



California Department of Fish and Game
Petaluma River Watershed
Stream Habitat Assessment Reports

Ellis Creek

Surveyed 2007



STREAM INVENTORY REPORT

Ellis Creek

Surveyed Summer 2007

Report Completed March 2008

INTRODUCTION

A stream inventory was conducted during 9/6/2007 to 9/10/2007 on Ellis Creek. The survey began at the confluence with the Petaluma River and extended upstream 5 miles.

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

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

WATERSHED OVERVIEW

Ellis Creek is a tributary to the Petaluma River before flowing into the Pacific Ocean, located in Sonoma County, California (Map 1). Ellis Creek's legal description at the confluence with the Petaluma River is T04N R07W S2. Its location is 38°12'43" north latitude and 122°34'03" west longitude, LLID number 1225676382120. Ellis Creek is a second order stream and has approximately 20.98 miles of streams according to the National Hydrography Dataset (NHD). Ellis Creek drains a watershed of approximately 10.9 square miles. Elevations range from about sea level at the mouth of the creek to 1,083 feet in the headwater areas. Mixed hardwood forest dominates the watershed. The watershed is primarily privately owned (98.7%). The local government owns the other 1.3% of the watershed. The land use is considered agriculture at 58.3%, Natural with 41.0% and urban at 0.7%. Vehicle access exists via Adobe Road in the town of Petaluma, CA.

METHODS

The habitat inventory conducted in Ellis 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. All pools except step-pools are fully sampled.

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 Ellis 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". Ellis Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a 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 Ellis 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 Ellis 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 Ellis 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 Ellis Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

10. Large Woody Debris Count:

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

11. Average Bankfull Width:

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

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Electrofishing was not conducted on Ellis Creek however fish presence was observed from the stream banks.

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

Ellis Creek 2007

- 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 Ellis Creek include:

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

HABITAT INVENTORY RESULTS

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

The habitat inventory of 9/6/2007 to 9/10/2007 was conducted by H. Fett (CDFG) and J. Hanson (WSP). The total length of the stream surveyed was 26,365 feet.

Stream flow was not measured on Ellis Creek.

Ellis Creek is a F5 channel type for 3,729 feet of the stream surveyed (Reach 1), a NA channel type for 6,512 feet of the stream surveyed (Reach 2), a G5 channel type for 5,306 feet of the stream surveyed (Reach 3), and a NA channel type for 7,681 feet (Reach 4) and a B3 for the remaining 3,137 feet (Reach 5).

F5 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and sand-dominant substrates. NA channels are characterized as reaches where landowner access was not obtained. G5 channels are entrenched “gully” step-pool

channels on moderate gradients with low width /depth ratios and sand dominant substrates. B3 Channels are moderately entrenched on moderate gradients and have riffle dominated channels with infrequently spaced pools; as well as having very stable plans and profiles along with stable banks and cobble channels.

Water temperatures were not taken during the survey period. Air temperatures ranged from 64 to 75 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 27% nosurvey units, 36% dry units, 9% flatwater units, 18% pool units and 9% culvert units (Graph 1). Based on total length of Level II habitat types there were 60% nosurvey units, 39% dry units, 0.2% flatwater units, 0.2% pool units and 0.2% culvert units (Graph 2).

Four Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 27% Not Surveyed units, 36% Dry units and 9% Glide units (Graph 3). The most frequent habitat types based on percent total length were 60% Not Surveyed units, 39% Dry units and 0.2% glides.

A total of 2 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 50%, and comprised 71% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. One of the 2 pools (50%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 2 pool tail-outs measured, 2 had a value of 5 (100%) (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. Flatwater habitat types had a mean shelter rating of 0 and pool habitats had a mean shelter rating of 8 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 5 and Scour pools had a mean shelter rating of 10 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small Woody Debris is the dominant cover types in Ellis Creek. Graph 7 describes the pool cover in Ellis Creek. Small Woody Debris is the dominant pool cover type followed by boulders.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs and sand was the only substrate observed in 100% of pool tail-outs.

The mean percent canopy density for the surveyed length of Ellis Creek was 70.5%. The mean percentages of hardwood and coniferous trees were 100% and 0%, respectively. Thirty percent of the canopy was open. Graph 9 describes the mean percent canopy in Ellis Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 38%. The mean percent left bank vegetated was 47%. The dominant elements composing the structure of the stream banks consisted of 100% sand/silt/clay (Graph 10).

BIOLOGICAL INVENTORY RESULTS

No Biological inventory was conducted on Ellis Creek.

DISCUSSION

Ellis Creek is a F5 channel type channel type for the first 3,729 feet of the stream surveyed (Reach 1) and a NA channel type for the next 6,512 feet (Reach 2), a G5 channel type for 5,306 feet of the stream surveyed (Reach 3), a NA channel type for 7,681 feet (Reach 4) and a B3 for the remaining 3,137 feet (Reach 5).

The suitability of F5 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover; and poor for boulder clusters. NA channels are characterized as reaches where land owner access was not obtained at the time of the survey and were therefore avoided by DFG and WSP field crew. The suitability of G5 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; poor for boulder clusters and single wing-deflectors. B3 suitability is excellent for plunge weirs, boulder clusters and bank placed boulders; as well as single and opposing wing deflectors, and log cover.

