STREAM INVENTORY REPORT

Redwood Creek

INTRODUCTION

A stream inventory was conducted from October 8 to October 30, 2013 on Redwood Creek. The survey began at the confluence with the Noyo River and extended upstream 4.9 miles.

The Redwood 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 Redwood 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

Redwood Creek is a tributary to the Noyo River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Redwood Creek's legal description at the confluence with the Noyo River is T18N R15W S11. Its location is 39.4309 degrees north latitude and 123.4939 degrees west longitude, LLID number 1234927394310. Redwood Creek is a second order stream and has approximately 4.2 miles of blue line stream according to the USGS Burbeck 7.5 minute quadrangle. Redwood Creek drains a watershed of approximately 5.3 square miles. Elevations range from about 410 feet at the mouth of the creek to 2,400 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production and rural development. Vehicle access exists via Irmulco Road, seven miles west of Willits, CA.

METHODS

The habitat inventory conducted in Redwood 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 and California Conservation Corps (CCC) members 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

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 Redwood 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". Redwood 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 Redwood Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed not suitable 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. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is classified according to a list of nine cover types. In Redwood 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. The shelter rating is then calculated for each fully-described habitat unit by multiplying shelter value and percent 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 Redwood 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 Redwood 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 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 Redwood Creek. In addition, underwater observations were made at seven 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 Wildlife. 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 Redwood 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 October 8 to October 30, 2013 was conducted by N. Massa (CDFW), M. Scott (CDFW), B. Brengettsey (California Conservation Corps), and B. Leonard (CDFW). The total length of the stream surveyed was 25,919 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.12 cfs on October 16, 2013.

Redwood Creek is an F4 channel type for the entire length of the survey, 25,919 feet. 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 45 to 56 degrees Fahrenheit. Air temperatures ranged from 41 to 62 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 39% riffle units, 33% pool units, 27% flatwater units, and 1% dry units (Graph 1). Based on total length of Level II habitat types there were 42% pool units, 28% riffle units, 24% flatwater units, and 5% unsurveyed units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units, 38%; mid-channel pool units, 32%; and run units, 17% (Graph 3). Based on percent total length, mid-channel pool units made up 41%, low gradient riffle units 28%, and run units 12%.

A total of 221 pools were identified (Table 3). Main channel pools were the most frequently encountered at 99% (Graph 4), and comprised 99% 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. Eighty-two of the 221 pools (37%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 221 pool tail-outs measured, 155 had a value of 1 (70%); 50 had a value of 2 (23%); 11 had a value of 3 (5%); two had a value of 4 (0.9%); 3 had a value of 5 (1.4%) (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 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 6, flatwater habitat types had a mean shelter rating of 7, and pool habitats had a mean shelter rating of 22 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 22. Scour pools had a mean shelter rating of 8 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type in Redwood Creek. Graph 7 describes the pool cover in Redwood Creek. Small woody debris is the dominant pool cover type followed by large woody debris.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the dominant substrate observed in 90% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 9% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Redwood Creek was 96%. Four percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 53% and 47%, respectively. Graph 9 describes the mean percent canopy in Redwood Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 96%. The mean percent left bank vegetated was 96%. The dominant elements composing the structure of the stream banks consisted of 56% cobble/gravel, 41% sand/silt/clay, 2% bedrock, and 1% boulders (Graph 10). Coniferous trees were the dominant vegetation type observed in 59% of the units surveyed. Additionally, 37% of the units surveyed had hardwood trees as the dominant vegetation type, and 2% had grass as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at seven sites for species composition and distribution in Redwood Creek on October 30, 2013. The sites were sampled by B. Leonard and J. Hollis (CDFW).

The reach sites yielded 11 young-of-the-year (YOY) steelhead/rainbow trout (SH/RT), 44 YOY coho salmon, and one age 1+ coho salmon.

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2013 Redwood Creek underwater observations.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Coho	
					YOY	1+	2+	YOY	1+
F4 Channel Type									
10/30/13	1	541	Pool	21,499	0	0	0	8	0
	2	546	Pool	21,680	10	0	0	16	1
	3	550	Pool	21,774	1	0	0	17	0
	4	567	Pool	22,264	0	0	0	3	0
	5	598	Pool	23,155	0	0	0	0	0
	6	602	Pool	23,276	0	0	0	0	0
	7	610	Pool	23,575	0	0	0	0	0

DISCUSSION

Redwood Creek is an F4 channel type for the entire 25,919 feet of stream surveyed. The suitability of F4 channel types for fish habitat improvement structures is as follows: 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 8 to October 30, 2013 ranged from 45 to 56 degrees Fahrenheit. Air temperatures ranged from 41 to 62 degrees Fahrenheit. This is a suitable water temperature range for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 24% of the total length of this survey, riffles 28%, and pools 42%. Eighty-two of the 221 (37%) 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 structures that will increase or deepen pool habitat is recommended.

Two hundred five of the 221 pool tail-outs measured had embeddedness ratings of 1 or 2. Thirteen 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.

Two hundred seventeen of the 221 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

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The mean shelter rating for pools is 22. The shelter rating in the flatwater habitats is 7. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by small woody debris in Redwood Creek. Small woody debris is 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 structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

The mean percent canopy density for the stream was 96%. The percentage of right and left bank covered with vegetation was 96% and 96%, respectively.

RECOMMENDATIONS

1) Redwood 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 small woody debris. Adding high quality complexity with woody cover in the pools is desirable.

COMMENTS AND LANDMARKS

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

Position (ft):	Habitat unit #:	Comments:
0	0001.00	Start of survey at the confluence with the Noyo River. The channel is an F4 for the entire length of the survey.
274	0012.00	The railroad crosses the channel. The crossing is a 9' diameter x 88' long metal culvert with a concrete apron. The slope of the culvert is 0.3% and there is a 0.5' high plunge at the outlet.
918	0027.00	A logging road crosses the channel. The crossing is a 13.8' wide x 50' long x 9.9' high wooden bridge with metal supports.
4385	0118.00	Log debris accumulation (LDA) #01 contains 15 pieces of large woody debris (LWD) and measures 5' high x 22' wide x 15' long. Water does not flow through the LDA and there are visible gaps in it. Retained

		sediment ranges from sand to gravel and measures 15' wide x 20' long x 25' deep. Fish were observed above the LDA.
5594	0155.00	LDA #02 contains approximately 20 pieces of LWD and measures 5.5' high x 21' wide x 11' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from sand to small cobble and measures 15' wide x 41' long x 13' deep. There is a 5.5' high plunge over the LDA. Fish were observed above the LDA.
5975	0166.00	A logging road crosses the channel. The crossing is a 14.5' wide x 61' long x 5.4' high wooden bridge with metal supports.
7296	0197.00	Dry tributary on right bank.
11302	0291.00	There is a 1.3' high plunge over woody debris.
11338	0292.00	Dry right bank tributary.
11474	0295.00	The left bank is eroding around LDA #03. It contains approximately 24 pieces of LWD and measures 4' high x 22' wide x 11' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from sand to gravel and measures 35' wide x 20' long x 2' deep. Fish were observed above the LDA.
12379	0321.00	There is a 1,370' long unsurveyed section.
13816	0324.00	LDA #04 contains approximately 14 pieces of LWD and measures 5.5' high x 21' wide x 11' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from sand to small cobble and measures 12' wide x 46' long x 2.5' deep. Fish were observed above the LDA.
14960	0354.00	There is a 1.5' high plunge over woody debris.
16248	0390.00	A logging road crosses the channel. The crossing is a 10' wide x 55' long x 8.5' high metal bridge.
16967	0411.00	Dry right bank tributary.
17843	0431.00	There is a 0.7' high plunge over bedrock.
18721	0457.00	A logging road crosses the channel. The crossing is a 9.5' wide x 47' long x 7.2' high metal bridge.
19682	0484.00	A large log spans the channel and is holding back cobble and gravel. It is forcing the flow to the left bank.

