

STREAM INVENTORY REPORT

Bear Creek

INTRODUCTION

A stream inventory was conducted from August 8 to August 18, 2010 on Bear Creek. The survey began at the confluence with Eel River and extended upstream 3.2 miles.

The Bear 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 Bear 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

Bear Creek is a tributary to the Eel River, which drains to the Pacific Ocean, located in Humboldt County, California (Map 1). Bear Creek's legal description at the confluence with Eel River is T1N R2E S32. Its location is 40.4312 north latitude and 123.9816 west longitude, LLID number 1239798404315. Bear Creek is a third order stream and has approximately 3.9 miles of blue line stream according to the USGS Redcrest 7.5 minute quadrangle. Bear Creek drains a watershed of approximately 8.5 square miles. Elevations range from about 110 feet at the mouth of the creek to 1,600 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is privately owned and is managed for timber production. Vehicle access exists from US 101, via the Holmes/Redcrest exit.

METHODS

The habitat inventory conducted in Bear 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 Bear 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". Bear 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 Bear 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 Bear 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 Bear 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 Bear 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 Bear Creek. In addition, underwater observations were made at 20 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 Bear 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 August 8 to August 18, 2010, was conducted by P. Scott and B. Leonard (WSP). The total length of the stream surveyed was 16,938 feet with an additional 577 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 2.7 cfs on August 16, 2010.

Bear Creek is a F3 channel type for 3,512 feet of the stream surveyed (Reach 1), and a B4 channel type for 13,426 feet of the stream surveyed (Reach 2). 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, very stable with cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 55 to 65 degrees Fahrenheit. Air temperatures ranged from 59 to 77 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 46% riffle units, 37% pool units, 16% flatwater units, and 1% no survey units (Graph 1). Based on total length of Level II habitat types there were 66% riffle units, 21% pool units, and 13% flatwater units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units, 39%; mid-channel pool units, 27%; and run units 14% (Graph 3). Based on percent total length, low gradient riffle units made up 56%, mid-channel pool units 16%, and run units 10%.

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A total of 100 pools were identified (Table 3). Main channel pools were the most frequently encountered at 72% (Graph 4), and comprised 77% 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. Eleven of the 100 pools (11%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 100 pool tail-outs measured, 29 had a value of 1 (29%); 51 had a value of 2 (51%); and 20 had a value of 3 (20%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst.

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 10, flatwater habitat types had a mean shelter rating of 22, and pool habitats had a mean shelter rating of 37 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 39. Scour 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 Bear Creek. Graph 7 describes the pool cover in Bear 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 55% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 32% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Bear Creek was 68%. Thirty-two percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 72% and 28%, respectively. Graph 9 describes the mean percent canopy in Bear Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 76%. The mean percent left bank vegetated was 78%. The dominant elements composing the structure of the stream banks consisted of 94% cobble/gravel, 3% bedrock, 2% sand/silt/clay, and 1% boulder (Graph 10). Deciduous trees were the dominant vegetation type observed in 88% of the units surveyed. Additionally, 12% of the units surveyed had coniferous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 20 sites for species composition and distribution in Bear Creek on October 18 and October 19, 2010. Water temperature taken during the survey period was 55 degrees Fahrenheit. Air temperature was 57 degrees Fahrenheit. The sites were sampled by I. Mikus (DFG), and M. McGowan (WSP).

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In reach 1, which comprised the first 3,512 feet of stream, 10 sites were sampled. The reach sites yielded 199 young-of-the-year steelhead/rainbow trout (SH/RT), 16 age 1+ SH/RT, 3 age 2+ SH/RT, and 4 Sacramento pikeminnow.

In reach 2, 10 sites were sampled starting approximately 5,492 feet from the confluence with Eel River and continuing upstream 1,717feet. The reach sites yielded 181 young-of-the-year SH/RT, 29 age 1+ SH/RT, and 6 age 2+ SH/RT.

The following chart displays the information yielded from these sites:

2010 Bear 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									
10/18/10	1	002	Pool	329	41	1	0	0	0
	2	004	Pool	385	34	2	0	0	0
	3	006	Pool	444	20	1	0	0	0
	4	010	Pool	769	12	0	0	0	0
	5	016	Pool	1,177	16	2	0	0	0
	6	021	Pool	1,432	8	1	1	0	0
	7	024	Pool	1,576	6	0	2	0	0
	8	030	Pool	1,841	23	6	0	0	0
	9	033	Pool	2,064	14	2	0	0	0
	10	037	Pool	2,421	25	2	0	0	0
Reach 2: B4 Channel Type									
10/19/10	11	089	Pool	4,866	13	2	0	0	0
	12	093	Pool	5,717	16	4	0	0	0
	13	095	Pool	5,865	27	4	3	0	0
	14	099	Pool	6,304	30	5	2	0	0
	15	105	Pool	6,648	15	0	0	0	0
	16	110	Pool	6,917	16	1	1	0	0
	17	112	Pool	6,989	11	5	2	0	0
	18	114	Pool	7,044	9	2	0	0	0
	19	116	Pool	7,160	19	3	2	0	0
	20	117	Pool	7,209	25	3	1	0	0

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DISCUSSION

Bear Creek is an F3 channel type for the first 3,512 feet of stream surveyed, and a B4 channel type for the remaining 13,426 feet of stream surveyed. The suitability of F3 and B4 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. 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 days August 8 to August 18, 2010, ranged from 55 to 65 degrees Fahrenheit. Air temperatures ranged from 59 to 77 degrees Fahrenheit. A water temperature of 65 degrees Fahrenheit if sustained is a marginal water temperature for rearing 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 13% of the total length of this survey, riffles 66%, and pools 12%. Eleven of the 100 (11%) pools had a maximum residual depth greater than 3 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.

Eighty of the 100 pool tail-outs measured had embeddedness ratings of 1 or 2. Twenty of the pool tail-outs had embeddedness ratings of 3 or 4. None of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Bear Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Eighty-seven of the 100 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 37. The shelter rating in the flatwater habitats is 22. 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 Bear 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 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 68%. Reach 1 had a canopy density of 60%, and Reach 2 had a canopy density of 69%. In general, revegetation projects are considered when canopy density is less than 80%.

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The percentage of right and left bank covered with vegetation was 76% and 78%, 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) Bear Creek should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are nearing temperature threshold 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.
- 6) Increase the canopy on Bear Creek by planting appropriate native vegetation like willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

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 Eel River.
297	0002.00	Left bank erosion is 8' tall x 120' long x 15' wide and is contributing sand to large cobble.

