

# STREAM INVENTORY REPORT

## Lake Creek

### INTRODUCTION

A stream inventory was conducted from July 6 through July 11, 1990 on Lake Creek. The survey began at the confluence with North Fork Elk River and extended upstream 1.3 miles.

The Lake 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 Lake 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 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

Lake Creek is a tributary to North Fork Elk River, a tributary to Elk River, a tributary to Humboldt Bay, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). Lake Creek's legal description at the confluence with North Fork Elk River is T04N R01E S32. Its location is 40.6918 degrees north latitude and 124.0924 degrees west longitude, LLID number 1240912406919. Lake Creek is a first order stream and has approximately 2.3 miles of blue line stream according to the USGS 7.5 minute quadrangle. Lake Creek drains a watershed of approximately 2.1 square miles. Elevations range from about 150 feet at the mouth of the creek to 1,000 feet in the headwater areas. Redwood forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production.

### METHODS

The habitat inventory conducted in Lake Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) 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

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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 Lake 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". Lake 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 Lake 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. 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 Lake 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 Lake 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 Lake 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

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elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

### 11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

## BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in Lake Creek. In addition, two sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

## HABITAT INVENTORY RESULTS

The habitat inventory of July 6 through July 11, 1990 was conducted by G. Moody, M. Long, and S. Holzerland (CCC). The total length of the stream surveyed was 6,716 feet with an additional 231 feet of side channel.

Stream flow was not measured on Lake Creek.

Lake Creek is a B1 channel type for 497 feet (Reach 1), a C5 channel type for 4,091 feet (Reach 2), and a C4 channel type for 2,128 feet (Reach 3). B1 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and bedrock-dominant substrates. C5 channels are meandering point-bar, riffle/pool, alluvial channels with broad well defined floodplain on low gradients and sand-dominant substrates. C4 channels are meandering point-bar, riffle/pool, alluvial channels with broad well defined floodplain on low gradients and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 52 to 55 degrees Fahrenheit. Air temperatures ranged from 55 to 68 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 65% pool units, 20% flatwater units, and 14% riffle units. Based on total length of Level II habitat types there were 67% pool units, 17% flatwater units, and 11% riffle units.

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Nineteen Level IV habitat types were identified. The most frequent habitat types by percent occurrence were log enhanced lateral scour pool units, 20%; mid-channel pool units, 19%; run units, 14%; and low gradient riffle units, 13%.

A total of 136 pools were identified. Scour pools were the most frequently encountered at 62%, and comprised 51% of the total length of all pools.

Table 4 is a summary of maximum residual pool depths by pool habitat types. The maximum depth for 109 of the 136 pools was less than three feet. Fourteen of the pools had a maximum depth of over four feet.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 136 pool tail-outs measured, 14 had an embeddedness rating of 1 (10%); 10 had a value of 2 (7%); eight had a value of 3 (6%); 104 had a value of 4 (77%). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst.

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. Of the pool types, the main channel pools had the highest mean shelter rating at 152. Backwater pools had a shelter rating of 128. Scour pools had a mean shelter rating of 119.

Small woody debris and large woody debris are the dominant cover types in Lake Creek.

Silt/clay was the dominant substrate observed in 76% of the units measured.

The mean percent canopy density for the surveyed length of Lake Creek was 84%.

For the stream reach surveyed, the mean percent right bank vegetated was 70%. The mean percent left bank vegetated was . The dominant elements composing the structure of the stream banks consisted of 32% bare soil, 31% grass, 14% coniferous trees and logs, 10% brush, 7% bedrock, and 6% deciduous trees.

## BIOLOGICAL INVENTORY RESULTS

Survey teams conducted an electrofishing survey at two sites for species composition and distribution in Lake Creek on August 6, 1990. The sites were sampled by G. Flosi (DFG), G. Moody (CCC), and S. Holzerland (CCC).

The first unit sampled was a root mass enhanced lateral scour pool approximately 165 feet from the confluence with the North Fork Elk River. The site yielded 21 coho salmon ranging from 40 millimeters to 75 millimeters, three coastal cutthroat trout ranging from 40 millimeters to 100 millimeters, and four stickleback.

The second unit sampled was a bedrock enhanced lateral scour pool and a log enhanced lateral scour pool, approximately 200 feet from the confluence with the North Fork Elk River. The site

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yielded eleven coastal cutthroat trout ranging from 32 millimeters to 102 millimeters, and two steelhead/rainbow trout ranging from 51 millimeters to 110 millimeters.

## DISCUSSION

Lake Creek is a B1 channel type for the first 497 feet of stream surveyed, a C5 channel type for the next 4,091 feet, and a C4 channel type for the remaining 2,128 feet. The suitability of B1, C5, and C4 channel types for fish habitat improvement structures is as follows: B1 channel types are excellent for bank-placed boulders and good for log cover. C5 channel types are good for bank-placed boulders and fair for plunge weirs and log cover. C4 channel types are good for bank placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover.

The water temperatures recorded on the survey days July 6 through July 11, 1990 ranged from 52 to 55 degrees Fahrenheit. Air temperatures ranged from 55 to 68 degrees Fahrenheit. This is a good water temperature range for salmonids. To make any further conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 17% of the total length of this survey, riffles 11%, and pools 67%. The maximum depth for 109 of the 136 pools was less than three feet. Fourteen of the pools had a maximum depth of over four 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 for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

Twenty-four of the 136 pool tail-outs measured had embeddedness ratings of 1 or 2. One hundred twelve 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. Sediment sources in Lake Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

The mean shelter rating for main channel pools is 152. The mean shelter rating for backwater pools is 128. The mean shelter rating for scour pools is 119. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by small woody debris and large woody debris in Lake Creek.

The mean percent canopy density for the stream was 84%. 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 70% and 67%, 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. Lake Creek should be managed as an anadromous, natural production stream.
2. The log debris accumulations should be modified to allow for fish passage. This should be done carefully, leaving as much of the woody debris cover as possible for the coho and coastal cutthroat. This must be done over a period of years to allow the silt and clay accumulated behind the log debris to wash out a little at a time, lessening the impact of the sediment downstream.
3. Stabilize bank failures to prevent fine sediment from entering the stream.

### 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    Comments:  
(ft):

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1000'	Debris accumulation 160' long.
2300'	Debris accumulation 170' long.
2670'	Debris accumulation 70' long.
2950'	Debris accumulation 50' long deflecting flow into left bank.
3260'	Debris accumulation 30' long.
3390'	Debris accumulation 12' long.
3700'	Debris accumulation 80' long.
3890'	Bank erosion 20' long x 30' high.
4010'	Debris accumulation 70' long.
4065'	Debris accumulation 40' long.
4370'	Debris accumulation 75' long.

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- 4440' Tributary enters from the left bank.
- 4450' Bank erosion 20' long x 10' high.
- 4630' Debris accumulation 20' long.
- 4640' Tributary enters from the left bank.
- 4850' Debris accumulation 35' long.
- 4930' Debris accumulation 36' long.
- 5020' Debris accumulation 10' long.
- 5130' Culvert in channel.
- 5360' Old road crossing.
- 5590' Debris accumulation 50' long deflecting flow into right bank.
- 5730' Debris accumulation 50' long.
- 5970' Debris accumulation 200' long.
- 6280' Debris accumulation 21' long.
- 6450' Debris accumulation 70' long.
- 6460' Bank erosion left bank 10' long X 25' high.
- 6560' Bank erosion right bank.
- 6610' Debris accumulation 23' long.
- 6720' Debris accumulation 30' long.

## 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]	