20202	0499.00	LDA #05 contains approximately 11 pieces of LWD and measures 4' high x 16' wide x 16' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from gravel to large cobble and measures 12' wide x 50' long x 2' deep. Fish were observed above the LDA.
20276	0503.00	Dry tributary on left bank. LDA #06 contains 19 pieces of LWD and measures 5' high x 36' wide x 36' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from sand to large cobble and measures 30' wide x 30' long x 2.5' deep. Fish were observed above the LDA.
21474	0541.00	A logging road crosses the channel. The crossing is an 11' wide x 44' long x 8' high metal bridge.
23548	0610.00	LDA #07 contains nine pieces of LWD and measures 6' high x 27' wide x 9' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from sand to gravel and measures 11' wide x 18' long x 3' deep. Fish were not observed above the LDA.
23914	0618.00	There is a 1' high plunge over woody debris. Tributary on the left bank on has flow for first 110'. 70' upstream from the mouth of the tributary is a culvert with a 1.5' high plunge at the outlet.
24631	0637.00	LDA #08 contains seven pieces of LWD and measures 5' high x 25' wide x 9' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from sand to large cobble and measures 18' wide x 13' long x 2.5' deep.
24917	0646.00	A logging road crosses the channel. The crossing is a 19' wide x 31' long x 9' high metal bridge.
25528	0659.00	Dry tributary on right bank.
25890	0669.00	LDA #09 contains five pieces of LWD and measures 7.5' high x 16' wide x 2.5' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from gravel to large cobble and measures 15' wide x 23' long x 3.5' deep. There is a 4.5' high plunge over the LDA.
25919	0670.00	End of survey. The channel goes dry for 45' leading up to a 14' high LDA associated with a large boulder on the right bank. The channel is dry for 92' upstream of the LDA. At the end of the dry section there is a 20' long run with a 5' high plunge above it where the bank collapsed in to the channel. The creek is dry for several hundred feet above the 5' high plunge. No fish were observed in the last 1,900' surveyed.

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.

Redwood Creek

LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE			
Low Gradient Riffle	(LGR)	[1.1]	{ 1}
High Gradient Riffle	(HGR)	[1.2]	{ 2}
CASCADE			
Cascade	(CAS)	[2.1]	{ 3}
Bedrock Sheet	(BRS)	[2.2]	{24}
FLATWATER			
Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}
MAIN CHANNEL POOLS			
Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}
SCOUR POOLS			
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }
BACKWATER POOLS			
Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}
ADDITIONAL UNIT DESIGNATIONS			
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

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

Stream Name: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Mean Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating
1	0	CULVERT	0.1	88	88	0.3									
5	0	DRY	0.7	10	49	0.2									
181	18	FLATWATER	27.1	34	6229	24.0	6.3	0.4	0.6	163	29486	58	10528		7
1	0	NOSURVEY	0.1	1370	1370	5.3									
221	221	POOL	33.0	49	10871	41.9	10.2	0.8	1.8	523	115687	571	126102	484	22
260	29	RIFFLE	38.9	28	7312	28.2	6.2	0.2	0.4	179	46592	37	9618		6

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
669	268	25919	191765	146247

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

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 (%)
255	28	LGR	38.1	28	7212	27.8	6	0.2	0.7	185	47205	38	9720		6	96
4	0	HGR	0.6	23	91	0.4										
1	1	CAS	0.1	9	9	0.0	2	0.4	0.7	14	14	5	5		10	95
1	0	GLD	0.1	62	62	0.2										
115	12	RUN	17.2	28	3166	12.2	6	0.4	0.9	98	11223	40	4559		8	97
65	6	SRN	9.7	46	3001	11.6	8	0.4	0.7	294	19080	95	6188		5	99
217	217	MCP	32.4	49	10699	41.3	10	0.8	4.8	525	113848	574	124464	487	22	96
1	1	STP	0.1	52	52	0.2	9	0.6	1.2	468	468	374	374	281	10	80
3	3	PLP	0.4	40	120	0.5	10	0.6	2	457	1371	421	1263	357	8	98
5	0	DRY	0.7	10	49	0.2										
1	0	CUL	0.1	88	88	0.3										
1	0	NS	0.1	1370	1370	5.3										

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
669	268	25919	193209	146575

Table 3 - Summary of Pool Types

Stream Name: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

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
218	218	MAIN	99	49	10751	99	10.2	0.8	524	114316	486	105968	22
3	3	SCOUR	1	40	120	1	10.0	0.6	457	1371	357	1072	8

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
221	221	10871	115687	107040

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

Stream Name: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

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
217	MCP	98	18	8	118	54	63	29	14	6	4	2
1	STP	0	0	0	1	100	0	0	0	0	0	0
3	PLP	1	1	33	1	33	1	33	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
221	19	9	120	54	64	29	14	6	4	2

Mean Maximum Residual Pool Depth (ft.): 1.8

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013 Dry Units: 5

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

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
255	28	LGR	3	27	1	0	0	0	0	69	0
4	0	HGR									
1	1	CAS	0	0	0	0	0	0	90	10	0
260	29	TOTAL RIFFLE	2	26	1	0	0	0	5	66	0
1	0	GLD									
115	13	RUN	19	38	10	0	0	0	0	34	0
65	6	SRN	7	18	7	0	0	0	0	67	0
181	19	TOTAL FLAT	15	31	9	0	0	0	0	46	0
217	217	MCP	18	33	33	1	4	0	0	11	0
1	1	STP	0	10	40	0	35	0	0	15	0
3	3	PLP	38	12	12	0	0	0	2	37	0
221	221	TOTAL POOL	18	33	33	1	4	0	0	11	0
1	0	CUL									
1	0	NS									
669	269	TOTAL	17	32	29	1	3	0	0	18	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013 Dry Units: 5

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

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
255	28	LGR	0	0	96	4	0	0	0
4	0	HGR	0	0	0	0	0	0	0
1	1	CAS	0	0	0	0	0	0	100
1	0	GLD	0	0	0	0	0	0	0
115	13	RUN	0	8	77	15	0	0	0
65	6	SRN	0	0	100	0	0	0	0
217	217	MCP	2	22	69	6	0	0	0
1	1	STP	0	0	100	0	0	0	0
3	3	PLP	0	67	33	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
96	47	53	0	96	96

