STREAM INVENTORY REPORT
Jack of Hearts Creek
October 2005

INTRODUCTION

A stream inventory was conducted from 10/17/2005 to 10/20/2005 on Jack of Hearts Creek. The survey began at the confluence with South Fork Eel River and extended upstream 3.1 miles.

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

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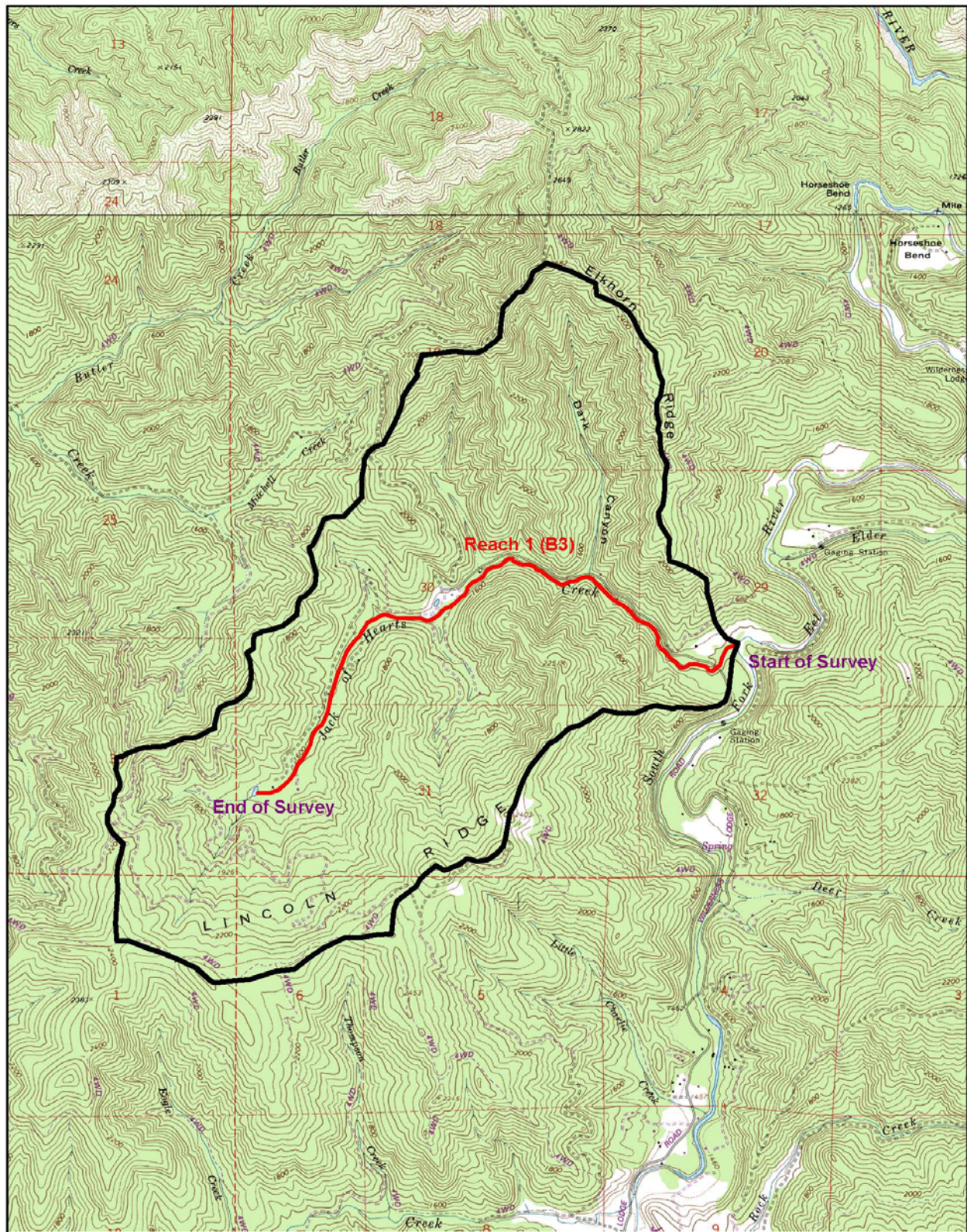

WATERSHED OVERVIEW

Jack of Hearts Creek is a tributary to South Fork Eel River, a tributary to the Eel River, located in Mendocino County, California (Map 1). Jack of Hearts Creek's legal description at the confluence with South Fork Eel River is T22N R16W S29. Its location is 39°43'26.0" north latitude and 123°38'58.0" west longitude, LLID number 1236495397239. Jack of Hearts Creek is a 2nd order stream and has approximately 3.9 miles of blue line stream according to the USGS Lincoln Ridge 7.5 minute quadrangle. Jack of Hearts Creek drains a watershed of approximately 3.8 square miles. Elevations range from about 1,385 feet at the mouth of the creek to 2,200 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is partially managed for timber production. Vehicle access exists via Highway 101, to Highway 271, to Branscomb Road, to Wilderness Lodge Road.

