

# STREAM INVENTORY REPORT

## Cow Creek

### INTRODUCTION

A stream inventory was conducted during June 4, 2007 to June 13, 2007 on Cow Creek. The survey began at the confluence with Bull Creek and extended upstream one mile.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Cow Creek.

A biological survey of Cow Creek was last conducted in 1991 to document the presence of juvenile salmonid species. Findings from that survey will also be included in 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

Cow Creek is a tributary to Bull Creek, tributary to South Fork Eel River, tributary to the Eel River which drains to the Pacific Ocean, located in Humboldt County, California (Map 1). Cow Creek's legal description at the confluence with Bull Creek is T1S R2E S28. Its location is 40.3491 north latitude and 123.9627 west longitude, LLID number 1239629403492. Cow Creek is a first order stream and has approximately 0.7 miles of blue line stream according to the USGS Weott 7.5 minute quadrangle. Cow Creek drains a watershed of approximately 2.3 square miles. Elevations range from about 170 feet at the mouth of the creek to 1,200 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is primarily state park and is managed for timber recreation. Vehicle access exists via Highway 101; take the Honeydew/South Fork exit to the Mattole Road towards Rockefeller Grove.

### METHODS

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

### SAMPLING STRATEGY

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

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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 Cow 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". Cow 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 Cow 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

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assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

### 6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Cow Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

### 7. Substrate Composition:

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

### 8. Canopy:

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

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### 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. Detailed biological sampling was not conducted on Cow Creek during the 2007 survey. Fish presence was observed from the stream banks in Cow Creek during the 2007 survey season. Data from a July 26, 1991 survey is listed in the Biological Inventory Results section of this report. 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 Cow 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 June 4, 2007 to June 13, 2007, was conducted by S. Truett and R. Marsh (WSP) and I. Mikus, S. McSmith (DFG). The total length of the stream surveyed was 5,438 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.68 cfs on June 18, 2007.

Cow Creek is an F3 channel type for 3,038 feet of the stream surveyed (Reach 1), a B3 channel type for 1,137 feet of the stream surveyed (Reach 2), and an A3 channel type for 1,263 feet of the stream surveyed (Reach 3).

F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates. B3 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and cobble-dominant substrates. A3 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 52 to 57 degrees Fahrenheit. Air temperatures ranged from 53 to 62 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 45% pool units, 40% riffle units, 14% flat water units, 1% culvert units, and 1% no survey units (Graph 1). Based on total length of Level II habitat types there were 48% riffle units, 38% pool units, 10% flatwater units, 3% no survey units, and 1% culvert units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 23% mid-channel pool units, 22% low gradient riffle units and 18% high gradient riffle units (Graph 3). Based on percent total length, high gradient riffle units made up 27%, low gradient riffle units 21%, and mid-channel pool units 19%.

A total of 65 pools were identified, 63 of them were fully sampled (Table 3). Main channel pools were the most frequently encountered, at 68% (Graph 4), and comprised 79% 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. Sixteen of the 63 pools (25%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 63 pool tail-outs measured, 10 had a value of 1 (15.9%); 24 had a value of 2 (38.1%); 19 had a value of 3 (30.2%); 6 had a value of 4 (9.5%); and 4 had a value of 5 (6.3%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 22, flatwater habitat types had a mean shelter rating of 8, and pool habitats had a mean shelter rating of 25 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 19, scour pools had a mean shelter rating of 38, and backwater pools had a mean shelter rating of 20 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Cow Creek. Graph 7 describes the pool cover in Cow Creek. Large woody debris is the dominant pool cover type followed by whitewater.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was observed in 43% of pool tail-outs and small cobble was observed in 25% of pool tail-outs.

The mean percent canopy density for the surveyed length of Cow Creek was 88%. Twelve percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 51% and 49%, respectively. Graph 9 describes the mean percent canopy in Cow Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 89%. The mean percent left bank vegetated was 96%. The dominant elements composing the structure of the stream banks consisted of 76% sand/silt/clay, 19% cobble/gravel, 4% boulder, and 1% bedrock (Graph 10). Coniferous trees were the dominant vegetation type observed in 55% of the units surveyed. Additionally, 23% of the units surveyed had deciduous trees as the dominant vegetation type, 10% had brush as the dominant vegetation, and 9% had grass as the dominant vegetation (Graph 11).

## BIOLOGICAL INVENTORY RESULTS

Cow Creek was biologically sampled on July 26, 1991, by the California Department of Fish and Game for fish presence and identification. Using a Smith Root Model 12 electrofisher, two sites were sampled. The first unit sampled was a plunge pool located approximately 1,187 feet from the confluence with Bull Creek, yielded 4 steelhead trout. The second unit sampled, a mid-channel pool located approximately 2,918 feet from the confluence with Bull Creek, yielded no fish.

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### DISCUSSION

Cow Creek is an F3 channel type for the first 3,038 feet of stream surveyed, a B3 channel type for the next 1,137 feet, and an A3 channel type for the remaining 1,263 feet. The suitability of F3, B3, and A3 channel types for fish habitat improvement structures is as follows: F3 channels are good for bank-placed boulders and single and opposing wing-deflectors, and fair for plunge weirs, boulder clusters, channel constrictors, and log cover. B3 channels are excellent for plunge weirs, boulder clusters, bank-placed boulders, log cover, and single and opposing wing deflectors. A3 channels are generally not suitable for fish habitat improvement projects.

The water temperatures recorded on the survey days June 4, 2007 to June 13, 2007, ranged from 52 to 57 degrees Fahrenheit. Air temperatures ranged from 53 to 62 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 10% of the total length of this survey, riffles 48%, and pools 38%. The pools are relatively shallow, with only 16 of the 63 (25%) pools having 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.

Thirty-four of the 63 pool tail-outs measured had embeddedness ratings of 1 or 2. Twenty-five 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.

Forty-three of the 63 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 was 25. The shelter rating in the flatwater habitats was 8. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by large woody debris in Cow Creek. Large woody debris is the dominant cover type in pools followed by whitewater. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 88%. Reach 1 had a canopy density of 85.5%, Reach 2 had a canopy density of 89.2%, and Reach 3 had a canopy density of 93.1%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was high at 89% and 96%, 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.

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### RECOMMENDATIONS

- 1) Cow Creek should be managed as an anadromous, natural production stream.
- 2) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from large wood. Adding high quality complexity with woody cover in the pools is desirable.
- 3) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.

### 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 stream survey at the confluence with Bull Creek. Reach 1 begins and the channel type was an F3.
205	0005.00	Bridge #01 was a wooden footbridge measuring 4.8 feet wide x 6.4 feet high x 36.2 feet long.
857	0022.00	Culvert #01 was constructed of metal and was located in the channel under Mattole Road. It measured 7.9 feet in diameter and had no plunge pools or baffles. Its slope was 1.2% and its outlet pool had a maximum depth of 1.4 feet within 5 feet of the culvert mouth. In good condition, this culvert was not a barrier to juvenile and adult salmonids
1207	0031.00	Erosion site on the left bank.
1243	0033.00	Erosion site on the left bank measuring 20 feet long x 9 feet high.
1275	0035.00	Erosion site on the left bank measuring 57 feet long x 15 feet high.
1299	0037.00	A log cribbing structure was in place on the left bank.
1332	0038.00	Erosion site on the left bank measuring 40 feet long x 6 feet high.
1393	0040.00	Erosion site located on left bank with slumping measuring 30 feet long.