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: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013 Survey Length (ft.): 25919 Main Channel (ft.): 25919 Side Channel (ft.): 0

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4
Reach Length (ft.): 25919
Riffle/Flatwater Mean Width (ft.): 6.2
BFW:
Range (ft.): 8 to 30
Mean (ft.): 17
Std. Dev.: 3
Base Flow (cfs.): 0.1
Water (F): 45 - 56 Air (F): 41 - 62
Dry Channel (ft): 49

Canopy Density (%): 96.3
Coniferous Component (%): 46.9
Hardwood Component (%): 53.1
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover (%): 96.2
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 27
LWD per 100 ft.:
Riffles: 2
Pools: 6
Flat: 3

Pools by Stream Length (%): 41.9
Pool Frequency (%): 33.0
Residual Pool Depth (%):
< 2 Feet Deep: 63
2 to 2.9 Feet Deep: 29
3 to 3.9 Feet Deep: 6
>= 4 Feet Deep: 2
Mean Max Residual Pool Depth (ft.): 1.8
Mean Pool Shelter Rating: 22

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 90 Sm Cobble: 9 Lg Cobble: 1 Boulder: 0 Bedrock: 0

Embeddedness Values (%): 1. 70.1 2. 22.6 3. 5.0 4. 0.9 5. 1.4

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

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	5	6	2.0
Boulder	4	1	0.9
Cobble / Gravel	156	145	55.9
Sand / Silt / Clay	104	117	41.1

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	7	3	1.9
Brush	6	3	1.7
Hardwood Trees	103	95	36.8
Coniferous Trees	151	168	59.3
No Vegetation	2	0	0.4

Total Stream Cobble Embeddedness Values: 1

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

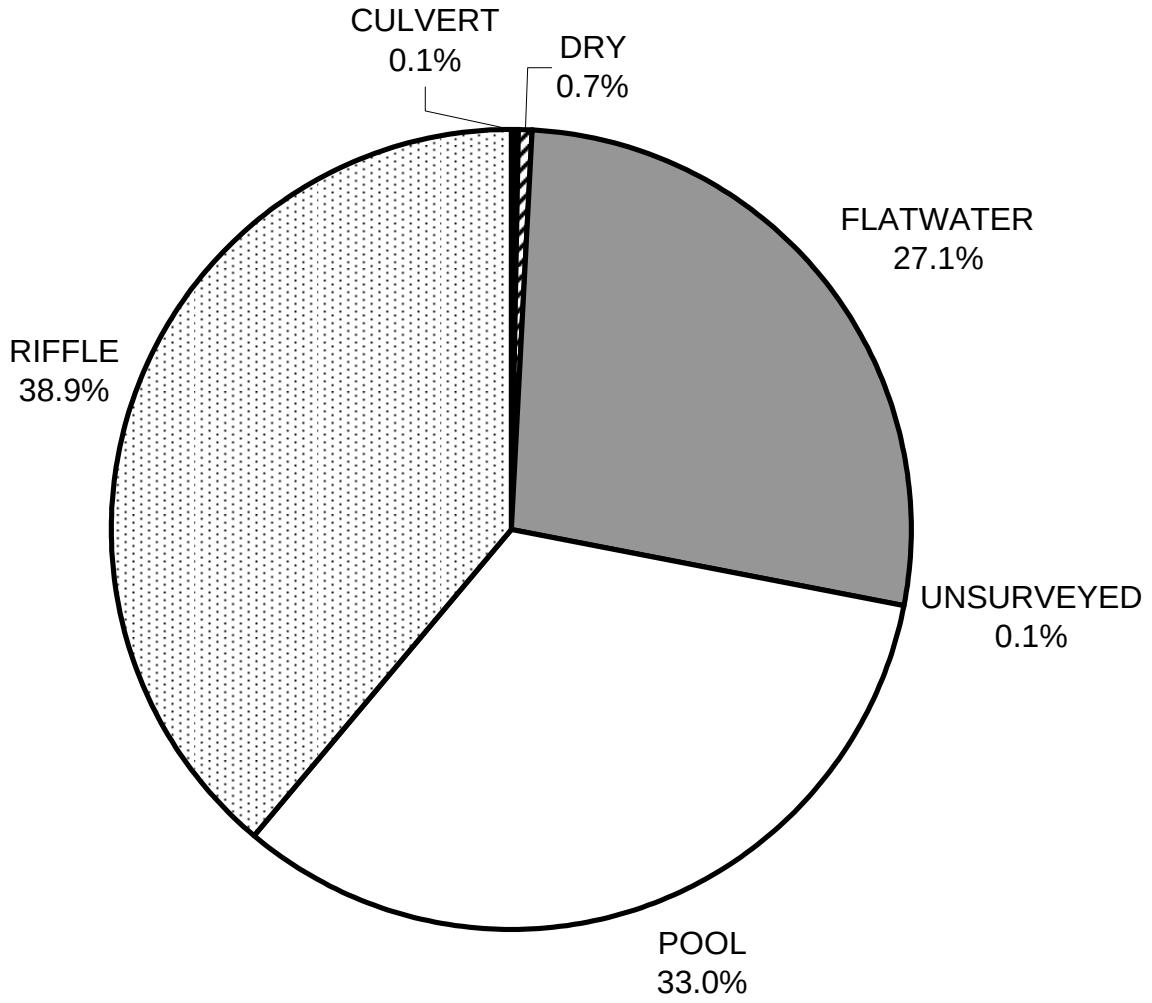
StreamName: Redwood Creek LLID: 1234927394310 Drainage: Noyo River

Survey Dates: 10/8/2013 to 10/30/2013

Confluence Location: Quad: BURBECK Legal Description: T18NR15WS11 Latitude: 39:25:52.0N Longitude: 123:29:34.0W

