CENTRAL NAPA RIVER WATERSHED PROJECT

SALMONID HABITAT FORM AND FUNCTION

October, 2005

FINAL REPORT

Prepared By

Napa County Resource Conservation District

For

California Department of Fish and Game

Contract # P9985160

SB271 Funded

CENTRAL NAPA RIVER WATERSHED PLAN

SALMONID HABITAT FORM AND FUNCTION

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This project was funded with a grant awarded to the Napa County RCD through SB271 salmonid restoration funds administered by the California Department of Fish & Game (Contract # P9985160).

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ACKNOWLEDGEMENTS

The RCD would like to thank all the landowners that made this work possible by granting access to their properties. The ongoing support and knowledge from community members greatly improved the quality of this project.

We would also like to thank the following individuals and agencies for assisting with data collection and field surveys: Daniel Chase, George Henke, Jeff Wickens, and Matt Kelly. We are grateful for the assistance we received from the following agencies, groups, and individuals: *The Rutherford Dust Society*, Davie Pina, Ellie Insley and Associates, San Francisco Bay Regional Water Quality Control Board, Mike Napolitano, Friends of the Napa River, Napa County Flood Control and Water Conservation District, Todd Adams, the City of St. Helena, the County of Napa Conservation, Development, and Planning Department, Jeff Sharp, and Joe Wheaton.

EXECUTIVE SUMMARY

The Napa County RCD received funding from the California Department of Fish and Game in 2002 to carry out the second phase of a three-phase watershed study covering the entire Napa River basin. The geographic scope of this project covered the Napa River basin from Bell Creek to Soda Creek. This study was intended to assess the quality and quantity of available aquatic habitat, specifically relating to salmonid life history requirements, and identify key areas for restoration, improvement, or preservation.

Extensive field surveys were conducted in the mainstem Napa River and the following nine tributaries: Bale Slough, Bell Creek, Canon Creek (tributary to Bell Creek), Conn Creek, Montgomery Creek (tributary to Dry Creek), Rector Creek, Soda Creek, Wing Canyon Creek (tributary to Dry Creek), and York Creek. Sufficient landowner access was not granted for Bear Creek, Campbell Creek, or Segassia Creek. In the ten streams with sufficient landowner access, we conducted habitat surveys, snorkel fish counts, gravel permeability, water quality monitoring, continuous temperature monitoring, stream flow monitoring. Salmon surveys were conducted in the mainstem Napa River in 2004.

Habitat survey results showed an overall lack of suitable summer rearing habitat for juvenile salmonids, due primarily to lack of perennial stream flow and poor water quality conditions during critical warm months. Continuous temperature monitoring results documented multiple sites with excessively warm summer water temperatures, especially in the mainstem Napa River. Tributaries with sufficient flow, canopy densities, and groundwater influence (York, Segassia, Canon, Soda) maintained favorably cool water temperatures during the hot summer period. Several reaches with high quality salmonid habitat were identified in the following tributaries: York Creek, Wing Canyon Creek, and relatively short stretches of Bell Creek and Soda Creek.

The Napa River offers minimal spawning and rearing habitat for steelhead as indicated by the low abundances of juveniles observed in the mainstem. However, the river does appear to provide spawning habitat for Chinook salmon. In 2003 and 2004, significant numbers of Chinook salmon were observed spawning in the mainstem and several of the larger tributaries. In 2004, we conducted spawner surveys, redd surveys, and carcass counts along the river. Results of these efforts documented over 100 live spawning Chinook salmon and 62 redds in a 3.6 mile reach of the Napa River near Rutherford. Coded wire tag analysis from one hatchery marked carcass was recovered and determined to be a 2002 Spring-run Chinook from the Feather River hatchery. Given the relative scarcity of available data on Chinook salmon in the basin, it is not clear what percentage of the observed run was of hatchery origin or wild Napa River stock.

A total of 135 potential restoration opportunities have been identified, mapped, and ranked according to their relative importance and cost. These restoration sites include 67 sites with exotic vegetation, 47 bank erosion areas, five migration barriers, eight riparian canopy sites, four sites with elevated water temperatures, and one potential site for immediate woody debris placement. Within the surveyed reaches, stream bank erosion was most prevalent followed by lack of riparian canopy, presence of migration barriers, and lack of rearing habitat. Restoration priorities for each of the ten surveyed streams are available from the Napa County RCD as separate documents, and are subject to landowner confidentiality agreements.

1 INTRODUCTION

In 2002, the Napa County Resource Conservation District (RCD) was awarded a Salmonid Habitat Restoration (SB 271) grant from the California Department of Fish & Game (DFG) to fund a study of the central region of the Napa River watershed. This study was the second step in the process of creating a watershed plan encompassing the entire Napa River watershed. The northern portion of the watershed was addressed in the *Northern Napa River Watershed Project* completed by the RCD and submitted to the DFG in 2002.

The goal of this study was to develop a comprehensive fisheries assessment of the central portion of the Napa River and its tributaries. The project provides both general and site-specific recommendations for restorative actions benefiting salmonids, with emphasis on steelhead trout (*Oncorhynchus mykiss*) and Chinook salmon (*Oncorhynchus tshawytscha*). Recommendations are focused on creating or restoring geomorphic and ecological functions and processes that support salmonids and improve aquatic and adjacent riparian habitat.

1.1 BACKGROUND

The Napa Valley supports a diverse community of plants, fish, and wildlife within a mosaic of landuses comprised largely of agriculture, rural residential development, and urban development (Figure 1-2). Over the past century, the Napa River watershed has experienced rapid and widespread change. Foremost of which has been vineyard development with wine grape growing becoming the primary landuse within the valley. The majority of vineyards have been planted along the Napa River and all of its 48 major tributaries, which has had both direct and indirect effects on the aquatic and riparian ecosystems. Additionally, urban and rural residential expansion has brought roads and other changes into previously undisturbed areas of the watershed.

The Napa River watershed covers an area of approximately 426 square miles, and is contained on three sides by mountains to the north, west, and east. The watershed is typical of the California coastal range with northwest-southeast trending topography. The Napa River runs through the center of the watershed on the valley floor. It drains 48 major tributaries and numerous smaller ephemeral streams on its 55 mile path from the headwaters of Mt. St. Helena in the Mayacamas Mountain range to the San Pablo Bay. Along this route the river winds through varied landscapes of forested mountain slopes, vineyards, urban areas, open pasture, industrial zones, grasslands, marshes, and brackish estuary.

1.2 FISH COMMUNITY

The Napa River basin is known to contain 27 species of freshwater fish, 14 of which are native and 13 are exotic species that have been intentionally or accidentally introduced (Stillwater Sciences, 2002; Moyle, 2002). The basin historically likely supported three salmonid species: chinook salmon, steelhead, and coho salmon; coho salmon are considered extirpated within the basin. Chinook salmon have been sporadically reported in the Napa River since the 1980’s; however no data on run size, timing, or origin have been collected (Pers. comm. J. Emig, 2000). In 2003 and 2004, significant numbers of fall-run chinook salmon were documented in the Napa River and several tributaries. In 2004, the spawning period began immediately following the first storm outflow in early November, peaked in early December, and was over by the end of December.

Regardless of origin, it is possible that a self sustaining population of Chinook salmon is developing in the Napa River. Similar runs have been established in other tributaries to the San Francisco Bay including the Guadalupe River and Coyote Creek (Moyle 2002). This scenario is further bolstered by the fact that a relatively long section of the river is owned by concerned landowners that have formed a voluntary stewardship group: *The Rutherford Dust Society*. Initial funding has been secured to plan and implement broad-based restoration to create favorable salmonid and native riparian habitat along 4.5 contiguous miles of the river between the Oakville Crossroad and Zinfandel Lane.

Common Name	Scientific Name	Origin	Ecological Guild	Family Name
American shad	*Alosa sapidissima*	Exotic	Cold – Exotic	Clupeidae
Yellowfin goby	*Acanthogobius flavimanus*	Exotic	Estuarine – Exotic	Gobiidae
Striped bass	*Morone saxatilis*	Exotic		Percichthyidae
Goldfish	*Carassius auratus*	Exotic	Warm – Exotic	Cyprinidae
Common carp	*Cyprinus carpio*	Exotic		Cyprinidae
Mosquitofish	*Gambusia affinis*	Exotic		Poeciliidae
White catfish	*Ameiurus catus*	Exotic		Ictaluridae
Channel catfish	*Ictalurus punctatus*	Exotic		Ictaluridae
Green sunfish	*Lepomis cyanellus*	Exotic		Centrarchidae
Bluegill	*Lepomis macrochirus*	Exotic		Centrarchidae
Inland silverside	*Menidia beryllina*	Exotic		Atherinidae
Smallmouth bass	*Micropterus dolomieui*	Exotic		Centrarchidae
Largemouth bass	*Micropterus salmoides*	Exotic		Centrarchidae
Steelhead/rainbow trout	*Oncorhynchus mykiss*	Native	Cold – Native	Salmonidae
Chinook salmon	*Oncorhynchus tshawytscha*	Native		Salmonidae
Sacramento sucker	*Catostomus occidentalis*	Native		Catostomidae
Prickly sculpin	*Cottus asper*	Native		Cottidae
Riffle sculpin	*Cottus gulosus*	Native		Cottidae
Pacific lamprey	*Lampetra tridentata*	Native		Petromyzontidae
Hardhead	*Mylopharodon conocephalus*	Native		Cyprinidae
Sacramento pikeminnow	*Ptychocheilus grandis*	Native		Cyprinidae
Threespine stickleback	*Gasterosteus aculeatus*	Native	Warm – Native	Gasterosteidae
California roach	*Hesperoleucus symmetricus*	Native		Cyprinidae
Tule perch	*Hysterocarpus traski*	Native		Embiotocidae
Sacramento splittail	*Pogonichthys macrolepidotus*	Native		Cyprinidae
White sturgeon	*Acipenser transmontanus*	Native	Estuarine – Native	Acipenseridae
Pacific staghorn sculpin	*Leptocottus armatus*	Native		Cottidae

Table 1-1. Freshwater fish species of the Napa River basin. (Source: Stillwater Sciences, 2002; Napa County RCD)

In terms of population size and geographic distribution, steelhead are the most significant salmonid species within the watershed. Napa River steelhead populations have been greatly reduced from historical levels. It is estimated that the Napa River watershed supported a population of approximately 8,000 adult steelhead as recently as 100 years ago. The current steelhead population is unknown due to a lack of quantitative data. Recent basin wide surveys estimate the population to be between 200 to 1,000 adult fish (Stillwater Sciences, 2002; EcoTrust, 2001). NOAA Fisheries listed steelhead as a threatened species in Napa County in August

1997. Spawning adult steelhead are still documented each year by landowners and agencies, and most tributaries to the Napa River appear to be well seeded with juveniles (Ecotrust, 2001). Despite reduced populations, the Napa River watershed is considered one of the most significant anadromous fish streams within San Francisco Bay (Leidy et al., 2005).

1.3 PROJECT DESCRIPTION

This study was intended to assess the quality and quantity of available aquatic habitat, specifically targeting salmonid life history requirements, and identify key areas for restoration, improvement, or preservation. The geographic scope of this project covers the Napa River basin from Bell Creek to Soda Creek, an area of approximately 172 square miles. Extensive field surveys were conducted in the mainstem Napa River and the following nine tributaries: Bale Slough, Bell Creek, Canon Creek, Conn Creek, Montgomery Creek, Rector Creek, Soda Creek, Wing Canyon Creek, and York Creek. Sufficient landowner access was not granted for Bear Creek, Campbell Creek, or Segassia Creek. All listed streams are known to either currently support salmonids or have historical accounts of salmonid presence (DFG; Leidy et al., 2005; Napa County RCD).

In ten streams, we conducted habitat surveys, fish counts (snorkel surveys), water quality monitoring, temperature monitoring, stream flow monitoring, and salmon surveys (Figure 1-1). Surveys were limited to reaches below major dams, which prevent anadromy. York Creek was surveyed above its instream dam, which is a complete migration barrier, because the dam is slated for removal in the next five years. Dry Creek and Sulphur Creek were omitted from this study due to previous watershed assessment work already completed for both watersheds. Reports for Dry Creek and Sulphur Creek are available from the RCD.

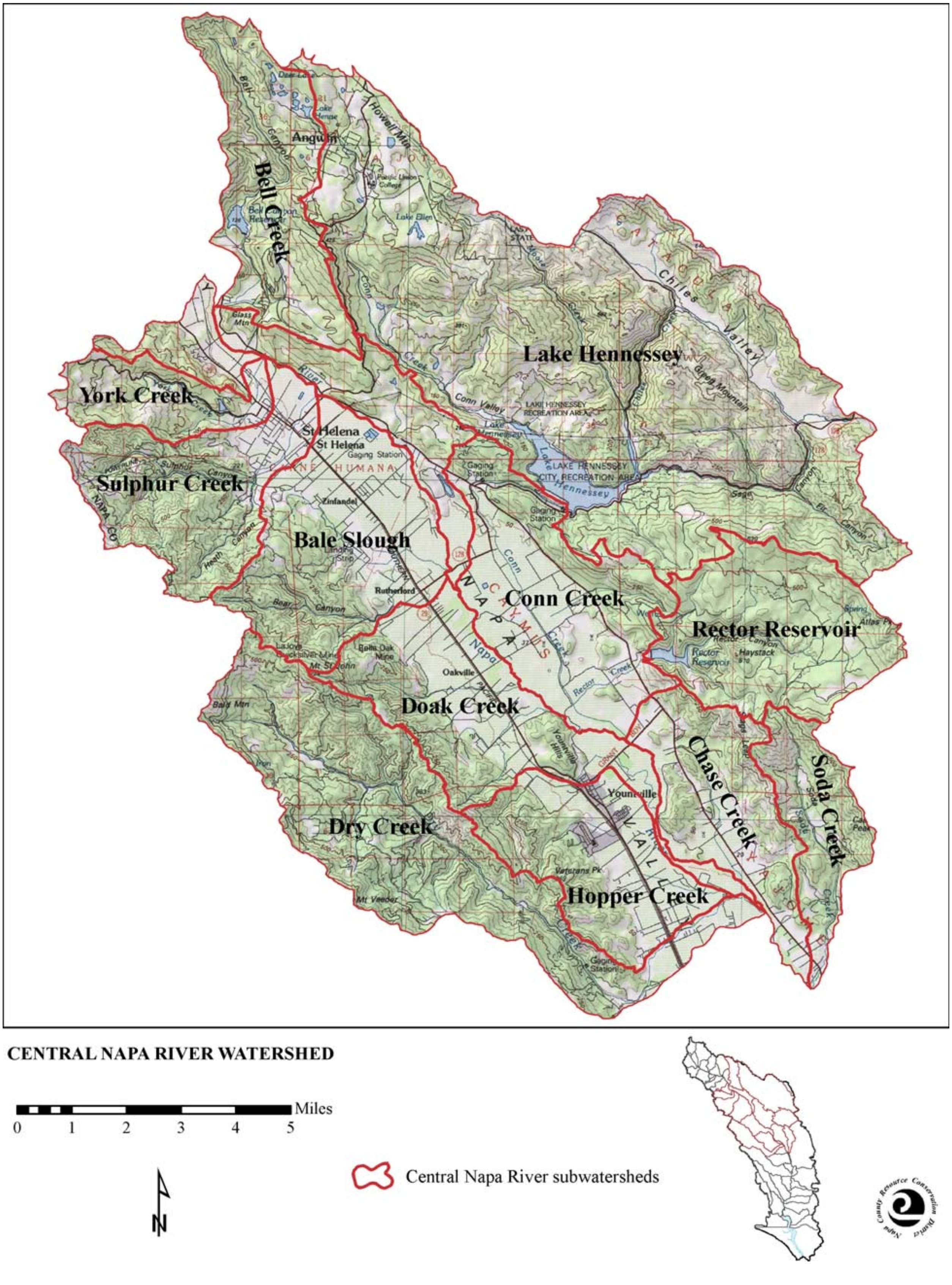


Figure 1-1. Geographic scope of the Central Napa River Watershed Project.

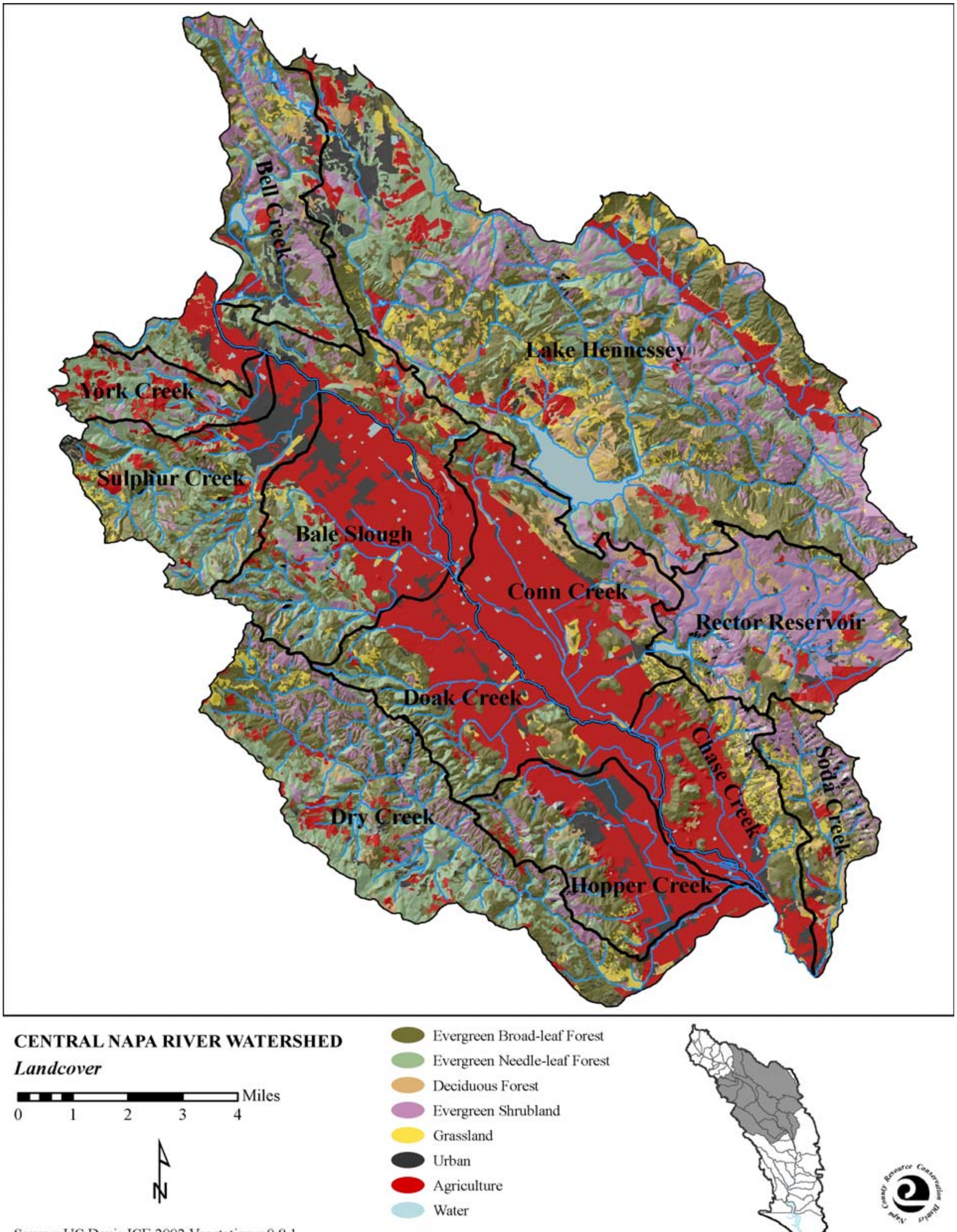


Figure 1-2. Landcover classifications within the project study area.

2 METHODS

This project includes several interlocking components designed to examine the primary life history requirements for adult and juvenile salmonids (Table 2-1).

Stream Name	Landowner Database	Habitat Survey	Snorkel Survey	Salmon Spawner Survey	Water Quality Monitoring	Water Temperature Monitoring	Gravel Permeability
Bale Slough	X	X	X		X	X	X
Bell Creek	X	X	X		X	X	X
Canon Creek	X	X	X		X	X	X
Conn Creek	X	X					X
Montgomery Creek	X	X					X
Napa River	X	X	X	X	X	X	X
Rector Creek	X	X	X		X	X	X
Segassia Creek	X				X		
Soda Creek	X	X			X	X	X
Wing Canyon Creek	X	X					X
York Creek	X	X	X		X	X	X

Table 2-1. Methods employed in central watershed streams to assess current conditions and identify significant areas for restoration and protection.

2.1 HABITAT TYPING

Habitat typing surveys were conducted in accordance with methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds, 1994). Two-person field crews conducted the inventories after being trained in standardized habitat inventory methods by experienced DFG and RCD staff.

The inventory uses a method that samples approximately 10% of the habitat units within the surveyed length. All habitat units included in the survey are classified according to habitat type and their lengths are measured. Habitat unit types encountered for the first time are further measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement. Since quantity and quality of pool habitat has been identified as a critical factor affecting salmonid populations in California streams, every third pool encountered was fully measured.

Detailed habitat typing methodology is described in Appendix C.

2.2 TEMPERATURE MONITORING

Water temperature within a stream, particularly during spring, summer, and early fall, has a major effect on the physical condition of salmonids. Seasonal fluctuations in water temperatures are caused by several synergistic factors including ambient air temperature, instream flow, groundwater influence, and riparian shading. Salmonids are coldwater species, exhibiting relatively low tolerance for elevated water temperatures. Exposure to elevated water temperatures may lead to reduced health and fitness, reduced growth rates, increased susceptibility to predation and disease, and depending on life-stage and duration of the exposure, may cause direct mortality.

Intermittent Northern California streams experience the highest temperatures during summer and early fall, particularly in isolated pools created by low base flow conditions. Elevated stream temperatures can affect steelhead more adversely than chinook salmon since steelhead spend at least one year rearing in freshwater while juvenile salmon typically migrate to the estuary during their first year. In general, during critical rearing months for steelhead (July-September), stream temperatures are not considered stressful to juvenile fish if average daily temperatures are 20° C (68° F) or less, with maximum hourly temperatures of approximately 23° C (73° F) or less. The optimal temperatures for growth of rainbow trout are between 15° - 18° C, a range that corresponds to temperatures selected in the field when possible (Moyle, 2002).

Steelhead are sensitive to elevated water temperature during all life stages, although adults have a higher thermal tolerance due in large part to their greater mass. Given adequate time to gradually acclimate, adult steelhead, and even larger parr, are capable of surviving temperatures as high as 26 - 27° C for short periods. It should be noted however, that the increased metabolic demand under such conditions has chronic effects on growth rates and vulnerability to disease. Even when acclimation temperatures are high, temperatures of 24 – 27°C are invariably lethal to trout, except for very short exposures (Moyle,2002). Steelhead and rainbow trout eggs are stenothermal, with highest survival rates between 5 – 10° C, but published data show considerable variation among strains. They can tolerate temperatures as low as 2° C or as high as 15° C but are subject to increased mortality. Time to hatching is inversely related to temperature, but as the temperature increases past the optimal range, there is reduction in alevin size (Myrick et. al, 2001).

To determine whether water temperatures in the Napa River and its tributaries are suitable for salmonids, continuous temperature monitoring was carried out at 10 sites using digital data loggers (*Optic Stowaway Temp*) manufactured by Onset Computer Corporation. Sites were selected in tributaries in potential steelhead rearing pools. Mainstem Napa River sites were selected based on flow persistence where salmon were likely to spawn or juvenile steelhead may occur. Thermographs were deployed as landowner access became available and were retrieved, downloaded, and re-deployed regularly. Thermographs were housed inside a short length of ABS plastic pipe to protect them from damage and direct sunlight. Each assembly was anchored to the streambed using a combination of cable and rebar. All thermographs were set to record water temperature at 30-minute intervals. Physical characteristics of each site were documented at the time of installation including depth, canopy, substrate, estimated flow, and vegetation. If a thermograph was found to be dry during a regular check, it was relocated to nearby reaches with sufficient water. Several thermographs in losing reaches experienced dry (out of water) conditions over the course of the study, and were permanently removed.

2.3 WATER QUALITY MONITORING

Water quality conditions affect all life stages of salmonids. In streams with severe seasonal surface flow reductions during summer and fall, water quality plays a critical role in the quality of summer rearing habitat for juvenile steelhead. As stream flows diminish in late spring and early summer, steelhead and other resident fish become trapped isolated pools for the duration of the summer. Under such conditions, water quality can quickly degrade without the flushing effects of continuous surface flow. Within the stream, intragravel flow of groundwater through the substrate is a vital source of new fresh water, but in the absence of agitation it contributes little or no dissolved oxygen.

Benthic macroinvertebrates are excellent indicators of water quality and ecological stream function over time. Samples taken from several locations along the stream will reflect environmental conditions within the aquatic ecosystem. Certain organisms are highly intolerant of pollutants including sediment, nutrients, and temperature. Taxonomic analysis of such samples yields information on the benthic community which relates to water quality in the stream. Essentially, the quality of the water, and often the surrounding landscape, can be determined based on what organisms are present within a given stream reach.

The objective of this study was to establish monitoring sites in suitable streams (Figure 2-1), and collect water quality data using field tests that could be conducted by volunteers. Parameters included dissolved oxygen (DO), electrical conductivity (EC), pH, water temperature, air temperature, and flow. Additional qualitative information on physical habitat was also collected including water color, odor, weather, stream bed appearance, water depth, and habitat change.

All water quality tests were carried out by RCD staff or trained volunteers using the RCD stream monitoring protocol (APPENDIX D). Site selection was limited by the presence of water. Samples were collected on an approximately monthly basis at all sites. Most sampling was done using a YSI-85 multi-meter and a hand held pH meter, which were calibrated prior to each sampling event. Volunteers were given field kits including LaMotte DO titration kits, pH paper, thermometers, and a hand-held conductivity meter. Flow was estimated and categorized as brisk, moderate, low, stagnant, or dry. Water depth at time of sampling was visually estimated.

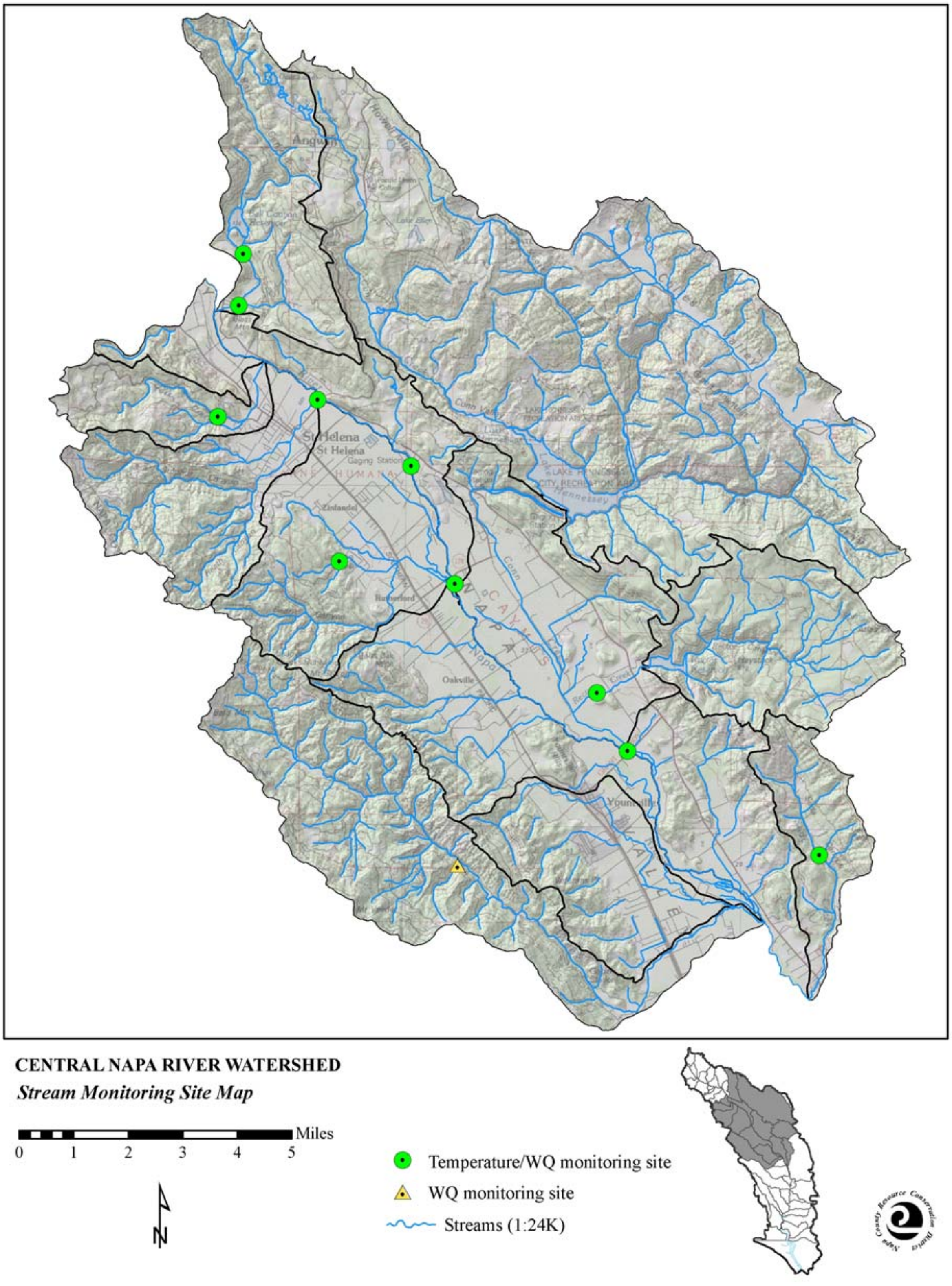


Figure 2-1. Stream monitoring sites established for each stream within the study area.

2.4 SNORKEL SURVEYS

Estimating juvenile salmonid abundance and distribution, both within a stream and at a watershed scale, provides important information on population trends and serves to focus restoration activities where they are most needed. Not all streams within a watershed provide equal habitat for salmonids. At the stream level, some reaches may be critically important while other areas are of lesser importance. Extensive steelhead snorkel surveys have been carried out by *The Friends of the Napa River* and *EcoTrust Environmental Inc.* in 2001 and 2002, which targeted tributaries to the Napa River.

To determine where critical reaches were located within the study area, snorkel surveys for juvenile salmonids were conducted in the Napa River and five tributaries. Surveys were conducted in summer 2004 by two-person crews using a modified Hankin-Reeves methodology. This method is consistent with previous snorkel survey efforts in the basin, providing a comparable follow-up dataset to past efforts.

The Hankin-Reeves methodology is based on classifying the streams into a number of habitat types and randomly sampling each of the habitat types. Three habitat classes were established: riffles, pools, and glides. Riffles are areas of deposition formed during high flows, pools are areas of stream scour during high flows, and glides are areas which are neither riffles nor pools. All habitat units must be longer than the stream is wide and all habitat units must be demarcated by a break. Defining units based on physical breaks minimizes the problem of fish moving out of the habitat unit being snorkeled. The length and width of every snorkeled habitat unit was measured using a field tape. We snorkeled one in five pools, one in 8 glides, and one in 10 riffles. The survey was conducted by moving upstream from the mouth or the first occurrence of permanent pools in the system. Surveys continued upstream until fish were no longer observed, the stream went completely dry, a barrier to spawning migration was reached, or landowner access ran out.

Steelhead were classified into three age categories based on size: young-of-the-year (less than three inches), 1+ (between three and six inches), and 2+ (greater than 6 inches). Data were entered into a computer spreadsheet to calculate steelhead densities for each snorkeled unit. The habitat units are then given a density ranking: not present, low (0-0.25 steelhead/m^2), moderate (0.25 – 0.5 steelhead/m^2), or high (0.5- 1 steelhead/m^2). Steelhead densities of surveyed reaches were determined by extrapolating the habitat unit data out to the reach scale.

2.5 SALMON SPAWNER SURVEYS

To better estimate the size and distribution of the Chinook salmon run in the Napa River basin, we conducted redd counts and carcass surveys along a 3.6 mile stretch of the mainstem Napa River. Biweekly surveys in November and December, 2004 were carried out to document Chinook salmon spawning and holding activities. Two person crews waded the Napa River to count carcasses and live fish, map redd locations and characteristics, and identify critical habitat areas. Surveys were conducted following California Department of Fish & Game protocols as described in the California Salmonid Stream Habitat Restoration Manual (Appendix A). Results of these surveys are discussed in detail in Section 3.7 of this report.

2.6 GRAVEL PERMEABILITY

Gravel permeability was measured at ten sites along the Napa River using methods developed by Stillwater Sciences during the Napa River Watershed Limiting Factors Analysis in 2002. Gravel permeability was also measured in nine tributaries: Bale Slough, Bell Creek, Canon Creek, Conn Creek, Montgomery Creek, Rector Creek, Soda Creek, Wing Canyon Creek, and York Creek. Permeability measurements were carried out by staff from Stillwater Sciences and the RCD. Further detail on the permeability measurement methodology is described in Appendix B.

To determine the quality of spawning gravels in the mainstem Napa River for Chinook salmon egg incubation and early rearing, substrate permeability was measured using a modified Mark IV standpipe (Terhune 1958, Barnard and McBain 1994). The recharge rate (the rate at which water moves through the substrate) derived from these measurements was converted to permeability using a rating table with a temperature and viscosity correction from Barnard and McBain (1994).

For consistency, we used the same analysis methods as those used in the Napa River Watershed Limiting Factors Analysis by Stillwater Sciences. The calculations are based on relationships between survival-to-emergence and permeability from two data sets (McCuddin 1977, Taggart 1976). We used the following simple linear regression on the combined data sets to estimate survival based on our permeability measurements:

$$\text{Survival} = 0.1488 * \ln(\text{Permeability}) - 0.8253$$

where permeability is in units of cm/hr and:

$$\text{Mortality Index} = (1 - \text{Survival})*100$$

At each site, the median particle size (D50) of each spawning patch sampled was estimated prior to permeability sampling. Water temperature, water depth, and the area of each spawning patch were measured, and the location of each spawning patch was recorded using a handheld GPS receiver. To further document the location and site conditions at each sampling location, digital photographs were taken and a sketch was made, which described notable features of the site.

2.7 FLOW MONITORING

Stream flow was monitored at all water quality sites with the same frequency as water quality sampling. Upon each visit, flow was visually assessed and ranked according to the following scale:

Level 3 = Briskly flowing
Level 2 = Moderately flowing
Level 1 = Slowly flowing
Level 0 = Stagnant flow with isolated pools present
Level -1 = Dry

If more than one visit was made to a monitoring site in a given month, the average flow value was calculated.

3 RESULTS AND DISCUSSION

Individual stream assessment results are presented in stream reports for each given study reach. The results of focused studies on gravel permeability, water temperature, salmonid distribution and spawning, stream flow, and water quality are discussed in the context of the central Napa River watershed in Section 3.2 – 3.7.

3.1 INSTREAM HABITAT

Detailed stream reports have been generated for the surveyed streams using *Stream Habitat V.2.0.3* developed by the DFG. These reports are a format consistent with previous habitat surveying efforts in Napa and with ongoing efforts throughout California. Data has been aggregated at the reach level when appropriate to maintain confidentiality. Digital data layers in Geographic Information System (GIS) format have been compiled for each survey and are available from the RCD. These GIS data contain a complete account of habitat typing and channel typing characteristics of the surveyed reaches.

All habitat typing results tables are listed in Appendix D

3.1.1 Bale Slough

A stream inventory of Bale Slough was conducted on 8/5/2004. The survey began at Whitehall Lane and extended upstream 0.3 miles to a point where the channel became too small to survey (<0.5 m wetted width) and surface flow was no longer present (Figure 3.1-1). This was the only reach of Bale Slough found to contain persistent pools; all other upstream and downstream reaches were dry by August. The Bale Slough inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Bale Slough. The biological component consisted of snorkel surveys for juvenile steelhead.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for Chinook salmon and steelhead. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

Bale Slough is a tributary to the Napa River, (Napa County, California) which is a tributary to the Pacific Ocean via the San Pablo Bay. Bale Slough's location at the confluence with Napa River is 38:27:52.0 north latitude and 122:24:45.0 west longitude, LLID number 1224124384645. Bale Slough is a third order stream and has approximately 8.51 miles of blue line stream according to the USGS Rutherford 7.5 minute quadrangle. Additionally, Bale Slough receives flow from a major tributary, Bear Canyon, which has approximately 11.68 miles of blue line stream. Landowner access was not granted for Bear Canyon. It is not known what amount of the total blue line stream in Bear Canyon is accessible to salmonids. Bale Slough drains a watershed of approximately 12.38 square miles including the Bear Canyon sub-drainage. Elevations range from about 130 feet at the mouth of the creek to 2,300 feet in the headwater areas. Mixed hardwood and conifer forest dominates the watershed. The watershed is almost entirely privately owned. Vehicle access exists via Whitehall Lane from State Highway 29.

HISTORICAL INFORMATION (Leidy et al., 2005)
In June 1981, DFG visually surveyed the lower one-mile of Bale Slough to locate stranded steelhead. The channel was dry and thus no fish were observed (Ambrosins 1981a).

Bear Canyon Creek is perennial and is tributary to Bale Slough. In October 1958, DFG visually surveyed the lower 4.5 miles of Bear Canyon Creek. Approximately 1.5 miles upstream of the confluence with Bale Slough, a 25-foot concrete dam at the Inglenook Winery was identified as a barrier to upstream migration. *Oncorhynchus mykiss* averaging 75 mm in length were fairly common in the 0.5-mile section of the creek with water in it downstream of the Inglenook Dam. Also, O. mykiss from 75–150 mm were common throughout the three miles surveyed upstream of the dam (Elwell 1958h). The survey noted that this stream was one of the better spawning reaches in the Napa River drainage (Elwell 1958h).

In May 1966, DFG surveyed Bear Canyon Creek downstream of the Inglenook dam. Steelhead juveniles at an estimated density of 15 per 30 meters were found in the 0.5-mile perennial reach directly downstream of the dam (CDFG 1966).

In September 1975, DFG surveyed the lower 3.3 miles of Bear Canyon Creek and the tributaries in this reach. *Oncorhynchus mykiss* were observed throughout the surveyed reach, but were most abundant upstream of the Inglenook Dam. *Oncorhynchus mykiss* ranged in size from 25–255 mm TL and averaged 75–100 mm (Henry and Van Zandt 1975). Density was estimated at 35 fish per 30 meters throughout the surveyed section.

In regards to an application to divert water from Bear Valley Creek in 1995, DFG stated that Bear Valley Creek supported a run of steelhead trout (Turner 1995). Minimum in-stream flows were required as a condition of approval of the proposed diversion. The application was later withdrawn.

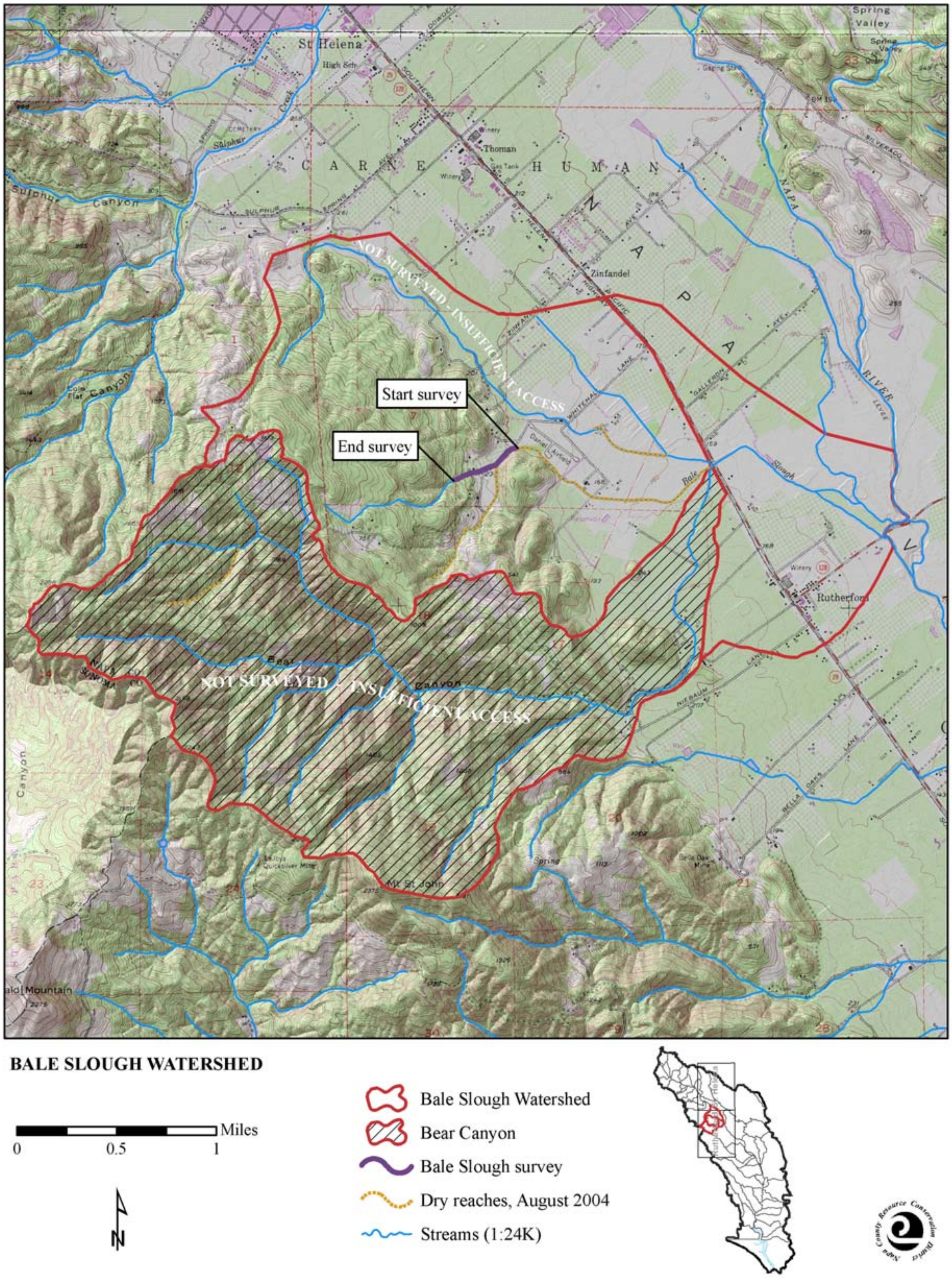


Figure 3.1-1. Watershed map of the Bale Slough drainage; dry reaches were not habitat typed including all reaches downstream of highway 29. The survey extended to the end of surface flow, where the channel was very small and heavily overgrown with riparian vegetation. Bear Canyon Creek was not surveyed due to insufficient landowner access.

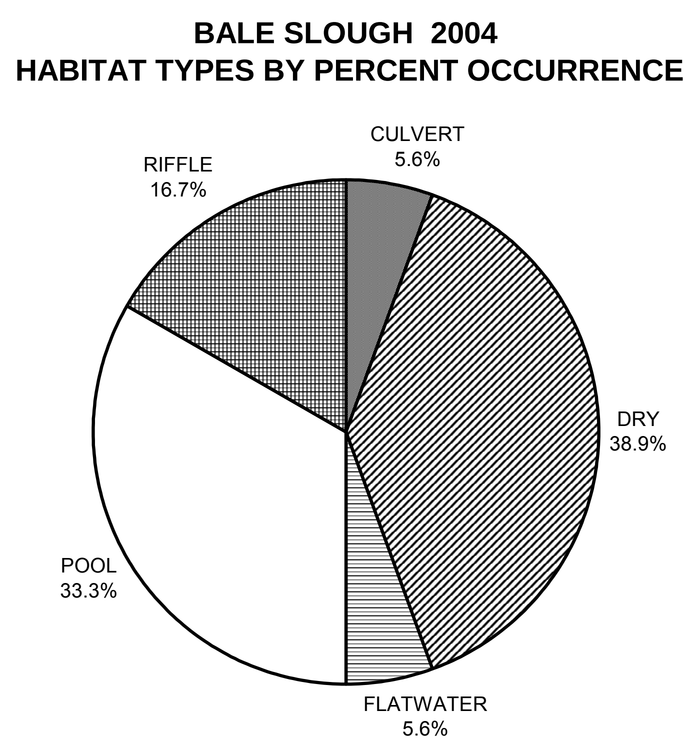
HABITAT INVENTORY RESULTS

The habitat inventory of 8/5/2004 to 8/5/2004 was conducted by C. Edwards, and D. Chase. The total length of the stream surveyed was 1,792 feet. Stream flow was not measured on Bale Slough due to very low flow conditions. The entire length of Bale Slough from the confluence to the bridge at Whitehall lane was completely dry with scattered, shallow pools unsuitable for salmonid rearing.

Bale Slough is a B4 channel type in the surveyed reach: 1,792 feet (Reach 1). In general, B4 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and gravel dominant substrates.

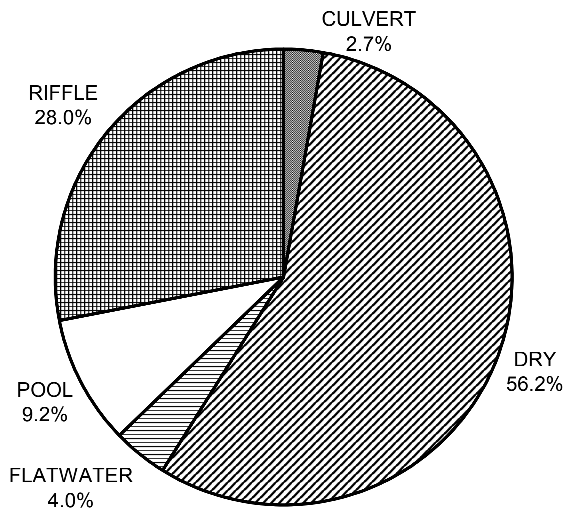
Water temperatures taken during the survey period ranged from 60° to 62° F, and air temperatures ranged from 70° to 78° F. Continuous temperature monitoring was conducted at one location on Bale Slough and the results are discussed in Section 3.6 of this report.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 39% dry units, 33% pool units, 6% flatwater units, 17% riffle units, and 6% culvert units (Graph 1). Based on total length of Level II habitat types there were 56% dry units, 9% pool units, 4% flatwater units, 28% riffle units, and 3% culvert units (Graph 2).



GRAPH 1

BALE SLOUGH 2004
HABITAT TYPES BY PERCENT TOTAL LENGTH

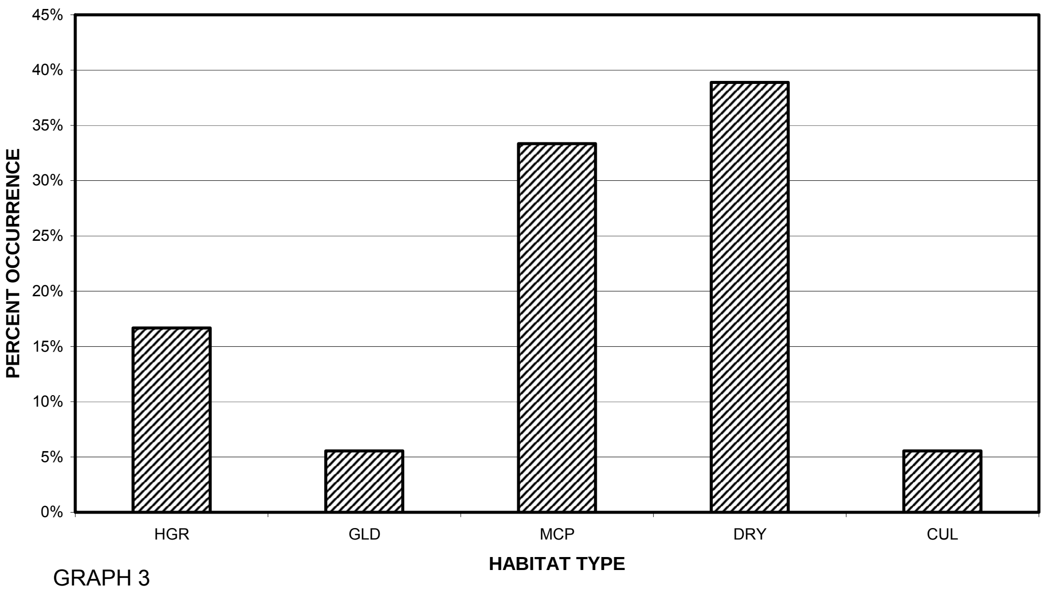


GRAPH 2

In total, four Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were; 39% Dry units, 33% Mid-Channel Pool units, and 17% High Gradient Riffle units (Graph 3). Based on percent total length, the most frequent habitat types found were; 56% Dry units, 9% Mid-Channel Pool units, and 28% High Gradient Riffle units.

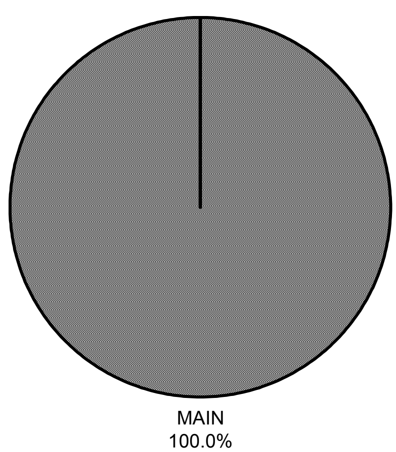
A total of 12 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 100%, and comprised 100% of the total length of all pools (Graph 4). Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. None of the 5 pools had a residual depth of two feet or greater (Graph 5).

BALE SLOUGH 2004
HABITAT TYPES BY PERCENT OCCURRENCE

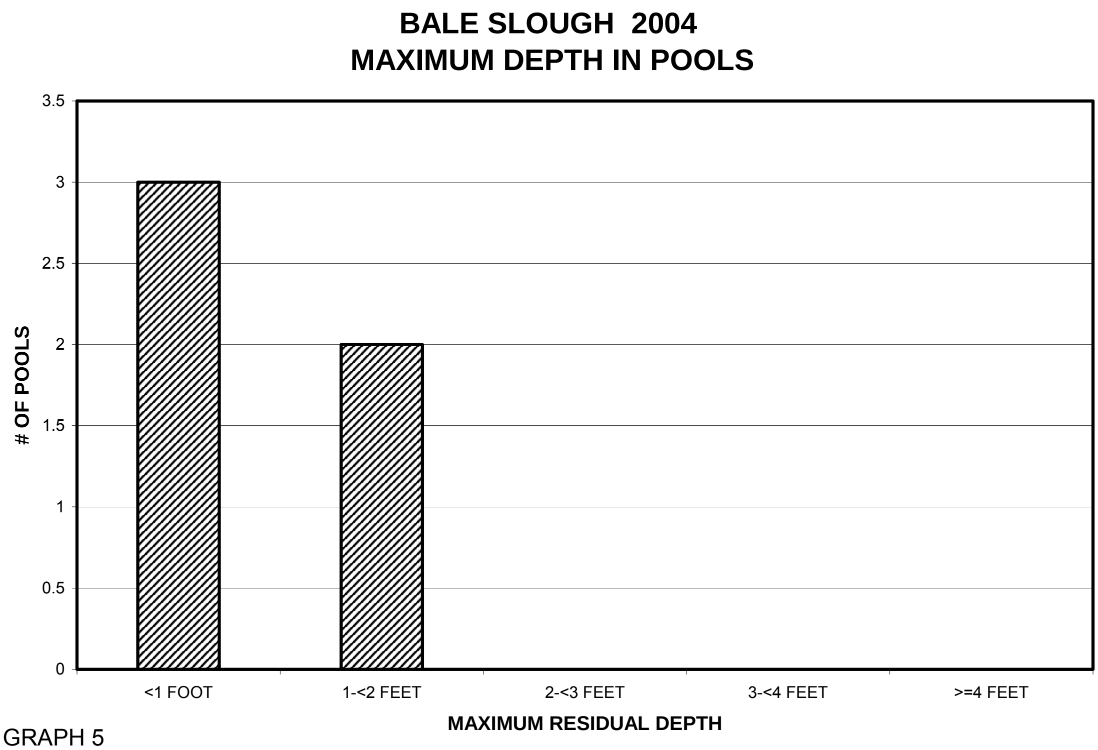


GRAPH 3

BALE SLOUGH 2004
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4



GRAPH 5

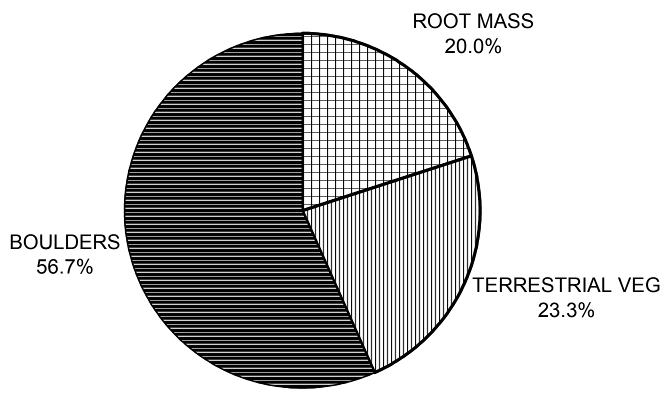
A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Water is scarce in riffle habitats during summer and fall months, and water is usually found only in isolated pools in Bale Slough. Flatwater habitat types had a mean shelter rating of 35, and pool habitats had a mean shelter rating of 35 also (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 35 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Bale Slough, as they provide necessary refuge in pools for the fish in this watershed. Terrestrial vegetation was also found to provide some cover in pools as well (Graph 7 describes pool cover in Bale Slough).

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs, in which gravel was observed in 60% of pool tail-outs, and small cobble observed in 40% of pool tail-outs.