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1437	0042.00	Erosion site located on right bank with vertical erosion.
1533	0045.00	A plunge weir structure with a plunge height of 0.4 feet at the top of the habitat unit.
1668	0049.00	Department of Fish and Game "Start of Spawner Survey" flagging dated January 5, 2005 was found. A plunge weir structure at the top of this habitat unit had a plunge height of 0.7 feet.
1682	0050.00	Log debris accumulation (LDA) #01 measured 8 feet high x 30 feet wide x 87 feet long with 35 pieces of large woody debris. Water was flowing through it and it had visible gaps. The LDA was not retaining sediment and it was not a barrier to salmonids. Fish were observed above the LDA. This LDA continues through habitat unit #054.
1862	0056.00	LDA #02 measured 12 feet high x 20 feet wide x 238 feet long with 45 pieces of large woody debris. Water flowed through and there were visible gaps. The retained sediment ranged in size from sand to small cobble. The LDA extended through habitat unit #060.
2100	0061.00	The left bank slumped off for 90 feet of length through this unit.
2202	0067.00	LDA #03 measured 4 feet high x 38 feet wide x 19 feet long with 16 pieces of large woody debris. Water was flowing through and there were visible gaps. There was sediment retained measuring 27 feet wide x 137 feet long x 7.5 feet high. The sediment ranged in size from sand to small cobble. This LDA was not a barrier to salmonids and fish were observed above the accumulation.
2466	0074.00	There was a plunge of 1.1 feet at the top of this unit.
2558	0076.00	LDA #04 measured 10 feet high x 29 feet wide x 11 feet long with 14 pieces of large woody debris. Water was flowing through, there were no visible gaps. Sediment retention was measured at 7.3 feet high with sediment ranging from sand to gravel. Fish were seen above.
2874	0084.00	An erosion site located on the right bank measuring 30 feet high x 150 feet long was recorded.
3038	0090.00	Reach 2 began at this unit. The channel type is a B3.
3076	0091.00	An erosion site located on the right bank measuring 23 feet high x 79 feet long.
3129	0092.00	There was a 2.3 foot plunge with a 2.2 foot jump pool.
3165	0095.00	An erosion site located on the left bank measuring 20 feet high x 55 feet long.

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3316	0100.00	A 1.5 foot plunge with 2 foot pool was measured.
3387	0102.00	LDA #05 measured 6 feet high x 27 feet wide x 37.5 feet long with 22 pieces of large woody debris. Water flowed through but there were no visible gaps. The sediment retained by the accumulation ranged from silt to small cobble and measured 18 feet wide, 41.5 long, and 7 feet high. Fish were observed above it.
3473	0104.00	An erosion site located on the left bank measuring 20 feet high x 10 feet long.
3544	0107.00	A 6.5 foot plunge with a 2 foot jump pool.
3544	0107.00	An erosion site located on the right bank measuring 25 feet high x 60 feet long.
3544	0107.00	LDA #06 measured 11 feet high x 42 feet wide x 30 feet long and contained 17 pieces of large woody debris. Water was flowing through but there were no visible gaps. The sediment retained by the accumulation ranged from gravel to cobble measured 28 feet wide x 71 long x 8 feet high. Fish were observed above it.
3674	0110.00	A 2.4 foot plunge with a 2.1 foot pool and another plunge measuring 2.2 feet high with a 0.9 foot jump pool.
3695	0111.00	LDA #07 measured 6 feet high, 22 feet wide x 13 feet long and contained 5 pieces of large woody debris. Water was not flowing through and there were no visible gaps. The sediment retained by the accumulation ranged in size from sand to small cobble and measured 22 feet wide x 15 long x 3 feet deep. Fish were observed above it.
3752	0112.00	A 1.9 foot plunge over a log.
3752	0112.00	LDA #08 measured 13 feet high x 28 feet wide x 26 feet long with 14 pieces of large woody debris contained in it. Water was not flowing through and there were no visible gaps. The sediment retained by the accumulation ranged in size from sand to large cobble. The sediment measured 26 feet wide x 35 long x 8 feet deep. Fish were observed above it. This LDA went through habitat unit #113.
3827	0114.00	A 2.3 foot plunge over a log.
3827	0114.00	LDA #09 measured 11 feet high x 43 feet wide x 50 feet long and it contained 18 pieces of large woody debris. Water was not flowing through it and it had no visible gaps. The sediment retained by the accumulation ranged in size from sand to small cobble. The sediment measured 58 feet wide x 50 long x 7 feet deep. Fish were observed above it.

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4080	0118.00	LDA #10 measured 8 feet high x 27 feet wide x 29 feet long and it contained 15 pieces of large woody debris. Water was not flowing through, there were visible gaps. The sediment retained by the accumulation ranged in size from sand to small cobble. The retained sediment measured 29 feet wide x 11.5 long x 5.5 feet deep. Fish were observed above it.
4175	0120.00	Reach 3 begins at this unit. It was an A3 channel type.
4211	0122.00	There was a plunge height of 1.8' over boulders.
4211	0122.00	Erosion site located on the left bank measuring 30 feet high x 30 feet long. The erosion was contributing sediment ranging in size from silt to boulders.
4322	0124.00	There was a 4' plunge over a root wad.
4322	0124.00	Tributary #01 entered from the left bank. It was flowing at less than 0.5 cfs, and was contributing to approximately 10% of Cow Creek's flow. The water temperature of the tributary was 52 degrees Fahrenheit. The temperature of Cow Creek downstream and upstream of the tributary was 54 degrees Fahrenheit. The tributary was not accessible to fish due to its high slope of 45%. No fish were observed in the tributary.
4353	0125.00	Young-of-the-year salmonids were observed throughout this survey, including in this unit. Upstream of this unit no young-of-the-year were observed.
4393	0126.00	LDA #11 was 6' high x 80' wide x 199' long and contained 50 pieces of LWD. Water was flowing through and there were visible gaps. The sediment being retained ranged in size from silt to large cobble and measured 40' wide x 30' long x 3' deep. No fish were seen above the LDA and it was a potential juvenile and adult barrier; possible end of anadromy.
4563	0127.00	There was right bank erosion measuring 25' high x 50' long.
4563	0127.00	LDA #12 was 5' high x 25' wide x 14' long with 14 pieces of LWD. Water flowed through and there were visible gaps. The retained sediment ranged in size from sand to gravel and measured 20' wide x 16' long x 3' deep. No fish were seen above and it was a potential barrier to both juvenile and adult salmonids.
4680	0129.00	There was a 1.3' plunge at the top of this unit.
5128	0139.00	There was right bank erosion measuring 30' high x 40' long.

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5160	0142.00	Tributary #02 entered from the right bank. It was flowing at an estimated 0.2 cfs and it was contributing to approximately 5% of Cow Creek's flow. The water temperatures of the tributary and of Cow Creek upstream and downstream of the tributary were all 52 degrees Fahrenheit. The tributary was not accessible to fish and it had a 20% slope. No fish were observed in the first 150' of the tributary.
5371	0143.00	There was a 1.8' boulder plunge at the top of this unit.
5390	0144.00	There was a 1.4' boulder plunge at the top of this unit.
5426	0146.00	LDA #13 was 9' high x 35' wide x 8' long and it contained 3 pieces of LWD. No water was flowing through and there were no visible gaps. The sediment being retained ranged in size from silt to large cobble and it measured 45' wide x 65' long x 5' deep. No fish were seen above it and it was a possible juvenile and adult barrier.
5438	0146.00	End of survey due to a 6' plunge with an inadequate jump pool and a massive LDA. No young-of-the-year were observed since habitat unit #125.