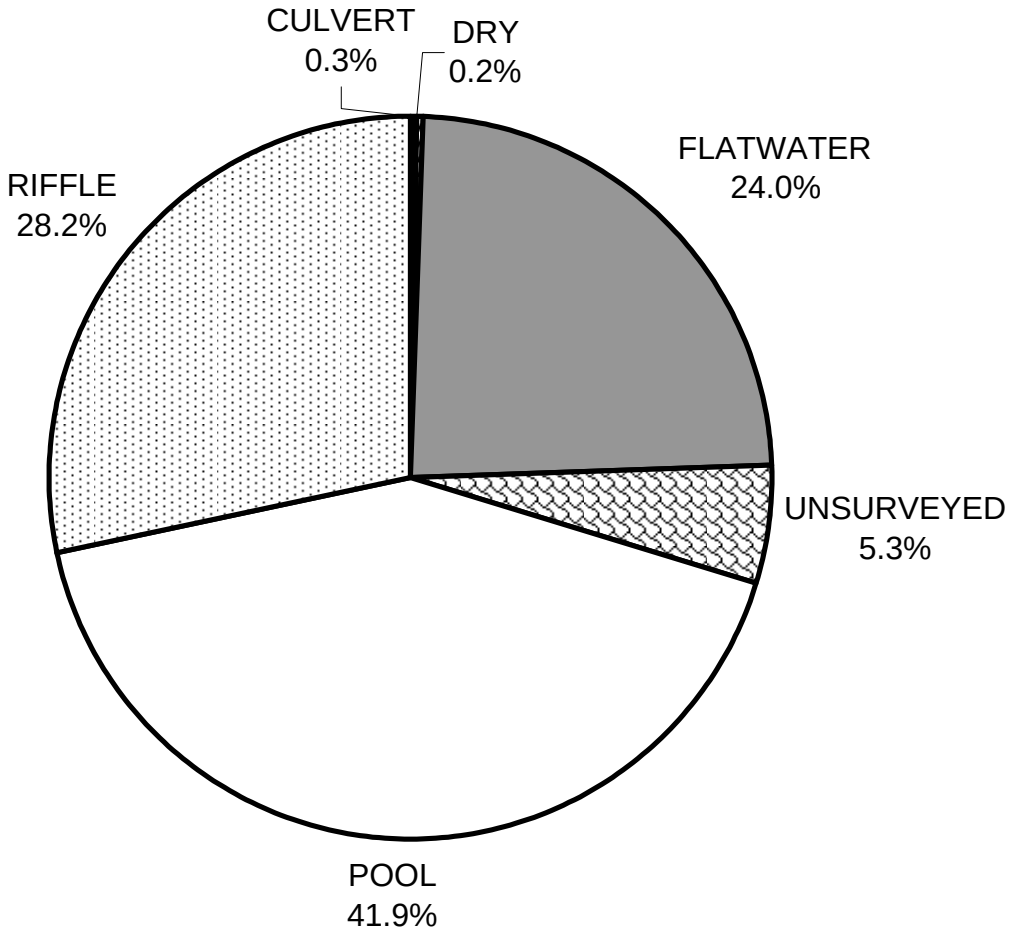
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	2	15	18
SMALL WOODY DEBRIS (%)	26	31	33
LARGE WOODY DEBRIS (%)	1	9	33
ROOT MASS (%)	0	0	1
TERRESTRIAL VEGETATION (%)	0	0	4
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	5	0	0
BOULDERS (%)	66	46	11
BEDROCK LEDGES (%)	0	0	0

