Report Revised April 14, 2006
Report Completed 2000
Assessment Completed 1999

CALIFORNIA DEPARTMENT OF FISH AND GAME
STREAM INVENTORY REPORT

Little Sulphur Creek

INTRODUCTION

A stream inventory was conducted during the summer of 1999 on Little Sulphur Creek. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the amount and condition of available habitat to fish and other aquatic species with an emphasis on anadromous salmonids. The objective of the biological inventory was to document the presence and distribution of salmonids and other aquatic 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

Little Sulphur Creek, located in Sonoma County, is a tributary of Big Sulphur Creek, which in turn flows into the Russian River (see Little Sulphur Creek map, page 2). The legal description at the confluence with Big Sulphur Creek is T11N, R10W, S12. Its location is 38°48'35" N. latitude and 122°55'32" W. longitude. Year round vehicle access exists from Geysers Road via River Road via Hwy 101 at Cloverdale.

Little Sulphur Creek and its tributaries drain a basin of approximately 43.9 square miles. Little Sulphur Creek is a third order stream and has approximately 16.6 miles of blue line stream, according to the USGS Asti, The Geysers, Jimtown and Mt. St. Helena 7.5 minute quadrangles. Major tributaries include Lover's Gulch and Anna Belcher, which are included in this report, and North Branch Little Sulphur, which is described in a separate stream report. Summer flow in Little Sulphur Creek was measured as approximately 1.89 cfs. Elevations range from about 640 feet at the mouth of the creek to 2,438 feet in the headwaters. Oak woodland dominates the watershed, but there are zones of mixed conifer forest in the upper watershed. The predominant upland vegetation throughout the watershed consists of annual grasses, buckeye, oak, California laurel, madrone, and fir, while the riparian corridor is dominated by alder and willow. The watershed is entirely privately owned and is managed for grazing and vineyard production, with scattered rural development. Sensitive species listed from the CNPS Inventory and DFG's Natural Diversity Database within Little Sulphur watershed includes the foothill yellow-legged frog (*Rana boylii)* and the Socrates mine jewel-flower *(Streptanthus brachiatus* ssp *brachiatus),* both federally listed Species of Concern. Also present in this watershed is the Steelhead (Onchorynchus mykiss), federally listed as threatened.

METHODS

The habitat inventory conducted in Little Sulphur Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 1998). The Americorps Volunteers 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 and was supervised by Bob Coey, Russian River Basin Planner (DFG).

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 (1998). This form was used in Little Sulphur Creek to record measurements and observations. There are nine components to the inventory form: flow, channel type, temperatures, habitat type, embeddedness, shelter rating, substrate composition, canopy, and bank composition.

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. Flows are also measured or estimated at major tributary confluences.

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 (1998). 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:

Water and air temperatures, and time, are measured by crew members with hand-held thermometers and recorded at each tenth unit typed. Temperatures are measured in Fahrenheit at the middle of the habitat unit and within one foot of the water surface. Temperatures are also recorded using remote Temperature recorders which log temperature every two hours, 24 hours/day.

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". Little Sulphur 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 unit lengths were measured. The first occurrence of each unit type and a randomly selected 10% subset of all units were completely sampled (Length, Mean Width, Mean Depth, Maximum Depth and Pool Tail Crest Depth). All measurements are 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 Little Sulphur Creek, embeddedness was visually estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3), 76 - 100% (value 4). "Not suitable" (value 5) is assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, absence of particulate substrate (e.g. 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. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All shelter is then classified according to a list of nine shelter types. In Little Sulphur Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the shelter. The shelter rating is calculated for each habitat unit by multiplying shelter value and percent covered. Thus, shelter ratings can range from 0-300, and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

In all fully measured habitat units, dominant and sub-dominant substrate elements are visually estimated using a list of seven size classes: Silt/Clay, Sand, Gravel, Small Cobble, Large Cobble, Boulder, and Bedrock.

8. Canopy:

Stream canopy density is estimated using modified handheld spherical densiometers as described in the California Salmonid Stream Habitat Restoration Manual (1998). Canopy density relates to the amount of stream shaded from the sun. In Little Sulphur 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. Finally, the total canopy over each habitat unit is visually divided into evergreen and deciduous, and the estimated percentages are recorded.

9. Bank Composition and Vegetation:

Banks may be composed primarily of (1) Bedrock, (2) Boulders, (3) Cobble/Gravel, or (4) Silt/Clay/Sand, and may be covered predominantly with (5) Grass, (6) Brush, (7) Deciduous Trees, (8) Coniferous Trees, or (9) No Vegetation at all. These factors influence the ability of stream banks to withstand winter flows. For each fully measured habitat unit in Little Sulphur Creek, the dominant Bank Composition Type and Vegetation Type of both the right and left banks were chosen from the options above. Additionally, the percentage of vegetal coverage was estimated and recorded for each bank.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species present and their distribution in the stream. Biological inventory is conducted using one or more of three basic methods: 1) stream bank observation, 2) underwater observation, and 3) electro-fishing. These sampling techniques are discussed in the California Salmonid Stream Habitat Restoration Manual (1998).

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat, a dBASE IV data entry program developed by CDFG. This program processes and summarizes the data, and produces the following tables and appendices:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Shelter by habitat types
- Dominant substrates by habitat types
- Vegetative cover and dominant bank composition
- Fish habitat elements by stream reach

Graphics are produced from the tables using Lotus 1,2,3. Graphics developed for Little Sulphur Creek include:

- Level II Habitat Types by % Occurrence and % Total Length
- Level IV Habitat Types by % Occurrence
- Pool Habitat Types by % Occurrence
- Maximum Depth in Pools
- Pool Shelter Types by % Area
- Substrate Composition in Low Gradient Riffles
- Percent Cobble Embeddedness by Reach

- Mean Percent Canopy
- Mean Percent Canopy by Reach
- Percent Bank Composition and Bank Vegetation

HISTORICAL STREAM SURVEYS:

The Department of Fish and Game conducted surveys of Little Sulphur Creek in August 1965, August 1968, September 1973 and September 1974.

In 1965, surveyors recorded a flow of 1.5-2 cfs, and a velocity was noted as rapid; more than .5 foot/second. The substrate was composed primarily of gravel and rubble. There was a good pool to riffle ratio; 50% pool and 50% riffle. Shelter was composed of overhanging branches, undercut banks, boulders and logs. It was rated as good shelter. There was good spawning habitat throughout the stream and only a few areas that were not spawnable due to heavy concentrations of clay. The stream temperature was 70_ F. Partial barriers were noted in the survey.

In 1968, DFG conducted a partial survey from the confluence of Big Sulphur to Pine Flat Road, for a total of 15 miles. The gradient was about 5 feet per 100 feet of stream, or 5% gradient. The average depth of the riffles was about 6 inches, and average maximum depth of pools was 3 feet. The following flows were recorded: 2.5 cfs near the confluence with Big Sulphur Creek; 1.8 cfs upstream from the confluence to the north branch; 1.7 cfs at the auger hole on the Pocket Ranch; and 0.5 cfs upstream from the Healdsburg Geyser Rd.

The substrate was composed primarily of gravel and rubble, followed by sand and silt. Approximately 5% of the stream gravel appeared to be suitable for spawning and less than 5% for chinook salmon spawning. There was excellent pool development in the upper portion surveyed. The pools found above Pocket Ranch Rd. were generally large and deep. Pools downstream from this road were generally long, narrow and shallow. Most of the stream had good shelter, provided primarily by undercut rocks and banks.

Two barriers in the form of waterfalls were observed 2 miles downstream from Healdsburg Geysers Rd. They were located within 100 feet of each other and appear to have been complete barriers to fish. A small temporary earthen dam located about 1 mile downstream from the Pine Flat on the Cinnabar Ranch was washed out.

Air temperatures were recorded as follows: 60° F to 90°F throughout the day. Corresponding water temperatures were recorded as between 57°F to 76°F.

In September 1973, Little Sulphur was surveyed from the confluence to the upper fisheries limit, which was 14 miles. The flow was recorded from 0.5 cfs in the upper section to 1.0 cfs at the confluence with Big Sulphur.

The streambed in the lower 5 miles was mainly composed of bedrock outcroppings covered with 60% boulder, 20% rubble, 10% gravel, 10% sand and silt. The streambed in the remainder of the creek consisted of 30% boulder, 10% bedrock, 30% gravel, 20% rubble, 10% silt and organic debris. Approximately .75 of the stream consisted of pools, which were larger and deeper in the lower stretches. The average pool was 10 feet in diameter and 4 feet deep. Much of the shelter was provided by undercut banks and rocks. About 1/10 of the streambed was suitable for spawning. An exception to this was a 2 mile section, 4 miles above the confluence with Big Sulphur, in which .75 of the streambed was suitable for spawning.

Several roads had recently been constructed across the creek one mile downstream from the Healdsburg Geysers Road Bridge. This road building created many intermittent, murky pools. There was one diversion noted.

In September 1974, the entire creek was surveyed, for a total of 15.6 miles. The flow ranged from 2 cfs at the confluence with Big Sulphur and 1 cfs in the upper stream section. The average flow for Little Sulphur Creek was 2 cfs.

The streambed in the upper section of Little Sulphur was composed of 30% boulder, 30% rubble, 30% gravel, 5% sand, 4% silt and 1% detritus. In the lower section, the substrate was composed of 5% bedrock, 5% boulder, 40% rubble, 40% gravel, 5% sand and 5% silt. Pools were frequent along the stream with a pool to riffle ration of 2.5 to1. The average pool length was 30 feet and the average width was 12 feet, with an average depth of 3 feet. Shelter consisted of undercut banks and boulders with a few fallen trees.

Suitable spawning areas for steelhead and rainbow trout occurred throughout the stream. Total stream usable for spawning was estimated at 8%, while an estimated 80% was suitable as nursery habitat.

An 8 foot high rock falls barrier was found and one water diversion was observed, which consisted of a 2” water pipe leading to a house. The average water temperature was 62° F, and the average air temperature was 85°F.

Pollution consisted of feces from cattle in and around the stream. There were also 3 car bodies and automobile parts in one section of the stream.

HABITAT INVENTORY RESULTS FOR LITTLE SULPHUR CREEK

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

The habitat inventory of August 16 through October 12, 1999, was conducted by Morgan Knechtle, Gary Neargardner, Stephanie Carey, Bryan Freele, Sarah Nossaman and Aaron Fairbrook (CDFG). The survey began at the confluence with Big Sulphur Creek and extended up Little Sulphur Creek

to the end of surface flows. The total length of the stream surveyed was 84,475 feet, with an additional 3,614 feet of side channel.

A flow of 1.9 cfs was measured on August 17, 1999 at habitat unit #68, 6,245 feet above survey start, with a Marsh-McBirney Model 2000 flowmeter.

This section of Little Sulphur Creek has 14 channel types: from the mouth to 8,954 feet an F3; next 5,707 feet a C3; next 1,514 feet a B2; next 4,615 feet a G1; next 2,635 feet an F4; next 2,550 feet a B4; next 1,499 feet a B1; next 4,885 feet a B2; next 3,108 feet an F4; next 16,595 feet a B2; next 2,761 feet an A2; next 10,475 feet a B2; next 16,863 feet an F3 and the upper 2,314 feet an F4.

F channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio. F3 channels have a predominantly cobble substrate and F4 channels have a predominantly gravel substrate.

C3 channel types are low gradient (<2%), meandering, point-bar, riffle/pool, alluvial channels with a broad, well defined floodplain and a predominantly cobble substrate.

B channel types are moderately entrenched, moderate gradient (2-4%), riffle dominated channels, with infrequently spaced pools, a very stable plan and profile, stable banks and. B2 channels have a predominantly boulder substrate, B4 channels have a predominantly gravel substrate, and B1 channels have a predominantly bedrock substrate.

G1 channel types are characterized as well entrenched "gully" step-pool channels with a low width/depth ratio, a moderate gradient (2-4%) and a predominantly bedrock substrate.

A2 channel types are steep (4-10%), narrow, cascading, step-pool streams with a high energy/debris transport associated with depositional soils and a predominantly boulder substrate.

Water temperatures on the survey dates ranged from 46°F to 80°F. Air temperatures ranged from 50°F to 92°F. Summer temperatures were also measured using remote temperature recorders placed in pools (see Temperature Summary graphs at end of report). A recorder in lower Little Sulphur Creek, beneath Pocket Ranch Road bridge, logged temperatures every 2 hours from June 30 through September 28, 1999. The highest temperature recorded was 76°F in July, and the lowest was 60°F in September. The mean of the daily highs was 71°F for the month of July, 69°F for August, and 65°F for September. Another recorder in upper Little Sulphur Creek, beneath Geysers Road bridge, logged temperatures from July 1 through September 27, 1999. The highest temperature recorded was 66°F in July, and the lowest was 51°F in September. The mean of the daily highs was 61°F for July, 59°F for August, and 58°F for September.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 39% pool units, 37% flatwater units, 23% riffle units, and 1% dry streambed units. Based on total **length** there were 52% flatwater units, 28% pool units, 18% riffle units, and 1% dry streambed units.

One thousand and forty-five habitat units were measured and 21% were completely sampled. Twenty-three Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent **occurrence** were step runs at 16%, low gradient riffles at 15%, runs at 13% and mid-channel pools at 12%. By percent total **length**, step runs made up 32%, low gradient riffles 14%, runs 11%, and mid-channel pools 10%.

Four hundred and five pools were identified (Table 3). Scour pools were most often encountered at 54%, and comprised 55% of the total length of pools.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Two hundred and eighty of the 405 pools (69%) had a depth of three feet or greater. These deeper pools comprised 22% of the total length of stream habitat.

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. Pool types had the highest shelter rating at 25. Riffle had the lowest rating with 9 and flatwater rated 13 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 29, main channel pools rated 26, and scour pools rated 24 (Table 3).

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were boulders at 45%, bedrock ledges at 18%, root masses at 9%, and small woody debris at 7%.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 10 of the 31 low gradient riffles measured. Small cobble was dominant in 6 of the low gradient riffles.

No mechanical gravel sampling was conducted in 1999 surveys due to inadequate staffing levels.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 384 pool tail-outs measured, 45 had a value of 1 (12%), 146 had a value of 2 (38%), 91 had a value of 3 (24%), and 16 had a value of 4 (4%). Eighty-six (22%) riffles rated a 5 (unsuitable substrate type for spawning). On this scale, a value of one is best for fisheries.

The mean percent canopy density for the stream reach surveyed was 54%. The mean percentages of deciduous and evergreen trees were 60% and 39%, respectively.

For the entire stream reach surveyed, the mean percent right bank vegetated was 38% and the mean percent left bank vegetated was 34%. For the habitat units measured, the dominant vegetation types for the stream banks were: 54% deciduous trees, 22% evergreen trees, 12% grass, 8% bare soil and 4% brush. The dominant substrate for the stream banks were: 37% bedrock, 29% cobble/gravel, 25% boulder and 9% silt/clay/sand.

HABITAT INVENTORY RESULTS FOR LOVER'S GULCH

The habitat inventory of October 6, 1999, was conducted by Morgan Knechtle and Sarah Nossaman (CDFG). The survey began at the confluence with Little Sulphur Creek and extended up Lover's Gulch to the end of the survey. The total length of the stream surveyed was 4,168 feet, with an additional 9 feet of side channel.

A flow of .031 cfs was measured on October 12, 1999 134 feet downstream of Bastian's road crossing, with a Marsh-McBirney Model 2000 flowmeter.
Lover's Gulch has 1 channel type; an F3. F3 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly cobble substrate.

Water temperatures on the survey date ranged from 54°F to 59°F. Air temperatures ranged from 56°F to 64°F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of ***occurrence*** *there were 38% riffle units, 31% flatwater units, and 31% pool units, with no dry streambed. Based on total* ***length*** *there were 51% flatwater units, 40% riffle units, and 9% pool units.*

Eighty habitat units were measured and 35% were completely sampled. Nine Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent ***occurrence*** *were step runs at 31%, followed by low gradient riffles at 25%, mid-channel pools at 18%, and cascades at 8%. By percent total* ***length****, step runs made up 51%, low gradient riffles 36%, mid-channel pools 5%, and high gradient riffles 4%..*

Twenty-five pools were identified (Table 3). Main Channel pools were most often encountered at 64%, and comprised 78% of the total length of pools.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Seven of the 25 pools (28%) had a depth of two feet or greater. These deeper pools comprised 3% of the total length of stream habitat.

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. Pool types had the highest shelter rating at 27. Riffles had the lowest rating with 2 and flatwater rated 12 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 37, main channel pools rated 24, and backwater pools rated 10 (Table 3).

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were boulders at 61%, followed by root masses at 13%, aquatic vegetation at 9%, and bedrock ledges at 5%.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 1 of the 6 low gradient riffles measured. Small cobble was dominant in 2 of the low gradient riffles.

.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 23 pool tail-outs measured, 1 had a value of 1 (4%), 6 had a value of 2 (26%), 9 had a value of 3 (39%), and 3 had a value of 4 (13%). Four (17%) riffles rated a 5 (unsuitable substrate type for spawning). On this scale, a value of one is best for fisheries.

The mean percent canopy density for the stream reach surveyed was 65%. The mean percentages of deciduous and evergreen trees were 64% and 36%, respectively.

For the entire stream reach surveyed, the mean percent right bank vegetated was 55% and the mean percent left bank vegetated was 51%. For the habitat units measured, the dominant vegetation types for the stream banks were: 47% deciduous trees, 28% evergreen trees, 22% grass, and 3% brush. The dominant substrate for the stream banks were: 45% boulder, 34% cobble/gravel, 12% bedrock and 9% silt/clay/sand.

HABITAT INVENTORY RESULTS FOR ANNA BELCHER CREEK

The habitat inventory of July 27, 1999, was conducted by Morgan Knechtle and Gary Neargardner (CDFG). The survey began at the confluence with Little Sulphur Creek and extended up Anna Belcher Creek to the end of anadromous fish passage at a 15' vertical cascade. The total length of the stream surveyed was 3,306 feet.

Flows were not measured on Anna Belcher Creek, as surface flow was intermittent.

This section of Anna Belcher Creek has 1 channel type; a B4. B4 channel types are moderately entrenched, moderate gradient (2-4%), riffle dominated channels, with infrequently spaced pools, a very stable plan and profile, stable banks and a predominantly gravel substrate.

Water temperatures on the survey dates ranged from 62 ℉ to 71 ℉. Air temperatures ranged from 72 ℉ to 75 ℉.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of ***occurrence*** *there were 33% dry streambed units, 29% flatwater units, 29% pool units, and 7% riffle units. Based on total* ***length*** *there were 60% dry streambed units, 27% flatwater units, 10% pool units, and 2% riffle units.*

Forty-five habitat units were measured and 11% were completely sampled. Nine Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent ***occurrence*** *were dry streambed at 33%, followed by runs at 22%, bedrock scour pools at 16% and low gradient riffles at 7%. By percent total* ***length****, dry streambed made up 60%, runs 24%, bedrock scour pools 4%, and glides 3%.*

Thirteen pools were identified (Table 3). Scour pools were most often encountered at 85%, and comprised 79% of the total length of pools.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Three of the 13 pools (23%) had a depth of two feet or greater. These deeper pools comprised 3% of the total length of stream habitat.

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. Flatwater types had the highest shelter rating at 39. Riffles had the lowest rating with 0 and pools rated 11 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 12, and main channel pools rated 5.

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were root masses at 56%, followed by aquatic vegetation at 21%, undercut banks at 13%, and bedrock ledges at 6%.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in the one low gradient riffle measured.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 9 pool tail-outs measured, 0 had a value of 1 (0%), 6 had a value of 2 (67%), 3 had a value of 3 (33%), and 0 had a value of 4 (0%). No riffles rated a 5 (unsuitable substrate type for spawning). On this scale, a value of one is best for fisheries.

The mean percent canopy density for the stream reach surveyed was 30%. The mean percentages of deciduous and evergreen trees were 26% and 74%, respectively.

For the entire stream reach surveyed, the mean percent right bank vegetated was 85% and the mean percent left bank vegetated was 83%. For the habitat units measured, the dominant vegetation types for the stream banks were: 73% grass, 14% deciduous trees, 9% brush, and 5% evergreen trees. The dominant substrate for the stream banks were: 64% silt/clay/sand, 27% cobble/gravel, and 9% bedrock.

BIOLOGICAL INVENTORY

JUVENILE SURVEYS OF LITTLE SULPHUR CREEK:

Biological surveys were conducted by CDFG in 1954, 1958, 1963, 1965, 1968, 1973, 1974, and 1999, to document the fish species composition and distribution at several locations in Little Sulphur Creek.

Notes dated August 1954 indicate that Little Sulphur Creek was chemically treated, but not sampled, in 1952. No sampling or treatment was performed in 1953. In 1954 Little Sulphur Creek

was electro-fished. The notes indicate that the observers believed a barrier in Big Sulphur Creek impeded passage of the majority of migrating adult steelhead during the 1953-1954 winter season.

During the 1954 sampling, a total of 115 fish (Sacramento sucker and rainbow trout/steelhead) were identified. Of this total, 85 were rainbow trout/steelhead varying in size from 2.0 inches to 6.5 inches with 70 individuals less than 3 inches and 15 individuals over 3 inches in length.

In August 1965, DFG noted large quantities of fish: trout, California roach, and Sacramento pike minnow. These fish were noted as occurring at the following densities: trout, 100/100' section in upper area, 75/100' in middle area and 50/100' in lower area; roach, 10/100' section in upper area; and Sacramento pike minnow, 5/100' in upper area and 50/100' in lower area.

Numbers of fish were estimated by Braille seining and eye count. Estimated total number of trout for the entire stream length: 112 to 860.

