**CALIFORNIA DEPARTMENT OF FISH AND GAME**
**STREAM INVENTORY REPORT**
Big Sulphur Creek
*Report revised April 14, 2006*
*Report Completed 2005*
*Assessment Completed 2000*

## INTRODUCTION

A stream inventory was conducted during the summer of 2000 on Big 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 in Big Sulphur Creek. 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

Big Sulphur Creek, located in Sonoma County, is a tributary of the Russian River. (see Big Sulphur Creek map, Appendix A). The legal description at the confluence with the Russian River is T11N, R10W, S7. Its location is 38.8180697994395° N. latitude and 123.010240395495° W. longitude. Year round vehicle access exists from Geysers Road via Highway 101.

Big Sulphur Creek and its tributaries drain a basin of approximately 85.43 square miles. Big Sulphur Creek is a fifth order stream and has approximately 22.34 miles of blue line stream, according to the USGS 7.5 minute quadrangles entitled “Cloverdale”, “Asti”, “The Geysers”, “Whispering Pines”, “Jimtown”, and “Mt. St. Helena”. Major tributaries include Hale, Frasier, Little Sulphur, Hot Springs, Cobb and Carpenter Creeks, which are described in separate stream reports. Summer flow was measured as approximately 2.03 cfs at 40' upstream of the River Road bridge, in Habitat Unit # 026 (DFG 2000). Elevations range from about 299 feet at the mouth of the creek to 4,498 feet in the headwaters. The creek originates in the northwest slope of Pine Mountain and runs down a narrow and steep "V"-shaped canyon, occasionally opening into shallow valleys. The lower basin is wide and shallow. Oak woodland dominates the watershed followed by shrubland. Riparian vegetation is limited along the entire stream, but especially in the lower reaches. The watershed is owned primarily privately owned by Calpine Corporation and is managed for geothermal power production. Big Sulphur Creek has historically had a large run of steelhead trout, but numbers drastically declined in the mid-twentieth century.

Sensitive species listed from the CNPS Inventory and DFG's Natural Diversity Database (CNDDB) within Big Sulphur watershed are listed in Table 1.

**Table 1. Sensitive Species in Big Sulphur Creek**

| Scientific Name | Common Name | Federal Status | State Status | Source |
|---|---|---|---|---|
| *Oncorinchus mykiss* | Steelhead trout | Threatened | Threatened | DFG |
| *Rana boylii* | Yellow-Legged Frog | Species Of Special Concern | Species Of Special Concern | DFG |
| *Dicamptodon ensatus* | Pacific Giant Salamander | Species Of Special Concern | Species Of Special Concern | CNDDB |
| *Dichanthelium lanuginosum var thermale* | Geysers dichanthelium | Species of Concern | Endangered | CNDDB |
| *Eriogonum nervulosum* | Snow Mountain Buckwheat | Species of Concern | None | CNDDB |
| *Streptanthus brachiatus Ssp brachiatus* | Socrates Mine Jewel-flower | Species of Concern | None | CNDDB |
| *Ceanothus divergens* | Calistoga Ceanothus | Species of Concern | None | CNDDB |
| *Streptanthus brachiatus Ssp hoffmanii* | Freed's Jewel-flower | Species of Concern | None | CNDDB |

## METHODS

The habitat inventory conducted in Big 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 Derek Acomb, 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 Big 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.

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. De-watered units are labeled "DRY". Big 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 Big 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 Big 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 Big 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 Big 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 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 graphs:

- Summary of Riffle, Flatwater, and Pool Habitat Types
- Summary of Habitat Types and Measured Parameters

- Summary of Pool Types
- Summary of Maximum Residual Pool Depths by Habitat Types
- Summary of Mean Percent Cover by Habitat Type
- Summary of Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Summary of Mean Percent Canopy for Entire Stream
- Summary of Fish Habitat Elements by Stream Reach
- Mean Percentages of Dominant Substrate and Vegetation
- Mean Percent Shelter Cover Types for Entire Stream

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Big Sulphur Creek include:

- Level II Habitat Types by Percent Occurrence
- Level II Habitat Types by Percent Total Length
- Level IV Habitat Types by Percent Occurrence
- Level I Pool Habitat Types by Percent Occurrence
- Maximum Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition in Survey Reach
- Dominant Bank Vegetation in Survey Reach

HISTORICAL STREAM SURVEYS:

The Department of Fish and Game has conducted many stream surveys and biological inventories on Big Sulphur Creek. Some of these surveys were well documented, others were not. A general summary of several surveys follows:

Flow surveys were conducted on Big Sulphur Creek from 1957-1964, and 1967.

A November 1965 survey showed many rough fish in the creek. A 5-mile section below a PG&E waste outflow, however, was completely barren of fish.

In November 1967, it was noted that increased road building for geothermal wells was increasing sedimentation in Big Sulphur Creek.

An August 1968 stream survey characterized Big Sulphur as a spawning and rearing habitat for steelhead and chinook salmon. Threats to the creek's salmonid habitat value were considered to be presence of rough fish, livestock runoff, pollution from PG&E and Union Oil thermal wells and failing roads, and mercury mining operations. Areas near the PG&E waste outflow were devoid of all fish. Hot

springs, increasing the stream temperature, were considered as another potential limiting factor for salmonid survival. In addition, there was a large degree of siltation and algal growth on the streambed. The width averaged 15', ranging from 6" to 40'. Fish barriers included a 10' dam, a bedrock chute (12' drop in 10'), and four rock falls located in the upper reaches of Big Sulfur Creek. These falls have been listed as a complete barrier to upstream migration. Water diversion was noted near the mouth.

In October 1968 it was noted that Union Oil road construction was loading rocks and silt into the stream, impeding the flow and reducing insect larvae. It was also noticed that the water near the confluence of Squaw Creek was highly silted.

The Regional Water Quality Control District conducted water sampling on Big Sulphur Creek from 1968-1973. The study monitored flow, temperature, dissolved Oxygen, pH, turbidity, electrical conductivity, nitrates, and other water quality parameters.

In an August 1973 stream survey, Big Sulphur Creek was assessed as having high spawning potential, with the lower 13 miles having abundant spawning gravels and many deep pools with good shelter. Very few steelhead were seen (1/1000') in this section of creek, however, due possibly to the high levels of rough fish, mercury concentrations in streambed gravels, or high water temperatures (64-80+°F) due to the influence of hot springs. Heavy livestock runoff was noted in the lower and middle reaches of the stream. The width averaged 8' and ranged from 3' to 30'. The depth averaged 1' and ranged from 3" to 15'. Flow was estimated to be 0.3 cfs near the headwaters and 1.9 c.f.s. near the mouth, with an overall average of 0.5 c.f.s. The substrate consisted of 10% sand and silt, 30% gravel, 30% cobble, 20% boulders, and 10% bedrock. Approximately 10% of the creek was considered to have good spawning gravel, described as "loose and relatively clean". Pools were primarily formed by bedrock and boulders, and the average size was 13.5'x40'x4'. Shelter consisted of undercut banks and boulders. Canopy averaged 20%, chiefly provided by alder and willow. The survey started at the mouth and continued to the headwaters and was conducted by car, foot, and in a few pools by snorkel.

In August 1975 a partial stream survey was conducted near The Geysers power plant, showing poor salmonid/trout habitat conditions. Flow was an estimated 2.5 cfs at the upper end and 4.5 cfs at the lower end of the survey. Substrate in the upper mile was composed of 30% gravel 20% bedrock, 20% boulders, 20% cobble, and 10% sand, silt and detritus. The lower half-mile contained 30% gravel, 30% cobble, 20% boulders, 10% bedrock, and 10% sand, silt and detritus. Stream temperatures ranged from 73-78°F, and near hot springs reached the mid 80's. Canopy was 20%, composed of alder and willow, and shelter was considered excellent, composed of boulders and undercut banks.

Acute mercury toxicity in streambed gravels were considered in 1974 a primary reason for the decline of steelhead in Big Sulphur Creek. Mercury is naturally present in the Big Sulphur watershed, but levels were increased by historic mercuric sulfide mining. There were six mercury mines in the watershed in close vicinity to The Geysers geothermal wells. Deposition of mercury from geothermal steams and runoff from mine tailings may have introduced toxic levels of mercury into the creek, affecting embryonic development and reproductive potential of salmonids.
In December 1982, the Department of Fish and Game blasted a natural partial barrier 2.2 miles from the mouth of Big Sulphur Creek, opening an estimated 35 miles of anadromous habitat.

HABITAT INVENTORY RESULTS

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

The habitat inventory of 08/15/00 to 11/09/00 was conducted by Jacob Newell and Teresa Wildfong (Americorps), Michael Shugars (Intern), and Sarah Nossaman (CDFG) with supervision and analysis by CDFG. The survey began at the confluence with the Russian River and extended up Big Sulphur Creek to the end of anadromous fish passage. The total length of the stream surveyed was 108,871 feet, with an additional 2,541 feet of side channel.

A flow of 2.03 cfs was measured on 8/30/00 at habitat unit# 026, 40 feet upstream of the River Road bridge with a Marsh-McBirney Model 2000 flow-meter.

This section of Big Sulphur has 10 channel types: from the mouth to 6,169 feet an F4; next 16,593 feet an F2; next 24,497 feet an F3; next 3,970 feet an F2; next 15,045 feet an F3; next 17,670 feet an F2; next 1,271 feet an A2; next 1,596 feet a B2; next 1,554 feet an A2 and the upper 20,506 feet a B2.

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

F2 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly boulder substrate.

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

B2 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 have a predominantly boulder substrate.

Water temperatures ranged from 44°F to 80°F. Air temperatures ranged from 39°F to 99°F. Summer temperatures were also measured using remote temperature recorders placed in pools (see Temperature Summary graphs, Appendix E). A recorder in Reach 3 logged temperatures every two hours from May 31 – October10, 2000. The highest temperature recorded was 89°F in August and the lowest was 58°F in September.

Another recorder in Reach 5 logged temperatures every two hours from June 15 - September 20, 2000. The highest temperature recorded was 85°F in August and the lowest was 56°F in September.

Another recorder in Reach 10 logged temperatures every two hours from June 21 - July 9, 2000, when the battery apparently failed. The highest temperature recorded was 65°F in June and the lowest was 55°F in July.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of ***occurrence*** there were 43% flatwater units, 26% riffle units, 30% pool units, and 0%dry streambed units (Graph 1). Based on total ***length*** there were 59% flatwater units, 24% riffle units, 13% pool units, and 0% dry streambed units (Graph 2).

Five hundred and ninety three habitat units were measured and 11% were completely sampled. Nineteen Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent ***occurrence*** were low gradient riffles at 17%, step runs 16%, glides 13% and runs 13% (Graph 3). By percent total ***length***, step runs made up 26%, low gradient riffles 22%, runs 21%, and glides 13%.

One hundred eighty one pools were identified (Table 3). Main Channel pools were most often encountered at 59%, and comprised 61% of the total length of pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat type. Pool quality for salmonids increases with depth. One hundred four of the 168 pools measured (62%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the one hundred thirty five pool tail-outs measured, nineteen had a value of 1 (13%); thirty six had a value of 2 (26%); fourteen had a value of 3 (9%); one had a value of 4 (.6%); sixty five (51%) riffles rated a 5 (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders.

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 types had the highest shelter rating at 16. Flatwater had the lowest rating with 8 and pools rated 16 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 14, main channel pools rated 15, and backwater pools rated 10 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant pool cover type followed by bedrock ledges (Graph 7).

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Boulders and gravel were the dominant substrate, both observed in 31% of pool tail outs.

The mean percent canopy density for the stream reach surveyed was 32%. The mean percentages of deciduous and evergreen trees were 30% and 69%, respectively. Graph 8 describes the canopy for the entire survey and graph 9 describes the canopy by reach.

For the entire stream reach surveyed, the mean percent right bank vegetated was 32% and the mean percent left bank vegetated was 27%. For the habitat units measured, the dominant vegetation types for the stream banks were: 42% evergreen trees, 22% deciduous trees, 20% grass, 9% brush and 7% bare soil (Graph 11). The dominant substrate for the stream banks were: 35% boulder, 31% bedrock, 28% cobble/gravel and 5% sand/silt/clay (Graph 10).

BIOLOGICAL INVENTORY

Steelhead, sucker, sculpin, pikeminnow and roach are known to inhabit Big Sulphur Creek.

The Department of Fish and Game has conducted many biological inventories on Big Sulphur Creek. Most of these surveys were focused on determining the presence/abundance of salmonids and rough fish, but some also included macroinvertebrate sampling. Big Sulphur has historically been a problem area for salmonids, being highly impacted by pollution from PG&E's waste discharge, high water temperatures, and the presence of rough non-game fish.

In an August 1957 electrofishing survey, the following fish were found: 2 steelhead (3-6"), 100+ roach and sucker of all sizes, 13 hardheads, 50 pikeminnow, one green sunfish, one perch, and several crayfish and ammocoetes. Above and below the sampling site 350 roach, 550 sucker, and 20 pikeminnow were observed.

October 1964 and November 1965 surveys showed a large population of YOY and 2+ salmonids (400steelhead/100'), a moderate number of rough fish (10fish/100'), and numerous insect larvae. The fun stopped abruptly at the 1 cfs PG&E waste outflow, and no fish or insects were found in a 5-mile stretch downstream.

