

STREAM INVENTORY REPORT

Juan Creek

INTRODUCTION

A stream inventory was conducted from June 23 to July 9, 2009 on Juan Creek. The survey began at the confluence with Pacific Ocean and extended upstream 3.6 miles. Stream inventories and reports were also completed for three tributaries to Juan Creek.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Juan 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

Juan Creek drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Juan Creek's legal description at the confluence with Pacific Ocean is T21N R18W S01. Its location is 39.70275 degrees north latitude and 123.80404 degrees west longitude, LLID number 1238029397028. Juan Creek is a second order stream and has approximately 3.6 miles of blue line stream according to the USGS Westport 7.5 minute quadrangle. Juan Creek drains a watershed of approximately 7.5 square miles. Elevations range from about 0 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 privately owned and is managed for timber production. Vehicle access exists via Highway 1 approximately 20 miles north of Fort Bragg.

METHODS

The habitat inventory conducted in Juan Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi 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 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

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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 Juan 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". Juan 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 Juan 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 not suitable 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 Juan 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 Juan 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 Juan 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.

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

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

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- 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 June 23 to July 9, 2009, was conducted by D. Wright (PSMFC), J. Green, and N. Bankston (WSP). The total length of the stream surveyed was 18,988 feet with an additional 176 feet of side channel.

Stream flow was not measured on Juan Creek.

Juan Creek is a B4 channel type for 6,876 feet of the stream surveyed (Reach 1), an F3 channel type for 2,597 feet of the stream surveyed (Reach 2), and a B3 channel type for 9,961 feet of the stream surveyed (Reach 3). 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. F3 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates. B3 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 47 to 61 degrees Fahrenheit. Air temperatures ranged from 58 to 71 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 50% pool units, 34% riffle units, and 16% flatwater units (Graph 1). Based on total length of Level II habitat types there were 39% riffle units, 30% flatwater units, and 29% pool units (Graph 2).

Thirteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 42%; low gradient riffle units, 33%; and step run units, 11% (Graph 3). Based on percent total length, low gradient riffle units made up 38%, step run units 26%, and mid-channel pool units 25%.

A total of 163 pools were identified (Table 3). Main channel pools were the most frequently encountered at 87% (Graph 4), and comprised 88% 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. Seventy-one of the 162 pools (44%) measured had a residual depth of two feet or greater (Graph 5).

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The depth of cobble embeddedness was estimated at pool tail-outs. Of the 162 pool tail-outs measured, 20 had a value of 1 (12.3%); 86 had a value of 2 (53.1%); 34 had a value of 3 (21%); 4 had a value of 4 (2.5%); and 18 had a value of 5 (11.1%); (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 not suitable 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 18, flatwater habitat types had a mean shelter rating of 13, and pool habitats had a mean shelter rating of 33 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 110. Scour pools had a mean shelter rating of 33 and main channel pools had a mean shelter rating of 32 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Juan Creek. Graph 7 describes the pool cover in Juan Creek. Large woody debris is the dominant pool cover type followed by small 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 61% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 17% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Juan Creek was 96%. Four percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 91% and 9%, respectively. Graph 9 describes the mean percent canopy in Juan Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 74%. The mean percent left bank vegetated was 70%. The dominant elements composing the structure of the stream banks consisted of 42% sand/silt/clay, 35% cobble/gravel, 16% bedrock, and 7% boulder (Graph 10). Brush was the dominant vegetation type observed in 62% of the units surveyed. Additionally, 20% of the units surveyed had deciduous trees as the dominant vegetation type, and 9% had coniferous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 31 sites for species composition and distribution in Juan Creek from July 19 to July 20, 2010. The sites were sampled by I. Mikus (DFG), and M. Groff (WSP).

In reach 1, which comprised the first 6,876 feet of stream, 10 sites were sampled. The reach sites yielded 141 young-of-the-year steelhead/rainbow trout (SH/RT), 11 age 1+ SH/RT, and 10 age 2+ SH/RT.

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In reach 2, 10 sites were sampled starting approximately 7,028 from the confluence with the Pacific Ocean and continuing upstream 2,108 feet. The reach sites yielded 141 young-of-the-year SH/RT, six age 1+ SH/RT, and seven age 2+ SH/RT.

In reach 3, 11 sites were sampled starting approximately 9,895 feet from the confluence with the Pacific Ocean and continuing upstream 9,014 feet. The reach sites yielded 70 young-of-the-year SH/RT, four age 1+ SH/RT, and four age 2+ SH/RT.

The following chart displays the information yielded from these sites:

2010 Juan 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: B4 Channel Type									
07/19/10	1	011	4.2	961	24	5	3	0	0
	2	012	4.2	1,024	7	2	1	0	0
	3	016	4.2	1,130	12	0	1	0	0
	4	030	4.2	1,679	7	0	2	0	0
	5	032	4.2	1,770	11	0	1	0	0
	6	038	4.2	2,212	8	0	1	0	0
	7	044	4.2	2,393	21	2	1	0	0
	8	066	4.2	3,987	15	2	0	0	0
	9	078	4.2	5,066	16	0	0	0	0
	10	090	5.2	6,223	20	0	0	0	0
Reach 2: F3 Channel Type									
07/19/10	11	105	4.2	7,048	3	0	0	0	0
	12	112	4.2	7,368	7	1	0	0	0
	13	124	4.2	7,943	4	1	1	0	0
	14	125	4.2	7,972	13	0	0	0	0
	15	133	4.2	8,427	29	0	0	0	0
	16	136	4.2	8,565	6	0	4	0	0
	17	138	4.2	8,741	40	4	2	0	0
	18	140	4.2	9,040	19	0	0	0	0
	19	141	4.2	9,078	6	0	0	0	0
	20	142	4.2	9,136	14	0	0	0	0

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Reach 3: B3 Channel Type									
07/19/10-07/20/10	21	148	4.2	9,927	5	0	0	0	0
	22	151	4.2	10,030	0	1	0	0	0
	23	153	4.2	10,099	1	0	0	0	0
	24	155	4.2	10,134	11	0	0	0	0
	25	157	4.2	10,199	4	0	0	0	0
	26	161	4.2	10,409	6	2	0	0	0
	27	168	4.2	10,757	16	1	0	0	0
	28	172	4.2	11,036	4	0	3	0	0
	29	174	4.2	11,173	7	0	0	0	0
	30	176	4.2	11,287	6	0	0	0	0
	31	318	4.2	18,909	10	0	1	0	0

DISCUSSION

Juan Creek is a B4 channel type for the first 6,876 feet of stream surveyed, an F3 channel type for the next 2,597 feet of stream surveyed, and a B3 channel type for the remaining 9,691 feet of stream surveyed. The suitability of B4, F3, and B3 channel types for fish habitat improvement structures is as follows: B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover. 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. B3 channel types are excellent for plunge weirs, boulder clusters and bank-placed boulders, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days June 23 to July 9, 2009, ranged from 47 to 61 degrees Fahrenheit. Air temperatures ranged from 58 to 71 degrees Fahrenheit. To make any 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 30% of the total length of this survey, riffles 39%, and pools 29%. Seventy-one of the 162 (44%) pools measured had a maximum residual 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 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 structures that will increase or deepen pool habitat is recommended.

