

# STREAM INVENTORY REPORT

## Mill Creek

### INTRODUCTION

A stream inventory was conducted from October 2 to October 10, 2012 on Mill Creek. The survey began at the confluence with Ten Mile River and extended upstream two 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 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 Ten Mile River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Mill Creek's legal description at the confluence with Ten Mile River is T20N R17W S34. Its location is 39.5481 degrees north latitude and 123.7349 degrees west longitude, LLID number 1237336395481. Mill Creek is a first order stream and has approximately 1.7 miles of blue line stream according to the USGS Dutchmans Knoll 7.5 minute quadrangle. Mill Creek drains a watershed of approximately 2.7 square miles. Elevations range from about 10 feet at the mouth of the creek to 900 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Georgia-Pacific Industrial Road north of Fort Bragg, CA.

### 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 Wildlife (CDFW) personnel that conducted the inventory were trained in standardized habitat inventory methods by the CDFW. 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

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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 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:

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

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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 17 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

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

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- 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 October 2 to October 10, 2012 was conducted by M. Groff and I. Mikus (CDFW). The total length of the stream surveyed was 10,319 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.52 cfs on October 3, 2012.

Mill Creek is a C4 channel type for 3,443 feet of the stream surveyed (Reach 1) and an F4 channel type for 6,876 feet of the stream surveyed (Reach 2). C4 channels are meandering point-bar, riffle/pool, alluvial channels with broad well defined floodplain on low gradients and gravel-dominant substrates. F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 50 to 53 degrees Fahrenheit. Air temperatures ranged from 45 to 63 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 42% pool units, 30% flatwater units, 28% riffle units, and 1% dry units (Graph 1). Based on total length of Level II habitat types there were 43% flatwater units, 32% pool units, 19% riffle units, and 6% dry units, (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 29%; low gradient riffle units, 26%; and step run units, 18% (Graph 3). Based on percent total length, step run units made up 34%, mid-channel pool units 24%, and low gradient riffle units 18%.

A total of 121 pools were identified (Table 3). Main channel pools were the most frequently encountered at 69% (Graph 4), and comprised 74% 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. Seventeen of the 121 pools (14%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 121 pool tail-outs measured, 43 had a value of 1 (35.5%); 56 had a value of 2 (46.3%); 19 had a value of 3 (15.7%); three had a value of 5 (2.5%) (Graph 6). On this scale, a value of 1 indicates the best

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spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed not suitable for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 0, flatwater habitat types had a mean shelter rating of 0, and pool habitats had a mean shelter rating of 10 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 15. Scour pools had a mean shelter rating of 12 and main channel pools had a mean shelter rating of 9 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Mill Creek. Graph 7 describes the pool cover in Mill 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 94% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 2% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Mill Creek was 98%. Two percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 88% and 12%, respectively. Graph 9 describes the mean percent canopy in Mill Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 99%. The mean percent left bank vegetated was 98%. The dominant elements composing the structure of the stream banks consisted of 89% sand/silt/clay, 5% boulders, 4% bedrock, and 2% cobble/gravel (Graph 10). Deciduous trees were the dominant vegetation type observed in 57% of the units surveyed. Additionally, 35% of the units surveyed had brush as the dominant vegetation type, and 7% had coniferous trees as the dominant vegetation type (Graph 11).

## BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 17 sites for species composition and distribution in Mill Creek on October 11, 2012 from 0830 to 0947. The sites were sampled by I. Mikus and M. Groff (CDFW).

In Reach 1, which comprised the first 3,443 feet of stream, seven sites were sampled. The reach sites yielded 24 young-of-the-year (YOY) steelhead/rainbow trout (SH/RT), four age 1+ SH/RT, two YOY coho salmon, four age 1+ coho salmon, and nine sculpin.

In Reach 2, ten sites were sampled starting approximately 3,477 from the confluence with Ten Mile River and continuing upstream 1,873 feet. The reach sites yielded 21 YOY SH/RT, seven age 1+ SH/RT, one age 2+ SH/RT, and three sculpin.

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The following chart displays the information yielded from these sites:

2012 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: C4 Channel Type									
10/11/12	1	005	pool	716	8	0	0	1	0
	2	017	pool	1,591	2	1	0	0	0
	3	019	pool	1,633	4	1	0	0	0
	4	022	pool	1,779	3	2	0	0	0
	5	032	pool	2,380	3	0	0	0	0
	6	036	pool	2,495	2	0	0	0	3
	7	042	pool	2,684	2	0	0	1	1
Reach 2: F4 Channel Type									
10/11/12	8	061	pool	3,477	3	0	0	0	0
	9	068	pool	3,772	1	0	0	0	0
	10	077	pool	4,191	0	3	0	0	0
	11	082	pool	4,418	2	1	1	0	0
	12	088	pool	4,578	0	1	0	0	0
	13	093	pool	4,858	5	0	0	0	0
	14	095	pool	4,905	3	0	0	0	0
	15	097	pool	4,948	4	1	0	0	0
	16	101	pool	5,049	1	1	0	0	0
	17	113	pool	5,350	2	0	0	0	0

## DISCUSSION

Mill Creek is a C4 channel type for the first 3,443 feet of stream surveyed and an F4 channel type for the next 6,876 feet. The suitability of C4 and F4 channel types for fish habitat improvement structures is as follows: C4 channel types are good for bank placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. F4 channel types are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover.

The water temperatures recorded on the survey days October 2 to October 10, 2012, ranged from 50 to 53 degrees Fahrenheit. Air temperatures ranged from 45 to 63 degrees Fahrenheit. This is a good water temperature range for salmonids. To make any conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

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Flatwater habitat types comprised 43% of the total length of this survey, riffles 19%, and pools 32%. Seventeen of the 121 (14%) pools had a maximum residual depth greater than two 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 log structure that will increase or deepen pool habitat is recommended.

Ninety-nine of the 121 pool tail-outs measured had embeddedness ratings of 1 or 2. Nineteen of the pool tail-outs had embeddedness ratings of 3 or 4. Three of the pool tail-outs had a rating of 5, which is considered not suitable 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.

One hundred seventeen of the 121 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 10. The shelter rating in the flatwater habitats is 0. 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 Mill Creek. Large woody debris is the dominant cover type in pools followed by small woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structures 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 98%. Reach 1 had a canopy density of 98% and Reach 2 had a canopy density of 98%. The percentage of right and left bank covered with vegetation was 99% and 98%, respectively.