Air temperatures ranged from 64 to 75 degrees Fahrenheit on the survey days 9/6/2007 to 9/10/2007. The water temperatures were not recorded. 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 0.2% of the total length of this survey, riffles 0%, and pools 0.2%. The pools are relatively shallow, with 1 of the 2 (50%) 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.

None of the 2 pool tail-outs measured had embeddedness ratings of 1 or 2. None 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 Ellis Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Two of the 2 pool tail-outs had silt, sand, large cobble, boulders or bedrock as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean shelter rating for pools was 8. The shelter rating in the flatwater habitats was 0. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by Small Woody Debris in Ellis Creek. Small Woody Debris is the dominant cover type in pools followed by boulders. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 70.5%. Reach 1 had a canopy density of 94%, Reach 3 had a canopy density of 94%, Reach 5 had a canopy density of 0. 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 38% and 47%, 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 RECOMMENDATIONS

Ellis 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.

RECOMMENDATIONS

- 1) 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. Potential

barriers noted in the assessment were located at the following locations: Adobe Road., Ely Road and a private crossing in reach 3.

- 2) Water quantity is an on-going issue in many of the Petaluma River tributaries. Water conservation measures should be explored with the landowners and developed where possible.
- 3) There are sections where the stream is being impacted from cattle trampling the riparian zone. Alternatives should be explored with the grazer and developed if possible.
- 4) 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.
- 5) Increase the canopy on Ellis 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.
- 6) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from Small Woody Debris. Adding high quality complexity with woody cover in the pools is desirable.
- 7) 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.
- 8) The limited water temperature data available suggest that maximum temperatures are above 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.
- 9) 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.

COMMENTS AND LANDMARKS

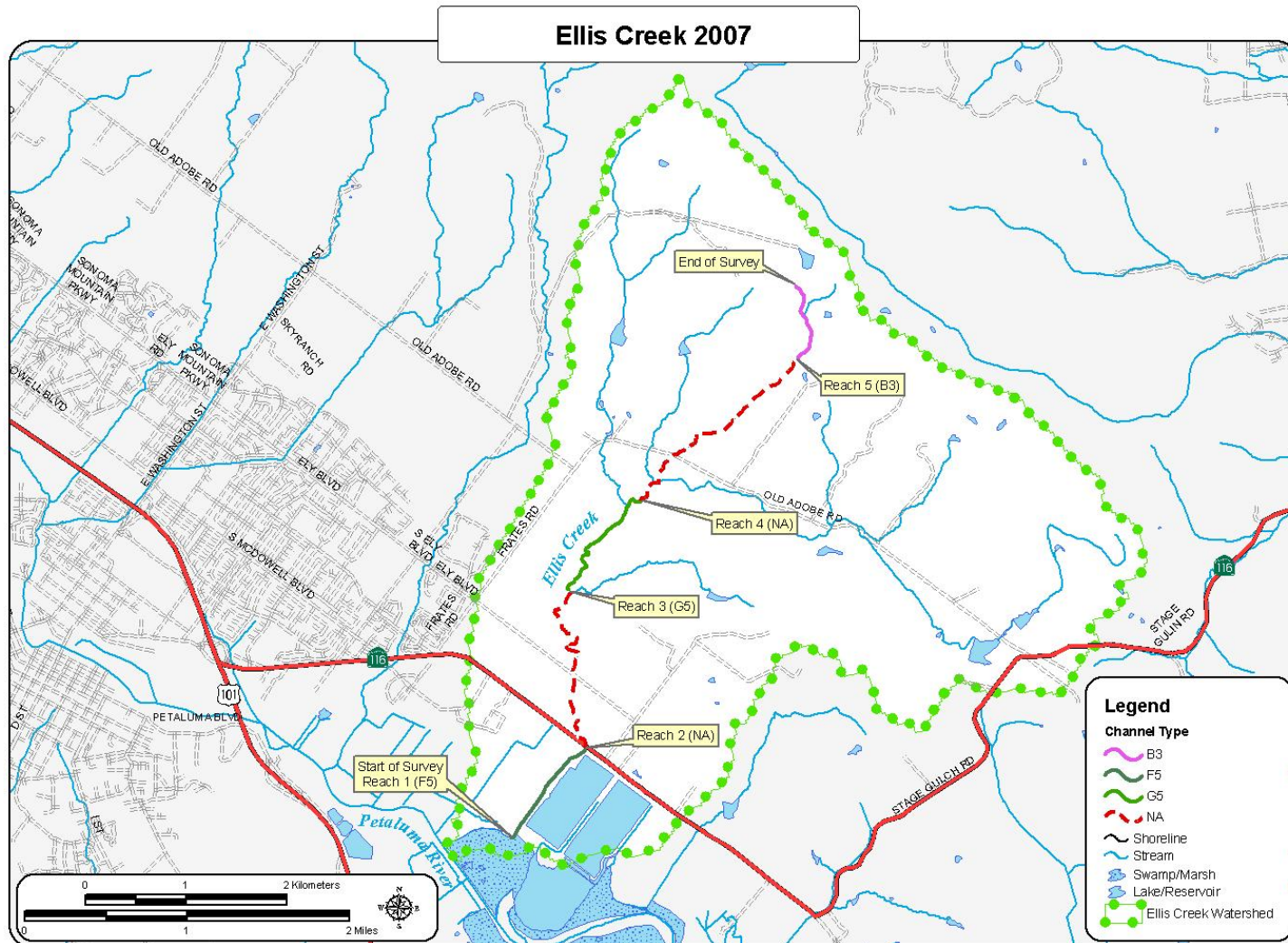
The following landmarks and possible problem sites were noted. All distances are approximate and taken from the beginning of the survey reach.

