

STREAM INVENTORY REPORT

Mill Creek

INTRODUCTION

A stream inventory was conducted from June 17 to June 24, 2008 on Mill Creek. The survey began at the confluence with Pacific Ocean and extended upstream 2.6 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 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 drains to the Pacific Ocean, located in Mendocino County, California (Map 1). Mill Creek's legal description at the confluence with Pacific Ocean is T19N R17W S19. Its location is 39.4909 degrees north latitude and 123.7967 degrees west longitude, LLID number 1237954394909. Mill Creek is a first order stream and has approximately 3.3 miles of blue line stream according to the USGS Fort Bragg 7.5 minute quadrangle. Mill Creek drains a watershed of approximately 3.0 square miles. Elevations range from about sea level at the mouth of the creek to 600 feet in the headwater areas. Redwood and mixed hardwood forest dominates the watershed. The lower watershed is state park land and managed for recreation. Above Highway 1 the watershed is primarily privately owned and managed for timber production and rural subdivision. Vehicle access exists via Highway 1 to Mill 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 Pacific States Marine Fisheries Commission (PSMFC) Fisheries Technician 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 embeddedness. Habitat unit types encountered for the first time are measured for all the

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parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

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

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10. Large Woody Debris Count:

Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.19, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

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

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- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

HABITAT INVENTORY RESULTS

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

The habitat inventory of June 17 to June 24, 2008, was conducted by R. Swan (WSP) and W. Holloway (PSMFC). The total length of the stream surveyed was 13,511 feet. A section from the Pacific Ocean upstream approximately 4,000 feet was not surveyed due to the influence of Pacific Ocean and Lake Cleone. Two sections of stream from 5,499 feet to 6,798 feet and from 9,266 feet to 9,666 feet were not surveyed due to a log debris accumulation and lack of landowner access. The data included in this report is for the 7,812 feet actually surveyed.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.22 cfs on June 26, 2008

Mill Creek is an unknown channel type for the first 4,000 feet of the stream (Reach 1), a C4 channel type for the next 1,499 feet of the stream surveyed (Reach 2), an unknown channel type for the next 1,299 feet of the stream not surveyed (Reach 3), a C4 channel type for the next 736 feet of the stream surveyed (Reach 4), a B4 channel type for the next 1,731 feet of the stream surveyed (Reach 5), an unknown channel type for the next 400 feet of the stream not surveyed (Reach 6), and a B4 for the remaining 3,846 feet of the stream surveyed (Reach 7). C4 channels are meandering point-bar, riffle/pool, alluvial channels with broad well defined floodplain on low gradients and gravel-dominant substrates. 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 48 to 57 degrees Fahrenheit. Air temperatures ranged from 57 to 70 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 49% pool units, 25% flatwater units, and 21% riffle units (Graph 1). Based on total length of Level II habitat types there were 43% pool units, 39% flatwater units, and 17% riffle units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were lateral scour pool - log enhanced units, 35%; low gradient riffle units, 21%; and step run units, 13% (Graph 3). Based on percent total length, lateral scour pool - log enhanced units made up 27%, step run units 25%, and low gradient riffle units 16%.

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A total of 92 pools were identified (Table 3). Scour pools were the most frequently encountered at 83% (Graph 4), and comprised 76% 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. Thirty-six of the 92 pools (39%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 92 pool tail-outs measured, 41 had a value of 1 (44.1%); 26 had a value of 2 (28.0%); 15 had a value of 3 (17.2%); 6 had a value of 4 (6.5%); 4 had a value of 5 (4.3%) (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 16, flatwater habitat types had a mean shelter rating of 30, and pool habitats had a mean shelter rating of 66 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 69. Main channel pools had a mean shelter rating of 53 (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 undercut banks.

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 78% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 13% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Mill Creek was 95%. Five percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 71% and 29%, respectively. Graph 9 describes the mean percent canopy in Mill Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 82%. The mean percent left bank vegetated was 82%. The dominant elements composing the structure of the stream banks consisted of 89% sand/silt/clay, 9% cobble/gravel, and 1% bedrock (Graph 10). Brush was the dominant vegetation type observed in 99% of the units surveyed.

DISCUSSION

Mill Creek is an unknown channel type for the first 4,000 feet of the stream (Reach 1), a C4 channel type for the next 1,499 feet of the stream surveyed (Reach 2), an unknown channel type for the next 1,299 feet of the stream (Reach 3), a C4 channel type for the next 736 feet of the stream surveyed (Reach 4), a B4 channel type for the next 1,731 feet of the stream surveyed

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(Reach 5), an unknown channel type for the next 400 feet of the stream (Reach 6), and a B4 for the remaining 3,846 feet of the stream surveyed (Reach 7). The suitability of C4 and B4 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. B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days June 17 to June 24, 2008, ranged from 48 to 57 degrees Fahrenheit. Air temperatures ranged from 57 to 70 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 39% of the total length of this survey, riffles 17%, and pools 43%. Thirty-six of the 92 (39%) 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.

Sixty-seven of the 92 pool tail-outs measured had embeddedness ratings of 1 or 2. Twenty-one 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.

Eighty-four of the 92 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 66. The shelter rating in the flatwater habitats was 30. 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 undercut banks. 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 95%. Reach 2 had a canopy density of 96.4%, Reach 4 had a canopy density of 97.4%, Reach 5 had a canopy density of 91.6%, and Reach 7 had a canopy density of 95.3%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 82% and 82%, 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.

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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) Due to the dam on Lake Cleone, near MacKerricher State Beach, access for migrating salmonids is an ongoing potential problem. Good water temperature and flow regimes exist in the stream and it offers good conditions for rearing fish. Fish passage should be monitored and improved where possible.
- 4) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from large woody debris. Adding high quality complexity with woody cover in the pools is desirable.
- 5) 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.

COMMENTS AND LANDMARKS

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

Position (ft):	Habitat unit #:	Comments:
0	0001.00	Start of survey at the Pacific Ocean. The first 4,000 of stream was not surveyed due to the influence with the Pacific Ocean, as well as the lower section of stream being a damned lake (Lake Cleone).
4000	0002.00	Begin full sampling of habitat approximately 30 feet upstream from the Highway 1 crossing.
810	0015.00	Salmonid young-of-the-year (YOY) observed.
1238	0024.00	Tributary enters on the right bank. The stream is not accessible for fish.
1499	0031.00	The stream was not surveyed for 1,299 feet.
2798	0032.00	Restart survey. Log debris accumulation (LDA) is 9' high x 12' wide

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x 17' long. Sediment retention is 22' long x 11' wide x 1.2' deep. There is a high gradient bedrock riffle. Juvenile fish were seen above the LDA.

3322	0046.00	LDA at bottom of unit is 5.5' high x 15' wide x 8' long cause by a fallen tree and root wad. Sediment retention is 7' wide x 12' long x 1' deep consisting of sand to gravel.
3644	0055.00	Large sand and gravel sediment retention.
3671	0056.00	LDA is 4' high x 8' wide x 21' long. Sediment retention is 6' wide x 32' long x 3' deep consisting of sand to gravel.
3747	0058.00	Sand and gravel sediment retention.
3774	0059.00	YOY observed. Sand and gravel is being retained. There is 5' high right bank erosion.
4132	0065.00	There is a left bank failure. Decommissioned road crossing has fallen into stream.
4385	0070.00	There is a right bank failure.
4600	0074.00	There is a right bank failure.
5265	0091.00	LDA is 6.5' high x 18 wide x 45' long and includes 30 or more pieces of large woody debris. Sediment retention is 10' wide x 75' long x 3' deep and ranges from sand to gravel. Fish were seen above the LDA. A 400' section of stream was unsurveyed due to unstable stream banks.
5677	0093.00	There is a left bank failure.
5861	0095.00	There is a failing decommissioned road crossing combined with a log debris accumulation bringing sediment into the stream.
6101	0102.00	There is a right bank failure and a large sediment retention. An age 2+ steelhead observed.
6445	0109.00	Private landowner foot bridge.
6445	0109.00	Left bank tributary was dry with residual pools throughout. Checked 300' up the tributary and found it to be accessible to fish. No fish were observed.
6612	0112.00	There is a left bank failure.

