



**California Department of Fish and Wildlife  
Marin County  
Marin Coastal Watershed  
Stream Habitat Assessment Report**

# **Fitz Henry Creek**

*Surveyed 2010*

*Report Completed in 2013*

## **Fitz Henry Creek**

### **STREAM INVENTORY REPORT**

#### **Fitz Henry Creek**

#### INTRODUCTION

A stream inventory was conducted on 7/15/2010 on Fitz Henry Creek. The survey began at the confluence with Easkoot Creek and extended upstream 0.3 miles.

The Fitz Henry 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 Fitz Henry 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, 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

Fitz Henry Creek is a tributary to Easkoot Creek, tributary to Bolinas Bay, tributary to Pacific Ocean, located in Marin County, California (Map 1). Fitz Henry Creek's legal description at the confluence with Easkoot Creek is T01N R07W S28. Its location is 37°53'55" north latitude and 122°38'15" west longitude, LLID number 1226372378986. Fitz Henry Creek is a first order stream and has approximately 1.19 miles of blue line stream according to the USGS National Hydrology Dataset (NHD). Fitz Henry Creek drains a watershed of approximately 0.77 square miles. Elevations range from about 59 feet at the mouth of the creek to 2077 feet in the headwater areas mixed forest, shrubland, deciduous forest and low intensity residential. The watershed is primarily state park which accounts for 91.7% of the watershed and is managed for recreation. 94.9% of the watershed is natural and 5.1% is urban. Vehicle access exists via Highway 1 and Belvedere Avenue near Stinson Beach.

#### METHODS

The habitat inventory conducted in Fitz Henry Creek follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Conservation Corps (CCC) Technical Advisors 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 Wildlife (CDFW). 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

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survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are fully measured. All other habitat unit types encountered for the first time in each reach 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 Fitz Henry 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". Fitz Henry 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.

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### 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 Fitz Henry 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 Fitz Henry 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 Fitz Henry 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 Fitz Henry 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.

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### 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. Fish presence was observed from the stream banks in Fitz Henry Creek. In addition, two sites were electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

## 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 Wildlife. 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 Fitz

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Henry 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 7/15/2010 was conducted by Bell, C. and Griffin, A. (WSP). The total length of the stream surveyed was 1,588 feet.

Stream flow was not measured on Fitz Henry Creek.

Fitz Henry Creek is a B4 channel type for 1,588 feet of the stream surveyed (Reach 1).

B4 channels are moderately entrenched riffle dominated channels with infrequently spaced pools; very stable plan and profile; and stable banks on moderate gradients with gravel dominant substrates.

Water temperatures taken during the survey period ranged from 59 to 60 degrees Fahrenheit. Air temperatures ranged from 64 to 70 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 50% riffle units, 10% pool units, 33% flatwater units and 7% culvert units (Graph 1). Based on total length of Level II habitat types there were 66% riffle units, 4% pool units, 29% flatwater units and 1% culvert units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 23% Low Gradient Riffle units, 23% High Gradient Riffle units and 20% Run units (Graph 3). The most frequent habitat types based on percent total length were 38% Low Gradient Riffle units, 28% High Gradient Riffle units and 15% Run units (Table 2).

A total of 3 pools were identified (Table 3). Main Channel pools were the most frequently encountered, at 67%, and comprised 83% 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

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salmonids increases with depth. One of the 3 pools (33%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 3 pool tail-outs measured, 2 had a value of 1 (66.7%) and 1 had a value of 2 (33.3%) (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 7, flatwater habitat types had a mean shelter rating of 14, and pool habitats had a mean shelter rating of 40 (Table 1). Of the pool types, the Main Channel pools had a mean shelter rating of 20 and Scour pools had a mean shelter rating of 80 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel is observed in 100% of pool tail-outs.

The mean percent canopy density for the surveyed length of Fitz Henry Creek was 53%. The mean percentages of hardwood and coniferous trees were 88% and 12%, respectively. Forty-seven percent of the canopy was open. Graph 9 describes the mean percent canopy in Fitz Henry Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 69%. The mean percent left bank vegetated was 72%. The dominant elements composing the structure of the stream banks consisted of 15% bedrock, 24% boulder, 35% cobble/gravel and 26% sand/silt/clay (Graph 10). Brush was the dominant vegetation type observed in 56% of the units surveyed. Additionally, 41% of the units surveyed had hardwood trees as the dominant vegetation type, and 3% had coniferous trees as the dominant vegetation (Graph 11).

## **BIOLOGICAL INVENTORY RESULTS**

Two sites were electrofished for species composition and distribution in Fitz Henry Creek on October 26, 2010. Water temperature taken during the electrofishing period 12:43-13:47 was 54 degrees Fahrenheit. Air temperatures ranged from 60 to 68 degrees Fahrenheit. The sites were sampled by Andrew Griffin (WSP), Chris Bell (WSP), and Dan Resnik (CDFW).

In reach 1, which comprised of 1,588 feet of stream, two sites were sampled. The reach sites yielded 13 young-of-the-year steelhead/rainbow trout (SH/RT), 7 age 1+ SH/RT and 4 age 2+ SH/RT, and 2 sculpin.