## **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

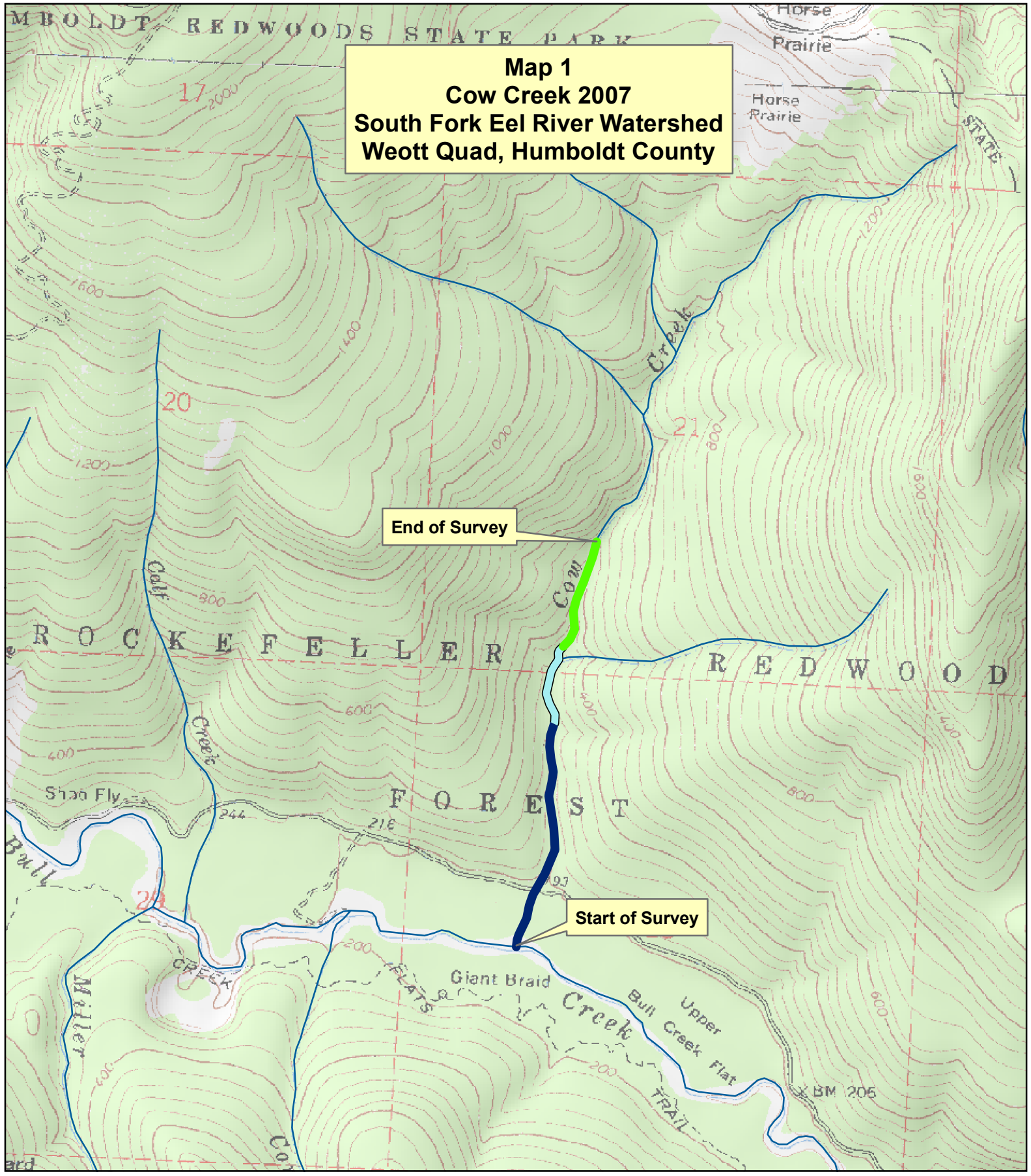
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }

#### 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

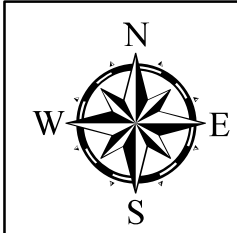
Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	



**Map 1**  
**Cow Creek 2007**  
**South Fork Eel River Watershed**  
**Weott Quad, Humboldt County**

End of Survey

Start of Survey



**Legend**

- Reach 1, F3 Channel Type
- Reach 2, B3 Channel Type
- Reach 3, A3 Channel Type

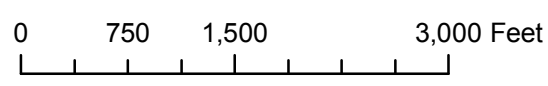


Table 1 - Summary of Riffle, Flatwater, and Pool Habitat Types

Stream Name: Cow Creek LLID: 1239629403492 Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: WEOTT Legal Description: T01SR02ES28 Latitude: 40:20:57.0N Longitude: 123:57:46.0

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
1	0	CULVERT	0.7	41	41	0.8									
20	5	FLATWATER	13.7	28	559	10.3	8.3	0.5	1.2	231	4617	124	2480		8
1	0	NOSURVEY	0.7	170	170	3.1									
65	63	POOL	44.5	32	2084	38.3	11.5	0.6	1.6	339	22063	350	22773	205	25
59	10	RIFFLE	40.4	44	2584	47.5	9.1	0.4	0.8	313	18444	118	6950		22
Total Units	Total Units Fully Measured			Total Length (ft.)						Total Area (sq.ft.)		Total Volume (cu.ft.)			
146	78			5438						45124		32203			

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

Stream Name: Cow Creek

LLID: 1239629403492

Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: WEOTT

Legal Description: T01SR02ES28

Latitude: 40:20:57.0N

Longitude: 123:57:46.0W

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 (%)
32	4	LGR	21.9	36	1138	20.9	10	0.3	0.9	324	10356	99	3154		4	88
27	6	HGR	18.5	54	1446	26.6	9	0.4	1	305	8242	131	3527		33	89
17	4	RUN	11.6	27	457	8.4	8	0.5	1.2	210	3573	108	1836		8	89
3	1	SRN	2.1	34	102	1.9	8	0.6	1.3	314	941	188	564		10	95
34	32	MCP	23.3	30	1023	18.8	10	0.6	2.7	290	9858	295	10017	177	17	86
10	10	STP	6.8	62	617	11.3	11	0.5	2.9	612	6117	600	5998	327	25	86
2	2	LSL	1.4	13	26	0.5	8	0.4	1.4	104	208	96	192	46	33	82
2	2	LSR	1.4	32	65	1.2	10	0.4	1.8	286	571	200	400	104	13	92
16	16	PLP	11.0	20	317	5.8	16	0.8	2.9	305	4886	362	5795	229	42	90
1	1	DPL	0.7	36	36	0.7	9	0.3	1.3	324	324	259	259	97	20	80
1	0	CUL	0.7	41	41	0.8										
1	0	NS	0.7	170	170	3.1										88

Total Units  
146

Total Units Fully Measured  
78

Total Length (ft.)  
5438

Total Area (sq.ft.)  
45076

Total Volume (cu.ft.)  
31742



Table 3 - Summary of Pool Types

Stream Name: Cow Creek

LLID: 1239629403492

Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: WEOTT

Legal Description: T01SR02ES28

Latitude: 40:20:57.0N

Longitude: 123:57:46.0W

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
44	42	MAIN	68	37	1640	79	10.3	0.5	367	16129	211	8824	19
20	20	SCOUR	31	20	408	20	14.2	0.7	283	5665	199	3971	38
1	1	BACKWATER	2	36	36	2	9.0	0.3	324	324	97	97	20
Total Units 65	Total Units Fully Measured 63				Total Length (ft.) 2084					Total Area (sq.ft.) 22117		Total Volume (cu.ft.) 12892	

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

Stream Name: Cow Creek

LLID: 1239629403492

Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: WEOTT

Legal Description: T01SR02ES28

Latitude: 40:20:57.0N

Longitude: 123:57:46.0W

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
32	MCP	51	2	6	22	69	8	25	0	0	0	0
10	STP	16	0	0	7	70	3	30	0	0	0	0
2	LSL	3	1	50	1	50	0	0	0	0	0	0
2	LSR	3	1	50	1	50	0	0	0	0	0	0
16	PLP	25	1	6	10	63	5	31	0	0	0	0
1	DPL	2	0	0	1	100	0	0	0	0	0	0

Total Units	Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Foot Max Resid. Depth	Total 1< 2 Foot % Occurrence	Total 2< 3 Foot Max Resid. Depth	Total 2< 3 Foot % Occurrence	Total 3< 4 Foot Max Resid. Depth	Total 3< 4 Foot % Occurrence	Total >= 4 Foot Max Resid. Depth	Total >= 4 Foot % Occurrence
63	5	8	42	67	16	25	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.6

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

Stream Name: Cow Creek

LLID: 1239629403492

Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Dry Units: 0

Confluence Location: Quad: WEOTT

Legal Description: T01SR02ES28

Latitude: 40:20:57.0N

Longitude: 123:57:46.0W

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
32	4	LGR	0	0	20	0	0	0	15	65	0
27	6	HGR	1	10	21	17	0	0	28	23	0
59	10	TOTAL RIFFLE	1	8	21	13	0	0	25	34	0
17	4	RUN	35	13	36	3	0	0	3	11	0
3	1	SRN	0	15	0	10	0	0	70	5	0
20	5	TOTAL FLAT	28	13	29	4	0	0	16	10	0
34	32	MCP	20	11	34	13	0	0	7	12	3
10	10	STP	12	8	47	16	0	0	13	7	0
2	2	LSL	20	30	50	0	0	0	0	0	0
2	2	LSR	30	0	30	40	0	0	0	0	0
16	16	PLP	8	4	30	6	0	0	42	11	0
1	1	DPL	55	0	40	0	5	0	0	0	0
65	63	TOTAL POOL	16	9	36	12	0	0	16	10	1
1	0	CUL									
1	0	NS									
146	78	TOTAL	15	9	34	12	0	0	17	12	1

