STREAM INVENTORY REPORT

Arvola Gulch

INTRODUCTION

A stream inventory was conducted during the summer of 1997 on Arvola Gulch beginning at the confluence of Chamberlain Creek. The 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 Arvola 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

Arvola Gulch is tributary to the Chamberlain Creek, tributary to the North Fork Big River, tributary to Big River, tributary to the Pacific Ocean located in Mendocino County, California (Map 1). Arvola Gulch's legal description at the confluence with Chamberlain Creek is T18N R15W S28. Its location is 39°22′52″ north latitude and 123°32′45″ west longitude. Arvola Gulch is a second order stream and has approximately 0.75 miles of blue line stream according to the USGS Northspur 7.5 minute quadrangle. Arvola Gulch drains a watershed of approximately 1.5 square miles. Elevations range from about 580 feet at the mouth of the creek to 1900 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely within Jackson Demonstration State Forest and is managed for timber production. Vehicle access exists via State Highway 20.

METHODS

The habitat inventory conducted in Arvola Gulch follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1991 rev. 1994). 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 (Hopelain, 1994). 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, dominant substrate composing the pool tail crest, and embeddedness.

Habitat unit types encountered for the first time are further 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 Arvola Gulch 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 standard flow measuring equipment, if available. In some cases flows are estimated.

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.

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". Arvola 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. Channel dimensions were measured using hip chains, range finders, tape measures, and stadia rods. All units were measured for mean length; additionally, the first occurrence of each unit type and a randomly selected 10% subset of all units were sampled for all features on the sampling form. Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Arvola 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 unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, 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 Arvola 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 Arvola Gulch, 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 Arvola 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 was

estimated and recorded.

BIOLOGICAL INVENTORY

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

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 Arvola Gulch 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
- Embeddedness
- Pool cover by cover type
- Dominant substrate in the pool tail outs
- 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 August 17 through 21, 1997, was conducted by Lisa Campbell

(WSP\AmeriCorps) and Tara Cooper (CCC). The total length of the stream surveyed was 4,949 feet with an additional 53 feet of side channel.

Flow was measured at the bottom of survey reach to be 0.45 cfs on August 20, 1997 with a Marsh-McBirney model 2000.

Arvola Gulch is an F4 channel type for the entire 4,949 feet of stream reach surveyed. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 55 to 67 degrees Fahrenheit. Air temperatures ranged from 59 to 76 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 28% riffle units, 34% flatwater units, and 37% pool units (Graph 1). Based on total **length** of Level II habitat types there were 19% riffle units, 59% flatwater units, and 21% pool units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent **occurrence** were low gradient riffles, 28%; step runs, 26%; and mid-channel pools, 23% (Graph 3). Based on percent total **length**, step runs made up 54%, low gradient riffles made up 19%, and mid-channel pools made up 14%.

A total of 66 pools were identified (Table 3). Main channel pools were most frequently encountered at 62% and comprised 69% 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 66 pools (14%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 66 pool tail-outs measured, 2 had a value of 1 (3%); 19 had a value of 2 (29%); 21 had a value of 3 (32%); 6 had a value of 4 (9%) and 18 had a value of 5 (27%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate and a value of 5 indicates the tail-out is not suitable for spawning. In Arvola Gulch, 9 of the 18 pool tail-outs (50%) which were valued at 5 had silt/clay/sand or gravel too small to be suitable for spawning as the substrate. The other tail-outs were unsuitable for spawning due to the tail-outs being comprised of large cobble, boulder, bedrock or wood.

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 4, flatwater habitat types had a mean shelter rating of 9, and pool habitats had a mean shelter rating of 33 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 56. Main channel pools had a mean shelter rating of 5 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Arvola Gulch. Graph 7 describes the pool cover in Arvola Gulch.

Table 6 summarizes the dominant substrate by habitat type. All seven low gradient riffles fully measured had gravel or small cobble as the dominant substrate. Gravel was also the dominant substrate observed in 44 of the 67 pool tail-outs measured (65.6%) (Graph 8).

The mean percent canopy density for the stream reach surveyed was 84%. The mean percentages of deciduous and coniferous trees were 24% and 76%, respectively. Graph 9 describes the canopy in Arvola Gulch.

