

STREAM INVENTORY REPORT

Root Creek

INTRODUCTION

A stream inventory was conducted from 6/5/2006 to 6/20/2006 on Root Creek. The survey began at the confluence with Van Duzen River and extended upstream 1.3 miles.

The Root 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 Root Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

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

WATERSHED OVERVIEW

Root Creek is a tributary to Van Duzen River which is a tributary the Eel River tributary to the Pacific Ocean, located in Humboldt County, California (Map 1). Root Creek's legal description at the confluence with Van Duzen River is T1N, R2E, Section 9. Its location is 40.47611 N latitude and 123.94972 W longitude, LLID number 1239496404762. Root Creek is a 3rd order stream and has approximately 9.52 miles of blue line stream according to the USGS Redcrest 7.5 minute quadrangle. Root Creek drains a watershed of approximately 5.9 square miles. Elevations range from about 290 feet at the mouth of the creek to 1,400 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 36 to Pacific Lumber Company private roads.

METHODS

The habitat inventory conducted in Root Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) Technical Advisors and Watershed Stewards Project/AmeriCorps (WSP) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). This inventory was conducted by a two-person team.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and

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

HABITAT INVENTORY COMPONENTS

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

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 Root Creek. In addition, 10 sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

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

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

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Graphics are produced from the tables using Microsoft Excel. Graphics developed for Root 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 6/5/2006 to 6/20/2006 was conducted by A. Renger (DFG), E. Pope (CCC) and E. Degenstein (WSP). The total length of the stream surveyed was 6,833 feet with no additional feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 1.76 cubic feet per second on 06/07/06.

Root Creek is a B4 channel type for the first 3,965 feet of the stream surveyed (Reach 1) and a F3 channel type for the remaining 2,868 feet of the stream surveyed (Reach 2).

B4 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and gravel dominant substrates. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 54 to 61 degrees Fahrenheit. Air temperatures ranged from 56 to 68 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 45% pool units, 30% riffle units and 25% flatwater units (Graph 1). Based on total length of Level II habitat types there were 53% pool units, 25% riffle units and 22% flatwater units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 41% mid-channel pool units, 27% low gradient riffle units and 19% run units

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(Graph 3). Based on percent total length, there were 49% mid-channel pool units, 23% low gradient riffle units and 15% run units.

A total of 68 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 91% (Graph 4), and comprised 92% 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. Thirteen of the sixty pools (22%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 60 pool tail-outs measured, 4 had a value of 2 (6.7%); 26 had a value of 3 (43.3%); 17 had a value of 4 (28.3%); 13 had a value of 5 (21.7%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 29, flatwater habitat types had a mean shelter rating of 18, and pool habitats had a mean shelter rating of 40 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 37, scour pools had a mean shelter rating of 73 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Root Creek. Graph 7 describes the pool cover in Root 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. Small cobble was observed in 28% of pool tail-outs and large cobble was observed in 28% of pool tail-outs.

The mean percent canopy density for the surveyed length of Root Creek was 97%. Three percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 82% and 18%, respectively. Graph 9 describes the mean percent canopy in Root Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 89%. The mean percent left bank vegetated was 87%. The dominant elements composing the structure of the stream banks consisted of 72% sand/silt/clay, 15% cobble/gravel, 8% boulder and 5% bedrock (Graph 10). Deciduous trees were the dominant vegetation type observed in 58% of the units surveyed. Additionally, 40% of the units surveyed had coniferous trees as the dominant vegetation type, and 2% had grass as the dominant vegetation (Graph 11).

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BIOLOGICAL INVENTORY RESULTS

Ten sites were electrofished for species composition and distribution in Root Creek on October 17 and 25, 2006. Water temperatures taken during the electrofishing period 10:30 to 16:50 on the 17th ranged from 51 to 52 degrees Fahrenheit and on the 25th from 9:30 to 16:45 ranged from 47 to 49 degrees Fahrenheit. Air temperatures ranged from 56 to 62 degrees Fahrenheit on the 17th and 42 to 54 degrees Fahrenheit on the 25th. The sites were sampled by J. Pixely, E. Meiners, S. Truett (WSP) and A. Renger (DFG).

In reach 1, which comprised the first 3,965 feet of stream, 4 sites were sampled. The reach sites yielded 59 young-of-the-year (YOY) steelhead/rainbow trout (SH/RT), and 14 yearling (1+) SH/RT.

In reach 2, 6 sites were sampled starting approximately 3,965 feet from the confluence with the Van Duzen River and continuing upstream for the next 2,868 feet. The reach sites yielded 29 YOY SH/RT, 15 age 1+ SH/RT, and 2 age 2+ SH/RT.

The following chart displays the information yielded from these sites:

2006 Root Creek e-fish observations.

Date	Site #	Hab. Unit #	Hab. Type	Approx. Dist. from mouth (ft.)	Coho		SH/RT		
					YOY	1+	YOY	1+	2+
Reach 1 B4 Channel Type									
10/17/06	1	36-37	3.3-4.2	1722	0	0	0	0	0
10/17/06	2	51-52	3.3-4.2	2444	0	0	25	8	0
10/17/06	3	73-74	1.1-4.2	3480	0	0	5	3	0
10/17/06	4	81-83	3.4-4.2-3.2	3965	0	0	29	3	0
Reach 2 F3 Channel Type									
10/25/06	5	93-94	4.2-1.1	4414	0	0	9	0	0
10/25/06	6	108-109	3.3-4.2	4965	0	0	6	3	1
10/25/06	7	116	4.2	5207	0	0	1	2	0
10/25/06	8	121-122	4.2-1.2	5431	0	0	2	1	0
10/25/06	9	131-132	4.2-1.1	5887	0	0	6	2	0

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2006 Root Creek e-fish observations.

Date	Site #	Hab. Unit #	Hab. Type	Approx. Dist. from mouth (ft.)	Coho		SH/RT		
					YOY	1+	YOY	1+	2+
10/25/06	10	146	4.2	6600	0	0	5	7	1

DISCUSSION

Root Creek is a B4 channel type for the first 3,965 feet of stream surveyed and a F3 channel type for the remaining 2,868 feet of the survey. The suitability of B4 channel types for fish habitat improvement structures is as follows: excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover. The suitability of F3 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders, single and opposing wing-deflectors; fair for plunge weirs, boulder clusters, channel constrictors and log cover.

The water temperatures recorded on the survey days 6/5/2006 to 6/20/2006, ranged from 54 to 61 degrees Fahrenheit. Air temperatures ranged from 56 to 68 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 22% of the total length of this survey, riffles 25%, and pools 53%. The pools are relatively shallow, with 13 of the 60 (22%) pools having a maximum residual depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum residual depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width.

Four of the 60 pool tail-outs measured had embeddedness ratings of 1 or 2. Forty-three of the pool tail-outs had embeddedness ratings of 3 or 4. Thirteen of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Root Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Thirty-two of the 60 pool tail-outs had silt, sand, large cobble, boulders or bedrock as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean shelter rating for pools was 40. The shelter rating in the flatwater habitats was 18. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is

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being provided primarily by boulders in Root 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 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 97%. Reach 1 had a canopy density of 95.4%, Reach 2 had a canopy density of 97.6%. In general, revegetation projects are considered when canopy density is less than 80%. The percentage of right and left bank covered with vegetation was 89% and 87%, respectively.

