

STREAM INVENTORY REPORT

Kelly Creek

INTRODUCTION

A stream inventory was conducted from July 21 to August 8, 2011 on Kelly Creek. The survey began at the confluence with Leggit Creek and extended upstream two miles.

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

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

WATERSHED OVERVIEW

Kelly Creek is a tributary to Leggit Creek, tributary to Mad River, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Kelly Creek's legal description at the confluence with Leggit Creek is T06N R01E S24. Its location is 40.8869 degrees north latitude and 124.0190 degrees west longitude, LLID number 1240178408870. Kelly Creek is a second order stream and has approximately 2.4 miles of blue line stream according to the USGS Arcata North 7.5 minute quadrangle. Kelly Creek drains a watershed of approximately 1.5 square miles. Elevations range from about 70 feet at the mouth of the creek to 1,100 feet in the headwater areas. Mixed hardwood forest and redwood forest dominate the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via West End Road.

METHODS

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

SAMPLING STRATEGY

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

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

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in Kelly Creek to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) near the bottom of the stream survey reach using a Marsh-McBirney Model 2000 flow meter.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1994). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel characteristics are measured using a clinometer, hand level, hip chain, tape measure, and a stadia rod.

3. Temperatures:

Both water and air temperatures are measured and recorded at every tenth habitat unit. The time of the measurement is also recorded. Both temperatures are taken in degrees Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (1990). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled "dry". Kelly 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 Kelly Creek, embeddedness was

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ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed not suitable for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. In Kelly 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. Next, 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. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two, respectively. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Kelly 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 Kelly 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

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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 Kelly Creek. In addition, eight sites were electrofished using a Smith-Root LR-24 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

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

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

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

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

HABITAT INVENTORY RESULTS

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

The habitat inventory of July 21 to August 8, 2011 was conducted by K. Christen, D. Opalacz, and M. McGowan (WSP). The total length of the stream surveyed was 10,644 feet with an additional 156 feet of side channel. Of this length, 1,200 feet were not surveyed due to lack of a defined channel. An additional 179 feet was not surveyed due to heavy vegetation. The data included in this report are for the 9,265 feet actually surveyed.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.22 cfs on August 9, 2011.

The first 1,200 feet of Kelly Creek were not surveyed; the channel type is unknown (Reach 1). Kelly Creek is a C6 channel type for the next 2,694 feet of the stream surveyed (Reach 2), an F4 channel type for 5,081 feet of the stream surveyed (Reach 3), and a G4 channel type for 1,825 feet of the stream surveyed (Reach 4). C6 channels are meandering point-bar, riffle/pool, alluvial channels with broad well defined floodplain on low gradients and silt-dominant substrates. F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios, very stable with gravel-dominant substrates. G4 channels are entrenched “gully” step-pool channels on moderate gradients with low width /depth ratios and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 50 to 70 degrees Fahrenheit. Air temperatures ranged from 60 to 74 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 38% pool units, 35% flatwater units, 27% riffle units, and 1% culvert units (Graph 1). Based on total length of Level II habitat types there were 54% flatwater units, 30% pool units, 16% riffle units, and 1% culvert units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 34%; low gradient riffle units, 24%; and run units, 18% (Graph 3). Based on percent total length, mid-channel pool units made up 28%, step run units 25%, and run units 21%.

A total of 120 pools were identified (Table 3). Main channel pools were the most frequently encountered at 92% (Graph 4), and comprised 96% of the total length of all pools (Table 3).

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Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Twelve of the 120 pools (10%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 120 pool tail-outs measured, 68 had a value of 1 (56.7%); 42 had a value of 2 (35%); 7 had a value of 3 (5.8%); and 3 had a value of 4 (2.5%); (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 not suitable for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 9, flatwater habitat types had a mean shelter rating of 12, and pool habitats had a mean shelter rating of 19 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 21. Main channel pools had a mean shelter rating of 19 (Table 3).

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

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 88% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 6% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Kelly Creek was 89%. Eleven percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 87% and 13%, respectively. Graph 9 describes the mean percent canopy in Kelly Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 95%. The mean percent left bank vegetated was 95%. The dominant elements composing the structure of the stream banks consisted of 77% sand/silt/clay, 19% cobble/gravel, 3% boulder, and 1% bedrock (Graph 10). Deciduous trees were the dominant vegetation type observed in 50% of the units surveyed. Additionally, 30% of the units surveyed had brush as the dominant vegetation type, and 14% had grass as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted an electrofishing survey at eight sites for species composition and distribution in Kelly Creek on August 16, 2011. Water temperatures taken during the survey period of 0840 to 1119 ranged from 55 to 64 degrees Fahrenheit. Air temperatures ranged from 62 to 68 degrees Fahrenheit. The sites were sampled by T. Tollefson, I. Mikus and M. Groff (DFG).

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In reach 2, five sites were sampled starting approximately 1,343 feet from the confluence with Leggit Creek and continuing upstream 2,369 feet. The reach sites yielded six young-of-the-year (YOY) SH/RT, one age 2+ SH/RT, five age 1+ cutthroat trout, 10 age 2+ cutthroat trout, four YOY unknown trout, one age 1+ unknown trout, 14 three-spine stickleback, and one lamprey ammocete.

In reach 3, three sites were sampled starting approximately 4,902 feet from the confluence with Leggit Creek and continuing upstream 366 feet. The reach sites yielded 16 young-of-the-year SH/RT, three age 1+ SH/RT, and one sculpin.

The following chart displays the information yielded from these sites:

2011 Kelly Creek electrofishing observations.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Cutthroat Trout		Unknown Trout	
					YOY	1+	2+	1+	2+	YOY	1+
Reach 2: C6 Channel Type											
08/16/11	1	005	Pool	1,478	0	0	0	1	3	2	0
	2	007	Pool	1,540	0	0	1	0	1	0	0
	3	030	Pool	2,356	0	0	0	0	0	0	0
	4	034	Run	3,386	6	0	0	0	0	0	0
	5	045	Pool	3,712	0	0	0	4	6	2	1
Reach 3: F4 Channel Type											
	6	098	Run	5,144	12	1	0	0	0	0	0
	7	104	Pool	5,268	3	1	0	0	0	0	0
	8	106	Pool	5,326	1	1	0	0	0	0	0

DISCUSSION

The first 1,200 feet of Kelly Creek were not surveyed; the channel type is unknown. Kelly Creek is a C6 channel type for the next 2,694 feet, an F4 channel type for the next 5,081 feet, and a G4 channel type for the remaining 1,825 feet. The suitability of C6, F4, and G4 channel types for fish habitat improvement structures is as follows: C6 channels are good for bank-placed boulders and log cover and fair for plunge weirs. F4 channels are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. G4 channels are good for bank-placed boulders and fair for plunge weirs, opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days July 21 to August 8, 2011 ranged from 50 to 70 degrees Fahrenheit. Air temperatures ranged from 60 to 74 degrees Fahrenheit. This is a marginal water temperature range for salmonids. If sustained, 70 degrees Fahrenheit is above the threshold stress level for salmonids. To make any further conclusions, temperatures need to be

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monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 54% of the surveyed length of this stream, riffles 16%, and pools 30%. Twelve of the 120 (10%) pools had a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended.

One hundred ten of the 120 pool tail-outs measured had embeddedness ratings of 1 or 2. Ten of the pool tail-outs had embeddedness ratings of 3 or 4. None 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 twelve of the 120 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 19. The shelter rating in the flatwater habitats is 12. 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 Kelly Creek. Small woody debris is the dominant cover type in pools followed by terrestrial vegetation. 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 length of stream surveyed was 89%. Reach 2 had a canopy density of 74%, Reach 3 had a canopy density of 92%, and Reach 4 had a canopy density of 93%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 95% and 95%, 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

- 1) Kelly Creek should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are above the threshold stress level 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.