In August 1968, fish species noted as present in Little Sulphur Creek included steelhead, rainbow trout, green sunfish, suckers and roach. Juvenile steelhead and/or rainbow trout ranging from 2 to 10 inches were found in the entire length of the stream; about 100/100 feet of stream. Numbers of salmonids were slightly less downstream from Pocket Ranch Road. Green sunfish ranging from 1 to 7 inches were found upstream from the Cinnabar Ranch. Numbers were approximately 50 /100 feet of stream. California roach averaging about 2 inches dominated the stream downstream from the Pocket Ranch. Numbers of roach were estimated at more than 250/100 feet of stream. Suckers averaging 8" long were found downstream from Pocket Ranch Road in numbers of about 150/ 100 feet of stream. Green sunfish, suckers and roach were not found upstream of Pocket Ranch Road.

On October 13, 1999, a biological inventory was conducted on four sites in Little Sulphur Creek to document the fish species composition and distribution. Each site was single pass electrofished using one Smith Root Model 12 electrofisher. Fish from each site were counted by species, and returned to the stream. A random sample of fish were selected from each site and tissues were taken for genetic analysis. The air temperature ranged from 61° to 84°F and the water temperature ranged from 52° to 62°F. The observers were Sarah Nossaman, Bryan Freele, and Morgan Knechtle of CDFG.

The inventory of Site 1 started at habitat unit #755 and ended approximately 397 feet upstream. In riffle, step-run and pool habitat types, 48 steelhead (ranging from 50-170mm) were observed along with 3 yellow-legged frogs, one Pacific Giant salamander and one Pacific lamprey.

The inventory of Site 2 started at habitat unit #808 and ended approximately 364 feet upstream. In riffle, step-run and pool habitat types, 46 steelhead (ranging from 45-165mm) were observed along with 3 Pacific lamprey.

The inventory of Site 3 started at habitat unit #471 and ended approximately 114 feet upstream. In riffle, run and pool habitat types, 36 steelhead (ranging from 45-175mm) were observed along

with approximately 80 California roach, approximately 80 sculpin, 5 signal crayfish, 2 Pacific lamprey and one yellow-legged frog.

The inventory of Site 4 started at habitat unit #549 and ended approximately 228 feet upstream. In riffle, run and pool habitat types, 30 steelhead (ranging from 60-110mm) were observed along with approximately 107 California roach, approximately 123 sculpin, and 7 signal crayfish. It was noted that this reach is impacted by cattle.

During the habitat inventory, no salmonids were observed upstream of unit #984, 7,150 feet above the confluence with Big Sulphur Creek.

A summary of historical and recent data collected appears in the table below.

Table 1. Species Observed in Historical and Recent Surveys

YEARS	SPECIES	SOURCE	Native/Introduced
1954,1958,1968 1973,1974,1999	Steelhead	DFG	N
1999	Yellow-legged frog	DFG	N
1999	Pacific Giant Salamander	DFG	N
1963,1965,1968 1973,1974,1999	California Roach	DFG	N
1954,1963,1965 1968,1973,1974	Sacramento Sucker	DFG	N
1968	Green Sunfish	DFG	I
1965	Stickleback	DFG	N
1963,1973, 1974	Sacramento Squawfish	DFG	N
1954,1999	Pacific Lamprey	DFG	N
1965	“Trout”	DFG	N
1999	Signal Crayfish	DFG	N
1999	Sculpin	DFG	N

Historical records reflect that fish stocking operations occurred from 1915 through the early 1980s.

Table 2. Summary of fish stocking into Little Sulphur Creek

YEAR	SOURCE	SPECIES	#	SIZE
1915	Upper Eel River	Steelhead	???	???
1958	Sausal Creek	Steelhead	3080	Fingerlings
1960	Mill Creek	Steelhead	26051	Fingerlings
1960	Pena Creek	Steelhead	27492	Fingerlings
1960	Maacama Creek	Steelhead	3006	Fingerlings
1960	Dry Creek	Steelhead	45607	Fingerlings
1961	Cherry Creek	Steelhead	11428	Fingerlings
1961	Dry Creek	Steelhead	24507	Fingerlings
1961	Franz Creek	Steelhead	5251	Fingerlings
1961	Maacama Creek	Steelhead	3941	Fingerlings
1961	Oat Valley Creek	Steelhead	1476	Fingerlings
1961	Pena Creek	Steelhead	13197	Fingerlings
1962	Brooks Creek	Steelhead	3960	Fingerlings
1962	Cherry Creek	Steelhead	2282	Fingerlings
1962	Dry Creek	Steelhead	60888	Fingerlings
1962	Maacama Creek	Steelhead	6379	Fingerlings
1962	Pena Creek	Steelhead	26051	Fingerlings
1964	Franz Creek	Steelhead	2108	Fingerlings
1982	Dry Creek	Steelhead	10800	Fingerlings

JUVENILE SURVEYS OF LOVER'S GULCH:

No historical biological surveys were conducted by CDFG on Lover's Gulch.

On October 11, 1999, a biological inventory was conducted on one site in Lover's Gulch to document the fish species composition and distribution. The site was single pass electrofished using one Smith Root Model 12 electrofisher. Fish were counted by species, and returned to the stream. A random sample of fish were selected from each reach and tissues were taken for genetic analysis. The air temperature was 67°F and the water temperature was 54°F. The observers were Bryan Freele and Morgan Knechtle of CDFG.

The inventory of Site 1 started at habitat unit #26 and ended approximately 463 feet upstream at habitat unit #34. In run, riffle, and pool habitat types, 18 steelhead (ranging from 30-125mm) were observed, along with 12 foothill yellow-legged frogs, 5 pacific giant salamanders and one rough-skinned newt. It was noted that bovine feces was found in the creek bed.

ADULT SURVEYS:

No carcass/spawning surveys were conducted on Little Sulphur Creek in 1999 due to inadequate staffing levels.

DISCUSSION FOR LITTLE SULPHUR CREEK

Little Sulphur Creek has 14 channel types: F3 (8,954 ft.), C3 (5,707 ft.), B2 (1,514 ft.), G1 (4,615 ft.), F4 (2,635 ft.), B4 (2,550 ft.), B1 (1,499 ft.), B2 (4,885 ft.), F4 (3,108 ft.), B2 (16,595 ft.), A2 (2,761 ft.), B2 (10,475 ft.), F3 (16,863 ft.) and F4 (2,314 ft.).

According to the DFG Salmonid Stream Habitat Restoration Manual, F3 channel types are good for bank-placed boulders as well as single and opposing wing-deflectors. They are fair for low-stage weirs, boulder clusters, channel constrictors and log cover. F4 channel types are good for bank-placed boulders and fair for low-stage weirs, single and opposing wing-deflectors, channel constrictors and log cover. Many site specific projects can be designed within F channel types, especially to increase pool frequency, volume and shelter. Any work considered for F channel types will require careful design, placement, and construction that includes protection for unstable banks.

C3 channel types are excellent for bank-placed boulders and good for low-stage weirs, boulder clusters, single and opposing wing deflectors and log cover. They are fair for medium-stage weirs.

B2 channel types are excellent for low and medium-stage plunge weirs, single and opposing wing deflectors and bank cover. B4 channel types are excellent for low-stage plunge weirs, boulder

clusters, bank placed boulders, single and opposing wing-deflectors and log cover. They are also good for medium-stage plunge weirs. B1 channel types are excellent for bank-placed boulders and bank cover and good for log cover. All B channel types have banks of suitable gradient and stability for the installation of instream structures designed to increase pool habitat, trap spawning gravels, and provide protective shelter for fish. Many site specific projects can be designed within B channel types, especially to increase pool frequency, volume and shelter.

G1 channel types are fair for log cover.

A2 channel types have stable stream banks and poor gravel retention capabilities and are generally not suitable for instream enhancement structures.

The water temperatures recorded on the survey days ranged from 46°F to 80°F. Air temperatures ranged from 50°F to 92°F. The warmer water temperatures were recorded in Reach 2. These temperatures, if sustained, are above the threshold stress level (65°F) for salmonids.

The Temperature Summary graphs shows **s**ummer temperatures measured using remote temperature recorders placed in pools. For much of the summer (June through September) the lower watershed exhibited temperatures above the optimal for salmonids, and the upper watershed exhibited temperatures near or slightly above optimal.

Pools comprised 28% of the total **length** of this survey. In third and fourth order streams a primary pool is defined to have a maximum depth of at least three feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. In Little Sulphur Creek, only 69% of pools have a maximum depth of at least 3 feet. These pools comprised 22% of the total length of stream habitat. In coastal coho and steelhead streams, it is generally considered desirable to have primary pools comprise approximately 50% of total habitat length.

The mean shelter rating for pools was 25. A pool shelter rating of approximately 80 is desirable. The relatively small amount of pool shelter that now exists is being provided primarily by boulders (45%) and bedrock ledges (18%), with the remainder provided by root masses (9%) and small woody debris (7%). Log and root wad cover in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Log cover provides rearing fry with protection from predation, respite from high flow water velocity, and also divides territorial units to reduce density-related competition.

Sixteen of the 31 low gradient riffles measured (52%) had either gravel or small cobble as the dominant substrate. This is generally considered fair for spawning salmonids.

Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. Twenty-eight of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 12% had a rating of 1. In a reach comparison, Reach 7 had the best ratings and Reach 4 had the poorest ratings.

The mean percent canopy for the survey was 54%. This is a low percentage of canopy, since 80% is generally considered desirable. Cooler water temperatures are desirable in Little Sulphur Creek. Elevated water temperatures could be reduced by increasing stream canopy. The large trees required for adequate stream canopy would also eventually provide a long term source of large woody debris needed for instream shelter and bank stability.

Furthermore, the riparian buffer is thin or nearly absent in areas with livestock grazing. Riparian removal and intensive grazing within the riparian corridor have lead to less stream canopy and channel incision causing bank erosion and higher water temperatures.

DISCUSSION FOR LOVERS GULCH

Lovers Gulch has one channel types: F3.

There are 4168 feet of F3 channel type in Reach 1. According to the DFG Salmonid Stream Habitat Restoration Manual, F3 channel types are good for bank-placed boulders as well as single and opposing wing-deflectors. They are fair for low-stage weirs, boulder clusters, channel constrictors and log cover. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

The water temperatures recorded on the survey days 10/06/99 to 10/06/99 ranged from 54°F to 59°F. Air temperatures ranged from 56°F to 64°F. This temperature regime is favorable to salmonids.

It is unknown if this thermal regime is typical. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and\or more extensive biological sampling conducted.

*Pools comprised 9% of the total **length** of this survey. 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. In LOVERS GULCH, the pools are relatively shallow/deep with 28% having a maximum depth of at least 2 feet. These pools comprised 3% of the total length of stream habitat. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat length.*

The mean shelter rating for pools was 27. However, a pool shelter rating of approximately 80 is desirable. The relatively small/moderate/large amount of pool shelter that now exists is being provided primarily by boulders (61%), root masses (13%), aquatic vegetation (9%), and bedrock ledges (5%).Log and root wad cover in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Log cover provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related

competition.

Three of the six low gradient riffles measured (50%) had either gravel or small cobble as the dominant substrate. This is generally considered good/poor/fair for spawning salmonids.

Fifty-two of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 4% had a rating of 1. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead.

The mean percent canopy for the survey was 65%. This is a low percentage of canopy, since 80 percent is generally considered desirable. Cooler water temperatures are desirable in LOVERS GULCH. Elevated water temperatures could be reduced by increasing stream canopy. The large trees required for adequate stream canopy would also eventually provide a long term source of large woody debris needed for instream shelter and bank stability.