RECOMMENDATIONS

- 1) Root Creek should be managed as an anadromous, natural production stream.
- 2) 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 large woody cover in the pools is desirable.
- 3) 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.
- 4) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.
- 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.

<u>Position</u> <u>(ft.)</u>	<u>Habitat</u> <u>Unit #</u>	<u>Comments:</u>
0	0001.00	Start of survey at confluence of Root Creek and Van Duzen River

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<u>Position</u> <u>(ft.)</u>	<u>Habitat</u> <u>Unit #</u>	<u>Comments:</u>
656	0016.00	Log debris accumulation (LDA): 6' high x 43' wide x 30' long consisting of 6 pieces large woody debris (LWD); water flows through visible gaps; no sediment retention; salmonid juveniles observed above; recruiting SWD
794	0019.00	End of hydraulic influence of receiving stream.
794	0019.00	LDA: 8' high x 20' wide x 16' long consisting of 5 pieces of LWD; water flows through visible gaps; no sediment retention; salmonid juveniles observed above; recruiting SWD
905	0021.00	Tributary #1: Small tributary enters left bank; flow contributes an estimated 0.01% to Root Creek flow; water temperature was 58° F; is accessible to fish, although no fish were observed within the first 300 feet; has small pools and appears to get steep; no slope measured.
1071	0024.00	Yearling salmonid observed
2938	0060.00	Rail car bridge crossing; 14' wide x 8' high x 60' long; it is a seasonal bridge put in 6/15/06.
3564	0072.00	Tributary #2: Enters left bank; flow contributes less than 5% to Root Creek flow; water temperature was 54° F; accessible to fish, although no fish were observed within the first 150 feet; approximate slope is 15-19%
3965	0081.00	Right bank erosion with associated LDA; 50' long x 10' high x 2' deep; contributing cobble and silt to creek
4038	0082.00	LDA: 10' high x 35' wide x 75' long consisting of 20 pieces of LWD; water flows through visible gaps; retaining silt/sand sediments 13' wide x 20' long x 5' deep; young of the year(YOY) salmonids seen above.
4183	0086.00	Salmonid observed from bank
4795	0105.00	Yearling sized salmonid observed from bank
5049	0110.00	Left bank erosion; 17' long x 20' high x 3' deep
5593	0124.00	Left bank erosion. Scoured 2' deep by 40' long undercut below perched redwoods 11' above creek

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5645 0125.00 Yearling sized salmonid observed from bank

6181 0134.00 YOY salmonids observed from bank

6833 0150.00 End of survey due to logging activity. Not the end of anadromous fish habitat.

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

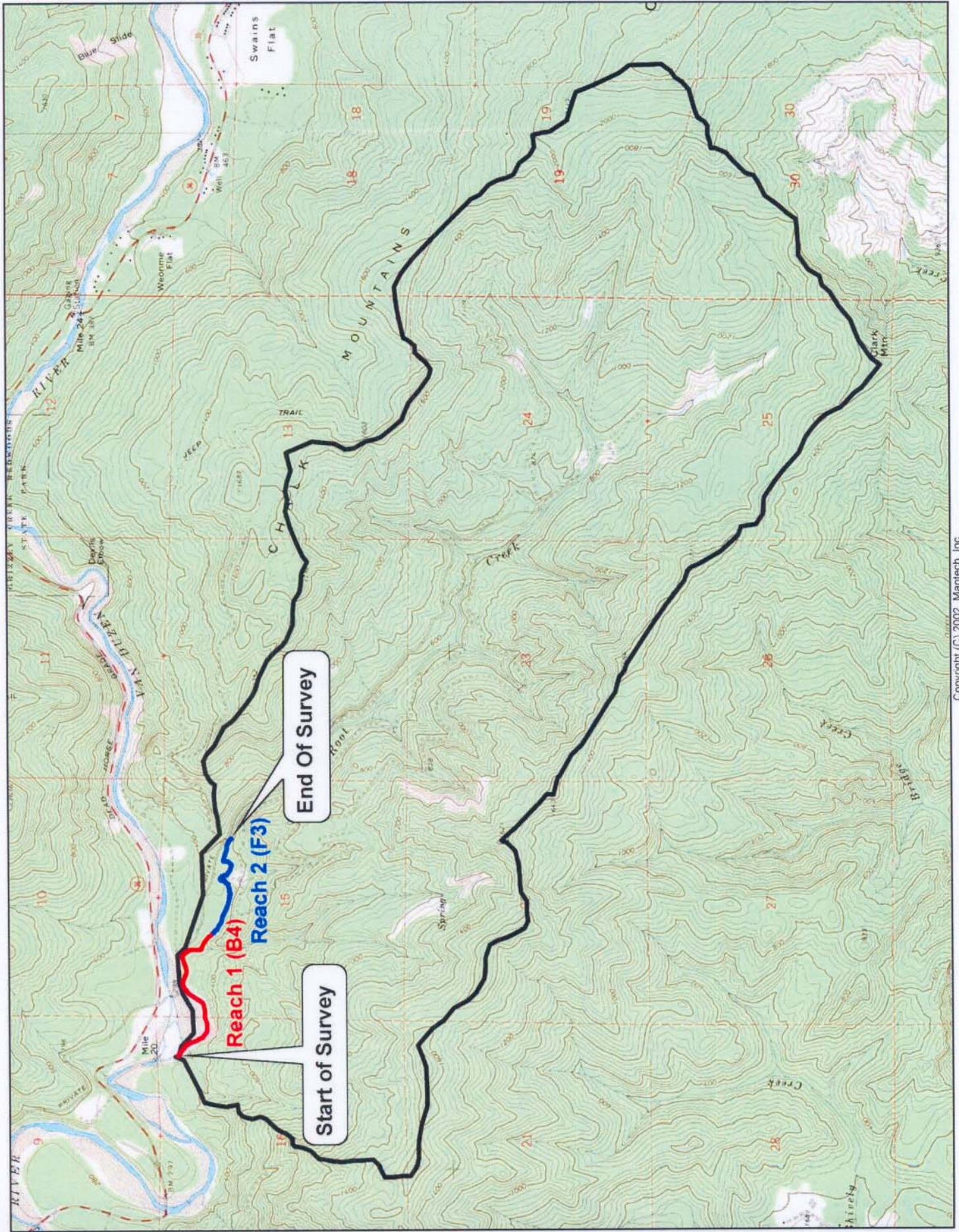
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }

BACKWATER POOLS

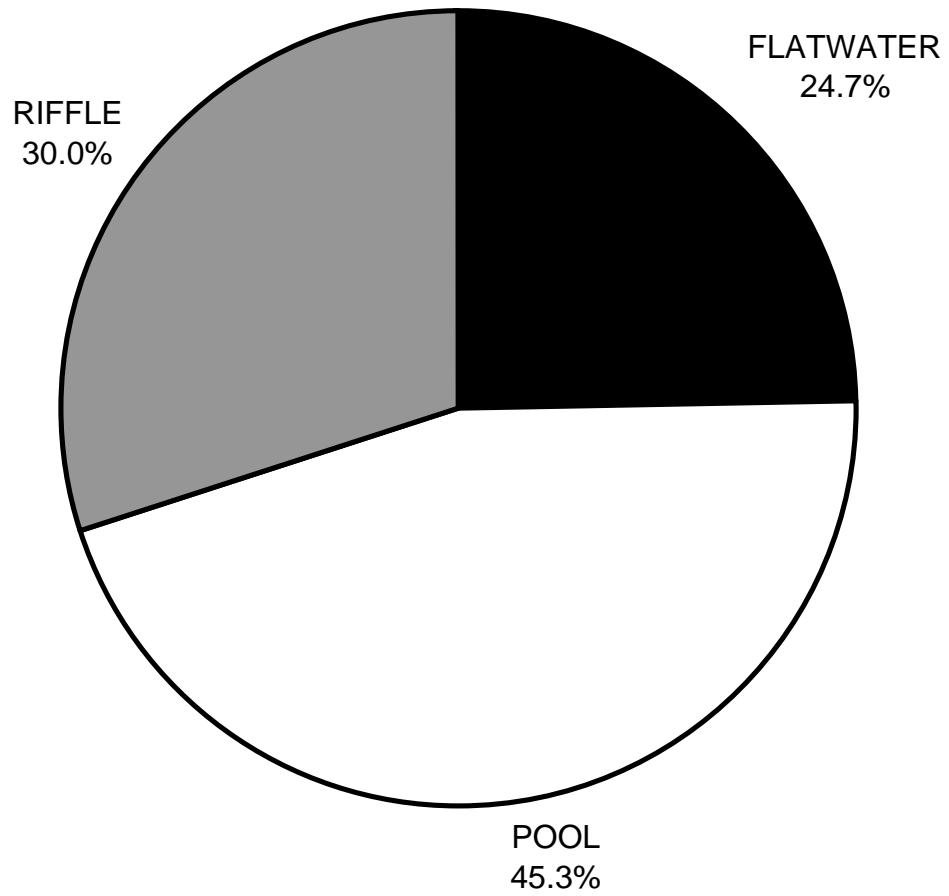
Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}

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]	

