

STREAM INVENTORY REPORT

Mill Creek

INTRODUCTION

A stream inventory was conducted on July 20, 2009 on Mill Creek. The survey began at the confluence with Salmon Creek and extended upstream 0.5 miles.

The Mill 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 Mill 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

Mill Creek is a tributary to Salmon Creek, tributary to South Fork Eel River, which drains to the Pacific Ocean, located in Humboldt County, California (Map 1). Mill Creek's legal description at the confluence with Salmon Creek is T03S R03E S05. Its location is 40.229 north latitude and 123.8623 west longitude, LLID number 1238610402292. Mill Creek is a second order stream and has approximately 2.1 miles of blue line stream according to the USGS Miranda 7.5 minute quadrangle. Mill Creek drains a watershed of approximately 2.0 square miles. Elevations range from about 270 feet at the mouth of the creek to 1,500 feet in the headwater areas. Mixed conifer and tan oak forest dominates the watershed. The watershed is owned by state park and private landowners. Vehicle access exists via Highway 101 to Salmon Creek Road.

METHODS

The habitat inventory conducted in Mill 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) Fish and Wildlife Scientific Aides that conducted the inventory were trained in standardized habitat inventory methods by 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

Mill Creek

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 Mill 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". Mill 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.

Mill Creek

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 Mill Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Mill 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 densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Mill 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 Mill 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.

Mill Creek

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 Mill Creek. In addition, underwater observations were made at nine 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

Mill Creek

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

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

HABITAT INVENTORY RESULTS

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

The habitat inventory of July 20, 2009, was conducted by I. Mikus and S. McSmith (DFG). The total length of the stream surveyed was 2,735 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.2 cfs on July 21, 2009.

Mill Creek is a B4 channel type for 2,735 feet of the stream surveyed (Reach 1). 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 59 to 63 degrees Fahrenheit. Air temperatures ranged from 59 to 86 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 40% riffle units, 29% flatwater units, 28% pool units, 1% no-survey units and 1% dry units (Graph 1). Based on total length of Level II habitat types there were 45% riffle units, 34% flatwater units, 19% pool units, 1% no-survey units, and 1% dry units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 24%; high gradient riffle units, 22%; and low gradient riffle units, 18% (Graph 3). Based on percent total length, high gradient riffle units made up 27%, step run units 25%, and low gradient riffle units 19%.

A total of 24 pools were identified (Table 3). Main channel pools were the most frequently encountered at 83% (Graph 4), and comprised 87% of the total length of all pools (Table 3).

Mill Creek

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. One of the 24 pools (4%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 24 pool tail-outs measured, 2 had a value of 1 (8.3%); 8 had a value of 2 (33.3%); 4 had a value of 3 (16.7%); 6 had a value of 4 (25%); 4 had a value of 5 (16.7%) (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 11, flatwater habitat types had a mean shelter rating of 12, and pool habitats had a mean shelter rating of 21 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 30. Main channel pools had a mean shelter rating of 19 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Mill Creek. Graph 7 describes the pool cover in Mill 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 42% of the pool tail-outs. Large cobble was the next most frequently observed dominant substrate type and occurred in 33% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Mill Creek was 91%. Nine percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 61% and 39%, respectively. Graph 9 describes the mean percent canopy in Mill Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 93%. The mean percent left bank vegetated was 92%. The dominant elements composing the structure of the stream banks consisted of 56% cobble/gravel, 27% sand/silt/clay, 9% bedrock, and 8% boulder (Graph 10). Deciduous trees were the dominant vegetation type observed in 47% of the units surveyed. Additionally, 36% of the units surveyed had coniferous trees as the dominant vegetation type, 14% had brush, and 2% had grass as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Nine sites were snorkeled for species composition and distribution in Mill Creek on July 21, 2009. Water temperatures, taken during the dive period of 1215 to 1430, ranged from 60 to 62 degrees Fahrenheit. Air temperatures ranged from 70 to 76 degrees Fahrenheit. The sites were sampled by I. Mikus and S. McSmith (DFG).

Mill Creek

In reach 1, which comprised the entire 2,735 feet of stream surveyed, 9 sites were sampled. The reach sites yielded 21 young-of-the-year steelhead/rainbow trout (SH/RT), 4 age 1+ SH/RT and 1 age 2+ SH/RT and 3 coho.

The following chart displays the information yielded from these sites:

2009 Mill 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									
07/21/09	1	005	5.6	203	3	0	0	1	0
07/21/09	2	015	4.2	470	2	0	0	0	0
07/21/09	3	017	4.2	518	5	0	0	1	0
07/21/09	4	021	5.5	656	4	1	0	0	0
07/21/09	5	025	4.2	919	5	1	0	1	0
07/21/09	6	030	4.2	1045	0	0	0	0	0
07/21/09	7	034	4.2	1109	1	1	0	0	0
07/21/09	8	045	4.2	1568	0	0	1	0	0
07/21/09	9	046	4.2	1606	1	1	0	0	0

DISCUSSION

Mill Creek is a B4 for the 2,735 feet of stream surveyed. The suitability of B4 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.

The water temperatures recorded on the survey day July 20, 2009 ranged from 59 to 63 degrees Fahrenheit. Air temperatures ranged from 59 to 86 degrees Fahrenheit. 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 34% of the total length of this survey, riffles 45%, and pools 19%. One of the 24 (4%) pools 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 structures that will increase or deepen pool habitat is recommended.

Mill Creek

Ten of the 24 pool tail-outs measured had embeddedness ratings of 1 or 2. Ten of the pool tail-outs had embeddedness ratings of 3 or 4. Four 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 Mill Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Twelve of the 24 pool tail-outs had silt, sand, large cobble, boulders or bedrock as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean shelter rating for pools is 21. The shelter rating in the flatwater habitats is 12. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Mill Creek. Boulders are the dominant cover type in pools followed by large woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 91%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 93% and 92%, 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) Mill 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 boulders. Adding high quality complexity with woody cover in the pools is desirable.
- 5) 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.

Mill Creek

- 6) Suitable size spawning substrate on Mill Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.

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 Units #:	Comments:
0	0001.00	The survey started at the confluence with Salmon Creek.
178	0005.00	There is erosion on the right bank that measures 80' long x 100' high. It is contributing sediment ranging from silt to gravel.
309	0011.00	This unit is the first out of the influence of Salmon Creek.
487	0017.00	There is erosion on the left bank that measures 120' long x 130' high. It is contributing sediment ranging from silt to gravel.
632	0021.00	There is a landslide on the right bank that is 20' long x 50' high. It is contributing sediment ranging from silt to gravel.
934	0027.00	Log debris accumulation (LDA) #01 contains 30 pieces of large woody debris (LWD) and measures 9' high x 40' wide x 17' long. There is no water flowing through and no there are visible gaps. Retained sediment ranges from fines to large cobble and measures 40' wide x 30' long x 5' deep. Fish are above the LDA.
1022	0030.00	There is a seep on the left bank.
1045	0031.00	There is left bank erosion. There is a seep on the left bank. The erosion is 12' wide x 20' high.
1175	0036.00	LDA #02 contains 9 pieces of LWD and measures 4.5' high x 30' wide x 6' long with water flowing through but there are no visible gaps. Retained sediment ranges from fines to gravel and measures 15' wide x 30' long x 2' deep. Fish are above the LDA. Small woody debris is plugging all visible gaps.
1568	0046.00	There is erosion on the right bank that is 50' long x 50' high. It is contributing sediment ranging in size from silt to cobble.

