NAPA CREEK SALMON MONITORING PROJECT

YEAR 1 REPORT

NAPA CREEK
NAPA COUNTY, CALIFORNIA

JUNE 23, 2006

PREPARED BY

NAPA COUNTY RESOURCE CONSERVATION DISTRICT

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INTRODUCTION

In 2006, the Napa County Resource Conservation District (RCD), funded by the City of Napa, began a five-year study of Napa Creek. The goal of this study is to develop a comprehensive fisheries assessment of Napa Creek, and provide both general and site-specific recommendations for restorative actions benefiting Chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*Oncorhynchus mykiss*) and other native fish species. Recommendations for habitat improvement are based upon target habitat values suitable for salmonids in California's north coast streams. This study consists of four interlocking components to be carried out over the course of five years: habitat assessment, adult salmon escapement surveys, juvenile salmon surveys, and genetic analysis.

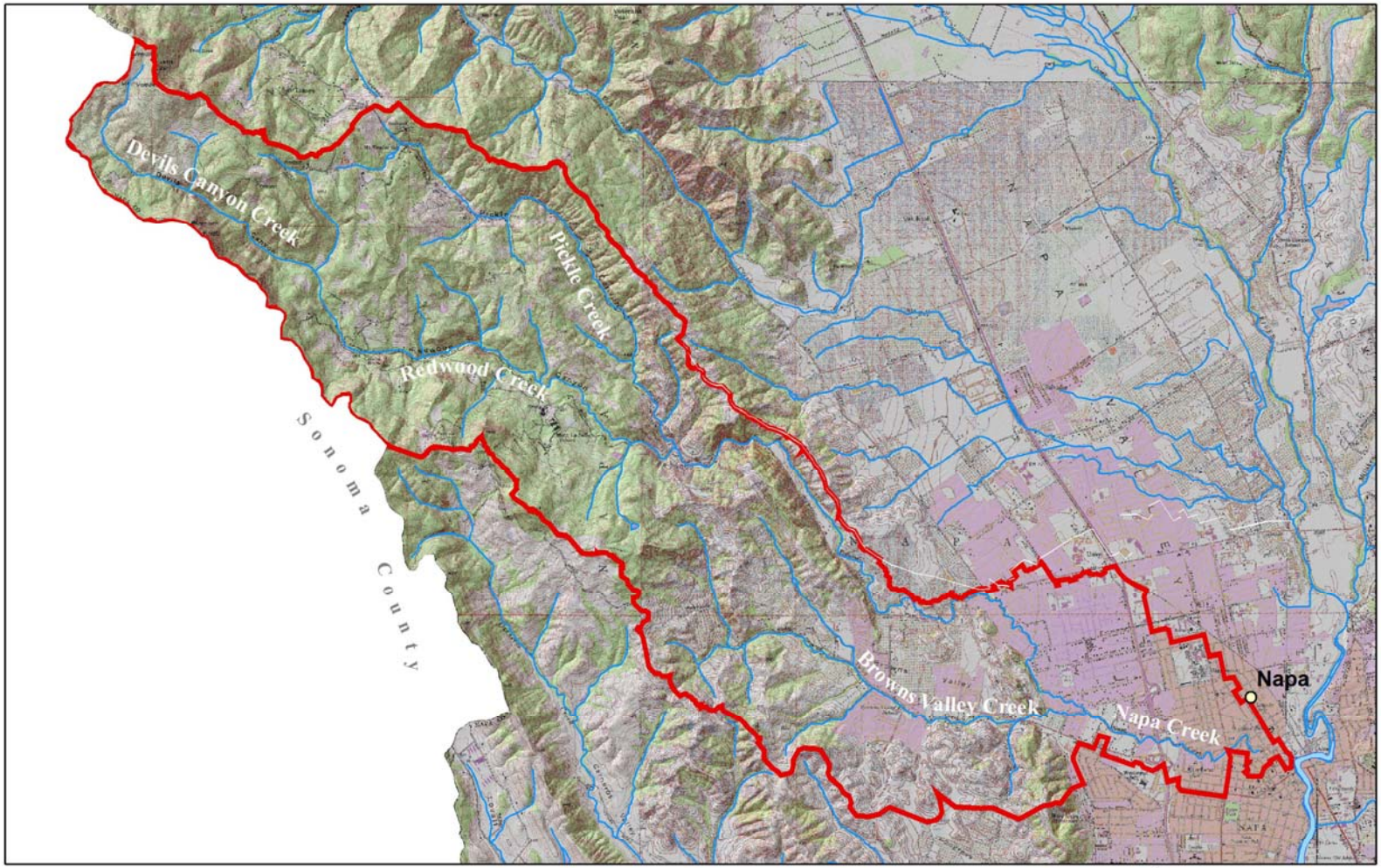
This report summarizes our findings to date, which include general watershed characterization and a detailed habitat assessment. Due to the late onset of this project, salmon surveys of Napa Creek were not conducted during this period; however adult and juvenile surveys will be conducted during fall and winter of this year.

A habitat survey of Napa Creek was conducted in May, 2006. The survey began at the First Street Bridge, approximately 360 feet upstream of the confluence with the Napa River, and extended upstream 2.2 miles. The objective of the habitat assessment was to document the amount and quality of habitat available to anadromous salmonids in Napa Creek. Additionally, visual observations were made to document the presence and distribution of juvenile salmonids and other fish.

BACKGROUND

In 2003 and 2004, significant numbers of adult and juvenile fall-run Chinook salmon (*Oncorhynchus tshawytscha*) were documented in the Napa River and several tributaries (NCRCD, 2005; NCRCD, 2006). Several adult and juvenile salmon have been observed in Napa Creek and its upstream tributaries, Redwood and Pickle Creeks, during the past four years. Napa Creek may represent an important spawning stream for Chinook salmon since it represents a relatively short migration, is not dammed, and maintains flow early in the year during the salmon spawning period.

Napa Creek is formed by the junction of Redwood and Browns Valley Creek. It is a third order tributary that flows through downtown Napa to the Napa River, which drains to San Pablo Bay. Napa Creek's location at the confluence with the Napa River is 38°17'57" north latitude and 122°16'57" west longitude, LLID number 1222824382992. The Napa Creek watershed contains approximately 36.6 miles of blue line streams according to the USGS Napa 7.5 minute quadrangle. Napa Creek drains a watershed of approximately 16.8 square miles. Elevations range from about six feet at the mouth of the creek to over 2,650 feet in the headwater areas of Pickle and Redwood Creeks. Redwoods and Douglas fir with mixed hardwoods dominate the upper watershed. The creek transitions to a riparian community of oaks, laurels, and willows on the valley floor. The watershed is almost entirely privately owned; heavy urban development along Napa Creek gives way to more rural landuse, including vineyards, in much of the upstream reaches of Browns Valley and Redwood Creeks. Easy stream access is available in Downtown Napa at Jefferson St, California St, and Highway 29. A total of ten road bridges cross Napa Creek between the Napa River and the confluence with Redwood and Browns Valley Creeks.