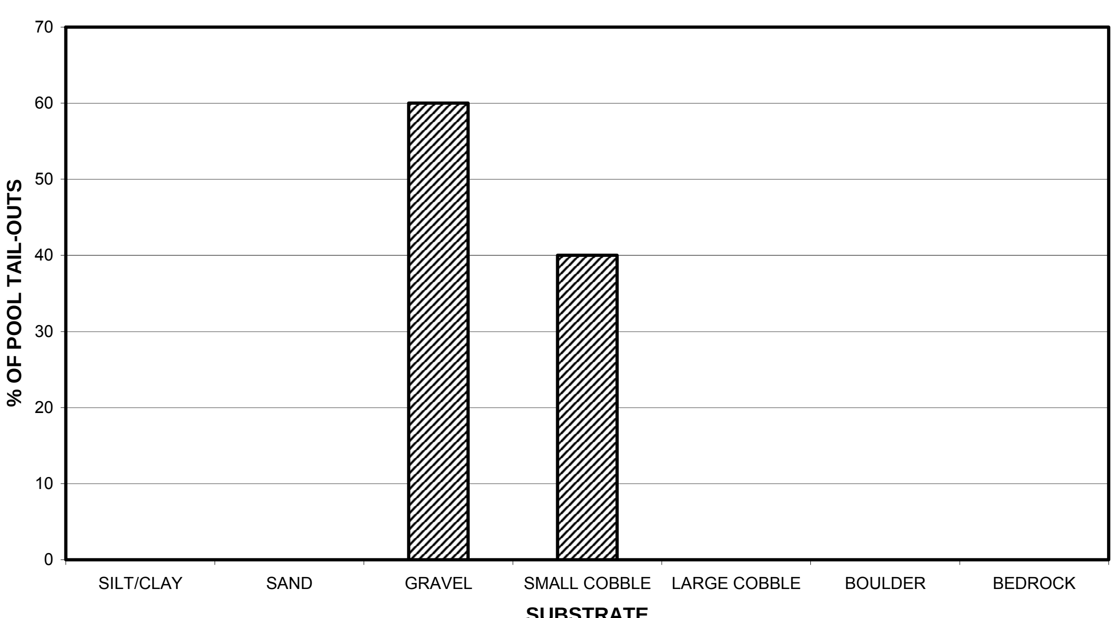
The mean percent canopy density for the surveyed length of Bale Slough was 99%. The mean percentages of hardwood and coniferous trees were 15% and 85%, respectively. One percent of the canopy was open (Graph 9 describes the mean percent canopy in Bale Slough).

BALE SLOUGH 2004
MEAN PERCENT COVER TYPES IN POOLS

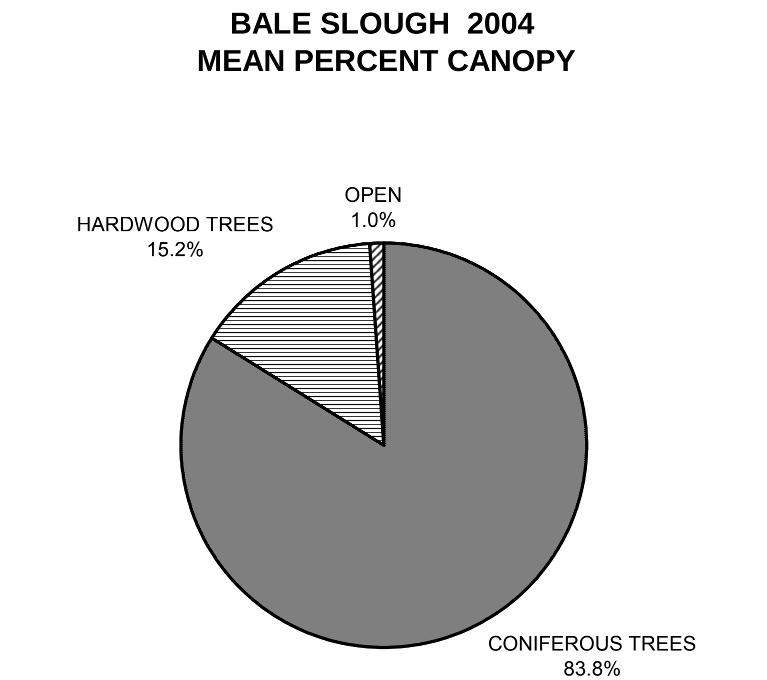


GRAPH 7

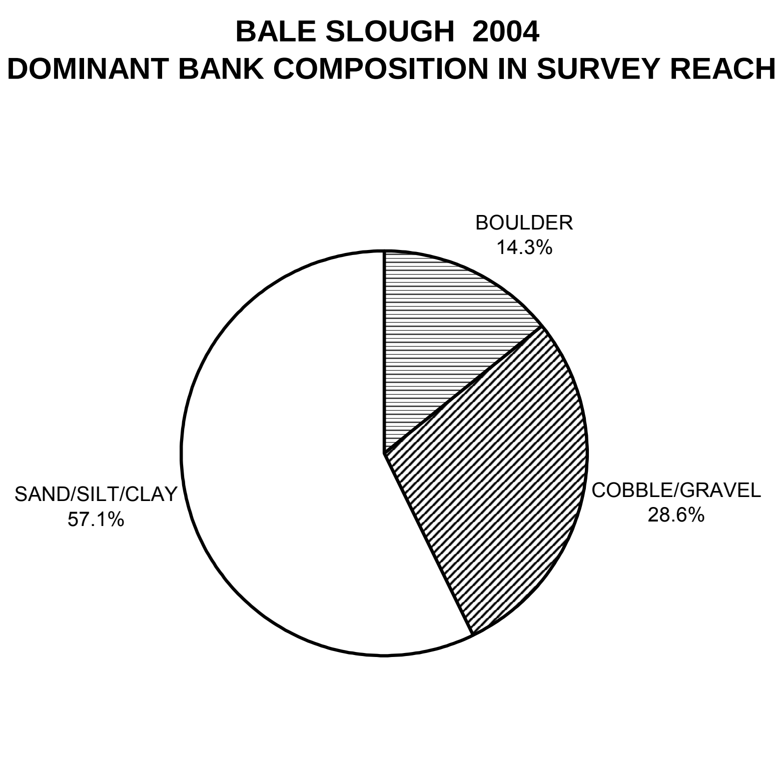
BALE SLOUGH 2004
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



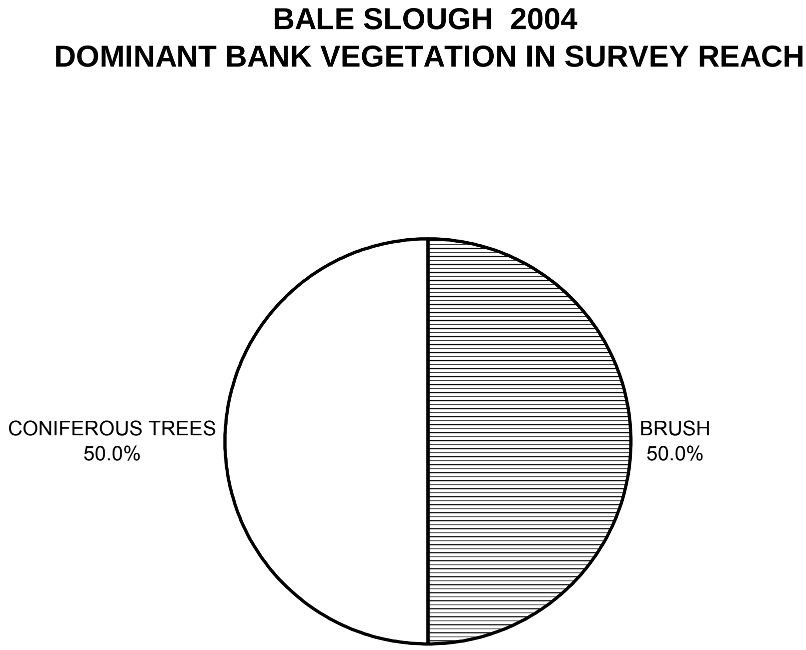
GRAPH 8



GRAPH 9



GRAPH 10



GRAPH 11

For the stream reach surveyed, the mean percent right bank vegetated was 31%, and the mean percent left bank vegetated was 58%. The dominant elements composing the structure of the stream banks consisted of 29% cobble/gravel, and 57% sand/silt/clay (Graph 10). Brush and coniferous trees were the dominant vegetation types observed in 50% of the units surveyed. Additionally, none of the units surveyed had hardwood trees as the dominant vegetation type (Graph 11)

BIOLOGICAL INVENTORY RESULTS

Bale Slough was snorkel surveyed for species composition and distribution. The survey was limited to a very short reach of Bale Slough with sufficient water to support fish. Steelhead yoy and 1+ juveniles were documented in a few pools in the survey reach. Abundance was low, due primarily to the lack of water. The results of this snorkel survey are discussed in Section 3.2 of this report.

DISCUSSION

The water temperatures recorded on the survey days 8/5/2004 to 8/5/2004, ranged from 60 to 62 degrees Fahrenheit. Air temperatures ranged from 70 to 78 degrees Fahrenheit. Continuous stream temperature results were generally favorable in Bale Slough when stream flow was present (Figure3.6-1). As surface flows receded during summer, water temperatures became elevated and unsuitable for juvenile steelhead rearing. A detailed description of temperature conditions is in section 3.6 of this report.

Flatwater habitat types comprised 4% of the total length of this survey, riffles 28%, pools 9%, and dry units composed 56% of Bale Slough in the summer and fall months. The pools are relatively shallow, with only 0 of the 5 pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

No pool tail outs were measured for embeddedness. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Gravel permeability was measured in potential spawning sites in Bale Slough, and the results of those efforts are discussed in section 3.3 of this report.

In total, all of the (five out of five) pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 35, and the shelter rating in the flatwater habitats was 35 as well. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Bale Slough. Boulders are the dominant cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from increasing water velocities, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 99%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was relatively low at 31% and 58%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting native species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

Overall, Bale Slough provides only minimal perennial salmonid habitat due to lack of summer baseflow during most years. Our surveys documented juvenile steelhead (yoy, 1+) in 2003 and 2004, but the available rearing habitat is very sparse. The lower reaches of the stream (downstream of Highway 29) function primarily as a migration corridor for adults and smolts to and from Bear Creek and the limited amount of habitat present in upper Bale Slough. The lower alluvial portion of the stream has been artificially straightened for much of its length. As a result, the channel lacks complexity, and does not support adequate riparian vegetation to shade the stream or provide a source for LWD recruitment. Flooding in the reaches below highway 29 occurs frequently, and the current channel bed height is at or slightly above grade with the surrounding land. Low elevation earthen levees confine the channel in this reach to the confluence with the Napa River. Local landowners are working with the NRCS and other agencies to reduce flooding risk and improve the stream corridor for fish and wildlife. A comprehensive habitat survey of Bear Creek is needed to assess the relative importance of the Bale Slough watershed to salmonid populations within the Napa River basin.

Prioritized restoration opportunities for Bale Slough are described in section 4 of this report.

3.1.2 Bell Creek

A stream inventory was conducted from 5/25/2004 to 6/9/2004 on Bell Creek. The survey began at the confluence with the Napa River and extended upstream 1.7 miles to the base of the dam at Bell Canyon Reservoir. A complimentary stream inventory and report was also completed for Bell Creek's main tributary, Canon Creek (Section 3.1.3).

The Bell Creek inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Bell Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for Chinook salmon, and steelhead trout. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

Bell Creek is is a tributary to Napa River, which flows to San Pablo Bay. Bell Creek's location at the confluence with the Napa River is 38:32:07° north latitude and 122:29:31° west longitude, LLID number 1224919385353. Bell Creek is a third order stream and has approximately10.6 miles of blue line stream according to the USGS St. Helena 7.5 minute quadrangle. However, only 1.75 miles are accessible to anadromous salmonids below Bell Reservoir. Bell Creek drains a watershed of approximately 10.1 square miles including the sub-drainage of Canon Creek. Elevations range from about 230 feet at the mouth of the creek to 2,750 feet in the headwater areas. Mixed hardwood forest and shrubland dominate the watershed with a few patches of mixed conifer forest. The watershed is primarily privately owned and vehicle access exists via the Silverado Trail, Glass Mountain Road, and Crystal Springs Road.

<u>HISTORICAL INFORMATION</u> (Leidy et al., 2005)

Bell Creek historically was a perennial steelhead stream that maintained flow in the headwaters even after numerous diversions caused the lower reach to become intermittent. Bell Canyon Reservoir, constructed in 1958, blocked steelhead passage to the upper, perennial reaches.

In February 1957, DFG visually surveyed portions of Bell Canyon Creek accessible by car, from the mouth upstream about 3.5 miles. No *O. mykiss* were observed, but residents stated that they had observed many small steelhead in the middle and lower sections of the creek in the early part of the year (Elwell 1957a).

In May 1958, DFG visually surveyed Bell Canyon Creek from the headwaters to a point approximately 3.5 miles upstream from the mouth. *Oncorhynchus mykiss* (40-50 mm) were common in the lower portion of the surveyed reach and appeared to be YOY (Elwell 1958i). A large population of *O. mykiss* (100-150 mm) that was deemed to be native stock was observed downstream of a natural falls about 5.5 miles upstream of the mouth (Elwell 1958i).

A May 1966 DFG field note identified *O. mykiss* (40-100 mm) at 5 per 30 meters in a flowing reach of Bell Canyon Creek downstream of Bell Canyon Reservoir. In another downstream reach with water in the channel, *O. mykiss* were estimated at 100 per 30 meters. In the lower 30 meters of this reach, approximately 100 dead *O. mykiss* were found (Brackett and Duff 1966).

A 1967 DFG memorandum stated that 2.5 miles of Bell Canyon Creek were available to steelhead prior to construction of Bell Canyon Reservoir. The memo noted the obligation by DFG to substantiate their claim for a flow release of 5 cubic feet per second from the reservoir (Nokes 1967).

In June 1969, DFG visually surveyed two miles of Bell Canyon Creek from the mouth to the reservoir. *Oncorhynchus mykiss* (25-365 mm) were observed in intermittently flowing reaches at densities of 50-100 fish per 30 meters. Maximum density was noted immediately upstream of the confluence of the south fork (Howell Creek) (Thompson and Michaels 1969).

In July 1969, DFG conducted an electrofishing survey in the same reach. Steelhead (40-150 mm FL) were estimated at 86 fish per 30 meters at a site one mile downstream of the Bell Canyon Dam, and 34 fish per 30 meters at the confluence with the south fork. The report conservatively estimated a steelhead standing crop of 4,100 fish (Anderson 1969e).

A 1970 DFG memorandum regarding St. Helena water rights states that Bell Canyon Creek at that time supported an average annual run of approximately 40 to 50 adult steelhead. The memo included an estimate of run size prior to construction of the reservoir of about 100 adult fish (Greenwald 1970).

In July 1975, DFG visually surveyed Bell Canyon Creek from the mouth to the reservoir. Intermittently flowing reaches had *O. mykiss* from 13-100 mm in length, at approximately 25 fish per 30 meters (Coleman and Van Zandt 1975).

In April 1978, DFG investigated a fish kill downstream of the Bell Canyon Reservoir chlorination facility. Staff found 106 dead YOY steelhead (mean length 57 mm) and one larger individual (~200 mm) (Cox 1978).

In July 1981, DFG observed steelhead juveniles at the Silverado Trail and the Glen Mountain Lane crossings, but found the mile of channel below the reservoir to be dry (Harris and Ambrosins 1981a).

In June 1987, DFG visually surveyed Bell Canyon Creek from the mouth to the reservoir. *Oncorhynchus mykiss* were observed averaging 50 mm in length. Natural propagation of *O. mykiss* was not considered “good” in the system (Montoya 1987a).

In August 1990, DFG electrofished Bell Canyon Creek sites to determine if the reach upstream of the reservoir contained *O. mykiss*. The survey area upstream from Angwin contained pools suitable as trout habitat, but no *O. mykiss* were observed (Gray 1990h).

Ecotrust and FONR carried out surveys in tributaries of the Napa River system in July and August 2001. Relative density of *O. mykiss* was noted between 1 and 3, with 3 indicating greater than one individual per square meter. Of four Bell Canyon Creek reaches, one was found to have *O. mykiss* at density level “1” (Ecotrust and FONR 2001).

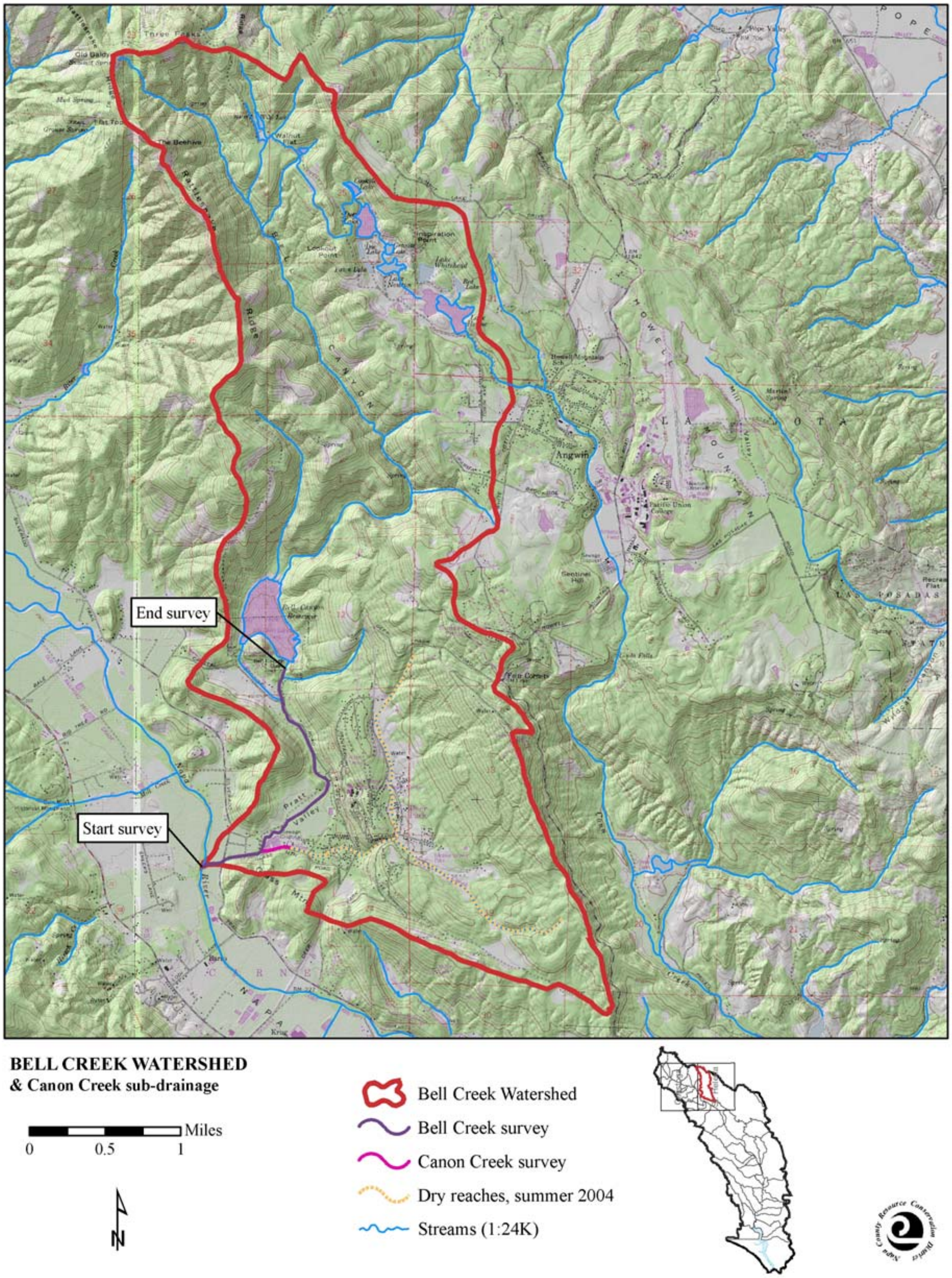


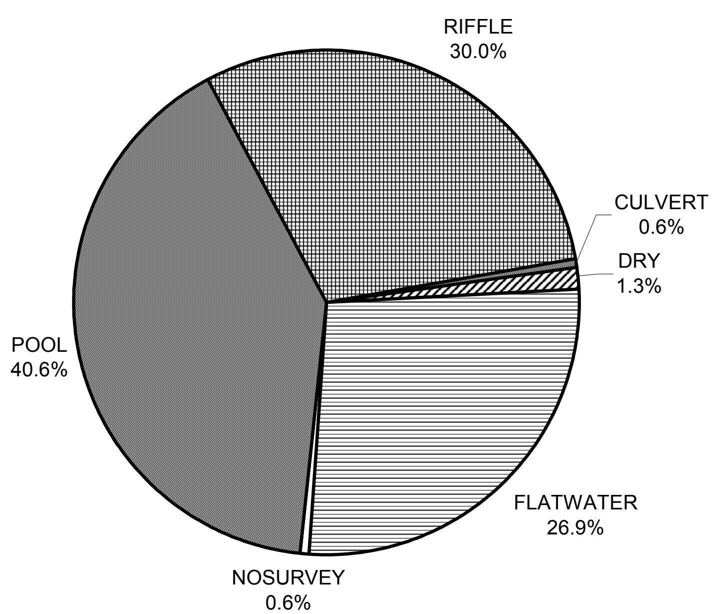
Figure 3.1-2 – Watershed map of the Bell Creek drainage. Bell reservoir represents a complete migration barrier; therefore no surveys were conducted above the dam.

HABITAT INVENTORY RESULTS

The habitat inventory of 5/25/2004 to 6/9/2004 was conducted by C. Edwards, and D. Chase. The total length of the stream surveyed was 9,178 feet with an additional 18 feet of side channel.
Stream flow was visually estimated on Bell Creek during the habitat survey and as part of the stream flow monitoring component discussed in section 4.6.

Bell Creek is an F4 channel type for 698 feet of the stream surveyed (Reach 1), a F4 channel type for 1,274 feet of the stream surveyed (Reach 2), a B3 channel type for 1,368 feet of the stream surveyed (Reach 3), an F4 channel type for 3,946 feet of the stream surveyed (Reach 4), and an F4 channel type for 1,891.5 feet of the stream surveyed (Reach 5). Generally, F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. Type G4 channels are entrenched "gully" step-pool channels on moderate gradients with low width /depth ratios and gravel dominant substrates. Type B3 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and cobble dominant substrates.

BELL CREEK 2004
HABITAT TYPES BY PERCENT OCCURRENCE



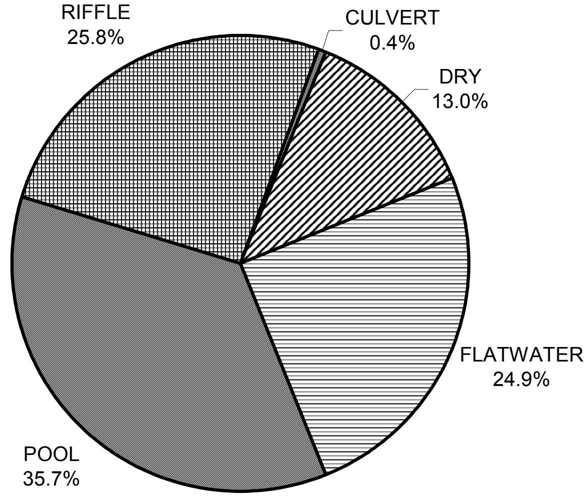
GRAPH 1

Water temperatures taken during the survey period ranged from 60 to 71 degrees Fahrenheit. Air temperatures ranged from 59 to 81 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 30% riffle units, 27% flatwater units, and 41% pool units (Graph 1). Based on total length of

Level II habitat types there were 26% riffle units, 25% flatwater units, and 36% pool units (Graph 2).

BELL CREEK 2004
HABITAT TYPES BY PERCENT TOTAL LENGTH



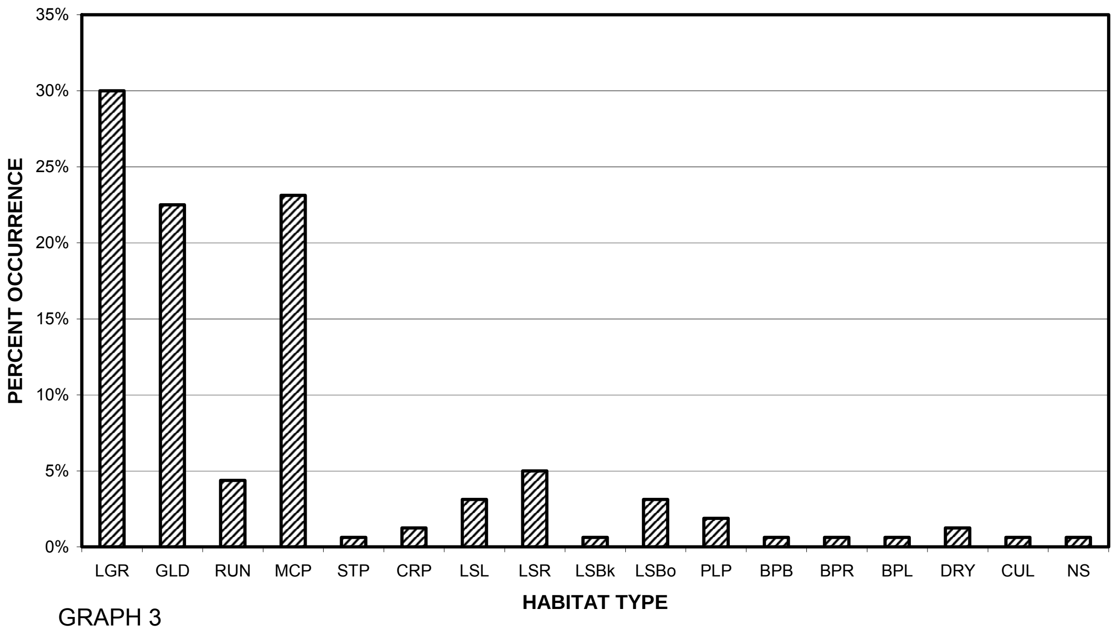
GRAPH 2

In total, fifteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were; 30% Low Gradient Riffle units, 22% Glide units, and 23% Mid-Channel Pool units (Graph 3). Based on percent total length, the most frequent habitat types are as follows; 26% Low Gradient Riffle units, 22% Glide units, and 21% Mid-Channel Pool units.

A total of 65 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 58%, and comprised 61% of the total length of all pools (Graph 4). Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth, and 12 of the 27 pools (44%) had a residual depth of two feet or greater (Graph 5).

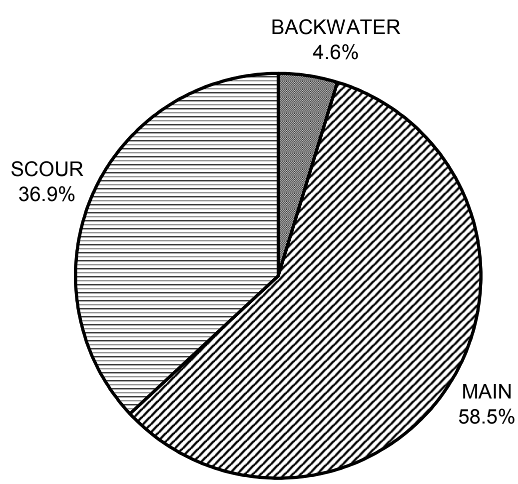
The depth of cobble embeddedness was estimated at pool tail-outs. Of the 28 pool tail-outs measured, 3 had a value of 1 (10.7%); 22 had a value of 2 (78.6%); and 3 had a value of 3 (10.7%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, or boulders.

BELL CREEK 2004
HABITAT TYPES BY PERCENT OCCURRENCE

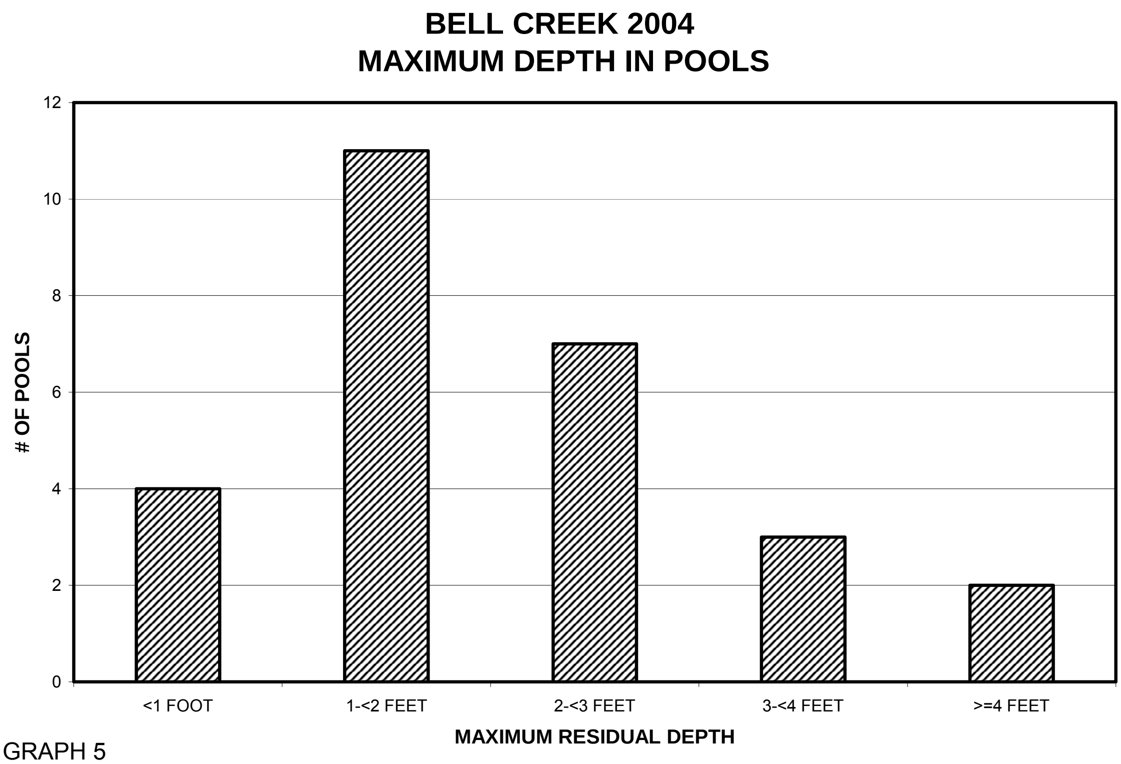


GRAPH 3

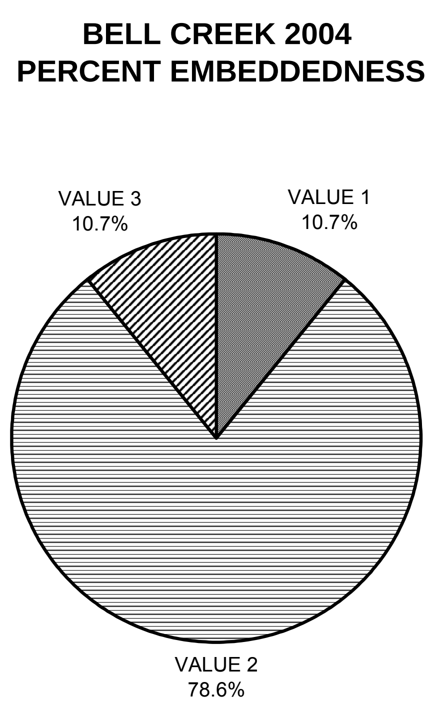
BELL CREEK 2004
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4



GRAPH 5



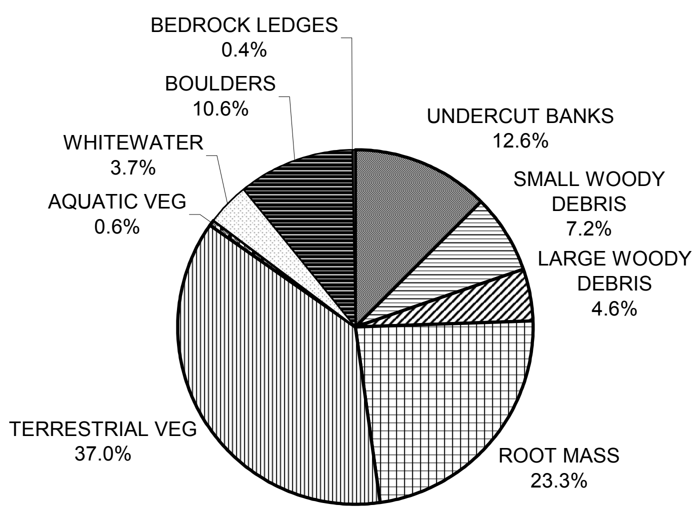
GRAPH 6

A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 29, flatwater habitat types had a mean shelter rating of 23, and pool habitats had a mean shelter rating of 77 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 87, Scour pools had a mean shelter rating of 71, and Backwater pools had a mean shelter rating of 10 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation is the dominant cover type found in Bell Creek. Terrestrial vegetation is also the dominant pool cover type, followed by root mass. Graph 7 describes the pool cover in Bell Creek.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. The two dominant types of substratum in this watershed are gravel, and small Cobble, which were both observed to occupy 43% of measured pool tail-outs.

BELL CREEK 2004
MEAN PERCENT COVER TYPES IN POOLS

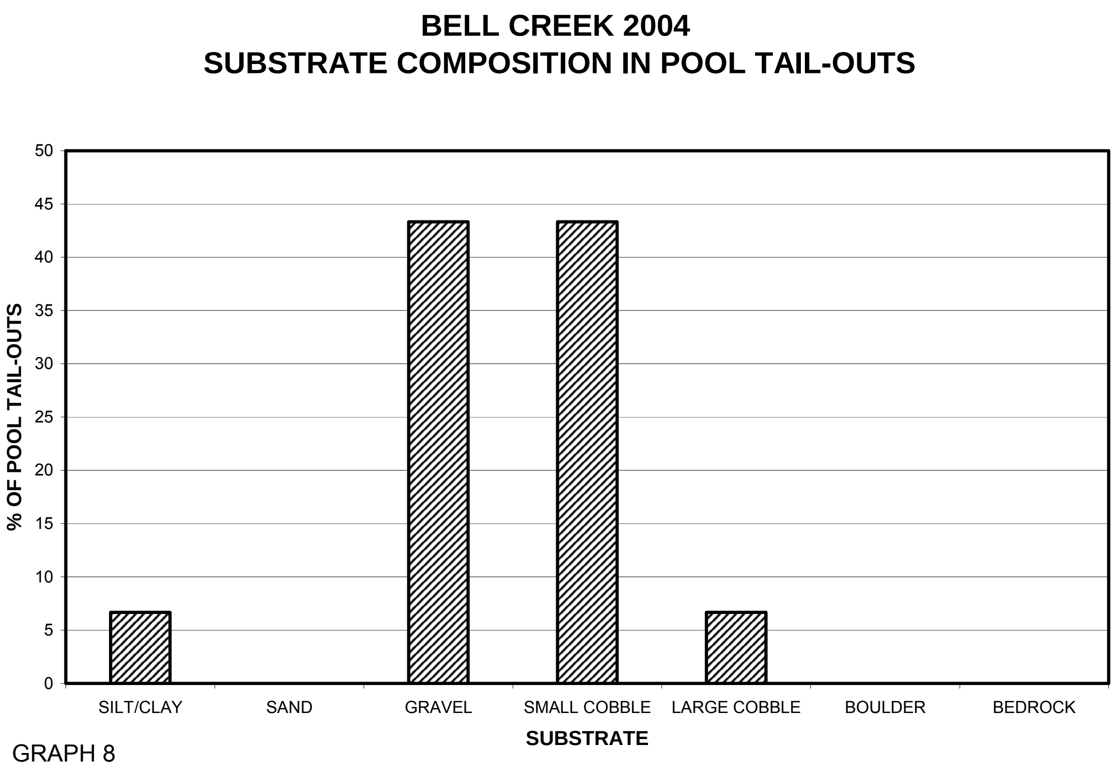


GRAPH 7

The mean percent canopy density for the surveyed length of Bell Creek was 84%. The mean percentages of hardwood and coniferous trees were 78% and 18%, respectively. Overall, sixteen percent of the canopy was open. Graph 9 describes the mean percent canopy in Bell Creek.

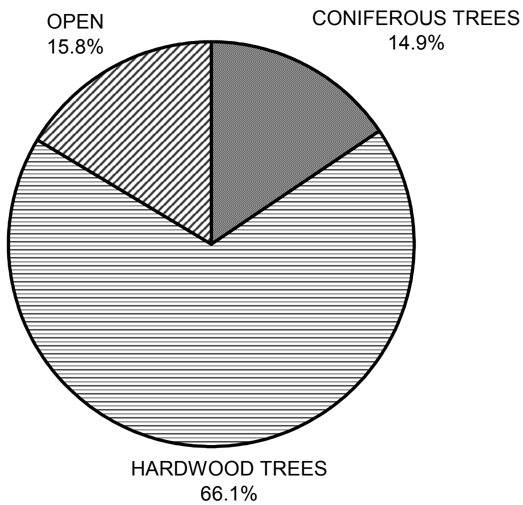
For the stream reach surveyed, the mean percent right bank vegetated was 87%, and the mean percent left bank vegetated was 78%. The dominant elements composing the structure of the stream banks consisted of 35% cobble/gravel, and 64% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in

65% of the units surveyed. Additionally, 26% of the units surveyed had hardwood trees as the dominant vegetation type, and 2% had coniferous trees as the dominant vegetation (Graph 11).



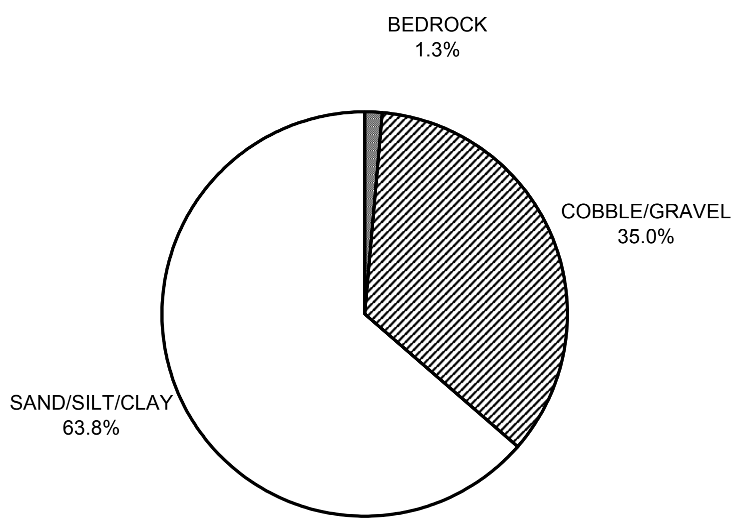
GRAPH 8

BELL CREEK 2004
MEAN PERCENT CANOPY



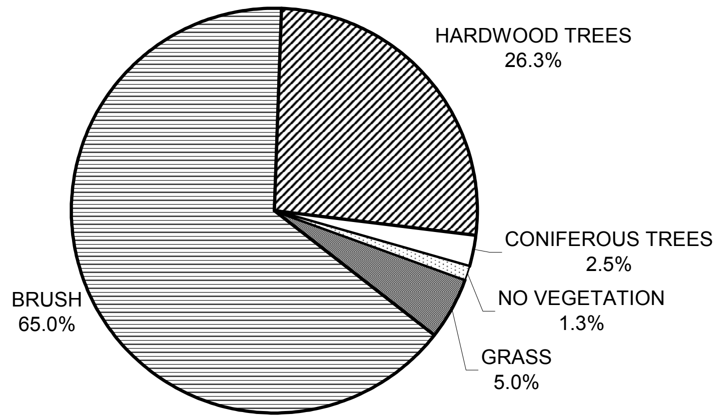
GRAPH 9

BELL CREEK 2004
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

BELL CREEK 2004
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

DISCUSSION

Bell Creek is an F4 channel type for 698 feet of the stream surveyed (Reach 1), an F4 channel type for 1,274 feet of the stream surveyed (Reach 2), a B3 channel type for 1,368 feet of the stream surveyed (Reach 3), an F4 channel type for 3,946 feet of the stream surveyed (Reach 4), and an F4 channel type for 1,891.5 feet of the stream surveyed (Reach 5).

The water temperatures recorded on the survey days 5/25/2004 to 6/9/2004, ranged from 60 to 71 degrees Fahrenheit. Air temperatures ranged from 59 to 81 degrees Fahrenheit.

Flatwater habitat types comprised 25% of the total length of this survey, riffles 26%, and pools 36%. The pools are relatively shallow, with only 12 of the 27 (44%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width (NOTE: for 3rd and 4th order streams maximum residual depth is at least three feet). Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

In total, 25 of the 28 pool tail-outs measured had embeddedness ratings of 1 or 2, and three of the pool tail-outs had embeddedness ratings of 3 or 4. None of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Bell Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Twenty six of the 30 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. Additionally, spawning habitat was well distributed within the surveyed portion of Bell Creek and does not appear to be a major limiting factor for successful salmonid reproduction.

The mean shelter rating for pools was 77, and the shelter rating in the flatwater habitats was 23. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by terrestrial vegetation in Bell Creek. Terrestrial vegetation is also the dominant cover type in pools followed by root mass. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 84% (Reach 1 had a canopy density of 84%, Reach 2 had a canopy density of 86%, Reach 3 had a canopy density of 78%, Reach 4 had a canopy density of 86%, and Reach 5 had a canopy density of 86%). In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was high at 87% and 78%, respectively. Bell Creek's riparian is in good condition. However, in areas with stream bank erosion or where bank vegetation is sparse, planting native vegetation, in conjunction with bank stabilization, is recommended.

Bell Creek has been heavily impacted by the construction and maintenance of Bell Reservoir. The reservoir restricts anadromy to a relatively short portion of the stream historically available to salmonids. Additionally, sediment transport and hydrology of the downstream reaches have been completely altered. Several reaches exhibited streambed incision, which is likely attributed to some degree to the influence of the dam.

Overall, Bell Creek below Bell Reservoir is in moderate condition. The stream contains some areas of high quality salmonid habitat, primarily in the middle reaches of the surveyed channel. As a result of managed reservoir releases, the stream maintains flow most of the year; however sporadic flow stoppages were documented during the summer period of this survey (Section 4.6). The full spatial and temporal extent of these flow cessations is not known, and future efforts to coordinate water releases with reservoir operators should be made. Releases should correspond to requirements of key periods in the steelhead life cycle (i.e. rearing, outmigration, etc.).

Prioritized restoration opportunities for Bell Creek are described in section 4 of this report.

3.1.3 Canon Creek

A stream inventory was conducted on 7/1/2004 on Cañon Creek. The survey began at the confluence with Bell Creek and extended upstream just 0.2 miles to a point where the stream went completely dry (Figure 3.1.2-a). Reconnaissance surveys in August and September of 2004 documented dry stream conditions in all reaches upstream of the surveyed channel near the confluence with Bell Creek.

The Cañon Creek inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Cañon Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for Chinook salmon and steelhead. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Cañon Creek is a tributary to Bell Creek, which is a tributary to the Napa River (Napa County, California), which is a tributary to the Pacific Ocean via the San Pablo Bay. Cañon Creek's location at the confluence with Bell Creek is 38.53638° north latitude and 122.48606° west longitude, LLID number 1224919385353. Cañon Creek is a second order stream and has approximately 3.7 miles of blue line stream according to the USGS St. Helena 7.5 minute quadrangle. Cañon Creek drains a watershed of approximately 2.82 square miles. Elevations range from about 250 feet at the mouth of the creek to 1,760 feet in the headwater areas. The watershed is approximately 45% mixed hardwood forest, 30% shrubland, 15% mixed conifer forest, and 10% developed residential. There are a few very small vineyards in the watershed that comprise <1% of the total area. The watershed is primarily privately owned and vehicle access exists via along Glass Mountain Road from the Silverado Trail.

HISTORICAL INFORMATION

No historical fisheries information on Canon Creek was found.

HABITAT INVENTORY RESULTS

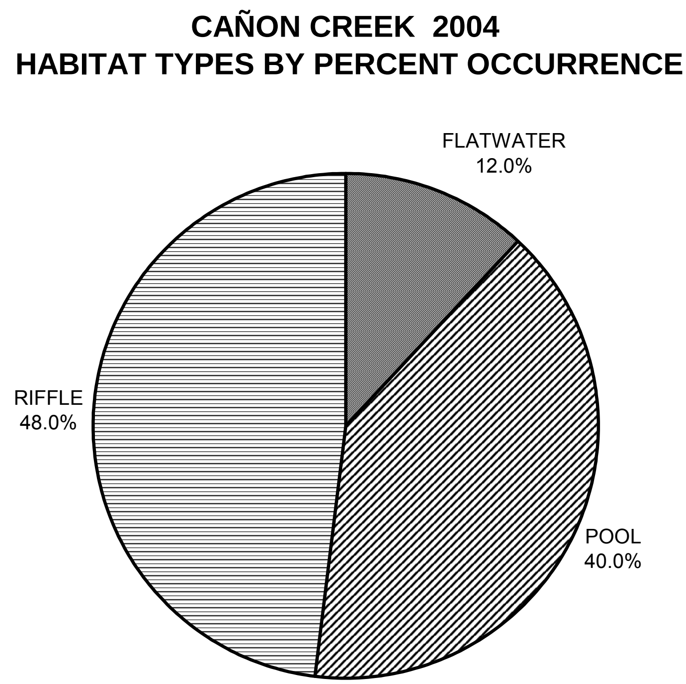
The habitat inventory of 7/1/2004 to 7/1/2004 was conducted by C. Edwards, and D. Chase. The total length of stream surveyed was limited to 1,101 feet due to intermittent stream flow. Reconnaissance surveys documented dry conditions above the surveyed reach in summer, 2003 and 2004. The surveyed reach contained several isolated pools that persisted during both years.

Cañon Creek is an F4 channel type for 1,101 feet of the stream surveyed (Reach 1). F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates.

Water temperature taken during the survey was 59 degrees Fahrenheit. Air temperature was 64 degrees Fahrenheit.

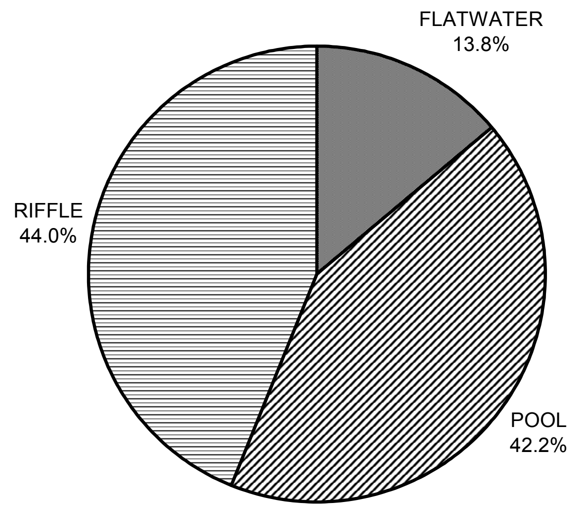
Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence, there were 48% riffle units, 40% pool units, and 12% flatwater units (Graph 1). Based on total length of Level II habitat types, there were 44% riffle units, 42% pool units, and 14% flatwater units (Graph 2).

In total, six Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 44% Low Gradient Riffle units, 28% Mid-Channel Pool units, and 12% Glide units (Graph 3). The most frequent habitat types based on percent total length were as follows; 41% Low Gradient Riffle units, 13% Lateral Scour Pool - Root Wad Enhanced units, and 26% Mid-Channel Pool units.



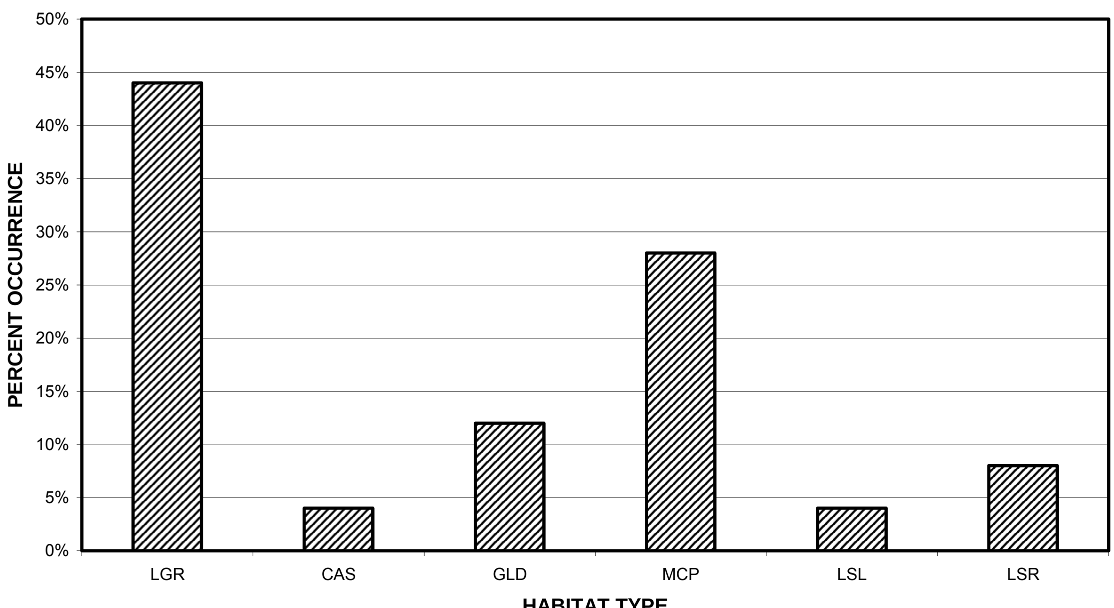
GRAPH 1

CAÑON CREEK 2004
HABITAT TYPES BY PERCENT TOTAL LENGTH



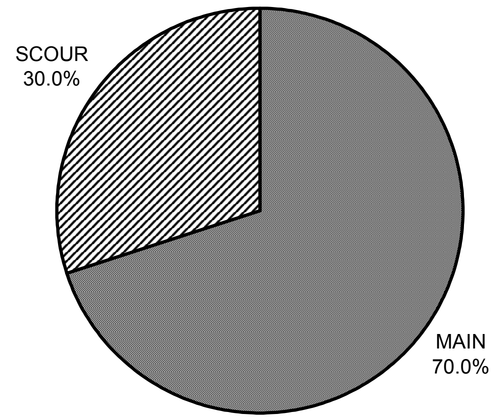
GRAPH 2

CAÑON CREEK 2004
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

CAÑON CREEK 2004
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4

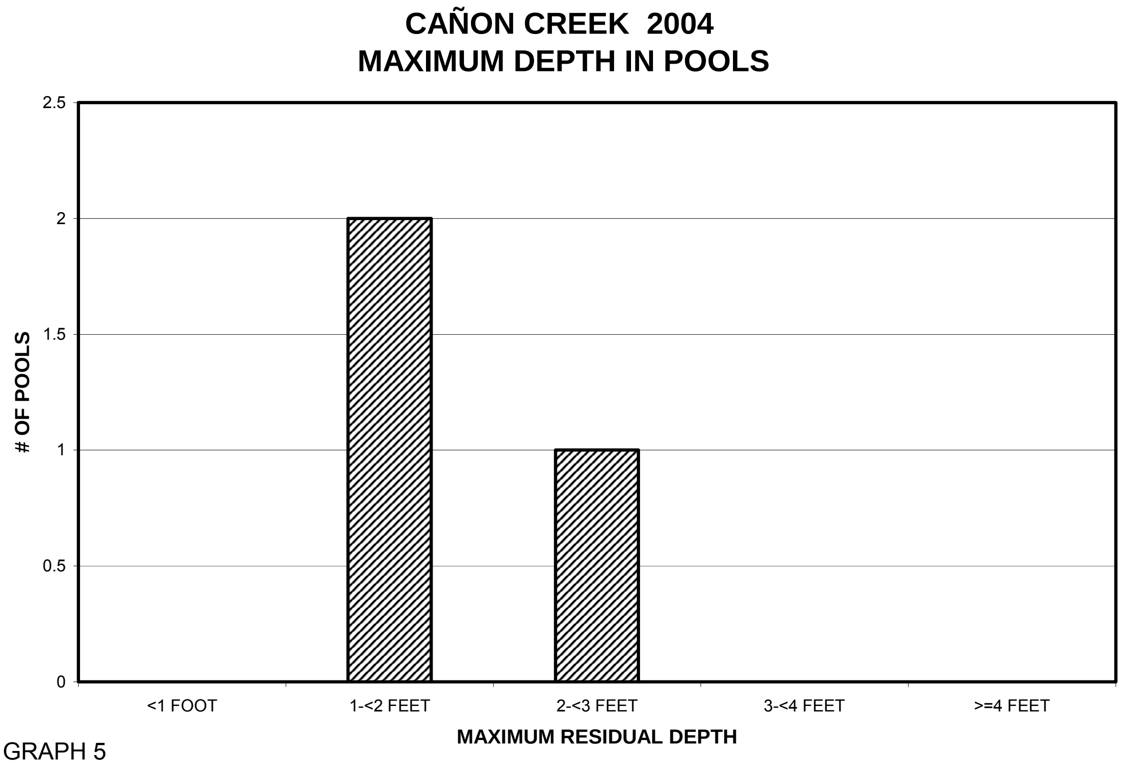
A total of 10 pools were identified (Table 3), and main Channel pools were the most frequently encountered, at 70%, and comprised 61% of the total length of all pools (Graph 4). Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. In total, one of the 3 pools (33%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 3 pool tail-outs measured, 1 had a value of 1; 2 had a value of 2 (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, and boulders.

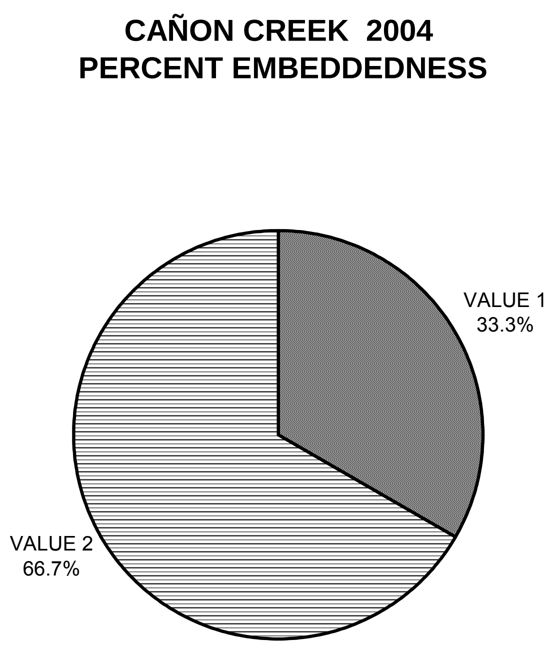
A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 30, flatwater habitat types had a mean shelter rating of 15, and pool habitats had a mean shelter rating of 37 (Table 1). Of the pool types, the scour pools had a mean shelter rating of 40, and main channel pools had a mean shelter rating of 35 (Table 3).

