CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

STREAM INVENTORY REPORT

Shively Creek

INTRODUCTION

A stream inventory was conducted from October 4 to October 19, 2016 on Shively Creek. The survey began at the confluence with Eel River and extended upstream 3.1 miles.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Shively Creek. Normally a biological inventory consisting of a mask and snorkel survey would be completed in conjunction with the habitat inventory; however, Shively Creek had been surveyed the previous summer as a component of the CDFW's Lower Eel River and Van Duzen River summer mask and snorkel surveys. Observations from that survey are presented in the "Biological Inventory Results" section of this report.

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

Shively Creek is a tributary to Eel River which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Shively Creek's legal description at the confluence with Eel River is T01N R02E S29. Its location is 40.4444° north latitude and -123.9816° west longitude, LLID number 1239818404455. Shively Creek is a second order stream and has approximately 3.6 miles of blue line stream according to the USGS Redcrest 7.5 minute quadrangle. Shively Creek drains a watershed of approximately 1.9 square miles. Elevations range from about 82 feet at the mouth of the creek to 600 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is primarily privately owned and is managed for timber production. Vehicle access exists via Highway 101 to Shively Creek Road (a few miles south of the towns of Rio Dell and Scotia).

METHODS

The habitat inventory conducted in Shively Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al. 1998). The California Department of Fish and Wildlife (CDFW) personnel that conducted the inventory were trained in standardized habitat inventory methods by CDFW. The inventory was conducted by a two-person team.

SAMPLING STRATEGY

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

parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement. Surveyors also take photos to document general habitat conditions (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 Shively 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". Shively 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 Shively 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 Shively 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 densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Shively 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 Shively 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.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.18, 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 Shively 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 October 4 to October 19, 2016 was conducted by Ryan Bernstein (CDFW), Maddelyn Harden (CDFW), and Matt Rice (CDFW). The total length of the stream surveyed was 16,566 feet.

Stream flow was not measured on Shively Creek due to a significant rain event that occurred between October 14th and 16th.

Shively Creek is an F4 channel type for the entire 16,566 feet of the stream surveyed. F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 51º to 60º Fahrenheit. Air temperatures ranged from 51º to 63º Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 49% pool units, 30% flatwater units, 17% riffle units, and 4% dry units (Graph 1). Based on total length of Level II habitat types there were 40% flatwater units, 32% pool units, 21% dry units, and 6% riffle units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 46%; low-gradient riffle units, 17%; run units, 15%; and step run units, 15% (Graph 3). Based on percent total length, mid-channel pool units made up 30%, step run units made up 27%, and dry units made up 21%.

A total of 168 pools were identified (Table 3). Main channel pools were the most frequently encountered at 92% (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. Thirty-six of the 168 pools (21%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 169 pool tail-outs measured, 120 had a value of 1 (71%); 44 had a value of 2 (26%); 1 had a value of 3 (0.6%); 4 had a value of 5 (2.4%) (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 2, and pool habitats had a mean shelter rating of 14 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 15, scour pools had a mean shelter rating of 14, and backwater pools had a mean shelter rating of 0 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Undercut banks are the dominant cover type in Shively Creek. Graph 7 describes the pool cover in Shively Creek. Undercut banks are 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 82% of pool tail-outs. Small cobble was the next most frequently observed dominant substrate and occurred in 24% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Shively Creek was 97%. Three percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 55% and 45%, respectively. Graph 9 describes the mean percent canopy in Shively 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 89% sand/silt/clay, 10% cobble/gravel, 1% bedrock, 1% boulder (Graph 10). Coniferous trees were the dominant vegetation type observed in 46% of the units surveyed. Additionally, 32% of the units surveyed had deciduous trees as the dominant vegetation type, and 16% had brush as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Normally a biological inventory consisting of a mask and snorkel survey would be completed in conjunction with the habitat inventory; however, Shively Creek was surveyed at the end of the field season (October), and during the habitat inventory significant rain events occurred. These rain events would have made mask and snorkel observations difficult and most likely inaccurate. Shively Creek had been surveyed the previous summer as a component of the CDFW's Lower Eel River and Van Duzen River summer mask and snorkel surveys. Data and observations from that survey are presented below.

Survey teams conducted a snorkel survey at 10 sites for species composition and distribution in Shively Creek on August 26, 2015 (Table A). Water temperatures taken during the survey period ranged from 56.3° to 61.7° Fahrenheit. The sites were sampled by Brian Starks and Melissa Fletcher (PSMFC).

The survey yielded 64 young-of-the-year (YOY) coho salmon, 16 YOY steelhead trout (SH), 8 age 1+ SH, and 4 YOY Chinook salmon.

During the survey, the upstream-most observation of coho salmon occurred at 40.4380° north latitude, -123.9523° west longitude, approximately 12,348 feet upstream from the confluence with Eel River. The upstream-most observation of steelhead trout occurred at 40.4415° north latitude, -123.9534° west longitude, approximately 15,119 feet upstream from the confluence with Eel River. The upstream-most observation of Chinook salmon occurred at 40.4380° north latitude, -123.9523° west longitude, approximately 12,348 feet upstream from the confluence with Eel River.

Table A. Summary of results for a fish composition and distribution survey within Sample Creek, Month, day, 201-.

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 1: F4 Channel Type										
08/26/15	1	209	Pool	11,632	7	1	0	12	0	3 CGS
	2	211	Pool	11,714	1	0	0	11	0	1 CHIN, 1 CGS, 1 RABO
	3	214	Pool	11,878	2	2	0	21	0	1 CHIN
	4	216	Pool	11,969	0	0	0	0	0	2 CGS
	5	220	Pool	12,132	2	2	0	13	0	
	6	222	Pool	12,161	2	1	0	3	0	
	7	226	Pool	12,275	1	2	0	11	0	1 CHIN, 1 CGS
	8	228	Pool	12,348	1	0	0	2	0	1 CHIN, 1 CGS, 1 RABO
	9	230	Pool	12,467	0	0	0	0	0	
	10	310	Pool	15,119	0	2	0	0	0	1 CGS

Species Abbreviations: CGS=Coastal/California Giant Salamander; CHIN=Chinook Salmon; RABO=Red-legged frog

DISCUSSION

Shively Creek is an F4 channel. The suitability of F4 channel types for fish habitat improvement structures is as follows: F4 channels are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover.

The water temperatures recorded on the survey days October 4, 2016 to October 19, 2016 ranged from 51º to 60º Fahrenheit. Air temperatures ranged from 51º to 63º degrees Fahrenheit. This is a suitable water temperature range for salmonids. However, 60º Fahrenheit, if sustained, is near the threshold stress level for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 40% of the total length of this survey, riffles 6%, and pools 32%. Thirty-six of the 168 (21%) pools had a maximum residual depth greater than two feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended.

One hundred sixty-four of the 169 pool tail-outs measured had embeddedness ratings of 1 or 2. One of the pool tail-outs had embeddedness ratings of 3 or 4. Four of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead.

One hundred sixty-one of the 169 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 14. The shelter rating in the flatwater habitats is 2. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by undercut banks in Shively Creek. Undercut banks are the dominant cover type in pools followed by large woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

The mean percent canopy density for the stream was 97%. The percentage of right and left bank covered with vegetation was 100% and 100%, respectively.

RECOMMENDATIONS

Shively 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 Shively 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 undercut banks. Adding high quality complexity with woody cover in the pools is desirable.

2) Based on observed conditions pools are likely to become disconnected. Streamflow should be monitored to determine if it is limiting for salmonids.

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 three to five 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 Eel River. Channel type is a F4. channel type cross-section location is at Habitat Unit (HU) #199.