For the stream reach surveyed, the mean percent right bank vegetated was 69.3%. The mean percent left bank vegetated was 68.3%. The dominant elements composing the structure of the stream banks consisted of 6.9% bedrock, 3.5% boulder, 53.5% cobble/gravel, and 36.2% sand/silt/clay (Graph 10). Coniferous trees were the dominant vegetation type observed in 62.1% of the units surveyed, including down trees, logs, and root wads. Additionally, 29.3% of the units surveyed had deciduous trees as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Two sites were electrofished on August 20, 1997, in Arvola Gulch. The sites were sampled by Craig Mesman and Tara Cooper (CCC).

The first site sampled included habitat units 27 through 36, a mid-channel pool, low gradient riffle, and step pool sequence approximately 550 feet from the confluence with Chamberlain Creek. The site yielded 3 steelhead, 1 coho, 6 sculpin, and 1 salamander.

The second site included habitat units 47 through 54, a low gradient riffle, run, and mid-channel pool located approximately 973 feet above the creek mouth. The site yielded 1 steelhead, 1 sculpin, and 3 salamanders.

DISCUSSION

Arvola Gulch is a F4 channel type for the entire 4,949 feet of stream surveyed. The suitability of F4 channel type for fish habitat improvement structures is as follows: good for bank placed boulders; fair for weirs, single and opposing wing deflectors, channel constrictors and log cover; and poor for boulder clusters.

The water temperatures recorded on the survey days from August 17 to 21, 1997, ranged from 55 to 67 degrees Fahrenheit. Air temperatures ranged from 59 to 76 degrees Fahrenheit. This is a fair 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 59% of the total **length** of this survey, riffles 19%, and pools 21%. The pools are relatively shallow, with only 9 of the 66 (13.6%) 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. Installing structures that will increase or deepen pool habitat is recommended.

Two of the 66 pool tail-outs measured had an embeddedness rating of 1. Twenty-seven of the pool tail-outs had embeddedness ratings of 3 or 4. Eighteen of the pool tail-outs had a rating of 5 or were considered unsuitable for spawning. Nine of the 18 were unsuitable for spawning due to the dominant substrate being silt/sand/clay or gravel being too small to be suitable. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. In Arvola Gulch, sediment sources should be mapped and rated according to their potential sediment yields, and control measures should be taken.

The mean shelter rating for pools was low with a rating of 33. The shelter rating in the flatwater habitats was 9. A pool shelter rating of approximately 100 is desirable. The relatively moderate amount of cover that now exists is being provided primarily by large woody debris in some habitat types. Additionally, undercut banks contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats are needed to improve 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.

Fifty of the 66 pool tail outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy density for the stream was 84%. This is a relatively high percentage of canopy. In general, revegetation projects are considered when canopy density is less than 80%.
The percentage of right and left bank covered with vegetation was moderate at 69.3% and 68.3%, 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) Arvola Gulch should be managed as an anadromous, natural production stream.

2) The limited water temperature data available suggest that maximum temperatures are approaching the upper end of 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 is from large woody debris in pools. Adding high quality complexity with woody cover is desirable.

4) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.

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) There are several log debris accumulations present on Arvola Gulch that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time, to avoid excessive sediment loading in downstream reaches. Large woody debris removed from log debris accumulations shall be left within the riparian zone so as to provide a source for future recruitment of wood into 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.

0'	Begin survey at confluence with Chamberlain Creek. Channel type is an F4. At 08:45, 07/17/97, water temperature was 58°F, air temperature was 59°F.
222'	At 09:30, 07/17/97, water temperature was 59°F, air temperature was 64°F.
233'	Right bank erosion.
430'	At 10:10, 07/17/97, water temperature was 63°F, air temperature was 62°F.
550'	First electrofishing site.
597'	At 10:45, 07/17/97, water temperature was 57°F, air temperature was 61°F.
848'	Tributary enters from the left bank, dry and steep.
873'	At 11:30, 07/17/97, water temperature was 57°F, air temperature was 65°F.
910'	Log debris accumulation (LDA), 5' high x 20' wide x 57' long. Retaining sediment. The LDA splits channel equally and creates two pools.