Table 5 summarizes mean percent cover by habitat type; boulders were found to be the dominant cover types in Cañon Creek. Graph 7 describes the pool cover in Cañon Creek, where undercut banks were the dominant pool cover type followed by root mass.

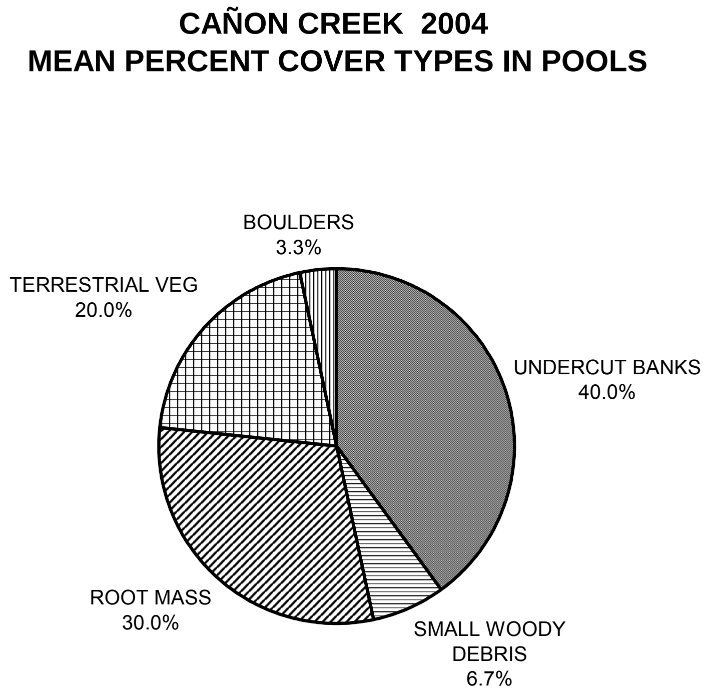
Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was observed in 33% of pool tail-outs, small Cobble observed in 33% of pool tail-outs, and large Cobble observed in 33% of pool tail-outs.



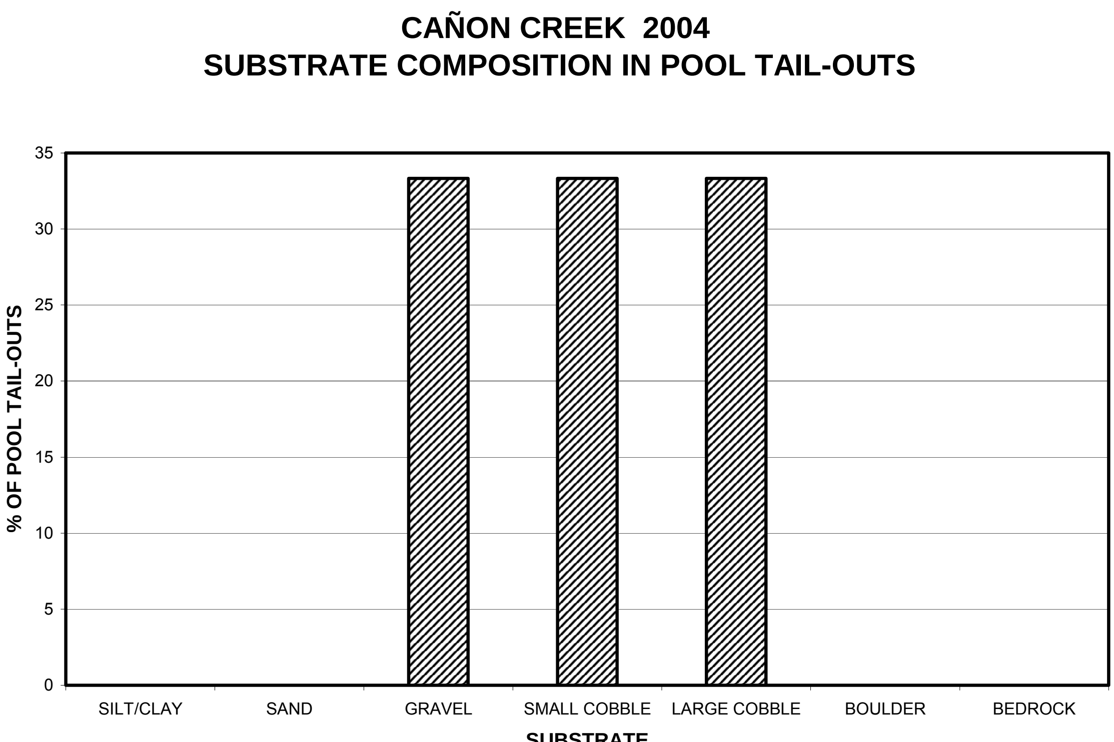
GRAPH 5



GRAPH 6

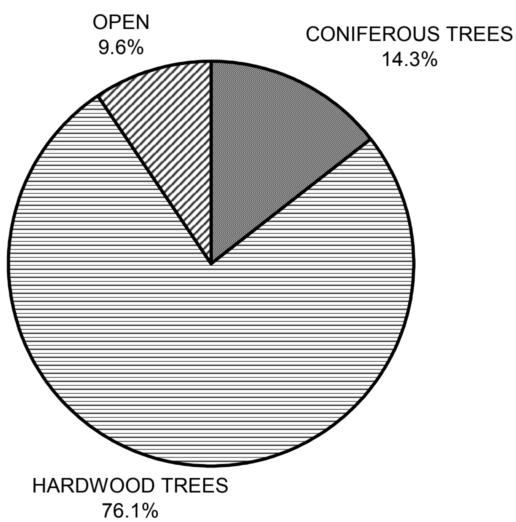


GRAPH 7



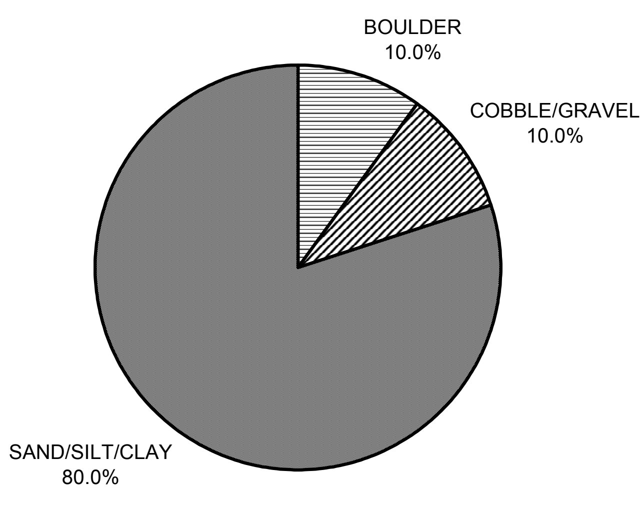
GRAPH 8

CAÑON CREEK 2004
MEAN PERCENT CANOPY



GRAPH 9

CAÑON CREEK 2004
DOMINANT BANK COMPOSITION IN SURVEY REACH

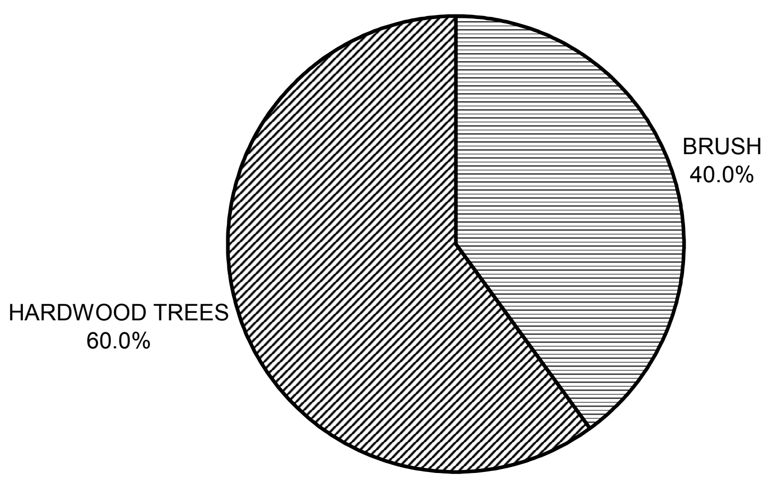


GRAPH 10

The mean percent canopy density for the surveyed length of Cañon Creek was 90%. The mean percentages of hardwood and coniferous trees were 84% and 16%, respectively. Ten percent of the canopy was open. Graph 9 describes the mean percent canopy in Cañon Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 45%, and the mean percent left bank vegetated was 28%. The dominant elements composing the structure of the stream banks consisted of 10% boulders, 10% cobble/gravel, and 80% sand/silt/clay (Graph 10). Deciduous trees and brush were the dominant bank vegetation types observed in 60%, and 40% of the units surveyed, respectively. None of the units surveyed had coniferous trees as the dominant vegetation type (Graph 11).

CAÑON CREEK 2004
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

BIOLOGICAL INVENTORY RESULTS

Cañon Creek was snorkel surveyed for species composition and distribution. The survey was limited to a very short reach of Cañon Creek with sufficient water to support fish. No salmonids were observed. Additional visual bank observations were made during habitat surveys, and no salmonids were documented. The results of the snorkel survey are discussed in Section 3.2 of this report.

DISCUSSION

Cañon Creek is an F4 channel type for 1,101 feet of the stream surveyed (Reach 1). The suitability of F4 channel types for fish habitat improvement structures is described in detail in the California Salmonid Stream Habitat Restoration Manual (CDFG). All potential projects should be coordinated with qualified staff from local resource agencies that are familiar with appropriate restoration strategies for a given site.

The water temperature recorded on the survey day (7/1/2004) was 59 degrees Fahrenheit; air temperature was 64 degrees Fahrenheit. Continuous temperature monitoring was conducted in Cañon Creek and it appears that temperatures are favorable throughout the year. Results of this temperature monitoring effort are discussed in detail in section 3.6 of this report.

Flatwater habitat types comprised 14% of the total length of this survey, riffles 44%, and pools 42%. The pools are relatively shallow with only 1 of the 3 pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

In total, all of the 3 pool tail-outs measured had embeddedness ratings of 1 or 2, and none of the pool tail-outs had embeddedness ratings of 3, or 4. None of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Cañon Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Two of the 3 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 37, and the shelter rating in the flatwater habitats was 15. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Cañon Creek, and undercut banks are the dominant cover type in pools followed by root mass. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from high flow events, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 90%. In general, revegetation projects are considered when canopy density is less than 80%. The percentage of right and left bank covered with vegetation was moderate to low at 45% and 28%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting native vegetation, in conjunction with bank stabilization efforts, is recommended.

Overall, Cañon Creek offers very little suitable salmonid habitat due to limited flow and urban encroachment along much of the channel. The lower reaches are heavily entrenched between Glass Mountain Road and private homes and development. Upstream reaches are intermittent and high gradient with extensive exotic vegetation (primarily Himalayan Blackberry) in the riparian zone.

Prioritized restoration opportunities on Cañon Creek are described in section 4 of this report.

3.1.4 Conn Creek

A stream inventory was conducted during 8/6/2004 to 8/10/2004 on Conn Creek. The survey began at the confluence with the Napa River and extended upstream 6.4 miles to the permanent pool below the Conn Dam spillway. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Conn Creek and visually document the presence and distribution of juvenile salmonids.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for steelhead and chinook salmon. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Conn Creek is a tributary to the Napa River, which is tributary to the Pacific Ocean via the San Pablo Bay (Map 1). Conn Creek's legal description at the confluence with the Napa River is 38.41951° north latitude and 122.35352° west longitude, LLID number 1223524384197. Conn Creek is a fourth order stream and has approximately 9.05 miles of blue line stream below Conn Dam according to the USGS St. Helena 7.5 minute quadrangle. Conn Creek drains a watershed of approximately 62.7 square miles total, of which 12.6 square miles are below the dam. Elevations range from about 90 feet at the mouth of the creek to 2,350 feet in the headwater areas. Mixed hardwood and conifer forest dominates the upper watershed, and approximately 85% of the land area below the dam is agriculture (vineyards and sparse ranching). The watershed is primarily privately owned with the exception of Lake Hennessey and some of the land adjacent to the lake. The reservoir is managed for water supply, flood protection, and recreation. Vehicle access exists via the Silverado Trail, Conn Creek Rd, and Sage Canyon Rd.

HISTORICAL INFORMATION (Leidy et al., 2005)

Construction of the Conn Valley Reservoir (Lake Hennessey) in 1945 completely curtailed access to more than eight miles of Conn Creek and numerous tributary streams, including Chiles, Moore, Sage and Fir creeks.

In September 1945, DFG observed large numbers of trout in the upper sections of Conn Creek (Ott 1945).

In 1946, DFG noted that a moderately large population of trout, from fingerlings to 200 mm in length, was present in the tributary streams of Conn Valley Reservoir (Murphy 1949).

In a May 1947 creel census, DFG found both hatchery and wild O. mykiss in the group taken by anglers from the reservoir. However, by 1948, practically no trout were present in the tributary streams (Murphy 1949). The Department of Fish and Game concluded that the trout fishery would not be self-maintaining even in years of “good” flows in spawning streams because of low survival of adults in the reservoir (Murphy 1949).

In February 1959, DFG made a cursory survey of eight sites near road access on Conn Creek upstream of Lake Hennessey. No O. mykiss were observed, but residents reported catching small numbers of O. mykiss up to 300 mm in length (Fisher 1959a).
In April 1979, DFG electrofished two sites above the reservoir on Conn Creek in relation to an oil spill. Approximately 400 feet upstream of Linda Falls, five O. mykiss were caught (131-192 mm FL). Behind the Angwin Fire Station on College Road, another seven O. mykiss were collected (95-157 mm). Additional O. mykiss were seen at both sites, but evaded capture (Cox 1979).

In September 1988, DFG electrofished two reaches on Conn Creek above the reservoir, near the Rossi Road Bridge. A total of seven O. mykiss were caught measuring 55-186 mm in length (Gray 1988a).

Leidy found O. mykiss downstream of the reservoir at two locations electrofished. Just downstream from Domain Chandon vineyard he caught five O. mykiss (78-100 mm FL) with an estimated density at 10 per 30 meters of stream. At the confluence with Rector Creek, he collected two O. mykiss (75, 95 mm) and estimated density at 5 fish per 30 meters (Leidy 2002).

Ecotrust and FONR carried out surveys in tributaries of the Napa River system in July and August 2001. Two Conn Creek reaches were surveyed, and O. mykiss were not observed (Ecotrust and FONR 2001).

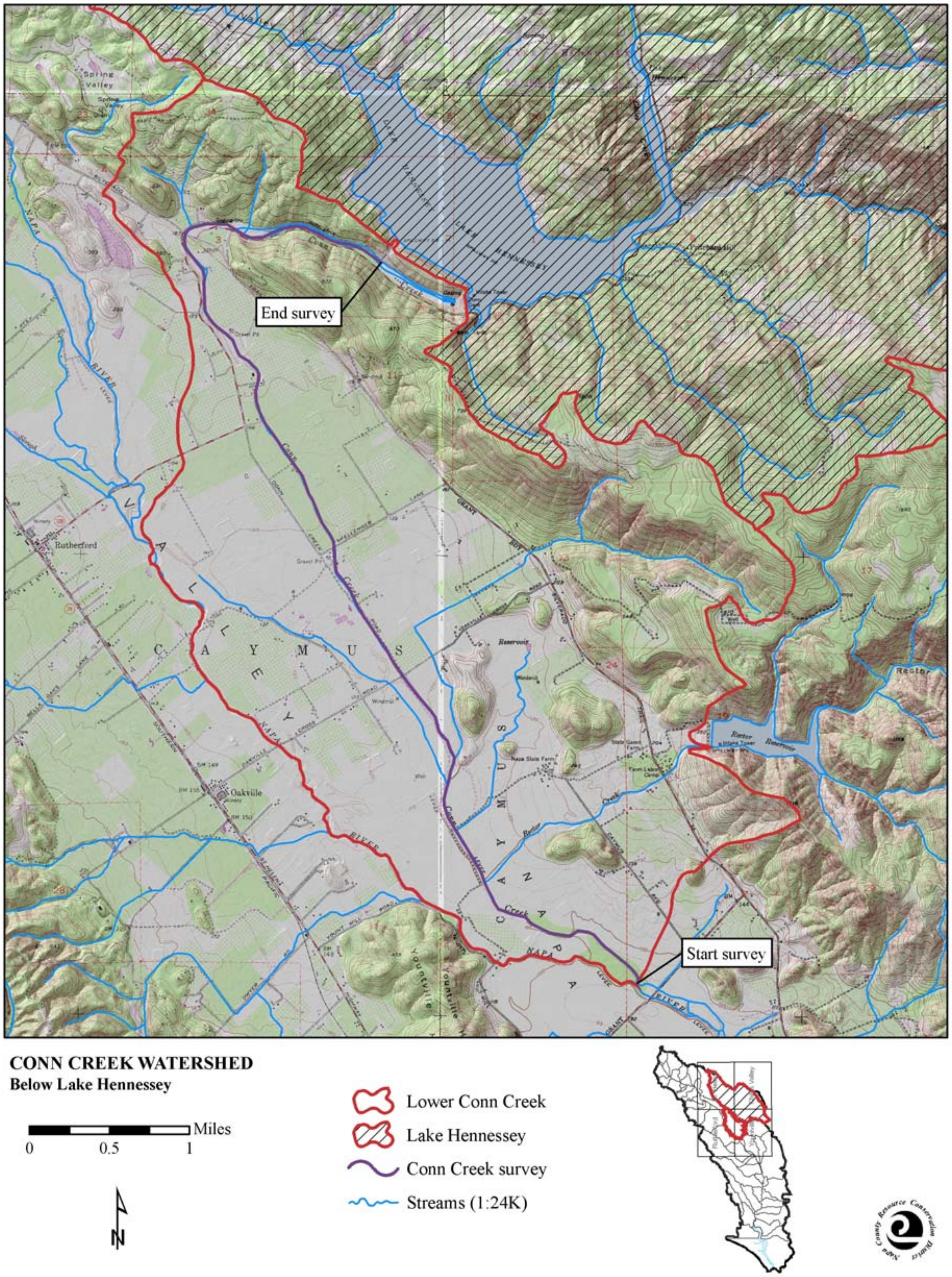


Figure 3.1-4. Watershed map of the lower Conn Creek drainage.

HABITAT INVENTORY RESULTS

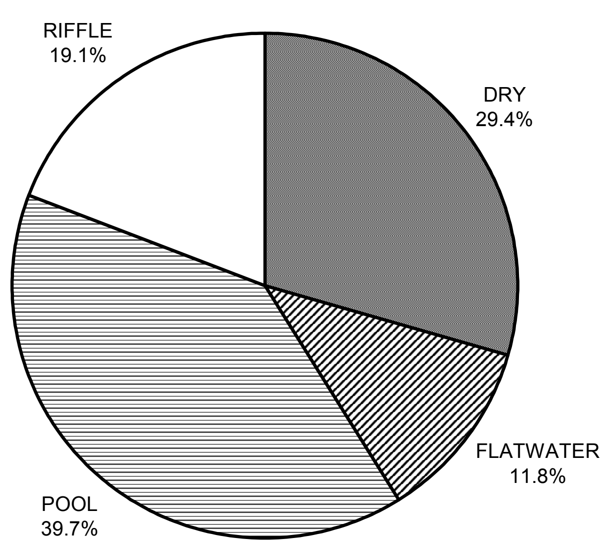
The habitat inventory of 8/6/2004 to 8/10/2004 was conducted by C. Edwards, & D. Chase. The total length of the stream surveyed was 33,673 feet. Stream flow was not measured on Conn Creek, and most of the habitat units were completely dry.

Conn Creek is an F4 channel type for 29,453 feet of the stream surveyed (Reach 1), and an F3 channel type for 4,220 feet of the stream surveyed (Reach 2). F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates.

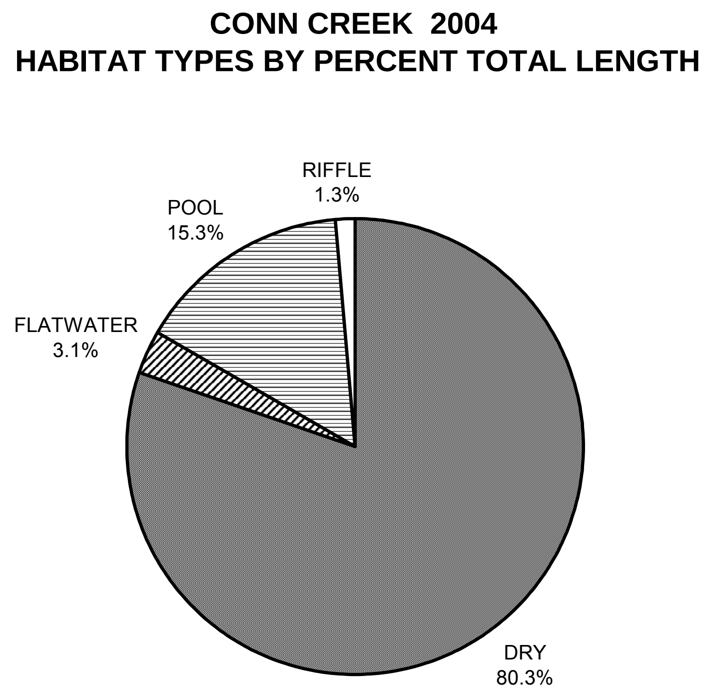
Water temperatures taken during the survey period ranged from 61 to 73 degrees Fahrenheit. Air temperatures ranged from 75 to 82 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 29% dry units, 40% pool units, 19% riffle units, and 12% flatwater units (Graph 1). Based on total length of Level II habitat types there were 80% dry units, 15% pool units, 1% riffle units, and 3% flatwater units (Graph 2).

CONN CREEK 2004
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1



GRAPH 2

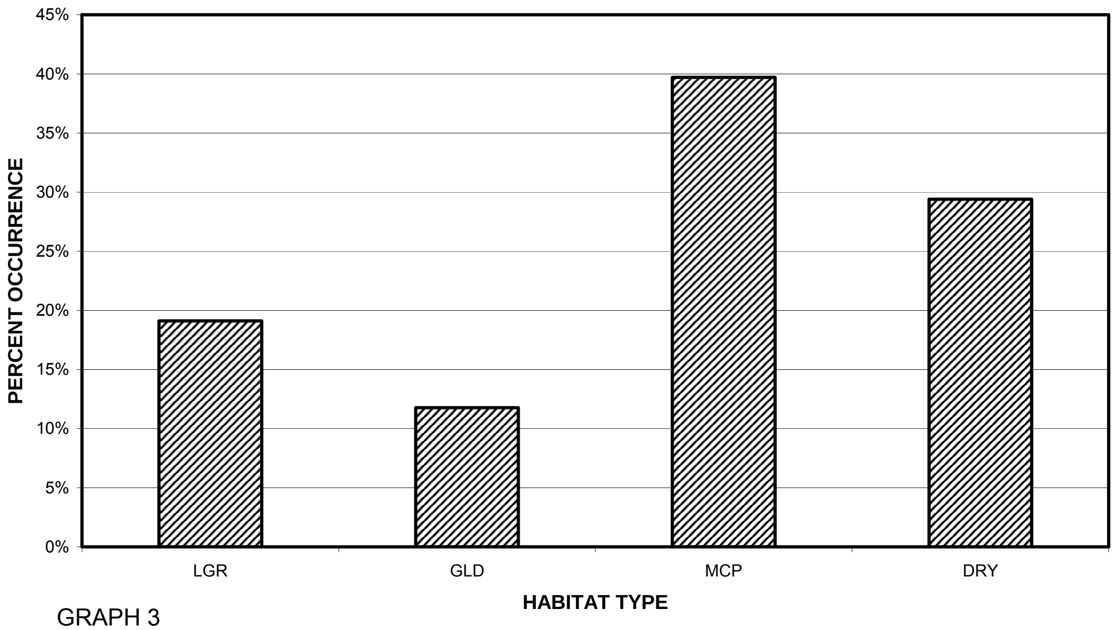
In total, four Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 29% Dry units, 40% Mid-Channel Pool units, and 19% Low Gradient Riffle units (Graph 3). Based on percent total length, 80% Dry units, 15% Mid-Channel Pool units, and 3% Glide units were the most frequent habitat types.

A total of 27 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 100%, and comprised 100% of the total length of all pools (Graph 4). Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Five of the 9 pools (56%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 6 pool tail-outs measured, 3 had a value of 1 (50%), and 3 had a value of 2 (50%, see 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, etc…

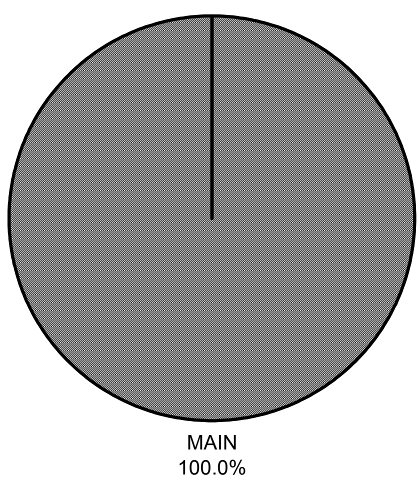
A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Flatwater habitat types had a mean shelter rating of 15, and pool habitats had a mean shelter rating of 19 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 19 (Table 3).

CONN CREEK 2004
HABITAT TYPES BY PERCENT OCCURRENCE



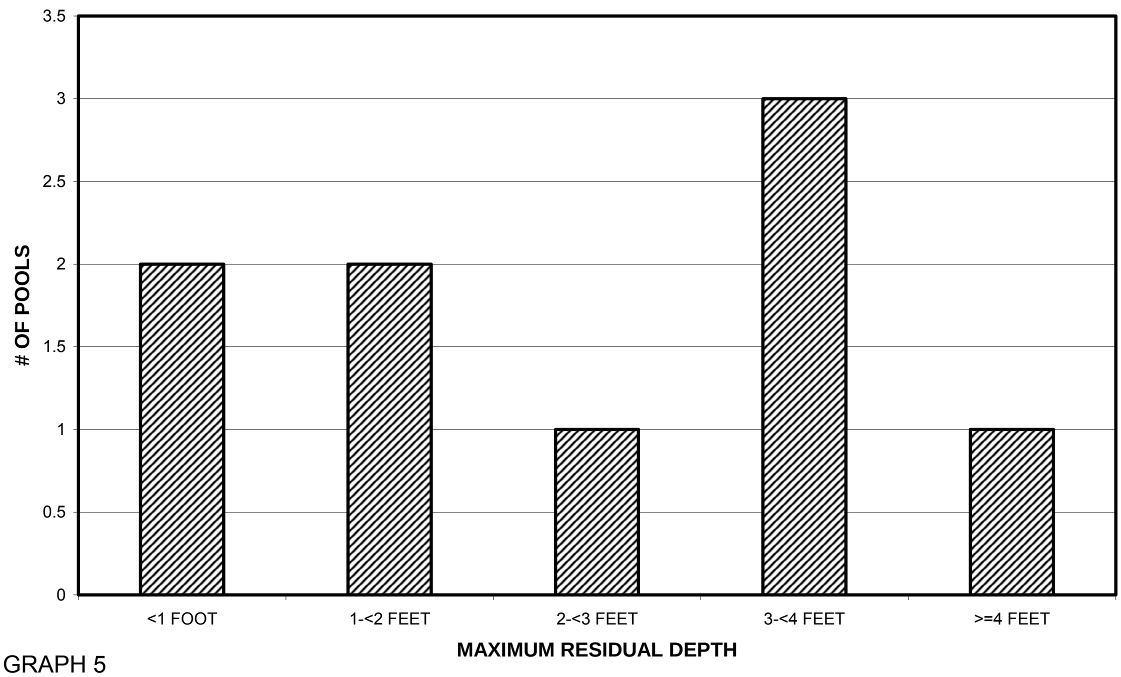
GRAPH 3

CONN CREEK 2004
POOL TYPES BY PERCENT OCCURRENCE



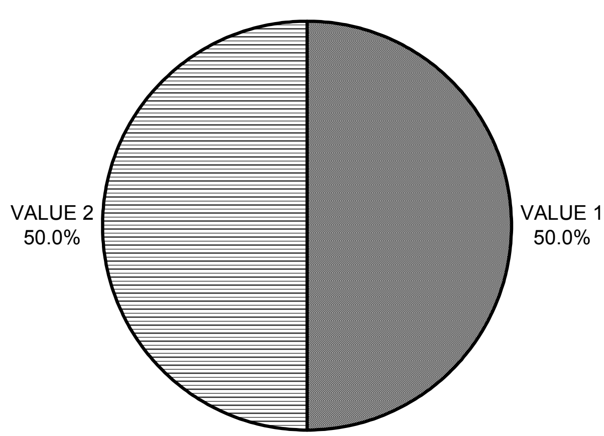
GRAPH 4

CONN CREEK 2004
MAXIMUM DEPTH IN POOLS



GRAPH 5

CONN CREEK 2004
PERCENT EMBEDDEDNESS



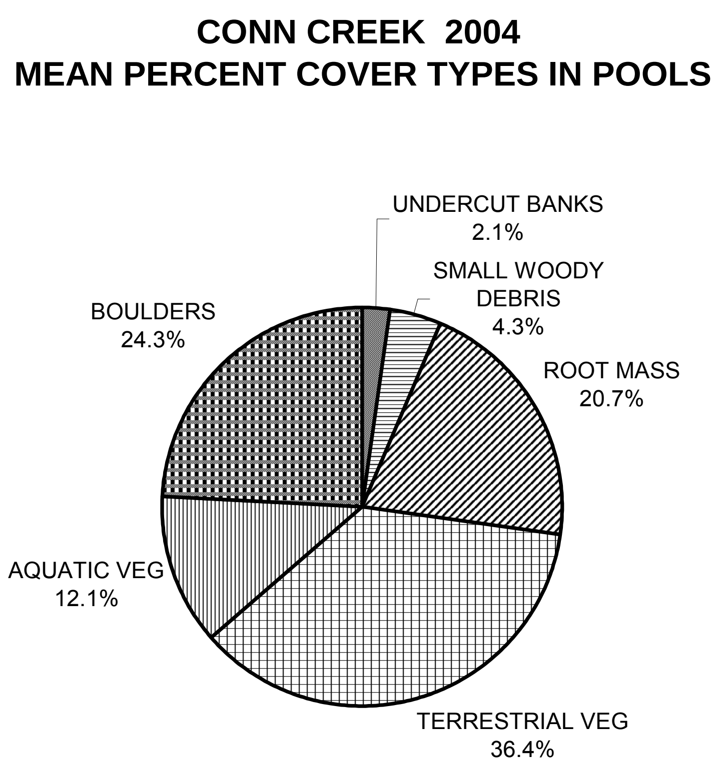
GRAPH 6

Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation was the dominant pool cover type followed by boulders. Graph 7 describes the pool cover in Conn Creek.

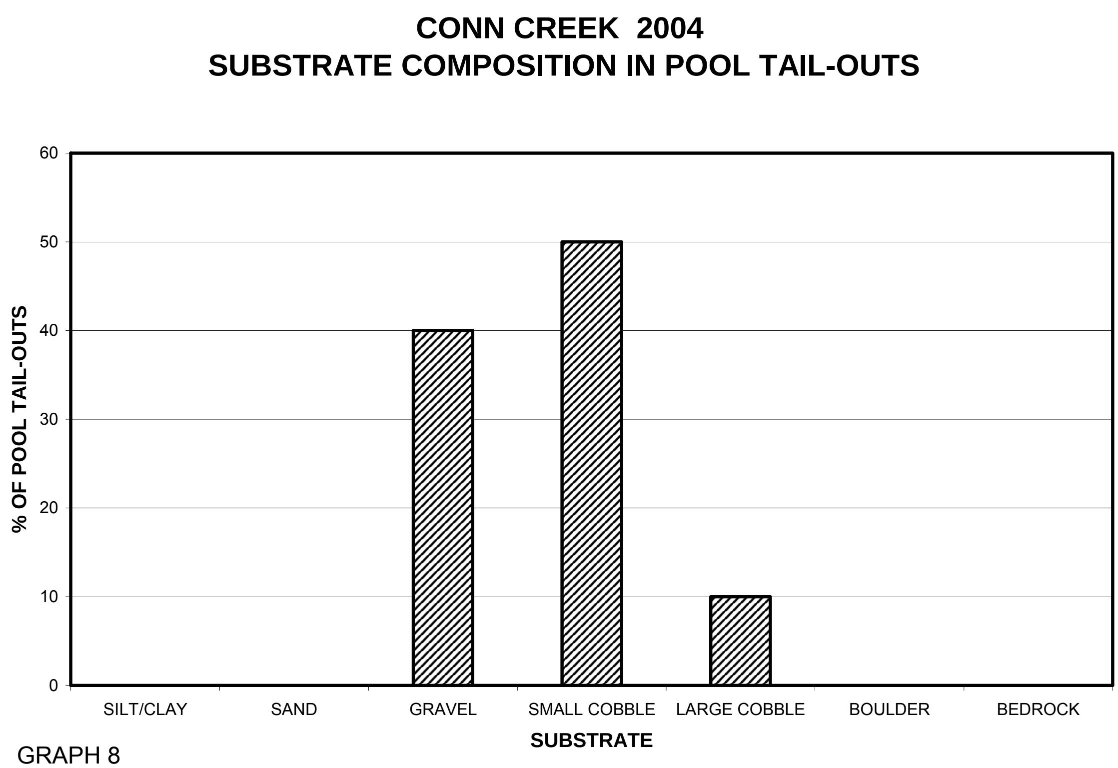
Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was observed in 40% of pool tail-outs, and small Cobble observed in 50% of pool tail-outs.

The mean percent canopy density for the surveyed length of Conn Creek was 39%. The mean percentages of hardwood and coniferous trees were 90% and 10%, respectively. Sixty one percent of the canopy was open. Graph 9 describes the mean percent canopy in Conn Creek.

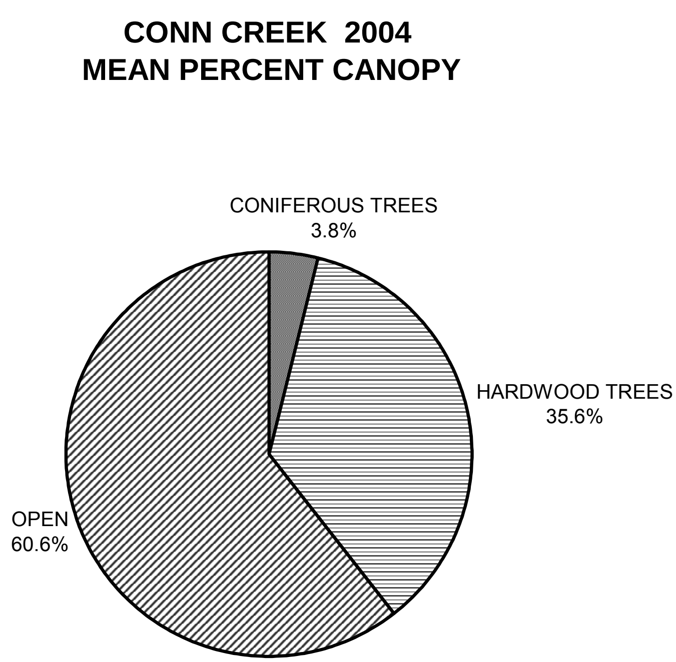
For the stream reach surveyed, the mean percent right bank vegetated was 56%. The mean percent left bank vegetated was 74%. The dominant elements composing the structure of the stream banks consisted of; 23% boulder, 23% cobble/gravel, and 55% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 59% of the units surveyed, and none had coniferous trees as the dominant vegetation (Graph 11).



GRAPH 7

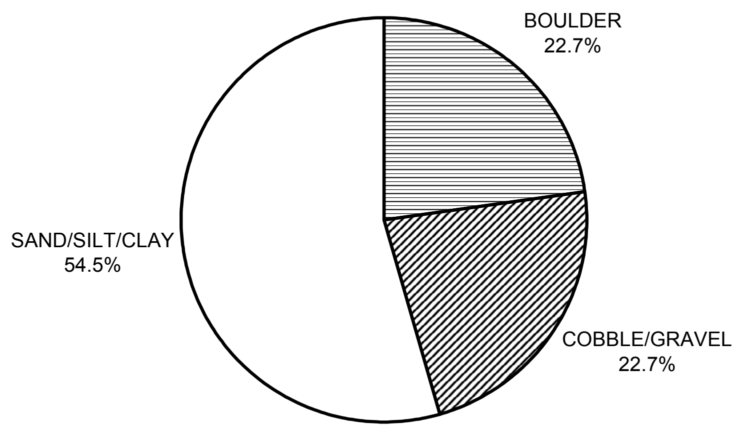


GRAPH 8



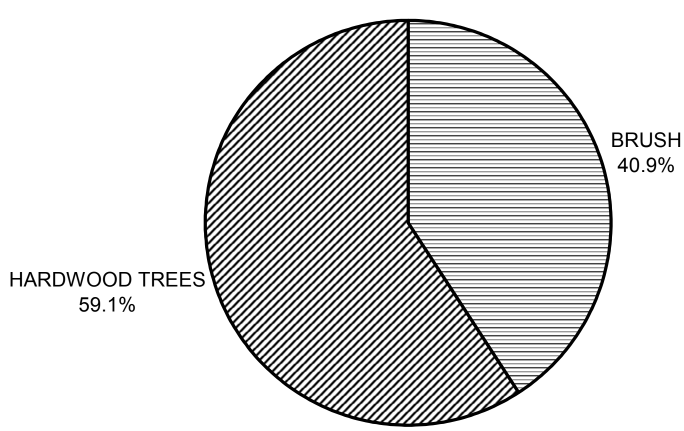
GRAPH 9

CONN CREEK 2004
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

CONN CREEK 2004
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

BIOLOGICAL INVENTORY RESULTS

Due to extensive dry conditions, a snorkel survey of Conn Creek was not warranted. Visual observations were made during habitat surveys, and no salmonids were documented. Several pools contained California roach; water temperatures were relatively high (>20° C) in these pools and little or no hiding/shaded refugia was present.

DISCUSSION

Conn Creek is an F4 channel type for 29,453 feet of the stream surveyed (Reach 1), and an F3 channel type for 4,220 feet of the stream surveyed (Reach 2). The suitability of F3 and F4 channel types for fish habitat improvement structures is discussed extensively in the California Salmonid Stream Habitat Restoration Manual (CDFG).

The water temperatures recorded on the survey days 8/6/2004 to 8/10/2004, ranged from 61 to 73 degrees Fahrenheit. Air temperatures ranged from 75 to 82 degrees Fahrenheit. These water temperatures are above the desired salmonid range, and when combined with the severe lack of persistent flow create unsuitable conditions for salmonid rearing. Efforts to increase flow persistence throughout the year would have a positive effect for rearing success by reducing stream temperatures during the late summer and fall when fish experience the most stressful conditions.

Flatwater habitat types comprised 3% of the total length of this survey, riffles 1%, pools 15%, and 80% dry units. The pools that do persist year-round are relatively deep, with 5 of the nine (56%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In fourth order streams, a primary pool is defined to have a maximum residual 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. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream. Of course, a lack of adequate late summer baseflow would render such efforts ineffective.

All of the six pool tail-outs measured had embeddedness ratings of 1 or 2, none of the pool tail-outs had embeddedness ratings of 3 or 4, and none of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Conn Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

In total, 9 of the 10 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 19, and the shelter rating in the flatwater habitats was 15. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by terrestrial vegetation in Conn Creek. Terrestrial vegetation is the dominant cover type in pools followed by boulders. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 39% (Reach 1 and 2 had a canopy density of 39%). In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was moderate at 56% and 74%, respectively.

In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

Overall, Conn Creek provides very limited habitat for salmonids due primarily to lack of perennial flow. Riparian encroachment and clearing are also extensive in the lower reaches. The construction and operation of Conn Dam has significantly altered the downstream reaches of the creek and eliminated access to upper tributary spawning and rearing grounds in Sage Creek, Moore Creek, and upper Conn Creek. The stream channel that now exists below the reservoir has been altered by adjacent landuse and flood control measures (i.e. riparian clearing and channel straightening). Under current conditions, Conn Creek is not capable of supporting salmonid rearing in any significant number, and although several perennial pools persist, they are exposed and experience elevated temperatures during the summer period.

Seasonal drying of the entire channel below the dam by mid June is typical in most years. Chinook spawning has been documented in the mainstem Napa River at the Yountville Eco-Reserve located at the confluence of Conn Creek and the Napa River (NCRCD, 2004). These intermittent reaches of Conn Creek contain suitable, though not ideal, Chinook spawning habitat and may be used during wet years. Unlike steelhead which require a year or more of stream residence, Chinook parr may successfully smolt in late spring prior to seasonal drying. It is not known whether Chinook salmon or steelhead regularly spawn in Conn Creek.

Prioritized restoration opportunities on Conn Creek are described in section 4 of this report.

3.1.5 Montgomery Creek

A stream inventory was conducted during 8/25/2004 to 8/25/2004 on Montgomery Creek. The survey began at the confluence with Dry Creek and extended upstream 0.9 miles to the end of anadromy at a natural boulder cascade. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Montgomery Creek.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for steelhead. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

<u>WATERSHED OVERVIEW</u>

Montgomery Creek is a tributary to Dry Creek, which is a tributary to Napa River, which is a tributary to the Pacific Ocean via San Pablo Bay (Map 1). Montgomery Creek's legal description at the confluence with Dry Creek is T07N R05W S32. Its location is 38.40597° north latitude and 122.44087 west longitude, LLID number 1224393384060. Montgomery Creek is a third order stream and has approximately 5.17 miles of blue line stream according to the USGS Rutherford 7.5 minute quadrangle. Montgomery Creek drains a watershed of approximately 2.12 square miles. Elevations range from about 580 feet at the mouth of the creek to 2,650 feet in the headwater areas. Oak and other mixed hardwoods along with mixed conifer forest dominate the watershed. The watershed is entirely privately owned, and vehicle access exists along Mt. Veeder Road off Dry Creek Road.

<u>HISTORICAL INFORMATION</u> (Leidy et al., 2005)

In December 1975, DFG visually surveyed Montgomery Creek from the mouth to the Mount Veeder Road crossing. No fish were observed. In the survey report DFG noted residents' reports that the creek dried up early in spring (Holstine, 1975).

A basic habitat survey was conducted in August and September 1998 by NCRCD, DFG, and local volunteers which covered 4,753 feet of channel (NCRCD, 2003). A total of 14 habitat units were identified in the survey reach including some dry sections. Most of the survey reach consisted of step-pool habitat sequences. The survey reach was predominantly boulder and cobble with occasional bedrock outcroppings. Embeddedness was generally low (0-50%) in pool tail-outs, and gravel was the most common substrate in riffles. Canopy densities were also favorable with a range of 68 – 96%. No fish sampling was conducted.

Ecotrust and FONR carried out surveys in tributaries of the Napa River system in July and August 2001. Relative density of steelhead was noted between 1 and 3, with 3 indicating greater than one individual per square meter. Of three Montgomery Creek reaches and two reaches in a tributary, one reach was found to have *O. mykiss* at density level "2," while two reaches had density level "3" (Ecotrust and FONR 2001).

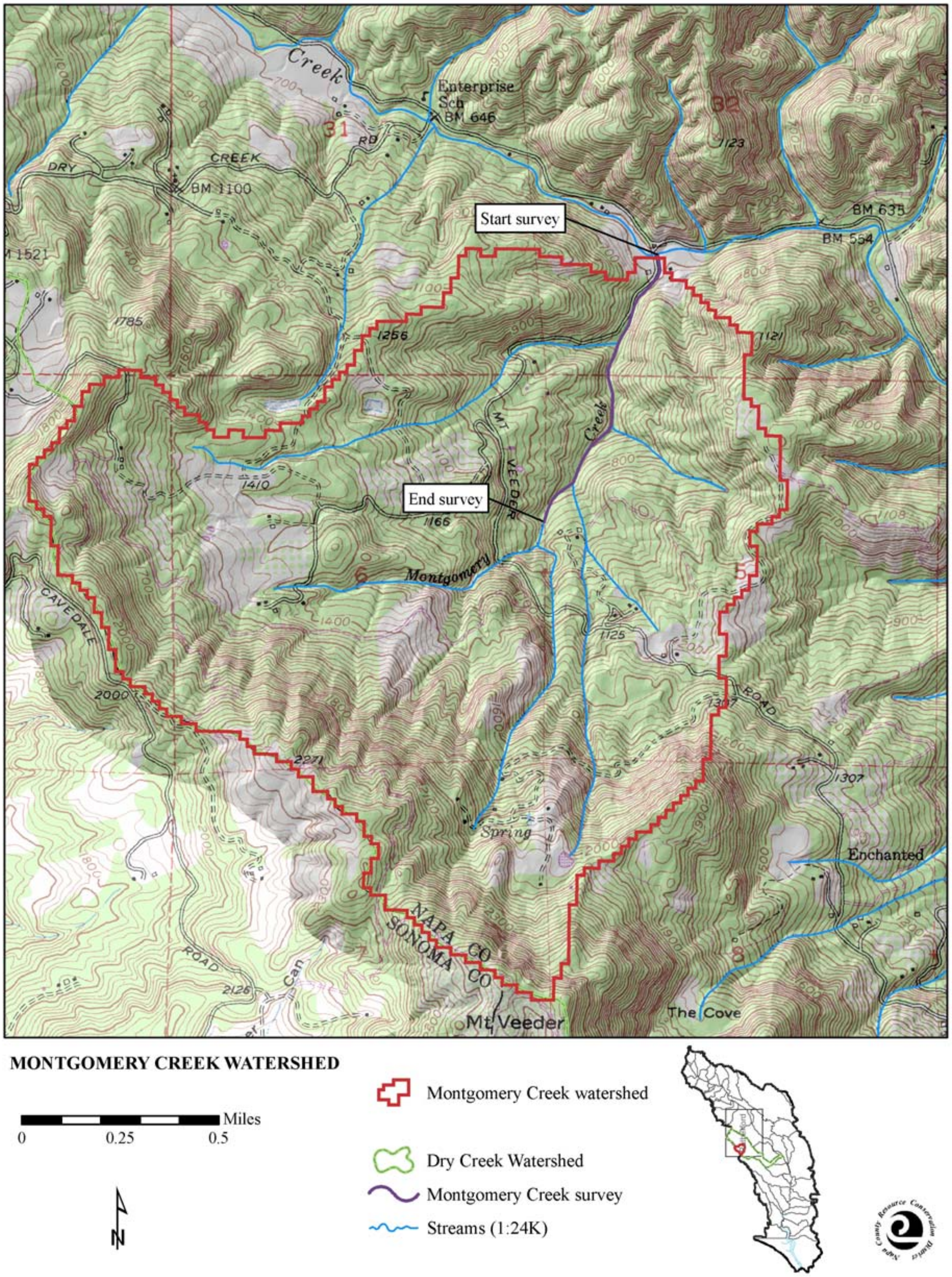


Figure 3.1-5. Watershed map of the Montgomery Creek drainage.

HABITAT INVENTORY RESULTS

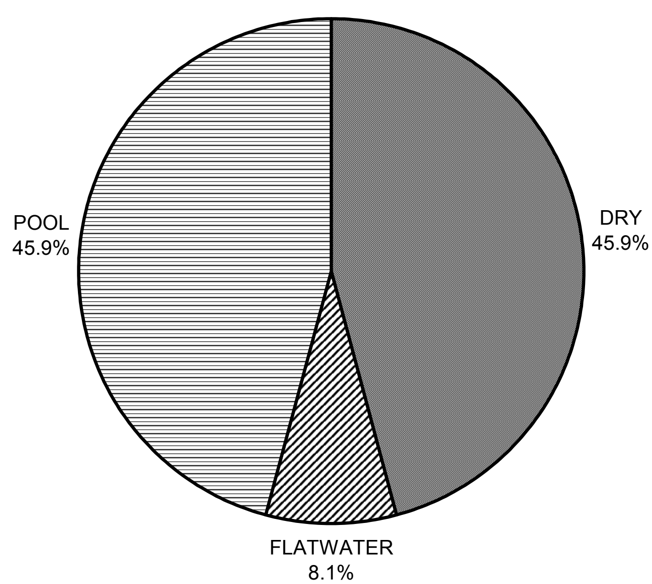
The habitat inventory of 8/25/2004 was conducted by J. Koehler, & C. Edwards. The total length of the stream surveyed was 4,559 feet. Stream flow was not quantitatively measured on Montgomery Creek; however during the habitat survey, surface flow was very low with many dry stretches and isolated pools. Several pools contained juvenile yoy steelhead. There were no pools and no surface water present along the entire surveyed reach during a follow-up reconnaissance survey of Montgomery Creek in September, 2004.

Montgomery Creek is a B3 channel type for 4,559 feet of the stream surveyed (Reach 1). B3 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and cobble-dominant substrates.

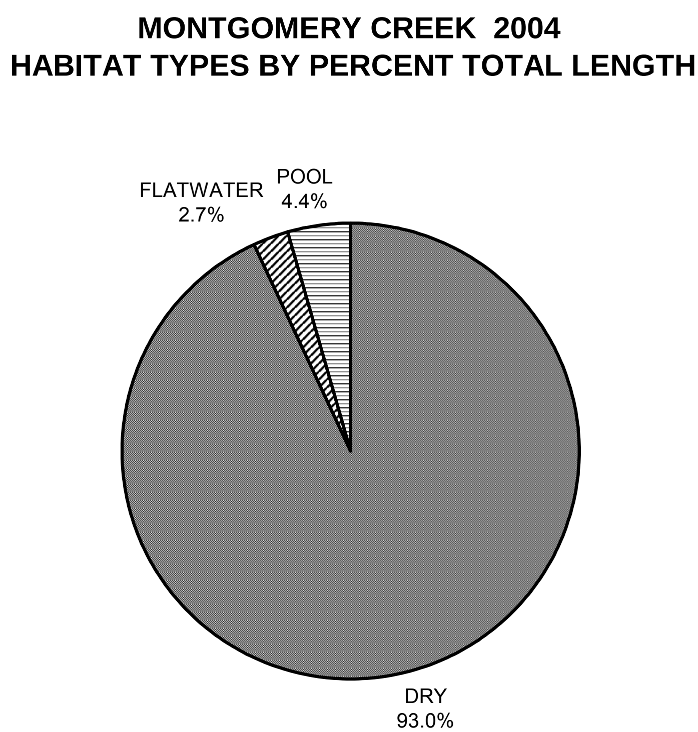
Water temperatures taken during the survey period ranged from 58 to 63 degrees Fahrenheit. Air temperatures ranged from 73 to 81 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 46% dry units, 46% pool units, and 8% flatwater units (Graph 1). Based on total length of Level II habitat types there were 93% dry units, 4% pool units, and 3% flatwater units (Graph 2).

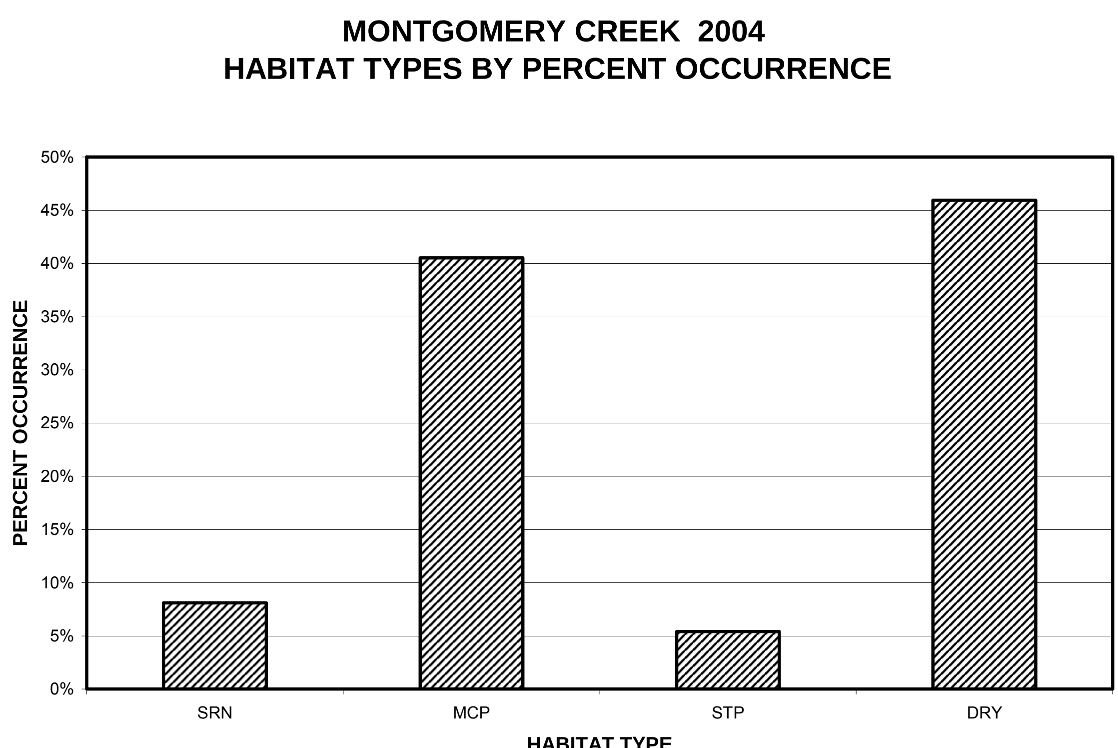
MONTGOMERY CREEK 2004
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1



GRAPH 2



GRAPH 3

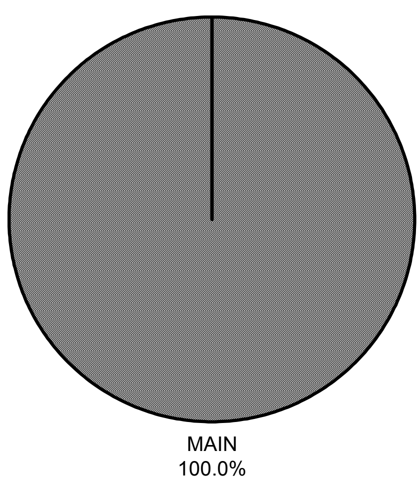
Four Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 46% Dry units, 41% Mid-Channel Pool units, and 8% Step Run units (Graph 3). Based on percent total length, the most frequent habitat types were; 93% Dry units, 3% Mid-Channel Pool units, and 3% Step Run units.