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6738	0115.00	There is a right bank tributary depositing fine sediment into Mill Creek. Checked 100' up the tributary. It is accessible to fish but none were observed. Water temperatures were 56 degrees Fahrenheit in the tributary, 57 degrees Fahrenheit downstream and 54 degrees Fahrenheit upstream in the main channel.
7068	0124.00	There is a left bank failure.
7239	0127.00	There is a large sediment retention.
7321	0131.00	There is a large sand and gravel sediment accumulation.
7660	0137.00	There is a left bank failure and a large sediment accumulation.
7687	0138.00	There is a left bank failure due to multiple fallen trees into the creek. Sediment is being retained.
7720	0139.00	LDA is 5.5' high x 23' wide x 33' long and consists of approximately 15 pieces of large wood. Sediment retention is 13' wide x 37' long x 2' deep and consists of gravel and small cobble. Water is subsurface. There is a left bank failure.
7747	0141.00	There is a left bank failure and large gravel sediment retention.
7814	0143.00	YOY observed. Partial wetted channel runs sub-surface.
7881	0144.00	Sand and gravel sediment accumulation.
7916	0145.00	LDA is 5' high x 22' wide x 43' long consisting of approximately 20 pieces of large wood. Sediment retention is 17' wide x 45' long x 2' high and ranges from gravel to small cobble. Water does not flow through due. There is a right bank failure.
7944	0148.00	There is a left bank failure.
8005	0151.00	Water is sub-surface.
8092	0155.00	There is a left bank failure.
8128	0156.00	There is a left bank failure.
8232	0158.00	There is a right bank failure.
8272	0160.00	There is a large sediment accumulation.

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8287	0162.00	There is a left bank failure with gravel sediment retained.
8424	0165.00	There is a right bank failure.
8507	0169.00	YOY observed. Gravel sediment accumulation.
8551	0170.00	There is a left bank landslide 35' high x 35' wide x 15' long. There is right bank failure and gravel/sand sediment retention.
8667	0172.00	Decommissioned road bed. There is a right bank failure and gravel sediment accumulation.
8695	0173.00	Gravel and sand sediment accumulation. Water is sub-surface.
8794	0176.00	There is a left bank sediment accumulation.
8811	0177.00	YOY observed.
8913	0178.00	There is a left bank failure. Gravel and sand sediment accumulation.
8937	0179.00	There is a large sand and gravel sediment accumulation.
8951	0180.00	There is a left bank landslide. Very large sand and gravel sediment accumulation.
8988	0181.00	There is a left bank landslide. Sand and gravel accumulation. Water is sub-surface.
9019	0182.00	There is a left bank failure. Gravel and sand sediment accumulation.
9119	0183.00	There is a left bank failure. Age 1 (Y+) steelhead observed.
9149	0184.00	There is a gravel sediment accumulation.
9254	0187.00	YOY observed.
9383	0188.00	There is a sand and gravel sediment accumulation. There is a decommissioned road crossing with rusty cables in the creek.
9439	0189.00	There is a right bank failure.
9457	0190.00	There is a left bank landslide.
9565	0191.00	End of survey.

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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: 1237954394909 Drainage: Noyo River

Survey Dates: 6/17/2008 to 6/24/2008

Confluence Location: Quad: FORT BRAGG Legal Description: T19NR17WS19 Latitude: 39:29:27.0N Longitude: 123:47:43.0

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
9	0	DRY	4.8	14	123	1.6									
47	12	FLATWATER	25.0	65	3038	38.9	5.3	0.5	1.0	293	13777	152	7160		30
3	0	NOSURVEY		1900	5699										
92	92	POOL	49.0	37	3360	43.0	9.3	1.1	1.9	328	30169	471	43339	426	66
40	13	RIFFLE	21.2	32	1291	16.5	4.1	0.2	0.5	121	4828	21	844		16
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
191	117				13511					48773			51343		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Mill Creek

LLID: 1237954394909

Drainage: Noyo River

Survey Dates: 6/17/2008 to 6/24/2008

Confluence Location: Quad: FORT BRAGG

Legal Description: T19NR17WS19

Latitude: 39:29:27.0N

Longitude: 123:47:43.0W

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 (%)
39	13	LGR	20.7	33	1274	16.3	4	0.2	0.8	121	4707	21	822		16	96
1	0	HGR	0.5	17	17	0.2										100
1	0	POW	0.5	50	50	0.6										99
21	6	RUN	11.2	50	1049	13.4	6	0.6	1.4	199	4170	144	3027		36	92
25	6	SRN	13.3	78	1939	24.8	4	0.4	1.3	388	9692	161	4013		24	95
16	16	MCP	8.5	49	790	10.1	10	1.3	3.5	478	7651	763	12212	686	53	97
4	4	CRP	2.1	32	126	1.6	8	0.8	2.7	239	957	218	873	188	19	94
66	66	LSL	35.1	33	2165	27.2	9	1.1	4.9	294	19396	419	27667	381	74	95
5	5	LSR	2.7	52	261	3.3	10	1.0	2.7	427	2133	508	2542	445	42	90
1	1	LSBk	0.5	18	18	0.2	2	1.3	2.3	32	32	45	45	42	90	98
9	0	DRY	4.8	14	123	1.6										95
3	0	NS		1900	5699											

Total Units
191

Total Units Fully Measured
117

Total Length (ft.)
13511

Total Area (sq.ft.)
48737

Total Volume (cu.ft.)
51203

Table 3 - Summary of Pool Types

Stream Name: Mill Creek

LLID: 1237954394909

Drainage: Noyo River

Survey Dates: 6/17/2008 to 6/24/2008

Confluence Location: Quad: FORT BRAGG

Legal Description: T19NR17WS19

Latitude: 39:29:27.0N

Longitude: 123:47:43.0W

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
16	16	MAIN	17	49	790	24	9.6	1.3	478	7651	686	10982	53
76	76	SCOUR	83	34	2570	76	9.2	1.1	296	22518	371	28187	69

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
92	92	3360	30169	39168

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

Stream Name: Mill Creek

LLID: 1237954394909

Drainage: Noyo River

Survey Dates: 6/17/2008 to 6/24/2008

Confluence Location: Quad: FORT BRAGG

Legal Description: T19NR17WS19

Latitude: 39:29:27.0N

Longitude: 123:47:43.0W

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
16	MCP	17	0	0	6	38	7	44	3	19	0	0
4	CRP	4	1	25	1	25	2	50	0	0	0	0
66	LSL	72	5	8	41	62	12	18	6	9	2	3
5	LSR	5	0	0	2	40	3	60	0	0	0	0
1	LSBk	1	0	0	0	0	1	100	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
92	6	7	50	54	25	27	9	10	2	2

Mean Maximum Residual Pool Depth (ft.): 1.9

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Mill Creek

LLID: 1237954394909

Drainage: Noyo River

Survey Dates: 6/17/2008 to 6/24/2008

Dry Units: 9

Confluence Location: Quad: FORT BRAGG

Legal Description: T19NR17WS19

Latitude: 39:29:27.0N

Longitude: 123:47:43.0W

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
39	13	LGR	16	17	6	1	45	0	0	15	0
1	0	HGR									
40	13	TOTAL RIFFLE	16	17	6	1	45	0	0	15	0
1	0	POW									
21	6	RUN	23	20	15	2	41	0	0	0	0
25	6	SRN	10	15	34	4	37	0	0	0	0
47	12	TOTAL FLAT	16	18	25	3	39	0	0	0	0
16	16	MCP	33	17	14	4	31	0	0	0	0
4	4	CRP	54	11	8	0	28	0	0	0	0
66	66	LSL	14	13	60	3	11	0	0	0	0
5	5	LSR	40	4	18	31	7	0	0	0	0
1	1	LSBk	20	5	70	0	5	0	0	0	0
92	92	TOTAL POOL	21	13	47	4	15	0	0	0	0
3	0	NS									
191	117	TOTAL	20	14	40	4	21	0	0	2	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Mill Creek