## 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) 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.



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### COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

Position (ft):	Unit # Habitat:	Comments:
0	0001.00	Start of survey at the confluence with Ten Mile River. The channel type is a C4. The first 600' of the stream were dry.
601	0002.00	Dead young-of-the-year (YOY) salmonids in the pool.
746	0007.00	Ten Mile Haul Road crosses the channel. The crossing is a 20' wide x 31' long x 6' high railcar bridge. The bridge abutments are half circle corrugated metal pipes with concrete fill, three on each side. The left bank has boulder rip-rap below the abutment and is being undercut.
3443	0061.00	The channel type changes from a C4 to an F4.
3772	0069.00	Dry left bank tributary.
3811	0070.00	Log debris accumulation (LDA) #01 contains 15 pieces of large woody debris (LWD) and measures 5' high x 26' wide x 9' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures 10' wide x 20' long x 2.5' deep. Fish were observed above the LDA.
3982	0074.00	The left bank is eroding and contributing silt, sand and gravel to the stream channel. The erosion measures approximately 15' long and 10' high.
4160	0077.00	LDA #02 contains 14 pieces of LWD and measures 4' high x 32' wide x 12' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures 8' wide x 15' long x 1' deep. Fish were observed above the LDA.
4418	0083.00	A decommissioned logging road crosses the channel. The crossing is an 18' wide x 40' long x 7.2' high log stringer bridge made up of seven redwood logs. The cables holding the logs together are drooping into the creek.
5454	0118.00	A decommissioned logging road crosses the channel. The crossing is a 20' wide x 40' long x 6' high log stringer bridge made up of seven redwood logs.

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5928	0127.00	There is a 2' high plunge over boulders. A seep enters from the right bank.
6102	0134.00	There is a 3' high plunge over woody debris.
6174	0136.00	There is a 4' high plunge over boulders. Two feet of accumulated LWD on top of the boulders creates a 6' high strainer barrier.
6190	0137.00	There is a 3.7' high plunge over boulders.
6262	0142.00	There is a 1.5' high plunge over boulders.
6370	0147.00	A decommissioned logging road crosses the channel. The crossing is a 20' wide x 38' long x 6.7' high log stringer bridge made up of nine redwood logs.
6575	0154.00	Dry left bank tributary.
7784	0187.00	Tributary #01 enters on the left bank. It contributes approximately 25% to Mill Creek's flow. The water temperature of the tributary was 52 degrees Fahrenheit; the water temperature downstream and upstream of the tributary was 52 degrees Fahrenheit. The slope of the tributary is approximately 2%. Salmonids were observed in the tributary.
8636	0219.00	LWD is accumulating in the channel. Most of the debris mass consists of an alder root wad mid-channel and the associated sediment. The alder tree collapsed into the channel from the right bank.
8869	0228.00	Tributary #02 enters on the right bank. It contributes approximately 60% to Mill Creek's flow. The water temperature of the tributary was 52 degrees Fahrenheit; the water temperature downstream and upstream of the tributary was 52 degrees Fahrenheit. The slope of the tributary is 2-3%. Fish were observed in the tributary.
8942	0231.00	There is a 2.2' high plunge over small woody debris.
9381	0251.00	One age 1+ steelhead observed.
9752	0267.00	YOY salmonid observed.
10299	0290.00	End of survey due to diminished habitat. 200' upstream from the end of survey point, there is an LDA with a 4.5' high plunge. 250' upstream from the end of survey point, there is another LDA with a 4.5' high plunge. There is no jump pool below either LDA. The maximum depth below each LDA is 0.5 feet. The gradient increases to over 4% just below the first LDA. One fish was observed directly below the first LDA.

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### 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: Mill Creek

LLID: 1237336395481 Drainage: Rockport

Survey Dates: 10/2/2012 to 10/10/2012

Confluence Location: Quad: DUTCHMANS Legal Description: T20NR17WS34 Latitude: 39:32:53.0N Longitude: 123:44:01.0

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
2	0	DRY	0.7	308	616	6.0									
86	11	FLATWATER	29.7	51	4412	42.8	7.0	0.4	0.8	314	27008	108	9331		0
121	121	POOL	41.7	27	3290	31.9	8.1	0.7	1.5	218	26419	201	24367	158	10
81	11	RIFFLE	27.9	25	2001	19.4	6.2	0.2	0.5	177	14309	35	2804		0
<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>		
290	143				10319					67736			36502		

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

Stream Name: Mill Creek

LLID: 1237336395481

Drainage: Rockport

Survey Dates: 10/2/2012 to 10/10/2012

Confluence Location: Quad: DUTCHMANS

Legal Description: T20NR17WS34

Latitude: 39:32:53.0N

Longitude: 123:44:01.0W

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 (%)
74	9	LGR	25.5	25	1863	18.1	6	0.2	0.8	192	14231	35	2607		0	99
7	2	HGR	2.4	20	138	1.3	6	0.3	0.6	106	743	32	223		0	98
34	6	RUN	11.7	28	960	9.3	6	0.4	1	196	6650	69	2347		1	98
52	5	SRN	17.9	66	3452	33.5	8	0.4	0.9	456	23722	156	8104		0	98
84	84	MCP	29.0	29	2440	23.6	8	0.7	3.4	232	19512	216	18151	171	9	98
1	1	CRP	0.3	14	14	0.1	7	1.0	1.7	98	98	127	127	98	0	99
16	16	LSL	5.5	22	347	3.4	10	0.7	1.8	207	3314	187	2990	144	18	98
4	4	LSR	1.4	36	143	1.4	7	0.5	1.8	255	1019	163	653	119	11	98
5	5	LSBk	1.7	28	140	1.4	6	0.6	1.9	185	926	148	738	106	0	99
9	9	PLP	3.1	19	174	1.7	9	0.9	2.6	157	1411	178	1605	143	9	99
2	2	DPL	0.7	16	32	0.3	5	0.6	1.3	70	140	51	102	37	15	98
2	0	DRY	0.7	308	616	6.0										

Total Units  
290

Total Units Fully Measured  
143

Total Length (ft.)  
10319

Total Area (sq.ft.)  
71766

Total Volume (cu.ft.)  
37648

**Table 3 - Summary of Pool Types**

Stream Name: Mill Creek

LLID: 1237336395481

Drainage: Rockport

Survey Dates: 10/2/2012 to 10/10/2012

Confluence Location: Quad: DUTCHMANS

Legal Description: T20NR17WS34

Latitude: 39:32:53.0N

Longitude: 123:44:01.0W

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
84	84	MAIN	69	29	2440	74	8.0	0.7	232	19512	171	14331	9
35	35	SCOUR	29	23	818	25	8.7	0.7	193	6767	134	4700	12
2	2	BACKWATER	2	16	32	1	5.0	0.6	70	140	37	74	15
<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>	
121	121				3290					26419		19105	

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

Stream Name: Mill Creek

LLID: 1237336395481

Drainage: Rockport

Survey Dates: 10/2/2012 to 10/10/2012

Confluence Location: Quad: DUTCHMANS

Legal Description: T20NR17WS34

Latitude: 39:32:53.0N

Longitude: 123:44:01.0W

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
84	MCP	69	12	14	57	68	12	14	3	4	0	0
1	CRP	1	0	0	1	100	0	0	0	0	0	0
16	LSL	13	1	6	15	94	0	0	0	0	0	0
4	LSR	3	0	0	4	100	0	0	0	0	0	0
5	LSBk	4	0	0	5	100	0	0	0	0	0	0
9	PLP	7	0	0	7	78	2	22	0	0	0	0
2	DPL	2	1	50	1	50	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
121	14	12	90	74	14	12	3	2	0	0