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

Stream Name: Cow Creek

LLID: 1239629403492

Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Dry Units: 0

Confluence Location: Quad: WEOTT

Legal Description: T01SR02ES28

Latitude: 40:20:57.0N

Longitude: 123:57:46.0W

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
32	4	LGR	0	0	75	0	25	0	0
27	6	HGR	0	0	50	33	17	0	0
17	4	RUN	0	0	75	25	0	0	0
3	1	SRN	0	0	100	0	0	0	0
34	32	MCP	3	34	38	19	6	0	0
10	10	STP	0	40	50	10	0	0	0
2	2	LSL	0	50	50	0	0	0	0
2	2	LSR	0	0	100	0	0	0	0
16	16	PLP	0	31	50	0	6	13	0
1	1	DPL	0	100	0	0	0	0	0

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

Stream Name: Cow Creek

LLID: 1239629403492

Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: WEOTT

Legal Description: T01SR02ES28

Latitude: 40:20:57.0N

Longitude: 123:57:46.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
88	49	51	0	89	96

Note: Mean percent conifer and hardwood for the entire reach are means of canopy components from units with canopy values greater than zero.

Open units represent habitat units with zero canopy cover.

Stream Name: Cow Creek	LLID: 1239629403492	Drainage: Eel River - South Fork
Survey Dates: 6/4/2007 to 6/13/2007	Survey Length (ft.): 5438	Main Channel (ft.): 5438
		Side Channel (ft.): 0
Confluence Location: Quad: WEOTT	Legal Description: T01SR02ES28	Latitude: 40:20:57.0N
		Longitude: 123:57:46.0W

<b>STREAM REACH: 1</b>									
Channel Type:	F3					Canopy Density (%):	85.5	Pools by Stream Length (%):	48.7
Reach Length (ft.):	3038					Coniferous Component (%):	41.4	Pool Frequency (%):	42.7
Riffle/Flatwater Mean Width (ft.):	9.4					Hardwood Component (%):	58.6	Residual Pool Depth (%):	
BFW:						Dominant Bank Vegetation:	Coniferous Trees	< 2 Feet Deep:	69
Range (ft.):	14	to	33			Vegetative Cover (%):	92.7	2 to 2.9 Feet Deep:	31
Mean (ft.):	21					Dominant Shelter:	Large Woody Debris	3 to 3.9 Feet Deep:	0
Std. Dev.:	6					Dominant Bank Substrate Type:	Sand/Silt/Clay	>= 4 Feet Deep:	0
Base Flow (cfs.):	0.7					Occurrence of LWD (%):	30	Mean Max Residual Pool Depth (ft.):	1.7
Water (F):	54 - 57	Air (F):	53 - 62			LWD per 100 ft.:		Mean Pool Shelter Rating:	19
Dry Channel (ft):	0					Riffles:	4		
						Pools:	8		
						Flat:	2		
Pool Tail Substrate (%):	Silt/Clay: 0	Sand: 8	Gravel: 58	Sm Cobble: 25	Lg Cobble: 6	Boulder: 0	Bedrock: 3		
Embeddedness Values (%):	1. 11.1	2. 38.9	3. 36.1	4. 11.1	5. 2.8				

Channel Type:	B3	Canopy Density (%):	89.2	Pools by Stream Length (%):	24.2		
Reach Length (ft.):	1137	Coniferous Component (%):	58.9	Pool Frequency (%):	43.3		
Riffle/Flatwater Mean Width (ft.):	7.2	Hardwood Component (%):	41.1	Residual Pool Depth (%):			
BFW:		Dominant Bank Vegetation:	Coniferous Trees	< 2 Feet Deep:	77		
Range (ft.):	11 to 23	Vegetative Cover (%):	90.6	2 to 2.9 Feet Deep:	23		
Mean (ft.):	17	Dominant Shelter:	Large Woody Debris	3 to 3.9 Feet Deep:	0		
Std. Dev.:	5	Dominant Bank Substrate Type:	Sand/Silt/Clay	>= 4 Feet Deep:	0		
Base Flow (cfs.):	0.7	Occurrence of LWD (%):	41	Mean Max Residual Pool Depth (ft.):	1.7		
Water (F):	52 - 56	Air (F):	55 - 60	Mean Pool Shelter Rating:	40		
Dry Channel (ft):	0	Riffles:	12				
		Pools:	25				
		Flat:	11				
Pool Tail Substrate (%):	Silt/Clay: 0	Sand: 0	Gravel: 15	Sm Cobble: 46	Lg Cobble: 23	Boulder: 15	Bedrock: 0
Embeddedness Values (%):	1. 15.4	2. 53.8	3. 23.1	4. 7.7	5. 0.0		

## Summary of Fish Habitat Elements By Stream Reach

### STREAM REACH: 3

Channel Type: A3	Canopy Density (%): 93.1	Pools by Stream Length (%): 26.2
Reach Length (ft.): 1263	Coniferous Component (%): 58.9	Pool Frequency (%): 51.9
Riffle/Flatwater Mean Width (ft.): 10.5	Hardwood Component (%): 41.1	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Coniferous Trees	< 2 Feet Deep: 86
Range (ft.): 17 to 38	Vegetative Cover (%): 93.3	2 to 2.9 Feet Deep: 14
Mean (ft.): 30	Dominant Shelter: Large Woody Debris	3 to 3.9 Feet Deep: 0
Std. Dev.: 5	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.7	Occurrence of LWD (%): 31	Mean Max Residual Pool Depth (ft.): 1.4
Water (F): 52 - 54 Air (F): 55 - 62	LWD per 100 ft.:	Mean Pool Shelter Rating: 26
Dry Channel (ft): 0	Riffles: 8	
	Pools: 14	
	Flat: 11	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 29 Sm Cobble: 7 Lg Cobble: 36 Boulder: 29 Bedrock: 0		
Embeddedness Values (%): 1. 28.6 2. 21.4 3. 21.4 4. 7.1 5. 21.4		

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

Stream Name: Cow Creek

LLID: 1239629403492

Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: WEOTT

Legal Description: T01SR02ES28

Latitude: 40:20:57.0N

Longitude: 123:57:46.0W

**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	0	1	0.6
Boulder	2	5	4.5
Cobble / Gravel	18	11	18.6
Sand / Silt / Clay	58	61	76.3

**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	7	9.0
Brush	8	8	10.3
Hardwood Trees	17	19	23.1
Coniferous Trees	42	44	55.1
No Vegetation	4	0	2.6