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444	0007.00	Avenue of the Giants crosses the channel. The crossing is a concrete, wood and asphalt bridge measuring 30' wide x 55' high x 52' long.
597	0008.00	Highway 101 crosses the channel. The crossing is a concrete bridge measuring 50' wide x 55' high x 77' long.
3351	0057.00	Log debris accumulation (LDA) #01 measures 200' wide x 100' long x 15' high and consists of more than 50 pieces of large woody debris (LWD). There are visible gaps in the LDA and water flows through it. Erosion sites on both banks are contributing fine sediment to the channel. The erosion site on the right bank measures 75' long x 50' high. The erosion site on the left bank measures 85' long x 60' high. The LDA splits the channel into six braided sections.
3512	0061.00	Begin B4 channel type.
4343	0071.00	Retaining wall on the left bank.
4827	0081.00	A road crosses the channel. The crossing is a 15' high railcar bridge with log and rip-rap footings.
7328	0121.00	Tributary #01 enters on the left bank. It contributes to approximately 1% of Bear Creek's flow. The water temperature downstream of the tributary is 57 degrees Fahrenheit, the water temperature of the tributary is 55 degrees Fahrenheit, and the water temperature upstream of the confluence is 61 degrees Fahrenheit. The slope of the tributary is 6%. Only the first 350 feet of the tributary are accessible to salmonids, due to a 9' high waterfall. No fish were observed in the tributary.
8584	0143.00	Tributary #02 enters on the left bank. It contributes to approximately 5% of Bear Creek's flow. The water temperature downstream and upstream of the tributary is 57 degrees Fahrenheit; the water temperature of the tributary is 55 degrees Fahrenheit. The slope of the tributary is 25%, making it too steep for salmonids.
9806	0164.00	An erosion site on the left bank is contributing fine sediment to the channel.
11104	0182.00	Right bank seep.
12019	0194.00	Tributary #03 enters on the right bank. It contributes to approximately 20% of Bear Creek's flow. The water temperature downstream of the tributary is 57 degrees Fahrenheit, the water temperature of the tributary is 56 degrees Fahrenheit, and the water temperature upstream of the confluence is 58 degrees Fahrenheit. The slope of the tributary is 8%.

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Only the first 75' of the tributary are accessible to salmonids due to an 8' high plunge. No fish were observed in the tributary.

13210	0207.00	An erosion site on the right bank measures 100' long x 50' high.
13343	0208.00	Tributary #04 enters on the left bank. It contributes to approximately 1% of Bear Creek's flow. The water temperature downstream and upstream of the tributary is 58 degrees Fahrenheit; the water temperature of the tributary is 56 degrees Fahrenheit. The slope of the tributary is 5%. The tributary is not accessible to salmonids.
14156	0222.00	Tributary #05 enters on the right bank. It contributes to approximately 35% of Bear Creek's flow. The water temperature downstream of the tributary is 59 degrees Fahrenheit, the water temperature of the tributary is 61 degrees Fahrenheit, and the water temperature upstream of the confluence is 58 degrees Fahrenheit. The slope of the tributary is 2%. Salmonids were observed in the tributary.
16938	0259.00	End of survey due to end of anadromy. The stream flows in a series of small shallow pools separated by 3' high to 8' high jumps. The slope is close to 20%. No young-of-the-year salmonids were observed beyond this point.

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: Bear Creek

LLID: 1239798404315

Drainage: Eel River - Lower

Survey Dates: 8/2/2010 to 8/18/2010

Confluence Location: Quad: SCOTIA

Legal Description: T01NR02ES32

Latitude: 40:25:53.0N

Longitude: 123:58:47.0W

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
43	3	FLATWATER	16.1	55	2348	13.4	16.7	0.6	1.3	449	19310	290	12457		22
2	0	NOSURVEY	0.7	26	51	0.3									
100	100	POOL	37.5	36	3637	20.8	17.0	0.8	2.0	586	58579	772	77224	503	37
122	15	RIFFLE	45.7	94	11479	65.5	17.8	0.5	1.2	1288	157085	732	89319		10
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
267	118				17515					234974			179001		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Bear Creek

LLID: 1239798404315

Drainage: Eel River - Lower

Survey Dates: 8/2/2010 to 8/18/2010

Confluence Location: Quad: SCOTIA

Legal Description: T01NR02ES32

Latitude: 40:25:53.0N

Longitude: 123:58:47.0W

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 (%)
104	13	LGR	39.0	94	9784	55.9	19	0.5	2.5	1366	142039	775	80567		10	57
17	2	HGR	6.4	94	1590	9.1	11	0.6	1.2	779	13250	455	7743		10	78
1	0	CAS	0.4	105	105	0.6										
37	3	RUN	13.9	49	1831	10.5	17	0.6	1.5	449	16615	290	10719		22	77
6	0	SRN	2.2	86	517	3.0										
72	72	MCP	27.0	39	2807	16.0	16	0.8	4.3	626	45057	843	60718	550	39	69
11	11	LSL	4.1	34	379	2.2	15	0.6	2.6	484	5321	522	5741	298	33	61
3	3	LSBk	1.1	42	126	0.7	13	1.1	3.5	548	1644	884	2651	637	12	70
14	14	PLP	5.2	23	325	1.9	22	0.8	3.2	468	6556	580	8114	381	35	74
2	0	NS	0.7	26	51	0.3										

Total Units
267

Total Units Fully Measured
118

Total Length (ft.)
17515

Total Area (sq.ft.)
230484

Total Volume (cu.ft.)
176254

Table 3 - Summary of Pool Types

Stream Name: Bear Creek LLID: 1239798404315 Drainage: Eel River - Lower
Survey Dates: 8/2/2010 to 8/18/2010
Confluence Location: Quad: SCOTIA Legal Description: T01NR02ES32 Latitude: 40:25:53.0N Longitude: 123:58:47.0W

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
72	72	MAIN	72	39	2807	77	16.5	0.8	626	45057	550	39069	39
28	28	SCOUR	28	30	830	23	18.3	0.7	483	13522	378	10215	32
Total Units	Total Units Fully Measured				Total Length (ft.)				Total Area (sq.ft.)			Total Volume (cu.ft.)	
100	100				3637				58579			49284	