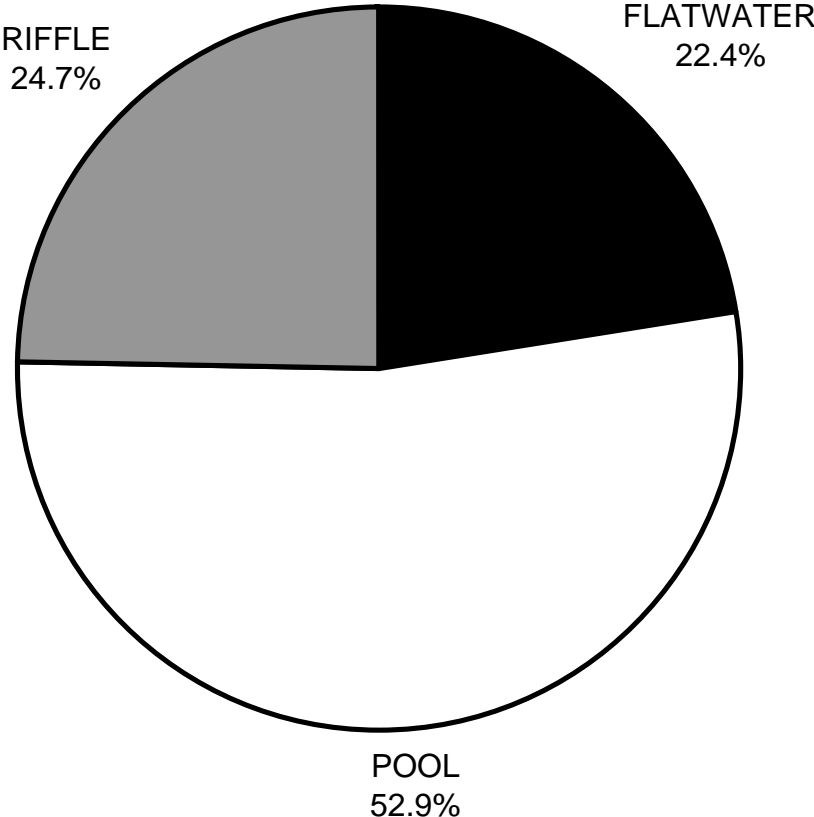


**ROOT CREEK 2006
HABITAT TYPES BY PERCENT OCCURRENCE**



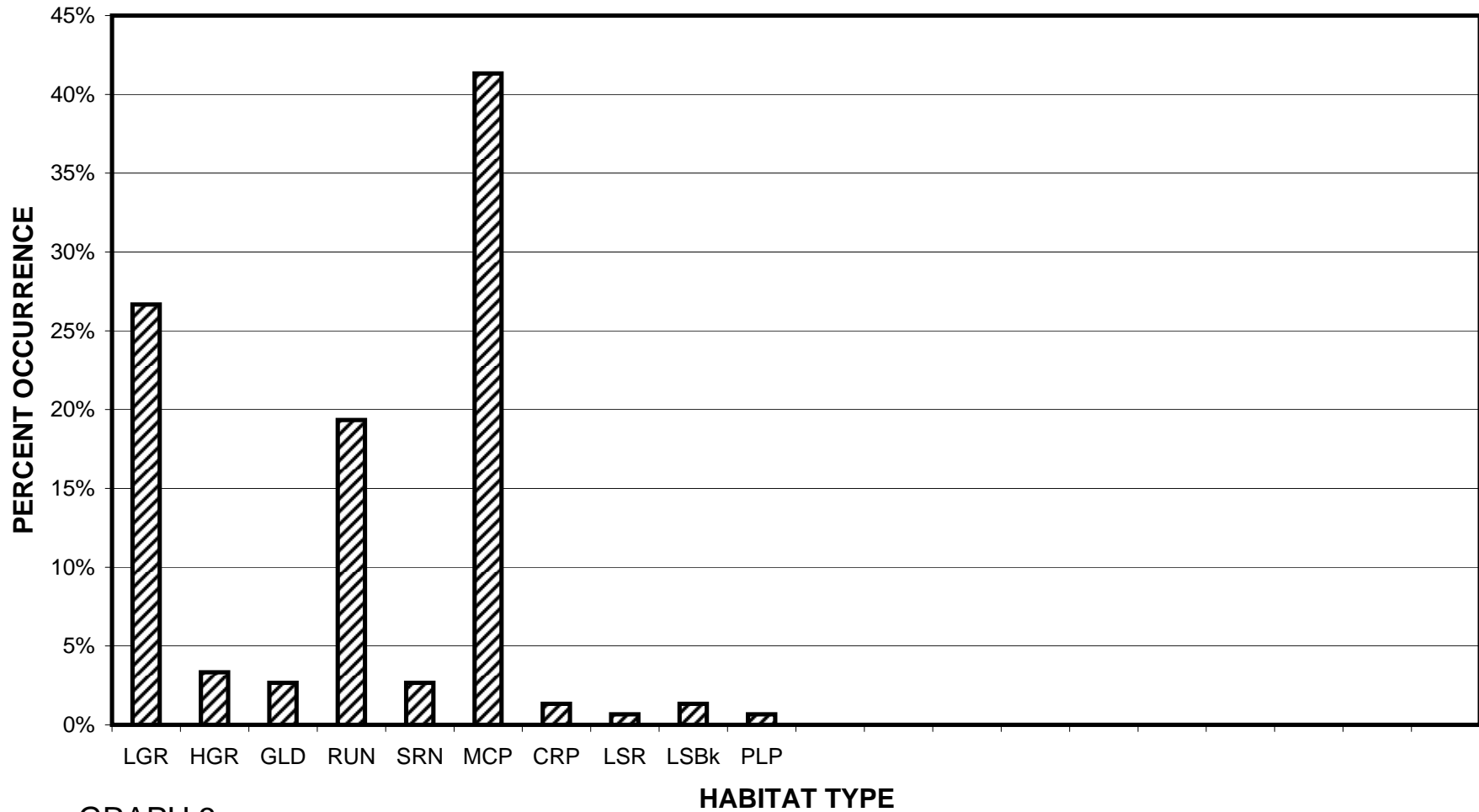
GRAPH 1

**ROOT CREEK 2006
HABITAT TYPES BY PERCENT TOTAL LENGTH**



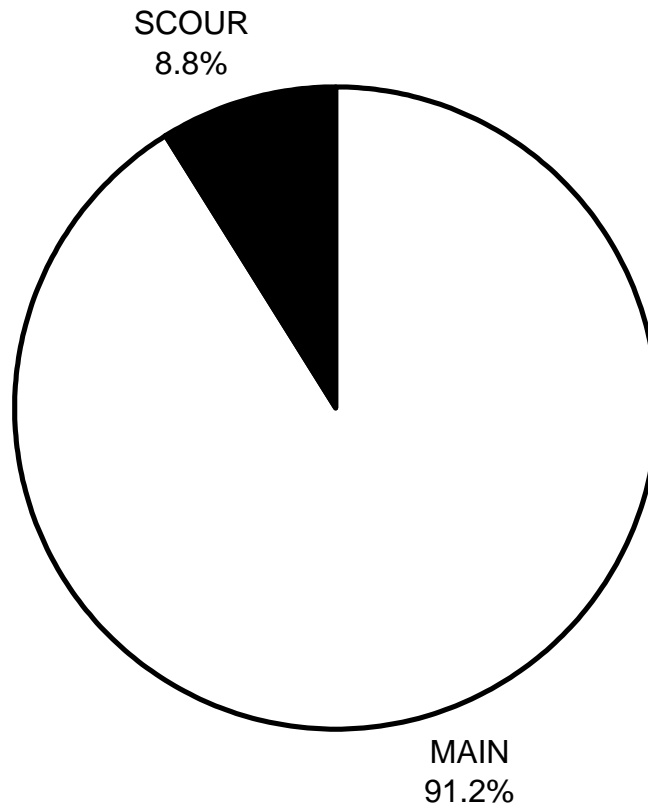
GRAPH 2

ROOT CREEK 2006 HABITAT TYPES BY PERCENT OCCURRENCE



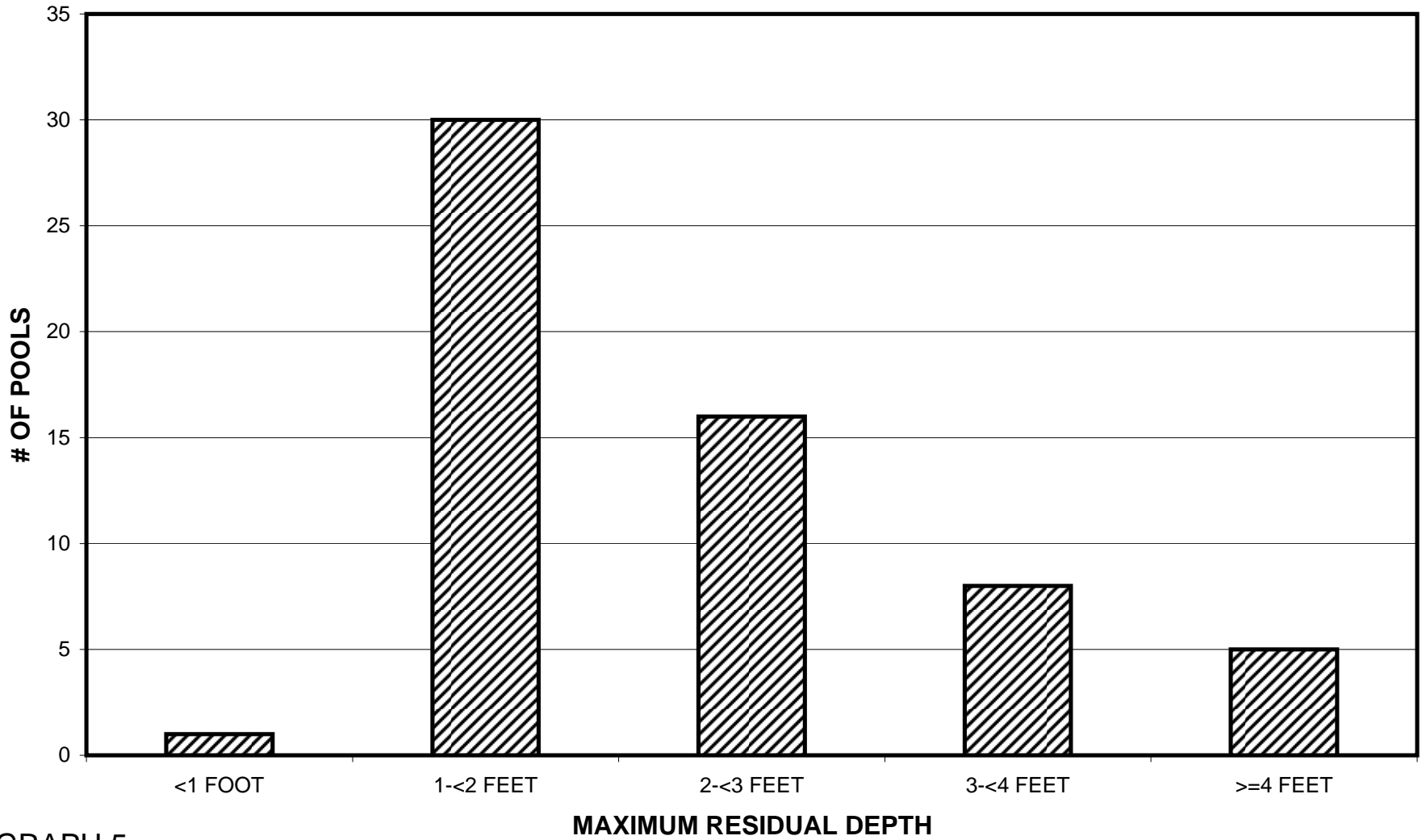
GRAPH 3

**ROOT CREEK 2006
POOL TYPES BY PERCENT OCCURRENCE**



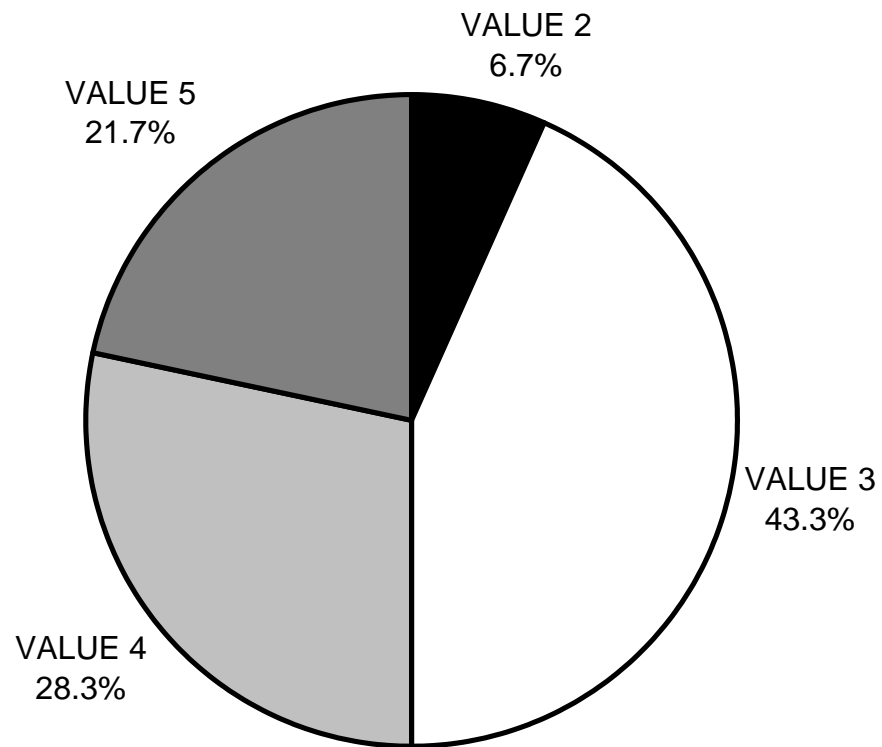
GRAPH 4

ROOT CREEK 2006 MAXIMUM DEPTH IN POOLS



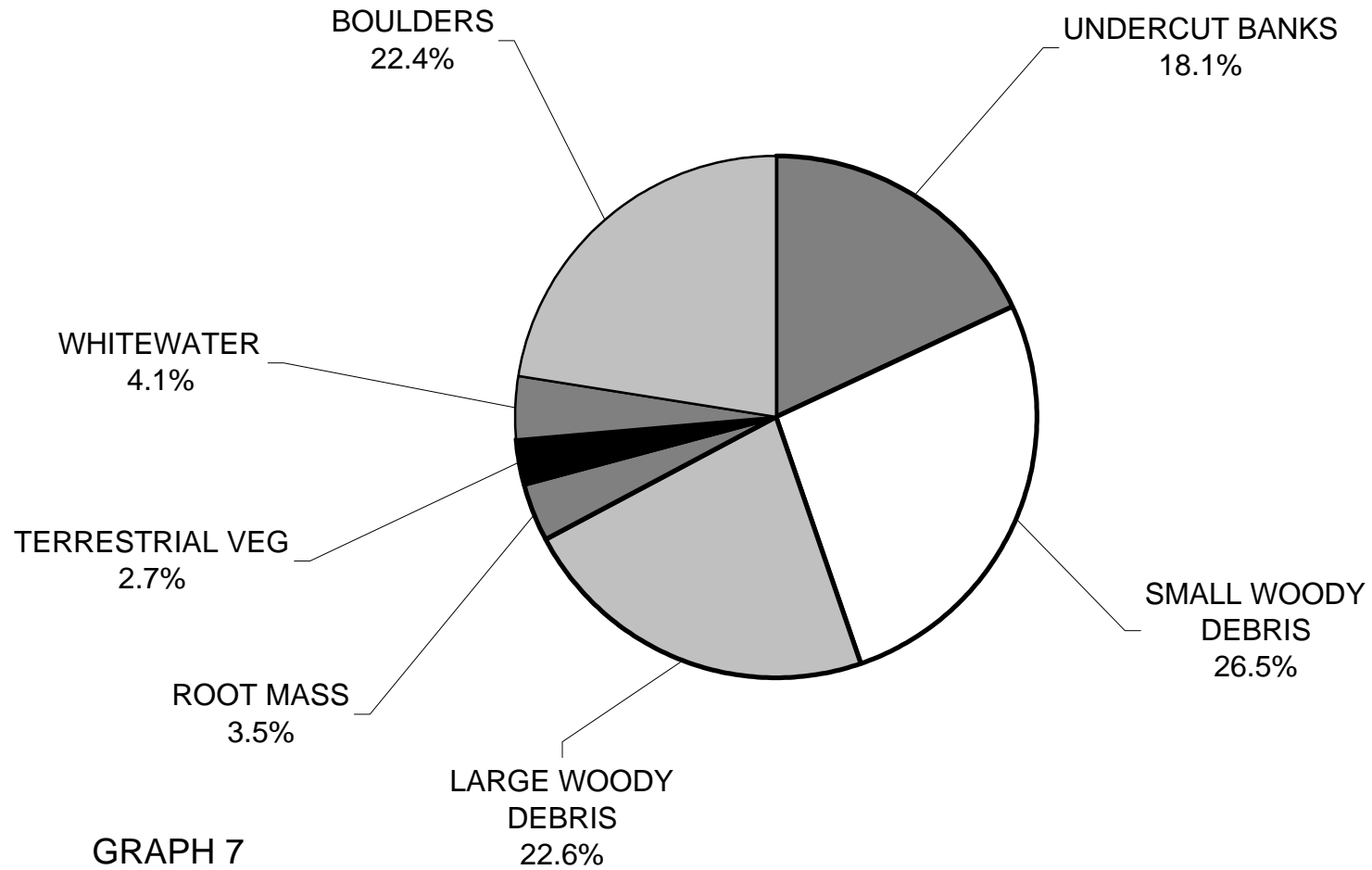
GRAPH 5

ROOT CREEK 2006 PERCENT EMBEDDEDNESS



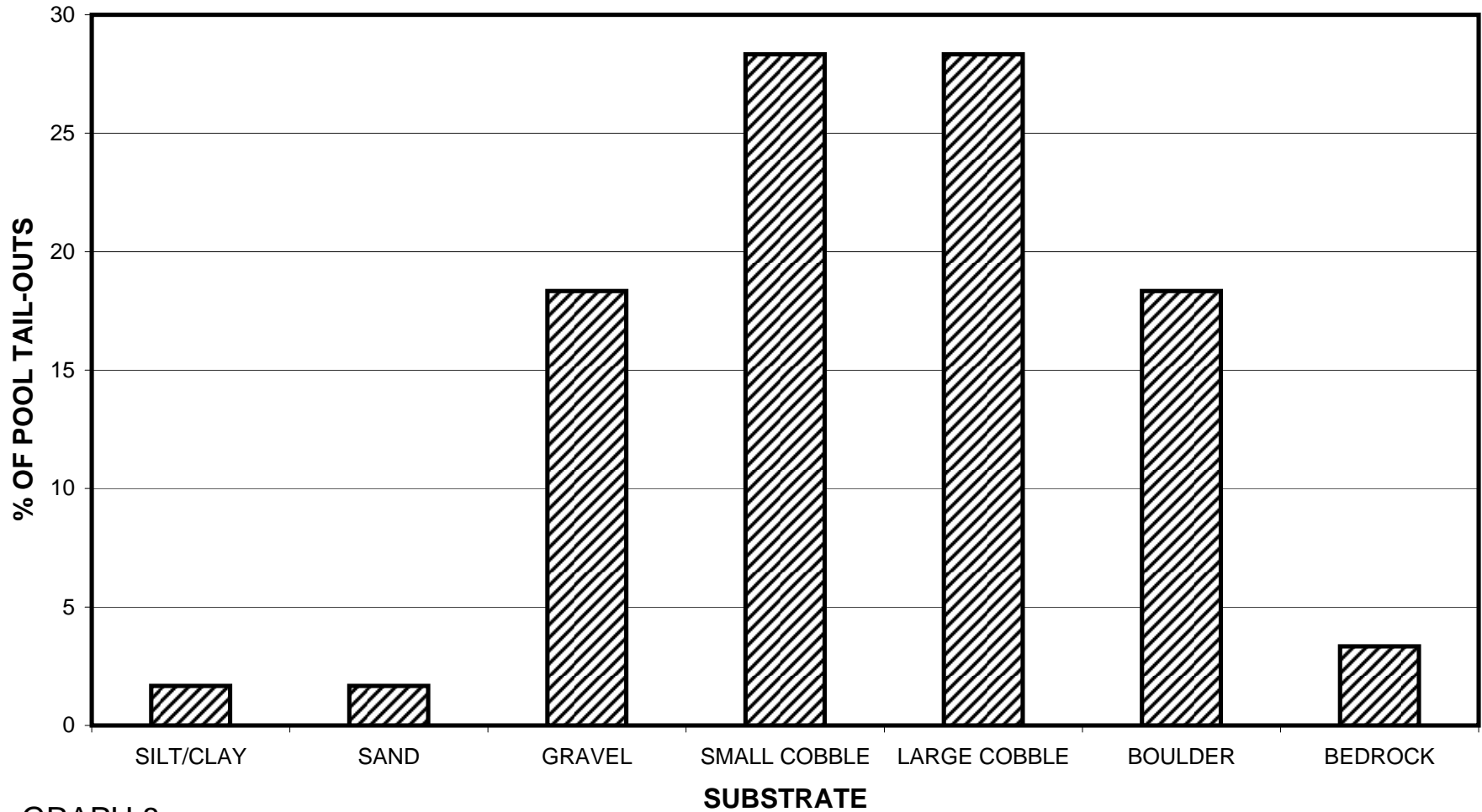
