

# STREAM INVENTORY REPORT

## Mill Creek

### INTRODUCTION

A stream inventory was conducted on July 9, 2007 on Mill Creek. The survey began at the confluence with Hall Creek and extended upstream 0.5 miles.

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

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for Chinook salmon, coho salmon, and steelhead trout. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

### WATERSHED OVERVIEW

Mill Creek is a tributary to Hall Creek, tributary to Mad River which drains to the Pacific Ocean, located in Humboldt County, California (Map 1). Mill Creek's legal description at the confluence with Hall Creek is T6N R1E S13. Its location is 40.9016 north latitude and 124.0075 west longitude, LLID number 1240075409016. Mill Creek is a first order stream and has approximately 2.1 miles of blue line stream according to the USGS Arcata North 7.5 minute quadrangle. Mill Creek drains a watershed of approximately 1.15 square miles. Elevations range from about 80 feet at the mouth of the creek to 1,100 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is primarily privately owned and is managed for timber production. Vehicle access exists via Highway 101, to Highway 299 East, to Glendale Drive, to McAdams Ranch 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 Conservation Corps (CCC) Technical Advisors and 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

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embeddedness. Habitat unit types encountered for the first time are measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

### HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in 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.

#### 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

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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 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 densiometers 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.

### 10. Large Woody Debris Count:

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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 is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks during habitat typing in Mill Creek. Bank observation techniques are 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 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 9, 2007, was conducted by K. Lindke & H. Sgalitzer, (WSP). The total length of the stream surveyed was 2,843 feet.

Stream flow was not measured on Mill Creek.

Mill Creek is a C4 channel type for the entire 2,843 feet of the stream surveyed (Reach 1). C4 channel types are meandering point-bar, riffle/pool alluvial channels with broad well defined floodplains on low gradients and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 56 to 58 degrees Fahrenheit. Air temperatures ranged from 64 to 70 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 44% riffle units, 23% flatwater units, 21% pool units, and 13% dry units (Graph 1). Based on total length of Level II habitat types there were 58% dry units, 27% riffle units, 9% flatwater units, and 5% pool units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 26% low gradient riffle units, 21% run units, and 18% high gradient riffle units (Graph 3). Based on percent total length, dry units made up 58%, low gradient riffle units 16%, and high gradient riffle units 12%.

A total of 8 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 62% (Graph 4), and comprised 65% of the total length of all pools (Table 3).

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Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. One of the 8 pools (12%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 8 pool tail-outs measured, 4 had a value of 3 (50%) and 4 had a value of 4 (50%) (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 2, flatwater habitat types had a mean shelter rating of 2, and pool habitats had a mean shelter rating of 10 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 10 and scour pools had a mean shelter rating of 10 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types 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 observed in 88% of pool tail-outs and small cobble was observed in 12% of pool tail-outs.

The mean percent canopy density for the surveyed length of Mill Creek was 93%. Seven percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 81% and 19%, respectively. Graph 9 describes the mean percent canopy in Mill Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 100%. The mean percent left bank vegetated was 94%. The dominant elements composing the structure of the stream banks consisted of 72% sand/silt/clay, 22% cobble/gravel, 3% bedrock, and 3% boulder (Graph 10). Brush was the dominant vegetation type observed in 44% of the units surveyed. Additionally, 41% of the units surveyed had deciduous trees as the dominant vegetation type, 9% had coniferous trees as the dominant vegetation, and 3% had grass as the dominant vegetation (Graph 11).

## BIOLOGICAL INVENTORY RESULTS

No biological survey was conducted during the 2007 stream survey.

## DISCUSSION

Mill Creek is a C4 channel type for the entire 2,843 feet of the stream surveyed. The suitability of C4 channel types for fish habitat improvement structures is as follows: C4 channel types are good for bank-placed boulders and are fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover.

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The water temperatures recorded on the survey day July 9, 2007, ranged from 56 to 58 degrees Fahrenheit. Air temperatures ranged from 64 to 70 degrees Fahrenheit. To make any further 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 9% of the total length of this survey, riffles 27%, and pools 5%. The pools are relatively shallow, with only 1 of the 8 (12%) pools having 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.

None of the 8 pool tail-outs measured had embeddedness ratings of 1 or 2. Eight 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 Mill Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

The 8 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 10. The shelter rating in the flatwater habitats was 2. 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 93%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 100% and 94%, 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) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

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- 3) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from boulders. Adding high quality complexity with woody cover in the pools is desirable.
- 4) 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.

### 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	This survey began at the confluence with Hall Creek. Mill Creek was dry for the first 867 feet. Bridge #1 crosses the creek 768' upstream of the confluence. The bridge was made of concrete and measured 10.5' wide, 4' high and 12' long. Below bridge #1, Mill Creek is heavily impacted by sediment and is overgrown with vegetation. The channel is unconfined and at higher flows the stream flows into an open field and then returns to its' channel before entering Hall Creek.
920	0003.00	The right bank was covered in concrete riprap.
1799	0015.00	There were 2 pieces of large woody debris (LWD) spanning the channel retaining large boulders and other sediment. The height was 5.5' from the bottom of the pool to the top of the retained sediment. There were two unknown salmonids observed in the pool, this is the last unit that salmonids were observed.
2830	0039.00	The survey ended at a possible end of anadromy. There was a 14% gradient and shallow boulder and bedrock jump pools with high jumps. Also, no fish have been observed since habitat unit #015.