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

Stream Name: Bear Creek

LLID: 1239798404315

Drainage: Eel River - Lower

Survey Dates: 8/2/2010 to 8/18/2010

Confluence Location: Quad: SCOTIA

Legal Description: T01NR02ES32

Latitude: 40:25:53.0N

Longitude: 123:58:47.0W

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
72	MCP	72	1	1	35	49	27	38	8	11	1	1
11	LSL	11	1	9	6	55	4	36	0	0	0	0
3	LSBk	3	0	0	2	67	0	0	1	33	0	0
14	PLP	14	0	0	8	57	5	36	1	7	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
100	2	2	51	51	36	36	10	10	1	1

Mean Maximum Residual Pool Depth (ft.): 2

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Bear Creek

LLID: 1239798404315

Drainage: Eel River - Lower

Survey Dates: 8/2/2010 to 8/18/2010

Dry Units: 0

Confluence Location: Quad: SCOTIA

Legal Description: T01NR02ES32

Latitude: 40:25:53.0N

Longitude: 123:58:47.0W

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
104	13	LGR	0	22	48	0	1	0	1	30	0
17	2	HGR	0	10	35	0	0	0	10	45	0
1	0	CAS									
122	15	TOTAL RIFFLE	0	20	47	0	0	0	1	31	0
37	3	RUN	0	65	12	0	0	0	0	23	0
6	0	SRN									
43	3	TOTAL FLAT	0	65	12	0	0	0	0	23	0
72	72	MCP	1	39	38	1	2	0	2	16	1
11	11	LSL	0	27	71	0	0	0	1	0	0
3	3	LSBk	0	0	0	0	0	0	0	3	97
14	14	PLP	1	18	37	0	0	0	27	16	1
100	100	TOTAL POOL	1	34	40	1	2	0	5	14	4
2	0	NS									
267	118	TOTAL	0	33	41	1	2	0	5	16	3

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Bear Creek

LLID: 1239798404315

Drainage: Eel River - Lower

Survey Dates: 8/2/2010 to 8/18/2010

Dry Units: 0

Confluence Location: Quad: SCOTIA

Legal Description: T01NR02ES32

Latitude: 40:25:53.0N

Longitude: 123:58:47.0W

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
104	13	LGR	0	0	15	46	38	0	0
17	2	HGR	0	0	0	0	100	0	0
1	0	CAS	0	0	0	0	0	0	0
37	3	RUN	0	0	67	33	0	0	0
6	0	SRN	0	0	0	0	0	0	0
72	72	MCP	0	3	75	18	4	0	0
11	11	LSL	0	0	55	36	9	0	0
3	3	LSBk	0	0	100	0	0	0	0
14	14	PLP	0	0	79	14	7	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Bear Creek

LLID: 1239798404315

Drainage: Eel River - Lower

Survey Dates: 8/2/2010 to 8/18/2010

Confluence Location: Quad: SCOTIA

Legal Description: T01NR02ES32

Latitude: 40:25:53.0N

Longitude: 123:58:47.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
68	28	72	0	76	78

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:	Bear Creek	LLID:	1239798404315	Drainage:	Eel River - Lower		
Survey Dates:	8/2/2010 to 8/18/2010	Survey Length (ft.):	17515	Main Channel (ft.):	16938	Side Channel (ft.):	577
Confluence Location:	Quad: SCOTIA	Legal Description:	T01NR02ES32	Latitude:	40:25:53.0N	Longitude:	123:58:47.0W

STREAM REACH: 1									
Channel Type: F3			Canopy Density (%): 60.1				Pools by Stream Length (%): 20.9		
Reach Length (ft.): 3512			Coniferous Component (%): 34.2				Pool Frequency (%): 35.0		
Riffle/Flatwater Mean Width (ft.): 17.8			Hardwood Component (%): 65.8				Residual Pool Depth (%):		
BFW:			Dominant Bank Vegetation: Hardwood Trees				< 2 Feet Deep: 43		
Range (ft.): 27 to 38			Vegetative Cover (%): 80.1				2 to 2.9 Feet Deep: 38		
Mean (ft.): 32			Dominant Shelter: Large Woody Debris				3 to 3.9 Feet Deep: 14		
Std. Dev.: 4			Dominant Bank Substrate Type: Cobble/Gravel				>= 4 Feet Deep: 5		
Base Flow (cfs.): 2.7			Occurrence of LWD (%): 48				Mean Max Residual Pool Depth (ft.): 2.1		
Water (F): 59 - 65			Air (F): 61 - 69				LWD per 100 ft.:		
Dry Channel (ft): 0			Riffles: 2				Mean Pool Shelter Rating: 47		
			Pools: 10						
			Flat: 4						
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 67 Sm Cobble: 33 Lg Cobble: 0 Boulder: 0 Bedrock: 0									
Embeddedness Values (%): 1. 33.3 2. 42.9 3. 23.8 4. 0.0 5. 0.0									

Channel Type:	B4			Canopy Density (%): 69.8			Pools by Stream Length (%): 20.7		
Reach Length (ft.):	13426			Coniferous Component (%): 26.8			Pool Frequency (%): 38.2		
Riffle/Flatwater Mean Width (ft.):	17.6			Hardwood Component (%): 73.2			Residual Pool Depth (%):		
BFW:				Dominant Bank Vegetation: Hardwood Trees			< 2 Feet Deep: 56		
Range (ft.):	18	to	37	Vegetative Cover (%): 75.9			2 to 2.9 Feet Deep: 35		
Mean (ft.):	27			Dominant Shelter: Large Woody Debris			3 to 3.9 Feet Deep: 9		
Std. Dev.:	5			Dominant Bank Substrate Type: Cobble/Gravel			>= 4 Feet Deep: 0		
Base Flow (cfs.):	2.7			Occurrence of LWD (%): 36			Mean Max Residual Pool Depth (ft.): 2.0		
Water (F):	55 - 65	Air (F):	59 - 77	LWD per 100 ft.:			Mean Pool Shelter Rating: 34		
Dry Channel (ft):	0			Riffles: 5					
				Pools: 11					
				Flat: 4					
Pool Tail Substrate (%):	Silt/Clay: 0	Sand: 1	Gravel: 52	Sm Cobble: 32	Lg Cobble: 10	Boulder: 5	Bedrock: 0		
Embeddedness Values (%):	1. 27.8	2. 53.2	3. 19.0	4. 0.0	5. 0.0				