LLID: 1237954394909

Drainage: Noyo River

Survey Dates: 6/17/2008 to 6/24/2008

Dry Units: 9

Confluence Location: Quad: FORT BRAGG

Legal Description: T19NR17WS19

Latitude: 39:29:27.0N

Longitude: 123:47:43.0W

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
39	13	LGR	0	8	77	8	8	0	0
1	0	HGR	0	0	0	0	0	0	0
1	0	POW	0	0	0	0	0	0	0
21	6	RUN	0	50	50	0	0	0	0
25	6	SRN	0	17	67	17	0	0	0
16	16	MCP	0	88	13	0	0	0	0
4	4	CRP	0	50	50	0	0	0	0
66	66	LSL	3	56	36	5	0	0	0
5	5	LSR	0	60	40	0	0	0	0
1	1	LSBk	0	100	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Mill Creek

LLID: 1237954394909

Drainage: Noyo River

Survey Dates: 6/17/2008 to 6/24/2008

Confluence Location: Quad: FORT BRAGG

Legal Description: T19NR17WS19

Latitude: 39:29:27.0N

Longitude: 123:47:43.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
95	29	71	0	82	82

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: 1237954394909 Drainage: Noyo River
 Survey Dates: 6/17/2008 to 6/24/2008 Survey Length (ft.): 13511 Main Channel (ft.): 13511 Side Channel (ft.): 0
 Confluence Location: Quad: FORT BRAGG Legal Description: T19NR17WS19 Latitude: 39:29:27.0N Longitude: 123:47:43.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: NA	Canopy Density (%):	Pools by Stream Length (%): 0.0
Reach Length (ft.): 4000	Coniferous Component (%):	Pool Frequency (%): 0.0
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%):	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation:	< 2 Feet Deep:
Range (ft.): to	Vegetative Cover (%): 0.0	2 to 2.9 Feet Deep:
Mean (ft.):	Dominant Shelter:	3 to 3.9 Feet Deep:
Std. Dev.:	Dominant Bank Substrate Type:	>= 4 Feet Deep:
Base Flow (cfs.):	Occurrence of LWD (%):	Mean Max Residual Pool Depth (ft.):
Water (F): 0 - 0 Air (F): 0 - 0	LWD per 100 ft.:	Mean Pool Shelter Rating:
Dry Channel (ft): 0	Riffles:	
	Pools:	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 0 Sm Cobble: 100 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 0.0 2. 0.0 3. 100.0 4. 0.0 5. 0.0		

STREAM REACH: 2

Channel Type: C4	Canopy Density (%): 96.4	Pools by Stream Length (%): 51.2
Reach Length (ft.): 1499	Coniferous Component (%): 0.0	Pool Frequency (%): 46.7
Riffle/Flatwater Mean Width (ft.): 5.6	Hardwood Component (%): 100.0	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 21
Range (ft.): 6 to 6	Vegetative Cover (%): 85.0	2 to 2.9 Feet Deep: 57
Mean (ft.): 6	Dominant Shelter: Undercut Banks	3 to 3.9 Feet Deep: 14
Std. Dev.: 0	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 7
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 11	Mean Max Residual Pool Depth (ft.): 2.4
Water (F): 48 - 54 Air (F): 58 - 62	LWD per 100 ft.:	Mean Pool Shelter Rating: 56
Dry Channel (ft): 0	Riffles: 3	
	Pools: 4	
	Flat: 3	
Pool Tail Substrate (%): Silt/Clay: 14 Sand: 7 Gravel: 50 Sm Cobble: 29 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 0.0 2. 7.1 3. 50.0 4. 35.7 5. 7.1		

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: NA	Canopy Density (%):	Pools by Stream Length (%): 0.0
Reach Length (ft.): 1299	Coniferous Component (%):	Pool Frequency (%): 0.0
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%):	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation:	< 2 Feet Deep:
Range (ft.): to	Vegetative Cover (%): 0.0	2 to 2.9 Feet Deep:
Mean (ft.):	Dominant Shelter:	3 to 3.9 Feet Deep:
Std. Dev.:	Dominant Bank Substrate Type:	>= 4 Feet Deep:
Base Flow (cfs.): 0.0	Occurrence of LWD (%):	Mean Max Residual Pool Depth (ft.):
Water (F): 54 - 54 Air (F): 61 - 61	LWD per 100 ft.:	Mean Pool Shelter Rating:
Dry Channel (ft): 0	Riffles:	
	Pools:	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:		
Embeddedness Values (%): 1. 2. 3. 4. 5. 0.0		

STREAM REACH: 4

Channel Type: C4	Canopy Density (%): 97.4	Pools by Stream Length (%): 61.8
Reach Length (ft.): 736	Coniferous Component (%): 15.3	Pool Frequency (%): 47.4
Riffle/Flatwater Mean Width (ft.): 4.8	Hardwood Component (%): 84.7	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 33
Range (ft.): 6 to 12	Vegetative Cover (%): 80.6	2 to 2.9 Feet Deep: 44
Mean (ft.): 6	Dominant Shelter: Undercut Banks	3 to 3.9 Feet Deep: 22
Std. Dev.: 2	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 25	Mean Max Residual Pool Depth (ft.): 2.3
Water (F): 52 - 53 Air (F): 58 - 59	LWD per 100 ft.:	Mean Pool Shelter Rating: 60
Dry Channel (ft): 0	Riffles: 4	
	Pools: 4	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 11 Sand: 0 Gravel: 89 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 22.2 2. 66.7 3. 0.0 4. 0.0 5. 11.1		

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 5

Channel Type: B4	Canopy Density (%): 91.6	Pools by Stream Length (%): 32.4
Reach Length (ft.): 1731	Coniferous Component (%): 8.2	Pool Frequency (%): 47.5
Riffle/Flatwater Mean Width (ft.): 4.8	Hardwood Component (%): 91.8	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 84
Range (ft.): 6 to 8	Vegetative Cover (%): 80.2	2 to 2.9 Feet Deep: 11
Mean (ft.): 6	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 5
Std. Dev.: 0	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 33	Mean Max Residual Pool Depth (ft.): 1.7
Water (F): 53 - 54	Air (F): 57 - 62	LWD per 100 ft.:
Dry Channel (ft): 0	Riffles: 1	Pools: 7
	Pools: 7	Flat: 1
	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. 63.2	2. 31.6	3. 5.3
	4. 0.0	5. 0.0

STREAM REACH: 6

Channel Type: NA	Canopy Density (%):	Pools by Stream Length (%): 0.0
Reach Length (ft.): 400	Coniferous Component (%):	Pool Frequency (%): 0.0
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%):	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation:	< 2 Feet Deep:
Range (ft.): to	Vegetative Cover (%): 0.0	2 to 2.9 Feet Deep:
Mean (ft.):	Dominant Shelter:	3 to 3.9 Feet Deep:
Std. Dev.:	Dominant Bank Substrate Type:	>= 4 Feet Deep:
Base Flow (cfs.):	Occurrence of LWD (%):	Mean Max Residual Pool Depth (ft.):
Water (F): 0 - 0	Air (F): 0 - 0	LWD per 100 ft.:
Dry Channel (ft): 0	Riffles:	Pools:
	Pools:	Flat:
	Flat:	
Pool Tail Substrate (%): Silt/Clay:	Sand:	Gravel:
	Sm Cobble:	Lg Cobble:
	Boulder:	Bedrock:
Embeddedness Values (%): 1.	2.	3.
	4.	5. 0.0