### 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 }

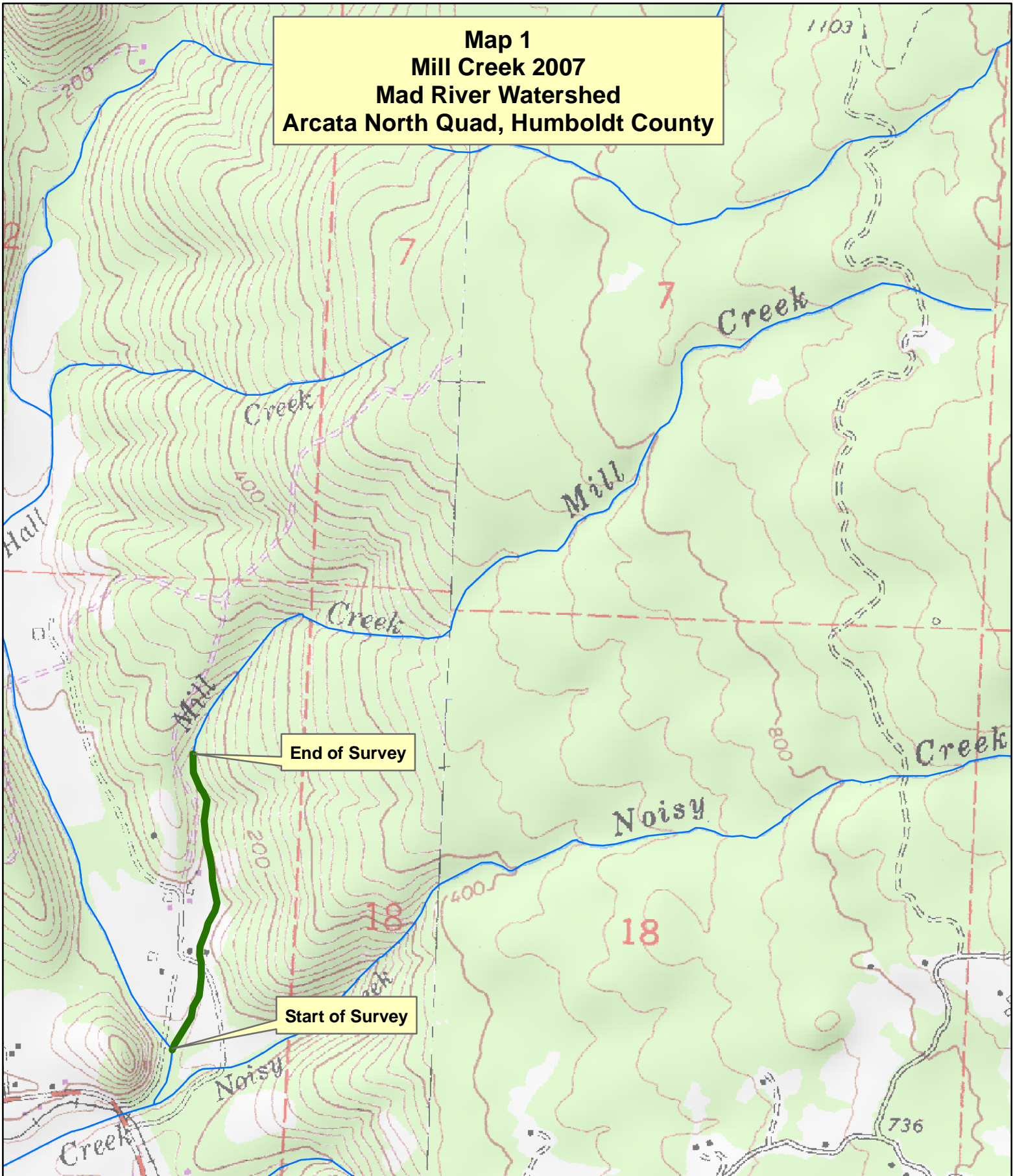
#### BACKWATER POOLS

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

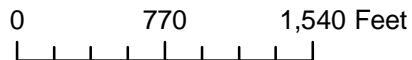
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

**Map 1**  
**Mill Creek 2007**  
**Mad River Watershed**  
**Arcata North Quad, Humboldt County**



**Legend**

 Reach 1, C4 Channel Type



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

Stream Name: Mill Creek

LLID: 1240075409016 Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Confluence Location: Quad: ARCATA NORTH Legal Description: T06NR01ES13 Latitude: 40:54:06.0N Longitude: 124:00:27.0

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
5	0	DRY	12.8	333	1663	58.5									
9	3	FLATWATER	23.1	28	249	8.8	5.0	0.5	0.8	134	1203	60	538		2
8	8	POOL	20.5	19	152	5.3	9.6	1.0	1.6	166	1329	181	1447	164	10
17	5	RIFFLE	43.6	46	779	27.4	4.0	0.2	0.4	104	1766	13	226		2
<b>Total Units</b>	<b>Total Units Fully Measured</b>				<b>Total Length (ft.)</b>					<b>Total Area (sq.ft.)</b>			<b>Total Volume (cu.ft.)</b>		
39	16				2843					4299			2211		

**Table 2 - Summary of Habitat Types and Measured Parameters**

Stream Name: Mill Creek

LLID: 1240075409016 Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Confluence Location: Quad: ARCATA NORTH Legal Description: T06NR01ES13 Latitude: 40:54:06.0N Longitude: 124:00:27.0W

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 (%)
10	2	LGR	25.6	44	441	15.5	4	0.1	0.2	52	521	5	52		0	97
7	3	HGR	17.9	48	338	11.9	4	0.2	0.8	138	969	19	131		3	99
8	2	RUN	20.5	27	217	7.6	5	0.5	0.8	137	1093	58	461		0	87
1	1	SRN	2.6	32	32	1.1	5	0.5	0.9	128	128	64	64		5	60
4	4	MCP	10.3	15	59	2.1	8	1.0	2.8	119	474	126	505	114	10	95
1	1	STP	2.6	40	40	1.4	7	1.0	1.6	224	224	246	246	224	10	100
1	1	LSL	2.6	22	22	0.8	9	1.4	1.7	198	198	297	297	277	15	98
1	1	LSBk	2.6	13	13	0.5	7	0.9	1.7	91	91	91	91	82	5	100
1	1	PLP	2.6	18	18	0.6	20	0.8	1.3	342	342	308	308	274	10	100
5	0	DRY	12.8	333	1663	58.5										