The following chart displays the information yielded from these sites:

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2010 Fitz Henry Creek e-fish observations

Date	Site #	Reference Point	Distance From Reference Point (ft.)	Steelhead/Rainbow Trout			Non Salmonids Name species
				0+	1+	2+	
10/26/2010	1	Confluence with Easkoot Creek	100 feet upstream	8	7	4	2 sculpin
10/26/2010	2	Matt Davis Trail Bridge	150 feet upstream	5	0	0	none

### DISCUSSION

Fitz Henry Creek is a B4 channel type for the entire 1,588 feet of stream surveyed (Reach 1). The suitability of B4 channel type for fish habitat improvement structures is excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover.

The water temperatures recorded on the survey day 7/15/2010, ranged from 59 to 60 degrees Fahrenheit. Air temperatures ranged from 64 to 70 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 29% of the total length of this survey, riffles 66%, pools 4% and 1% culvert units. The pools are relatively shallow, with only 1 of the 3 (33%) 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.

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

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



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The mean shelter rating for pools was 40. The shelter rating in the flatwater habitats was 14. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Fitz Henry Creek. Boulders are the dominant cover type in pools followed by terrestrial vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 53%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 69% and 72%, 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

Fitz Henry 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) 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.
- 2) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from Boulders. Adding high quality complexity with woody cover in the pools is desirable.
- 3) Increase the canopy throughout Fitz Henry Creek, particularly Reach 1, by planting appropriate native vegetation like willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. Supplemental removal of invasive vegetative species should be done in conjunction with riparian restoration. 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.

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- 4) Access for migrating salmonids should be assessed at all road crossings and dams. All fish passage assessments should be done according to Part 9 of the California Salmonid Stream Habitat Restoration Manual (Flosi et al, 1998). Where needed, crossings should be replaced or modified to improve fish passage.
- 5) 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 July and August 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 Comments:

(ft.) Unit #

- 0 0001.00 Start of survey at confluence with Easkoot Creek.  
Waypoint #36. N37.89855 W122.63718
- 177 0005.00 On the right bank is a six foot high cement retaining wall which runs the entire length of unit.
- 360 0008.00 Salmonid young of year observed.
- 434 0011.00 Bridge #1 is the Matt Davis Trail footbridge; it has a length=4', a height=4', and a width=21'. It is made of wood, not retaining gravel, and has no sill. It is not down cutting and is not a possible barrier to salmonids. Waypoint #37 N37.89968 W122.63736
- 438 0012.00 Channel clogged with english ivy, cape ivy, mint, rattlesnake grass, Etc.
- 554 0014.00 Both banks overgrown with english ivy and cape ivy.
- 874 0018.00 Salmonid young of year observed.
- 995 0019.00 Right bank tributary #1 is flagged and marked on topo-map.

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### Position Habitat Comments:

(ft.) Unit #

995 0019.00 Right bank tributary #1 is unnamed and enters Fitz Henry Creek. It is not flowing, has discharge= 0, and contributes 0% of flow to The receiving stream. The water temperature downstream= 59F, and upstream temperature= 59F. The survey crew checked 30' upstream and found the tributary is not accessible to fish, with a slope=10% No fish observed. Waypoint#38 N37.90122 W122.63724

1304 0027.00 Right bank tributary #2 flagged and marked on topo.

1304 0027.00 Right bank tributary #2 is an unnamed tributary which enters Fitz Henry Creek. It is not flowing, with Discharge= 0, and a 0% contribution of flow to the receiving stream. Water temperature upstream= 60 F. The survey crew checked 25' up the tributary and found its not accessible to fish with a slope estimated of 10%. No fish were observed. Waypoint#39 N37.90178 W122.63672

1552 0029.00 Bridge # 2 is the Matt Davis Trail footbridge. It has a length=5', a height=5', and a width=26'. It is made of wood and steal, not retaining gravel, and has no sill. It is not creating down cutting and is not a barrier to salmonids. Waypoint #40 N37.90214 W122.63618

1588 0030.00 End of survey due to very steep channel and banks which is solidly blocked by thick vegetation. Waypoint #41 N37.90218 W122.63611

### 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.

## Fitz Henry Creek

### 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]	

# Fitz Henry Creek



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Prepared by: Scott Webb, December 2010

# Fitz Henry Creek

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

**Stream Name:** Fitz Henry Creek

**LLID:** 1226372378986

**Drainage:** Bolinas

**Survey** 7/15/2010 to 7/15/2010

**Confluence Location: Quad:** BOLINAS

**Legal Description:** T01NR07WS28

**Latitude:** 37:53:55.2N

**Longitude:** 122:38:14.5W

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
2	0	CULVERT	6.7	4	9	0.6									
10	10	FLATWATER	33.3	46	461	29.0	4.1	0.5	0.9	162	1616	69	692		14
3	3	POOL	10.0	22	65	4.1	7.3	0.8	1.4	149	448	188	564	154	40
15	15	RIFFLE	50.0	70	1053	66.3	4.4	0.3	0.5	264	3959	76	1133		7
<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>		
30	28				1588						6024		2389		