REDWOOD CREEK 2013
HABITAT TYPES BY PERCENT OCCURRENCE



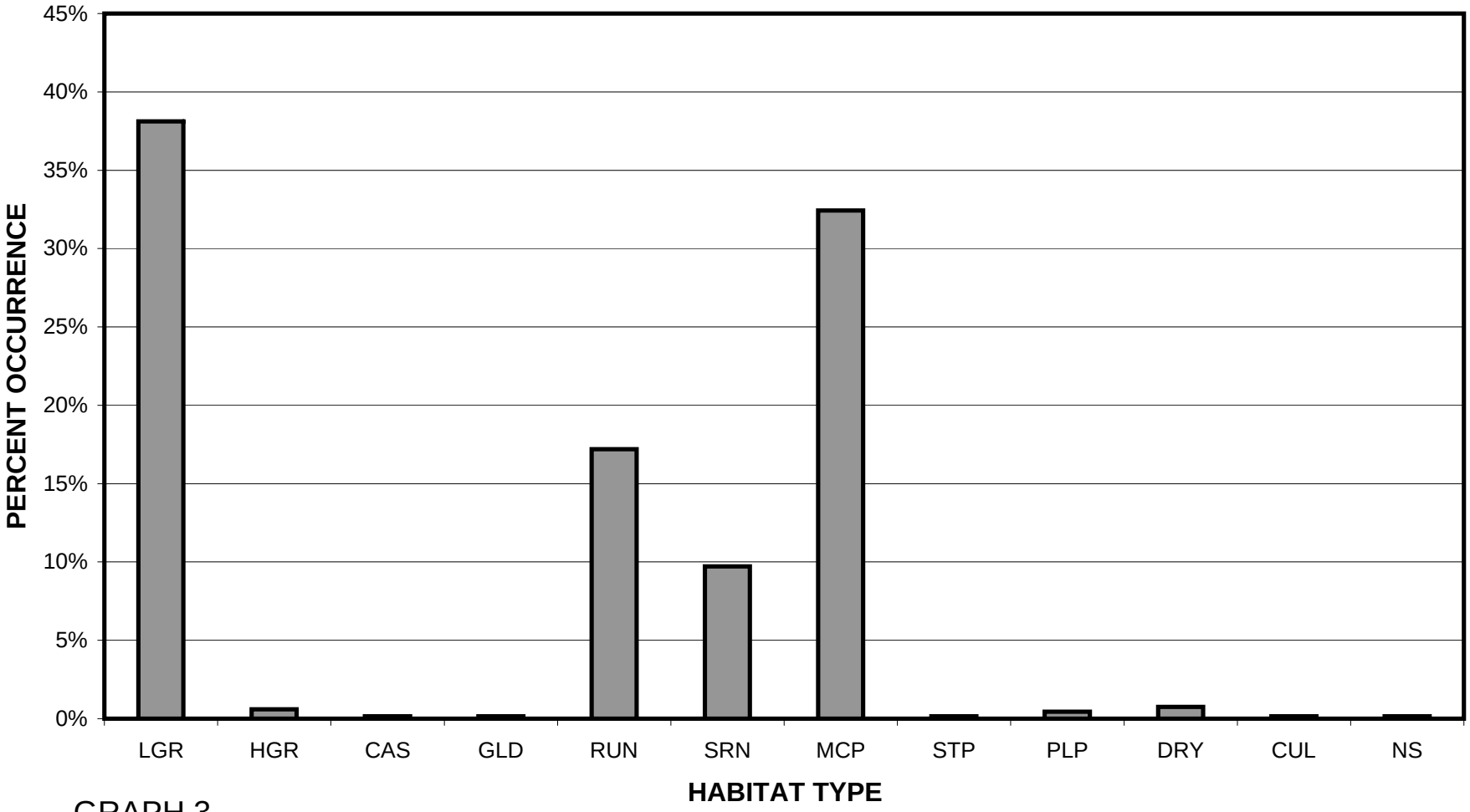
GRAPH 1

REDWOOD CREEK 2013
HABITAT TYPES BY PERCENT TOTAL LENGTH



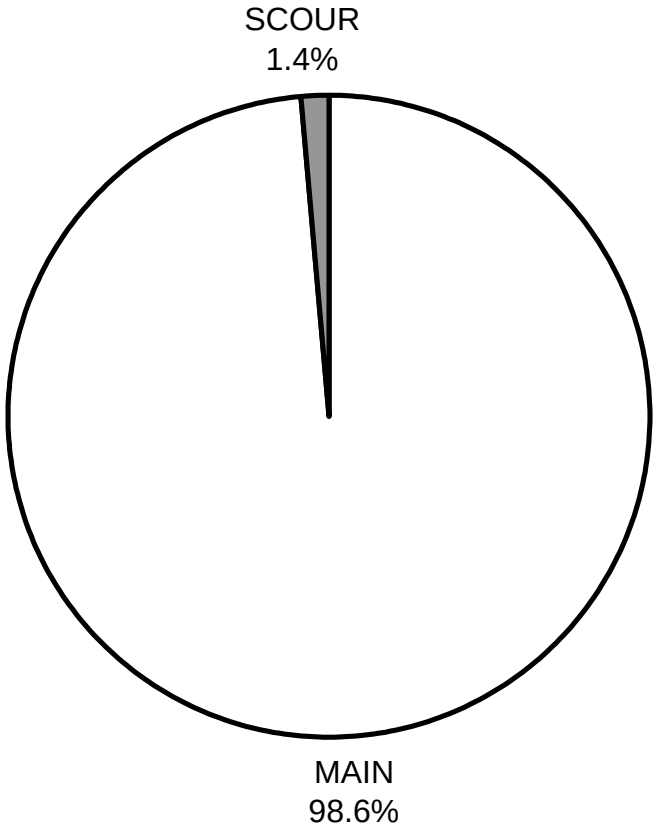
GRAPH 2

REDWOOD CREEK 2013
HABITAT TYPES BY PERCENT OCCURRENCE



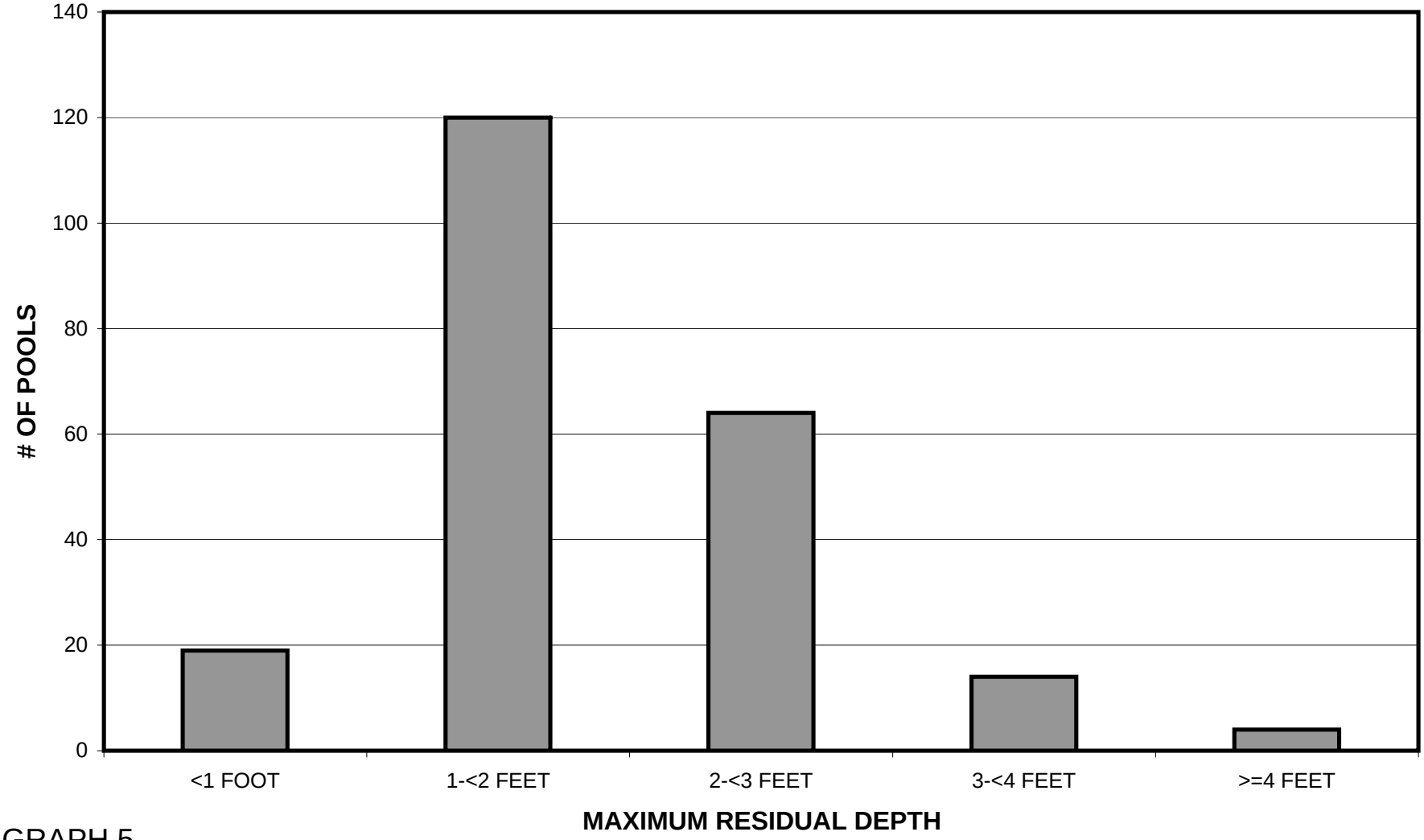
GRAPH 3

REDWOOD CREEK 2013