DISCUSSION FOR ANNA BELCHER

Anna Belcher Creek has one channel type: B4.

There are 3306 feet of B4 channel type in Reach 1. According to the DFG Salmonid Stream Habitat Restoration Manual, B4 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover. They are also good for medium-stage plunge weirs. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. These channel types have suitable gradients and the stable stream banks that are necessary for the installation of instream structures designed to increase pool habitat, trap spawning gravels, and provide protective shelter for fish.

The water temperatures recorded on the survey days 07/27/99 to 07/27/99 ranged from 62°F to 71°F. Air temperatures ranged from 72°F to 75°F. The warmer water temperatures were recorded in Reach 1.

It is unknown if this thermal regime is typical. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and\or more extensive biological sampling conducted.

*Pools comprised 10% of the total **length** of this survey. 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. In Anna Belcher Creek, the pools are relatively shallow with 23% having a maximum depth of at least 2 feet. These pools comprised 3% of the total length of stream habitat. In coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat length.*

The mean shelter rating for pools was 11. However, a pool shelter rating of approximately 80 is desirable. The relatively small amount of pool shelter that now exists is being provided primarily by root masses (56%), and aquatic vegetation (21%). Log and root wad cover in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Log cover provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

One low gradient riffles measured (100%) had either gravel or small cobble as the dominant substrate. This is generally considered poor for spawning salmonids.

Thirty three of the pool tail-outs measured had embeddedness ratings of either 3 or 4. None had a rating of 1. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead.

The mean percent canopy for the survey was 30%. This is a very low percentage of canopy, since 80 percent is generally considered desirable. Cooler water temperatures are desirable in Anna Belcher Creek. Elevated water temperatures could be reduced by increasing stream canopy. The large trees required for adequate stream canopy would also eventually provide a long term source of large woody debris needed for instream shelter and bank stability.

GENERAL MANAGEMENT RECOMMENDATIONS

Little Sulphur Creek should be managed as an anadromous, natural production stream.

Woody debris, if left undisturbed, will provide fish shelter and rearing habitat, and offset channel incision. Landowners should be sensitive about the natural and positive role woody debris plays in the system, and encouraged not to remove woody debris from the stream, except under extreme buildup and only under guidance by a fishery professional.

PRIORITY FISHERY ENHANCEMENT OPPORTUNITIES

1) There are several sections (Reaches 1, 2, 5-10 and Reach 13) where the stream is being impacted from livestock in the riparian zone. Livestock in streams generally inhibit the growth of new trees, exasperate erosion, and reduce summertime survival of juvenile fish due to defecation in the water. Alternatives to limit cattle access, control erosion and increase canopy, should be explored with landowners, and developed if possible.

2) Increase the canopy on Little Sulphur Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels (portions of all reaches, excluding Reach 13). In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

3) Map sources of upslope and in-channel 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. Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffering against agricultural, grazing and urban runoff.

4) Reaches throughout the stream (excluding Reach 11 and Reach 14) would benefit from the utilization of bio-technical vegetative techniques to re-establish floodplain benches and a defined low flow channel. This would discourage lateral migration of the base flow channel and decrease bank erosion.

5) Where feasible, increase woody cover in the pool and flatwater habitat units along the entire stream. Most of the existing shelter is from boulders and bedrock ledges. Adding high quality complexity with larger woody cover is desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations throughout the stream. This must be done where the banks are stable (Reaches 3, 6, 7, 8, 10 and Reach 12) or in conjunction with stream bank armor to prevent erosion. In some areas the material is at hand.

6) Where feasible, design and engineer pool enhancement structures to increase the number and depth of pools throughout the stream. This must be done where the banks are stable (Reaches 3, 6, 7, 8, 10 and Reach 12) or in conjunction with stream bank armor to prevent erosion. In some areas the material is at hand.

7) If riparian areas are not improved throughout Little Sulphur Creek, temperatures in the lower sections of the stream should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

PROBLEM SITES AND LANDMARKS -- LITTLE SULPHUR CREEK SURVEY COMMENTS

The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach. The survey started at the confluence with Big Sulphur Creek.

HABITAT UNIT #	DISTANCE UPSTREAM	COMMENTS
1.00	20	Big Sulphur Creek H20 temp 66F
8.00	598	Spring RB
10.00	684	Summer Rd. on side of channel ends (started @ mouth)
11.00	713	20 juv. western toads
13.00	1140	Wet trib RB- water temp 62F (worth scouting??)
20.00	1755	6" crawdad; river otter scat

21.00	1819	yellow-legged frog
24.00	1913	Dry trib RB
24.10	1937	Dry trib RB; extensive algae
25.00	1928	Dry trib RB
26.00	1993	No SHD seen
27.00	2078	Sring RB; cow feces
33.00	2615	Landslide RB- H200'x L200'x D10'
34.00	2937	Cow patties; algae
35.00	2981	Algae everywhere; abandoned road RB
38.00	3232	15 6" suckers; cow patties
46.00	5219	Dry trib LB
47.00	5349	Otter scat
56.00	6401	Dripping spring LB
59.00	6710	Spring LB
62.00	7074	3+ resident trout
64.00	7192	Spring LB
68.00	7395	Flow cross-section; spring LB
69.00	7481	1 1+ SHD
73.00	7786	Signal crayfish
77.00	7954	1 1+ SHD
79.00	8139	6 resident rainbows >12"; dry trib RB
83.00	8444	Dry TRIB RB
87.00	8812	Wet trib RB- water temp 63F; Pacific Giant Salamander
92.00	9073	Channel change to C3; beginning of cow pies
93.00	9222	1st unit of split channel- RB
93.20	9317	2 0+ SHD
93.31	9552	This 3rd channel splits off of the 2nd channel.
93.32	9651	stagnant
93.40	9974	Appears stagnant; 85% of surface covered with algae
95.00	9318	Dry trib RB
98.00	9715	Sring RB
99.00	9745	Confluence trib is dry
100.00	9834	Blue heron
102.00	10042	Large gravel bar contributes to width
110.00	11146	Dry trib LB
111.00	11194	End of massive amounts of algae
112.00	11245	1 0+ SHD; a few 5" suckers
114.00	11328	1 0+ steelhead, few 5" suckers
119.00	11672	Dry trib LB
123.00	12261	Jeep trail LB
125.00	12409	1st unit of split channel
125.10	12807	little flow
128.00	12611	Dry trib LB (good size trib)
134.00	13300	Wet trib LB
142.00	14227	Confluence with North Branch Little Sulphur Creek
143.00	14454	Evidence of cows in entire channel
145.00	14583	Cattle crossing
146.00	14689	One 1+ SHD; cow feces in water
147.00	14719	Dry trib RB

148.00	14764	Channel change to B2
152.00	15003	Road on RB
153.00	15121	River otter scat
155.00	15332	Large dry trib LB; 3 3+ SHD
157.00	15554	road crossing through creek
158.00	15688	1+ SHD
160.00	15769	5 2+ SHD
162.00	15988	Dry trib RB
163.00	16120	3 2+ SHD
165.50	16246	Bedrock formed; spring fed
166.00	16247	Channel change to G1; bedrock gorge
167.00	16298	4 0+ SHD
169.00	16695	Dead 1+ SHD
180.00	17235	Spring RB
182.00	17341	Spring RB
183.00	17428	Spring RB
188.00	17609	Dead 3+ SHD
192.00	17822	Road comes to the left bank (4 wheel drive)
195.00	18017	Swim to cross; spring RB; 12 3+ SHD
206.00	18552	4 3+ SHD
212.00	18886	2 3+ SHD
214.00	18981	3 3+ SHD
224.00	19572	Sulfur spring LB
227.00	19714	Spring RB
228.00	19748	Dry trib RB
231.00	19850	Channel in transition-less bedrock
234.00	19983	Spring RB 65F
240.00	20268	Spring RB; 1 3+ SHD
241.00	20300	Small rockside RB
245.00	20534	Spring LB
247.00	20633	4 2+ SHD
248.00	20691	Spring RB
252.00	21040	Channel change to F4; evidence of cows in creek begins
253.00	21084	Slump LB
257.00	21261	Cattle fence down RB
261.00	21486	3+ SHD
262.00	21514	Dry trib LB
264.00	21757	4 3+ SHD
271.00	22360	3+ SHD
275.00	22794	Dry trib LB
277.00	23001	Bridge #1 (Pocket Ranch Rd.); Hobotemp location.
282.00	23227	Dry trib rt. bank
297.00	24269	Tribs rt. bank
299.20	24395	Wet trib rt. bank (66 degrees), 6' pvc pipe (storm drain?)
300.00	24353	Wet trib rt. bank, 65 degrees
301.00	24444	pumping station
304.00	24688	Road access
310.00	25044	3+ fish
316.10	25334	6 crayfish in pool

328.00	25840	Old road access left bank. Trib wet rt bank.
329.00	25932	Lots of algae everywhere. Stream too warm.
330.00	26033	spring left bank
331.00	26061	dry trib left bank
334.00	26201	wierd bedrock formations
341.00	26721	3 3+ steelhead
346.00	26881	3+, 2+, 1+, 0+ steelhead. left bank dry trib.
349.00	27087	10 3+ steelhead
351.00	27230	3+ fish
352.00	27468	0+ steelhead. Possible channel substrate change.
352.10	27484	Large dry trib. Surprisingly dry.
353.00	27532	0+, 1+ steelhead
354.00	27569	Landslide left bank
357.00	27687	spring left bank
358.00	27766	3 3+ steelhead
361.00	27877	Dry trib right bank
363.00	27947	spring left bank
364.00	27997	Spring left bank.
367.00	28254	naturally placed small digger log
368.00	28282	large trib left bank dry.
371.00	28442	3+ fish
374.00	28583	0+, 1+, 2+, 3+ fish
376.00	28688	couple 3+ fish, many (12 or so) 1+ fish.
380.00	28870	3 3+ fish
386.00	29086	1 1+, 2 3+ fish
387.00	29170	Big trib rt. bank (68 degrees) wet on top, too steep for fish.
392.00	29487	2 big boulders, may be problem spot in the future (log jam).
396.00	29607	Dry trib left bank
399.00	29849	seepage left bank
400.10	29905	0+ fish (steelhead)
405.00	30043	Dry trib, seepage left bank.
407.00	30125	1 0+ fish
410.00	30368	2+ steelhead
414.00	30533	spring rt bank 59 degrees
415.00	30590	spring rt. bank
416.00	30663	30 0+, 1+, 3+ steelhead
417.00	30774	spring rt bank
418.00	30920	spring rt bank
419.00	30946	4 3+ steelhead
423.00	31130	spring right bank
425.00	31199	3+ steelhead
432.00	31535	0+, 1+ steelhead. Spring right bank.
434.00	31614	10 3+ steelhead, dry trib right bank.
448.00	32455	channel change
449.00	32565	Root wad causing 1.5ft of gravel aggradation upstream.
451.00	32648	root wad causing 1.5ft of gravel aggradation upstream.
452.00	32677	wet trib right bank 64 degrees (little water).
454.00	32802	2+, 3+ steelhead
456.00	32936	80% covered by aquatic vegetation