Mill Creek

1807	0051.00	There is erosion on the right bank that is 40' long x 70' high. It is contributing sediment ranging from silt to gravel.
1952	0056.00	There is right bank erosion that is 20' long x 40' high. It is contributing sediment ranging in size from silt to gravel.
2117	0062.00	There is a 1.5' boulder plunge. The pool maximum depth is 1.2'.
2200	0065.00	There is an LDA which appears to have been modified to open the stream flow.
2234	0067.00	There is a 3.3' log plunge. The maximum depth of the pool is 1'.
2654	0083.00	LDA #03 contains 14 pieces of LWD and measures 4.5' high x 30' wide x 9' long with water flowing through and no visible gaps. Retained sediment ranges from fines to cobble and measures 15' wide x 40' long x 4' deep. No fish were observed above the LDA, and it is a possible barrier to juvenile and adult salmonids.
2735	0085.00	This survey ended due to lack of access.

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.

Mill Creek

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: Mill Creek

LLID: 1238610402292 Drainage: Eel River - South Fork

Survey Dates: 7/20/2009 to 7/20/2009

Confluence Location: Quad: MIRANDA

Legal Description: T03SR03ES05

Latitude: 40:13:45.0N

Longitude: 123:51:40.0W

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	DRY	1.2	34	34	1.2									
25	3	FLATWATER	29.4	37	926	33.9	7.3	0.3	0.8	221	5513	71	1775		12
1	0	NOSURVEY	1.2	20	20	0.7									
24	24	POOL	28.2	22	519	19.0	7.9	0.6	1.3	168	4028	124	2987	95	21
34	5	RIFFLE	40.0	36	1236	45.2	8.0	0.3	0.7	255	8658	75	2557		11
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
85	32				2735					18199			7319		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Mill Creek

LLID: 1238610402292

Drainage: Eel River - South Fork

Survey Dates: 7/20/2009 to 7/20/2009

Confluence Location: Quad: MIRANDA

Legal Description: T03SR03ES05

Latitude: 40:13:45.0N

Longitude: 123:51:40.0W

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 (%)
15	1	LGR	17.6	34	507	18.5	5	0.2	0.3	60	900	12	180		5	97
19	4	HGR	22.4	38	729	26.7	9	0.3	1.3	303	5763	91	1729		13	97
12	1	RUN	14.1	20	236	8.6	10	0.3	0.6	120	1440	36	432		10	85
13	2	SRN	15.3	53	690	25.2	6	0.4	0.9	271	3520	89	1151		13	97
20	20	MCP	23.5	23	453	16.6	8	0.6	2.1	181	3629	139	2783	107	19	90
1	1	LSBo	1.2	24	24	0.9	5	0.3	1.1	114	114	46	46	34	5	96
3	3	PLP	3.5	14	42	1.5	9	0.4	1.3	95	285	53	158	37	38	79
1	0	DRY	1.2	34	34	1.2										
1	0	NS	1.2	20	20	0.7										

Total Units
85

Total Units Fully Measured
32

Total Length (ft.)
2735

Total Area (sq.ft.)
15651

Total Volume (cu.ft.)
6479

Table 3 - Summary of Pool Types

Stream Name: Mill Creek

LLID: 1238610402292

Drainage: Eel River - South Fork

Survey Dates: 7/20/2009 to 7/20/2009

Confluence Location: Quad: MIRANDA

Legal Description: T03SR03ES05

Latitude: 40:13:45.0N

Longitude: 123:51:40.0W

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
20	20	MAIN	83	23	453	87	7.8	0.6	181	3629	107	2132	19
4	4	SCOUR	17	17	66	13	8.3	0.4	100	399	36	144	30

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
24	24	519	4028	2276

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

Stream Name: Mill Creek

LLID: 1238610402292

Drainage: Eel River - South Fork

Survey Dates: 7/20/2009 to 7/20/2009

Confluence Location: Quad: MIRANDA

Legal Description: T03SR03ES05

Latitude: 40:13:45.0N

Longitude: 123:51:40.0W

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
20	MCP	83	5	25	14	70	1	5	0	0	0	0
1	LSBo	4	0	0	1	100	0	0	0	0	0	0
3	PLP	13	1	33	2	67	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
24	6	25	17	71	1	4	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.3

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Mill Creek

LLID: 1238610402292

Drainage: Eel River - South Fork

Survey Dates: 7/20/2009 to 7/20/2009

Dry Units: 1

Confluence Location: Quad: MIRANDA

Legal Description: T03SR03ES05

Latitude: 40:13:45.0N

Longitude: 123:51:40.0W

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
15	1	LGR	0	0	0	0	0	0	0	100	0
19	4	HGR	0	0	0	0	0	0	0	100	0
34	5	TOTAL RIFFLE	0	0	0	0	0	0	0	100	0
12	1	RUN	0	0	0	0	0	0	0	100	0
13	2	SRN	10	0	0	0	0	0	0	90	0
25	3	TOTAL FLAT	7	0	0	0	0	0	0	93	0
20	20	MCP	5	11	20	3	0	0	0	48	4
1	1	LSBo	0	0	0	0	0	0	0	100	0
3	3	PLP	2	0	23	0	0	0	5	70	0
24	24	TOTAL POOL	5	10	21	3	0	0	1	57	3
1	0	NS									
85	32	TOTAL	4	7	15	2	0	0	0	64	2

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Mill Creek

LLID: 1238610402292

Drainage: Eel River - South Fork

Survey Dates: 7/20/2009 to 7/20/2009

Dry Units: 1

Confluence Location: Quad: MIRANDA

Legal Description: T03SR03ES05

Latitude: 40:13:45.0N

Longitude: 123:51:40.0W

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
15	1	LGR	0	0	0	0	100	0	0
19	4	HGR	0	0	0	0	25	75	0
12	1	RUN	0	0	100	0	0	0	0
13	2	SRN	0	0	100	0	0	0	0
20	20	MCP	0	5	80	5	0	10	0
1	1	LSBo	0	0	100	0	0	0	0
3	3	PLP	0	0	67	0	0	33	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Mill Creek

LLID: 1238610402292

Drainage: Eel River - South Fork

Survey Dates: 7/20/2009 to 7/20/2009

Confluence Location: Quad: MIRANDA

Legal Description: T03SR03ES05

Latitude: 40:13:45.0N

Longitude: 123:51:40.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
91	39	61	0	93	92