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Bear Creek

LLID: 1239798404315

Drainage: Eel River - Lower

Survey Dates: 8/2/2010 to 8/18/2010

Confluence Location: Quad: SCOTIA

Legal Description: T01NR02ES32

Latitude: 40:25:53.0N

Longitude: 123:58:47.0W

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	4	2	2.5
Boulder	2	1	1.3
Cobble / Gravel	110	113	94.5
Sand / Silt / Clay	2	2	1.7

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	0	0	0.0
Hardwood Trees	103	105	88.1
Coniferous Trees	15	13	11.9
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Bear Creek

LLID: 1239798404315

Drainage: Eel River - Lower

Survey Dates: 8/2/2010 to 8/18/2010

Confluence Location: Quad: SCOTIA

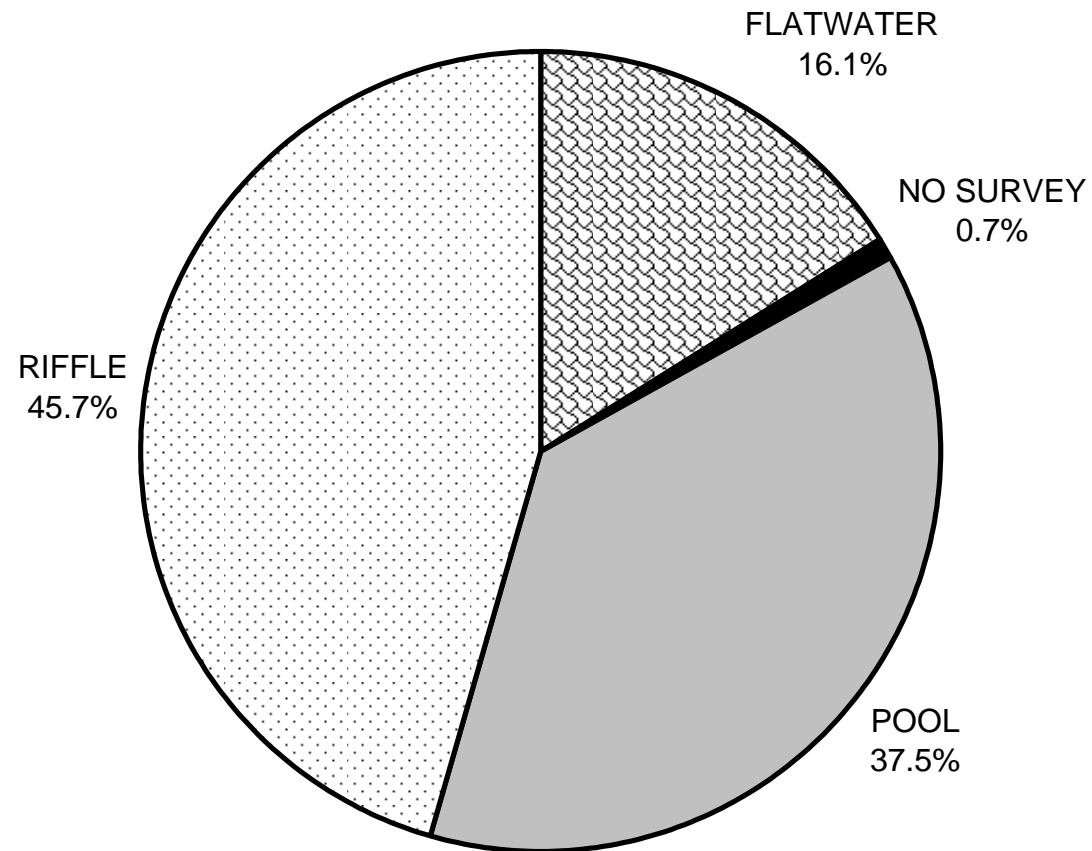
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Longitude: 123:58:47.0W

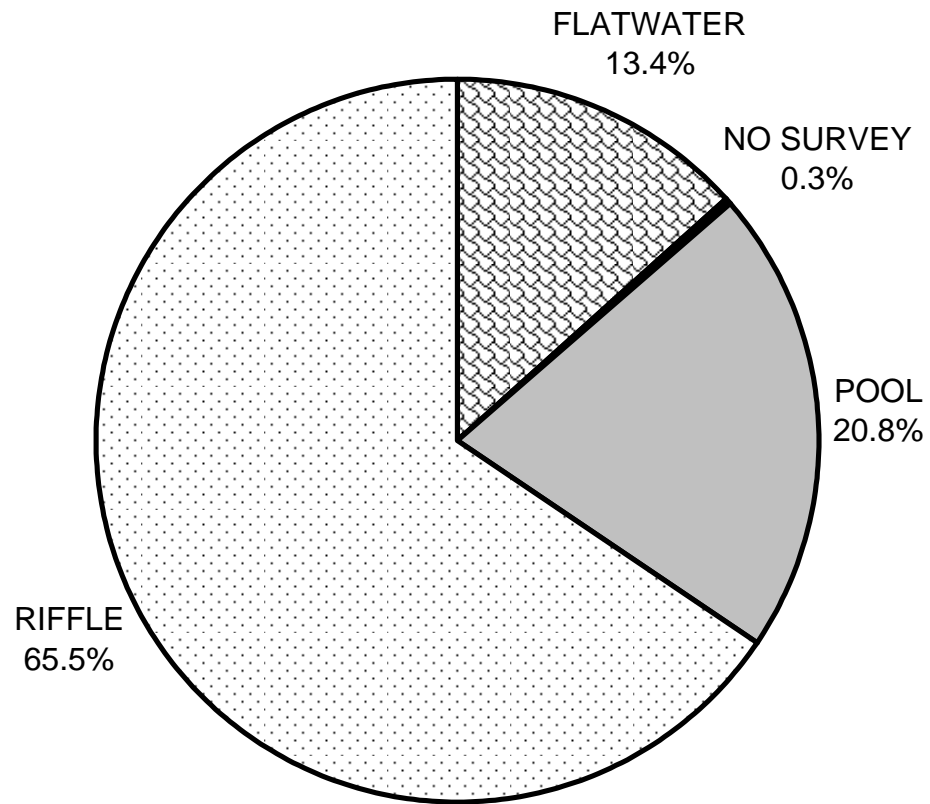
	Riffles	Flatwater	Pools
<hr/>			
UNDERCUT BANKS (%)	0	0	1
SMALL WOODY DEBRIS (%)	20	65	34
LARGE WOODY DEBRIS (%)	47	12	40
ROOT MASS (%)	0	0	1
TERRESTRIAL VEGETATION (%)	0	0	2
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	1	0	5
BOULDERS (%)	31	23	14
BEDROCK LEDGES (%)	0	0	4