POOL TYPES BY PERCENT OCCURRENCE



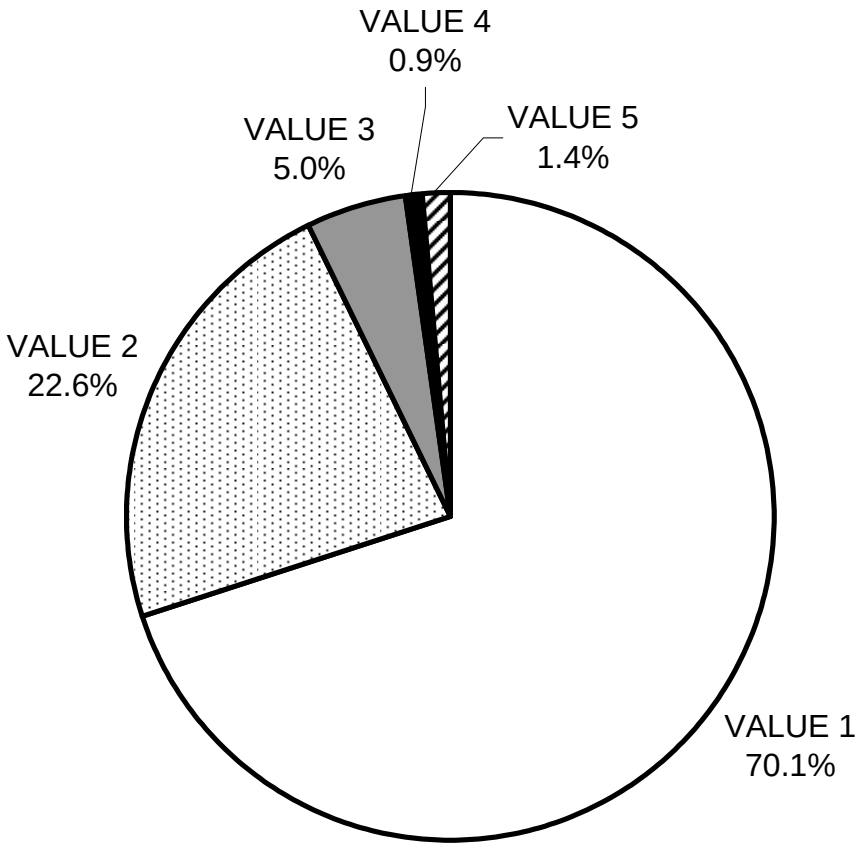
GRAPH 4

REDWOOD CREEK 2013
MAXIMUM DEPTH IN POOLS



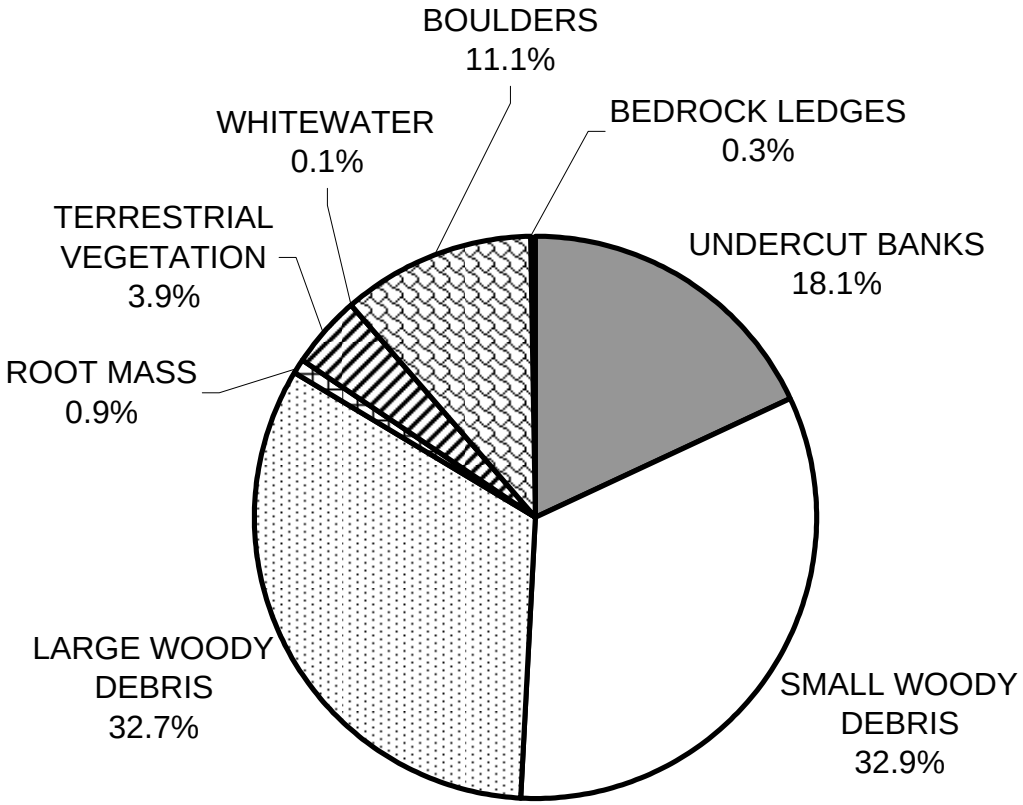
GRAPH 5

REDWOOD CREEK 2013
PERCENT EMBEDDEDNESS



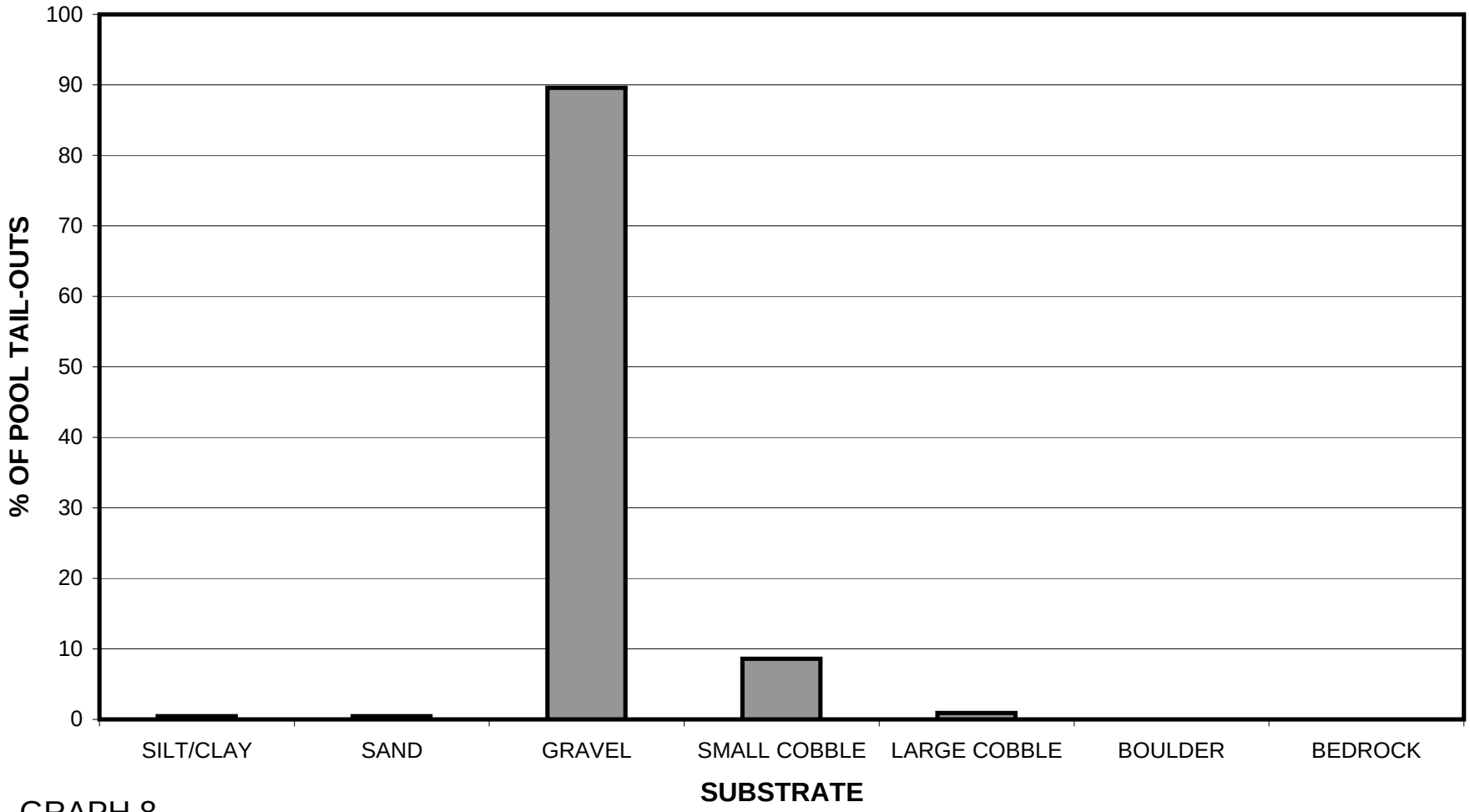
GRAPH 6

REDWOOD CREEK 2013
MEAN PERCENT COVER TYPES IN POOLS



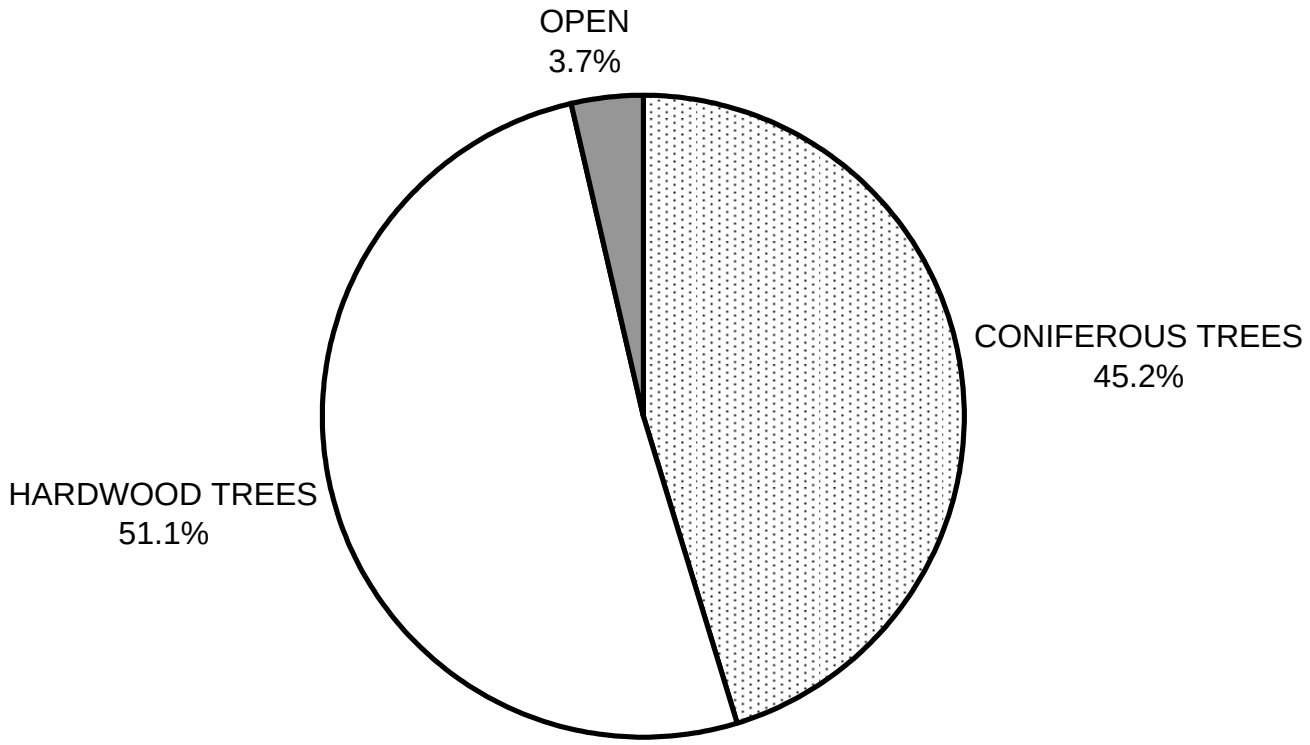