A total of 17 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 100%, and comprised 100% of the total length of all pools (Graph 4). Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth, and one of the 7 pools (14%) had a residual depth of two feet or greater (Graph 5).

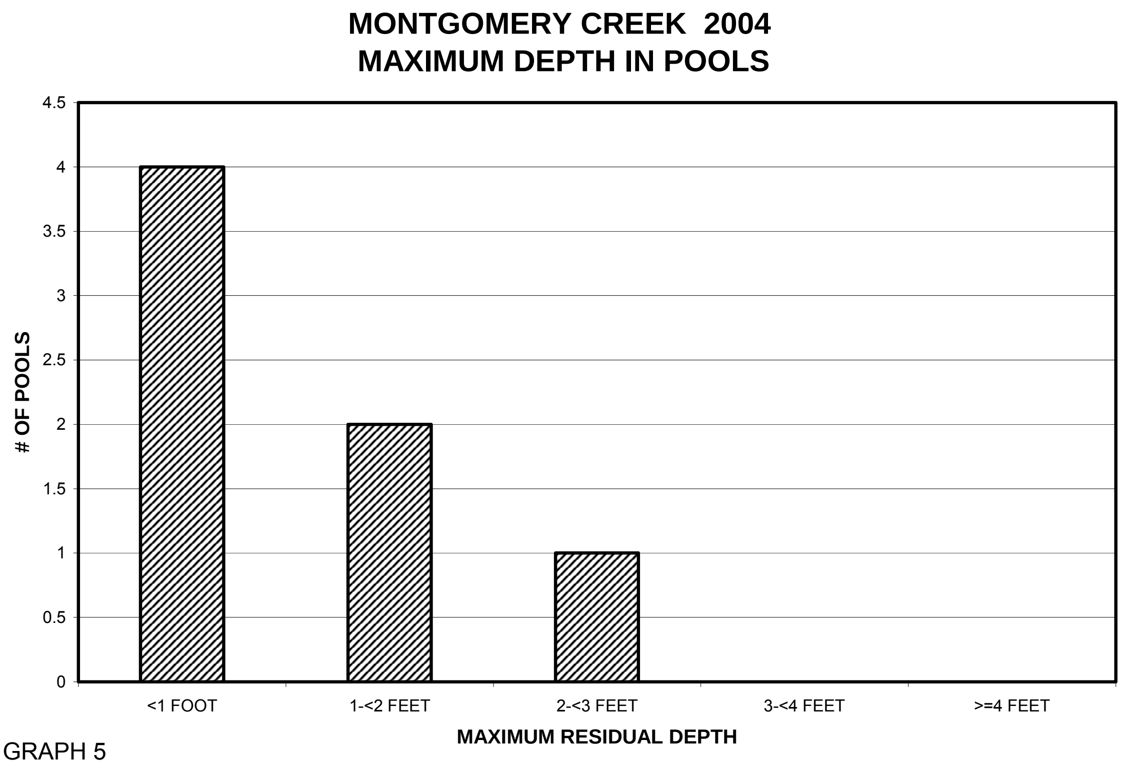
The depth of cobble embeddedness was estimated at pool tail-outs. Of the 5 pool tail-outs measured, 2 had a value of 1 (40%); 2 had a value of 2 (40%); and one had a value of 5 (20%, see Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock.

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 habitat types had a mean shelter rating of 20, and pool habitats had a mean shelter rating of 20 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 20 (Table 3). Due to the ephemeral nature of Montgomery Creek, riffle habitats are nearly nonexistent in the late summer and early fall.

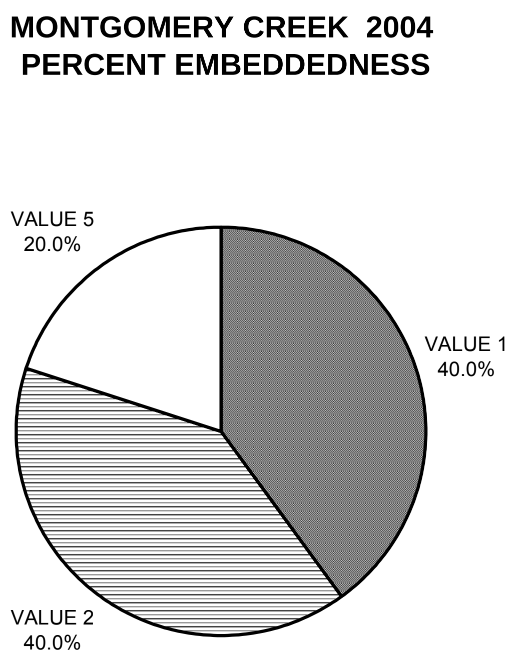
MONTGOMERY CREEK 2004
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4

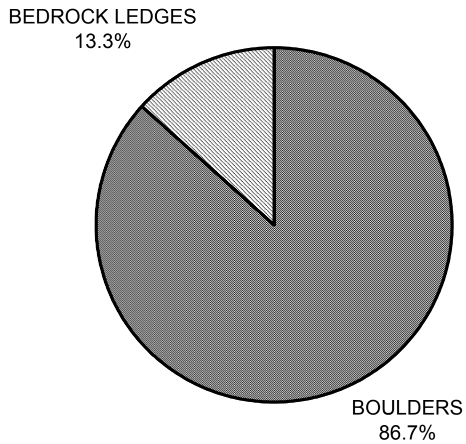


GRAPH 5



GRAPH 6

MONTGOMERY CREEK 2004
MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

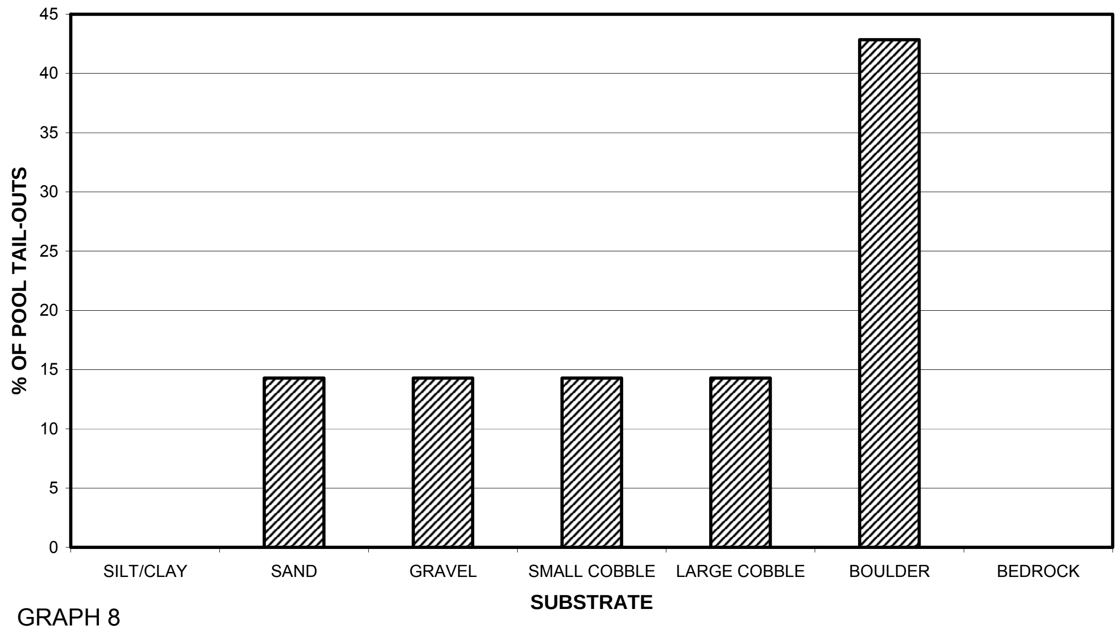
Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Montgomery Creek, and are the dominant pool cover type followed by bedrock ledges (Graph 7 describes the pool cover in Montgomery Creek).

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. The dominant pool tail-out substrate observed in Montgomery Creek were boulders (43%), and gravel (14%).

The mean percent canopy density for the surveyed length of Montgomery Creek was 97%. The mean percentages of hardwood and coniferous trees were 40% and 60%, respectively, and 3% of the canopy was open. Graph 9 describes the mean percent canopy in Montgomery Creek.

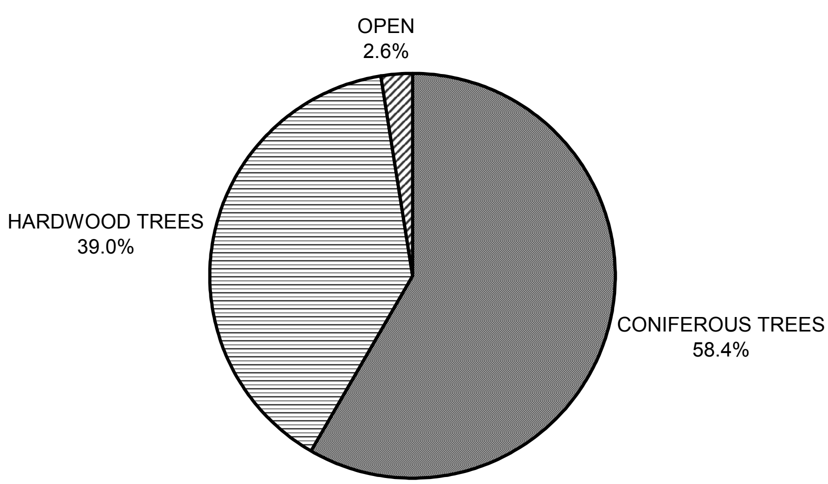
For the stream reach surveyed, the mean percent right bank vegetated was 65%, and the mean percent left bank vegetated was 69%. The dominant elements composing the structure of the stream banks consisted of 12% bedrock, 56% boulder, 25% cobble/gravel, and 6% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 44% of the units surveyed. Additionally, 44% of the units surveyed had hardwood trees as the dominant vegetation type, and 38% had coniferous trees as the dominant vegetation (Graph 11).

MONTGOMERY CREEK 2004
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



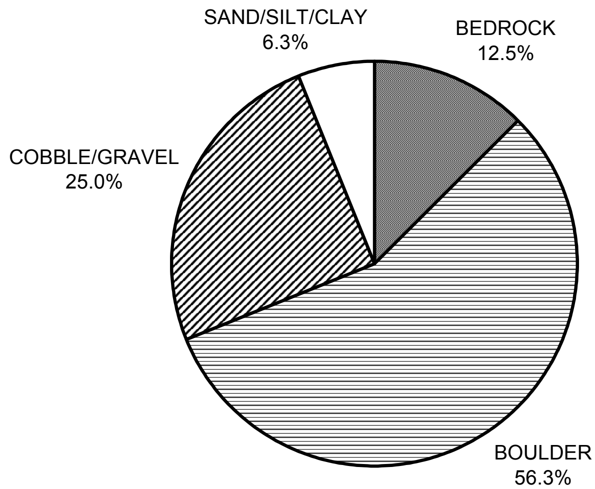
GRAPH 8

MONTGOMERY CREEK 2004
MEAN PERCENT CANOPY



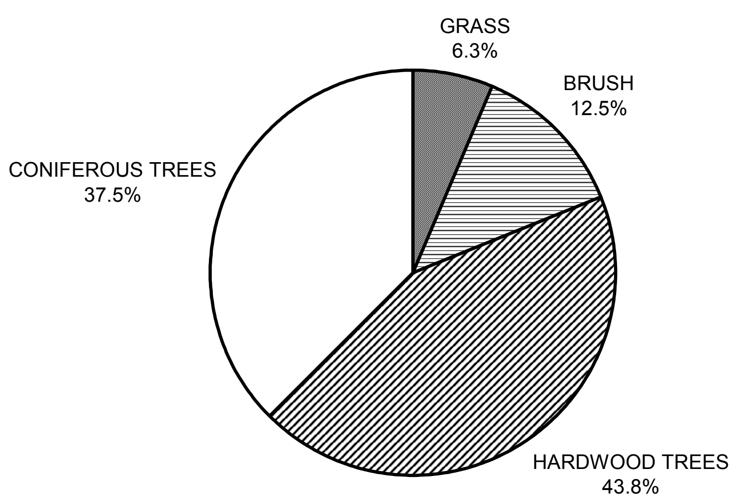
GRAPH 9

MONTGOMERY CREEK 2004
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

MONTGOMERY CREEK 2004
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

DISCUSSION

Montgomery Creek is a B3 channel type for 4,559 feet of the stream surveyed (Reach 1). The suitability of B3 channel types for fish habitat improvement structures is described extensively in the California Salmonid Stream Habitat Restoration Manual (CDFG).

The water temperatures recorded on the survey day (8/25/2004), ranged from 58 to 63 degrees Fahrenheit. Air temperatures ranged from 73 to 81 degrees Fahrenheit. These stream temperatures are favorable for juvenile steelhead rearing.

Flatwater habitat types comprised 3% of the total length of this survey, dry units 93 %, and pools 4%. The pools are relatively shallow, with only 1 of the 7 (14%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third order streams, a primary pool is defined to have a maximum residual 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 total, 4 of the 5 pool tail-outs measured had embeddedness ratings of 1 or 2, and none of the pool tail-outs had embeddedness ratings of 3 or 4. One of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead.

Two of the 7 pool tail-outs measured had gravel or small cobble as the dominant substrate, which is favorable for spawning salmonids.

The mean shelter rating for pools and flatwater habitats was 20. A pool shelter rating of approximately 100 is desirable. Boulders are the dominant cover type in pools followed by bedrock ledges. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 97%, which is very favorable for maintaining cool stream temperatures and providing complex riparian habitat.

The percentage of right and left bank covered with vegetation was moderate at 65% and 69%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting native plant species, in conjunction with bank stabilization, is recommended.

Overall, salmonid habitat in Montgomery Creek is significantly limited by the lack of stream flow persistence during summer. Steelhead rearing is restricted to isolated pools, which appear to go dry during most years. Successful steelhead spawning occurred in 2004 (yoy steelhead documented), but it is not known whether steelhead regularly spawn in Montgomery Creek. Aside from flow, all other physical characteristics of Montgomery Creek are suitable or favorable for salmonid spawning and rearing.

3.1.6 Napa River

A stream inventory was conducted from 7/6/2004 to 8/2/2004 in the central reaches of the Napa River. The survey began at the Yountville Crossroad and extended upstream 13.4 miles to the confluence of Bell Creek.

The Napa River inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Napa River. The objective of the biological inventory was to document the presence and distribution of juvenile salmonids and other fish 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, and steelhead. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

HISTORICAL INFORMATION (Leidy et al., 2005)

A watershed-wide steelhead resource analysis was performed by DFG in 1969 for the Napa River drainage. In the final document, DFG estimated the standing crop of juvenile steelhead at 87,300 to 144,600 fish (Anderson 1969f). According to DFG, this crop would result in an adult run of 580 to 960 steelhead given a return of 0.5 percent, or 1,160 to 1,930 steelhead based on a return of 1.0 percent (Anderson 1969f). The report also found larger populations of smaller-sized juvenile steelhead in the upper reaches of tributary streams, while lower reaches of tributary streams and isolated sections of Napa River supported smaller populations of larger-sized juveniles (Anderson 1969f). Mean juvenile fork length was about 25 mm less in upper reaches of tributary streams (64 mm) than in the mainstem Napa River (89 mm).

A 1959 DFG survey of the Napa River included mention of a creel survey during the winter of 1954-55. The creel survey found that almost 400 steelhead were harvested from the mouth upstream to Lincoln Bridge in the city of Calistoga (Fisher 1959c).

In June 1961, DFG visually surveyed the Napa River from one mile north of Calistoga downstream to Zinfandel Lane. In this 11.5-mile reach, 26 YOY O. mykiss were observed up to about 75 mm in length (Day 1961b). Staff from DFG considered this reach of the Napa River to be the most important spawning and nursery area of the mainstem, but it was said to act primarily as a migration route for adult steelhead returning to spawn in the tributaries (Day 1961a).

In July and August 1969, DFG electrofished seven stations on mainstem Napa River between the Blossom and Dry creek confluences. Oncorhynchus mykiss were collected at three stations near the Sulphur Creek confluence, with a total of 37 juvenile steelhead recorded (Anderson 1969a). Most of the steelhead were caught at Zinfandel Lane, including 30 fish ranging from 69-122 mm FL. Steelhead densities were estimated at 39 per 30 meters at Zinfandel Lane and four per 30 meters at both Pratt Avenue and Pope Street. The report included an estimate of 3,000 juvenile steelhead in the standing crop of 1969 between Calistoga and Yountville (Anderson 1969a).

In October 1988, DFG electrofished the Napa River from the confluence with Bell Canyon Creek downstream to Lodi Lane. No O. mykiss were caught (Montoya 1988c). In early October 1989, DFG set gill-nets in the Napa River downstream of the city of Napa and caught one steelhead (398 mm FL) (Gray 1989b).

Leidy found no O. mykiss when he electrofished four locations between Yountville and Calistoga in August and September 1993, nor when he conducted otter-trawls at four locations in the Napa sloughs in July 1994 (Leidy 2002). In July 1997, Leidy electrofished a pool on the upper Napa River, immediately downstream of an Arizona crossing at the Calistoga water treatment plant. He caught two O. mykiss (255, 210 mm FL) with a silvery appearance suggesting anadromy (Leidy 2002).

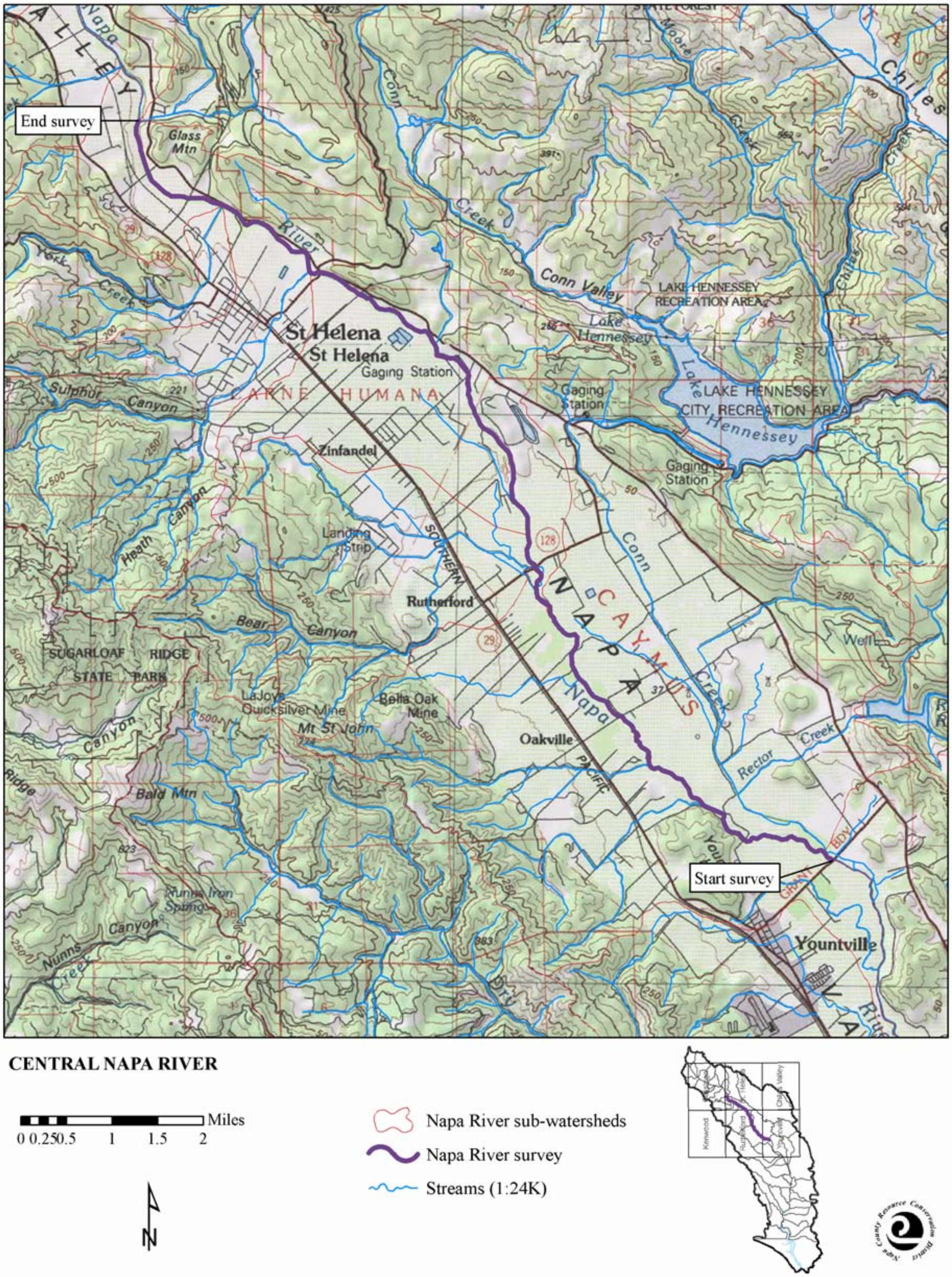


Figure 3.1-6. Watershed map of the central Napa River basin.

HABITAT INVENTORY RESULTS

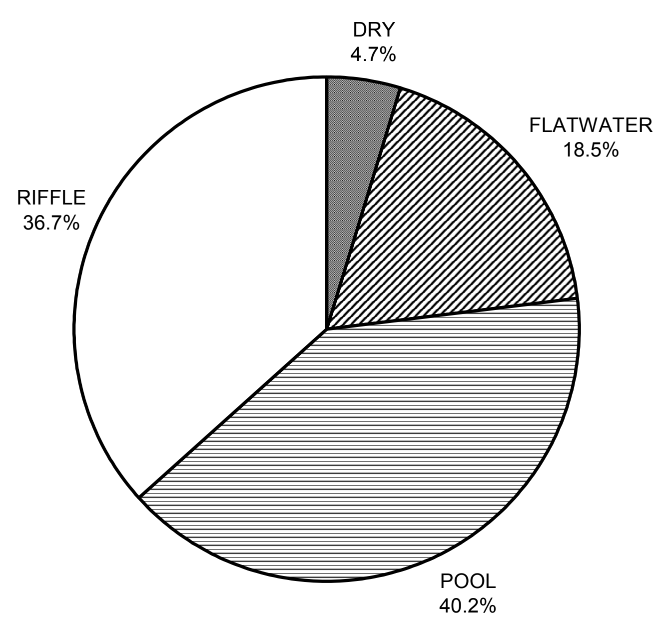
The habitat inventory of 7/6/2004 to 8/2/2004 was conducted by C. Edwards, and D. Chase. The total length of the stream surveyed was 70,852 feet with an additional 90 feet of side channel. Stream flow was not measured on Napa River

The Napa River is an F4 channel type for 17,078 feet of the stream surveyed (Reach 3), an F4 channel type for 4,484 feet of the stream surveyed (Reach 1), an F4 channel type for 3,468 feet of the stream surveyed (Reach 2), an F4 channel type for 16,992 feet of the stream surveyed (Reach 4), an F4 channel type for 15,794 feet of the stream surveyed (Reach 5), and an E4 channel type for 13,036 feet of the stream surveyed (Reach 6). F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. E4 channels are low gradient, meandering riffle/pool streams with low width/depth ratios and little deposition. They are very efficient and stable, with a high meander width ratio, and gravel dominant substrates.

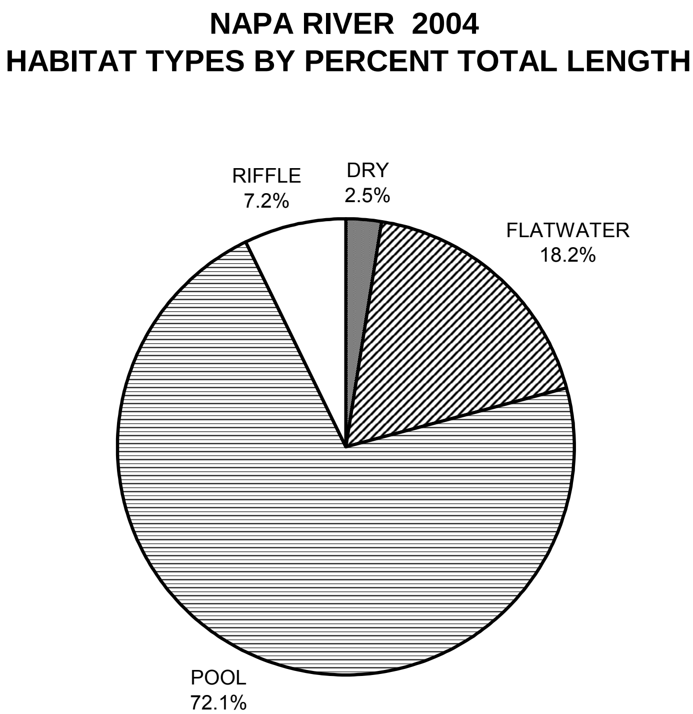
Water temperatures taken during the survey period ranged from 64 to 78 degrees Fahrenheit. Air temperatures ranged from 60 to 93 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 40% pool units, 37% riffle units, 18% flatwater units, and 5% dry units (Graph 1). Based on total length of Level II habitat types there were 72% pool units, 7% riffle units, 18% flatwater units, and 3% dry units (Graph 2).

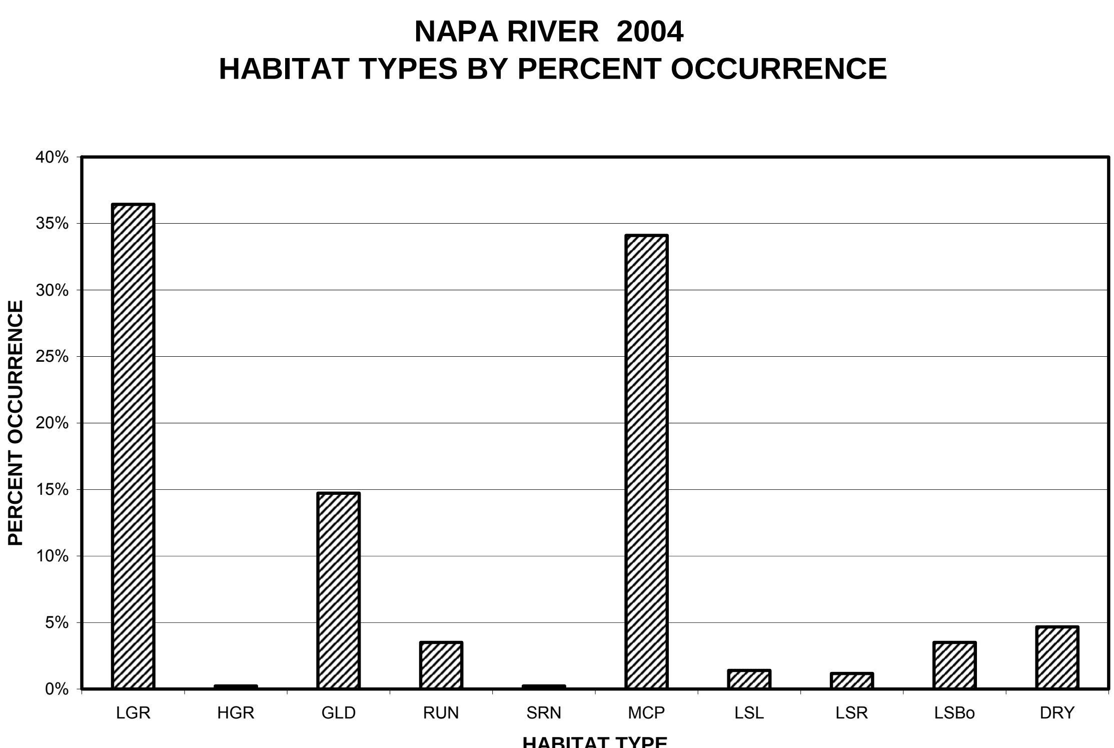
NAPA RIVER 2004
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

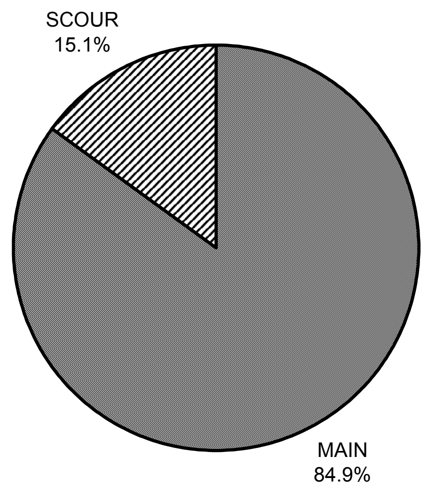


GRAPH 2



GRAPH 3

NAPA RIVER 2004
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4

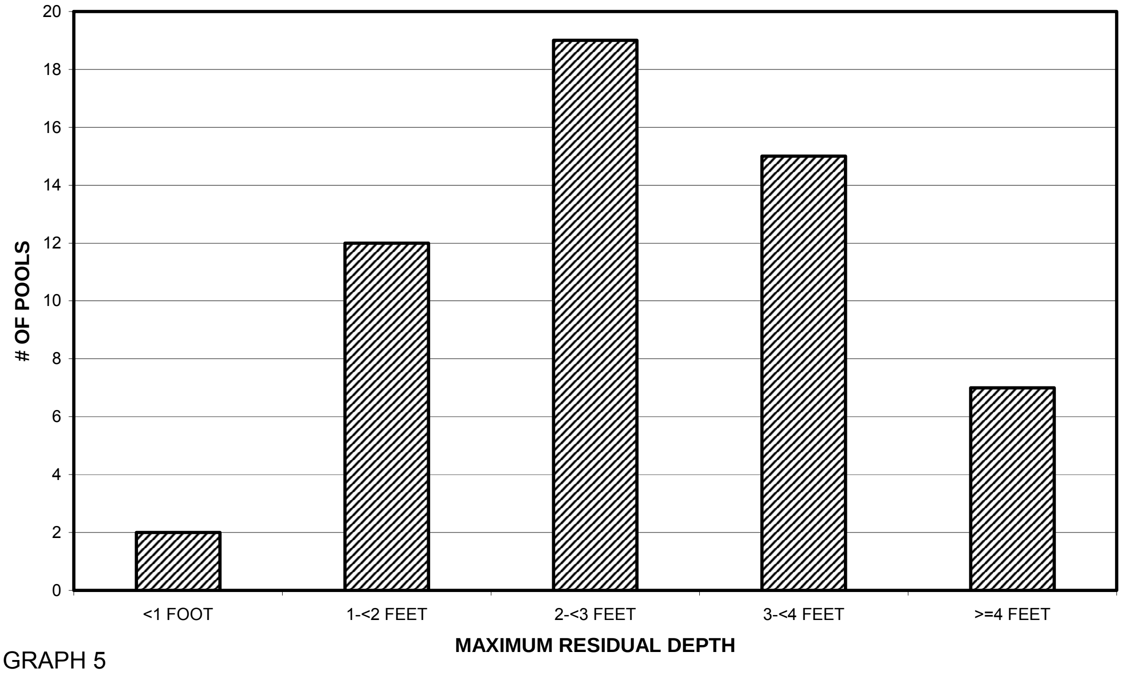
In total, ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 34% Mid-Channel Pool units, 36% Low Gradient Riffle units, and 15% Glide units (Graph 3). Based on percent total length, the most frequently encountered habitat units were as follows; 65% Mid-Channel Pool units, 7% Low Gradient Riffle units, and 16% Glide units.

A total of 172 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 85%, and comprised 90% of the total length of all pools (Graph 4). Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth, and 22 of the 55 pools (40%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 46 pool tail-outs measured, 21 had a value of 1 (45.7%); 21 had a value of 2 (45.7%); 2 had a value of 3 (4.3%); 1 had a value of 4 (2.2%); and 1 had a value of 5 (2.2%, see 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 including logs or bedrock.

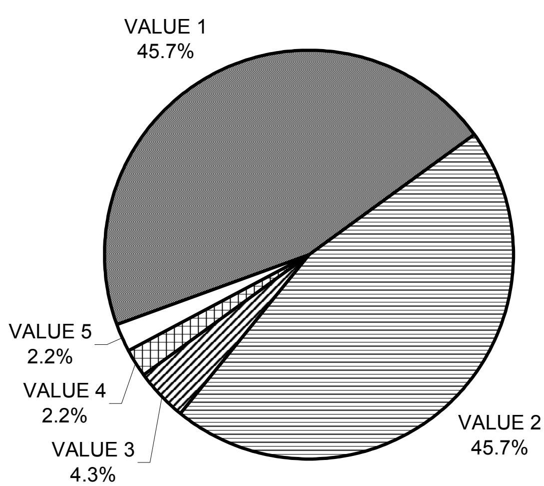
A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Riffle habitat types had a mean shelter rating of 49, flatwater habitat types had a mean shelter rating of 35, and pool habitats had a mean shelter rating of 57 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 53, and Scour pools had a mean shelter rating of 75 (Table 3).

NAPA RIVER 2004
MAXIMUM DEPTH IN POOLS



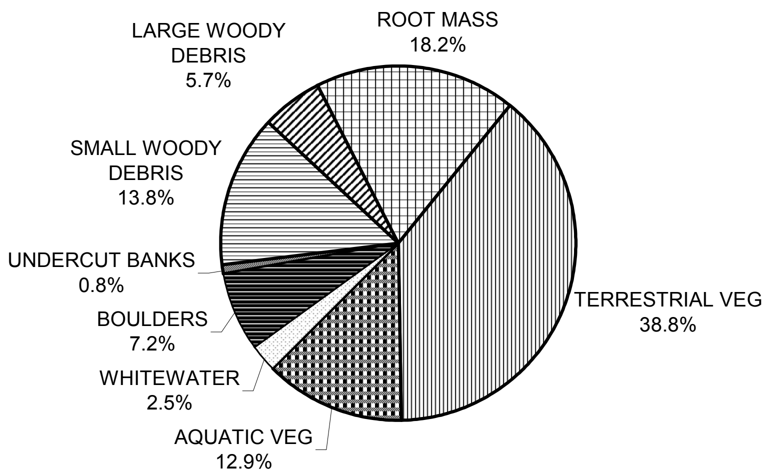
GRAPH 5

NAPA RIVER 2004
PERCENT EMBEDDEDNESS



GRAPH 6

NAPA RIVER 2004
MEAN PERCENT COVER TYPES IN POOLS



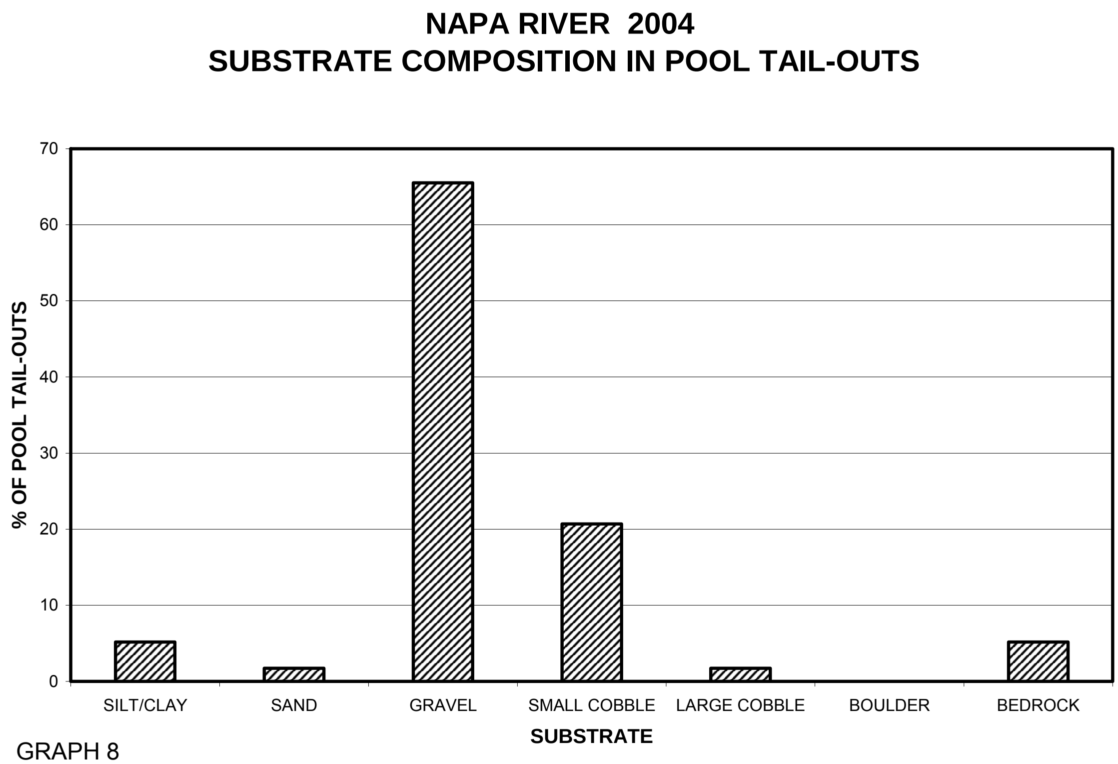
GRAPH 7

Table 5 summarizes mean percent cover by habitat type. Terrestrial vegetation is the dominant cover type in Napa River. Terrestrial vegetation is also the dominant pool cover type followed by root mass. Graph 7 describes the pool cover in Napa River.

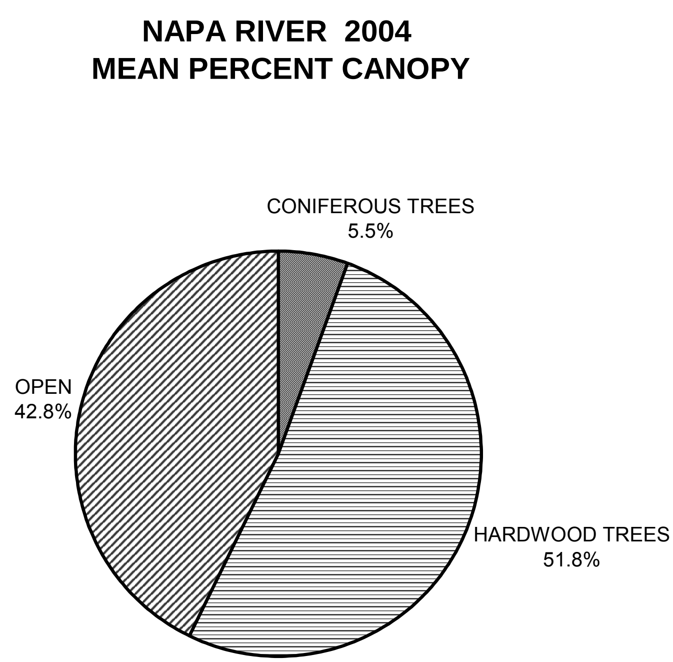
Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs (a silt/clay substrate type was observed in 5% of pool tail-outs, gravel was observed in 66% of pool tail-outs, and small Cobble observed in 21% of pool tail-outs).

The mean percent canopy density for the surveyed length of Napa River was 57%. The mean percentages of hardwood and coniferous trees were 90% and 10%, respectively. In total, forty three percent of the canopy was open. Graph 9 describes the mean percent canopy in Napa River.

For the stream length surveyed, the mean percent right bank vegetated was 81%, and the mean percent left bank vegetated was 84%. The dominant elements composing the structure of the stream banks consisted of 3% bedrock, 1% boulder, 33% cobble/gravel, and 62% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 57% of the units surveyed. Additionally, 57% of the units surveyed had hardwood trees as the dominant vegetation type, and 1% had coniferous trees as the dominant vegetation (Graph 11).

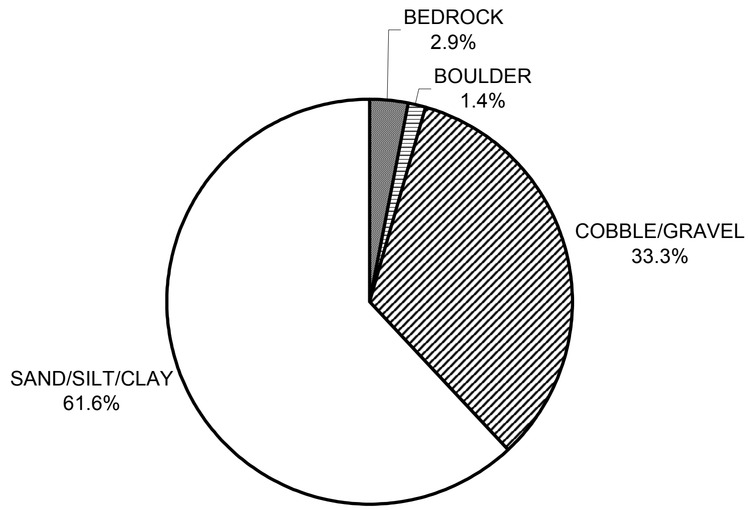


GRAPH 8



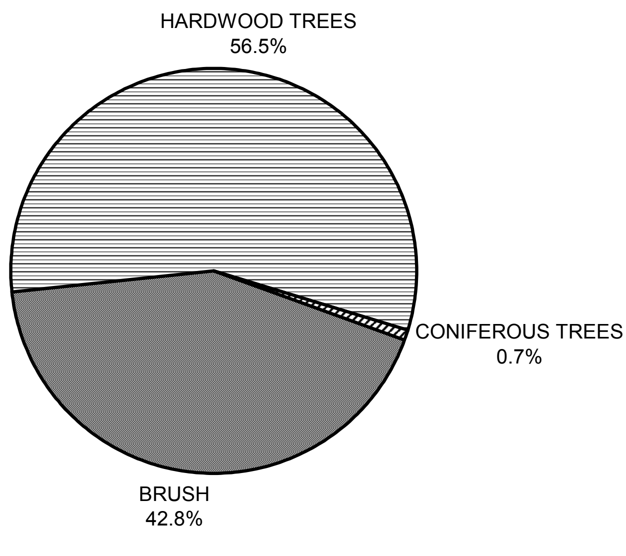
GRAPH 9

NAPA RIVER 2004
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

NAPA RIVER 2004
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

BIOLOGICAL INVENTORY RESULTS

A snorkel survey of the Napa River was conducted in summer 2004, which documented several juvenile steelhead primarily in deeper pools. Densities were relatively low, and most fish were older 1+ and 2+ juveniles. The results are discussed in further detail in section 3.2 of this report. Salmon spawner surveys were also conducted in fall 2004, and the results are discussed in section 3.7 of this report.

DISCUSSION

The Napa River is an F4 channel type for 17,078 feet of the stream surveyed (Reach 3), an F4 channel type for 4,484 feet of the stream surveyed (Reach 1), an F4 channel type for 3,468 feet of the stream surveyed (Reach 2), an F4 channel type for 16,992 feet of the stream surveyed (Reach 4), an F4 channel type for 15,794 feet of the stream surveyed (Reach 5), and an E4 channel type for 13,036 feet of the stream surveyed (Reach 6). The suitability of F and E channel types for fish habitat improvement structures is discussed extensively in the California Salmonid Stream Habitat Restoration Manual (CDFG).

The water temperatures recorded on the survey days 7/6/2004 to 8/2/2004, ranged from 64 to 78 degrees Fahrenheit. Air temperatures ranged from 60 to 93 degrees Fahrenheit. These water temperatures are above the desired range for rearing salmonids. There was great variability in measured stream temperatures, and juvenile steelhead and salmon may be able to seek out thermal refugia near groundwater seeps or heavily shaded banks. Overall however, summertime temperatures are limiting the ability of the Napa River to support rearing.

Continuous temperature monitoring was conducted at four sites on the mainstem Napa River, which showed a broad range of conditions throughout the monitoring period. These results are discussed in further detail in section 3.6 of this report. Flow persistence and riparian shading, or lack thereof, were the two most likely factors contributing to elevated summertime temperatures.

Flatwater habitat types comprised 18% of the total length of this survey, riffles 7%, and pools 72%. The pools are relatively deep, with 41 of the 55 (75%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In fourth order streams, a primary pool is defined to have a maximum residual 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. The pools in much of the surveyed reach are relatively homogenous and do not provide sufficient complexity for hiding and holding. Such conditions favor predatory fish including Sacramento pikeminnow and bass species, which are predators on juvenile salmonids.

In total, 42 of the 46 pool tail-outs measured had embeddedness ratings of 1 or 2, and three of the pool tail-outs had embeddedness ratings of 3 or 4. One of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, which is considered to indicate good quality spawning substrate for salmon and steelhead.

Fifty of the 58 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. Eight of the 58 pool tail-outs had silt, sand, large cobble, and boulders or bedrock as the dominant substrate, which is generally unsuitable for spawning salmonids. Overall, spawning habitat is limited in large part due to lack of pool/riffle habitat. Long pool/runs dominate the surveyed reach and suitable spawning pool tail-outs or deep riffles were relatively uncommon.

The mean shelter rating for pools was 57, and the shelter rating in the flatwater habitats was 35. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by terrestrial vegetation in the Napa River. Terrestrial vegetation is also the dominant cover type in pools followed by root mass. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 57%. Reach 1 had a canopy density of 57%, Reach 2 had a canopy density of 55%, Reach 3 had a canopy density of 74%, Reach 4 had a canopy density of 53%, Reach 5 had a canopy density of 54%, and Reach 6 had a canopy density of 62%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was high at 81% and 84%, respectively. Stream bank erosion was common, and prioritized locations have been identified for potential bank stabilization and revegetation efforts; these are discussed in section 4 of this report.

3.1.7 Rector Creek

A stream inventory was conducted during 5/19/2003 to 5/23/2003 on Rector Creek. The survey began at the confluence with Conn Creek and extended upstream 1.6 miles to a point just above the Silverado Trail. Stream flow was very limited, especially in the between State Lane and the Silverado Trail.

The Rector Creek inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Rector Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for steelhead and possibly chinook salmon. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

<u>WATERSHED OVERVIEW</u>

Rector Creek is a tributary to Conn Creek, which is a tributary to Napa River, which flows to the Pacific Ocean via San Pablo Bay. Rector Creek's location at the confluence with Conn Creek is 38.42848° north latitude and 122.37103° west longitude, LLID number 1223699384288. Rector Creek is a third order stream and has approximately 1.65 miles of blue line stream below Rector Reservoir according to the USGS Yountville 7.5 minute quadrangle. Rector Creek drains a watershed of approximately 10.86 square miles above Rector Reservoir; hydrologic boundaries are not well established for Rector Creek below the reservoir. Elevations range from about 110 feet at the mouth of the creek to 2,630 feet in the headwater areas above Rector Reservoir. Mixed hardwood and conifer forest dominates the upper watershed; agriculture and oak woodland dominate the area below the reservoir. Vehicle access exists via the Silverado Trail and State Lane from the Yountville Crossroad.

<u>HISTORICAL INFORMATION</u> (Leidy et al., 2005)

Rector Reservoir, located immediately upstream of the Silverado Trail, is a complete barrier to upstream steelhead migration.

In December 1985, DFG electrofished a 300 meter reach of Rector Creek upstream of Rector Reservoir. A total of 41 *O. mykiss* (52-116 mm FL) were caught and kept for disease analysis. One female and three males were found to be sexually mature (Gray 1986b).

In March 1986 DFG electrofished Rector Creek between the Silverado Trail and the spillway of Rector Reservoir, which was spilling at the time of the survey. Three adult *O. mykiss* (approximately 305 mm FL) and 30 *O. mykiss* juveniles (100-150 mm) were caught. Some fish were silvery, indicating smolt transformation (Emig 1986).

In February 1988, DFG electrofished approximately 600 meters of Rector Creek upstream from the reservoir collecting *O. mykiss* for bacterial kidney disease analysis. A total of 53 *O. mykiss* were caught ranging in size from 60-400 mm FL. According to DFG, the two largest individuals (315 and 400 mm) were in spawning condition (Gray 1988b).

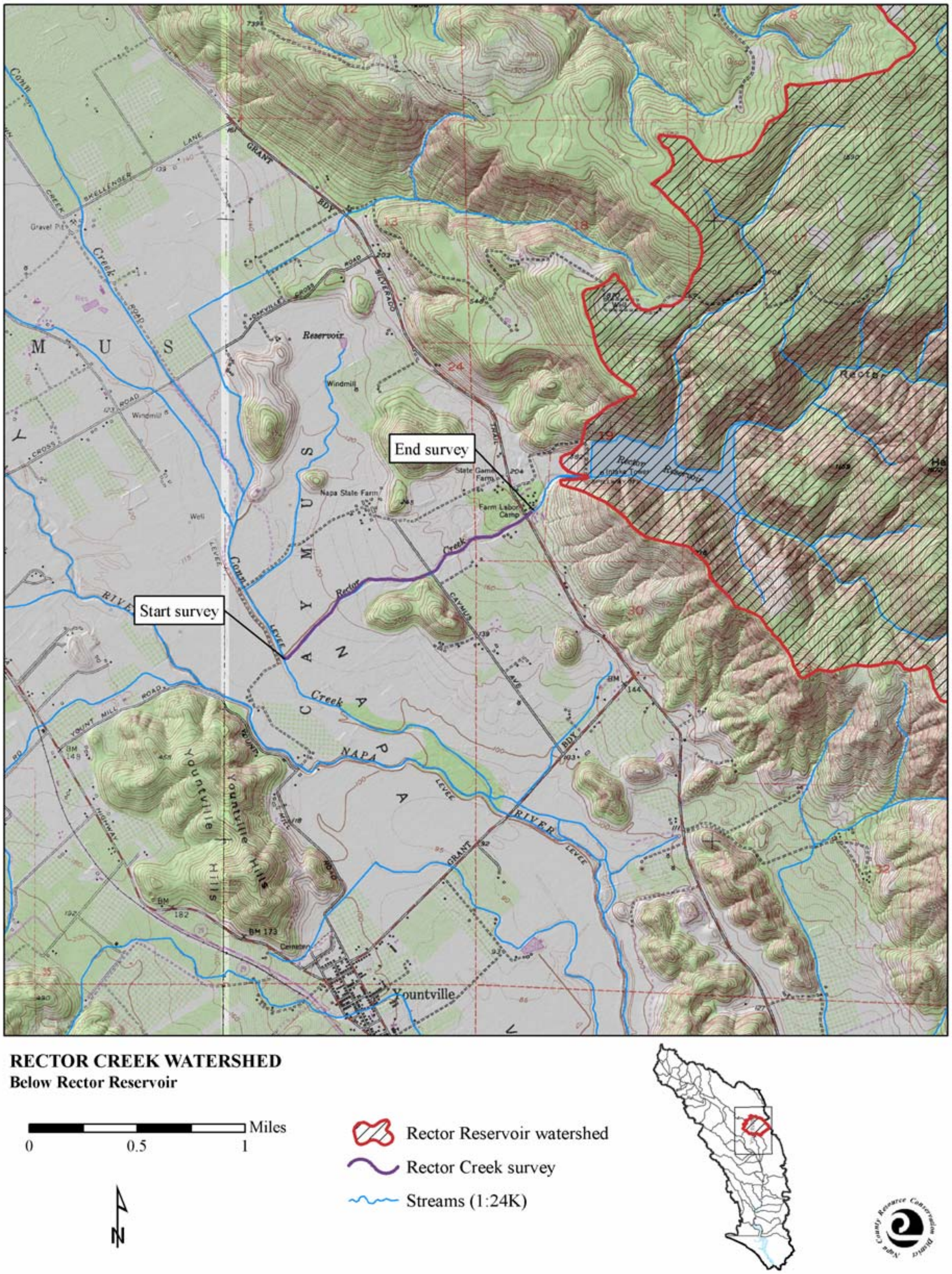


Figure 3.1-7. Watershed map of the lower Rector Creek drainage.

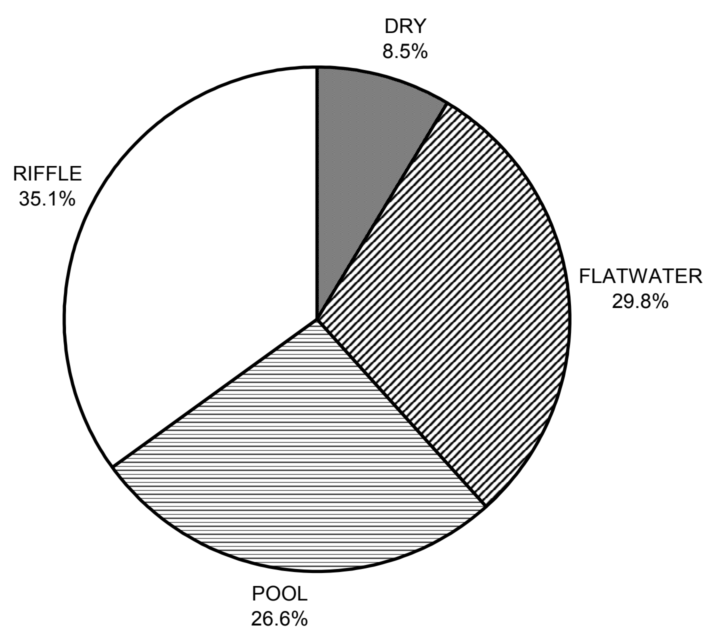
HABITAT INVENTORY RESULTS

The habitat inventory of Rector Creek between 5/19/2003 and 5/23/2003 was conducted by J. Koehler, and M. Champion. The total length of the stream surveyed was 8,215 feet with an additional 352 feet of side channel. Stream flow was very limited during the survey period. A small discharge point from a pipe in the right bank on the California Department of Fish and Game property was the sole source of surface flow on the final survey day (5/23/2003); the channel was dry above this point. During follow up reconnaissance visits, the entire length of the channel was dry by 6/1/2003 with the exception of a few scattered isolated pools, which retained water through the summer.

