

Woodacre Creek

Surveyed 2006



**California Department of Fish and Game
Stream Habitat Assessment Report**

STREAM INVENTORY REPORT

Woodacre Creek

Survey Completed Summer 2006

Report Completed April 2008

INTRODUCTION

A stream inventory was conducted during 9/19/2006 to 9/20/2006 on Woodacre Creek. The survey began at the confluence with San Geronimo Creek and extended upstream 1.3 miles. Stream inventories and reports were also completed for one tributary to Woodacre Creek. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Woodacre Creek.

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

WATERSHED OVERVIEW

Woodacre Creek is a tributary to San Geronimo Creek, is a tributary to Lagunitas Creek, is a tributary to Tomales Bay located in, Marin County, California (Map 1). Woodacre Creek's legal description at the confluence with San Geronimo Creek is T02N R07W S17. Its location is 38°00'48" north latitude and 122°38'47" west longitude, LLID number 1226465380133. Woodacre Creek is a 2nd order stream and has approximately 2.81 miles of blue line stream according to the USGS National Hydrography Datasheet (NHD). Woodacre Creek drains a watershed of approximately 1.475 square miles. Elevations range from about 341 feet at the mouth of the creek to about 1,391 feet in the headwater areas. Hardwood/mixed conifer forest dominates the watershed. About half the watershed is privately owned which accounts for 59.8% of the land area. The local government owns the other half of about 40.2%. Seventy eight percent of the land is considered natural and 21.6% is urban. Vehicle access exists via Sir Francis Drake Blvd. in Marin County.

METHODS

The habitat inventory conducted in Woodacre Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Department of Fish and Game (DFG) personnel and Watershed Stewards Project/AmeriCorps (WSP) members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game. This inventory was conducted by a two-person team.

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 Woodacre Creek to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) near the bottom of the stream survey reach using a Marsh-McBirney Model 2000 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 degrees Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (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". Woodacre 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

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measured using a clinometer, hip chain, 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 Woodacre 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 Woodacre 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 densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Woodacre 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 ocularly 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 Woodacre 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

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(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 ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.18, 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 Woodacre Creek include:

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length
- Total Habitat Types by Percent Occurrence

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- 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 INVENTORY RESULTS

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

The habitat inventory of 9/19/2006 to 9/20/2006 was conducted by Mitsuko Terry (DFG), and Henning Fett (DFG). The total length of the stream surveyed was 6,747 feet with no additional feet of side channel.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.01 cfs on 9/21/06.

Woodacre Creek is a F3 channel type for 5,204 feet of the stream surveyed (Reach 1) and a A3 channel type for 1,543 feet of the stream surveyed (Reach 2).

F3 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates. A3 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and cobble dominant substrates.

Water temperatures taken during the survey period ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 48 to 75 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 30% riffle units, 13% pool units, 45% flatwater units, 6% culvert units, 1% nosurvey_marsh units, 1% nosurvey units, and 4% dry units (Graph 1). Based on total length of Level II habitat types there were 19% riffle units, 7% pool units, 50% flatwater units, 5% culvert units, 3% nosurvey_marsh units, 4% nosurvey units, and 12% dry units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 26% Low Gradient Riffle units, 9% Run units, and 29% Glide units (Graph 3). The most frequent habitat types based on percent total length were 17% Low Gradient Riffle units, 28% Glide units, and 14% Step Run units.

A total of 15 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 60%, and comprised 58% of the total length of all pools (Graph 4).

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Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Eleven of the 15 pools (73%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 15 pool tail-outs measured, 7 had a value of 1 (46.7%); 4 had a value of 2 (26.7%); 1 had a value of 3 (6.7%); 1 had a value of 4 (6.7%); and 2 had a value of 5 (13.3%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate such as bedrock, log sills, boulders, or other considerations.

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 0, flatwater habitat types had a mean shelter rating of 6, and pool habitats had a mean shelter rating of 37 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 34 and Scour pools had a mean shelter rating of 40 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover types in Woodacre Creek. Graph 7 describes the pool cover in Woodacre Creek. Bedrock Ledges are the dominant pool cover type followed by root mass.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was observed in 47% of pool tail-outs and small Cobble was observed in 40% of pool tail-outs.

The mean percent canopy density for the surveyed length of Woodacre Creek was 77%. The mean percentages of hardwood and coniferous trees were 93% and 7%, respectively. Twenty-three percent of the canopy was open. Graph 9 describes the mean percent canopy in Woodacre Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 28% and mean percent left bank vegetated was 30%. The dominant elements composing the structure of the stream banks consisted of 25% bedrock, 11% boulder, 37% cobble/gravel and 28% sand/silt/clay (Graph 10). Hardwood trees made up the dominant vegetation type and they were observed in 65% of the units surveyed. Additionally, 10% of the units surveyed had brush as the dominant vegetation type and 4% had coniferous trees as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished for species composition and distribution in Woodacre Creek on October 27, 2006. Water temperature taken during the electrofishing period was 53 degrees Fahrenheit. Air temperature was 57 degrees Fahrenheit. The sites were sampled by H. Fett (DFG) and M. Terry (DFG).

In reach two, one site was sampled starting approximately at Habitat Unit 99 and ending at Habitat Unit 112. The reach sites yielded 8 young-of-the-year (yoy) steelhead/rainbow trout (SH/RT), 10 age 1+ SH/RT and 10 age 2+ SH/RT.

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The following chart displays the information yielded from these sites:

2006 Woodacre Creek e-fish observations

Date	Site #	Reference Point	Distance From Reference Point (ft.)	Steelhead/Rainbow Trout			Coho Salmon
				0+	1+	2+	0+ and 1+
10/27/2006	637	Madrone Ave Culvert		8	10	10	0

DISCUSSION

Woodacre Creek is a F3 channel type for the first 5,204 feet of stream surveyed and an A3 channel type for the next 1,543 feet. The suitability of F3 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders and single and opposing wing-deflectors; and fair for plunge weirs, boulder clusters, channel constrictors and log cover. The suitability of A3 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, opposing wing-deflectors and log cover; and poor for boulder clusters and single wing-deflectors.