457.00	33010	small trib on left bank 62 degrees.
462.00	33476	dry trib right bank.
465.00	33742	8 0+ steelhead
466.00	33899	road right bank owner pocket ranch. 2+, 3+ steelhead, 15" resident rainbow.
467.00	34098	1+, 2+ SHD. 2 18"+ rwb.
469.10	34206	dry trib left bank
471.00	34255	0+, 1+, 3+ SHD. Dry trib right bank
474.00	34395	2+ steelhead
475.00	34436	0+ SHD
478.00	34547	moist left bank
481.00	34870	dry trib left bank
482.00	34938	wet trib right bank 63 degrees. No fish observed but decent habitat.
485.00	35059	sculpin
487.00	35122	2+, 3+ SHD, possible point for future log jam.
490.00	35536	possible channel change
491.00	35620	dry trib right bank.
492.00	35674	dry trib left bank
495.00	35952	Dry trib RB. 3+ SH. Trib from LB has created a dammed pool on margin of channel 35'L 25'W 5.5'D max, average 3.0.
497.00	36116	3+ SHD
500.00	36382	dry trib right bank.
502.00	36418	thermometer left in truck
503.00	36552	6" turtle
503.10	36574	fed by wet trib. ~50 yoy SHD. Road parallel to river all the way from Fred Hock's road.
507.00	36716	possible site for future log jam.
520.00	37526	3+ SHD
523.00	37780	3+ SHD
524.00	37833	3+SHD
527.00	37934	0+ SHD
532.00	38146	yoy SHD
533.00	38238	possible change to cobble
539.00	38591	Dry trib right bank
540.00	38699	boulders back
542.00	38806	cow presence decreasing but still here.
547.00	39221	dry trib right bank
548.00	39587	dry trib left bank. unstable left bank for 300'
551.00	39877	3 3+ SH, trib right bank 60 degrees (future habitat typing?)
552.00	40035	2 3+ SH
554.00	40178	cow on bank, 1 3+ SH
555.00	40242	upstream barrier for cows
560.00	41784	1+, 3+ SH. Dry trib left bank.
566.00	42110	photoworthy for possible future jam.
570.00	42295	3 1+ SH. Grazing resumes. Yellow legged frog.
574.00	42508	fence begins on left bank, appears relatively new.
576.00	42587	3+ SH (1), old fence begins right bank.
577.00	42652	A few juvenile western toads, many 0+ and 1+ SH.
579.00	42818	0+, 1+, 3+ SH. Fence left bank ends

580.00	42949	Fence down RB.
581.00	42987	a few 3+ SH.
583.00	43132	a few 3+ SH
585.00	43215	0+, 1+, 2+, 3+ SH.
587.00	43281	cattle barrier.
589.00	43466	2+, 3+ SH. Spring right bank.
596.00	44401	dry trib left bank
598.00	44529	yellow legged frog
599.00	44573	0+, 1+, 2+, 3+ SH.
600.00	44718	garter snake.
602.00	44909	heavily grazed, dry trib right bank
603.00	44985	Pedroncelli road access left bank
604.00	45092	dry trib right bank
610.00	45574	2+ SH
613.00	45911	dry trib left bank
614.00	46037	House right bank, 2-6' drainage pipes RB.
615.00	46172	dry trib left bank, 0+ yoy SHD, house RB.
616.00	46255	2+SH, plunging
619.00	46433	dry trib left bank
620.00	46644	cow presence, start fence left bank, 8 yoy SH.
621.00	46689	2+ SHD
624.00	46905	end fence
625.00	47506	all age classes SHD
627.00	47710	3+ SHD, saturated left bank
628.00	47820	saturated left bank, 3+ SHD
631.00	48268	truck in creek, dry right trib, steep.
633.00	48383	5' drop at top
635.00	48446	roughly 35% slope
638.00	48533	3+, 2+, 1+ SHD
639.00	48576	not a barrier, site for possible future problems.
640.00	48645	3-2+ SHD
642.00	48903	Rd xing in creek, bridge, Lover's Gulch
643.00	49041	wet trib right bank, lots of water
644.00	49092	roach all over, 1-2+ SHD, yoy SHD
645.00	49190	roach 60-80, 10 yoy SHD.
648.00	49505	possible property line, algae bloom, fence over dry secondary channel.
650.00	49727	signs of cattle in creek, 2+ SHD, dry trib. left bank, water line coming from spring.
651.00	49804	Mt. lion print, water line coming from spring.
652.00	49872	signs of cattle, water line coming from spring.
655.00	50460	otter scat
656.00	50583	2-3+ SHD
657.00	50639	many juv lizards.
658.00	50762	road crossing - dirt. Water line across creek. Cabin right bank. Wet springs RB
659.00	50854	wet trib right bank, water pump LB, high sediment in pool.
660.00	50911	dry side channel

661.00	50939	signs of cattle
663.00	51169	two dry tribs left bank (high sediment sources), high sediment in pool
664.00	51340	outbuilding rb
664.10	51642	heavily used by cattle, two dry tribs.
666.00	51616	0+, 1+, 2+ SHD
667.00	51663	1+, 2+ SHD, otter scat
669.00	51738	SHD all age classes
672.00	52131	0+, 1+, 2+ SHD
673.00	52168	side drainage, change to A2 channel
673.20	52539	dozens of pg salamanders
673.40	52590	pg salamanders everywhere
677.00	52449	wet trib joins channel LB, runs 90 degrees to verticle. Cascade, YLF, 0+ SH
681.00	52564	possible channel change to A
682.00	52571	dozens of juvenile pg salamanders
683.00	52633	river otter scat, lots of LWD built up throughout this and surrounding units.
684.00	52672	otter scat (or muskrat?), 2+ SHD
686.00	52740	8+ SHD, dozens PG salmander juvies, rough-skinned newt
688.00	52779	PG salamanders. river otter scat
689.00	52989	YL frog, garter snake
692.00	53190	PG sals juveniles
694.00	53511	wet trib left bank 57 degrees, 3+/2+ SH
695.00	53665	wet trib left bank 58 degrees, 3-2+ SH
696.00	53725	Catys fly larvae. 1+, 2+ SHD/PGS.
697.00	53789	clear water, good quality and visibility.
702.00	53992	spring left bank
703.00	54035	2 yoy SH
704.00	54056	spring right bank
711.00	54327	PGS juvenile snails
712.10	54383	PGS juv
713.00	54443	PGS juv, rough skin newt, YLF, dripping LB
714.00	54459	6'elevation change
716.00	54500	few fish seen
718.00	54542	wet trib left bank 55 degrees, upmap, cold springs, 2+ SHD
724.00	54707	juv PGS, snails
729.00	54892	yoy SHD, possible change back to B2 From A. Small slide left bank.
730.00	54911	yoy SHD, 1+SHD
731.00	54936	1+ yoy SHD
732.00	55045	1+ SHD, PGS Juv
733.00	55089	1+ SHD, PGS juv
737.00	55235	2+ SHD
739.00	55289	oil on surface of water (small amt), juv. PGS
742.00	55413	past upslope fire on right bank
744.00	55886	YL frog, 6-yoy SH
747.00	56093	car in creek - ten years old. Not many fish
752.00	56267	2-yoy SHD, 2+ SHD
753.00	56324	4-2+SHD

756.00	56626	dripping spring right bank
758.00	56736	small, wrecked tractor in creek
759.00	56766	wet trib right bank 54 degrees
764.00	58284	right bank supported by row of alders.
766.00	58350	Natural slide left bank 30'H x 50'L
767.00	58810	wet trib/spring left bank. Too small for temp.
769.00	58990	nice established fir forest upslope through most of this reach.
772.00	59067	2+ SHD. Natrual slide left bank 20' H, 30’ L.
773.00	61947	Left bank natural slide 50'Hx20'L. RB natural (?) slide 80'Hx50'L
775.00	63776	Dirt road crossing channel (Remmel's, not on topo). Channel type at beg. of unit.
776.00	63832	1+ SHD
779.00	63920	wet trib left bank 54 degrees
780.00	64010	wet trib right bank 55 degrees
783.00	64186	2+SHD, PG sal.
784.00	64282	0+ SHD
785.00	64316	2+ SHD (4), 1+ SHD (2), suckers
788.00	64419	0+SHD
790.00	64637	0+/1+/2+ SHD
791.00	64692	0+/1+/2+ SHD
793.00	64842	Fresh water snails, half dozen 0+SH, 3+/1+SH
794.00	64907	Juv newts
796.00	64994	0+/1+/2+ SHD, PG sals
800.00	65367	possible change from boulder channel/lower slope? (B to F?)
801.00	65458	channel change from B2 to F3
804.00	65644	PG sals, 0+
820.00	66778	dry trib right bank
820.10	66829	PG sals
824.00	67055	0+ SHD
825.00	67084	brown color to water
830.00	67355	wet trib left bank
832.00	67464	leaves in the water, water still brown.
833.00	67526	PGS Juv, slump left bank, benefit from tree planting.
834.00	67734	alders dead along both banks, dry trib and road LB.
835.00	68029	yoy SHD, dry trib right bank, road access via mark remmel.
838.00	68159	wet trib left bank
839.00	68194	water still brown
845.00	68560	dripping left bank trib
847.00	68652	water still brown
848.00	68740	wet trib left bank, house right bank, evidence of grazing
849.00	68800	evidence of grazing
850.00	68945	dripping left bank, evidence of grazing.
851.00	68990	18" culvert left bank from road, evidence of grazing
852.00	69108	20% covered by alder leaves
853.00	69157	old bridge abuttment
854.00	69262	Geysers Road bridge, hobo temp
855.00	69423	wet trib left bank, 24" culvert RB from Gruyers Rd.
857.00	69679	saturated left bank, slump left bank, dripping trib on left bank

858.00	69753	fishing line in tree, water still brown, dry trib right bank
859.00	70005	Juv PGS
860.00	70090	road along right bank, dripping spring LB.
861.00	70152	riprap boulders on right bank
862.00	70251	leaves cover 30% of pool, wet spring LB, rip rap RB.
866.00	70465	leaves cover 20% of pool, dark pool, 2’ visibility.
868.00	70761	leaves cover 15% of pool
871.00	70932	dry trib left bank
872.00	70978	water still very dark
875.00	72229	covered 10% by leaves
876.00	72312	spring left bank 56 degrees, still dark water.
877.00	72347	30% covered by leaves
878.00	72369	possible channel change
881.00	72482	left third of channel debris jam not a current problem
885.00	72776	rough skin newt, dry trib RB - major source of boulders, 2' vis. very dark, back to "F3".
889.00	73022	water dark brown, high amount of leaf litter in stream (alder leaves)
893.00	73328	nice well established alders lining channel throughout reach.
897.00	74592	water still brownish with improved visibility.
898.00	74775	fish present
899.00	75785	dry side channel RB, wet trib LB 51 deg. Comes in appearing like secondary channel.
900.00	75900	PG sals
901.00	76111	dry trib right bank, wet tribLB 51 deg.
903.00	76262	fish present - species? (poor vis.)
904.00	76358	RS newt
907.10	76495	dry trib right bank (comes in at 907.3)
907.30	76561	unit nearly dry in spots
908.00	76656	Unit nearly dry in spots
913.00	77063	dry side channel left bank, small dry trib LB
914.00	77108	right bank is vert. silt bank +/- 5’.
915.00	77209	yoy, water clarity improving
917.00	77330	2+SHD
918.00	77391	2+ SHD (2), 1+ SHD (6), 0+ SHD (4), PGS.
923.00	79003	0+/1+ SHD
925.00	79185	1+/0+ SHD
927.00	79312	good water clarity, 2-1+SHD, 8-2+SH
928.00	79410	some kind of aquatic larvae present in flat round grey-green cocoon.
929.00	79528	oil on water surface, RS newt, 4-0+SH, 1+/2+SHD
930.00	79793	dry trib right bank with 5' bedrock wall at mouth. Dozen 0+/1+.
934.00	79967	small dry trib right bank
935.00	80101	0+ SHD
938.00	80209	dry trib right bank
945.00	80739	wet trib left bank 52 degrees.
947.00	80899	0+ SHD
950.00	81015	alder lined channel
951.00	81470	0+ SHD (6)