NAPA CREEK WATERSHED

Napa Creek Watershed

N

0 0.5 1 1.5 2 Miles

METHODS

The habitat survey conducted in Napa Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). This inventory was conducted by a two-person team.

The inventory uses a method that samples a minimum of 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement. Every third pool was fully sampled.

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in Napa Creek to record measurements and observations. There are eleven components to the inventory.

1. Flow:
Flow is measured in cubic feet per second (cfs) near the bottom of the stream survey reach using a USGS pygmy flow meter.

2. Channel Type:
Channel typing is conducted according to the classification system developed and revised by David Rosgen (1994). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel characteristics are measured using a clinometer, hand level, hip chain, tape measure, and a stadia rod.

3. Temperatures:
Both water and air temperatures are measured and recorded at every tenth habitat unit. The time of the measurement is also recorded. Both temperatures are taken in the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:
Habitat typing uses the 24 habitat classification types defined by McCain and others (1990). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled "dry". Napa Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a sight level, fiberglass tape, and stadia rod.

5. Embeddedness:
The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Napa Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

6. Shelter Rating:
Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids

protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Napa Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:
Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two, respectively. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

8. Canopy:
Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Napa Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated visually into percentages of coniferous or hardwood trees.

9. Bank Composition and Vegetation:
Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Napa Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

10. Large Woody Debris Count:
Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:
Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

Data from the habitat inventory form are entered into Stream Habitat 2.0.19, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

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

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

HABITAT ASSESSMENT RESULTS

All result tables are located in Appendix B.

The habitat inventory of 5/9/2006 to 5/12/2006 was conducted by Jonathan Koehler and Chad Edwards of the Napa County Resource Conservation District. The total length of the stream surveyed was 11,678 feet with an additional 192 feet of side channel. Stream flow was measured at the Jefferson St. Bridge with a USGS pygmy flow meter at 11 cfs on 5/9/2006.

Channel type was measured in three locations. All three sites yielded the same result: an F4 channel. To simplify discussion of distinct stream segments, we divided the survey into three reaches based on landmarks and general channel form. Reach one is 3,869 feet long beginning at the confluence with the Napa River and extending upstream to the Jefferson St. Bridge. Reach two is 4,116 feet long from the Jefferson St. Bridge upstream to Highway 29. Reach three is 3,885.00 feet long from Highway 29 to the confluence of Browns Valley and Redwood Creeks.

In general, F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width to depth ratios and gravel-dominant substrates. The average channel slope for the survey was approximately 0.6 %. The channel was characterized by steep banks with heavy to moderate residential and commercial development at the top of both banks.

The suitability of F4 channel types for fish habitat improvement structures is as follows:

- Good for bank-placed boulders.
- Fair for plunge weirs; single and opposing wing-deflectors; channel constrictors; log cover.
- Poor for boulder clusters.

Water temperatures taken during the survey period ranged from 58° to 61° Fahrenheit. Air temperatures ranged from 57° to 70° Fahrenheit. These temperatures are generally favorable for juvenile salmonid rearing. However, temperatures will be monitored throughout the warm summer months to fully document the thermal regime of Napa Creek.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 36% pool units, 32% flatwater units, and 32% riffle units, (Figure 1). Based on total length of Level II habitat types there were 46% pool units, 27% flatwater units, and 27% riffle units (Figure 2).