# Fitz Henry Creek

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

**Stream Name:** Fitz Henry Creek

**LLID:** 1226372378986

**Drainage:** Bolinas

**Survey** 7/15/2010 to 7/15/2010

**Confluence Location: Quad:** BOLINAS

**Legal Description:** T01NR07WS28

**Latitude:** 37:53:55.2N

**Longitude:** 122:38:14.5W

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 (%)
7	7	LGR	23.3	87	610	38.4	4.0	0.3	0.6	315	2206	77	539		6	63
7	7	HGR	23.3	63	439	27.6	5.0	0.3	0.7	250	1749	85	594		9	39
1	1	BRS	3.3	4	4	0.3	1.0	0.1	0.1	4	4	0	0		0	84
1	1	GLD	3.3	12	12	0.8	6.0	0.8	1.0	72	72	58	58		20	48
6	6	RUN	20.0	40	238	15.0	4.0	0.5	1.4	138	827	61	364		16	26
3	3	SRN	10.0	70	211	13.3	4.0	0.4	1.0	239	718	90	271		8	69
1	1	MCP	3.3	16	16	1.0	7.0	0.6	1.0	112	112	101	101	67	10	87
1	1	STP	3.3	38	38	2.4	7.0	1.4	2.3	253	253	404	404	354	30	84
1	1	LSL	3.3	11	11	0.7	8.0	0.5	0.8	84	84	59	59	42	80	87
2	0	CUL	6.7	4	9	0.6										
<b>Total Units</b>	<b>Total Units Fully Measured</b>				<b>Total Length (ft.)</b>						<b>Total Area (sq.ft.)</b>		<b>Total Volume</b>			
30	28				1588						6024		2389			

# Fitz Henry Creek

### Table 3 - Summary of Pool Habitat Types

**Stream Name:** Fitz Henry Creek

**LLID:** 1226372378986

**Drainage:** Bolinas

**Survey** 7/15/2010 to 7/15/2010

**Confluence Location: Quad:** BOLINAS

**Legal Description:** T01NR07WS28

**Latitude:** 37:53:55.2N

**Longitude:** 122:38:14.5W

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
2	2	MAIN	67	27	54	83	7.0	1.0	182	365	210	421	20
1	1	SCOUR	33	11	11	17	8.0	0.5	84	84	42	42	80
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
3	3				65					448		463	



# Fitz Henry Creek

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

**Stream Name:** Fitz Henry Creek

**LLID:** 1226372378986

**Drainage:** Bolinas

**Survey** 7/15/2010 to 7/15/2010

**Confluence Location: Quad:** BOLINAS

**Legal Description:** T01NR07WS28

**Latitude:** 37:53:55.2N

**Longitude:** 122:38:14.5W

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	33	0	0	1	100	0	0	0	0	0	0
1	STP	33	0	0	0	0	1	100	0	0	0	0
1	LSL	33	1	100	0	0	0	0	0	0	0	0
<b>Total Units</b>			<b>Total &lt; 1 Foot Max Resid. Depth</b>	<b>Total &lt; 1 Foot % Occurrence</b>	<b>Total 1 &lt; 2 Feet Max Resid. Depth</b>	<b>Total 1 &lt; 2 Feet % Occurrence</b>	<b>Total 2 &lt; 3 Feet Max Resid. Depth</b>	<b>Total 2 &lt; 3 Feet % Occurrence</b>	<b>Total 3 &lt; 4 Feet Max Resid. Depth</b>	<b>Total 3 &lt; 4 Feet % Occurrence</b>	<b>Total &gt;= 4 Feet Max Resid. Depth</b>	<b>Total &gt;= 4 Feet % Occurrence</b>
3			1	33	1	33	1	33	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1

# Fitz Henry Creek

## Table 5 - Summary of Mean Percent Cover By Habitat

**Stream Name:** Fitz Henry Creek

**Dry Units:**

**LLID:** 1226372378986

**Drainage:** Bolinas

**Survey Dates:** 7/15/2010 to 7/15/2010

**Confluence Location: Quad:** BOLINAS

**Legal Description:** T01NR07WS28

**Latitude:** 37:53:55.2N

**Longitude:** 122:38:14.5W

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
7	5	LGR	0	0	0	0	18	0	0	62	0
7	7	HGR	0	4	0	0	3	0	4	46	0
1	1	BRS	0	0	0	0	0	0	0	0	0
15	13	TOTAL RIFFLE	0	2	0	0	8	0	2	48	0
1	1	GLD	0	0	20	0	80	0	0	0	0
6	6	RUN	0	2	0	0	31	0	0	51	0
3	3	SRN	0	7	0	0	10	0	0	83	0
10	10	TOTAL FLAT	0	3	2	0	30	0	0	56	0
1	1	MCP	0	0	0	0	0	0	0	100	0
1	1	STP	0	0	0	0	50	0	0	0	50
1	1	LSL	0	10	10	0	20	0	0	60	0
3	3	TOTAL POOL	0	3	3	0	23	0	0	53	17
2	0	CUL									
30	26	TOTAL	0	3	1	0	18	0	1	52	2