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- 3) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.
- 4) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from small woody debris. Adding high quality complexity with woody cover in the pools is desirable.

COMMENTS AND LANDMARKS

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

Position (ft):	Habitat Unit #:	Comment:
0	0001.00	Start of survey. The survey crew was unable to locate the confluence of Kelly Creek with Leggit Creek. The channel was ill-defined and appeared to be dry. Therefore, the first 1,200 feet of Kelly Creek were not surveyed (Reach 1; this distance is approximate).
1200	0002.00	Start of data collection. The channel is a C6 (Reach 2).
1304	0004.00	Fence crosses the channel.
1516	0007.00	Fence crosses the channel.
1705	0013.00	Fence crosses the channel.
2073	0016.00	Fence crosses the channel.
3489	0037.03	Fence crosses the channel.
3551	0041.00	Fence crosses the channel.
3593	0043.00	There is a 0.7' high plunge.
3608	0044.00	Fence crosses the channel. The fence has partially collapsed, submerging the bottom half of the wiring. The top half of the wiring has been cut. Pieces of rebar have been pounded into the stream bed just upstream of the fence. The rebar is collecting small woody debris.
3766	0047.00	The channel changes from a C6 (Reach 2) to an F4 (Reach 3).

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4601	0078.00	A farm road crosses the channel. The crossing is a 10' wide x 15' long x 6' high wooden bridge. A fence crosses the channel just upstream of the bridge.
5217	0102.00	Fence crosses the channel.
5236	0103.00	West End Road crosses the channel. The crossing is a 4' high x 6' wide x 22' long corrugated metal culvert.
6123	0142.00	Fence crosses the channel.
6643	0164.00	Tributary #01 enters on the left bank. It contributes approximately 15% to Kelly Creek's flow. The slope of the tributary is approximately 1.5%. The tributary is accessible to salmonids. Fish were observed in the tributary.
7052	0176.00	Tributary #02 enters on the left bank. It contributes approximately 5% to Kelly Creek's flow. The slope of the tributary is approximately 4%.
7661	0199.00	Fence crosses the channel.
8775	0244.00	A logging road crosses the channel. The crossing is a 3.6' high x 7' wide x 44' long corrugated metal arch culvert. The slope of the culvert is approximately 2%.
8819	0245.00	The channel changes from an F4 (Reach 3) to a G4 (Reach 4).
9111	0249.00	There is a 1.2' high plunge.
9924	0276.00	Log debris accumulation (LDA) #01 contains six pieces of large woody debris (LWD) and measures 3' high x 12' wide x 11' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to small cobble and measures 6' wide x 30' long x 3' deep. It is a possible barrier to juvenile and adult salmonids. No fish were observed above the LDA.
9981	0281.00	There is a 2' high plunge.
10008	0283.00	There is a 4' high plunge over boulders and redwood root wads.
10045	0286.00	There is a 1.3' high plunge.
10060	0288.00	There is a 1.1' high plunge.
10182	0292.00	There is a 0.9' high plunge.
10277	0297.00	There is a 2' high plunge.

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- 10508 0305.00 There is a 2.5' high plunge.
- 10631 0315.00 End of survey. There are two plunges in a row; the first is 4.8' high, the second is 4' high. No fish were observed above these plunges and the slope of the channel continues to increase.

REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd edition. California Department of Fish and Game, Sacramento, California.

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LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE

Low Gradient Riffle	(LGR)	[1.1]	{ 1 }
High Gradient Riffle	(HGR)	[1.2]	{ 2 }

CASCADE

Cascade	(CAS)	[2.1]	{ 3 }
Bedrock Sheet	(BRS)	[2.2]	{24}

FLATWATER

Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}

MAIN CHANNEL POOLS

Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}

SCOUR POOLS

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

BACKWATER POOLS

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

ADDITIONAL UNIT DESIGNATIONS

Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

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

Stream Name: Kelly Creek

LLID: 1240178408870 Drainage: Blue Lake

Survey Dates: 7/21/2011 to 8/8/2011

Confluence Location: Quad: ARCATA NORTH Legal Description: T06NR01ES24 Latitude: 40:53:13.0N Longitude: 124:01:04.0

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
2	0	CULVERT	0.6	33	66	0.7									
109	16	FLATWATER	34.6	46	5043	53.5	4.6	0.3	0.6	191	20820	60	6498		12
6	0	NOSURVEY		230	1379										
120	120	POOL	38.1	23	2802	29.7	6.8	0.8	1.3	169	20335	185	22160	156	19
84	10	RIFFLE	26.7	18	1510	16.0	4.1	0.2	0.3	55	4655	11	904		9
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
321	146				10800					45811			29562		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Kelly Creek

LLID: 1240178408870

Drainage: Blue Lake

Survey Dates: 7/21/2011 to 8/8/2011

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES24

Latitude: 40:53:13.0N

Longitude: 124:01:04.0W

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 (%)
75	6	LGR	23.8	18	1382	14.7	3	0.2	0.6	46	3452	8	610		5	86
7	4	HGR	2.2	16	115	1.2	6	0.2	0.7	70	487	15	103		15	94
2	0	CAS	0.6	6	13	0.1										
6	1	GLD	1.9	106	639	6.8	4	0.2	0.4	156	936	31	187		5	40
58	9	RUN	18.4	35	2017	21.4	4	0.4	0.7	101	5877	36	2108		15	87
45	6	SRN	14.3	53	2387	25.3	5	0.4	0.7	331	14912	99	4467		9	90
107	107	MCP	34.0	24	2597	27.6	7	0.8	3	180	19310	200	21394	169	18	89
3	3	STP	1.0	28	84	0.9	6	0.2	0.5	131	394	52	157	26	20	94
10	10	PLP	3.2	12	121	1.3	6	0.9	2.3	63	632	61	609	52	21	91
2	0	CUL	0.6	33	66	0.7										98
6	0	NS		230	1379											

Total Units
321

Total Units Fully Measured
146

Total Length (ft.)
10800

Total Area (sq.ft.)
45998

Total Volume (cu.ft.)
29635

Table 3 - Summary of Pool Types

Stream Name: Kelly Creek

LLID: 1240178408870

Drainage: Blue Lake

Survey Dates: 7/21/2011 to 8/8/2011

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES24

Latitude: 40:53:13.0N

Longitude: 124:01:04.0W

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
110	110	MAIN	92	24	2681	96	6.9	0.7	179	19704	166	18040	19
10	10	SCOUR	8	12	121	4	5.6	0.9	63	632	52	522	21

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
120	120	2802	20335	18562

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

Stream Name: Kelly Creek

LLID: 1240178408870

Drainage: Blue Lake

Survey Dates: 7/21/2011 to 8/8/2011

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES24

Latitude: 40:53:13.0N

Longitude: 124:01:04.0W

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
107	MCP	89	33	31	63	59	10	9	1	1	0	0
3	STP	3	3	100	0	0	0	0	0	0	0	0
10	PLP	8	3	30	6	60	1	10	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
120	39	32	69	58	11	9	1	1	0	0