360	0002.00	Bridge # 1 is the crossing for a train, and is 45’ high x 20’ wide x 60' long. It is a train bridge (made of wood) and is/is not a barrier to salmonids.
3020	0003.00	The creek is out of the influence of the confluence with Eel River at this unit.
3130	0007.00	Salmonid young-of-the-year (YOY) present.
3293	0009.00	Bedrock wall on right bank of unit.
3655	0018.00	Rip Rap along right bank.
4009	0026.00	Tributary # 1 enters on the right bank. It contributes to approximately 2% of Shively Creek's flow. The water temperature of the tributary was 58 degrees Fahrenheit; the water temperature downstream of the confluence was 58 degrees
4973	0060.00	Stopped at the top of unit because of private property. Land owner did not give permission to survey.
6168	0077.00	There is sediment retention measuring 10' long.
7587	0109.00	Bridge #5 is the crossing for Road Bridge #1, and is 13.1' high x 22' wide x 54' long. It is a vehicle bridge made of steel and is not a barrier to salmonids.
9519	0147.00	Left bank severely undercut as run off contributes to erosion.
9745	0153.00	Clay occurs on both sides of bank.
10471	0163.00	Log debris accumulation (LDA) #2 is 10.7' high x 12' wide x 8' long and contains 3 pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is not being retained. Fish were observed above the LDA.
10829	0175.00	Wood debris accumulation.
11002	0182.00	One coho YOY observed from streambanks.
11078	0184.00	Bridge #6 is the crossing for an unknown HRC road, and is 15.5' high x 24.5' wide x 60' long. It is a vehicle bridge (made of metal) and is not a barrier to salmonids.
11102	0185.00	Rip-rap throughout unit.
11551	0198.00	Left bank erosion.
11570	0199.00	Tributary #3 enters on the left bank. It contributes to approximately 0.5% of Shively Creek's flow which is estimated 0.1 cfs. The water

		temperature of the tributary was 58 degrees Fahrenheit, the water temperature downstream of the confluence was 58 degrees Fahrenheit, and the water temperature upstream of the confluence was 58 degrees Fahrenheit. The slope of the tributary is estimated 0.1%. The tributary is accessible to salmonids. Fish were not observed in the tributary.
11879	0203.00	Wood accumulation doesn't cover bankfull width.
11978	0206.00	Right bank landslide has sloughed mud into creek. Log debris accumulation (LDA) #3 is 4.9' high x 15' wide x 1.4' long and contains one piece of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 15' wide x 2' long x 1.3' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as there is a 4.9' high plunge, as well as a 1.6' plunge over wood into 3.1' deep water. Water flows subsurface into a bubble curtain. Fish were observed above the LDA.
12032	0209.00	Log debris accumulation (LDA) #4 is 2' high x 7' wide x 1' long and contains one piece of large woody debris (LWD). Water flows through the LDA and there are no visible gaps in it. Sediment is being retained in the approximate dimensions of 7' wide x 1' long x 2' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as there is a 2' high plunge over the wood into gravel. Fish were observed above the LDA.
12114	0211.00	Old train tracks in creeks.
12561	0222.00	Log debris accumulation (LDA) #5 is 5.5' high x 40' wide x 12' long and contains 4 pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 40' wide x 12' long x 4' deep. The sediment ranges in size from gravel to boulder. The LDA is a possible barrier to juvenile salmonids as there is a 4.5' plunge over wood into 1.5' water. The plunge goes into two separate pools, A mid channel and backwater. Fish were observed above the LDA.
12601	0223.00	LDA #5 stretches into HU #223 as well.
12818	0230.00	Log debris accumulation (LDA) #6 is 1.4' high x 13' wide x 2.3' long and contains one piece of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 13' wide x 2' long x 1' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as there is a 5' plunge over wood into a 2.6' deep pool. Fish were observed above the LDA.

13222	0245.00	Log debris accumulation (LDA) #7 is 1.4' high x 13' wide x 2.3' long and contains one piece of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 13' wide x 2' long x 1' deep. The sediment is gravel. The LDA is not a possible barrier to salmonids as water flows under the LDA into a 1.4' plunge into a 1' deep pool. Fish were observed above the LDA.
13269	0247.00	Tributary #4 enters on the left bank. It contributes to approximately 5% of Shively Creek's flow. The water temperature of the tributary was 54 degrees Fahrenheit, the water temperature downstream of the confluence was 54 degrees Fahrenheit, and the water temperature upstream of the confluence was 54 degrees Fahrenheit. The slope of the tributary is estimated 1%. The tributary is accessible to salmonids. Fish (YOY salmonid) were observed in the tributary.
13403	0252.00	One salmonid YOY observed.
13444	0254.00	Dry side channel.
13688	0262.00	Backwater pool formed by LDA.
13710	0264.00	Log debris accumulation (LDA) #8 is 3' high x 34' wide x 19’ long and contains three pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 8' wide x 8' long x 1' deep. The sediment is gravel. The LDA is not a possible barrier to salmonids as LDA forms backwater pool and water flows under LDA into pool. Fish were not observed above the LDA.
13801	0267.00	Log debris accumulation (LDA) #9 is 3' high x 6' wide x 12’ long and contains four pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 9' wide, 6' long and 3' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as there is a 3' plunge over wood into a pool. Fish were not observed above the LDA.
14281	0281.00	Log debris accumulation (LDA) #10 is 3.5' high x 20' wide x 2.5' long and contains one piece of large woody debris (LWD). Water flows through the LDA and there are no visible gaps in it. Sediment is being retained in the approximate dimensions of 19' wide x 17' long x 1' deep. The sediment ranges in size from silt to gravel. The LDA is a possible barrier to juvenile salmonids as it has a 3.5' plunge over the LDA, where water goes under the LDA. Fish were not observed above the LDA.
14500	0288.00	Log debris accumulation (LDA) #11 is 1.5' high x 13' wide x 1.5' long and contains one piece of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being

		retained in the approximate dimensions of 10' wide, 2' long and 1' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adults could get through the 1.5' plunge over wood into a 1.4' deep pool. Fish were not observed above the LDA.
14571	0292.00	Log debris accumulation (LDA) #12 is 0.5' high x 30' wide x 25' long and contains eight pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 15' wide x 30' long x 1' deep. The sediment ranges in size from silt to gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adults could get through the log jam of LWD with no significant plunge. Fish were not observed above the LDA.
14791	0299.00	Log debris accumulation (LDA) #13 is 3' high x 27' wide x 7’ long and contains eight pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 13' wide x 9' long x 2' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adults can swim past 3' plunge over wood into pool. Fish were not observed above the LDA.
14908	0301.00	Log debris accumulation (LDA) #14 is 5' high x 16' wide x 6’ long and contains four pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 12' wide x 4' long x 3' deep. The sediment ranges is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows, adults can swim through, however, juveniles may be stopped by the 5' plunge over wood into a pool. Fish were not observed above the LDA.
15464	0310.00	Old lumber structures cross over creek. Wooden planks are across the creek.
15784	0316.00	Log debris accumulation (LDA) #15 is 5' high x 10' wide x 6’ long and contains three pieces of large woody debris (LWD). Water flows through the LDA and there are no visible gaps in it. Sediment is being retained in the approximate dimensions of 9' wide x 15' long x 3' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adults could pass through the LDA and over the 5' plunge over wood into the shallow run. Fish were not observed above the LDA.
15875	0320.00	Log debris accumulation (LDA) #16 is 4' high x 8' wide x 3.5’ long and contains three pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 7' wide x 2' long x 2' deep.

		The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adults could pass over LDA, but juveniles may be blocked by the 4' plunge over wood into the 1.3' deep pool. Fish were not observed above the LDA.
15897	0321.00	Log debris accumulation (LDA) #17 is 4' high x 14' wide x 4’ long and contains five pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 9' wide x 7' long x 2' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows, adults could swim over, however water mainly flows under the LDA. Fish were not observed above the LDA.
15985	0326.00	Log debris accumulation (LDA) #18 is 4' high x 24' wide x 4’ long and contains one piece of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 9' wide x 7' long x 2' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adults could swim over, but juveniles may be stopped by the 4' plunge over LWD into a step run. Fish were not observed above the LDA.
16255	0329.00	Log debris accumulation (LDA) #19 is 3.5' high x 15' wide x 2.8' long and contains three pieces of large woody debris (LWD). Water flows through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 10' wide x 5' long x 2.5' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adults could swim over, but juveniles may be stopped by the 3.5' plunge over wood into a pool. Fish were not observed above the LDA.
16330	0333.00	Log debris accumulation (LDA) #20 is 2.5' high x 13' wide x 3' long and contains two pieces of large woody debris (LWD). Water does not flow through the LDA and there are visible gaps in it. Sediment is not being retained. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adults could swim over the LDA, however right now there is a dry tail above the LDA. Fish were not observed above the LDA.
16365	0335.00	Log debris accumulation (LDA) #21 is 3' high x 15' wide x 3' long and contains one piece of large woody debris (LWD). Water does not flow through the LDA and there are visible gaps in it. Sediment is being retained in the approximate dimensions of 13' wide x 9' long x 3' deep. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adult fish could get through, but right now it is dry above the LDA. Fish were not observed above the LDA.

