

**CALIFORNIA DEPARTMENT OF FISH AND GAME  
STREAM INVENTORY REPORT**

Barrelli Creek

*Report Revised April 14, 2006*

*Report Completed 2005*

*Assessment Completed 2002*

INTRODUCTION

A stream inventory was conducted during the summer of 2002 on Barrelli Creek, a stream in the Russian River Basin. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the amount and condition of available habitat to fish, and other aquatic species with an emphasis on anadromous salmonids in Barrelli Creek. The objective of the biological inventory was to document the salmonid and other aquatic species present and their distribution.

The objective of this report is to document the current habitat conditions and, after analyzing historical and recent data, 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

Barrelli Creek is a tributary of the Russian River and is located in Sonoma County, California (see Barrelli Creek map, Appendix A). The legal description at the confluence with the Russian River is T11N, R10W, S28. Its location is 38°46'09.14"N latitude and 122°58'43.09"W longitude. Access exits from Hwy 101 take the Asti Exit and go left at the 4-way stop to a bridge crossing Barrelli Creek.

Barrelli Creek and its tributaries drain a basin of approximately 976.83 acres (1.53 square miles). Barrelli Creek is a maximum second order stream and has approximately 16574.8 feet (3.14 miles) of blue line stream, according to the USGS "Asti" 7.5 minute quadrangles. Barrelli Creek has one minor unnamed tributary that was not surveyed. Elevations range from 253 feet at the mouth of the creek to 1371 feet in the headwaters. Vegetation in the watershed is primarily hardwood (36%) with minor amounts of mixed conifer/hardwood (9%), shrub (3%), and herbaceous vegetation (1%). The basin is 47% agricultural and 1% urban. The watershed is 87.9% privately owned and 12.1% federally owned. The lower surveyed section of Barrelli Creek is managed as vineyards and residential area with several major road, highway, and railroad crossings. The upper portion of Barrelli Creek extends into the Lake Sonoma Wildlife Management Area.

Salmonid fish species historically present include steelhead trout.

METHODS

The habitat inventory conducted in Barrelli Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi, et al., 1998). The Americorp Volunteers and the California Department of Fish and Game (DFG) field crew that conducted the inventory was trained in standardized habitat inventory methods by DFG. This inventory was conducted by two person teams and

was supervised by Derek Acomb, Russian River Planner (DFG).

## SAMPLING STRATEGY

The inventory uses a method that samples approximately 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.

## HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the California Salmonid Stream Habitat Restoration Manual. This form was used in Barrelli Creek to record measurements and observations. There are nine components to the inventory form: flow, channel type, air and water temperatures, habitat type, embeddedness, shelter rating, substrate composition, canopy, and bank composition.

### 1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated. Flows were also measured or estimated at major tributary confluences.

### 2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1985 rev. 1994). This methodology is described in the California Salmonid Stream Habitat Restoration Manual. 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:

Water and air temperatures, and time, are measured by crew members with hand held thermometers and recorded at each tenth unit typed. Temperatures are measured in Fahrenheit at the middle of the habitat unit and within one foot of the water surface. Temperatures are also recorded using remote temperature recorders which log temperatures every 1.5 hours, 24 hours/day.

### 4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (1988). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled dry. Barrelli 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 were in feet to the nearest tenth. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a hip chain and a stadia rod.

#### 5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Barrelli Creek, embeddedness was visually estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3), 76 - 100% (value 4). Additionally, a rating of "not suitable" (value 5) was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations

#### 6. Shelter Rating:

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

#### 7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully measured habitat units, dominant and sub-dominant substrate elements were visually estimated using a list of seven size classes which are defined in the California Salmonid Stream Habitat Restoration Manual.

#### 8. Canopy:

Stream canopy density was estimated using modified handheld spherical densimeters as described in the California Salmonid Stream Habitat Restoration Manual. Canopy density relates to the amount of stream shaded from the sun. In Barrelli Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the top 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 evergreen or deciduous trees.

## 9. Bank Composition and Vegetation:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Barrelli Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully measured 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.

### BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. Biological inventory is conducted using one or more of four basic methods: 1) stream bank observation, 2) underwater observation, 3) electro-fishing, or 4) seine netting. Methods 1-3 are discussed in the California Salmonid Stream Habitat Restoration Manual. Seine netting is a fish capture technique that involves the use of a one meter square net attached to dowels on two parallel sides. The surveyor pushes the seine through the habitat unit to catch aquatic organisms. At the end of the unit the surveyor scoops up the seine and places all captured organisms in a bucket partially filled with stream water for holding. The water is aerated with a bubbler to maintain dissolved oxygen levels and minimize stress on the organisms. All fish, amphibians, and reptiles in the holding bucket are identified to species, counted and returned to the stream. Data is recorded on an electro-fishing field form. Seine netting is used to confirm the presence of a species, particularly salmon and steelhead, and is not intended to quantify a population estimate.

### IMPACT INVENTORY & ANALYSIS

Problems such as migration barriers, streambed erosion, poor water quality or temperatures are noted in the comments and landmarks section. In some cases measurements are taken, an analysis of what caused the problem is made and restoration potential and alternatives are recommended.

### DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat for data storage and analysis. Habitat is a Visual Basic extension to Microsoft Access, developed by Zebulon Young, University of California, Berkeley. This program processes and summarizes the data, and produces the following tables and appendices:

- Summary of riffle, flatwater, and pool habitat types
- Summary of habitat types and measured parameters
- Summary of pool types
- Summary of maximum pool depths by pool habitat types
- Summary of shelter by habitat types
- Summary of dominant substrates by habitat types
- Summary of fish habitat elements by stream reach

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

- Level II habitat types by % occurrence
- Level II habitat types by % total length
- Level IV habitat types by % occurrence
- Level I pool habitat types by % occurrence
- Maximum depth in pools
- Percent embeddedness estimated in pool tail-outs
- Mean percent cover types in pools
- Substrate composition in pool tail-outs
- Mean percent canopy
- Dominant bank composition in survey reach
- Dominant bank vegetation in survey reach

#### HISTORICAL STREAM SURVEYS:

No previous surveys of Barrelli Creek have been conducted by DFG.

#### HABITAT INVENTORY RESULTS FOR BARRELLI CREEK

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

The habitat inventory of Barrelli Creek, 7/23/2002 - 7/25/2002, was conducted by Kate Hall (CCC) and Amy Livingston (Americorps) with supervision and analysis by California Department of Fish and Game (DFG). The survey began at the confluence with the Russian River and extended up Barrelli Creek to the end of landowner permission. The total length of stream surveyed was 6945 feet.

Flows were not measured on Barrelli Creek.

This section of Barrelli Creek has one reach with one distinct channel type: from the mouth to 6945 feet a F4. F4 channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio and a predominantly gravel substrate.

Water temperatures ranged from 59°F to 72°F. Air temperatures ranged from 59°F to 82°F. Summer temperatures were also measured using a remote temperature recorder placed in a pool (see Temperature Summary graphs, Appendix E). The recorder in Reach 1 logged temperatures every 1.5 hours from July 24, 2002 to October 31, 2002. The pool where the temperature recorder was placed probably dried up August 25 to September 4 so there are no data for that time period. The highest temperature recorded was 69.0°F on September 12 and the lowest was 47.6°F on October 31. The mean of the daily highs was 65.9°F for the month of July, 65.3°F for August, 62.5°F for September, and 57.5°F for October.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 41.4% flatwater units, 35.7% dry units, 17.1% pool units, 4.3% riffle units and 1.4% culvert units, (Graph 1). Based on total **length** there were 67.9% dry units, 20.7% flatwater units, 5.3% pool units ,

2.0% riffle units and 4.0% culvert units (Graph 2).