NAPA CREEK HABITAT SURVEY

Miles

0 0.1 0.2 0.3 0.4 0.5

N

Scale = 1:12,000

1 inch equals 1,000 feet

- Reach 1
- Reach 2
- Reach 3
- Upstream Tributaries

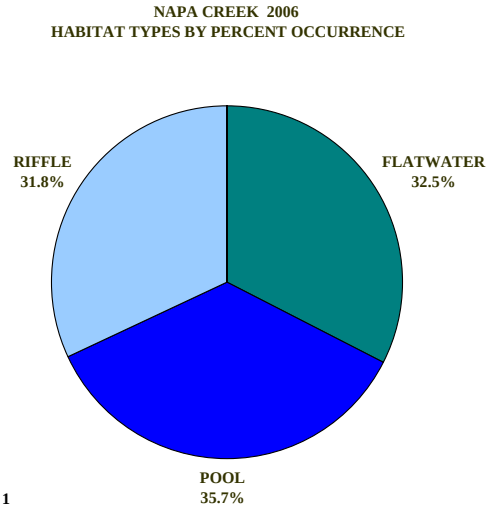


Figure 1

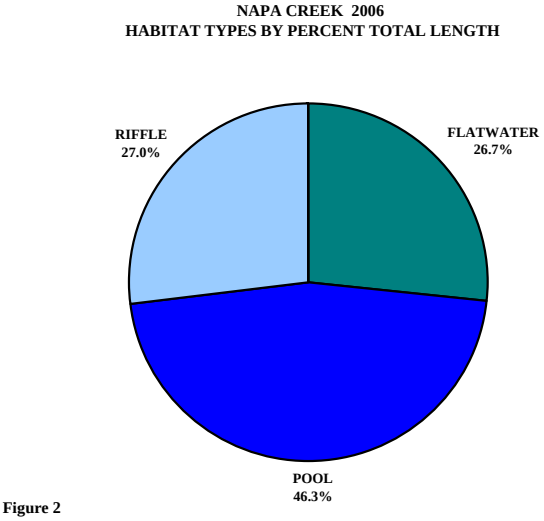
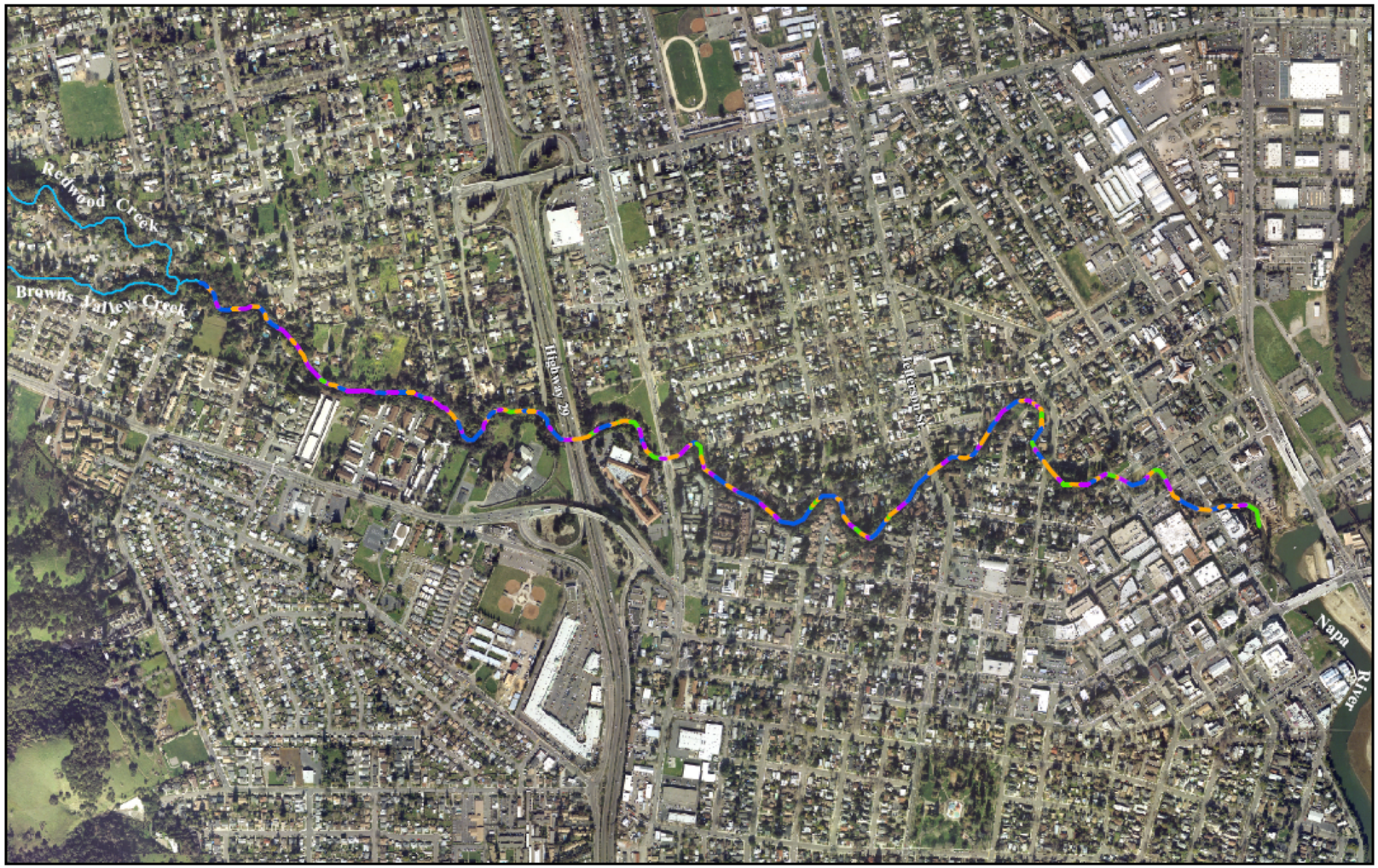


Figure 2

A total of nine Level IV habitat types were identified (Table 2). The most frequent habitat types, both by percent occurrence and percent total length, were low gradient riffles, mid-channel pools, and glides (Figure 3). The pools were relatively deep, with 7 of the 18 (39%) fully measured pools having a maximum residual depth greater than 3 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.

A total of 55 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 67%, and comprised 77% of the total length of all pools (Figure 4).



NAPA CREEK HABITAT SURVEY

Miles
0 0.1 0.2 0.3 0.4 0.5

Scale = 1:12,000
1 inch equals 1,000 feet

Habitat Type
- Riffle
- Flatwater
- Main-channel Pool
- Scour Pool

NAPA CREEK 2006
HABITAT TYPES BY PERCENT OCCURRENCE

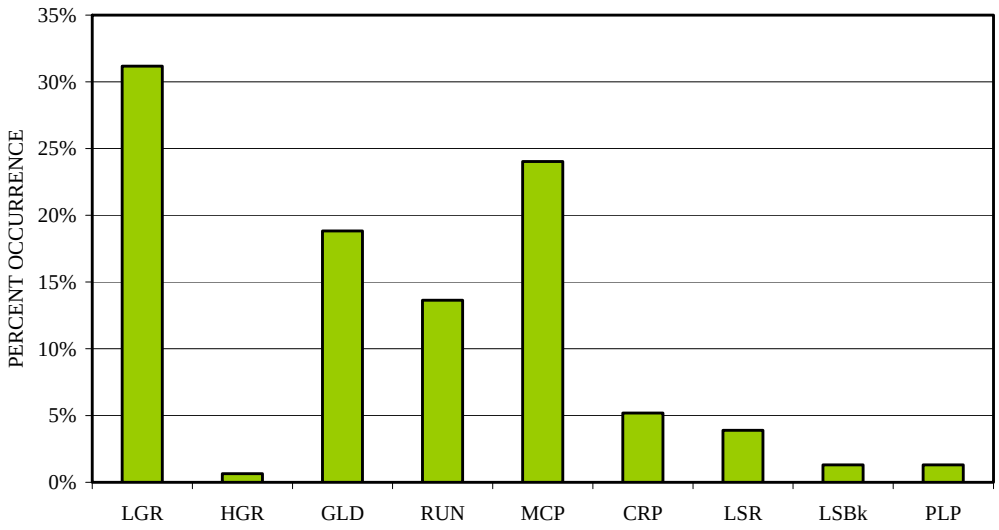


Figure 3

NAPA CREEK 2006
POOL TYPES BY PERCENT OCCURRENCE

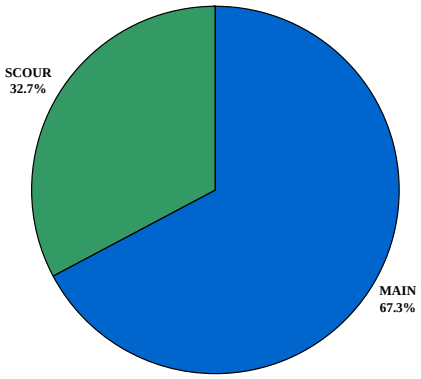


Figure 4

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Seven of the 18 fully measured pools (39%) had a residual depth of three feet or greater (Figure 5).