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 7

Channel Type: B4	Canopy Density (%): 95.3	Pools by Stream Length (%): 41.0
Reach Length (ft.): 3846	Coniferous Component (%): 49.4	Pool Frequency (%): 50.5
Riffle/Flatwater Mean Width (ft.): 4.1	Hardwood Component (%): 50.6	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 68
Range (ft.): 6 to 10	Vegetative Cover (%): 81.6	2 to 2.9 Feet Deep: 22
Mean (ft.): 7	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 8
Std. Dev.: 1	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 2
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 56	Mean Max Residual Pool Depth (ft.): 1.8
Water (F): 52 - 57 Air (F): 58 - 70	LWD per 100 ft.:	Mean Pool Shelter Rating: 71
Dry Channel (ft): 123	Riffles: 2	
	Pools: 13	
	Flat: 4	
Pool Tail Substrate (%): Silt/Clay: 4 Sand: 0 Gravel: 76 Sm Cobble: 16 Lg Cobble: 4 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 54.0 2. 26.0 3. 14.0 4. 2.0 5. 4.0		

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Mill Creek

LLID: 1237954394909

Drainage: Noyo River

Survey Dates: 6/17/2008 to 6/24/2008

Confluence Location: Quad: FORT BRAGG

Legal Description: T19NR17WS19

Latitude: 39:29:27.0N

Longitude: 123:47:43.0W

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	0	2	0.8
Boulder	0	1	0.4
Cobble / Gravel	12	10	9.3
Sand / Silt / Clay	106	105	89.4

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	1	0.8
Brush	117	117	99.2
Hardwood Trees	0	0	0.0
Coniferous Trees	0	0	0.0
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Mill Creek

LLID: 1237954394909

Drainage: Noyo River

Survey Dates: 6/17/2008 to 6/24/2008

Confluence Location: Quad: FORT BRAGG

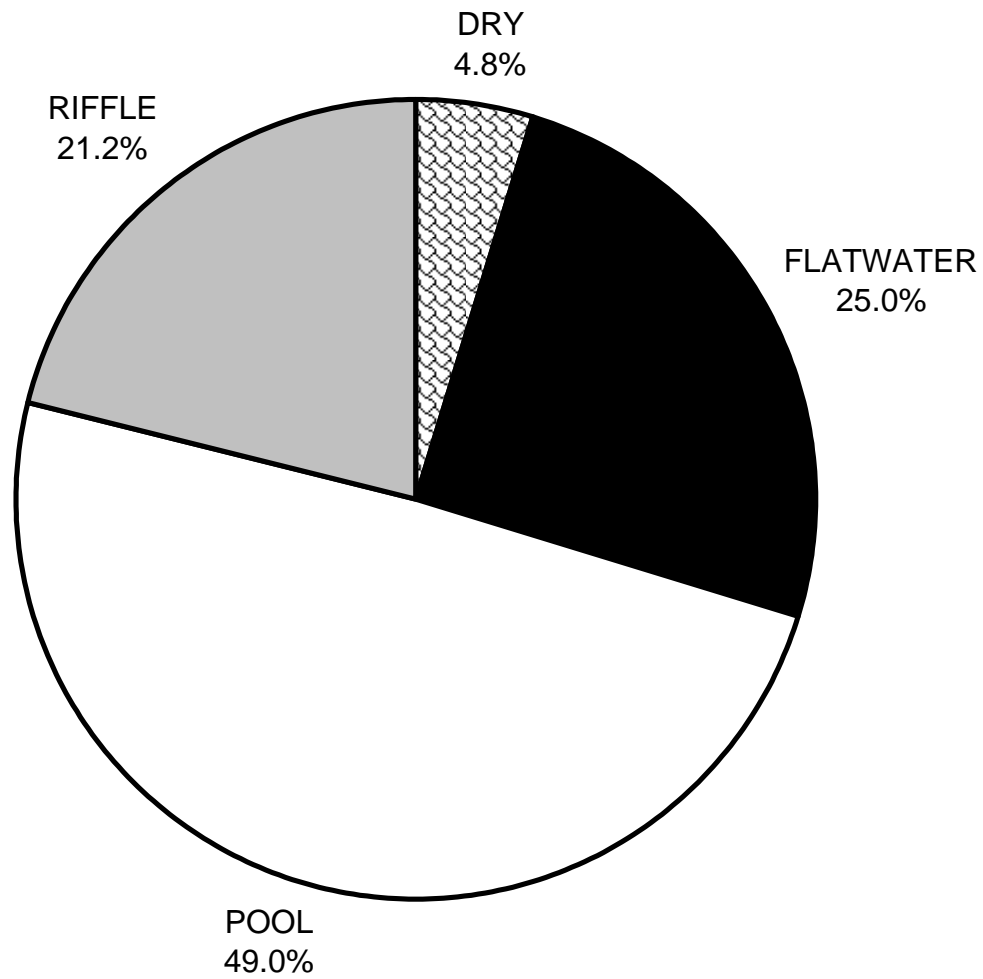
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Longitude: 123:47:43.0W

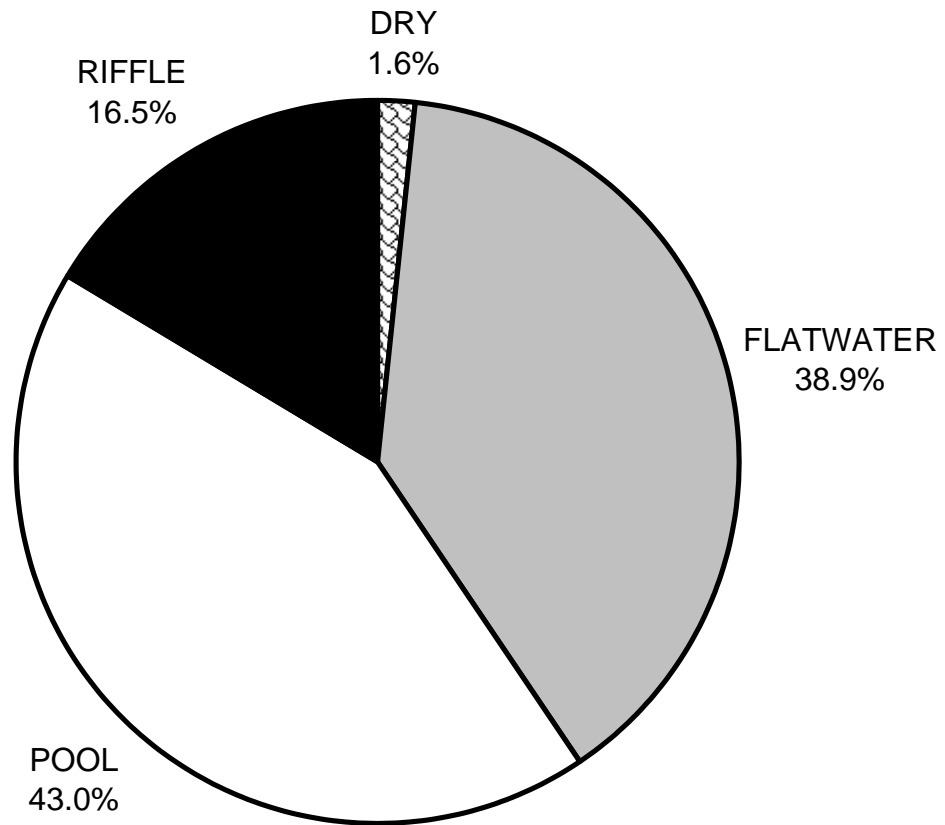
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	16	16	21
SMALL WOODY DEBRIS (%)	17	18	13
LARGE WOODY DEBRIS (%)	6	25	47
ROOT MASS (%)	1	3	4
TERRESTRIAL VEGETATION (%)	45	39	15
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	0
BOULDERS (%)	15	0	0
BEDROCK LEDGES (%)	0	0	0