METHODS

The habitat inventory conducted in Jack of Hearts 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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Map1

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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 Jack of Hearts 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". Jack of Hearts 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 Jack of Hearts 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 Jack of Hearts 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 Jack of Hearts 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 Jack of Hearts Creek, the dominant composition type and the

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dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

10. Large Woody Debris Count:

Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:

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

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 Jack of Hearts Creek. In addition, underwater observations were made at nine sites using techniques 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)

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- 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 Jack of Hearts Creek include:

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

HABITAT INVENTORY RESULTS

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

The habitat inventory of 10/17/2005 to 10/20/2005, was conducted by Isaac Mikus (WSP) and Sean McSmith (WSP). The total length of the stream surveyed was 16,198 feet with an additional 87 feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.33 cfs on 10/21/05.

Jack of Hearts Creek is a B3 channel type for 16,285 feet of the stream surveyed.

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.

Water temperatures taken during the survey period ranged from 48 to 52 degrees Fahrenheit. Air temperatures ranged from 40 to 61 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 26% riffle units, 41% pool units, 31% flatwater units, 1% was not surveyed (Graph 1). Based on total length of Level II habitat types there were 18% riffle units, 38% pool units, 39% flatwater units, 6% was not surveyed (Graph 2).

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Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 39% mid-channel pool units, 23% low gradient riffle units, 16% run units, (Graph 3). Based on percent total length the stream were 36% mid-channel pool units, 23% step run units, and 16% low gradient riffle units.

A total of 136 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 96%, and comprised 97% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Fifty-two of the 134 pools (39%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 135 pool tail-outs measured, 71 had a value of 1 (52.6%); 34 had a value of 2 (25.2%); 13 had a value of 3 (9.6%); 4 had a value of 4 (3%); 13 had a value of 5 (9.6%); (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 17, flatwater habitat types had a mean shelter rating of 16, and pool habitats had a mean shelter rating of 37 (Table 1). Of the pool types, the main channel pools had a mean shelter rating of 37, backwater pools had a mean shelter rating of 40, scour pools had a mean shelter rating of 44 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Undercut banks are the dominant cover types in Jack of Hearts Creek. Graph 7 describes the pool cover in Jack of Hearts Creek. Undercut banks are the dominant pool cover type followed by boulders.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was observed in 47% of pool tail-outs and small cobble was observed in 29% of pool tail-outs.

The mean percent canopy density for the surveyed length of Jack of Hearts Creek was 94%. The mean percentages of hardwood and coniferous trees were 29% and 71%, respectively. Six percent of the canopy was open. Graph 9 describes the mean percent canopy in Jack of Hearts Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 98%. The mean percent left bank vegetated was 98%. The dominant elements composing the structure of the stream banks consisted of 14% bedrock, 2% boulder, 2% cobble/gravel, and 82% sand/silt/clay, (Graph 10). Coniferous trees were the dominant vegetation type observed in 72.6% of the units surveyed. Additionally, 26.2% of the units surveyed had hardwood trees as the dominant vegetation type, and 1.2% had brush as the dominant vegetation (Graph 11).

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BIOLOGICAL INVENTORY RESULTS

Nine sites were snorkel surveyed for species composition and distribution in Jack of Hearts Creek on November 1, 2005. Water temperature during the snorkeling period (10:00 am – 11:00 am) ranged was 44 degrees Fahrenheit. Air temperatures ranged from 44 to 46 degrees Fahrenheit. The sites were sampled by Trevor Tollefson (DFG).

The stream survey included the 16,198 feet of stream surveyed. The survey yielded 36 young-of-the-year steelhead/rainbow trout (SH/RT) and 65 coho.

