

# STREAM INVENTORY REPORT

## Lawrence Creek 2006

### INTRODUCTION

A stream inventory was conducted from August 8, 2006 to August 17, 2006 on Lawrence Creek. The survey began at the confluence with Yager Creek and extended upstream 6 miles.

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

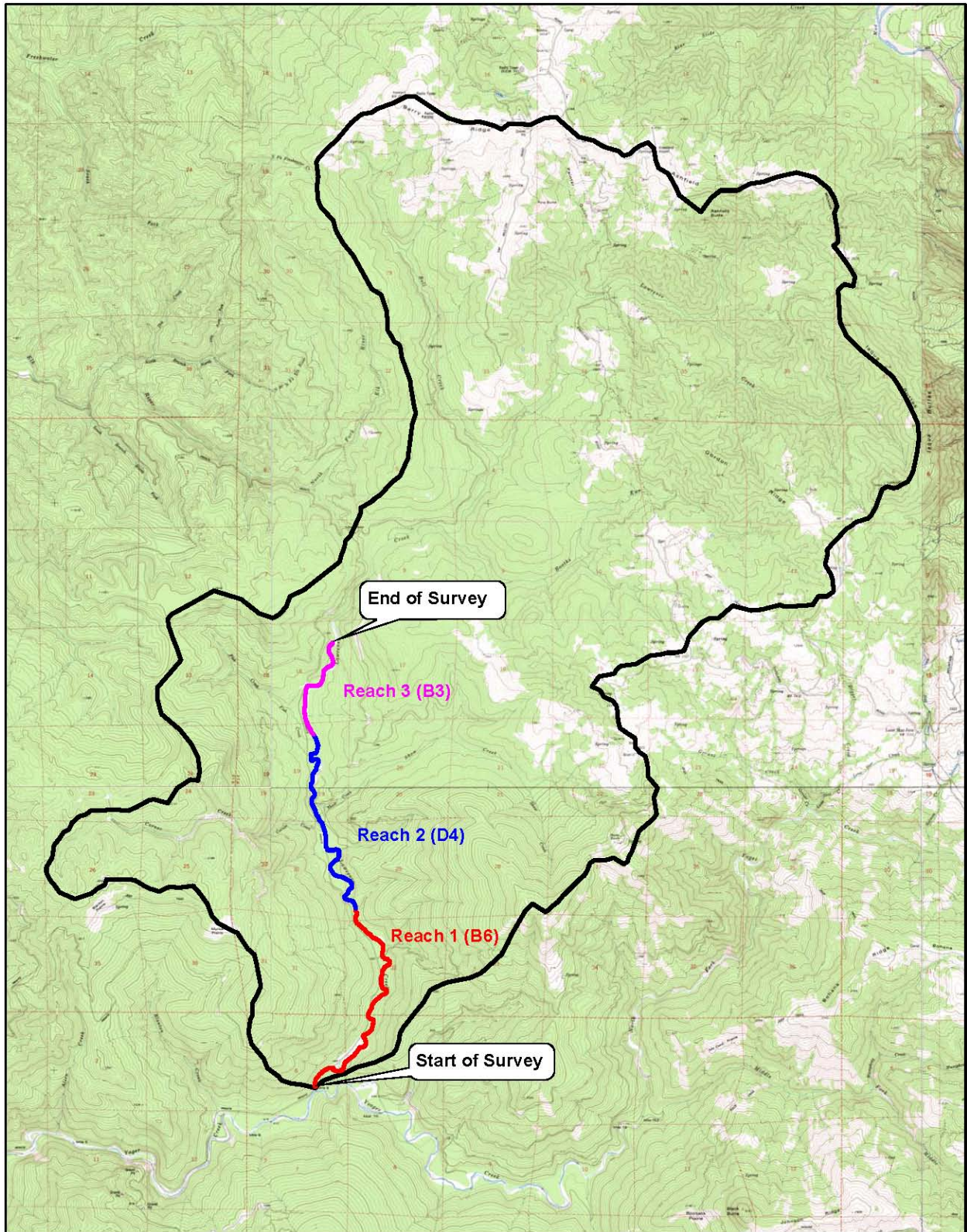
### WATERSHED OVERVIEW

Lawrence Creek is a tributary to Yager Creek, tributary to Van Duzen River, tributary to the Eel River, which is a tributary to Pacific Ocean, located in Humboldt County, California. Lawrence Creek's legal description at the confluence with Yager Creek is T04N R02E S34. Its location is 40°34'49.0N" north latitude and 123°59'29.0W" west longitude, LLID number 1239913405804. Lawrence Creek is a 3<sup>rd</sup> order stream according to the USGS Iaqua Buttes 7.5 minute quadrangle. Lawrence Creek drains a watershed of approximately 42.07 square miles. Summer base runoff is approximately 1.6 cubic feet per second (cfs) at the mouth. Elevations range from about 414 feet at the mouth of the creek to 2,900 feet in the headwater areas. Mixed hardwood and mixed conifer forest dominates the watershed. The watershed is privately owned mostly by Pacific Lumber Company and is managed for timber production. Vehicle access exists via Highway 101 south of Fortuna to Highway 36 East. Turn left onto Fisher Road, and proceed to PALCO property. Then turn left onto the main haul road at the orange gate, and then turn right onto the next road at the 'Y' intersection. Travel on the main haul road for 7.2 miles past Yager Camp to access Road #9.

### METHODS

The habitat inventory conducted in Lawrence 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.

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### 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. All pools except step-pools are fully sampled.

### 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 Lawrence 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". Lawrence 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

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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 Lawrence 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 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 Lawrence 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 Lawrence 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 Lawrence Creek, the dominant composition type and the dominant

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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. Currently the LWD data forms are missing and therefore there are no tables generated communicating the LWD encounters.

### 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 2.0.19, 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 Lawrence Creek include:

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence



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- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

### HABITAT INVENTORY RESULTS

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

The habitat inventory of August 8, 2006 to August 17, 2006, was conducted by H. Sgalitzer, I. Mikus, and B. Rahn (WSP). The total length of the stream surveyed was 31,890 feet with an additional 1,718 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 1.6 cfs on October 31, 2006.

Lawrence Creek is a B6 channel type for 14,465 feet of the stream surveyed (Reach 1), an F4 channel type for 12,300 feet of the stream surveyed (Reach 2), and a B3 channel type for 5,125 feet of the stream surveyed (Reach 3).

B6 channels are moderately entrenched riffle dominated channels with infrequently spaced pools and moderate gradients, very stable plan and profile with stable banks and silt/clay-dominant channels. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. B3 channels are: moderately entrenched riffle dominated channels with infrequently spaced pools, have moderate gradients, a very stable plan and profile with stable banks, and cobble-dominant channels.

Water temperatures taken during the survey period ranged from 56 to 68 degrees Fahrenheit. Air temperatures ranged from 56 to 76 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 34% flatwater units, 32% riffle units, 31% pool units, and 3% dry units (Graph 1). Based on total length of Level II habitat types there were 36% flatwater units, 33% riffle units, 28% pool units, and 3% dry units (Graph 2).

Sixteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 29% low gradient riffle units, 27% run units, and 18% mid-channel pool units, (Graph 3). Based on percent total length, 30% low gradient riffle units, 26% run units, and 16% mid-channel pool units.