Ellis Creek 2007

Position	Habitat Unit #	Comments
0	0001.00	Start of Survey: Start of survey was at the confluence of a tidal Marsh - slough of the Petaluma River.
1720	0002.00	General Comment: The riparian corridor is absent of vegetation until 450' into the unit.
3578	0005.00	Bio Sample: (Other) A Red fox was observed resting in riparian shrubs.
3681	0006.00	Access Points / Location: (Bridge) Bridge #1, Lakeville Highway bridge. H8', W52', L48'. No down-cutting or retained gravel. The bridge is in good condition.
3729	0007.00	General Comment: Channel Type Change, F5=>NA; R1=>R2.
10241	0008.00	General Comment: Begin Access at WP032: 38.24056, 122.57868. Na => G5, Reach 2 to 3. Tributaries: 4450' into unit, Tributary #1 (Richardson Creek) on right bank. The tributary was not flowing but would be accessible to fish if flowing. Access Points / Location: (Culvert) 2630' into unit, fill crossing over creek with smashed culvert. No passage allowed through the culvert. The crossing was 12' long, 25' wide, and 2.5' high and compacted from field traffic.
15535	0009.00	Bio Sample: (Bank Observation) Many large California Roach observed; no salmonids observed.
15547	0010.00	General Comment: Channel Type Change: G5=>NA, R3=>R4.
23228	0011.00	General Comment: HU011 begins access and a channel type change: NA=>B3; R4=>R5.
23228	0011.00	Tributaries: Tributary #2 on the left bank located 2238' into HU011. The tributary was dry and accessible to fish when flowing.
26365	0011.00	End of Survey: End of survey due to end of landowner access. WP038: 38.26853,1 22.55351, taken at end of Ellis Creek survey.

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: Ellis Creek

LLID: 1225676382120

Drainage: Petaluma River

Survey Dates: 9/6/2007 to 9/10/2007

Confluence Location: Quad: PETALUMA RIVER

Legal Description: T04NR07WS02

Latitude: 38:12:43.0N

Longitude: 122:34:03.0W

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	9.1	48	48	0.2									
4	0	DRY	36.4	2577	10307	39.1									
1	1	FLATWATER	9.1	55	55	0.2	14.0	0.8	1.3	770	770	616	616		0
3	0	NOSURVEY	27.3	5304	15913	60.4									
2	2	POOL	18.2	21	42	0.2	9.0	1.0	1.9	189	378	232	464	165	8
Total Units	Total Units Fully Measured				Total Length (ft.)						Total Area (sq.ft.)		Total Volume (cu.ft.)		
11	3				26365						1148		1080		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Ellis Creek

LLID: 1225676382120

Drainage: Petaluma River

Survey Dates: 9/6/2007 to 9/10/2007

Confluence Location: Quad: PETALUMA RIVER

Legal Description: T04NR07WS02

Latitude: 38:12:43.0N

Longitude: 122:34:03.0W

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 (%)
1	1	GLD	9.1	55	55	0.2	14.0	0.8	1.3	770	770	616	616		0	94
1	1	MCP	9.1	30	30	0.1	9.0	0.7	1.6	270	270	324	324	189	5	94
1	1	PLP	9.1	12	12	0.0	9.0	1.3	2.1	108	108	140	140	140	10	94
4	0	DRY	36.4	2577	10307	39.1										0
1	0	CUL	9.1	48	48	0.2										
3	0	NS	27.3	5304	15913	60.4										
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)				
11	3				26365					1148		1080				

Table 3 - Summary of Pools Types

Stream Name: Ellis Creek

LLID: 1225676382120

Drainage: Petaluma River

Survey Dates: 9/6/2007 to 9/10/2007

Confluence Location: Quad: PETALUMA RIVER

Legal Description: T04NR07WS02

Latitude: 38:12:43.0N

Longitude: 122:34:03.0W

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
1	1	MAIN	50	30	30	71	9.0	0.7	270	270	189	189	5
1	1	SCOUR	50	12	12	29	9.0	1.3	108	108	140	140	10
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
2	2				42					378		329	

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

Stream Name: Ellis Creek **LLID:** 1225676382120 **Drainage:** Petaluma River

Survey Dates: 9/6/2007 to 9/10/2007

Confluence Location: Quad: PETALUMA RIVER **Legal Description:** T04NR07WS02 **Latitude:** 38:12:43.0N **Longitude:** 122:34:03.0W