Total Units  
39

Total Units Fully Measured  
16

Total Length (ft.)  
2843

Total Area (sq.ft.)  
4040

Total Volume (cu.ft.)  
2155

**Table 3 - Summary of Pool Types**

Stream Name: Mill Creek

LLID: 1240075409016

Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES13

Latitude: 40:54:06.0N

Longitude: 124:00:27.0W

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
5	5	MAIN	63	20	99	65	8.2	1.0	140	698	136	682	10
3	3	SCOUR	38	18	53	35	12.0	1.0	210	631	211	633	10

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
8	8	152	1329	1314

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

Stream Name: Mill Creek

LLID: 1240075409016

Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES13

Latitude: 40:54:06.0N

Longitude: 124:00:27.0W

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
4	MCP	50	0	0	3	75	1	25	0	0	0	0
1	STP	13	0	0	1	100	0	0	0	0	0	0
1	LSL	13	0	0	1	100	0	0	0	0	0	0
1	LSBk	13	0	0	1	100	0	0	0	0	0	0
1	PLP	13	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
8	0	0	7	88	1	12	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.6

**Table 5 - Summary of Mean Percent Cover By Habitat Type**

Stream Name: Mill Creek

LLID: 1240075409016

Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Dry Units: 5

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES13

Latitude: 40:54:06.0N

Longitude: 124:00:27.0W

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
10	2	LGR	0	0	0	0	0	0	0	0	0
7	3	HGR	0	0	30	0	0	0	0	70	0
17	5	TOTAL RIFFLE	0	0	30	0	0	0	0	70	0
8	2	RUN	0	0	0	0	0	0	0	0	0
1	1	SRN	0	0	100	0	0	0	0	0	0
9	3	TOTAL FLAT	0	0	100	0	0	0	0	0	0
4	4	MCP	0	0	27	0	7	0	0	67	0
1	1	STP	0	0	0	0	0	0	0	100	0
1	1	LSL	80	0	20	0	0	0	0	0	0
1	1	LSBk	0	0	0	0	0	0	0	100	0
1	1	PLP	0	20	0	0	0	0	0	80	0
8	8	TOTAL POOL	11	3	14	0	3	0	0	69	0
39	16	TOTAL	9	2	26	0	2	0	0	61	0

**Table 6 - Summary of Dominant Substrates By Habitat Type**

Stream Name: Mill Creek

LLID: 1240075409016

Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Dry Units: 5

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES13

Latitude: 40:54:06.0N

Longitude: 124:00:27.0W

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
10	2	LGR	0	0	100	0	0	0	0
7	3	HGR	0	0	67	33	0	0	0
8	2	RUN	0	100	0	0	0	0	0
1	1	SRN	0	0	100	0	0	0	0
4	4	MCP	0	50	0	25	0	25	0
1	1	STP	0	0	100	0	0	0	0
1	1	LSL	0	100	0	0	0	0	0
1	1	LSBk	0	0	0	100	0	0	0
1	1	PLP	0	100	0	0	0	0	0



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

Stream Name: Mill Creek

LLID: 1240075409016

Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES13

Latitude: 40:54:06.0N

Longitude: 124:00:27.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
93	19	81	0	100	94

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

LLID: 1240075409016

Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Survey Length (ft.): 2843

Main Channel (ft.): 2843

Side Channel (ft.): 0

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES13

Latitude: 40:54:06.0N

Longitude: 124:00:27.0W

**Summary of Fish Habitat Elements By Stream Reach****STREAM REACH: 1**

Channel Type: C4

Canopy Density (%): 93.4

Pools by Stream Length (%): 5.3

Reach Length (ft.): 2843

Coniferous Component (%): 19.3

Pool Frequency (%): 20.5

Riffle/Flatwater Mean Width (ft.): 4.4

Hardwood Component (%): 80.7

Residual Pool Depth (%):

BFW:

Dominant Bank Vegetation: Brush

&lt; 2 Feet Deep: 88

Range (ft.): 11 to 13

Vegetative Cover (%): 96.9

2 to 2.9 Feet Deep: 13

Mean (ft.): 12

Dominant Shelter: Boulders

3 to 3.9 Feet Deep: 0

Std. Dev.: 1

Dominant Bank Substrate Type: Sand/Silt/Clay

&gt;= 4 Feet Deep: 0

Base Flow (cfs.): 0.0

Occurrence of LWD (%): 14

Mean Max Residual Pool Depth (ft.): 1.6

Water (F): 56 - 58 Air (F): 64 - 70

LWD per 100 ft.:

Mean Pool Shelter Rating: 10

Dry Channel (ft): 1663

Riffles: 0

Pools: 3

Flat: 0

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 88 Sm Cobble: 13 Lg Cobble: 0 Boulder: 0 Bedrock: 0

Embeddedness Values (%): 1. 0.0 2. 0.0 3. 50.0 4. 50.0 5. 0.0

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

Stream Name: Mill Creek

LLID: 1240075409016

Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES13

Latitude: 40:54:06.0N

Longitude: 124:00:27.0W

**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	1	0	3.1
Boulder	1	0	3.1
Cobble / Gravel	4	3	21.9
Sand / Silt / Clay	10	13	71.9

**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	3.1
Brush	7	7	43.8
Hardwood Trees	5	8	40.6
Coniferous Trees	2	1	9.4
No Vegetation	1	0	3.1