BEAR CREEK 2010 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

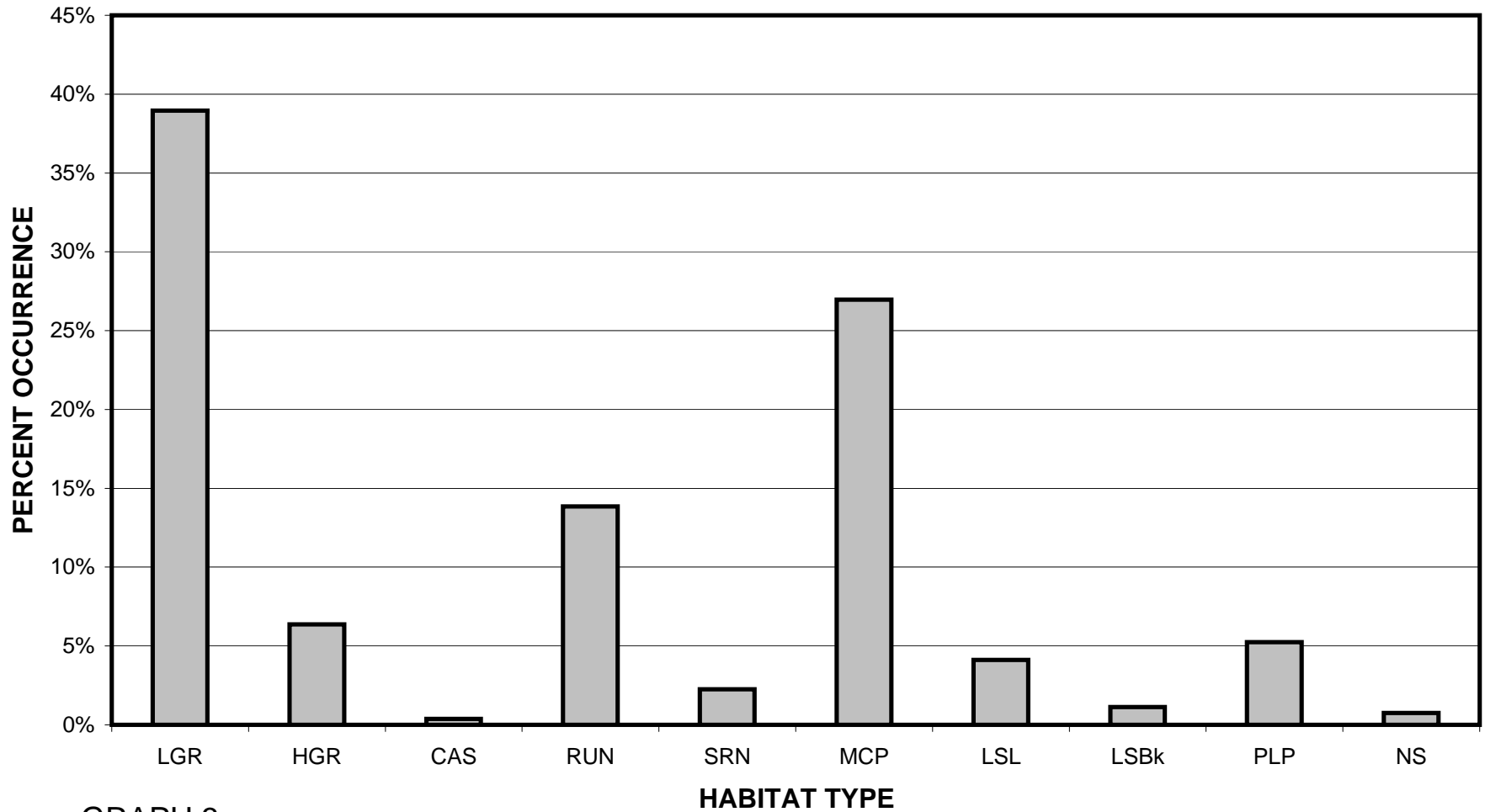
BEAR CREEK 2010 HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

