STREAM INVENTORY REPORT

McCready Gulch

INTRODUCTION

A stream inventory was conducted in July 2004 on McCready Gulch. The survey began at the upstream side of the box culvert under Freshwater-Kneeland road located approximately 970 feet from the confluence with Freshwater Creek. The survey extended upstream 1.7 miles.

The McCready Gulch 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 McCready Gulch. 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

McCready Gulch is a tributary to Freshwater Creek, a tributary to Freshwater Slough, a tributary to Eureka Slough, a tributary to Humboldt Bay, which drains to the Pacific Ocean. It is located in Humboldt County, California (Map 1). McCready Gulch's legal description at the confluence with Freshwater Creek is T04N R01E S04. Its location is 40.7639 degrees north latitude and 124.0639 degrees west longitude, LLID number 1240640407638. McCready Gulch is a second order stream and has approximately 3.7 miles of blue line stream according to the USGS Arcata South 7.5 minute quadrangle. McCready Gulch drains a watershed of approximately 3.7 square miles. Elevations range from about 30 feet at the mouth of the creek to 570 feet in the headwaters area. Redwood forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Freshwater-Kneeland Road.

METHODS

The habitat inventory conducted in McCready Gulch follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) Technical Advisors 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 100% 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. All habitat unit types are measured for all the parameters and characteristics on the field form. 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 McCready Gulch 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". McCready Gulch 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 McCready Gulch, 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 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 McCready Gulch, 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 McCready Gulch, an estimate of the percentage of the habitat unit covered by canopy was made from the center of every unit, giving a 100% 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 McCready Gulch, 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.

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 McCready Gulch. In addition, selected sites were sampled using a Smith-Root Model 12 electrofisher and underwater observations, as discussed in unpublished data from the Juvenile Salmonid Abundance Summer Survey Report, 2004 (Ricker, S., McCanne, D. 2004).

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.9, 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

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Graphics are produced from the tables using Microsoft Excel. Graphics developed for McCready Gulch 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 July 19 to July 29, 2004 was conducted by Leslie Merrick and Elizabeth Pope (CCC). The total length of the stream surveyed was 8,773 feet with an additional 19 feet of side channel.

Stream flow was measured 89 feet from the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.19 cfs on July 26, 2004.

McCready Gulch is a G4 channel type for 7,827 feet of the stream surveyed (Reach 1) and an A4 channel type for 946 feet of the stream surveyed (Reach 2). G4 channels are entrenched "gully" step-pool channels on moderate gradients with low width/depth ratios and gravel dominant substrates. A4 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils and gravel dominant substrates.

Water temperatures taken during the survey period ranged from 60 to 66 degrees Fahrenheit. Air temperatures ranged from 62 to 68 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 43% pool units, 31% riffle units, 23% flatwater units, 2% dry units, and 1% unsurveyed units (Graph 1). Based on total length of Level II habitat types there were 43% pool units, 31% flatwater units, 24% riffle units, 1% dry units, and 1% unsurveyed units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 38% mid-channel pool units, 29% low gradient riffle units, and 23% run units (Graph 3). Based on percent total length, the most frequent habitat types were 41% mid-channel pool units, 31% run units, and 22% low gradient riffle units.

A total of 133 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 90%, and comprised 94% 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. Thirty-two of the 133 pools (24%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 132 pool tail-outs measured: 14 had a value of 1 (11%); 56 had a value of 2 (42%); 37 had a value of 3 (28%); six had a value of 4 (5%); and 19 had a value of 5 (14%); (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 not suitable for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 3, flatwater habitat types had a mean shelter rating of 14, and pool habitats had a mean shelter rating of 56 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 58. Backwater pools had a mean shelter rating of 43. Scour pools had a mean shelter rating of 37 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in McCready Gulch. Graph 7 describes the pool cover in McCready Gulch. Large woody debris is the dominant pool cover type followed by small 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 71% of pool tail-outs and small cobble was observed in 15% of pool tail-outs.

The mean percent canopy density for the surveyed length of McCready Gulch was 92%. The mean percentages of hardwood and coniferous trees were 43% and 57%, respectively (Table 7). Eight percent of the canopy was open. Graph 9 describes the mean percent canopy in McCready Gulch.