MILL CREEK 2008 HABITAT TYPES BY PERCENT OCCURRENCE



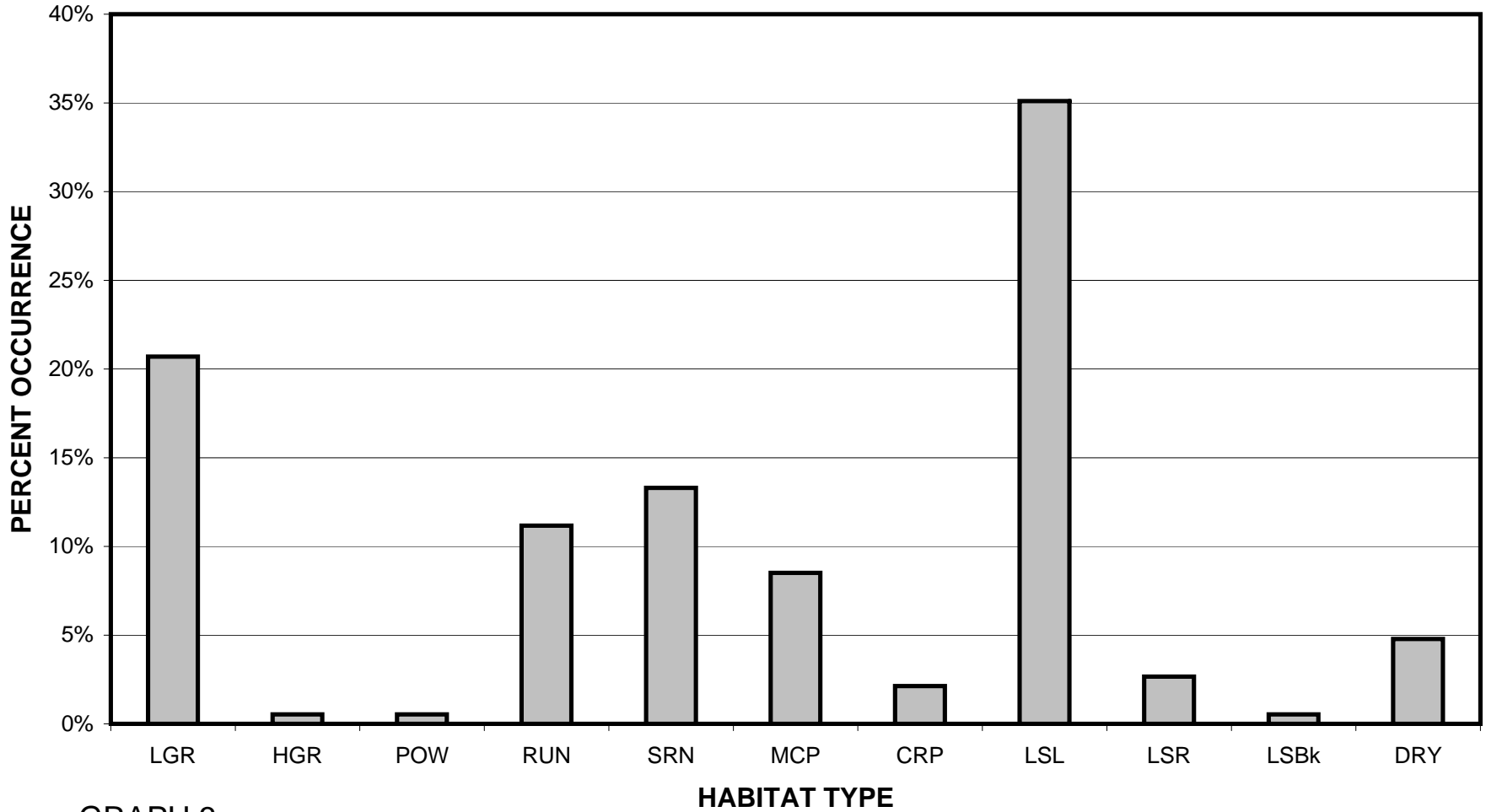
GRAPH 1

**MILL CREEK 2008
HABITAT TYPES BY PERCENT TOTAL LENGTH**



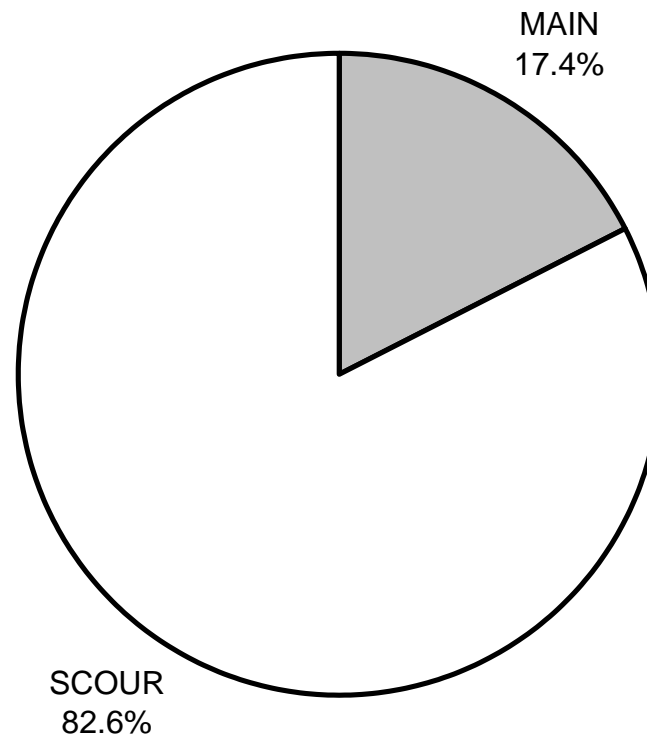
GRAPH 2

MILL CREEK 2008 HABITAT TYPES BY PERCENT OCCURRENCE



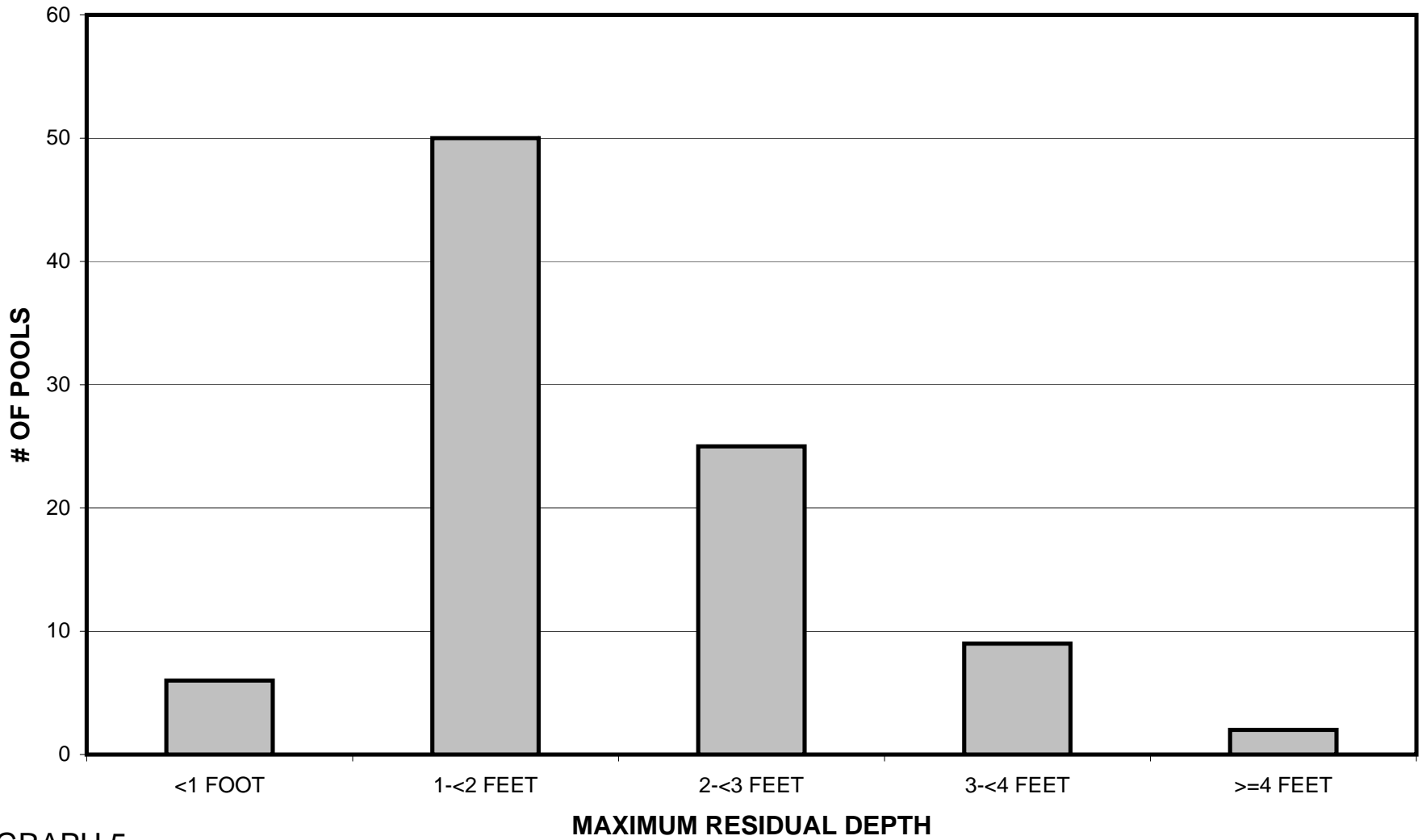
GRAPH 3