**Total Stream Cobble Embeddedness Values:** 4

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

StreamName: Mill Creek

LLID: 1240075409016

Drainage: Blue Lake

Survey Dates: 7/9/2007 to 7/9/2007

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES13

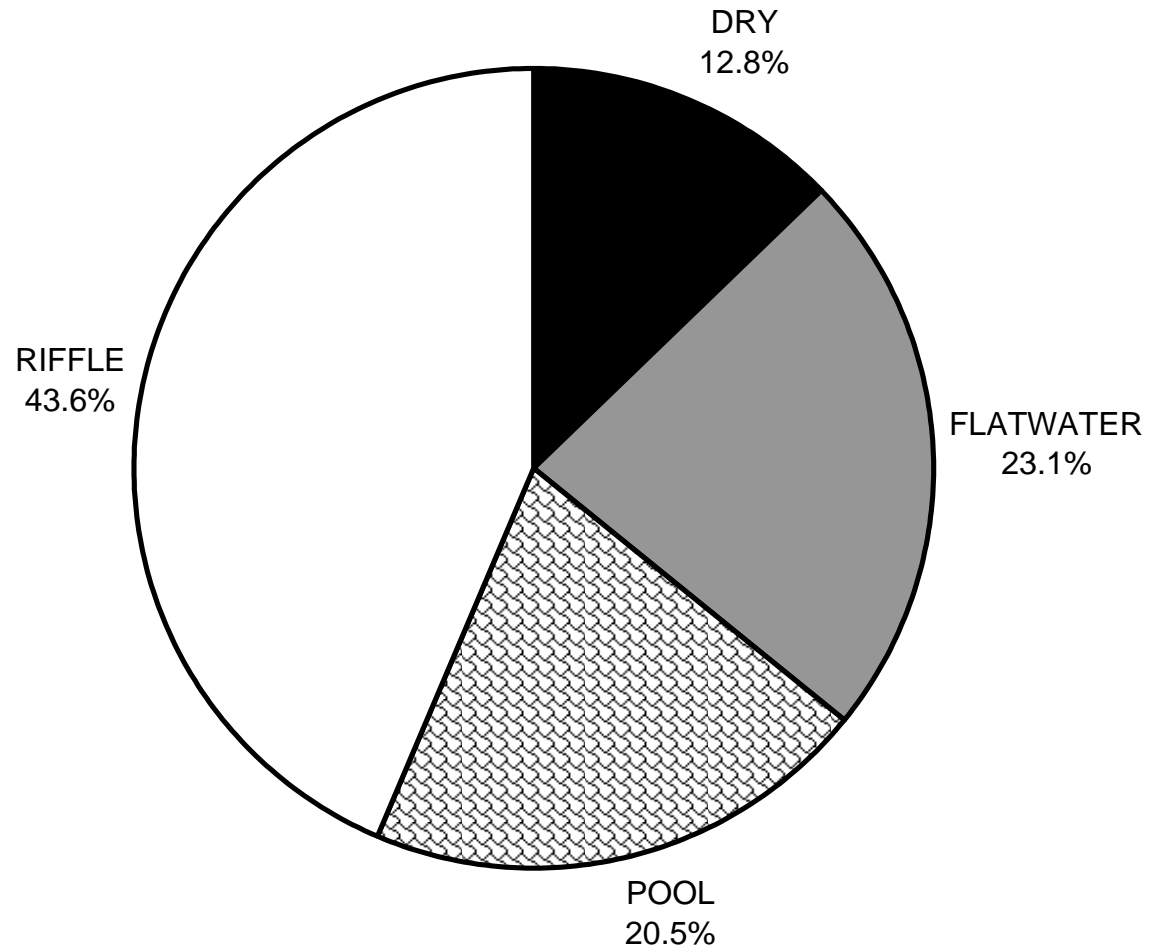
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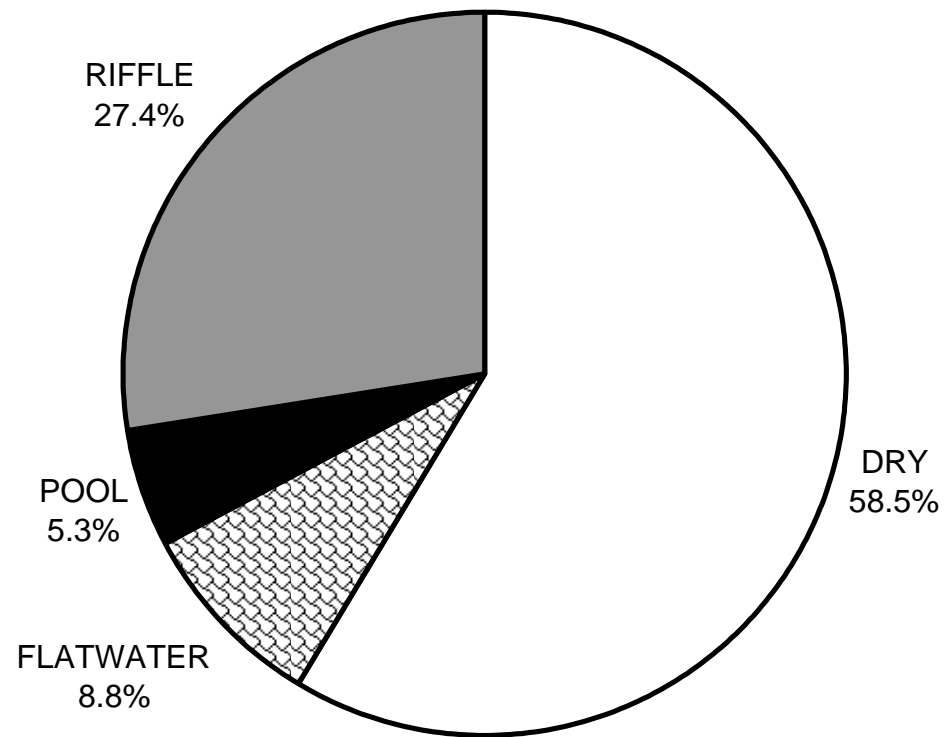
	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
UNDERCUT BANKS (%)	0	0	11
SMALL WOODY DEBRIS (%)	0	0	3
LARGE WOODY DEBRIS (%)	30	100	14
ROOT MASS (%)	0	0	0
TERRESTRIAL VEGETATION (%)	0	0	3
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	0
BOULDERS (%)	70	0	69
BEDROCK LEDGES (%)	0	0	0