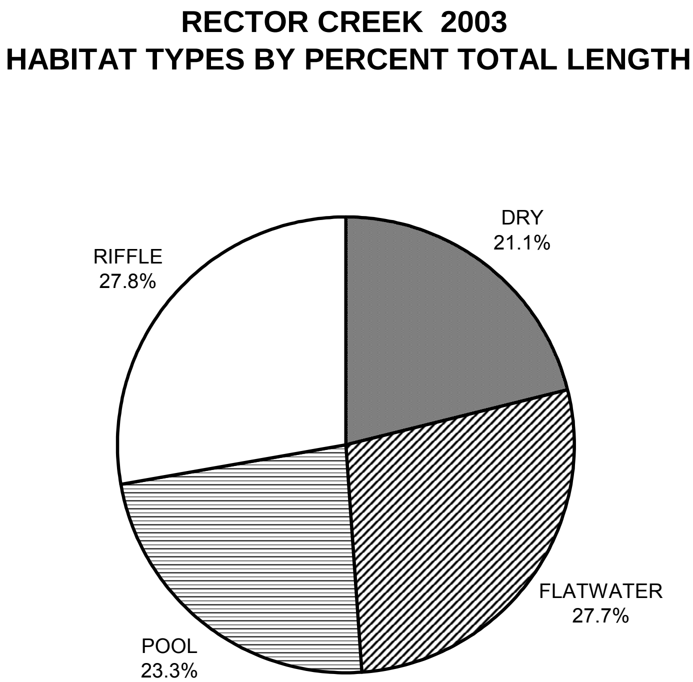
Rector Creek is an F4 channel type for 1,900 feet of the stream surveyed (Reach 1), a D3 channel type for 4,195 feet of the stream surveyed (Reach 2), and an F3 channel type for 2,120 feet of the stream surveyed (Reach 3). F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble dominant substrates. D3 channel types are characteristically multiple channels with longitudinal and transverse bars; very wide with eroding banks, and cobble-dominant substrates.

Water temperatures taken during the survey period ranged from 60 to 71 degrees Fahrenheit. Air temperatures ranged from 68 to 86 degrees Fahrenheit.

RECTOR CREEK 2003
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

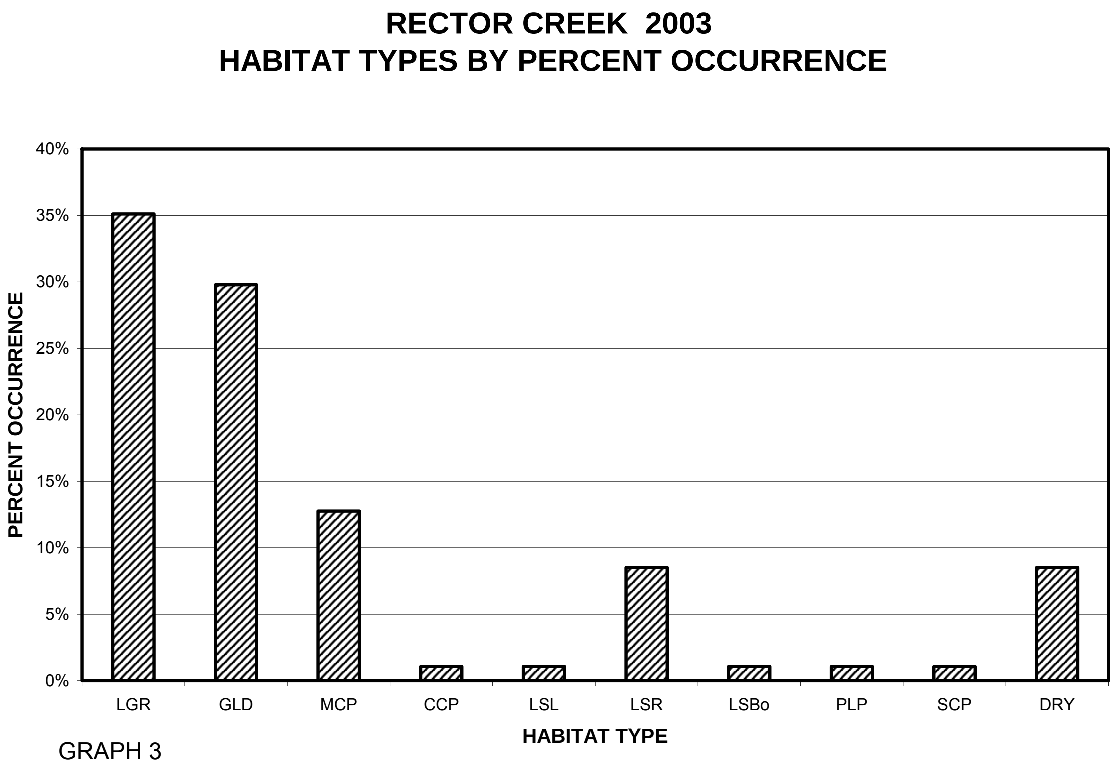


GRAPH 2

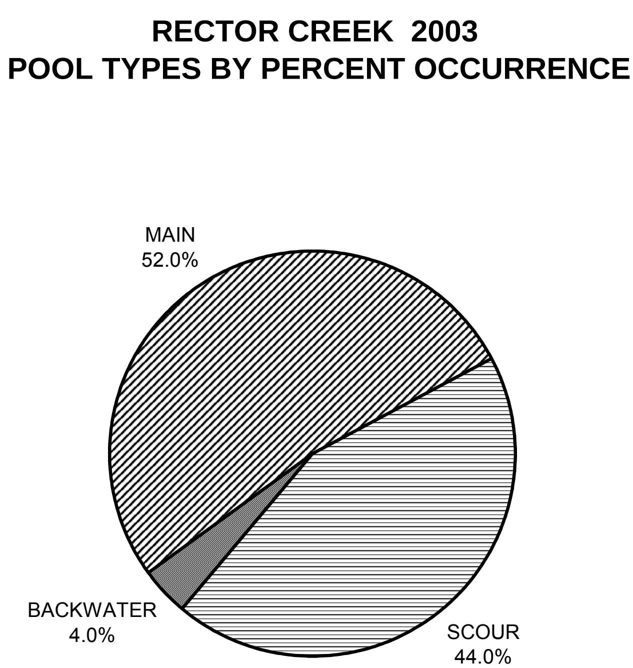
Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 35% riffle units, 30% flatwater units, 27% pool units, and 9% dry units (Graph 1). Based on total length of Level II habitat types there were 28% riffle units, 28% flatwater units, 23% pool units, and 21% dry units (Graph 2).

In total, ten Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were; 35% Low Gradient Riffle units, 30% Glide units, and 13% Mid-Channel Pool units (Graph 3). Based on percent total length, the most frequent habitat units were; 28% Low Gradient Riffle units, 28% Glide units, and 13% Mid-Channel Pool units.

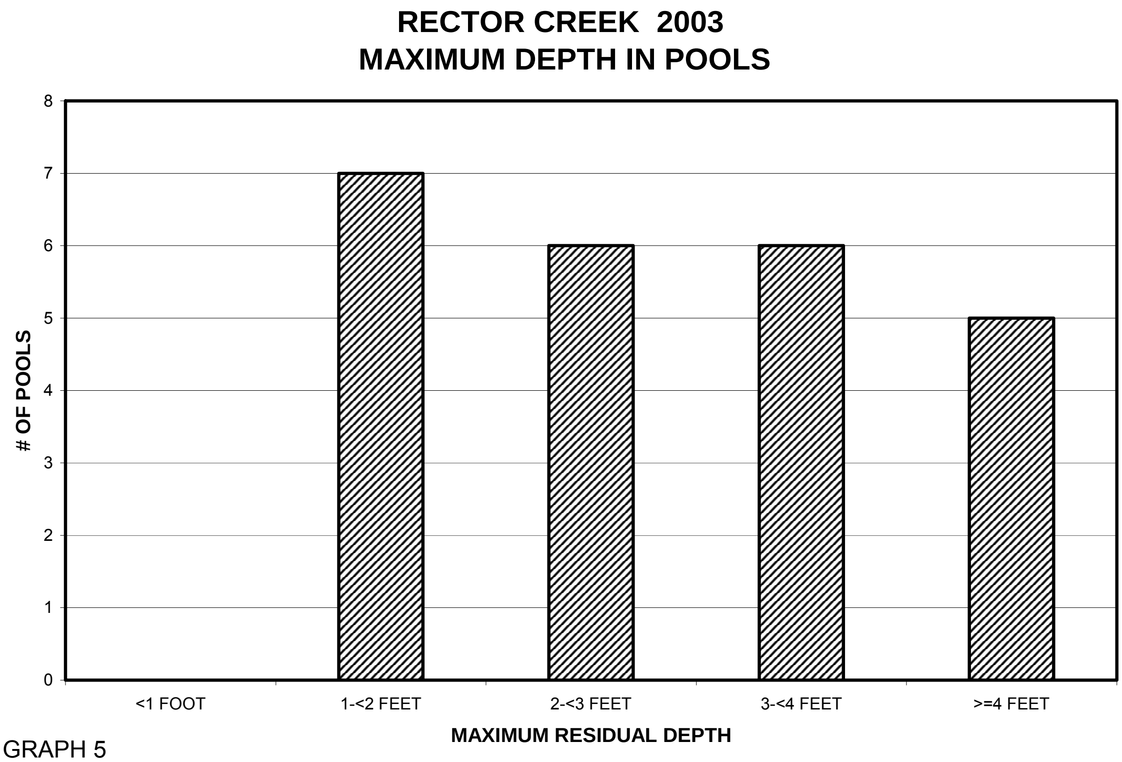
A total of 25 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 52%, and comprised 57% of the total length of all pools (Graph 4). Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. In total, 11 of the 24 pools (46%) had a residual depth of three feet or greater (Graph 5).



GRAPH 3



GRAPH 4



GRAPH 5

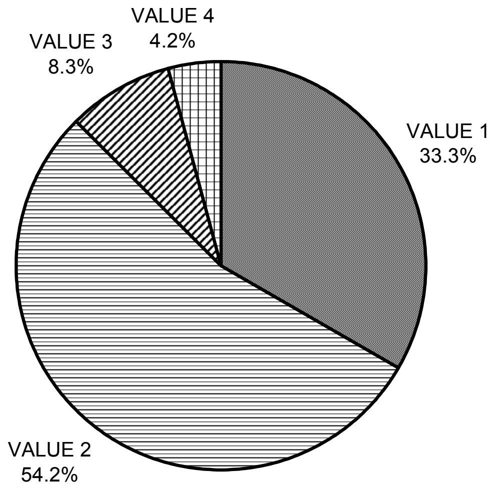
The depth of cobble embeddedness was estimated at pool tail-outs. Of the 24 pool tail-outs measured, 8 had a value of 1 (33.3%); 13 had a value of 2 (54.2%); 2 had a value of 3 (8.3%); and 1 had a value of 4 (4.2%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value 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 habitat types had a mean shelter rating of 25, flatwater habitat types had a mean shelter rating of 15, and pool habitats had a mean shelter rating of 71 (Table 1). Of the pool types, the Scour pools had a mean shelter rating of 61, Main Channel pools had a mean shelter rating of 75, and Backwater pools had a mean shelter rating of 120 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Root masses are the dominant cover types in Rector Creek. Graph 7 describes the pool cover in Rector Creek. Root mass is the dominant pool cover type followed by terrestrial vegetation.

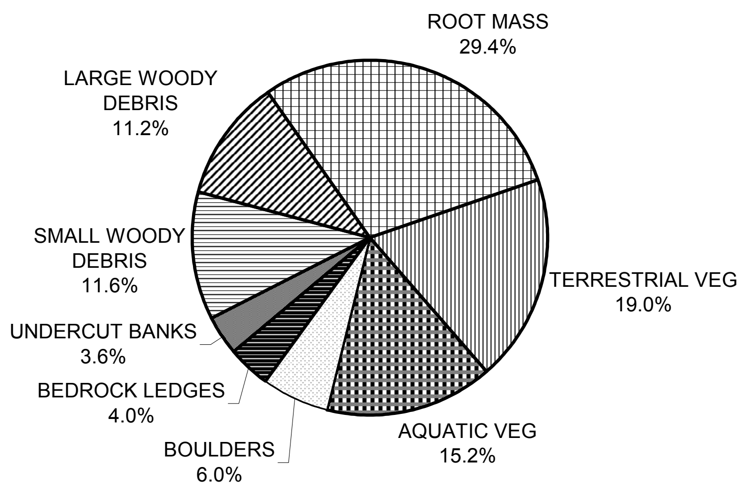
Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs (Small Cobble observed in 46% of pool tail-outs, and large Cobble observed in 21% of pool tail-outs).

RECTOR CREEK 2003
PERCENT EMBEDDEDNESS



GRAPH 6

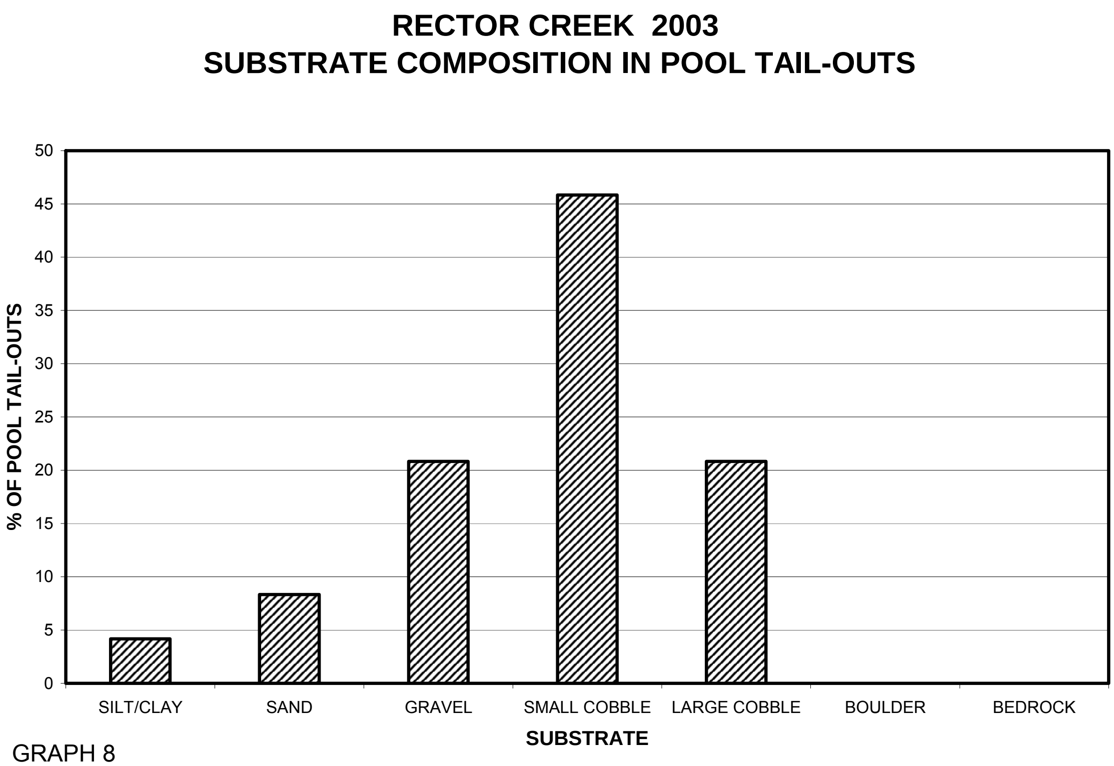
RECTOR CREEK 2003
MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

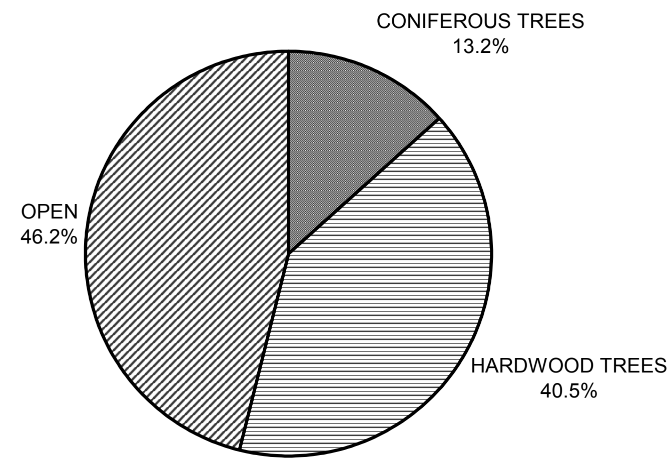
The mean percent canopy density for the surveyed length of Rector Creek was 54%. The mean percentages of hardwood and coniferous trees were 75% and 25%, respectively. In total, forty six percent of the canopy was open. Graph 9 describes the mean percent canopy in Rector Creek.

For the stream length surveyed, the mean percent right bank vegetated was 78%, and the mean percent left bank vegetated was 52%. The dominant elements composing the structure of the stream banks consisted of 2% bedrock, 5% boulder, 56% cobble/gravel, and 37% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 61% of the units surveyed. Additionally, 61% of the units surveyed had hardwood trees as the dominant vegetation type, and 3% had coniferous trees as the dominant vegetation (Graph 11).



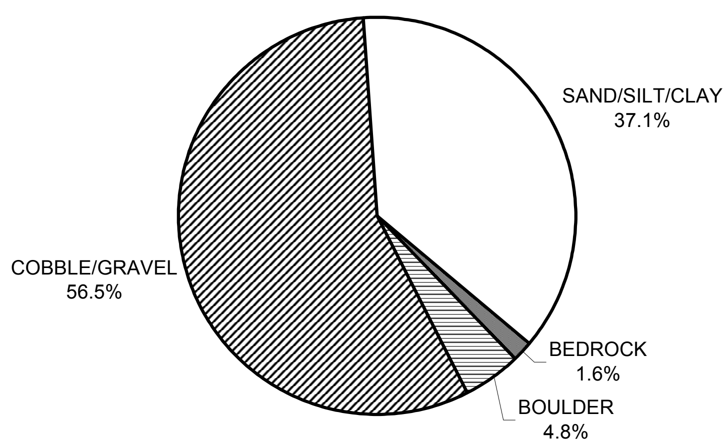
GRAPH 8

RECTOR CREEK 2003
MEAN PERCENT CANOPY



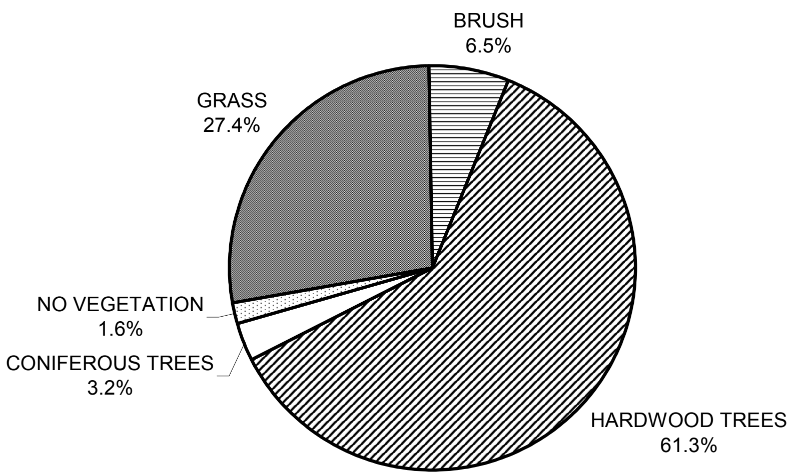
GRAPH 9

RECTOR CREEK 2003
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

RECTOR CREEK 2003
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

BIOLOGICAL INVENTORY RESULTS

A snorkel survey of Rector Creek was conducted in summer 2004, which documented three juvenile steelhead in one deep perennial pool. The survey was limited to five habitat units (4 pools and one run), which were the only places with sufficient surface water to dive. The results are discussed in further detail in section 3.2 of this report.

DISCUSSION

Rector Creek is an F4 channel type for 1,900 feet of the stream surveyed (Reach 1), a D3 channel type for 4,195 feet of the stream surveyed (Reach 2), and an F3 channel type for 2,120 feet of the stream surveyed (Reach 3). The suitability of D and F channel types for fish habitat improvement structures is as follows: (SEE SUITABILITY IN MANUAL)

The water temperatures recorded on the survey days 5/19/2003 to 5/23/2003, ranged from 60 to 71 degrees Fahrenheit. Air temperatures ranged from 68 to 86 degrees Fahrenheit. These stream temperatures are above the desirable range for juvenile salmonid rearing. Additionally, continuous temperature monitoring was conducted (section 3.6), which documents widely variable temperature conditions that appear to be largely coupled with stream flow.

Flatwater habitat types comprised 28% of the total length of this survey, riffles 28%, and pools 23%. The pools are relatively deep, with 17 of the 24 (71%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width (NOTE: for 3rd and 4th order streams maximum residual depth is at least three feet). Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy. Due to low-flow constraints, it may be difficult to identify suitable sites for such restoration efforts that will support rearing salmonids during critical summer dry periods.

In total, 21 of the 24 pool tail-outs measured had embeddedness ratings of 1 or 2; 3 of the pool tail-outs had embeddedness ratings of 3 or 4; and none of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sixteen of the 24 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 71, and the shelter rating in the flatwater habitats was 15. A pool shelter rating of approximately 100 is desirable. Root mass is the dominant cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. As stated above, low-flow constraints may make it difficult to identify suitable sites for such restoration efforts that will support rearing salmonids during critical summer dry periods.

The mean percent canopy density for the stream was 54%. Reach 1 had a canopy density of 81%, Reach 2 had a canopy density of 32%, and Reach 3 had a canopy density of 25%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was high to moderate at 78% and 52%, respectively. Several areas with significant stream bank erosion where identified and have been prioritized in section 4 of this report. These sites would benefit greatly from planting native plant species, in conjunction with bank stabilization, wherever appropriate.

A complete inventory of potential restoration sites for Rector Creeek has been compiled in section 4 of this report.

3.1.8 Soda Creek

A stream inventory of Soda Creek was conducted on 8/31/2004. The channel was dry below Loma Vista Avenue to the confluence with the Napa River. The survey began at the Loma Vista Bridge and extended upstream 1.2 miles until the channel became completely dry.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Soda Creek.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for steelhead and possibly chinook salmon. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Soda Creek is a tributary to the Napa River, which flows to the Pacific Ocean via San Pablo Bay. Soda Creek's location at the confluence with the Napa River is 38.35262° north latitude and 122.29103° west longitude, LLID number 1222898383528. Soda Creek is a second order stream and has approximately 10.69 miles of blue line stream according to the USGS Yountville 7.5 minute quadrangle. Soda Creek drains a watershed of approximately 5.15 square miles. Elevations range from about 30 feet at the mouth of the creek to about 2,130 feet in the headwater areas. Scrubland with mixed oak forest dominates the watershed. The watershed is entirely privately owned, and vehicle access exists via Soda Canyon Road off the Silverado Trail.

HISTORICAL INFORMATION (Leidy et al., 2005)

In June 1940, DFG identified *O. mykiss* ranging from 50 to 75 mm in length near the mouth of an unnamed tributary of Soda Creek (Shapovalov 1940d).

In November 1958, DFG visually surveyed Soda Creek from the mouth to the headwaters. Small numbers of *O. mykiss* ranging between 75 and100 mm in length were observed in the middle section of drainage that had recorded flows on this date (Elwell 1958n). The upper and lower reaches were dry at the time of the survey. In the survey report, DFG cited the local warden as saying that each year steelhead runs occurred that were smaller than only the Dry Creek and Redwood Creek runs. A 14-foot bedrock barrier was described near the junction of Soda Canyon and Soda Springs roads. (Elwell 1958n).

A November 1958 DFG report noted that the lowermost three miles of Soda Creek was utilized by steelhead for spawning purposes (Elwell 1958e). The report also noted that the lowest one-mile portion of this reach maintained permanent flows and served as a nursery area for juvenile steelhead (Elwell 1958n).

In February 1964, ten female and four male steelhead kelts were rescued from a drying pool in Soda Creek approximately two miles upstream of the mouth. The rescued fish were transported to the Napa River. Additional fish were reportedly poached in the previous week (Jones 1964a).

In May 1980, Soda Creek was surveyed visually from the Silverado Trail to the headwaters. Three sites were electrofished. The first station, at the first junction with Soda Canyon Road, produced seven *O. mykiss* (52-67 mm). The second site, at Loma Vista Drive, had six *O. mykiss* (57-69 mm). The last site, approximately 2.3 mile upstream of the mouth, had 37 *O. mykiss* (60-279 mm) (Ellison and Carnine 1980).

In December 1985, DFG caught 18 wild *O. mykiss* in Soda Creek while monitoring the movement of stocked steelhead. Sizes of fish ranged from 79-202 mm, and a 159 mm male was found to be sexually mature (Gray 1986a). Planted *O. mykiss* also were recovered during the survey. In February 1986, three wild *O. mykiss* (75-125 mm) and 104 planted steelhead were caught during a monitoring study (Gray 1986d). In May 1986, an additional 16 *O. mykiss* (180-270 mm) were caught, nine of which were assumed to be wild (Gray 1986e).

Ecotrust and FONR carried out surveys in tributaries of the Napa River system between June and September 2002. *Oncorhynchus mykiss* were found in four Soda Creek reaches (Ecotrust and FONR 2002).

The San Francisco Estuary Institute conducted a baseline study of geomorphic processes and habitat function in Soda Creek in 2002. The report states that two adult steelhead were observed during 2001 field data collection. The report concludes that, with the exception of the extreme lower reach, steelhead spawning and rearing habitat have not changed significantly changed in the past 50 years, and is sufficient to maintain a viable anadromous population (Pearce et al., 2002).

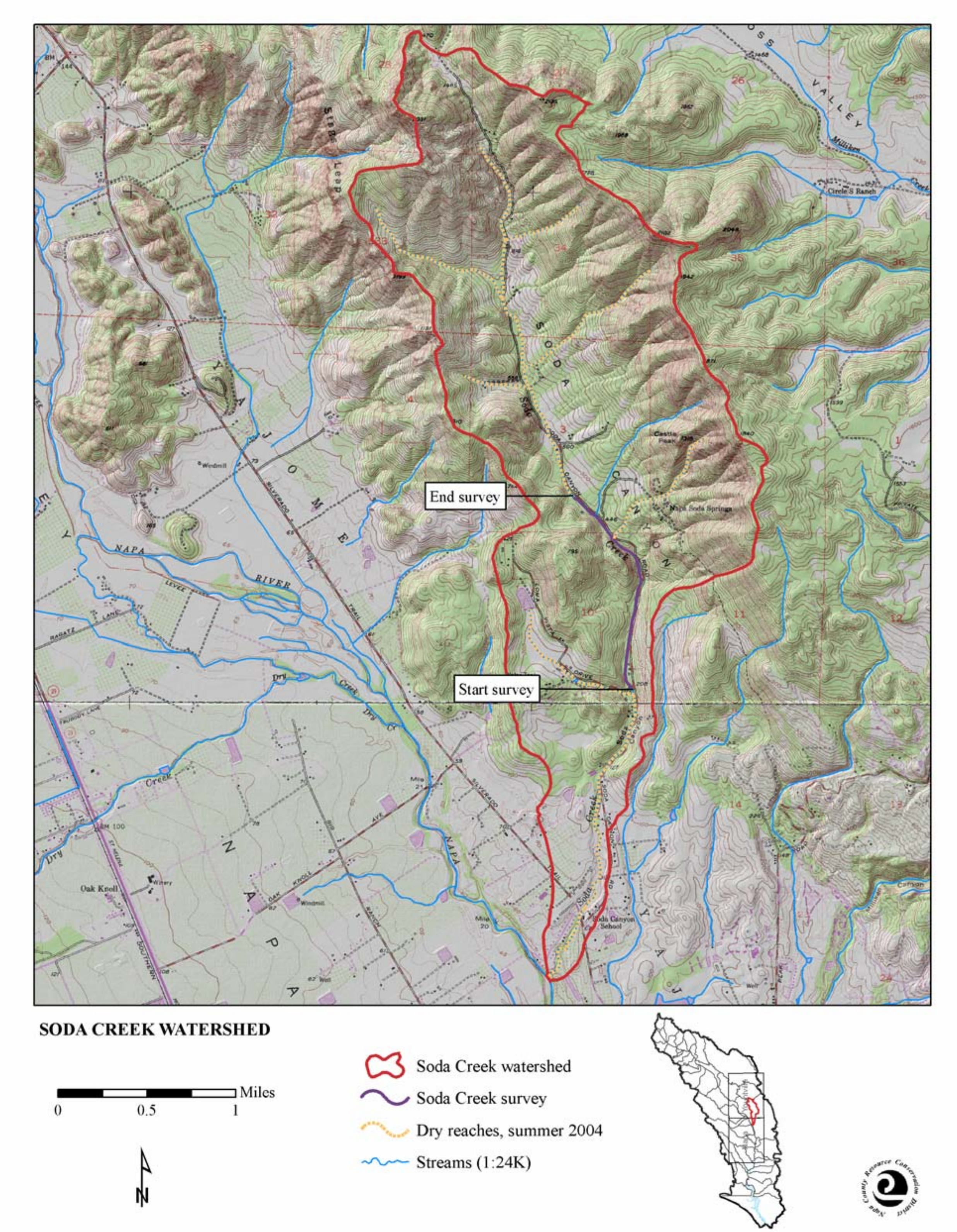


Figure 3.1-8. Watershed map of the Soda Creek watershed; dry reaches were not habitat typed including all reaches downstream of Loma Vista.

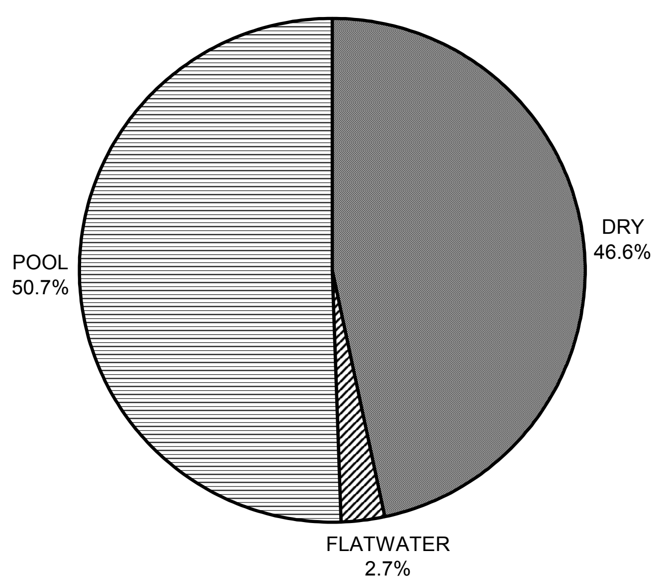
HABITAT INVENTORY RESULTS

The habitat inventory of 8/31/2004 to 8/31/2004 was conducted by J. Koehler, & C. Edwards. The total length of the stream surveyed was 6,472 feet. Stream flow was not measured on Soda Creek.

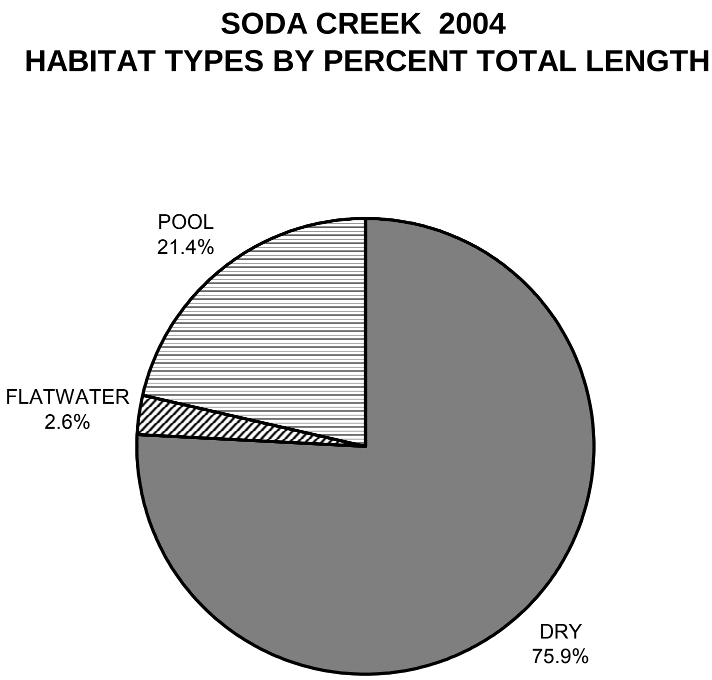
Soda Creek is a B1 channel type for 2,598 feet of the stream surveyed (Reach 1), a C3 channel type for 1,490 feet of the stream surveyed (Reach 2), and a B3 channel type for 2,384 feet of the stream surveyed (Reach 3). B1 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and bedrock dominant substrates. B3 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and cobble dominant substrates. C3 channels are meandering point-bar riffle/pool alluvial channels with a broad well defined floodplain on low gradients and have a cobble dominant substrate.

Water temperatures taken during the survey period ranged from 58 to 68 degrees Fahrenheit, and air temperatures ranged from 65 to 81 degrees Fahrenheit. Continuous temperature monitoring was conducted at one site on Soda Creek; the results are discussed in 3.6 of this report.

SODA CREEK 2004
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1



GRAPH 2

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 47% dry units, 51% pool units, and 3% flatwater units (Graph 1). Based on total length of Level II habitat types there were 76% dry units, 21% pool units, and 3% flatwater units (Graph 2).

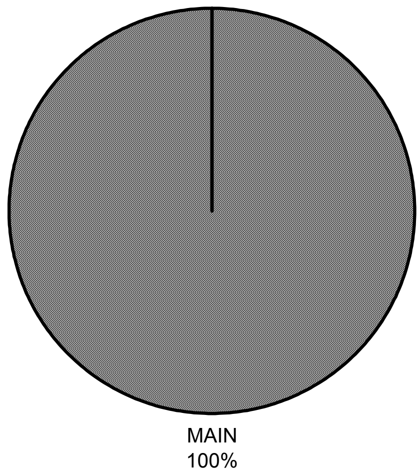
In total, four Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 47% Dry units, 41% Mid-Channel Pool units, and 10% Step Pool units (Graph 3). Based on percent total length, there were 76% Dry units, 13% Mid-Channel Pool units, and 8% Step Pool units found on Soda Creek.

A total of 37 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 100%, and comprised 100% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. One of the 12 pools (8%) had a residual depth of two feet or greater (Graph 5).

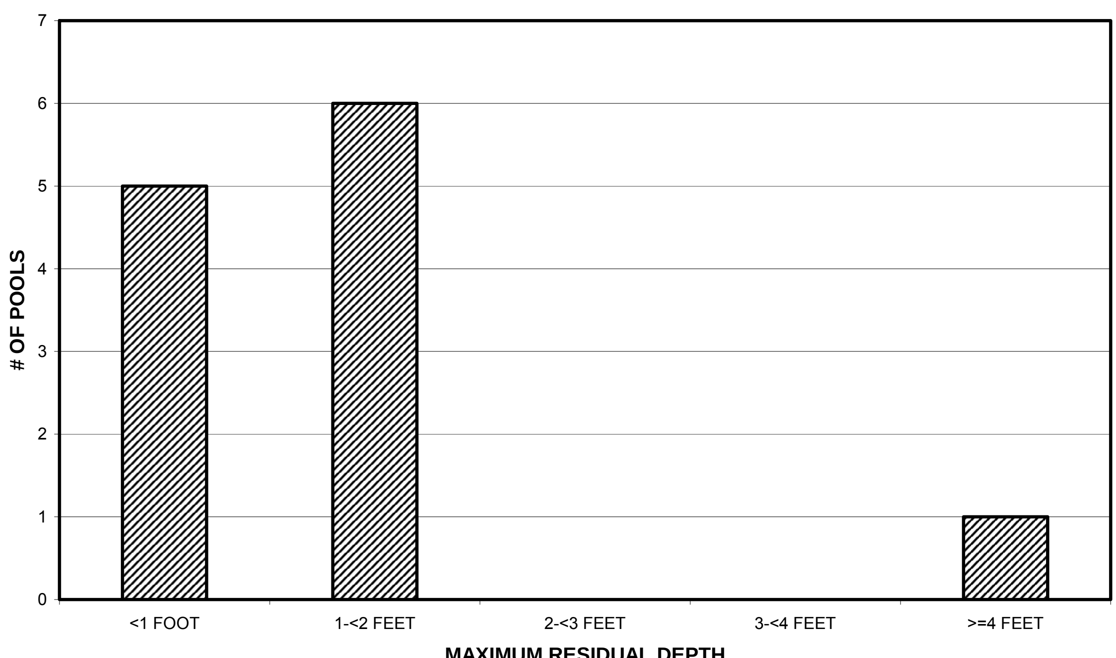
The depth of cobble embeddedness was estimated at pool tail-outs. Of the 15 pool tail-outs measured, 4 had a value of 1 (26.7%); 9 had a value of 2 (60%); and 2 had a value of 5 (13.3%, see Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock.

SODA CREEK 2004
POOL TYPES BY PERCENT OCCURRENCE

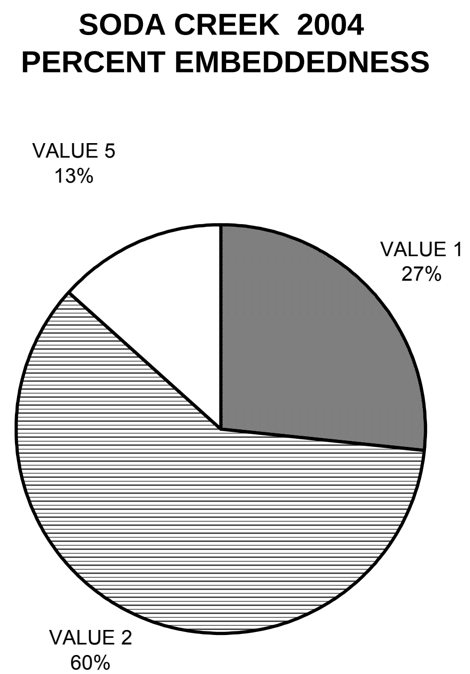


GRAPH 4

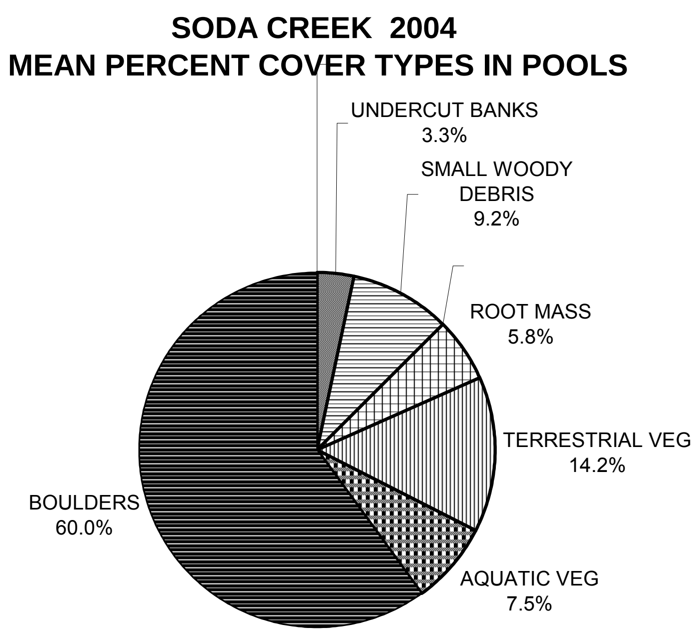
SODA CREEK 2004
MAXIMUM DEPTH IN POOLS



GRAPH 5



GRAPH 6

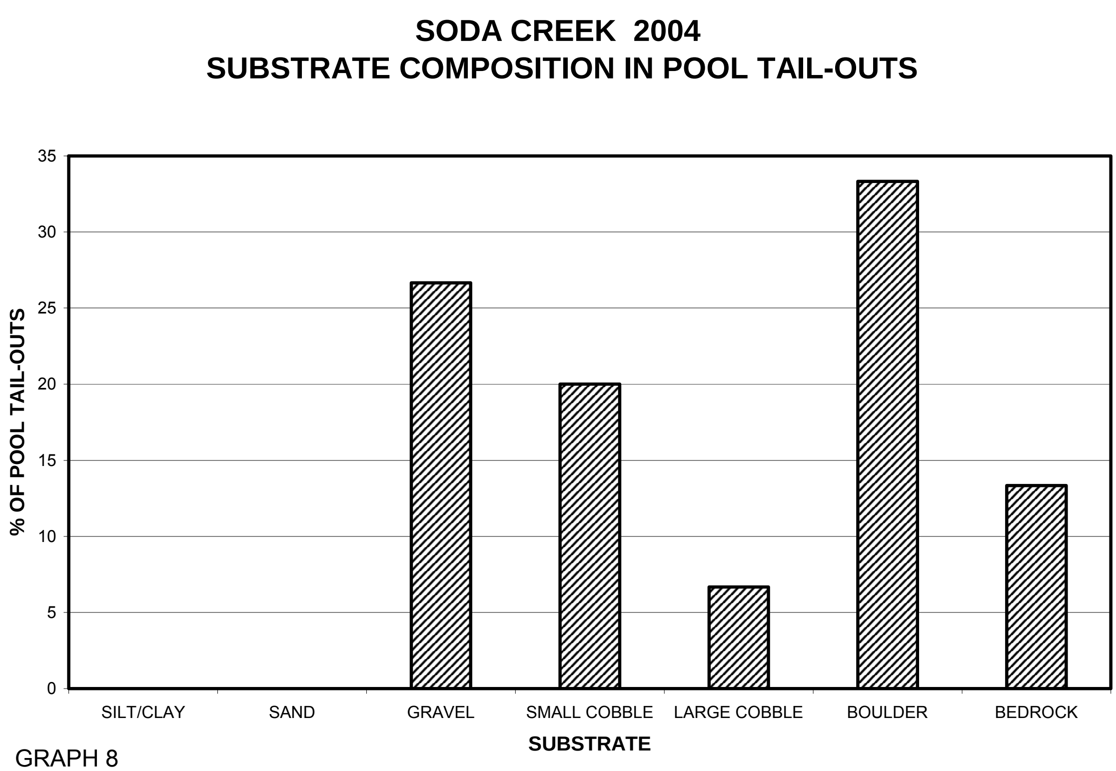


GRAPH 7

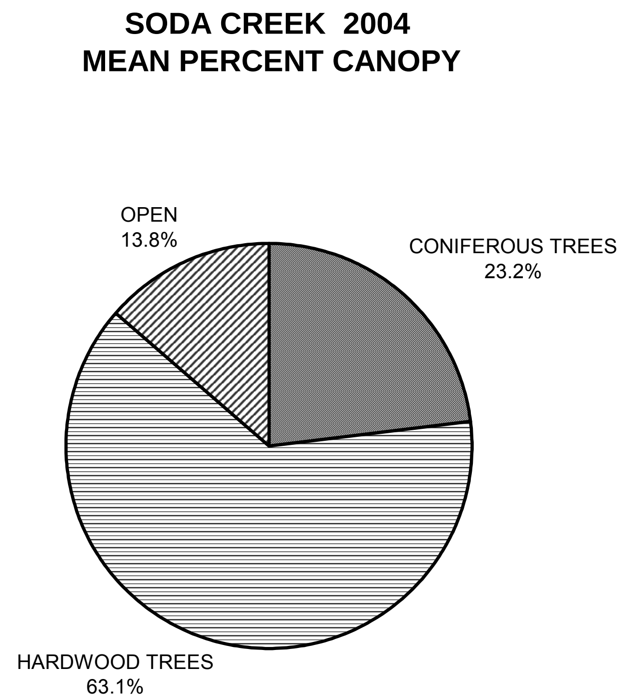
A shelter rating was calculated for each habitat unit and expressed as a mean value for each habitat type within the survey using a scale of 0-300. Due to the ephemeral nature of much of Soda Creek's habitat, shelter ratings for flatwater and riffle habitats are nearly nonexistent. The only measurable shelter rating is found in main channel pool habitats, which had a mean shelter rating of 51 (see Table 1 & Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Soda Creek, and are the dominant pool cover type followed by terrestrial vegetation. Graph 7 describes the pool cover in Soda Creek.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs (gravel observed in 27% of pool tail-outs, and boulders observed in 33% of pool tail-outs).



GRAPH 8

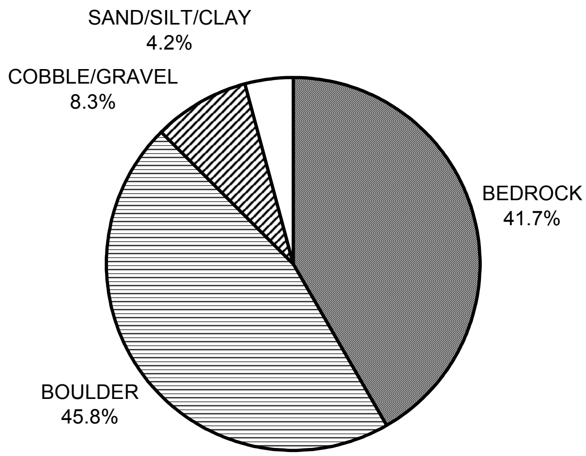


GRAPH 9

The mean percent canopy density for the surveyed length of Soda Creek was 86%. The mean percentages of hardwood and coniferous trees were 73% and 27%, respectively. In total, fourteen percent of the canopy was open. Graph 9 describes the mean percent canopy in Soda Creek.

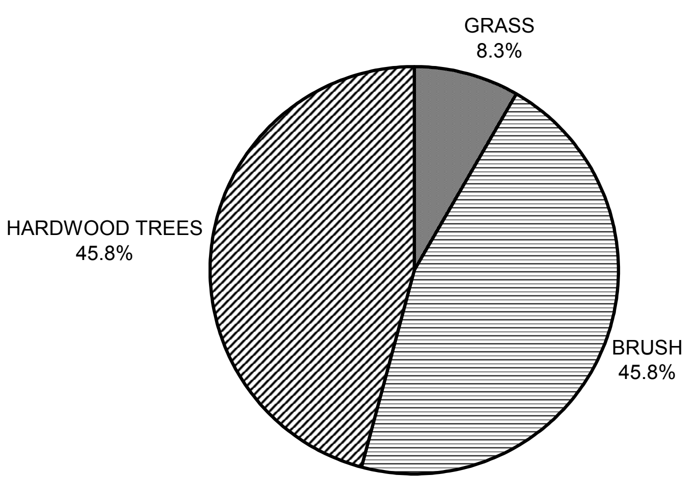
For the stream reach surveyed, the mean percent right bank vegetated was 83% and the mean percent left bank vegetated was 94%. The dominant elements composing the structure of the stream banks consisted of 42% bedrock, 46% boulder, 8% cobble/gravel, and 4% sand/silt/clay (Graph 10). Brush and deciduous trees combined to form the dominant vegetation type observed in 46% of the units surveyed. Additionally, 46% of the units surveyed had hardwood trees as the dominant vegetation type; none had coniferous trees as the dominant vegetation (Graph 11).

SODA CREEK 2004
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

SODA CREEK 2004
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

DISCUSSION

Soda Creek is a B1 channel type for 2,598 feet of the stream surveyed (Reach 1), a C3 channel type for 1,490 feet of the stream surveyed (Reach 2), and a B3 channel type for 2,384 feet of the stream surveyed (Reach 3). The suitability of B and C channel types for fish habitat improvement structures is discussed in detail in the California Salmonid Stream Habitat Restoration Manual (CDFG).

The water temperatures recorded on the survey day of 8/31/2004, ranged from 58 to 68 degrees Fahrenheit. Air temperatures ranged from 65 to 81 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 3% of the total length of this survey, and pools 21%. The pools are relatively shallow, with only 1 of the 12 (8%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low-flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy. Such structures should be placed only in reaches of stream that maintain year-round water.

In total, 13 of the 15 pool tail-outs measured had embeddedness ratings of 1 or 2; none of the pool tail-outs had embeddedness ratings of 3 or 4; and 2 of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead.

Seven of the 15 pool tail-outs measured had gravel or small cobble as the dominant substrate; this is generally considered good for spawning salmonids. Spawning habitat, though usually not a limiting factor for steelhead, is relatively sparse in the surveyed portion of Soda Creek. Bedrock substrate was common throughout all reaches, and was the dominant substrate in many pools. This provided marginal to unsuitable spawning habitat in most cases.

The mean shelter rating for pools was 51, which is relatively low. A pool shelter rating of approximately 100 is desirable. Boulders are the dominant cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat by providing juvenile fish with protection from predation, rest from water velocity, and reduced territorial competition.

The mean percent canopy density for the stream was 86%. Reach 1 had a canopy density of 94%, Reach 2 had a canopy density of 77%, and Reach 3 had a canopy density of 94%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was consistently high at 83% and 94%, respectively. In the relatively few areas of Soda Creek with stream bank erosion or where bank vegetation is sparse, planting native vegetation in conjunction with bank stabilization is recommended.

Overall, Soda Creek offers a relatively short length of suitable salmonid rearing habitat due to limited flow during the summer. The surveyed reach covered the only portion of Soda Creek with persistent flow. Much of the habitat in reach 3 was very high quality, and appeared well seeded with juvenile steelhead (yoy, 1+, 2+), some of which were likely resident rainbow trout form. A flowing tributary from the left bank near the top of reach 3 appeared to be the major source of stream flow during our survey. The channel went completely above this tributary, except for a few isolated bedrock pools. Water quality in the pools above this tributary input was poor with tannin-stained water and very low dissolved oxygen levels during summer months.

The “Soda Hole” does not appear to be a complete barrier for adult steelhead, and under appropriate flow conditions (observed during winter, 2004) is likely passable by most adults. No fish were observed passing the obstacle during our reconnaissance surveys, but jump heights and the depths of jump pools below were adequate for steelhead to migrate upstream. The highest quality spawning and rearing habitat in Soda Creek is located above the Soda Hole.

A complete inventory of potential restoration sites for Soda Creek has been compiled in section 4 of this report.

3.1.9 Wing Canyon Creek

A stream inventory was conducted during 9/22/2004 to 10/1/2004 on Wing Canyon Creek. The survey began at the confluence with Dry Creek and extended upstream 0.8 miles to a large boulder waterfall. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Wing Canyon Creek.

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

Wing Canyon Creek is a tributary to Dry Creek, which is a tributary to the Napa River, which flows to the Pacific Ocean via San Pablo Bay. Wing Canyon Creek's location at the confluence with Dry Creek is 38.39404° north latitude and 122.41847 west longitude, LLID number 1224081383889. Wing Canyon Creek is a second order stream and has approximately 4.78 miles of blue line stream according to the USGS Rutherford 7.5 minute quadrangle. Wing Canyon Creek drains a watershed of approximately 1.51 square miles. Elevations range from about 450 feet at the mouth of the creek to 2,630 feet in the headwater areas. Mixed hardwood and conifer forest dominates the watershed with minor agricultural (vineyard) development in the headwater areas. The watershed is entirely privately owned and limited vehicle access exists via Mt. Veeder Road.

HISTORICAL INFORMATION

Ecotrust and FONR carried out surveys in tributaries of the Napa River system between June and September 2002. *Oncorhynchus mykiss* were found in several Wing Canyon Creek and tributary creek reaches, including six reaches at density level “3” (Ecotrust and FONR 2002).

Wing Canyon was heavily logged in the late 1800’s and a select harvest was done in 1964 (NCRCD, 2003).

A basic habitat survey was conducted on Wing Canyon Creek in summer 1998 by staff from CDFG, NCRCD, and local volunteers. The survey found that Wing Canyon Creek had predominantly boulder substrate with ample in-stream shelter from LWD and boulders. Embeddedness levels within the survey reaches were generally low (0-50%). Canopy densities were favorable ranging from 81 – 96 %. No flow measurements were taken, but flow was categorized as low by the survey crew. Water temperatures ranged from 58 - 64° F and air temperatures ranged from 62 – 75° F. An abandoned skid road was noted along the right bank above the channel margin, which likely contributes some fine sediment to Wing Canyon Creek. The road is no longer maintained, and culverts and ditches have become plugged with sediment. A prior survey by DFG in 1997 identified two potential partial migration barriers including the skid road crossing in the lower section and an abandoned flashboard dam further upstream (NCRCD, 2003).