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A total of 91 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 63% (Graph 4), and comprised 70% 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. Forty-two of the 91 pools (46%) had a residual depth of three feet or greater (Graph 5). The depth of cobble embeddedness was estimated at pool tail-outs. Of the 84 pool tail-outs measured, 14 had a value of 1 (16.7%); 48 had a value of 2 (57.1%); 14 had a value of 3 (16.7%); 6 had a value of 4 (7.1%); 2 had a value of 5 (2.4%); (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 38, flatwater habitat types had a mean shelter rating of 18, and pool habitats had a mean shelter rating of 40 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 36, scour pools had a mean shelter rating of 41, backwater pools had a mean shelter rating of 52 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Lawrence Creek. Graph 7 describes the pool cover in Lawrence Creek. Boulders 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 observed in 34% of pool tail-outs and small cobble observed in 29% of pool tail-outs.

The mean percent canopy density for the surveyed length of Lawrence Creek was 70%. Thirty percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 14% and 86%, respectively. Graph 9 describes the mean percent canopy in Lawrence Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 93%. The mean percent left bank vegetated was 91%. The dominant elements composing the structure of the stream banks consisted of 56% cobble/gravel, 22% sand/silt/clay, 17% boulder, and 5% bedrock (Graph 10). Hardwood trees were the dominant vegetation type observed in 74% of the units surveyed. Additionally, 18.8% of the units surveyed had coniferous trees as the dominant vegetation type, and 6.0% had brush as the dominant vegetation (Graph 11).

## BIOLOGICAL INVENTORY RESULTS

No sites were sampled for species composition and distribution in Lawrence Creek.

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### DISCUSSION

Lawrence Creek is a B6 channel type for the first 14,465 feet of the stream surveyed (Reach 1), a F4 channel type for the next 12,300 feet (Reach 2), and a B3 channel type for the remaining 5,125 feet (Reach 3). The suitability of B6, F4, B3 channel types for fish habitat improvement structures is as follows: B6 channel types are excellent for bank-placed boulders and/or log cover, good for plunge weirs, single and opposing wing-deflectors, and channel constrictors, fair for boulder clusters. F4 channel types are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover. B3 channel types are excellent for plunge weirs, boulder clusters and bank placed boulders, single and opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days August 8, 2006 to August 17, 2006, ranged from 56 to 68 degrees Fahrenheit. Air temperatures ranged from 56 to 76 degrees Fahrenheit. To make any 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 36% of the total length of this survey, riffles 33%, and pools 28%. Forty-two of the 91 (46%) pools had a maximum residual depth greater than 3 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third order streams, a primary pool is defined to have a maximum residual depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended.

Sixty-two of the 84 pool tail-outs measured had embeddedness ratings of 1 or 2. Twenty of the pool tail-outs had embeddedness ratings of 3 or 4. Two 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.

Fifty-seven of the 91 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 40. The shelter rating in the flatwater habitats was 18. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Lawrence Creek. Boulders 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 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 70%. Reach 1 had a canopy density of 71%, Reach 2 had a canopy density of 64%, Reach 3 had a canopy density of 73%. In general, revegetation projects are considered when canopy density is less than 80%.



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The percentage of right and left bank covered with vegetation was 93% and 91%, 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) Lawrence Creek should be managed as an anadromous, natural production stream.
- 2) 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.
- 3) Where feasible, design and engineer pool enhancement structures to increase the number and depth 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 boulders. Adding high quality complexity with woody cover in the pools is desirable.
- 5) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.
- 6) Increase the coniferous tree canopy on Lawrence Creek by planting appropriate native vegetation like redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

### 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 confluence of Yager Creek.
276	0004.00	Out of influence Yager Creek, start of 100% survey.

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910	0006.00	Log structure
1455	0009.00	Log/boulder structure
1829	0011.00	Log/boulder structure
2224	0015.00	Log structure
3004	0022.00	Bridge: railroad car, 20' wide x 18' high x 69' long.
3265	0026.00	Log/boulder structure
3843	0029.00	Log/boulder structure
4766	0039.00	Log/boulder structure
5183	0042.00	Boulder structure
6684	0055.00	Boulder structure
6728	0056.00	Right bank log structure, log spanning channel
7655	0065.00	Log debris accumulation (LDA); 8' high x 40' wide x 7' long, composed of 2 pieces large woody debris (LWD), water flows through, visible gaps, sediment retained, 25' wide x 30' long x 1' deep, fish observed above LDA.
7814	0066.00	Bank erosion
7936	0067.00	Bank erosion with vegetation, 20' high x 200' long x 5' deep
8700	0074.00	Boulder structure spanning creek
9703	0082.00	Log structure
11040	0100.00	Bridge: railroad car, 17' wide x 19' high x 47' long.
11993	0109.00	LDA, 11' high x 41' wide x 8' long; composed of 5 pieces LWD, water flows through, visible gaps, sediment retained, 20' wide x 30' long x 6' deep, fish observed above LDA.
12853	0113.05	Boulder/root wad structure
13394	0119.00	Boulder structure
15691	0141.00	Blown out LDA, has split channel

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15746	0142.00	Left bank erosion; 200' long x 60' high x 150' deep
16038	0144.00	Boulder structure
16721	0150.00	Boulder structure Right bank erosion; 40' long x 20' high x 3' deep
17151	0153.00	Boulder structure
24637	0225.00	Tributary #5; Fish Creek, dry at the confluence
28993	0254.00	Left bank tributary #6, water temperature in the tributary was 55° F, not accessible to fish, checked up tributary 60', slope: 18% slope, no fish observed
29710	0259.00	Right bank tributary #7, water temperature in the tributary was 55° F, access to fish, checked up tributary 40', slope: 7%, no fish observed
31890	0269.00	End of survey due to increase in gradient and reached end of previous habitat survey. Not the end of anadromy.

## REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3<sup>rd</sup> 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: Lawrence Creek

LLID: 1239913405804 Drainage: Van Duzen River

Survey Dates: 8/8/2006 to 8/17/2006

Confluence Location: Quad: IAQUA BUTTES Legal Description: T04NR02ES34 Latitude: 40:34:49.0N Longitude: 123:59:29.0

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
9	0	DRY	3.1	102	920	2.7									
99	16	FLATWATER	33.9	123	12212	36.3	26.7	1.0	2.1	4734	468633	4390	434648		18
91	91	POOL	31.2	105	9532	28.4	27.5	1.3	3.0	2805	255213	5535	503722	3900	40
93	10	RIFFLE	31.8	118	10944	32.6	24.9	0.6	1.3	1984	184480	1300	120895		38
<b>Total Units</b>	<b>Total Units Fully Measured</b>				<b>Total Length (ft.)</b>					<b>Total Area (sq.ft.)</b>			<b>Total Volume (cu.ft.)</b>		
292	117				33608					908325			1059265		