The water temperatures recorded on the survey days 9/19/2006 to 9/20/2006, ranged from 53 to 58 degrees Fahrenheit. Air temperatures ranged from 48 to 75 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 50% of the total length of this survey, riffles 19%, and pools 7%. The pools are relatively shallow, with only 11 of the 15 (73%) pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

Eleven of the 15 pool tail-outs measured had embeddedness ratings of 1 or 2. Two of the pool tail-outs had embeddedness ratings of 3 or 4. Two of the pool tail-outs had a rating of 5, which is considered unsuitable for spawning. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered to indicate good quality spawning substrate for salmon and steelhead. Sediment sources in Woodacre Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

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Thirteen of the 15 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean shelter rating for pools was 37 and for flatwater habitats it was 6. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by Boulders in Woodacre Creek. Bedrock Ledges are the dominant cover type in pools followed by root mass. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 77%. Reach 1 had a canopy density of 80.9% and Reach 2 had a canopy density of 66.9%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 28% and 30%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

GENERAL MANAGEMENT RECOMMENDATIONS

Woodacre 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 AND RECOMMENDATIONS

- 1) Rearing conditions throughout Woodacre Creek appeared inadequate at the time of survey. Pools were disconnected due to lack of flow. Low instream flow should be addressed by increasing native riparian vegetation, reducing fine sediment, and employing water conservation and best management practices that encourage permeability and infiltration.
- 2) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from Bedrock Ledges. Adding high quality complexity with woody cover in the pools is desirable.
- 3) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

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- 4) Access for migrating salmonids should be assessed, monitored and improved along the stream, particularly at all road crossings and culverts. Where needed crossings and culverts should be replaced or modified to improve fish passage.
- 5) Inventory and map sources of stream bank 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.
- 6) Increase the canopy on Woodacre Creek by planting appropriate native vegetation like willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.
- 7) Active and potential sediment sources related to the road system need to be identified, mapped, and treated according to their potential for sediment yield to the stream and its tributaries.
- 8) Woodacre Creek would benefit from utilizing bio-technical vegetative techniques for bank stabilization and to re-establish floodplain benches and a defined low flow channel. This would discourage lateral migration of the base flow channel and decrease bank erosion.
- 9) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the May through October temperature extreme period should be performed for 3 to 5 years.

COMMENTS AND LANDMARKS

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

Position	Habitat Unit	Comments:
0	0001.00	Start of Survey at the confluence with San Geronimo Creek (38.01286N 122.64718W)
97	0006.00	Structures: Culvert #1, L: 48 W: 11.5 H: 7, No down cutting was observed, the height of the culvert lip to H2O level 2.8 feet, the structure was not retaining gravel.

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Position	Habitat Unit	Comments:
145	0007.00	General Comment: Retaining wall on right bank, wood with cement bags Pedestrian bridge at 40' into unit, 9'high wood retaining wall on right bank, 100' long cement retaining wall on left bank, 55' long footbridge at 155' into unit, 9' high
362	0008.00	Structures: Footbridge at 70' into unit, 10' H Riprap on left bank up stream of bridge.
502	0011.00	Structures: Old flashboard dam 1' jump onto flashboard dam bottom 2 separate dams 7' apart pedestrian bridge at 10' into unit, 9' high wood retaining wall on left bank, 42' long concrete riprap wall on left bank, 50' long
627	0013.00	Structures: Retaining walls on both sides bridge 5' high x 2' artificial bottom, cement
671	0014.00	Structures: Retaining wall, cement
791	0016.00	Structures: Retaining wall on left bank culvert on top of wall (Cement)
887	0018.00	General Comment: Erosion on right bank
910	0019.00	Structures: Bridge #1 at 20' into unit, H: 9.5 W: 12.5 L: 10, No down cutting, Not retaining gravel
943	0020.00	Structures: Retaining wall on left bank (cement).
1085	0023.00	Structures: Park Ave. bridge
1387	0026.00	General Comment: Manmade rock/cobble dam 8" high is the pool tail out Erosion on right bank
1440	0027.00	Structures: Bridge #2 at 46' into unit, H:8 W: 34 L: 10, No down cutting, Not retaining gravel
1839	0036.00	General Comment: 250 foot section not surveyed due to lack of landowner access.
2180	0039.00	Structures: Footbridge at top of unit, 8' high
2208	0040.00	Structures: Footbridge at 36' into unit, 6' high
2508	0045.00	General Comment: Active erosion on left bank influenced by high flows, Depth: 10 Length: 15 Width: 30, Old flashboard dam, fish were observed
2936	0053.00	Structures: Old flashboard at 53' into unit
3290	0060.00	Structures: Retaining wall on right bank, top of unit
3436	0062.00	Structures: Riprap on left bank on top of unit
3489	0063.00	Structures: Retaining wall on left bank
3547	0065.00	General Comment: Tributary #1 at 72 feet into unit on right bank, temporary cobble dam
3631	0066.00	General Comment: Pump on right bank
3833	0070.00	General Comment: Shotgun culvert with minimal flow and erosion on right bank.
4009	0074.00	General Comment: Flow goes under cemented riprap on left bank.

