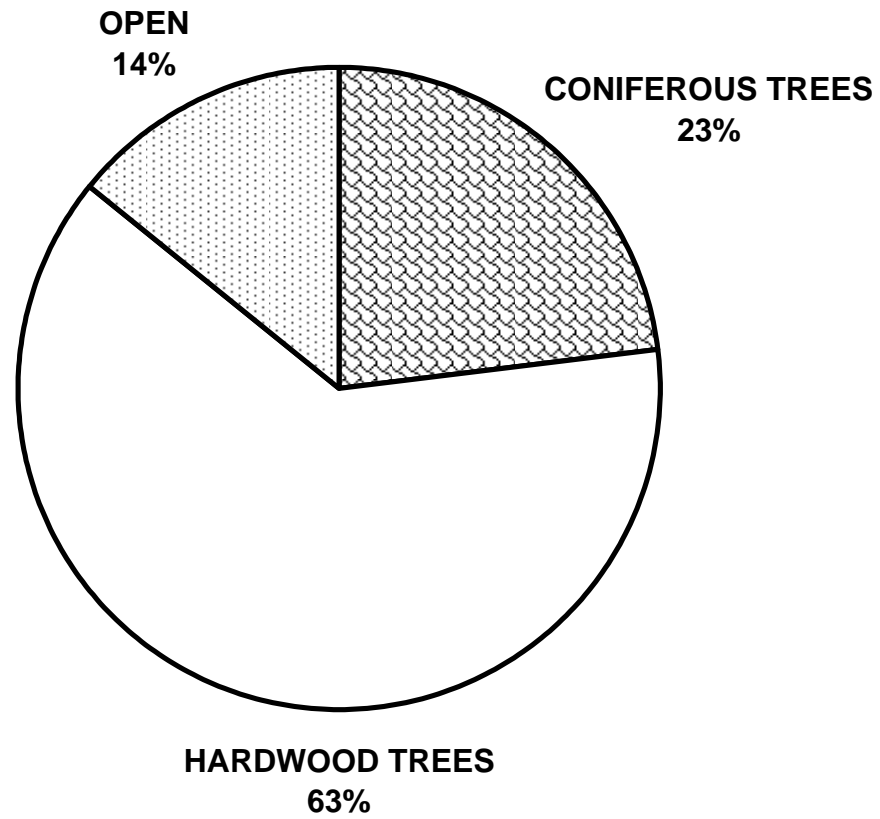
GRAPH 7

# BRUSH CREEK SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



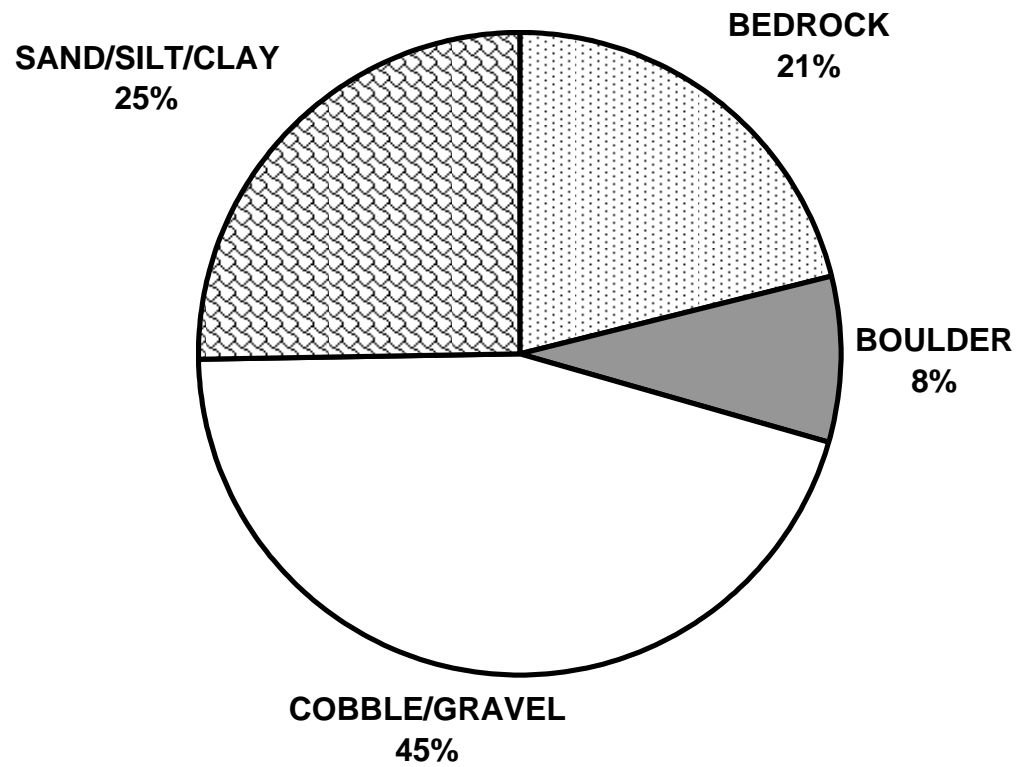
GRAPH 8