# Fitz Henry Creek

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

**Stream Name:** Fitz Henry Creek

**Dry Units:**

**LLID:** 1226372378986

**Drainage:** Bolinas

**Survey** 7/15/2010 to 7/15/2010

**Confluence Location: Quad:** BOLINAS

**Legal Description:** T01NR07WS28

**Latitude:** 37:53:55.2N

**Longitude:** 122:38:14.5W

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
7	5	LGR	0	0	80	20	0	0	0
7	7	HGR	0	0	0	29	43	29	0
1	1	BRS	0	0	0	0	0	0	100
1	1	GLD	0	0	100	0	0	0	0
6	6	RUN	0	0	67	33	0	0	0
3	3	SRN	0	0	33	67	0	0	0
1	1	MCP	0	100	0	0	0	0	0
1	1	STP	0	0	100	0	0	0	0
1	1	LSL	0	100	0	0	0	0	0
2	0	CUL	0	0	0	0	0	0	0

## Fitz Henry Creek

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

**Stream Name:** Fitz Henry Creek

**LLID:** 1226372378986

**Drainage:** Bolinas

**Survey** 7/15/2010 to 7/15/2010

**Confluence Location: Quad:** BOLINAS

**Legal Description:** T01NR07WS28

**Latitude:** 37:53:55.2N

**Longitude:** 122:38:14.5W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
53	12	88	26	69	72

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.

# Fitz Henry Creek

**Table 8 - Fish Habitat Inventory Data Summary**

Stream Fitz Henry Creek LLID: 1226372378986 Drainage Bolinas  
 Survey Dates: 7/15/2010 to 7/15/2010 Survey Length (ft.): 1588 Main Channel (ft.): 1588 Side Channel (ft.): 0  
 Confluence Location: Quad BOLINAS Legal Description: T01NR07WS28 Latitude: 37:53:55.2N Longitude: 122:38:14.5W

## Summary of Fish Habitat Elements By Stream Reach

**STREAM REACH: 1**

Channel Type: B4	Canopy Density (%): 53.2	Pools by Stream Length: 4.1
Reach Length (ft.): 1588	Coniferous Component (%): 11.8	Pool Frequency (%): 10.0
Riffle/Flatwater Mean Width (ft.): 4.3	Hardwood Component: 88.2	Residual Pool Depth (%):
BFW:	Dominant Bank: Brush	< 2 Feet Deep: 66.7
Range (ft.): 7.00 to 12.00	Vegetative Cover (%): 70.2	2 to 2.9 Feet Deep: 33.3
Mean (ft.): 9.67	Dominant: Boulders	3 to 3.9 Feet Deep: 0.0
Std. Dev.: 2.05	Dominant Bank Substrate: Cobble/Gravel	>= 4 Feet Deep: 0.0
Base Flow (cfs): 0	Occurrence of LWD (%): 1.2	Mean Max Residual Pool Depth: 1.36
Water (F): 59 - 60	Air (F): 64 - 70	LWD per 100 ft.:
Dry Channel (ft.): 0	Riffles: 1	Mean Pool Shelter: 40
	Pools: 2	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 100. Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 0.0		
Embeddedness Values (%): 1. 66.7 2. 33.3 3. 0.0 4. 0.0 5. 0.0		

## Fitz Henry Creek

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

**Stream Name:** Fitz Henry Creek

**LLID:** 1226372378986

**Drainage:** Bolinas

**Survey** 7/15/2010 to 7/15/2010

**Confluence Location: Quad:** BOLINAS

**Legal Description:** T01NR07WS28

**Latitude:** 37:53:55.2N

**Longitude:** 122:38:14.5W

### 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	3	2	14.7
Boulder	4	4	23.5
Cobble/Gravel	4	8	35.3
Sand/Silt/Clay	6	3	26.5

### 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	12	7	55.9
Hardwood	5	9	41.2
Coniferous	0	1	2.9
No Vegetation	0	0	0.0

**Total Stream Cobble Embeddedness Values:** 1

## Fitz Henry Creek

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

**Stream Name:** Fitz Henry Creek

**LLID:** 1226372378986

**Drainage:** Bolinas

**Survey** 7/15/2010 to 7/15/2010

**Confluence Location: Quad:** BOLINAS

**Legal Description:** T01NR07WS28

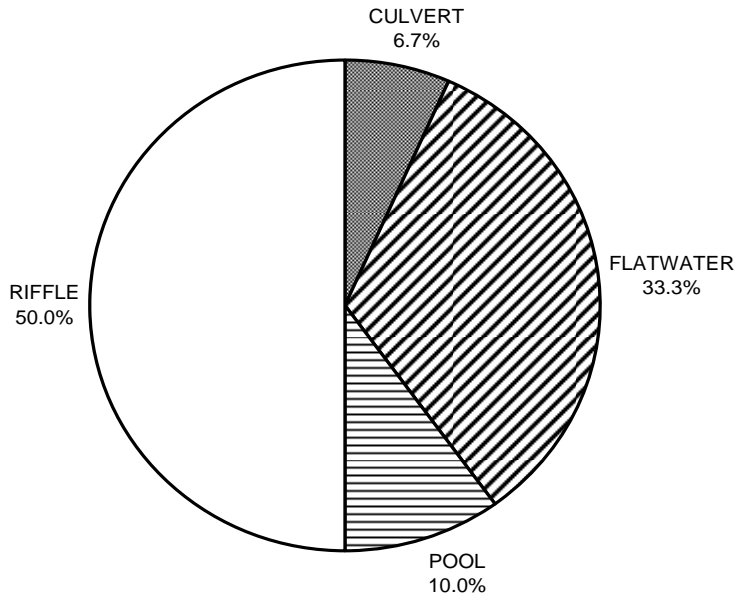
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**Longitude:** 122:38:14.5W