**Total Stream Cobble Embeddedness Values:** 3



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

StreamName: Cow Creek

LLID: 1239629403492

Drainage: Eel River - South Fork

Survey Dates: 6/4/2007 to 6/13/2007

Confluence Location: Quad: WEOTT

Legal Description: T01SR02ES28

Latitude: 40:20:57.0N

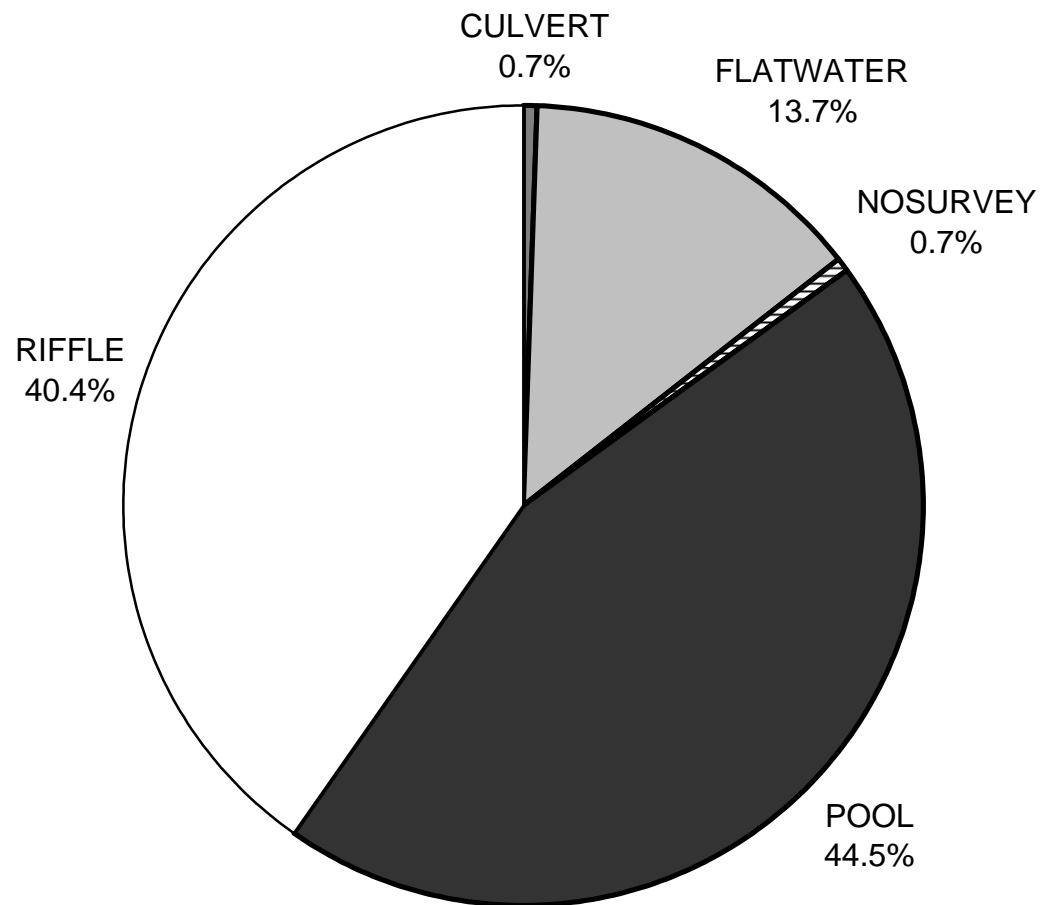
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	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
<hr/>			
UNDERCUT BANKS (%)	1	28	16
SMALL WOODY DEBRIS (%)	8	13	9
LARGE WOODY DEBRIS (%)	21	29	36
ROOT MASS (%)	13	4	12
TERRESTRIAL VEGETATION (%)	0	0	0
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	25	16	16
BOULDERS (%)	34	10	10
BEDROCK LEDGES (%)	0	0	1