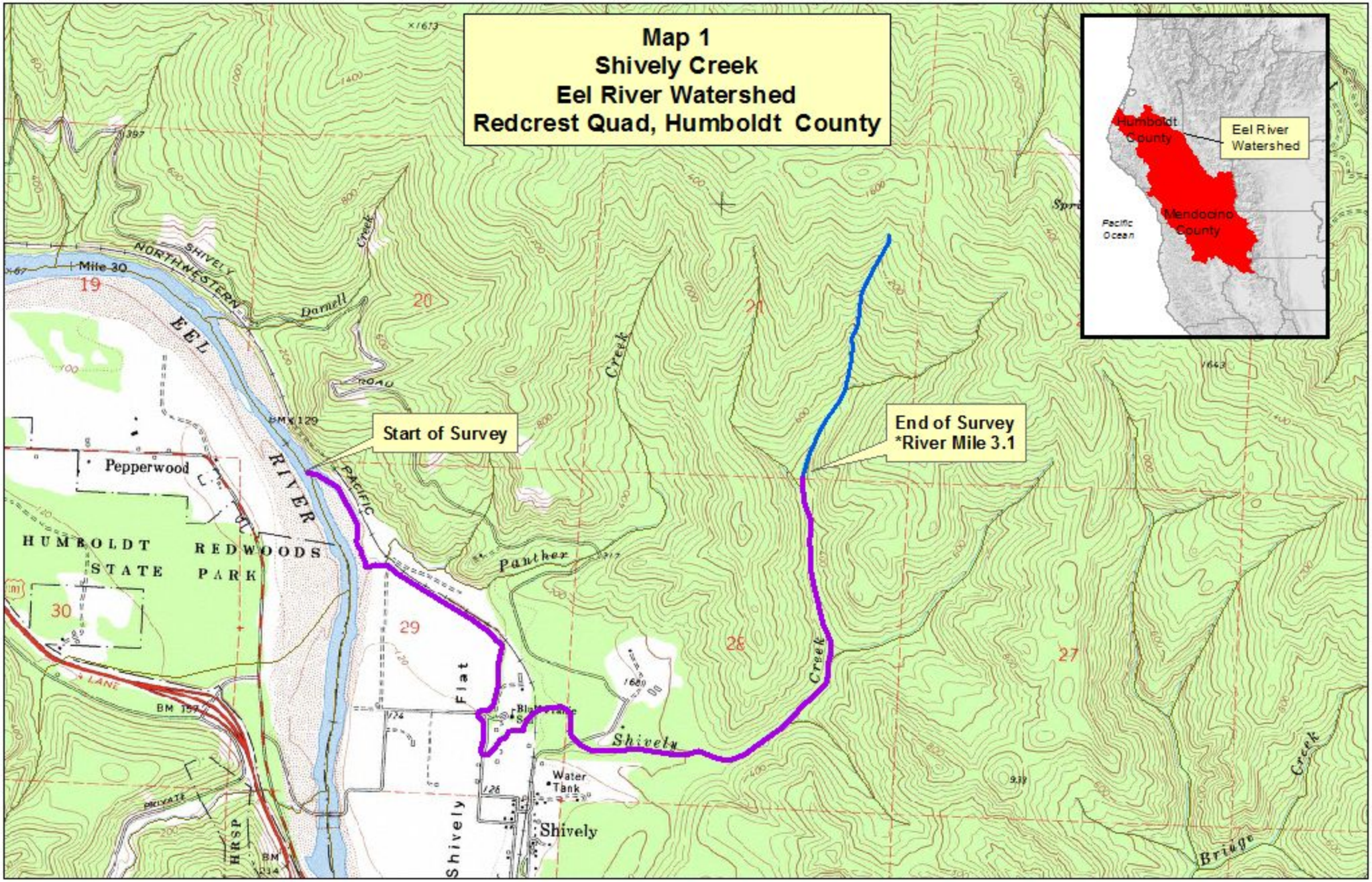
16395	0337.00	Log debris accumulation (LDA) #22 is 3' high x 13' wide x 9’ long and contains one piece of large woody debris (LWD). Water does not flow through the LDA and there are visible gaps in it. Sediment is not being retained. The sediment is gravel. The LDA is a possible barrier to juvenile salmonids as during high flows adult fish could get through; however, it is dry above the LDA right now. Fish were not observed above the LDA. Tributary #5 (unknown) enters on the right bank. It contributes to approximately 0.5% of Shively Creek's flow, with an estimated flow of 0.1cfs. The water temperature of the tributary was 54 degrees Fahrenheit, the water temperature downstream of the confluence was 54 degrees Fahrenheit, and the water temperature upstream of the confluence was 54 degrees Fahrenheit. The slope of the tributary is estimated 1%. The tributary is accessible to salmonids. Fish were not observed in the tributary.
16498	0340.00	End of survey due to 13 LDA and no fish had observed in the last 2,788. There is still plenty of flow without much change in elevation. Flow was not taken because of a big/early rain fall (October 14th-16th, 2016) occurring before there was a chance to take a summer flow. The 2016 survey extends past where 1992 survey had stopped by about 0.2 miles.

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.

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]	



N
W E
S

Reach 1: F4 Channel Type — Shively Creek

0 0.15 0.3 0.6 Miles

0 0.325 0.65 1.3 Kilometers

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

*River Mile indicates distance from confluence with Eel River

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

APPENDIX I

TABLES AND GRAPHS

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

Stream Name: Shively Creek LLID: 1239818404455 Drainage: Eel River - Lower

Survey Dates: 10/4/2016 to 10/19/2016

Confluence Location: Quad: REDCREST Legal Description: T01NR02ES29 Latitude: 40:26:44.0N Longitude: 123:58:54.0

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
12	0	DRY	3.5	289	3463	20.9									
102	13	FLATWATER	30.0	66	6699	40.4	5.7	0.4	0.7	270	27566	103	10519		2
1	0	NOSURVEY	0.3	10	10	0.1									
168	166	POOL	49.4	32	5332	32.2	8.5	0.8	1.6	271	45496	273	45784	237	14
57	5	RIFFLE	16.8	19	1062.3	6.4	6.2	0.2	0.3	140	7952	16	913		0

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
340	184	16566.3	81014	57216

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Shively Creek LLID: 1239818404455 Drainage: Eel River - Lower

Survey Dates: 10/4/2016 to 10/19/2016

Confluence Location: Quad: REDCREST Legal Description: T01NR02ES29 Latitude: 40:26:44.0N Longitude: 123:58:54.0W

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 (%)
57	5	LGR	16.8	19	1062	6.4	6	0.2	0.5	140	7952	16	913		0	99
50	8	RUN	14.7	45	2263	13.7	5	0.3	0.9	214	10700	56	2818		0	100
52	5	SRN	15.3	85	4436	26.8	6	0.4	1.4	360	18734	178	9254		5	100
155	153	MCP	45.6	32	5008	30.2	8	0.8	3.5	274	42506	274	42438	237	15	97
6	6	LSL	1.8	31	186	1.1	9	0.9	2.8	299	1794	296	1775	264	13	98
2	2	LSR	0.6	32	64	0.4	8	0.6	1.6	263	526	210	421	158	10	99
3	3	PLP	0.9	16	47	0.3	9	1.5	3	145	434	287	860	275	18	93
1	1	BPR	0.3	11	11	0.1	9	1.3	1.9	99	99	149	149	129	0	90
1	1	BPL	0.3	16	16	0.1	9	1.0	1.5	144	144	144	144	144	0	99
12	0	DRY	3.5	289	3463	20.9										
1	0	NS	0.3	10	10	0.1										

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
340	184	16566.3	82888	58771

Table 3 - Summary of Pool Types

Stream Name: Shively Creek LLID: 1239818404455 Drainage: Eel River - Lower

Survey Dates: 10/4/2016 to 10/19/2016

Confluence Location: Quad: REDCREST Legal Description: T01NR02ES29 Latitude: 40:26:44.0N Longitude: 123:58:54.0W

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
155	153	MAIN	92	32	5008	94	8.5	0.8	274	42506	237	36801	15
11	11	SCOUR	7	27	297	6	8.9	1.0	250	2754	247	2722	14
2	2	BACKWATER	1	14	27	1	9.0	1.2	122	243	136	273	0

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
168	166	5332	45503	39796

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

Stream Name: Shively Creek LLID: 1239818404455 Drainage: Eel River - Lower

Survey Dates: 10/4/2016 to 10/19/2016

Confluence Location: Quad: REDCREST Legal Description: T01NR02ES29 Latitude: 40:26:44.0N Longitude: 123:58:54.0W

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
155	MCP	92	13	8	110	71	29	19	3	2	0	0
6	LSL	4	0	0	4	67	2	33	0	0	0	0
2	LSR	1	0	0	2	100	0	0	0	0	0	0
3	PLP	2	0	0	1	33	1	33	1	33	0	0
1	BPR	1	0	0	1	100	0	0	0	0	0	0
1	BPL	1	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
168	13	8	119	71	32	19	4	2	0	0