# BRUSH CREEK MEAN PERCENT CANOPY



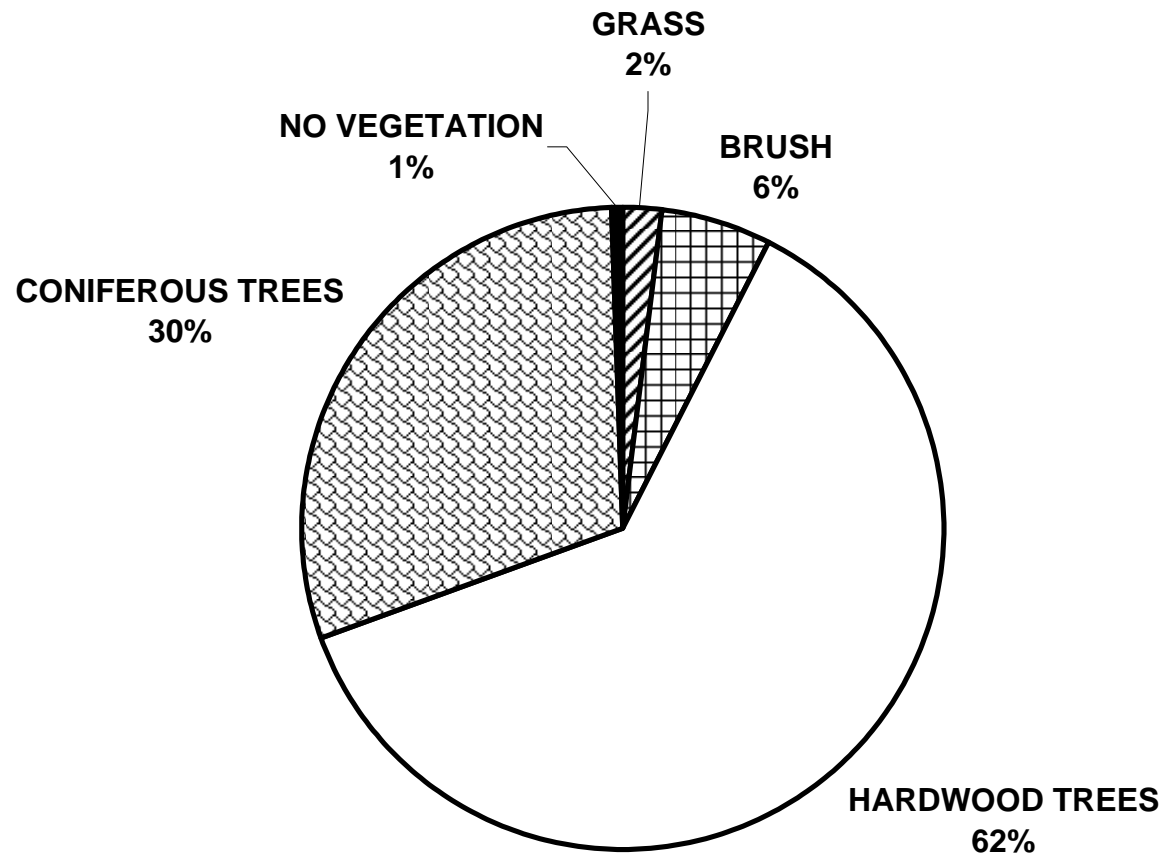
GRAPH 9

# BRUSH CREEK DOMINANT BANK COMPOSITION IN SURVEY REACH

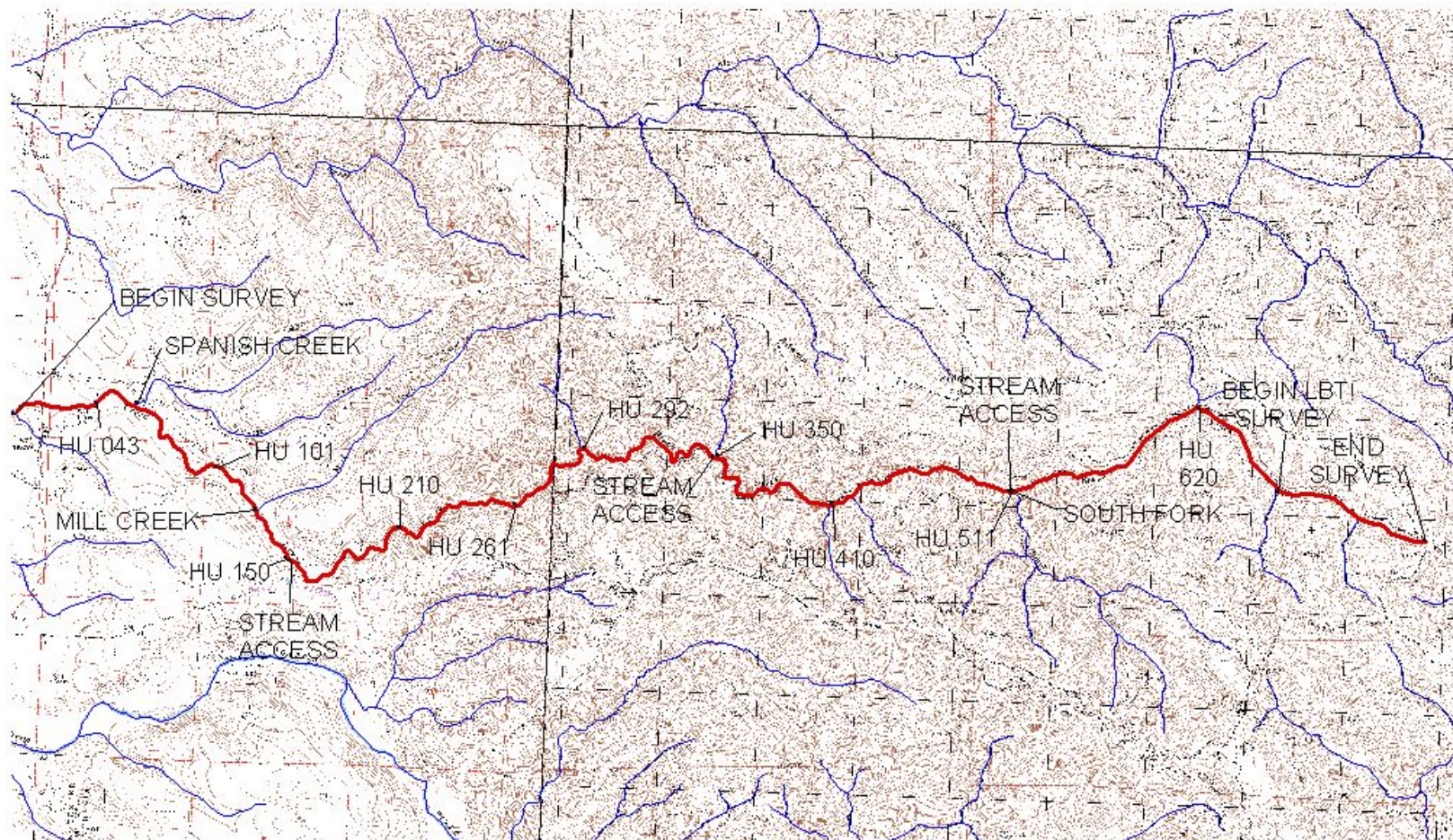


GRAPH 10


# BRUSH CREEK DOMINANT BANK VEGETATION IN SURVEY REACH




GRAPH 11



**Brush Creek Stream Habitat Survey**

 Brush Creek Survey Reach

 Streams