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Position	Habitat Unit	Comments:
4117	0077.00	Tributaries: Dry tributary on left bank at top of unit
4154	0078.00	Structures: Culvert #2, double box L58 W5 H5, No down cutting Height culvert lip to H2O: 0.5, Not retaining gravel, Old metal culvert on right bank, new concrete culvert on left bank.
4212	0079.00	General Comment: Retaining wall on right bank
4234	0080.00	Structures: Footbridge / Patio 5' high
4234	0080.00	Tributaries: Dry tributary on left bank at 53' into unit (Unnamed tributary to Woodacre)
4443	0081.00	Structures: Culvert #3, L: 45 W: 5 H: 3.5, no down cutting, not retaining gravel
4488	0082.00	General Comment: Pipes across creek at 8' into unit
4488	0082.00	Structures: Culvert on left bank at 150' into unit, footbridge at 200' into unit, 5' high
4830	0083.00	Structures: Culvert #4, L: 45 W: 4.3 H: 4.3, no down cutting, not retaining gravel
4875	0084.00	Structures: Retaining wall on right bank, culvert on right bank at 45' into unit, Footbridge at 145' into unit, 5' high
5112	0085.00	Structures: Retaining wall on left bank below culvert
5142	0086.00	Structures: Culvert #5, L: 62 W: 4.2 H: 4.2, no down cutting, not retaining gravel, upstream end dimension W2.9 H2.9 with cement poured around opening and into upstream of culvert, WP98: 38.00492N 122.63934W
5204	0087.00	General Comment: Channel changes from Reach 1 to Reach 2, F3 to A3. house foundation over creek water temperature 53 degrees
5356	0090.00	General Comment: Gully on left bank.
5394	0091.00	Structures: 1.6' jump - cement dam with metal pipe outlet
5509	0095.00	General Comment: Erosion on left bank
5766	0097.00	General Comment: Active erosion on left bank , Depth:20 Length: 20 Width: 50, brand new house upslope.
6045	0098.00	General Comment: Fish observed
6238	0103.00	General Comment: Riprap on left bank
6327	0105.00	Structures: Retaining wall on left bank, Footbridge at 43' into unit, 6' high
6387	0106.00	General Comment: 1 Fish observed
6485	0109.00	General Comment: Approximately a dozen 3+ SH/RT observed, also failing culvert on right bank
6512	0110.00	Structures: Culvert #6 L: 45 W: 3.9 H: 3.9, down cutting: 0.5, height from culvert lip to H2O level: 0.5, not retaining gravel,
6557	0111.00	Tributaries: Culverted tributary on right bank

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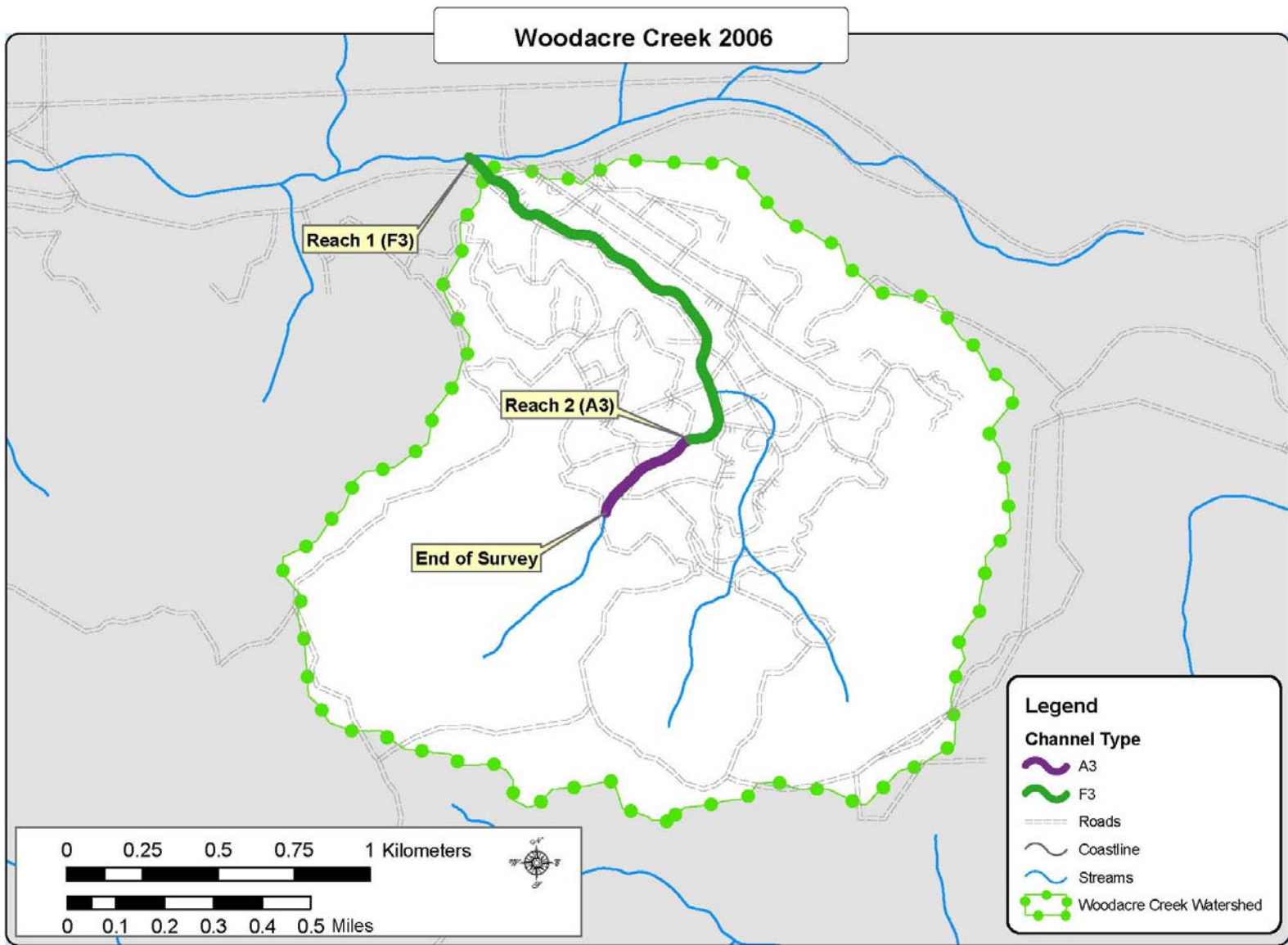
Position	Habitat Unit	Comments:
6577	0112.00	Structures: Culvert #7, box, L:62 W:4 H:4.1, no down cutting, not retaining gravel
6639	0113.00	Structures: Retaining walls on both sides
6697	0115.00	Structures: Footbridge at 15' into unit, 4' high
6747	0116.00	End of Survey: ended survey at dam, 38.00348N 122.64221W , Dam is likely a fish barrier, Hiked 500' past dam, there was limited water and an "A" channel type, no fish were observed above the dam but there were two erosion sites.

