



## **CALIFORNIA DEPARTMENT OF FISH & WILDLIFE**

### **STREAM INVENTORY REPORT**

#### **Root Creek**

#### INTRODUCTION

A stream inventory was conducted May 30 to June 15, 2017 on Root Creek. The survey began at the confluence with Van Duzen River and extended upstream 3.8 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 and 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 to Eel River, which is a tributary to Pacific Ocean, located in Humboldt County, California (Map 1). Root Creek's legal description at the confluence with Van Duzen River is T01N R02E S16. Its location is 40.47611° north latitude and 123.94972° west longitude, LLID number 1239496404762. Root Creek is a second 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 6.5 square miles. Elevations range from about 280 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 State Highway 36 to Humboldt Redwood 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 Watershed Stewards Project (WSP) members and California Department of Fish and Wildlife (CDFW) personnel that conducted the inventory were trained in standardized habitat inventory methods by the CDFW. This inventory was conducted by a three-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. Surveyors also take photos to document general habitat conditions, significant features (landslides, potential barriers, etc.), and end of survey (Appendix II).

## 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 hand level, hip chain, tape measure, and a stadia rod.

### 3. Temperatures:

Water and air temperatures are measured and recorded at every tenth habitat unit using a hand-held thermometer. Both temperatures are taken in degrees (°) Fahrenheit and the time of the measurement is also recorded. Air temperatures are recorded within one foot of the water surface, while water temperatures are recorded (where possible) in flowing water within the habitat unit.

### 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 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 unsuitable 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 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. The shelter rating is then calculated by multiplying the qualitative shelter value by the percent of the unit covered. 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 densimeters 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.

#### 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, underwater mask and snorkel observations were made at 6 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

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 IN APPENDIX I \*

The habitat inventory of May 30 to June 15, 2017, was conducted by Ryan Bernstein (CDFW), Josh Gruver (CDFW), and Angela Cruz (WSP). The total length of the stream surveyed was 19,952 feet.

Stream flow measurement of 1.59 cfs was recorded on June 14, 2017 near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter.

Root Creek is a F4 channel type for 3,576 feet of the stream surveyed (Reach 1), a B2 channel type for 2,091 feet of the stream surveyed (Reach 2), and a F4 channel type for 14,285 feet of the stream surveyed (Reach 3). F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. B2 channels are moderately entrenched, moderate gradient, riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks and boulder-dominant substrates.

Water temperatures taken during the survey period ranged from 50° to 60° Fahrenheit. Air temperatures ranged from 52° to 72° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 42% pool units, 31% riffle units, and 28% flatwater units (Graph 1). Based on total length of Level II habitat types there were 47% pool units, 37% flatwater units, and 15% riffle units (Graph 2).

Eight Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 37%, low gradient riffle units, 25%, and run units, 15% (Graph 3). Based on percent total length, mid-channel pool units made up 43%, step run units 24%, and run units 14%.

A total of 188 pools were identified (Table 3). Main channel pools were the most frequently encountered at 91% (Graph 4), and comprised 94% 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. Sixty-eight of the 187 pools (36%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 187 pool tail-outs measured, 75 had a value of 1 (40.1%); 74 had a value of 2 (39.6%); 26 had a value of 3 (13.9%); 12 had a value of 5 (6.4%); (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate. Additionally, a value of 5 was assigned to tail-outs deemed unsuitable for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 0, flatwater habitat types had a mean shelter rating of 24, and pool habitats had a mean shelter rating of 44 (Table 1). Of the pool types, scour pools had a mean shelter rating of 74, whereas main channel pools had a mean shelter rating of 41 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type 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. Gravel was the dominant substrate observed in 51% of pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 42% 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 61% and 39%, respectively. Graph 9 describes the mean percent canopy in Root Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 100%. The mean percent left bank vegetated was 100%. The dominant elements composing the structure of the stream banks consisted of 95% sand/silt/clay, 2% bedrock, 2% boulder, and 1% cobble/gravel (Graph 10). Deciduous trees were the dominant vegetation type observed in 57% of the units surveyed. Additionally, 33% of the units surveyed had coniferous trees as the dominant vegetation type, and 9% had brush as the dominant vegetation type (Graph 11).

## BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a mask and snorkel survey at six sites (all mid-channel pools) for species composition and distribution in Root Creek on June 15, 2017 (Table A). The sites were sampled by Ryan Bernstein (CDFW), Josh Gruver (CDFW), and Angela Cruz (WSP). All snorkel surveys were conducted on the third reach of Root Creek.

In Reach 3, which comprised the last 14,285 feet of stream, six sites were sampled. The reach sites yielded 21 young-of-the-year (YOY) steelhead trout (SH) and two age 1+ SH.

During the survey, the upstream-most observation of steelhead trout occurred at 40.44872° north latitude, -123.90173° west longitude, approximately 19,818 feet upstream from the confluence with Van Duzen River (Map 1). No coho salmon were observed during the biological or habitat inventory. While not denoted in Table A, several lamprey redds were observed during the stream

inventory survey (see Comments and Landmarks section for observations and corresponding locations).

Table A. Summary of results for a fish composition and distribution survey within Root Creek, June 15, 2017.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	Steelhead Trout			Coho Salmon		Additional Aquatic Species Observed
					YOY	1+	2+	YOY	1+	
Reach 3: F4 Channel Type										
06/15/17	1	176	4.2	7914	9	0	0	0	0	
	2	177	4.2	7955	3	0	0	0	0	
	3	201	4.2	8845	0	0	0	0	0	
	4	206	4.2	9065	5	1	0	0	0	
	5	210	4.2	9300	4	0	0	0	0	
	6	451	4.2	19818	0	1	0	0	0	

## DISCUSSION

Root Creek is a F4 channel type for 3,576 feet of the stream surveyed (Reach 1), a B2 channel type for 2,091 feet of the stream surveyed (Reach 2), and a F4 channel type for the remaining 14,285 feet of the stream surveyed (Reach 3). The suitability of F4 and B2 channel types for fish habitat improvement structures is as follows: F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates; and B2 channels are moderately entrenched, moderate gradient, riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks and boulder-dominant substrates.

The water temperatures recorded on the survey days May 30 to June 15, 2017, ranged from 50° to 60° Fahrenheit. Air temperatures ranged from 52° to 72° Fahrenheit. This is a suitable water temperature range for salmonids. To make any further conclusions, water temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 37% of the total length of this survey, riffles 15%, and pools 47%. Sixty-eight of the 187 (36%) pools had 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 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.

One hundred forty-nine of the 187 pool tail-outs measured had embeddedness ratings of 1 or 2. Twenty-six of the pool tail-outs had embeddedness ratings of 3 or 4. Twelve 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.

One hundred seventy-five of the 187 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools is 44. The shelter rating in the flatwater habitats is 24. 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 Root Creek. Small woody debris is the dominant cover type in pools followed by large woody debris. Log and rootwad 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 96%, Reach 2 had a canopy density of 99%, and Reach 3 had a canopy density of 97%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 100% and 100%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

## RECOMMENDATIONS

Root Creek should be managed as an anadromous, natural production stream. Recommendations for potential habitat improvement activities are based on target habitat values suitable for salmonids in California's north coast streams. Considering the results from this stream habitat inventory, factors that affect salmonid productivity and CDFW's professional judgment, the following list prioritizes habitat improvement activities in Root Creek. Keep in mind, watershed and stream ecosystem processes, land use alterations, changes in land ownership, and other factors could potentially change the order of these recommendations or create the need to remove/add recommendations in the future.

- 1) 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.
- 2) There are numerous log debris accumulations present on Root Creek, some of which are retaining large quantities of fine sediment and large woody debris. The modification of these debris accumulations could be examined to help distribute large wood debris for cover in other portions of the stream. Any modification must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.
- 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.