GRAPH 6

ROOT CREEK 2006 MEAN PERCENT COVER TYPES IN POOLS



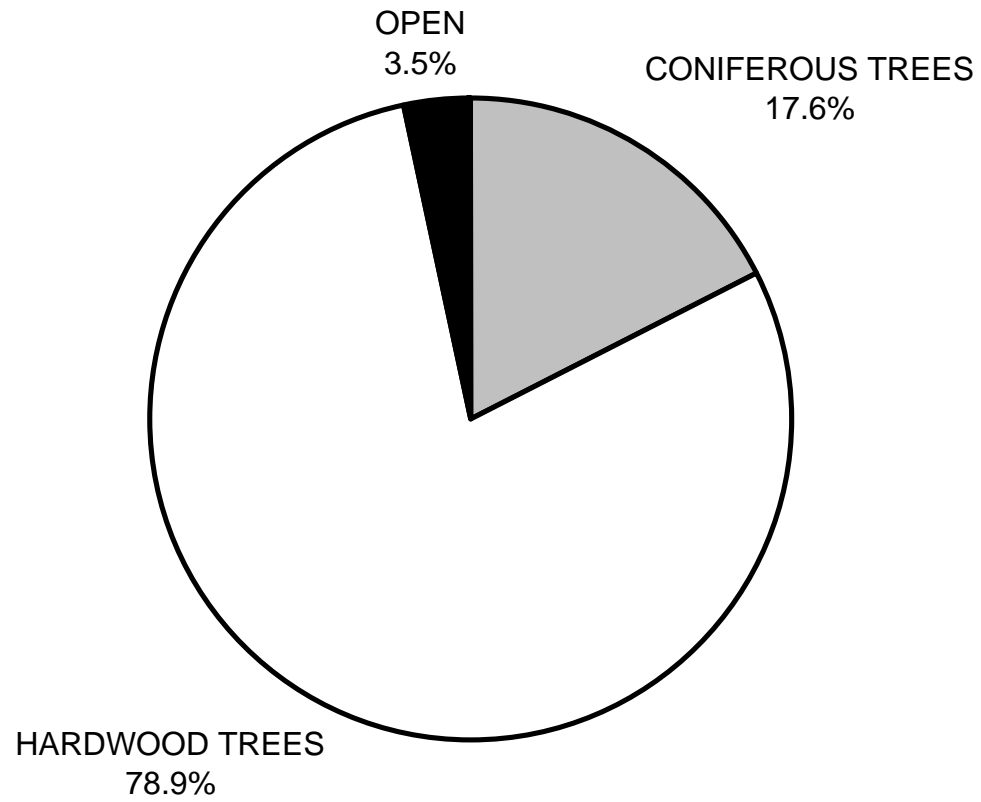
GRAPH 7

ROOT CREEK 2006 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



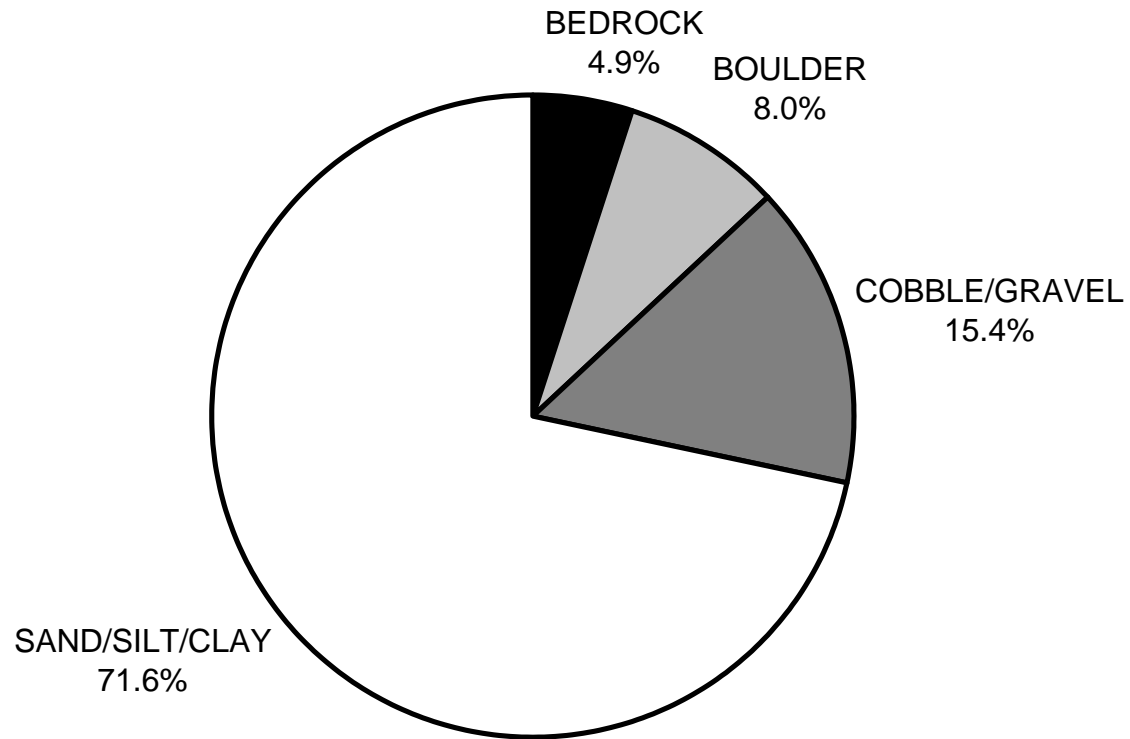
GRAPH 8

**ROOT CREEK 2006
MEAN PERCENT CANOPY**



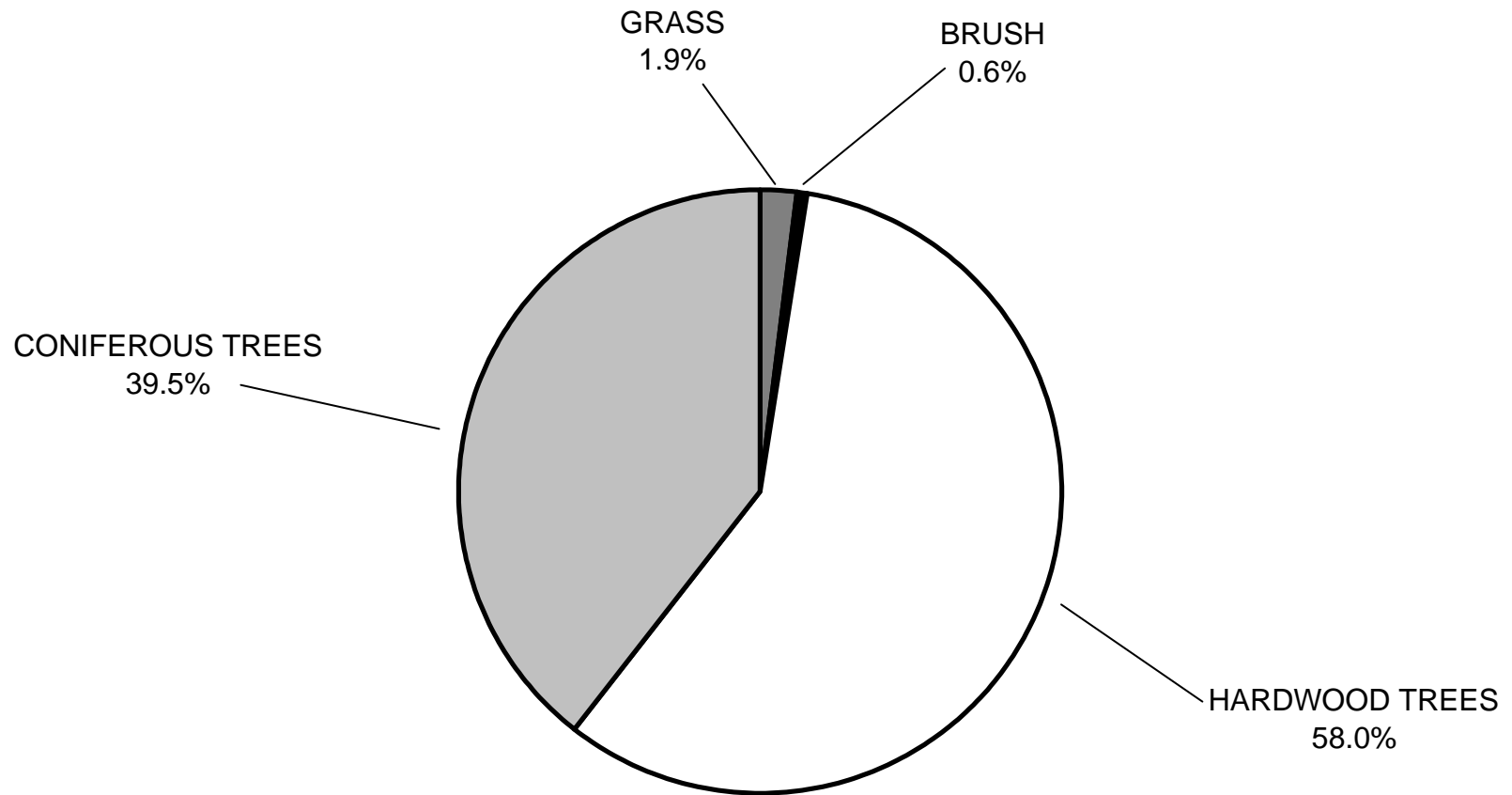
GRAPH 9

**ROOT CREEK 2006
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

ROOT CREEK 2006 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

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

Stream Name: Root Creek

LLID: 1239496404762 Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/20/2006