The depth of cobble embeddedness was estimated at pool tail-outs (Figure 6). Of the 15 pool tail-outs measured for embeddedness, five had a value of 1 (33%), five had a value of 2 (33%), three had a value of 3 (20%), and two had a value of 4 (13%). 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 unsuitable for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

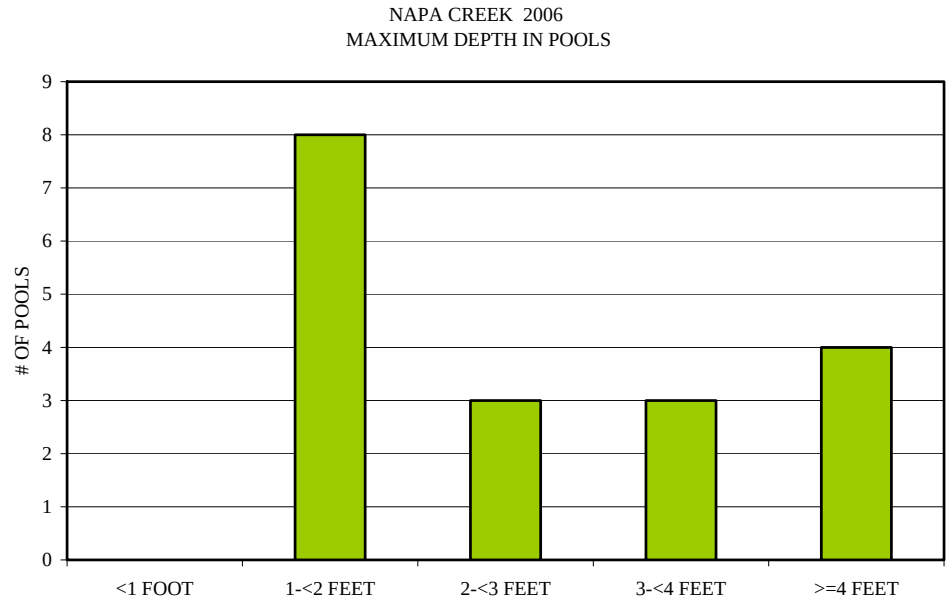


Figure 5

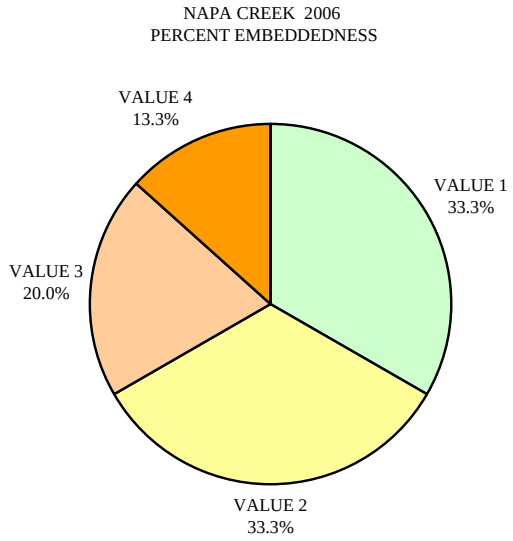


Figure 6

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 24, flatwater habitat types had a mean shelter rating of 35, and pool habitats had a mean shelter rating of 69 (Table 1). Of the pool types, scour pools had a mean shelter rating of 66, and main channel pools had a mean shelter rating of 72 (Table 3).

A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being

provided primarily by boulders, many of which are from rip-rap bank stabilization efforts. Well-anchored root wad cover elements in pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition. Flooding considerations would need to be carefully incorporated into any instream habitat enhancement project.

Table 5 summarizes mean percent cover by habitat type. Undercut banks and boulders (including rip-rap) were the primary sources of cover observed in pools (Figure 7).

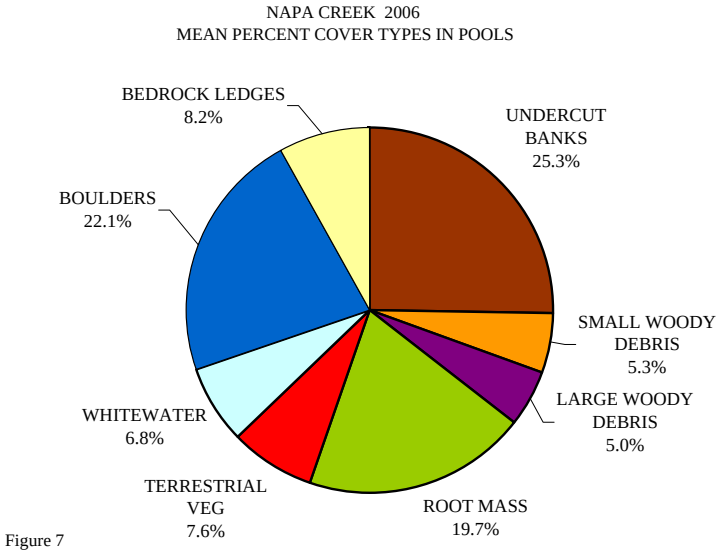


Figure 7

Table 6 summarizes the dominant substrate by habitat type. Fifteen of the 18 pool tail-outs fully measured had gravel as the dominant substrate (Figure 8). Gravel is favorable for spawning salmonids, especially if it is well sorted and consists mostly of larger grains approximately 0.5 – 2 inches in diameter. However, Napa Creek gravels were generally small (<0.5 inches), and were associated with deposits of sand and fine silt. This condition decreases water flow through the gravel, causing lower survival to emergence of developing embryos.

The mean percent canopy density for the surveyed length of Napa Creek was 70%. The mean percentages of hardwood and coniferous trees were 82% and 18%, respectively. On average, thirty percent of the canopy was open (Figure 9).

Reach 1 had a canopy density of 66%, Reach 2 had a canopy density of 60 %, and Reach 3 had a canopy density of 88%. In general, revegetation projects are considered when canopy density is less than 80%. Much of Reach one and two would greatly benefit from having native secondary riparian trees planted at the tops of both banks. These trees would mature over 10-20 years while providing additional canopy, adding buffer width for the creek, and contributing organic material to the stream for aquatic invertebrate forage.