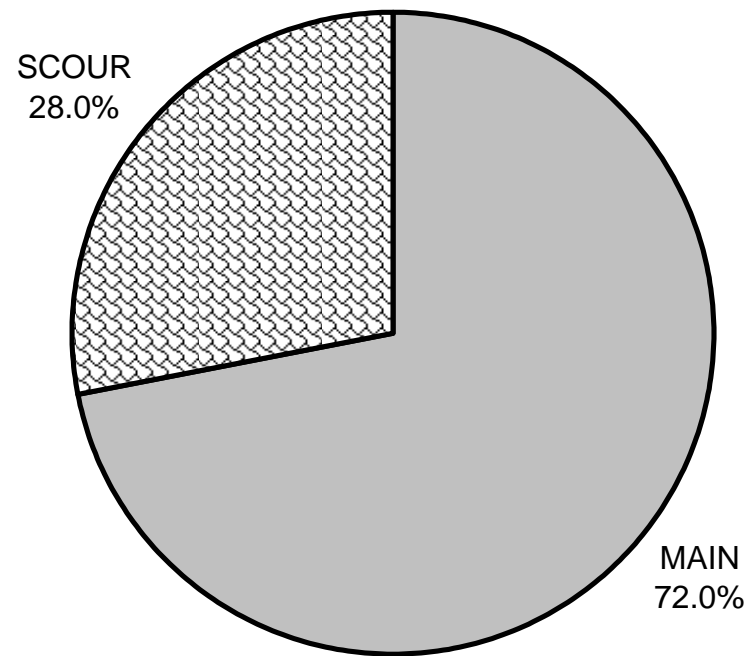
BEAR CREEK 2010

HABITAT TYPES BY PERCENT OCCURRENCE



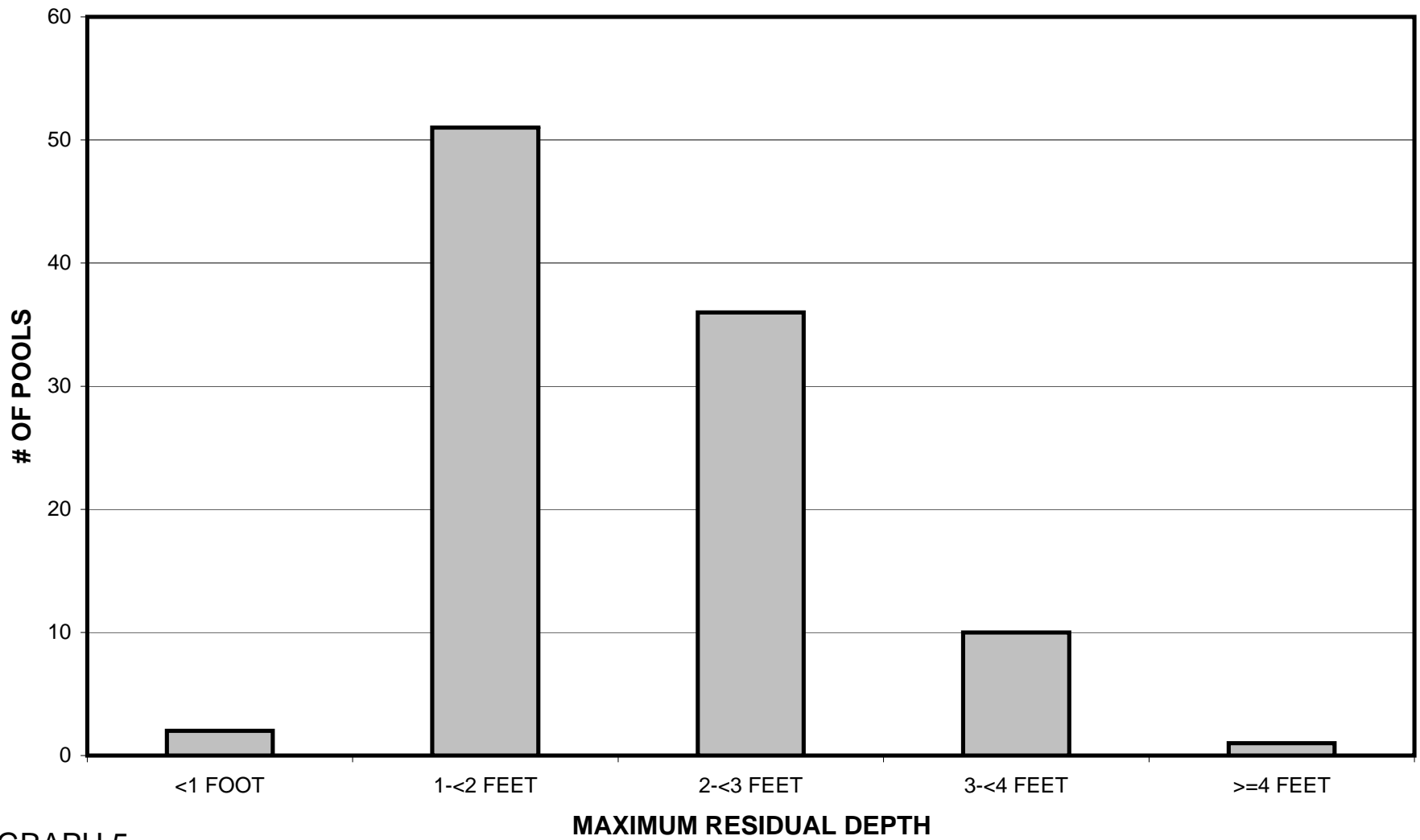
GRAPH 3

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



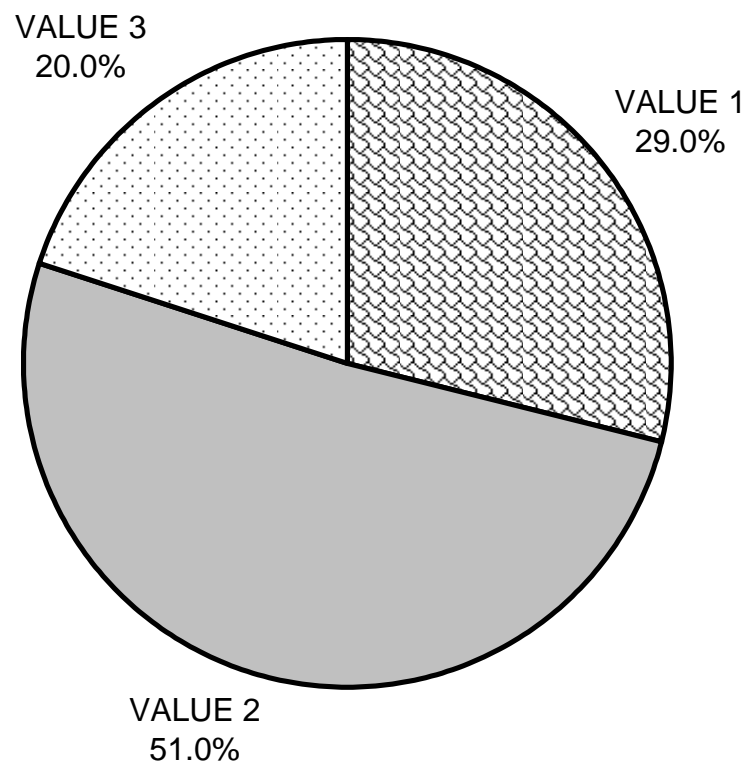
GRAPH 4

BEAR CREEK 2010 MAXIMUM DEPTH IN POOLS



GRAPH 5

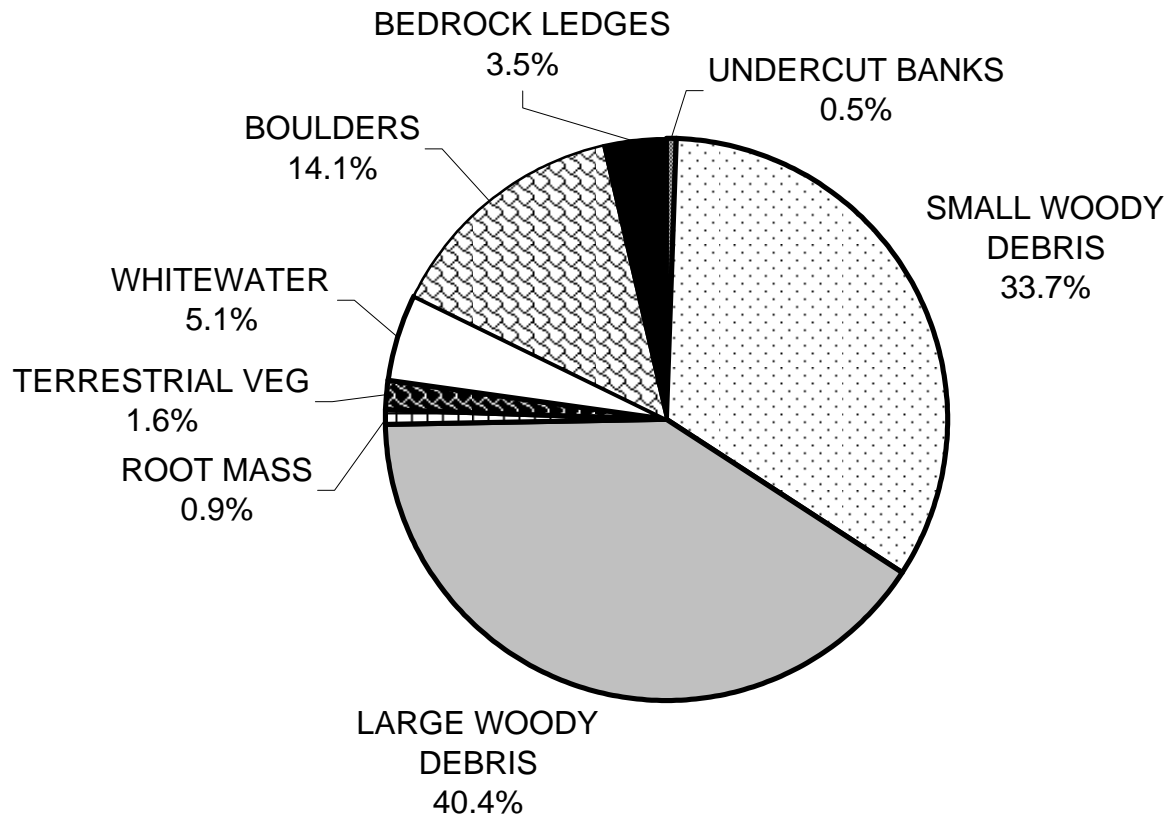