In January 1968 it was noted that insect larvae populations were depressed near the PG&E discharge.

A July 1968 survey showed a depressed biological system, especially near the PG&E pollution source. An August survey that year showed high numbers of rough fish: 500 sucker/100', 100 pikeminnow/100', and 100 roach/100', with only one steelhead seen, along with a few smallmouth bass. Spawning areas were highly silted.

The Department of Fish and Game applied several chemical treatments to Big Sulphur Creek from 1952-1968 in an attempt to kill non-game fish.

A survey of fish and fish-food organisms was conducted in July 1969. Significant numbers of steelhead, sucker, and roach were observed.

In an August 1973 survey, one per 1000' steelhead were observed in the lower 17 miles of creek. Rainbow trout were abundant (25 fish per 100') above a 50' migration barrier. Pike minnow were abundant (35 fish per 100') up to the barrier. Suckers (35 fish per 100') and roach (50 fish per 100) were observed almost all the way up the headwaters.

In October 1974 it was estimated that only 100 juvenile steelhead were in Big Sulphur Creek.

The stream surveys of 1968, 1973, and 1975 showed steelhead from 1/4 mile to the 9-mile section located between the PG&E plant at the geysers and the confluence with Little Sulfur Creek. A two mile section immediately upstream from the geysers was also found to be devoid of fish. A resident trout population was found upstream from the devoid area in the headwaters. In the lower section, from the mouth to the confluence of Little Sulphur Creek, steelhead observations were 25 fish per 100'. Steelhead

in this section ranged from 1" to 6" in length, and averaged 2" in length. In the upper section, above the area devoid of fish, steelhead observations were 100 fish per 100'. The steelhead observed in the upper reaches were to in excellent condition.

In October 2000 a biological inventory was conducted in Big Sulphur Creek to document the fish species composition and distribution at four locations on the main stem as well as several locations on tributaries. Each site was single-pass electro-fished using one Smith Root Model 12 electro-fisher. Fish from each site were counted by species and returned to the stream. Tissue samples were taken from several randomly selected juvenile steelhead for genetic analysis at each site where steelhead were found. The observers were Stephanie Carey, Bryan Freele, and Jacob Newell.

Site 1 was located in Reach 3 near the confluence of Hale creek, and stretched 187 feet upstream. No salmonids were observed, but the survey did yield 31 roach, 22 sculpin, and 1 sucker.

Site 2 was located in Reach 5 at the confluence of Squaw Creek and stretched 367 feet upstream. At this site 5 YOY steelhead were observed, along with 145 roach, 4 sculpin, 4 suckers (3 juveniles and 1 adult), and 1 yellow-legged frog.

Site 3 was located in Reach 10, starting 100 feet downstream from the confluence of Hot Springs Creek and stretching 263 feet upstream. The only fish observed were 350 roach.

Site 4, also in Reach 10, started at the Pine Flat Bridge and stretched 644 feet upstream. Fifty juvenile steelhead were observed, ranging from 35 to 180 mm in fork length. 2 yellow-legged frogs and one Pacific giant salamander were also observed.

During the habitat inventory, no salmonids were observed upstream of electro-fishing Site 4, habitat unit # 627, 105,413 feet above the confluence with the Russian River.

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

Table 2. Species Observed in Historical and Recent Surveys

| YEARS | SPECIES | SOURCE | Native/Introduced |
|---|---|---|---|
| 1957, 1964-5, 1973-4, 2000 | Steelhead | DFG | N |
| 1957, 1964-5, 1973, 2000 | Pike Minnow | DFG | N |
| 1957, | Sculpin | DFG | N |
| 1957, 1964-5, 1973, 2000 | Roach | DFG | N |
| 1957, 1964-5, | Sacramento Sucker | DFG | N |

| Table 2. Species Observed in Historical and Recent Surveys | | | |
|---|---|---|---|
| **YEARS** | **SPECIES** | **SOURCE** | **Native/Introduced** |
| 1973, 2000 | | | |
| 1957, | Green Sunfish | DFG | ??? |
| 1957, | Perch | DFG | ??? |
| 1968, 2000 | Smallmouth Bass | DFG | ??? |
| 1957, | Hardhead | DFG | ??? |
| 1957 | Crayfish | DFG | N |
| 2000 | California Newt | DFG | N |
| 2000 | Pacific Giant Salamander | DFG | N |
| 2000 | Yellow-legged Frog | DFG | N |
| 1953 | Lamprey | DFG | N |
| 1957 | Ammocoetes | DFG | N |

Historical records reflect that steelhead fingerlings and advanced fingerlings were transferred to Big Sulphur Creek from various creeks, between 1958 and 1983 (Table 1). Steelhead fingerlings were rescued/transferred from Big Sulphur Creek and released in the Russian River in 1964 (Table 2).

| **Table 1. Summary of fish transfers into Big Sulphur Creek** | | | | |
|---|---|---|---|---|
| **YEAR** | **SOURCE** | **SPECIES** | **#** | **SIZE** |
| 1958 | Dry Creek | SH | 1,335 | ADFNG |
| 1958 | Maacama Creek | SH | 1,548 | FING |
| 1959 | Brooks Creek | SH | 1,782 | FING |
| 1959 | Cherry Creek | SH | 7,569 | FING |

| Table 1. Summary of fish transfers into Big Sulphur Creek | | | | |
|---|---|---|---|---|
| **YEAR** | **SOURCE** | **SPECIES** | **#** | **SIZE** |
| 1959 | Dry Creek | SH | 723 | ADFNG |
| 1959 | Franz Creek | SH | 3,060 | FING |
| 1959 | Maacama | SH | 6,429 | FING |
| 1959 | Oat Valley Creek | SH | 6,240 | FING |
| 1959 | Pena Creek | SH | 46,592 | FING |
| 1959 | Sausal Creek | SH | 4,831 | FING |
| 1959 | Dry Creek | SH | 19,593 | FING |
| 1960 | Cherry Creek | SH | 6,444 | FING |
| 1960 | Oat Valley Creek | SH | 560 | FING |
| 1962 | Franz Creek | SH | 4,380 | FING |
| 1962 | Maacama Creek | SH | 2,889 | FING |
| 1962 | Pena Creek | SH | 5,460 | FING |
| 1963 | Cherry Creek | SH | 3,168 | FING |
| 1963 | Pena Creek | SH | 5,622 | FING |
| 1982 | Dry Creek | SH | 13,056 | FING |
| 1983 | Dry Creek | SH | 12,600 | FING |

SH = steelhead
FING = fingerling
ADFNG = advanced fingerling

**Table 2. Summary of fish rescues/transfers from Big Sulphur Creek**

| YEAR | RELEASE LOCATION | SPECIES | # | SIZE |
|---|---|---|---|---|
| 1964 | Russian River | SH | 7,968 | FING |

SH = steelhead
FING = fingerling

ADULT SALMONID SURVEYS:

There are no records of spawning/adult carcass surveys on Big Sulphur Creek.

DISCUSSION

Big Sulphur has 10 channel types: F4 (6169 ft.), F2 (16593 ft.), F3 (24497 ft.), F2 (3970 ft.), F3 (15045 ft.), F2 (17670 ft.), A2 (1271 ft.), B2 (1596 ft.), A2 (1554 ft.) and B2 (20506 ft.).

There are 6,169 feet of F4 channel type in Reach 1. According to the DFG Salmonid Stream Habitat Restoration Manual, 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.

There are 38,233 feet of F2 channel type in Reaches 2, 4, and 6. F2 channel types are fair for low-stage weirs, single and opposing wing-deflectors and log cover.

There are 39,542 feet of F3 channel type in Reaches 3 and 5. 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. Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

There are 2,835 feet of A2 channel type in Reaches 7 and 9. The high energy, steep gradient A2 channel types have stable stream banks and poor gravel retention capabilities and are generally not suitable for instream enhancement structures.

There are 22,102 feet of B2 channel type in Reaches 8 and 10. B2 channel types are excellent for low and medium-stage plunge weirs, single and opposing wing deflectors and bank cover. 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.

Many site specific projects can be designed within both B and F channel types, especially to increase pool frequency, volume and shelter.

The water temperatures were recorded on the survey dates 8/15/00 to 11/15/00 ranged from 44°F to 80°F. Air temperatures ranged from 39°F to 99°F. The warmer water temperatures were recorded in Reach 1.

Remote temperature monitors were placed in pools at three sites along Big Sulphur Creek. Summer temperatures ranged from 59° to 88°F in the lower reach, 50° to 90+°F in the middle reach, and 50° to 90+°F in the upper reach. The Temperature Summary graph shows that for much of the summer (July through August) the lower, middle, and upper watershed exhibited extreme temperatures above the optimal 65°F for salmonids.

The Temperature Summary graph (Appendix E) shows that for much of the summer (July through August) the lower and upper watershed exhibited temperatures ranging from favorable to unfavorable for salmonids. It is unknown if this thermal regime is typical, but our electrofishing samples found steelhead more frequently in the upper, cooler sample sites.

Pools comprised 12% 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 Big Sulphur, the pools are relatively deep with 78% having a maximum depth of at least 3 feet. These pools comprised 10% 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 15. 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 boulders (66%), bedrock ledges (11%), root masses (4%), and large woody debris (1%).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.

Eight of the 20 low gradient riffles measured (40%) had either gravel or small cobble as the dominant substrate. This is generally considered fair for spawning salmonids.

Eleven of the pool tail-outs measured had embeddedness ratings of either 3 or 4. Only 13% 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. In a reach comparison, Reach 8 had the best ratings and Reaches 7 and 9 had the poorest ratings. The other reaches generally rated fair.

The mean percent canopy for the survey was 32%. This is a very low percentage of canopy, since 80 percent is generally considered desirable. Cooler water temperatures are desirable in Big Sulphur. 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.

The riparian buffer is thin or nearly absent throughout the lower half of the creek. Riparian grazing by livestock, deer, and feral pigs are likely keeping the young alders and willow from surviving in the riparian zone. However, it is possible that Big Sulphur naturally has limited canopy, especially in the lower, broad reaches.

## GENERAL MANAGEMENT RECOMMENDATIONS

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

Winter storms often bring down large trees and other woody debris into the stream, which increases the number and quality of pools. This 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) Access for migrating salmonids is a potential problem in Big Sulphur Creek, therefore, fish passage should be monitored, and improved where possible.

2) There are sections 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 by defecating in the water. Alternatives to limit cattle access, control erosion and increase canopy, should be explored with the landowner, and developed if possible.

3) Increase the canopy on Big Sulphur Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable level. The non-anadromous reach above the survey section should be assess for planting and treated as well, since water temperatures throughout are effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

4) 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.

5) In Big Sulphur Creek, active and potential sediment sources related to the road system need to be mapped, and treated according to their potential for sediment yield to the stream and its tributaries.

6) Where feasible, increase woody cover in the pool and flatwater habitat units along the entire

stream. Most of the existing shelter is from vegetation and undercut banks. 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 in the upper reaches. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion. In some areas the material is at hand.

7) Where feasible, design and engineer pool enhancement structures to increase the number of pools in the upper reaches. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

8) If riparian areas are not improved in Big Sulphur Creek, temperatures should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

BIG 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.

| HABITAT UNIT # | DISTANCE UPSTREAM | COMMENTS |
|---|---|---|
| 1.0 | 296 | Mouth 45' wide, narrows to 9'. WP #050 (F1) @57' upstream of mouth: 38:49'6.7"N, 123:00'39.9"W. |
| 2.0 | 375 | LB: gravel mining in progress. |
| 3.0 | 450 | Suckers, small pike minnow. |
| 4.0 | 509 | RB: Rip-rap; large boulders. |
| 7.0 | 744 | Old cars LB. |
| 8.0 | 813 | Dry side channel. Bass. |
| 10.0 | 1081 | WP #051 (F1) 38°49'15"N 123°0'33.4"W. 300 roach. Young willow wall LB, 8-10' high Willows distinguish main channel from floodplain |
| 12.0 | 1344 | Roach of all age classes. |
| 13.0 | 1413 | LB Willow wall ends. |
| 14.0 | 1503 | LB Road on gravel bar for gravel mining tractors. |
| 15.0 | 1591 | Heavy algae, no fish |
| 16.0 | 1977 | Unit yellow with algae. LB 1-2'willow/ cottonwood. LB inactive 2' culvert. |
| 16.1 | 2316 | Includes 10' dry habitat. |
| 16.2 | 2346 | Enhanced by human-made cobble dam. |
| 18.0 | 2437 | WP 052 (F1). |
| 19.0 | 2576 | RB Ranch entrance |
| 20.0 | 2688 | LB old cars. |