One hundred six of the 162 pool tail-outs measured had embeddedness ratings of 1 or 2. Thirty-eight of the pool tail-outs had embeddedness ratings of 3 or 4. Eighteen of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to

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be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Juan Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One hundred twenty-six of the 162 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 33. The shelter rating in the flatwater habitats was 13. 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 Juan Creek. Large woody debris is the dominant cover type in pools followed by small 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 provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

The mean percent canopy density for the stream was 96%. Reach 1 had a canopy density of 95%, Reach 2 had a canopy density of 98%, and Reach 3 had a canopy density of 96%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 74% and 70%, 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) Juan 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) 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) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from large woody debris. Adding high quality complexity with woody cover in the pools is desirable.
- 5) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.

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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 the Pacific Ocean. This unit is within the influence of the Pacific Ocean. The channel is a B4.
1338	0021.00	Log Debris Accumulation (LDA) #01, is 5' high x 25' wide x 20' long, and is composed of 11 pieces of large woody debris. Water flows through it and there are visible gaps. It is not retaining sediment. Fish are present above LDA.
1679	0031.00	Little Juan Creek enters this unit from the left bank.
2086	0037.00	A road crosses the creek.
2190	0038.00	There is a large sediment deposit along the right bank.
2245	0040.00	LDA #02 is 3' high x 35' wide x 15' long, and is composed of 9 pieces of large woody debris. Water flows through the LDA and there are visible gaps in it. It is storing sediment ranging in size from sand to small cobble and measuring approximately 10' wide x 10' long x 0.5' deep. It is not a barrier and fish are present above LDA.
2393	0045.00	There is fire damage along the left bank.
3055	0052.00	Tributary #01 enters from the right bank, contributing approximately 2% of the flow of Juan Creek. The water temperature of Juan Creek downstream of the tributary is 54 degrees Fahrenheit and upstream of the tributary is 58 degrees Fahrenheit. The water temperature of the tributary is 54 degrees Fahrenheit. The tributary is accessible to fish, but no fish were observed within the first 300'.
5852	0089.00	There is a landslide on the left bank.
6152	0090.00	LDA #03 is 6.5' high x 30' wide x 30' long, and consists of 15-20 pieces of large woody debris. Water flows through the LDA and there are no visible gaps in it. It is retaining sediment which ranges in size from sand to gravel and measures approximately 5' wide x 15' long x 1' deep. Fish are present above the LDA.

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6663	0098.00	LDA #04 is 4.5' high x 40' wide x 20' long, and consists of 12 pieces of large woody debris. Water flows through the LDA and there are visible gaps in it. It is retaining sediment which ranges in size from sand to large cobble and measures approximately 35' wide x 20' long x 1' deep. The LDA is not a barrier and fish are present above the LDA.
6780	0100.00	The channel type changes from a B4 to an F3.
8031	0128.00	LDA #05 is 7' high x 30' wide x 55' long, and is composed of 35+ pieces of large woody debris. Water flows through the LDA and there are no visible gaps in it. It is retaining sediment which ranges in size from sand to small cobble and measures approximately 20' wide x 80' long x 1' deep. Fish are present above the LDA.
9298	0144.00	LDA #06 is 13.5' high x 30' wide x 30' long, and consists of 25 pieces of large woody debris. Water flows through the LDA and there are no visible gaps in it. It is retaining sediment which ranges in size from sand to large cobble and measures approximately 25' wide x 35' long x 2' deep. Fish are above the LDA.
9377	0145.00	The channel type changes from an F3 to a B3.
10202	0159.00	LDA #07 is 8' high x 35' wide x 40' long, and consists of 25-30 pieces of large woody debris. Water flows through the LDA and there are visible gaps in it. It is retaining sediment ranging in size from sand to large cobble, the sediment measures approximately 15' wide x 20' long x 2' deep. Fish are present above LDA.
12296	0196.00	LDA #08 is 8' high x 35' wide x 15' long, and is composed of 15 pieces of large woody debris. Water flows through the LDA and there are no visible gaps in it. It is retaining sediment which ranges in size from sand to small cobble, the retained sediment measures approximately 30' wide x 4' long x 35' deep. Fish are present above LDA.
12547	0201.00	There is a right bank landslide that has burnt trees on it.
14389	0233.00	LDA #09 is 7' high x 25' wide x 16' long, and is composed of 8 pieces of large woody debris. Water flows through the LDA and there are visible gaps in it. It is retaining sediment that ranges in size from gravel to large cobble and measures approximately 5' wide x 14' long x 2' deep. The LDA is not a barrier to adult salmonids.
15362	0256.00	LDA #10 is 7' high x 36' wide x 43' long, and is composed of 11 pieces of large woody debris. Water flows through the LDA and there are visible gaps in it. It is retaining sediment that ranges in size from sand

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to small cobble and measuring approximately 16' wide x 12' x 1' deep. The LDA is not a barrier to juveniles or adults.

- | | | |
|-------|---------|---|
| 16953 | 0284.00 | There is a right bank failure that has brought 3 trees into the stream. |
| 17631 | 0298.00 | There is a 2.5' waterfall. |
| 18065 | 0303.00 | Tributary #04 enters from the right bank. It is contributing approximately 1% of Juan Creek's flow. The water temperature of the tributary is 55 degrees Fahrenheit, the water temperature of Juan Creek upstream of the tributary is 55 degrees Fahrenheit and the water temperature downstream is 57 degrees Fahrenheit. The tributary is not accessible to fish and there are no fish present. |
| 18988 | 0319.00 | End of survey at the confluence of North Fork Juan Creek with South Fork Juan Creek. |

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: Juan Creek

LLID: 1238029397028 Drainage: Rockport

Survey Dates: 6/23/2009 to 7/9/2009

Confluence Location: Quad: WESTPORT

Legal Description: T21NR18WS01

Latitude: 39:42:10.0N

Longitude: 123:48:10.0

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
53	8	FLATWATER	16.2	109	5789	30.2	12.9	0.6	1.2	711	37664	433	22953		13
1	0	NOSURVEY	0.3	347	347	1.8									
163	163	POOL	49.8	35	5642	29.4	14.5	0.9	1.9	481	78381	627	101625	429	33
110	13	RIFFLE	33.6	67	7386	38.5	11.9	0.6	1.0	716	78801	397	43675		18
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
327	184				19164					194847			168254		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Juan Creek