	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
UNDERCUT BANKS (%)	0	0	0
SMALL WOODY DEBRIS (%)	2	3	3
LARGE WOODY DEBRIS (%)	0	2	3
ROOT MASS (%)	0	0	0
TERRESTRIAL VEGETATION	8	30	23
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	2	0	0
BOULDERS (%)	48	56	53
BEDROCK LEDGES (%)	0	0	17

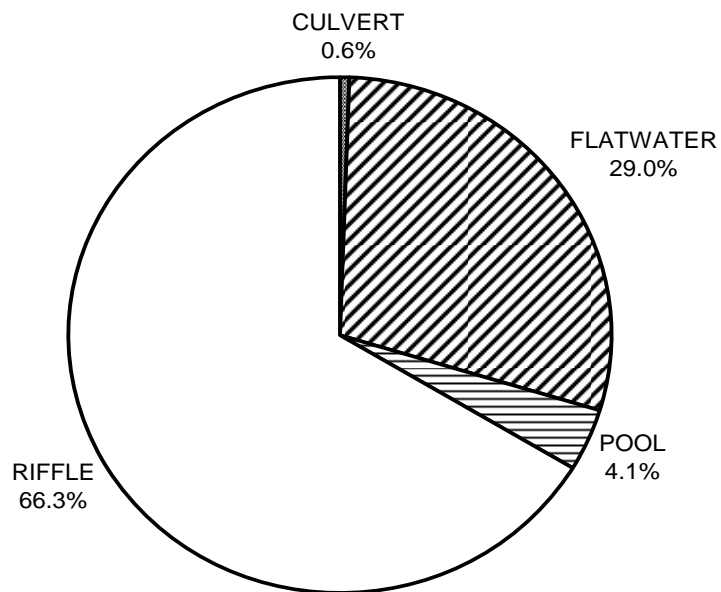
# Fitz Henry Creek

## FITZ HENRY CREEK 2010 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

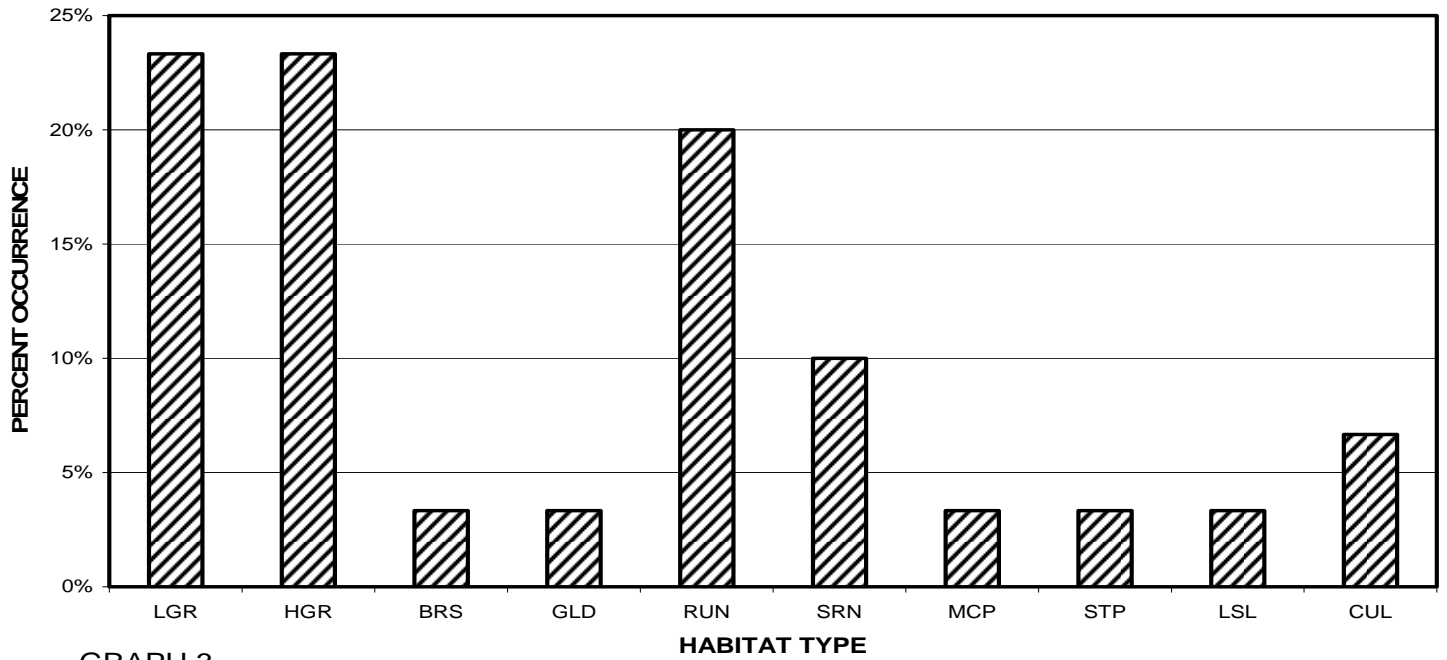
## FITZ HENRY CREEK 2010 HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