Mean Maximum Residual Pool Depth (ft.): 1.6

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Shively Creek | LLID: 1239818404455 | Drainage: Eel River -Lower

Survey Dates: 10/4/2016 to 10/19/2016 | Dry Units: 12

Confluence Location: | Quad: REDCREST | Legal Description: T01NR02ES29 | Latitude: 40:26:44.0N | Longitude: 123:58:54.0W

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
57	5	LGR	0	0	0	0	0	0	0	0	0
57	5	**TOTAL RIFFLE**	0	0	0	0	0	0	0	0	0
50	6	RUN	0	0	0	0	0	0	0	0	0
52	4	SRN	88	12	0	0	0	0	0	0	0
102	10	**TOTAL FLAT**	90	10	0	0	0	0	0	0	0
155	150	MCP	52	16	23	7	0	0	0	2	0
6	5	LSL	36	26	38	0	0	0	0	0	0
2	2	LSR	50	0	50	0	0	0	0	0	0
3	3	PLP	33	0	53	0	0	0	7	7	0
1	1	BPR	0	0	0	0	0	0	0	0	0
1	1	BPL	0	0	0	0	0	0	0	0	0
168	162	**TOTAL POOL**	51	16	26	6	0	0	0	1	0
1	0	NS	0	0	0	0	0	0	0	0	0
340	177	**TOTAL**	52	16	25	6	0	0	0	1	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Shively Creek LLID: 1239818404455 Drainage: Eel River - Lower

Survey Dates: 10/4/2016 to 10/19/2016 Dry Units: 12

Confluence Location: Quad: REDCREST Legal Description: T01NR02ES29 Latitude: 40:26:44.0N Longitude: 123:58:54.0W

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
57	5	LGR	0	0	40	60	0	0	0
50	8	RUN	13	0	88	0	0	0	0
52	5	SRN	0	0	40	40	20	0	0
155	153	MCP	31	6	52	10	1	1	0
6	6	LSL	33	0	33	33	0	0	0
2	2	LSR	0	0	50	50	0	0	0
3	2	PLP	50	0	50	0	0	0	0
1	1	BPR	0	0	100	0	0	0	0
1	1	BPL	100	0	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Shively Creek LLID: 1239818404455 Drainage: Eel River - Lower

Survey Dates: 10/4/2016 to 10/19/2016

Confluence Location: Quad: REDCREST Legal Description: T01NR02ES29 Latitude: 40:26:44.0N Longitude: 123:58:54.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
97	45	55	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: Shively Creek LLID: 1239818404455 Drainage: Eel River - Lower

Survey Dates: 10/4/2016 to 10/19/2016 Survey Length (ft.): 16566.3 Main Channel (ft.): 16566.3 Side Channel (ft.): 0

Confluence Location: Quad: REDCREST Legal Description: T01NR02ES29 Latitude: 40:26:44.0N Longitude: 123:58:54.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4
Reach Length (ft.): 16566.3
Riffle/Flatwater Mean Width (ft.): 5.8
BFW:
Range (ft.): 8 to 20
Mean (ft.): 12
Std. Dev.: 3
Base Flow (cfs.): 0.0
Water (F): 51 - 60 Air (F): 51 - 63
Dry Channel (ft): 3463

Canopy Density (%): 97.4
Coniferous Component (%): 44.9
Hardwood Component (%): 55.1
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover (%): 100.0
Dominant Shelter: Undercut Banks
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 17
LWD per 100 ft.:
Riffles: 0
Pools: 3
Flat: 1

Pools by Stream Length (%): 32.2
Pool Frequency (%): 49.4
Residual Pool Depth (%):
< 2 Feet Deep: 79
2 to 2.9 Feet Deep: 19
3 to 3.9 Feet Deep: 2
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 1.6
Mean Pool Shelter Rating: 14

Pool Tail Substrate (%): Silt/Clay: 3 Sand: 0 Gravel: 72 Sm Cobble: 24 Lg Cobble: 1 Boulder: 0 Bedrock: 1

Embeddedness Values (%): 1. 71.0 2. 26.0 3. 0.6 4. 0.0 5. 2.4

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Shively Creek LLID: 1239818404455 Drainage: Eel River - Lower

Survey Dates: 10/4/2016 to 10/19/2016

Confluence Location: Quad: REDCREST Legal Description: T01NR02ES29 Latitude: 40:26:44.0N Longitude: 123:58:54.0W

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	1	0.8
Boulder	2	2	1.1
Cobble / Gravel	22	14	9.6
Sand / Silt / Clay	161	170	88.5

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	7	10	4.5
Brush	32	28	16.0
Hardwood Trees	62	56	31.6
Coniferous Trees	83	89	46.0
No Vegetation	3	4	1.9

Total Stream Cobble Embeddedness Values: 1

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

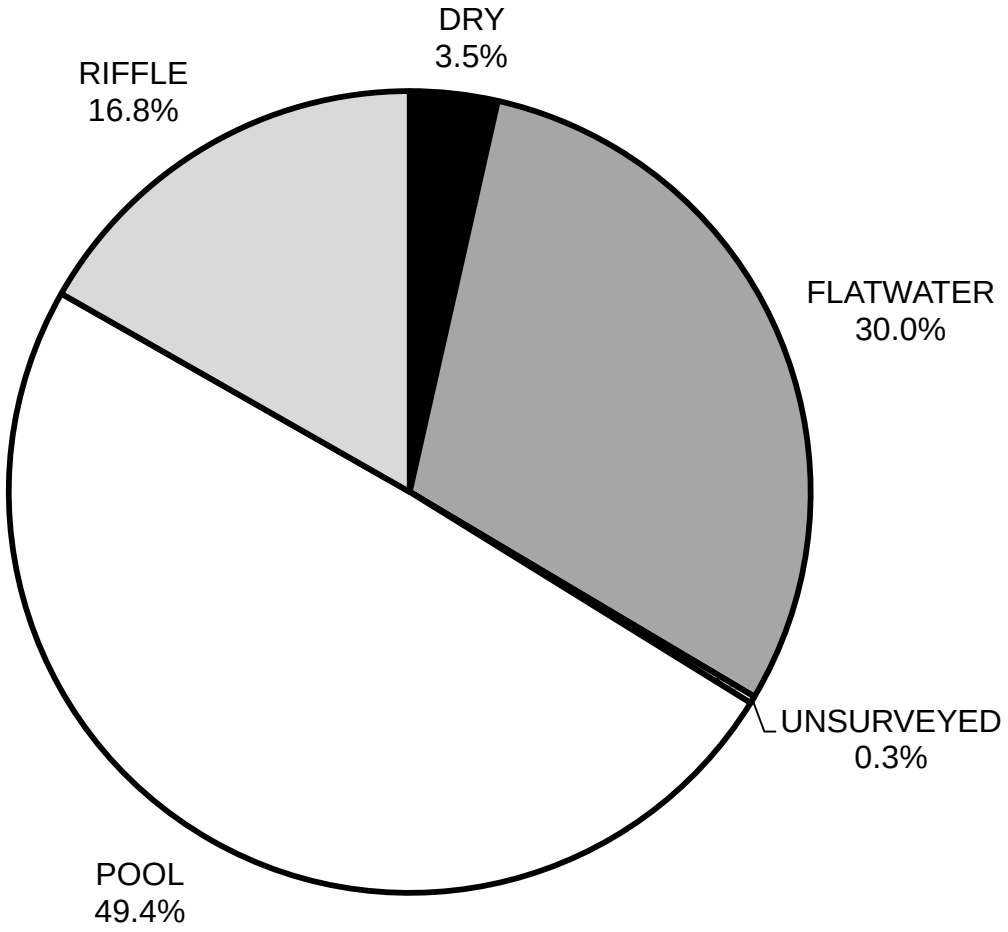
Stream Name: Shively Creek | LLID: 1239818404455 | Drainage: Eel River-Lower

Survey Dates: 10/4/2016 to 10/19/2016

Confluence Location: Quad: REDCREST | Legal Description: T01NR02ES29 | Latitude: 40:26:44.0N | Longitude: 123:58:54.0W