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: Mill Creek LLLID: 1238610402292 Drainage: Eel River - South Fork
 Survey Dates: 7/20/2009 to 7/20/2009 Survey Length (ft.): 2735 Main Channel (ft.): 2735 Side Channel (ft.): 0
 Confluence Location: Quad: MIRANDA Legal Description: T03SR03ES05 Latitude: 40:13:45.0N Longitude: 123:51:40.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: B4	Canopy Density (%): 90.8	Pools by Stream Length (%): 19.0
Reach Length (ft.): 2735	Coniferous Component (%): 39.2	Pool Frequency (%): 28.2
Riffle/Flatwater Mean Width (ft.): 7.8	Hardwood Component (%): 60.8	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 96
Range (ft.): 15 to 37	Vegetative Cover (%): 92.3	2 to 2.9 Feet Deep: 4
Mean (ft.): 21	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 0
Std. Dev.: 7	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.2	Occurrence of LWD (%): 15	Mean Max Residual Pool Depth (ft.): 1.3
Water (F): 59 - 63 Air (F): 59 - 86	LWD per 100 ft.:	Mean Pool Shelter Rating: 21
Dry Channel (ft): 34	Riffles: 5	
	Pools: 9	
	Flat: 3	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 4 Gravel: 42 Sm Cobble: 8 Lg Cobble: 33 Boulder: 8 Bedrock: 4		
Embeddedness Values (%): 1. 8.3 2. 33.3 3. 16.7 4. 25.0 5. 16.7		

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Mill Creek

LLID: 1238610402292

Drainage: Eel River - South Fork

Survey Dates: 7/20/2009 to 7/20/2009

Confluence Location: Quad: MIRANDA

Legal Description: T03SR03ES05

Latitude: 40:13:45.0N

Longitude: 123:51:40.0W

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	3	3	9.4
Boulder	2	3	7.8
Cobble / Gravel	18	18	56.3
Sand / Silt / Clay	9	8	26.6

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	1	0	1.6
Brush	5	4	14.1
Hardwood Trees	14	16	46.9
Coniferous Trees	12	11	35.9
No Vegetation	0	1	1.6