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
1	MCP	50	0	0	1	100	0	0	0	0	0	0
1	PLP	50	0	0	0	0	1	100	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
2			0	0	1	50	1	50	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.9

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Ellis Creek **LLID:** 1225676382120 **Drainage:** Petaluma River
Survey Dates: 9/6/2007 to 9/10/2007 **Dry Units:** 4
Confluence Location: Quad: PETALUMA RIVER **Legal Description:** T04NR07WS02 **Latitude:** 38:12:43.0N **Longitude:** 122:34:03.0W

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
0	0	TOTAL RIFFLE									
1	1	GLD	0	0	0	0	0	0	0	0	0
1	1	TOTAL FLAT	0	0	0	0	0	0			
1	1	MCP	0	0	0	0	30	0	0	70	0
1	1	PLP	0	100	0	0	0	0	0	0	0
2	2	TOTAL POOL	0	50	0	0	15	0	0	35	0
1	0	CUL									
3	0	NS									
11	3	TOTAL	0	33	0	0	10	0	0	23	0

Table 6 - Summary of Dominant Substrates by Habitat Type

Stream Name: Ellis Creek		LLID: 1225676382120		Drainage: Petaluma River					
Survey Dates: 9/6/2007 to 9/10/2007		Dry Units: 4							
Confluence Location: Quad: PETALUMA RIVER		Legal Description: T04NR07WS02		Latitude: 38:12:43.0N		Longitude: 122:34:03.0W			
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
1	1	GLD	0	100	0	0	0	0	0
1	1	MCP	0	100	0	0	0	0	0
1	1	PLP	0	100	0	0	0	0	0
1	0	CUL	0	0	0	0	0	0	0
3	0	NS	0	0	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Ellis Creek **LLID:** 1225676382120 **Drainage:** Petaluma River
Survey Dates: 9/6/2007 to 9/10/2007
Confluence Location: Quad: PETALUMA RIVER **Legal Description:** T04NR07WS02 **Latitude:** 38:12:43.0N **Longitude:** 122:34:03.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
71	0	100	25	38	47

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: Ellis Creek LLID: 1225907382178 Drainage: Petaluma River
 Survey Dates: 9/6/2007 to 9/10/2007 Survey Length (ft.): 26365 Main Channel (ft.): 26365 Side Channel (ft.): 0
 Confluence Location: Quad PETALUMA Legal T04NR07WS02 Latitude 38:13:04.1N Longitude 122:35:26.6W

Summary of Fish Habitat Elements By Stream

STREAM REACH: 1

Channel Type: F5	Canopy Density (%): 94.0	Pools by Stream Length (%): 0.8
Reach Length (ft.): 3729	Coniferous Component (%): 0.0	Pool Frequency (%): 16.7
Riffle/Flatwater Mean Width (ft.): 14.0	Hardwood Component (%): 100.0	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 100.0
Range (ft.): 20 to 20	Vegetative Cover (%): 30.0	2 to 2.9 Feet Deep: 0.0
Mean (ft.): 20	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 0.0
Std. Dev.: 0	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0.0
Base Flow (cfs):	Occurrence of LWD (%): 0.0	Mean Max Residual Pool Depth (ft.): 1.6
Water (F): - Air (F): 75 - 75	LWD per 100 ft.:	Mean Pool Shelter Rating: 5
Dry Channel (ft.): 1876	Riffles:	
	Pools: 0	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 100. Gravel: 0.0 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 0.0		
Embeddedness Values (%): 1. 0.0 2. 0.0 3. 0.0 4. 0.0 5. 100.0		

STREAM REACH: 2

Channel Type: NA	Canopy Density (%):	Pools by Stream Length (%):
Reach Length (ft.): 6512	Coniferous Component (%):	Pool Frequency (%):
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%):	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation:	< 2 Feet Deep:
Range (ft.): to	Vegetative Cover (%):	2 to 2.9 Feet Deep:
Mean (ft.):	Dominant Shelter:	3 to 3.9 Feet Deep:
Std. Dev.:	Dominant Bank Substrate Type:	>= 4 Feet Deep:
Base Flow (cfs):	Occurrence of LWD (%):	Mean Max Residual Pool Depth (ft.):
Water (F): - Air (F): -	LWD per 100 ft.:	Mean Pool Shelter Rating:
Dry Channel (ft.):	Riffles:	
	Pools:	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:		
Embeddedness Values (%): 1. 2. 3. 4. 5.		