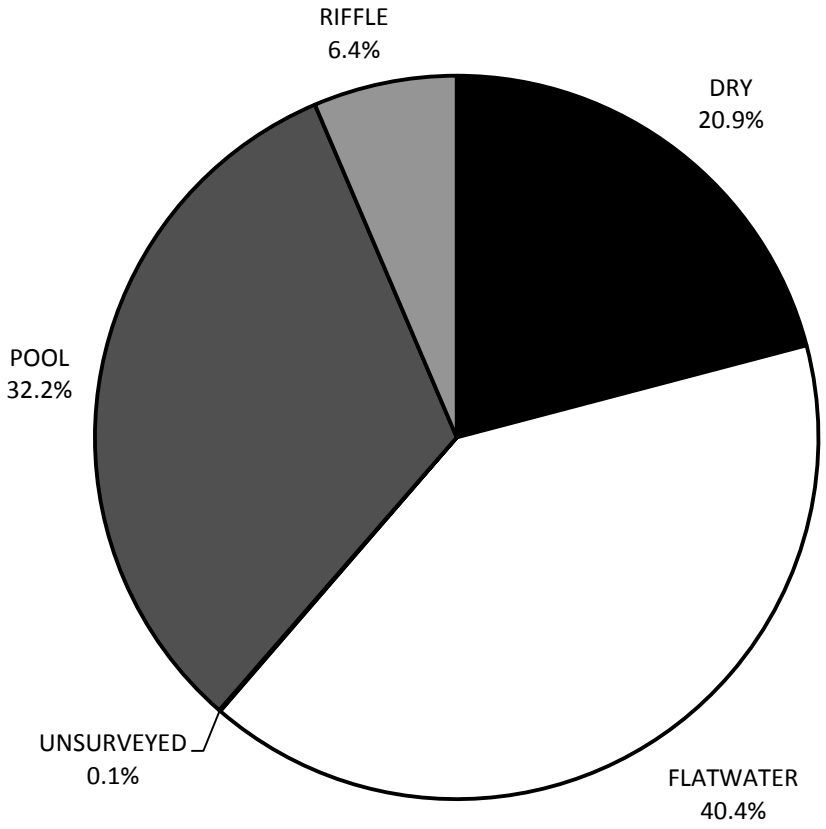
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	90	51
SMALL WOODY DEBRIS (%)	0	10	16
LARGE WOODY DEBRIS (%)	0	0	26
ROOT MASS (%)	0	0	6
TERRESTRIAL VEGETATION (%)	0	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	0
BOULDERS (%)	0	0	1
BEDROCK LEDGES (%)	0	0	0