952.00	81484	dry trib left bank
954.00	81601	0+ SHD
956.00	81739	0+ SHD (5)
959.00	81904	dry trib right bank
960.00	81995	great shelter, 4' undercut bank, wet spring LB.
961.00	82141	dry trib left bank with lots of gravel 4’ aggradation left bank
962.00	82230	flows significantly decreased. RS newt, channel change (substrate) to F4.
963.00	82276	dry side channel left bank, 0+SHD, channel change to F4.
968.00	82571	0+ SHD (12), 3+ SHD
974.00	82927	0+/1+/2+ SHD
975.00	83087	0+ SHD (2 dozen), 1+ SHD, 2+SHD
975.10	83094	full of leaves, surface oil
976.00	83113	opens up to full sun for +/- 100'
977.00	83274	many frogs, 0+ SHD (20), fruit trees LB.
977.50	83380	channel covered in sedge grass
978.00	83292	channel over grown with sedge grass
979.00	83449	house right bank, 0+/1+ SHD (Colby Gellar), RS newts
980.00	83506	2+ SHD
984.00	83851	road crossing creek (Gellar's dirt rd), 0+ SH (12)
987.00	84022	water line crossing creek.
988.00	84144	wet trib left bank 48 degrees
989.00	84544	dry trib left bank, end of survey 293’ above road goes dry.

END SURVEY

PROBLEM SITES AND LANDMARKS -- ANNA BELCHER CREEK SURVEY COMMENTS

The following landmarks and possible problem sites were noted.
All distances are approximate and taken from the beginning of the survey reach.

HABITAT UNIT #	*FEET UPSTREAM*	*COMMENTS*
4.00	*281*	*Rough Skin Newt*
9.00	*911*	*8 Dead 0+ SH in Receding Pool*
21.00	*1713*	*2 Garter Snakes*
24.00	*1768*	*2 5" SH and Many 0+'S*
30.00	*2064*	*Dry Trib on Right Bank*
36.00	*2395*	*Dense Stand of Young Alders for Host*
39.00	*2489*	*8 7" Sh*
41.00	*3118*	*Dry Trib Rt. Bank; Wet Trib W/ Fish; Just Below next H.u.*
44.00	*3306*	*16 Ft Verticle Cascade -Opening of a Mine Shaft on Rt Bank*

45.00 3306 End of Survey

PROBLEM SITES AND LANDMARKS – LOVER'S GULCH SURVEY COMMENTS

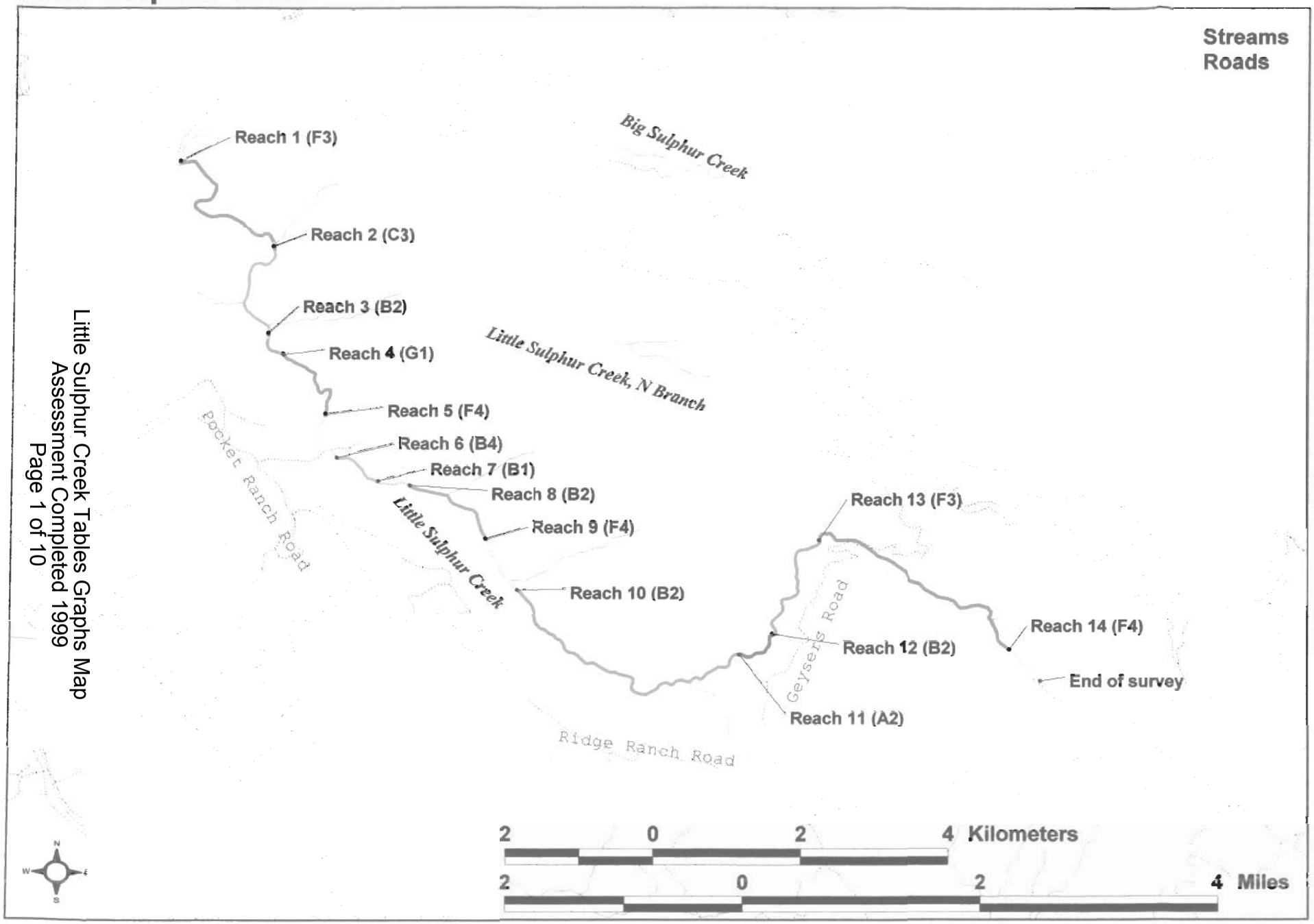
The following landmarks and possible problem sites were noted.
All distances are approximate and taken from the beginning of the survey reach.

HABITAT UNIT #	*FEET UPSTREAM*	*COMMENTS*
1.00	*58*	*Road in Creek, Lots of Sediment in Creek, Highly Angular Material. Evidence of Cows Starting at Mouth.*
2.00	*183*	*Fence Across Creek; 6" Sq.'s and Barbed Wire. Fence Isn't Effective-cows Can Go Around.*
3.00	*193*	*Major Sediment, Sculpin, 1+SH*
4.00	*301*	*Bubbles in Water*
6.00	*446*	*Dry Trib Left Bank*
7.00	*501*	*Western Toad, Sml Slide Rt Bank*
8.00	*587*	*Yellow Legged Frog*
10.00	*608*	*Bubbles in Water*
12.00	*620*	*2.5' Jump*
13.00	*645*	*Crayfish*
15.00	*709*	*Fence down and on Left Bank*
16.00	*725*	*Fence up on Rt. Bank*
19.00	*1104*	*Yellow Legged Frog*
22.00	*1241*	*2+SH*
24.00	*1334*	*Gully Rt. Bank*
26.00	*1407*	*2-2+SH*
27.00	*1461*	*Yellow Legged Frog*
28.00	*1518*	*Dry Trib Left Bank*
29.00	*1701*	*Dry Trib Left Bank*
30.00	*1723*	*Bubbles in Water, Cow Barrier*
31.00	*1732*	*Possible Change*
33.00	*1783*	
34.00	*1799*	*Dry Trib. Left Bank*
39.00	*1992*	*1+ SH, Cows Back*
42.00	*2060*	*3-1+SH*
43.00	*2111*	*0+ SH*
45.00	*2151*	*0+ SH; Channel Change.*
48.00	*2224*	*3-0+SH; Rough Skin Newt*
49.00	*2255*	*0+ SH; Dry Trib. Rt. Bank*

51.00	*2366*	*0+ SH*
52.00	*2435*	*3-o+SH*
53.00	*2482*	*Water Line Crossing Creek; 1+ SH; Metal Weir Acting as a Grade Stabelizer...Pool 0.8, 3.5' Drop*
54.00	*2622*	*Rd. Crossong; Yellow Legged Frog*
55.00	*2715*	*Dry Trib Left Bank*
56.00	*2836*	*Dry Trib Rt. Bank*
57.00	*2928*	*Rough Skin Newt*
60.00	*3059*	*Rough Skin Newt; Lots of Sediment; Wet Trib Right Bank 57 Degrees*
63.00	*3284*	*Dry Trib Left Bank*
67.00	*3623*	*Slump Right Bank*
69.00	*3716*	*Dead Spike*
70.00	*3837*	*Gully Left Bank*
72.00	*3980*	*Possible Change, Increased Slope*
73.00	*3998*	*Dry Trib Left Ban k*
77.00	*4089*	
79.00	*4168*	*Lack of Fish. Decent Habitat Remained. Wetted with Roughly 4' and Steep Slope. End of Survey.*

END SURVEY

Little Sulphur Creek



Little Sulphur Creek Tables Graphs Map
Assessment Completed 1999
Page 1 of 10

Central Coast Region
California Dept. of Fish and Game

Map prepared by: Z. Jacob Young, July 12, 2001
L:/mondo3/data/stream-maps/lsulphur1999.apr

Little Sulphur Creek

APPENDIX A. Summary of Mean Percent Vegetative Cover for Entire Stream

Mean Percent Canopy	Mean Percent Evergreen	Mean Percent Deciduous	Mean Right bank % Cover	Mean Left Bank % Cover
54.40	39.36	60.23	37.66	34.44

APPENDIX B.