# MILL CREEK 2007 HABITAT TYPES BY PERCENT OCCURRENCE



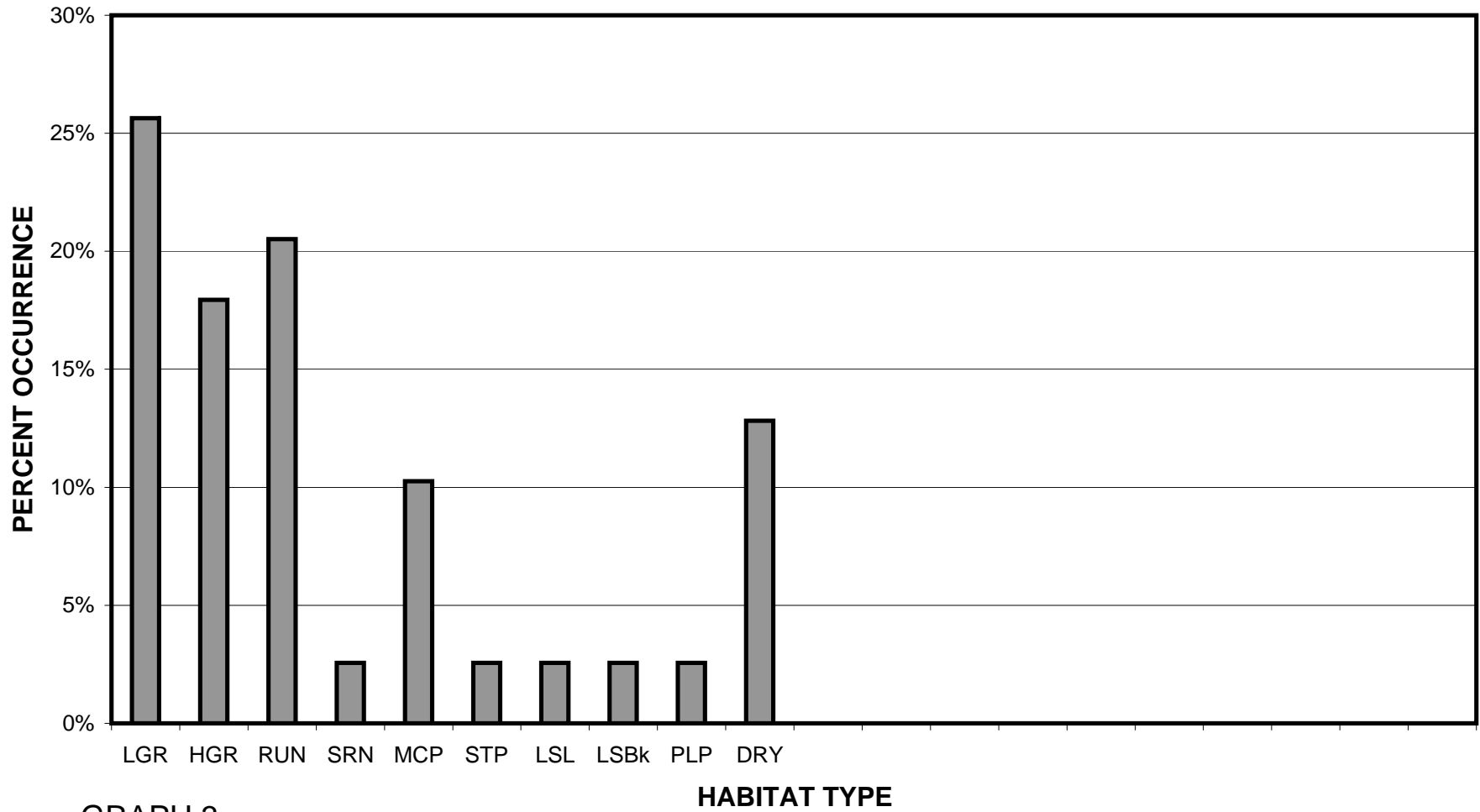
GRAPH 1

**MILL CREEK 2007**  
**HABITAT TYPES BY PERCENT TOTAL LENGTH**



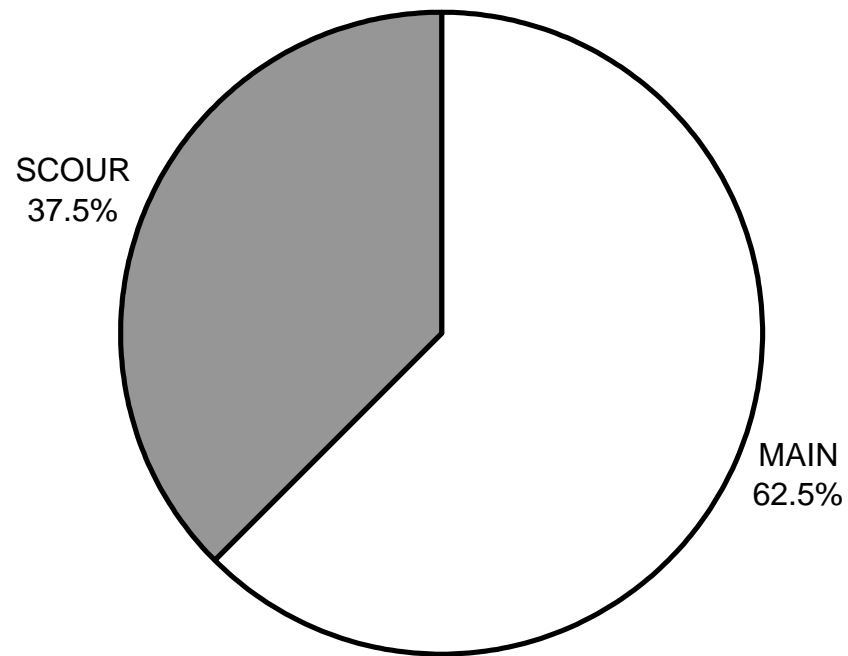