NAPA CREEK 2006
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS

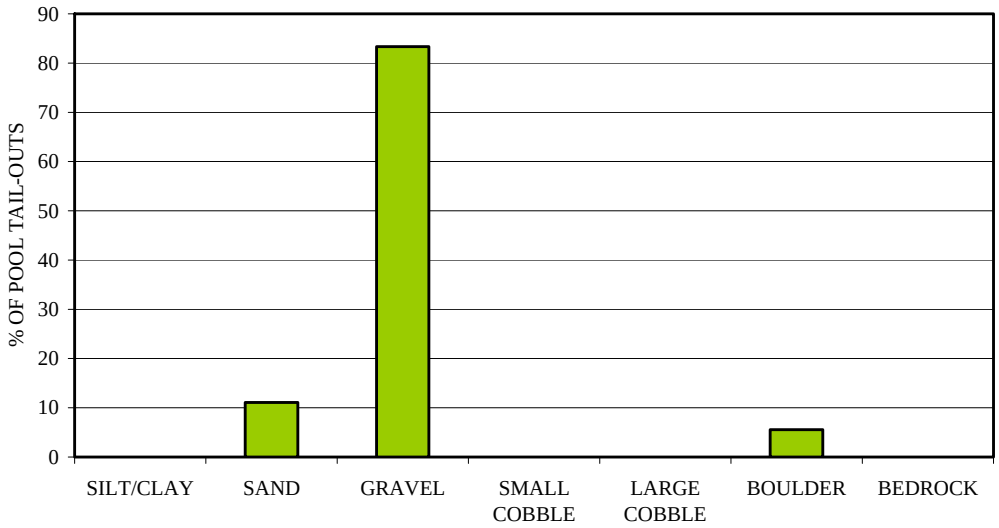


Figure 8

NAPA CREEK 2006
MEAN PERCENT CANOPY

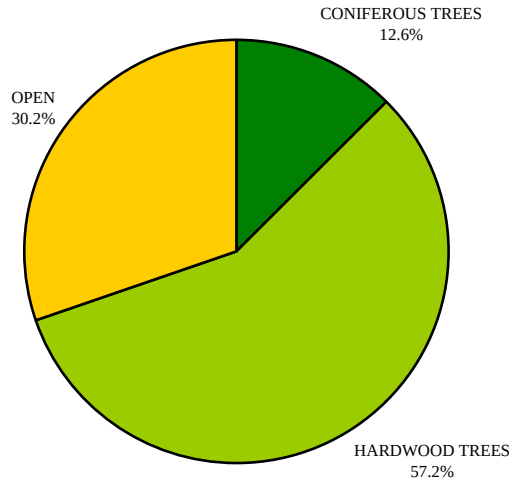


Figure 9

For the stream reaches surveyed, the mean percent right bank vegetated was 65%. The mean percent left bank vegetated was 71%. The stream banks consisted mostly of silt and clay with many areas of placed boulders and artificial bank protection (Graph 10).

NAPA CREEK 2006
DOMINANT BANK COMPOSITION IN SURVEY REACH

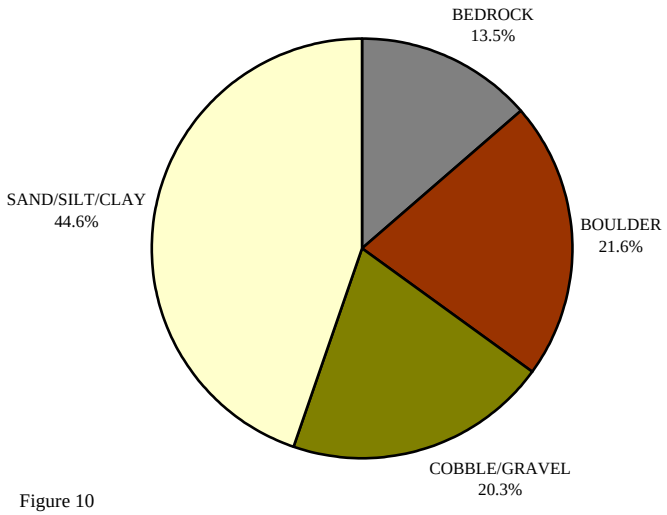


Figure 10

NAPA CREEK 2006
DOMINANT BANK VEGETATION IN SURVEY REACH

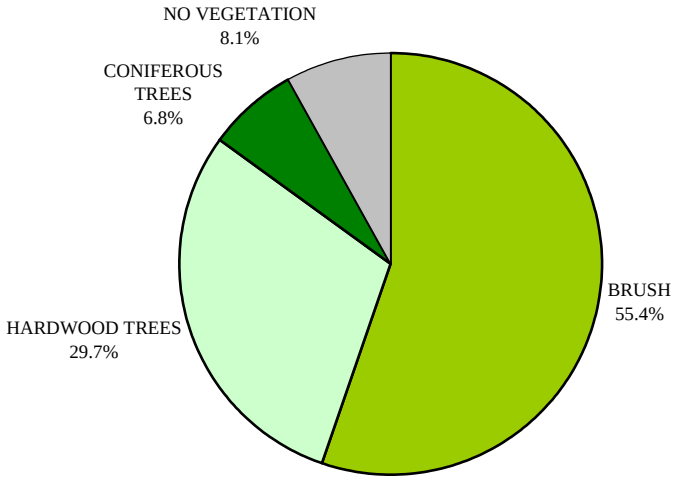


Figure 11

The percentage of right and left bank covered with vegetation was fairly high. However, much of this vegetation is comprised of exotic, invasive species. Planting native trees and under-story plant species, in conjunction with bank stabilization, is recommended wherever feasible.

Brush was the dominant vegetation type observed followed by hardwood trees (Graph 11). Common brush species included spicebush, Himalayan blackberry, wild grape, English ivy, and Arundo donax. Common tree species included valley oak, bay laurel, willow spp., cottonwood, walnut, buckeye, Oregon ash, and maple.

Overall, Napa Creek has a few areas of high-quality habitat in Reaches 2 and 3. Reach 1 can be generally characterized as an impacted urban creek. Habitat conditions for salmon and steelhead (and other native coldwater fishes) improves in the upstream portions of Reach 2 and are markedly better throughout Reach 3. The poor conditions in Reach 1 reflect the effects of development along the channel through the city of Napa, and the cumulative effects of riparian clearing, polluted residential and commercial runoff, and bank modification for flood protection. Reach 1 appears to act primarily as a migration corridor for salmon and steelhead moving to more suitable areas upstream. No fish migration barriers or obstacles were present throughout the survey.

CONCLUSIONS

- Napa Creek is an anadromous, natural production stream that supports Chinook salmon, steelhead trout, and several other native fish species. Steelhead and salmon spawning and rearing conditions are best in Reaches 2 and 3.