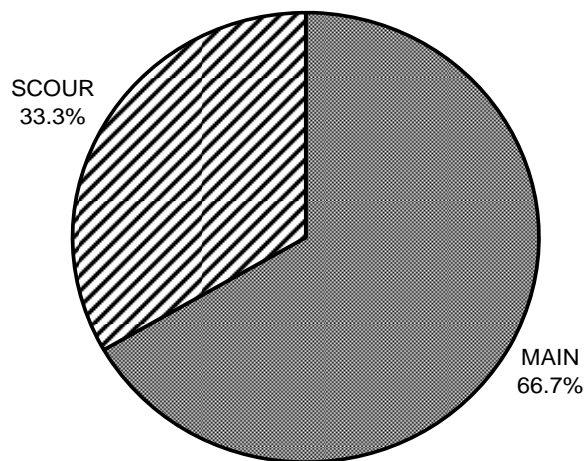


### FITZ HENRY CREEK 2010 HABITAT TYPES BY PERCENT OCCURRENCE



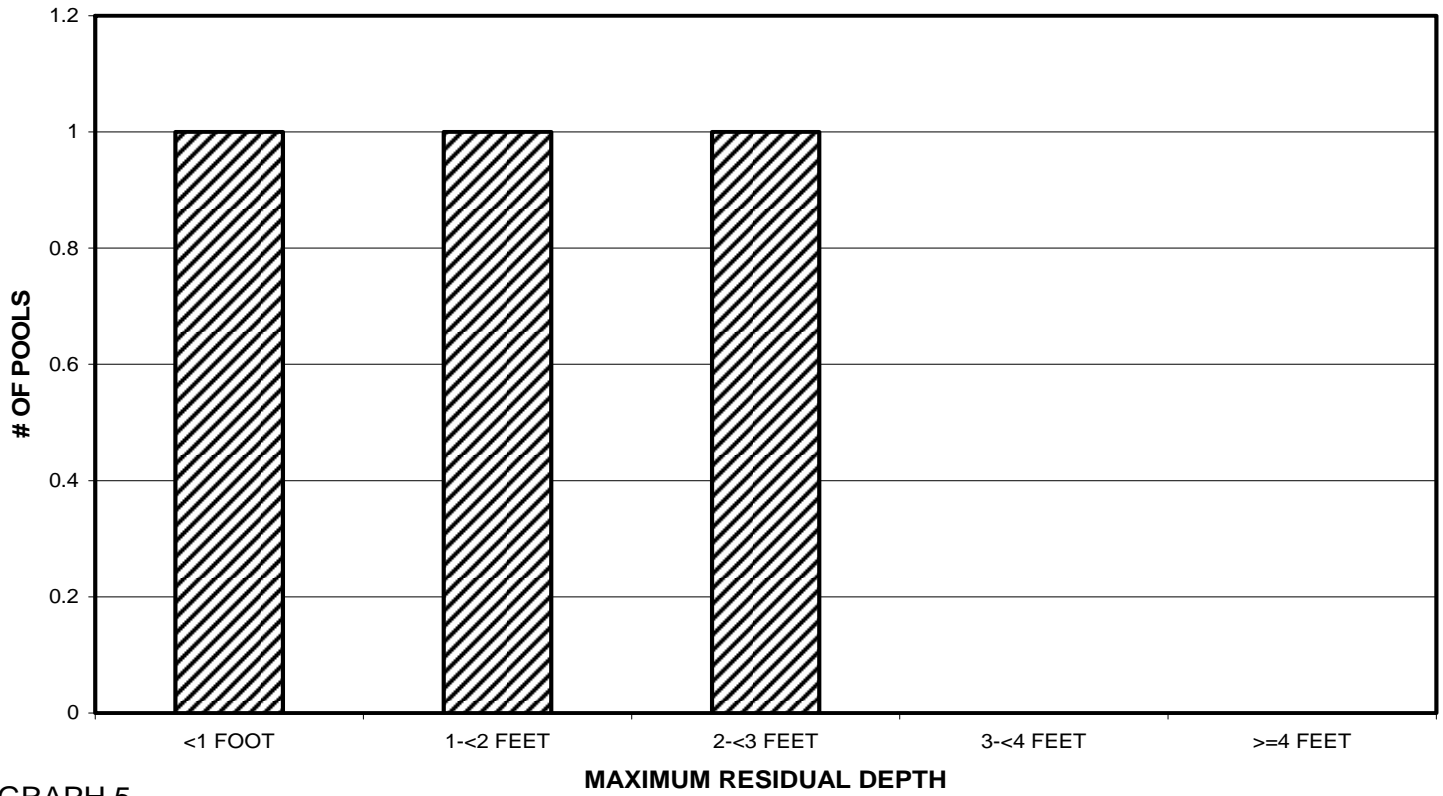
GRAPH 3

### FITZ HENRY CREEK 2010 POOL TYPES BY PERCENT OCCURRENCE



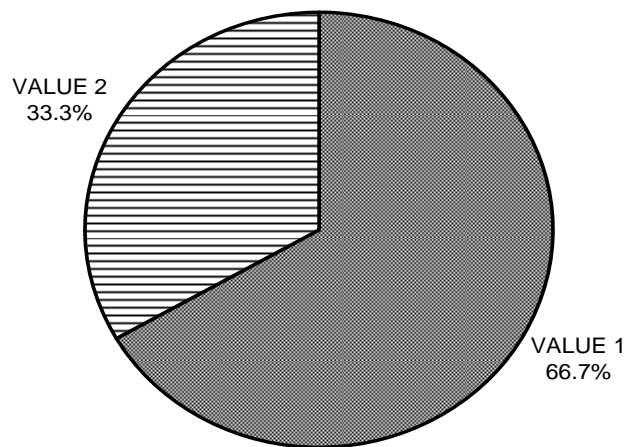
GRAPH 4

### FITZ HENRY CREEK 2010 MAXIMUM DEPTH IN POOLS



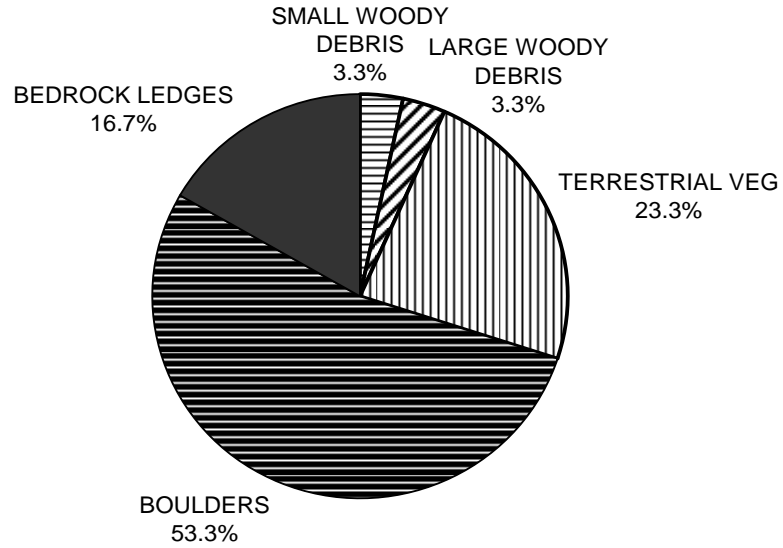