GRAPH 2

# MILL CREEK 2007 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

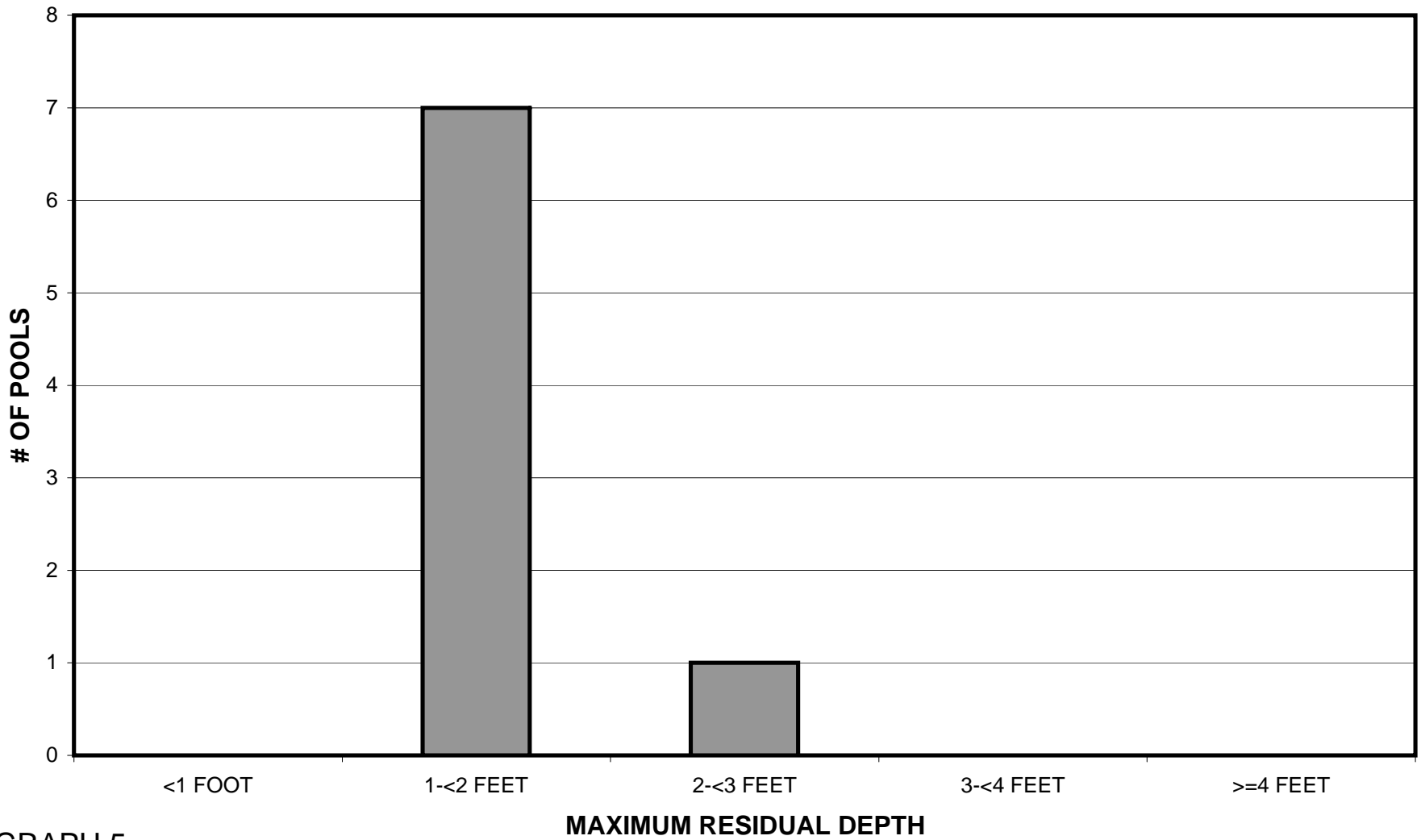
**MILL CREEK 2007  
POOL TYPES BY PERCENT OCCURRENCE**