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 Van Duzen River. Channel type is a F4. Channel type cross-section location is at Habitat Unit (HU) #46.
641	0012.00	Salmonid young-of-the-year (YOY) present. This pool has a large amount of cover provided by woody debris.
915	0017.00	There is a dry tributary on the right bank.
2531	0042.00	There is a metal structure with a boulder attached present in the pool creating shelter.
2773	0047.00	There are lamprey redds present above the riffle.
3189	0052.00	Log debris accumulation (LDA) #1 is 6' high, 28' wide, and 56' long and contains 65 pieces of LWD. Water does flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 10.5' wide, 14' long, and 1' deep. The sediment ranges in size from silt to gravel. The LDA is not a possible barrier to salmonids. Fish were observed above the LDA.
3271	0054.00	Bridge #1 is the crossing for an unnamed road and is 14' high x 18' wide x 60' long. It is a car bridge made of metal and is not a barrier to salmonids. Tributary #1 enters on the left bank. It contributes to approximately 1% of Root Creek's flow. The water temperature of the tributary was 53° Fahrenheit, the water temperature downstream of the confluence was 53° Fahrenheit, and the water temperature upstream of the confluence was 53° Fahrenheit. The slope of the tributary is 1%. The tributary is accessible to salmonids. Fish were not observed in the tributary.
3529	0060.00	There is a substrate change from primarily gravel to boulders.
3586	0061.00	There is a lamprey redd present.
3698	0062.00	Channel type changes from a F4 to a B2 at Habitat Unit (HU) #62. Channel type cross section location is at HU #74. LDA #2 is 7' high, 30' wide, 11' long and contains 14 pieces of LWD. Water flows through the

LDA and there are visible gaps in it. Sediment is not being retained. The sediment size is boulders. The LDA is not a possible barrier to salmonids. Fish were observed above the LDA.

4659	0088.00	There is a 3.7' plunge into a 2.4' plunge at the top of this unit. It is not a barrier to salmonids.
4707	0090.00	Pool tail out substrate is majority silt.
5018	0100.00	The channel is becoming more entrenched and is still boulder dominated substrate.
5134	0104.00	There is rip rap lining the sides of the stream leading up to an old logging road crossing.
5671	0117.00	There are a lot of pools that are primarily silt substrate with boulders.
6040	0126.00	Channel type changes from a B2 to a F4 at HU#126. Channel type cross-section location at HU #168.
7401	0154.00	LDA #3 is 3' high, 23' wide, 5' long and contains 3 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 8' wide, 9' long and 0.5' deep. The sediment ranges in size from silt to gravel. The LDA is not a possible barrier to salmonids. Fish were observed above the LDA.
7575	0160.00	LDA #4 is 9' high, 40' wide, 40' long and contains more than 100 pieces of wood. Water does flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 40' wide, 45' long, and 2' deep. The sediment ranges in size from silt to gravel. The LDA is a possible barrier to juvenile salmonids, but not adults. Fish were observed above the LDA.
7839	0166.00	LDA #5 is 5.8' high, 27' wide, and 15' long and contains 30 pieces of LWD. Water flows through it and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 22' wide, 42' long, and 1.6' deep. The sediment ranges in size from silt to gravel. The LDA is a possible barrier to juvenile salmonids, but not adults. Fish were observed above the LDA. There is a 2.3' plunge into a 4' pool.
9066	0197.00	+1 salmonid observed.
9283	0204.00	LDA #11 is 4' high, 18' wide, 18' long, and contains 8 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment

is being retained in the approximate dimensions of 17' wide, 15' long and 1.4' deep. The sediment ranges in size from silt to gravel. The LDA is a possible barrier to juvenile salmonids but not to adults. Fish were observed above the LDA.

9772	0213.00	LDA #12 is 6.5' high, 70' wide, 200' long and contains 150 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 75' wide, 20' long and 4' deep. The sediment ranges in size from silt to gravel. The LDA is a possible barrier to juvenile salmonids but not to adults. Fish were observed above the LDA.
10192	0222.00	LDA #13 is 6' high, 36' wide, 66' long and contains 150 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 30' wide, 22' long and 2.8' deep. The sediment ranges in size from silt to gravel. The LDA is a possible barrier to salmonids]. Fish were observed above the LDA.
10396	0228.00	LDA #14 is 9' high, 30' wide, 143' long and contains 150 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is being retained in approximate dimensions of 12' wide, 18' long and 1.6' deep. The sediment ranges in size from silt to gravel. The LDA is not a barrier to salmonids and fish were observed above the LDA.
11076	0244.00	LDA #15 is 5.5' high, 80' wide, 84' long and contains 65 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 20' wide, 50' long and 1.7' deep. The sediment ranges in size from silt to gravel. The LDA is a possible barrier to salmonids. Fish were observed above the LDA.
11189	0252.00	The plunge pool has a 4.7' plunge into a 3.0' pool. The plunge pool provides good cover.
11306	0253.00	LDA #16 is 8' high, 72' wide, 52' long and contains 25 pieces of LWD. Water does flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimension of 40' wide, 52' long and 2.2' deep. The sediment ranges in size from silt to gravel the LDA is not a possible barrier to salmonids. Fish were observed above the LDA. Due to LDA #16 this unit is unsurveyable, with log accumulation accounting for a length of 52'.
11524	0257.00	A +1 salmonid was observed in this unit.

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11538	0258.00	A +1 salmonid was observed in this unit.
11843	0263.00	LDA #17 is 5.5' high, 18' wide, 29' long and contains 18 pieces of LWD. Water does flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 26' wide, 14' long and 3.4' deep. The sediment ranges in size from silt to gravel. The LDA is not a possible barrier to salmonids. Fish were observed above the LDA.
11900	0265.00	This pool provides no cover for salmonids.
11930	0266.00	Tributary #2 enters on the right bank. It contributes approximately 1% of Root Creek's flow. The water temperature of the tributary was 54° Fahrenheit, the water temperature downstream of the confluence was 54° Fahrenheit, and the water temperature upstream of the confluence was 54° Fahrenheit. The slope of the tributary is 1%. Fish were not observed in the tributary. A +1 salmonid was observed in this unit.
12212	0270.00	Tributary #3 enters on the left bank. It contributes to approximately 1% of Root Creek's flow. The water temperature of the tributary was 54° Fahrenheit, the water temperature downstream of the confluence was 54° Fahrenheit, and the water upstream of the confluence was 54° Fahrenheit. The slope of the tributary is 1%. Fish were not observed in the tributary.
12290	0272.00	A +1 salmonid was observed in this unit.
12320	0273.00	LDA #18 is 4.6' high, 66' wide, and 110' long and contains 21 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 66' wide, 18' long, and 12' deep. The sediment ranges in size from silt to gravel. The LDA is not a possible barrier to salmonids. Fish were observed above the LDA.
13371	0294.00	LDA #19 is 3.3' high, 22' wide, 33' long and contains 8 pieces of LWD. Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 19' wide, 14' long and 1' deep. The sediment ranges in size from silt to gravel. The LDA is not a possible barrier to salmonids. Fish were observed above the LDA.
13492	0297.00	LDA #20 is 4.2' high, 27' wide, 16' long and contains 21 pieces of wood. Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 20' wide, 10' long

and 3' deep. The sediment ranges in size from silt to cobble. The LDA is not a possible barrier to salmonids. Fish were observed above the LDA.

13958	0308.00	LDA #21 is 7.5' high, 18' wide, 45' long and contains 17 pieces of LWD. Water does flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 14' wide, 6' long and 1' deep. The sediment ranges in size from silt to large cobble. Fish were observed above the LDA.
14127	0313.00	LDA #22 is 6.3' high, 19' wide, 21' long and contains 26 pieces of LWD. Water does flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 16' wide, 8' long and 1' deep. The sediment ranges in size from silt to small cobble. Fish were observed above the LDA.
14199	0314.00	There is a noticeable increase in slope beginning at this unit. Tributary #4 enters on the left bank. It contributes to approximately 1% of Root Creek's flow. The water temperature of the tributary was 51° Fahrenheit, the water temperature downstream of the confluence was 51° Fahrenheit, and the water temperature upstream of the confluence was 51° Fahrenheit. The slope of the tributary is 3%. The tributary is accessible to salmonids. Fish were not observed in the tributary.
14440	0315.00	There is a 3' plunge into a 5' pool at this unit.
14552	0318.00	LDA #23 is 5.5' high, 16' wide, 67' long and contains 67 pieces of LWD. Water does flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 13' wide, 11' long and 2' deep. The sediment ranges in size from silt to gravel. Fish were seen above the LDA.
14656	0320.00	There is a 2.3' plunge into a 3.0' pool at this unit.
14980	0326.00	There is a 1' plunge into a 4' pool at this unit.
15260	0332.00	LDA #24 is 5' high, 14' wide, 26' long and contains 8 pieces of wood. Water does flow through it and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 14' wide, 22' long and 2.3' deep. The sediment ranges in size from silt to clay. The LDA is not a possible barrier to adult salmonids but may be a barrier to juveniles. Fish were observed above the LDA.
15286	0333.00	A +1 salmonid was observed in this unit.