Mean Maximum Residual Pool Depth (ft.): 1.5



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

Stream Name: Mill Creek

LLID: 1237336395481

Drainage: Rockport

Survey Dates: 10/2/2012 to 10/10/2012

Dry Units: 2

Confluence Location: Quad: DUTCHMANS

Legal Description: T20NR17WS34

Latitude: 39:32:53.0N

Longitude: 123:44:01.0W

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
74	9	LGR	0	0	0	0	0	0	0	0	0
7	2	HGR	0	0	0	0	0	0	0	0	0
81	11	TOTAL RIFFLE	0	0	0	0	0	0	0	0	0
34	6	RUN	0	100	0	0	0	0	0	0	0
52	5	SRN	0	0	0	0	0	0	0	0	0
86	11	TOTAL FLAT	0	100	0	0	0	0	0	0	0
84	84	MCP	11	28	54	7	0	0	0	0	0
1	1	CRP	0	0	0	0	0	0	0	0	0
16	16	LSL	1	28	71	0	0	0	0	0	0
4	4	LSR	5	65	0	30	0	0	0	0	0
5	5	LSBk	0	0	0	0	0	0	0	0	0
9	9	PLP	4	12	47	3	0	0	5	28	0
2	2	DPL	0	5	45	0	0	0	35	15	0
121	121	TOTAL POOL	8	27	55	5	0	0	1	3	0
290	143	TOTAL	8	28	55	5	0	0	1	3	0

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

Stream Name: Mill Creek

LLID: 1237336395481

Drainage: Rockport

Survey Dates: 10/2/2012 to 10/10/2012

Dry Units: 2

Confluence Location: Quad: DUTCHMANS

Legal Description: T20NR17WS34

Latitude: 39:32:53.0N

Longitude: 123:44:01.0W

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
74	9	LGR	0	0	100	0	0	0	0
7	2	HGR	0	0	100	0	0	0	0
34	6	RUN	0	0	100	0	0	0	0
52	5	SRN	0	0	100	0	0	0	0
84	84	MCP	1	1	96	0	0	1	0
1	1	CRP	0	100	0	0	0	0	0
16	16	LSL	0	0	100	0	0	0	0
4	4	LSR	0	0	100	0	0	0	0
5	5	LSBk	0	0	100	0	0	0	0
9	9	PLP	0	0	100	0	0	0	0
2	2	DPL	50	0	0	0	0	50	0

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

Stream Name: Mill Creek

LLID: 1237336395481

Drainage: Rockport

Survey Dates: 10/2/2012 to 10/10/2012

Confluence Location: Quad: DUTCHMANS

Legal Description: T20NR17WS34

Latitude: 39:32:53.0N

Longitude: 123:44:01.0W

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Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
98	12	88	0	99	98

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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: 1237336395481 Drainage: Rockport  
 Survey Dates: 10/2/2012 to 10/10/2012 Survey Length (ft.): 10319 Main Channel (ft.): 10319 Side Channel (ft.): 0  
 Confluence Location: Quad: DUTCHMANS Legal Description: T20NR17WS34 Latitude: 39:32:53.0N Longitude: 123:44:01.0W

**Summary of Fish Habitat Elements By Stream Reach**

**STREAM REACH: 1**

Channel Type: C4	Canopy Density (%): 97.9	Pools by Stream Length (%): 30.0
Reach Length (ft.): 3443	Coniferous Component (%): 2.0	Pool Frequency (%): 46.7
Riffle/Flatwater Mean Width (ft.): 7.9	Hardwood Component (%): 98.0	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 75
Range (ft.): 14 to 20	Vegetative Cover (%): 99.5	2 to 2.9 Feet Deep: 21
Mean (ft.): 17	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 4
Std. Dev.: 2	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.5	Occurrence of LWD (%): 21	Mean Max Residual Pool Depth (ft.): 1.5
Water (F): 50 - 51 Air (F): 45 - 57	LWD per 100 ft.:	Mean Pool Shelter Rating: 6
Dry Channel (ft): 601	Riffles: 2	
	Pools: 5	
	Flat: 1	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 100 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 46.4 2. 35.7 3. 17.9 4. 0.0 5. 0.0		

**STREAM REACH: 2**

Channel Type: F4	Canopy Density (%): 98.2	Pools by Stream Length (%): 32.8
Reach Length (ft.): 6876	Coniferous Component (%): 14.4	Pool Frequency (%): 40.4
Riffle/Flatwater Mean Width (ft.): 6.3	Hardwood Component (%): 85.6	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 89
Range (ft.): 9 to 24	Vegetative Cover (%): 98.4	2 to 2.9 Feet Deep: 9
Mean (ft.): 15	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 2
Std. Dev.: 3	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.5	Occurrence of LWD (%): 30	Mean Max Residual Pool Depth (ft.): 1.4
Water (F): 51 - 53 Air (F): 50 - 63	LWD per 100 ft.:	Mean Pool Shelter Rating: 12
Dry Channel (ft): 15	Riffles: 2	
	Pools: 8	
	Flat: 4	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 92 Sm Cobble: 3 Lg Cobble: 0 Boulder: 2 Bedrock: 2		
Embeddedness Values (%): 1. 32.3 2. 49.5 3. 15.1 4. 0.0 5. 3.2		

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

Stream Name: Mill Creek

LLID: 1237336395481

Drainage: Rockport

Survey Dates: 10/2/2012 to 10/10/2012

Confluence Location: Quad: DUTCHMANS

Legal Description: T20NR17WS34

Latitude: 39:32:53.0N

Longitude: 123:44:01.0W

**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	7	4	3.8
Boulder	7	6	4.5
Cobble / Gravel	2	5	2.4
Sand / Silt / Clay	127	128	89.2

**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	0.3
Brush	42	59	35.3
Hardwood Trees	89	75	57.3
Coniferous Trees	11	8	6.6
No Vegetation	0	1	0.3