LLID: 1238029397028

Drainage: Rockport

Survey Dates: 6/23/2009 to 7/9/2009

Confluence Location: Quad: WESTPORT

Legal Description: T21NR18WS01

Latitude: 39:42:10.0N

Longitude: 123:48:10.0W

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 (%)
107	11	LGR	32.7	68	7239	37.8	12	0.5	1.3	785	84028	428	45769		15	97
3	2	HGR	0.9	49	147	0.8	10	0.7	1.6	337	1012	228	685		35	95
18	2	RUN	5.5	42	761	4.0	11	0.7	1.4	278	5006	174	3140		10	99
35	6	SRN	10.7	144	5028	26.2	14	0.6	1.4	855	29919	519	18176		13	97
138	138	MCP	42.2	34	4761	24.8	14	0.9	4.6	476	65730	629	86735	434	33	96
4	4	STP	1.2	52	208	1.1	12	1.0	3	595	2378	722	2887	445	18	95
1	1	CRP	0.3	30	30	0.2	17	1.6	3	510	510	1020	1020	816	30	99
8	8	LSL	2.4	34	271	1.4	15	0.5	2.7	497	3977	497	3976	255	45	92
1	1	LSR	0.3	39	39	0.2	12	1.0	2.5	468	468	608	608	468	10	100
2	2	LSBk	0.6	40	80	0.4	14	0.9	2.8	605	1209	932	1863	763	5	97
1	1	LSBo	0.3	11	11	0.1	11	0.7	1.1	115	115	126	126	80	10	97
6	6	PLP	1.8	27	164	0.9	14	1.2	3.8	346	2076	549	3293	406	34	97
2	2	DPL	0.6	39	78	0.4	23	0.3	1	959	1918	1115	1115	478	110	94
1	0	NS	0.3	347	347	1.8										

Total Units
327

Total Units Fully Measured
184

Total Length (ft.)
19164

Total Area (sq.ft.)
198346

Total Volume (cu.ft.)
169394

Table 3 - Summary of Pool Types

Stream Name: Juan Creek

LLID: 1238029397028

Drainage: Rockport

Survey Dates: 6/23/2009 to 7/9/2009

Confluence Location: Quad: WESTPORT

Legal Description: T21NR18WS01

Latitude: 39:42:10.0N

Longitude: 123:48:10.0W

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
142	142	MAIN	87	35	4969	88	14.4	0.9	480	68108	435	61701	32
19	19	SCOUR	12	31	595	11	14.4	0.9	440	8355	388	7369	33
2	2	BACKWATER	1	39	78	1	23.0	0.3	959	1918	478	478	110
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
163	163				5642					78381		69547	

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

Stream Name: Juan Creek

LLID: 1238029397028

Drainage: Rockport

Survey Dates: 6/23/2009 to 7/9/2009

Confluence Location: Quad: WESTPORT

Legal Description: T21NR18WS01

Latitude: 39:42:10.0N

Longitude: 123:48:10.0W

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
138	MCP	85	6	4	72	52	53	38	5	4	2	1
4	STP	2	1	25	1	25	1	25	1	25	0	0
1	CRP	1	0	0	0	0	0	0	1	100	0	0
8	LSL	5	3	38	3	38	2	25	0	0	0	0
1	LSR	1	0	0	0	0	1	100	0	0	0	0
2	LSBk	1	0	0	1	50	1	50	0	0	0	0
1	LSBo	1	0	0	1	100	0	0	0	0	0	0
6	PLP	4	1	17	1	17	2	33	2	33	0	0
1	DPL	1	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
162			11	7	80	49	60	37	9	6	2	1

Mean Maximum Residual Pool Depth (ft.): 1.9

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Juan Creek

LLID: 1238029397028

Drainage: Rockport

Survey Dates: 6/23/2009 to 7/9/2009

Dry Units: 0

Confluence Location: Quad: WESTPORT

Legal Description: T21NR18WS01

Latitude: 39:42:10.0N

Longitude: 123:48:10.0W

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
107	11	LGR	0	11	18	0	22	0	2	47	0
3	2	HGR	0	38	13	0	0	0	18	33	0
110	13	TOTAL RIFFLE	0	15	17	0	18	0	4	45	0
18	2	RUN	0	0	0	0	45	0	0	50	5
35	6	SRN	0	18	22	18	6	0	5	33	0
53	8	TOTAL FLAT	0	13	16	13	16	0	4	37	1
138	138	MCP	5	24	33	9	5	0	3	16	5
4	4	STP	5	4	5	23	0	0	11	48	5
1	1	CRP	0	0	20	70	0	0	0	0	10
8	8	LSL	3	41	49	1	4	0	0	2	0
1	1	LSR	0	0	0	50	0	0	0	50	0
2	2	LSBk	0	50	0	0	0	0	0	0	0
1	1	LSBo	0	0	0	0	0	0	0	100	0
6	6	PLP	3	8	39	0	0	0	33	12	6
2	2	DPL	0	25	25	0	0	0	0	50	0
163	163	TOTAL POOL	4	23	32	9	5	0	4	17	4
1	0	NS									
327	184	TOTAL	4	22	31	8	6	0	4	20	4

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Juan Creek

LLID: 1238029397028

Drainage: Rockport

Survey Dates: 6/23/2009 to 7/9/2009

Dry Units: 0

Confluence Location: Quad: WESTPORT

Legal Description: T21NR18WS01

Latitude: 39:42:10.0N

Longitude: 123:48:10.0W

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
107	11	LGR	0	0	36	45	18	0	0
3	2	HGR	0	0	0	0	0	100	0
18	2	RUN	0	0	50	0	50	0	0
35	6	SRN	0	0	67	33	0	0	0
138	138	MCP	0	17	47	14	17	1	2
4	4	STP	0	0	25	75	0	0	0
1	1	CRP	0	0	0	0	100	0	0
8	8	LSL	0	25	50	13	13	0	0
1	1	LSR	0	0	100	0	0	0	0
2	2	LSBk	0	0	100	0	0	0	0
1	1	LSBo	0	0	0	0	100	0	0
6	6	PLP	17	50	0	33	0	0	0
2	2	DPL	0	0	50	0	50	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Juan Creek

LLID: 1238029397028

Drainage: Rockport

Survey Dates: 6/23/2009 to 7/9/2009

Confluence Location: Quad: WESTPORT

Legal Description: T21NR18WS01

Latitude: 39:42:10.0N

Longitude: 123:48:10.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
96	9	91	0	74	70

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: Juan Creek LLID: 1238029397028 Drainage: Rockport
 Survey Dates: 6/23/2009 to 7/9/2009 Survey Length (ft.): 19164 Main Channel (ft.): 18988 Side Channel (ft.): 176
 Confluence Location: Quad: WESTPORT Legal Description: T21NR18WS01 Latitude: 39:42:10.0N Longitude: 123:48:10.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: B4	Canopy Density (%): 95.6	Pools by Stream Length (%): 23.9
Reach Length (ft.): 6780	Coniferous Component (%): 1.7	Pool Frequency (%): 44.7
Riffle/Flatwater Mean Width (ft.): 14.2	Hardwood Component (%): 98.3	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 52
Range (ft.): 5 to 31	Vegetative Cover (%): 59.5	2 to 2.9 Feet Deep: 41
Mean (ft.): 20	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 7
Std. Dev.: 8	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 26	Mean Max Residual Pool Depth (ft.): 1.9
Water (F): 47 - 58 Air (F): 61 - 71	LWD per 100 ft.:	Mean Pool Shelter Rating: 44
Dry Channel (ft): 0	Riffles: 0	
	Pools: 8	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 100 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 15.2 2. 69.6 3. 15.2 4. 0.0 5. 0.0		