| | | |
|---|---|---|
| 21.0 | 2763 | RB rip-rap from bridge to mouth. |
| 22.0 | 2813 | LB willows. |
| 23.0 | 3033 | Hundreds of roach. |
| 24.0 | 3158 | LB mature cottonwoods. |
| 25.0 | 3238 | Three inch sucker with swollen, bruised belly. |
| 26.0 | 3348 | Bridge - see form. Two culverts - see form |
| 27.0 | 2133 | Thirty feet upstream from bridge crossing- erosion stopped w/ new concrete 12x10x.5 |
| 28.0 | 2176 | WP 054 (F1). |
| 31.0 | 3938 | Egrets, Herons |
| 32.0 | 4084 | RB house. |
| 33.0 | 4434 | RB & LB houses. |
| 35.0 | 4688 | RB 2' water pump active. |
| 37.0 | 4815 | Boulder enhanced 4.2 |
| 38.0 | 4957 | WP 055 (F1) |
| 39.0 | 4985 | Twelve 5-10" pike minnow |
| 42.0 | 5253 | 100 pike minnow |
| 45.0 | 6169 | RB water pump for residential purpose. |
| 46.0 | 6322 | Channel change. |
| 48.0 | 6598 | Channel more entrenched. |
| 49.0 | 6673 | Signal crayfish. |
| 50.0 | 6883 | Man-made dam makes 2 step pools. 60 pike minnow up to 1' length. |
| 53.0 | 7035 | 25' cascade w/ 12' vert. rise |
| 55.0 | 7341 | WP #011 (F3). |
| 57.0 | 7850 | 100 unidentified fingerlings. |
| 63.0 | 9987 | RB invasive non-native vines. |
| 65.0 | 10396 | Shallow backwater pool present, 2'deep 100'long, 12'wide. Dozens of roach. WP #012 (F3): 38:49'322"N, 122:59'172"W. |
| 67.0 | 11613 | Dry trib. 400' up unit. |
| 67.1 | 11934 | Separated from main flow by 30-70' gravel bar wooded with young willow & cottonwood |
| 68.0 | 11651 | Includes 4'and 3'jumps. |
| 73.0 | 12116 | HU’s #068-74 show A2 characteristics. |
| 74.0 | 12382 | WP #013: 38:49'105"N 122:58'952"W |
| 75.0 | 12584 | LB cold spings. |
| 76.0 | 13043 | Upper RB culvert. No active erosion. |
| 77.0 | 13153 | RB abandoned vehicle; flag hung here. Heavily silted. Contains small side pool 3' deep |
| 79.1 | 14398 | RB med. size dry trib. |
| 80.0 | 14402 | Heavy silt. |
| 81.0 | 14630 | LB erosive (see form). Many gravel deposits |

| | | |
|---|---|---|
| 82.0 | 15754 | in creek bed. |
| | | WP #014 (F3): 38:48.884'N 122:58.301'W. |
| 83.0 | 16154 | Heavy silt. |
| | | Many gravel bars in this reach. |
| 84.0 | 16284 | LB erosion (see form). |
| 85.0 | 16437 | LB erosion (see form). LB 2 small scour |
| 86.0 | 17037 | pools w/ good shelter. |
| | | WP #015 (F3) 38:48.926'N 122:58.172'W |
| 87.0 | 17197 | HU’s #088 & 089 flat w/ gravel substrate and |
| 88.0 | 17417 | steep bedrock banks. |
| | | Includes several riffles. RB large trib. |
| 89.0 | 17841 | Culvert (see form). |
| 90.0 | 17923 | Includes several 5'deep "4.2" pools, |
| 92.0 | 19427 | several "1.2"/"1.1" riffles, 3' jump. |
| | | 6 foot vert. jump |
| 94.0 | 19481 | RB large trib. RB several culverts. Cattle presence. |
| 95.0 | 20831 | WP #016 (F3) 38:48.973'N 122:57.409'W. |
| 97.0 | 21481 | Concrete boulders 6' dia., block 60'W, |
| 99.0 | 21668 | 15'H, 10'L; old dam or bridge. |
| | | Cattle presence in creek. |
| 100.0 | 21748 | Oil on water surface. |
| 101.0 | 22448 | Channel Change to F3. WP #019 (F3) |
| 104.0 | 22899 | Tons of roach throughout reach. |
| 105.0 | 23005 | RB Hale Creek mouth (dry) @ 200' up unit. |
| 106.0 | 23389 | WP #017 (F3) N38:49.054 W122:57.111 |
| 107.0 | 23599 | Cows in creek, at least through unit #163 |
| 108.0 | 23936 | Often much algae in cow-infested areas. |
| | | Substrate changes to cobble. |
| | | RB dry trib & fence. |
| 121.0 | 28120 | Channel type change; see form. |
| 123.0 | 28721 | RB small trib. |
| 125.0 | 29361 | 400 pike minnow fingerlings. |
| 128.0 | 30176 | LB small trib. |
| 130.0 | 30987 | Jeep trail through unit. |
| 137.0 | 32712 | Possibly confluence w/ Little Sulfur Creek |
| 138.0 | 32812 | Jeep trail. Possible channel change. |
| 139.0 | 33007 | Signal crayfish. |
| 144.0 | 33852 | WP #022 (F3). |
| 147.0 | 34557 | Signal crayfish. |
| 153.0 | 36528 | RB dry trib. |
| 160.0 | 38860 | LB fence. 100s of pike fingerlings. |
| 162.0 | 39960 | LB fence |
| 163.0 | 40054 | Culvert 100' up. Cows presence (from unit |

| | | |
|---|---|---|
| 164.0 | 40924 | 108). 300 fingerlings (squawfish?). |
| | | RB small dry trib. |
| 165.0 | 40994 | 100s of fingerlings. |
| 166.0 | 41169 | Two old cars. |
| 168.0 | 41547 | Gravel bar 20' X 100'. |
| 169.0 | 42612 | Heavy sedimentation. |
| 170.0 | 42722 | LB wet trib: Frazier Creek. |
| 171.0 | 43122 | Road crossing in creek. |
| 173.0 | 43676 | 200 pike fingerlings. |
| 179.0 | 46048 | Four foot vert. jump. |
| 181.0 | 46110 | Young roach. Several *H. regilla*. |
| 184.0 | 47259 | Channel change to F2. |
| 185.0 | 47409 | Red willow along banks. |
| 187.0 | 47639 | RB 1" hose drawing water from shallow pool |
| | | Yellow-legged frog *(R. boylii)* |
| 188.0 | 49464 | LB small dry trib. |
| 192.0 | 50239 | WP 56 (F1): N38:49'29.1" W122:53'20.3" |
| 193.0 | 50289 | LB spring. Upslope banks: gradient increases. |
| 194.0 | 50929 | Human-made cobble / boulder dam at tail |
| 195.0 | 50989 | Two plunge 2' thick, 30' wide. |
| | | LB small dry trib. Channel change to F3. |
| 197.0 | 51409 | Two dozen turkeys. |
| 198.0 | 51609 | Small swim dams throughout unit, 1-2' height |
| 199.0 | 52009 | Bridge - see form. RB small dry trib. |
| 202.0 | 52699 | WP #057 (F1) N38:49'25.3" W122:53'.4". |
| 203.0 | 52889 | RB small gully, no erosion. |
| 206.0 | 53549 | RB wet trib. Main 72 degrees; trib. 71 |
| 209.0 | 54026 | degrees (200' upstream). |
| | | Bridge - see form. |
| 210.0 | 54141 | Steep bedrock banks starting at bridge. |
| 211.0 | 54211 | Boulder substrate begins. |
| 212.0 | 55051 | WP #059 (F1). |
| 213.0 | 55171 | LB culvert. Old rusty culvert in stream |
| 214.0 | 56731 | Hundreds of pike minnows / roach. |
| | | LB old car frame. RB dry trib. |
| 216.0 | 56846 | WP #060 (F1) N38:49'6.0" W122: 51'57.7" |
| 223.0 | 58339 | A few 2.5' deep pools, no spawning. |
| 227.0 | 59564 | Small fig trees sporadically through reach |
| 229.0 | 60029 | RB small dry trib. 100 pike minnows. |
| 231.0 | 60409 | WP #061 (F1). |
| 233.0 | 60824 | 100's of pike minnow yoy>z+ |
| 235.0 | 61089 | LB dry trib, small |

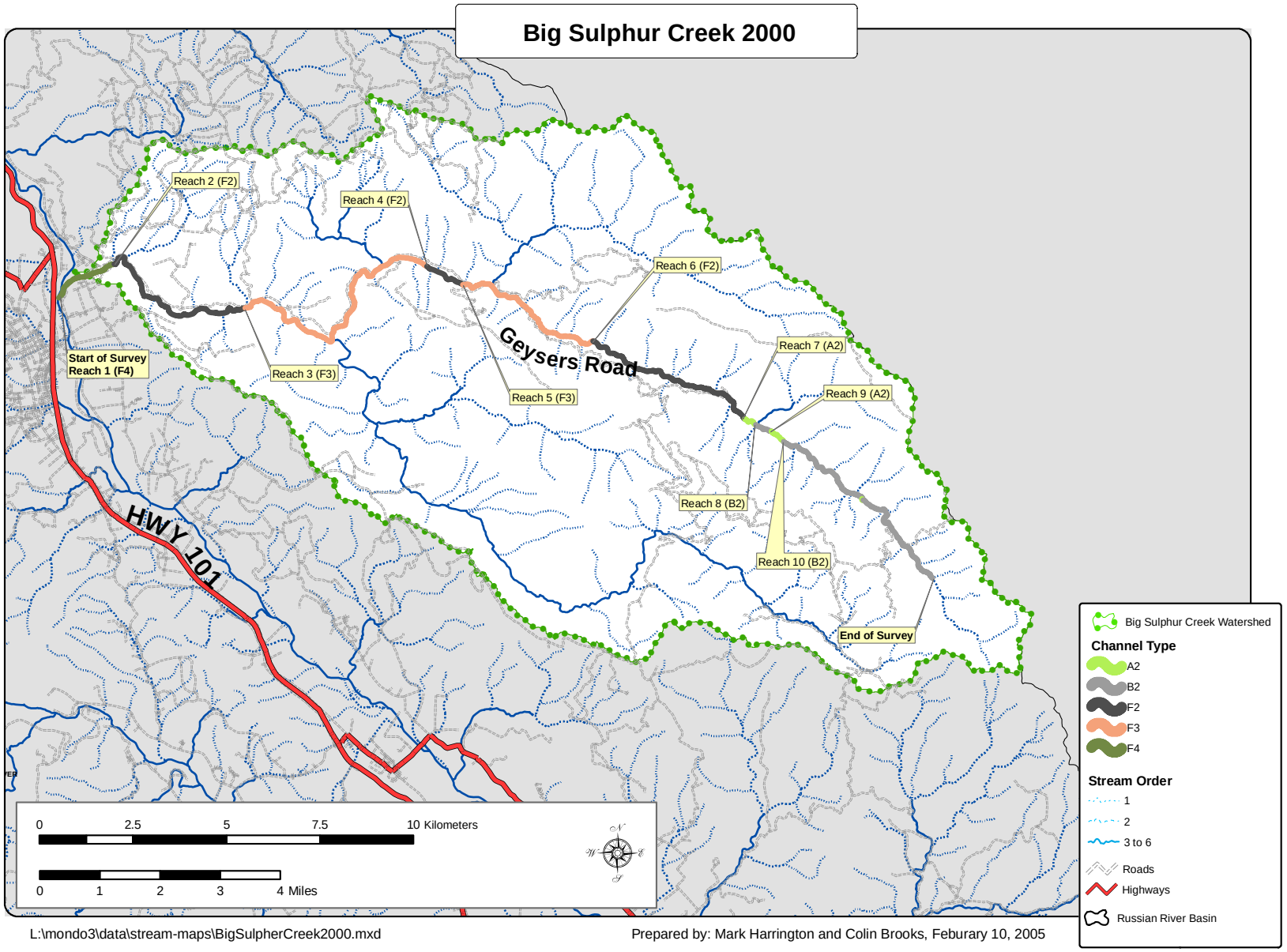
| | | |
|---|---|---|
| 238.0 | 61559 | Road crossing (looks used) at velocity crossover |
| 240.0 | 61789 | RB. road Heavy silt |
| 242.0 | 62094 | LB wet trib, at confluence: 65deg; up trib: 70deg |
| 243.0 | 62264 | above confluence in main creek: 62deg |
| | | 300 pike minnow |
| 244.0 | 62604 | RB small dry trib |
| 245.0 | 63109 | WP#063(F1)100 pila minnow |
| 253.0 | 64409 | several 2' jumps, no passage problems |
| 254.0 | 64449 | (photo) LB large dry trib, "Traitt Creek" |
| 255.0 | 64549 | Heavy silt in pool. 5 fish 1foot long, No ID |
| 259.0 | 65294 | 300 pike minnow |
| 261.0 | 65574 | WP# 064 dry trib RB |
| 262.0 | 66274 | Somewhere on this page channel changes to F2 |
| 263.0 | 66389 | pring on RB |
| 273.0 | 68126 | LB Wet trib; Road crosses tributary; |
| 274.0 | 68866 | Trib is plugged by culvert (WP#066) |
| | | Saw fish jump in pool |
| 278.0 | 69325 | Dammed pool at summer residence- |
| 279.0 | 69555 | Dam is removed in winters (see form) |
| | | 30' sewage hose in creek- both |
| 289.0 | 71048 | 60' long pipe in creek |
| | | Red shouldered hawk |
| 291.0 | 71388 | WP#068 (F1) N38 48' 18.7" |
| 295.0 | 72262 | Large dry trib LB |
| 298.0 | 72791 | One 4' jump, several 1-2' jumps |
| 301.0 | 73007 | Hot spring in unit |
| 392.0 | 73303 | Bedrock currently dry except for water |
| | | flowing underneath bedrock |
| | | Dry side channel |
| 394.0 | 73698 | Hot spring in unit |
| 395.0 | 73974 | Wet trib @65deg/67deg, @confluence -dry side channel |
| 397.0 | 74329 | Dipper observed (bird) |
| 399.0 | 75356 | Wet trib RB: 64deg/66deg@ confluence |
| 401.0 | 75581 | 1-2' jumps for a vertical gain of 10' |
| 403.0 | 75742 | +14' jump |
| 406.0 | 75843 | 9' vertical jump WP#071 (F1) |
| 407.0 | 75880 | Water flowing under 4'of boulders |
| 408.0 | 76054 | WP#072; 4' jump pool |
| 409.0 | 76076 | RB small wet trib., substantial flow, many blackberries |
| 423.0 | 78604 | 1' pipe passes under stream covered |
| 426.0 | 79120 | w/6'Lx13'W concrete slab: water .1' deep; |
| | | no passage problem |