**Total Stream Cobble Embeddedness Values:** 2

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

StreamName: Mill Creek

LLID: 1237336395481

Drainage: Rockport

Survey Dates: 10/2/2012 to 10/10/2012

Confluence Location: Quad: DUTCHMANS

Legal Description: T20NR17WS34

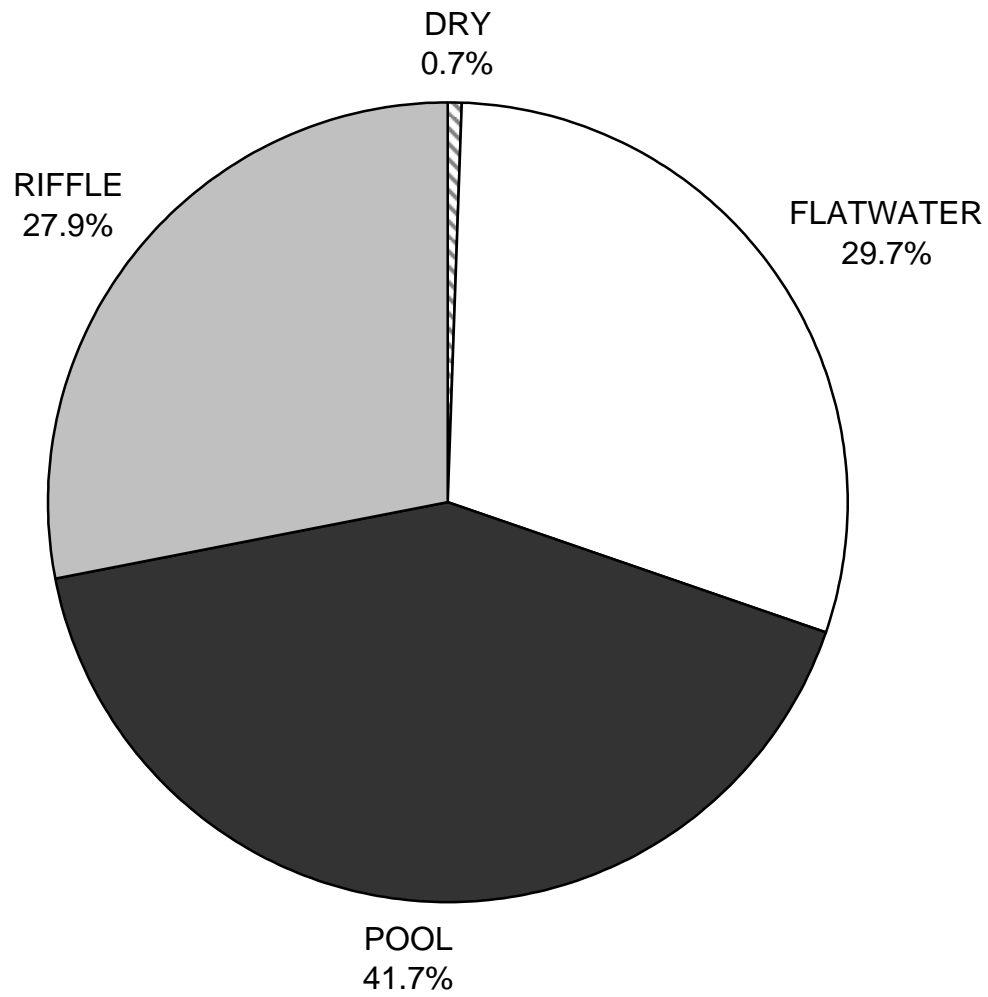
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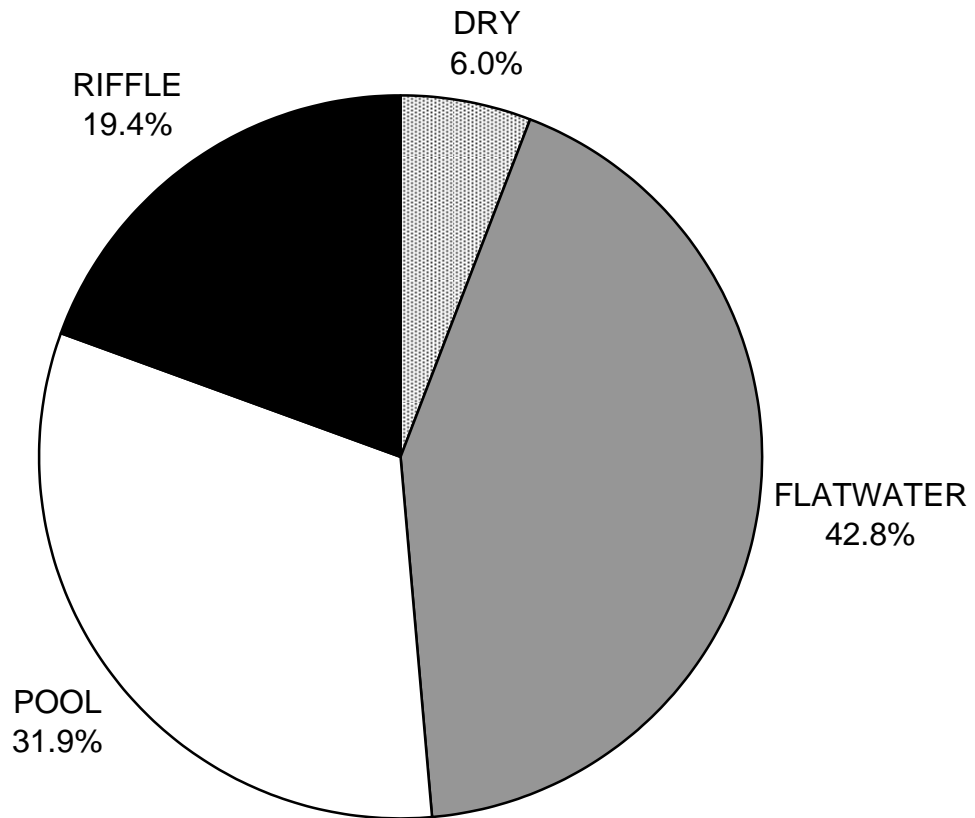
	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
UNDERCUT BANKS (%)	0	0	8
SMALL WOODY DEBRIS (%)	0	100	27
LARGE WOODY DEBRIS (%)	0	0	55
ROOT MASS (%)	0	0	5
TERRESTRIAL VEGETATION (%)	0	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	1
BOULDERS (%)	0	0	3
BEDROCK LEDGES (%)	0	0	0

# MILL CREEK 2012 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

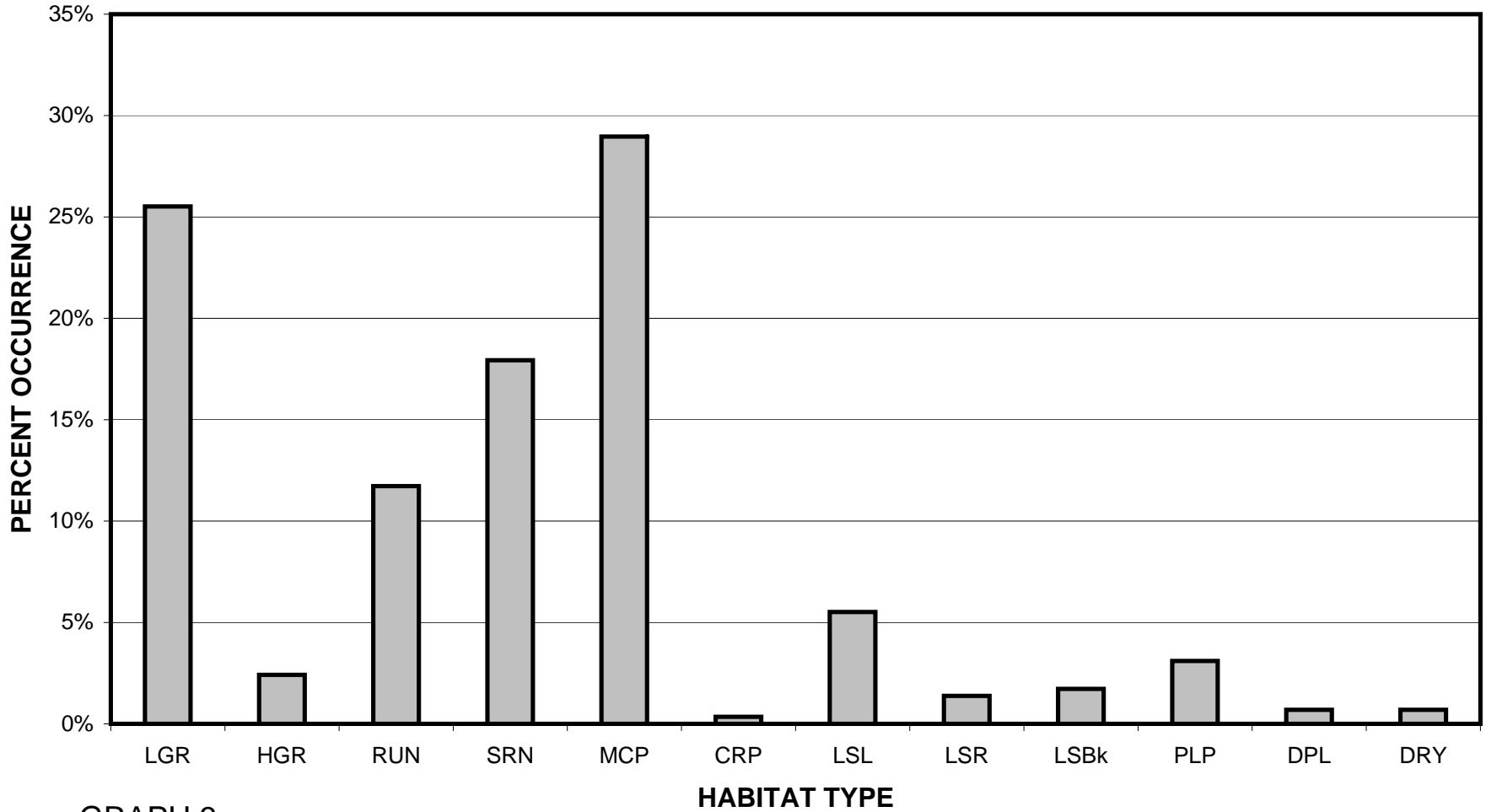
# MILL CREEK 2012 HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