Seventy habitat units were measured and 27 were completely sampled. Nine Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent **occurrence** were dry at 35.7%, glide at 28.8%, run at 12.9%, mid-channel pool at 10%, low gradient riffle at 4.3%, corner pool at 4.3%, lateral scour pool - root wad enhanced at 1.4%, lateral scour pool - log enhanced at 1.4% and culvert at 1.4% (Graph 3). By percent total **length**, dry at 67.9%, glide at 10.6%, run at 10.1%, culvert at 4%, mid-channel pool at 3.2%, low gradient riffle at 2%, corner pool at 1.4%, lateral scour pool – root was enhanced at 0.2% and lateral scour pool - log enhanced at 0.5%.

Twelve pools were identified (Table 3). Mid-channel pool pools were most often encountered at 58%, and comprised 60% of the total length of pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Seven of the 12 pools (70%) had a depth of two feet or greater (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. Pools rated 13 (Table 1). Of the pool types, lateral scour pool - log enhanced rated 30, lateral scour pool - root wad enhanced rated 20, mid-channel pool rated 11 and corner pool rated 8 (Table 2).

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were small wood at 26%, aquatic vegetation at 20%, terrestrial vegetation at 18%, undercut banks at 17%, boulders at 10%, root mass at 7%, and bedrock at 2%. Graph 7 describes the pool shelter in Barrelli Creek.

Table 6 summarizes the dominant substrate by habitat type. In the three low-gradient riffles surveyed, the dominant substrate by percent of the area surveyed was: silt & clay in one riffle and gravel in one riffle.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the twelve pool tail-outs measured, six had a value of 2 (50%), three had a value of 3 (25%) and three had a value of 4 (25%). No riffles were rated a 1 or a 5 (unsuitable substrate type for spawning). On this scale, a value of 1 is best for fisheries. Small cobble was the dominant substrate observed at pool tail-outs (Graph 8). Graph 6 describes percent embeddedness. No mechanical gravel sampling was conducted in 2002 surveys.

The mean percent canopy density for the stream reach surveyed was 72%. The mean percentages of deciduous and evergreen trees were 67% and 33%, respectively. Graph 9 describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 39% and the mean percent left bank vegetated was 41%. For the habitat units measured, the dominant vegetation types for the stream banks were: 36.4% deciduous trees, 34.1% brush, 22.7% evergreen trees and 6.5% grass (Graph 11). The dominant substrate for the stream banks were: 68.2% silt, 15.9% cobble & gravel, 11.4% bedrock and 4.5% boulder (Graph 10).

## BIOLOGICAL INVENTORY

### JUVENILE SURVEYS:

Department of Fish and Game has not conducted previous biological inventories of Barrelli Creek, nor are there any records of hatchery releases or fish rescues in the Barrelli Creek watershed. A biological inventory was conducted in 2002.

On 10/31/02 a biological inventory was conducted at one site on Barrelli Creek to document fish species composition and distribution. The site was triple pass seine netted. Fish from the site were counted by species, and returned to the stream. The air temperature was 70°F and the water temperature was 50°F. The observers were Amy Livingston and Cassie Simons (Americorps).

The inventory began at 1232 hours in Reach 1 and ended 500' upstream. Habitat types surveyed were glides and mid-channel pools. No steelhead were observed. The following table displays the information yielded from this site.

| 2002 Juvenile Biologic Inventory Results                   |                           |
|--|---------------------------|
| Species Observed   | Number Recorded at Site 1 |
| SACRAMENTO PIKE MINNOW<br>( <i>Ptychocheilus grandis</i> ) | 38                        |
| CRAYFISH   | 80                        |

### DISCUSSION FOR BARRELLI CREEK

Barrelli Creek has one channel type: F4. Many site specific projects can be designed within an F channel type, especially to increase pool frequency, volume and shelter. According to the DFG Salmonid Stream Habitat Restoration Manual, F4 channel types are good for bank-placed boulders and fair for low-stage weirs, single and opposing wing-deflectors, channel constrictors and log cover. Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

The water temperatures recorded on the survey days 7/23/2002 - 7/25/2002 ranged from 59°F to 72°F. Air temperatures ranged from 59°F to 82°F. Water temperatures over 65°F, if sustained, are above the threshold stress level for salmonids.

Summer temperatures measured using a remote temperature recorder in Reach 1 ranged from 47.6° to 69.0°F. The Temperature Summary graph shows that for much of the summer (July through October) the lower watershed exhibited temperatures above the optimal for salmonids. It is unknown if this thermal regime is typical. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months in more locations, and extensive biological sampling would need to be conducted.

Pools comprised 5% of the total length of this survey. In first and second order streams a primary pool is defined to have a maximum depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. In Barrelli Creek, the pools are relatively deep with 75% having a maximum depth of at least two feet. These pools comprised 5% of the total length of stream habitat. In coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat length.

The mean shelter rating for pools was 13. However, a pool shelter rating of approximately 80 is desirable. The relatively small amount of pool shelter that now exists is being provided primarily by small wood at 27%, aquatic vegetation at 13%, terrestrial vegetation at 19%, undercut banks at 14%, boulders at 7%, root mass at 5%, and bedrock at 17%, (Table 5). Log and root wad cover in the pool and flatwater habitats would improve both summer and winter salmonid habitat. Log cover provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

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

Fifty percent of the pool tail-outs measured had embeddedness ratings of either 3 or 4. None had a rating of 1 or 5. Cobble embeddedness measured to be 25% or less (a rating of 1) is considered best for the needs of salmon and steelhead. The higher the percent of fine sediment, the lower the probability that eggs will survive to hatch. This is due to the reduced quantity of oxygenated water able to percolate through the gravel, or because of fine sediment capping the redd and preventing fry emergence.

The mean percent canopy for the survey was 72%. This is a low percentage of canopy, since 80 percent is generally considered desirable. Cooler water temperatures are desirable in Barrelli Creek. Elevated water temperatures could be reduced by increasing stream canopy. The large trees required for adequate stream canopy would also eventually provide a long term source of large woody debris needed for instream shelter and bank stability.

However, the riparian buffer is thin or nearly absent in areas with agriculture. In the lower portion of the creek surveyed, there was little to no vegetation or it was thickly vegetated by deciduous trees, poison oak, and Himalayan blackberry. Riparian removal and vineyard development within the riparian corridor have lead to less stream canopy and channel incision causing bank erosion and higher water temperatures. Areas with bank erosion could benefit from bio-technical re-vegetation techniques using native species.

Several major erosion sites, and possible diversion pipes were noted.



## GENERAL MANAGEMENT RECOMMENDATIONS

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

Winter storms often bring down large trees and other woody debris into the stream, which increases the number and quality of pools. This woody debris, if left undisturbed, will provide fish shelter and rearing habitat, and offset channel incision. Landowners should be sensitive about the natural and positive role woody debris plays in the system, and encouraged not to remove woody debris from the stream, except under extreme buildup and only under guidance by a fishery professional.