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.

McCain, M., D. Fuller, L. Decker and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHC Currents. No.1. U.S. Department of Agriculture. Forest Service, Pacific Southwest Region.

Rosgen, D.L., 1994. A Classification of Natural Rivers. *Catena*, Vol 22: 169-199, Elsevier Science, B. V. Amsterdam.



LEVEL III and LEVEL IV HABITAT TYPES

RIFFLE

Low Gradient Riffle	(LGR)	[1.1]	{ 1 }
High Gradient Riffle	(HGR)	[1.2]	{ 2 }

CASCADE

Cascade	(CAS)	[2.1]	{ 3 }
Bedrock Sheet	(BRS)	[2.2]	{24}

FLATWATER

Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}

MAIN CHANNEL POOLS

Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}

SCOUR POOLS

Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Root Wad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }

BACKWATER POOLS

Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}

ADDITIONAL UNIT DESIGNATIONS

Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

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

Stream Name: Woodacre Creek

LLID: 1226465380133

Drainage: Tomales Bay

Survey Dates: 9/19/2006 to 9/20/2006

Confluence Location: Quad: SAN GERONIMO

Legal Description: T02N R07W S17

Latitude: 38:00:48.0N

Longitude: 122:38:47.0W

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
7	2	CULVERT	6.0	52	365	5.4	5.0	0.1	0.1	120	838	1	5		0
5	0	DRY	4.3	163	814	12.1									
52	9	FLATWATER	44.8	65	3388	50.2	6.4	0.6	1.2	225	11689	144	7489		6
1	0	NOSURVEY	0.9	250	250	3.7									
1	0	NOSURVEY_MARSH	0.9	200	200	3.0									
15	15	POOL	12.9	32	474	7.0	8.7	1.4	2.8	236	3547	382	5729	345	37
35	13	RIFFLE	30.2	36	1256	18.6	3.4	0.2	0.3	52	1824	10	353		0
Total Units	Total Units Fully Measured				Total Length (ft.)						Total Area (sq.ft.)		Total Volume (cu.ft.)		
116	39				6747						17897		13576		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Woodacre Creek

LLID: 1226465380133

Drainage: Tomales Bay

Survey Dates: 9/19/2006 to 9/20/2006

Confluence Location: Quad: SAN GERONIMO

Legal Description: T02N R07W S17

Latitude: 38:00:48.0N

Longitude: 122:38:47.0W

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	Mean Canopy (%)
30	10	LGR	25.9	38	1131	16.8	4.0	0.2	0.8	65	1944	13	384		1	80
5	3	BRS	4.3	25	125	1.9	2.0	0.1	0.2	10	49	1	5		0	42
34	5	GLD	29.3	56	1889	28.0	7.0	0.6	1.6	171	5819	104	3533		6	81
11	1	RUN	9.5	49	536	7.9	4.0	0.3	1.2	71	785	21	236		0	73
7	3	SRN	6.0	138	963	14.3	7.0	0.7	1.4	365	2557	252	1762		10	88
9	9	MCP	7.8	31	276	4.1	9.0	1.6	4.3	245	2208	444	3996	401	34	84
1	1	CRP	0.9	23	23	0.3	8.0	1.2	2.8	156	156	235	235	188	40	65
1	1	LSL	0.9	43	43	0.6	10.0	0.8	2.1	430	430	387	387	344	90	65
1	1	LSR	0.9	37	37	0.5	9.0	1.0	2.2	283	283	311	311	283	60	80
1	1	LSBk	0.9	19	19	0.3	7.0	0.6	1.8	120	120	84	84	72	10	50
2	2	LSBo	1.7	38	76	1.1	7.0	1.5	4.1	175	349	358	717	341	20	80
5	0	DRY	4.3	163	814	12.1										90
7	2	CUL	6.0	52	365	5.4	5.0	0.1	0.1	120	838	1	5		0	
1	0	NS	0.9	250	250	3.7										
1	0	MAR	0.9	200	200	3.0										
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)				
116	39				6747					15540		11655				

Table 3 - Summary of Pool Types

Stream Name: Woodacre Creek

LLID: 1226465380133

Drainage: Tomales Bay

Survey Dates: 9/19/2006 to 9/20/2006

Confluence Location: Quad: SAN GERONIMO

Legal Description: T02N R07W S17

Latitude: 38:00:48.0N

Longitude: 122:38:47.0W

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
9	9	MAIN	60	31	276	58	9.1	1.6	245	2208	401	3606	34
6	6	SCOUR	40	33	198	42	8.0	1.1	223	1338	261	1568	40
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
15	15				474					3547		5175	

Table 4 - Summary of Maximum Residual Pool Depths By Pool Habitat Type

Stream Name: Woodacre Creek

LLID: 1226465380133

Drainage: Tomales Bay

Survey Dates: 9/19/2006 to 9/20/2006

Confluence Location: Quad: SAN GERONIMO

Legal Description: T02N R07W S17

Latitude: 38:00:48.0N

Longitude: 122:38:47.0W

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
9	MCP	60	0	0	2	22	3	33	3	33	1	11
1	CRP	7	0	0	0	0	1	100	0	0	0	0
1	LSL	7	0	0	0	0	1	100	0	0	0	0
2	LSBo	13	0	0	1	50	0	0	0	0	1	50
1	LSR	7	0	0	0	0	1	100	0	0	0	0
1	LSBk	7	0	0	1	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
15			0	0	4	27	6	40	3	20	2	13