SHIVELY CREEK 2016
HABITAT TYPES BY PERCENT OCCURRENCE



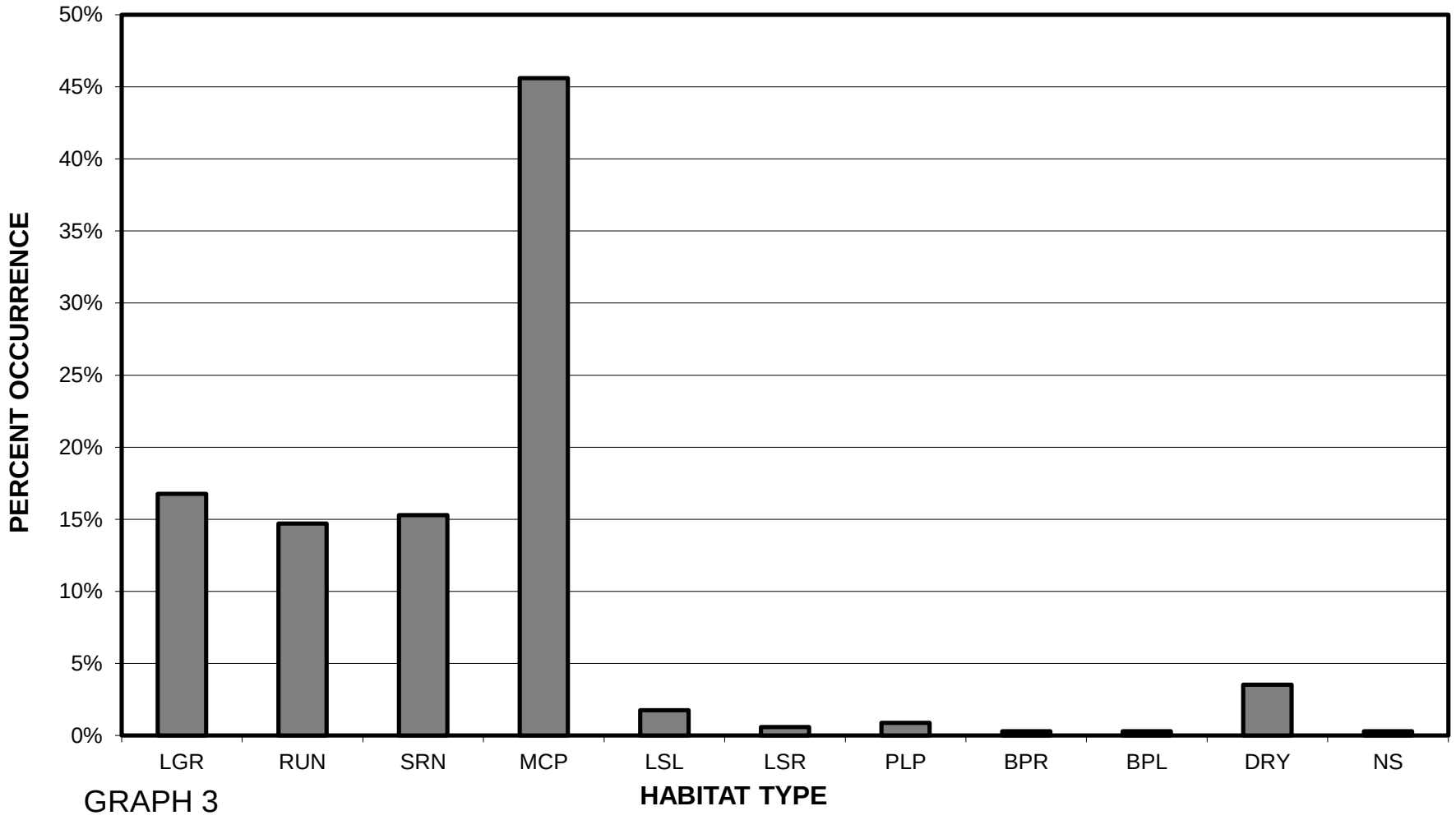
GRAPH 1

SHIVELY CREEK 2016
HABITAT TYPES BY PERCENT TOTAL LENGTH



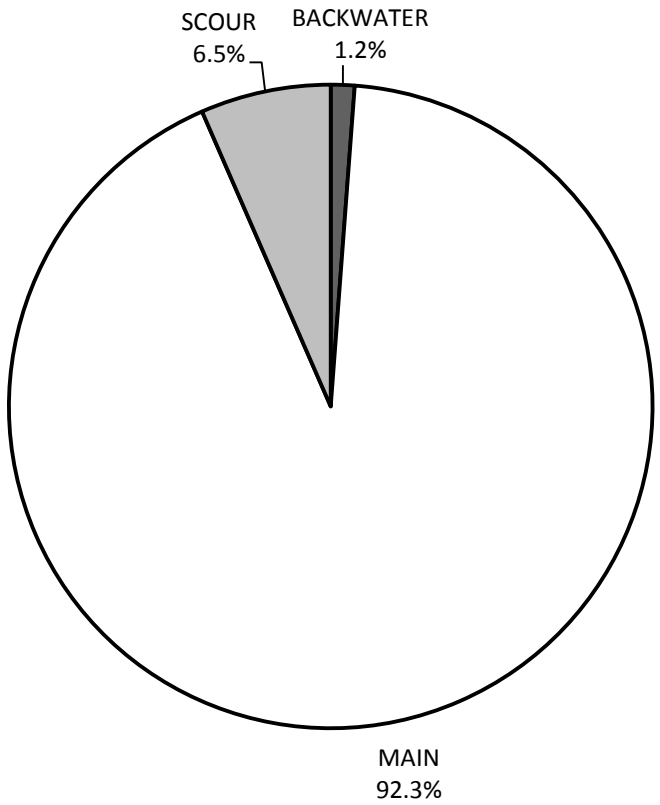
GRAPH 2

SHIVELY CREEK 2016
HABITAT TYPES BY PERCENT OCCURRENCE



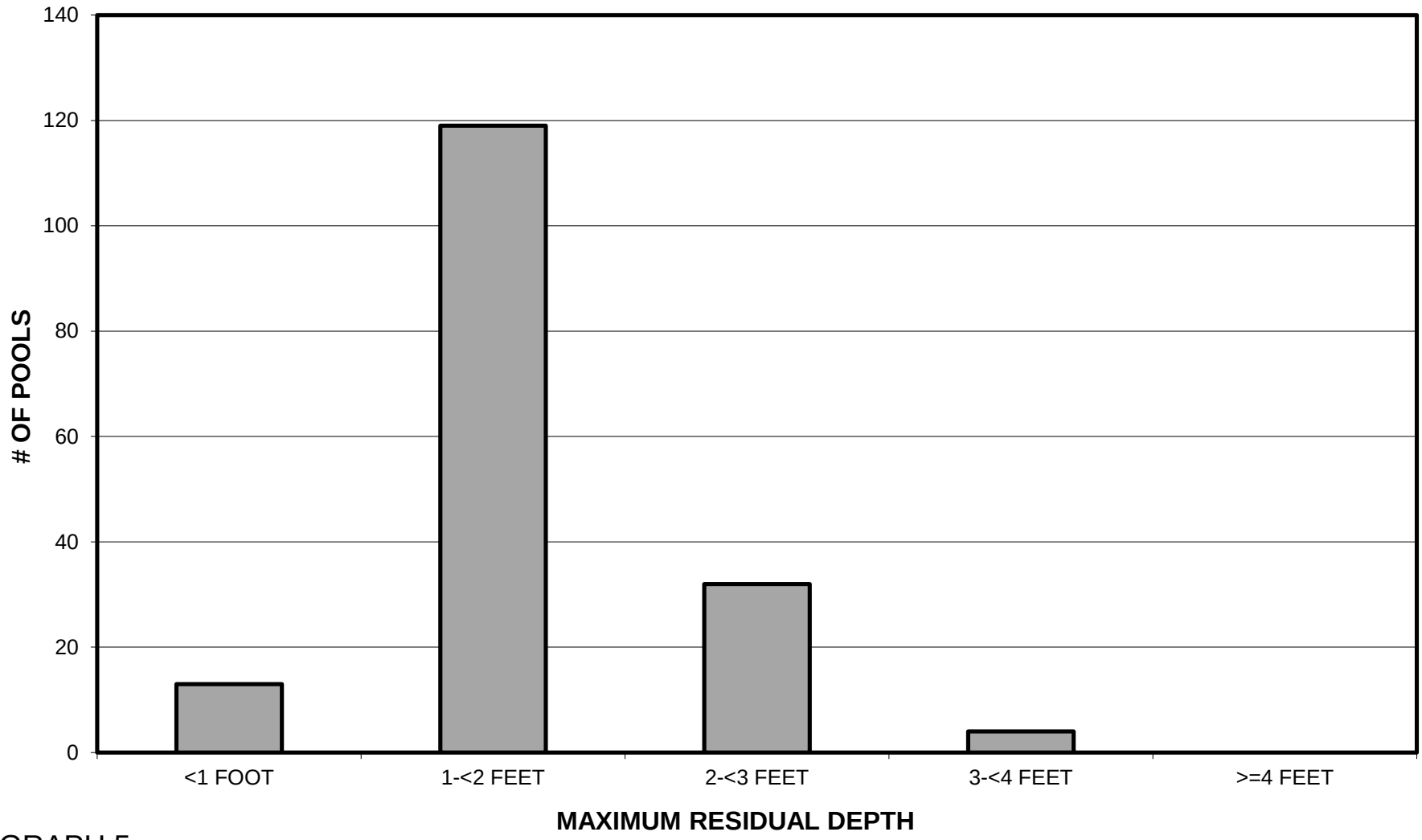
GRAPH 3

SHIVELY CREEK 2016
POOL TYPES BY PERCENT OCCURRENCE



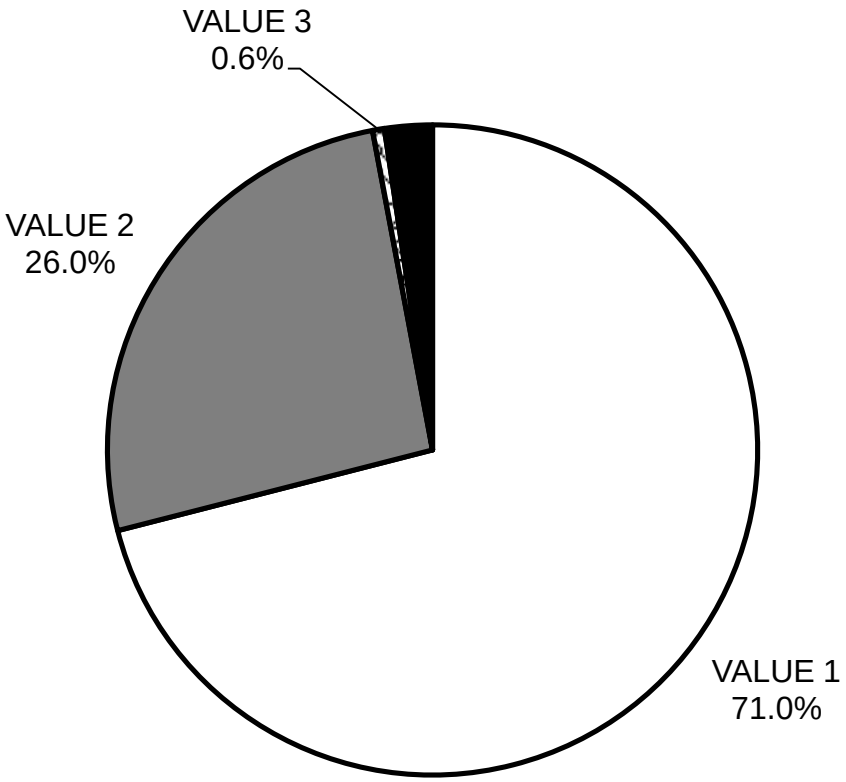
GRAPH 4

SHIVELY CREEK 2016