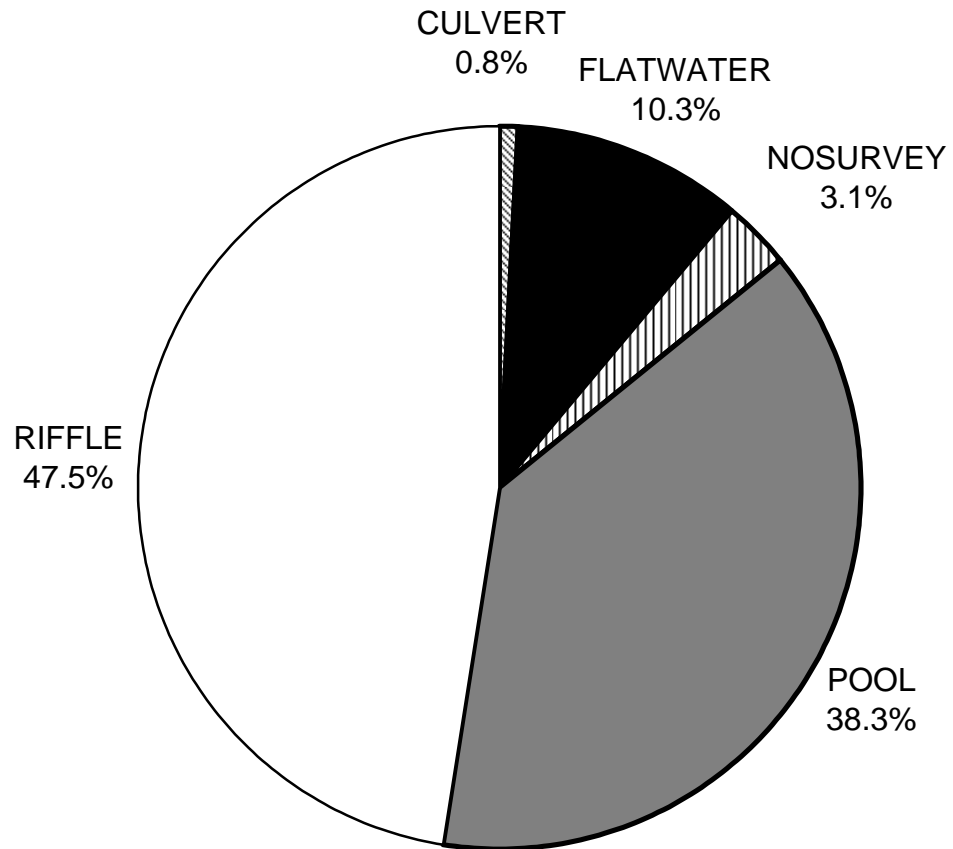
# COW CREEK 2007

## HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

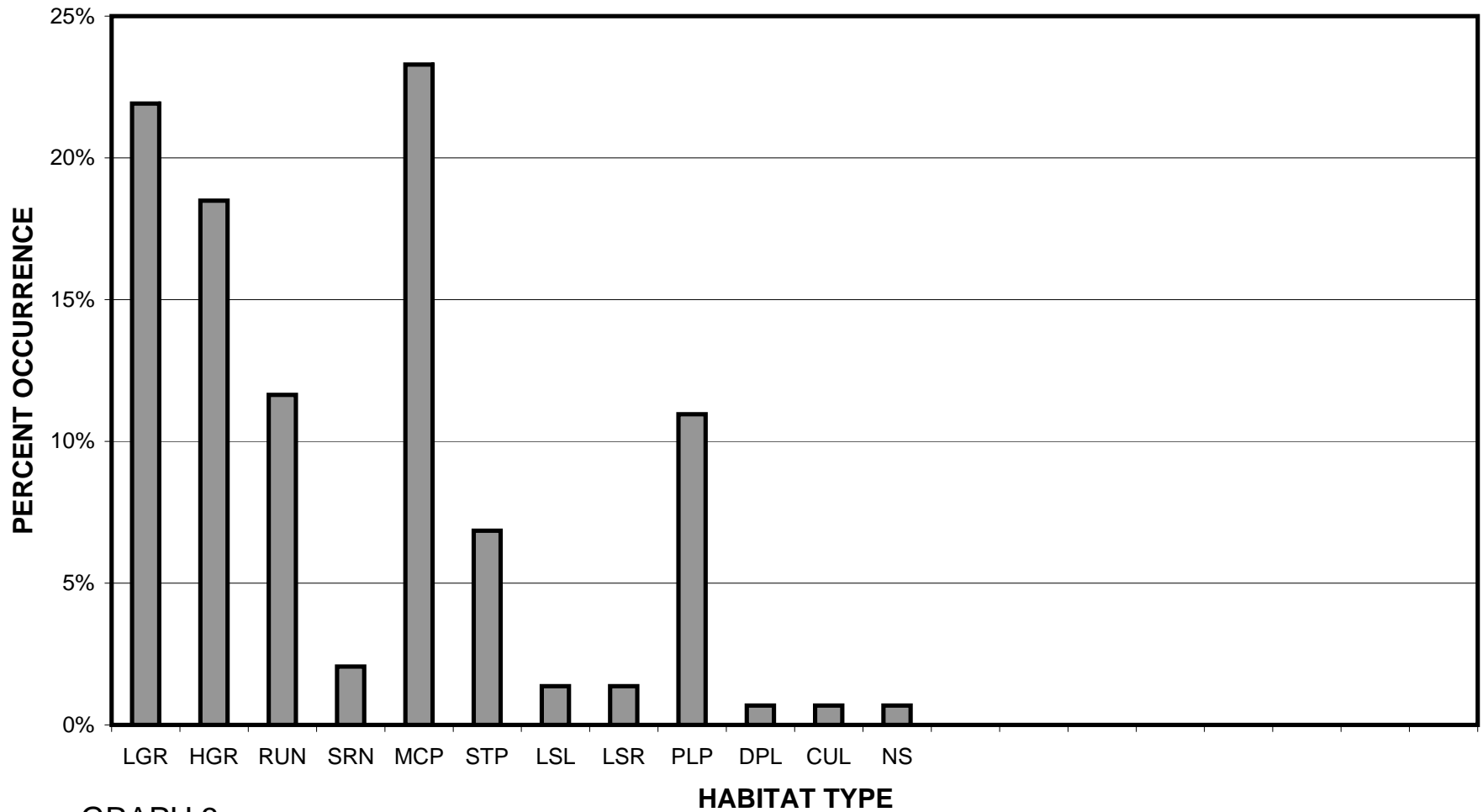
**COW CREEK 2007**  
**HABITAT TYPES BY PERCENT TOTAL LENGTH**



GRAPH 2

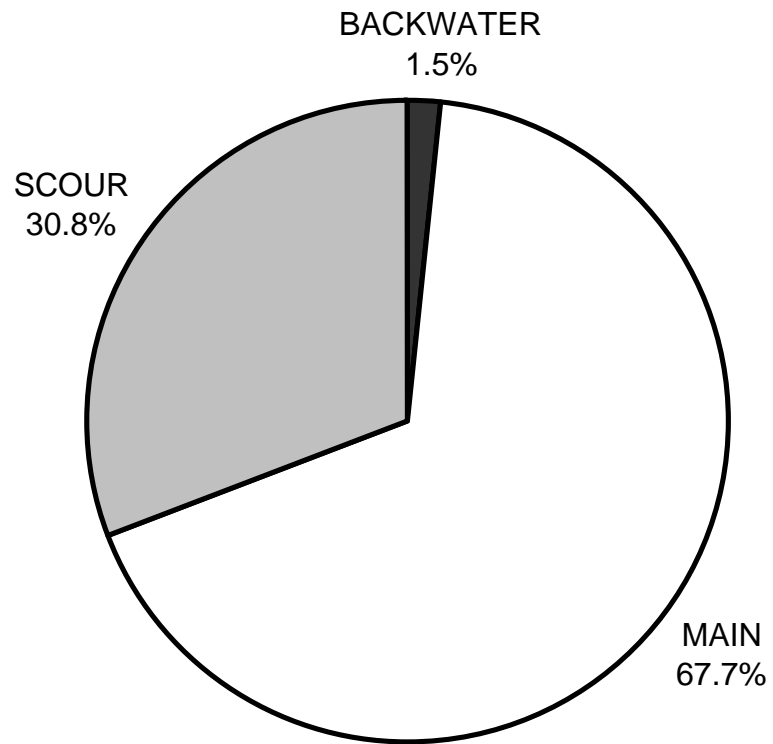
# COW CREEK 2007

## HABITAT TYPES BY PERCENT OCCURRENCE



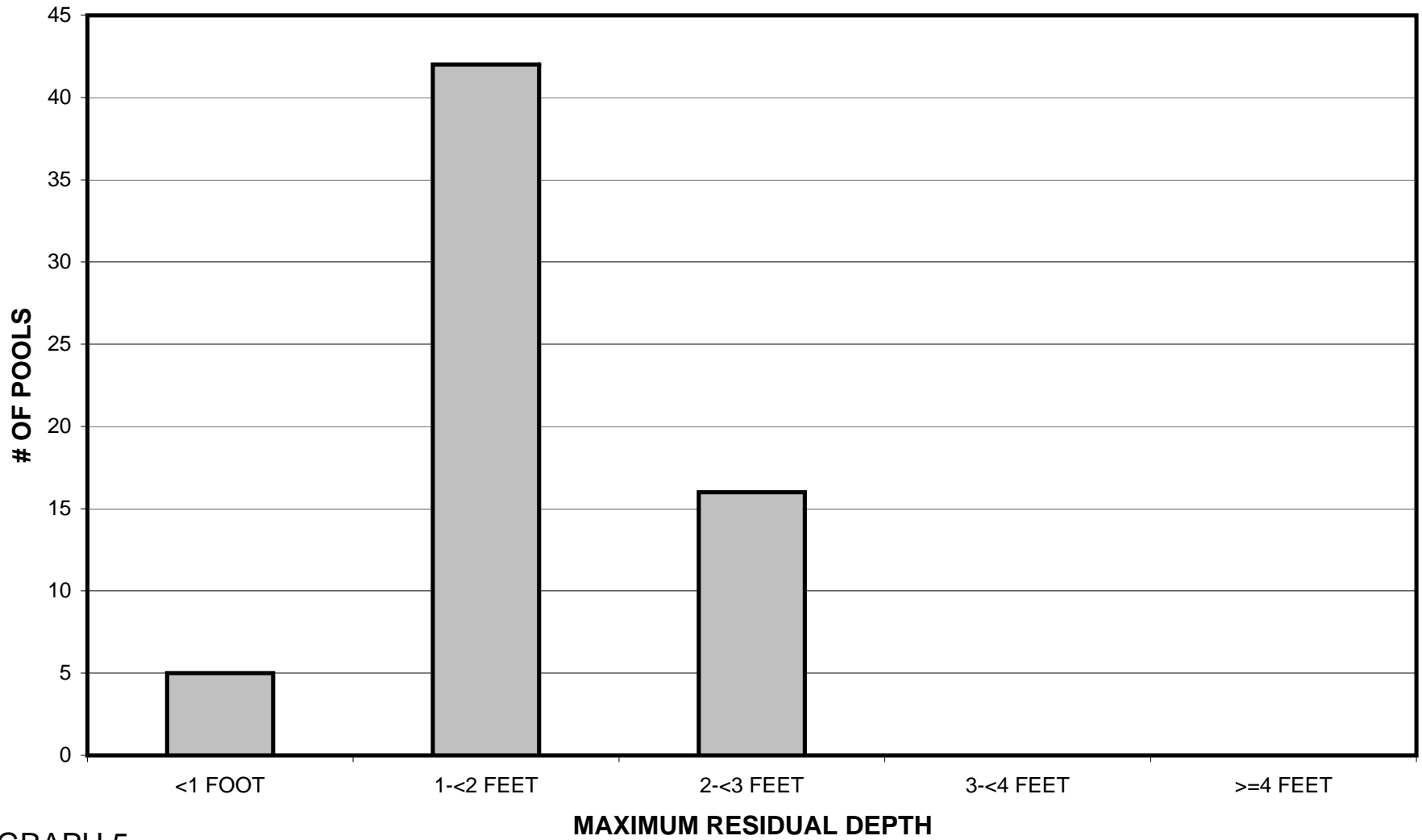