STREAM REACH: 2

Channel Type: F3	Canopy Density (%): 98.6	Pools by Stream Length (%): 36.0
Reach Length (ft.): 2597	Coniferous Component (%): 8.8	Pool Frequency (%): 55.6
Riffle/Flatwater Mean Width (ft.): 11.0	Hardwood Component (%): 91.2	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 44
Range (ft.): 15 to 30	Vegetative Cover (%): 50.3	2 to 2.9 Feet Deep: 44
Mean (ft.): 26	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 8
Std. Dev.: 5	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 4
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 52	Mean Max Residual Pool Depth (ft.): 2.1
Water (F): 56 - 58 Air (F): 62 - 68	LWD per 100 ft.:	Mean Pool Shelter Rating: 33
Dry Channel (ft): 0	Riffles: 2	
	Pools: 10	
	Flat: 2	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 76 Sm Cobble: 20 Lg Cobble: 0 Boulder: 0 Bedrock: 4		
Embeddedness Values (%): 1. 4.0 2. 52.0 3. 36.0 4. 4.0 5. 4.0		

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: B3	Canopy Density (%): 95.6	Pools by Stream Length (%): 31.6
Reach Length (ft.): 9611	Coniferous Component (%): 13.5	Pool Frequency (%): 51.4
Riffle/Flatwater Mean Width (ft.): 11.6	Hardwood Component (%): 86.5	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 62
Range (ft.): 15 to 39	Vegetative Cover (%): 83.3	2 to 2.9 Feet Deep: 33
Mean (ft.): 25	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 4
Std. Dev.: 5	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 1
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 27	Mean Max Residual Pool Depth (ft.): 1.8
Water (F): 55 - 61	Air (F): 58 - 71	LWD per 100 ft.:
Dry Channel (ft): 0	Riffles: 1	Pools: 5
	Flat: 2	
Pool Tail Substrate (%): Silt/Clay: 0	Sand: 0	Gravel: 37
	Sm Cobble: 24	Lg Cobble: 15
	Boulder: 20	Bedrock: 3
Embeddedness Values (%): 1. 13.2	2. 45.1	3. 19.8
	4. 3.3	5. 18.7

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Juan Creek

LLID: 1238029397028

Drainage: Rockport

Survey Dates: 6/23/2009 to 7/9/2009

Confluence Location: Quad: WESTPORT

Legal Description: T21NR18WS01

Latitude: 39:42:10.0N

Longitude: 123:48:10.0W

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	22	37	16.0
Boulder	15	9	6.5
Cobble / Gravel	61	69	35.3
Sand / Silt / Clay	86	69	42.1

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	13	12	6.8
Brush	102	127	62.2
Hardwood Trees	42	30	19.6
Coniferous Trees	20	12	8.7
No Vegetation	7	3	2.7

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Juan Creek

LLID: 1238029397028

Drainage: Rockport

Survey Dates: 6/23/2009 to 7/9/2009

Confluence Location: Quad: WESTPORT

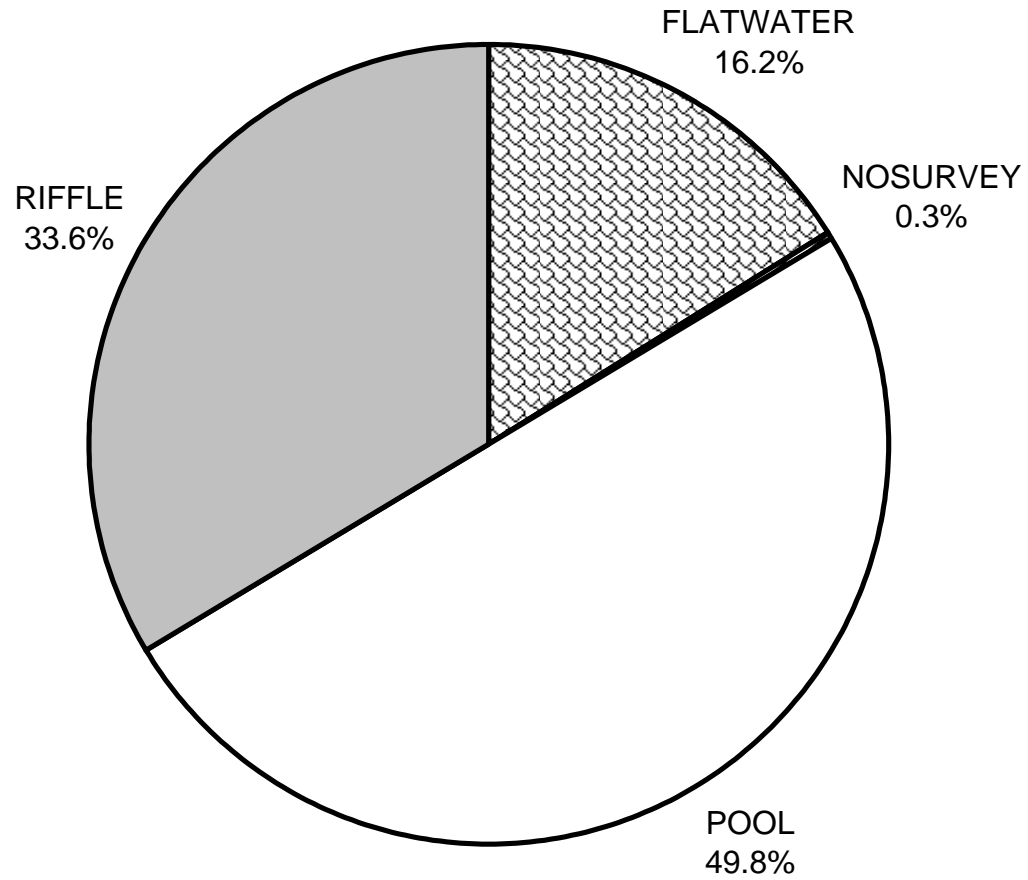
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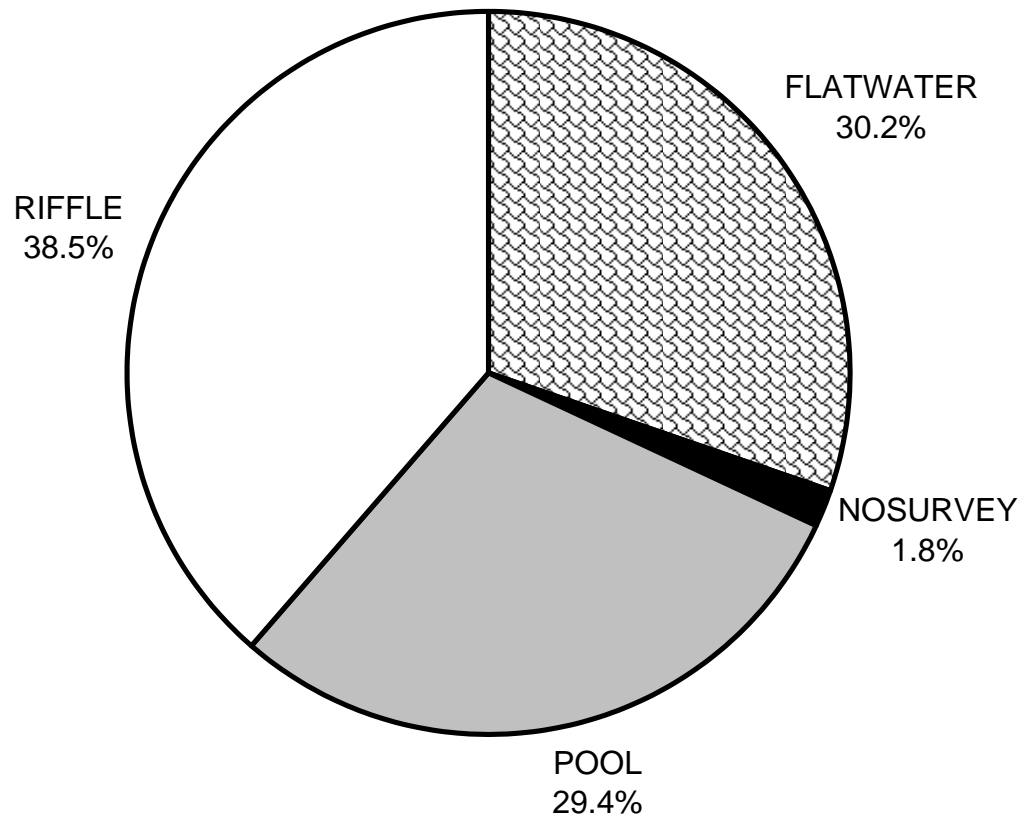
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	4
SMALL WOODY DEBRIS (%)	15	13	23
LARGE WOODY DEBRIS (%)	17	16	32
ROOT MASS (%)	0	13	9
TERRESTRIAL VEGETATION (%)	18	16	5
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	4	4	4
BOULDERS (%)	45	37	17
BEDROCK LEDGES (%)	0	1	4