Total Stream Cobble Embeddedness Values: 3

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

StreamName: Mill Creek

LLID: 1238610402292

Drainage: Eel River - South Fork

Survey Dates: 7/20/2009 to 7/20/2009

Confluence Location: Quad: MIRANDA

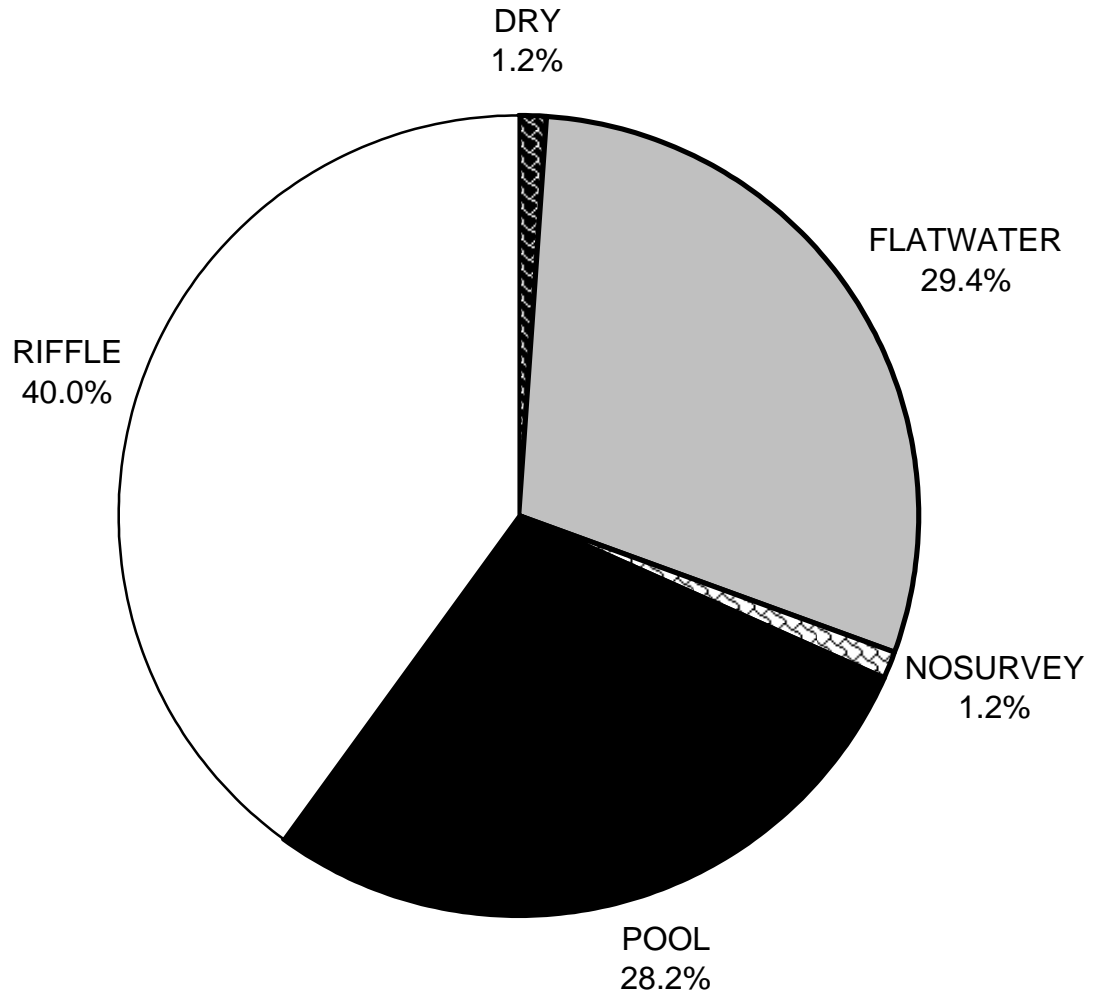
Legal Description: T03SR03ES05

Latitude: 40:13:45.0N

Longitude: 123:51:40.0W

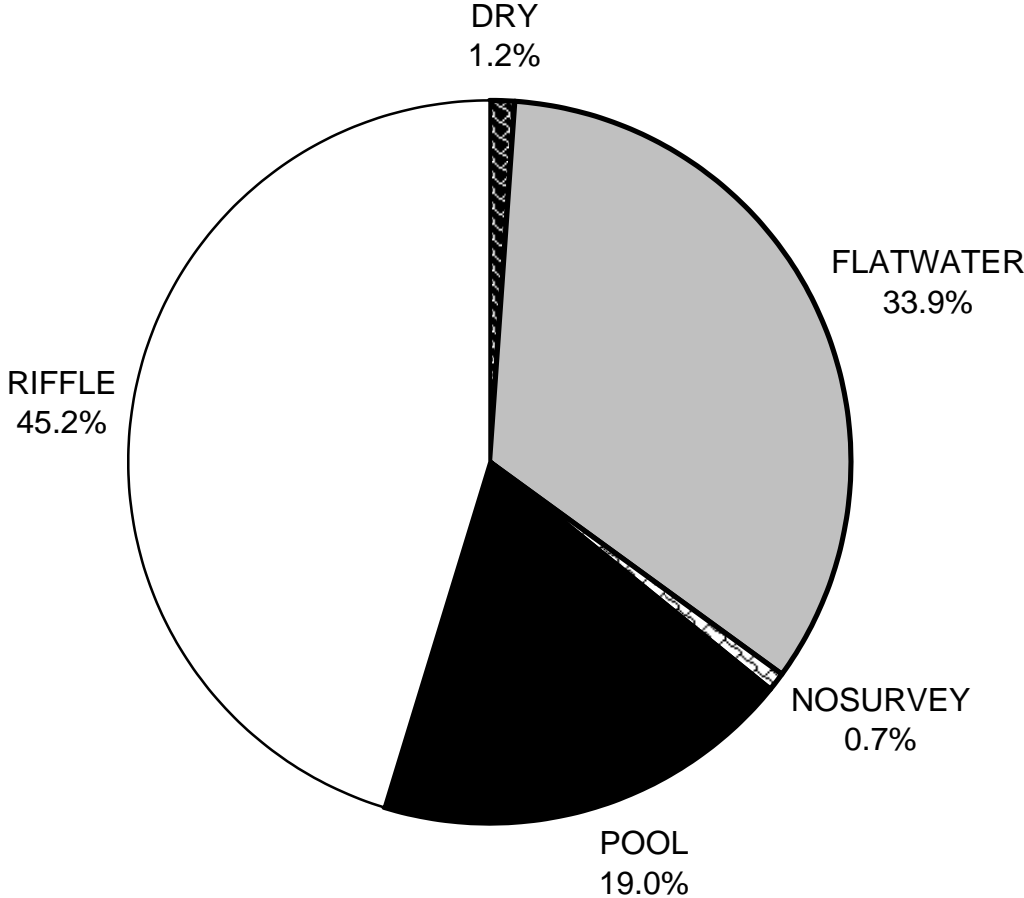
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	7	5
SMALL WOODY DEBRIS (%)	0	0	10
LARGE WOODY DEBRIS (%)	0	0	21
ROOT MASS (%)	0	0	3
TERRESTRIAL VEGETATION (%)	0	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	1
BOULDERS (%)	100	93	57
BEDROCK LEDGES (%)	0	0	3