For the stream reach surveyed, the mean percent right bank vegetated was 91%. The mean percent left bank vegetated was 90%. The dominant elements composing the structure of the stream banks consisted of 71% sand/silt/clay and 25% bedrock (Graph 10). Brush was the dominant vegetation type observed in 57% of the units surveyed. Additionally, 25% of the units surveyed had coniferous trees as the dominant vegetation type, and 16% had hardwood trees as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

A biological survey was conducted by the Institute for River Ecosystems (IRE) in cooperation with the Department of Fish and Game. The sample reach was 9,435 feet, which included 660

feet above the end of the habitat survey. Coho were observed up to approximately 7,461 feet into Reach 1. In this survey trout species were not distinguished and include cutthroat trout and steelhead/rainbow trout, both resident and anadromous forms. Trout were observed throughout Reaches 1 and 2 and 660 feet above the end of survey, a total distance of approximately 9,435 feet (Ricker, S., McCanne, D. Unpublished Data, 2004). Juvenile salmonids were also observed from the stream banks throughout the entire survey reach in McCready Gulch.

DISCUSSION

McCready Gulch is a G4 channel type for the first 7,827 feet of stream surveyed and an A4 channel type for the remaining 946 feet. The suitability of G4 channel types for fish habitat improvement structures is as follows: good for bank placed boulders; fair for plunge weirs, opposing wing deflectors, and log cover; poor for boulder clusters and single wing deflectors. The suitability of A4 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders, fair for plunge weirs, opposing wing deflectors, and log cover; poor for boulder clusters and single wing deflectors.

The water temperatures recorded on the survey days July 19 to July 29, 2004 ranged from 60 to 66 degrees Fahrenheit. Air temperatures ranged from 62 to 68 degrees Fahrenheit. This is a suitable range of water temperatures for juvenile 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 31% of the total length of this survey, riffles 24%, and pools 43%. The pools are relatively shallow, with only 32 of the 133 (24%) pools having a maximum residual depth greater than two 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 deepen pool habitat is recommended for locations where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

Seventy-two of the 132 pool tail-outs measured had embeddedness ratings of 1 or 2. Forty-three of the pool tail-outs had embeddedness ratings of 3 or 4. Seventeen of the pool tail-outs had a rating of 5, which is considered not suitable 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 McCready Gulch should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One-hundred-fourteen of the 132 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 56. The shelter rating in the flatwater habitats was 14. 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 McCready Gulch. Large woody debris is the

dominant cover type in pools followed by small woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

The mean percent canopy density for the stream was 92%. Reach 1 had a canopy density of 92% and Reach 2 had a canopy density of 96%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 91% and 90%, 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) McCready Gulch 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) 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.

4) There are several log debris accumulations present on McCready Gulch that are retaining large quantities of fine sediment. The modification of these debris accumulations using the large wood to increase the cover in the pool and flatwater habitat units is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches.

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	Survey starts 300 meters upstream from the confluence with Freshwater Creek due to lack of access.
25	0003.00	Bridge measures 10' long x 40' wide x 30' high.

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38	0004.00	Bridge on a private road with rip-rap on both banks 18' into unit.
89	0006.00	Left bank rip-rap throughout unit.
164	0010.00	Salmonids observed.
295	0015.00	Humboldt Fish Action Council (HFAC) 400 meter mark at top of unit.
430	0023.00	Small log debris accumulation consisting of three pieces of large wood with small wood causing right bank erosion. Also retaining small amount of sand on left bank.
557	0027.00	HFAC rearing facility.
578	0028.00	Rearing tank outlet.
655	0031.00	HFAC fish trap site. Riprap structure, top of unit.
681	0032.00	Cement weir top of unit.
700	0033.00	Three logs roped to alder on left bank. Cement weir. Old fish holding tank end of unit.
887	0036.00	Log debris accumulation (LDA) consisting of a downed alder combined with SWD, retaining sand measuring 4' deep.
922	0037.00	HFAC 600 meter mark 47' into unit. Flow monitoring site 78' into unit.
1129	0042.00	Accumulation of small wood across channel not retaining sediment.
1183	0044.00	Erosion both banks throughout unit. LDA measures 6' high x 15' wide x 4' long and is composed of two pieces of large wood. Stored sediment measures 2' deep.
1244	0046.00	Juvenile salmonid observed.
1256	0047.00	HFAC 700 meter marker 74' into unit.
1345	0048.00	Right bank exposed silt measuring 5' high.
1481	0053.00	LDA measures 7' high x 13' wide x 22' long and is composed of eight pieces of large wood. Stored sediment measures 1' deep.
1617	0059.00	HFAC 800 meter marker top of unit. LDA measures 8' high x 15' wide x 30' long and is composed of 12 pieces of large wood. Sediment retention measures 3' deep.