Mean Percentage of Dominant Substrate

Dominant Class of Substrate	Number Units Right Bank	Number Units Left Bank	Percent Total Units
Bedrock	85	95	36.51
Boulder	63	61	25.15
Cobble/Gravel	81	62	29.01
Silt/clay	18	28	9.33

Mean Percentage of Dominant Vegetation

Dominant Class of Vegetation	Number Units Right Bank	Number Units Left Bank	Percent Total Units
Grass	36	23	11.94
Brush	8	11	3.85
Deciduous Trees	136	130	53.85
Evergreen Trees	51	60	22.47
No Vegetation	16	23	7.89

Little Sulphur Creek — Drainage: Big Sulphur Creek; Russian River

Table 1 - SUMMARY OF RIFFLE, FLATWATER, AND POOL HABITAT TYPES — Survey Dates: 08/16/99 to 10/12/99

Confluence Location: QUAD: Asti — LEGAL DESCRIPTION: T11NR10WS12 — LATITUDE: 38°48'35" — LONGITUDE: 122°55'32"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	ESTIMATED TOTAL AREA (sq.ft.)	MEAN VOLUME (cu.ft.)	ESTIMATED TOTAL VOLUME (cu.ft.)	MEAN RESIDUAL POOL VOL (cu.ft.)	MEAN SHELTER RATING
2	0		0	15	29	0	13.0	1.0	143	286	143	286	100	25
237	40	RIFFLE	23	68	16029	18	18.0	0.5	614	145593	303	71723	460	9
390	75	FLATWATER	37	118	46165	52	19.8	0.9	1625	633754	1474	575024	567	13
405	104	POOL	39	61	24826	28	22.7	2.2	1554	629457	3909	1583273	3195	25
11	0	DRY	1	97	1069	1	0.0	0.0	0	0	0	0	0	0

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq. ft.)	TOTAL VOL. (cu. ft.)
1045	219	88118	1409090	2230305

Little Sulphur Creek

Drainage: Big Sulphur Creek; Russian River

Table 2 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS

Survey Dates: 08/16/99 to 10/12/99

Confluence Location: QUAD: Asti

LEGAL DESCRIPTION: T11NR10WS12 LATITUDE: 38°48'35" LONGITUDE: 122°55'32"

HABITAT UNITS #	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT OCCURRENCE %	MEAN LENGTH ft.	TOTAL LENGTH ft.	TOTAL LENGTH %	MEAN WIDTH ft.	MEAN DEPTH ft.	MAXIMUM DEPTH ft.	MEAN AREA sq.ft.	TOTAL AREA EST. sq.ft.	MEAN VOLUME cu.ft.	TOTAL VOLUME EST. cu.ft.	MEAN RESIDUAL POOL VOL cu.ft.	MEAN SHELTER RATING	MEAN CANOPY %
2	0		0	15	29	0	13	1.0	2.8	143	286	143	286	100	25	75
160	21	LGR	15	79	12579	14	18	0.4	1.7	680	108737	273	43667	0	8	54
60	13	HGR	6	53	3150	4	21	0.7	2.4	716	42976	455	27280	460	11	55
14	3	CAS	1	15	211	0	11	0.4	2.6	106	1490	33	461	0	15	59
3	3	BRS	0	30	89	0	10	0.3	0.9	266	799	96	289	0	3	43
2	1	POW	0	61	121	0	14	1.3	2.3	454	907	590	1179	0	50	50
84	17	GLD	8	99	8317	9	26	1.1	3.0	2412	202583	2668	224131	0	13	46
133	26	RUN	13	70	9366	11	20	0.9	3.0	1214	161415	1094	145469	0	10	58
168	28	SRN	16	168	28223	32	17	0.8	2.6	1669	280440	1242	208670	0	15	58
3	3	EDW	0	46	138	0	12	1.2	2.6	540	1620	676	2029	567	10	32
1	1	TRP	0	30	30	0	8	2.0	4.2	228	228	456	456	296	45	75
129	27	MCP	12	66	8503	10	23	2.4	11.3	1914	246860	5254	677754	3991	24	64
3	3	CCP	0	76	228	0	37	2.9	7.5	2907	8720	9988	29964	8601	13	15
29	9	STP	3	58	1682	2	21	2.2	12.0	1062	30796	2569	74502	2104	35	49
18	5	LSR	2	69	1244	1	25	1.6	4.8	1667	30008	2976	53569	2576	36	58
95	21	LSBk	9	70	6666	8	23	2.1	15.0	1680	159595	4190	398063	3475	16	47
90	15	LSBo	9	59	5316	6	26	2.1	12.5	1504	135383	3574	321686	2929	27	51
15	9	PLP	1	23	339	0	18	1.8	5.0	438	6571	864	12961	750	40	56
3	2	SCP	0	67	201	0	17	1.5	5.0	1091	3272	1666	4997	936	18	33
18	8	BPB	2	25	448	1	14	1.7	5.1	327	5877	681	12256	423	30	61
1	1	BPR	0	7	7	0	10	0.8	1.4	70	70	56	56	0	20	90
2	2	BPL	0	24	48	0	16	1.8	4.2	379	757	502	1005	440	55	68
1	1	DPL	0	114	114	0	26	1.1	2.1	2964	2964	3260	3260	2371	10	95
11	0	DRY	1	97	1069	1	0	0.0	0.0	0	0	0	0	0	0	39

TOTAL UNITS	TOTAL UNITS	LENGTH (ft.)	AREA (sq.ft)	TOTAL VOL. (cu.ft)
1045	219	88118	1432356	2243991

Little Sulphur Creek

Drainage: Big Sulphur Creek; Russian River

Table 3 - SUMMARY OF POOL TYPES

Survey Dates: 08/16/99 to 10/12/99

Confluence Location: QUAD: Asti LEGAL DESCRIPTION: T11NR10WS12 LATITUDE: 38°48'35" LONGITUDE: 122°55'32"

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA EST. (sq.ft.)	MEAN VOLUME (cu.ft.)	TOTAL VOLUME EST. (cu.ft.)	MEAN RESIDUAL POOL VOL. (cu.ft.)	MEAN SHELTER RATING
2	0		0	15	29	0	13.0	1.0	143	286	143	286	100	25
162	40	MAIN	40	64	10443	42	22.5	2.4	1769	286588	4827	781945	3717	26
218	50	SCOUR	54	62	13565	55	23.8	2.0	1518	330965	3599	784612	2990	24
25	14	BACKWATER	6	33	818	3	14.8	1.6	518	12941	863	21574	601	29

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq.ft.)	TOTAL VOL. (cu.ft.)
407	104	24855	630779	1588417

Little Sulphur Creek Drainage: Big Sulphur Creek; Russian River

Table 4 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPES Survey Dates: 08/16/99 to 10/12/99

Confluence Location: QUAD: Asti LEGAL DESCRIPTION: T11NR10WS12 LATITUDE: 38°48'35" LONGITUDE: 122°55'32"

UNITS MAX DPTH MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	<1 FOOT MAXIMUM DEPTH	<1 FOOT PERCENT OCCURRENCE	1-<2 FT. MAXIMUM DEPTH	1-<2 FOOT PERCENT OCCURRENCE	2-<3 FT. MAXIMUM DEPTH	2-<3 FOOT PERCENT OCCURRENCE	3-<4 FT. MAXIMUM DEPTH	3-<4 FOOT PERCENT OCCURRENCE	>=4 FEET MAXIMUM DEPTH	>=4 FEET PERCENT OCCURRENCE
1		0	0	0	0	0	1	100	0	0	0	0
1	TRP	0	0	0	0	0	0	0	0	0	1	100
129	MCP	32	0	0	2	2	26	20	46	36	55	43
3	CCP	1	0	0	0	0	1	33	0	0	2	67
29	STP	7	0	0	1	3	7	24	11	38	10	34
18	LSR	4	1	6	2	11	6	33	8	44	1	6
95	LSBK	23	0	0	4	4	27	28	30	32	34	36
89	LSBo	22	0	0	0	0	24	27	34	38	31	35
15	PLP	4	0	0	1	7	6	40	5	33	3	20
3	SCP	1	0	0	0	0	2	67	0	0	1	33
18	BPB	4	0	0	2	11	9	50	4	22	3	17
1	BPR	0	0	0	1	100	0	0	0	0	0	0
2	BPL	0	0	0	1	50	0	0	0	0	1	50
1	DPL	0	0	0	0	0	1	100	0	0	0	0

TOTAL UNITS
405

Little Sulphur Creek — Drainage: Big Sulphur Creek; Russian River

Table 5 - Summary of Shelter by Habitat Type — Survey Dates: 08/16/99 to 10/12/99

Confluence Location: QUAD: Asti — LEGAL DESCRIPTION: T11NR10WS12 — LATITUDE: 38°48'35" — LONGITUDE: 122°55'32"

UNITS MEASURED	UNITS SHELTER MEASURED	HABITAT TYPE	% TOTAL UNDERCUT BANKS	% TOTAL SWD	% TOTAL LWD	% TOTAL ROOT MASS	% TOTAL TERR. VEGETATION	% TOTAL AQUATIC VEGETATION	% TOTAL WHITE WATER	% TOTAL BOULDERS	% TOTAL BEDROCK LEDGES
2	1		0	15	0	0	0	0	0	85	0
160	24	LGR	1	0	0	2	0	59	2	36	1
60	14	HGR	0	1	0	0	3	12	3	78	4
14	3	CAS	0	0	0	0	0	0	0	100	0
3	3	BRS	0	0	0	0	100	0	0	0	0
2	1	POW	0	5	0	0	0	0	5	90	0
84	17	GLD	1	8	1	24	7	29	0	29	1
133	26	RUN	0	5	2	10	0	9	1	62	11
168	29	SRN	0	2	1	1	0	28	2	63	3
3	3	EDW	0	0	0	0	20	0	0	80	0
1	1	TRP	0	0	0	0	0	0	10	40	50
129	123	MCP	8	6	3	7	2	3	7	44	21
3	3	CCP	0	0	0	13	0	0	0	54	33
29	28	STP	3	3	4	3	2	2	11	69	3
18	18	LSR	17	16	7	44	8	3	0	4	0
95	91	LSBk	3	3	5	9	6	4	0	33	38
90	82	LSBo	2	9	10	6	2	5	1	57	7
15	13	PLP	0	2	3	3	0	2	13	69	9
3	3	SCP	18	10	23	15	0	0	2	15	15
18	18	BPB	7	12	3	4	3	8	0	55	8
1	1	BPR	0	0	0	0	0	70	0	30	0
2	2	BPL	18	10	5	11	15	22	0	15	5
1	1	DPL	0	40	0	0	10	20	0	30	0
11	0	DRY	0	0	0	0	0	0	0	0	0
ALL HABITAT TYPES 1045	505		5	6	5	9	3	7	3	47	15
POOLS ONLY 405	384		6	7	5	9	3	4	4	45	12