Summary of Fish Habitat Elements By Stream

STREAM REACH: 3

Channel Type: G5	Canopy Density (%): 94.0	Pools by Stream Length (%): 0.2
Reach Length (ft.): 5306	Coniferous Component (%): 0.0	Pool Frequency (%): 50.0
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%): 100.0	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 0.0
Range (ft.): 20 to 20	Vegetative Cover (%): 67.5	2 to 2.9 Feet Deep: 100.0
Mean (ft.): 20	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 0.0
Std. Dev.: 0	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0.0
Base Flow (cfs):	Occurrence of LWD (%): 0.0	Mean Max Residual Pool Depth (ft.): 2.1
Water (F): - Air (F): 75 - 75	LWD per 100 ft.:	Mean Pool Shelter Rating: 10
Dry Channel (ft.): 5294	Riffles:	
	Pools: 0	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 100. Gravel: 0.0 Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 0.0		
Embeddedness Values (%): 1. 0.0 2. 0.0 3. 0.0 4. 0.0 5. 100.0		

STREAM REACH: 4

Channel Type: NA	Canopy Density (%):	Pools by Stream Length (%):
Reach Length (ft.): 7681	Coniferous Component (%):	Pool Frequency (%):
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%):	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation:	< 2 Feet Deep:
Range (ft.): to	Vegetative Cover (%):	2 to 2.9 Feet Deep:
Mean (ft.):	Dominant Shelter:	3 to 3.9 Feet Deep:
Std. Dev.:	Dominant Bank Substrate Type:	>= 4 Feet Deep:
Base Flow (cfs):	Occurrence of LWD (%):	Mean Max Residual Pool Depth (ft.):
Water (F): - Air (F): -	LWD per 100 ft.:	Mean Pool Shelter Rating:
Dry Channel (ft.):	Riffles:	
	Pools:	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:		
Embeddedness Values (%): 1. 2. 3. 4. 5.		

Summary of Fish Habitat Elements By Stream

STREAM REACH: 5

Channel Type: B3	Canopy Density (%): 0	Pools by Stream Length (%):
Reach Length (ft.): 3137	Coniferous Component (%):	Pool Frequency (%):
Riffle/Flatwater Mean Width (ft.):	Hardwood Component (%):	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation:	< 2 Feet Deep:
Range (ft.): 15 to 15	Vegetative Cover (%):	2 to 2.9 Feet Deep:
Mean (ft.): 15	Dominant Shelter:	3 to 3.9 Feet Deep:
Std. Dev.: 0	Dominant Bank Substrate Type:	>= 4 Feet Deep:
Base Flow (cfs):	Occurrence of LWD (%):	Mean Max Residual Pool Depth (ft.):
Water (F): - Air (F): 64 - 64	LWD per 100 ft.:	Mean Pool Shelter Rating:
Dry Channel (ft.): 3137	Riffles:	
	Pools:	
	Flat:	
Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:		
Embeddedness Values (%): 1. 2. 3. 4. 5.		

Table 9 -Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Ellis Creek **LLID:** 1225676382120 **Drainage:** Petaluma River
Survey Dates: 9/6/2007 to 9/10/2007
Confluence Location: Quad: PETALUMA RIVER **Legal Description:** T04NR07WS02 **Latitude:** 38:12:43.0N **Longitude:** 122:34:03.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Bedrock	0	0	0.0
Boulder	0	0	0.0
Cobble/Gravel	0	0	0.0
Sand/Silt/Clay	3	3	100.0

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Grass	0	0	0.0
Brush	0	0	0.0
Hardwood Trees	3	3	100.0
Coniferous Trees	0	0	0.0
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 5