The following chart displays the information yielded from these sites:

2003 Jack of Hearts Creek dive observations.

Date	Site #	Hab. Unit #	Hab. Type	Approx. Dist. from mouth (ft.)	Coho		SH/RT		
					YOY	1+	YOY	1+	2+
Reach 1 B3 Channel Type									
11/01/05	1	013	4.2	541	0	0	1	0	0
11/01/05	2	016	4.2	595	34	0	16	0	0
11/01/05	3	092	3.3	4681	4	0	6	0	0
11/01/05	4	093	4.2	4737	3	0	6	0	0
11/01/05	5	209	4.2	11009	5	0	6	0	0
11/01/05	6	211	4.2	11086	18	0	0	0	0
11/01/05	7	317	5.6	15833	1	0	1	0	0
11/01/05	8	319	5.6	15936	0	0	0	0	0
11/01/05	9	322	4.2	16048	0	0	0	0	0

DISCUSSION

Jack of Hearts Creek is a B3 channel type for the entire 16,198 feet of stream surveyed. The suitability of B3 channel types for fish habitat improvement structures is as follows: excellent for plunge weirs, boulder clusters and bank placed boulders, single and opposing wing deflectors as well as log cover.

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The water temperatures recorded on the survey days 10/17/2005 to 10/20/2005, ranged from 48 to 52 degrees Fahrenheit. Air temperatures ranged from 40 to 61 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 39% of the total length of this survey, riffles 18%, and pools 38%. Fifty-two of the 134 (39%) pools had a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width.

One-hundred-five of the 135 pool tail-outs measured had embeddedness ratings of 1 or 2. Seventeen of the pool tail-outs had embeddedness ratings of 3 or 4. Thirteen 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 Jack of Hearts Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One-hundred-three of the 135 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 37. The shelter rating in the flatwater habitats was 16. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by undercut banks in Jack of Hearts Creek. Undercut banks are the dominant cover type in pools followed by boulders. 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 94%. 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 98% and 98%, 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)   Jack of Hearts 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.

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3)   Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from undercut banks. Adding high quality complexity with woody cover in the pools is desirable.

4)   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.

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)	Hab Unit #	Comments
0	001	Start of survey at the confluence with the South Fork Eel River. Channel type is a B3.
541	013	First biological sampling site.
595	016	Second biological sampling site.
662	017	Bridge, 14' wide x 20' high x 55' long.
1652	033	Right bank erosion, 40' long x 15' wide.
3939	080	Bridge, 10.5' wide x 10.4' high x 50' long.
4681	092	Third biological sampling site.
4737	093	Dark Canyon Creek enters from the left bank. Assessable to fish.
4737	093	Fourth biological sampling site.
6331	125	Log debris accumulation (LDA) 4' high x 13' wide x 6' long. Composed of 4 pieces of large wood. Not a barrier.
7016	140	Not surveyed due to lack of access permission.
7073	141	Left bank tributary.

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Position (ft)	Hab Unit #	Comments
7962	142	Bridge, 10' wide x 10' high x 50' long.
8425	154	Right bank tributary.
8501	156	Road near creek.
9649	181	Right bank erosion contributing sediment.
10436	199	LDA, 5.5' high x 21' x wide x 10' long. Composed of 7 pieces of large wood. Not a barrier.
11009	209	Fifth biological sampling site.
11086	211	Sixth biological sampling site.
11198	214	Bridge, 9.5' wide x 7' high x 40' long.
11719	221	Left bank tributary.
11828	223	Bedrock chute.
12968	255	Right bank erosion, 30' long x 14' high.
13060	259	Bridge.
13098	260	Not surveyed due to heavy brush and downed tree, not a fish barrier.
15069	301	Bridge, 9.5' wide x 10' high x 20' long.
15159	303	Right bank tributary.
15485	311	Creek goes subsurface.
15833	317	Seventh biological sampling site. No fish observed beyond this point.
15836	317	Plunge 1.2'high. Possible barrier.

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Position (ft)	Hab Unit #	Comments
15936	319	Eighth biological sampling site.
15964	320	Culvert 4' in diameter, with a 0.4' plunge. Culvert is in good condition.
16048	322	Ninth biological sampling site.
16178	326	End of survey. The stream forks. Both channels go dry as they are seeping out of a pond. The ponds were not spilling at the time of the survey.

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.

McCain, M., D. Fuller, L. Decker and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHC Currents. No.1. U.S. Department of Agriculture. Forest Service, Pacific Southwest Region.

Rosgen, D.L., 1994. A Classification of Natural Rivers. Catena, Vol 22: 169-199, Elsevier Science, B. V. Amsterdam.

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]