Mean Maximum Residual Pool Depth (ft.): 1.3

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Kelly Creek

LLID: 1240178408870

Drainage: Blue Lake

Survey Dates: 7/21/2011 to 8/8/2011

Dry Units: 0

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES24

Latitude: 40:53:13.0N

Longitude: 124:01:04.0W

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
75	6	LGR	0	44	0	2	45	0	0	9	0
7	4	HGR	0	3	0	0	0	0	0	98	0
2	0	CAS	0	0	0	0	0	0	0	0	0
84	10	TOTAL RIFFLE	0	32	0	1	32	0	0	34	0
6	1	GLD	0	0	0	0	95	5	0	0	0
58	9	RUN	4	30	7	4	55	0	0	1	0
45	6	SRN	0	49	3	2	40	0	0	6	0
109	16	TOTAL FLAT	2	36	5	3	52	0	0	3	0
107	107	MCP	13	38	10	10	23	3	0	3	0
3	3	STP	0	18	2	0	7	0	2	72	0
10	10	PLP	0	13	30	2	0	0	3	54	0
120	120	TOTAL POOL	11	35	12	9	20	3	0	9	0
2	0	CUL									
6	0	NS									
321	146	TOTAL	10	35	10	8	24	2	0	10	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Kelly Creek

LLID: 1240178408870

Drainage: Blue Lake

Survey Dates: 7/21/2011 to 8/8/2011

Dry Units: 0

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES24

Latitude: 40:53:13.0N

Longitude: 124:01:04.0W

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
75	6	LGR	0	0	67	33	0	0	0
7	4	HGR	0	0	0	50	0	50	0
2	0	CAS	0	0	0	0	0	0	0
6	1	GLD	100	0	0	0	0	0	0
58	9	RUN	22	11	67	0	0	0	0
45	6	SRN	17	17	67	0	0	0	0
107	107	MCP	23	36	37	3	0	0	0
3	3	STP	0	0	33	67	0	0	0
10	10	PLP	0	10	30	20	0	40	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Kelly Creek

LLID: 1240178408870

Drainage: Blue Lake

Survey Dates: 7/21/2011 to 8/8/2011

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES24

Latitude: 40:53:13.0N

Longitude: 124:01:04.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
89	13	87	0	95	95

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: Kelly Creek LLID: 1240178408870 Drainage: Blue Lake
 Survey Dates: 7/21/2011 to 8/8/2011 Survey Length (ft.): 10800 Main Channel (ft.): 10644 Side Channel (ft.): 156
 Confluence Location: Quad: ARCATA NORTH Legal Description: T06NR01ES24 Latitude: 40:53:13.0N Longitude: 124:01:04.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1							
Channel Type:	NA	Canopy Density (%):		Pools by Stream Length (%):	0.0		
Reach Length (ft.):	1200	Coniferous Component (%):		Pool Frequency (%):	0.0		
Riffle/Flatwater Mean Width (ft.):		Hardwood Component (%):		Residual Pool Depth (%):			
BFW:		Dominant Bank Vegetation:		< 2 Feet Deep:			
Range (ft.):	12 to 12	Vegetative Cover (%):	0.0	2 to 2.9 Feet Deep:			
Mean (ft.):	12	Dominant Shelter:		3 to 3.9 Feet Deep:			
Std. Dev.:	0	Dominant Bank Substrate Type:		>= 4 Feet Deep:			
Base Flow (cfs.):	0.2	Occurrence of LWD (%):		Mean Max Residual Pool Depth (ft.):			
Water (F):	68 - 68	Air (F):	73 - 73	LWD per 100 ft.:			
Dry Channel (ft):	0	Riffles:		Mean Pool Shelter Rating:			
		Pools:					
		Flat:					
Pool Tail Substrate (%):	Silt/Clay:	Sand:	Gravel:	Sm Cobble:	Lg Cobble:	Boulder:	Bedrock:
Embeddedness Values (%):	1.	2.	3.	4.	5.	0.0	

STREAM REACH: 2							
Channel Type:	C6	Canopy Density (%):	74.2	Pools by Stream Length (%):	29.1		
Reach Length (ft.):	2566	Coniferous Component (%):	0.0	Pool Frequency (%):	40.8		
Riffle/Flatwater Mean Width (ft.):	3.8	Hardwood Component (%):	100.0	Residual Pool Depth (%):			
BFW:		Dominant Bank Vegetation:	Grass	< 2 Feet Deep:	70		
Range (ft.):	5 to 45	Vegetative Cover (%):	96.8	2 to 2.9 Feet Deep:	25		
Mean (ft.):	16	Dominant Shelter:	Terrestrial Veg.	3 to 3.9 Feet Deep:	5		
Std. Dev.:	15	Dominant Bank Substrate Type:	Sand/Silt/Clay	>= 4 Feet Deep:	0		
Base Flow (cfs.):	0.2	Occurrence of LWD (%):	3	Mean Max Residual Pool Depth (ft.):	1.5		
Water (F):	60 - 70	Air (F):	65 - 73	LWD per 100 ft.:			
Dry Channel (ft):	0	Riffles:	0	Mean Pool Shelter Rating:	15		
		Pools:	0				
		Flat:	0				
Pool Tail Substrate (%):	Silt/Clay:	Sand:	Gravel:	Sm Cobble:	Lg Cobble:	Boulder:	Bedrock:
Embeddedness Values (%):	1. 50.0	2. 20.0	3. 15.0	4. 15.0	5. 0.0	0	0

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: F4	Canopy Density (%): 91.9	Pools by Stream Length (%): 33.1
Reach Length (ft.): 5053	Coniferous Component (%): 6.2	Pool Frequency (%): 38.5
Riffle/Flatwater Mean Width (ft.): 4.3	Hardwood Component (%): 93.8	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 94
Range (ft.): 7 to 12	Vegetative Cover (%): 93.8	2 to 2.9 Feet Deep: 6
Mean (ft.): 9	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 0
Std. Dev.: 1	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.2	Occurrence of LWD (%): 6	Mean Max Residual Pool Depth (ft.): 1.3
Water (F): 50 - 60 Air (F): 60 - 74	LWD per 100 ft.:	Mean Pool Shelter Rating: 17
Dry Channel (ft): 0	Riffles: 0	
	Pools: 1	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 100 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 62.3 2. 33.8 3. 3.9 4. 0.0 5. 0.0		

STREAM REACH: 4

Channel Type: G4	Canopy Density (%): 92.5	Pools by Stream Length (%): 18.4
Reach Length (ft.): 1825	Coniferous Component (%): 41.3	Pool Frequency (%): 32.4
Riffle/Flatwater Mean Width (ft.): 4.9	Hardwood Component (%): 58.7	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 96
Range (ft.): 6 to 12	Vegetative Cover (%): 96.9	2 to 2.9 Feet Deep: 4
Mean (ft.): 9	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 0
Std. Dev.: 2	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.2	Occurrence of LWD (%): 26	Mean Max Residual Pool Depth (ft.): 1.0
Water (F): 56 - 57 Air (F): 62 - 70	LWD per 100 ft.:	Mean Pool Shelter Rating: 26
Dry Channel (ft): 0	Riffles: 2	
	Pools: 10	
	Flat: 2	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 70 Sm Cobble: 30 Lg Cobble: 0 Boulder: 0 Bedrock: 0		
Embeddedness Values (%): 1. 43.5 2. 52.2 3. 4.3 4. 0.0 5. 0.0		

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Kelly Creek

LLID: 1240178408870

Drainage: Blue Lake

Survey Dates: 7/21/2011 to 8/8/2011

Confluence Location: Quad: ARCATA NORTH

Legal Description: T06NR01ES24

Latitude: 40:53:13.0N

Longitude: 124:01:04.0W

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	2	1.4
Boulder	6	2	2.7
Cobble / Gravel	26	28	18.5
Sand / Silt / Clay	112	114	77.4