| | | |
|---|---|---|
| | | Gully RB WP#074 Many Roach- Potential E-fish site |
| 428.0 | 79164 | RB 40' shear bedrock cliff |
| 430.0 | 79664 | Banks infested w/ blackberry& vinca (periwinkle) |
| 431.0 | 80099 | Trib; scrap metal in LB creek |
| | | Dry side channel present |
| 436.0 | 80489 | Old rusty 2' pipes, old dam 20'H 12'L |
| 437.0 | 80609 | WP#075 (f1) |
| 438.0 | 80764 | RB steaming hot spring w/ a dry trib, road |
| 439.0 | 80909 | Visible upper RB |
| | | 2' pipe crosses creek, 20' above water; |
| 443.0 | 81369 | Calpine-in use |
| | | Upper end 1.8' plunge over concrete slab, |
| 446.0 | 81594 | old concrete structure, 20'L, 70'W, 5'H w/3' pipe |
| | | within not active, only flow impediment |
| | | is dam 0.8' L, 8'W, 1.8'H |
| | | WP#076 RB staff gauge attached to 2' pipe |
| 448.0 | 81814 | Road upper RB |
| 449.0 | 81859 | Box culvert- see bridge form |
| 451.0 | 81986 | Dry trib. LB w/ 3' culvert |
| 452.0 | 82170 | Road along LB |
| 454.0 | 82401 | 20 juvenile roach; dry trib RB |
| 455.0 | 82499 | Spring seepage LB |
| 456.0 | 82608 | No GPS position aval. in canyon |
| 458.0 | 82856 | Small dry trib LB |
| 459.0 | 83151 | Sulphur spring seeping- both banks |
| 464.0 | 83563 | Dozen juv. roach |
| 465.0 | 83687 | Small dry trib LB |
| 467.0 | 83771 | N38deg 47'39.2" W122deg 47'55.5" |
| 468.0 | 83836 | Waypoint #023 (F2) |
| | | Channel Change to A2 |
| 470.0 | 83928 | Pool, come in from above, increased |
| 473.0 | 84371 | shelter % due to depth+obscurity, Park on |
| | | left of Geysers Resort rd 1 mile past |
| | | entrance Kiosk, walk down to Big Sulphur, |
| | | go downstream to unit #475(pass Cobb Creek) |
| | | No access to unit-steep bedrock canyon |
| 477.0 | 85281 | No SH seen |
| 480.0 | 85853 | Gully LB due to culverts at road |
| 481.0 | 85902 | Spring LB, dry trib LB |
| 482.0 | 86177 | No GPS position possible |
| 483.0 | 86238 | Dry trib LB Spring LB |
| 484.0 | 86600 | Dry trib RB |
| 486.0 | 86811 | Changes to A2 channel |

| | | |
|---|---|---|
| 487.0 | 86876 | Spring LB |
| 488.0 | 86950 | 8-9' jump at low flow |
| 491.0 | 87059 | Spring LB |
| 492.0 | 88101 | N38deg 47' 19.9", W122deg 47' 12.5"<br>WP #025 (F2) |
| 493.0 | 88165 | Dry trib LB |
| 498.0 | 88718 | N38deg 47' 15.4" W122deg 47' 01.2" WP#026(F2) |
| 503.0 | 89361 | West trib 54deg 55°F@ confluence; no salmonids<br>"End E-fish" flag RB, dozen of roach |
| 506.0 | 89457 | "Start E-fish" flag LB |
| 509.0 | 89692 | 6' vert. jump, passable by side channel @ high flow |
| 511.0 | 89779 | Hot spring LB (33' into unit) |
| 512.0 | 89882 | N38deg 47' 16.4" W122deg 46' 55.3" |
| 513.0 | 89957 | Unit includes 3' cascade |
| 516.0 | 90133 | Hot spring RB |
| 520.0 | 90704 | Bridge- see form, Waypoint #028(F2) |
| 523.0 | 90920 | N 38 47' 11", W 122deg 46' 45.4"<br>100's of cattis flies N 38deg 47' 5.0" |
| 533.0 | 92001 | W122deg 46' 37.7" Way point #029 (F2)<br>Dozen of juv. roaches |
| 534.0 | 92476 | WP #030 N 38 46' 58.2" W122 46'28.2" |
| 543.0 | 93256 | Dry trib RB |
| 546.2 | 94007 | Wet trib RB 64Deg.(190'into unit); |
| 549.0 | 94403 | 2nd wet trib RB 74deg. (280’ into unit);<br>63deg@confluence. No salmonid passage in either;<br>Slide RB-see form HU #549 Fresh water snails.<br>7' Jump under boulder into shallow water |
| 555.0 | 94976 | |
| 560.0 | 95441 | Road X-ing; no GPS position- low battery |
| 566.0 | 96168 | House LB; landowner says 1/2 dozen 8" SH |
| 568.0 | 96334 | in man-made pool w/flashboard dam;<br>Culvert at upstream end.<br>See Dam Form<br>Concrete wall used along LB, 6-9'tall,<br>Unit #569-70 |
| 570.0 | 96483 | Concrete used to enhanced pool on both banks,<br>Wet trib LB 50deg @ confluence; |
| 572.0 | 96698 | 4' Jump:<br>Dry trib LB |
| 576.0 | 97139 | Wet Trib RB 57deg, 56deg at confluence,<br>no anadromous access |
| 581.0 | 97634 | Low visibility in H20 throughout reach, (poor light) |
| 582.0 | 97664 | No salmonids seen |

| | | |
|---|---|---|
| 583.0 | 97856 | No GPS position |
| 586.0 | 98061 | Dry trib to RB |
| 602.0 | 98803 | No fish observed throughout reach |
| 604.0 | 98891 | Small spring RB, dry trib LB |
| 606.0 | 99579 | Small dry trib RB |
| 608.0 | 100141 | 10' jump |
| 610.0 | 100298 | Survey flags stakes on bank |
| 611.0 | 100593 | Step bridge across ck.w/ survey rigs and pipes |
| 612.0 | 100660 | Extending into H2O via Pulleys, dry trib. LB |
| | | Wet trib RB 90deg 56deg at confluence |
| 615.0 | 100982 | Road X-ing WP #O33(f2) N38 46' 22.1" |
| 616.0 | 101074 | W122 43' 16.2"*H2O withdrawal @40cfs+ |
| | | By Calpine |
| | | Had to leave due to extreme weather-snowing |
| 619.0 | 103666 | Bridge-see form, WP #034 begin E-fish, flag |
| 620.0 | 103723 | Dry trib into LB |
| 621.0 | 103872 | Temperature flag |
| 623.0 | 104063 | End E-fish flag |
| 627.0 | 104370 | Waypoint #035(F2) |
| 627.1 | 104430 | Dam- see form |
| 631.0 | 104725 | Wet trib-RB, 52deg, 45deg @ confluence. SH |
| 632.0 | 104884 | H20 withdrawal pipes RB |
| 636.0 | 105191 | Waypoint# 036(F2) |
| 637.0 | 105333 | Dry trib LB |
| 644.0 | 106082 | Two 2" Long fish observed- no ID |
| 647.0 | 106474 | Waypoint #037 (F2) |
| | | Dry trib LB, *Great LWD recruitment |
| 648.0 | 106940 | throughout this section |
| | | Clean substrate, clear H2O, significantly |
| 649.0 | 106970 | Lower flows here than downstream |
| | | Lg. Blue- lined redwood tree RB(for |
| 654.0 | 107552 | Logging? Prob. Old operation) |
| | | Dry trib. Old rd. meets creek RB |
| 655.0 | 107753 | Way Point#038 (F2) |
| 657.0 | 107860 | Company geologist told us this upper |
| | | Section is intermittent in late summer |
| 658.0 | 107886 | Small dry trib RB |
| 662.0 | 108453 | Wet trib RB at upstream end of unit 43 deg |
| 664.0 | 108756 | 45deg@confluence |
| | | No salmonids seen |
| 665.0 | 108798 | Waypoint #039(F2); |
| | | END SURVEY |

# APPENDIX A: MAP




Big Sulphur Creek Tables Graphs Map
Assessment Completed 2000

## Table 1 - Summary of Riffle, Flatwater, and Pool Habitat Types

Stream Name: Big Sulphur Creek

LLID: 1230102388180

Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

| Habitat Units | Units Fully Measured | Habitat Type | Habitat Occurrence (%) | Mean Length (ft.) | Total Length (ft.) | Total Length (%) | Mean Width (ft.) | Mean Depth (ft.) | Mean Max 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 | CULVERT | 0.3 | 66 | 132 | 0.1 | | | | | | | | | |
| 2 | 0 | DRY | 0.3 | 195 | 390 | 0.3 | | | | | | | | | |
| 254 | 36 | FLATWATER | 42.8 | 262 | 66561 | 59.5 | 18.1 | 0.8 | 1.7 | 4562 | 1158723 | 3819 | 970095 | | 8 |
| 2 | 0 | NOSURVEY | 0.3 | 1250 | 2500 | 2.2 | | | | | | | | | |
| 181 | 173 | POOL | 30.5 | 83 | 14951 | 13.4 | 22.2 | 1.9 | 3.8 | 2065 | 373749 | 5548 | 946164 | 4631 | 15 |
| 152 | 36 | RIFFLE | 25.6 | 180 | 27335 | 24.4 | 20.8 | 0.5 | 1.2 | 1997 | 303575 | 1022 | 146720 | | 16 |

| Total Units | Total Units Fully Measured | Total Length (ft.) | Total Area (sq.ft.) | Total Volume (cu.ft.) |
|---|---|---|---|---|
| 593 | 245 | 111869 | 1836048 | 2062979 |

## Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Big Sulphur Creek

LLID: 1230102388180 Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

| Habitat Units | Units Fully Measured | Habitat Type | Habitat Occurrence (%) | Mean Length (ft.) | Total Length (ft.) | Total Length (%) | Mean Width (ft.) | Mean Depth (ft.) | Max 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 | Mean Canopy (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 104 | 22 | LGR | 17.5 | 237 | 24659 | 22.0 | 23 | 0.5 | 3.5 | 2945 | 306229 | 1525 | 144216 | | 19 | 23 |
| 17 | 2 | HGR | 2.9 | 98 | 1673 | 1.5 | 18 | 0.7 | 1.4 | 2820 | 47940 | 1715 | 29155 | | 20 | 44 |
| 27 | 8 | CAS | 4.6 | 35 | 955 | 0.9 | 22 | 0.6 | 3.2 | 164 | 4421 | 97 | 2631 | | 10 | 38 |
| 4 | 4 | BRS | 0.7 | 12 | 48 | 0.0 | 6 | 0.2 | 1 | 43 | 170 | 8 | 33 | | | 25 |
| 80 | 16 | GLD | 13.5 | 178 | 14243 | 12.7 | 22 | 0.9 | 2.8 | 3922 | 313736 | 3535 | 282785 | | 9 | 28 |
| 77 | 15 | RUN | 13.0 | 302 | 23273 | 20.8 | 15 | 0.7 | 3.5 | 5736 | 441699 | 4494 | 346052 | | 10 | 21 |
| 97 | 5 | SRN | 16.4 | 299 | 29045 | 26.0 | 15 | 0.8 | 2.8 | 3087 | 299460 | 2705 | 262365 | | 5 | 45 |
| 100 | 96 | MCP | 16.9 | 83 | 8256 | 7.4 | 22 | 2.1 | 8.7 | 2159 | 215879 | 6132 | 574870 | 5200 | 15 | 41 |
| 1 | 1 | CCP | 0.2 | 100 | 100 | 0.1 | 40 | 3.8 | 7.8 | 4000 | 4000 | 16000 | 16000 | 15200 | | 0 |
| 5 | 5 | STP | 0.8 | 154 | 768 | 0.7 | 20 | 1.7 | 5.7 | 3107 | 15536 | 7498 | 37492 | 5928 | 16 | 40 |
| 7 | 7 | LSR | 1.2 | 85 | 592 | 0.5 | 26 | 1.8 | 5.8 | 2496 | 17470 | 6464 | 38782 | 5083 | 24 | 14 |
| 14 | 14 | LSBk | 2.4 | 90 | 1259 | 1.1 | 23 | 2.2 | 8.1 | 2062 | 28864 | 6252 | 87530 | 5245 | 10 | 36 |
| 47 | 45 | LSBo | 7.9 | 71 | 3356 | 3.0 | 21 | 1.5 | 6.2 | 1622 | 76248 | 3278 | 147218 | 2528 | 14 | 36 |
| 2 | 2 | PLP | 0.3 | 31 | 62 | 0.1 | 22 | 1.3 | 3.6 | 697 | 1394 | 1639 | 3277 | 806 | 18 | 5 |
| 4 | 2 | SCP | 0.7 | 82 | 328 | 0.3 | 26 | 0.4 | 0.7 | 1409 | 5636 | 836 | 1672 | 836 | | 5 |