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

Stream Name: Lawrence Creek

LLID: 1239913405804

Drainage: Van Duzen River

Survey Dates: 8/8/2006 to 8/17/2006

Confluence Location: Quad: IAQUA BUTTES

Legal Description: T04NR02ES34

Latitude: 40:34:49.0N

Longitude: 123:59:29.0W

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 (%)
84	9	LGR	28.8	121	10192	30.3	24	0.6	2	2134	179294	1410	118405		41	65
9	1	HGR	3.1	84	752	2.2	29	0.5	0.8	626	5638	313	2819		20	53
5	2	POW	1.7	136	680	2.0	31	1.4	3.2	3679	18393	5879	29395		35	70
78	11	RUN	26.7	112	8725	26.0	26	0.9	3.7	4541	354195	4208	328199		12	71
16	3	SRN	5.5	175	2807	8.4	26	0.9	3.2	6144	98298	4068	65087		22	69
54	54	MCP	18.5	101	5453	16.2	29	1.3	5.2	2887	155922	5794	312894	4062	37	71
3	3	STP	1.0	399	1196	3.6	31	1.0	3.8	8688	26064	15568	46704	9400	25	71
10	10	CRP	3.4	122	1216	3.6	27	1.5	4.8	3390	33903	7668	76677	5710	64	62
1	1	LSR	0.3	81	81	0.2	20	0.6	3.7	1539	1539	2309	2309	923	50	85
2	2	LSBk	0.7	99	198	0.6	34	0.7	2.8	3191	6383	3925	7851	2186	8	38
4	4	LSBo	1.4	89	356	1.1	24	1.4	3.5	1671	6686	2996	11982	2294	20	88
3	3	PLP	1.0	53	159	0.5	28	1.3	3	1339	4018	2292	6876	1756	17	56
7	7	SCP	2.4	49	344	1.0	15	0.8	4.2	695	4868	737	5160	619	50	89
2	2	BPB	0.7	78	155	0.5	33	1.0	4	2158	4315	3514	7027	2671	20	73
5	5	BPR	1.7	75	374	1.1	31	1.4	7.3	2303	11516	5249	26243	4158	68	71
9	0	DRY	3.1	102	920	2.7										98

Total Units Fully Measured  
292 117

Total Length (ft.)  
33608

Total Area (sq.ft.)  
911031

Total Volume (cu.ft.)  
1047626



**Table 3 - Summary of Pool Types**

Stream Name: Lawrence Creek

LLID: 1239913405804

Drainage: Van Duzen River

Survey Dates: 8/8/2006 to 8/17/2006

Confluence Location: Quad: IAQUA BUTTES

Legal Description: T04NR02ES34

Latitude: 40:34:49.0N

Longitude: 123:59:29.0W

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
57	57	MAIN	63	117	6649	70	28.8	1.3	3193	181986	4343	247557	36
20	20	SCOUR	22	101	2010	21	26.9	1.3	2626	52528	3842	76835	41
14	14	BACKWATER	15	62	873	9	23.2	1.0	1478	20699	2176	30463	52
<b>Total Units</b>	<b>Total Units Fully Measured</b>				<b>Total Length (ft.)</b>					<b>Total Area (sq.ft.)</b>		<b>Total Volume (cu.ft.)</b>	
91	91				9532					255213		354855	

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

Stream Name: Lawrence Creek LLID: 1239913405804 Drainage: Van Duzen River  
 Survey Dates: 8/8/2006 to 8/17/2006  
 Confluence Location: Quad: IAQUA BUTTES Legal Description: T04NR02ES34 Latitude: 40:34:49.0N Longitude: 123:59:29.0W

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
54	MCP	59	1	2	6	11	22	41	16	30	9	17
3	STP	3	0	0	0	0	1	33	2	67	0	0
10	CRP	11	0	0	1	10	2	20	2	20	5	50
1	LSR	1	0	0	0	0	0	0	1	100	0	0
2	LSBk	2	0	0	0	0	2	100	0	0	0	0
4	LSBo	4	0	0	0	0	2	50	2	50	0	0
3	PLP	3	0	0	0	0	2	67	1	33	0	0
7	SCP	8	0	0	4	57	2	29	0	0	1	14
2	BPB	2	0	0	1	50	0	0	0	0	1	50
5	BPR	5	0	0	0	0	3	60	1	20	1	20
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
91			1	1	12	13	36	40	25	27	17	19

Mean Maximum Residual Pool Depth (ft.): 3

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

Stream Name: Lawrence Creek

LLID: 1239913405804

Drainage: Van Duzen River

Survey Dates: 8/8/2006 to 8/17/2006

Dry Units: 9

Confluence Location: Quad: IAQUA BUTTES

Legal Description: T04NR02ES34

Latitude: 40:34:49.0N

Longitude: 123:59:29.0W

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
84	8	LGR	1	9	1	4	9	0	1	74	1
9	1	HGR	0	0	0	0	0	0	0	100	0
93	9	TOTAL RIFFLE	1	8	1	3	8	0	1	77	1
5	2	POW	0	0	0	0	5	0	0	95	0
78	9	RUN	23	3	4	0	4	0	0	56	9
16	3	SRN	3	0	3	0	0	0	0	80	13
99	14	TOTAL FLAT	16	2	4	0	4	0	0	66	9
54	49	MCP	6	10	25	7	4	0	0	41	7
3	3	STP	0	0	3	7	0	0	7	83	0
10	9	CRP	6	17	10	13	16	0	0	29	10
1	1	LSR	40	30	20	0	0	0	0	10	0
2	2	LSBk	0	0	0	0	0	0	0	70	30
4	4	LSBo	0	4	21	18	3	0	0	55	0
3	3	PLP	7	3	27	0	0	3	3	57	0
7	6	SCP	3	2	30	38	7	0	0	20	0
2	2	BPB	0	0	0	15	5	0	0	80	0
5	5	BPR	2	18	18	50	0	0	0	12	0
91	84	TOTAL POOL	5	9	21	13	5	0	1	40	6
292	107	TOTAL	6	8	17	10	5	0	1	47	6

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

Stream Name: Lawrence Creek

LLID: 1239913405804

Drainage: Van Duzen River

Survey Dates: 8/8/2006 to 8/17/2006

Dry Units: 9

Confluence Location: Quad: IAQUA BUTTES

Legal Description: T04NR02ES34

Latitude: 40:34:49.0N

Longitude: 123:59:29.0W

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
84	9	LGR	0	0	11	33	11	44	0
9	1	HGR	0	0	0	0	0	100	0
5	2	POW	0	0	0	0	0	100	0
78	11	RUN	0	18	36	27	0	18	0
16	3	SRN	0	0	33	0	0	67	0
54	54	MCP	17	13	9	20	20	19	2
3	3	STP	0	33	0	0	0	67	0
10	10	CRP	10	20	30	0	30	10	0
1	1	LSR	0	0	100	0	0	0	0
2	2	LSBk	50	50	0	0	0	0	0
4	4	LSBo	25	0	25	0	0	50	0
3	3	PLP	0	0	0	67	33	0	0
7	7	SCP	43	0	14	14	29	0	0
2	2	BPB	50	0	0	0	0	50	0
5	5	BPR	20	0	40	20	20	0	0

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

Stream Name: Lawrence Creek

LLID: 1239913405804

Drainage: Van Duzen River

Survey Dates: 8/8/2006 to 8/17/2006

Confluence Location: Quad: IAQUA BUTTES

Legal Description: T04NR02ES34

Latitude: 40:34:49.0N

Longitude: 123:59:29.0W

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Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
70	14	86	0	93	91

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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: Lawrence Creek LLID: 1239913405804 Drainage: Van Duzen River  
 Survey Dates: 8/8/2006 to 8/17/2006 Survey Length (ft.): 33608 Main Channel (ft.): 31890 Side Channel (ft.): 1718  
 Confluence Location: Quad: IAQUA BUTTES Legal Description: T04NR02ES34 Latitude: 40:34:49.0N Longitude: 123:59:29.0W