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16130	0346.00	Tributary #5 enters on the right bank. It contributes to approximately 1% of Root Creek's flow. The water temperature of the tributary was 52° Fahrenheit, the water temperature downstream of the confluence was 52° Fahrenheit, and the water temperature upstream of the confluence was 52° Fahrenheit. The slope of the tributary is estimated to be 1%. Fish were not observed in the tributary.
16154	0347.00	LDA #25 is 7.2' high, 12' wide, 64' long and contains 33 pieces of LWD. Water does flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 12' wide, 30' long and 2' deep. The sediment is the size of silt/clay. The LDA is a possible barrier to juvenile salmonids but not to adults. Fish were observed above the LDA.
16734	0358.00	Tributary #6 enters on the left bank. It contributes to approximately 1% of Root Creek's flow. The water temperature of the tributary was 52° Fahrenheit, the water temperature downstream of the confluence was 52° Fahrenheit, and the water temperature upstream of the confluence was 52° Fahrenheit. The slope of the tributary is 1%. The tributary is accessible to salmonids. Fish were not observed in the tributary.
17006	0365.00	Two lamprey were observed in this unit.
17306	0373.00	There is a 4.4' plunge into a 3.2' deep pool at this unit.
17408	0376.00	LDA #26 is 5.3' high, 16' wide, 22' long and contains 10 pieces of LWD. Water does flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 16' wide, 12' long and .5' deep. The sediment ranges in size to silt to gravel. The LDA is a possible barrier to juvenile salmonids but not to adults. Fish were observed above the LDA.
17765	0383.00	There is a 4.4' plunge into a 3.8' deep pool at this unit.
18019	0388.00	A +1 salmonid was observed at this unit.
18108	0390.00	There is a 2.7' plunge into a 2.6' deep pool at this unit.
18287	0393.00	There is a 9.0' plunge into a 4.0' deep pool at this unit.
19022	0420.00	LDA #27 is 7' high, 24' wide, 35' long and contains 16 pieces of LWD. Water flows through the LDA and there are visible gaps in it. The sediment ranges in size from silt to gravel. The LDA is a possible barrier to salmonids. Fish were observed above the LDA.

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19272	0428.00	There is a 6.2' plunge into a 3.2' pool at this unit.
20061	0447.00	Tributary #7 enters on the left bank. It contributes approximately 1% of Root Creek's flow. The water temperature of the tributary was 52° Fahrenheit, the water temperature downstream of the confluence was 52° Fahrenheit, and the water upstream of the confluence was 52° Fahrenheit. The slope of the tributary is approximately 3%. Fish were not observed in the tributary.
20165	0449.00	The sediment is primarily silt and clay.
20359	0451.00	A +1 steelhead was observed at this unit.
20414	0452.00	End of survey at road crossing due to access issues. Visual observations of a very entrenched silt/clay dominated channel with plenty of wood and habitat complexity beyond the last habitat unit. A salmonid measuring approximately 12" was observed one unit below the end of survey.

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.

REPORT CONTACT INFORMATION

California Department of Fish and Wildlife  
Coastal Watershed Planning and Assessment Program  
1487 Sandy Prairie ct., Suite A  
Fortuna, CA 95540  
[www.coastalwatersheds.ca.gov](http://www.coastalwatersheds.ca.gov)

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 - Rootwad 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 }

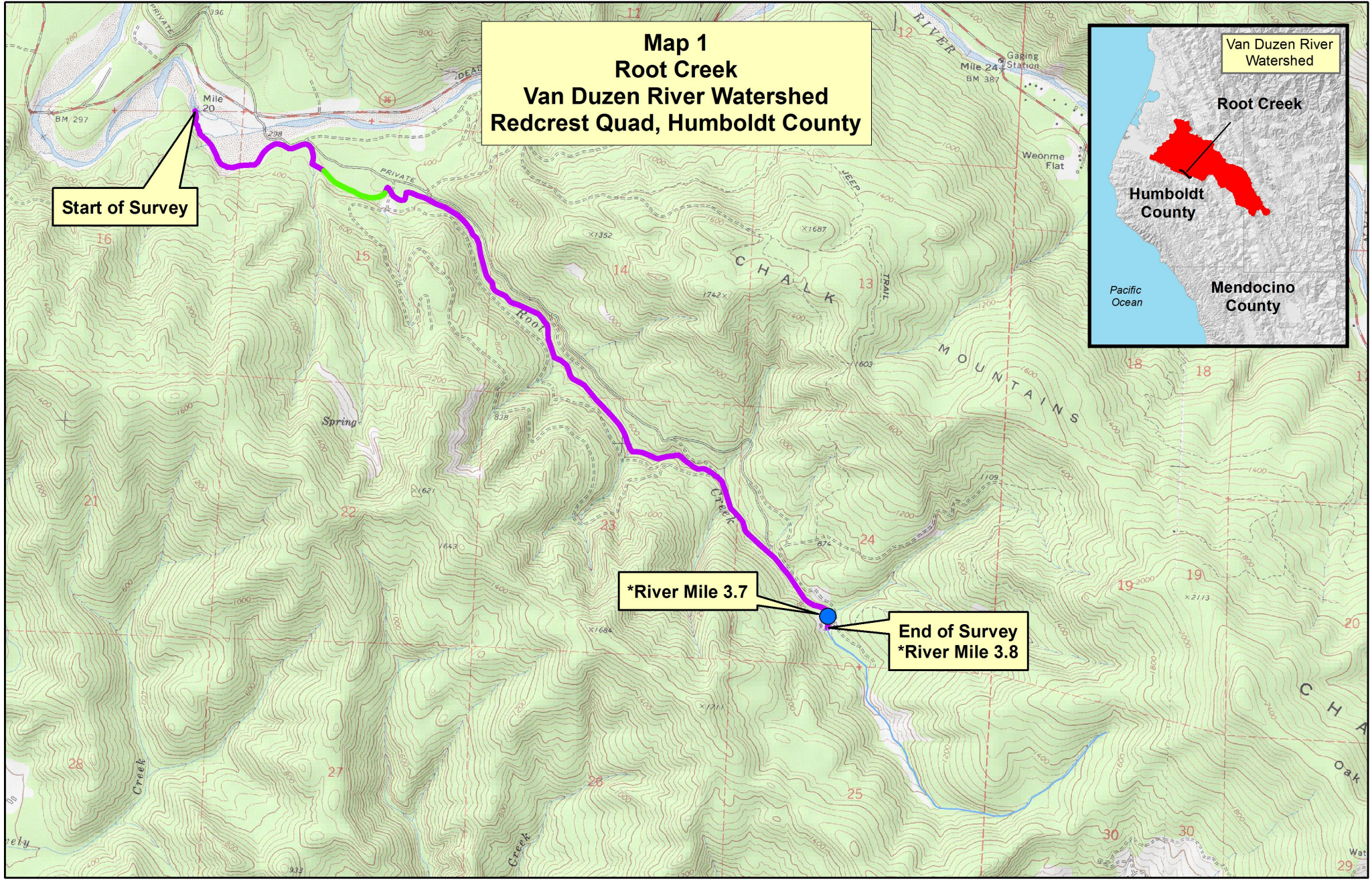
## BACKWATER POOLS

Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Rootwad 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]	





- Reach 1: F4 channel type
- Reach 2: B2 channel type
- Reach 3: F4 channel type
- Root Creek

● Last observed juvenile steelhead trout



Coordinate System: NAD 1983 California Teale Albers  
Data Sources: CDFW, USGS, CalWater 2.21, CDF 24k

\*River Mile indicates distance from confluence with Van Duzen River



# **APPENDIX I**

## **TABLES AND GRAPHS**

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

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 5/30/2017 to 6/15/2017

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
125	12	FLATWATER	27.7	61	7668	37.3	14.3	0.5	1.0	874	109308	469	58648		24
188	187	POOL	41.6	52	9759	47.5	14.4	1.2	2.8	746	140306	1127	210811	963	44
139	17	RIFFLE	30.8	22	3121	15.2	10.9	0.3	0.6	220	30572	68	9460		0
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
452	216				20548					280186			278919		