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	20	20	13.7
Brush	43	43	29.5
Hardwood Trees	74	71	49.7
Coniferous Trees	9	12	7.2
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 2

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

StreamName: Kelly Creek

LLID: 1240178408870

Drainage: Blue Lake

Survey Dates: 7/21/2011 to 8/8/2011

Confluence Location: Quad: ARCATA NORTH

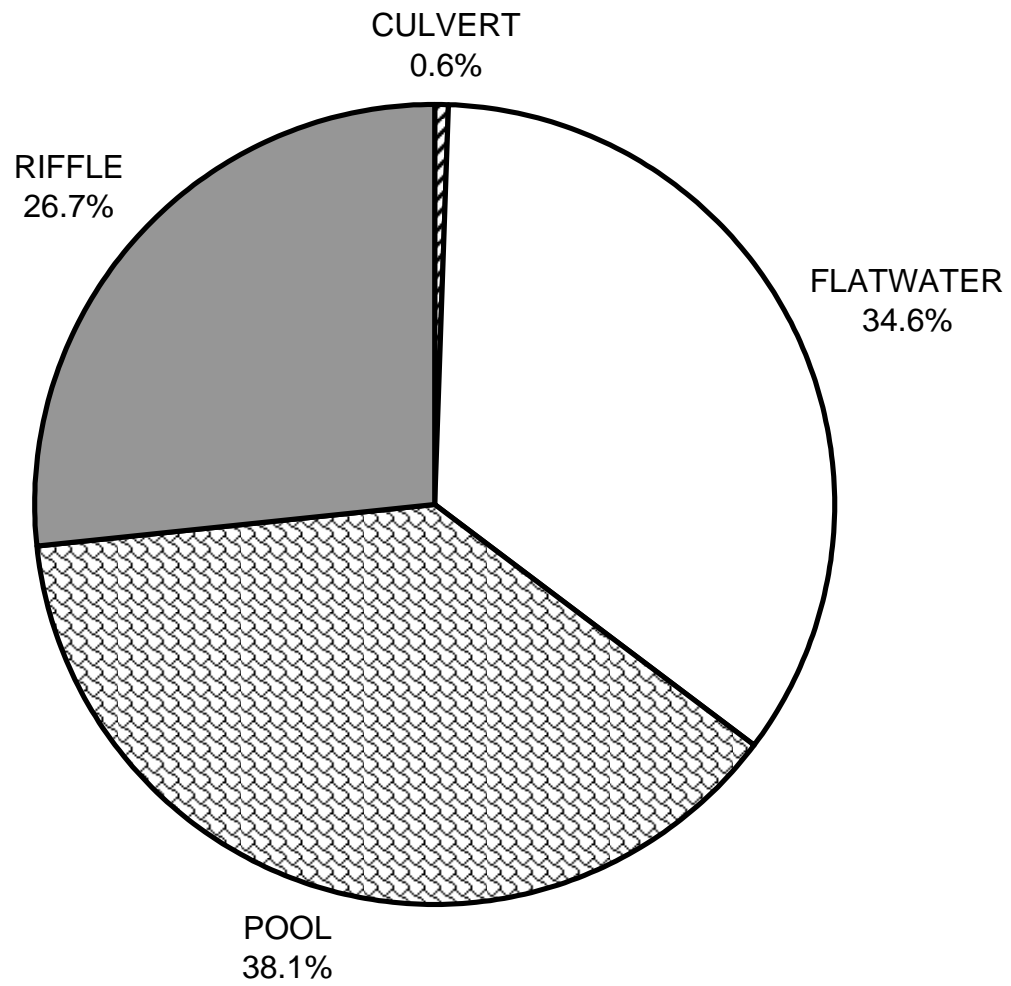
Legal Description: T06NR01ES24

Latitude: 40:53:13.0N

Longitude: 124:01:04.0W

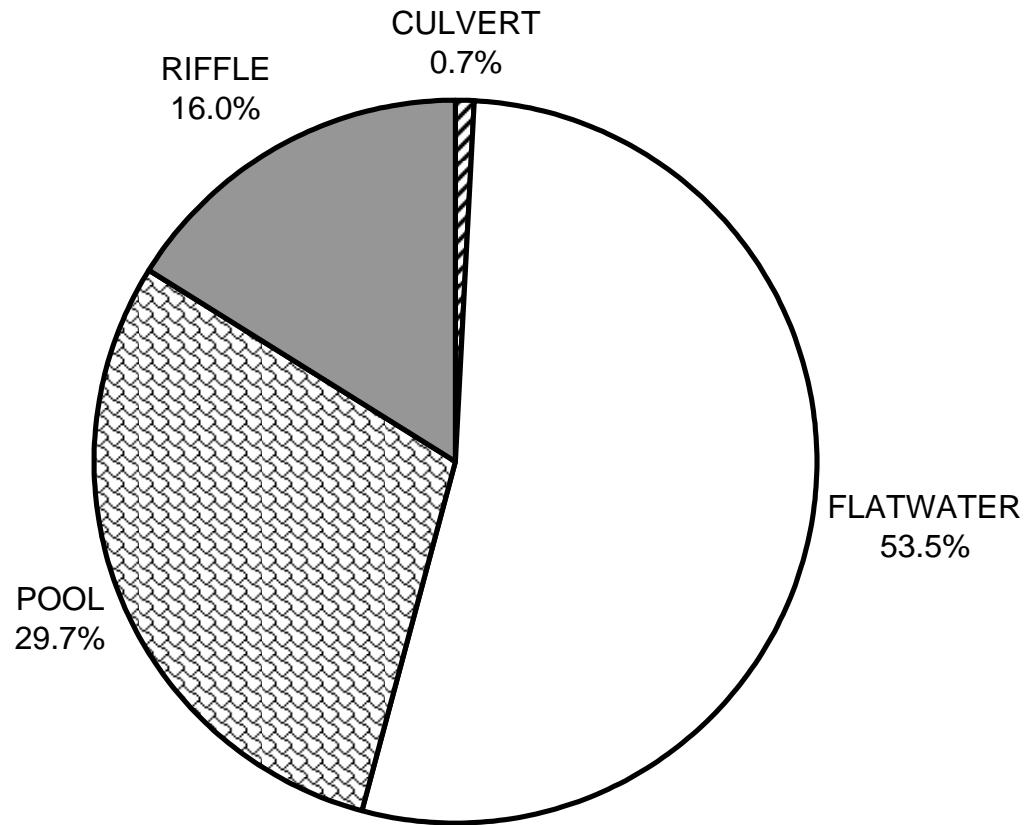
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	2	11
SMALL WOODY DEBRIS (%)	32	36	35
LARGE WOODY DEBRIS (%)	0	5	12
ROOT MASS (%)	1	3	9
TERRESTRIAL VEGETATION (%)	32	52	20
AQUATIC VEGETATION (%)	0	0	3
WHITEWATER (%)	0	0	0
BOULDERS (%)	34	3	9
BEDROCK LEDGES (%)	0	0	0