**JUAN CREEK 2009
HABITAT TYPES BY PERCENT OCCURRENCE**



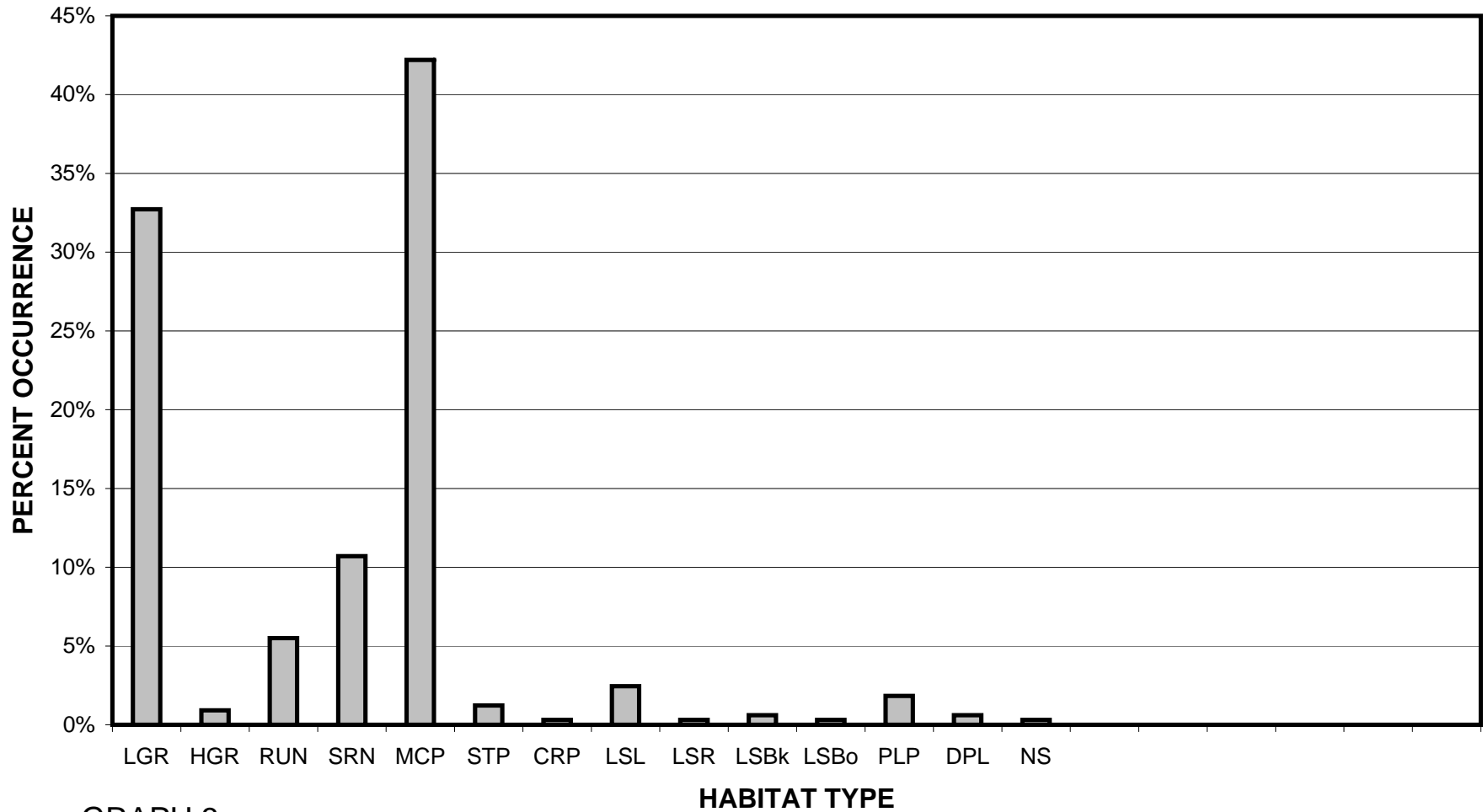
GRAPH 1

JUAN CREEK 2009 HABITAT TYPES BY PERCENT TOTAL LENGTH



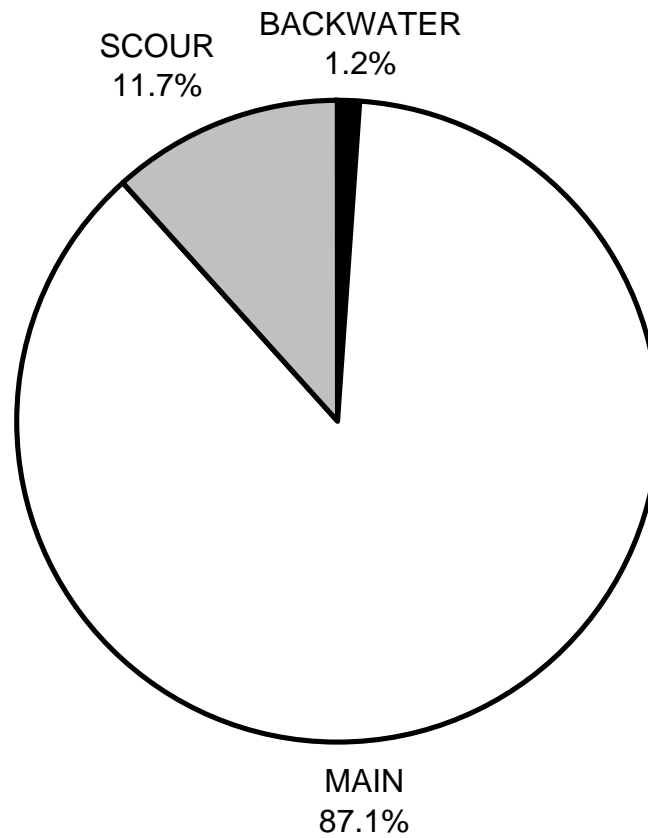
GRAPH 2