MILL CREEK 2009 HABITAT TYPES BY PERCENT OCCURRENCE



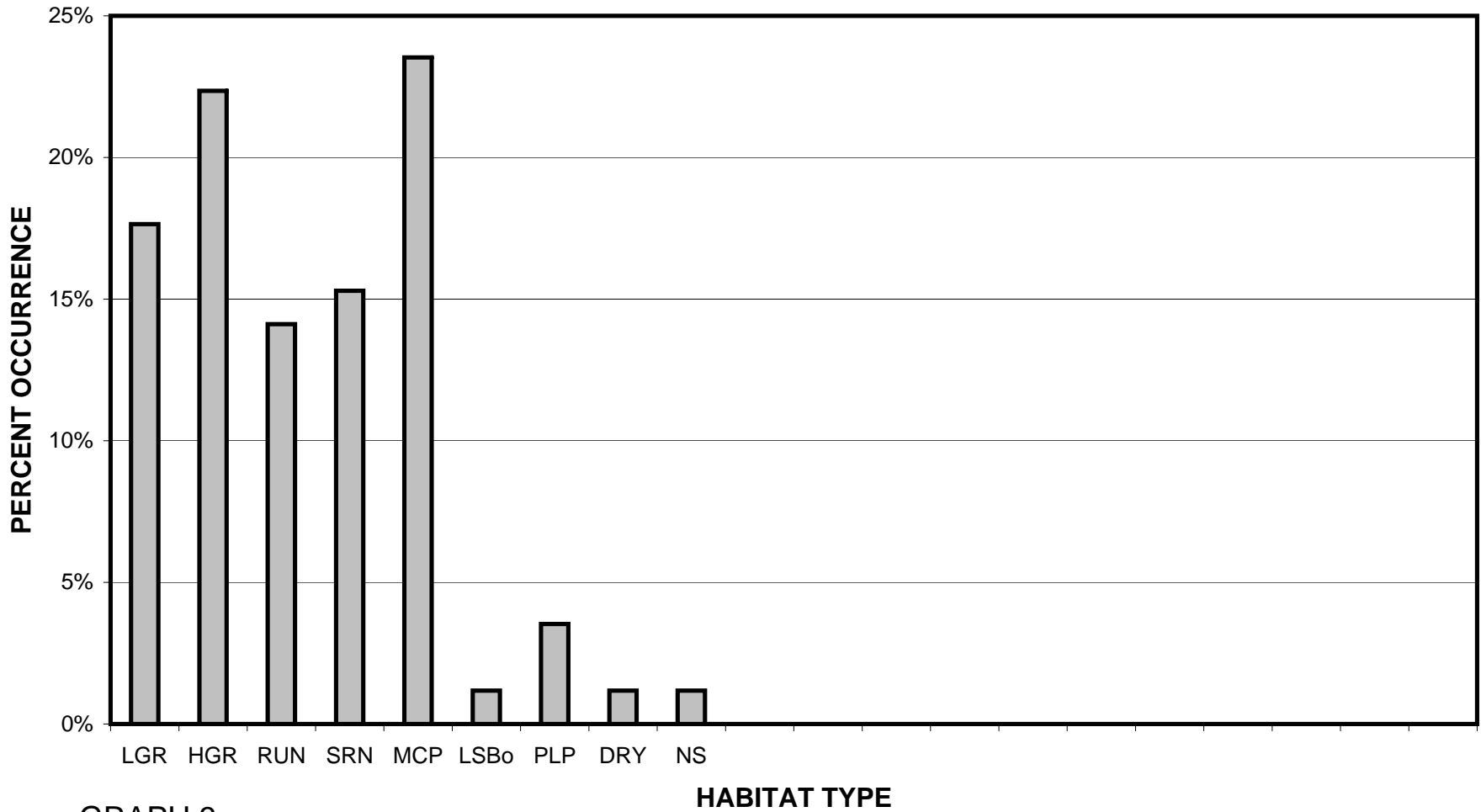
GRAPH 1

**MILL CREEK 2009
HABITAT TYPES BY PERCENT TOTAL LENGTH**



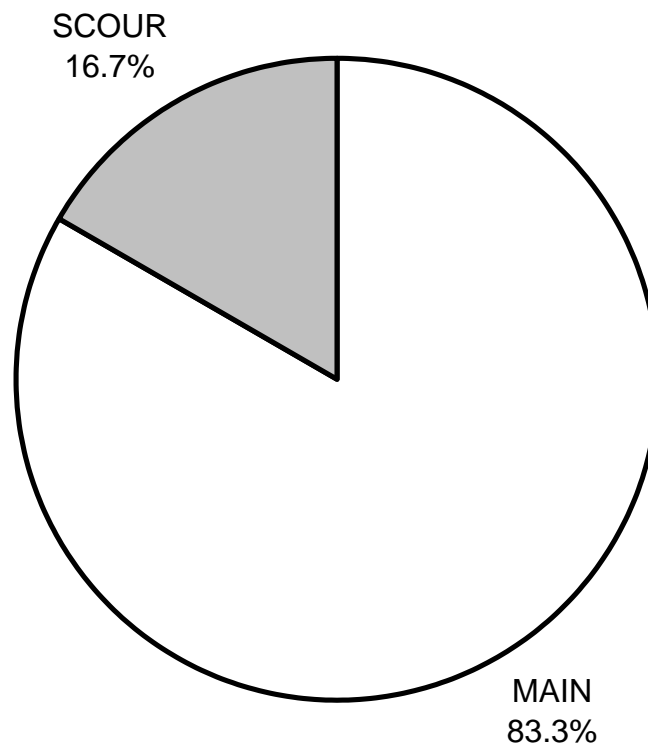
GRAPH 2

MILL CREEK 2009 HABITAT TYPES BY PERCENT OCCURRENCE



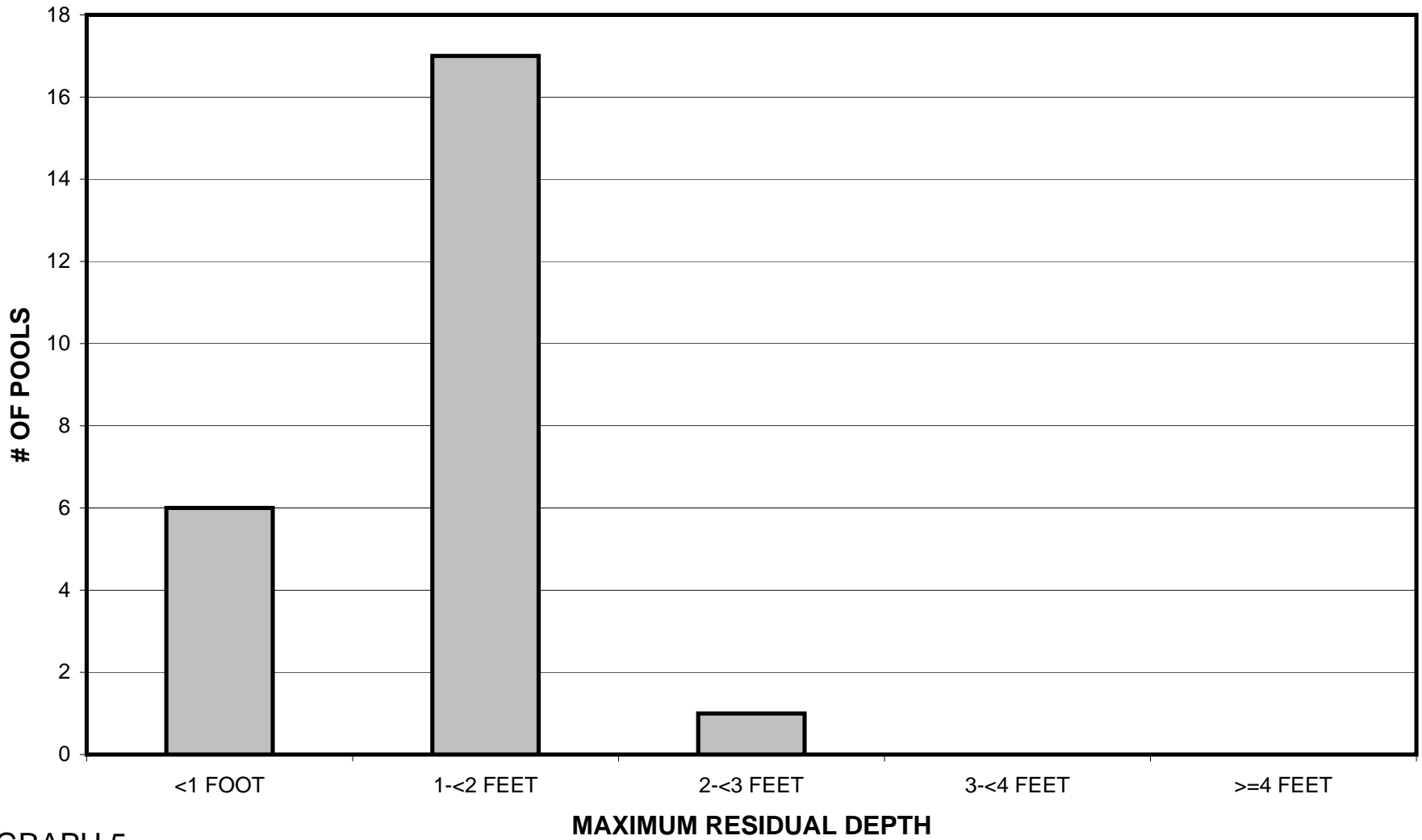