973'	Second electrofishing site.
1,010'	Tributary enters from the left bank.
1,044'	At 12:50, 07/17/97, water temperature was 61°F, air temperature was 72°F.
1,074'	LDA, 12' high x 30' wide x 25' long, retaining sediment.
1,108'	Tributary enters from the left bank. Steep, narrow cobble dominated channel. At 75' up the channel is an LDA, 10' high x 5' wide x 8' long.
1,156'	No fish observed above the LDA at 1,074'.
1,234'	Right bank erosion, 30' high x 50' long along a marshy area.
1,409'	At 13:25, 07/17/97, water temperature was 61°F, air temperature was 72°F.
1,412'	Tributary enters from the left bank, dry, very steep channel.
1,599'	At 13:55, 07/17/97, water temperature was 60°F, air temperature was 71°F.
1,643'	Tributary enters from the left bank, dry and steep.
1,750'	LDA, 6' high x 35' wide x 82' long. LDA retaining cobble and gravel intermittent with large woody debris.
1,771'	Tributary enters from the left bank, dry and steep.
1,845'	Tributary enters from the right bank, very steep and dry with a large cobble/boulder dominated channel.
1,895'	Right bank erosion, 6.5' high x 31' long.
2,132'	At 14:50, 07/17/97, water temperature was 59°F, air temperature was 73°F.
2,459'	At 15:20, 07/17/97, water temperature was 58°F, air temperature was 72°F.
2,572'	Tributary enters from the left bank.
2,616'	At 15:50, 07/17/97, water temperature was 57°F, air temperature was 71°F.
2,820'	At 09:55, 07/18/97, water temperature was 55°F.
2,941'	At 10:30, 07/18/97, water temperature was 55°F, air temperature was 73°F.

2,960'	Left bank erosion, 8' high x 50' long.
2,975'	LDA, 8' high x 10' wide x 10' long, not a barrier.
3,013'	Culvert, 1' diameter x 25' long, from an abandoned left bank road.
3,063'	Left bank erosion, 7' high x 24' long.
3,104'	At 11:15, 07/18/97, water temperature was 56°F, air temperature was 73°F.
3,111'	Right bank erosion, 9' high x 30' long.
3,175'	Right bank erosion, 45' high x 15' long.
3,250'	LDA, 8' high x 10' wide x 18' long.
3,261'	Tributary enters from the left bank, dry.
3,357'	At 15:01, 07/21/97, water temperature was 62°F, air temperature was 75°F.
3,491'	Salmonid observed.
3,559'	At 15:43, 07/21/97, water temperature was 67°F, air temperature was 75°F.
3,689'	Metal culvert with a concrete bottom, 12' high x 12' wide x 47' long.
4,217'	Right bank erosion, 25' long x 30' high.
4,262'	At 16:41, 07/17/97, water temperature was 63°F, air temperature was 74°F.
4,384'	Right and left bank erosion.
4,436'	Left bank erosion, 25' high x 68' long.
4,466'	LDA, 40' long x 10' wide, retaining sediment, not a barrier, with associated right bank erosion, 20' high x 20' long, contributing sediment.
4,568'	At 17:40, 07/21/97, water temperature was 62°F, air temperature was 76°F.
4,618'	Tributary enters from the right bank.
4,738'	Right bank erosion, 50 high x 50' long.
4,757'	Tributary enters from the left bank, steep and very entrenched cobble dominated channel.

Arvola Gulch

4,788'	Right bank erosion.
4,823'	Left bank erosion.
4,881'	Right bank erosion, 40' high x 100' long.
4,949'	End of survey at a log forming a 10' jump that is a barrier to fish passage. Upstream of the log the channel is dominated by large cobble, with no spawning areas.