Mean Maximum Residual Pool Depth (ft.): 3

Table 5 - Summary of Mean Percent Cover By Habitat

Stream Name:		Woodacre Creek		Dry Units:		5		LLID:		1226465380133		Drainage:		Tomales Bay	
Survey Dates:		9/19/2006 to 9/20/2006		Confluence Location: Quad:		SAN GERONIMO		Legal Description:		T02N R07W S17		Latitude:		38:00:48.0N	
Longitude:												Longitude:		122:38:47.0W	
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				
30	10	LGR	0	0	0	0	0	0	0	10	0				
5	3	BRS	0	0	0	0	0	0	0	0	0				
35	13	TOTAL RIFFLE	0	0	0	0	0	0	0	8	0				
34	5	GLD	0	0	0	20	0	0	0	20	0				
11	2	RUN	0	0	0	0	0	0	0	0	0				
7	3	SRN	0	0	0	0	0	0	0	67	0				
52	10	TOTAL FLAT	0	0	0	10	0	0	0	30	0				
9	9	MCP	14	0	2	32	0	0	0	14	26				
1	1	CRP	40	50	10	0	0	0	0	0	0				
1	1	LSL	50	10	40	0	0	0	0	0	0				
1	1	LSR	50	10	0	30	0	10	0	0	0				
1	1	LSBk	0	0	0	0	0	0	0	0	100				
2	2	LSBo	0	50	0	0	0	0	0	50	0				
15	15	TOTAL POOL	18	11	5	21	0	1	0	15	22				
7	1	CUL	0	0	0	0	0	0	0	0	0				
1	0	NS													
1	0	MAR													
116	39	TOTAL	7	4	2	11	0	0	0	16	8				

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Woodacre Creek

LLID: 1226465380133

Drainage: Tomales Bay

Survey Dates: 9/19/2006 to 9/20/2006

Confluence Location: Quad: SAN GERONIMO

Legal Description: T02N R07W S17

Latitude: 38:00:48.0N

Longitude: 122:38:47.0W

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
30	10	LGR	0	0	40	50	10	0	0
5	3	BRS	0	0	0	0	0	0	100
34	5	GLD	0	40	40	0	0	0	20
11	2	RUN	0	0	100	0	0	0	0
7	3	SRN	0	0	33	0	0	33	33
9	9	MCP	0	56	44	0	0	0	0
1	1	CRP	0	100	0	0	0	0	0
1	0	LSL	0	0	0	0	0	0	0
1	1	LSR	0	0	100	0	0	0	0
1	1	LSBk	0	100	0	0	0	0	0
2	2	LSBo	0	0	100	0	0	0	0
7	1	CUL	0	0	0	0	0	0	100
1	0	NS	0	0	0	0	0	0	0
1	0	MAR	0	0	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Woodacre Creek

LLID: 1226465380133

Drainage: Tomales Bay

Survey Dates: 9/19/2006 to 9/20/2006

Confluence Location: Quad: SAN GERONIMO

Legal Description: T02N R07W S17

Latitude: 38:00:48.0N

Longitude: 122:38:47.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
77	7	93	0	28	30

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 Name: Woodacre Creek
 Drainage: Tomales Bay

LLID: 1226465380133

Survey Dates: 9/19/2006 to 9/20/2006 Survey Length (ft.): 6747 Main Channel (ft.): 6747
 Side Channel (ft.): 0

Confluence Location: Quad: SAN GERONIMO Legal Description: T02N R07W S17 Latitude: 38:00:48.0N
 Longitude: 122:38:47.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F3 (%): 7.6	Canopy Density (%): 80.9	Pools by Stream Length
Reach Length (ft.): 5204 12.8	Coniferous Component (%): 4.2	Pool Frequency (%):
Riffle/Flatwater Mean Width (ft.): 5.1	Hardwood Component (%): 95.8	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 18.2
Range (ft.): 10 to 15	Vegetative Cover (%): 30.5	2 to 2.9 Feet Deep: 54.5
Mean (ft.): 11.97	Dominant Shelter: Root masses	3 to 3.9 Feet Deep: 9.1
Std. Dev.: 1.51	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 18.2
Base Flow (cfs): 0.0066	Occurrence of LWD (%): 2.6	Mean Max Residual Pool
Depth (ft.): 2.77		
Water (F): 53 - 58 Air (F): 48 - 66	LWD per 100 ft.:	Mean Pool Shelter Rating: 35
Dry Channel (ft.): 814	Riffles: 0	
	Pools: 1	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 45.5 Sm Cobble: 45.5 Lg Cobble: 0.0 Boulder: 9.1 Bedrock: 0.0		
Embeddedness Values (%): 1. 54.5 2. 27.3 3. 0.0 4. 9.1 5. 9.1		

STREAM REACH: 2

Channel Type: A3 (%): 5.2	Canopy Density (%): 66.9	Pools by Stream Length
Reach Length (ft.): 1543 13.3	Coniferous Component (%): 13.9	Pool Frequency (%):
Riffle/Flatwater Mean Width (ft.): 3.7	Hardwood Component (%): 86.1	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 50.0
Range (ft.): 5 to 15	Vegetative Cover (%): 25.6	2 to 2.9 Feet Deep: 0.0
Mean (ft.): 10	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 50.0
Std. Dev.: 2.94	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 0.0
Base Flow (cfs): 0.0066	Occurrence of LWD (%): 0.0	Mean Max Residual Pool
Depth (ft.): 2.7		
Water (F): 53 - 55 Air (F): 54 - 75	LWD per 100 ft.:	Mean Pool Shelter Rating: 43
Dry Channel (ft.): 0	Riffles: 0	
	Pools: 0	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 50.0 Sm Cobble: 25.0 Lg Cobble: 0.0 Boulder: 25.0 Bedrock: 0.0		
Embeddedness Values (%): 1. 25.0 2. 25.0 3. 25.0 4. 0.0 5. 25.0		

Table 9 -Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Woodacre Creek **LLID:** 1226465380133 **Drainage:** Tomales Bay
Survey Dates: 9/19/2006 to 9/20/2006
Confluence Location: Quad: SAN GERONIMO **Legal Description:** T02N R07W S17 **Latitude:** 38:00:48.0N **Longitude:** 122:38:47.0W