KELLY CREEK 2011 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

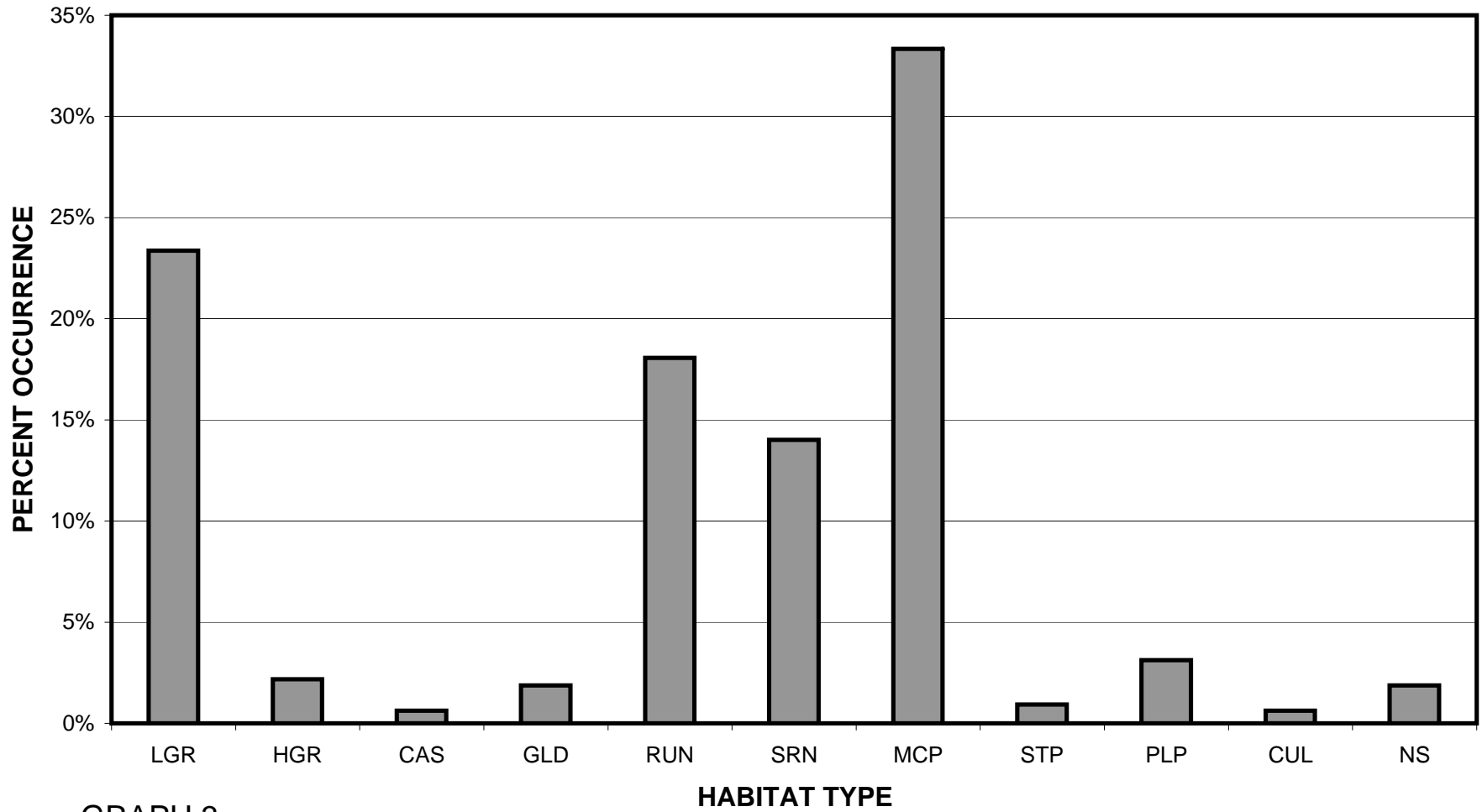
KELLY CREEK 2011 HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