## Table 2 (cont.) - Summary of Habitat Types and Measured Parameters

Stream Name: Big Sulphur Creek LLID: 1230102388180 Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

| Habitat Units | Units Fully Measured | Habitat Type | Habitat Occurrence (%) | Mean Length (ft.) | Total Length (ft.) | Total Length (%) | Mean Width (ft.) | Mean Depth (ft.) | Max 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 | Mean Canopy (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | DPL | 0.2 | 230 | 230 | 0.2 | 30 | 3.9 | 14.9 | 6900 | 6900 | 27600 | 27600 | 26910 | 10 | 10 |
| 2 | 0 | DRY | 0.3 | 195 | 390 | 0.3 | | | | | | | | | | 45 |
| 2 | 0 | CUL | 0.3 | 66 | 132 | 0.1 | | | | | | | | | | 100 |
| 2 | 0 | NS | 0.3 | 1250 | 2500 | 2.2 | | | | | | | | | | |

| Total Units | Total Units Fully Measured | Total Length (ft.) | Total Area (sq.ft.) | Total Volume (cu.ft.) |
|---|---|---|---|---|
| 593 | 245 | 111869 | 1785583 | 2001677 |

## Table 3 - Summary of Pool Types

Stream Name: Big Sulphur Creek LLID: 1230102388180 Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

| Habitat Units | Units Fully Measured | Habitat Type | Habitat Occurrence (%) | Mean Length (ft.) | Total Length (ft.) | Total Length (%) | Mean Width (ft.) | Mean Residual Depth (ft.) | Mean Area (sq.ft.) | Estimated Total Area (sq.ft.) | Mean Residual Pool Vol (cu.ft.) | Estimated Total Resid.Vol. (cu.ft.) | Mean Shelter Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 106 | 102 | MAIN | 59 | 86 | 9124 | 61 | 21.9 | 2.1 | 2223 | 235674 | 5343 | 532994 | 15 |
| 70 | 68 | SCOUR | 39 | 75 | 5269 | 35 | 22.3 | 1.7 | 1775 | 124283 | 3296 | 220564 | 14 |
| 5 | 3 | BACKWATER | 3 | 112 | 558 | 4 | 27.0 | 2.2 | 3239 | 16197 | 13873 | 46243 | 10 |

| Total Units | Total Units Fully Measured | Total Length (ft.) | Total Area (sq.ft.) | Total Volume (cu.ft.) |
|---|---|---|---|---|
| 181 | 173 | 14951 | 376153 | 799802 |

## Table 4 - Summary of Maximum Residual Pool Depths By Pool Habitat Types

Stream Name: Big Sulphur Creek LLID: 1230102388180 Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

| Habitat Units | Habitat Type | Habitat Occurrence (%) | < 1 Foot Maximum Residual Depth | < 1 Foot Percent Occurrence | 1 < 2 Feet Maximum Residual Depth | 1 < 2 Feet Percent Occurrence | 2 < 3 Feet Maximum Residual Depth | 2 < 3 Feet Percent Occurrence | 3 < 4 Feet Maximum Residual Depth | 3 < 4 Feet Percent Occurrence | >= 4 Feet Maximum Residual Depth | >= 4 Feet Percent Occurrence |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 93 | MCP | 55 | 0 | 0 | 5 | 5 | 29 | 31 | 25 | 27 | 34 | 37 |
| 1 | CCP | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 100 |
| 5 | STP | 3 | 0 | 0 | 0 | 0 | 1 | 20 | 2 | 40 | 2 | 40 |
| 6 | LSR | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 50 | 3 | 50 |
| 14 | LSBk | 8 | 0 | 0 | 1 | 7 | 4 | 29 | 1 | 7 | 8 | 57 |
| 45 | LSBo | 27 | 0 | 0 | 2 | 4 | 21 | 47 | 14 | 31 | 8 | 18 |
| 2 | PLP | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 100 | 0 | 0 |
| 1 | SCP | 1 | 1 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | DPL | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 100 |

Total Units

| | Total < 1 Foot Max Resid. Depth | Total < 1 Foot % Occurrence | Total 1< 2 Foot Max Resid. Depth | Total 1< 2 Foot % Occurrence | Total 2< 3 Foot Max Resid. Depth | Total 2< 3 Foot % Occurrence | Total 3< 4 Foot Max Resid. Depth | Total 3< 4 Foot % Occurrence | Total >= 4 Foot Max Resid. Depth | Total >= 4 Foot % Occurrence |
|---|---|---|---|---|---|---|---|---|---|---|
| 168 | 1 | 1 | 8 | 5 | 55 | 33 | 47 | 28 | 57 | 34 |

Mean Maximum Residual Pool Depth (ft.): 3.8

## Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Big Sulphur Creek LLID: 1230102388180 Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000 Dry Units: 2

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

| Habitat Units | Units Fully Measured | Habitat Type | Mean % Undercut Banks | Mean % SWD | Mean % LWD | Mean % Root Mass | Mean % Terr. Vegetation | Mean % Aquatic Vegetation | Mean % White Water | Mean % Boulders | Mean % Bedrock Ledges |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 104 | 7 | LGR | 0 | 9 | 0 | 0 | 0 | 35 | 0 | 56 | 0 |
| 17 | 1 | HGR | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 85 | 0 |
| 27 | 3 | CAS | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 93 | 0 |
| 4 | 0 | BRS | | | | | | | | | |
| 152 | 11 | TOTAL RIFFLE | 0 | 7 | 0 | 0 | 0 | 22 | 2 | 69 | 0 |
| 80 | 6 | GLD | 0 | 3 | 0 | 0 | 13 | 17 | 0 | 68 | 0 |
| 77 | 7 | RUN | 0 | 3 | 0 | 0 | 0 | 11 | 0 | 86 | 0 |
| 97 | 6 | SRN | 0 | 2 | 0 | 0 | 8 | 23 | 0 | 48 | 2 |
| 254 | 19 | TOTAL FLAT | 0 | 3 | 0 | 0 | 7 | 17 | 0 | 68 | 1 |
| 100 | 72 | MCP | 2 | 2 | 2 | 4 | 4 | 6 | 2 | 66 | 9 |
| 1 | 0 | CCP | | | | | | | | | |
| 5 | 5 | STP | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 82 | 18 |
| 7 | 7 | LSR | 2 | 6 | 10 | 44 | 0 | 0 | 1 | 35 | 1 |
| 14 | 12 | LSBk | 0 | 1 | 1 | 0 | 0 | 3 | 0 | 18 | 73 |
| 47 | 44 | LSBo | 2 | 3 | 0 | 1 | 4 | 4 | 1 | 79 | 4 |
| 2 | 2 | PLP | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 70 | 20 |
| 4 | 0 | SCP | | | | | | | | | |
| 1 | 1 | DPL | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| 181 | 143 | TOTAL POOL | 1 | 2 | 2 | 4 | 3 | 4 | 2 | 65 | 14 |
| 2 | 0 | CUL | | | | | | | | | |
| 2 | 0 | NS | | | | | | | | | |
| 593 | 173 | TOTAL | 1 | 2 | 1 | 4 | 3 | 7 | 1 | 66 | 11 |

## Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Big Sulphur Creek LLID: 1230102388180 Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000 Dry Units: 2

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

| Habitat Units | Units Fully Measured | Habitat Type | % Total Silt/Clay Dominant | % Total Sand Dominant | % Total Gravel Dominant | % Total Small Cobble Dominant | % Total Large Cobble Dominant | % Total Boulder Dominant | % Total Bedrock Dominant |
|---|---|---|---|---|---|---|---|---|---|
| 104 | 20 | LGR | 0 | 0 | 15 | 25 | 35 | 20 | 5 |
| 17 | 2 | HGR | 0 | 0 | 0 | 0 | 50 | 50 | 0 |
| 27 | 8 | CAS | 0 | 0 | 0 | 0 | 0 | 50 | 50 |
| 4 | 3 | BRS | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| 80 | 16 | GLD | 13 | 19 | 63 | 6 | 0 | 0 | 0 |
| 77 | 15 | RUN | 7 | 7 | 0 | 20 | 40 | 20 | 7 |
| 97 | 6 | SRN | 0 | 0 | 0 | 33 | 17 | 50 | 0 |
| 100 | 15 | MCP | 0 | 47 | 20 | 7 | 0 | 7 | 20 |
| 1 | 1 | CCP | 0 | 100 | 0 | 0 | 0 | 0 | 0 |
| 5 | 1 | STP | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| 7 | 3 | LSR | 0 | 33 | 33 | 0 | 0 | 33 | 0 |
| 14 | 3 | LSBk | 33 | 67 | 0 | 0 | 0 | 0 | 0 |
| 47 | 9 | LSBo | 0 | 44 | 22 | 0 | 0 | 11 | 22 |
| 2 | 1 | PLP | 0 | 0 | 0 | 0 | 0 | 100 | 0 |
| 4 | 2 | SCP | 0 | 50 | 50 | 0 | 0 | 0 | 0 |
| 1 | 1 | DPL | 0 | 0 | 0 | 0 | 0 | 100 | 0 |

## Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Big Sulphur Creek

LLID: 1230102388180 Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

| Mean Percent Canopy | Mean Percent Conifer | Mean Percent Hardwood | Mean Percent Open Units | Mean Right Bank % Cover | Mean Left Bank % Cover |
|---|---|---|---|---|---|
| 32 | 70 | 30 | 13 | 32 | 27 |

Note: Mean percent conifer and hardwood for the entire reach are means of canopy components from units with canopy values greater than zero.

Open units represent habitat units with zero canopy cover.

## Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Big Sulphur Creek

LLID: 1230102388180

Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

### Mean Percentage of Dominant Stream Bank Substrate

| Dominant Class of Substrate | Number of Units Right Bank | Number of Units Left Bank | Total Mean Percent (%) |
|---|---|---|---|
| Bedrock | 34 | 30 | 31.4 |
| Boulder | 36 | 35 | 34.8 |
| Cobble / Gravel | 26 | 32 | 28.4 |
| Sand / Silt / Clay | 6 | 5 | 5.4 |

### Mean Percentage of Dominant Stream Bank Vegetation

| Dominant Class of Vegetation | Number of Units Right Bank | Number of Units Left Bank | Total Mean Percent (%) |
|---|---|---|---|
| Grass | 19 | 22 | 20.1 |
| Brush | 8 | 10 | 8.8 |
| Hardwood Trees | 23 | 21 | 21.6 |
| Coniferous Trees | 45 | 40 | 41.7 |
| No Vegetation | 7 | 8 | 7.4 |

### Total Stream Cobble Embeddedness Values: 3

## Table 10 - Mean Percent of Shelter Cover Types For Entire Stream

StreamName: Big Sulphur Creek LLID: 1230102388180 Drainage: Russian River - Middle

Survey Dates: 8/15/2000 to 11/15/2000

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

| | Riffles | Flatwater | Pools |
|---|---|---|---|
| UNDERCUT BANKS (%) | 0 | 0 | 1 |
| SMALL WOODY DEBRIS (%) | 7 | 3 | 2 |
| LARGE WOODY DEBRIS (%) | 0 | 0 | 2 |
| ROOT MASS (%) | 0 | 0 | 4 |
| TERRESTRIAL VEGETATION (%) | 0 | 7 | 3 |
| AQUATIC VEGETATION (%) | 22 | 17 | 4 |
| WHITEWATER (%) | 2 | 0 | 2 |
| BOULDERS (%) | 69 | 68 | 65 |
| BEDROCK LEDGES (%) | 0 | 1 | 14 |

## Appendix C- Fish Habitat Inventory Data Summary

Stream Name: Big Sulphur Creek LLID: 1230102388180 Drainage: Russian River -
Survey Dates: 8/15/2000 to 11/15/2000 Survey Length (ft.): 111869 Main Channel (ft.): 109066 Side Channel (ft.): 2803
Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:49:05.0N Longitude: 123:00:37.0W

## Summary of Fish Habitat Elements By Stream Reach

**STREAM REACH: 1**

Channel Type: F4
Reach Length (ft.): 5907
Riffle/Flatwater Mean Width (ft.): 32.4
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 65 - 80 Air (F): 65 - 92
Dry Channel (ft.): 90

Canopy Density (%): 15.8
Coniferous Component (%): 80.0
Hardwood Component (%): 20.0
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover (%): 35.3
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 0.3
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 19.7
Pool Frequency (%): 23.8
Residual Pool Depth (%):
< 2 Feet Deep: 30.0
2 to 2.9 Feet Deep: 40.0
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 30.0
Mean Max Residual Pool Depth (ft.): 3.04
Mean Pool Shelter Rating: 12