## PRIORITY FISHERY ENHANCEMENT OPPORTUNITIES

- 1) Access for migrating salmonids is an ongoing potential problem, therefore, fish passage should be monitored, and improved where possible. Baffles should be installed in several culverts to facilitate easier fish access.
- 2) Increase the canopy on Barelli Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reach above the survey section should be assessed for planting and treated as well, since water temperatures throughout are effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.
- 3) Map sources of upslope and in-channel erosion, and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream. Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffering against agricultural, grazing and urban runoff.
- 4) In Barelli Creek, active and potential sediment sources related to the road system need to be mapped and treated according to their potential for sediment yield to the stream and its tributaries.
- 5) Where feasible, design and engineer pool enhancement structures to increase the number of pools in the upper reaches. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.
- 6) Where feasible, increase woody cover in the pool and flatwater habitat units along the entire stream. Most of the existing shelter is from vegetation and undercut banks. Adding high quality complexity with larger woody cover is desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations in the upper reaches. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion. In some areas the material is at hand.

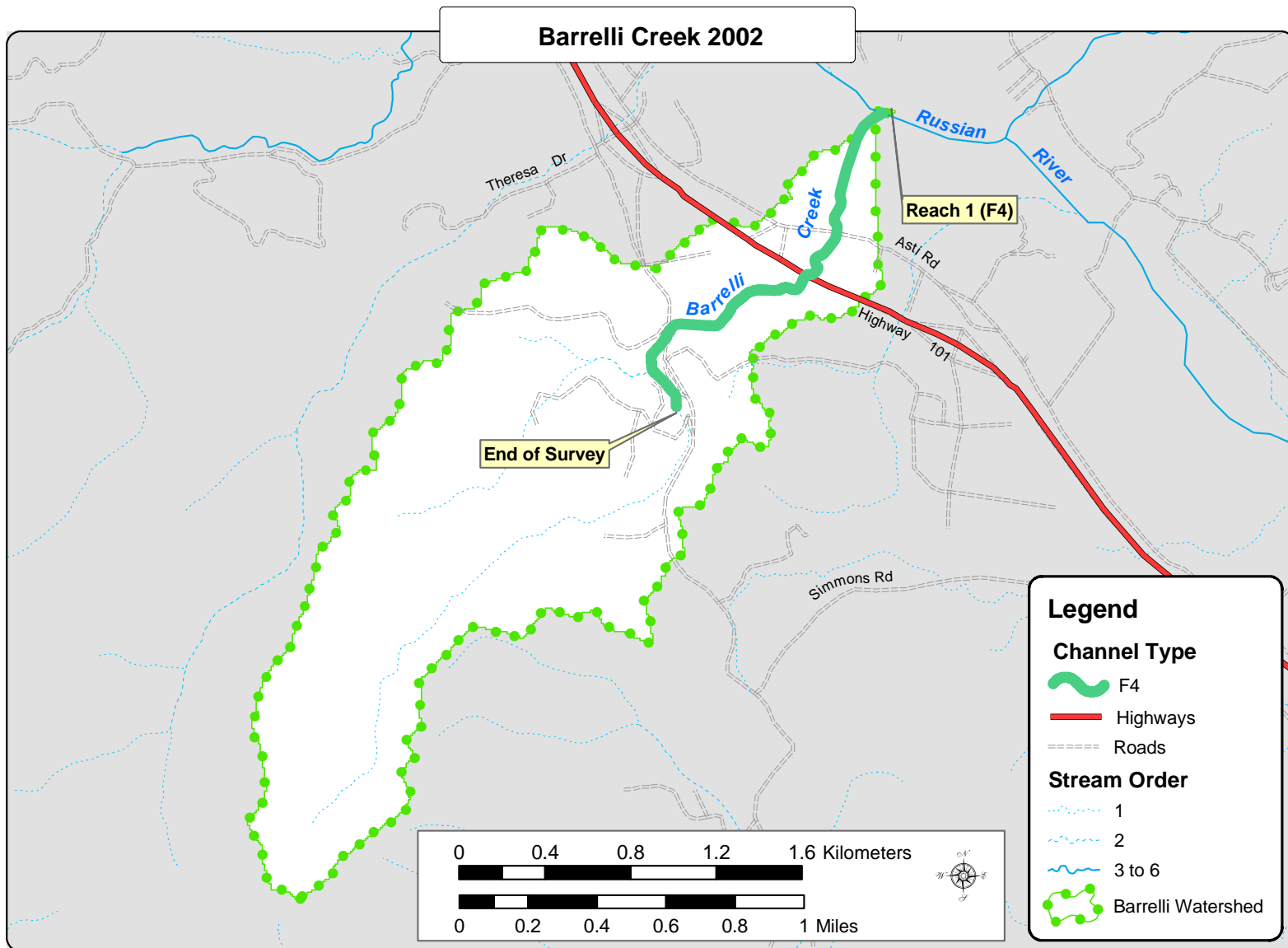
## COMMENTS AND LANDMARKS

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

- 0' Creek is channelized and begins in vineyard. Bridge 1: Rail car BRIDGE 400' into unit: 8'H x 36'W x 10.5'L, no downcutting, no sill (dry), not retaining gravel. Bridge 2: Cement railroad BRIDGE.
- 2314' BRIDGE over Hwy 101: 279'L x 6'W x 5' H, no downcutting, height from water to sill 0.4', gravel deposit on sill. A 200-300' section of water between the Hwy 101 Bridge and Dutcher Creek Bridge was anaerobic and smelled of sulfur. The 100% silt substrate was very black deposits with some white and red deposits. The riparian zone was thicker after the Hwy 101 Bridge.
- 2593' BRIDGE: 34'L x 8'W x 7'H, downcutting, sill dry, not retaining gravel. Bedrock on channel bottom at bridge, rock retaining wall on sides, scouring due to boulder rip rap walls.
- 2761' First young rough fish observed.
- 2819' Dry unit interspersed with wet patches.
- 2846' EROSION throughout habitat unit, significant erosion on left bank causing an oak tree to almost fall into the creek.
- 3103' Check dam structure 1' high.
- 3139' Railroad car. BRIDGE: 11'L x 40'W x 9.3'H, no downcutting, no sill, not retaining gravel.
- 3158' CULVERT on right bank 2' wide (dry).
- 3317' LARGE WOODY DEBRIS ACCUMULATION: 3.5'L x 12'W x 5'D, not retaining gravel, scour pool under and. Some erosion on LB. Black hose (1" diameter) coming out of pool, several pipes were observed from creek between Hwy 101 Bridge and Dutcher Creek Bridge.
- 3355' EROSION on left bank with a covering of new grass.
- 3592' Human-made rock sills separating glides and pools.
- 3896' Rip rap at upstream end of unit. Last rough fish observed.
- 4006' BRIDGE: 9.5'H x 21'W x 9.7'L, no downcutting, no sill, not retaining gravel. Pipe near buildings. Substrate is black, anaerobic silt.
- 4389' Dutcher Creek Road BRIDGE: 122'L x 12'W x 10'H, has a double culvert, each pipe 39'L x 4'W x 4'H, downcutting, sill dry, not retaining gravel, no maintenance required. Near a parking lot, 100% canopy. Above Dutcher Creek there was a more diverse and larger riparian zone. There was a noted improvement in embeddedness. Substrate changed from silt/sand to cobble and gravel.
- 5367' Left bank dry tributary enters through a culvert under Poinsettia Road. Upstream 400' is a damned pond.
- 5510' Rip rap throughout unit on right and left bank.
- 5691' Three instream culverts at water level, all same size, 20'L x 3'W x 3'H, no downcutting, not retaining gravel, no maintenance required.
- 5706' Culvert makes up first 20' of unit.
- 6045' Terrain/brush impassable.
- 6055' END OF SURVEY, end of access, long dry stretch. Overall, very few rough fish were observed.