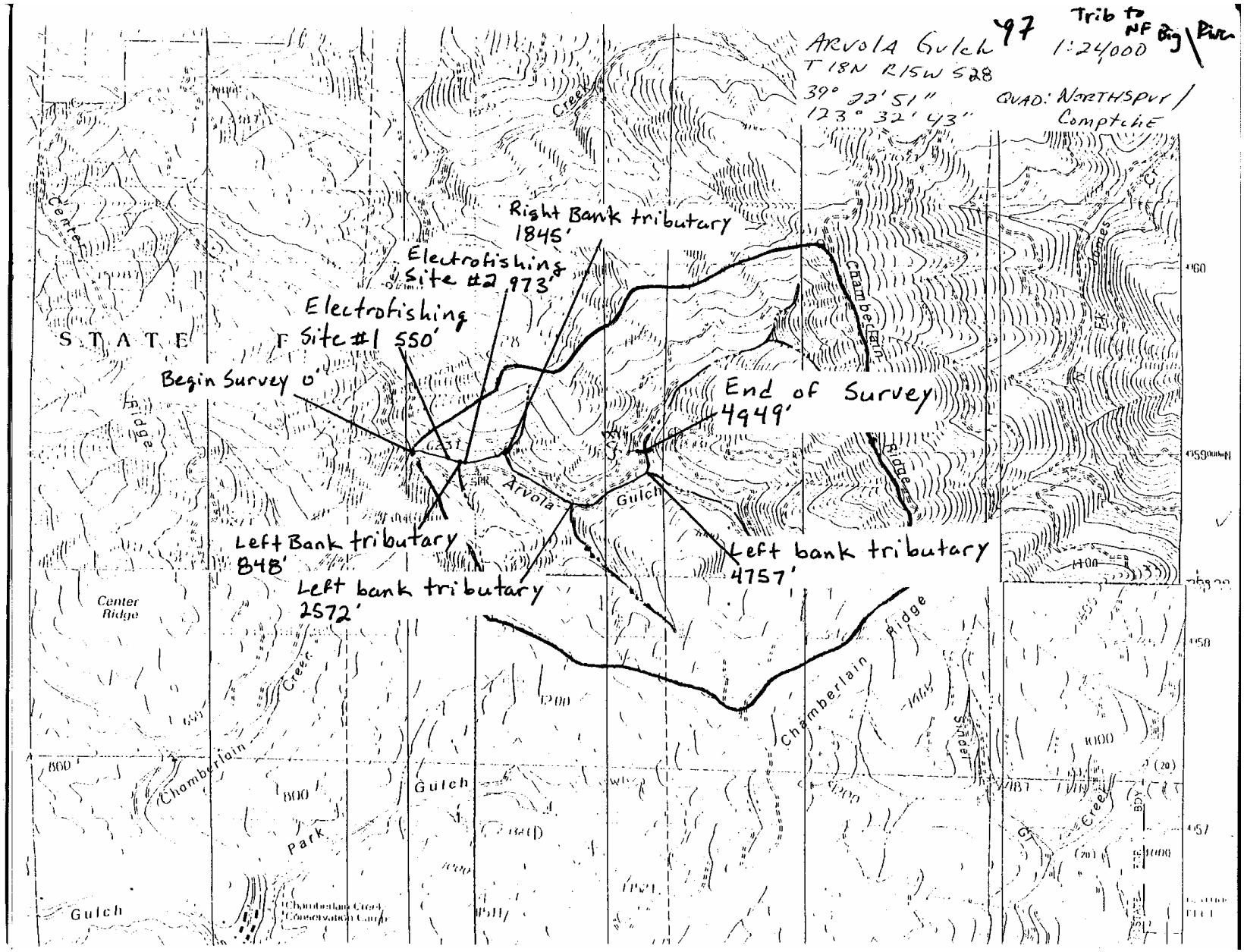
REFERENCES

Flosi, G., and F. Reynolds. 1994. California salmonid stream habitat restoration manual, 2nd edition. California Department of Fish and Game, Sacramento, California.

Hopelain, J. 1995. Sampling levels for fish habitat inventory, unpublished manuscript. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

LEVEL III and LEVEL IV HABITAT TYPE KEY

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6
BACKWATER POOLS		
Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5


Arvola Gulch '97
T18N R15W S28
39° 22' 51"
123° 32' 43"
Trib to NF Big River
1:24000
QUAD: Northspur / Comptche
Right Bank tributary 1845'
Electrofishing Site #2 973'
Electrofishing Site #1 550'
Begin Survey 0'
End of Survey 4949'
Left Bank tributary 848'
Left bank tributary 2572'
Left bank tributary 4757'
Arvola Gulch
Chamberlain Creek
Center Ridge
Chamberlain Ridge
Chamberlain Creek Conservation Camp
STATE