JUAN CREEK 2009 HABITAT TYPES BY PERCENT OCCURRENCE



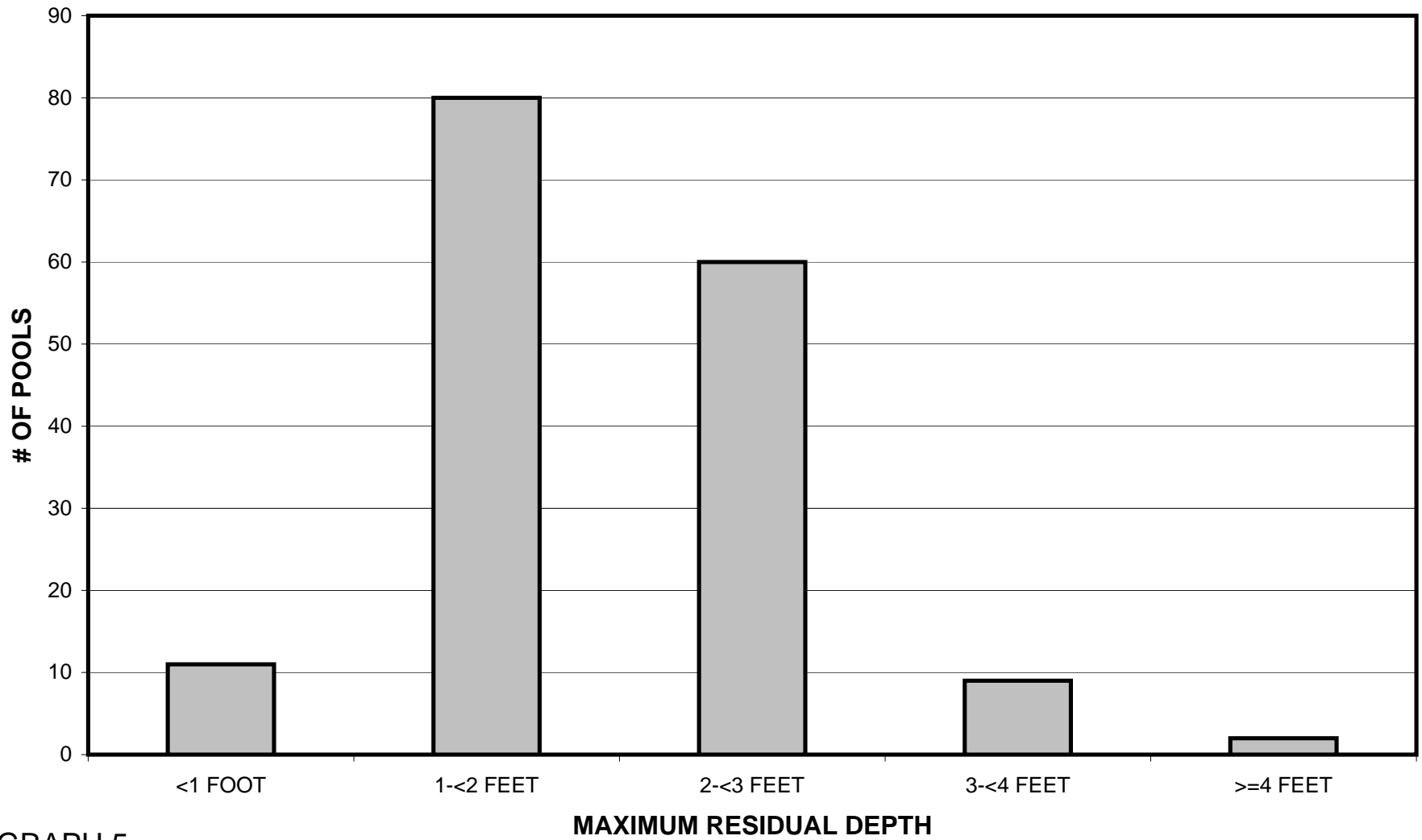
GRAPH 3

JUAN CREEK 2009 POOL TYPES BY PERCENT OCCURRENCE



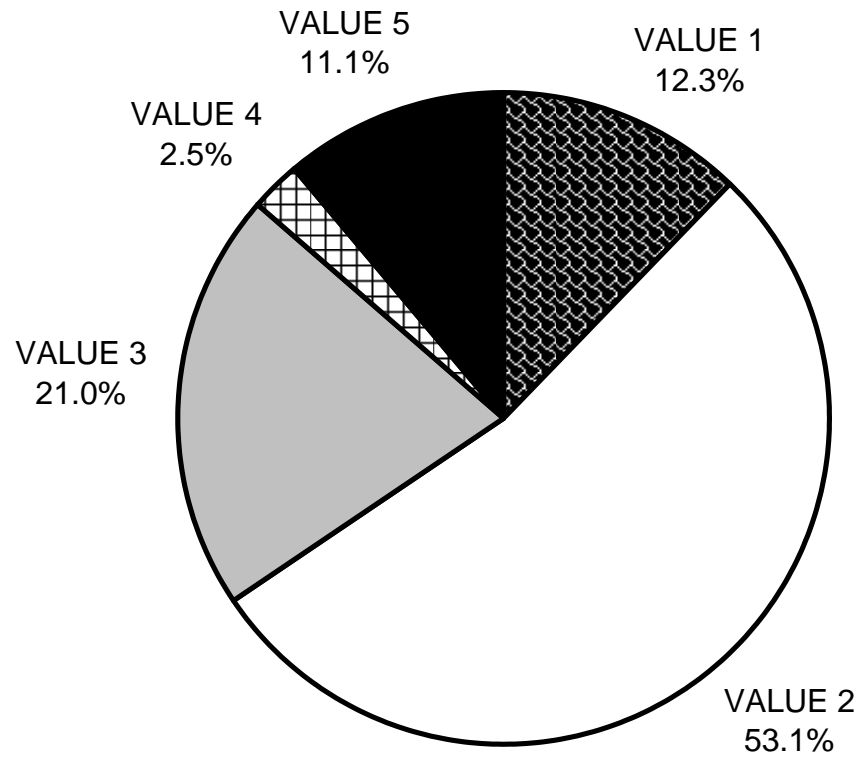
GRAPH 4

JUAN CREEK 2009 MAXIMUM DEPTH IN POOLS