GRAPH 5

### FITZ HENRY CREEK 2010 PERCENT EMBEDDEDNESS



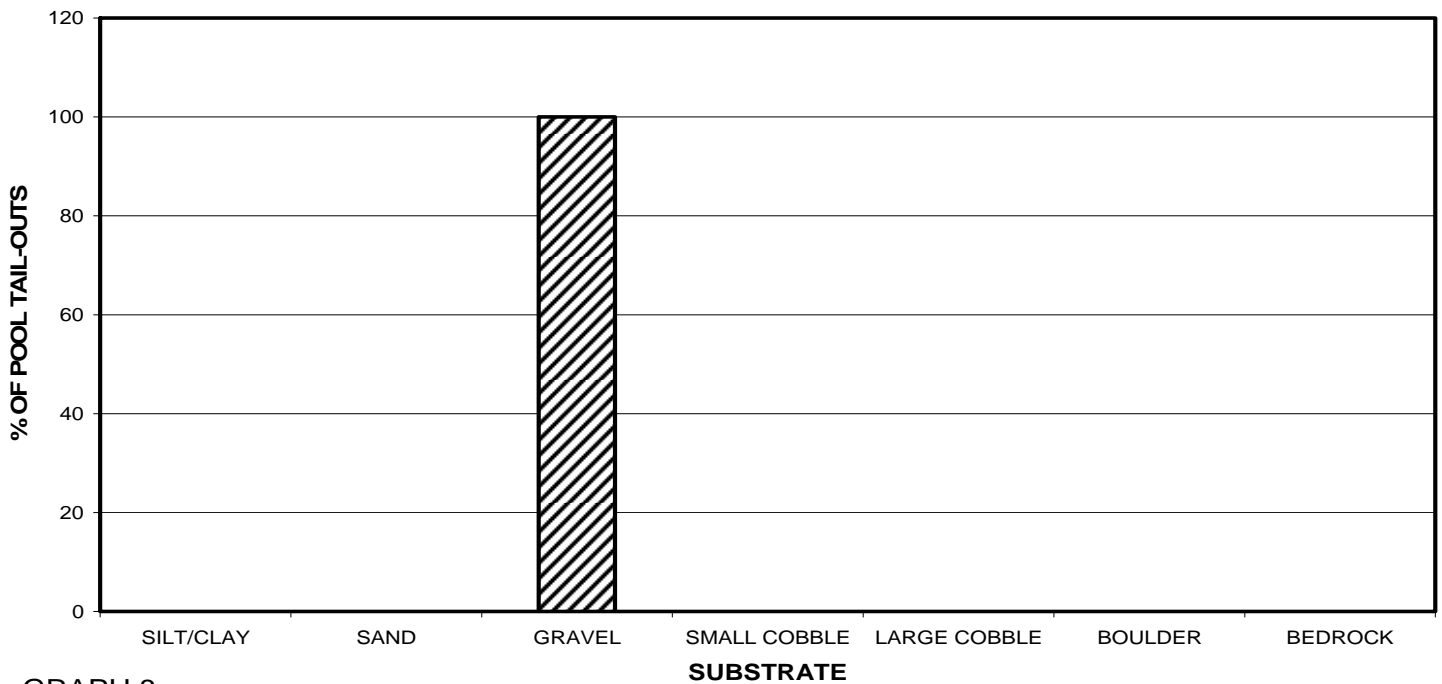
GRAPH 6

### FITZ HENRY CREEK 2010 MEAN PERCENT COVER TYPES IN POOLS



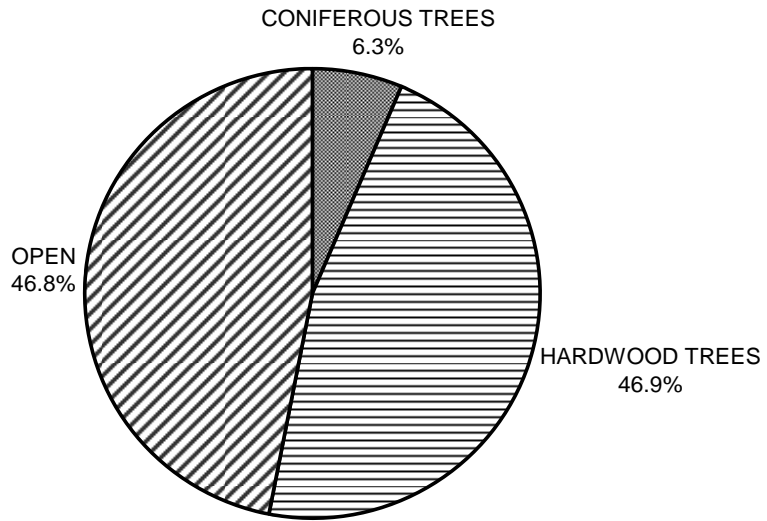
GRAPH 7

### FITZ HENRY CREEK 2010 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