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1668	0061.00	LDA measures 7' high x 15' wide x 10' long and is composed of eight pieces of large wood. Stored sediment measures 4' deep.
1877	0071.00	Juvenile salmonids observed.
2001	0076.00	HFAC 900 meter mark.
2121	0080.00	LDA measures 4' high x 18.5' wide x 9' long and is composed of seven pieces of large wood. Stored sediment measures 2' deep.
2613	0095.00	HFAC 1100 meter mark. LDA measures 8' high x 43' wide x 16' long and is composed of 13 pieces of large wood. Stored sediment measures 4' deep. Stream above the LDA is dry.
2629	0096.00	Dry habitat unit with sand as the dominant substrate.
2702	0100.00	LDA measures 13' high x 28' wide x 29' long and is composed of 27 pieces of large wood. Stored sediment measures 6" deep.
2856	0106.00	Juvenile salmonids observed.
2939	0110.00	HFAC 1200 meter marker top of unit.
3124	0117.00	Footbridge measures 30' long x 4' wide x 7' high.
3240	0122.00	HFAC 1300 meter marker 13' into unit. Station #135, green shack - turbidity monitor.
3425	0128.00	LDA measures 6' high x 16’ wide x 15’ long and is composed of four pieces of large wood. Stored sediment measures 2' deep.
3491	0130.00	LDA measures 8' high x 33' wide x 12' long and is composed of 16 pieces of large wood. Stored sediment measures 4' high.
3530	0132.00	Log bridge with boulder footing. HFAC 1400 meter marker, top of unit.
3612	0137.00	Channel becoming narrow, steeper and very overgrown.
3826	0145.00	LDA measures 8' high x 25' wide x 20’ long and is composed of 11 pieces of large wood. Stored sediment measures 4' deep. Old railroad footings.
3856	0146.00	HFAC 1500 meter marker 5' into unit.
4247	0161.00	HFAC 1600 meter marker 29' into unit.

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4362	0165.00	LDA measures 7' high x 25' wide x 23' long and is composed of eight pieces of large wood. Stored sediment measures 3' deep. Channel above the unit is dry for 13'.
4494	0171.00	Juvenile salmonids observed.
4583	0173.00	HFAC 1700 meter marker 23' into unit. LDA measures 16' high x 35' wide x 69' long and is composed of 14 pieces of large wood. Stored sediment measures 4' high.
4718	0175.00	Dry left bank tributary. LDA measures 7' high x 19' wide x 22' long and is composed of six pieces of large wood. Stored sediment measures 2' high. Channel above the unit is dry for 13'.
4969	0183.00	HFAC 1800 meter marker 13' into unit.
5076	0187.00	Gradient increasing and substrate change.
5254	0194.00	HFAC 1900 meter mark 51' into unit.
5372	0198.00	LDA measures 7' high x 24' wide x 31' long and is composed of nine pieces of large wood. Stored sediment measures 3' deep.
5644	0209.00	HFAC 2000 meter marker start of unit.
5693	0211.00	LDA measures 5' high x 13' wide x 19' long and is composed of seven pieces of large wood. Stored sediment measures 1' deep.
6324	0234.00	HFAC 2200 meter marker at start of unit. Two logs across channel storing sand and gravel measuring 1' deep.
6532	0238.00	Numerous large logs in the channel causing small amounts of sediment backup.
6714	0244.00	HFAC 2300 meter marker 5' into unit. Channel narrowing.
6763	0245.00	Downed redwood spanning channel; small amount of small woody debris build-up.
6810	0246.00	Horse Gulch enters on the right bank. Accessible to fish, but no fish were observed. The water temperature of the tributary was 60 degrees Fahrenheit.
6931	0249.00	One 3" long salmonid observed.
6958	0250.00	Channel is confined with bedrock banks.