**Summary of Fish Habitat Elements By Stream Reach**

**STREAM REACH: 1**

Channel Type: B6	Canopy Density (%): 72.4	Pools by Stream Length (%): 31.4
Reach Length (ft.): 14465	Coniferous Component (%): 12.6	Pool Frequency (%): 37.9
Riffle/Flatwater Mean Width (ft.): 29.7	Hardwood Component (%): 87.4	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 15
Range (ft.): 25 to 59	Vegetative Cover (%): 91.6	2 to 2.9 Feet Deep: 42
Mean (ft.): 43	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 25
Std. Dev.: 9	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 19
Base Flow (cfs.): 1.6	Occurrence of LWD (%): 21	Mean Max Residual Pool Depth (ft.): 3.0
Water (F): 62 - 68 Air (F): 56 - 76	LWD per 100 ft.:	Mean Pool Shelter Rating: 40
Dry Channel (ft): 480	Riffles: 0	
	Pools: 2	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 6 Gravel: 36 Sm Cobble: 26 Lg Cobble: 28 Boulder: 2 Bedrock: 2		
Embeddedness Values (%): 1. 22.6 2. 43.4 3. 17.0 4. 13.2 5. 3.8		

**STREAM REACH: 2**

Channel Type: D4	Canopy Density (%): 65.0	Pools by Stream Length (%): 28.7
Reach Length (ft.): 12300	Coniferous Component (%): 13.4	Pool Frequency (%): 27.5
Riffle/Flatwater Mean Width (ft.): 23.8	Hardwood Component (%): 86.6	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 15
Range (ft.): 32 to 76	Vegetative Cover (%): 92.2	2 to 2.9 Feet Deep: 36
Mean (ft.): 44	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 30
Std. Dev.: 10	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 18
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 13	Mean Max Residual Pool Depth (ft.): 3.0
Water (F): 59 - 65 Air (F): 57 - 66	LWD per 100 ft.:	Mean Pool Shelter Rating: 41
Dry Channel (ft): 440	Riffles: 0	
	Pools: 2	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 33 Sm Cobble: 30 Lg Cobble: 21 Boulder: 15 Bedrock: 0		
Embeddedness Values (%): 1. 6.1 2. 72.7 3. 21.2 4. 0.0 5. 0.0		



### Summary of Fish Habitat Elements By Stream Reach

**STREAM REACH: 3**

Channel Type: B3	Canopy Density (%): 72.5	Pools by Stream Length (%): 18.6
Reach Length (ft.): 5125	Coniferous Component (%): 23.8	Pool Frequency (%): 15.6
Riffle/Flatwater Mean Width (ft.): 23.5	Hardwood Component (%): 76.2	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 0
Range (ft.): 34 to 57	Vegetative Cover (%): 92.5	2 to 2.9 Feet Deep: 40
Mean (ft.): 44	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 40
Std. Dev.: 10	Dominant Bank Substrate Type: Boulder	>= 4 Feet Deep: 20
Base Flow (cfs.): 0.0	Occurrence of LWD (%): 4	Mean Max Residual Pool Depth (ft.): 3.3
Water (F): 56 - 60	Air (F): 58 - 60	Mean Pool Shelter Rating: 26
Dry Channel (ft): 0	LWD per 100 ft.:	
	Riffles: 0	
	Pools: 0	
	Flat: 0	
Pool Tail Substrate (%):	Silt/Clay: 0	Sand: 0
	Gravel: 20	Sm Cobble: 40
	Lg Cobble: 0	Boulder: 40
	Bedrock: 0	
Embeddedness Values (%):	1. 0.0	2. 40.0
	3. 20.0	4. 40.0
	5. 0.0	

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

Stream Name: Lawrence Creek

LLID: 1239913405804

Drainage: Van Duzen River

Survey Dates: 8/8/2006 to 8/17/2006

Confluence Location: Quad: IAQUA BUTTES

Legal Description: T04NR02ES34

Latitude: 40:34:49.0N

Longitude: 123:59:29.0W

**Mean Percentage of Dominant Stream Bank Substrate**

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Bedrock	4	7	4.7
Boulder	21	19	17.1
Cobble / Gravel	65	65	55.6
Sand / Silt / Clay	27	25	22.2

**Mean Percentage of Dominant Stream Bank Vegetation**

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	1	0	0.4
Brush	4	10	6.0
Hardwood Trees	85	89	74.4
Coniferous Trees	27	17	18.8
No Vegetation	0	0	0.0