Confluence Location: Quad: REDCREST

Legal Description: T01NR02ES16

Latitude: 40:28:34.0N

Longitude: 123:56:59.0

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
37	10	FLATWATER	24.7	41	1529	22.4	13.4	0.8	1.2	534	19744	359	13288		18
68	60	POOL	45.3	53	3615	52.9	14.3	1.5	2.3	735	49968	1426	95322	1219	40
45	8	RIFFLE	30.0	38	1689	24.7	10.6	0.5	0.9	175	7895	89	3989		29
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
150	78				6833					77606			112599		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/20/2006

Confluence Location: Quad: REDCREST

Legal Description: T01NR02ES16

Latitude: 40:28:34.0N

Longitude: 123:56:59.0W

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 (%)
40	5	LGR	26.7	39	1565	22.9	10	0.5	1.2	187	7491	82	3296		29	95
5	3	HGR	3.3	25	124	1.8	11	0.7	1.1	156	779	99	495		30	97
4	1	GLD	2.7	82	330	4.8	16	0.7	1.1	864	3456	605	2419		10	96
29	6	RUN	19.3	34	996	14.6	12	0.7	1.6	373	10809	260	7541		16	97
4	3	SRN	2.7	51	203	3.0	15	1.0	2	745	2981	475	1902		23	100
62	55	MCP	41.3	53	3315	48.5	14	1.4	5.7	733	45444	1362	82882	1156	37	97
2	2	CRP	1.3	62	125	1.8	20	2.5	4.1	1126	2251	2946	5893	2711	45	100
1	0	LSR	0.7	52	52	0.8										
2	2	LSBk	1.3	56	112	1.6	14	2.8	4.6	735	1470	2309	4619	2016	55	99
1	1	PLP	0.7	11	11	0.2	10	0.9	1.6	55	55	72	72	50	135	91