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6997	0251.00	HFAC 2400 meter marker 11' into unit. Left bank erosion measuress 31' long x 10' high x 4’ deep. There is also an LDA. Channel is very narrow, clogged with small wood debris. Stored sediment measures 4' deep.
7230	0258.00	HFAC 2500 meter marker 113' into unit. HFAC spawner survey end flag. Road HWQ10 – 508. Water quality monitoring station.
7359	0259.00	LDA measures 6' high x 16' wide x 21' long and is composed of five pieces of large wood. Stored sediment measures 2' deep.
7464	0263.00	LDA measures 7' high x 10' wide x 37' long and is composed of six pieces of large wood. Stored sediment measures 2' deep. Last observation of coho by IRE.
7733	0272.00	LDA measures 5' high x 13' wide x 8' long and is composed of four pieces of large wood. Stored sediment measures 3' high.
7769	0273.00	Stream channel has a 10% slope and 4' high plunge.
7827	0276.00	Channel type change to A4.
7859	0278.00	LDA measures 5' high x 23' wide x 8' long and is composed of four pieces of large wood. Stored sediment measures 2' high.
7931	0281.00	Two 3' diameter logs in channel. Most flow is under the logs.
7985	0283.00	Two 3' diameter logs raise bed 2.5' and create 5' high plunge.
8104	0287.00	One 4" salmonid observed.
8133	0289.00	LDA measures 3' high x 12' wide x 9' long and is composed of four pieces of large wood. Stored sediment measures 1' deep.
8171	0291.00	LDA measures 4' high x 11' wide x 3' long and is composed of four pieces of large wood. Stored sediment measures 2' high.
8261	0295.00	One 5" salmonid observed. LDA measures 3' high x 10' wide x 30' long and is composed of six pieces of large wood. Stored sediment measures 1' deep.
8372	0299.00	The slope has been increasing for 708'. The channel is clogged with log jams and vegetation.
8468	0301.00	One 4" salmonid observed.

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8745	0309.00	LDA measures 6' high x 10' wide x 8' long and is composed of eight pieces of large wood. Stored sediment measures 2' deep. Survey ended due to LDA's, debris clogging the channel, slope increasing to near 10%.

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.

Richer, S., McCanne, D., 2004. Unpublished data from the *Juvenile Salmonid Abundance Summer Survey Report 2004.* Anadromous Fisheries Research and Monitoring Program (AFRAMP), California Department of Fish and Game and Institute for River Ecosystems (IRE), Humboldt State University, Arcata, California.

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]	

Appendix A

California Department of Fish & Game

Large Woody Debris (LWD) Riparian Inventory

Freshwater Basin, Humboldt County

BACKGROUND

The importance of large woody debris (LWD) in the development of a stream's morphological and biological productivity has been well documented. It strongly influences stream habitat characteristics and biotic composition. Large woody debris is often the structural element associated with pool formation and is considered one of the major elements that create complex fish habitat vital for juvenile salmonid survival. Habitat complexity is particularly important for coho salmon and steelhead trout juveniles because these salmonids remain in the stream for at least one year before migrating to the ocean.

Large woody debris inventories describe the present relative abundance of LWD elements providing, or with the potential to provide, fish habitat within the stream channel. Large woody debris inventories also describe the relative abundance of "recruitable" LWD. Recruitable LWD is the large wood existing out of the stream channel that has a high potential of entering the stream channel in the future.

METHODS

Prior to conducting the LWD inventory, the stream was habitat-typed employing the methods described by Flosi, et al (1998). The McCready Gulch habitat-typing survey delineated 2 stream reaches. The start and end points for the LWD inventory reaches correspond to stream reach start and end points of the habitat survey.

Large woody debris inventory methods, data recording forms, and database structure are described in Flosi, et al (1998). Large woody debris minimum size criteria was 12-inches in diameter and 6 feet in length. Root wads had the 12-inch minimum diameter criteria but had no minimum length requirement. Diameter and length categories consisted of the following:

Diameter Category	**Length Category**
1. 1-2 feet 2. 2-3 feet 3. 3-4 feet 4. Over 4 feet	1. 6-20 feet 2. Over 20 feet

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Condition or status categories included:

a) dead and down
b) dead and standing
c) perched for imminent delivery to the stream channel
d) live coniferous trees
e) live broadleaf trees (a.k.a. deciduous/hardwood)

The sampling strategy consisted of selecting a random starting point near the beginning of the LWD survey reach, and then systematically sampling 200 foot sections out of every 1,000 feet of stream length surveyed. The first 1,200 feet of the LWD survey reach was segmented into 200 foot sections and consecutively numbered 1 through 6. One of these six 200 foot sections was randomly selected as the beginning of the *first* sample section. After conducting the inventory survey in the initial 200 foot section, surveyors proceeded upstream 800 feet and surveyed the next 200 feet as the *second* sample section. The *third* sample section began 800 feet upstream of the end of the second sample section and the next 200 feet were surveyed, and so on. Systematic sampling continued upstream until the end of the LWD survey reach. This method produced a sampling level of approximately 20 percent. For channel type reaches that were less than 1000 feet, the entire reach was surveyed.