BEAR CREEK 2010 PERCENT EMBEDDEDNESS



GRAPH 6

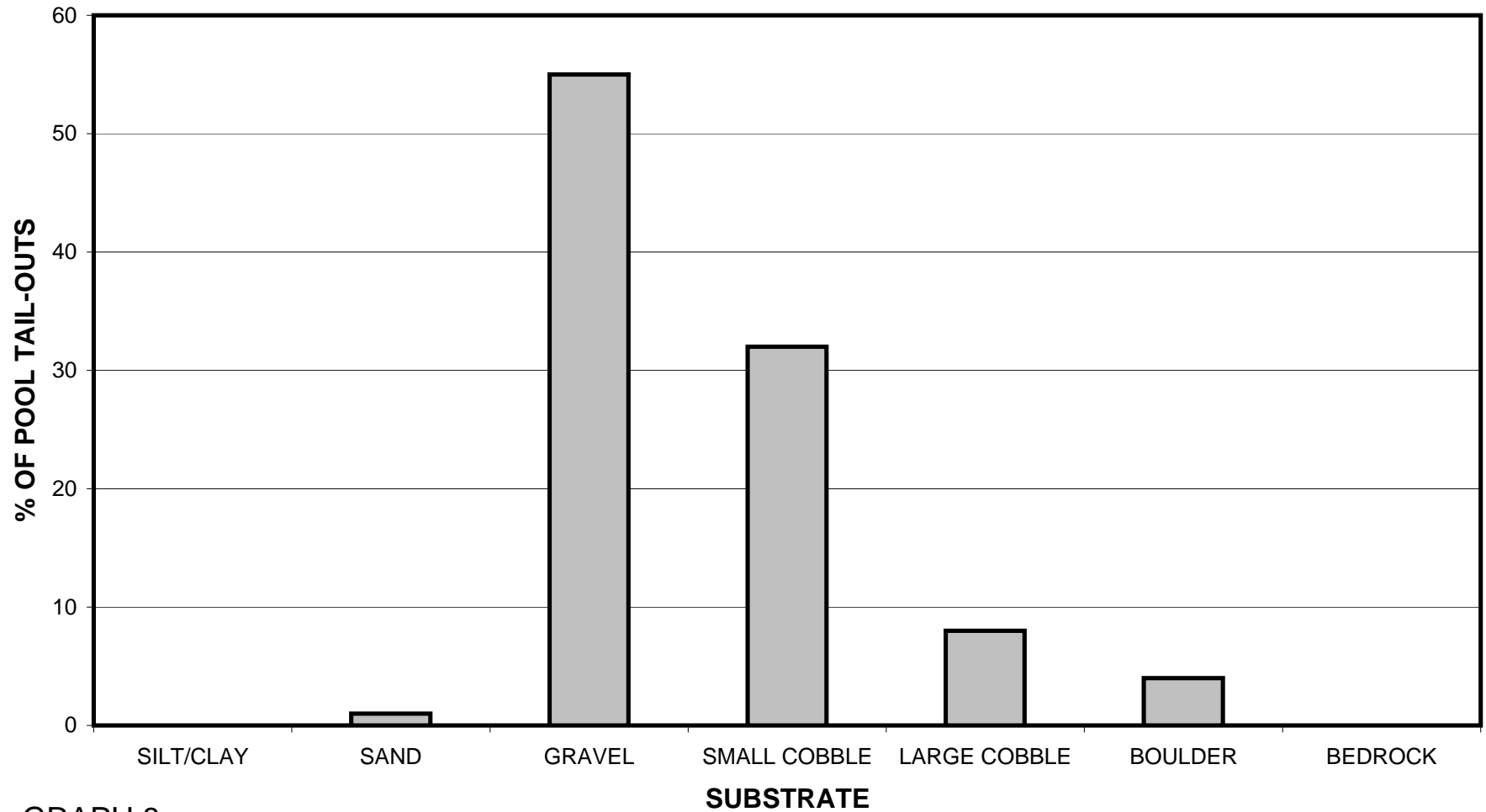
BEAR CREEK 2010

MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

BEAR CREEK 2010 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



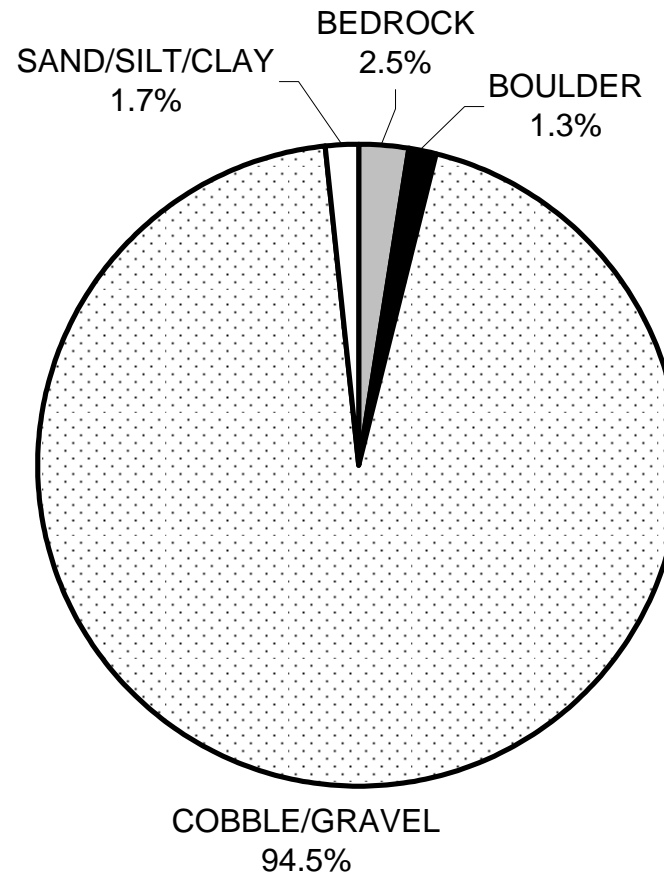
GRAPH 8

**BEAR CREEK 2010
MEAN PERCENT CANOPY**