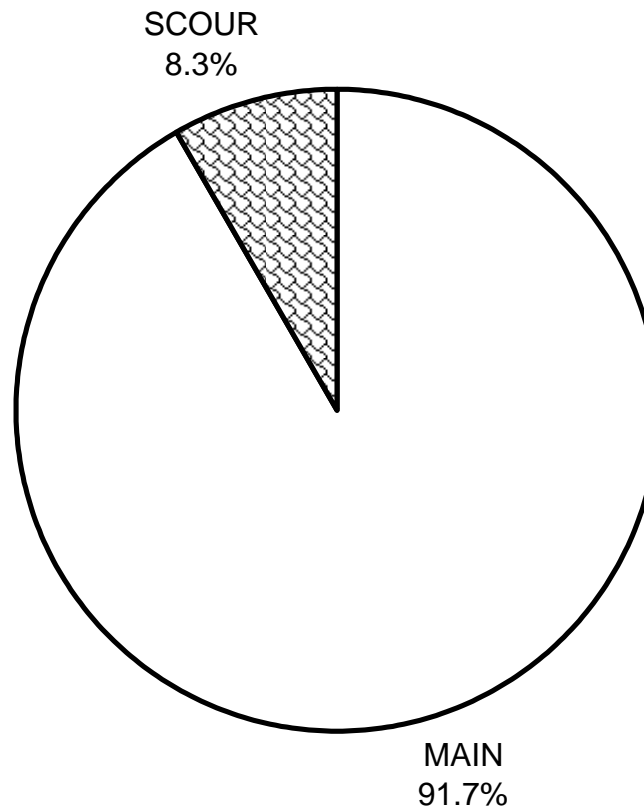
KELLY CREEK 2011

HABITAT TYPES BY PERCENT OCCURRENCE



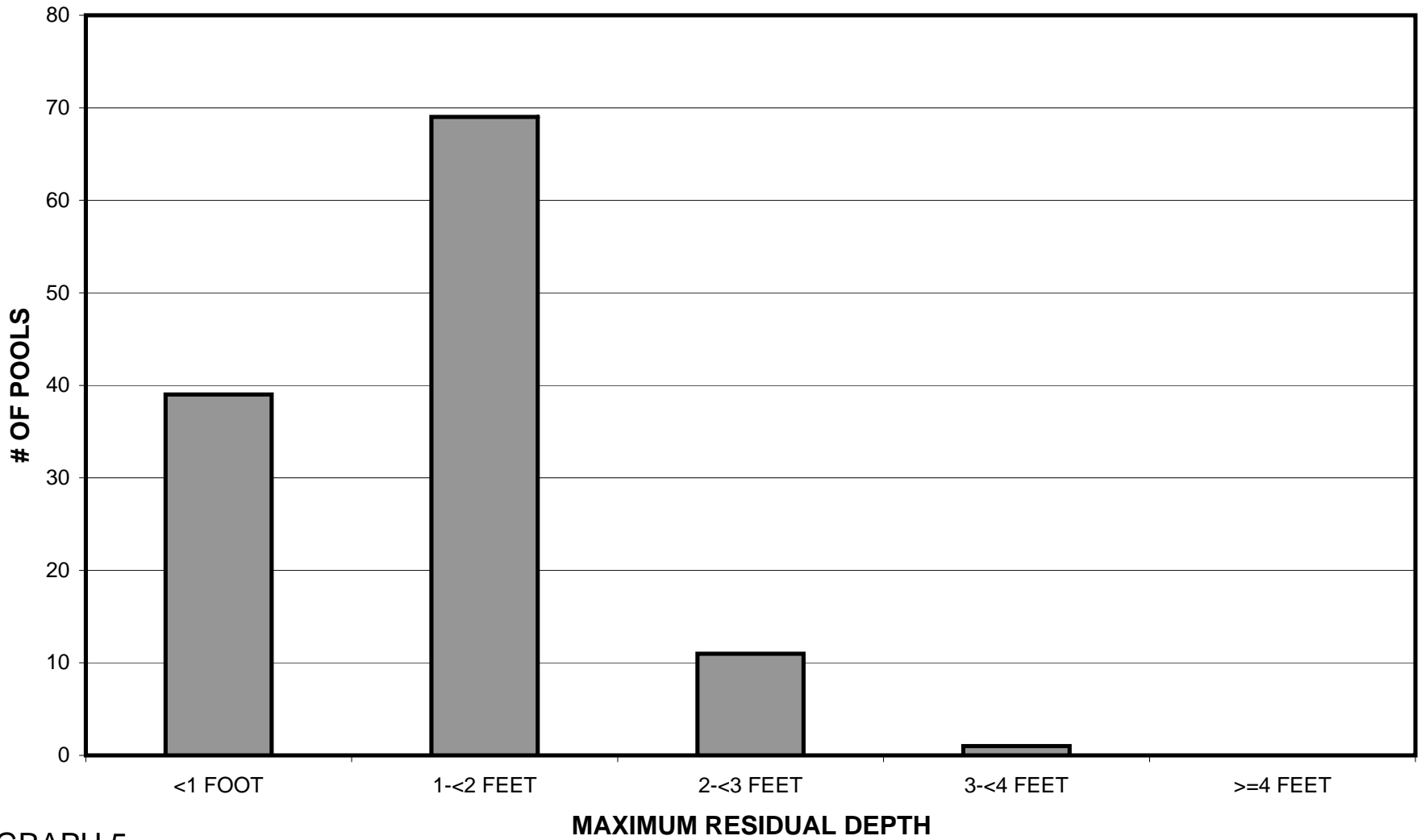
GRAPH 3

KELLY CREEK 2011 POOL TYPES BY PERCENT OCCURRENCE



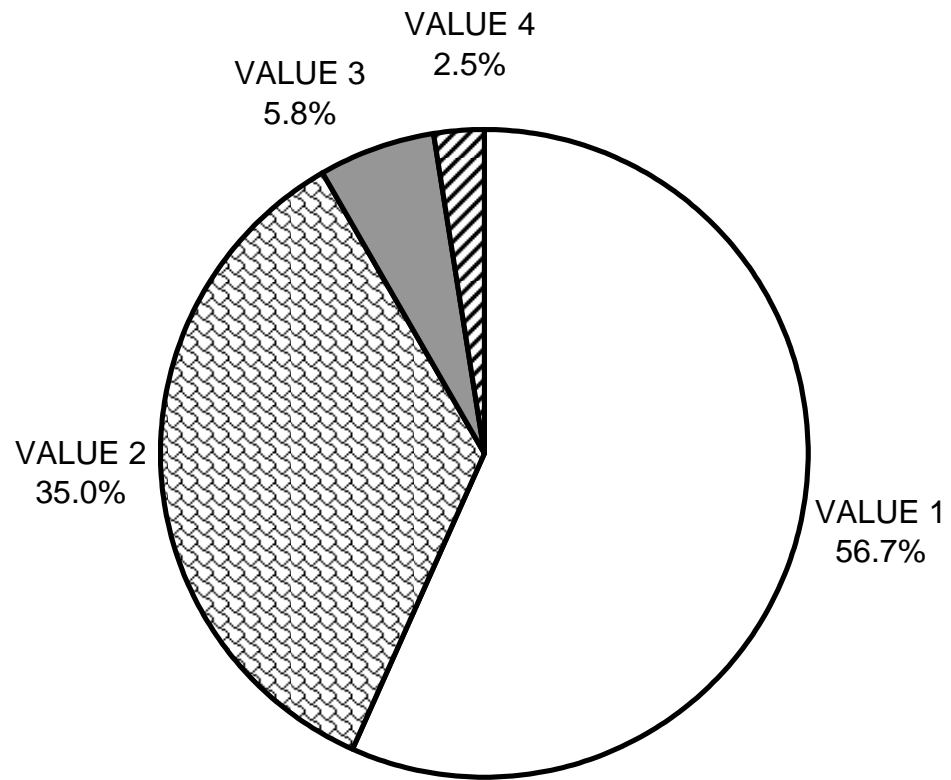
GRAPH 4

KELLY CREEK 2011 MAXIMUM DEPTH IN POOLS



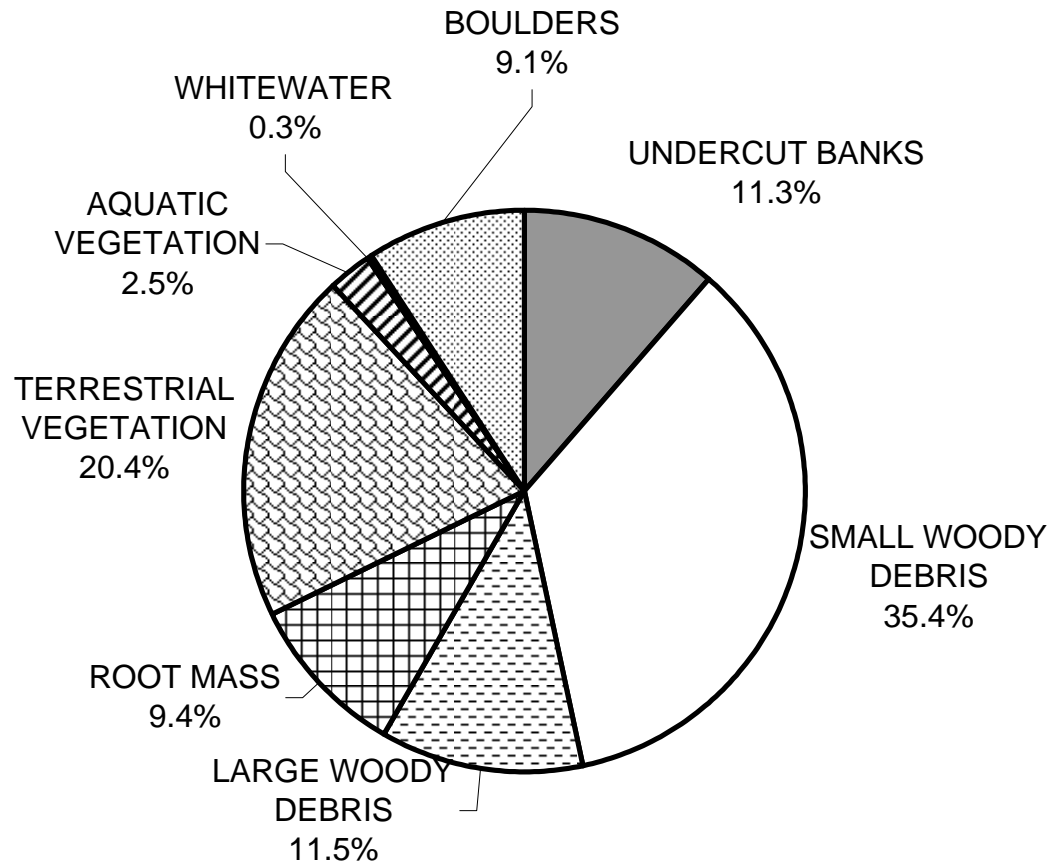
GRAPH 5

KELLY CREEK 2011 PERCENT EMBEDDEDNESS