Total Units
150

Total Units Fully Measured
78

Total Length (ft.)
6833

Total Area (sq.ft.)
74735

Total Volume (cu.ft.)
109118

Table 3 - Summary of Pool Types

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/20/2006

Confluence Location: Quad: REDCREST

Legal Description: T01NR02ES16

Latitude: 40:28:34.0N

Longitude: 123:56:59.0W

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
62	55	MAIN	91	53	3315	92	14.1	1.4	733	45444	1156	70357	37
6	5	SCOUR	9	50	300	8	15.8	2.3	755	4531	1900	11403	73

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
68	60	3615	49975	81760

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

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/20/2006

Confluence Location: Quad: REDCREST

Legal Description: T01NR02ES16

Latitude: 40:28:34.0N

Longitude: 123:56:59.0W

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
55	MCP	92	1	2	29	53	15	27	8	15	2	4
2	CRP	3	0	0	0	0	1	50	0	0	1	50
2	LSBk	3	0	0	0	0	0	0	0	0	2	100
1	PLP	2	0	0	1	100	0	0	0	0	0	0

Total Units	Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Foot Max Resid. Depth	Total 1< 2 Foot % Occurrence	Total 2< 3 Foot Max Resid. Depth	Total 2< 3 Foot % Occurrence	Total 3< 4 Foot Max Resid. Depth	Total 3< 4 Foot % Occurrence	Total >= 4 Foot Max Resid. Depth	Total >= 4 Foot % Occurrence
60	1	2	30	50	16	27	8	13	5	8

Mean Maximum Residual Pool Depth (ft.): 2.3

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/20/2006

Dry Units: 0

Confluence Location: Quad: REDCREST

Legal Description: T01NR02ES16

Latitude: 40:28:34.0N

Longitude: 123:56:59.0W

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
40	6	LGR	2	10	18	0	1	0	3	67	0
5	3	HGR	13	7	0	0	0	0	7	73	0
45	9	TOTAL RIFFLE	6	9	12	0	1	0	4	69	0
4	1	GLD	0	60	0	40	0	0	0	0	0
29	7	RUN	27	33	0	0	1	0	0	39	0
4	3	SRN	3	3	0	0	0	0	7	87	0
37	11	TOTAL FLAT	18	27	0	4	1	0	2	48	0
62	51	MCP	19	26	21	4	3	0	3	23	0
2	1	CRP	0	20	80	0	0	0	0	0	0
1	0	LSR									
2	2	LSBk	10	45	45	0	0	0	0	0	0
1	1	PLP	0	0	0	0	0	0	65	35	0
68	55	TOTAL POOL	18	27	23	4	3	0	4	22	0
150	75	TOTAL	17	25	18	3	2	0	4	32	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/20/2006

Dry Units: 0

Confluence Location: Quad: REDCREST

Legal Description: T01NR02ES16

Latitude: 40:28:34.0N

Longitude: 123:56:59.0W

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
40	33	LGR	0	0	36	27	18	18	0
5	5	HGR	0	0	0	0	0	100	0
4	3	GLD	67	33	0	0	0	0	0
29	26	RUN	27	4	35	15	4	15	0
4	4	SRN	0	0	0	0	25	75	0
62	55	MCP	64	4	15	2	4	11	2
2	2	CRP	100	0	0	0	0	0	0
1	0	LSR	0	0	0	0	0	0	0
2	2	LSBk	100	0	0	0	0	0	0
1	1	PLP	0	0	0	0	0	100	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/20/2006

Confluence Location: Quad: REDCREST

Legal Description: T01NR02ES16

Latitude: 40:28:34.0N

Longitude: 123:56:59.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
97	18	82	0	89	87

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: Root Creek LLID: 1239496404762 Drainage: Van Duzen River
 Survey Dates: 6/5/2006 to 6/20/2006 Survey Length (ft.): 6833 Main Channel (ft.): 6833 Side Channel (ft.): 0
 Confluence Location: Quad: REDCREST Legal Description: T01NR02ES16 Latitude: 40:28:34.0N Longitude: 123:56:59.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: B4	Canopy Density (%): 95.4	Pools by Stream Length (%): 53.7
Reach Length (ft.): 3965	Coniferous Component (%): 16.5	Pool Frequency (%): 45.0
Riffle/Flatwater Mean Width (ft.): 12.0	Hardwood Component (%): 83.5	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 43
Range (ft.): 21 to 28	Vegetative Cover (%): 86.9	2 to 2.9 Feet Deep: 39
Mean (ft.): 25	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 11
Std. Dev.: 2	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 7
Base Flow (cfs.): 1.8	Occurrence of LWD (%): 15	Mean Max Residual Pool Depth (ft.): 2.4
Water (F): 56 - 61 Air (F): 58 - 68	LWD per 100 ft.:	Mean Pool Shelter Rating: 31
Dry Channel (ft): 0	Riffles: 1	
	Pools: 3	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 4 Sand: 4 Gravel: 32 Sm Cobble: 46 Lg Cobble: 14 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 0.0 2. 10.7 3. 67.9 4. 21.4 5. 0.0		

STREAM REACH: 2

Channel Type: F3	Canopy Density (%): 97.6	Pools by Stream Length (%): 51.8
Reach Length (ft.): 2868	Coniferous Component (%): 19.8	Pool Frequency (%): 45.7
Riffle/Flatwater Mean Width (ft.): 12.3	Hardwood Component (%): 80.2	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Coniferous Trees	< 2 Feet Deep: 59
Range (ft.): 18 to 29	Vegetative Cover (%): 89.1	2 to 2.9 Feet Deep: 16
Mean (ft.): 22	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 16
Std. Dev.: 3	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 9
Base Flow (cfs.): 1.8	Occurrence of LWD (%): 20	Mean Max Residual Pool Depth (ft.): 2.3
Water (F): 54 - 58 Air (F): 56 - 60	LWD per 100 ft.:	Mean Pool Shelter Rating: 49
Dry Channel (ft): 0	Riffles: 1	
	Pools: 4	
	Flat: 3	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 6 Sm Cobble: 13 Lg Cobble: 41 Boulder: 34 Bedrock: 6		
Embeddedness Values (%): 1. 0.0 2. 3.1 3. 21.9 4. 34.4 5. 40.6		

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/20/2006

Confluence Location: Quad: REDCREST

Legal Description: T01NR02ES16

Latitude: 40:28:34.0N

Longitude: 123:56:59.0W

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	2	6	4.9
Boulder	9	4	8.0
Cobble / Gravel	9	16	15.4
Sand / Silt / Clay	61	55	71.6

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	1	2	1.9
Brush	0	1	0.6
Hardwood Trees	45	49	58.0
Coniferous Trees	35	29	39.5
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 4

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

StreamName: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 6/5/2006 to 6/20/2006

Confluence Location: Quad: REDCREST

Legal Description: T01NR02ES16

Latitude: 40:28:34.0N

Longitude: 123:56:59.0W

	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	6	18	18
SMALL WOODY DEBRIS (%)	9	27	27
LARGE WOODY DEBRIS (%)	12	0	23
ROOT MASS (%)	0	4	4
TERRESTRIAL VEGETATION (%)	1	1	3
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	4	2	4
BOULDERS (%)	69	48	22
BEDROCK LEDGES (%)	0	0	0