GRAPH 3

**COW CREEK 2007**  
**POOL TYPES BY PERCENT OCCURRENCE**



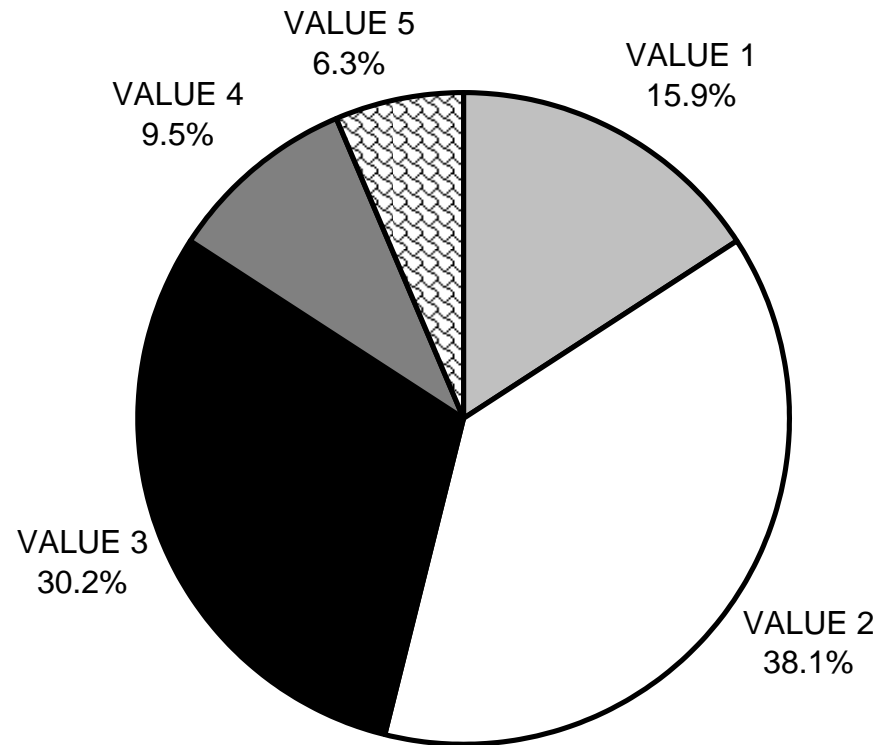
GRAPH 4

# COW CREEK 2007 MAXIMUM DEPTH IN POOLS



GRAPH 5

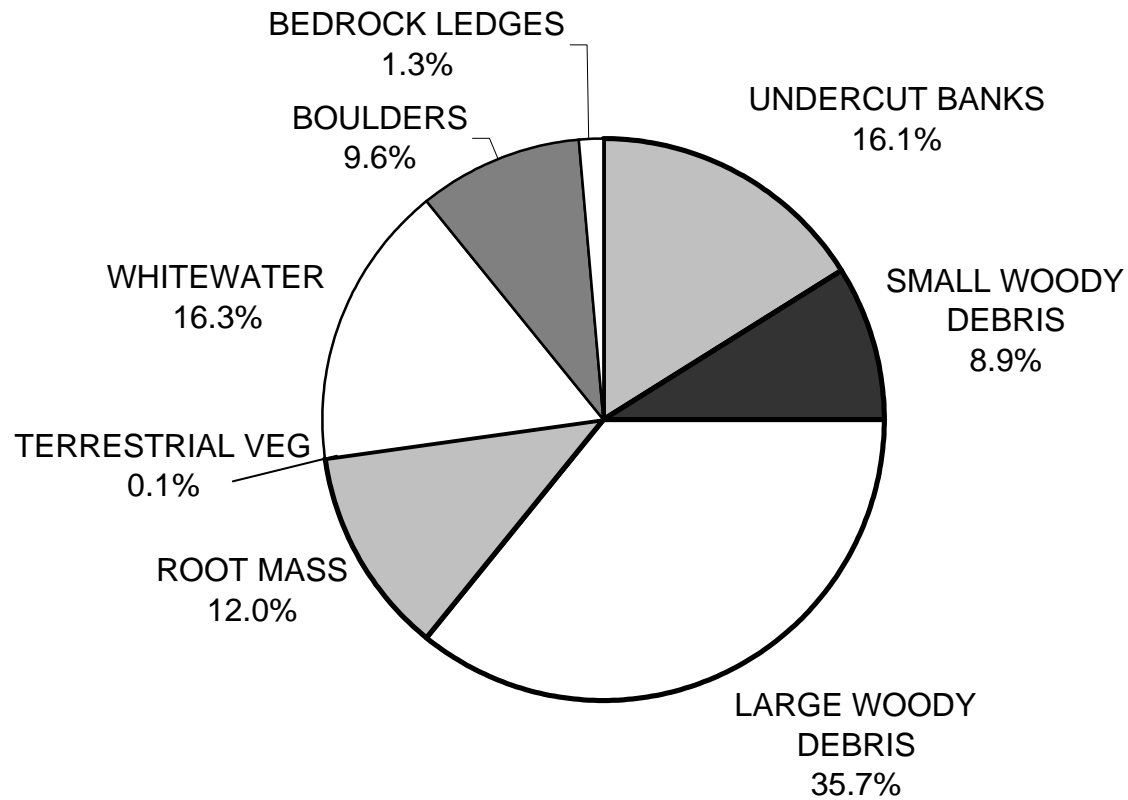
# COW CREEK 2007 PERCENT EMBEDDEDNESS



GRAPH 6

# COW CREEK 2007

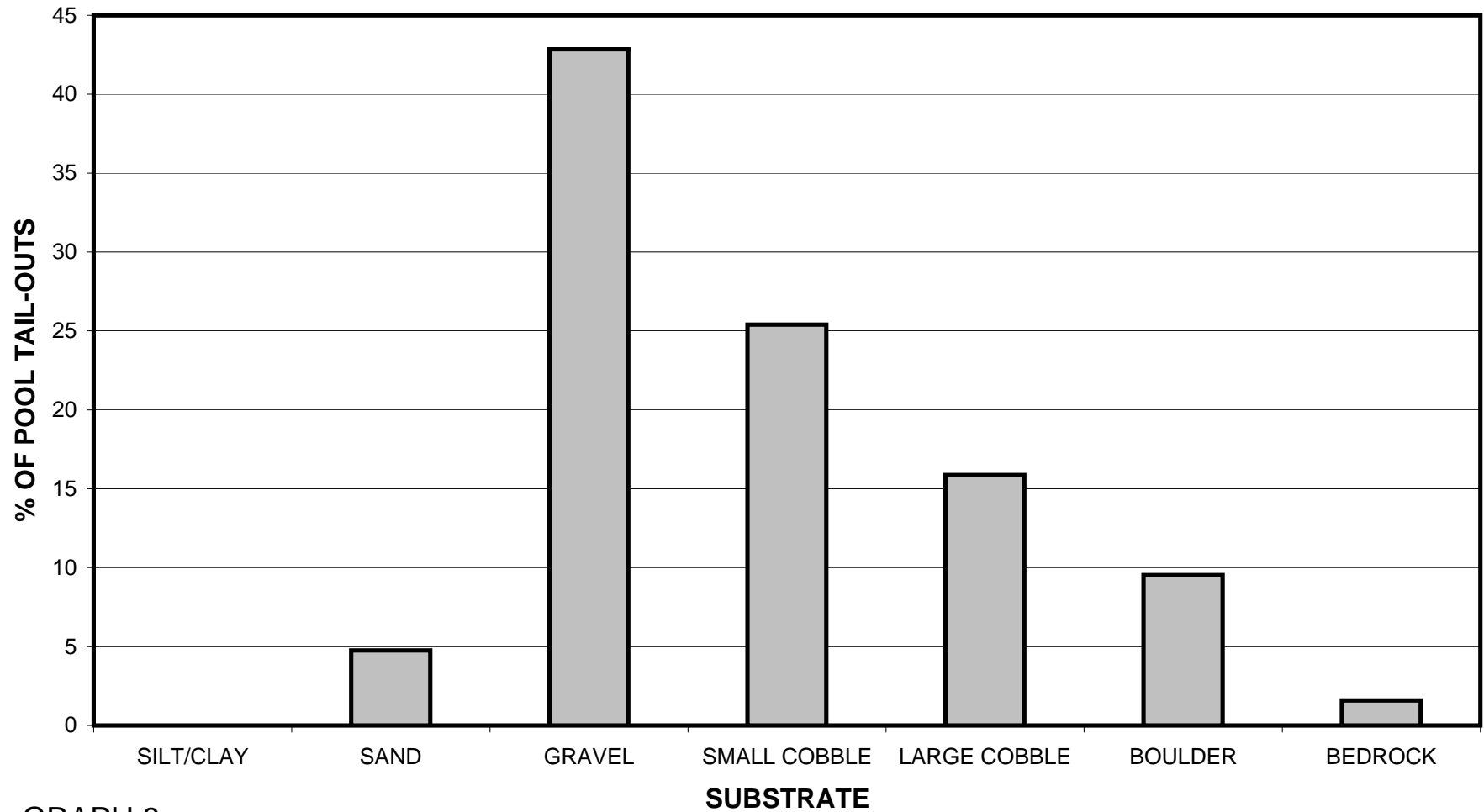
## MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