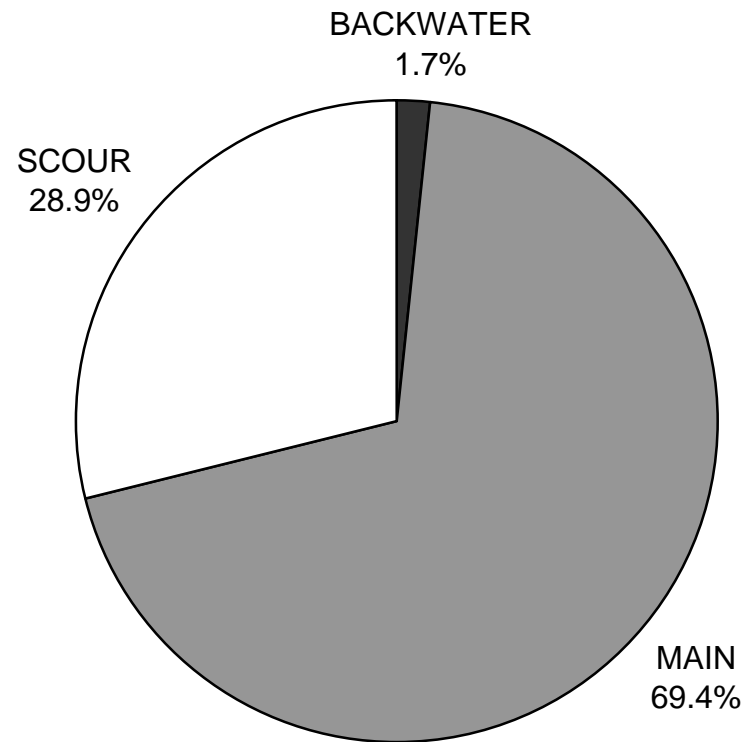


# MILL CREEK 2012 HABITAT TYPES BY PERCENT OCCURRENCE



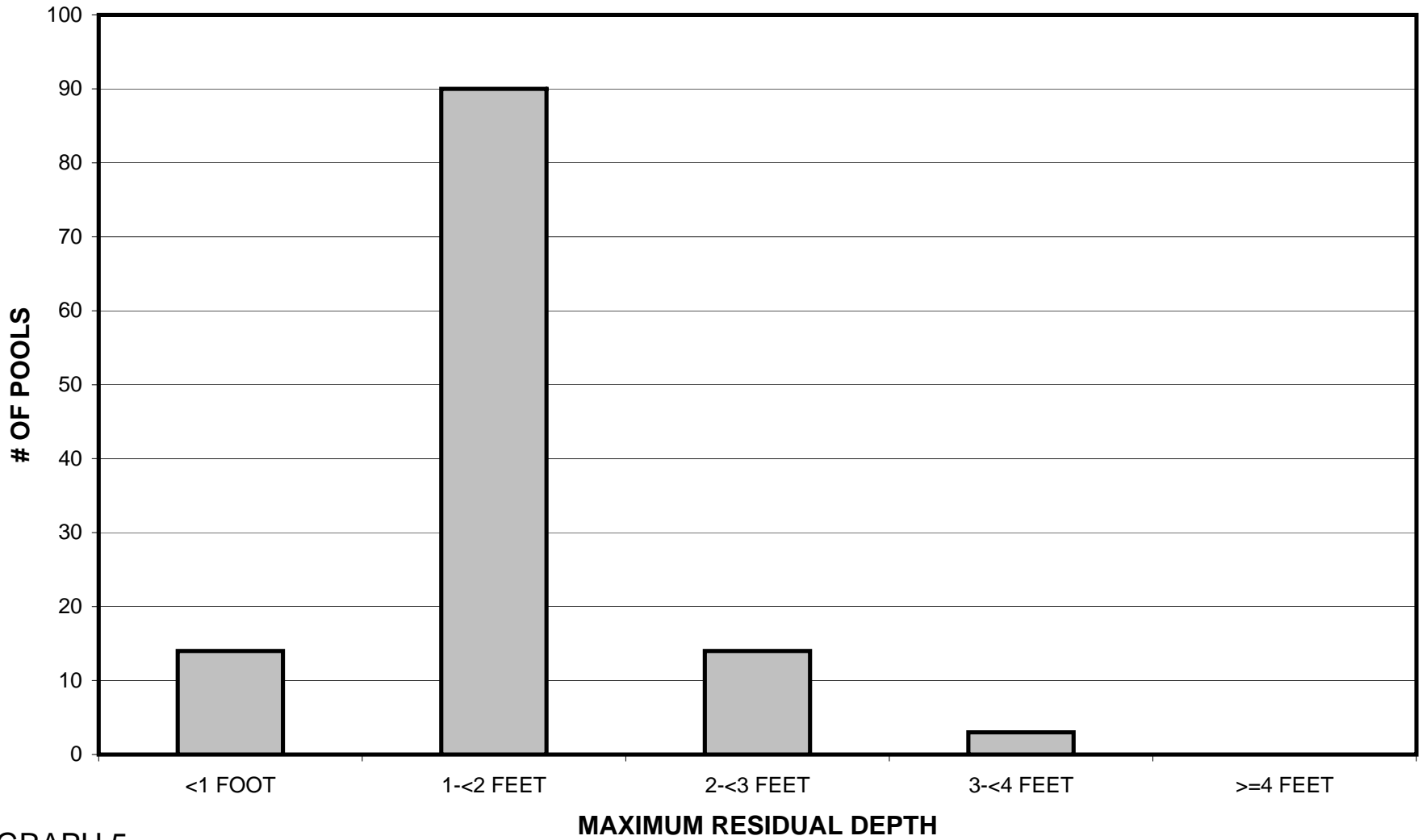
GRAPH 3

**MILL CREEK 2012  
POOL TYPES BY PERCENT OCCURRENCE**



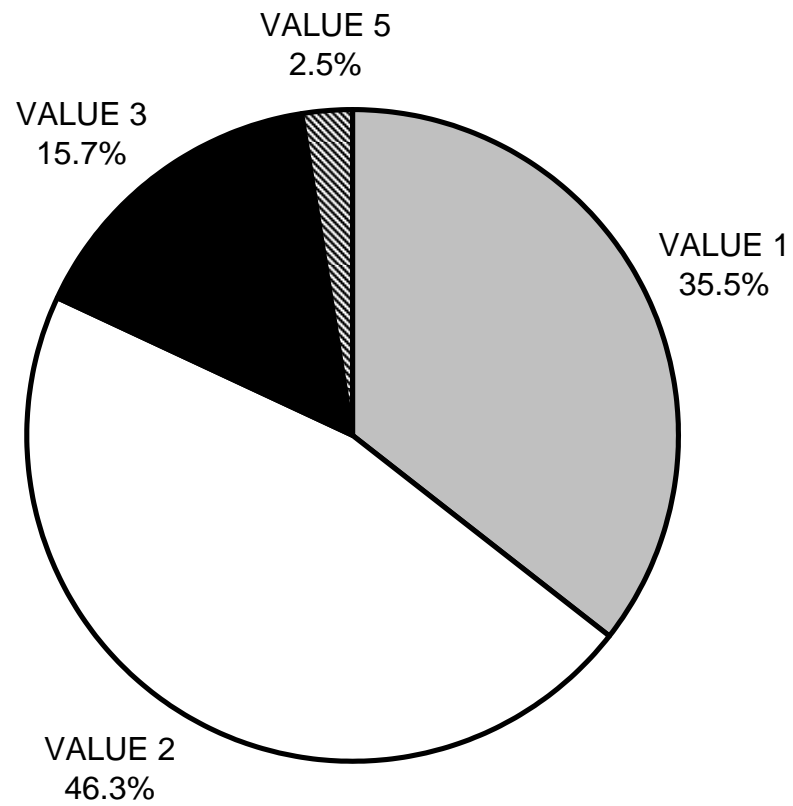
GRAPH 4