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

Stream Name: Ellis Creek

LLID: 1225676382120

Drainage: Petaluma River

Survey Dates: 9/6/2007 to 9/10/2007

Confluence Location: Quad: PETALUMA RIVER

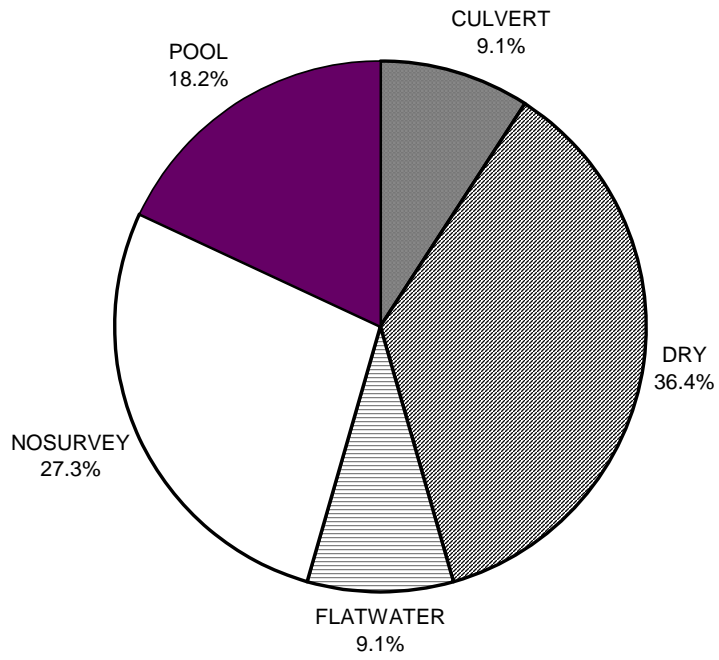
Legal Description: T04NR07WS02

Latitude: 38:12:43.0N

Longitude: 122:34:03.0W

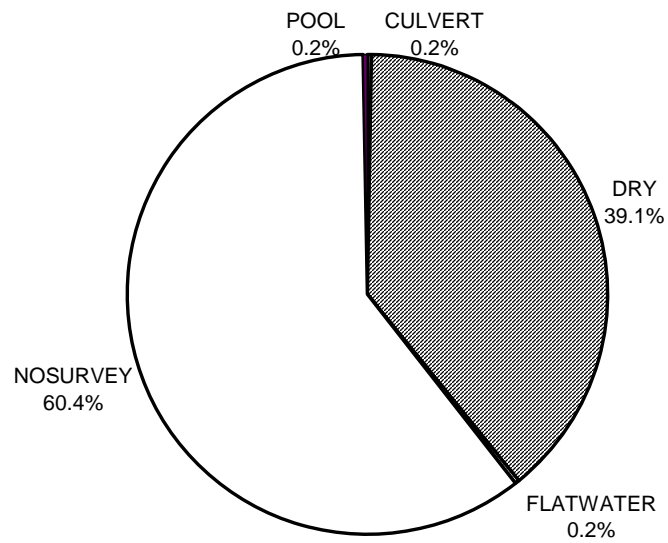
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)		0	0
SMALL WOODY DEBRIS (%)		0	50
LARGE WOODY DEBRIS (%)		0	0
ROOT MASS (%)		0	0
TERRESTRIAL VEGETATION (%)		0	15
AQUATIC VEGETATION (%)		0	0
WHITewater (%)		0	0
BOULDERS (%)		0	35
BEDROCK LEDGES (%)		0	0