GRAPH 3

**MILL CREEK 2009
POOL TYPES BY PERCENT OCCURRENCE**



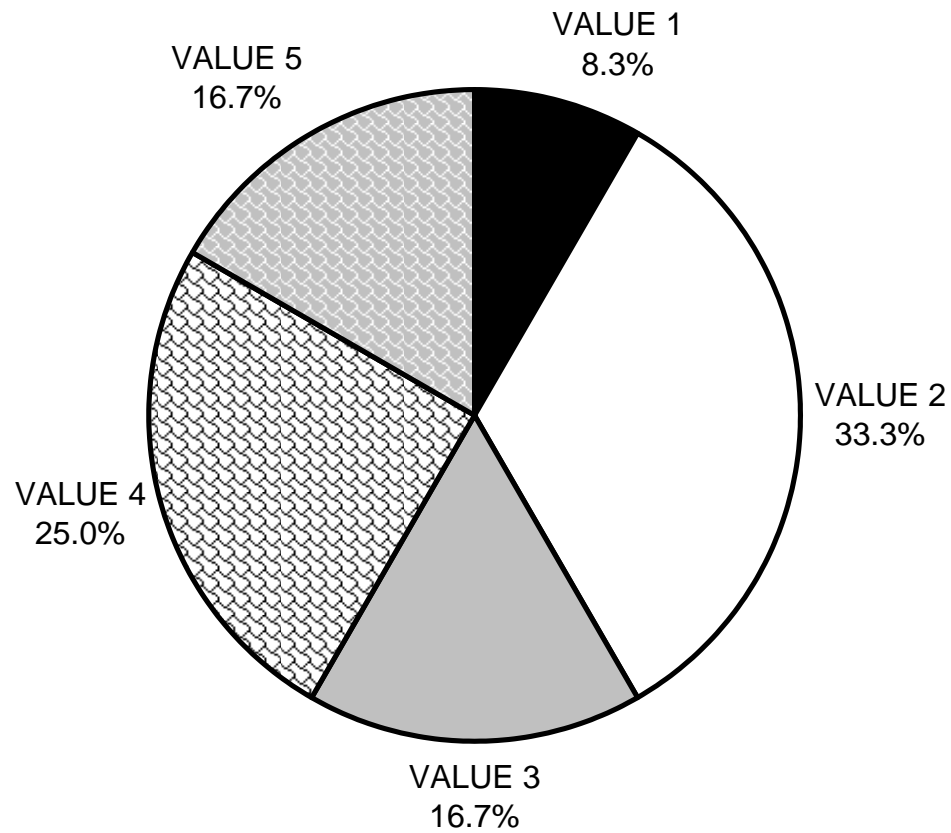
GRAPH 4

MILL CREEK 2009 MAXIMUM DEPTH IN POOLS



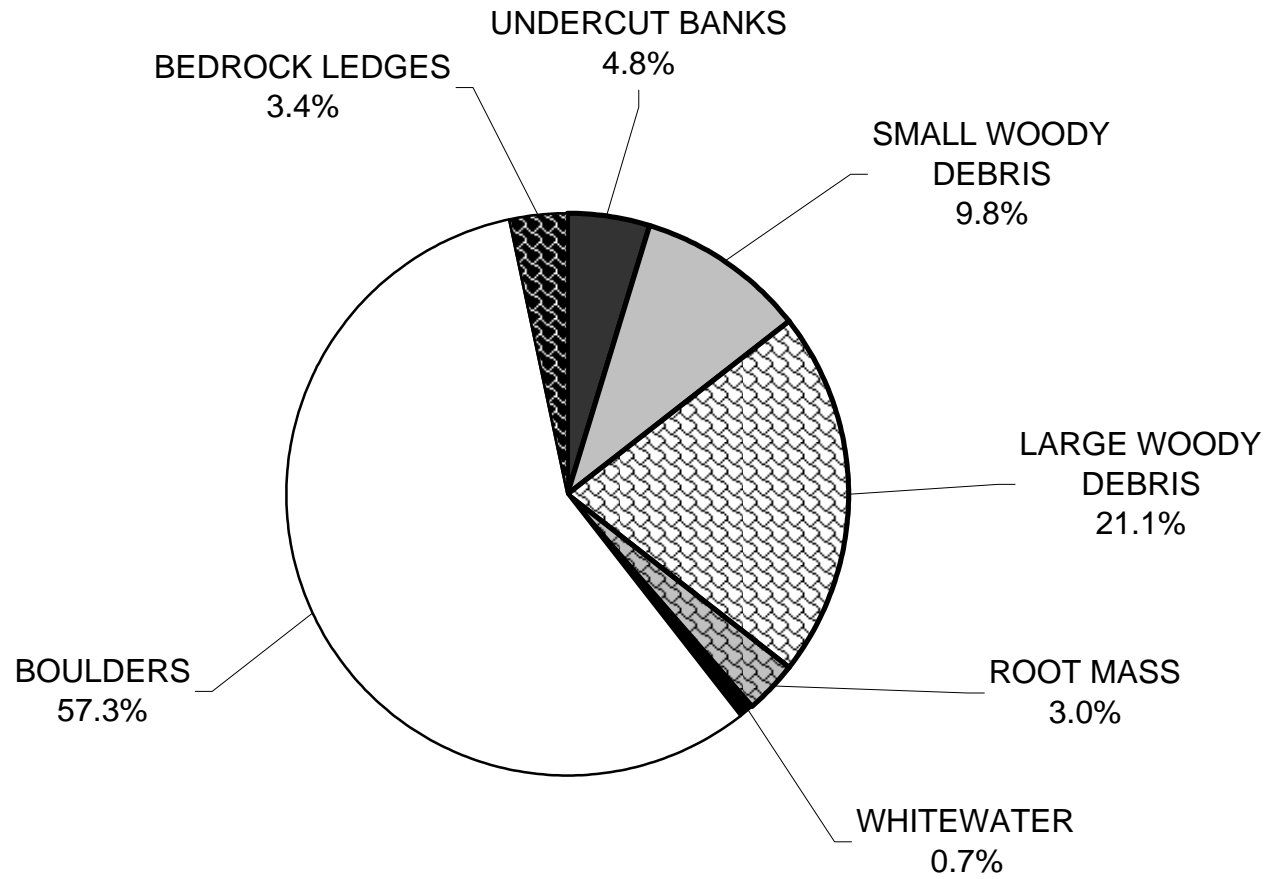
GRAPH 5

MILL CREEK 2009 PERCENT EMBEDDEDNESS



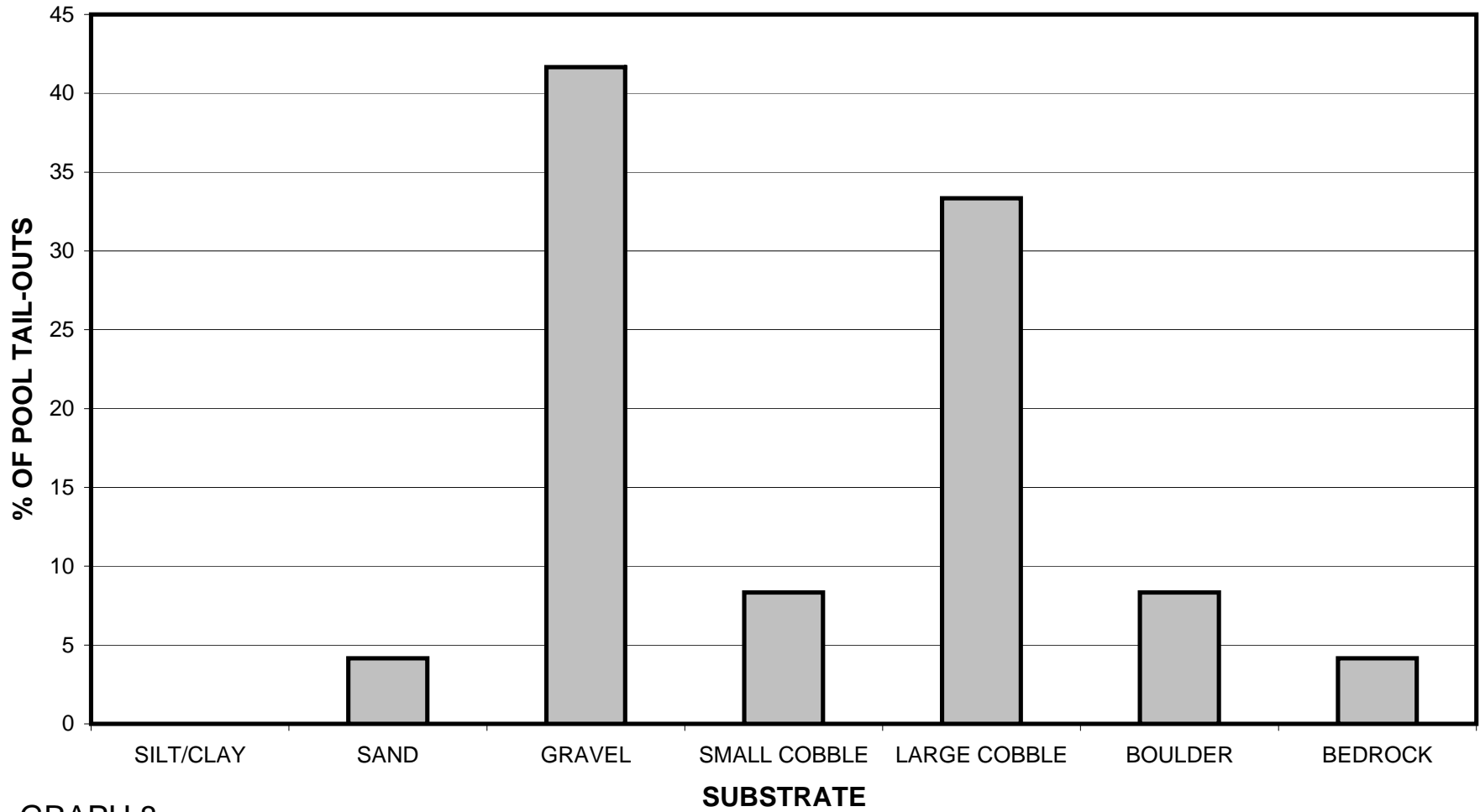
GRAPH 6