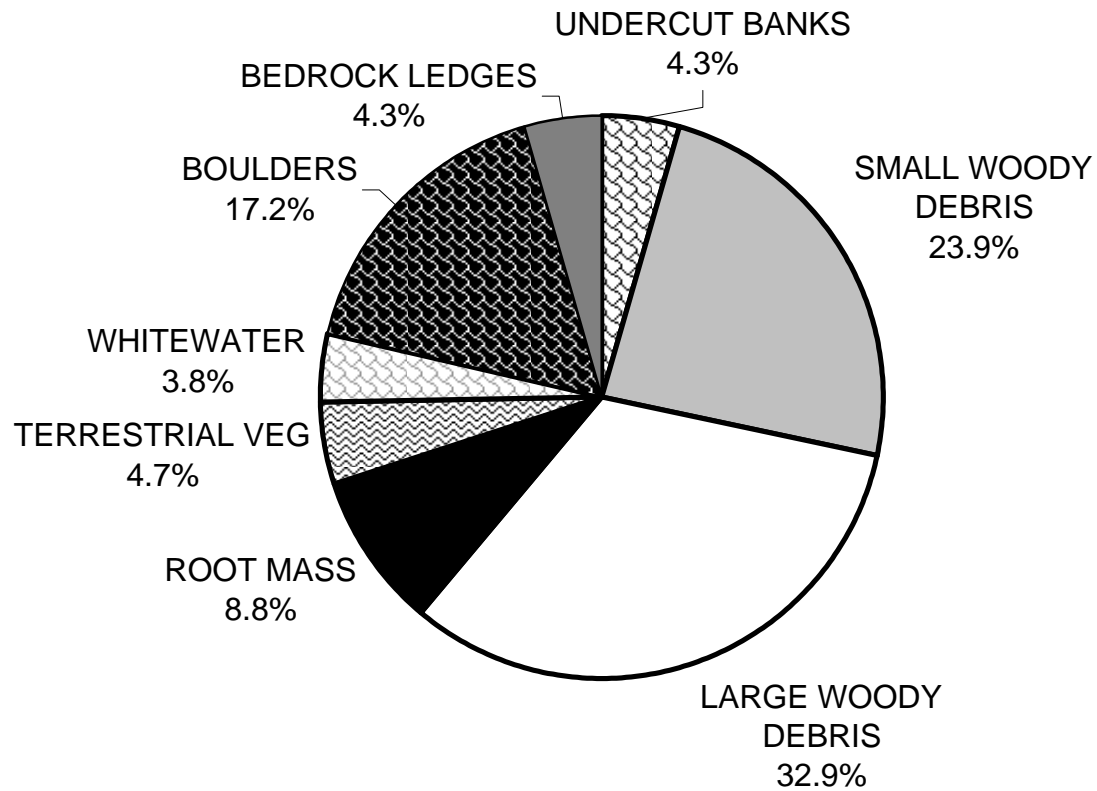
GRAPH 5

JUAN CREEK 2009 PERCENT EMBEDDEDNESS



GRAPH 6

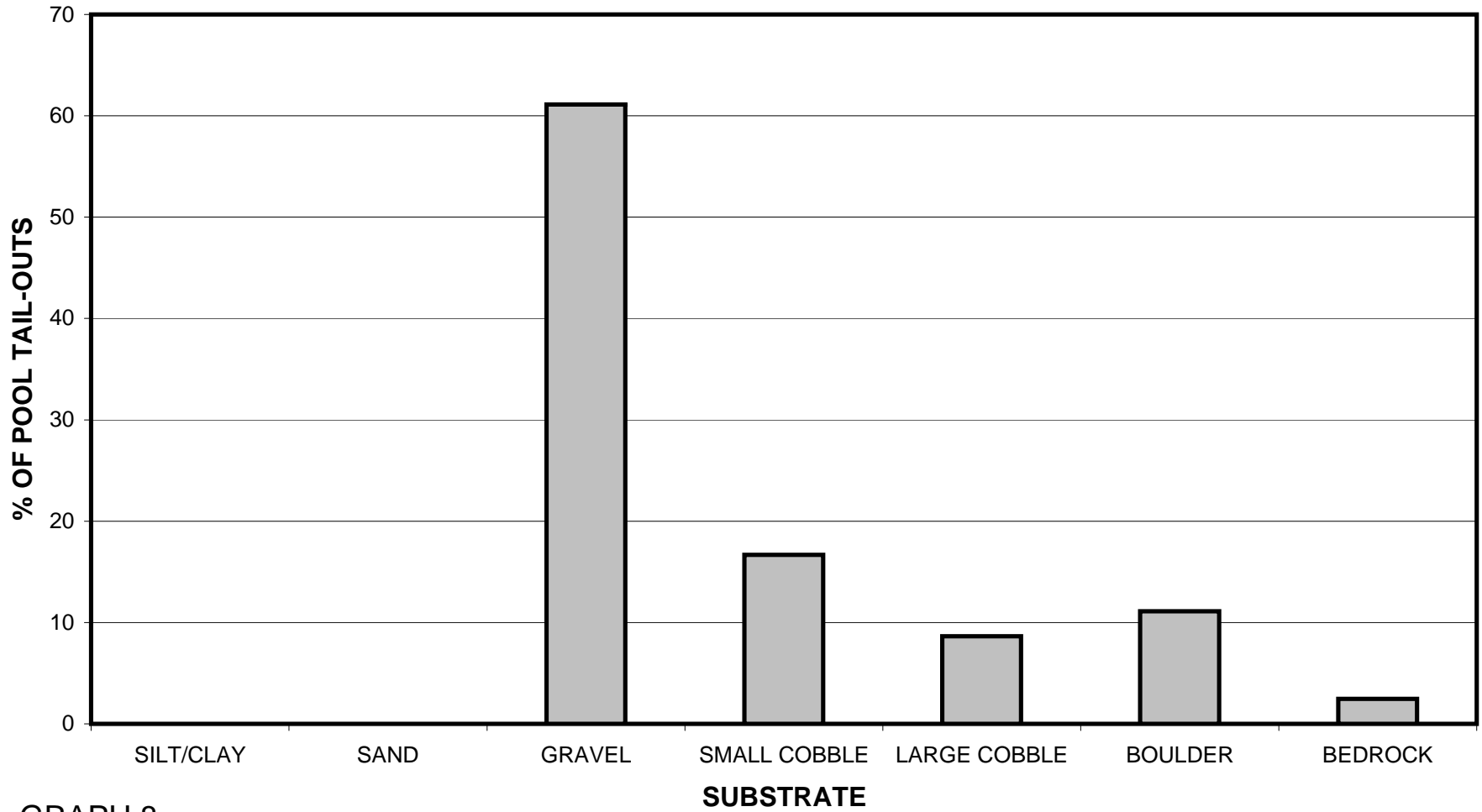
JUAN CREEK 2009 MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