**MILL CREEK 2008
POOL TYPES BY PERCENT OCCURRENCE**



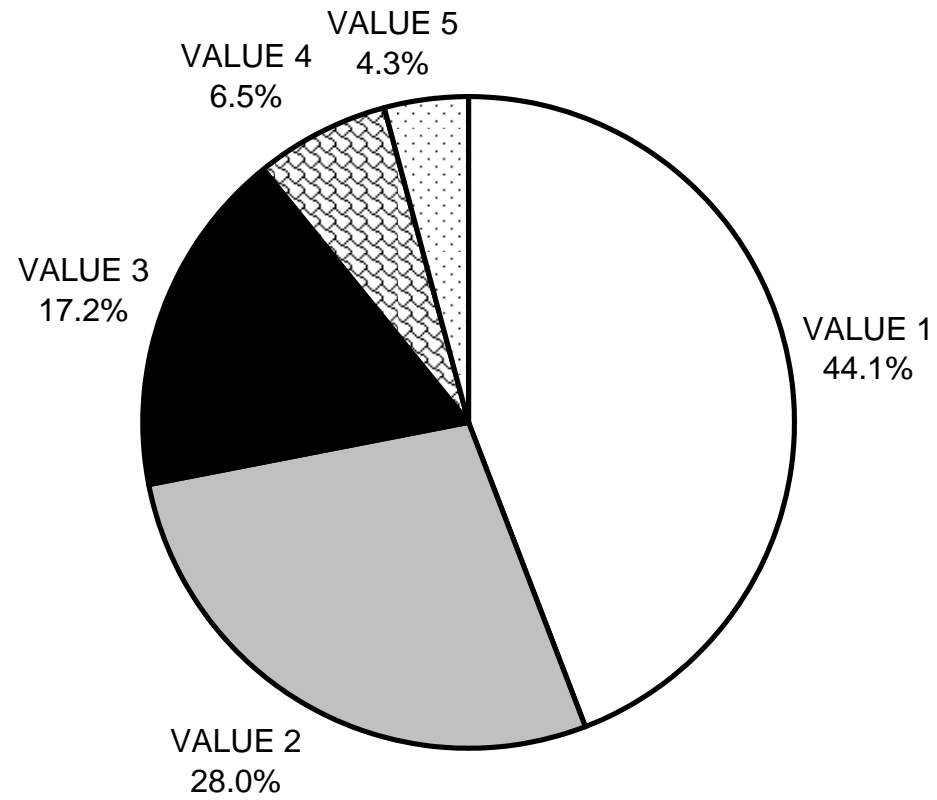
GRAPH 4

MILL CREEK 2008 MAXIMUM DEPTH IN POOLS



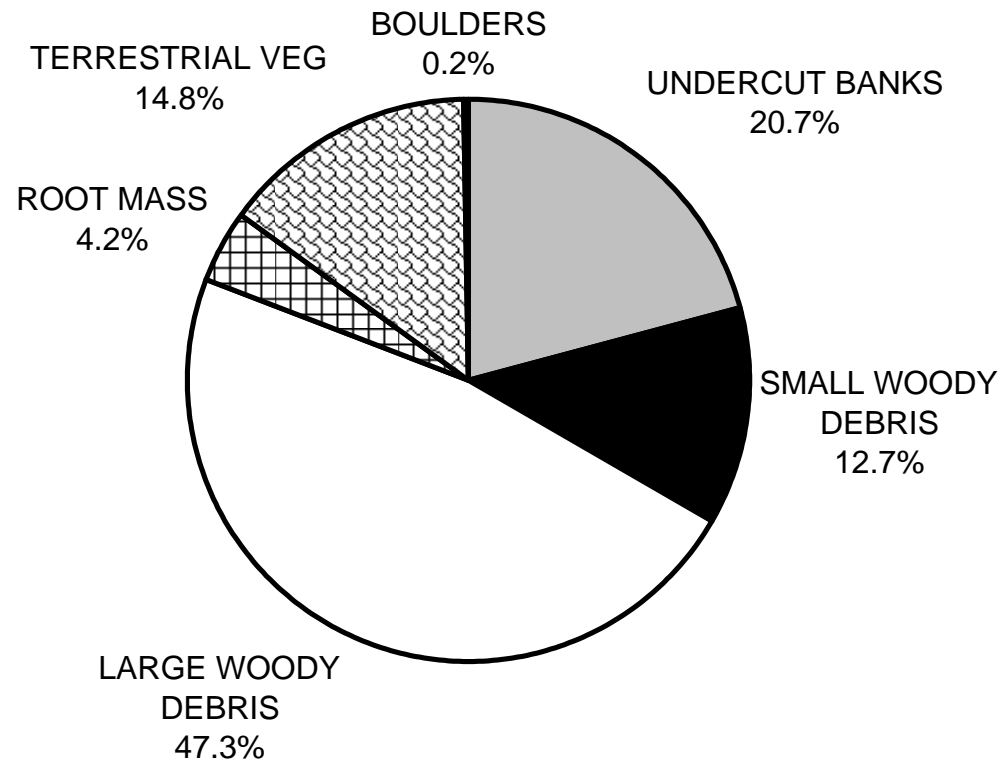
GRAPH 5

MILL CREEK 2008 PERCENT EMBEDDEDNESS



GRAPH 6

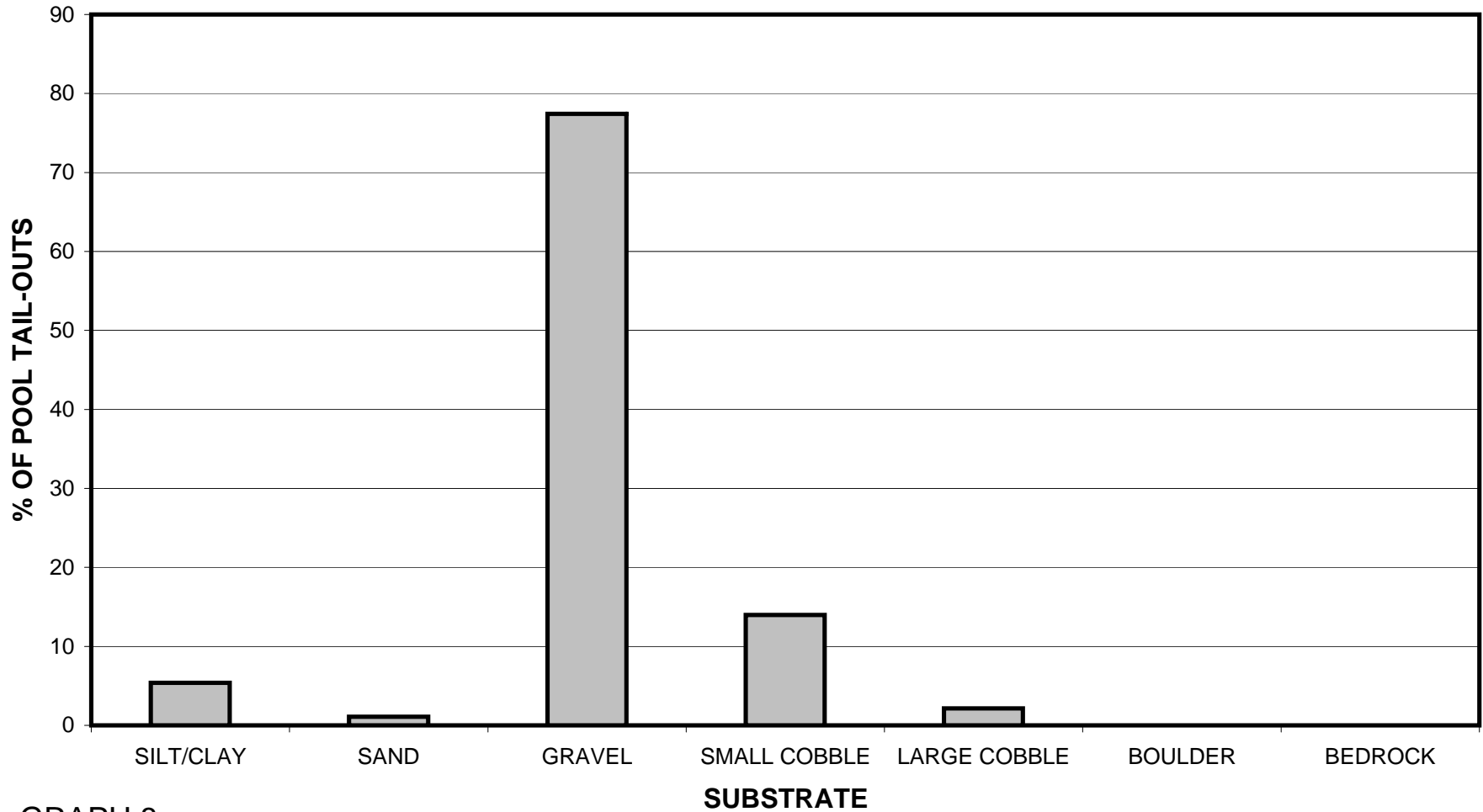
MILL CREEK 2008 MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