- Reach 1 and parts of Reach 2 would benefit from planting native vegetation, such as willow, alder, cottonwood, and ash along the stream where riparian canopy is sparse or the buffer width is narrow. Reach 3 had generally favorable canopy densities, but would still benefit from adding an additional row of trees to the existing riparian zone in areas where it is narrow. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

- Most of the existing cover in pools is from undercut banks and boulders from rip-rap bank protection efforts. Adding high quality complexity with woody cover in pools is desirable, yet may prove difficult due to the high stream energy in Napa Creek associated with its deeply entrenched channel form. Any instream cover elements would need to be well-anchored to the bank and constructed of material of suitable size to withstand forces from winter storm flows.

- The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. However, to establish more complete and meaningful temperature regime information, continuous temperature monitoring will be conducted in summer 2006 with digital data loggers.

- Suitable size spawning substrate in Napa Creek appears to be limited. The dominant substrate in most spawning patches consisted of small gravels and sand. Additional permeability measurements at potential spawning locations are needed to determine the severity of this condition as it relates to egg survival.

- There are relatively few log debris accumulations present in Napa Creek. These debris accumulations provide desirable cover elements for juvenile fish during summer low flows and winter storms. Efforts to clear the channel for flood protection should try to leave as many logs in the stream as possible. Debris jams can often be broken up and oriented in the channel in a way that prevents flow obstruction, yet still retains habitat complexity.

RESTORATION OPPORTUNITIES

Individual stream restoration sites were identified for further investigation or direct project implementation. In total, 18 specific sites were found that would benefit from future restorative or

protective measures. Potential project types were grouped into three broad categories including bank erosion, lack of riparian canopy, and exotic vegetation.

Stream Section	Exotic Vegetation Removal	Erosion	Low Riparian Canopy	*Total*
Reach 1	5			*5*
Reach 2	2	3	2	*7*
Reach 3	4	2		*6*
Total	*11*	*5*	*2*	*18*

Access agreements secured by the NCRCD allowed individual landowners 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 is available from the NCRCD, subject to limitations of these landowner confidentiality agreements.

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Koehler, J. 2005. The Napa River Fisheries Study, the Rutherford Dust Society Restoration Reach. Napa County Resource Conservation District, Napa, Californinia. January

APPENDICES

Appendix A: Site Photos

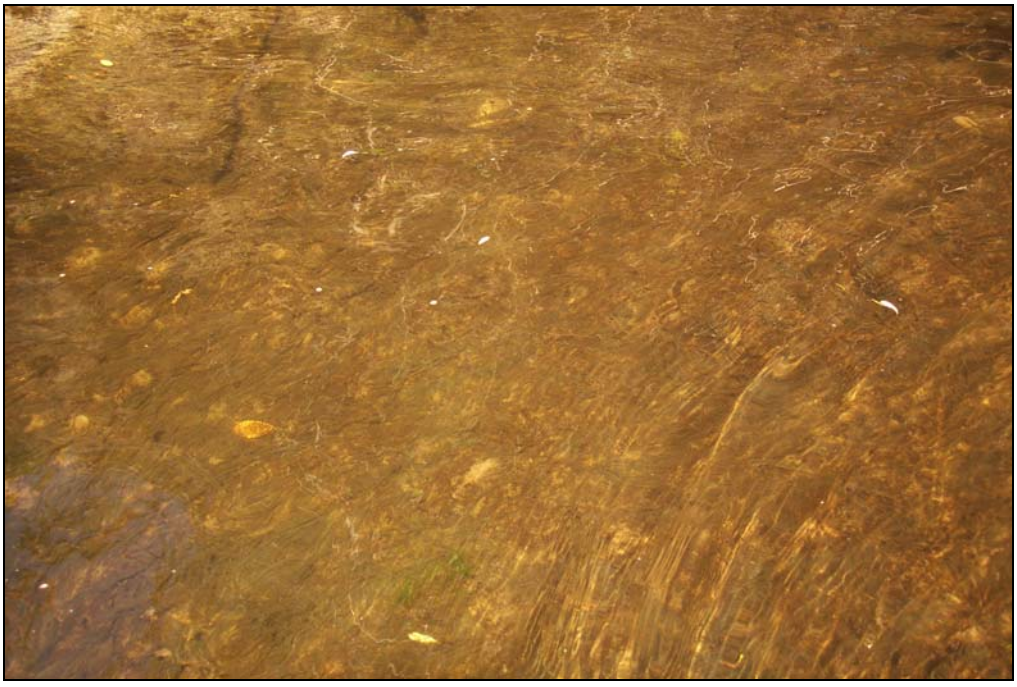
Appendix B: Habitat Typing Results (Tables)

APPENDIX A: SITE PHOTOS

Reach 1 – Downtown Napa just below Brown Street Bridge.

Reach 1 – Arundo donax stand on left bank.

Reach 1 – Behrens Street Bridge. Erosion cloth on right bank



Reach 1 – Typical glide substrate dominated by sand and silt with heavy algal growth.

Reach 2 – Favorable spawning riffle.

Reach 2 – High quality plunge pool habitat formed by root wad and buried log.

Reach 2 – Exposed canopy, right bank covered by exotic Himalayan Blackberry.

Reach 2 (upper) – Eroded left bank with exposed canopy.

Reach 3 – Favorable run habitat with large woody debris and well-sorted spawning gravels.

Reach 3 – Fallen trees inline with channel flow across from left bank retaining wall.

Reach 3 – Confluence of Browns Valley Creek (left) and Redwood Creek (right)

APPENDIX B: HABITAT TYPING TABLES

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

Stream Name: Napa Creek **LLID:** 1222824382992 **Drainage:** Napa River

Survey Dates: 5/9/2006 to 5/12/2006

Confluence Location: **Quad:** NAPA **Legal Description:** T000R000S00 **Latitude:** 38:17:57.0N **Longitude:** 122:16:57.0

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Mean Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating
50	10	FLATWATER	32.5	63	3172	26.7	17.8	1.1	2.1	1140	56985	1245	62259		35
55	19	POOL	35.7	100	5498	46.3	18.9	1.1	2.6	1639	90157	2956	154043	1802	69
49	8	RIFFLE	31.8	65	3200	27.0	15.9	0.9	2.3	1402	68718	1167	57206		24