GRAPH 4

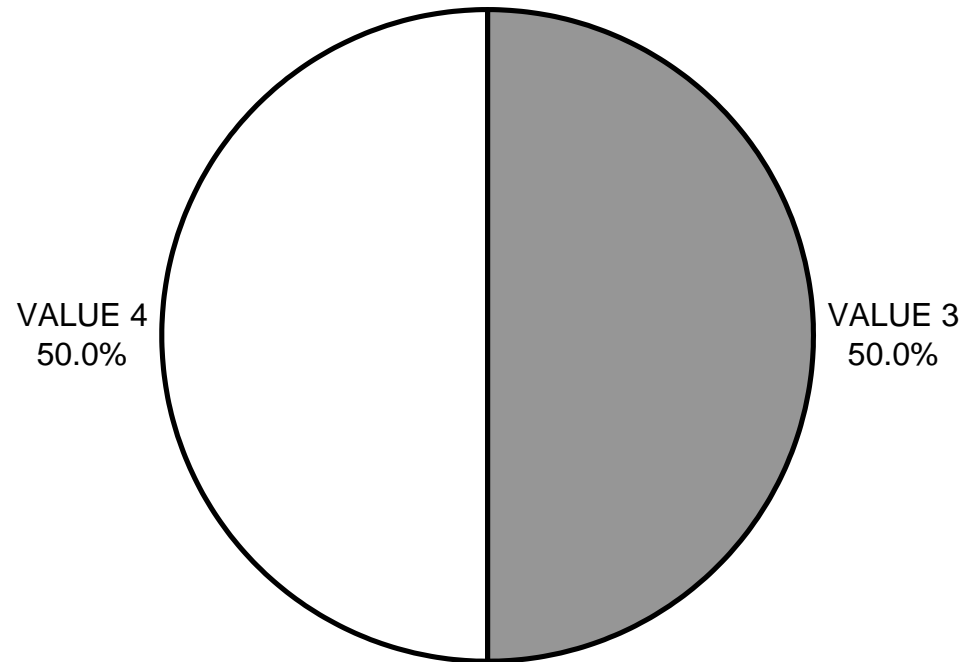


# MILL CREEK 2007 MAXIMUM DEPTH IN POOLS



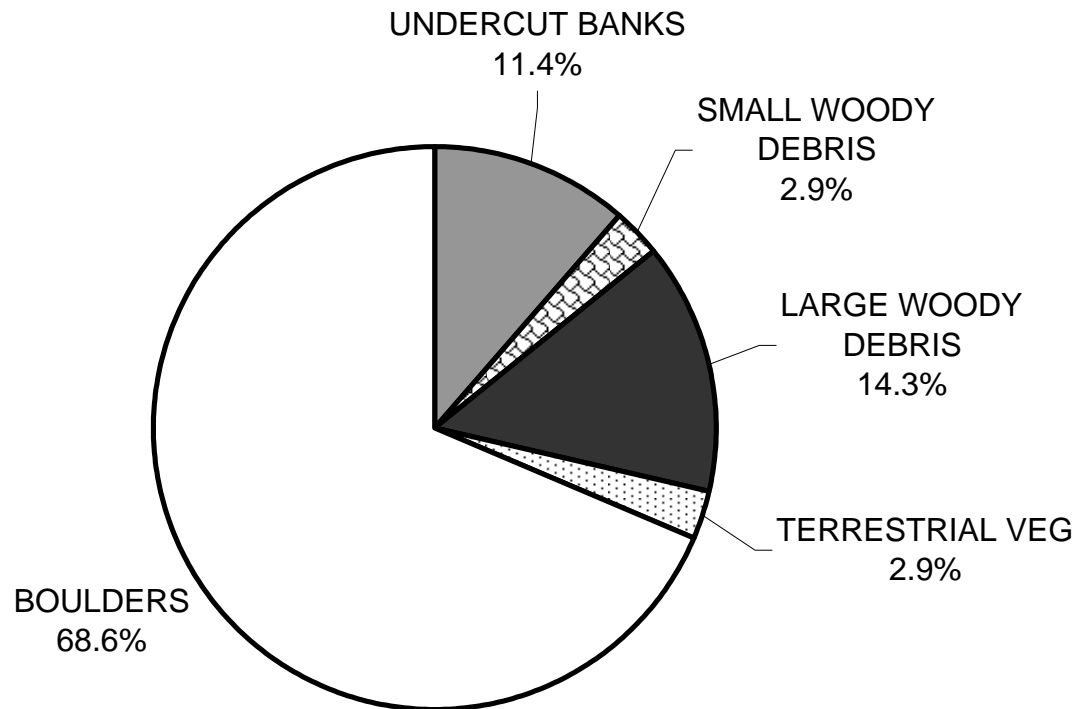
GRAPH 5

# MILL CREEK 2007 PERCENT EMBEDDEDNESS



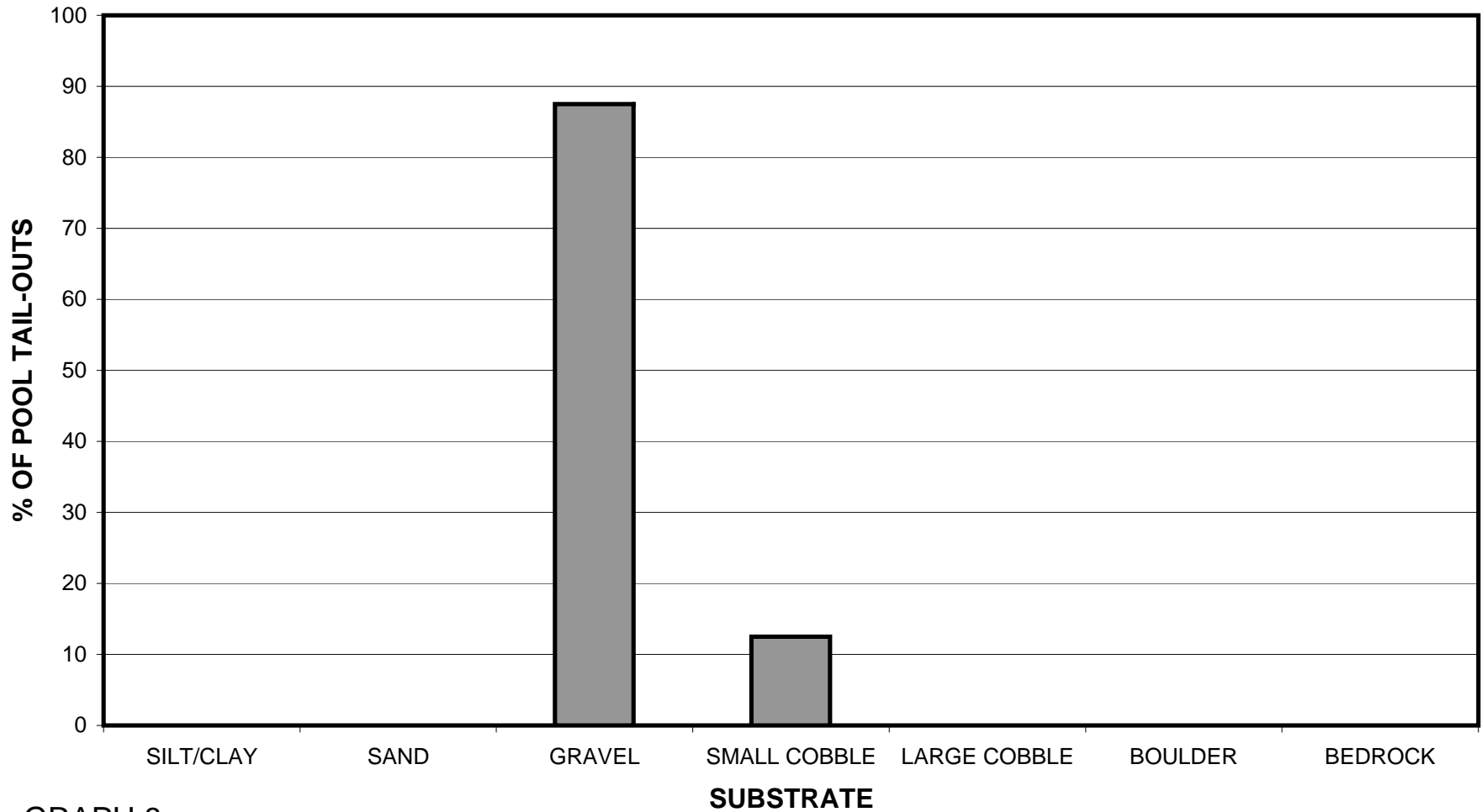
GRAPH 6

# MILL CREEK 2007 MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

# MILL CREEK 2007 