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 10.0 Gravel: 50.0 Sm Cobble: 10.0 Lg Cobble: 30.0 Boulder: 0.0 Bedrock: 0.0
Embeddedness Values (%): 1. 40.0 2. 40.0 3. 0.0 4. 0.0 5. 20.0

**STREAM REACH: 2**

Channel Type: F2
Reach Length (ft.): 16593
Riffle/Flatwater Mean Width (ft.): 27.3
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 60 - 74 Air (F): 60 - 99
Dry Channel (ft.): 0

Canopy Density (%): 4.5
Coniferous Component (%): 84.7
Hardwood Component (%): 15.3
Dominant Bank Vegetation: Grass
Vegetative Cover (%): 9.0
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Boulder
Occurrence of LWD (%): 0.4
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 9.9
Pool Frequency (%): 27.6
Residual Pool Depth (%):
< 2 Feet Deep: 0.0
2 to 2.9 Feet Deep: 25.0
3 to 3.9 Feet Deep: 18.8
>= 4 Feet Deep: 56.3
Mean Max Residual Pool Depth (ft.): 4.73
Mean Pool Shelter Rating: 13

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 12.5 Gravel: 37.5 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 43.8 Bedrock: 6.3
Embeddedness Values (%): 1. 18.8 2. 18.8 3. 0.0 4. 0.0 5. 62.5

## Summary of Fish Habitat Elements By Stream Reach

**STREAM REACH: 3**

Channel Type: F3
Reach Length (ft.): 24497
Riffle/Flatwater Mean Width (ft.): 21.5
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 62 - 70 Air (F): 60 - 94
Dry Channel (ft.): 0

Canopy Density (%): 10.0
Coniferous Component (%): 75.2
Hardwood Component (%): 24.8
Dominant Bank Vegetation: Grass
Vegetative Cover (%): 16.7
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 4.6
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 12.7
Pool Frequency (%): 29.6
Residual Pool Depth (%):
< 2 Feet Deep: 0.0
2 to 2.9 Feet Deep: 8.3
3 to 3.9 Feet Deep: 33.3
>= 4 Feet Deep: 58.3
Mean Max Residual Pool Depth (ft.): 4.75
Mean Pool Shelter Rating: 7

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 16.7 Gravel: 66.7 Sm Cobble: 8.3 Lg Cobble: 4.2 Boulder: 4.2 Bedrock: 0.0
Embeddedness Values (%): 1. 25.0 2. 37.5 3. 16.7 4. 0.0 5. 20.8

**STREAM REACH: 4**

Channel Type: F2
Reach Length (ft.): 3970
Riffle/Flatwater Mean Width (ft.): 22.5
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 69 - 70 Air (F): 90 - 98
Dry Channel (ft.): 0

Canopy Density (%): 7.5
Coniferous Component (%): 83.3
Hardwood Component (%): 16.7
Dominant Bank Vegetation: Grass
Vegetative Cover (%): 8.5
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Boulder
Occurrence of LWD (%): 1.7
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 4.9
Pool Frequency (%): 25.0
Residual Pool Depth (%):
< 2 Feet Deep: 0.0
2 to 2.9 Feet Deep: 100.0
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 2.4
Mean Pool Shelter Rating: 12

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 33.3 Gravel: 33.3 Sm Cobble: 0.0 Lg Cobble: 33.3 Boulder: 0.0 Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 33.3 3. 0.0 4. 0.0 5. 66.7

## Summary of Fish Habitat Elements By Stream Reach

**STREAM REACH: 5**

Channel Type: F3
Reach Length (ft.): 15045
Riffle/Flatwater Mean Width (ft.): 13.9
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 68 - 76 Air (F): 80 - 98
Dry Channel (ft.): 0

Canopy Density (%): 32.5
Coniferous Component (%): 62.4
Hardwood Component (%): 37.6
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover (%): 28.0
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Bedrock
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 10.2
Pool Frequency (%): 24.6
Residual Pool Depth (%):
< 2 Feet Deep: 6.3
2 to 2.9 Feet Deep: 25.0
3 to 3.9 Feet Deep: 12.5
>= 4 Feet Deep: 56.3
Mean Max Residual Pool Depth (ft.): 4.03
Mean Pool Shelter Rating: 8

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 12.5 Gravel: 18.8 Sm Cobble: 31.3 Lg Cobble: 25.0 Boulder: 6.3 Bedrock: 6.3
Embeddedness Values (%): 1. 0.0 2. 31.3 3. 18.8 4. 6.3 5. 43.8

**STREAM REACH: 6**

Channel Type: F2
Reach Length (ft.): 17670
Riffle/Flatwater Mean Width (ft.): 12.3
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 54 - 70 Air (F): 54 - 84
Dry Channel (ft.): 0

Canopy Density (%): 29.0
Coniferous Component (%): 63.6
Hardwood Component (%): 36.4
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover (%): 22.9
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Boulder
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 16.5
Pool Frequency (%): 31.9
Residual Pool Depth (%):
< 2 Feet Deep: 9.4
2 to 2.9 Feet Deep: 50.0
3 to 3.9 Feet Deep: 18.8
>= 4 Feet Deep: 21.9
Mean Max Residual Pool Depth (ft.): 3.33
Mean Pool Shelter Rating: 10

Pool Tail Substrate (%): Silt/Clay: 3.1 Sand: 0.0 Gravel: 21.9 Sm Cobble: 18.8 Lg Cobble: 9.4 Boulder: 34.4 Bedrock: 12.5
Embeddedness Values (%): 1. 3.1 2. 21.9 3. 18.8 4. 0.0 5. 56.3

## Summary of Fish Habitat Elements By Stream Reach

**STREAM REACH: 7**

Channel Type: A2
Reach Length (ft.): 1271
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 54 - 58 Air (F): 58 - 58
Dry Channel (ft.): 0

Canopy Density (%): 55.0
Coniferous Component (%): 80.0
Hardwood Component (%): 20.0
Dominant Bank Vegetation: Grass
Vegetative Cover (%): 15.0
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Bedrock
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 20.9
Pool Frequency (%): 28.6
Residual Pool Depth (%):
< 2 Feet Deep: 0.0
2 to 2.9 Feet Deep: 0.0
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 100.0
Mean Max Residual Pool Depth (ft.): 6.65
Mean Pool Shelter Rating: 10

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 0.0 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 100. Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 0.0 3. 0.0 4. 0.0 5. 100.0

**STREAM REACH: 8**

Channel Type: B2
Reach Length (ft.): 1596
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 58 - 64 Air (F): 58 - 62
Dry Channel (ft.): 0

Canopy Density (%): 50.0
Coniferous Component (%): 71.0
Hardwood Component (%): 29.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 22.5
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Bedrock
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 19.2
Pool Frequency (%): 50.0
Residual Pool Depth (%):
< 2 Feet Deep: 0.0
2 to 2.9 Feet Deep: 0.0
3 to 3.9 Feet Deep: 40.0
>= 4 Feet Deep: 60.0
Mean Max Residual Pool Depth (ft.): 4.24
Mean Pool Shelter Rating: 20

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 80.0 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 20.0 Bedrock: 0.0
Embeddedness Values (%): 1. 40.0 2. 40.0 3. 0.0 4. 0.0 5. 20.0

**STREAM REACH: 9**

Channel Type: A2
Reach Length (ft.): 1554
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 64 - 69 Air (F): 62 - 62
Dry Channel (ft.): 0

Canopy Density (%): 40.0
Coniferous Component (%): 60.0
Hardwood Component (%): 40.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 22.5
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Bedrock
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 13.1
Pool Frequency (%): 37.5
Residual Pool Depth (%):
< 2 Feet Deep: 0.0
2 to 2.9 Feet Deep: 0.0
3 to 3.9 Feet Deep: 33.3
>= 4 Feet Deep: 66.7
Mean Max Residual Pool Depth (ft.): 4.46
Mean Pool Shelter Rating: 23

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 0.0 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 100. Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 0.0 3. 0.0 4. 0.0 5. 100.0

**STREAM REACH: 10**

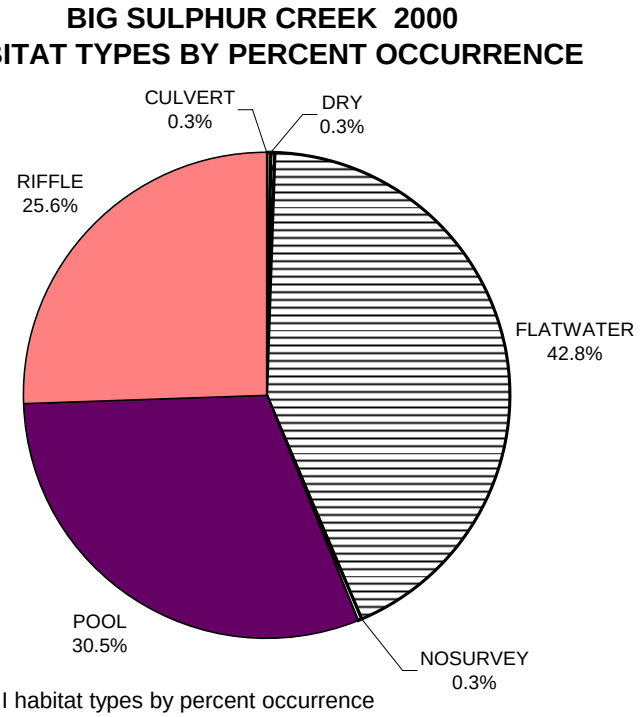
Channel Type: B2
Reach Length (ft.): 20963
Riffle/Flatwater Mean Width (ft.): 16.9
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 2.03
Water (F): 44 - 69 Air (F): 39 - 64
Dry Channel (ft.): 0

Canopy Density (%): 58.9
Coniferous Component (%): 69.9
Hardwood Component (%): 30.1
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 58.2
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Boulder
Occurrence of LWD (%): 0.6
LWD per 100 ft.:
Riffles:
Pools:
Flat:

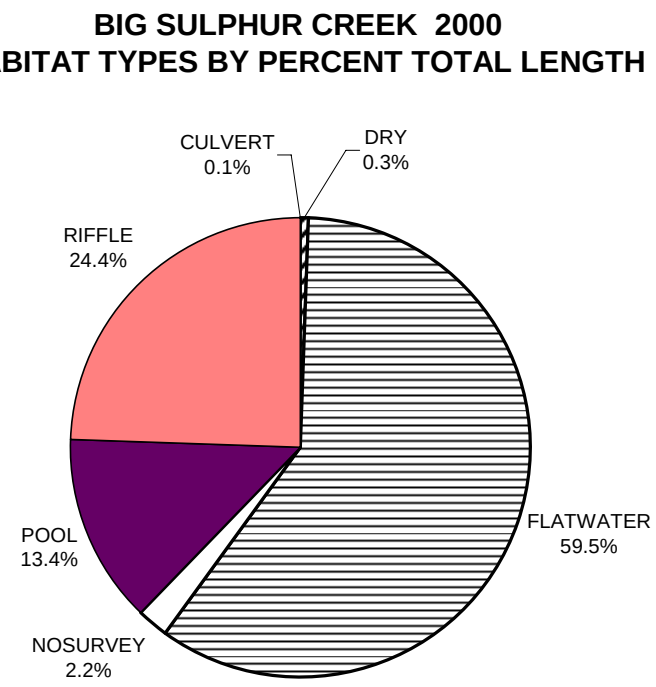
Pools by Stream Length (%): 14.4
Pool Frequency (%): 32.7
Residual Pool Depth (%):
< 2 Feet Deep: 1.9
2 to 2.9 Feet Deep: 38.9
3 to 3.9 Feet Deep: 44.4
>= 4 Feet Deep: 14.8
Mean Max Residual Pool Depth (ft.): 3.35
Mean Pool Shelter Rating: 22

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 16.7 Sm Cobble: 14.8 Lg Cobble: 7.4 Boulder: 50.0 Bedrock: 11.1
Embeddedness Values (%): 1. 11.1 2. 22.2 3. 3.7 4. 0.0 5. 63.0