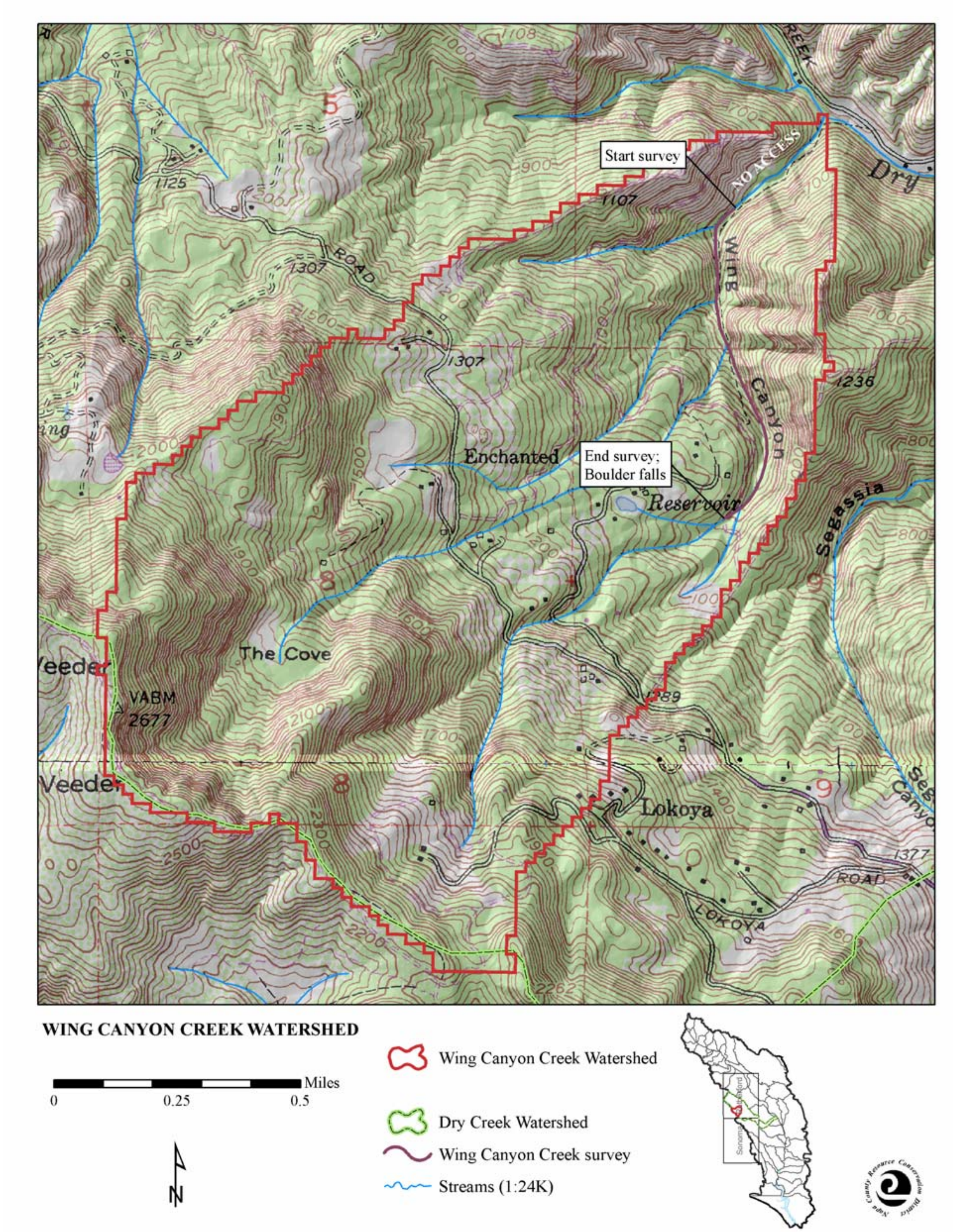


Figure 3.1-9. Watershed map of the Wing Canyon drainage; the lower-most reach was not surveyed due to insufficient landowner access.

HABITAT INVENTORY RESULTS

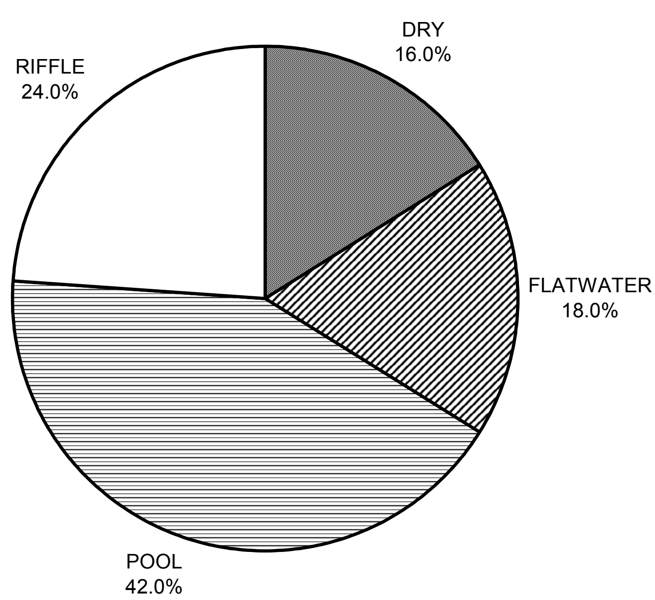
The habitat inventory of 9/22/2004 to 10/1/2004 was conducted by C. Edwards, P. Blank, and J. Koehler. The total length of the stream surveyed was 4,006 feet. The survey began a point where landowner access was granted and extended upstream to a natural boulder waterfall, which represents the end of anadromy. The reach between the survey start and Dry Creek was not surveyed due to lack of landowner permission. Stream flow was visually assessed as moderate to low throughout the surveyed length. Local landowners described creek flows as moderate year-round in all but the driest years.

Wing Canyon Creek is an A4 channel type for 1,169 feet of the stream surveyed (Reach 1), and an A2 channel type for 2,837 feet of the stream surveyed (Reach 2). A4 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and gravel dominant substrates, and an A2 channel is relatively the same except for it has a boulder dominant substrate.

Water temperatures taken during the survey period ranged from 54 to57 degrees Fahrenheit. Air temperatures ranged from 55 to 75 degrees Fahrenheit.

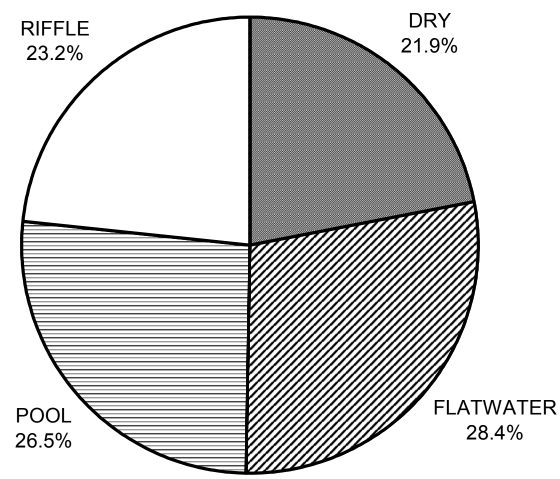
Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 18% flatwater units, 42% pool units, 24% riffle units, and 16% dry units (Graph 1). Based on total length of Level II habitat types there were 28% flatwater units, 26% pool units, 23% riffle units, and 22% dry units (Graph 2).

WING CANYON CREEK 2004
HABITAT TYPES BY PERCENT OCCURRENCE



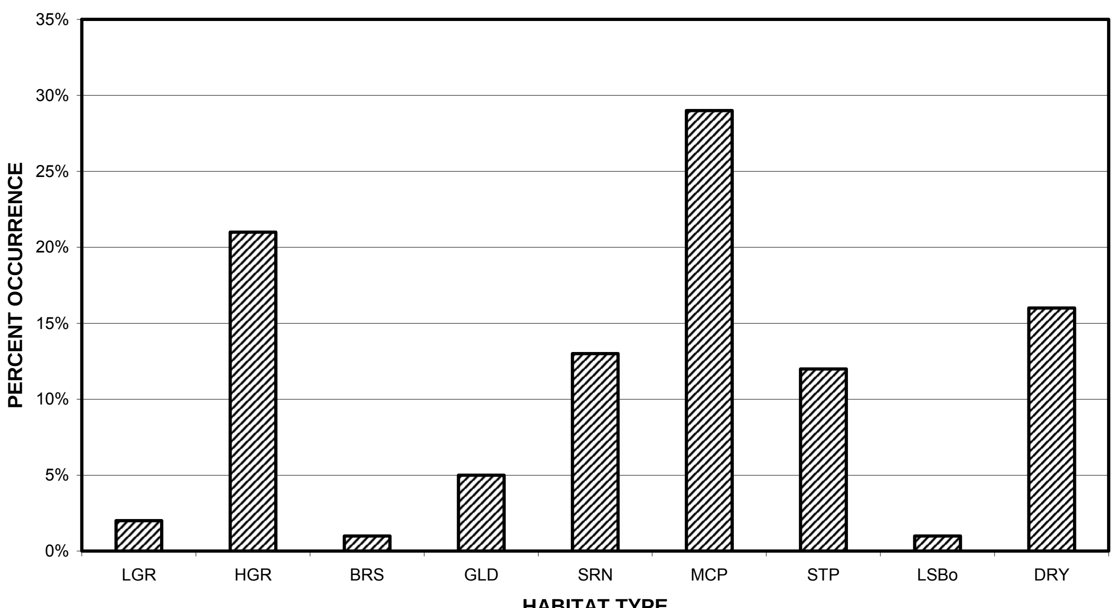
GRAPH 1

WING CANYON CREEK 2004
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

WING CANYON CREEK 2004
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

In total, nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were; 29% Mid-Channel Pool units, 21% High Gradient Riffle units, and 12% Step Pool units (Graph 3). The most frequent habitat types based on percent total length are as follows; 13% Mid-Channel Pool units, 25% Step Run units, and 18% High Gradient Riffle units.

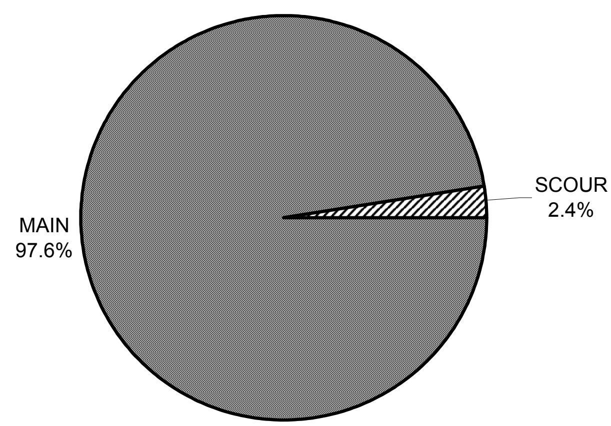
A total of 42 pools were identified (Table 3). Main Channel pools were the most frequent type of pool encountered (98%) and comprised 99% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Only one of the 14 pools (7%) had a residual depth of two feet or greater (Graph 5).

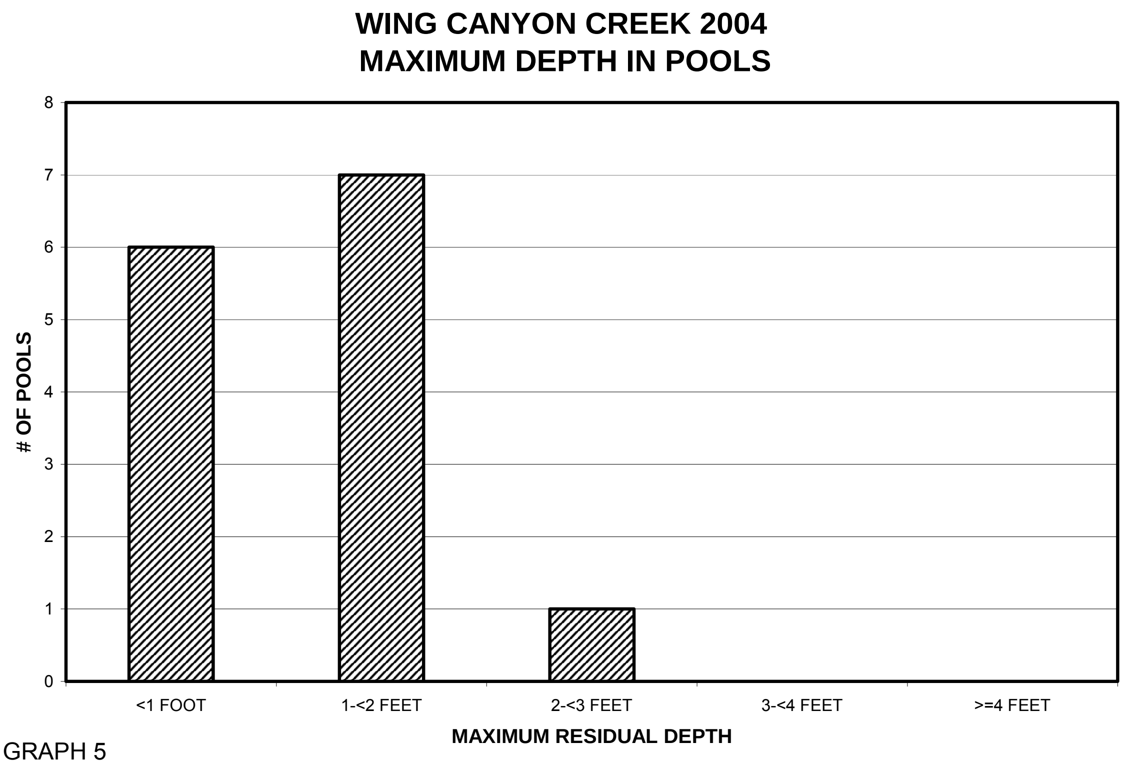
The depth of cobble embeddedness was estimated at pool tail-outs. Of the 4 pool tail-outs measured, 2 had a value of 1 (50%); 2 had a value of 2 (50%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst conditions. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, and 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 habitat types had a mean shelter rating of 23, flatwater habitat types had a mean shelter rating of 42, and pool habitats had a mean shelter rating of 48 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 44, and Scour pools had a mean shelter rating of 100 (Table 3).

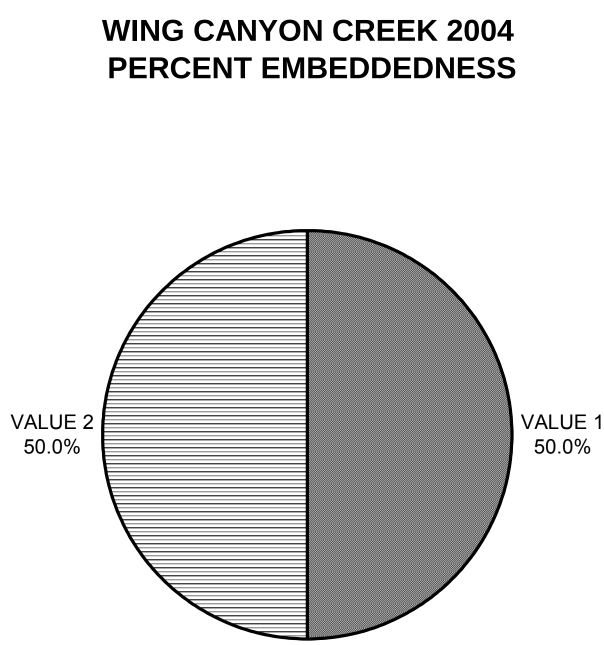
WING CANYON CREEK 2004
POOL TYPES BY PERCENT OCCURRENCE



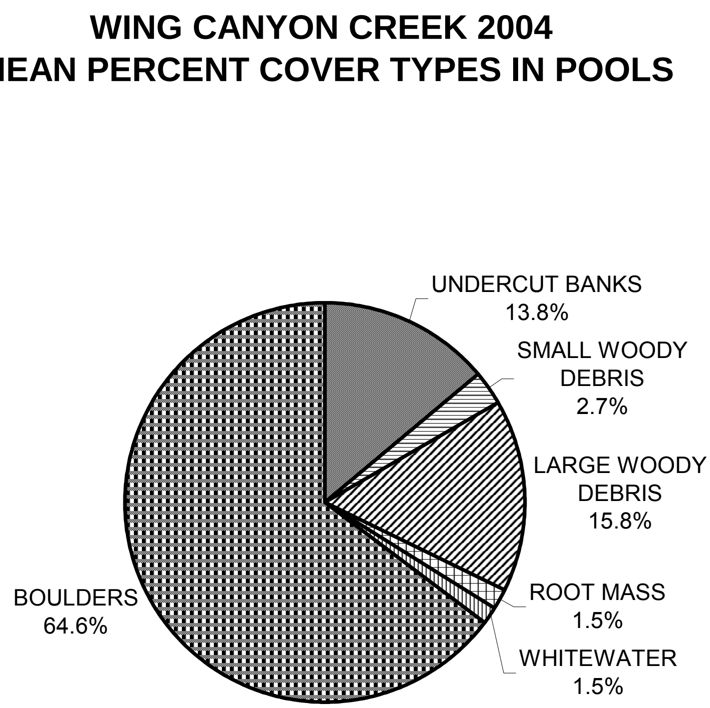
GRAPH 4



GRAPH 5



GRAPH 6



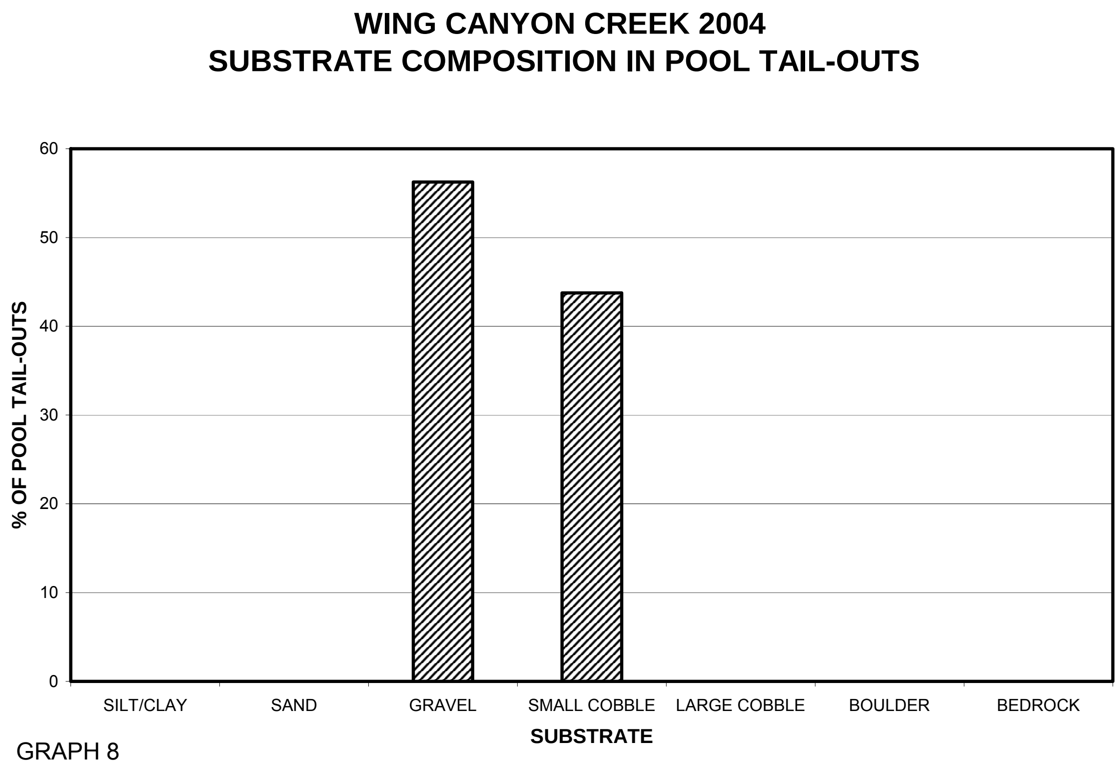
GRAPH 7

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Wing Canyon Creek. Graph 7 describes the pool cover in Wing Canyon Creek. Boulders are the dominant pool cover type, followed by large woody debris.

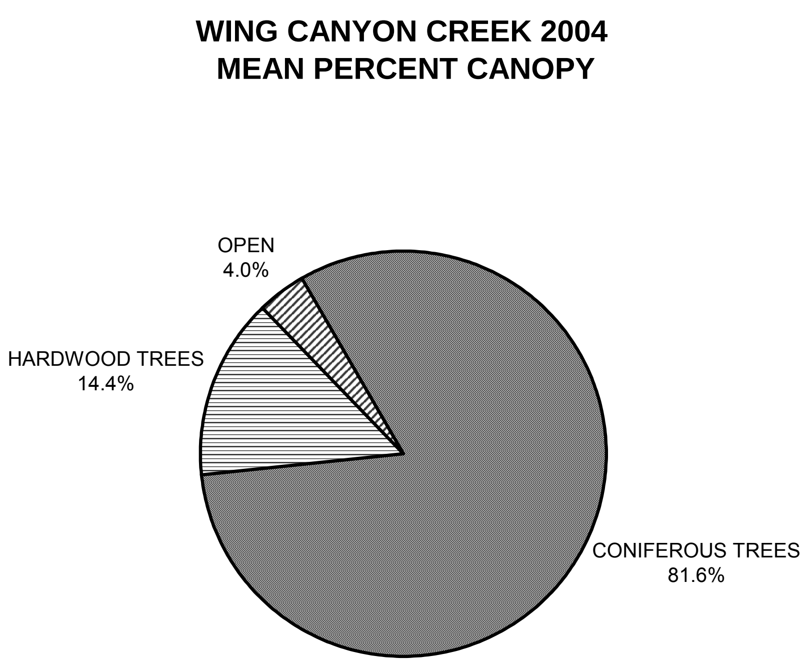
Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was observed in 56% of pool tail-outs, and small cobble observed in 44% of pool tail-outs.

The mean percent canopy density for the surveyed length of Wing Canyon Creek was 96%. The mean percentages of hardwood and coniferous trees were 15% and 85%, respectively. Four percent of the canopy was open. Graph 9 describes the mean percent canopy in Wing Canyon Creek.

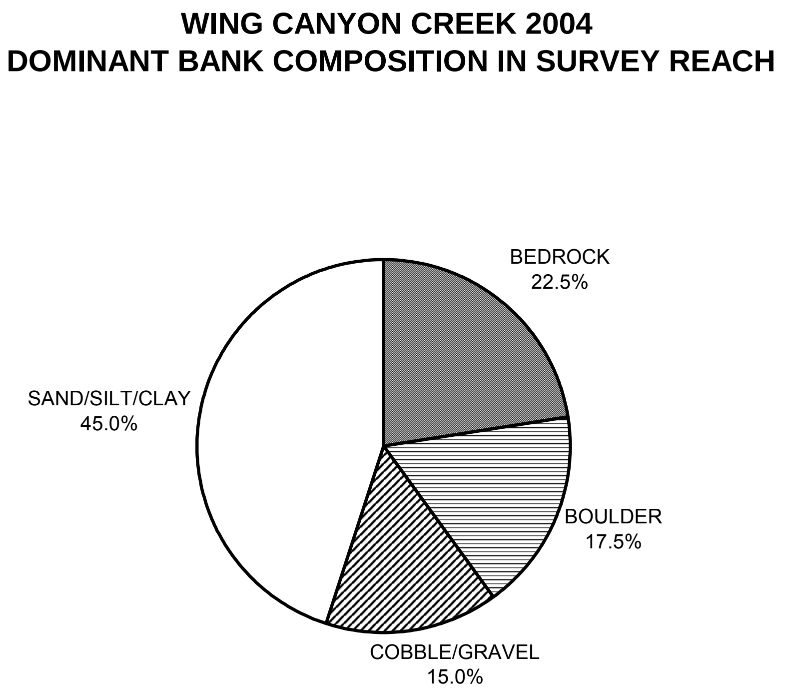
For the stream reach surveyed, the mean percent right bank vegetated was 74%, and the mean percent left bank vegetated was 78%. The dominant elements composing the structure of the stream banks consisted of 22% bedrock, and 45% sand/silt/clay (Graph 10). Coniferous trees were the dominant vegetation type observed in 62% of the units surveyed. Additionally, 20% of the units surveyed had hardwood trees as the dominant vegetation type (Graph 11).



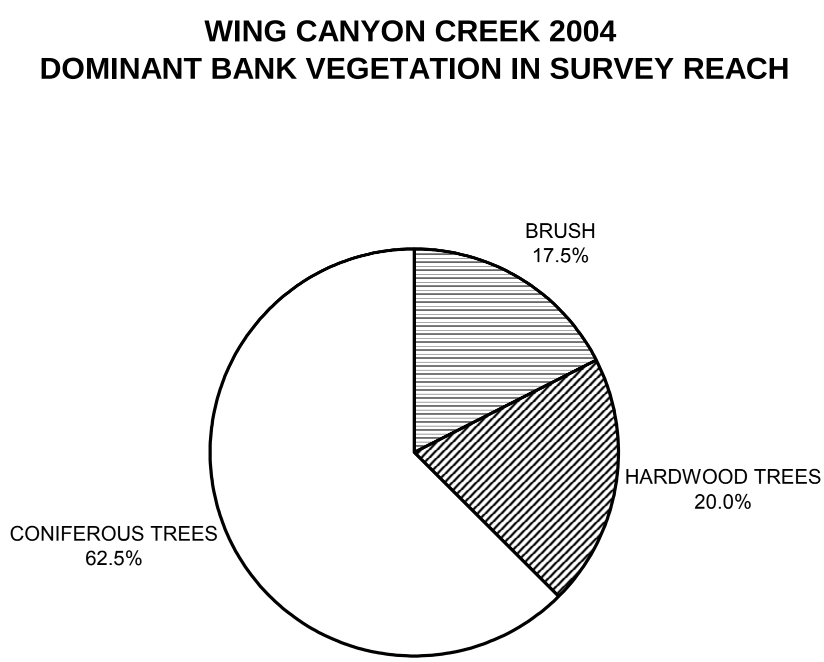
GRAPH 8



GRAPH 9



GRAPH 10



GRAPH 11

DISCUSSION

Wing Canyon Creek is an A4 channel type for 1,169 feet of the stream surveyed (Reach 1), and an A2 channel type for 2,837 feet of the stream surveyed (Reach 2). The suitability of an A channel type for fish habitat improvement structures is described in detail in the California Salmonid Stream Habitat Restoration Manual (CDFG). Generally, A2 channels are poor candidates for instream restoration structures due to high stream gradient/energy and high risk of failure.

The water temperatures recorded on the survey days 9/22/2004 to 10/1/2004, ranged from 54 to 57 degrees Fahrenheit. Air temperatures ranged from 55 to 75 degrees Fahrenheit. These water temperatures are favorable for salmonids and are likely sustained by the sufficient riparian shading and perennial flows that exist throughout the stream.

Flatwater habitat types comprised 28% of the total length of this survey, riffles 23%, and pools 26%. The pools are relatively shallow, with only one of the 14 pools having a maximum residual depth greater than two feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat in Wing Canyon Creek may be threatened by high stream energy.

In total, all of the four pool tail-outs measured had embeddedness ratings of 1 or 2, and none of the pool tail-outs had embeddedness ratings of 3 or 4. None of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less (a rating of 1) indicates suitable spawning substrate for salmon and steelhead. All of the 16 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 48, and the shelter rating in the flatwater habitats was 42. A pool shelter rating of approximately 100 is desirable. Boulders are the dominant cover type in pools, followed by large woody debris.

The mean percent canopy density for the stream was 96%. Reach 1 had a canopy density of 97%, Reach 2 had a canopy density of 95%. Wing Canyon Creek has an excellent canopy comprised of mature conifers and hardwood trees that are providing ample shade and LWD inputs. The percentage of right and left bank covered with vegetation was high at 74% and 78%, respectively. No revegetation efforts are needed in the surveyed reach.

Overall, Wing Canyon Creek offers high quality spawning and rearing habitat for steelhead throughout the entire surveyed length. Perennial flow and frequent cool shaded pools offer favorable conditions for juvenile rearing. Fish passage is limited only by the natural boulder falls at the top of the survey, and a migration obstacle in reach 1, which consisted of a dilapidated concrete dam built on a short bedrock chute. The dam is no longer functional, and woody debris formed a small jam in the main breach. Upstream migration of adult steelhead may be impeded or delayed by the bedrock chute and LWD jam during high to moderate flow conditions.

A complete inventory of potential restoration sites for Wing Canyon Creek has been compiled in section 4 of this report.

3.1.10 York Creek

A stream inventory was conducted during 9/3/2003 to 9/24/2003 on York Creek. The survey began at the confluence with Napa River and extended upstream 4.6 miles, including the reaches above the instream reservoir. The survey ended at a bedrock waterfall (Figure 3.1-10).

The York Creek inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in York Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for steelhead and Chinook salmon. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

<u>WATERSHED OVERVIEW</u>

York Creek is a tributary to Napa River, which flows to the Pacific Ocean via San Pablo Bay. York Creek's location at the confluence with Napa River is 38.52189° north latitude and 122.47580° west longitude, LLID number 1224747385220. York Creek is a second order stream and has approximately 7.24 miles of blue line stream according to the USGS Calistoga and St. Helena 7.5 minute quadrangles. York Creek drains a watershed of approximately 4.4 square miles. Elevations range from about 220 feet at the mouth of the creek to 2,160 feet in the headwater areas. Redwoods and mixed conifer forest dominates the riparian corridors in the upper watershed. Mixed hardwood forest and vineyards cover much of the remaining watershed with urban and built up areas in the lower reaches. The watershed is almost entirely privately owned, and vehicle access exists via Highway 29 (Main Street), and Spring Mountain Road in St. Helena.

<u>HISTORICAL INFORMATION</u> (Leidy et al., 2005)

A 1941 DFG report noted anecdotal evidence of trout in York Creek upstream of a 12-foot dam in the middle reach of the creek (Curtis 1941b). In 1962, DFG determined that two diversion dams restricted all flow during the critical steelhead egg incubation period. A study was recommended to determine adequate flow releases to protect steelhead spawning and whether to require provision for fish passage at the dams (Day 1962).

In July 1973, DFG visually surveyed portions of York Creek from the mouth to the second diversion dam. No *O. mykiss* were observed (Nelson and Finlayson 1973). In June 1974, DFG again surveyed York Creek from the mouth to the upper end of St. Helena’s reservoir. Both YOY (estimated at over 100 per 30 meters) and age 1+ steelhead (20 per 30 meters) were abundant between the Spring Mountain Road Bridge in St. Helena and the upper reservoir (Bruns 1974).

In August 1975, DFG visually surveyed York Creek from the city of St. Helena reservoir upstream to the headwaters. *Oncorhynchus mykiss* juveniles (25-100 mm) believed to be from steelhead decent were observed at approximately 20 per 30 meters throughout the surveyed reach (Henry 1975).

In June 1981, while locating stranded fish for rescue, DFG observed salmonids in York Creek near the Highway 29 crossing and the mouth (Ambrosins and Hams 1981).

In April 1986, DFG electrofished a 150 meter reach upstream from the in-channel reservoir. A total of ten *O. mykiss* were caught ranging in size from 92-198 mm (Gray 1986f). The fish were assumed to be resident, as the two downstream dams were deemed impassable to steelhead (Gray 1986f).

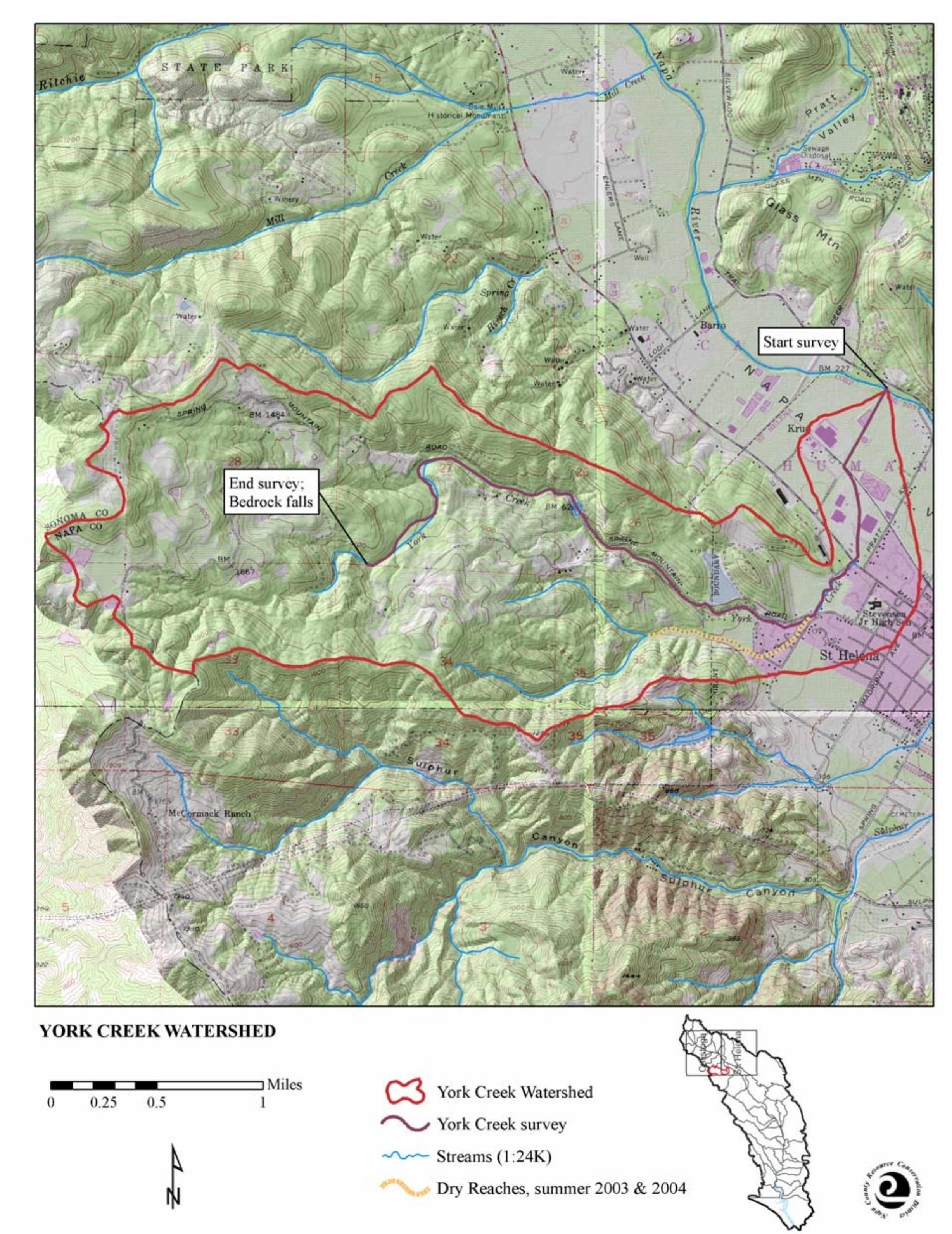


Figure 3.1-10. Watershed map of the York Creek drainage.

In August 1992, DFG identified one dead *O. mykiss* in York Creek and discovered evidence of more dead *O. mykiss* that had been consumed by scavengers. The DFG report noted the presence of recent sediment deposition up to 18 inches deep, which likely resulted from operations at the city of St. Helena in-channel reservoir (Emig 1992c).

In September 2000, DFG electrofished York Creek downstream of the York dam along Spring Mountain Road. Juvenile steelhead were abundant and uniformly distributed throughout the entire reach (Cox 2000). The vast majority was YOY (40-100 mm), with lesser numbers of age 1+ (100-140 mm) and still fewer age 2+ and 3+ individuals (140-180 mm). The survey also revealed an unusually large number of older *O. mykiss* (200-250 mm), which was attributed to particularly good physical conditions (e.g., shade, pools, food, and instream cover) rather than anadromy (Cox 2000).

Ecotrust and FONR carried out surveys in tributaries of the Napa River system in July and August 2001. Relative density of steelhead was noted between 1 and 3, with 3 indicating greater than one individual per square meter. Of seven York Creek reaches, two were found to have *O. mykiss* at density level "1," while two reaches had density level "2" (Ecotrust and FONR 2001).

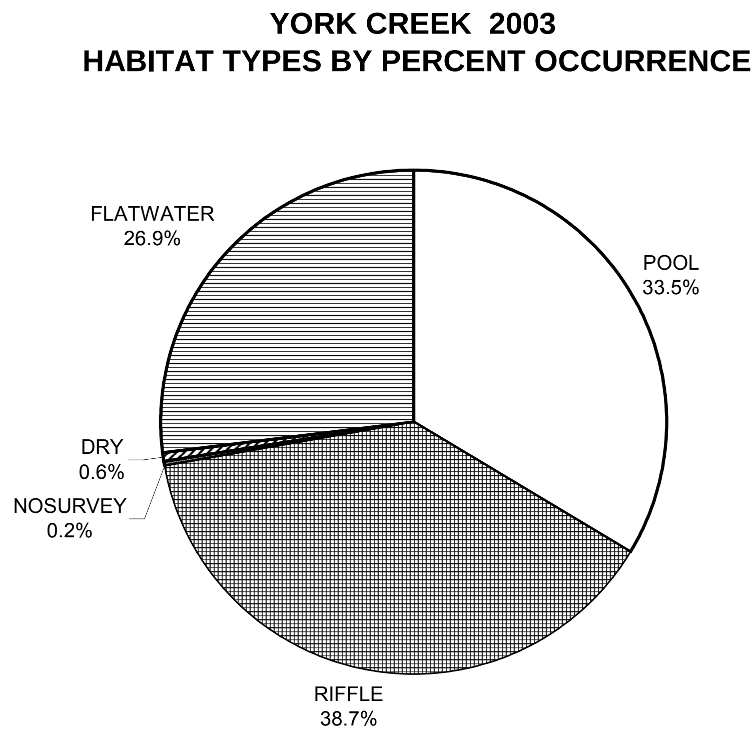
HABITAT INVENTORY RESULTS

The habitat inventory of 9/3/2003 to 9/24/2003 was conducted by J. Koehler, and M. Champion. The total length of the stream surveyed was 24,314 feet. Stream flow was visually assessed on York Creek, and moderate year round flow was present in all reaches upstream of Highway 29. During summer, intermittent flow and isolated pools were observed downstream of Highway 29 (Reach 1) to the confluence with the Napa River.

York Creek is an F3 channel type for 5,759 feet of the stream surveyed (Reach 1), a B3 channel type for 3,051 feet of the stream surveyed (Reach 2), an F3 channel type for 2,101 feet of the stream surveyed (Reach 3), a B3 channel type for 5,373 feet of the stream surveyed (Reach 4), a B3 channel type for 5,273 feet of the stream surveyed (Reach 5), an F3 channel type for 2,757 feet of the stream surveyed (Reach 6). F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble dominant substrates. B3 channels are moderately entrenched riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and cobble dominant substrates.

Air temperatures ranged from 53 to 88 degrees Fahrenheit. Water temperatures taken with a recording thermograph deployed from 10/01/03 to 10/29/04, ranged from 43.0 to 71.0 degrees Fahrenheit.

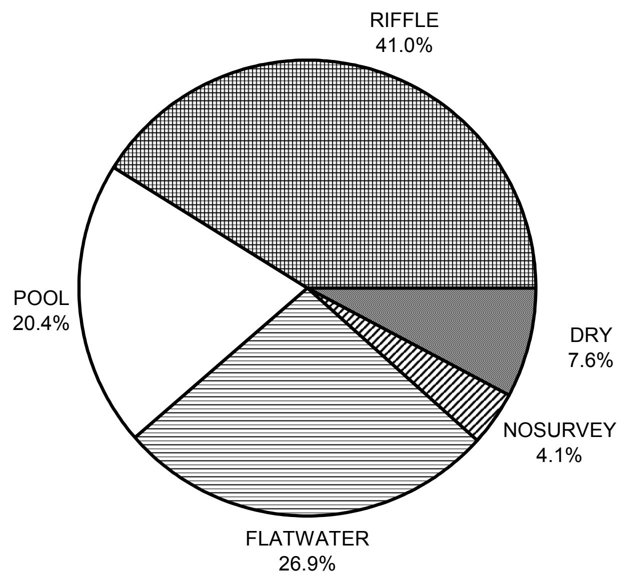
Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 34% pool units, 1% dry units, and 39% riffle units (Graph 1). Based on total length of Level II habitat types there were 20% pool units, 41% riffle units, and 27% flatwater units (Graph 2).



GRAPH 1

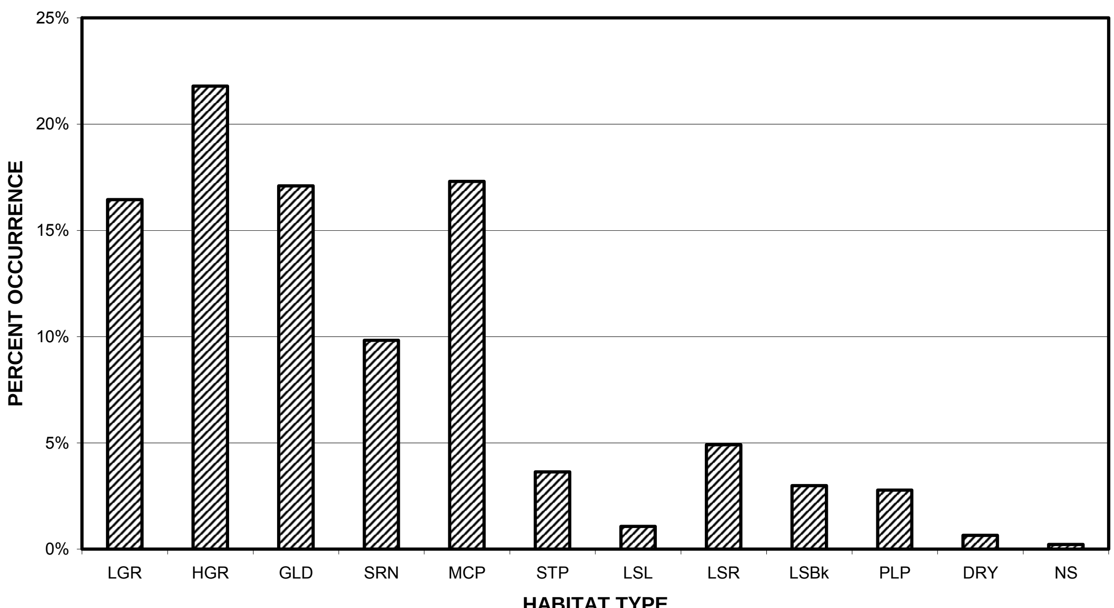
A total of fourteen Level IV habitat units were identified (Table 2). The most frequent habitat units by percent occurrence were as follows; 17% Mid-Channel Pool units, 16% Low Gradient Riffle units, 17% Glide units, and 22% High Gradient Riffle units (see Graph 3 for the entire listing). Habitat units based on percent total length are as follows; 11% Mid-Channel Pool units, 18% Low Gradient Riffle unit, 14% Step Run units, and 23% High Gradient Riffle units.

YORK CREEK 2003
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

YORK CREEK 2003
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

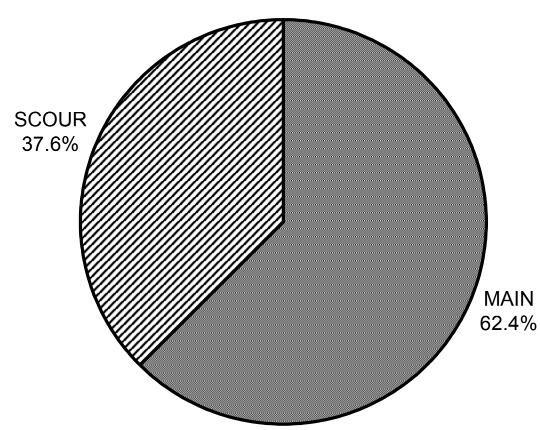
A total of 157 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 62%, and comprised 71% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Out of the 62 pools surveyed, eleven (18%) had a residual depth of two feet or greater (Graph 5). Only three of the 62 pools (5%) had a residual depth of three feet or greater (Graph 5).

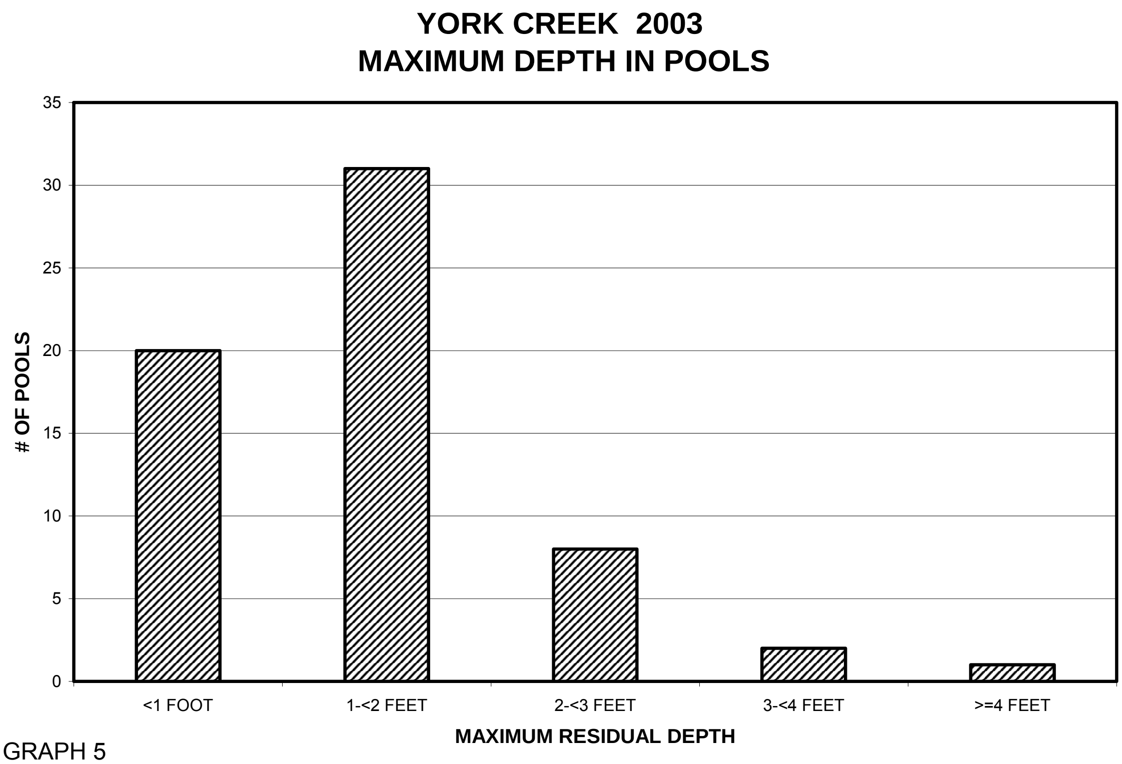
The depth of cobble embeddedness was estimated at pool tail-outs. Of the 61 pool tail-outs measured (Graph 6), 25 had a value of one (41%); 24 had a value of two (39.3%); 11 had a value of three (18%); and one had a value of four (1.6%). On this scale, a value of 1 indicates the best spawning conditions 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 or 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 habitat types had a mean shelter rating of 12, flat-water habitat types had a mean shelter rating of 26, and pool habitats had a mean shelter rating of 58 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 41, and Scour pools had a mean shelter rating of 78 (Table 3).

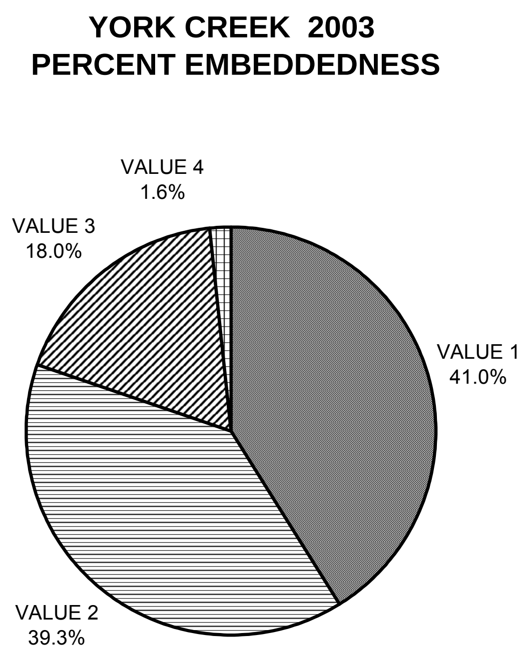
YORK CREEK 2003
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4



GRAPH 5



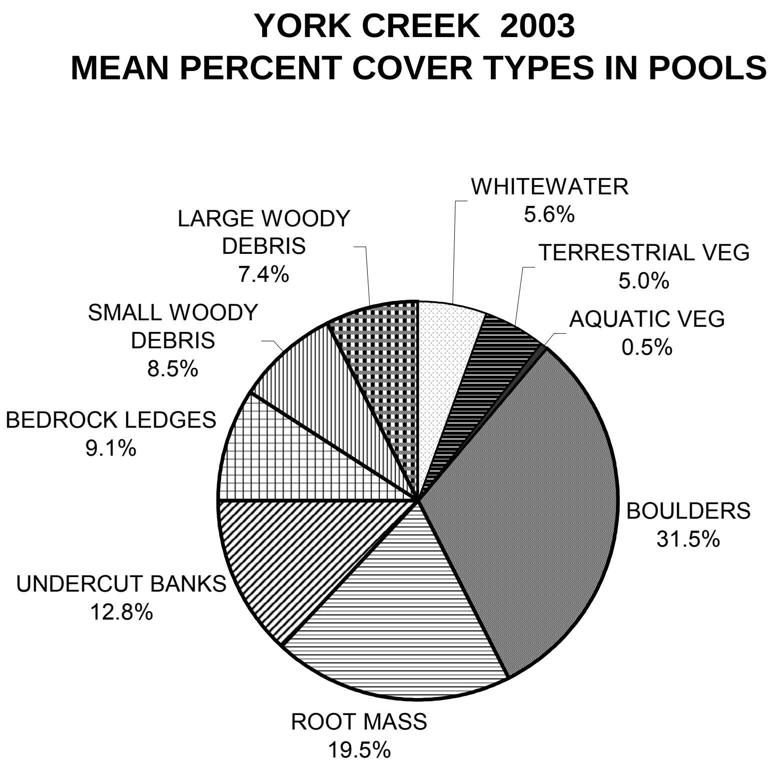
GRAPH 6

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in York Creek; followed by root mass extending from the left or right banks (Graph 7).

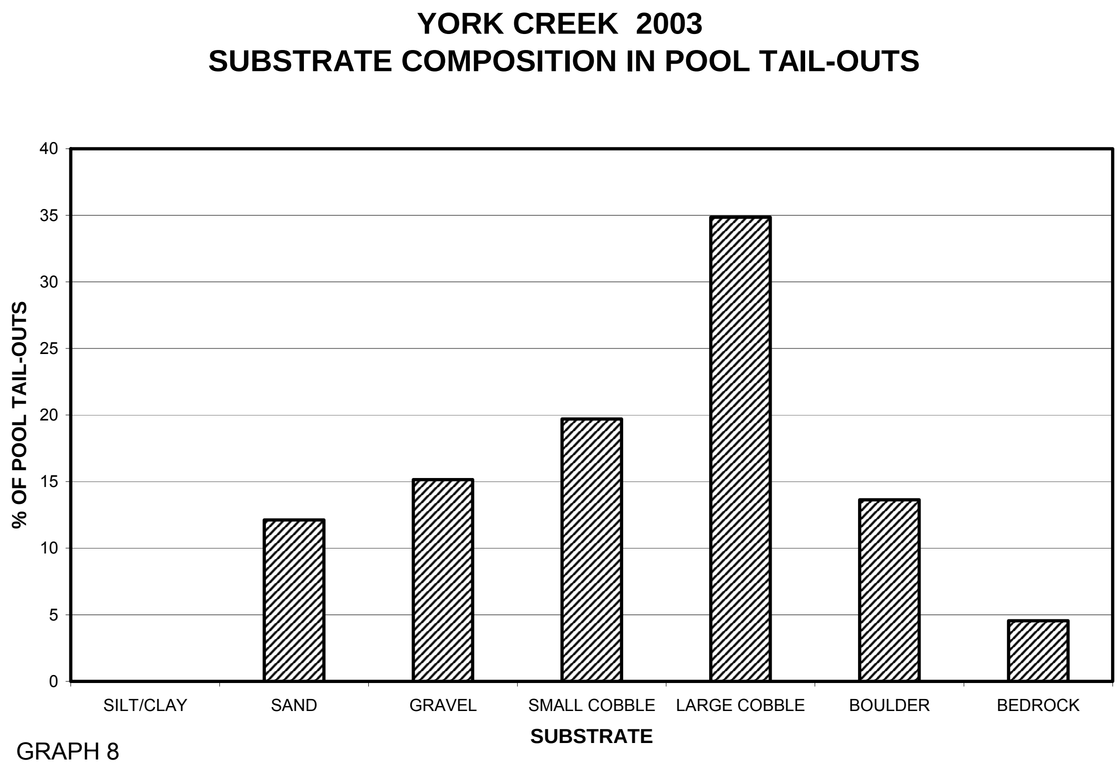
Table 6 summarizes the dominant substrate by habitat type, and Graph 8 depicts the dominant substrate observed in pool tail-outs. Small cobble was observed in 20% of pool tail-outs, and large cobble observed in 35% of pool tail-outs.

The mean percent canopy density for the surveyed length of York Creek was 94%. The mean percentages of hardwood and coniferous trees were 46% and 54%, respectively. Approximately 6% of the canopy was open (Graph 9)

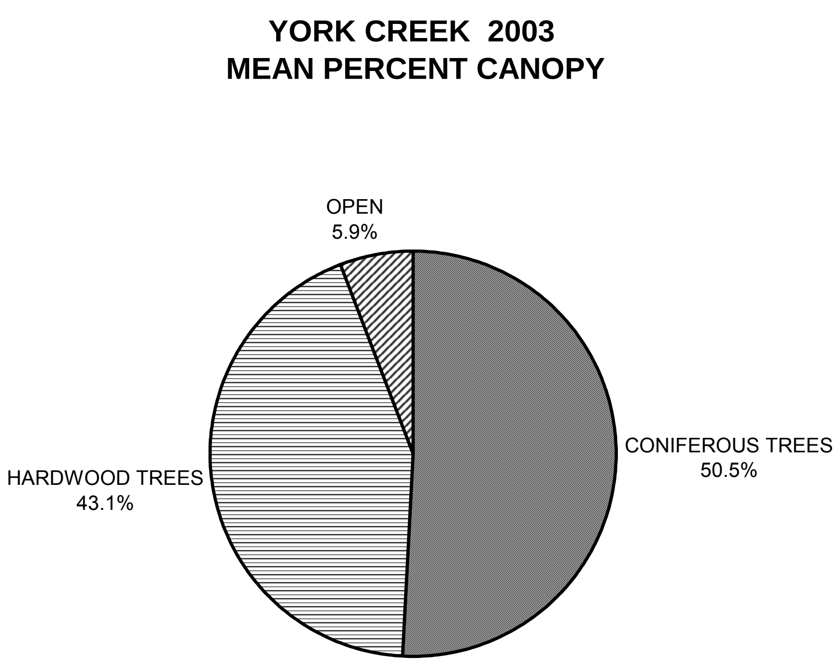
For the stream reach surveyed, the mean percent right bank vegetated was 71%, and the mean percent left bank vegetated was 73%. The dominant elements composing the structure of the stream banks consisted of 51% cobble/gravel, and 21% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in 45% of the units surveyed. Additionally, 28% of the units surveyed had hardwood trees as the dominant vegetation type, and 19% had coniferous trees as the dominant vegetation (Graph 11).