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

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 5/30/2017 to 6/15/2017

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 (%)
112	17	LGR	24.8	21	2336	11.4	11	0.3	0.9	220	24633	68	7623		0	98
27	0	HGR	6.0	29	785	3.8										
1	0	POW	0.2	40	40	0.2										
68	6	RUN	15.0	41	2779	13.5	14	0.5	1.8	767	52138	429	29153		38	99
56	6	SRN	12.4	87	4849	23.6	15	0.5	1.6	982	55003	510	28540		8	99
168	167	MCP	37.2	53	8932	43.5	14	1.2	6.7	753	126555	1121	187232	957	41	97
3	3	STP	0.7	75	226	1.1	17	0.9	3.6	1113	3338	1482	4445	1179	57	97
17	17	PLP	3.8	35	601	2.9	18	1.5	6.7	613	10420	1125	19127	979	74	98

Total Units  
452

Total Units Fully Measured  
216

Total Length (ft.)  
20548

Total Area (sq.ft.)  
272087

Total Volume (cu.ft.)  
276120

**Table 3 - Summary of Pool Types**

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 5/30/2017 to 6/15/2017

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
171	170	MAIN	91	54	9158	94	14.1	1.2	760	129899	961	163348	41
17	17	SCOUR	9	35	601	6	17.6	1.5	613	10420	979	16647	74

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
188	187	9759	140319	179995

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

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 5/30/2017 to 6/15/2017

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
167	MCP	89	2	1	39	23	70	42	42	25	14	8
3	STP	2	0	0	1	33	1	33	1	33	0	0
17	PLP	9	0	0	1	6	5	29	9	53	2	12

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
187	2	1	41	22	76	41	52	28	16	9

Mean Maximum Residual Pool Depth (ft.): 2.8

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

Stream Name: Root Creek

LLID: 1239496404762 Drainage: Van Duzen River

Survey Dates: 5/30/2017 to 6/15/2017

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
112	17	LGR	0	100	0	0	0	0	0	0	0
27	0	HGR	0	0	0	0	0	0	0	0	0
139	17	TOTAL RIFFLE	0	100	0	0	0	0	0	0	0
1	0	POW	0	0	0	0	0	0	0	0	0
68	7	RUN	33	50	17	0	0	0	0	0	0
56	6	SRN	0	60	0	0	0	0	0	40	0
125	13	TOTAL FLAT	13	56	6	0	0	0	0	24	0
168	168	MCP	0	0	0	0	0	0	0	0	0
3	3	STP	0	3	0	0	0	0	13	84	0
17	17	PLP	6	35	17	8	0	0	20	11	4
188	188	TOTAL POOL	8	50	16	9	0	0	3	11	2
452	218	TOTAL	9	49	15	9	0	0	3	13	2

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

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 5/30/2017 to 6/15/2017

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
112	17	LGR	0	0	76	18	6	0	0
27	0	HGR	0	0	0	0	0	0	0
1	0	POW	0	0	0	0	0	0	0
68	6	RUN	50	0	50	0	0	0	0
56	6	SRN	0	0	50	17	0	17	17
168	168	MCP	30	4	43	10	4	9	0
3	3	STP	0	0	0	0	0	100	0
17	17	PLP	18	0	29	18	18	18	0



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

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 5/30/2017 to 6/15/2017

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	39	61	0	100	100

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: 5/30/2017 to 6/15/2017

Survey Length (ft.): 20548

Main Channel (ft.): 20548

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: F4	Canopy Density (%): 96.0	Pools by Stream Length (%): 47.1
Reach Length (ft.): 3698	Coniferous Component (%): 9.6	Pool Frequency (%): 36.1
Riffle/Flatwater Mean Width (ft.): 11.5	Hardwood Component (%): 90.4	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 36
Range (ft.): 17 to 23	Vegetative Cover (%): 99.6	2 to 2.9 Feet Deep: 36
Mean (ft.): 20	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 23
Std. Dev.: 2	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 5
Base Flow (cfs.): 1.6	Occurrence of LWD (%): 13	Mean Max Residual Pool Depth (ft.): 2.5
Water (F): 53 - 53 Air (F): 59 - 60	LWD per 100 ft.:	Mean Pool Shelter Rating: 55
Dry Channel (ft): 0	Riffles: 2	
	Pools: 6	
	Flat: 1	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 73 Sm Cobble: 27 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 9.1 2. 59.1 3. 31.8 4. 0.0 5. 0.0		

**STREAM REACH: 2**

Channel Type: B2	Canopy Density (%): 99.0	Pools by Stream Length (%): 52.6
Reach Length (ft.): 2342	Coniferous Component (%): 51.3	Pool Frequency (%): 39.1
Riffle/Flatwater Mean Width (ft.): 14.0	Hardwood Component (%): 48.7	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 28
Range (ft.): 16 to 26	Vegetative Cover (%): 100.0	2 to 2.9 Feet Deep: 44
Mean (ft.): 20	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 20
Std. Dev.: 3	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 8
Base Flow (cfs.): 1.6	Occurrence of LWD (%): 9	Mean Max Residual Pool Depth (ft.): 2.7
Water (F): 52 - 53 Air (F): 56 - 61	LWD per 100 ft.:	Mean Pool Shelter Rating: 36
Dry Channel (ft): 0	Riffles: 0	
	Pools: 3	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 4 Sand: 0 Gravel: 20 Sm Cobble: 56 Lg Cobble: 0 Boulder: 16 Bedrock: 4		
Embeddedness Values (%): 1. 16.0 2. 52.0 3. 8.0 4. 0.0 5. 24.0		

## Summary of Fish Habitat Elements By Stream Reach

### STREAM REACH: 3

Channel Type: F4	Canopy Density (%): 96.8	Pools by Stream Length (%): 46.8
Reach Length (ft.): 14508	Coniferous Component (%): 41.4	Pool Frequency (%): 43.1
Riffle/Flatwater Mean Width (ft.): 12.3	Hardwood Component (%): 58.6	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 20
Range (ft.): 12 to 48	Vegetative Cover (%): 100.0	2 to 2.9 Feet Deep: 41
Mean (ft.): 21	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 30
Std. Dev.: 8	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 9
Base Flow (cfs.): 1.6	Occurrence of LWD (%): 14	Mean Max Residual Pool Depth (ft.): 2.8
Water (F): 50 - 60    Air (F): 52 - 72	LWD per 100 ft.:	Mean Pool Shelter Rating: 43
Dry Channel (ft): 0	Riffles: 3	
	Pools: 11	
	Flat: 9	
Pool Tail Substrate (%): Silt/Clay: 1    Sand: 0    Gravel: 54    Sm Cobble: 42    Lg Cobble: 0    Boulder: 3    Bedrock: 0		
Embeddedness Values (%): 1. 49.3    2. 34.3    3. 12.1    4. 0.0    5. 4.3		

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

Stream Name: Root Creek

LLID: 1239496404762

Drainage: Van Duzen River

Survey Dates: 5/30/2017 to 6/15/2017

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	4	4	1.8
Boulder	6	4	2.3
Cobble / Gravel	2	3	1.2
Sand / Silt / Clay	205	206	94.7

**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	0.7
Brush	20	17	8.5
Hardwood Trees	153	95	57.1
Coniferous Trees	42	102	33.2
No Vegetation	1	1	0.5