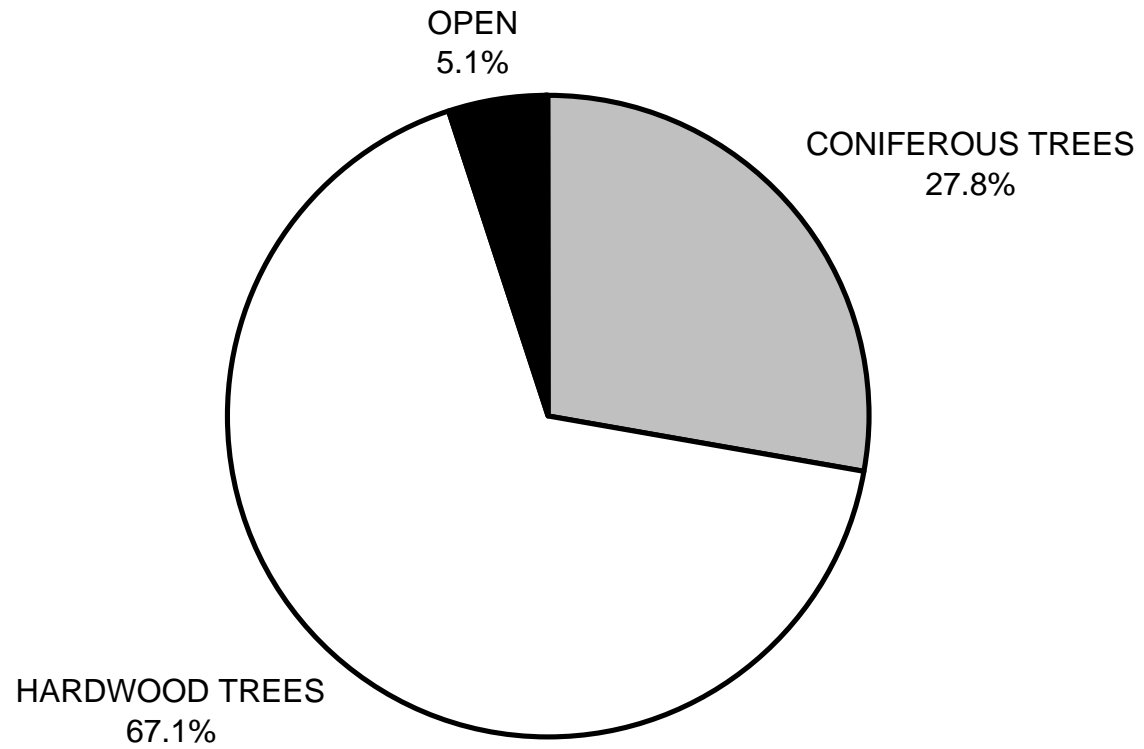
MILL CREEK 2008

SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



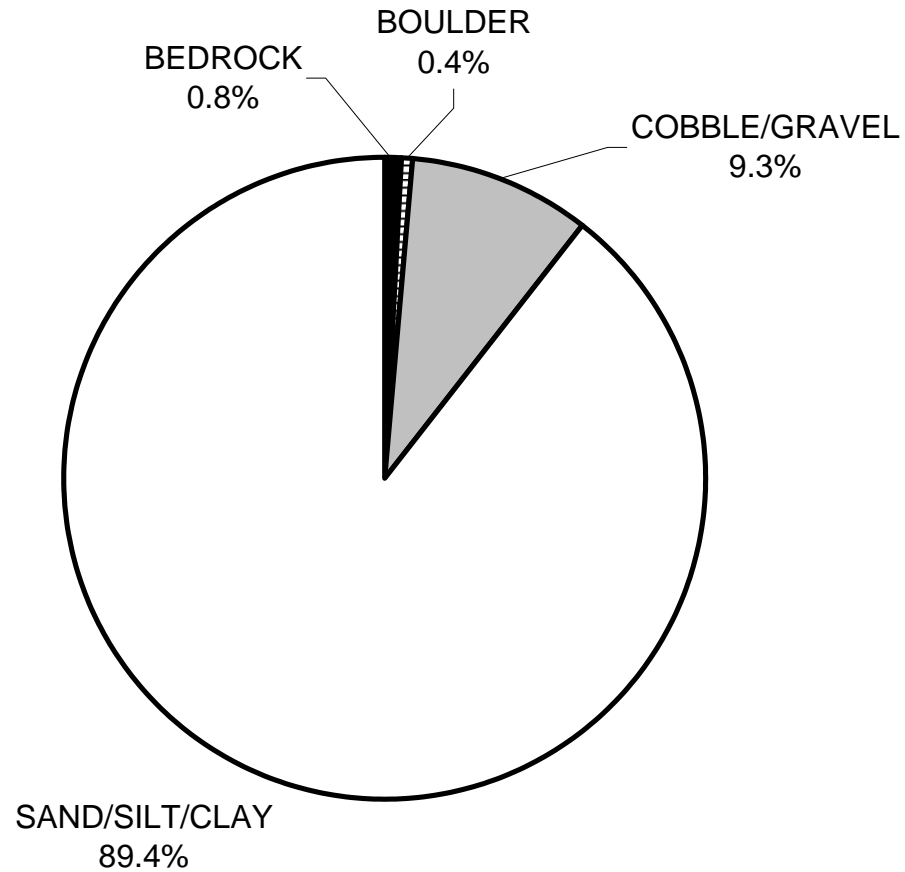
GRAPH 8

MILL CREEK 2008 MEAN PERCENT CANOPY



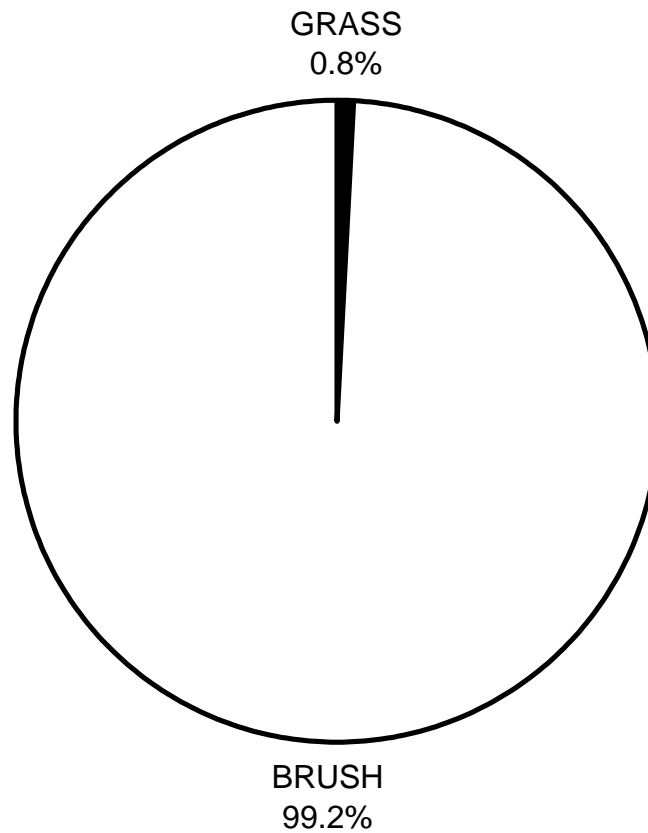
GRAPH 9

MILL CREEK 2008 DOMINANT BANK COMPOSITION IN SURVEY REACH



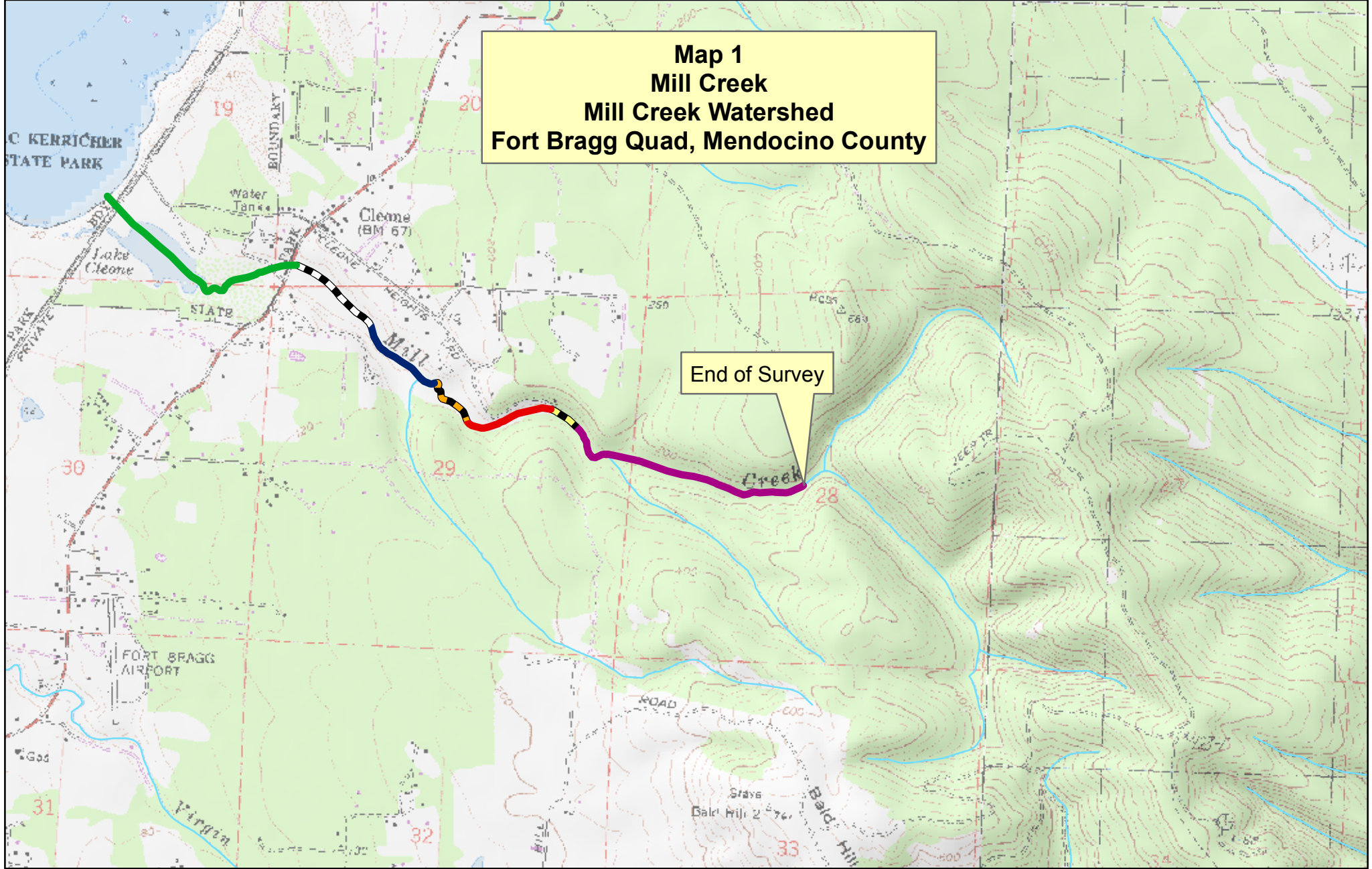
GRAPH 10

**MILL CREEK 2008
DOMINANT BANK VEGETATION IN SURVEY REACH**

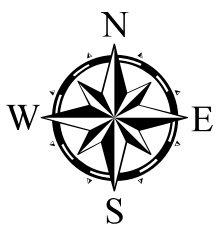


GRAPH 11

**Map 1
Mill Creek
Mill Creek Watershed
Fort Bragg Quad, Mendocino County**



End of Survey



Legend

- Reach 1, Not Surveyed
- Reach 2, C4 Channel Type
- Reach 3, Not Surveyed
- Reach 4, C4 Channel Type
- Reach 5, B4 Channel Type
- Reach 6, Not Surveyed
- Reach 7, B4 Channel Type