# APPENDIX D: GRAPHS

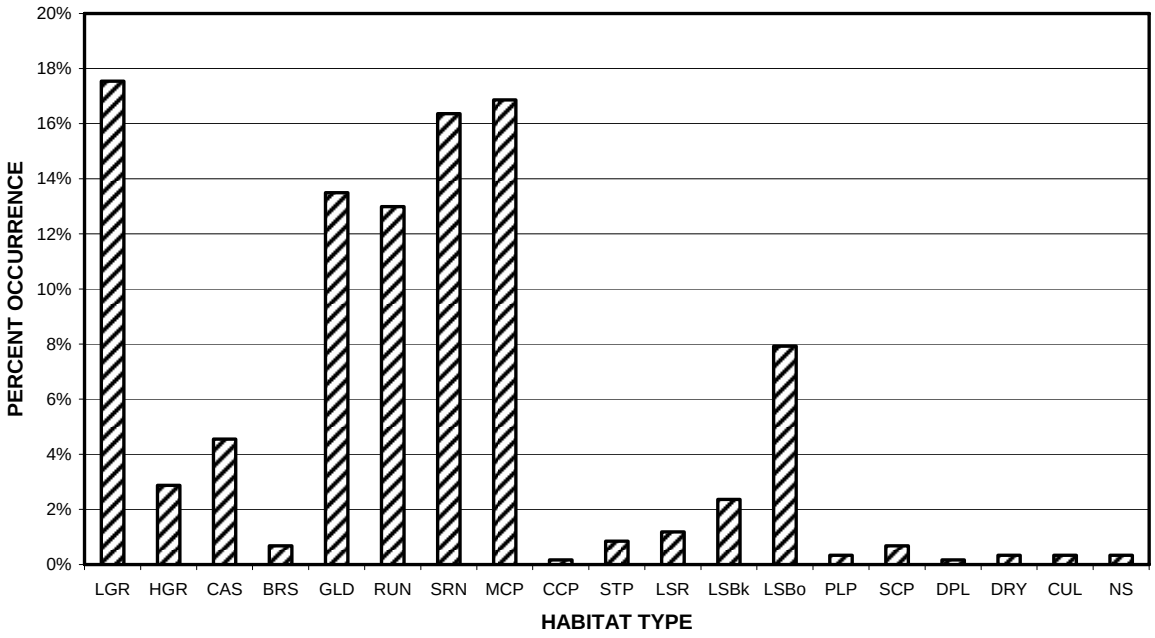



GRAPH 1: Level II habitat types by percent occurrence



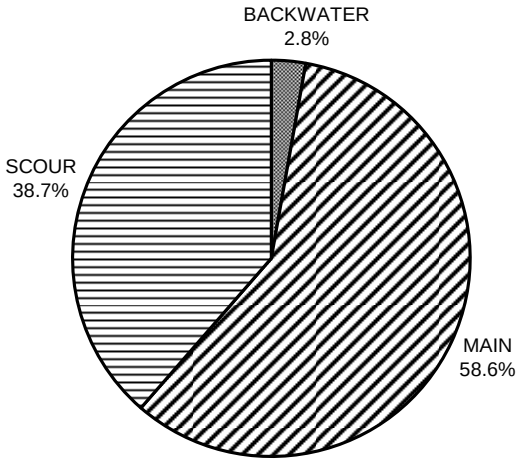

GRAPH 2: Level II habitat types by percent total length

## BIG SULPHUR CREEK 2000
## HABITAT TYPES BY PERCENT OCCURRENCE




GRAPH 3: Level IV habitat types by percent occurrence

## BIG SULPHUR CREEK 2000
## POOL TYPES BY PERCENT OCCURRENCE

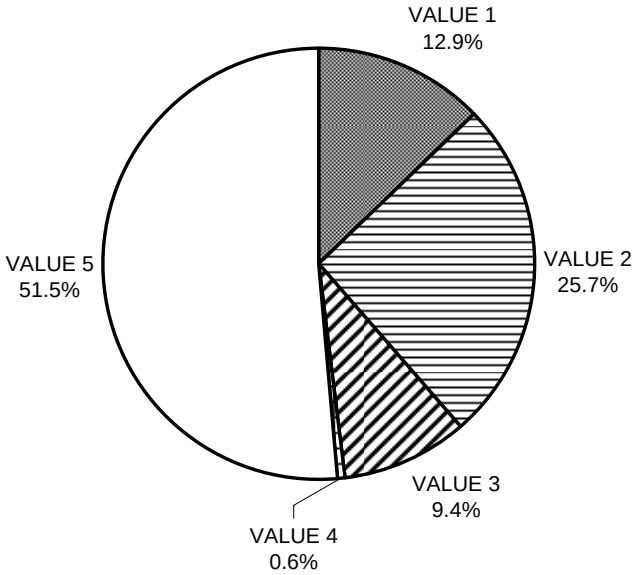



GRAPH 4: Level I pool types by percent occurrence

## BIG SULPHUR CREEK 2000
## MAXIMUM DEPTH IN POOLS

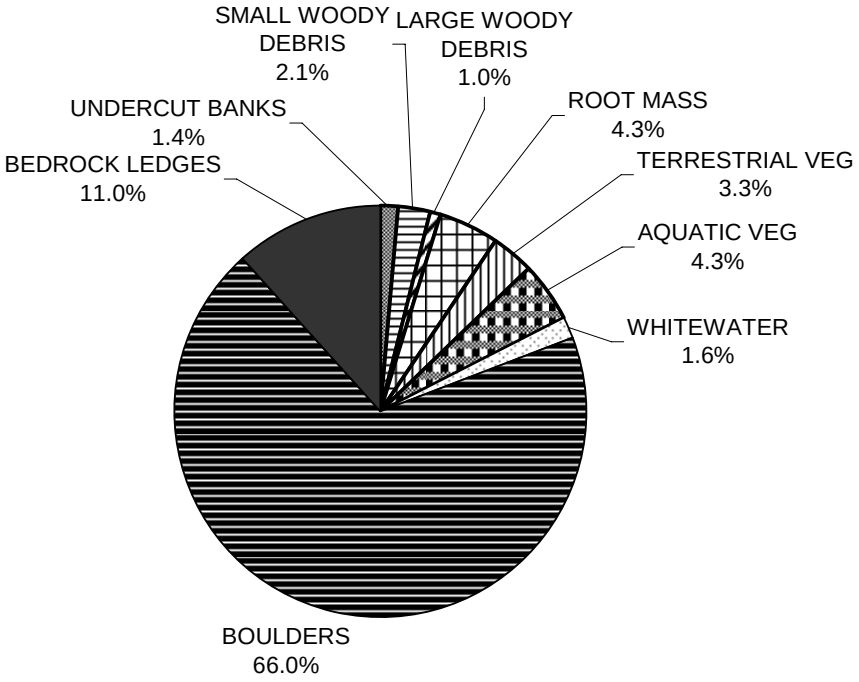

GRAPH 5

## BIG SULPHUR CREEK 2000
## PERCENT EMBEDDEDNESS



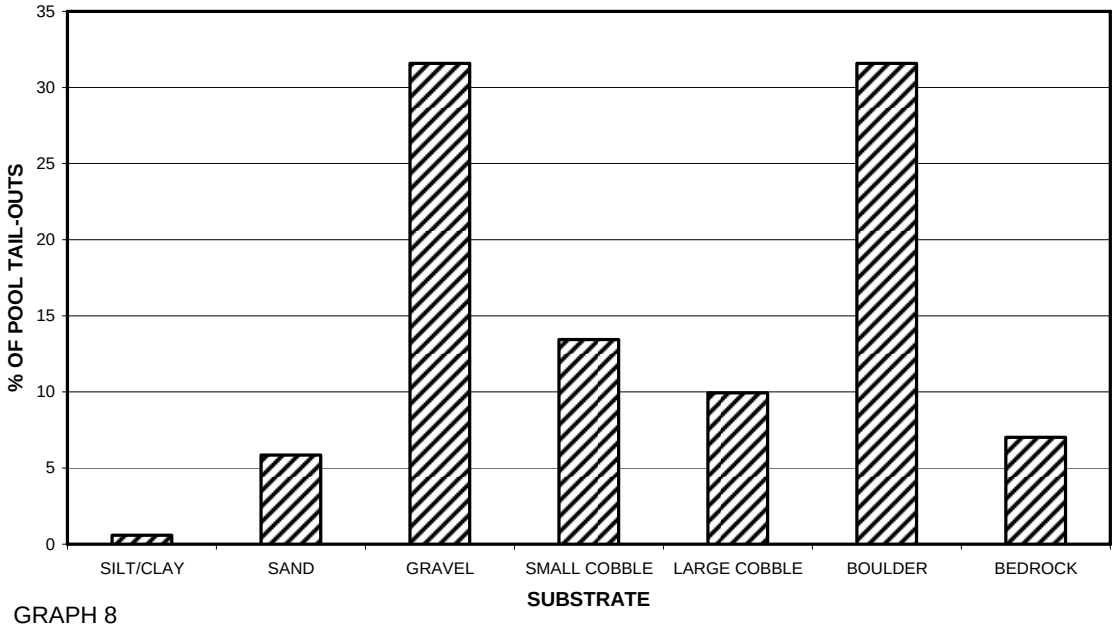

GRAPH 6

## BIG SULPHUR CREEK 2000
## MEAN PERCENT COVER TYPES IN POOLS



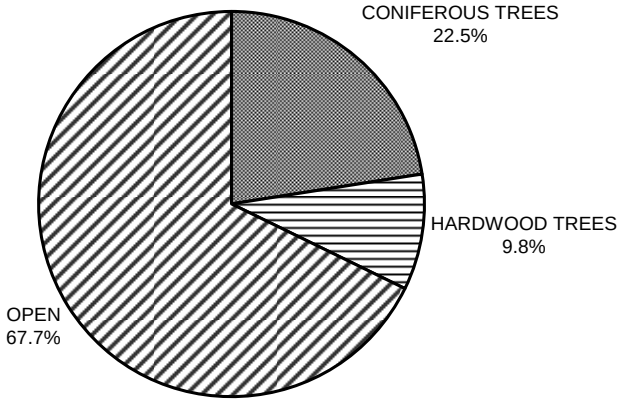

GRAPH 7

## BIG SULPHUR CREEK 2000
## SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



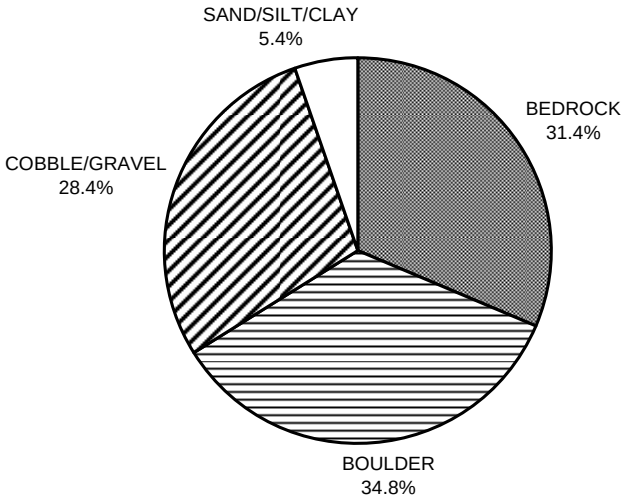

GRAPH 8

**BIG SULPHUR CREEK 2000**
**MEAN PERCENT CANOPY**



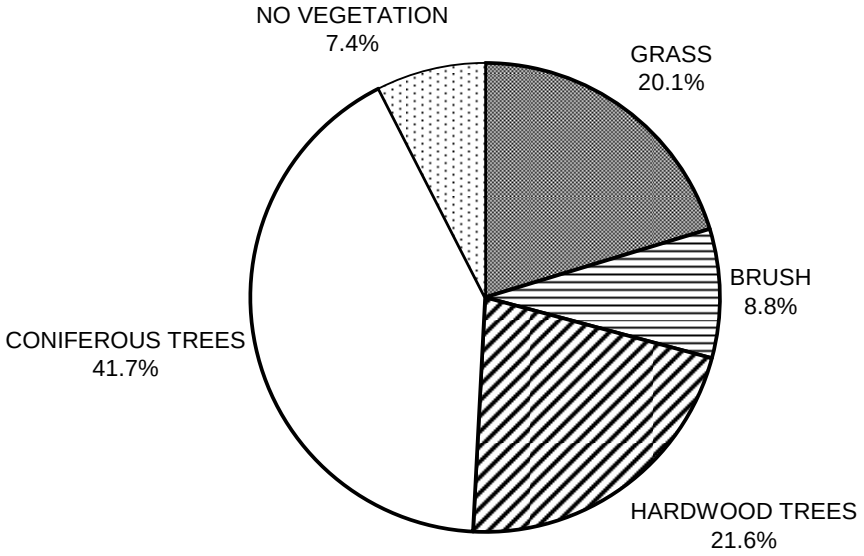

GRAPH 9

**BIG SULPHUR CREEK 2000**
**DOMINANT BANK COMPOSITION IN SURVEY REACH**



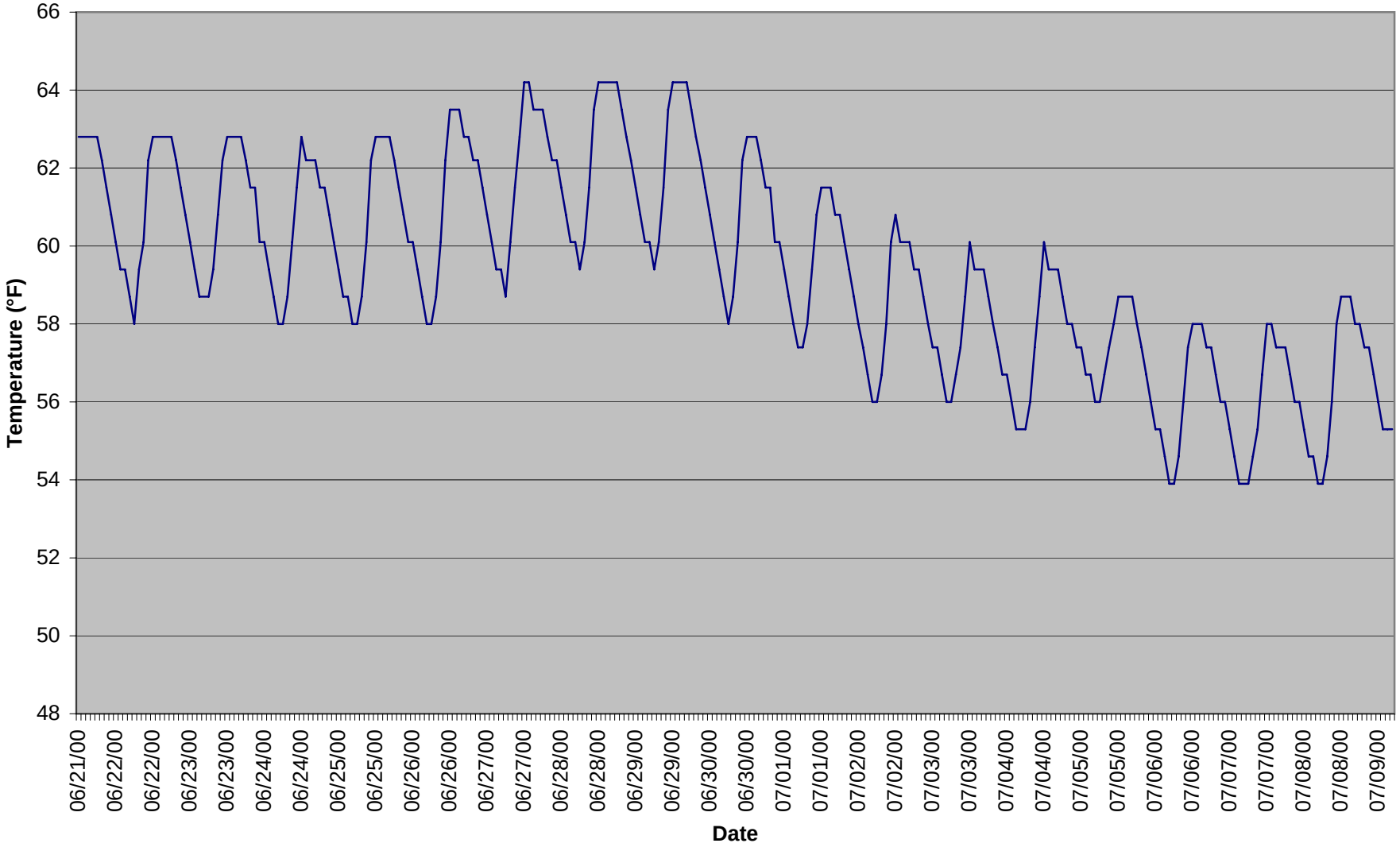

GRAPH 10

## BIG SULPHUR CREEK 2000
## DOMINANT BANK VEGETATION IN SURVEY REACH

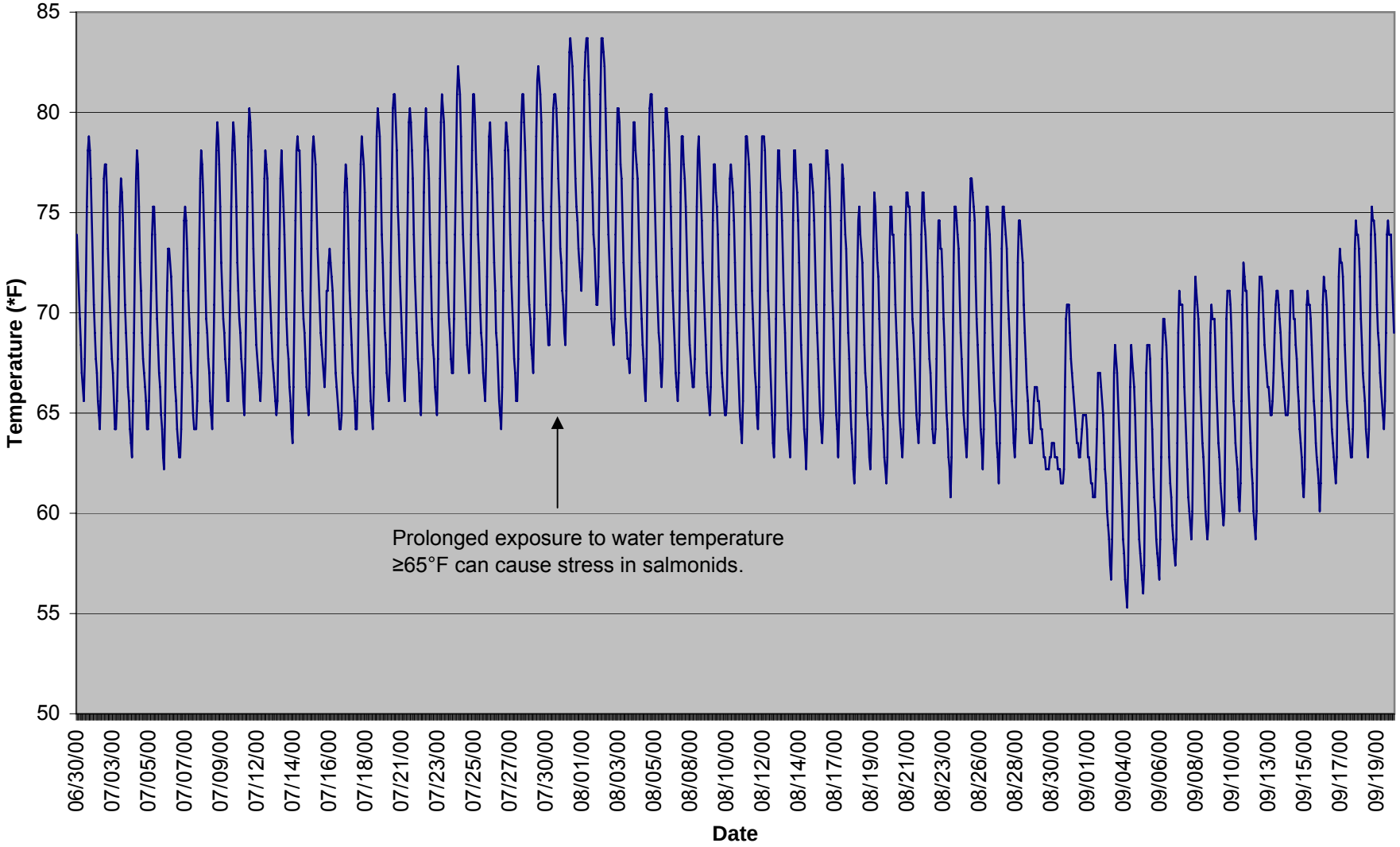



GRAPH 11

## Big Sulphur Creek (Upper Reach)



## Big Sulphur (Middle Reach)



**Watershed Hydroid** **405** Big Sulphur Creek

**Hydrologic Sub-Areas covered by the watershed:**

| Name: | LLId: (1:24k) | County: | Tributary to | Russian River |
|---|---|---|---|---|
| Big Sulphur Creek | 1230102388180 | Mendocino/Sonom | Tributary to | |
| | | | Tributary to | |

**Location:** **T:** 11N **R:** 10W **S:** 7 **Latitude:** 38.8180697994395 **Longitude** 123.010240395495

Hydrologic Boundary Delineation: Watershed boundaries were delineated using the Watershed Point tool in ArcHydro, running under ArcMap 8.3 (ArcInfo version). A 1:24k stream network was "burned" into the underlying DEM to enforce hydrologic routing.

Aerial Photos (Source): For Mendocino County watersheds, 1993 USGS DOQQs are available in the Teale Albers, NAD27 projection. For Sonoma County watersheds, 2000 County-created orthophotos in the State Plane, NAD83 projection are also available.

**Stream Order:** 5 **Total Length:** 22.34 Miles 35.97 Km

Note: Stream order is by Strahler method, recorded in CDF-NCWAP "nchydro1" 1:24k streams layer.

Note: Length is for the USGS blue-line 1:24,000 stream.

**Drainage Area:** 22127 Hectares; 54678 Acres; 85.43 sq. mi.

**Elevations:** Mouth: 299 feet; Headwaters: 4498 feet

Note: Headwaters elevation is the highest elevation found in the watershed.

**Lakes in Watershed:** Number: 0 Surface area: 0 sq. mi.

Note: Source for lakes data is the USGS-DFG 1:100k lakes layer "lakes.shp"

**Fish Species (as indicated by historical salmonid streams layer created by Bob Coey):** Steelhead

**Ownership, for the watershed, in acres (and % of total watershed):**

| Federal: | State: | Local: | Private: |
|---|---|---|---|
| 3611.3 acres | 0.0 | 0.0 | 51066.3 |
| 6.60 % | 0.00 % | 0.00 % | 93.40 % |

Note: Source for owneship data is 2002 DFG-CCR "ccr_public_lands.shp" GIS layer.

**Major Land Uses in the Watershed, in acres (and % of total watershed)**

| Mixed hardwood/conifer: | Hardwood: | Conifer: | Agriculture: | Urban: |
|---|---|---|---|---|
| 4288.80 acres | 22519.23 | 1892.66 | 250.81 | 154.59 |
| 7.8 % | 41.2 % | 3.5 % | 0.5 % | 0.3 % |