**Total Stream Cobble Embeddedness Values:** 2

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

StreamName: Root Creek

LLID: 1239496404762 Drainage: Van Duzen River

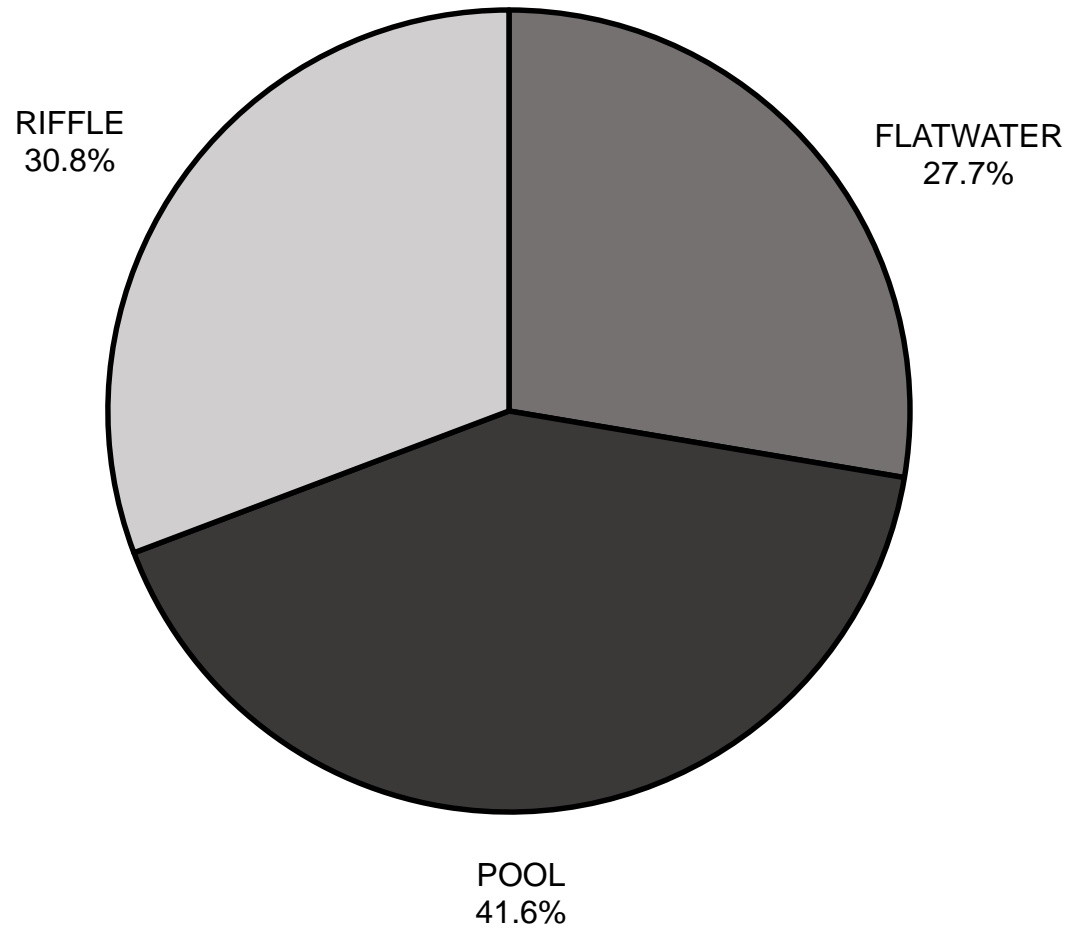
Survey Dates: 5/30/2017 to 6/15/2017

Confluence Location: Quad: REDCREST Legal Description: T01NR02ES16 Latitude: 40:28:34.0N Longitude: 123:56:59.0W

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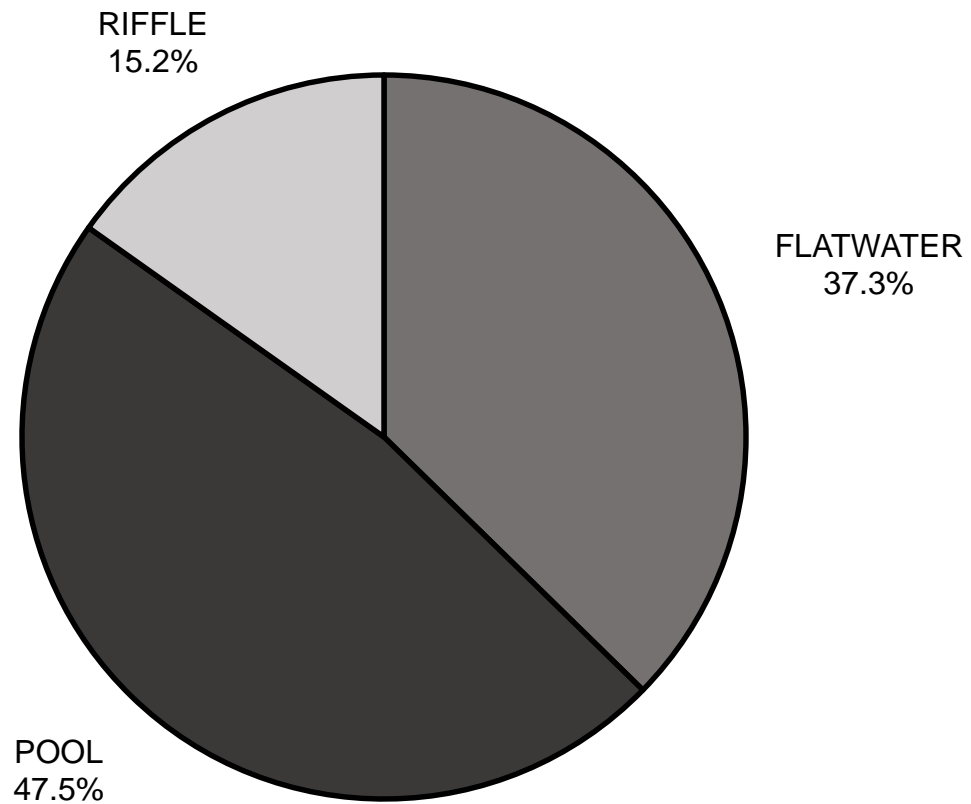
	Riffles	Flatwater	Pools
UNDERCUT BANKS(%)	0	13	8
SMALL WOODY DEBRIS (%)	100	56	50
LARGE WOODY DEBRIS (%)	0	6	16
ROOT MASS (%)	0	0	9
TERRESTRIAL VEGETATION (%)	0	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	3
BOULDERS (%)	0	24	11
BEDROCK LEDGES (%)	0	0	2