GRAPH 7

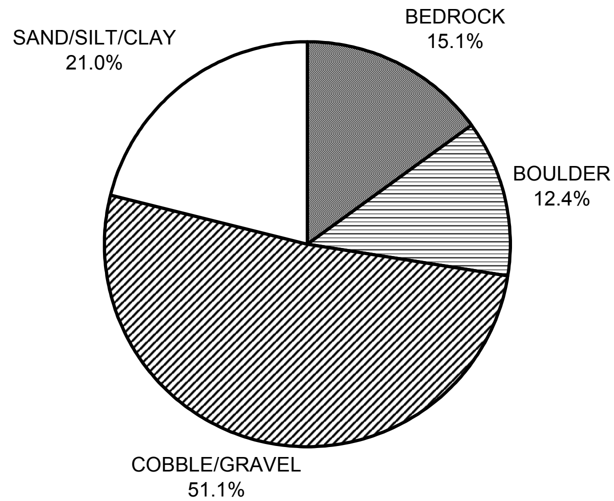


GRAPH 8



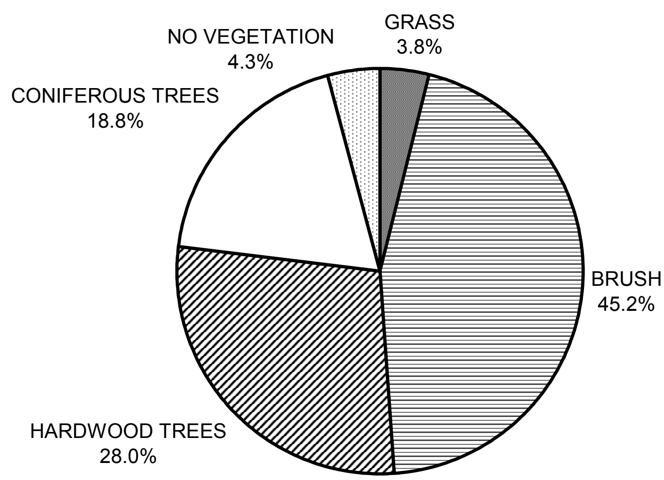
GRAPH 9

YORK CREEK 2003
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

YORK CREEK 2003
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

BIOLOGICAL INVENTORY RESULTS

A snorkel survey of York Creek was conducted on 6/29/2004-7/1/2004 by J. Koehler, D. Chase, and C. Edwards. The survey began above the dry lower reach and extended upstream past the instream reservoir to the bedrock falls (Figure 3.1-10). York Creek had high to moderate densities of juvenile steelhead (yoy, 1+, 2+) and larger resident rainbow trout in most reaches. York Creek had the highest fish densities of all the streams surveyed in this project, and it is one of the most significant steelhead streams in the Napa Basin. Juvenile steelhead were observed primarily in the reaches upstream of Highway 29 where year-round water is present. A few juvenile steelhead were observed in pools in reach 1 during the habitat survey, but rearing habitat is severely limited. The results of this survey are graphically depicted in section 3.2 of this report.

DISCUSSION

York Creek is an F3 channel type for 5,759 feet of the stream surveyed (Reach 1), a B3 channel type for 3,051 feet of the stream surveyed (Reach 2), an F3 channel type for 2,101 feet of the stream surveyed (Reach 3), a B3 channel type for 5,373 feet of the stream surveyed (Reach 4), a B3 channel type for 5,273 feet of the stream surveyed (Reach 5), and an F3 channel type for 2,757 feet of the stream surveyed (Reach 6). The suitability of F3 and B3 channel types for fish habitat improvement structures is described in detail in the California Salmonid Stream Habitat Restoration Manual (CDFG).

The water temperatures recorded on the survey days 9/3/2003 to 9/24/2003, ranged from 55.5 to 59 degrees Fahrenheit. Air temperatures ranged from 53 to 88 degrees Fahrenheit. A thermograph was also deployed in York Creek in Reach 3 and the results suggest temperatures are favorable for most of the year with marginal periods during summer. Temperature monitoring results are described in section 3.6 of this report.

Flatwater habitat types comprised 27% of the total length of this survey, riffles 41%, and pools 20%. The pools are relatively shallow, with only 11 of the 62 (18%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined as having a maximum residual depth of at least two feet occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy. Reach 1 and 2 would benefit greatly from increased pool frequency and complexity.

In total, 12 of the 61 pool tail-outs measured had embeddedness ratings of one or two, and 12 of the pool tail-outs had embeddedness ratings of three or four. None of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. A rating of 1 indicates good quality spawning substrate for salmon and steelhead. Sediment sources in York Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken to reduce overall sediment delivery wherever feasible.

Twenty three of the 66 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids. Typically, steelhead are not limited by spawning gravel availability, and the creek was well seeded with juveniles during our surveys.

The mean shelter rating for pools was 58. The shelter rating in the flatwater habitats was 26. A pool shelter rating of approximately 100 is desirable. Boulders are the dominant cover type in pools followed by root mass. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from high water velocities, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 94% (Reach 1 had a canopy density of 82%, Reach 2 had a canopy density of 89%, Reach 3 had a canopy density of 98%, Reach 4 had a canopy density of 98%, Reach 5 had a canopy density of 97%, and Reach 6 had a canopy density of 97%). In general, revegetation projects are considered when canopy density is less than 80%. Reaches 1 and 2 would benefit from riparian planting and restoration in areas with sparse canopy and narrow buffers. Reach 2 has extensive areas of exotic vegetation that should be removed and replaced with native species.

The percentage of right and left bank covered with vegetation was high at 71% and 73%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting native plant species, in conjunction with bank stabilization, is recommended. Bank vegetation was most sparse in Reach 1.

Overall, York Creek is one of the most significant spawning and rearing streams for steelhead within the Napa Basin. Reach 1 and 2 have been adversely affected by riparian encroachment, levee construction, road building, and channel modifications (i.e. straightening). Reaches 2, 3, and 4 are the only reaches currently accessible and suitable for steelhead spawning and rearing. These reaches contain high quality habitat and sustained flow. Reach 1 contains limited rearing habitat, primarily above Highway 29. The instream reservoir on York Creek is scheduled for removal in 2006-2008 by the US Army Corps of Engineers and the City of St. Helena. Removing the reservoir will allow access to over 1.5 miles of high quality steelhead habitat. The upper reaches of York Creek offer excellent rearing and spawning habitat, and creating access to these areas will greatly benefit the overall steelhead population.

A small diversion dam in Reach 3 that was identified in our 2003 habitat survey was removed by the City of St. Helena in 2004 and restored to allow fish passage. The site is a significant improvement to fish migration in York Creek.

A complete inventory of 35 potential restoration sites for York Creek has been compiled and prioritized in section 4 of this report.

3.2 SNORKEL SURVEYS

Juvenile steelhead distribution and density was examined in Bale Slough, Bell Creek, Canon Creek, Napa River, Rector Creek, and Soda Creek (Figure 3.2-a). All surveys were conducted during the summer of 2004. Juvenile steelhead were documented in all survey streams except Canon Creek. The highest steelhead densities were observed in York Creek with several high-density reaches, both above and below the York Creek dam. The fish observed above York Creek dam are presumed to be resident rainbow trout due to the complete barrier to anadromy presented by this dam.

Many stream reaches had very limited surface flow during our snorkel surveys - specifically Canon Creek, Bale Slough, and Rector Creek. These three streams had relatively short sections of divable habitat, which consisted primarily of isolated pools. Although such isolated pools do not provide ideal habitat for salmonid rearing, our surveys suggest these pools are significant refuges in intermittent streams within the Napa River basin.

The Napa River had juvenile steelhead present in several reaches with low to moderate densities. All steelhead observed in the Napa River were larger fish; no young of year steelhead were seen. The size classes indicate these were smolts (5-7 inches) or resident fish; life history of these fish can not be determined by visual observation alone. Typically, one would expect to find mostly young-of-year, fewer 1+ fish, and far fewer 2+ fish in a good spawning and rearing stream. The size classes documented in the Napa River suggest these were either resident trout or steelhead smolts from upstream tributaries, which hold in pools on their way to the ocean.

Results from the current steelhead distribution study were consistent with previous efforts (Ecotrust & FONR, 2001), which suggest that most suitable rearing habitat in the Napa River basin is well-seeded with juvenile steelhead. Overall, steelhead densities were lower in the current study; this discrepancy may be attributed to a series of factors: different streams were surveyed, different survey crews were used, and seasonal population fluctuations may affect densities. Long-term monitoring of steelhead density and distribution in several key tributaries is needed to examine population trends over several years.

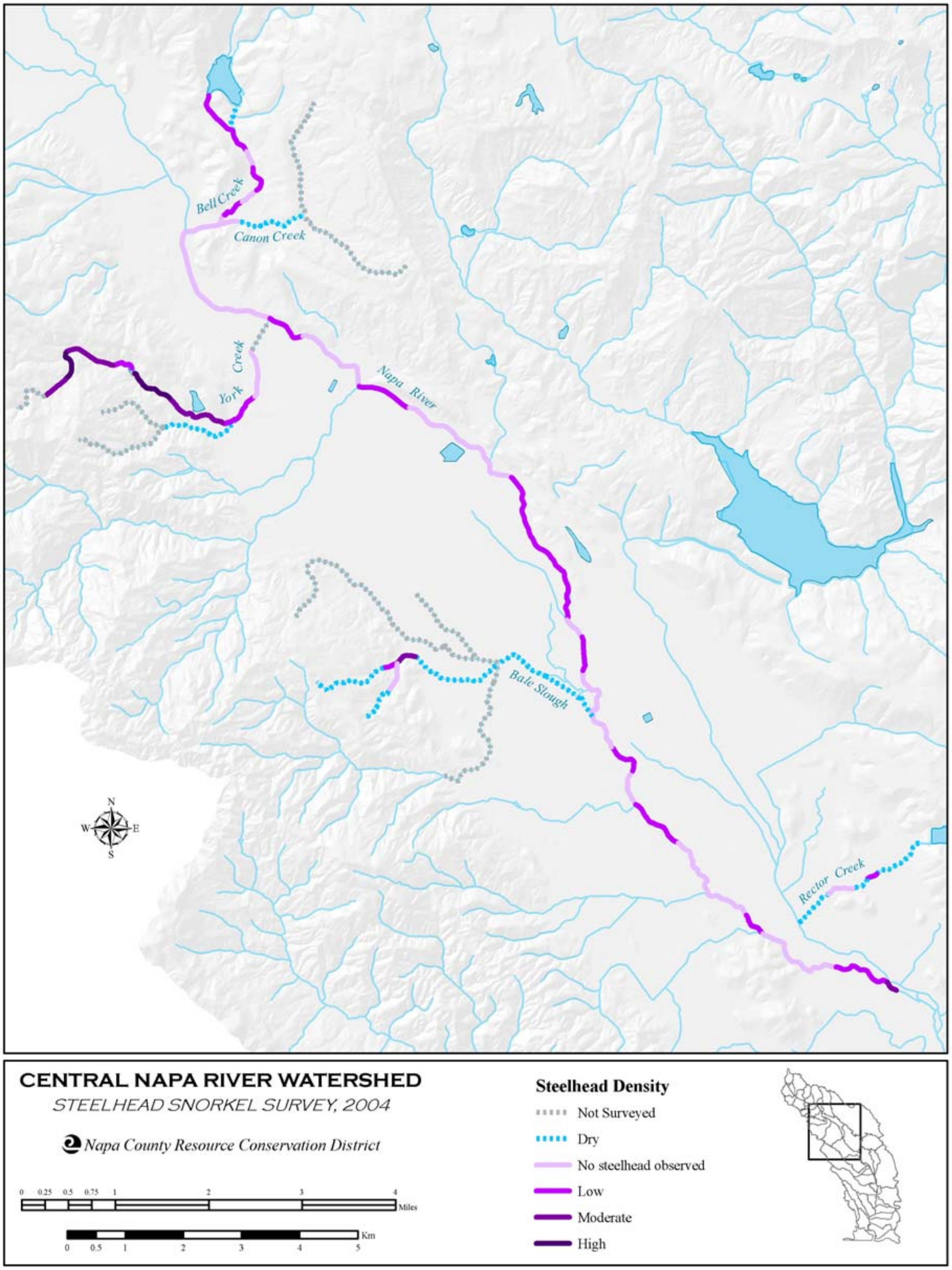


Figure 3.2-1. Juvenile steelhead distribution map with 2004 survey results. Reach densities are based on the number of steelhead counted per measured habitat area: High = 0.5 – 1 SH per sq. meter, Moderate = 0.25 – 0.5 SH per sq. meter, Low = ≤ 0.25 SH per sq. meter.

3.3 GRAVEL PERMEABILITY

Based on permeability measurements at the 46 potential steelhead spawning sites (Figure3.3-1), the median predicted survival to emergence index was 50% (Table 3.3-1). Raw survival index values ranged from 3% to 95%, with average site values ranging from 7% to 72%. Median permeability values ranged from 314 cm/hr to 150,684 cm/hr.

The results of this intensive spawning gravel suitability study are not uniformly low or high values, but rather cover a broad range of conditions within local streams. The median survival index of 50% indicates conditions that are suitable, although not ideal, for successful salmonid reproduction. In the context of the central Napa River watershed, spawning gravel conditions in tributary streams appear to sufficiently support steelhead spawning. Additionally, current and previous steelhead distribution surveys document most reaches with adequate flow and suitable temperature conditions are well seeded with juvenile steelhead.

Table 3.3-1. Summary of permeability sampling in nine tributaries in the central Napa River watershed.
[1]The standpipe was driven into the streambed at two sampling locations for each site.

Stream Name	Site Description	Latitude	Longitude	Date	D50 estimate (mm)	Standpipe drive #[1]	Median permeability (cm/hr)	Survival index	Average survival index by site
Bale Slough	BA_PM_1	N 38.46890	W 122.44997	1/19/2005	15	1	5051	0.44	0.48
		N 38.46890	W 122.44997		15	2	8750	0.53	
	BA_PM_2	N 38.46915	W 122.44956	1/19/2005	15	1	3907	0.41	0.36
		N 38.46915	W 122.44956		15	2	2255	0.32	
Bell Creek	BL_PM_1	N 38.55128	W 122.48317	1/21/2005	10	1	1351	0.25	0.30
		N 38.55132	W 122.48665		21	2	2608	0.35	
	BL_PM_2	N 38.54940	W 122.48232	1/20/2005	96	1	2823	0.36	0.39
		N 38.54900	W 122.48224		92	2	4603	0.43	
	BL_PM_3	N 38.53817	W 122.48407	1/20/2005	38	1	10813	0.56	0.53
		N 38.53827	W 122.48348		90	2	7235	0.50	
	BL_PM_4	N 38.53762	W 122.48524	1/20/2005	50	1	20836	0.65	0.52
		N 38.53791	W 122.48473		45	2	3363	0.38	
	BL_PM_5	N 38.53535	W 122.49154	1/20/2005	63	1	2723	0.35	0.25
		N 38.53531	W 122.49138		65	2	740	0.16	
	BL_PM_6	N 38.53529	W 122.49251	1/20/2005	65	1	26529	0.69	0.56
		N 38.53529	W 122.49251		45	2	4470	0.43	
Canon Creek	CN_PM_1	N 38.53646	W 122.48457	1/21/2005	27	1	1893	0.30	0.31
		N 38.53646	W 122.48457		56	2	2334	0.33	
	CN_PM_2	N 38.53664	W 122.48440	1/21/2005	12	1	314	0.03	0.07
		N 38.53678	W 122.48402		48	2	505	0.10	
Conn Creek	CO_PM_1	N 38.48715	W 122.39655	1/19/2005	35	1	5508	0.46	0.46
		N 38.48715	W 122.39655		35	2	5632	0.46	
	CO_PM_2	N 38.48697	W 122.39787	1/19/2005	30	1	11057	0.56	0.46
		N 38.48697	W 122.39787		35	2	2920	0.36	
	CO_PM_3	N 38.43182	W 122.37358	1/18/2005	20	1	5444	0.45	0.44
		N 38.43182	W 122.37358		20	2	4659	0.43	
	CO_PM_4	N 38.4281	W 122.37117	1/18/2005	40	1	14203	0.60	0.71
		N 38.4281	W 122.37117		45	2	62977	0.82	

Stream Name	Site Description	Latitude	Longitude	Date	D50 estimate (mm)	Standpipe drive #[1]	Median permeability (cm/hr)	Survival index	Average survival index by site
	CO_PM_5	N 38.48808	W 122.40235	1/19/2005	40	1	5321	0.45	0.40
		N 38.48808	W 122.40235		35	2	2588	0.34	
Montgomery Creek	MO_PM_1	N 38.39610	W 122.44607	2/4/2005	70	1	17841	0.63	0.57
		N 38.39701	W 122.44580		65	2	7493	0.50	
	MO_PM_2	N 38.39788	W 122.44477	2/4/2005	60	1	8777	0.53	0.58
		N 38.39765	W 122.44478		30	2	18987	0.64	
	MO_PM_3	N 38.39937	W 122.44321	2/4/2005	32	1	5612	0.46	0.54
		N 38.39857	W 122.44421		62	2	16910	0.62	
	MO_PM_4	N 38.40065	W 122.44286	2/4/2005	44	1	15156	0.61	0.53
		N 38.39964	W 122.44284		78	2	5056	0.44	
	MO_PM_5	N 38.40311	W 122.44243	2/4/2005	52	1	7265	0.50	0.60
		N 38.40235	W 122.44257		68	2	29683	0.71	
	MO_PM_6	N 38.40424	W 122.44186	2/4/2005	58	1	2411	0.33	0.44
		N 38.40339	W 122.44202		70	2	10255	0.55	
Rector Creek	RE_PM_1	N 38.43623	W 122.35571	1/18/2005	35	1	28641	0.70	0.69
		N 38.43623	W 122.35571		30	2	25699	0.69	
	RE_PM_2	N 38.43602	W 122.35619	1/18/2005	50	1	4120	0.41	0.48
		N 38.43602	W 122.35619		40	2	9985	0.54	
	RE_PM_3	N 38.43419	W 122.36261	1/18/2005	40	1	62622	0.82	0.69
		N 38.43419	W 122.36261		55	2	10712	0.56	
	RE_PM_4	N 38.43369	W 122.36184	1/18/2005	45	1	2497	0.34	0.55
		N 38.43369	W 122.36184		55	2	43091	0.76	
Soda Creek	SO_PM_0	N 38.37847	W 122.28313	1/21/2005	81	1	8356	0.52	0.57
		N 38.37719	W 122. 2832		78	2	17206	0.63	
	SO_PM_1	N 38.39027	W 122.28657	2/2/2005	67	1	8365	0.52	0.72
		N 38.39077	W 122.28706		75	2	128491	0.93	
	SO_PM_2	N 38.38970	W 122.28571	2/2/2005	70	1	10758	0.56	0.55
		N 38.39004	W 122.28578		85	2	9801	0.54	
	SO_PM_3	N 38.38908	W 122.28500	2/2/2005	75	1	2618	0.35	0.35
		N 38.38908	W 122.28500		75	2	2632	0.35	
	SO_PM_4	N 38.38845	W 122.28439	2/2/2005	55	1	5618	0.46	0.46
		N 38.38886	W 122.28478		95	2	5685	0.46	
	SO_PM_5	N 38.38723	W 122.28253	2/2/2005	55	1	5346	0.45	0.46
		N 38.38747	W 122.28297		70	2	5900	0.47	
Wing Canyon Creek	WC_PM_3	N 38.38794	W 122.42289	2/3/2005	70	1	16642	0.62	0.58
		N 38.38794	W 122.42289		43	2	9917	0.54	
	WC_PM_4	N 38.38847	W 122.42231	2/3/2005	65	1	21545	0.66	0.53
		N 38.38849	W 122.42263		80	2	3906	0.41	
	WC_PM_5	N 38.38925	W 122.42224	2/3/2005	65	1	2895	0.36	0.39
		N 38.38884	W 122.42222		50	2	4430	0.42	
	WC_PM_6	N 38.39061	W 122.42278	2/3/2005	50	1	14220	0.60	0.52
		N 38.39020	W 122.42253		40	2	4982	0.44	
	WC_PM_7	N 38.39077	W 122.42197	2/3/2005	31	1	7576	0.50	0.50
		N 38.39080	W 122.42215		28	2	7191	0.50	

Stream Name	Site Description	Latitude	Longitude	Date	D50 estimate (mm)	Standpipe drive #[1]	Median permeability (cm/hr)	Survival index	Average survival index by site
York Creek	YK_PM_1	N 38.51619	W 122.51126	1/13/2005	82	1	29718	0.71	0.65
		N 38.51653	W 122.51165		73	2	14266	0.60	
	YK_PM_2	N 38.51523	W 122.50960	1/13/2005	55	1	6578	0.48	0.49
		N 38.51525	W 122.50999		72	2	7217	0.50	
	YK_PM_3	N 38.51502	W 122.50854	1/13/2005	65	1	1226	0.23	0.30
		N 38.5150	W 122.50945		70	2	3130	0.37	
	YK_PM_5	N 38.51455	W 122.50684	1/13/2005	87	1	9311	0.53	0.46
		N 38.51474	W 122.50746		66	2	3232	0.38	
	YK_PM_6	N 38.51070	W 121.50002	1/14/2005	75	1	8127	0.51	0.44
		N 38.51220	W 122.50170		59	2	2811	0.36	
	YK_PM_7	N 38.51049	W 122.49799	1/14/2005	55	1	8937	0.53	0.50
		N 38.51112	W 122.49880		56	2	5903	0.47	
	YK_PM_8	N 38.50850	W 122.49462	1/14/2005	58	1	2899	0.36	0.45
		N 38.50856	W 122.49472		74	2	9731	0.54	
	YK_PM_9	N 38.50775	W 122.49357	1/14/2005	93	1	19664	0.65	0.62
		N 38.50806	W 122.49395		65	2	14295	0.60	
	YK_PM_10	Not recorded		1/6/2005	77	1	5808	0.46	0.71
		Not recorded			45	2	150684	0.95	
	YK_PM_11	N 38.50729	W 122.48138	1/21/2005	77	1	46751	0.77	0.65
		N 38.50781	W 122.48116		85	2	8532	0.52	

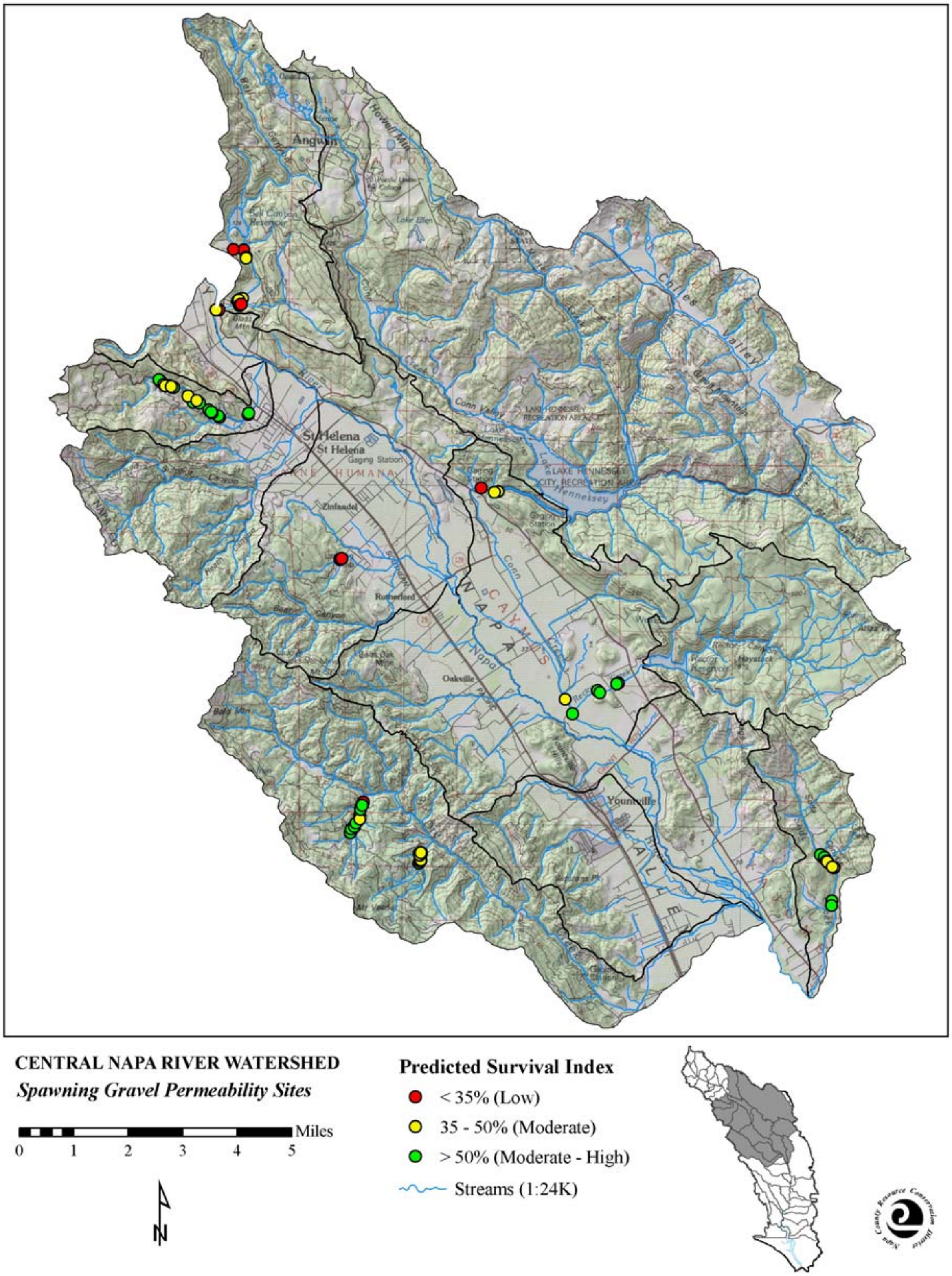


Figure 3.3-1. Gravel permeability measurement sites (total = 46) within the study area. Permeability is displayed using the predicted survival index for each sampling site, as discussed in detail in section 2.6.

3.4 WATER QUALITY

Water quality monitoring was conducted at ten sites from September 2003 – November 2004 by RCD staff and trained volunteers (Figure2-1). Results for each stream site are available in electronic format from the RCD. Dissolved oxygen levels appear to be generally low in most streams during late summer and early fall (Figure 3.4-1).

As expected, basic water quality appears to be strongly associated with the hydrologic conditions of a given site. Water quality indicators (pH, DO, temperature, specific conductance) generally declined as flows receded in late summer, and reached seasonal lows just before the first rains of the season. The most stressful period for juvenile salmonids was recorded in September through October at all sites. This period was characterized by high water temperatures, and low dissolved oxygen levels, especially at sites with low flow. Specific conductance and pH remained generally stable throughout the year but did show the highest amount of variance during late summer and early fall.

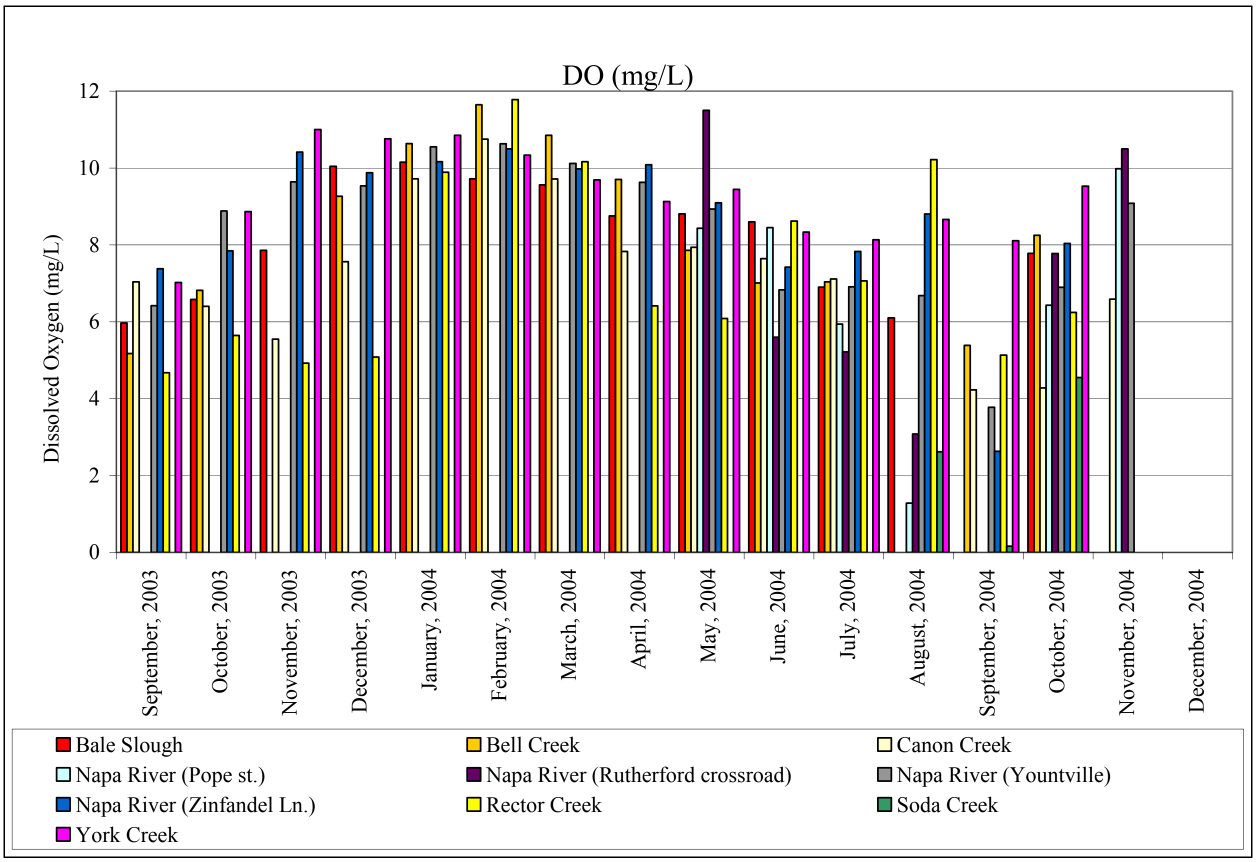


Figure 3.4-1. Dissolved oxygen data from all sites show typical seasonal patterns of high levels in winter and lower levels in summer.

3.5 STREAM FLOW

Stream flows were observed for the duration of the study at nine sites. Results show that most streams in the central Napa River watershed, including the mainstem Napa River, experienced severe seasonal flow recessions, with many reaches going completely dry by late summer.
Stream flow was categorized using the following scale:

Flow Category 3 = Briskly flowing
Flow Category 2 = Moderately flowing
Flow Category 1 = Slowly flowing
Flow Category 0 = Stagnant flow with isolated pools present
Flow Category -1 = Dry

Bale Slough had limited baseflow throughout much of the spring and summer periods monitored (Figure 3.5-1). Much of Bale Slough was completely dry in early summer (July 2004) including the reach from Whitehall Lane downstream to the confluence with the Napa River. As discussed in Section 3.1.1, perennial rearing habitat is limited to a short reach along Whitehall Lane. This reach had baseflow during late summer 2003, but no surface water was present during August and September 2004.

Surface flow in Bell Creek above Canon Creek appears to be largely regulated by water releases from Bell Reservoir. Results from our monitoring on Bell Creek indicate a relatively constant release throughout the study period (Figure 3.5-3). One anomaly in this pattern occurred in November 2003 and November 2004 when the monitoring site had no surface flow present; several scattered isolated pools remained. Reconnaissance surveys of Bell Creek in fall of 2004 between the Silverado Trail and the confluence with the Napa River documented dry channel conditions throughout much of this reach.

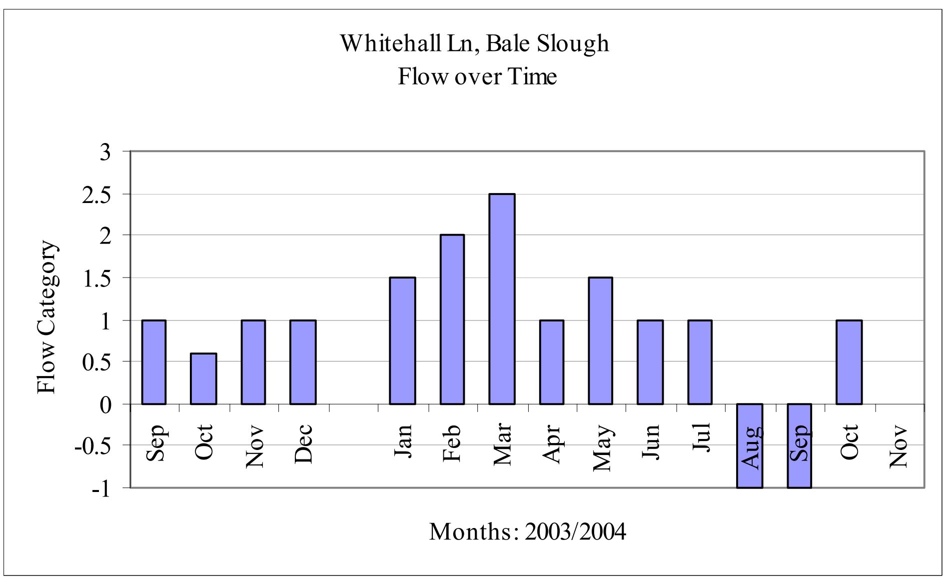


Figure 3.5-1. Stream flow in Bale Slough from September 2003 – November 2004 Multiple observations within the same month were averaged.

Figure 3.5-2. Bale Slough monitoring site completely dry, October 7, 2004.

Canon Creek maintained water throughout the study period with only one month (August, 2004) lacking surface flow. The length of wetted channel in Canon Creek was limited to approximately 1,500 feet during summer 2004, as described in detail in Section 3.1.3.

Conn Creek was not continuously monitored for stream flow in this study. Reconnaissance surveys to several sites along Conn Creek (Skellenger Lane, Silverado Trail, Yountville Eco-Reserve) documented dry conditions throughout much of the year. The instream habitat survey in August, 2004 also documented dry channel reaches with very few widely scattered isolated pools. The short reach of Conn Creek immediately below Conn Dam retains year-round water. This reach provides lacustrine habitat with stands of cattails and relatively deep stagnant water.

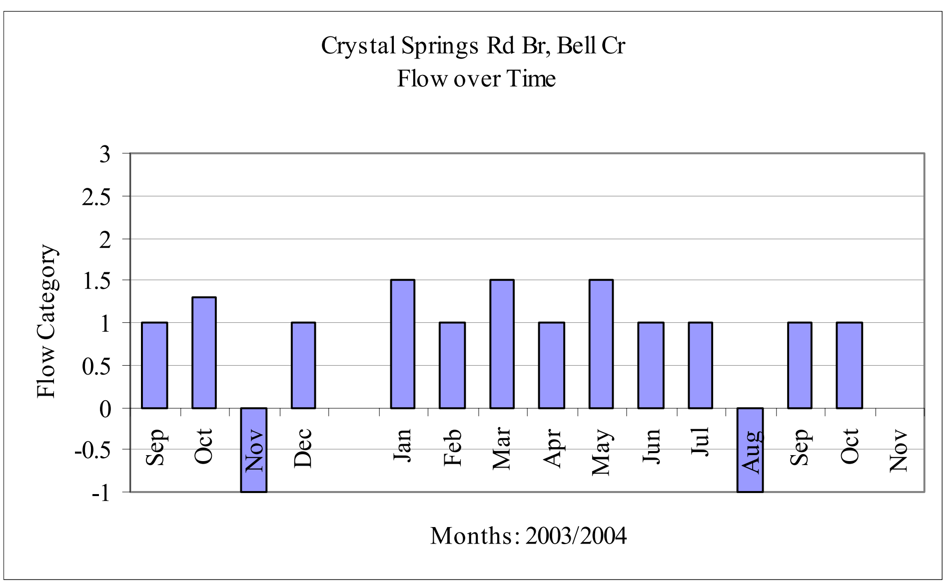


Figure 3.5-3. Stream flow in Bell Creek from September 2003 – November 2004. Multiple observations within the same month were averaged.

Montgomery Creek was not continuously monitored for stream flow in this study. Dry channel conditions were observed during the habitat survey in August 2004 as described in Section 3.1.5

The Napa River sustained year-round flow at Zinfandel Lane and Yountville Eco Reserve (Figure 3.5-7 and Figure 3.5-8). The Zinfandel site had very minimal surface flow in September and November 2004, which was recorded as "no flow" (flow category 0). The other two Napa River sites, Pope Street and Rutherford Crossroad, had no surface flow in August 2004, and were both completely dry in September 2004 (Figure 3.5-5 and Figure 3.5-6). Summer baseflow in the Napa River was minimal in all surveyed reaches in 2003 and 2004.

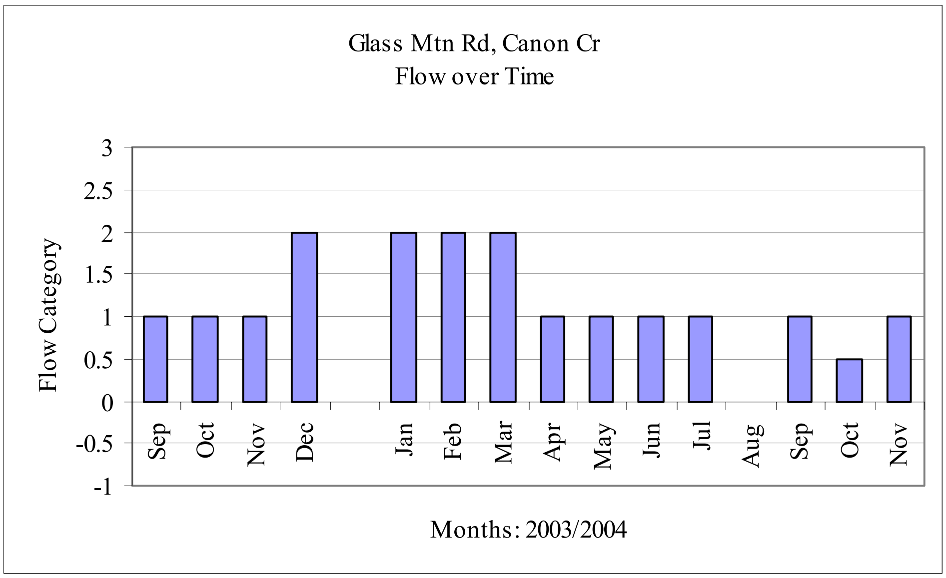


Figure 3.5-4. Stream flow in Canon Creek from September 2003 – November 2004. Multiple observations within the same month were averaged.

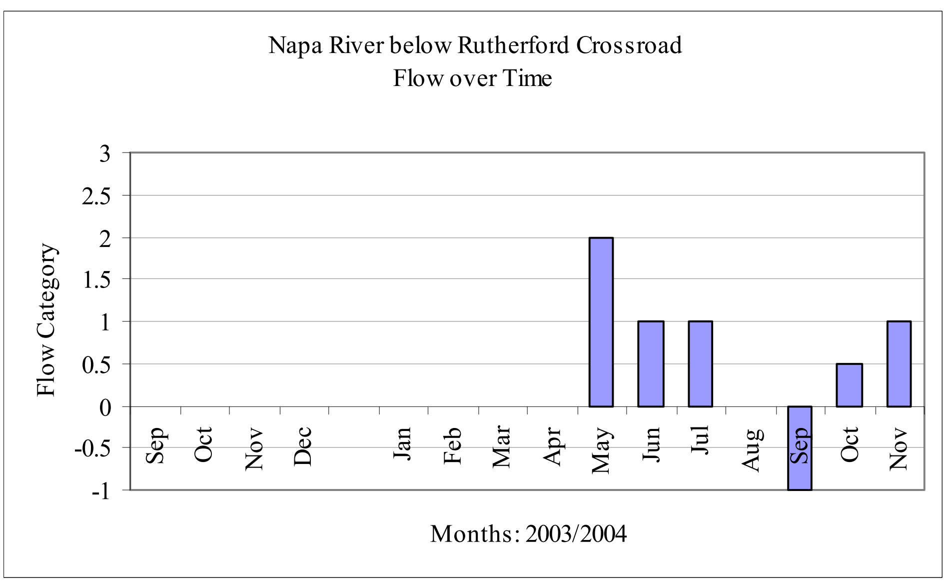


Figure 3.5-5. Stream flow in the Napa River near the Rutherford Crossroad from May 2004 – November 2004. Multiple observations within the same month were averaged.

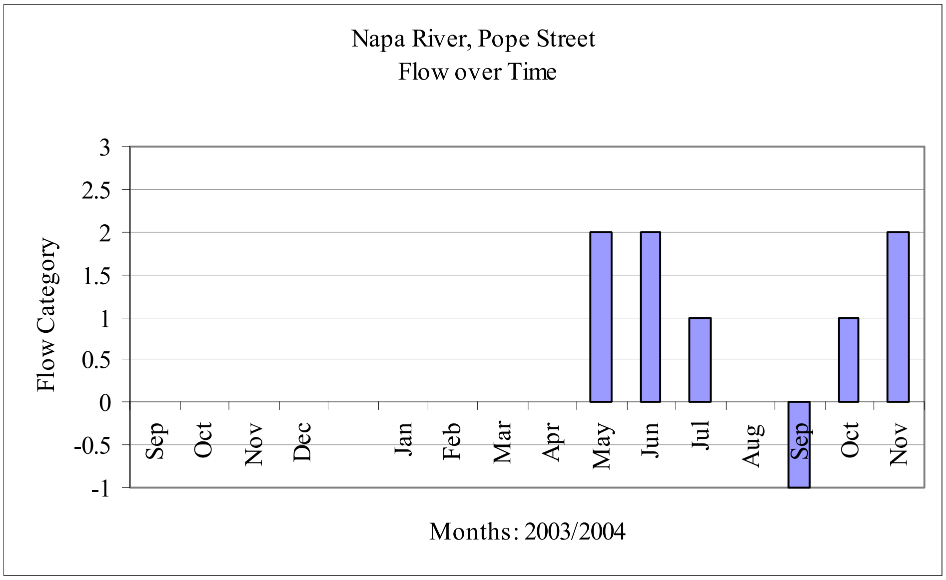


Figure 3.5-6. Stream flow in the Napa River at the Pope Street Bridge from May 2004 – November 2004. Multiple observations within the same month were averaged.

Figure 3.5-6a. Napa River completely dry at Pope Street in St. Helena, October 2004.

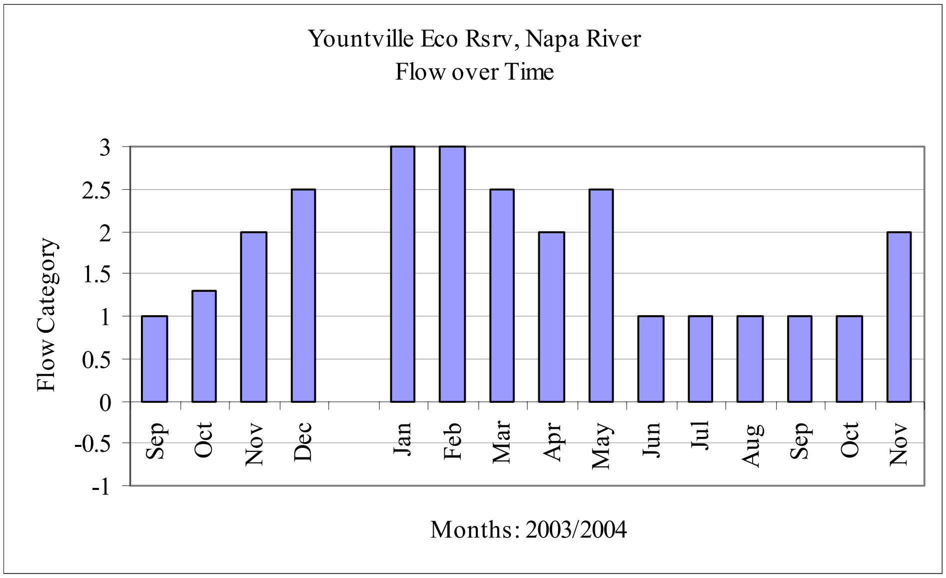


Figure 3.5-7. Stream flow in the Napa River from September 2003 – November 2004. Multiple observations within the same month were averaged.

Figure 3.5-7a. Low flow conditions in the Napa River at the Yountville Eco Reserve, October 2004.

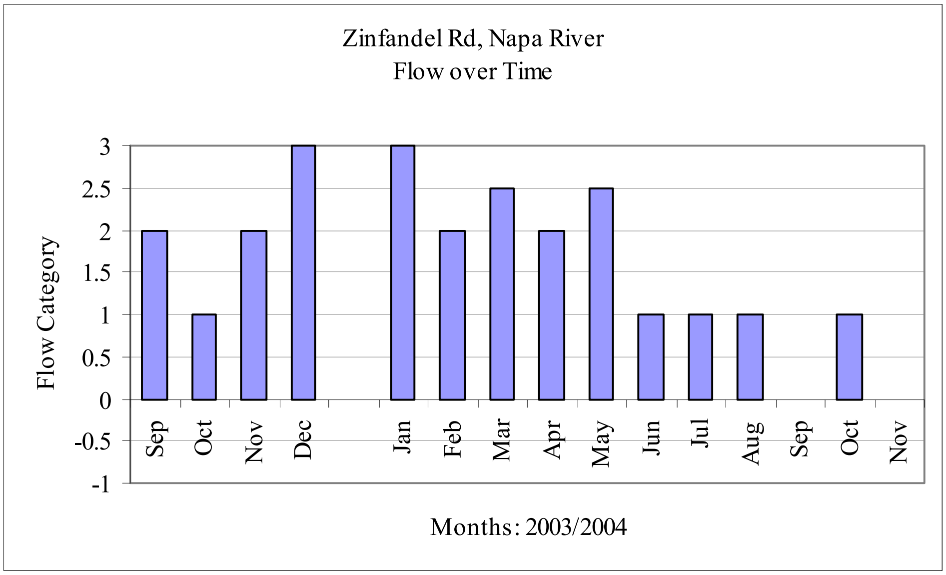


Figure 3.5-8. Stream flow in the Napa River near the Zinfandel Lane Bridge from September 2003 – November 2004. Multiple observations within the same month were averaged.

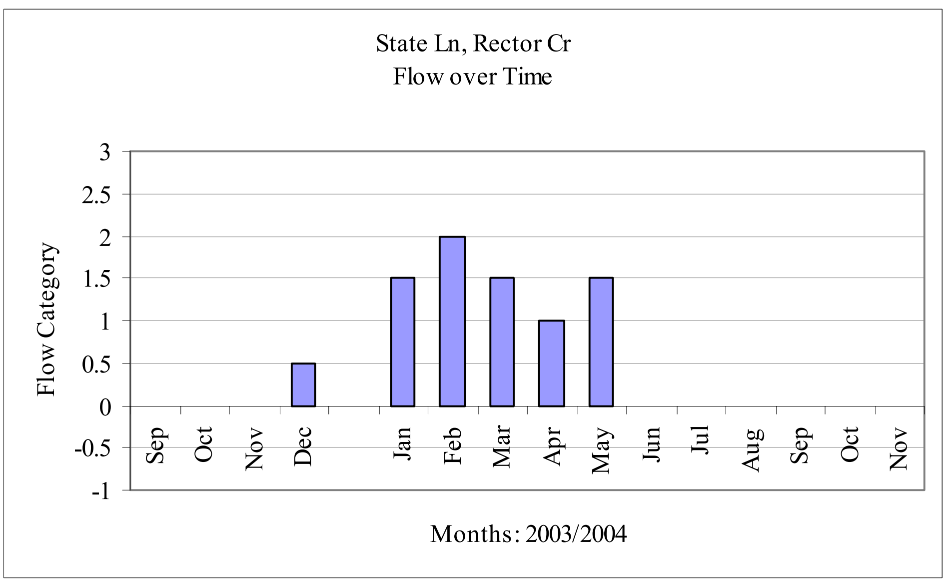


Figure 3.5-8. Stream flow in Rector Creek downstream from State Lane from September 2003 – November 2004. Multiple observations within the same month were averaged.

Rector Creek was completely dry with a few scattered pools present during most of the study period (Figure 3.5-8). The monitoring site was located near a pool that persisted year-round in 2003 and 2004. Other pools that retained year-round water were observed in isolated stretches described in Section 3.1.7. Streamflow in this lower reach is dictated primarily by Rector Reservoir, which is a non-regulated, top-spill, earthen dam. A relatively small amount of water is piped from Rector Reservoir to the fish hatchery facility at the DFG headquarters in Yountville. The hatchery tanks are regularly refreshed with reservoir water, and the waste stream is directed through a settling basin on DFG property, then ultimately into Rector Creek via a valved pipe at the base of the stream bank. Surface flow above this discharge point was non-existent during our habitat survey in May 2003, and the discharge stream appeared to be the sole source of water for downstream reaches during that period. This water source may be responsible for maintaining the perennial pools downstream through slow, constant groundwater recharge.

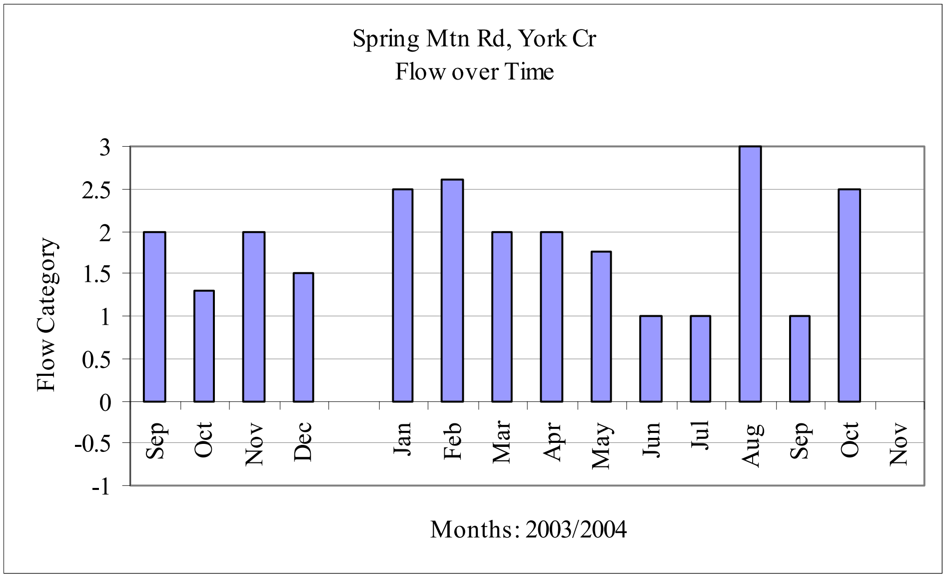


Figure 3.5-9. Stream flow in York Creek from September 2003 – November 2004. Multiple observations within the same month were averaged.

York Creek sustained perennial flow throughout the monitoring period (Figure 3.5-9). As opposed to most other sites, flow conditions remained favorable in York Creek during summer months with a steady flow of cool water. Such conditions were atypical within the Napa basin and warrant special attention and efforts for conservation.

3.6 WATER TEMPERATURE

Continuous water temperature data indicate widely varying conditions exist within the ten study streams. Summarized data are listed in 3.6-1. Maximum recorded temperatures ranged from 17.27° C to 32.49° C. Mean water temperatures ranged from 13.13° C to 20.07° C. The maximum weekly average temperature (MWAT) was analyzed for each dataset. The following guidelines for MWAT thresholds for steelhead were used to assess temperature suitability for juvenile steelhead rearing:

MWAT (°C)	Steelhead Rearing Suitability
<15	Best
15-17	Good
17-19	Marginal
>19	Poor/unsuitable

None of the ten sites had an MWAT value of <15, which is considered best for juvenile rearing. One site (Soda Creek) had an MWAT value of 16.7° C, which is considered favorable. Four sites had MWAT values that are marginal, and five sites were in the poor/unsuitable category. All sites in the Napa River experienced chronic summer temperatures above the suitability threshold for juvenile steelhead. It should be noted that we observed relatively few juvenile steelhead in the Napa River during our 2004 snorkel survey. It is not clear whether elevated summertime temperatures are prohibiting steelhead from utilizing the Napa River for rearing. Water temperatures in tributary streams were generally near or slightly above levels at which adverse effects on juvenile growth and fitness begin.

Stream Name	Site Description	Duration	Number of data points	Mean (°C)	Median (°C)	Max (°C)	Min (°C)	MWAT (°C)
Bale Slough	Whitehall Lane	8/21/03 - 9/8/04	10,055	15.32	15.36	22.31	9.58	18.44
Bell Creek	Crystal Springs Rd. Br.	8/29/03 - 10/29/04	19,428	15.52	15.86	24.36	7.03	21.32
Canon Creek	Glass Mt. Rd.	8/29/03 - 10/29/03	20,211	14.25	14.26	18.07	8.22	17.65
Napa River	Pope St. Br.	3/25/04 - 9/9/04	6,744	20.07	20.58	27.64	12.14	23.86
Napa River	Below Rutherford Crossroad	4/1/04 - 9/8/04	6,890	19.93	20.17	27.33	13.34	23
Napa River	Yountville Eco Reserve	4/1/04 - 10/27/04	10,041	18.59	19.36	25.91	12.56	21.93
Napa River	Zinfandel Ln. Br.	8/21/04 - 10/29/04	19,728	16.87	17.35	25.13	6	21.18
Rector Creek	State Ln.	8/21/03 - 10/29/04	20,780	15.82	16.28	32.49*	9.28	18.12
Soda Creek	Above Soda Hole	6/3/04 - 10/29/04	7,112	14.83	15.05	17.27	11.63	16.79
York Creek	Spring Mt. Rd. crossing	10/1/03 - 10/29/04	18,906	13.13	13.32	21.63	6.04	18.1

Table 3.6-1. Continuous water temperature monitoring results. All statistics were calculated with data excluding known periods when temperature loggers were dry. Maximum weekly average temperature (MWAT) represents the highest weekly average value recorded at each site.
*Rector Creek site went dry during this recording period; therefore the actual maximum water temperature recorded is not known.