McCready Gulch

RESULTS

*Tables 1 and 2 are located at the end of this report.

Table 3. Large Woody Debris Inventory for McCready Gulch, Humboldt County, California 2004.
Expressed in Number of Pieces Per 100 linear Feet of Stream Channel.

STREAM	REACH	CHANNEL TYPE	TOTAL LENGTH	DEAD DOWN	DEAD STANDING	--LIVE TREES-- PERCHED	CONIFER	BROADLEAF	TOTAL
				Number of pieces per 100 linear feet of stream out of channel on right and left banks					
McCready Gulch	1	G4	7827	2.6	1	0.2	9.5	0.4	13.7
	2	A4	946	1.5	0.5	0	4	2	8
				Number of pieces per 100 linear feet of stream within the bankfull channel					
McCready Gulch	1	G4	7827	5.1	0		0.1	0	5.2
	2	A4	946	8	0		0	0	8
				Number of pieces per 100 linear feet of stream out of channel on right and left banks and within the bankfull channel					
McCready Gulch	1	G4	7827	7.8	1	0.2	9.6	0.4	19
	2	A4	946	9.5	0.5	0	4	2	16
				Percentage of LWD pieces found out of channel on right and left banks					
McCready Gulch	1	G4	7827	19.0	7.3	1.5	69.3	2.9	100.0
	2	A4	946	18.8	6.3	0.0	50.0	25.0	100.0
				Percentage of LWD pieces found within the bankfull channel					
McCready Gulch	1	G4	7827	98.1	0.0	0.0	1.9	0.0	100
	2	A4	946	100.0	0.0	0.0	0.0	0.0	100
				Percentage of LWD pieces found out of channel on right and left banks and within the bankfull channel					
McCready Gulch	1	G4	7827	41.1	5.3	1.1	50.5	2.1	100
	2	A4	946	59.4	3.1	0.0	25.0	12.5	100

The McCready Gulch LWD inventory consisted of 2 inventory reaches.
Reach 1, a G4 channel type extended upstream approximately 7,827 feet from the mouth. This reach contained 13.7 pieces of LWD on both the right and the left banks per 100 linear feet of stream. In descending proportions, the condition of the pieces were 69.3% live coniferous, 19.0% dead and down, 7.3% dead and standing, 2.9% live broadleaf, and 1.5% perched (Table 3). Within the bankfull channel, reach 1 contained 5.2 pieces of LWD per 100 linear feet of stream. The conditions of the pieces were 98.1% dead and down, 1.9% live coniferous, 0% live broadleaf, 0% dead and standing, and 0% perched. The total number of pieces per 100 linear feet for both the banks and bankfull channel were 19.0, of which 50.5% were live coniferous, 41.1% were dead and down, 5.3% dead and standing, 2.1% live broadleaf, and 1.1% perched. Of the pieces in reach 1, 73.2% were in LWD size category of 1-2 feet in diameter, 21.9% were in the 2-3 foot category, 3.8% were in the 3-4 foot category, and 1.1 % were in the >4 foot category (Figure 1).

Reach 2, an A4 channel type, started 7,827 feet from the mouth and extended upstream 946 feet. This reach contained 8 pieces of LWD on both the right and the left banks per 100 linear feet of stream. In descending proportions, the conditions of the pieces were 50.0% live coniferous,

25.0% live broadleaf, 18.8% dead and down, 6.3% dead and standing, and 0% perched (Table 3). Within the bankfull channel, reach 2 contained 8 pieces of LWD per 100 linear feet of stream. The conditions of the pieces were 100% dead and down and 0% for all other categories. The total number of pieces per 100 linear feet for both the banks and the bankfull channel was 16.0, of which 59.4% were dead and down, 25.0% live coniferous, 12.5% live broadleaf, 3.1% dead and standing and 0% perched. Of the pieces in reach 2, 78.1% were in the LWD size category of 1-2 feet in diameter, 18.8% were in the 2-3 foot category, 3.1% were in the 3-4 foot category, and 0% in the >4 foot category (Figure 1).