**ROOT CREEK 2017  
HABITAT TYPES BY PERCENT OCCURRENCE**



GRAPH 1

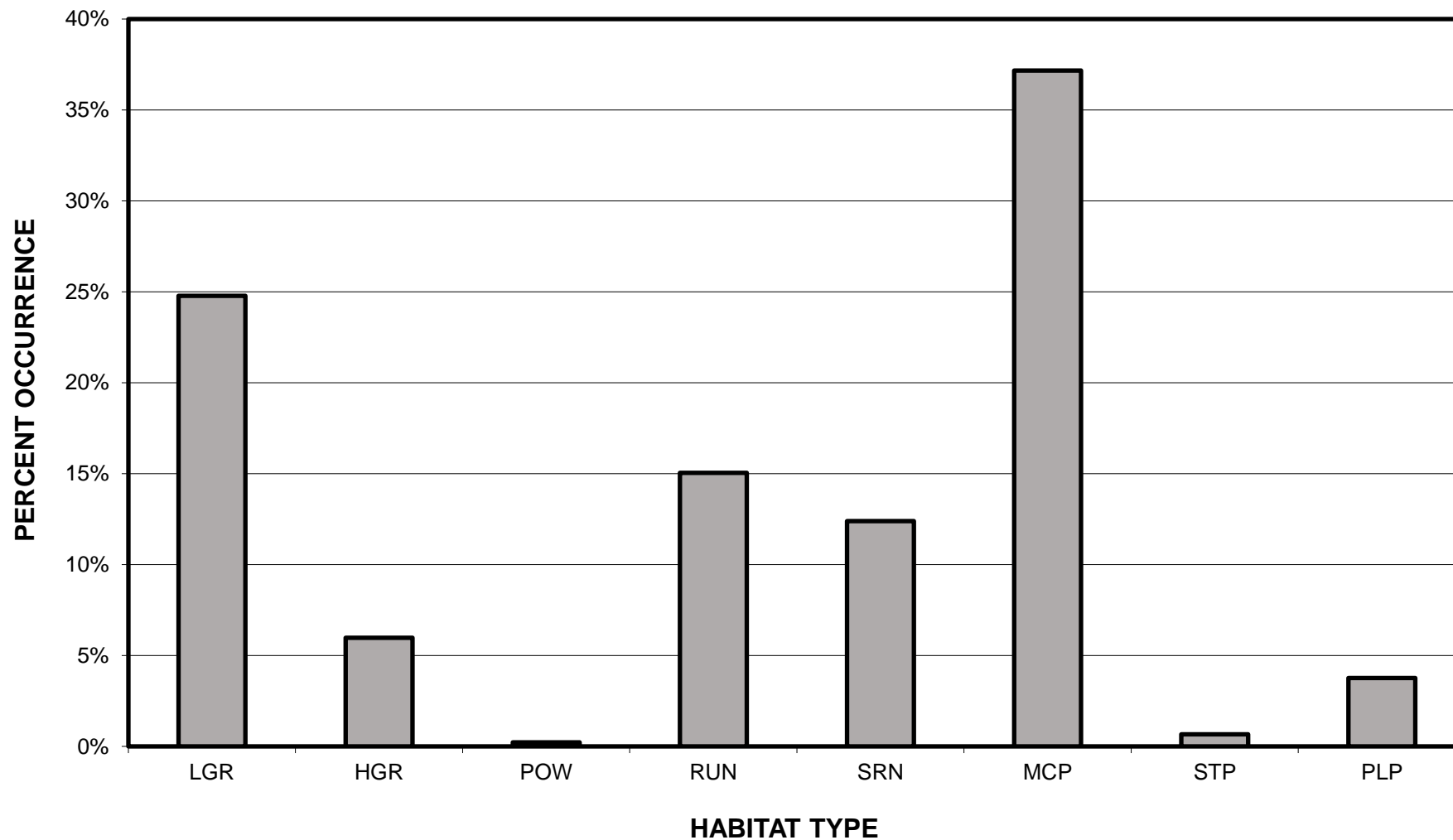
**ROOT CREEK 2017**  
**HABITAT TYPES BY PERCENT TOTAL LENGTH**



GRAPH 2

# ROOT CREEK 2017

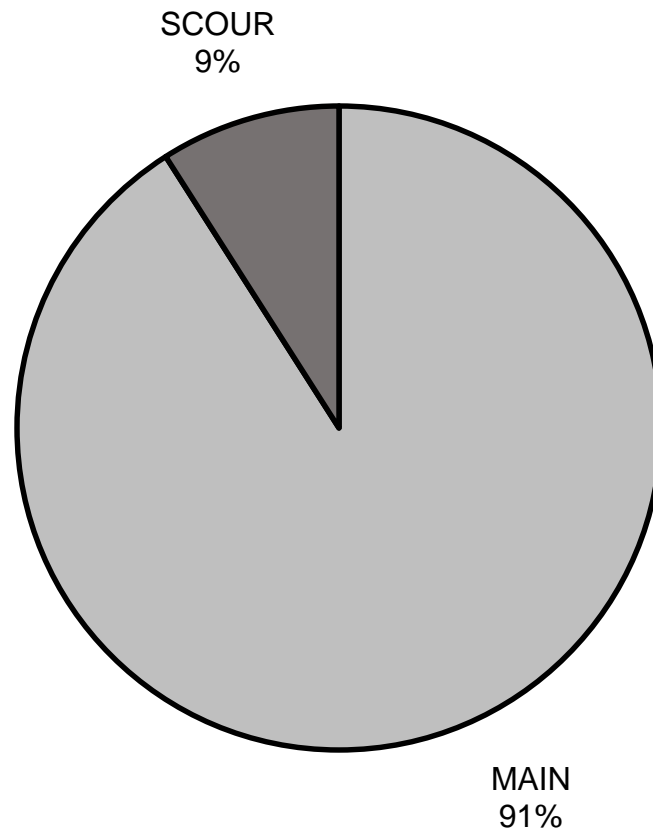
## HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