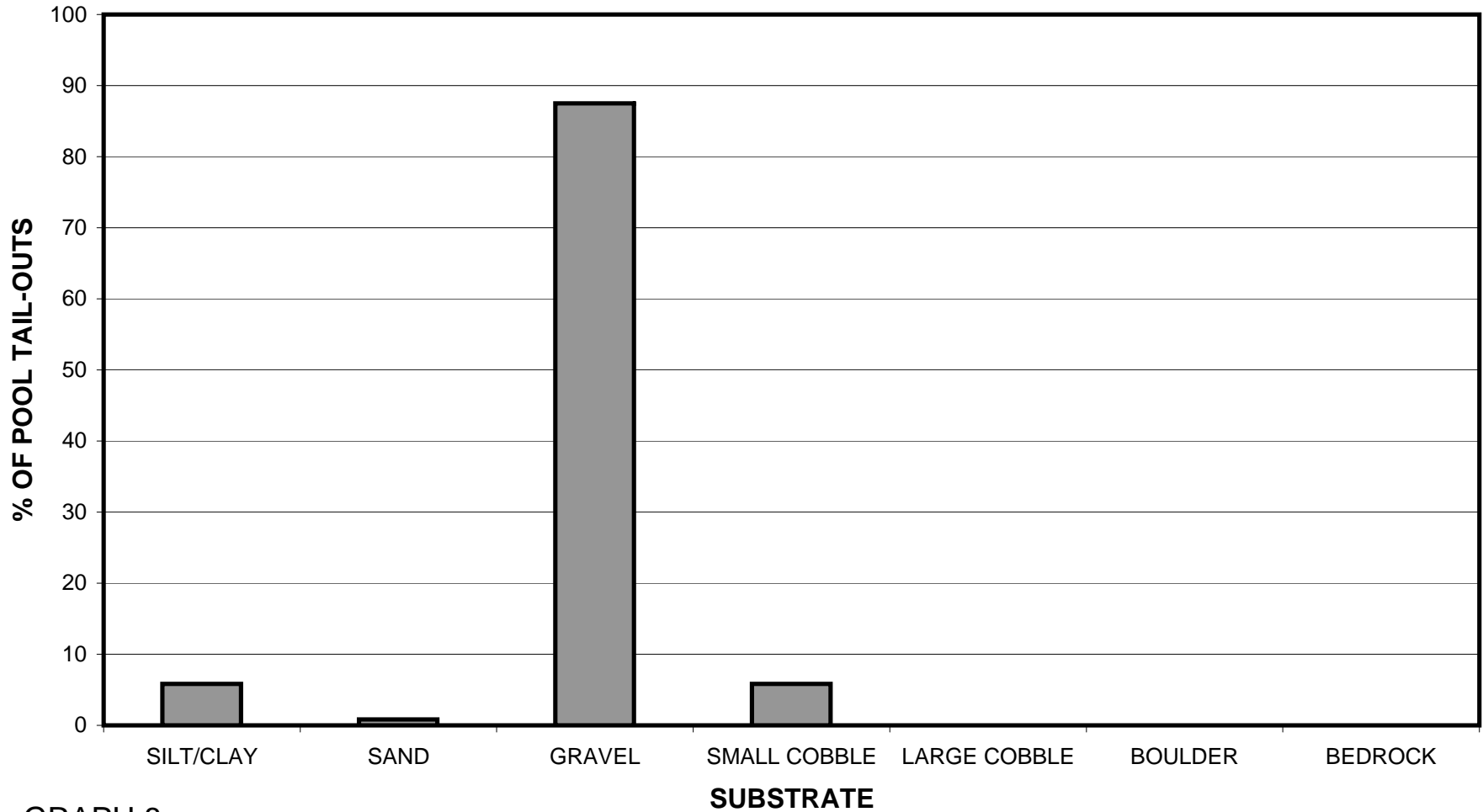
GRAPH 6

KELLY CREEK 2011 MEAN PERCENT COVER TYPES IN POOLS



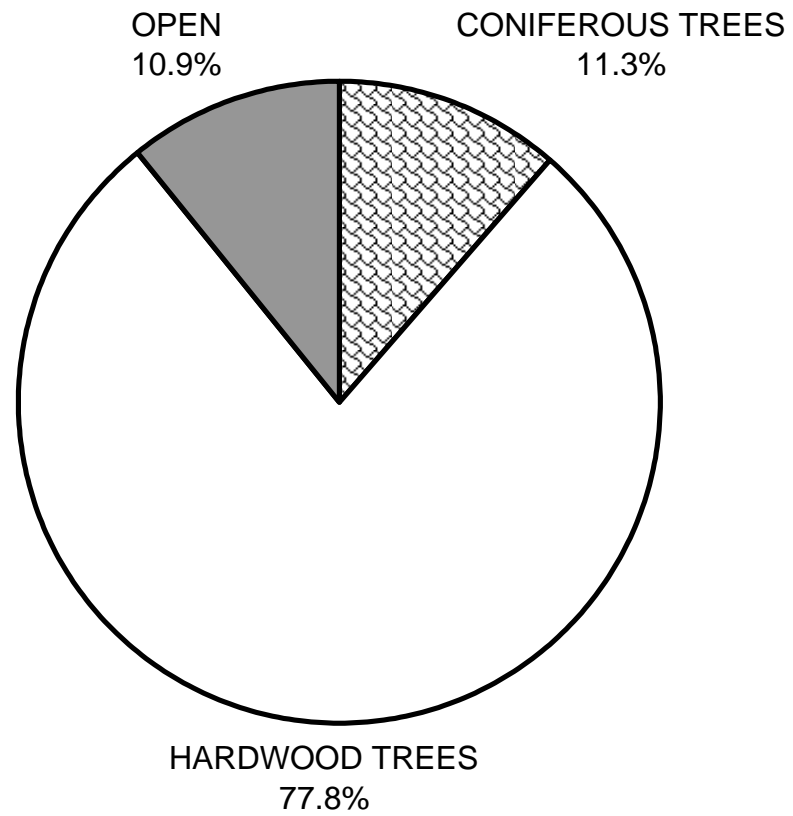
GRAPH 7

KELLY CREEK 2011 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



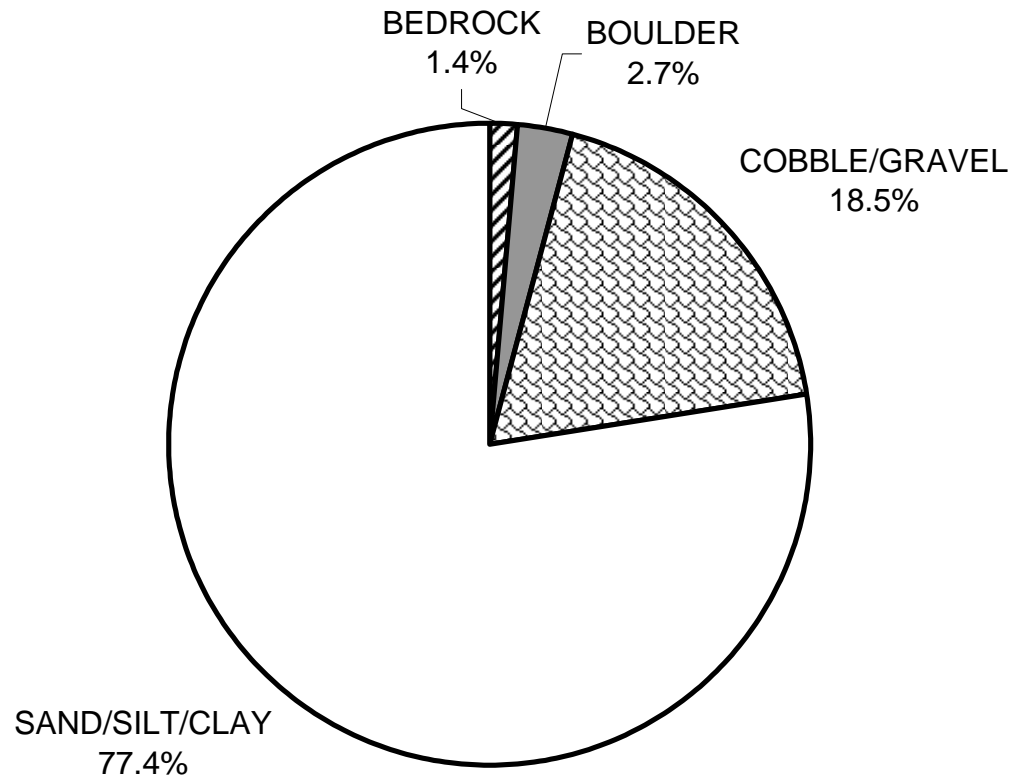
GRAPH 8

KELLY CREEK 2011 MEAN PERCENT CANOPY



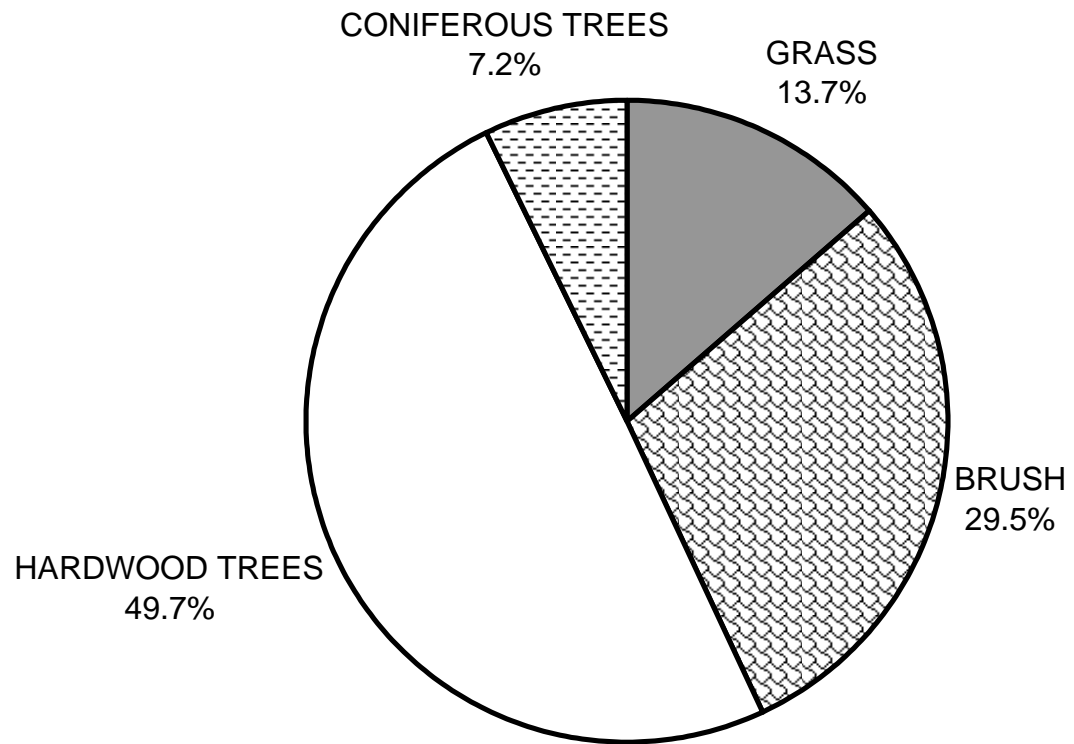
GRAPH 9