MAXIMUM DEPTH IN POOLS



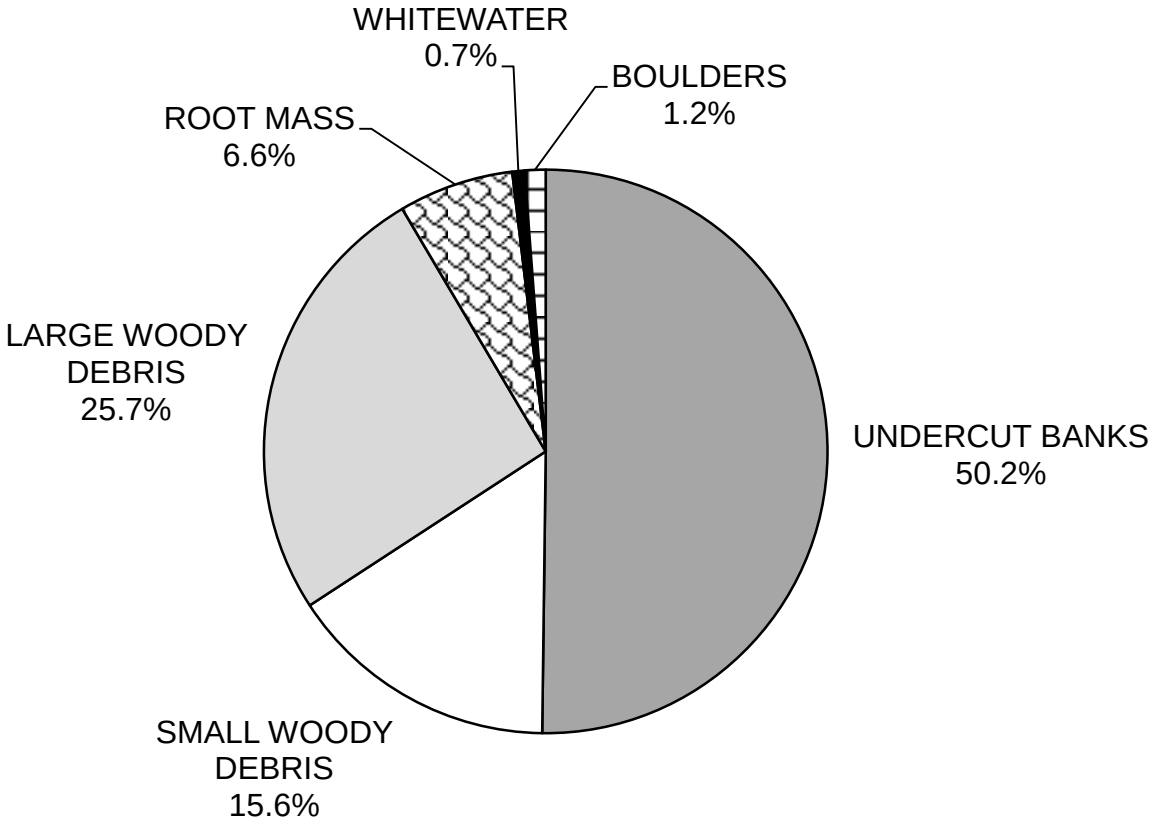
GRAPH 5

SHIVELY CREEK 2016
PERCENT EMBEDDEDNESS



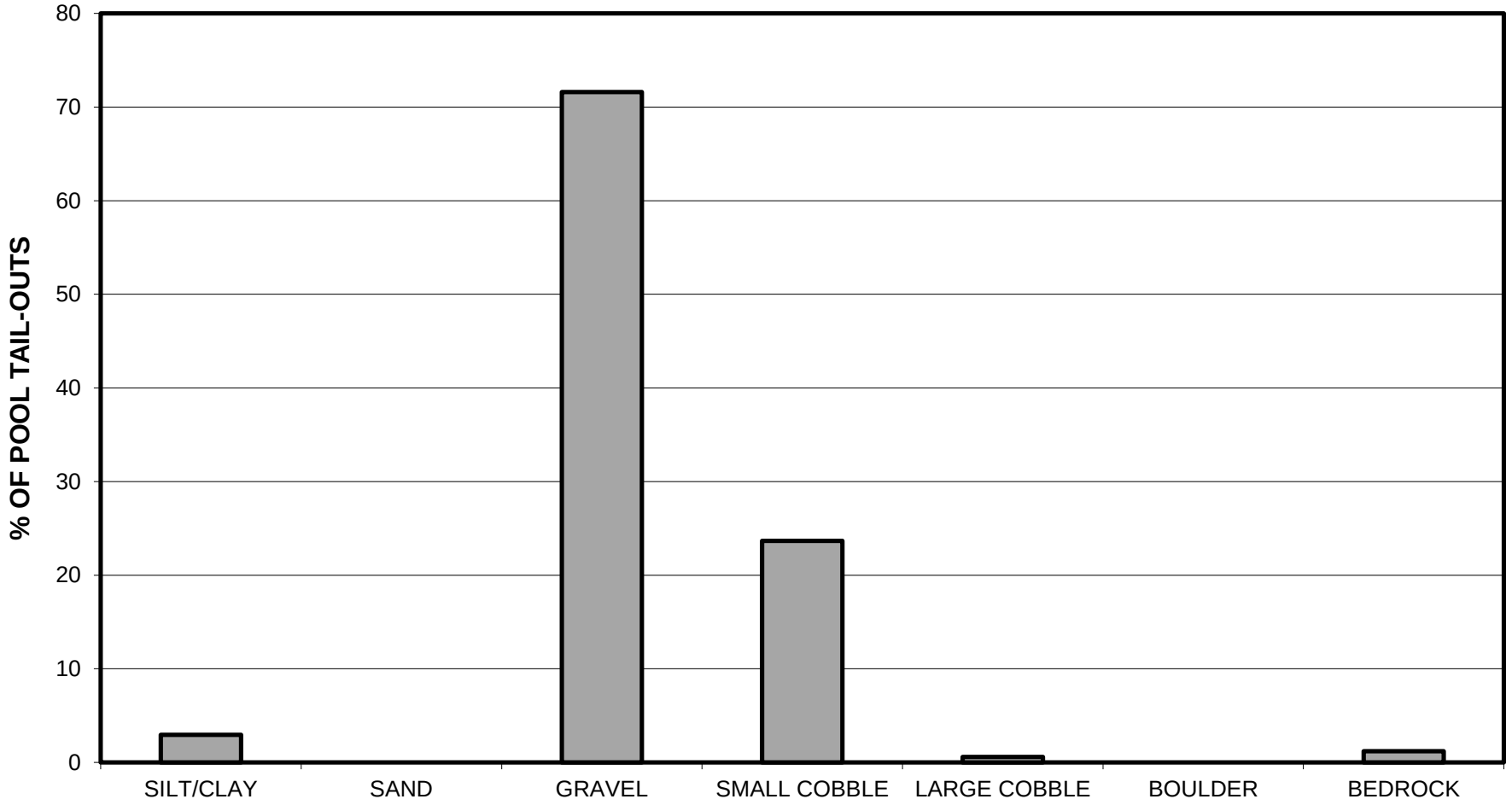
GRAPH 6

SHIVELY CREEK 2016
MEAN PERCENT COVER TYPES IN POOLS



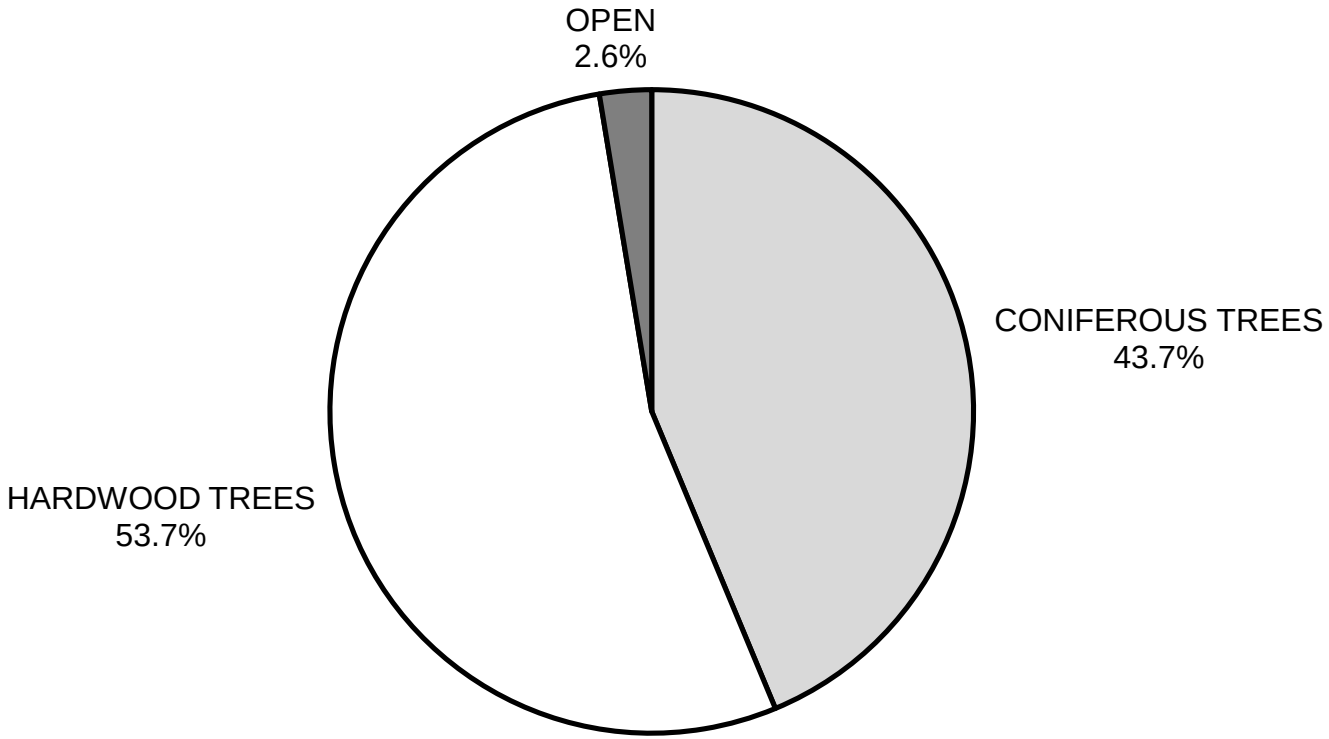
GRAPH 7

SHIVELY CREEK 2016
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



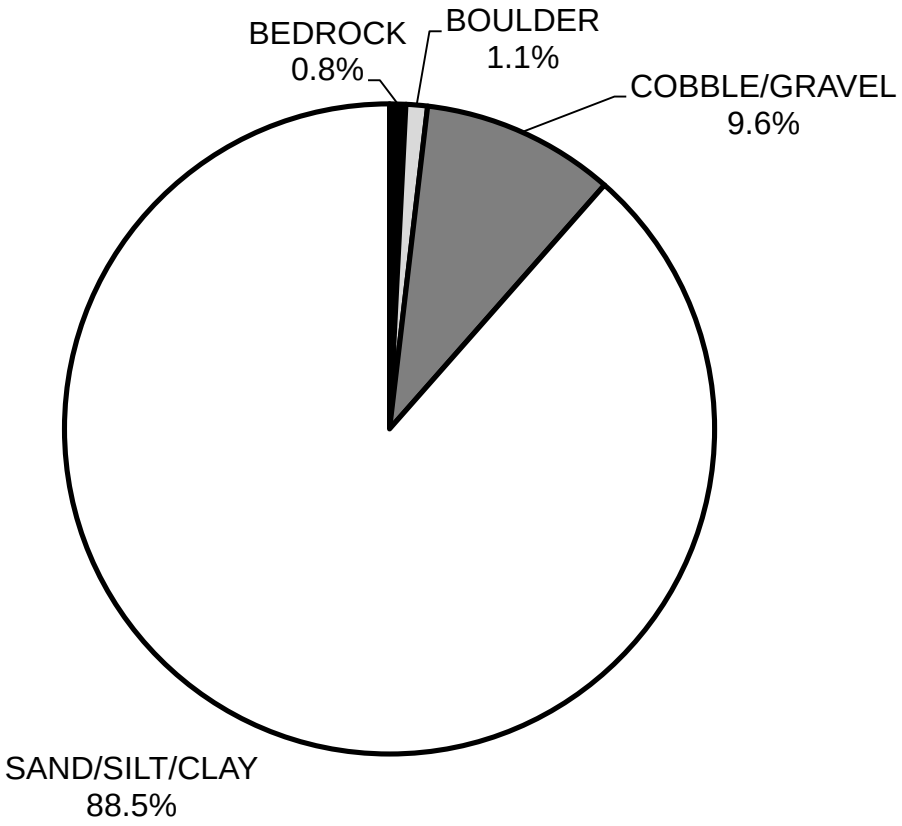
GRAPH 8

SHIVELY CREEK 2016
MEAN PERCENT CANOPY