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



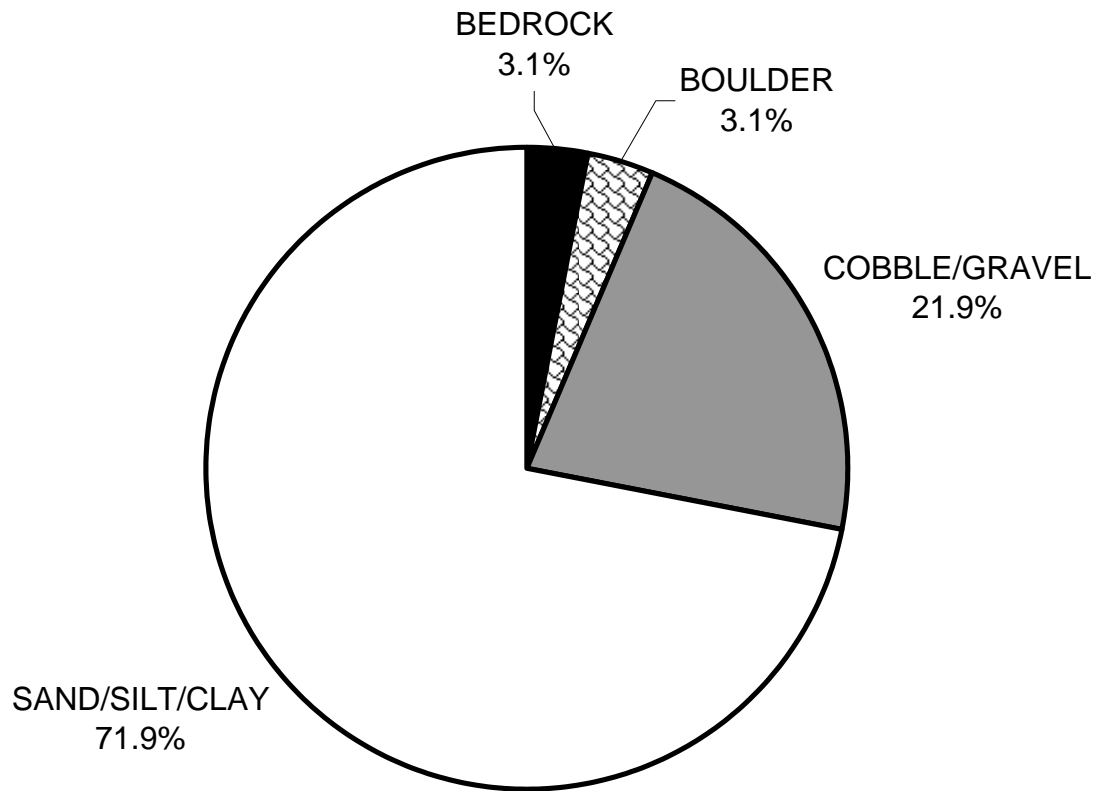
GRAPH 8

**MILL CREEK 2007  
MEAN PERCENT CANOPY**



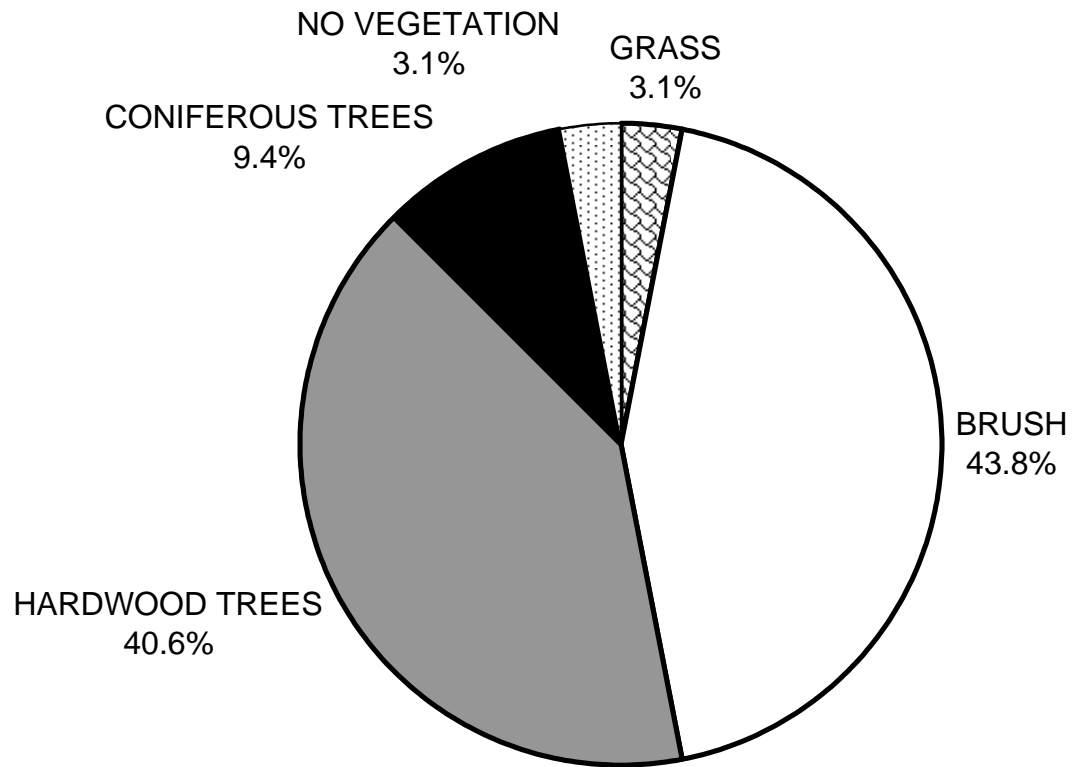
GRAPH 9

**MILL CREEK 2007  
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

# MILL CREEK 2007 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11