GRAPH 9

BEAR CREEK 2010
DOMINANT BANK COMPOSITION IN SURVEY REACH



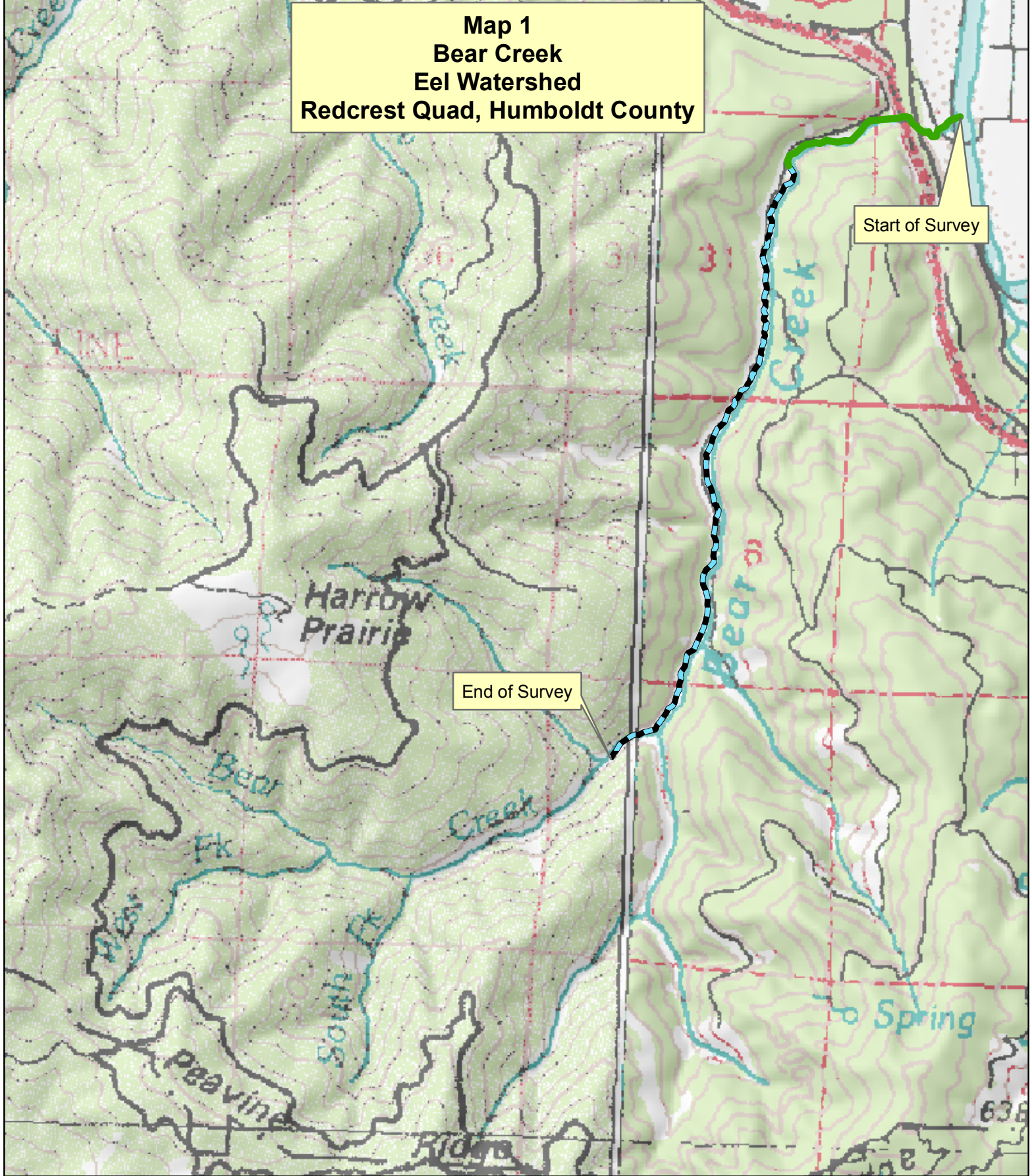
GRAPH 10

**BEAR CREEK 2010
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11

Map 1
Bear Creek
Eel Watershed
Redcrest Quad, Humboldt County



Legend



- Reach 1, F3 Channel Type
- - - Reach 2, B4 Channel Type

0 3,000 Feet