GRAPH 7

REDWOOD CREEK 2013
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



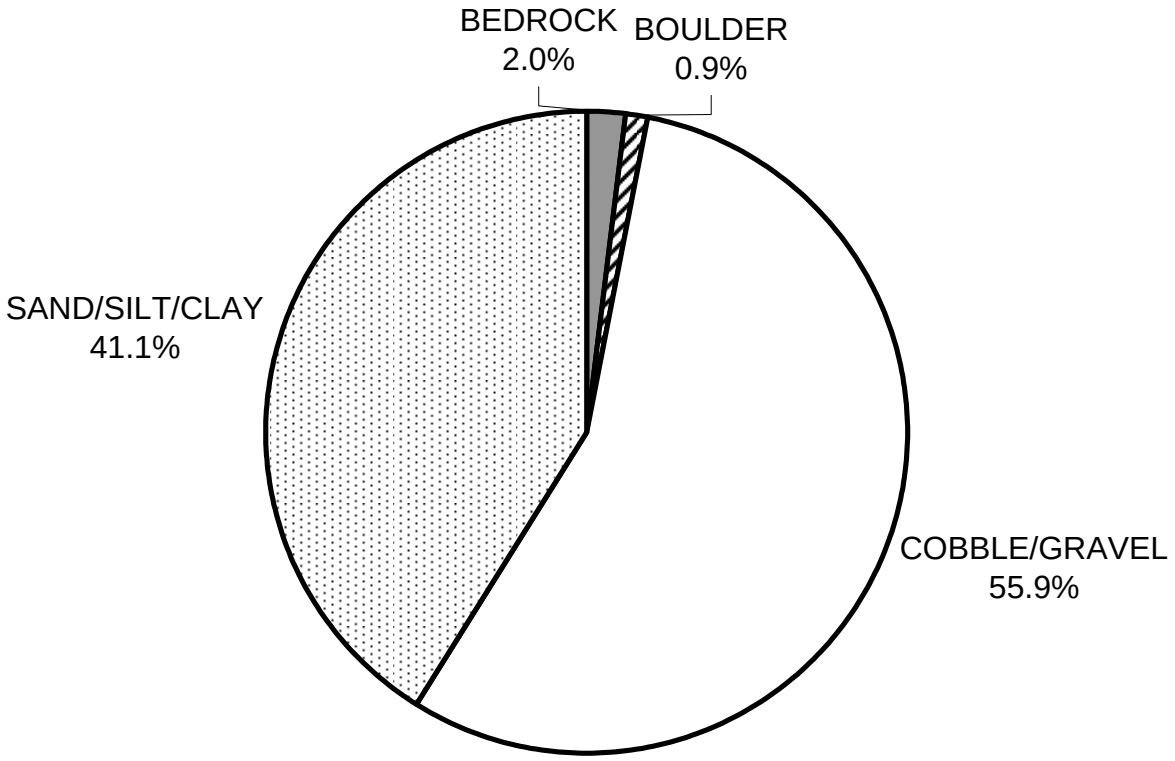
GRAPH 8

REDWOOD CREEK 2013
MEAN PERCENT CANOPY



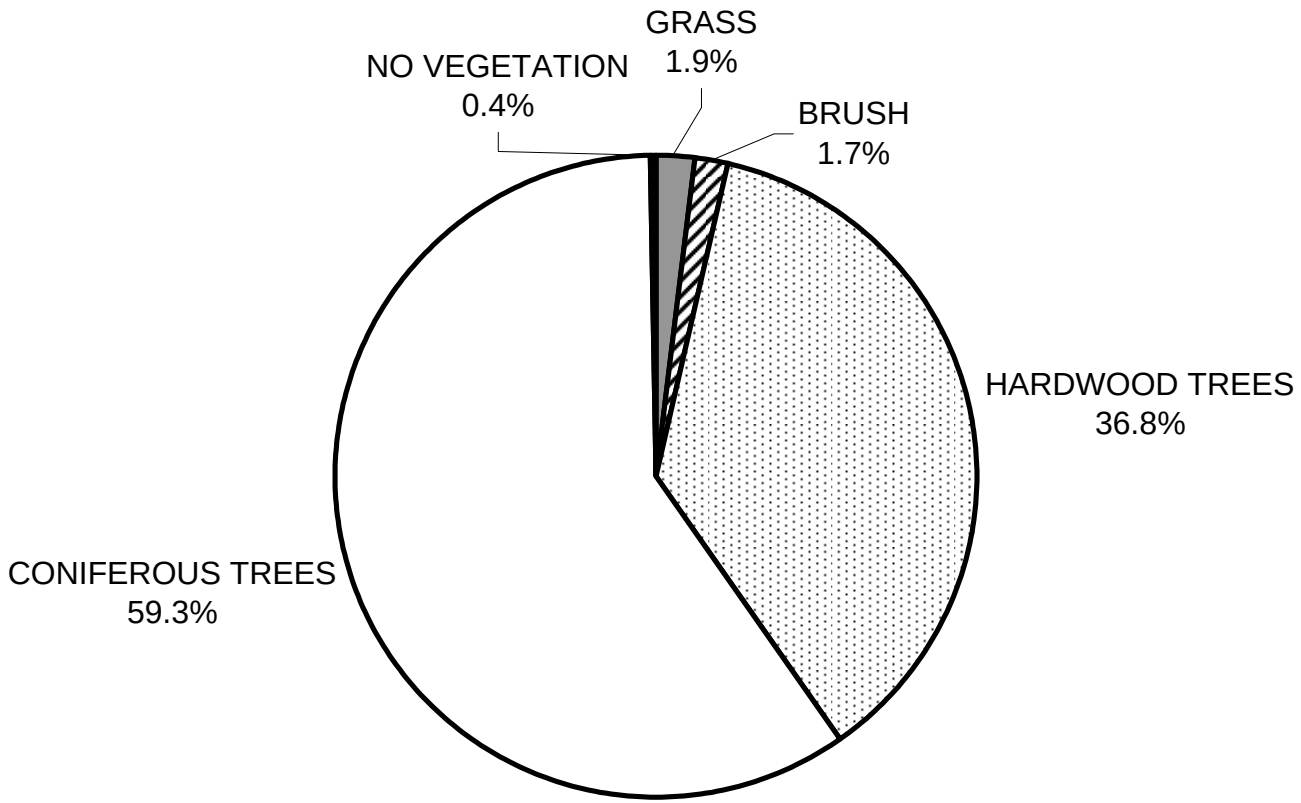
GRAPH 9

REDWOOD CREEK 2013
DOMINANT BANK COMPOSITION IN SURVEY REACH

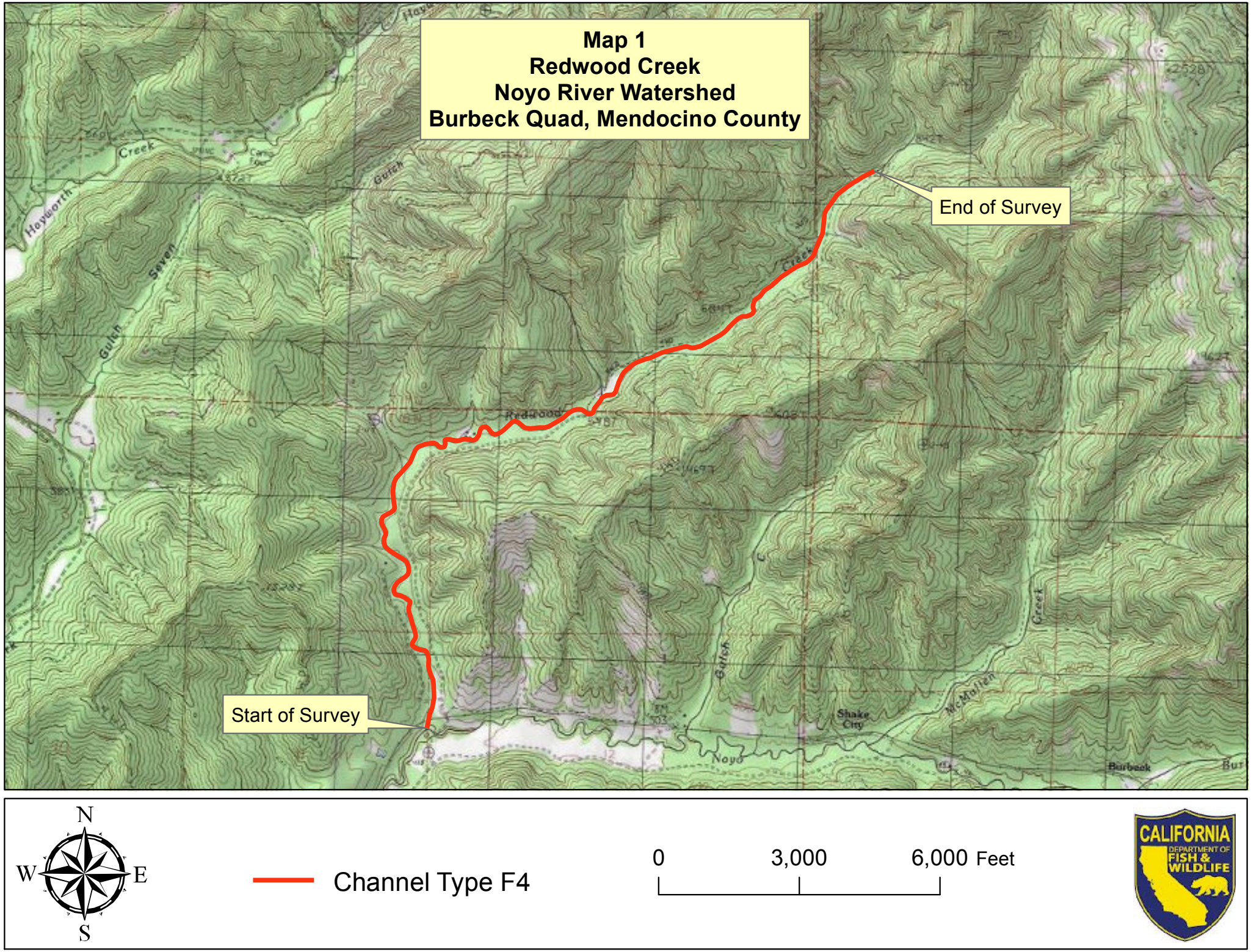


GRAPH 10

REDWOOD CREEK 2013
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11


Map 1
Redwood Creek
Noyo River Watershed
Burbeck Quad, Mendocino County
End of Survey
Start of Survey
Haywarth Creek
Seven Gulch
Redwood Creek
Gulch
Shake City
Noyo
McMullen Creek
Burbeck
N
W
E
S
Channel Type F4
0
3,000
6,000 Feet
CALIFORNIA
DEPARTMENT OF FISH & WILDLIFE