## REFERENCES

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B. 1998. *California Salmonid Stream Habitat Restoration Manual*, 3rd edition. California Department of Fish and Game, Sacramento, California.



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Prepared by: Ann-Marie Osterback, May 7, 2003

## APPENDIX B: TABLES

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

Stream Name: Barrelli Creek

LLID:

1229792387691

Drainage:

Russian River - Middle

Survey Dates: 7/23/2002 to 7/25/2002

Confluence Location: Quad: ASTI

Legal Description: T000R000S00

Latitude: 38:46:09.0N

Longitude: 122:58:45.0W

| Habitat Units      | Units Fully Measured              | Habitat Type | Habitat Occurrence (%) | Mean Length (ft.)         | Total Length (ft.) | Total Length (%) | Mean Width (ft.) | Mean Depth (ft.) | Mean Max Depth (ft.) | Mean Area (sq.ft.)         | Estimated Total Area (sq.ft.) | Mean Volume (cu.ft.) | Estimated Total Volume (cu.ft.) | Mean Residual Pool Vol (cu.ft.) | Mean Shelter Rating |
|--------------------|-----------------------------------|--------------|------------------------|---------------------------|--------------------|------------------|------------------|------------------|----------------------|----------------------------|-------------------------------|----------------------|---------------------------------|---------------------------------|---------------------|
| 1                  | 0                                 | CULVERT      | 1.4                    | 279                       | 279                | 4.0              |                  |                  |                      |                            |                               |                      |                                 |                                 |                     |
| 25                 | 2                                 | DRY          | 35.7                   | 189                       | 4717               | 67.9             | 13.5             |                  |                      |                            |                               |                      |                                 |                                 |                     |
| 29                 | 12                                | FLATWATER    | 41.4                   | 50                        | 1440               | 20.7             | 6.0              | 0.6              | 1.0                  | 358                        | 10385                         | 116                  | 1117                            |                                 |                     |
| 12                 | 11                                | POOL         | 17.1                   | 31                        | 369                | 5.3              | 9.1              | 1.6              | 2.2                  | 288                        | 3460                          | 512                  | 5027                            | 490                             | 13                  |
| 3                  | 2                                 | RIFFLE       | 4.3                    | 47                        | 140                | 2.0              | 2.0              | 0.3              | 0.7                  | 53                         | 158                           | 16                   | 48                              |                                 |                     |
| <b>Total Units</b> | <b>Total Units Fully Measured</b> |              |                        | <b>Total Length (ft.)</b> |                    |                  |                  |                  |                      | <b>Total Area (sq.ft.)</b> |                               |                      | <b>Total Volume (cu.ft.)</b>    |                                 |                     |
| 70                 | 27                                |              |                        | 6945                      |                    |                  |                  |                  |                      | 14003                      |                               |                      | 6193                            |                                 |                     |

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

Stream Name: Barrelli Creek

LLID:

1229792387691

Drainage: Russian River - Middle

Survey Dates: 7/23/2002 to 7/25/2002

Confluence Location: Quad: ASTI

Legal Description: T000R000S00

Latitude: 38:46:09.0N

Longitude: 122:58:45.0W

| Habitat Units      | Units Fully Measured              | Habitat Type | Habitat Occurrence (%) | Mean Length (ft.) | Total Length (ft.)        | Total Length (%) | Mean Width (ft.) | Mean Depth (ft.) | Max Depth (ft.) | Mean Area (sq.ft.)         | Estimated Total Area (sq.ft.) | Mean Volume (cu.ft.)         | Estimated Total Volume (cu.ft.) | Mean Residual Pool Vol (cu.ft.) | Mean Shelter Rating | Mean Canopy (%) |
|--------------------|-----------------------------------|--------------|------------------------|-------------------|---------------------------|------------------|------------------|------------------|-----------------|----------------------------|-------------------------------|------------------------------|---------------------------------|---------------------------------|---------------------|-----------------|
| 3                  | 2                                 | LGR          | 4.3                    | 47                | 140                       | 2.0              | 2                | 0.3              | 1.1             | 53                         | 158                           | 16                           | 48                              |                                 |                     | 82              |
| 20                 | 9                                 | GLD          | 28.6                   | 37                | 736                       | 10.6             | 6                | 0.6              | 1.6             | 225                        | 4506                          | 102                          | 677                             |                                 |                     | 66              |
| 9                  | 3                                 | RUN          | 12.9                   | 78                | 704                       | 10.1             | 6                | 0.8              | 1.5             | 757                        | 6809                          | 158                          | 473                             |                                 |                     | 70              |
| 7                  | 6                                 | MCP          | 10.0                   | 31                | 220                       | 3.2              | 9                | 1.8              | 3               | 271                        | 1899                          | 486                          | 2269                            | 464                             | 11                  | 81              |
| 3                  | 3                                 | CRP          | 4.3                    | 32                | 97                        | 1.4              | 11               | 1.8              | 3.1             | 373                        | 1118                          | 772                          | 2315                            | 748                             | 8                   | 67              |
| 1                  | 1                                 | LSL          | 1.4                    | 38                | 38                        | 0.5              | 9                | 0.6              | 2               | 342                        | 342                           | 239                          | 239                             | 205                             | 30                  | 85              |
| 1                  | 1                                 | LSR          | 1.4                    | 14                | 14                        | 0.2              | 6                | 1.3              | 2.2             | 84                         | 84                            | 109                          | 109                             | 109                             | 20                  | 80              |
| 25                 | 2                                 | DRY          | 35.7                   | 189               | 4717                      | 67.9             | 14               |                  |                 | 0                          | 0                             |                              |                                 |                                 |                     | 69              |
| 1                  | 0                                 | CUL          | 1.4                    | 279               | 279                       | 4.0              |                  |                  |                 |                            |                               |                              |                                 |                                 |                     |                 |
| <b>Total Units</b> | <b>Total Units Fully Measured</b> |              |                        |                   | <b>Total Length (ft.)</b> |                  |                  |                  |                 | <b>Total Area (sq.ft.)</b> |                               | <b>Total Volume (cu.ft.)</b> |                                 |                                 |                     |                 |
| 70                 | 27                                |              |                        |                   | 6945                      |                  |                  |                  |                 | 14915                      |                               | 6131                         |                                 |                                 |                     |                 |

**Table 3 - Summary of Pool Types**

Stream Name: Barrelli Creek

LLID:

1229792387691 Drainage: Russian River - Middle

Survey Dates: 7/23/2002 to 7/25/2002

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:46:09.0N Longitude: 122:58:45.0W

| Habitat Units | Units Fully Measured | Habitat Type | Habitat Occurrence (%) | Mean Length (ft.) | Total Length (ft.) | Total Length (%) | Mean Width (ft.) | Mean Residual Depth (ft.) | Mean Area (sq.ft.) | Estimated Total Area (sq.ft.) | Mean Residual Pool Vol (cu.ft.) | Estimated Total Resid.Vol. (cu.ft.) | Mean Shelter Rating |
|---------------|----------------------|--------------|------------------------|-------------------|--------------------|------------------|------------------|---------------------------|--------------------|-------------------------------|---------------------------------|-------------------------------------|---------------------|
| 7             | 6                    | MAIN         | 58                     | 31                | 220                | 60               | 8.8              | 1.8                       | 271                | 1899                          | 464                             | 2166                                | 11                  |
| 5             | 5                    | SCOUR        | 42                     | 30                | 149                | 40               | 9.4              | 1.4                       | 309                | 1544                          | 511                             | 2557                                | 16                  |

| Total Units | Total Units Fully Measured | Total Length (ft.) | Total Area (sq.ft.) | Total Volume (cu.ft.) |
|-------------|----------------------------|--------------------|---------------------|-----------------------|
| 12          | 11                         | 369                | 3443                | 4723                  |

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

Stream Name: Barrelli Creek

LLID:

1229792387691

Drainage: Russian River - Middle

Survey Dates: 7/23/2002 to 7/25/2002

Confluence Location: Quad: ASTI

Legal Description: T000R000S00

Latitude: 38:46:09.0N

Longitude: 122:58:45.0W

| Habitat Units | Habitat Type | Habitat Occurrence (%) | < 1 Foot Maximum Residual Depth | < 1 Foot Percent Occurrence | 1 < 2 Feet Maximum Residual Depth | 1 < 2 Feet Percent Occurrence | 2 < 3 Feet Maximum Residual Depth | 2 < 3 Feet Percent Occurrence | 3 < 4 Feet Maximum Residual Depth | 3 < 4 Feet Percent Occurrence | >= 4 Feet Maximum Residual Depth | >= 4 Feet Percent Occurrence |
|---------------|--------------|------------------------|---------------------------------|-----------------------------|-----------------------------------|-------------------------------|-----------------------------------|-------------------------------|-----------------------------------|-------------------------------|----------------------------------|------------------------------|
| 5             | MCP          | 50                     | 0                               | 0                           | 2                                 | 40                            | 2                                 | 40                            | 1                                 | 20                            | 0                                | 0                            |
| 3             | CRP          | 30                     | 0                               | 0                           | 1                                 | 33                            | 1                                 | 33                            | 1                                 | 33                            | 0                                | 0                            |
| 1             | LSL          | 10                     | 0                               | 0                           | 0                                 | 0                             | 1                                 | 100                           | 0                                 | 0                             | 0                                | 0                            |
| 1             | LSR          | 10                     | 0                               | 0                           | 0                                 | 0                             | 1                                 | 100                           | 0                                 | 0                             | 0                                | 0                            |

Total Units

| Total Units | Total < 1 Foot Max Resid. Depth | Total < 1 Foot % Occurrence | Total 1 < 2 Foot Max Resid. Depth | Total 1 < 2 Foot % Occurrence | Total 2 < 3 Foot Max Resid. Depth | Total 2 < 3 Foot % Occurrence | Total 3 < 4 Foot Max Resid. Depth | Total 3 < 4 Foot % Occurrence | Total >= 4 Foot Max Resid. Depth | Total >= 4 Foot % Occurrence |
|-------------|---------------------------------|-----------------------------|-----------------------------------|-------------------------------|-----------------------------------|-------------------------------|-----------------------------------|-------------------------------|----------------------------------|------------------------------|
| 10          | 0                               | 0                           | 3                                 | 30                            | 5                                 | 50                            | 2                                 | 20                            | 0                                | 0                            |

Mean Maximum Residual Pool Depth (ft.): 2.2



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

Stream Name: Barrelli Creek LLID: 1229792387691 Drainage: Russian River - Middle  
 Survey Dates: 7/23/2002 to 7/25/2002 Dry Units: 25  
 Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:46:09.0N Longitude: 122:58:45.0W

| Habitat Units | Units Fully Measured | Habitat Type | Mean % Undercut Banks | Mean % SWD | Mean % LWD | Mean % Root Mass | Mean % Terr. Vegetation | Mean % Aquatic Vegetation | Mean % White Water | Mean % Boulders | Mean % Bedrock Ledges |
|---------------|----------------------|--------------|-----------------------|------------|------------|------------------|-------------------------|---------------------------|--------------------|-----------------|-----------------------|
| 3             | 0                    | LGR          |                       |            |            |                  |                         |                           |                    |                 |                       |
| 3             | 0                    | TOTAL RIFFLE |                       |            |            |                  |                         |                           |                    |                 |                       |
| 20            | 0                    | GLD          |                       |            |            |                  |                         |                           |                    |                 |                       |
| 9             | 0                    | RUN          |                       |            |            |                  |                         |                           |                    |                 |                       |
| 29            | 0                    | TOTAL FLAT   |                       |            |            |                  |                         |                           |                    |                 |                       |
| 7             | 6                    | MCP          | 3                     | 33         | 0          | 8                | 2                       | 17                        | 0                  | 10              | 28                    |
| 3             | 2                    | CRP          | 13                    | 0          | 0          | 0                | 88                      | 0                         | 0                  | 0               | 0                     |
| 1             | 1                    | LSL          | 25                    | 65         | 0          | 0                | 0                       | 0                         | 0                  | 10              | 0                     |
| 1             | 1                    | LSR          | 70                    | 0          | 0          | 0                | 0                       | 30                        | 0                  | 0               | 0                     |
| 12            | 10                   | TOTAL POOL   | 14                    | 27         | 0          | 5                | 19                      | 13                        | 0                  | 7               | 17                    |
| 1             | 0                    | CUL          |                       |            |            |                  |                         |                           |                    |                 |                       |
| 70            | 10                   | TOTAL        | 14                    | 27         | 0          | 5                | 19                      | 13                        | 0                  | 7               | 17                    |

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

Stream Name: Barrelli Creek LLID: 1229792387691 Drainage: Russian River - Middle  
 Survey Dates: 7/23/2002 to 7/25/2002 Dry Units: 25  
 Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:46:09.0N Longitude: 122:58:45.0W

| Habitat Units | Units Fully Measured | Habitat Type | % Total Silt/Clay Dominant | % Total Sand Dominant | % Total Gravel Dominant | % Total Small Cobble Dominant | % Total Large Cobble Dominant | % Total Boulder Dominant | % Total Bedrock Dominant |
|---------------|----------------------|--------------|----------------------------|-----------------------|-------------------------|-------------------------------|-------------------------------|--------------------------|--------------------------|
| 3             | 2                    | LGR          | 50                         | 0                     | 50                      | 0                             | 0                             | 0                        | 0                        |
| 20            | 3                    | GLD          | 0                          | 67                    | 33                      | 0                             | 0                             | 0                        | 0                        |
| 9             | 1                    | RUN          | 0                          | 0                     | 0                       | 100                           | 0                             | 0                        | 0                        |
| 7             | 7                    | MCP          | 57                         | 29                    | 14                      | 0                             | 0                             | 0                        | 0                        |
| 3             | 3                    | CRP          | 100                        | 0                     | 0                       | 0                             | 0                             | 0                        | 0                        |
| 1             | 1                    | LSL          | 0                          | 100                   | 0                       | 0                             | 0                             | 0                        | 0                        |
| 1             | 1                    | LSR          | 100                        | 0                     | 0                       | 0                             | 0                             | 0                        | 0                        |