KELLY CREEK 2011 DOMINANT BANK COMPOSITION IN SURVEY REACH



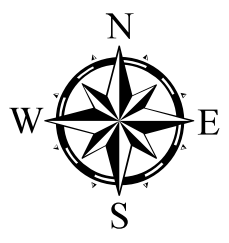
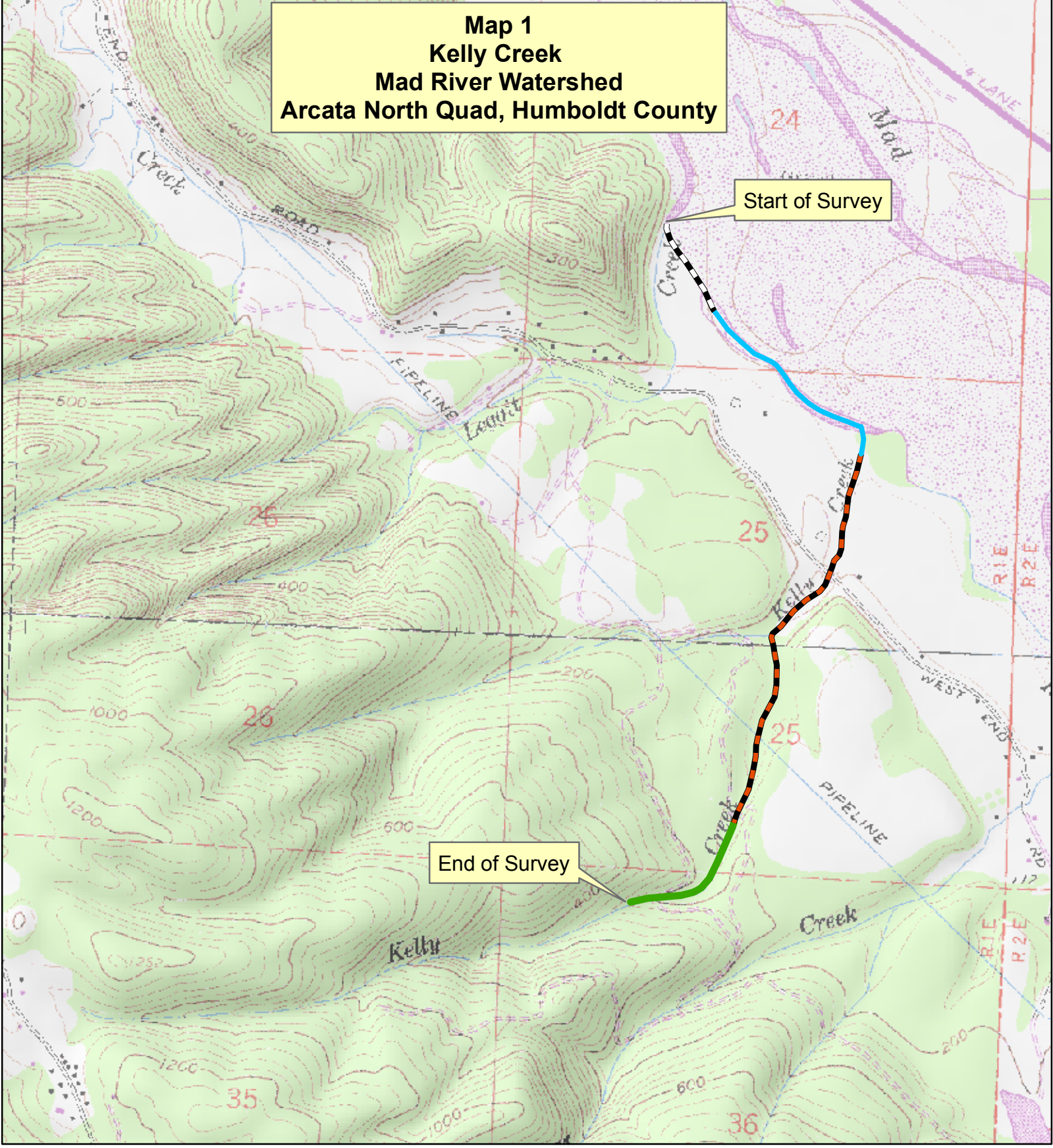
GRAPH 10

KELLY CREEK 2011 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

**Map 1
Kelly Creek
Mad River Watershed
Arcata North Quad, Humboldt County**



Legend

- Reach 1, Unsurveyed
- Reach 2, C6 Channel Type
- Reach 3, F4 Channel Type
- Reach 4, G4 Channel Type