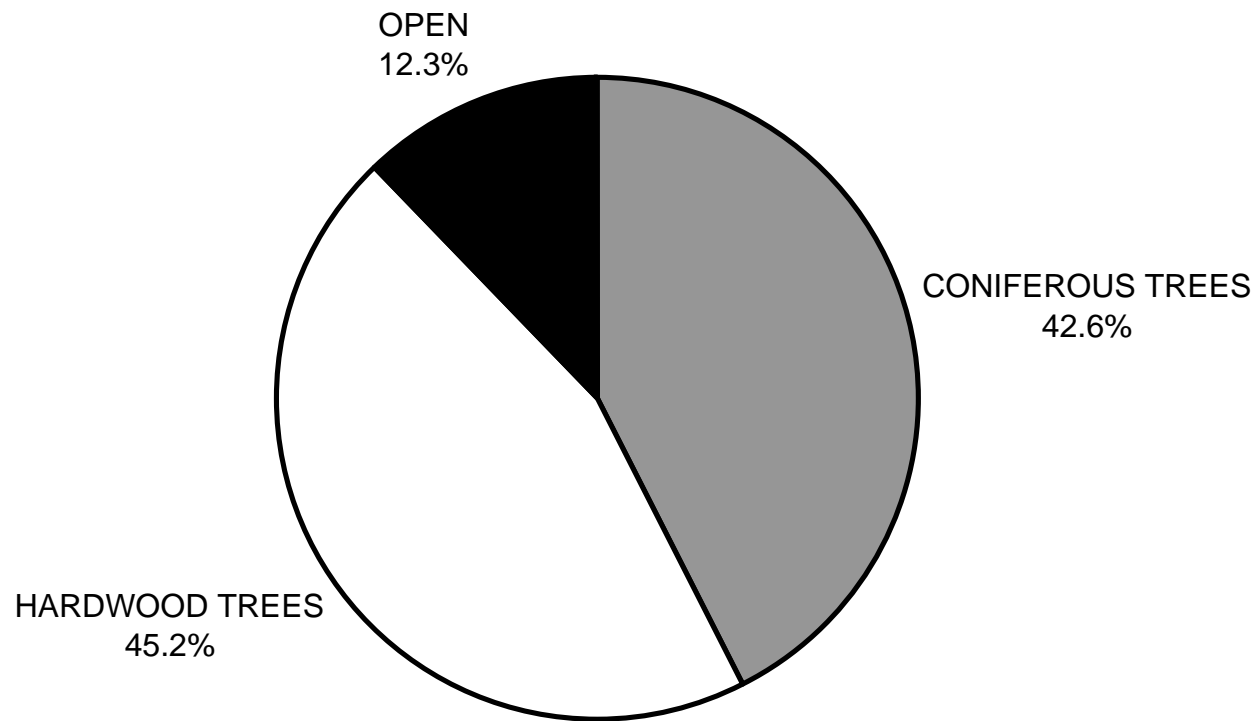


**COW CREEK 2007**  
**SUBSTRATE COMPOSITION IN POOL TAIL-OUTS**



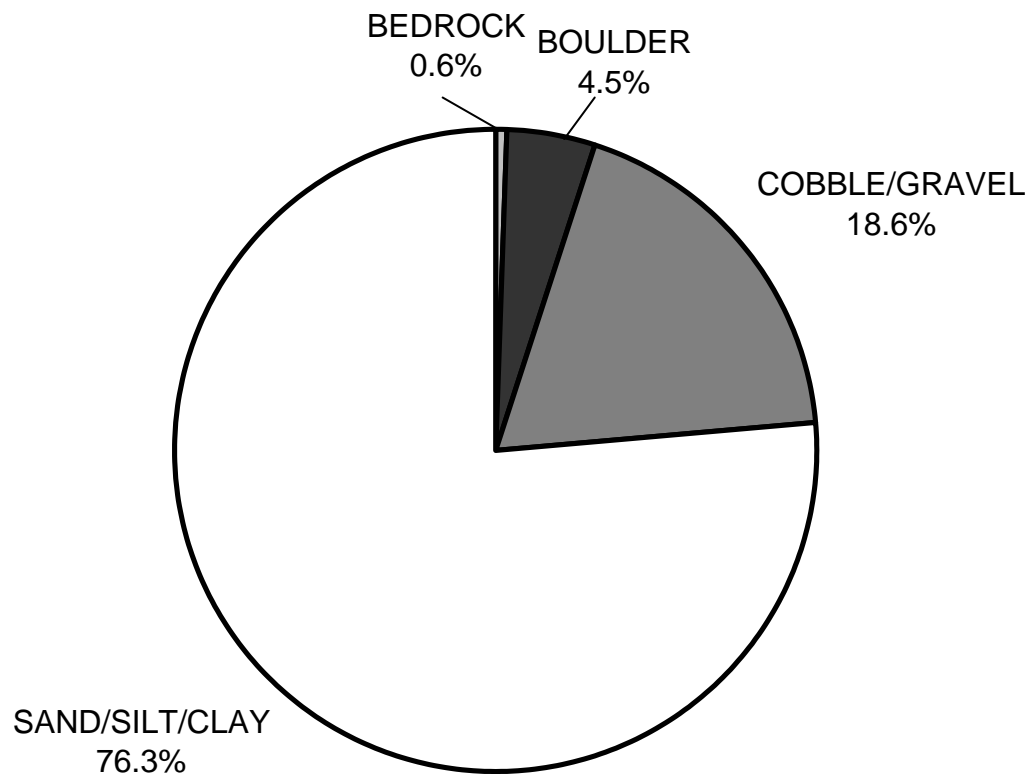
GRAPH 8

**COW CREEK 2007  
MEAN PERCENT CANOPY**



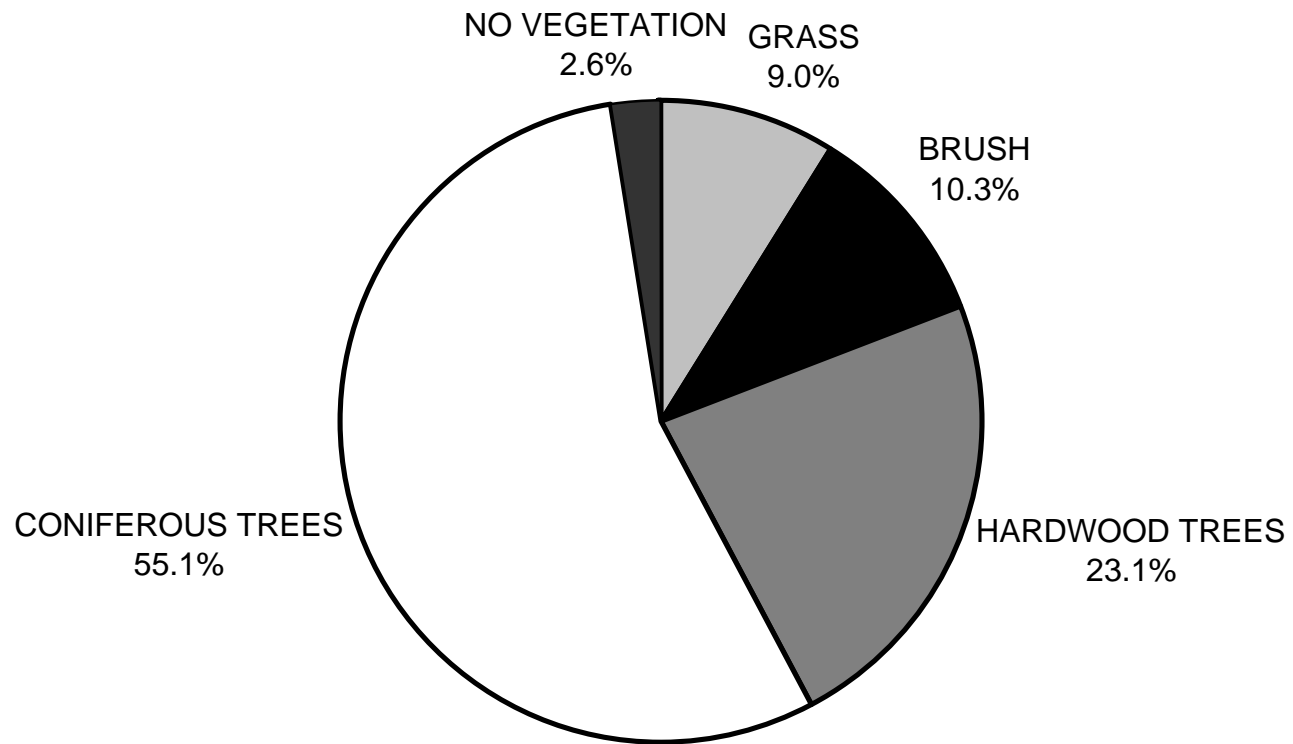
GRAPH 9

**COW CREEK 2007**  
**DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**COW CREEK 2007**  
**DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11