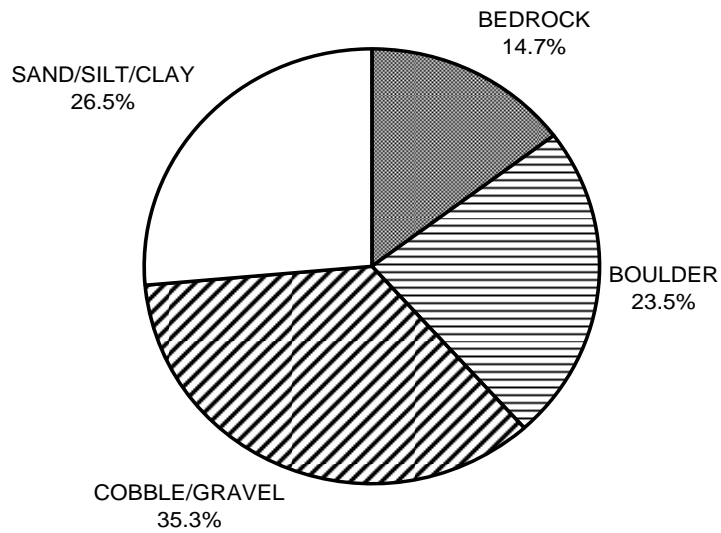
GRAPH 8

**FITZ HENRY CREEK 2010  
MEAN PERCENT CANOPY**



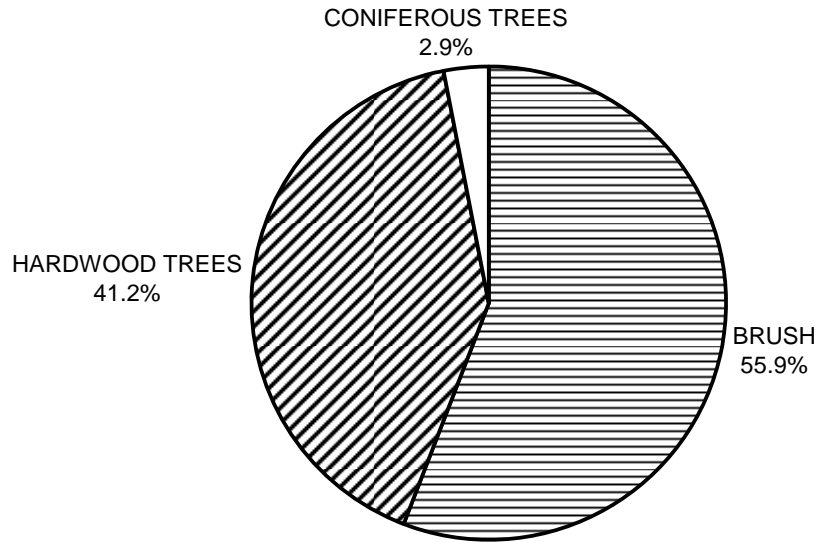
GRAPH 9

**FITZ HENRY CREEK 2010  
DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10

**FITZ HENRY CREEK 2010  
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11