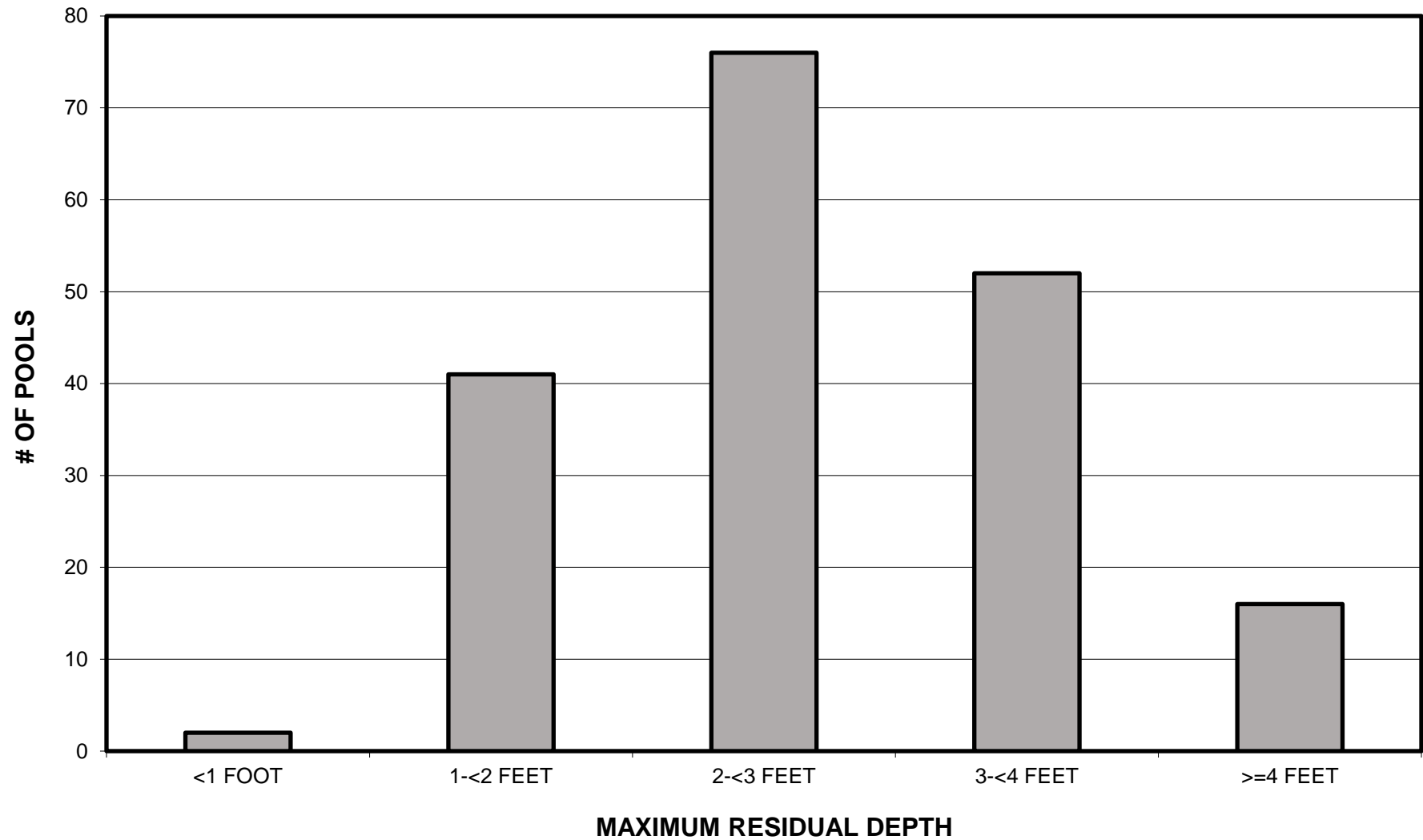


**ROOT CREEK 2017  
POOL TYPES BY PERCENT OCCURRENCE**



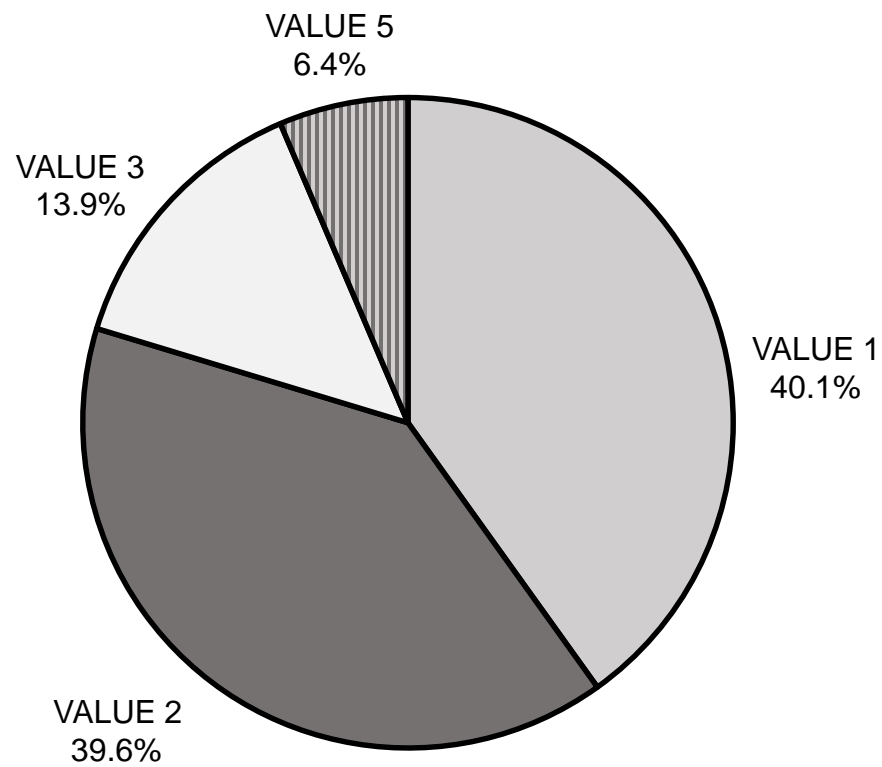
GRAPH 4

# ROOT CREEK 2017 MAXIMUM DEPTH IN POOLS



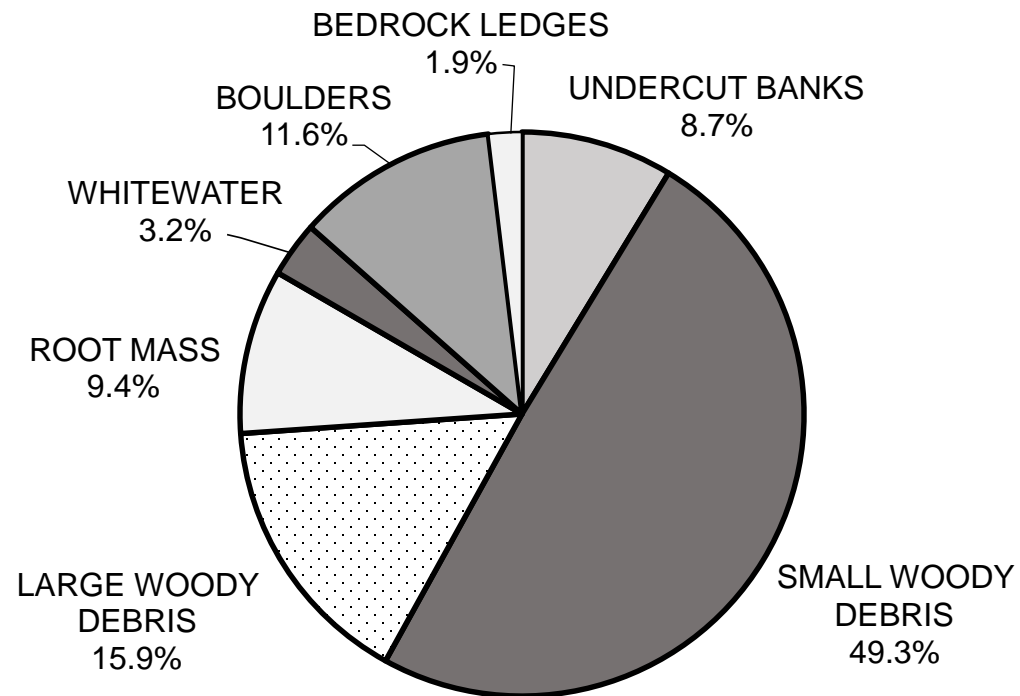
GRAPH 5

# ROOT CREEK 2017 PERCENT EMBEDDEDNESS



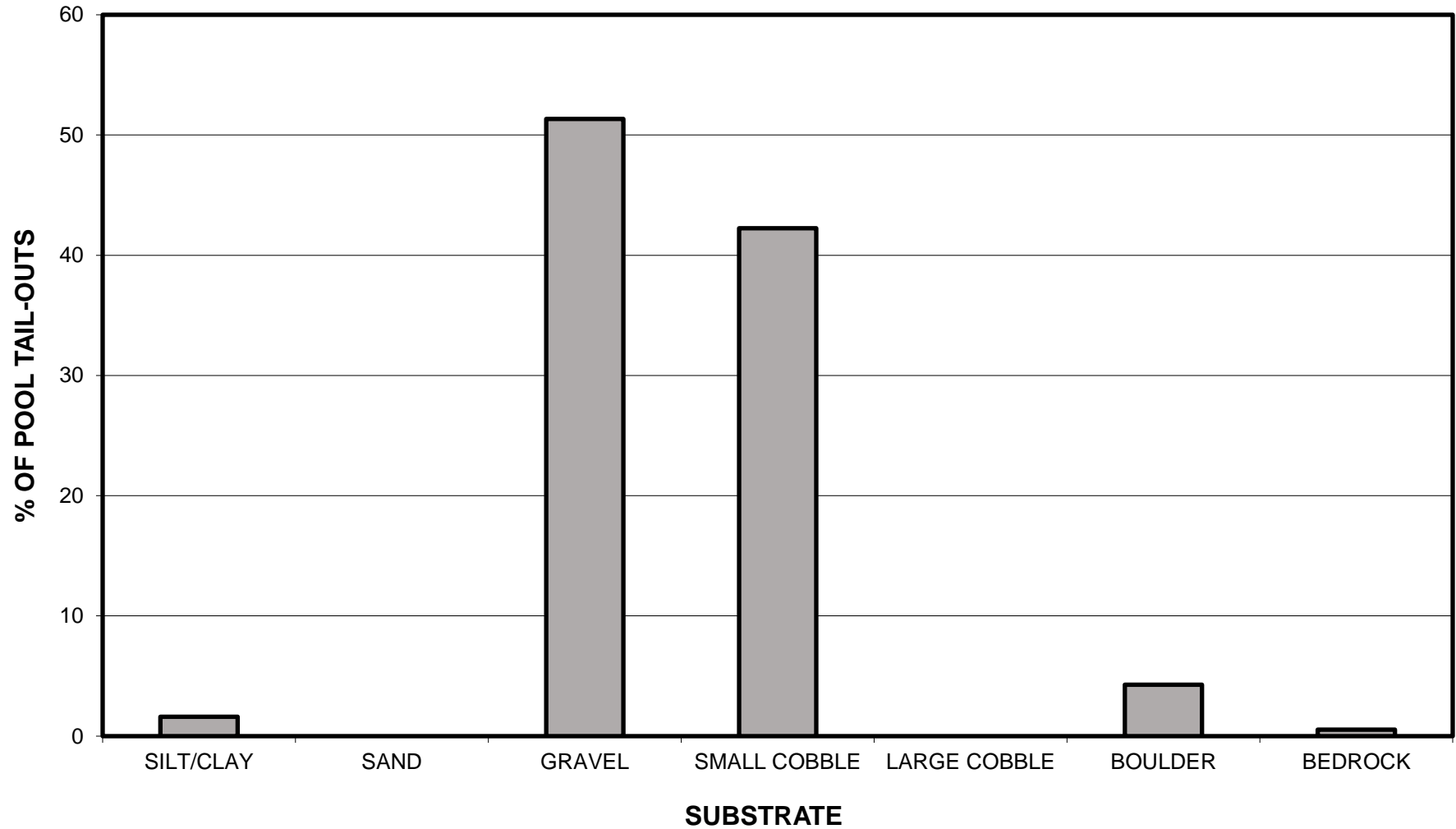
GRAPH 6

# ROOT CREEK 2017 MEAN PERCENT COVER TYPES IN POOLS



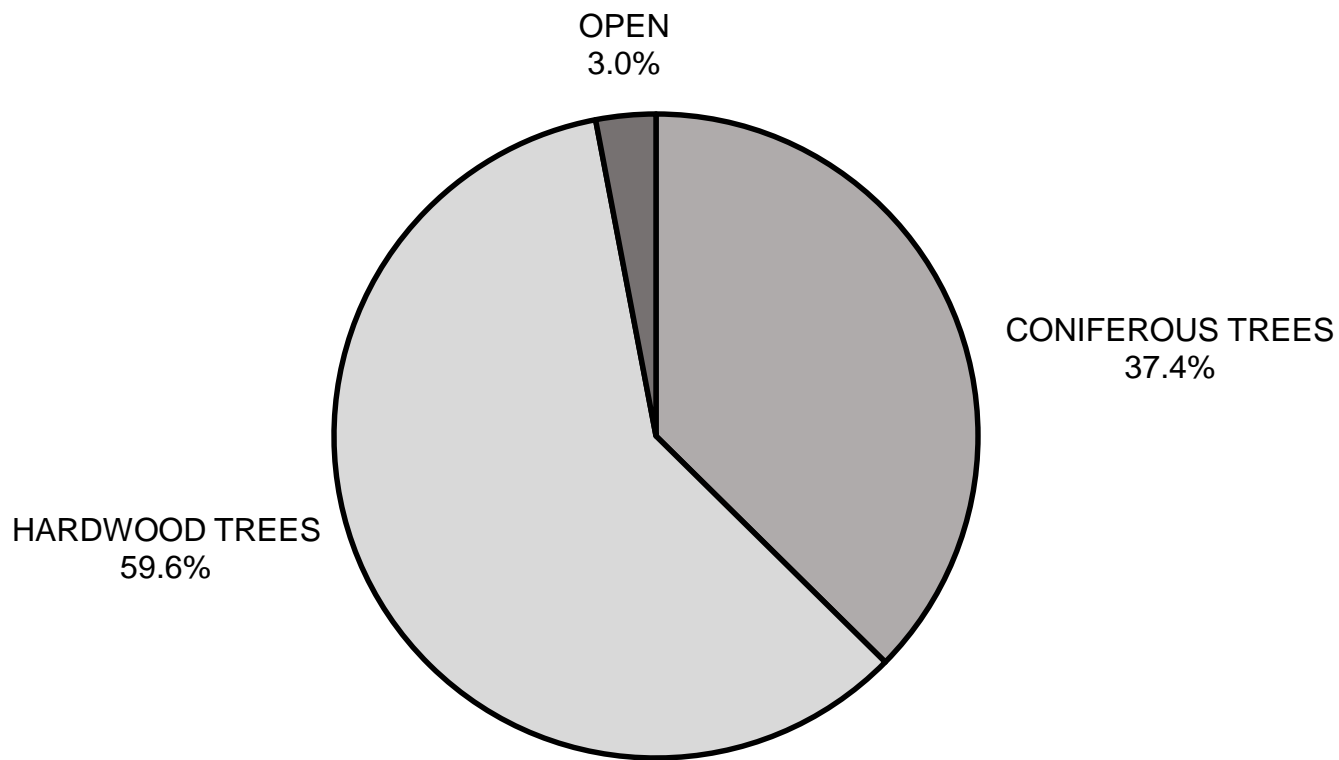
GRAPH 7

# ROOT CREEK 2017 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



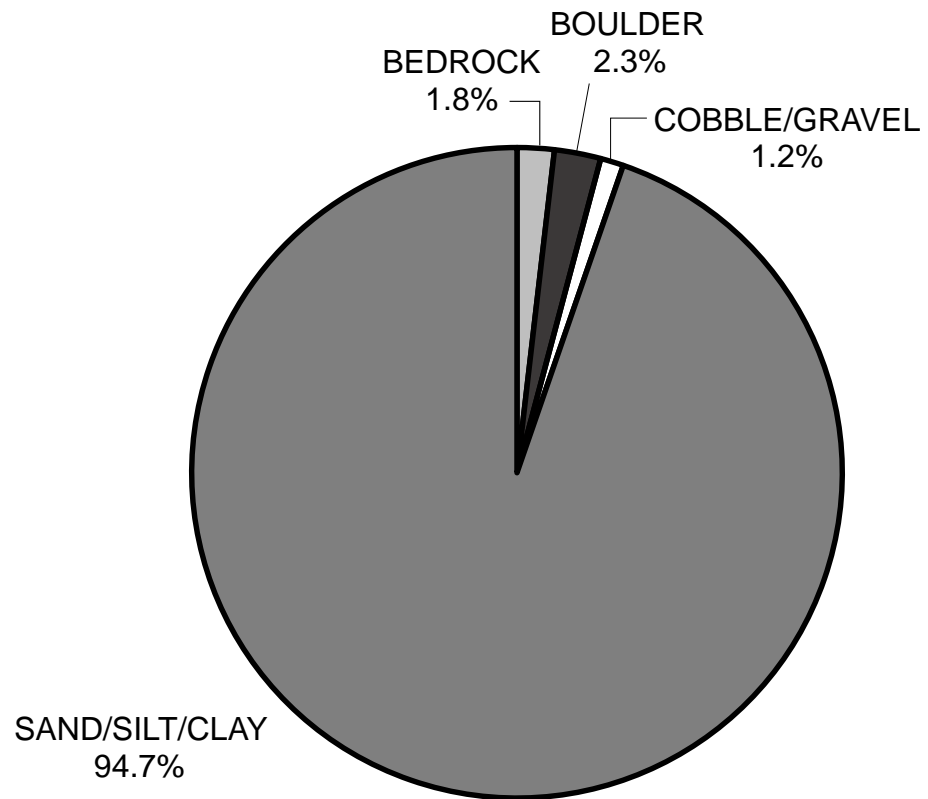
GRAPH 8

**ROOT CREEK 2017  
MEAN PERCENT CANOPY**



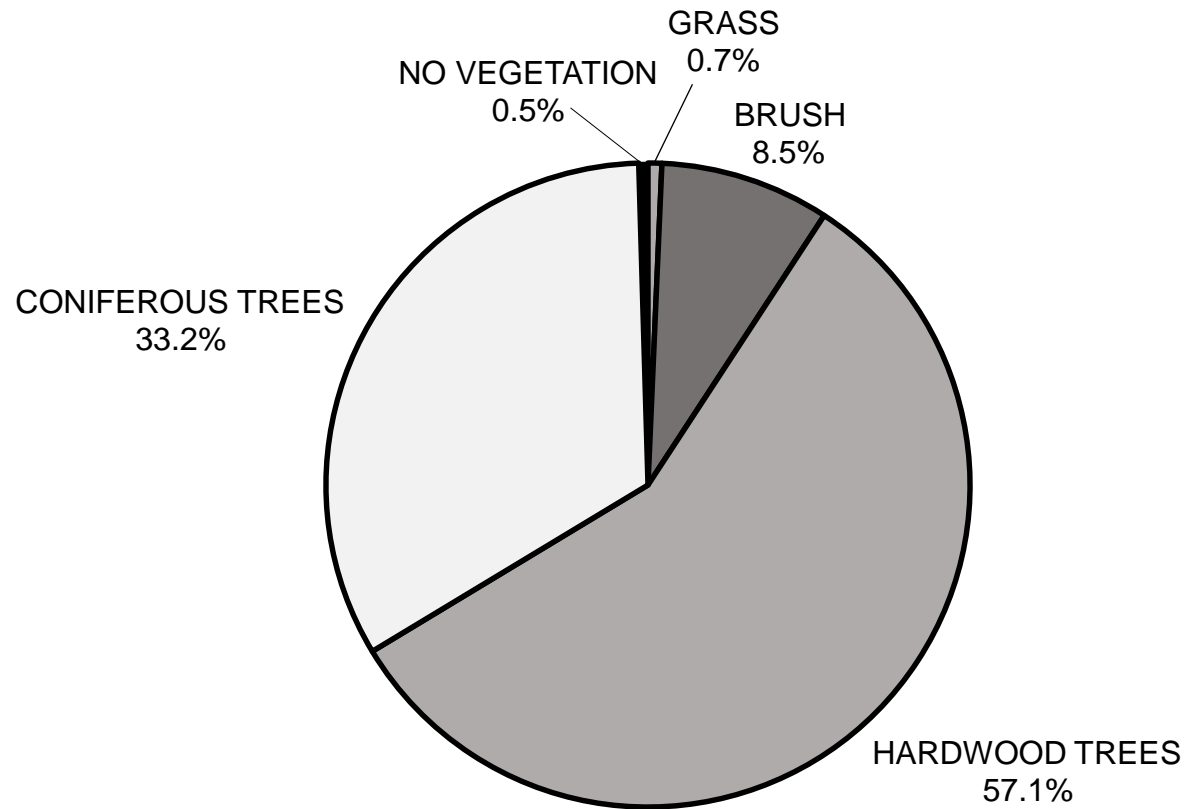
GRAPH 9

**ROOT CREEK 2017  
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**ROOT CREEK 2017  
DOMINANT BANK VEGETATION IN SURVEY REACH**





## **APPENDIX II**

# **STREAM INVENTORY PHOTOS**



Photo 1: Sediment build-up behind large debris accumulation at habitat unit #213, 9,400' upstream from start of survey. (Photo taken 6/1/17)





Photo 2: Represents typical channel configuration of Reach 2 at unknown distance from start of survey. Pictured: Angela Cruz, and Josh Gruver. (Photo taken 6/13/17)





Photo 3: Photo represents typical Reach 3 channel configuration at unknown distance from start of survey. (Photo taken 6/15/17)





Photo 4: Large debris accumulation with plunge pool at habitat unit #393, 17,986' upstream from start of survey. Pictured: Ryan Bernstein. (Photo taken 6/13/17)