**Ellis Creek 2007
HABITAT TYPES BY PERCENT OCCURRENCE**



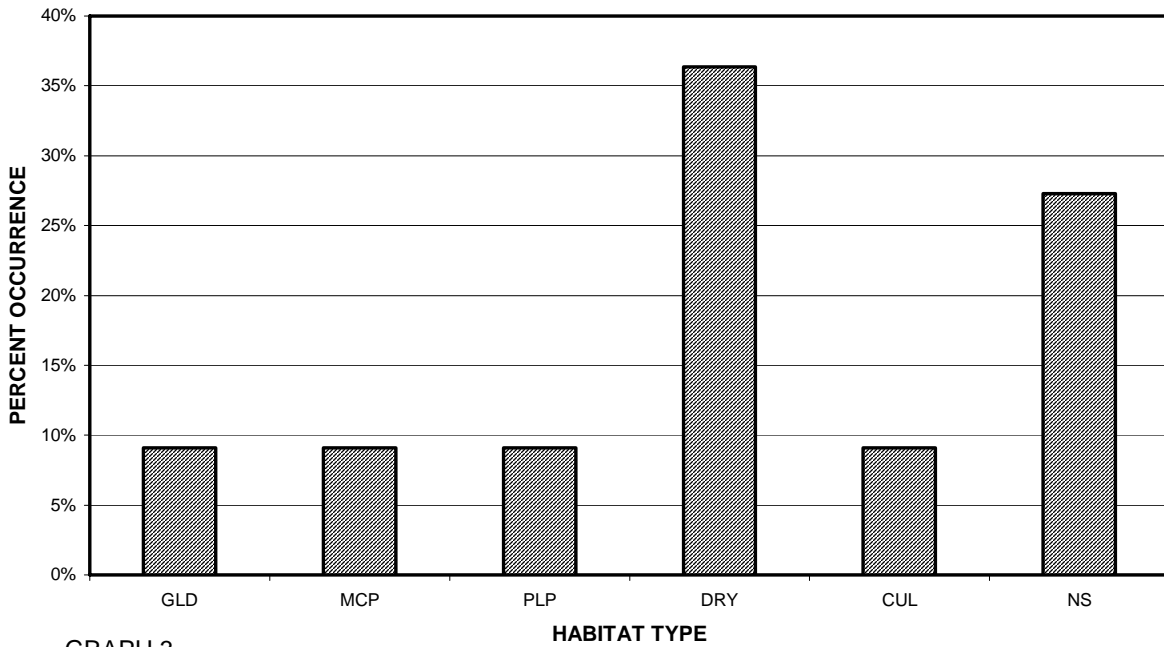
GRAPH 1

**Ellis Creek 2007
HABITAT TYPES BY PERCENT TOTAL LENGTH**



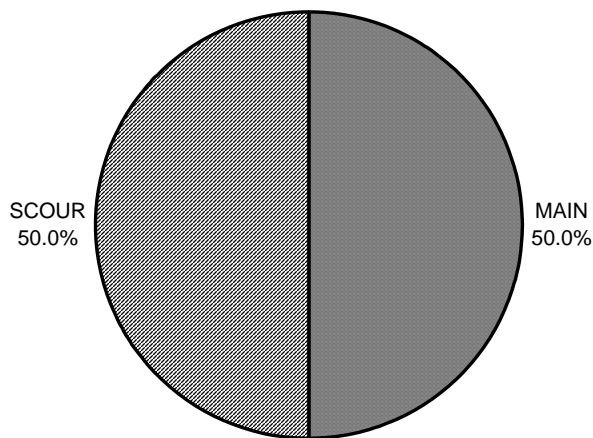
GRAPH 2

**Ellis Creek 2007
HABITAT TYPES BY PERCENT OCCURRENCE**



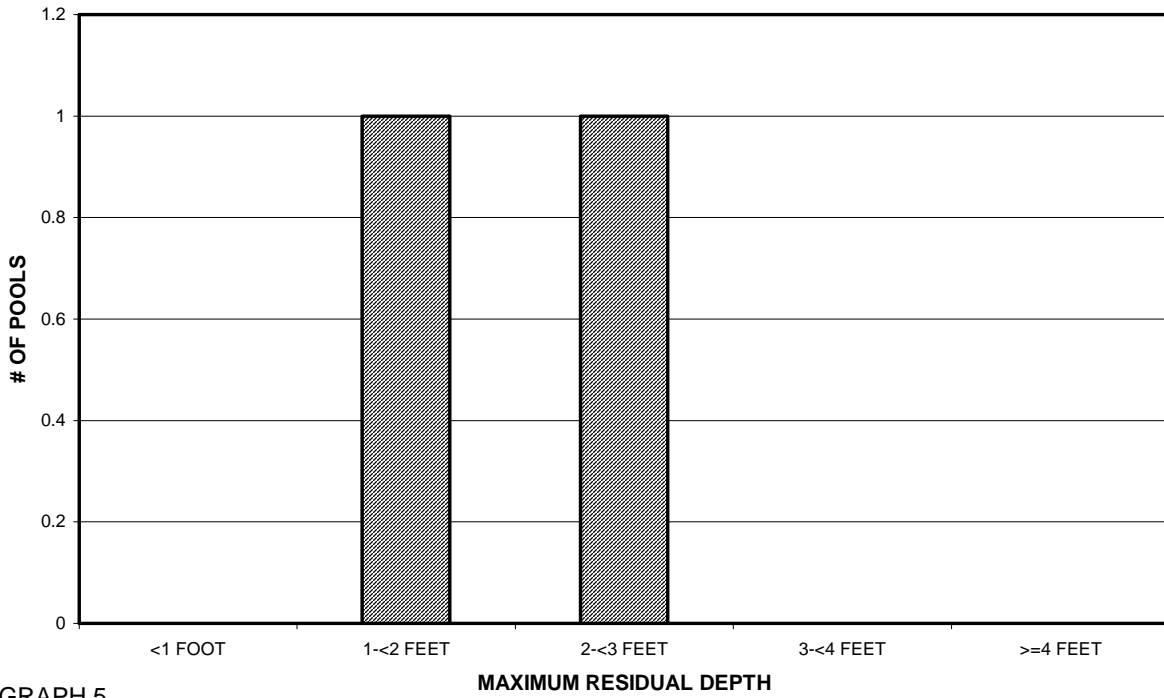
GRAPH 3

**Ellis Creek 2007
POOL TYPES BY PERCENT OCCURRENCE**



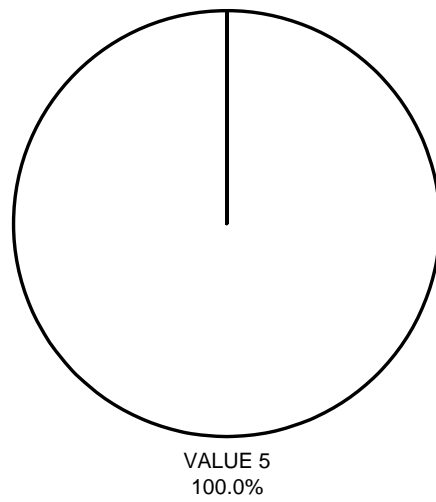
GRAPH 4

Ellis Creek 2007 MAXIMUM DEPTH IN POOLS



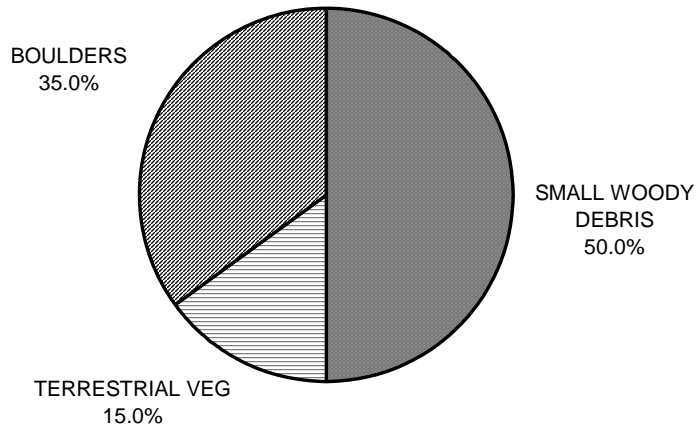
GRAPH 5