# MILL CREEK 2012 MAXIMUM DEPTH IN POOLS



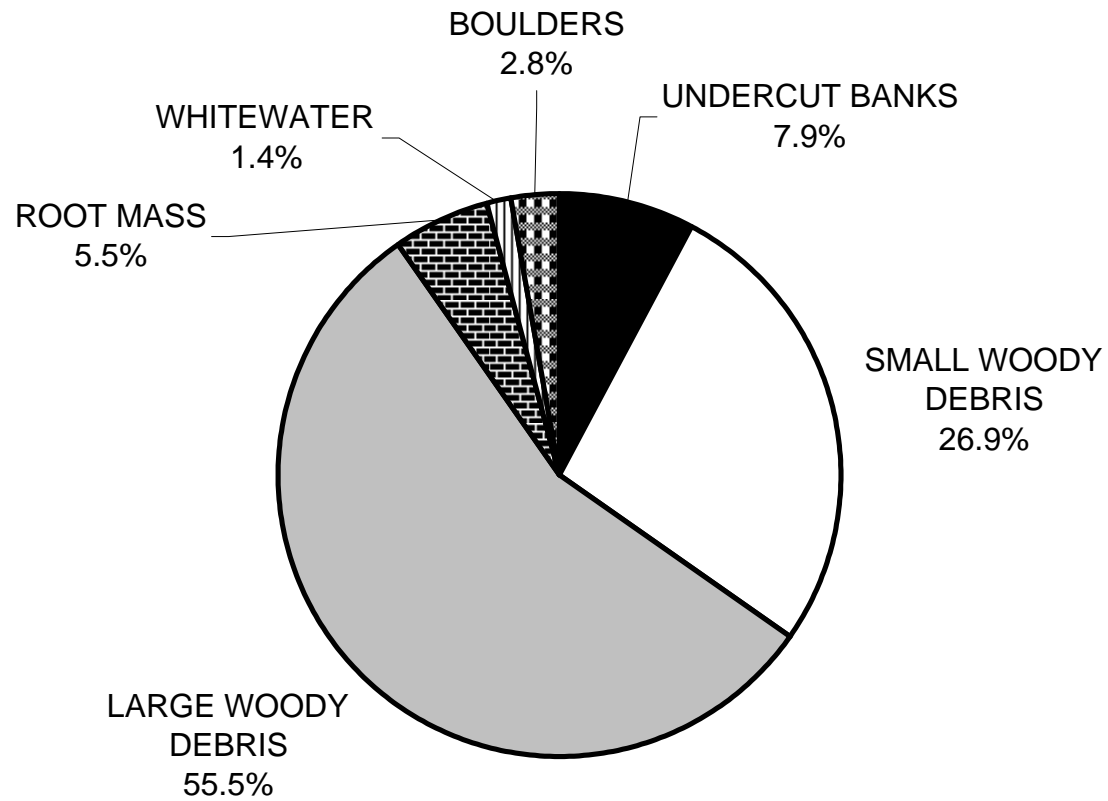
GRAPH 5

# MILL CREEK 2012 PERCENT EMBEDDEDNESS



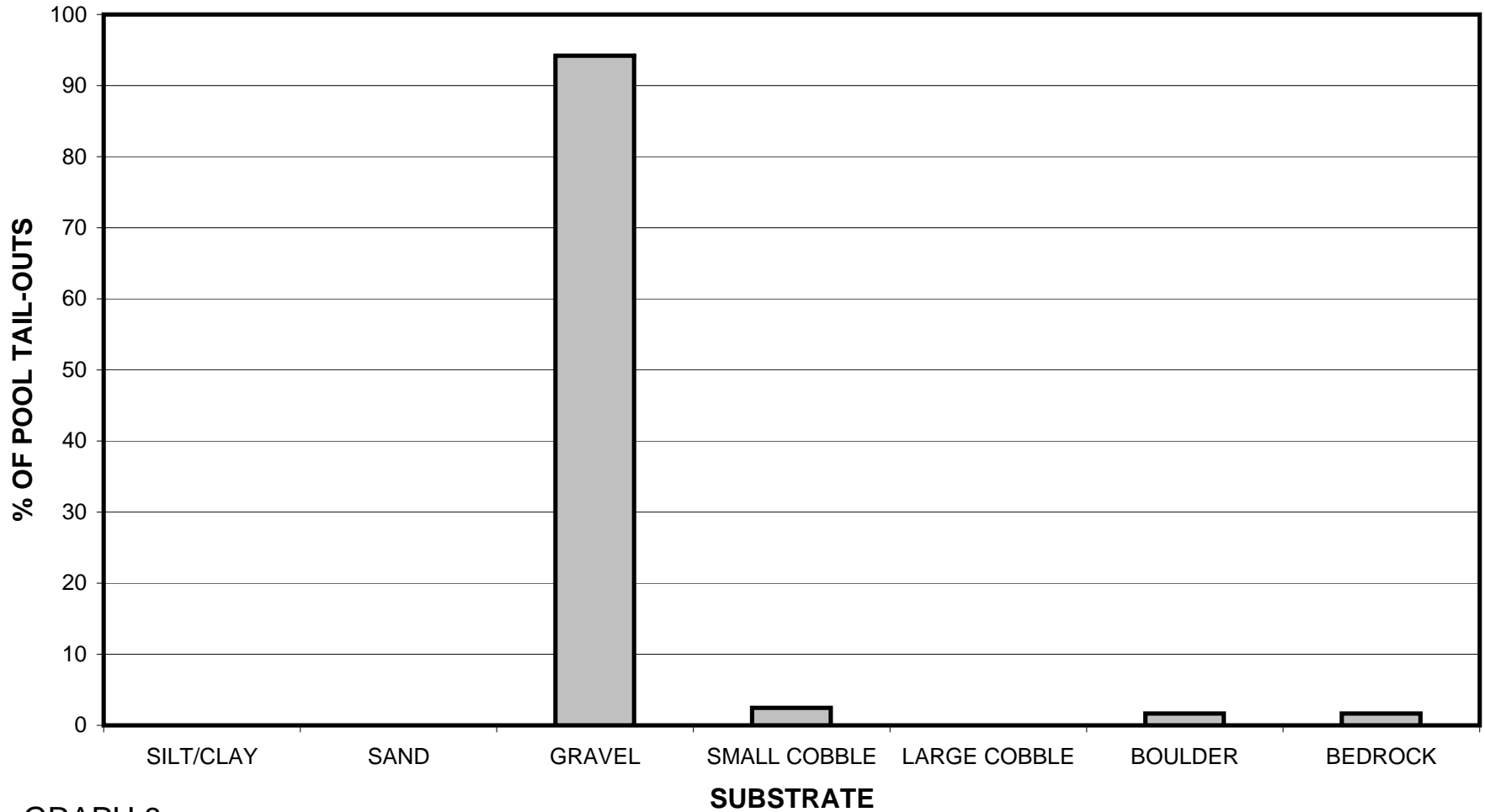
GRAPH 6

# MILL CREEK 2012 MEAN PERCENT COVER TYPES IN POOLS



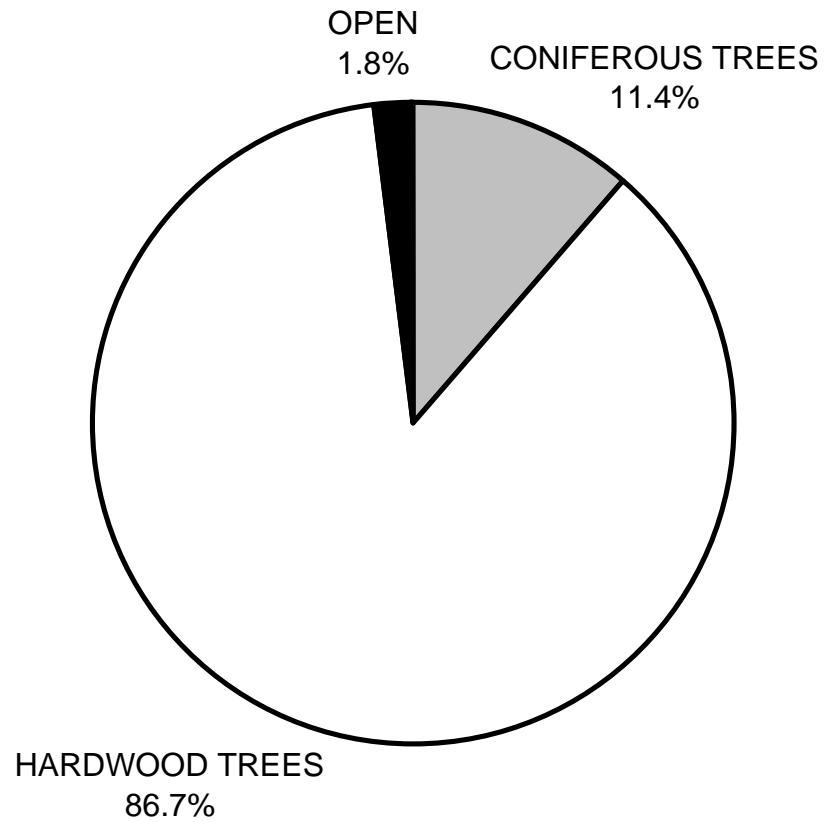
GRAPH 7