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
154	37	11870	215860	273507

Table 2 - Summary of Habitat Types and Measured

Stream Name: Napa Creek **LLID:** 1222824382992 **Drainage:** Napa River

Survey Dates: 5/9/2006 to 5/12/2006

Confluence Location: **Quad:** NAPA **Legal Description:** T000R000S00 **Latitude:** 38:17:57.0N **Longitude:** 122:16:57.0

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Mean Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating	Mean Canopy (%)
48	7	LGR	31.2	65	3107	26.2	15.0	0.9	9.0	1417	68004	1185	56902		24	66
1	1	HGR	0.6	93	93	0.8	20.0	0.8	1.3	1302	1302	1042	1042		20	0
29	4	GLD	18.8	72	2092	17.6	18.0	0.9	3.0	1334	38679	1273	36921		8	78
21	6	RUN	13.6	51	1080	9.1	18.0	1.3	3.2	1010	21217	1227	25757		53	64
37	9	MCP	24.0	114	4221	35.6	21.0	1.3	4.2	1938	71698	4114	152209	2504	72	74
8	2	CRP	5.2	107	855	7.2	28.0	1.6	4.7	4575	36600	7875	31500	5040	60	56
6	4	LSR	3.9	47	284	2.4	16.0	1.2	4.8	710	4262	1569	9412	1046	64	89
2	2	LSBk	1.3	38	76	0.6	12.0	0.3	1.6	456	912	481	962	175	20	96
2	2	PLP	1.3	31	62	0.5	13.0	0.4	1.2	401	802	540	1079	159	120	52

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
154	37	11870	243475	315784

Table 3 - Summary of Pools

Stream Name: Napa Creek **LLID:** 1222824382992 **Drainage:** Napa River

Survey Dates: 5/9/2006 to 5/12/2006

Confluence Location: **Quad:** NAPA **Legal Description:** T000R000S00 **Latitude:** 38:17:57.0N **Longitude:** 122:16:57.0

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Residual Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Residual Pool Vol (cu.ft.)	Estimated Total Resid. Vol (cu.ft.)	Mean Shelter Rating
37	9	MAIN	67	114	4221	77	21.1	1.3	1938	71698	2504	92651	72
18	10	SCOUR	33	71	1277	23	17.0	0.9	1371	24669	1099	17808	66

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
55	19	5498	96367	110460

Table 4 - Summary of Maximum Residual Pool Depths by Type

Stream Name: Napa Creek **LLID:** 1222824382992 **Drainage:** Napa River

Survey Dates: 5/9/2006 to 5/12/2006

Confluence Location: **Quad:** NAPA **Legal Description:** T000R000S00 **Latitude:** 38:17:57.0N **Longitude:** 122:16:57.0

Habitat Units	Habitat Type	Habitat Occurrence (%)	< 1 Foot Maximum Residual Depth	< 1 Foot Percent Occurrence	1 < 2 Feet Maximum Residual Depth	1 < 2 Feet Percent Occurrence	2 < 3 Feet Maximum Residual Depth	2 < 3 Feet Percent Occurence	3 < 4 Feet Maximum Residual Depth	3 < 4 Feet Percent Occurrence	>= 4 Feet Maximum Residual Depth	>= 4 Feet Percent Occurrence
1	CRP	6	0	0	0	0	0	0	0	0	1	100
9	MCP	50	0	0	2	22	2	22	3	33	2	22
4	LSR	22	0	0	2	50	1	25	0	0	1	25
2	LSBk	11	0	0	2	100	0	0	0	0	0	0
2	PLP	11	0	0	2	100	0	0	0	0	0	0

Total Units	Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Feet Max Resid. Depth	Total 1< 2 Feet % Occurrence	Total 2< 3 Feet Max Resid. Depth	Total 2< 3 Feet % Occurrence	Total 3< 4 Feet Max Resid. Depth	Total 3< 4 Feet % Occurrence	Total >= 4 Feet Max Resid. Depth	Total >= 4 Feet % Occurrence
18	0	0	8	44	3	17	3	17	4	22

Mean Maximum Residual Pool Depth (ft.): 3

Table 5 - Summary of Mean Percent Cover by Habitat Type

Stream Name: Napa Creek **LLID:** 1222824382992 **Drainage:** Napa River

Survey Dates: 5/9/2006 to 5/12/2006

Confluence Location: **Quad:** NAPA **Legal Description:** T000R000S00 **Latitude:** 38:17:57.0N **Longitude:** 122:16:57.0

Habitat Units	Units Fully Measured	Habitat Type	Mean % Undercut Banks	Mean % SWD	Mean % LWD	Mean % Root Mass	Mean % Terr. Vegetation	Mean % Aquatic Vegetation	Mean % White Water	Mean % Boulders	Mean % Bedrock Ledges
48	7	LGR	0	0	0	14	0	0	27	59	0
1	1	HGR	0	0	0	0	0	0	0	100	0
29	4	GLD	0	0	0	25	0	0	0	25	0
21	6	RUN	7	0	15	38	3	0	23	13	0
37	9	MCP	26	4	8	16	8	0	0	32	6
8	2	CRP	15	10	0	15	3	0	0	58	0
6	4	LSR	25	5	0	50	13	0	8	0	0
2	2	LSBk	50	0	0	0	0	0	0	0	50
2	2	PLP	10	10	10	0	10	0	50	10	0

Table 6 - Summary of Dominant Substrates by Habitat Type

Stream Name: Napa Creek **LLID:** 1222824382992 **Drainage:** Napa River

Survey Dates: 5/9/2006 to 5/12/2006

Confluence Location: **Quad:** NAPA **Legal Description:** T000R000S00 **Latitude:** 38:17:57.0N **Longitude:** 122:16:57.0

Habitat Units	Units Fully Measured	Habitat Type	% Total Silt/Clay Dominant	% Total Sand Dominant	% Total Gravel Dominant	% Total Small Cobble Dominant	% Total Large Cobble Dominant	% Total Boulder Dominant	% Total Bedrock Dominant
48	7	LGR	0	0	29	43	0	29	0
1	1	HGR	0	0	0	0	0	100	0
29	4	GLD	0	25	75	0	0	0	0
21	6	RUN	0	33	50	17	0	0	0
37	9	MCP	0	89	11	0	0	0	0
8	2	CRP	0	100	0	0	0	0	0
6	4	LSR	25	50	25	0	0	0	0
2	2	LSBk	0	50	50	0	0	0	0
2	2	PLP	0	0	100	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Napa Creek **LLID:** 1222824382992 **Drainage:** Napa River

Survey Dates: 5/9/2006 to 5/12/2006

Confluence Location: **Quad:** NAPA **Legal Description:** T000R000S00 **Latitude:** 38:17:57.0N **Longitude:** 122:16:57.0

Habitat Units	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
70	18	82	4	65	71

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

Open units represent habitat units with zero canopy cover.