**Total Stream Cobble Embeddedness Values:**

2

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

StreamName: Lawrence Creek

LLID: 1239913405804

Drainage: Van Duzen River

Survey Dates: 8/8/2006 to 8/17/2006

Confluence Location: Quad: IAQUA BUTTES

Legal Description: T04NR02ES34

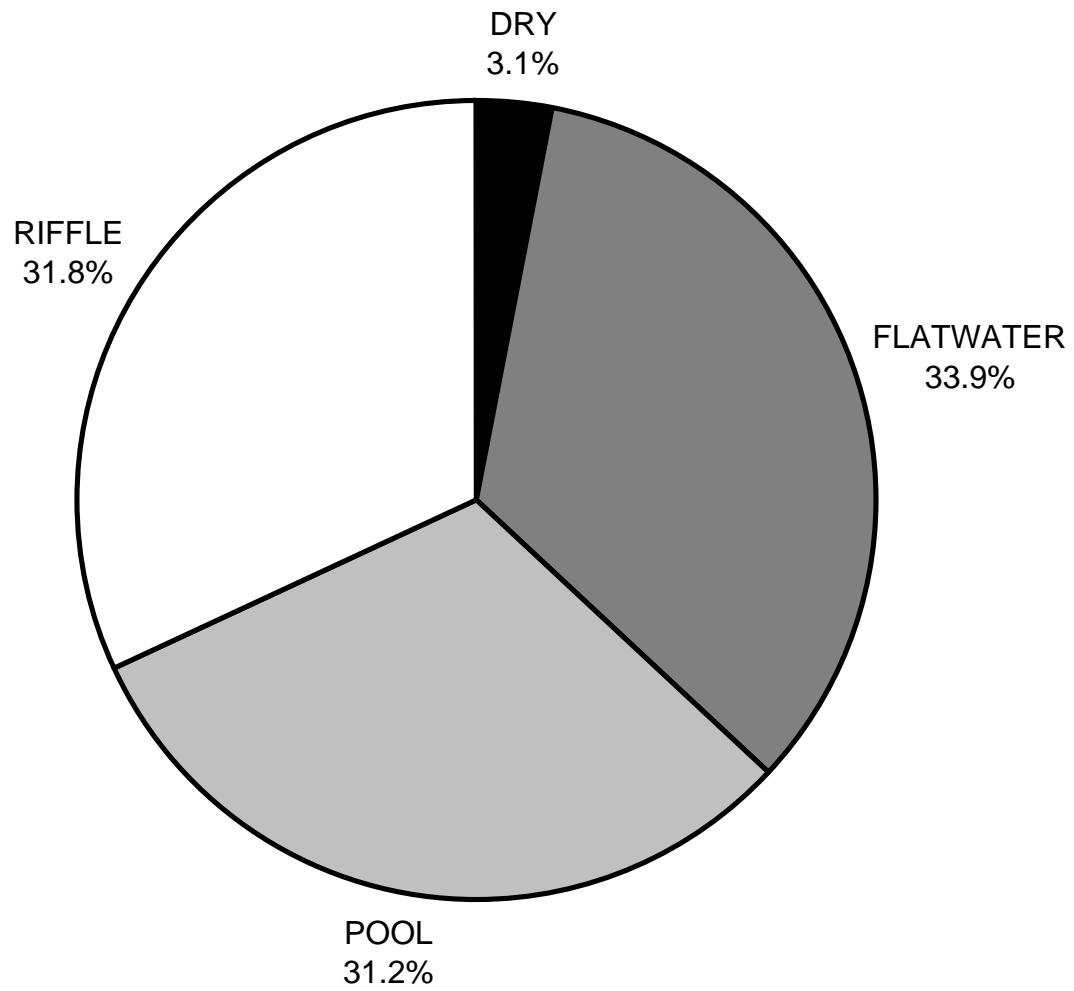
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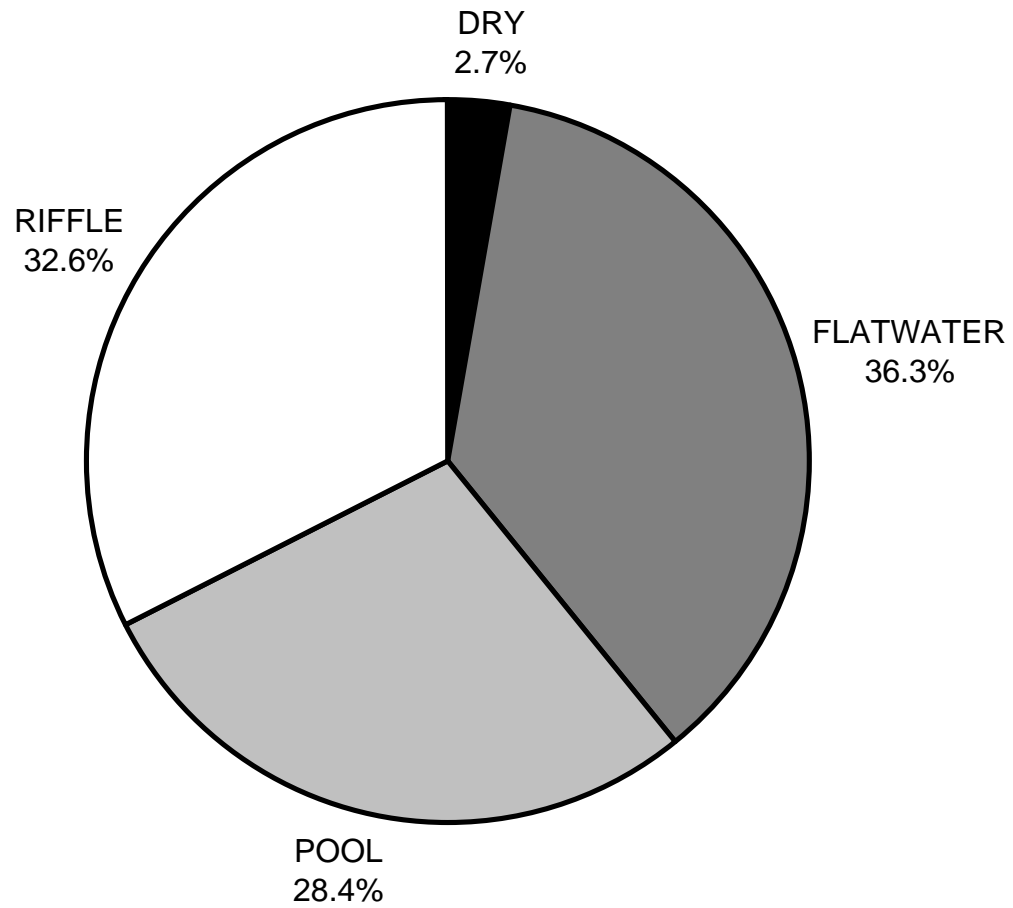
	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
UNDERCUT BANKS (%)	1	16	5
SMALL WOODY DEBRIS (%)	8	2	9
LARGE WOODY DEBRIS (%)	1	4	21
ROOT MASS (%)	3	0	13
TERRESTRIAL VEGETATION (%)	8	4	5
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	1	0	1
BOULDERS (%)	77	66	40
BEDROCK LEDGES (%)	1	9	6