Little Sulphur Creek

Drainage: Big Sulphur Creek; Russian River

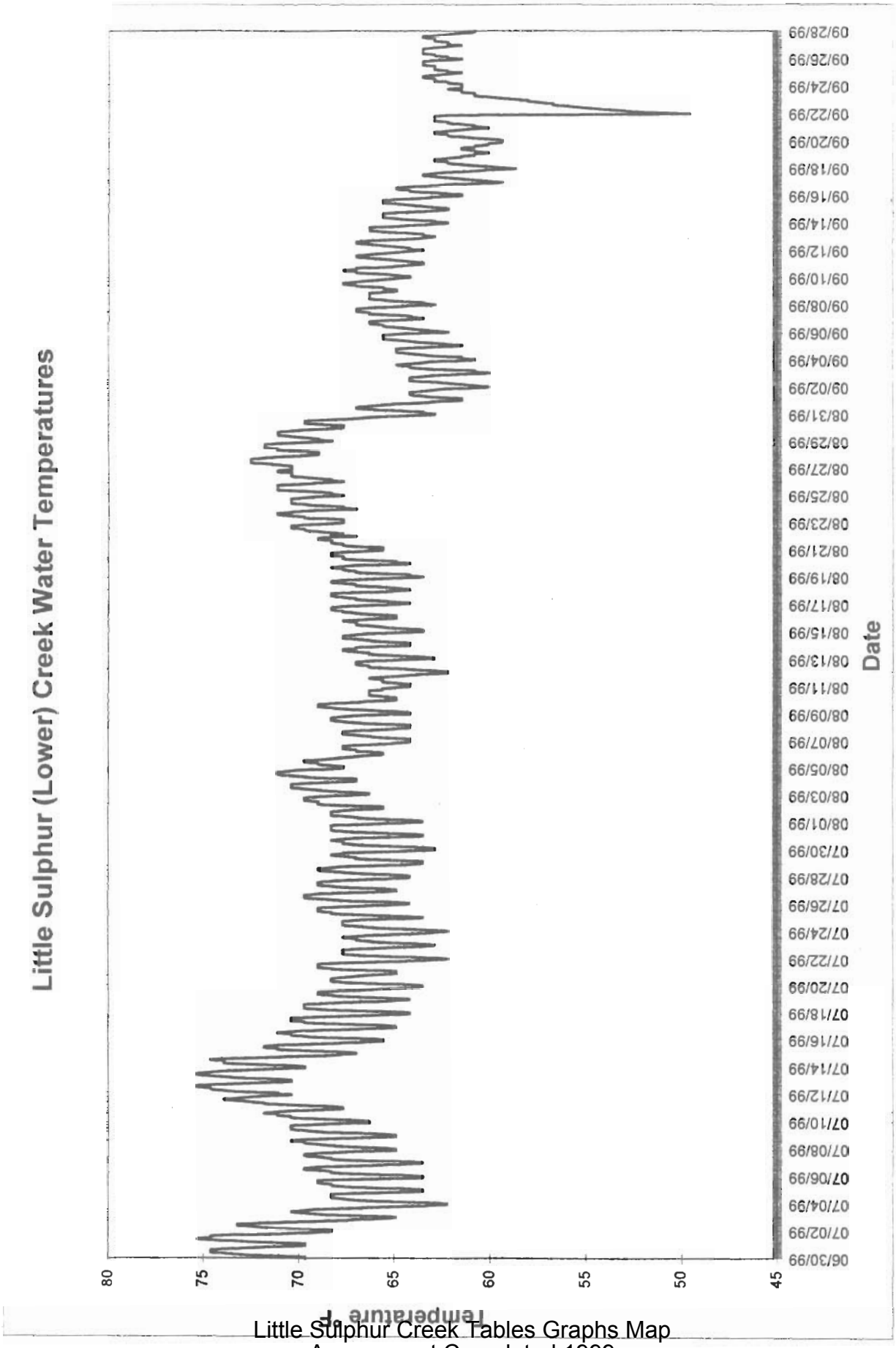
Table 6 - SUMMARY OF DOMINANT SUBSTRATES BY HABITAT TYPE

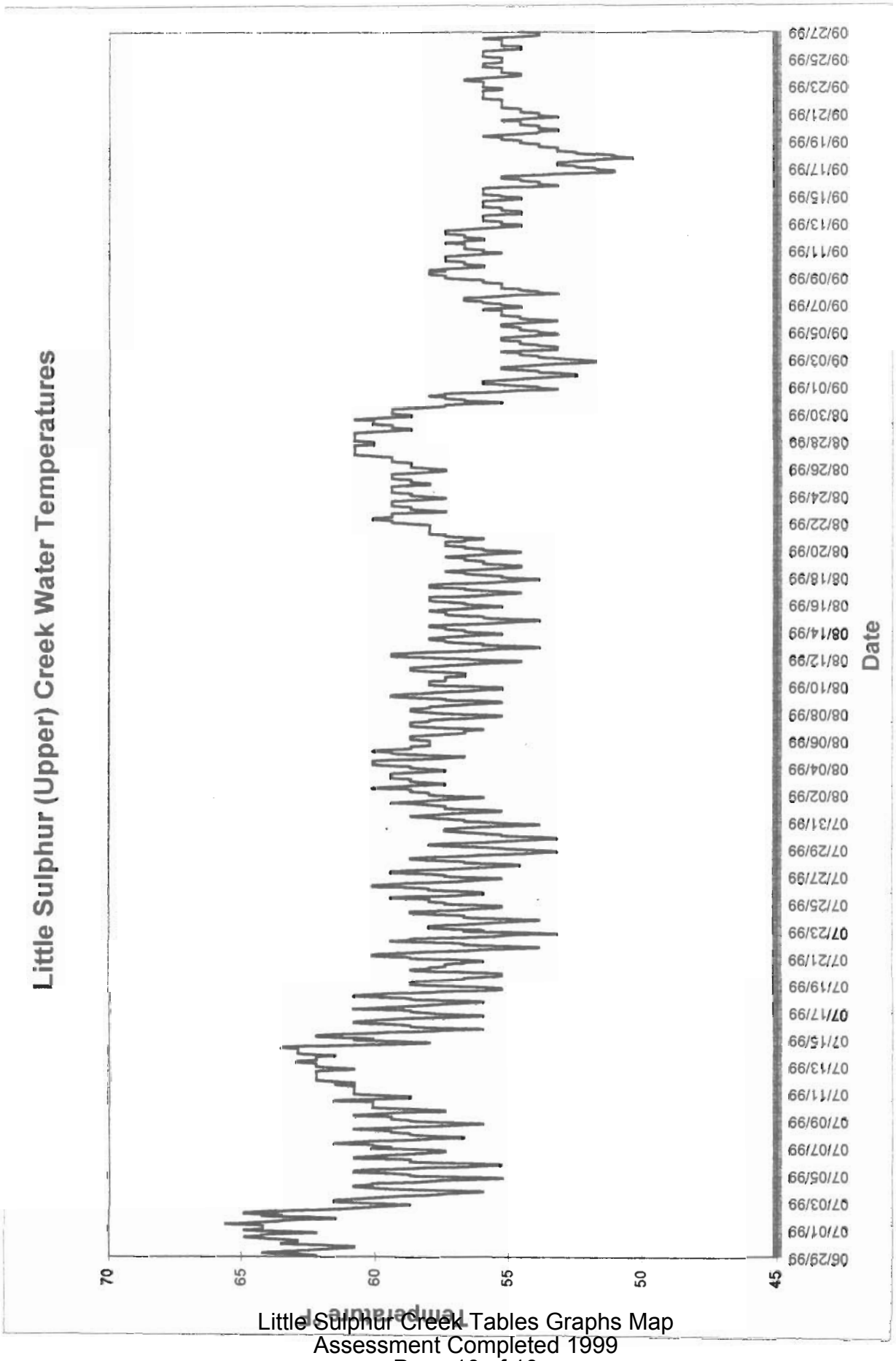
Survey Dates: 08/16/99 to 10/12/99

Confluence Location: QUAD: Asti

LEGAL DESCRIPTION: T11NR10WS12 LATITUDE: 38°48'35" LONGITUDE: 122°55'32"

TOTAL HABITAT UNITS	UNITS SUBSTRATE MEASURED	HABITAT TYPE	% TOTAL SILT/CLAY DOMINANT	% TOTAL SAND DOMINANT	% TOTAL GRAVEL DOMINANT	% TOTAL SM COBBLE DOMINANT	% TOTAL LG COBBLE DOMINANT	% TOTAL BOULDER DOMINANT	% TOTAL BEDROCK DOMINANT
2	0		0	0	0	0	0	0	0
60	31	LGR	0	0	32	19	32	16	0
30	18	HGR	0	0	0	11	17	67	6
4	6	CAS	0	0	0	0	17	33	50
3	3	BRS	0	0	0	0	0	0	100
2	1	POW	0	0	0	0	0	100	0
4	17	GLD	0	12	65	12	6	0	6
33	28	RUN	0	0	46	18	11	18	7
8	31	SRN	0	0	23	6	6	35	29
3	3	EDW	0	0	100	0	0	0	0
1	1	TRP	0	0	0	0	0	0	100
29	27	MCP	0	7	37	4	7	15	30
3	3	CCP	0	33	0	33	0	0	33
9	9	STP	0	0	11	11	0	78	0
8	6	LSR	0	0	50	0	50	0	0
95	22	LSBk	0	18	27	5	14	14	23
0	18	LSBo	0	17	39	0	11	33	0
15	9	PLP	0	0	44	0	0	22	33
3	3	SCP	0	0	67	0	0	33	0
18	9	BPB	0	33	0	0	11	11	44
1	1	BPR	0	100	0	0	0	0	0
2	2	BPL	0	0	50	0	0	0	50
1	1	DPL	0	0	100	0	0	0	0
11	2	DRY	0	0	50	50	0	0	0


Little Sulphur (Lower) Creek Water Temperatures
Temperature °F
80
75
70
65
60
55
50
45
Date
06/30/99
07/02/99
07/04/99
07/06/99
07/08/99
07/10/99
07/12/99
07/14/99
07/16/99
07/18/99
07/20/99
07/22/99
07/24/99
07/26/99
07/28/99
07/30/99
08/01/99
08/03/99
08/05/99
08/07/99
08/09/99
08/11/99
08/13/99
08/15/99
08/17/99
08/19/99
08/21/99
08/23/99
08/25/99
08/27/99
08/29/99
08/31/99
09/02/99
09/04/99
09/06/99
09/08/99
09/10/99
09/12/99
09/14/99
09/16/99
09/18/99
09/20/99
09/22/99
09/24/99
09/26/99
09/28/99


Little Sulphur (Upper) Creek Water Temperatures
Temperature
70
65
60
55
50
45
Date
06/29/99
07/01/99
07/03/99
07/05/99
07/07/99
07/09/99
07/11/99
07/13/99
07/15/99
07/17/99
07/19/99
07/21/99
07/23/99
07/25/99
07/27/99
07/29/99
07/31/99
08/02/99
08/04/99
08/06/99
08/08/99
08/10/99
08/12/99
08/14/99
08/16/99
08/18/99
08/20/99
08/22/99
08/24/99
08/26/99
08/28/99
08/30/99
09/01/99
09/03/99
09/05/99
09/07/99
09/09/99
09/11/99
09/13/99
09/15/99
09/17/99
09/19/99
09/21/99
09/23/99
09/25/99
09/27/99