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

Stream Name: Barrelli Creek

LLID:

1229792387691 Drainage: Russian River - Middle

Survey Dates: 7/23/2002 to 7/25/2002

Confluence Location: Quad: ASTI

Legal Description: T000R000S00

Latitude: 38:46:09.0N Longitude: 122:58:45.0W

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| Mean Percent Canopy | Mean Percent Conifer | Mean Percent Hardwood | Mean Percent Open Units | Mean Right Bank % Cover | Mean Left Bank % Cover |
|---------------------|----------------------|-----------------------|-------------------------|-------------------------|------------------------|
| 72                  | 33                   | 67                    | 0                       | 64                      | 58                     |

---

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

Open units represent habitat units with zero canopy cover.

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

Stream Name: Barrelli Creek

LLID:

1229792387691 Drainage: Russian River - Middle

Survey Dates: 7/23/2002 to 7/25/2002

Confluence Location: Quad: ASTI

Legal Description: T000R000S00

Latitude: 38:46:09.0N Longitude: 122:58:45.0W

**Mean Percentage of Dominant Stream Bank Substrate**

| Dominant Class of Substrate | Number of Units Right Bank | Number of Units Left Bank | Total Mean Percent (%) |
|-----------------------------|----------------------------|---------------------------|------------------------|
| Bedrock                     | 3                          | 2                         | 11.4                   |
| Boulder                     | 1                          | 1                         | 4.5                    |
| Cobble / Gravel             | 4                          | 3                         | 15.9                   |
| Sand / Silt / Clay          | 14                         | 16                        | 68.2                   |

**Mean Percentage of Dominant Stream Bank Vegetation**

| Dominant Class of Vegetation | Number of Units Right Bank | Number of Units Left Bank | Total Mean Percent (%) |
|------------------------------|----------------------------|---------------------------|------------------------|
| Grass                        | 0                          | 3                         | 6.8                    |
| Brush                        | 9                          | 6                         | 34.1                   |
| Hardwood Trees               | 8                          | 8                         | 36.4                   |
| Coniferous Trees             | 5                          | 5                         | 22.7                   |
| No Vegetation                | 0                          | 0                         | 0.0                    |

**Total Stream Cobble Embeddedness Values:** 3

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

StreamName: Barrelli Creek LLID: 1229792387691 Drainage: Russian River - Middle  
 Survey Dates: 7/23/2002 to 7/25/2002  
 Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:46:09.0N Longitude: 122:58:45.0W

|                            | Riffles | Flatwater | Pools |
|----------------------------|---------|-----------|-------|
| UNDERCUT BANKS (%)         |         |           | 14    |
| SMALL WOODY DEBRIS (%)     |         |           | 27    |
| LARGE WOODY DEBRIS (%)     |         |           | 0     |
| ROOT MASS (%)              |         |           | 5     |
| TERRESTRIAL VEGETATION (%) |         |           | 19    |
| AQUATIC VEGETATION (%)     |         |           | 13    |
| WHITEWATER (%)             |         |           | 0     |
| BOULDERS (%)               |         |           | 7     |
| BEDROCK LEDGES (%)         |         |           | 17    |

## APPENDIX C - Fish Habitat Inventory Data Summary

Stream Name: Barrelli Creek LLID: 1229792387691  
Drainage: Russian River - Middle

Survey Dates: 7/23/2002 to 7/25/2002 Survey Length (ft.): 6945  
Main Channel (ft.): 6945 Side Channel (ft.): 0

Confluence Location: Quad: ASTI Legal Description: T000R000S00 Latitude: 38:46:09.0N Longitude: 122:58:45.0W

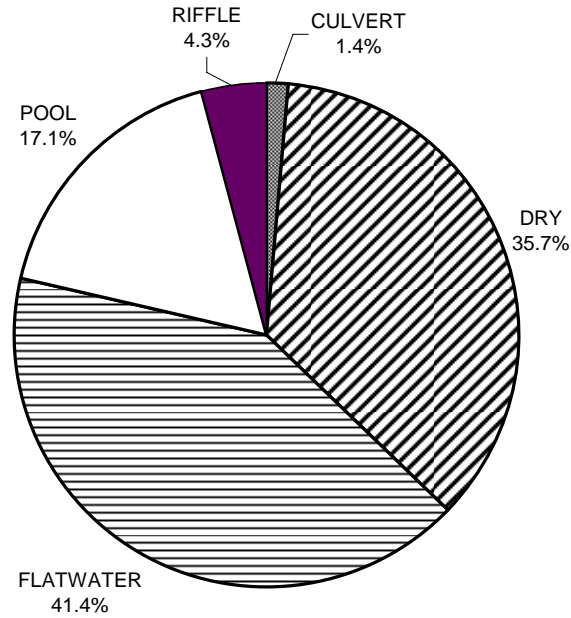
### Summary of Fish Habitat Elements By Stream Reach

**STREAM REACH: 1**

|   |  |   |
|---|--|---|
| Channel Type: F4  | Canopy Density (%): 71.8                     | Pools by Stream Length (%): 5.3         |
| Reach Length (ft.): 6945  | Coniferous Component (%): 32.6               | Pool Frequency (%): 17.1                |
| Riffle/Flatwater Mean Width: 5.5                                    | Hardwood Component (%): 67.4                 | Residual Pool Depth (%):                |
| BFW:  | Dominant Bank Vegetation: Hardwood Trees     | < 2 Feet Deep: 30                       |
| Range (ft.): to   | Vegetative Cover (%): 60.7                   | 2 to 2.9 Feet Deep: 50                  |
| Mean (ft.):   | Dominant Shelter: Small Woody Debris         | 3 to 3.9 Feet Deep: 20                  |
| Std. Dev.:  | Dominant Bank Substrate Type: Sand/Silt/Clay | >= 4 Feet Deep: 0                       |
| Base Flow (cfs.):   | Occurrence of LWD (%): 0                     | Mean Max Residual Pool Depth (ft.): 2.2 |
| Water (F): 0 - 72 Air (F): 59 - 82                                  | LWD per 100 ft.:                             | Mean Pool Shelter Rating: 13            |
| Dry Channel (ft): 4717  | Riffles:                                     |   |
|   | Pools:                                       |   |
|   | Flat:  |   |
| Pool Tail Substrate (%): Silt/Clay 27 Sand: 0 Gravel: 27 Sm Cobble: |  |   |
|   | 45 Lg Cobble: 0 Boulder: 0 Bedrock: 0        |   |
| Embeddedness Values (%): 1.   |  |   |
|   | 0.0 2. 50.0 3. 25.0 4. 25.0 5. 0.0           |   |