Mean Percentage of Dominant Stream Bank

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Bedrock	10	9	25.0
Boulder	3	5	10.5
Cobble/Gravel	17	11	36.8
Sand/Silt/Clay	8	13	27.6

Mean Percentage of Dominant Stream Bank

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Grass	1	1	2.6
Brush	4	4	10.5
Hardwood Trees	25	24	64.5
Coniferous Trees	2	1	3.9
No Vegetation	6	8	18.4

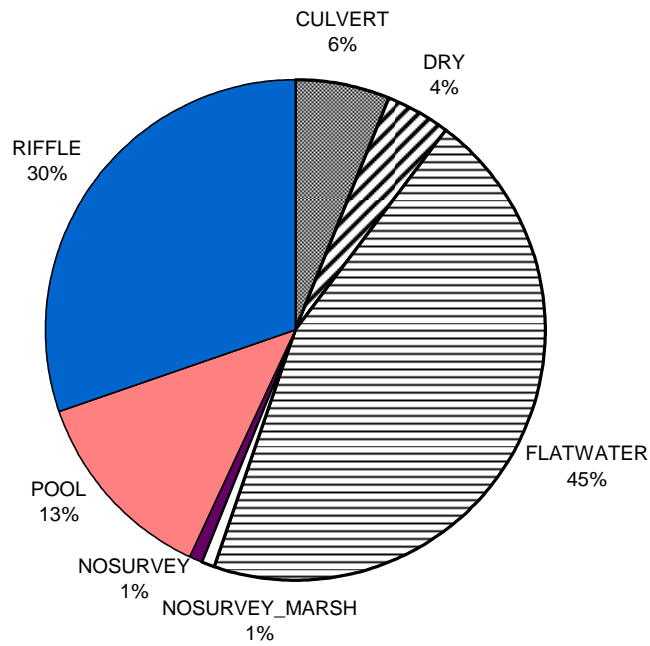
Total Stream Cobble Embeddedness 2

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

Stream Name: Woodacre Creek **LLID:** 1226465380133 **Drainage:** Tomales Bay
Survey Dates: 9/19/2006 to 9/20/2006
Confluence Location: Quad: SAN GERONIMO **Legal Description:** T02N R07W S17 **Latitude:** 38:00:48.0N **Longitude:** 122:38:47.0W

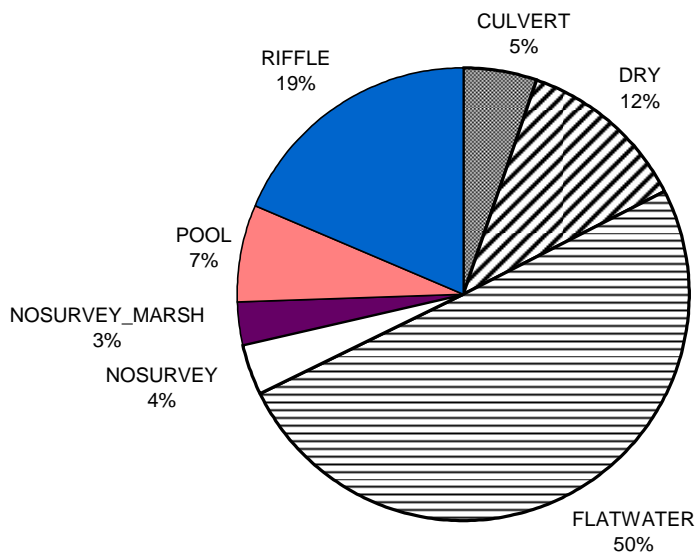
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	18
SMALL WOODY DEBRIS (%)	0	0	11
LARGE WOODY DEBRIS (%)	0	0	5
ROOT MASS (%)	0	10	21
TERRESTRIAL VEGETATION (%)	0	0	0
AQUATIC VEGETATION (%)	0	0	1
WHITEWATER (%)	0	0	0
BOULDERS (%)	8	30	15
BEDROCK LEDGES (%)	0	0	22