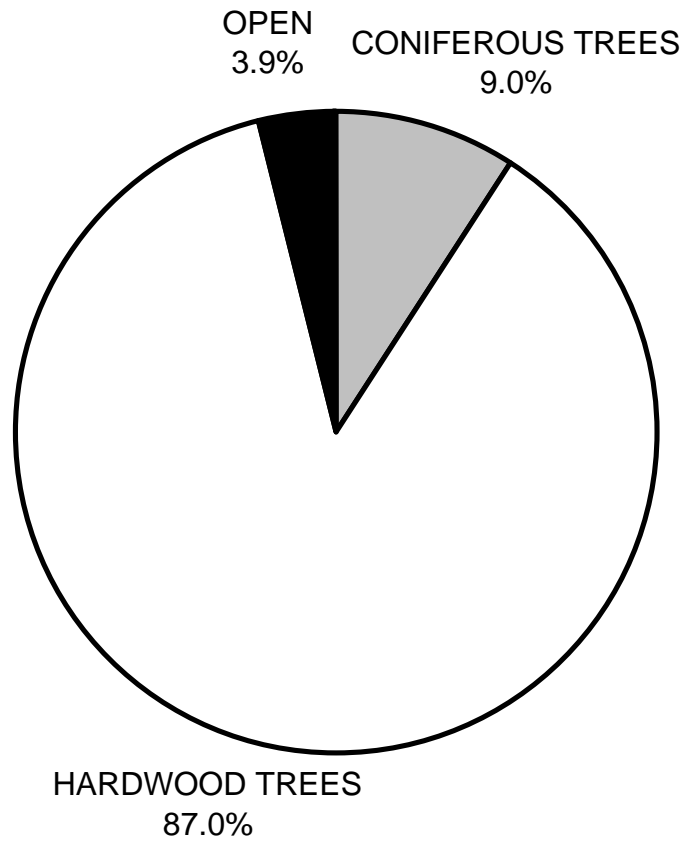
JUAN CREEK 2009

SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



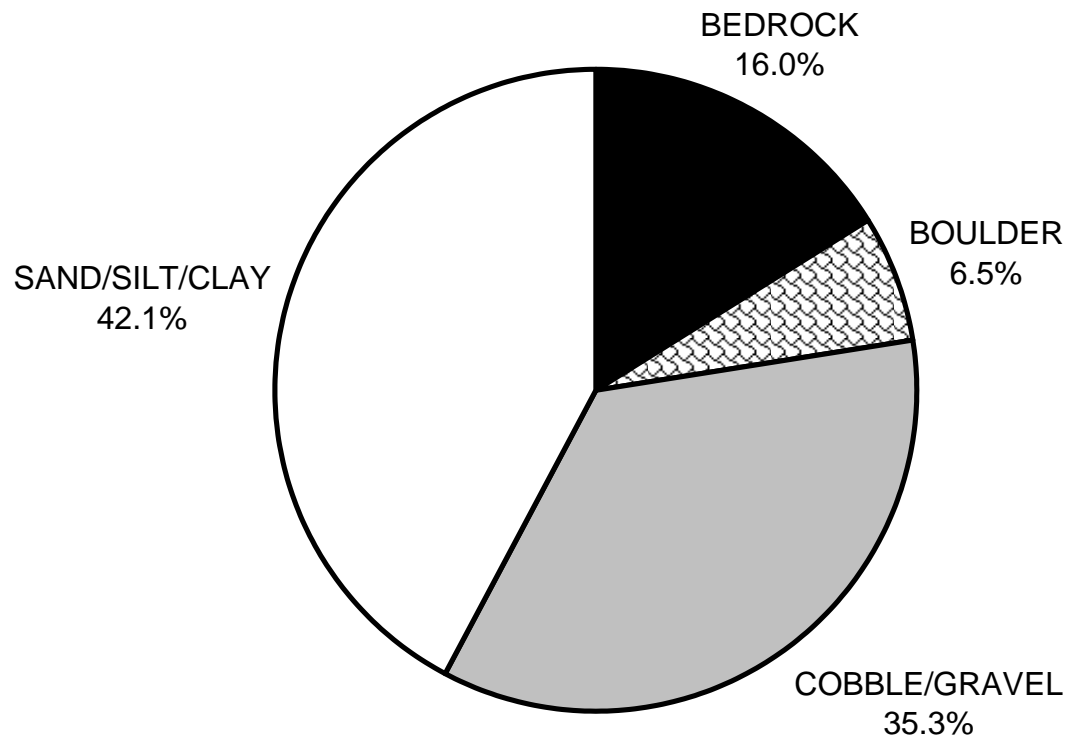
GRAPH 8

JUAN CREEK 2009 MEAN PERCENT CANOPY



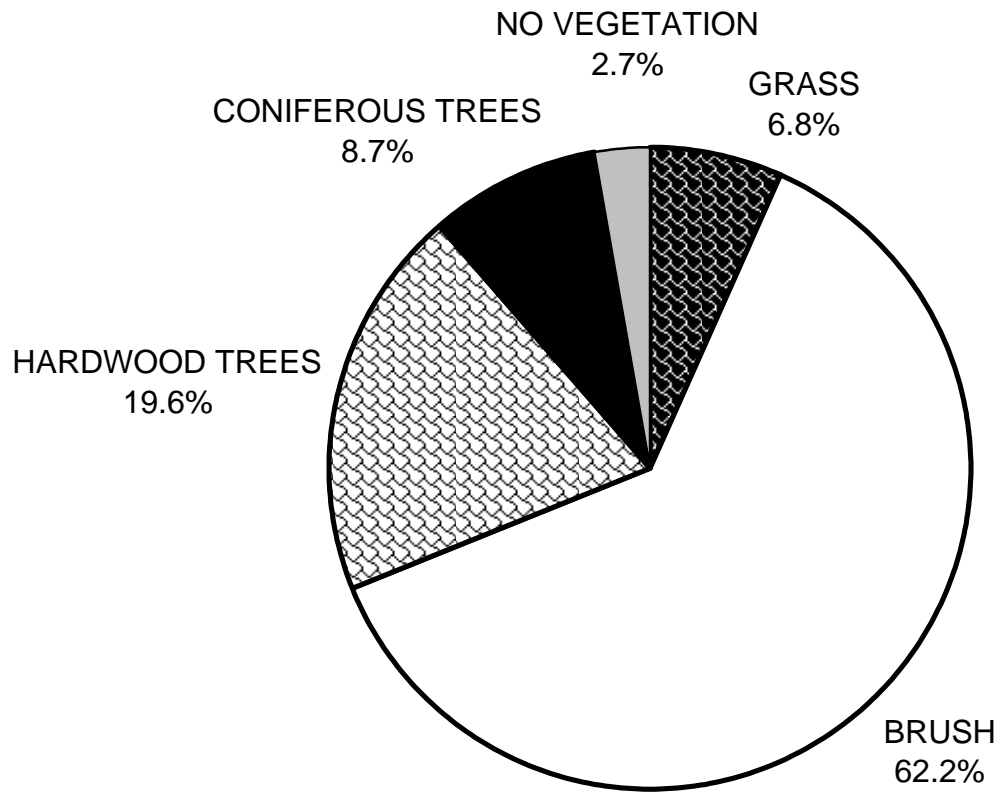
GRAPH 9

**JUAN CREEK 2009
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

JUAN CREEK 2009 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