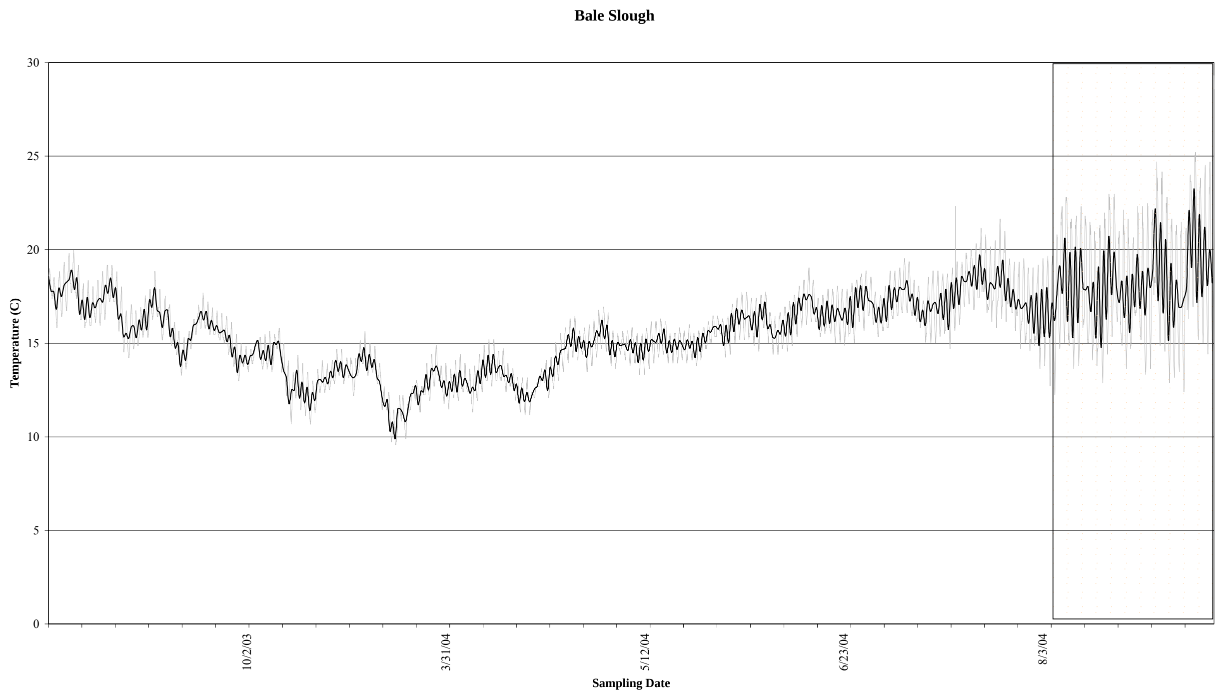


Figure 3.6-1. Continuous water temperature data from Bale Slough from 8/21/2003 – 9/8/2004. The dark black line represents the daily average temperature, and the grey line represents daily range. Shaded boxes indicate portions of the sampling period in which the sampling site was known, or assumed, to have gone dry.

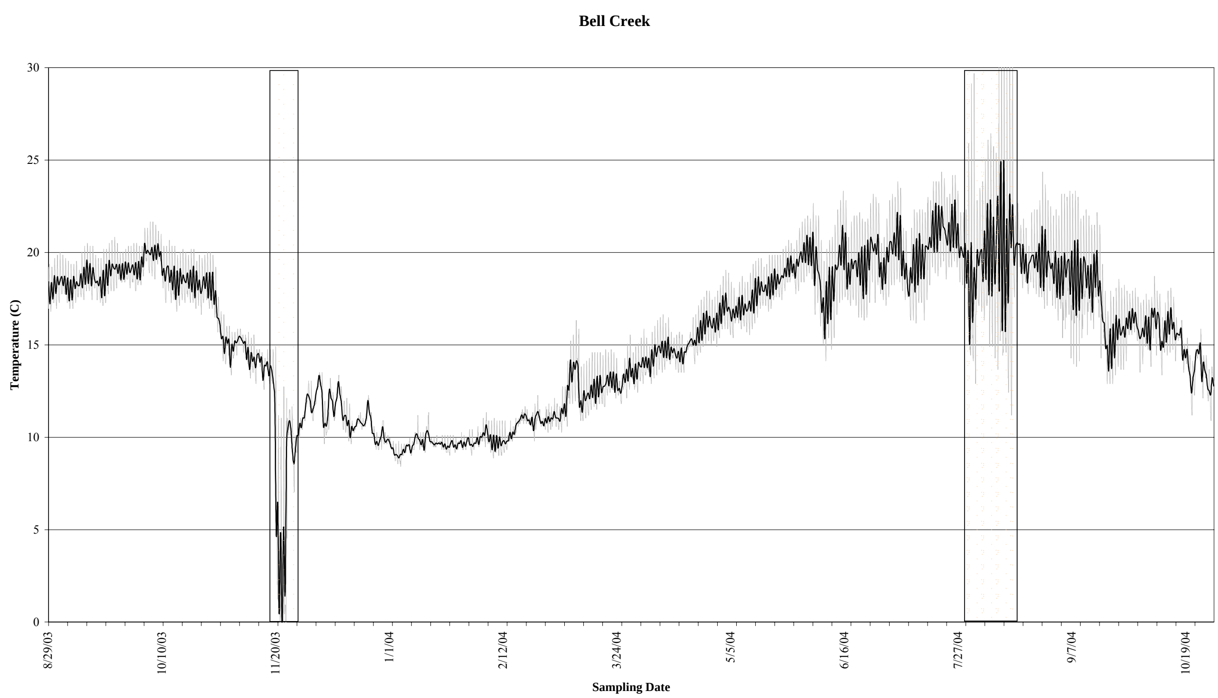


Figure 3.6-2. Continuous water temperature data from Bell Creek from 8/29/2003 – 10/29/2004. The dark black line represents the daily average temperature, and the grey line represents daily range. Shaded boxes indicate portions of the sampling period in which the sampling site was known, or assumed, to have gone dry.

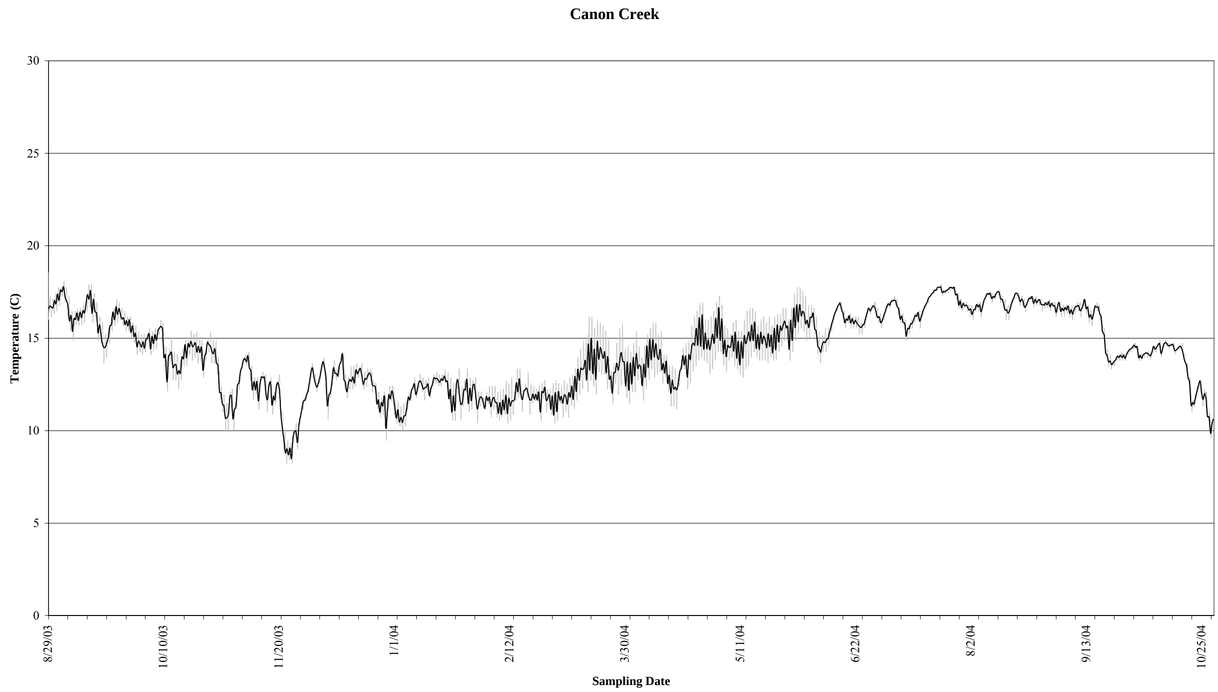


Figure 3.6-3. Continuous water temperature data from Canon Creek from 8/29/2003 – 10/29/2004. The dark black line represents the daily average temperature, and the grey line represents daily range.

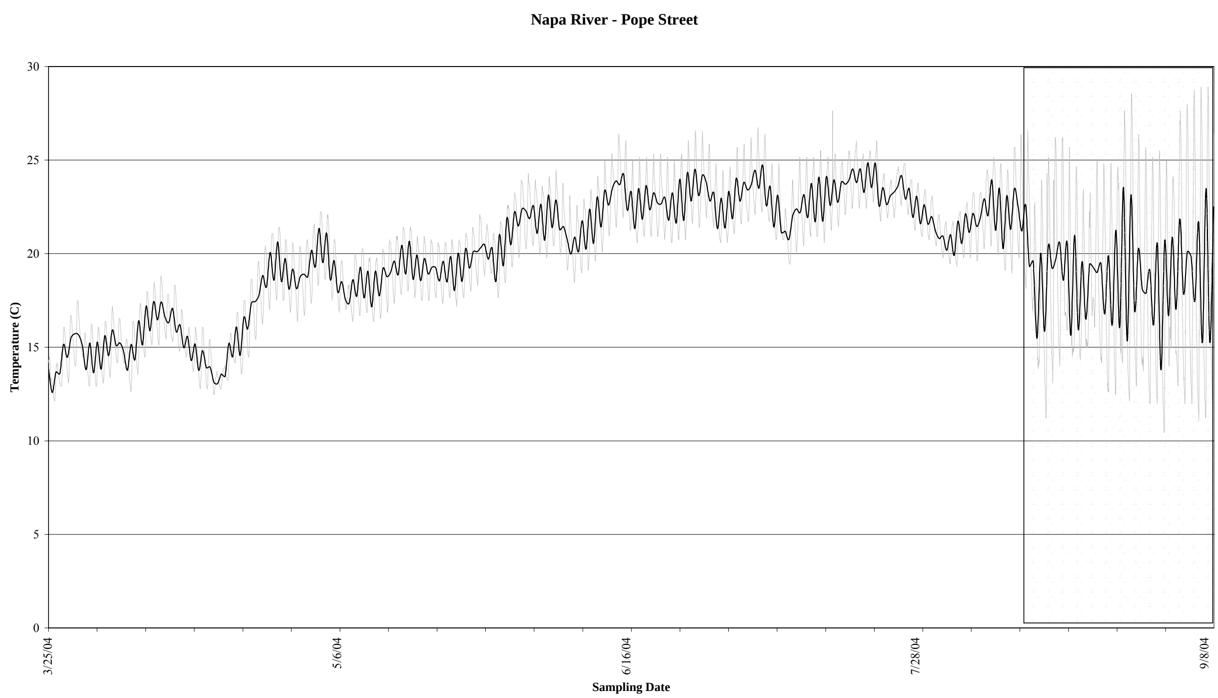


Figure 3.6-4. Continuous water temperature data from Napa River at Pope St. from 3/25/2004 – 9/9/2004. The dark black line represents the daily average temperature, and the grey line represents daily range. Shaded boxes indicate portions of the sampling period in which the sampling site was known, or assumed, to have gone dry.

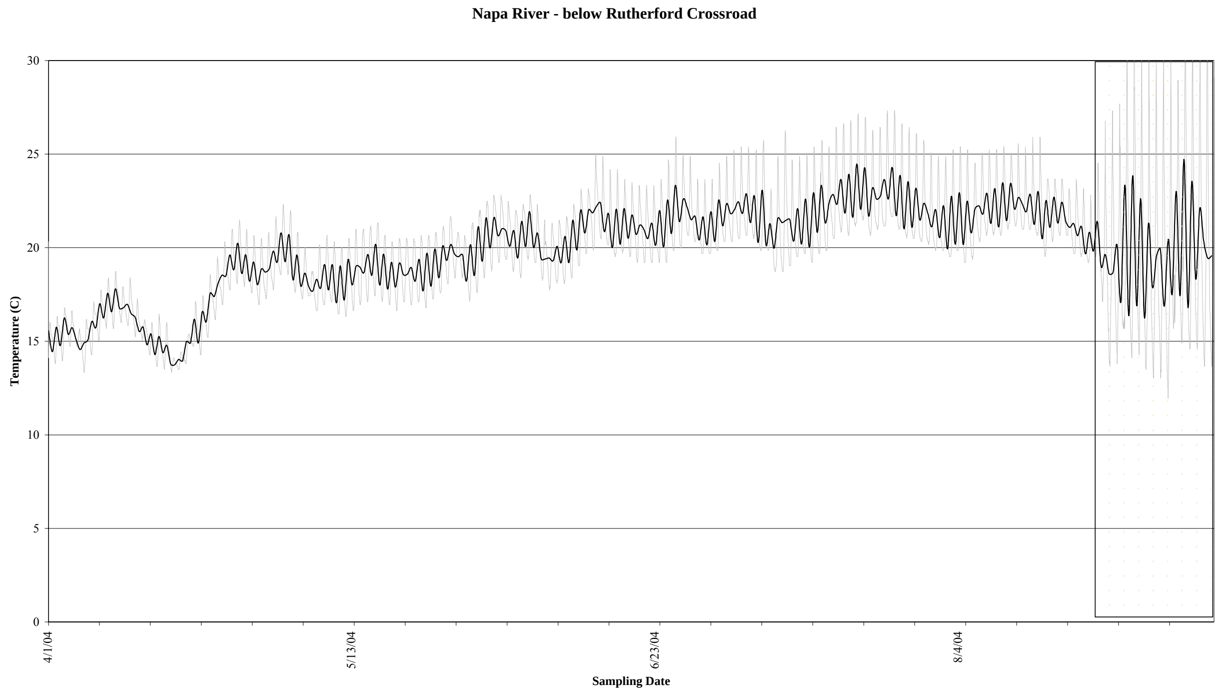


Figure 3.6-5. Continuous water temperature data from Napa River at the Rutherford crossroad from 4/1/2004 – 9/8/2004. The dark black line represents the daily average temperature, and the grey line represents daily range. Shaded boxes indicate portions of the sampling period in which the sampling site was known, or assumed, to have gone dry.

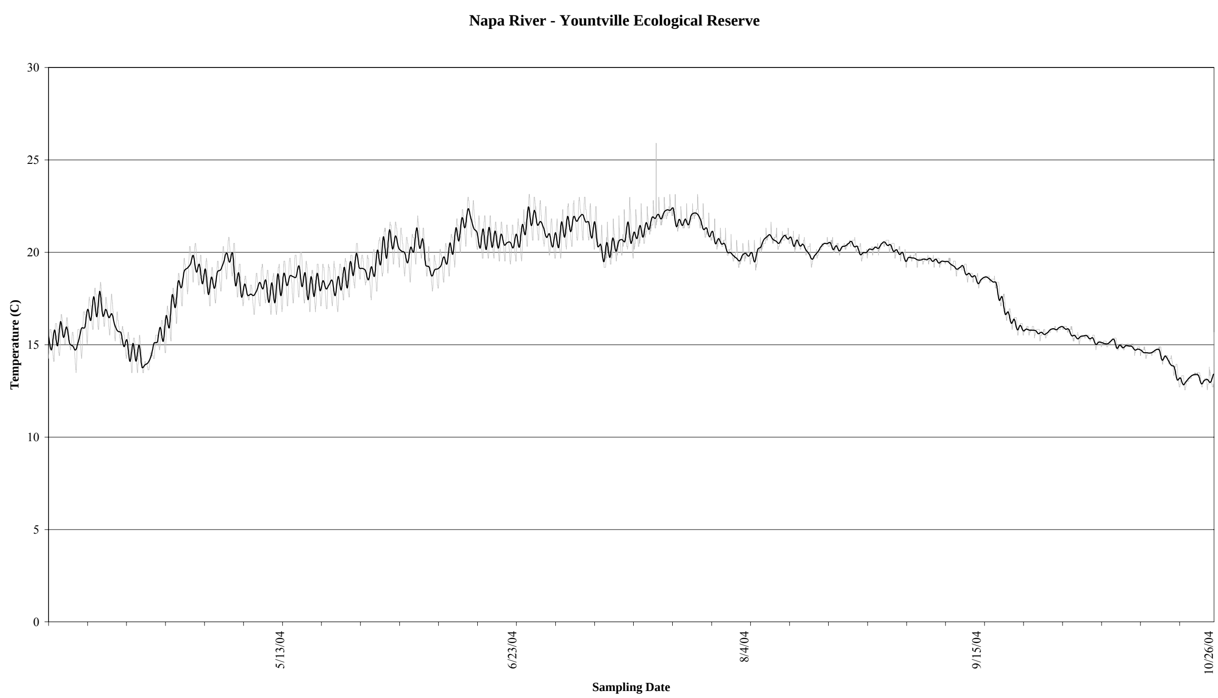


Figure 3.6-6. Continuous water temperature data from the Napa River at the Yountville Eco Reserve from 4/1/2004 – 10/27/2004. The dark black line represents the daily average temperature, and the grey line represents daily range.

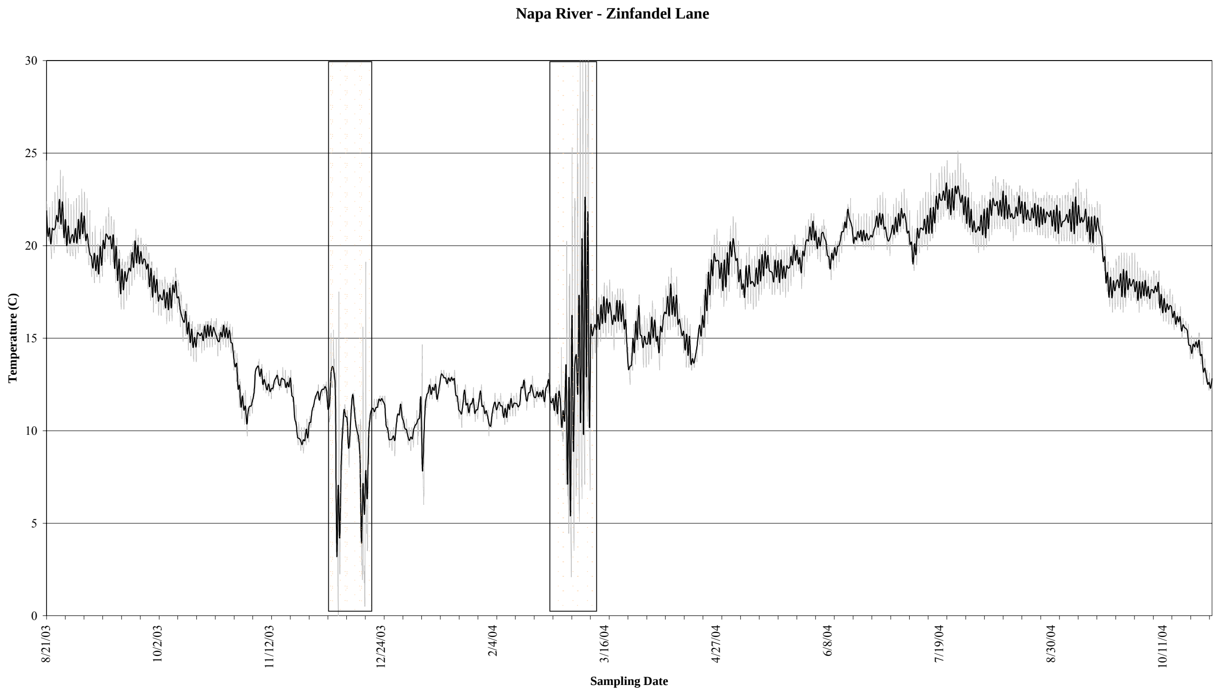


Figure 3.6-7. Continuous water temperature data from the Napa River at Zinfandel Lane from 8/21/2003 – 10/29/2004. The dark black line represents the daily average temperature, and the grey line represents daily range. Shaded boxes indicate portions of the sampling period in which the sampling site was known, or assumed, to have gone dry.

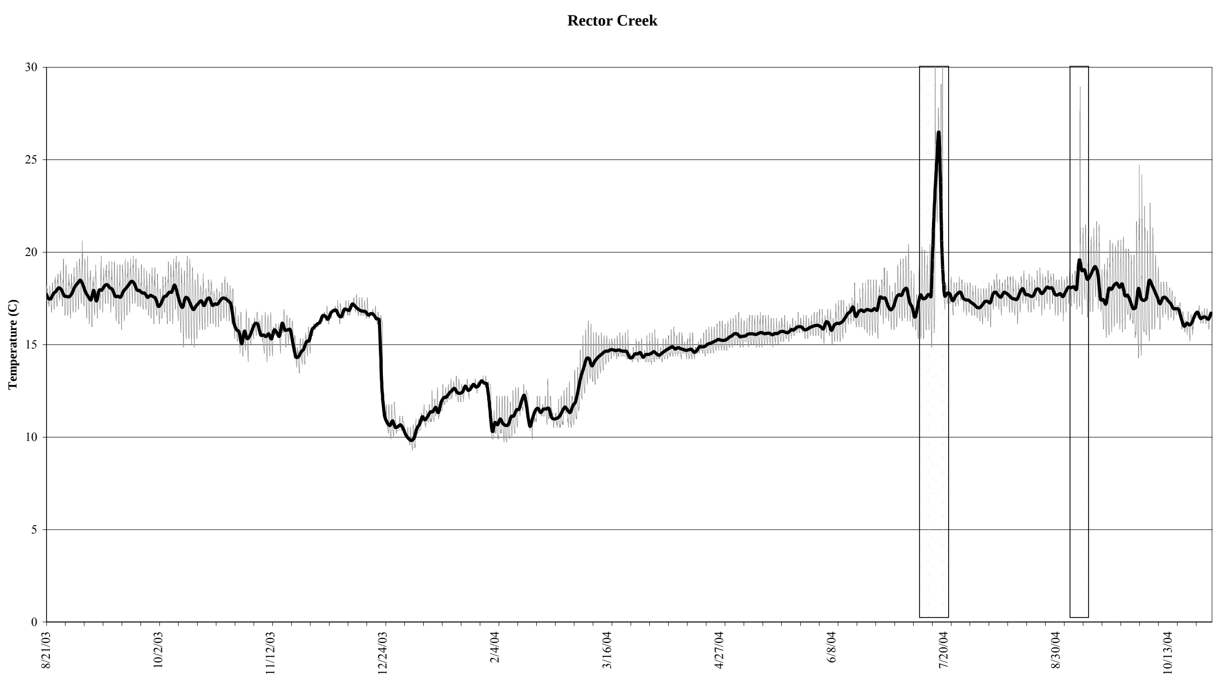


Figure 3.6-8. Continuous water temperature data from Rector Creek from 8/21/2003 – 10/29/2004. The dark black line represents the daily average temperature, and the grey line represents daily range. Shaded boxes indicate portions of the sampling period in which the sampling site was known, or assumed, to have gone dry.

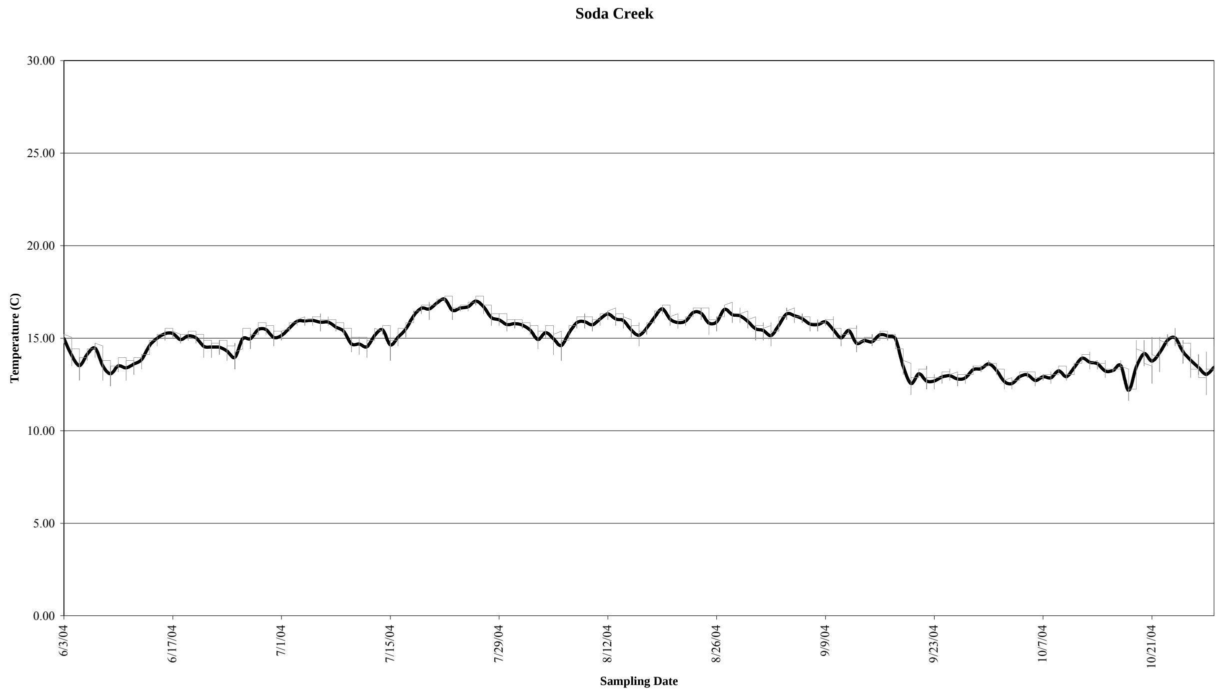


Figure 3.6-9. Continuous water temperature data from Soda Creek from 6/3/2004 – 10/29/2004. The dark black line represents the daily average temperature, and the grey line represents daily range.

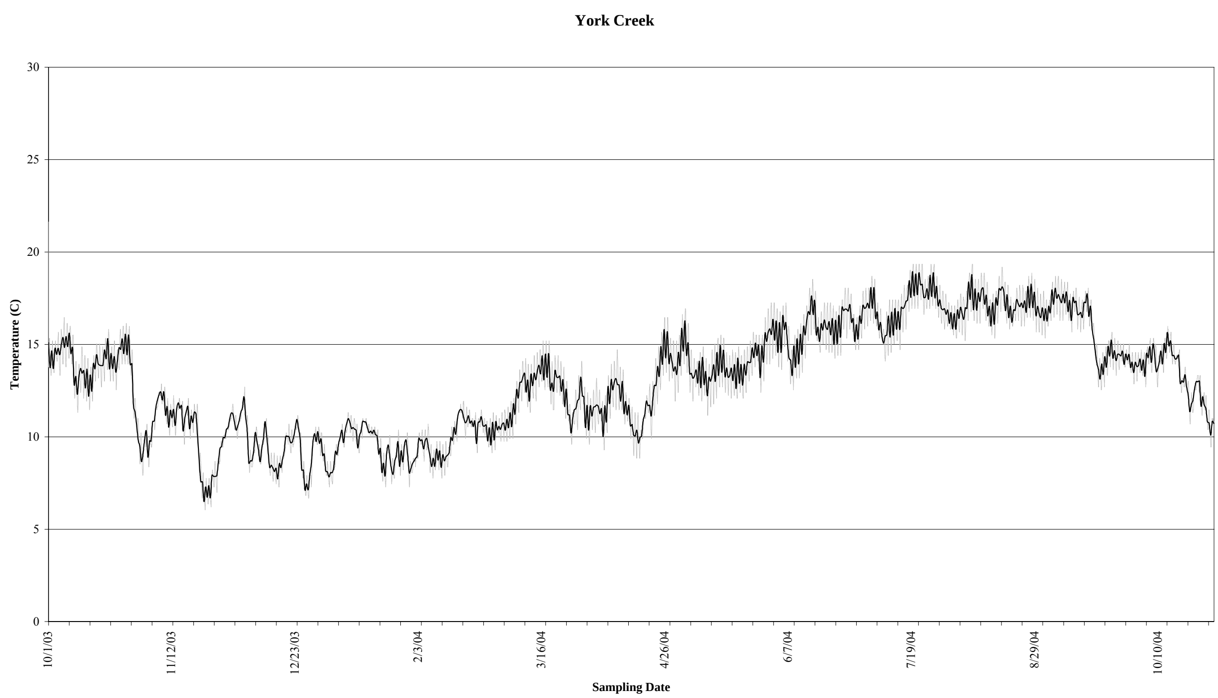


Figure 3.6-10. Continuous water temperature data from York Creek from 10/1/2003 – 10/29/2004. The dark black line represents the daily average temperature, and the grey line represents daily range.

3.7 SALMON SPAWNER SURVEYS

The results of the spawner surveys are given in Table 3.7-1 and mapped redd locations are shown in Figures 3.7-1 and 3.7-2.

A salmon carcass survey was conducted by Jonathan Koehler and Paul Blank of the NCRCD on 11/19/04. The survey documented 102 live Chinook salmon in the ~3.6 mile Rutherford reach. The location and size of 27 redds, many of which had fish on them, were recorded using a handheld GPS. Most redds were upstream of the Rutherford Crossroad with a large number just below the Zinfandel Lane Bridge. Stream flow during the survey was not adequate to allow passage over the bridge apron. Two carcasses were recovered, one of which had an adipose fin clip. The snout of the ad-fin clipped fish was removed and sent to DFG for coded-wire-tag (CWT) analysis. One CWT (#062760) was recovered, and the fish was determined to be a 2002 Spring-run Chinook salmon from the Feather River Hatchery, one of 54,357 released by the hatchery on 4/28/03 in Benicia.

On 12/3/04, a follow-up survey of the 3.6 mile Rutherford reach was conducted by Jonathan Koehler and Chad Edwards of the NCRCD. The crew counted 93 live Chinook salmon spawning and holding. An additional 34 new redds were mapped, many of which were below the Rutherford Crossroad. Sixteen carcasses and 12 skeletons were recovered; none had fin clips. Most carcasses were between 85-100 cm FL (33-39 inches).

A final survey of the reach was conducted on 12/21/04. A total of 21 live Chinook salmon were observed, mostly holding in deeper water and hiding near redds. Most fish appeared worn with visible signs of physical deterioration. Stream flow was considerably higher than previous surveys, which hindered identification of new redds. We mapped one new redd bringing the total to 62 for the reach for all three surveys. Twenty-six carcasses and 15 skeletons were recovered; none had fin clips. The mean fork length of the carcasses was 75 cm.

Survey Date	**19-Nov-2004**	**3-Dec-2004**	**22-Dec-2004**	**Total**
Survey distance (ft)	19,108 ft	19,129 ft	19,173 ft	
Water temp	11.5˚ C	8˚ C	8˚ C	
Air temp	11˚ C	14˚ C	20˚ C	
Live salmon observed	102	93	21	**216***
Carcasses	4	16	26	**46**
Mean fork length (cm)	68	80	75	
Range fork length (cm)	54 - 84	62 - 100	55-95	
Adipose fin clip	2	0	0	**2**
Skeletons	3	12	15	**30**
Redd count	27	34	1	**62**

Table 3.7-1. Summarized salmon spawner/redd surveys of the Rutherford reach in 2004.
*Total count of live salmon may include fish counted multiple times in subsequent surveys and is therefore not an accurate estimate of total reach density.

It is not known what proportion of the Chinook salmon observed in the Napa River were of direct hatchery origin or Napa River stock. State and federal hatcheries release surplus Chinook smolts into the Carquinez Straits and San Pablo Bay each year to supplement the declining salmon populations from the Sacramento and

San Joaquin River systems. The Mokelumne and Feather River hatcheries released a combined 8 – 10 million Chinook smolts (≥ 30/lb.) into the San Pablo bay in 2002 (Mokelumne River Hatchery pers. comm., 2002).

Of all Pacific salmon, Chinook have the highest rates of straying from their natal streams (Moyle 2002). The relatively recent surge in salmon returns to the Napa River may be attributed either to an increase in the number of hatchery strays entering the basin, or an increase in the number of fish that have successfully spawned in the river, the offspring of which are now returning. Another hypothesis is that the bulk of the run consists of Napa River spawned salmon that have led other ambiguous fish into the Napa River basin, thus increasing the size of the run with each subsequent year. Chinook spawning was successful last year; we captured and released several Chinook smolts (50-60 mm) in the river in the spring of 2004. A quantitative assessment of survival is needed to achieve smolt production and adult return estimates.

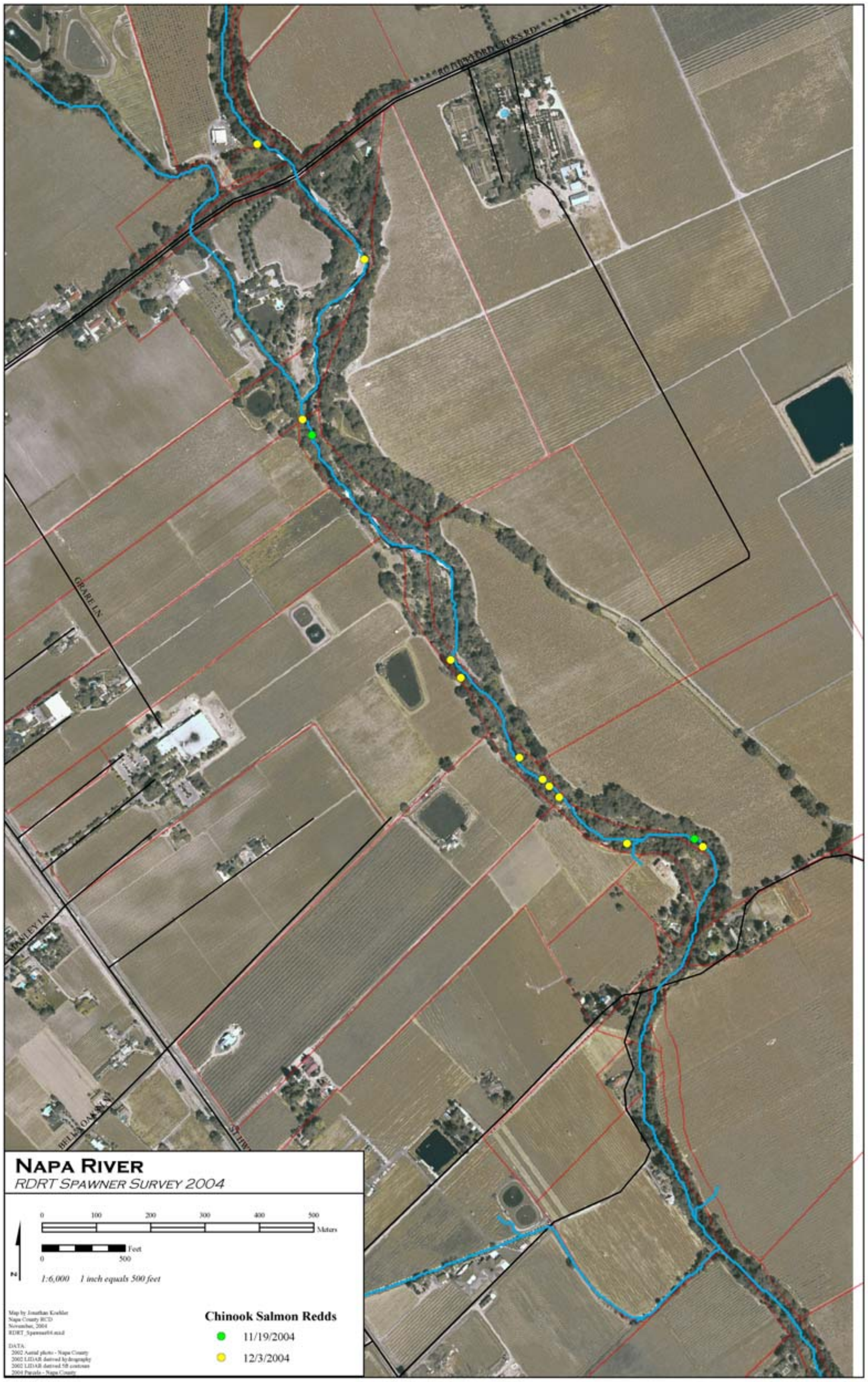


Figure 3.7-1. Chinook salmon spawning redd sites in fall 2004 along the lower survey reach of the Napa River below the Rutherford Crossroad.

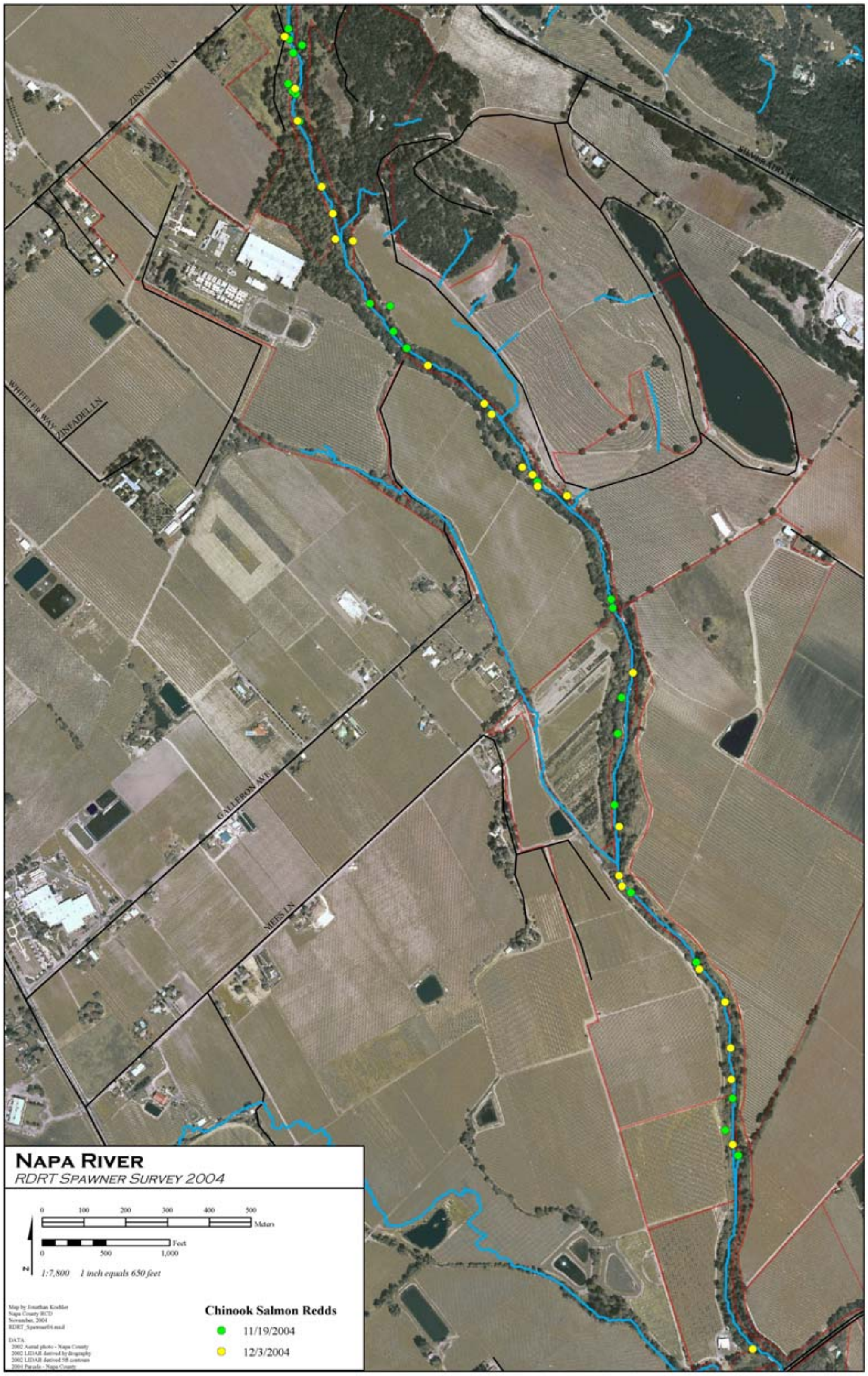


Figure 3.7-2. Chinook salmon spawning redd sites in fall 2004 along the upper survey reach of the Napa River between the Rutherford Crossroad and Zinfandel Lane. Redd density was highest just below the Zinfandel Lane Bridge, which formed a complete barrier to upstream migration during low flow periods.

4 RECOMMENDATIONS

The central region of the Napa River watershed contains several streams that support salmonid spawning and rearing. Instream restoration in conjunction with watershed education is needed to address the environmental and social factors currently limiting salmonid populations within these streams. As a whole, the central region of the Napa River watershed has experienced tremendous changes during the past 100 years, foremost of which has been the construction of dams on several major tributaries (Conn, Rector, York, Bell). Recreating the former habitat value of these streams poses a considerable and likely impossible challenge. Therefore, an effort to maximize the amount of currently available habitat while focusing on protecting and expanding all critical remaining habitats is the most practical strategy for increasing salmonid populations.

All fish migration obstacles and complete barriers should be given the highest priority for removal or modification to allow free movement of adult and juvenile salmonids to all suitable habitats within the basin. We recommend addressing migration barriers as a first priority because it has direct benefit to the fish community and will enable fish to fully utilize the available habitat. These migration barriers consist of specific structures or sites that are likely to significantly impair fish migration upstream as adults or downstream as smolts or dispersing juveniles. A total of eight barriers were identified in the surveyed streams; five of which can be modified or removed; Bell Creek (concrete weir), Napa River (bridge apron), Rector (concrete ford crossing), Wing Canyon (dirt road crossing, and concrete/bedrock dam structure). The remaining three barriers consist of large natural geologic features. Additionally, the major dams on Bell Creek, Rector Creek, and Conn Creek were not included in this total.

In the short term (5-10 years), we recommend addressing the lack of habitat complexity and cover by installing instream bioengineered features (rootwads, logs, etc.) in conjunction with riparian planting, which will ultimately provide LWD recruitment and shading. Lower reaches of tributary streams lacked instream habitat complexity, which reduces juvenile survival through predation and exposure to adverse conditions. Efforts to increase the quantity and quality of pools and resting habitat in lower stream reaches would have the most benefit to salmonid migration as smolts and adults. Improving pool shelter in higher gradient tributary reaches with the highest steelhead densities would be beneficial for juvenile rearing. Chinook rearing, and to a lesser degree spawning, would benefit from additional cover elements in the mainstem Napa River and low gradient reaches of key tributaries. Overall, we recommend focusing instream work in the lower tributary reaches to improve conditions for migrating fish rather than attempt to create more cover in suitable rearing reaches that are already well seeded.

The effects of fine sediment on spawning success for steelhead appear to be less significant than other factors including flow persistence, juvenile growth, and habitat availability. This study, as well as others (Stillwater Sciences, 2002; Ecotrust & FONR, 2001) found that most tributaries with suitable rearing habitat were well seeded with juveniles and therefore spawning success does not appear to be a primary limiting factor. However, fine sediment appears to play a more significant role in chinook salmon spawning success in the mainstem Napa River. Reducing fine sediment inputs from chronic sources like roads and bank erosion should focus primarily on the relative contribution to the mainstem Napa River where chinook salmon are expected to spawn. From our limited surveys, we suggest that most salmon spawning occurs upstream of the Yountville Crossroad, and therefore sediment reduction efforts should focus on reaches of the Napa River and tributaries upstream of this area.

We have ranked streams on current habitat quality and steelhead densities (Table 4-1) to better assess the relative contribution each stream makes to the overall salmonid population in the basin. York Creek and Wing Canyon Creek had the greatest amount of high quality spawning and rearing habitat and relatively high steelhead densities. Unlike most other surveyed tributaries, these two streams maintain perennial flow, making them especially valuable rearing habitat for juvenile steelhead. York Creek is one of the best steelhead spawning and rearing streams within the Napa River basin, and it is likely very important for the overall Napa River steelhead population.

Stream	Overall Habitat Quality	Overall Habitat Quantity	Steelhead Density	Priority
York Creek	High	High	High	**High**
Wing Canyon Creek	High	High	Moderate	**High**
Bell Creek	Moderate	Moderate	Moderate	**Moderate**
Soda Creek	High	Low (dry)	Moderate	**Moderate**
Montgomery Creek	Moderate	Low (dry)	Moderate	**Moderate**
Napa River	Moderate	Moderate	Low	**Moderate**
Canon Creek	Moderate	Low (dry)	Low	**Low**
Bale Slough	Low	Low (dry)	Low	**Low**
Rector Creek	Low	Low (dry)	Low	**Low**
Conn	Low	Low (dry)	Low	**Low**

Table 4-1. Qualitative ranking of study streams based on current habitat quality, habitat quantity, and steelhead densities. Priority values of high, moderate, or low were assigned to estimate the relative importance of each stream to the overall steelhead population of the Napa River basin.

Under current conditions, Rector Creek, Canon Creek, Bale Slough, and Conn Creek, appear to have very little suitable rearing habitat, and therefore likely contribute minimally to the basin-wide salmonid population. These streams do support steelhead spawning in some years, as documented by historical records and recent surveys. Due to lack of flow in summer, juvenile steelhead would need to emigrate downstream to the Napa River or other perennial water to survive the summer. It is not clear to what extent juvenile steelhead are able to carry out this survival strategy, although it appears to be negligible based on the low steelhead densities we observed in the mainstem Napa River in summer 2004.

Watersheds with the highest potential cooperation from landowners should be given priority for future project planning and implementation. The Napa RCD assists local landowner stewardship groups countywide, including two within the study area: Rector Creek watershed and the Napa River Rutherford appellation. A stewardship group within the Dry Creek watershed, which includes Wing Canyon and Montgomery Creek, is no longer active.

4.1 RESTORATION OPPORTUNITIES

Individual stream restoration sites were identified for further investigation or direct project implementation. In total, 135 specific sites were found that would benefit from future restorative or protective measures (Table 4-1). Potential project types were grouped into six broad categories including erosion, riparian vegetation, exotic vegetation, habitat complexity, barriers, and temperature/water quality.

The landowner agreement contracts used by the NCRCD allowed the landowner to maintain confidentiality with respect to any information gathered on their property. As a result the NCRCD is unable to release this information without the landowner's consent. We anticipate working closely with all involved landowners to facilitate any restoration or habitat improvement projects that they wish to pursue. The list of potential sites for each surveyed stream is available from the NCRCD, subject to limitations of these landowner confidentiality agreements.

Stream	BAR	ERO	RIP	LWD	EXO	TMP	*Total*
Bale Slough							*0*
Bell Creek	2	5	1		13		*21*
Canon Creek		1					*1*
Conn Creek	2				2		*4*
Montgomery Creek		1					*1*
Napa River	2	15			32		*49*
Rector Creek	1	8	5	1	3	2	*20*
Soda Creek					2		*2*
Wing Canyon Creek		2					*2*
York Creek	1	15	2		15	2	*35*
Total	*8*	*47*	*8*	*1*	*67*	*4*	*135*

Table 4-1. Restoration opportunities by stream and project type. BAR = Barrier removal/modification, ERO = Erosion, RIP = Riparian planting/improvement, LWD = Lacks cover/structure, EXO = Exotic vegetation removal, TMP = Temperature related issues

4.2 Restoration and Preservation Priorities

Potential restoration sites identified during field surveys have been summarized by stream and ranked according to a prioritization matrix with to the following criteria:

• Landowner cooperation *(5 pts = High, 3 pts. = Moderate, 1 pt. = Low)*
• Species benefited *(3 pts. = both Chinook and steelhead, 2 pts. = 1 salmonid species, 1 pt = no salmonids)*
• Lifestage benefited *(5 pts. = 3 or more lifestages, 3 pts. = 2 lifestages, 1 pt. = 1 lifestage)*
• Amount of habitat improved *(5 pts. = watershed level, 3 pts. = stream level, 1 pt. = local level)*
• Limiting factors addressed *(9 possible - 1 pt. for each factor: water quantity, water quality, riparian dysfunction, excessive sediment, spawning, overwintering, summer rearing, escape cover, passage, bank erosion)*
• Effort and complexity of project *(3 pts. = low effort, 2 pts. = moderate effort, 1 pt. = high effort)*

The total possible score is 30 points

High priority	**20 - 30 pts.**
Medium priority	**10 - 19 pts.**
Low priority	**less than 9 pts.**

4.3 POTENTIAL FUNDING SOURCES

Potential funding for restoration comes from a broad spectrum of sources including federal, state, and local government agencies, private foundations, and local interest groups. There are often grant funds available to offset the cost of restoration planning and implementation available from the following sources:

US Department of Agriculture Natural Resources Conservation Service (USDA NRCS)
The NRCS maintains a local office in Napa and can provide general conservation assistance to agricultural landowners in Napa County. They also operate several grant programs that can provide cost sharing for implementation of conservation practices on agricultural land. Conservation practices may include but are not limited to: cover crops, streamside buffer vegetation, bio-engineered streambank stabilization, livestock troughs and water development, erosion control practices, management of noxious weeds, and Pierce's disease management. Additional information is available at www.ca.nrcs.usda.gov or inquiries can be made to Phillip.Blake@ca.usda.gov.

Environmental Protection Agency (EPA)
The EPA has a regional office in San Francisco. Grant programs administered by the EPA generally involve pollution prevention; terrestrial aquatic, and coastal ecosystem research and monitoring; wetland protection; and ecosystem restoration projects. Additional information about specific grants offered through EPA can be found through a federal grant site at http://fedgrants.gov/Applicants/index.html.

US Fish and Wildlife Service (FWS)
The Mission of the U.S. Fish & Wildlife Service is to work with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. They generally fund projects that involve habitat protection and restoration, species status surveys, public education and outreach, and restoration of species at risk. Additional information about grant programs administered by FWS can be found at: http://grants.fws.gov. Alternatively, FWS grant programs can also be searched on a federal grant website through the Department of Interior: http://fedgrants.gov/Applicants/index.html.

National Oceanic and Atmospheric Administration – Fisheries Division (NOAA Fisheries)
NOAA Fisheries (previously National Marine Fisheries Service) is dedicated to the stewardship of living marine resources through science-based conservation and management, and the promotion of healthy ecosystems. They have a local office in Santa Rosa. They generally fund projects that involve habitat protection and restoration (particularly habitat for threatened and endangered species), public education and outreach, and restoration of species at risk. Additional information about current grants offered through NOAA Fisheries can be found at http://www.nmfs.noaa.gov/mb/grants/. Alternatively, NOAA Fisheries grant programs can be searched on a federal grant website through the Department of Commerce at http://fedgrants.gov/Applicants/index.html.

California Bay-Delta Authority & CALFED Bay-Delta Program
The California Bay-Delta Authority oversees 23 state and federal agencies working cooperatively through the CALFED Bay-Delta Program to improve the quality and reliability of California's water supplies while restoring the Bay-Delta ecosystem. The mission of the CALFED Bay-Delta Program is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta System. The program supports 11 different elements to support its 4 objectives: Water Supply Reliability, Levee System Integrity, Water Quality, and Ecosystem Restoration. Grant opportunities available can generally be found at the Bay-Delta homepage: http://calwater.ca.gov/.

California State Water Resources Control Board (SWRCB)
The SWRCB's mission is to preserve, enhance and restore the quality of California's water resources, and ensure their proper allocation and efficient use for the benefit of present and future generations. The SWRCB

and their Regional Offices administer a variety of water quality and habitat restoration funds. Available grants are posted on the following website: http://www.swrcb.ca.gov/funding/index.html.

California State Coastal Conservancy – SF Bay Area Conservancy Program
The San Francisco Bay Area Conservancy Program, administered by the Coastal Conservancy, was established to address the natural resource and recreational goals of the nine-county Bay Area in a coordinated and comprehensive way. The Conservancy may award grants to help achieve the following Bay Program goals: (1) protect, restore, and enhance natural habitats and other open-space resources of regional significance throughout the nine-county area; (2) improve public access and related facilities to and around the Bay, its surrounding hills, and the coast, through completion of bay, coast, and ridge trails that are part of a regional trail system; and (3) promote projects that provide open space that is accessible to urban populations for recreational and educational purposes. Applications for funding are accepted on a continual basis. Additional information about the Program and the application package are available on line at: http://www.coastalconservancy.ca.gov/Programs/BACP.htm.

California Department of Conservation
The Department of Conservation provides services and information that promote environmental health, economic vitality, informed land-use decisions and sound management of our state's natural resources. Most of the applicable assistance provided is offered through the Division of Land Resource Protection and includes voluntary programs that help to meet individual needs, including property tax incentives, grants for the purchase of agricultural conservation easements, and funding for conservation projects conducted by Resource Conservation Districts. Additional information is available at: http://www.consrv.ca.gov/DLRP/index.htm.

California Department of Fish and Game (DFG)
The mission of the Department of Fish and Game is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. They administer a number of grant programs that make funds available for several types of projects including: restoration implementation, education, assessment, and monitoring. Additional information about DFG can be found at: http://www.dfg.ca.gov.

Wildlife Conservation Commission of Napa County
The Wildlife Conservation Commission awards grant funds to local projects that support the preservation, propagation, and protection of birds, mammals, fish and amphibians. Funds are generated through local fines levied by the California Department of Fish & Game and may be used for a variety of projects including, but not limited to: education, monitoring, land acquisition, or restoration work. Contact Patrick Lowe at the Napa County Conservation, Development and Planning Department for additional information: 707.253.4188.

Napa County Public Works Program
Napa County has funds available to help with watershed restoration work related to creeks for properties that are not eligible for alternative funds, such as NRCS Environmental Quality Incentive Program (EQIP). Mike Forte, with Napa County Public Works Department, can be contacted regarding these funds.

Napa County Resource Conservation District (Napa RCD)
The Napa RCD is a local non-regulatory agency whose mission is to promote responsible watershed management through voluntary community stewardship and technical assistance. The RCD is available to assist with grant writing for projects and is available on a limited basis to provide advice and assistance to landowners and managers.

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