# LAWRENCE CREEK 2006 HABITAT TYPES BY PERCENT OCCURRENCE



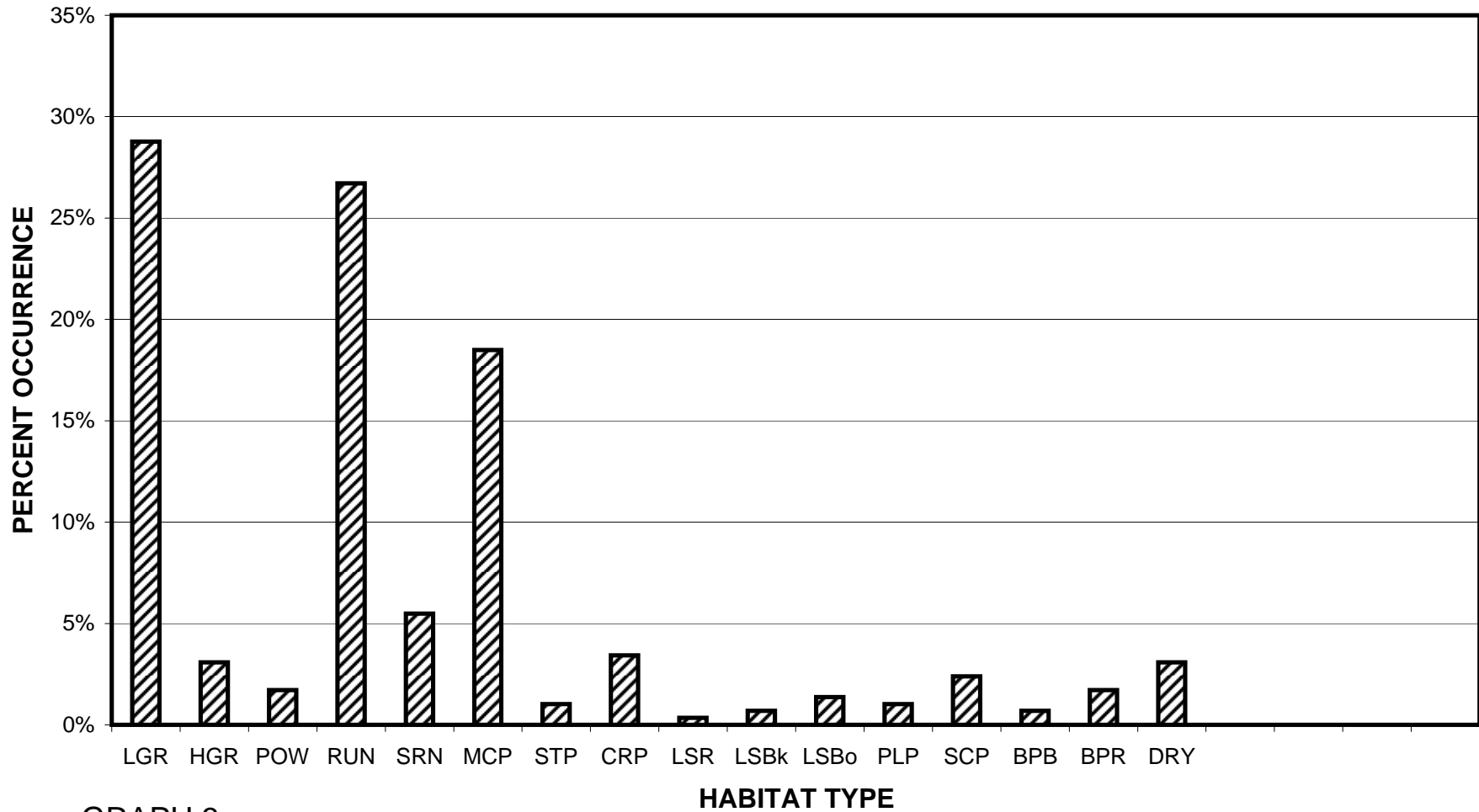
GRAPH 1

# LAWRENCE CREEK 2006 HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

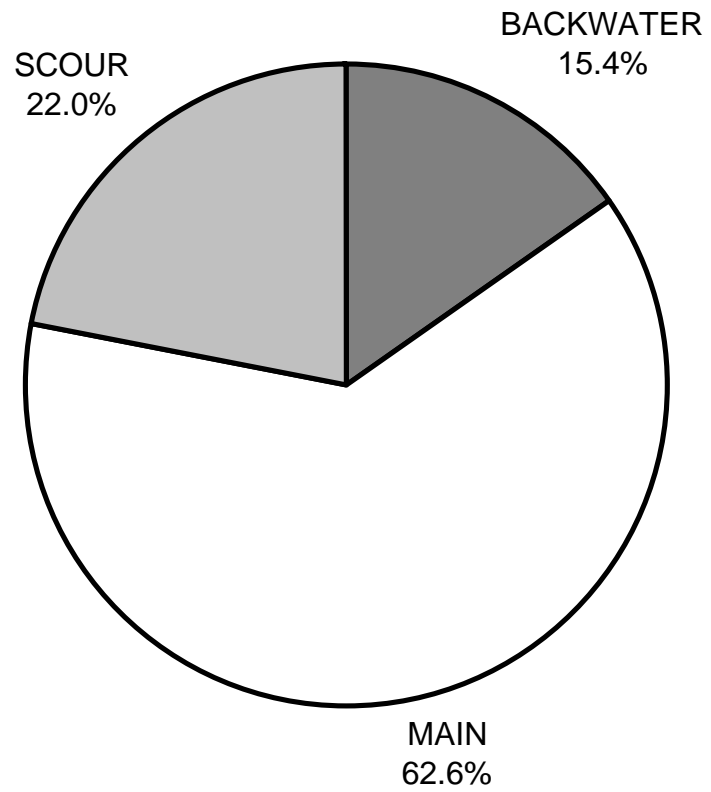
# LAWRENCE CREEK 2006 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