| Shrub: | Herbaceous: | Barren/rock: | Water: |
|---|---|---|---|
| 17034.91 | 7835.37 | 595.98 | 43.08 |
| 31.2 % | 14.3 % | 1.1 % | 0.1 % |

Note: Land use areas were calculated using the 1994 CDF-USFS "Calveg" GIS layer.

**USGS 7.5' Topographic Quads completely or partially in the watershed:**

| Quad Name | USGS Code |
|---|---|
| MOUNT ST. HELENA | 38122F6 |
| JIMTOWN | 38122F7 |
| WHISPERING PINES | 38122G6 |
| THE GEYSERS | 38122G7 |
| ASTI | 38122G8 |
| CLOVERDALE | 38123G1 |

**Endangered/Threatened/Sensitive Species: (California Natural Diversity Database, May 5, 2003 version )**

| Scientific Name | Common Name |
|---|---|
| Eriogonum nervulosum | Snow Mountain buckwheat |
| Ceanothus confusus | Rincon Ridge ceanothus |
| Streptanthus brachiatus ssp. brachiatus | Socrates Mine jewel-flower |
| Rana boylii | foothill yellow-legged frog |
| Layia septentrionalis | Colusa layia |
| Streptanthus brachiatus ssp. brachiatus | Socrates Mine jewel-flower |
| Arctostaphylos manzanita ssp. elegans | Konocti manzanita |
| Arctostaphylos manzanita ssp. elegans | Konocti manzanita |
| Ceanothus divergens | Calistoga ceanothus |
| Rana boylii | foothill yellow-legged frog |
| Dichanthelium lanuginosum var. thermal | Geysers dichanthelium |
| Emys (=Clemmys) marmorata marmorat | northwestern pond turtle |
| Streptanthus brachiatus ssp. hoffmanii | Freed's jewel-flower |
| Streptanthus brachiatus ssp. brachiatus | Socrates Mine jewel-flower |
| Streptanthus brachiatus ssp. hoffmanii | Freed's jewel-flower |
| Eriogonum nervulosum | Snow Mountain buckwheat |
| Oncorhynchus mykiss irideus | steelhead-central California coast esu |
| Eriogonum nervulosum | Snow Mountain buckwheat |
| Arctostaphylos canescens ssp. sonomen | Sonoma manzanita |
| Rana boylii | foothill yellow-legged frog |
| Rana boylii | foothill yellow-legged frog |
| Dichanthelium lanuginosum var. thermal | Geysers dichanthelium |
| Streptanthus brachiatus ssp. brachiatus | Socrates Mine jewel-flower |
| Dichanthelium lanuginosum var. thermal | Geysers dichanthelium |
| Dichanthelium lanuginosum var. thermal | Geysers dichanthelium |
| Streptanthus brachiatus ssp. brachiatus | Socrates Mine jewel-flower |
| Streptanthus morrisonii | see individual subspecies! |
| Lupinus sericatus | Cobb Mountain lupine |

| | |
|---|---|
| Rana boylii | foothill yellow-legged frog |
| Emys (=Clemmys) marmorata marmorat | northwestern pond turtle |
| Dichanthelium lanuginosum var. thermal | Geysers dichanthelium |
| Streptanthus brachiatus ssp. hoffmanii | Freed's jewel-flower |
| Dichanthelium lanuginosum var. thermal | Geysers dichanthelium |
| Dichanthelium lanuginosum var. thermal | Geysers dichanthelium |
| Streptanthus brachiatus ssp. brachiatus | Socrates Mine jewel-flower |
| Streptanthus brachiatus ssp. brachiatus | Socrates Mine jewel-flower |
| Progne subis | purple martin |
| Rana boylii | foothill yellow-legged frog |
| Dichanthelium lanuginosum var. thermal | Geysers dichanthelium |
| Lupinus sericatus | Cobb Mountain lupine |

**Hydrologic Sub-Areas covered by the watershed**

| Hydrologic Sub-Area Name: | ID code (RBUAS) | Hydrologic Area Name | % of watershed in this HSA |
|---|---|---|---|
| Upper Putah Creek | 551230 | Upper Putah Creek | 0.01 |
| Ukiah | 111431 | Upper Russian River | 0.01 |
| Sulphur Creek | 111426 | Middle Russian River | 96.06 |
| Lakeport | 551355 | Upper Cache Creek | 0.01 |
| Geyserville | 111425 | Middle Russian River | 3.91 |