**WOODACRE CREEK 2006
HABITAT TYPES BY PERCENT OCCURRENCE**



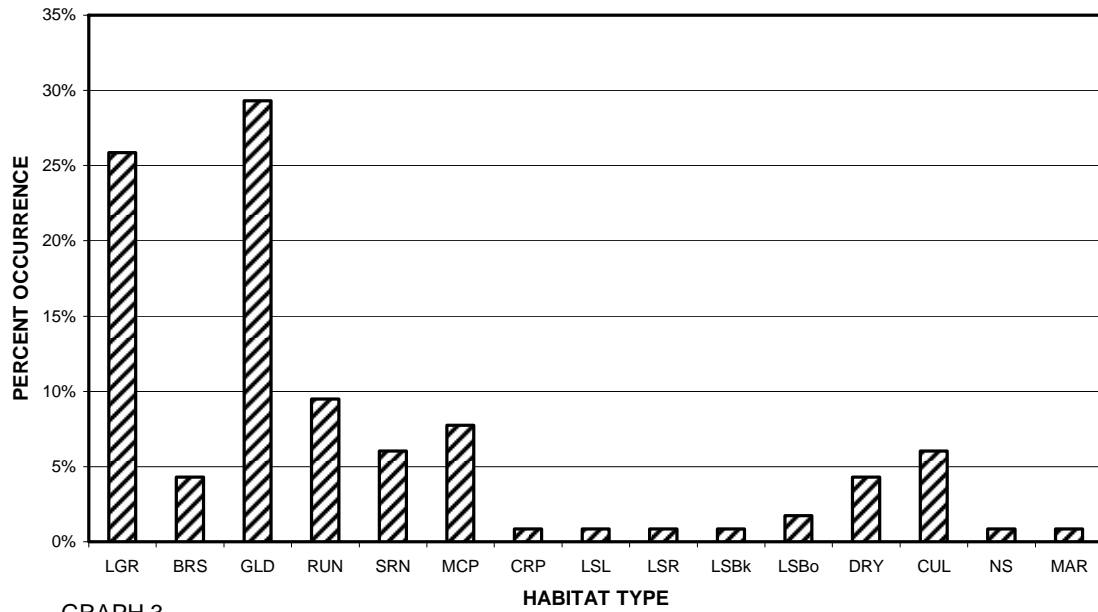
GRAPH 1

**WOODACRE CREEK 2006
HABITAT TYPES BY PERCENT TOTAL LENGTH**



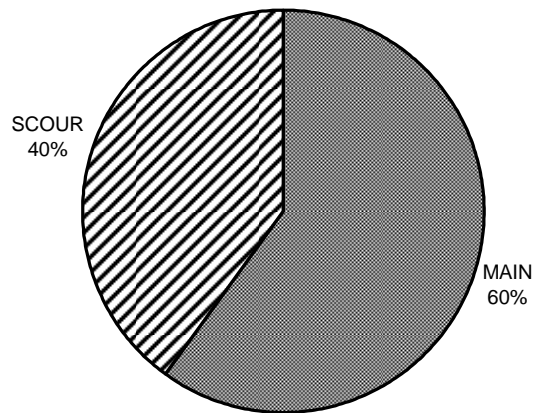
GRAPH 2

WOODACRE CREEK 2006 HABITAT TYPES BY PERCENT OCCURRENCE



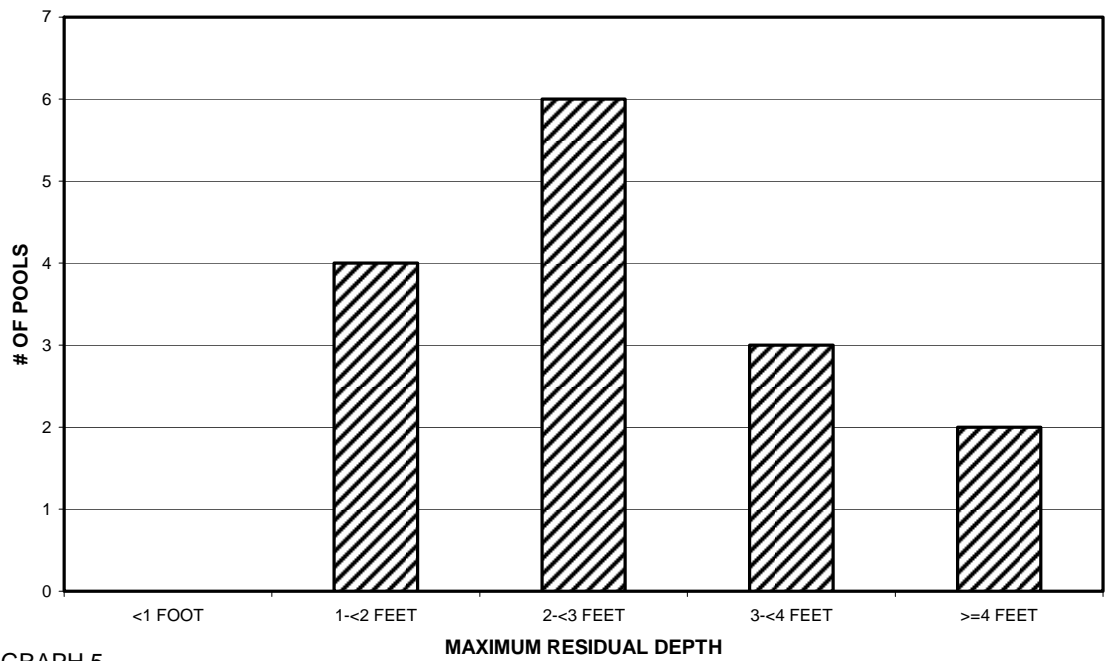
GRAPH 3

WOODACRE CREEK 2006 POOL TYPES BY PERCENT OCCURRENCE



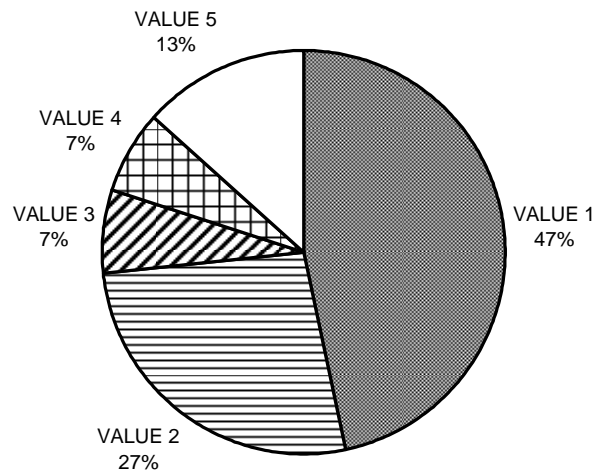
GRAPH 4

WOODACRE CREEK 2006 MAXIMUM DEPTH IN POOLS



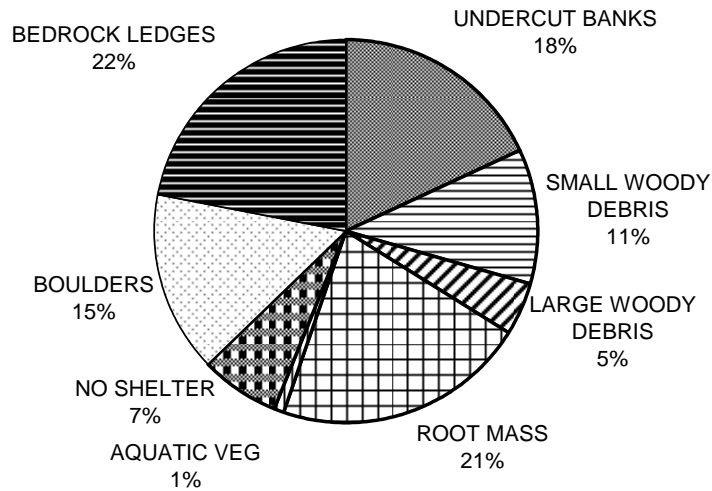
GRAPH 5