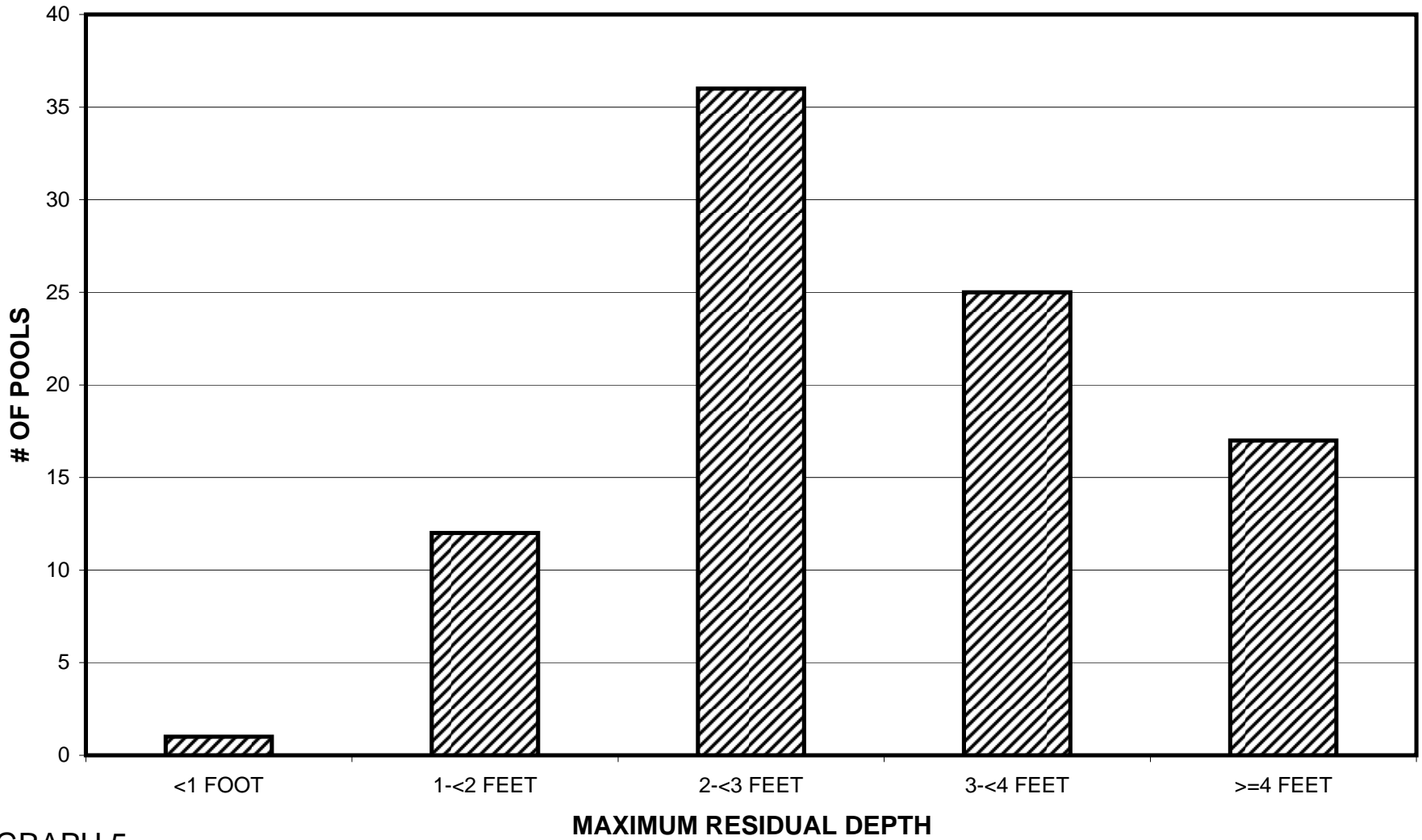


# LAWRENCE CREEK 2006 POOL TYPES BY PERCENT OCCURRENCE



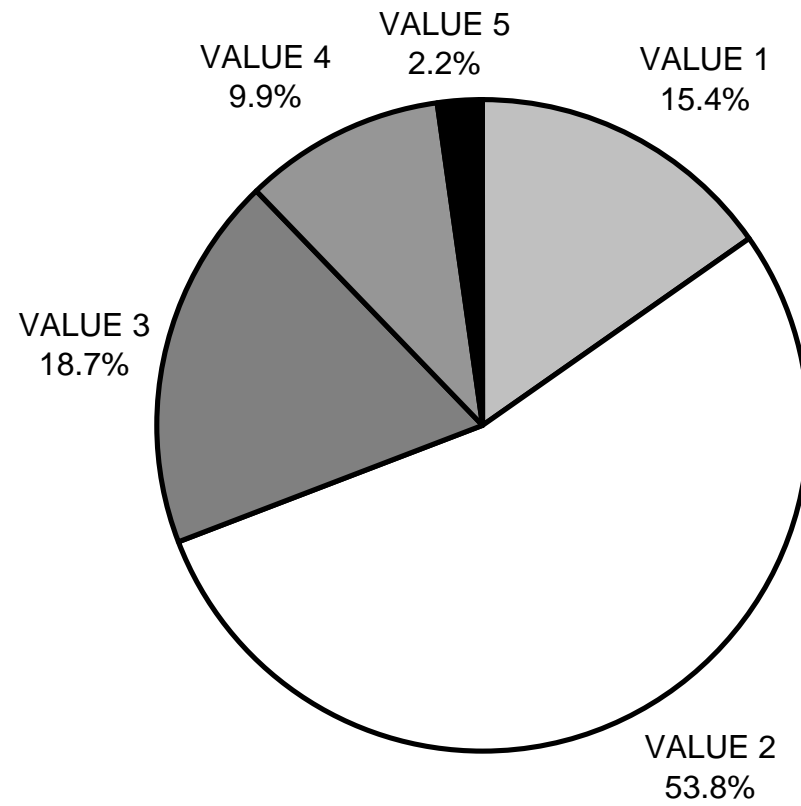
GRAPH 4

# LAWRENCE CREEK 2006 MAXIMUM DEPTH IN POOLS



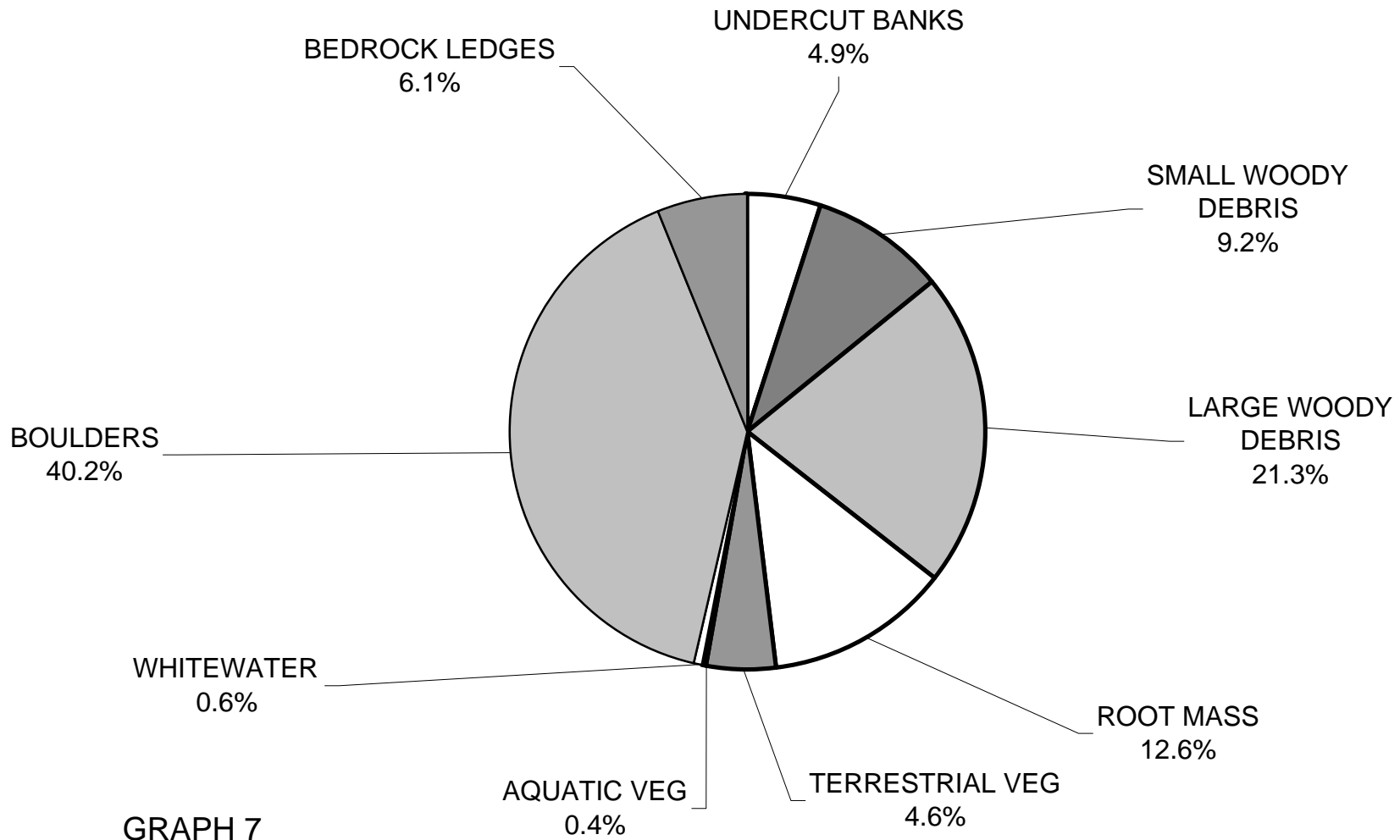
GRAPH 5

# LAWRENCE CREEK 2006 PERCENT EMBEDDEDNESS



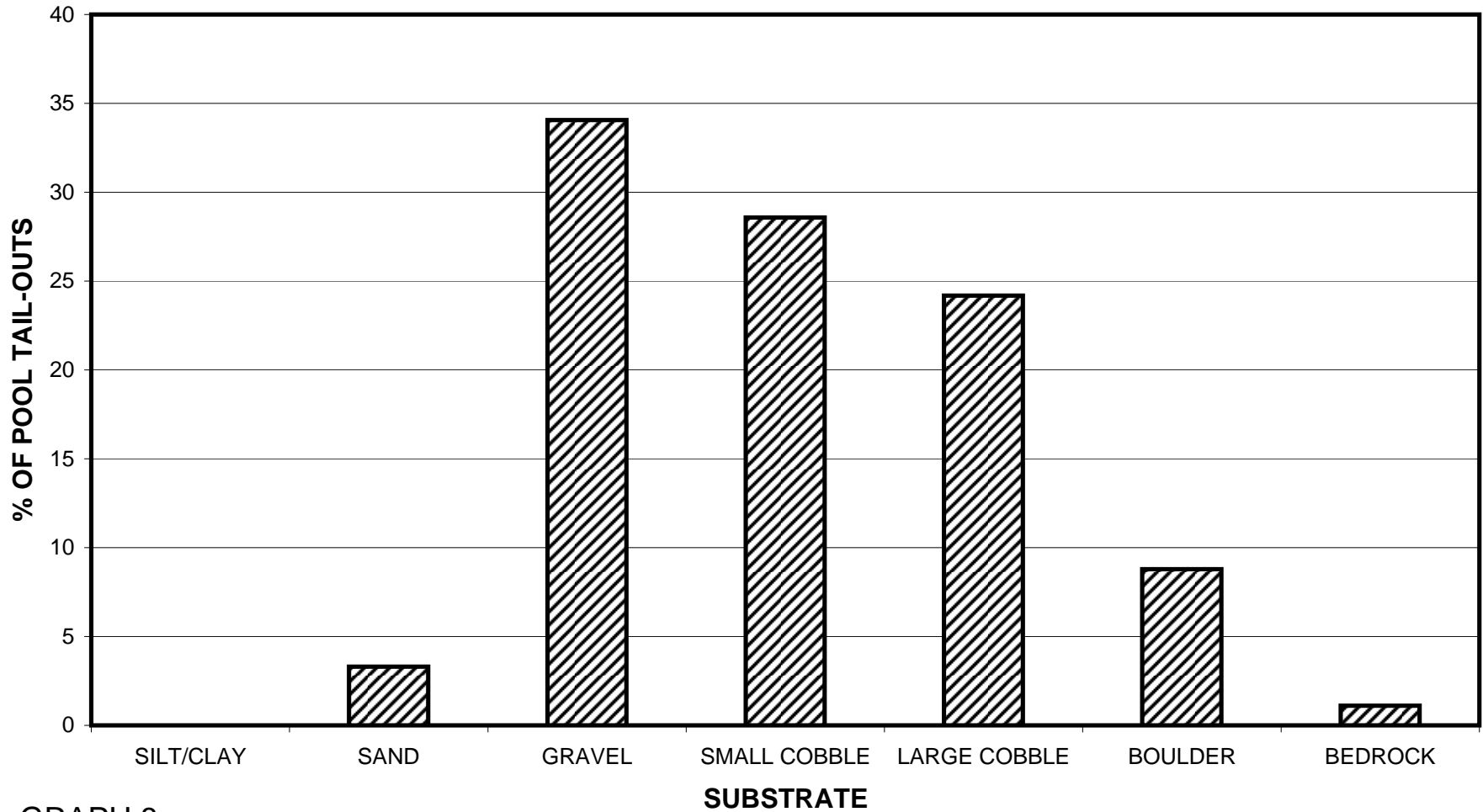
GRAPH 6