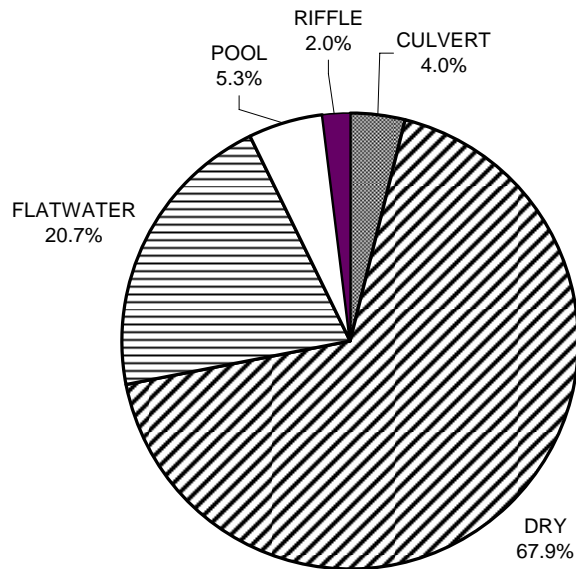
APPENDIX D: GRAPHS

**BARRELLI CREEK  
HABITAT TYPES BY PERCENT OCCURRENCE**



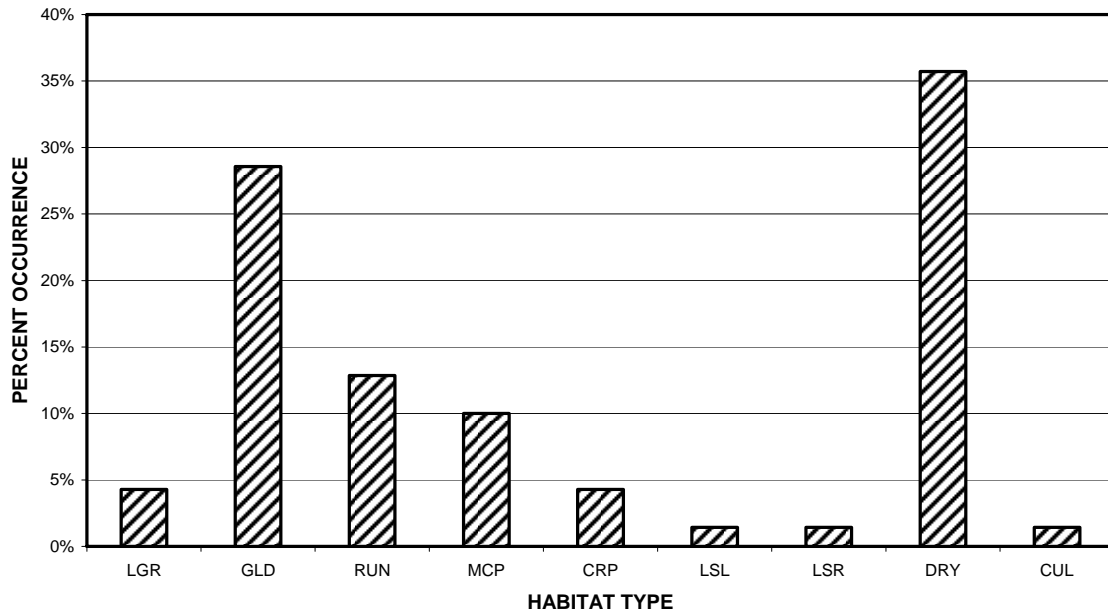
GRAPH 1: Level II habitat types by percent occurrence

**BARRELLI CREEK  
HABITAT TYPES BY PERCENT TOTAL LENGTH**



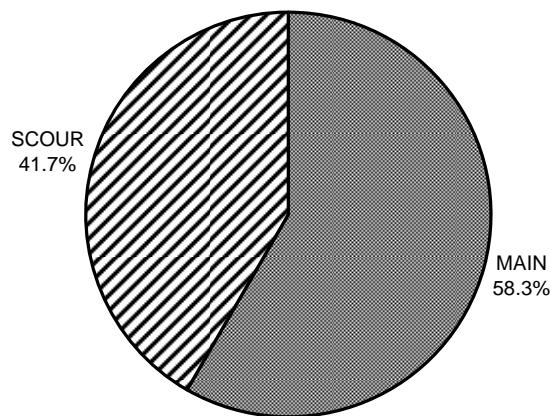
GRAPH 2: Level II habitat types by percent total length