Table 8 - Fish Habitat Inventory Data Summary

Stream	Napa Creek			LLID: 1222824382992		Drainage:	Napa River
Survey Dates:	5/9/2006 to 5/12/2006	Survey Length (ft.):	11870	Main Channel (ft.):	11678	Side Channel (ft.):	192
Confluence	Quad: NAPA	Legal	T000R000S00	Latitude	38:17:57.0N	Longitude	122:16:57.0

Summary of Fish Habitat Elements by Stream Reach

STREAM REACH: 1

Channel	F4				Canopy Density (%):	66.0			Pools by Stream Length	44.4				
Reach Length (ft.):	3869				Coniferous Component (%):	7.0			Pool Frequency (%):	35.4				
Riffle/Flatwater Mean Width (ft.):	14.9				Hardwood Component	93.0			Residual Pool Depth					
BFW:					Dominant Bank	Brush			< 2 Feet Deep:	33.3				
Range (ft.):	32	to	42		Vegetative Cover (%):	63.8			2 to 2.9 Feet	0.0				
Mean (ft.):	34.2				Dominant	Boulders			3 to 3.9 Feet	33.3				
Std. Dev.:	3.97				Dominant Bank Substrate:	Bedrock	>= 4 Feet Deep:	33.3						
Base Flow (cfs):	11				Occurrence of LWD	0.7			Mean Max Residual Pool Depth	3.2				
Water (F):	58 - 61	Air (F):	57 - 67		LWD per 100 ft.:				Mean Pool Shelter	56				
Dry Channel (ft.):	0				Riffles:	0								
					Pools:	0								
					Flat:	0								
Pool Tail Substrate	Silt/Clay:	0.0	Sand:	0.0	Gravel	83.3	Sm	0.0	Lg	0.0	Boulder:	16.7	Bedrock:	0.0
Embeddedness Values	1.	50.0	2.	50.0	3.	0.0	4.	0.0	5.	0.0				

STREAM REACH: 2

Channel	F4				Canopy Density (%):	60.3			Pools by Stream Length	51.0				
Reach Length (ft.):	3924				Coniferous Component (%):	15.6			Pool Frequency (%):	35.8				
Riffle/Flatwater Mean Width (ft.):	15.7				Hardwood Component	84.4			Residual Pool Depth					
BFW:					Dominant Bank	Brush			< 2 Feet Deep:	42.9				
Range (ft.):	32.5	to	41		Vegetative Cover (%):	69.2			2 to 2.9 Feet	28.6				
Mean (ft.):	38.6				Dominant	Boulders			3 to 3.9 Feet	0.0				
Std. Dev.:	2.49				Dominant Bank Substrate:	Sand/Silt/Clay			>= 4 Feet Deep:	28.6				
Base Flow (cfs):	11				Occurrence of LWD	10.0			Mean Max Residual Pool Depth	2.4				
Water (F):	59 - 61	Air (F):	59 - 70		LWD per 100 ft.:				Mean Pool Shelter	76				
Dry Channel (ft.):	0				Riffles:	0								
					Pools:	0								
					Flat:	0								
Pool Tail Substrate	Silt/Clay:	0.0	Sand:	12.5	Gravel	87.5	Sm	0.0	Lg	0.0	Boulder:	0.0	Bedrock:	0.0
Embeddedness Values	1.	50.0	2.	16.7	3.	33.3	4.	0.0	5.	0.0				

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel F4	Canopy Density (%): 88.7	Pools by Stream Length 43.2
Reach Length (ft.): 3885	Coniferous Component (%): 35.6	Pool Frequency (%): 35.8
Riffle/Flatwater Mean Width (ft.): 23.0	Hardwood Component 64.4	Residual Pool Depth
BFW:	Dominant Bank Brush	< 2 Feet Deep: 60.0
Range (ft.): 36 to 44	Vegetative Cover (%): 71.9	2 to 2.9 Feet 20.0
Mean (ft.): 39.3	Dominant Whitewater	3 to 3.9 Feet 20.0
Std. Dev.: 3.18	Dominant Bank Substrate: Sand/Silt/Clay	>= 4 Feet Deep: 0.0
Base Flow (cfs): 11	Occurrence of LWD 5.0	Mean Max Residual Pool Depth 2.08
Water (F): 59 - 60 Air (F): 57 - 64	LWD per 100 ft.:	Mean Pool Shelter 76
Dry Channel (ft.): 0	Riffles: 0	
	Pools: 0	
	Flat: 0	
Pool Tail Substrate Silt/Clay: 0.0 Sand: 25.0 Gravel 75.0 Sm 0.0 Lg 0.0 Boulder: 0.0 Bedrock: 0.0		
Embeddedness Values 1. 0.0 2. 40.0 3. 20.0 4. 40.0 5. 0.0		

Table 9 -Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Napa Creek **LLID:** 1222824382992 **Drainage:** Napa River

Survey Dates: 5/9/2006 to 5/12/2006

Confluence Location: **Quad:** NAPA **Legal Description:** T000R000S00 **Latitude:** 38:17:57.0N **Longitude:** 122:16:57.0

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Bedrock	5	5	13.5
Boulder	7	9	21.6
Cobble/Gravel	8	7	20.3
Sand/Silt/Clay	17	16	44.6

Mean Percentage of Dominant Stream Bank

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage
Grass	0	0	0.0
Brush	18	23	55.4
Hardwood	13	9	29.7
Coniferous	4	1	6.8
No Vegetation	2	4	8.1

Total Stream Cobble Embeddedness Values: 2

Table 10 - Mean Percent of Shelter Cover Types For Entire System

Stream Name: Napa Creek **LLID:** 1222824382992 **Drainage:** Napa River

Survey Dates: 5/9/2006 to 5/12/2006

Confluence Location: **Quad:** NAPA **Legal Description:** T000R000S00 **Latitude:** 38:17:57.0N **Longitude:** 122:16:57.0

	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	4	25
SMALL WOODY DEBRIS (%)	0	0	5
LARGE WOODY DEBRIS (%)	0	9	5
ROOT MASS (%)	13	33	20
TERRESTRIAL VEGETATION (%)	0	2	8
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	24	14	7
BOULDERS (%)	64	18	22
BEDROCK LEDGES (%)	0	0	8