# LAWRENCE CREEK 2006 MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

# LAWRENCE CREEK 2006 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



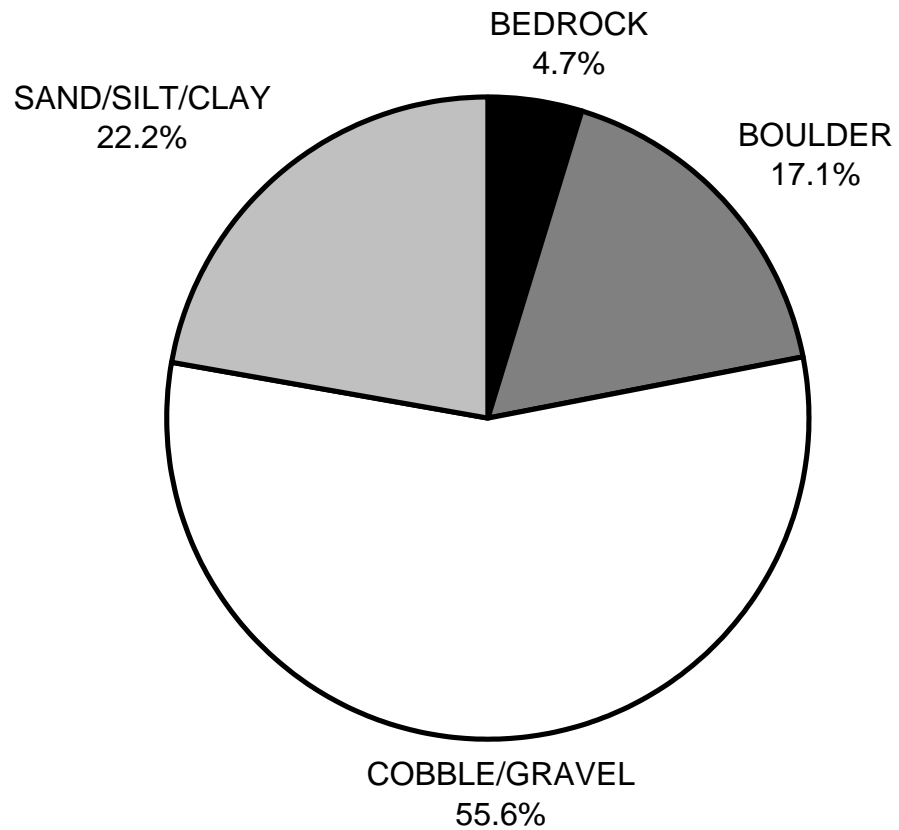
GRAPH 8

**LAWRENCE CREEK 2006  
MEAN PERCENT CANOPY**



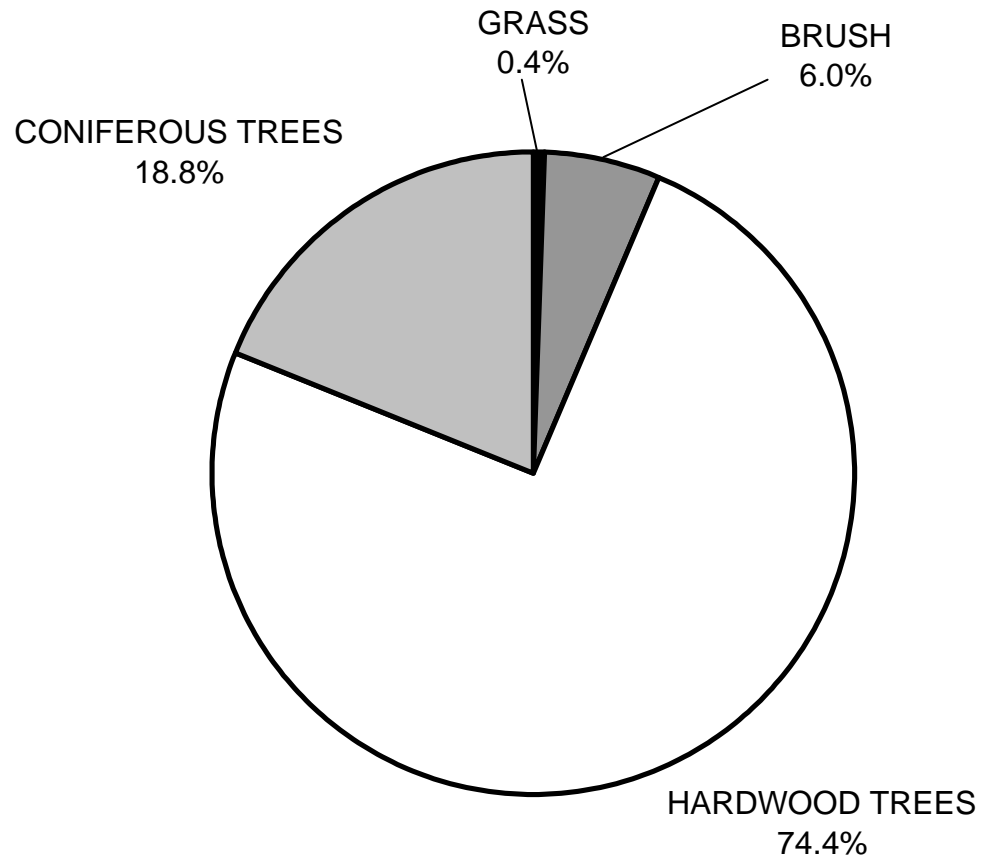
GRAPH 9

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



GRAPH 10

# LAWRENCE CREEK 2006 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11