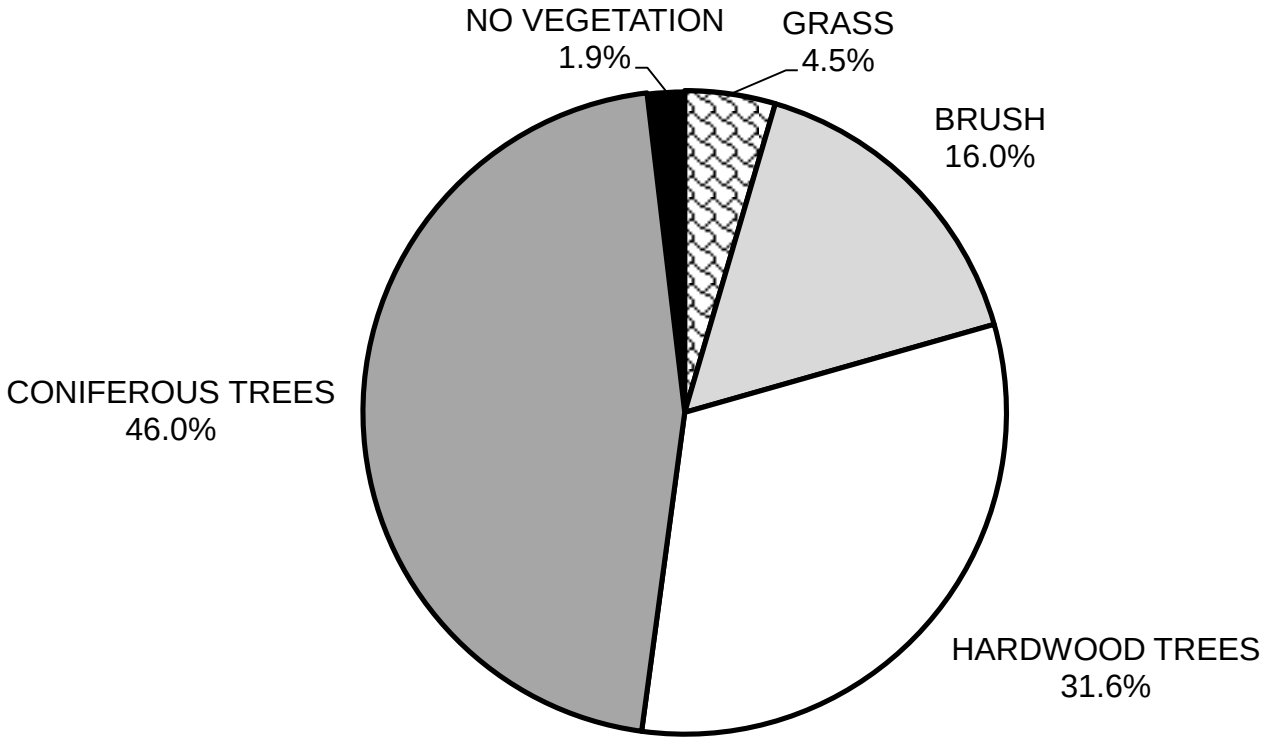
GRAPH 9

SHIVELY CREEK 2016
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

SHIVELY CREEK 2016
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

APPENDIX II

STREAM INVENTORY PHOTOS

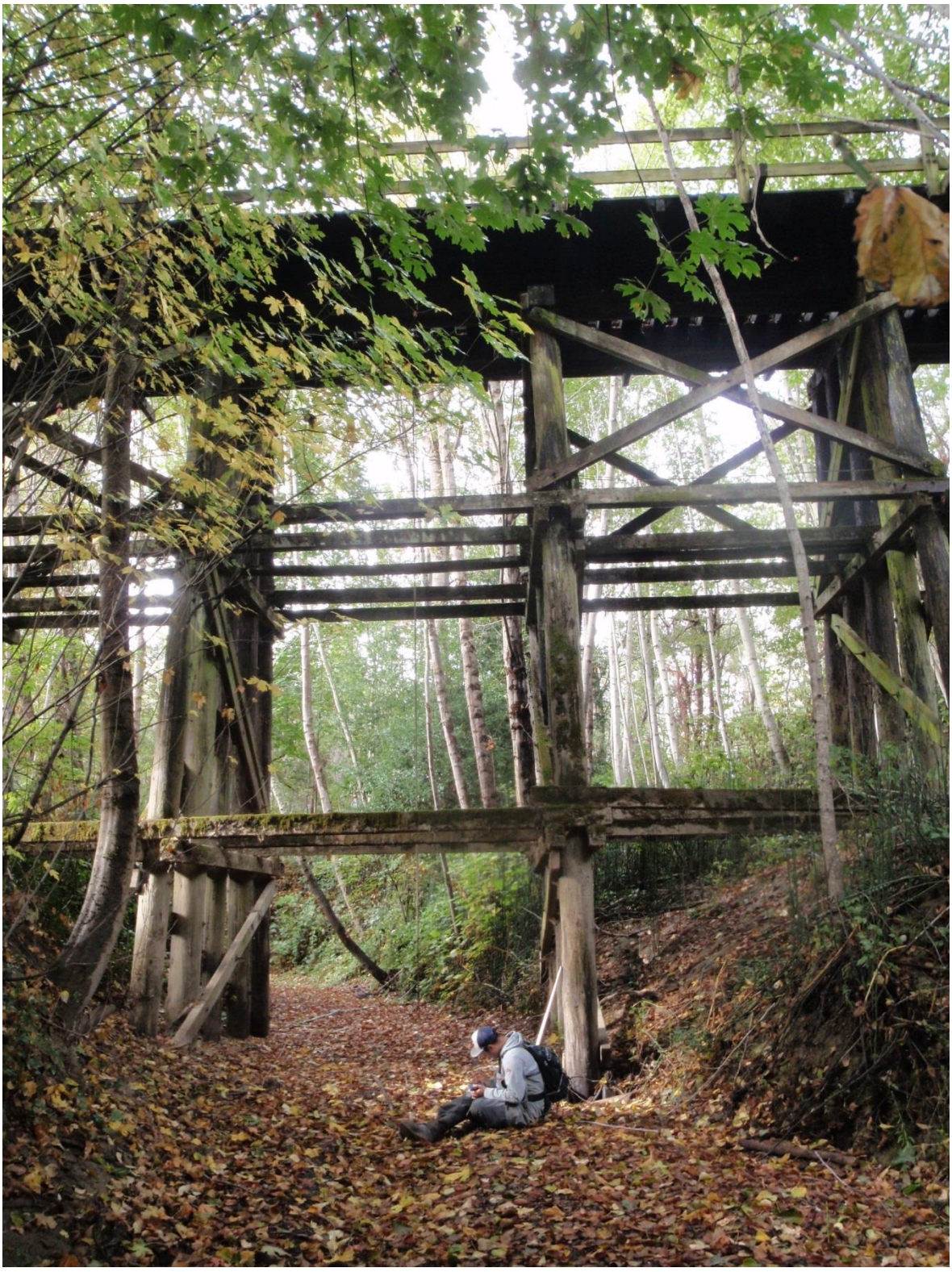


Photo 1: Railroad crossing at habitat unit 2. Shively Creek was dry for 2300' starting ~300' from the mouth of the creek. Ryan Bernstein is pictured (Photo taken 10-4-16).