MILL CREEK 2009 MEAN PERCENT COVER TYPES IN POOLS



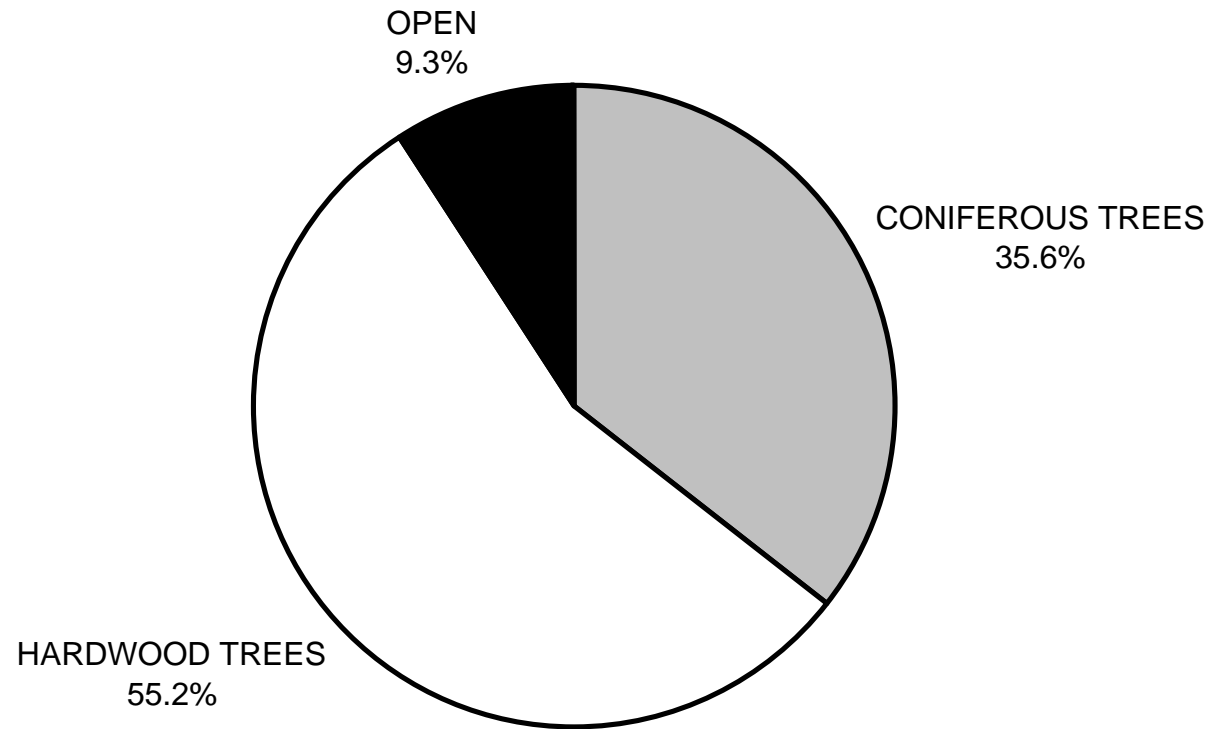
GRAPH 7

MILL CREEK 2009 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



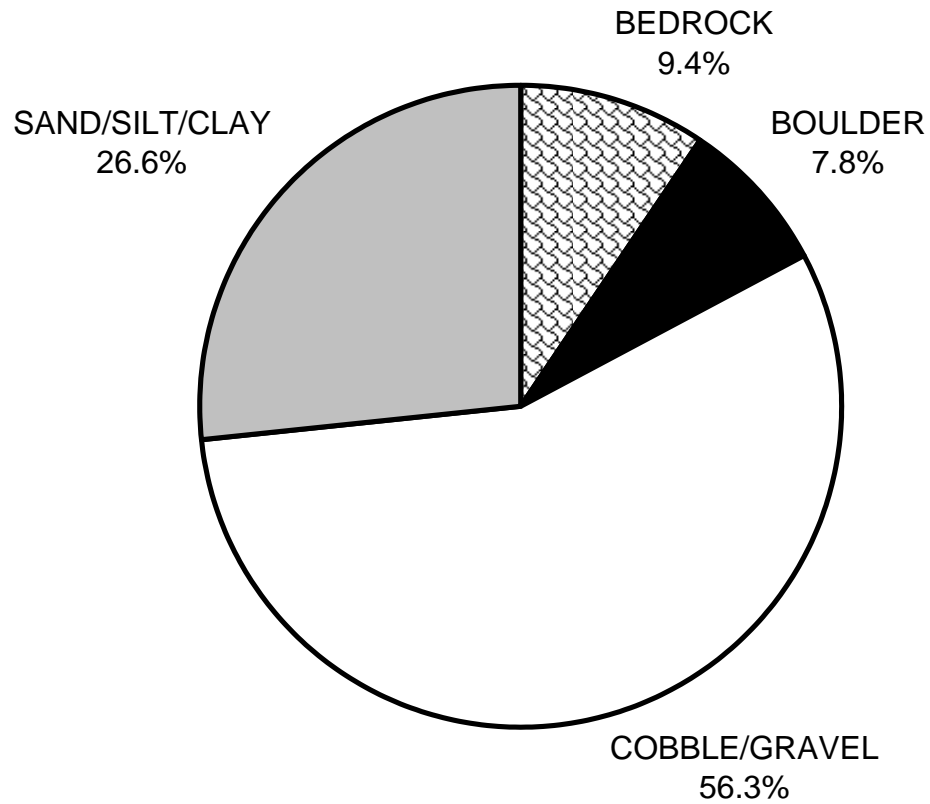
GRAPH 8

MILL CREEK 2009 MEAN PERCENT CANOPY



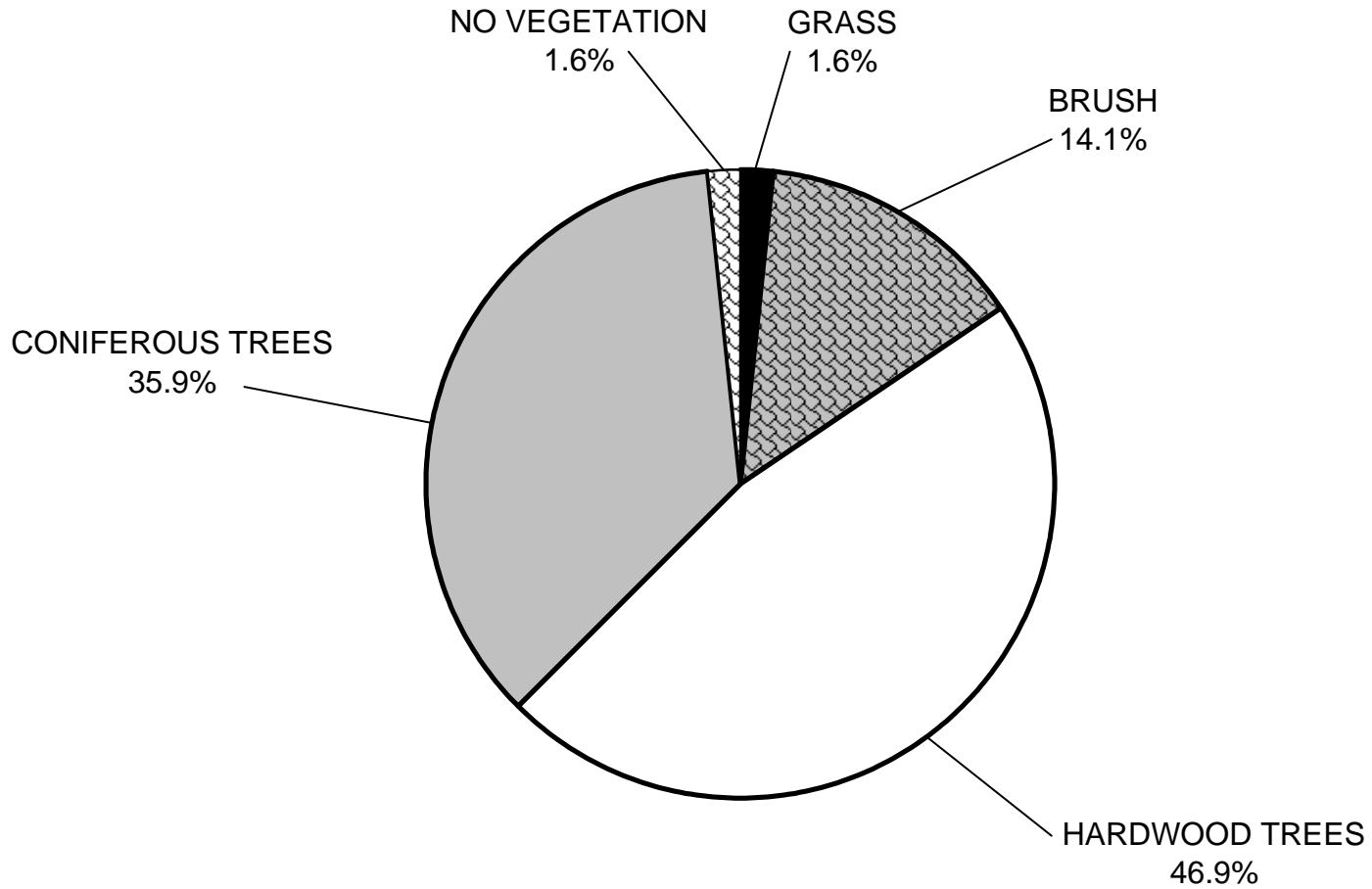
GRAPH 9