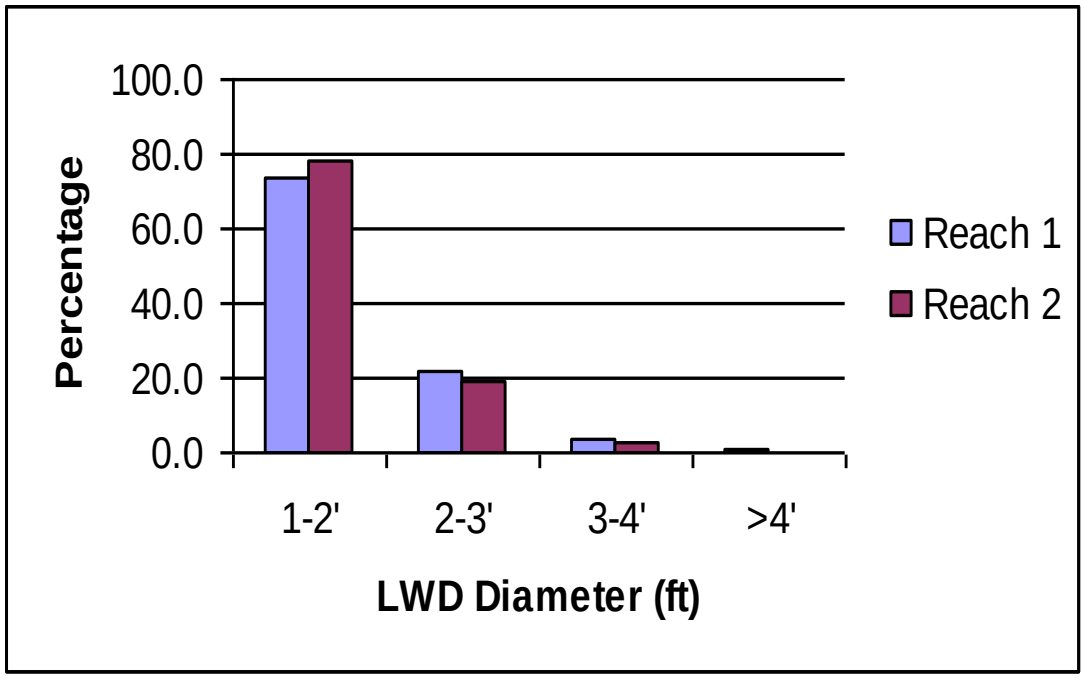

Figure 1 Percent of LWD according to diameter size and stream reach.

DISCUSSION

Reach 1, a G4 channel type had a bankfull width of 14 feet. LWD on the banks was dominated by live coniferous trees having a diameter of 1-2 feet and a height greater than 20 feet. While dead and down, less than 20 feet long, 1-2 feet diameter pieces dominated the stream channel. The 1-2 diameter size class was the most common for all LWD pieces in both the stream channel and the bank zones (Table 1). In the stream channel, there were 5.1 pieces of dead and down LWD per 100 linear feet of stream observed (Table 2).

Reach 2, an A4 channel type had a bankfull width of 11 feet. LWD on the banks was dominated by live coniferous trees having a diameter of 1-2 feet and a height greater than 20 feet. While dead and down, less than 20 feet long, 1-2 feet diameter pieces dominated the stream channel. The 1-2 diameter size class was the most common for all LWD pieces in both the stream channel and the bank zones (Table 1). In the stream channel, there were 8.0 pieces of dead and down LWD per 100 linear feet of stream observed (Table 2).

McCready Gulch

One goal of conducting LWD inventories is to provide data that, along with fish population and habitat type data, will enable resource managers to characterize the quality of available and potential fish habitat. Although, the relationship between the number, size, and type of LWD pieces per 100 feet, and quality of fish habitat has not been fully established, it is generally accepted that LWD in the stream channel plays a vital role in contributing to the quality of fish habitat. Large woody debris within the bank zone is the source for future instream LWD and addresses the issue of LWD recruitment to the stream channel. Information in this report will enable resource managers to identify areas lacking in LWD, subsequently leading to planning and prioritizing prescriptions for improvement. This information will also be useful in detecting changes in LWD relative abundance with relation to land use practices or riparian zone restoration projects.