WOODACRE CREEK 2006 PERCENT EMBEDDEDNESS



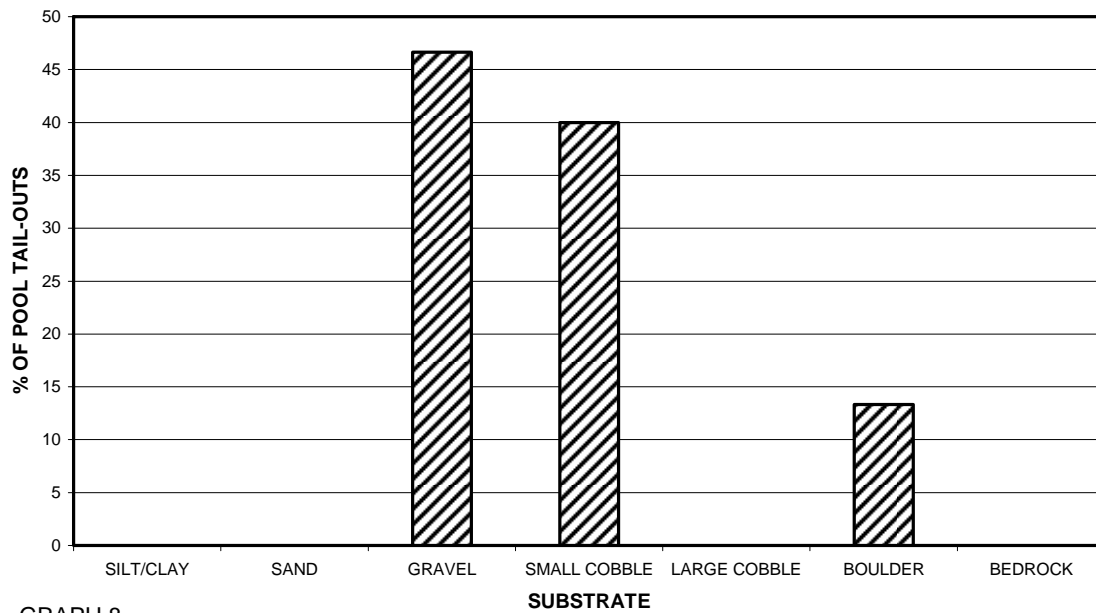
GRAPH 6

WOODACRE CREEK 2006 MEAN PERCENT COVER TYPES IN POOLS



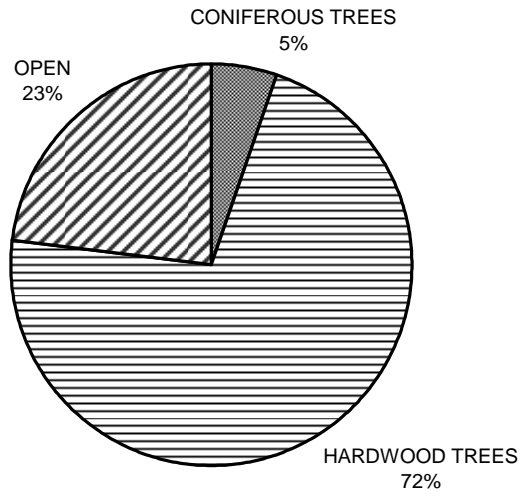
GRAPH 7

WOODACRE CREEK 2006 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



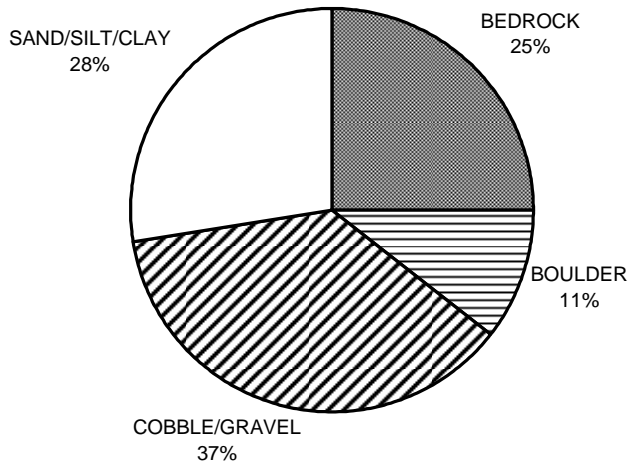
GRAPH 8

**WOODACRE CREEK 2006
MEAN PERCENT CANOPY**



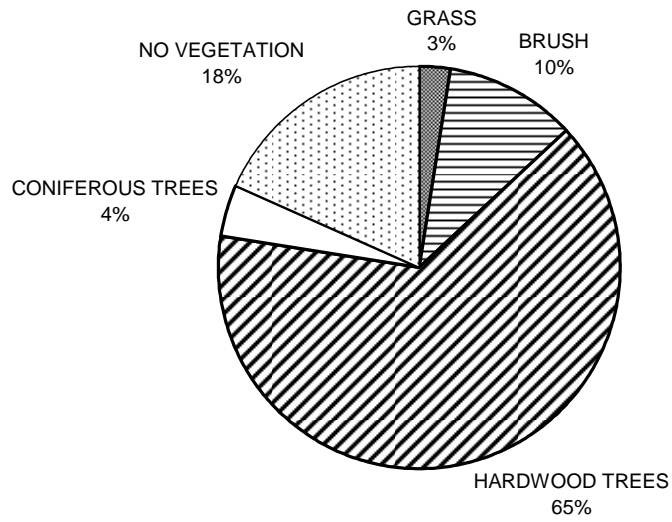
GRAPH 9

**WOODACRE CREEK 2006
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**WOODACRE CREEK 2006
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11