**BARRELLI CREEK  
HABITAT TYPES BY PERCENT OCCURRENCE**



GRAPH 3: Level IV habitat types by percent occurrence

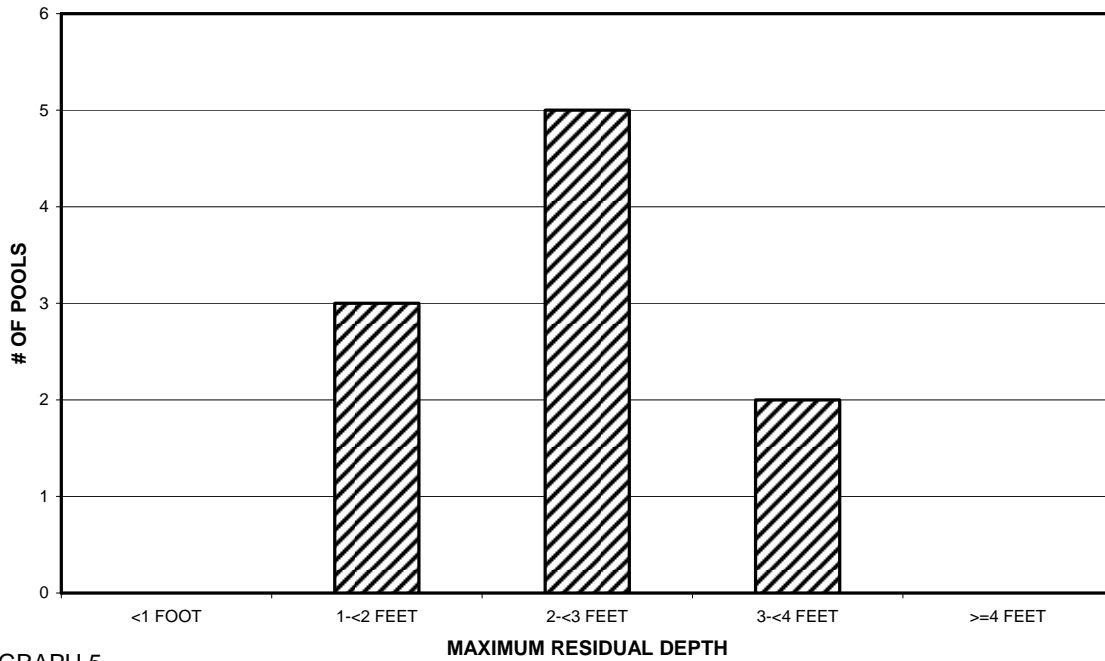
**BARRELLI CREEK  
POOL TYPES BY PERCENT OCCURRENCE**



GRAPH 4: Level I pool types by percent occurrence

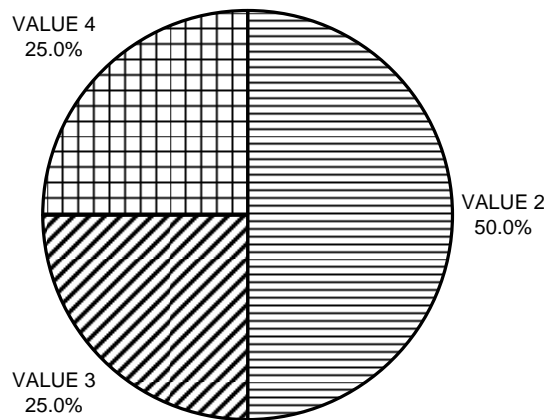


**BARRELLI CREEK  
MAXIMUM DEPTH IN POOLS**



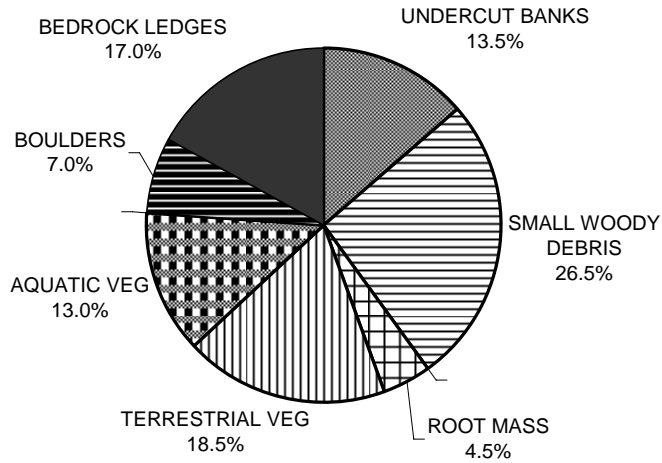
GRAPH 5

**BARRELLI CREEK  
PERCENT EMBEDDEDNESS**



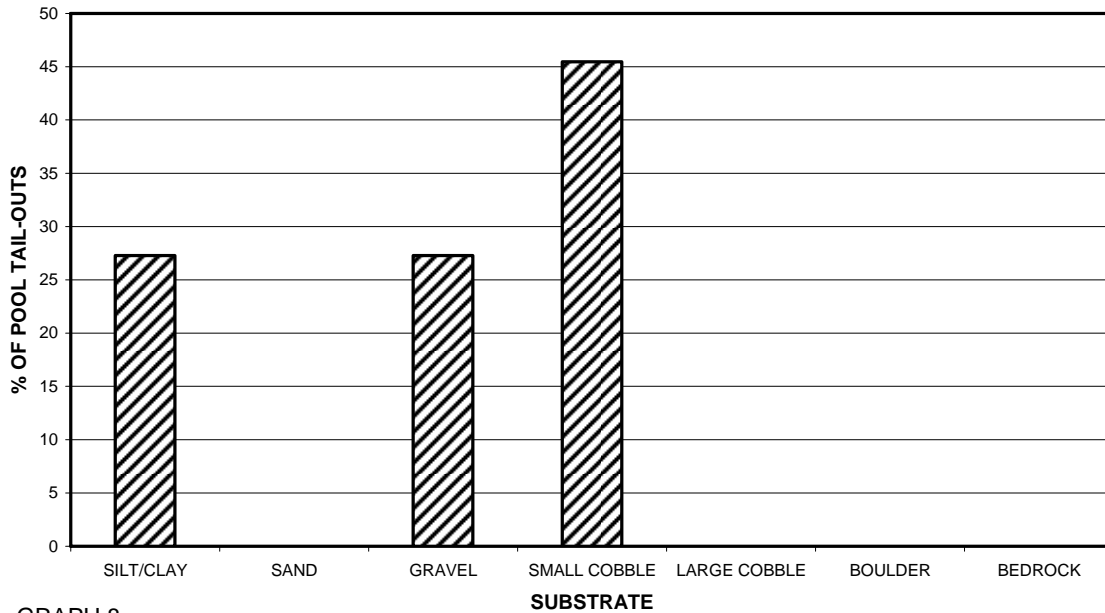
GRAPH 6

**BARRELLI CREEK  
MEAN PERCENT COVER TYPES IN POOLS**



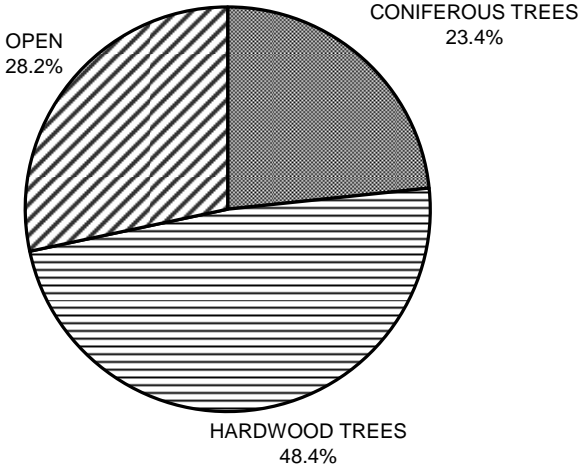
GRAPH 7

**BARRELLI CREEK  
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS**



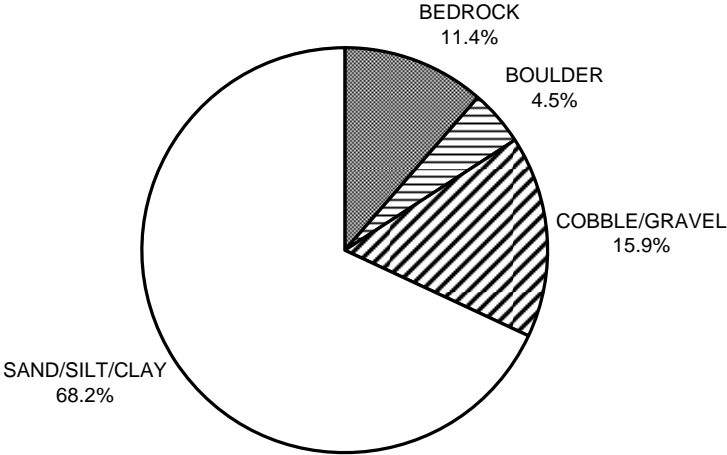
GRAPH 8

**BARRELLI CREEK  
MEAN PERCENT CANOPY**



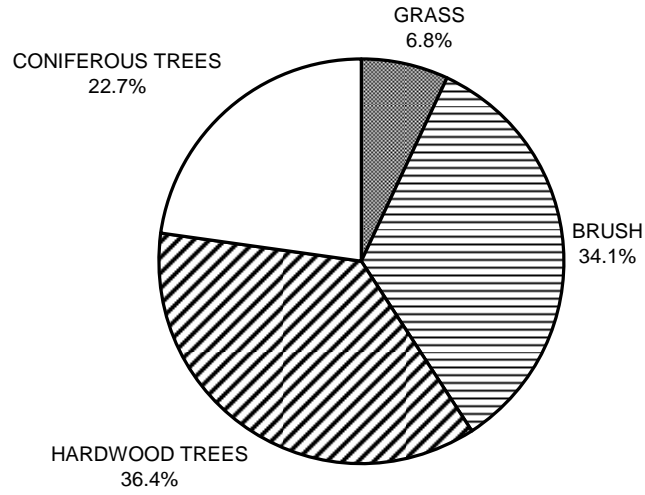
GRAPH 9

**BARRELLI CREEK  
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**BARRELLI CREEK  
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11

### Barrelli Creek Water Temperature 2002 (Reach 1)