# MILL CREEK 2012 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



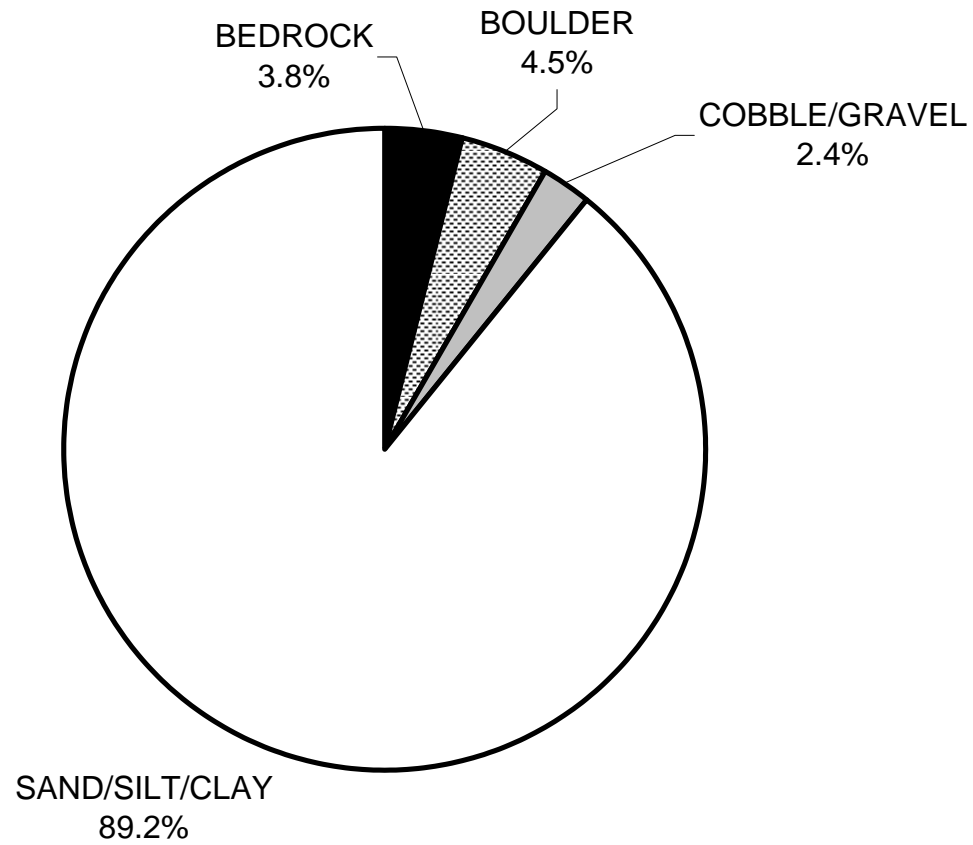
GRAPH 8

# MILL CREEK 2012 MEAN PERCENT CANOPY



GRAPH 9

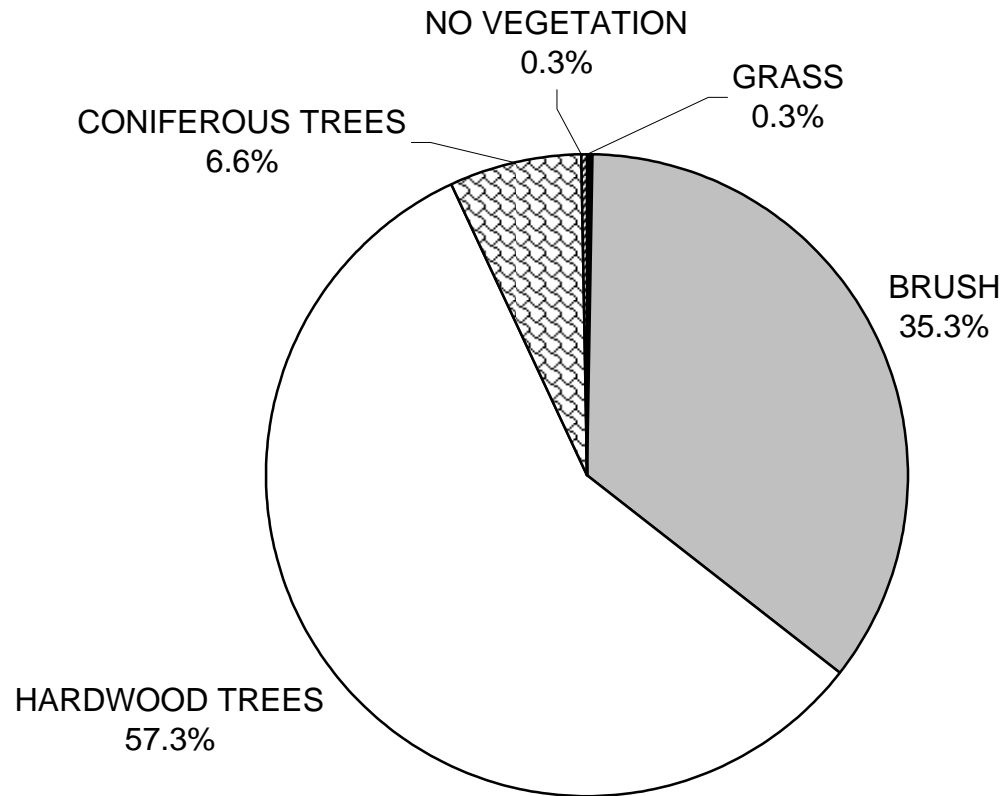
**MILL CREEK 2012  
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

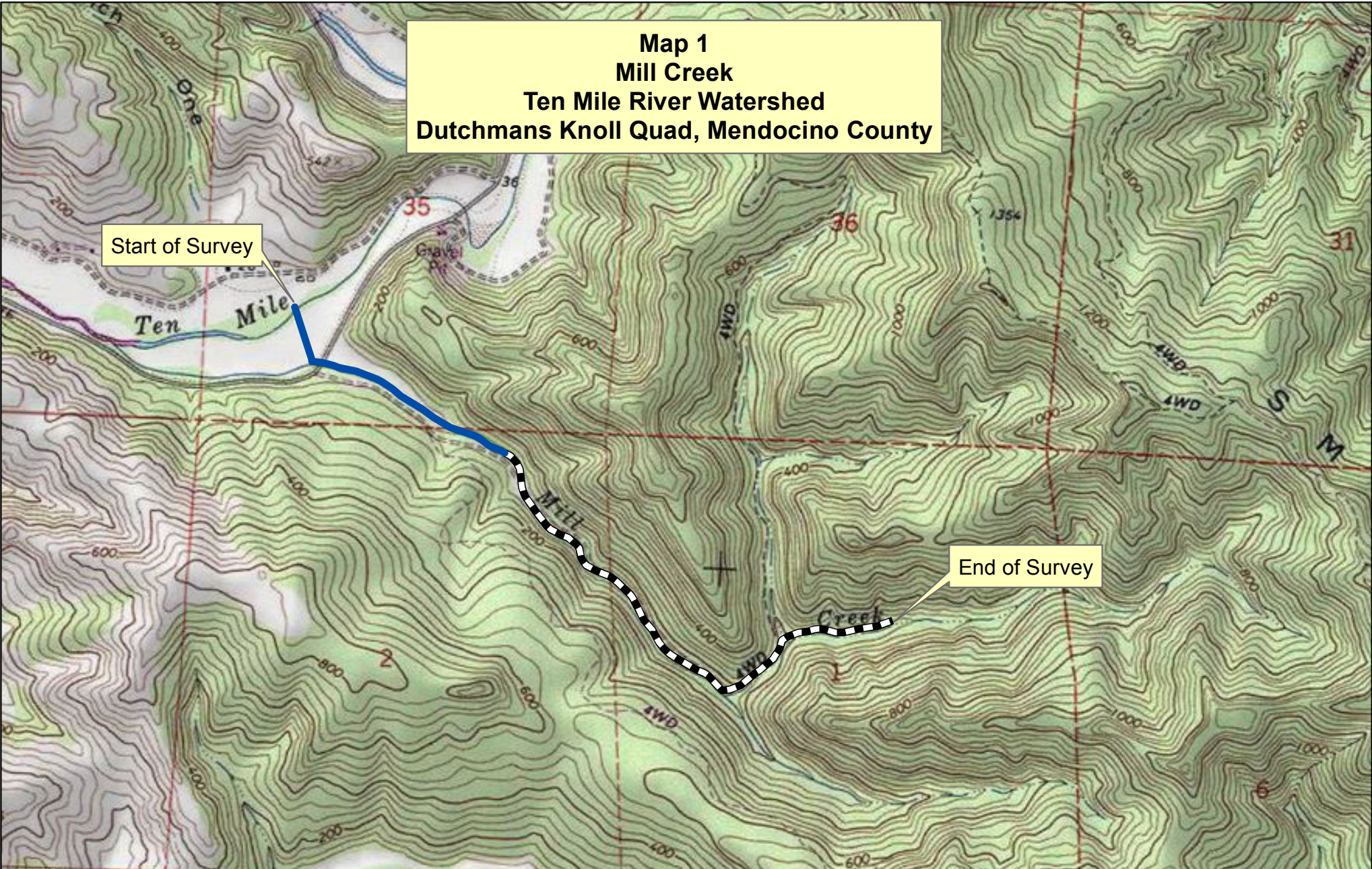


# MILL CREEK 2012 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11



**Map 1  
Mill Creek  
Ten Mile River Watershed  
Dutchmans Knoll Quad, Mendocino County**



Start of Survey

End of Survey

**Legend**

-  Reach 1, C4 Channel Type
-  Reach 2, F4 Channel Type

