STREAM INVENTORY REPORT

McMahon Creek

INTRODUCTION

A stream inventory was conducted during the summer of 2001 on McMahon Creek. The survey began at the confluence with Larabee Creek and extended upstream 1.5 miles.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for chinook 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

McMahon Creek is a tributary to Larabee Creek, a tributary to the Eel River, located in Humboldt County, California (Map 1). McMahon Creek's legal description at the confluence with Larabee Creek is T02S R05E S06. Its location is 40°19′12.6″ north latitude and 123°39′43.4″ west longitude. McMahon Creek is a first order stream and has approximately 3.14 miles of blue line stream according to the USGS Blocksburg 7.5 minute quadrangle. McMahon Creek drains a watershed of approximately 3.7 square miles. Elevations range from about 1392 feet at the mouth of the creek to 3088 feet in the headwater areas. Mixed hardwood forest dominates the watershed. The watershed is entirely privately owned and is managed for rangeland. Vehicle access exists via Highway 36 to Alderpoint Road for approximately 17 miles until cross McMahon Creek bridge.

METHODS

The habitat inventory conducted in McMahon 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/AmeriCorps) Members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). This inventory was conducted by a two-person team.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to

habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the 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 McMahon Creek to record measurements and observations. There are nine components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) at 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 (1985 rev. 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 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 (1988). 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". McMahon 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 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 McMahon 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 particle size, bedrock, or other considerations.

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide 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. 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 McMahon 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 McMahon 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 deciduous 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 McMahon 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.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*. Biological sampling for McMahon Creek was not conducted.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat, a dBASE 4.2 data entry program developed by Tim Curtis, Inland Fisheries Division, California Department of Fish and Game. This program processes and summarizes the data, and produces the following six tables:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Dominant substrates by habitat types
- Mean percent shelter by habitat types

Graphics are produced from the tables using Quattro Pro. Graphics developed for McMahon Creek include:

- Riffle, flatwater, pool habitats by percent occurrence
- Riffle, flatwater, pool habitats by total length
- Total habitat types by percent occurrence
- Pool types by percent occurrence
- Total pools by maximum depths

McMahon Creek

- Embeddedness
- Pool cover by cover type
- Dominant substrate in low gradient riffles
- Mean percent canopy
- Bank composition by composition type
- Bank vegetation by vegetation type

HABITAT INVENTORY RESULTS

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

The habitat inventory of November 5, 6, 7, and 8, 2001, was conducted by Devin Best (CCC) and Hillary Kleeb, and Toni Russell (WSP/AmeriCorps). The total length of the stream surveyed was 7,917 feet with an additional 81 feet of side channel.

Stream flow was not measured on McMahon Creek.

McMahon Creek is a F3 channel type for the first 5,581 feet of the stream surveyed, a B4 channel type for the next 1,993 feet of the stream surveyed, and a A2 channel type for the last 343 feet of the stream surveyed. F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble dominant substrates. B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks, and gravel dominant substrate. A2 channels are steep, narrow, cascading, step-pool streams with high energy/debris transport associated with depositional soils and boulder dominant substrate.

Water temperatures taken during the survey period ranged from 51 to 54 degrees Fahrenheit. Air temperatures ranged from 46 to 66 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 30% pool units, 28% flatwater units, 23% dry, and 19% riffle units (Graph 1). Based on total **length** of Level II habitat types there were 50% dry, 29% flatwater units, 13% riffle units, and 9% pool units (Graph 2).

Ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were step run, 21%; low gradient riffle, 15%; and mid-channel pool, 14% (Graph 3). Based on percent total **length**, step run made up 27%, low gradient riffle 11%, and mid-channel pool 4%.

A total of 30 pools were identified (Table 3). Main channel pools were the most frequently encountered, at 53%, and comprised 58% of the total length of all pools

(Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Nine of the 30 pools (30%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 30 pool tail-outs measured, 13 had a value of 1 (43.3%); 12 had a value of 2 (40.0%); 2 had a value of 3 (6.7%); 0 had a value of 4; and 3 had a value of 5 (10.0%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate. The breakdown of dominant substrate composition for the 3 pool tail-outs that had a embeddedness value of 5 were as follows: 67% silt/clay/sand or small gravel and 33% large cobble.

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 10, flatwater habitat types had a mean shelter rating of 26, and pool habitats had a mean shelter rating of 18 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating at 22. Scour pools had a mean shelter rating of 16 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in McMahon Creek. Large and small woody debris are lacking in nearly all habitat types. Graph 7 describes the pool cover in McMahon Creek. Boulders are the dominant pool cover type followed by root mass.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel and small cobble were the dominant substrate observed in 80% of pool tail-outs while boulders were the next most frequently observed substrate type, at 13%.