Ellis Creek 2007 PERCENT EMBEDDEDNESS



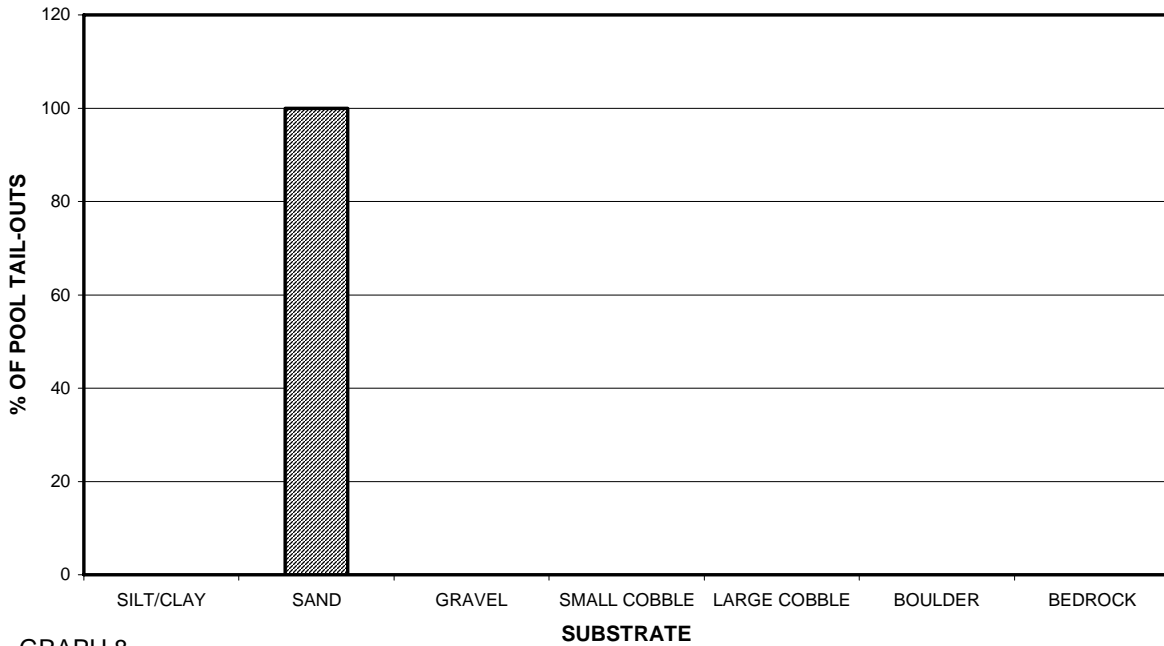
GRAPH 6

**Ellis Creek 2007
MEAN PERCENT COVER TYPES IN POOLS**



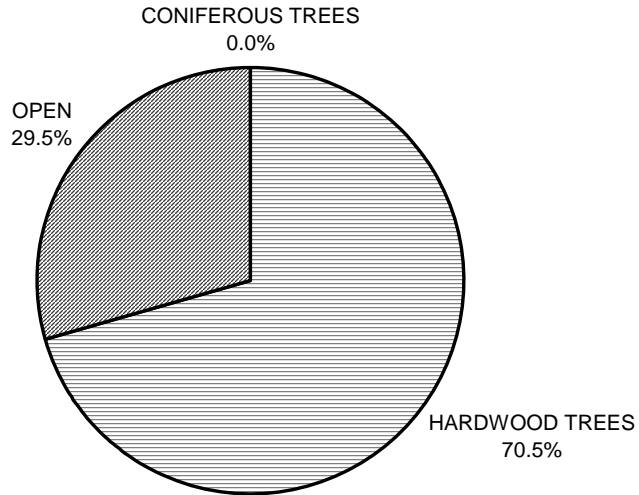
GRAPH 7

**Ellis Creek 2007
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS**



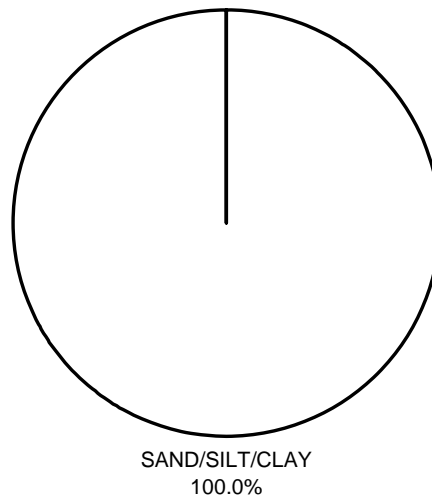
GRAPH 8

**Ellis Creek 2007
MEAN PERCENT CANOPY**



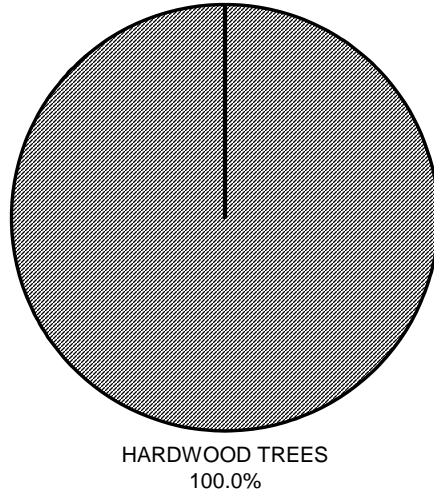
GRAPH 9

**Ellis Creek 2007
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**Ellis Creek 2007
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11