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



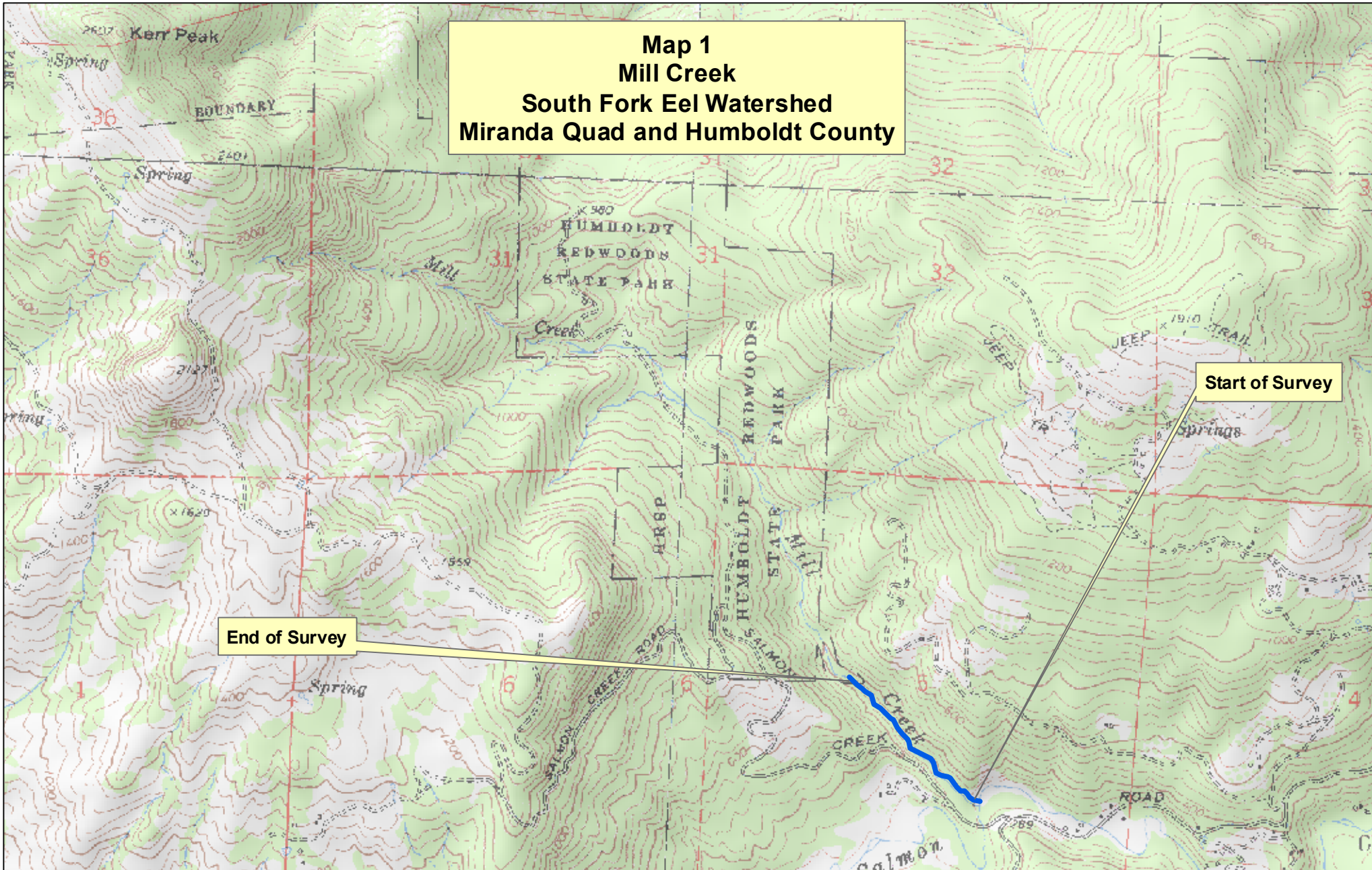
GRAPH 10

MILL CREEK 2009 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

Map 1
Mill Creek
South Fork Eel Watershed
Miranda Quad and Humboldt County



End of Survey

Start of Survey



Legend

 Mill Creek Reach 1