The mean percent canopy density for the surveyed length of McMahon Creek was 53%. The mean percentages of deciduous and coniferous trees were 70% and 30%, respectively. Graph 9 describes the mean percent canopy in McMahon Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 63.7%. The mean percent left bank vegetated was 60.6%. The dominant elements composing the structure of the stream banks consisted of 55.8% cobble/gravel,19.2% sand/silt/clay, 13.5% bedrock, and 11.5% boulder (Graph 10). Deciduous trees were the dominant vegetation type observed in 69.2% of the units surveyed. Additionally, 15.4% had brush as the dominant vegetation type, and 11.5% of the units surveyed had coniferous trees as the dominant vegetation (Graph 11).

DISCUSSION

McMahon Creek is a F3 channel type for the first 5,581 feet of stream surveyed, a B4 for the next 1,993 feet of stream surveyed, and a A2 channel type for the remaining 343 feet of stream surveyed. The suitability of F3 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders, single and opposing wing-deflectors. Fair for plunge weirs, boulder clusters, channel constrictors, log cover. The suitability of B4 channel types for fish habitat improvement structures is as follows: excellent for plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors, log cover. A2 channel types are not suitable for fish habitat improvement structures due to A2 channels are high energy streams with stable stream banks, and poor gravel retention capabilities.
The water temperatures recorded on the survey days November, 2001, ranged from 51 to 54 degrees Fahrenheit. Air temperatures ranged from 46 to 66 degrees Fahrenheit. This is a good water temperature range for salmonids. 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 29% of the total **length** of this survey, riffles 13%, and pools 9%. The pools are relatively shallow, with only 9 of the 30 (30.0%) pools having a maximum 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 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.

Twenty-five of the 30 pool tail-outs measured had embeddedness ratings of 1 or 2. Two of the pool tail-outs had embeddedness ratings of 3 or 4. Three of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Two of the three were unsuitable for spawning due to the dominant substrate being silt/sand/clay or small gravel. The other of pool tails valued at 5 were dominated by boulders. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead.

Twenty-four of the 30 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 18. The shelter rating in the flatwater habitats was 26. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in all habitat types. Additionally, root mass contributes a small amount. 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 53%. Reach 1 had a canopy density of 55% while Reaches 2 and 3 had canopy densities of 48% and 47%, respectively. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 63.7% and 60.6%, respectively. In areas of stream bank erosion or where bank vegetation is not at acceptable levels, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) McMahon 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) In the F3 and B4 channel types design and engineer pool enhancement structures to increase the number of pools or deepen existing 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 is from boulders. Adding high quality complexity with woody cover 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 canopy on McMahon Creek by planting willow, alder, 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 effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization 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.

0'	Begin survey at confluence with Larabee Creek. Channel type is F3.
281'	Bridge 30' wide x 30' long x 6' tall.
1,639'	Log debris accumulation (LDA), 40' wide x 10' long x 8' high, composed of mainly smaller sized logs, 1-2' diameter. Left bank erosion, 70' high x 60' long.
1,951'	LDA, 20' wide x 5' high x 10' long, retaining some sediment. Left bank erosion, 40' high x 50' long.
3,196'	LDA, consisting of two root wads flanked by small woody debris. Right bank erosion, 76' high x 25' long, contributing sediment.
3,500'	Erosion, 25' high x 40' long, contributing sediment.
5,280'	Channel type changes from F3 to B4.
5,424'	Right bank erosion, 220' long x 35' high, sparsely vegetated with grass and shrubs.
5,653'	Left bank erosion, 350' long, with little vegetation.
6,067'	LDA, 50' wide x 20' long x 10' tall, composed of eight logs approximately 2-3' diameter, not retaining sediment.
6,357'	Left bank erosion, 150' long x 100' tall.
6,672'	Right bank erosion, 100' long x 20' high.
6,997'	Left bank erosion, 80' long x 25' high.
7,177'	Left bank erosion, 80' wide x 100' high, active erosion.
7,419'	Unnamed tributary enters from left bank, dry, steep gradient. Possible fish barrier approximately 500' into tributary, plunge height 6-8' with no pool

below.

7,456' Plunge height 4'.

7,715' Plunge height 3.4'.

7,750' Channel type change from B4 to A2.

7,989 End of survey due to steep gradient for the last 533' of stream surveyed. Gradient is 20% or greater and may be a possible fish barrier. No fish observed since channel type change at 7,750'. Above end survey point, the channel remains steep with boulders dominant for approximately 400 feet.

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.

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]			