

# STREAM INVENTORY REPORT

## Booth Gulch

### INTRODUCTION

A stream inventory was conducted from September 26 to October 31, 2012 on Booth Gulch. The survey began at the confluence with Middle Fork Ten Mile River and extended upstream 0.9 miles.

The Booth Gulch 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 Booth Gulch. 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 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

Booth Gulch is a tributary to Middle Fork Ten Mile River, a tributary to Ten Mile River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Booth Gulch's legal description at the confluence with Middle Fork Ten Mile River is T19N R16W S01. Its location is 39.5389 degrees north latitude and 123.5994 degrees west longitude, LLID number 1235980395388. Booth Gulch is a first order stream and has approximately 1.1 miles of blue line stream according to the USGS Sherwood Peak 7.5 minute quadrangle. Booth Gulch drains a watershed of approximately 1.8 square miles. Elevations range from about 360 feet at the mouth of the creek to 1,200 feet in the headwater. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Georgia-Pacific Industrial Road, north of Fort Bragg, CA.

### METHODS

The habitat inventory conducted in Booth Gulch follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Department of Fish and Wildlife (CDFW) personnel and Watershed Stewards Project/AmeriCorps (WSP) members that conducted the inventory were trained in standardized habitat inventory methods by the 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 survey reach. All habitat units included in the survey are classified according to habitat type and

## Booth Gulch

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 Booth Gulch 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". Booth Gulch 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.

## Booth Gulch

### 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 Booth Gulch, 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 not suitable 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. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is classified according to a list of nine cover types. In Booth Gulch, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. The shelter rating is then calculated for each fully-described habitat unit by multiplying shelter value and percent 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 Booth Gulch, 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 Booth Gulch, 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.

## Booth Gulch

### 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 Booth Gulch. In addition, underwater observations were made at eight sites using techniques discussed in the *California Salmonid Stream Habitat Restoration Manual*.

## DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.19, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and 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

## Booth Gulch

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Booth Gulch 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 September 26 to October 31, 2012 was conducted by T. Anderson, B. Leonard, and I. Mikus (CDFW). The total length of the stream surveyed was 4,837 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.05 cfs on November 7, 2012.

Booth Gulch is a G4 channel type for the entire 4,837 feet of the stream surveyed. G4 channels are entrenched “gully” step-pool channels on moderate gradients with low width/depth ratios and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 49 to 50 degrees Fahrenheit. Air temperatures ranged from 49 to 60 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 40% pool units, 32% riffle units, 26% flatwater units, 2% dry units, and 1% unsurveyed units, (Graph 1). Based on total length of Level II habitat types there were 38% flatwater units, 31% riffle units, 27% pool units, and 3% dry units (Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 36%; low gradient riffle units, 24%; and step run units, 18% (Graph 3). Based on percent total length, step run units made up 33%, low gradient riffle units 27%, and mid-channel pool units 23%.

## **Booth Gulch**

A total of 60 pools were identified (Table 3). Main channel pools were the most frequently encountered at 93% (Graph 4), and comprised 94% of the total length of all pools (Table 3).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Ten of the 60 pools (17%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 60 pool tail-outs measured, nine had a value of 2 (15%); 37 had a value of 3 (61.7%); 10 had a value of 4 (16.7%); four had a value of 5 (6.7%) (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 not suitable 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 5, flatwater habitat types had a mean shelter rating of 14, and pool habitats had a mean shelter rating of 20 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 24. Main channel pools had a mean shelter rating of 20 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Small woody debris is the dominant cover type in Booth Gulch. Graph 7 describes the pool cover in Booth Gulch. Large woody debris is the dominant pool cover type followed by small woody debris.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Small cobble was the dominant substrate observed in 45% of the pool tail-outs. Gravel was the next most frequently observed dominant substrate type and occurred in 40% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Booth Gulch was 97%. Three percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 30% and 70%, respectively. Graph 9 describes the mean percent canopy in Booth Gulch.

For the stream reach surveyed, the mean percent right bank vegetated was 96%. The mean percent left bank vegetated was 95%. The dominant elements composing the structure of the stream banks consisted of 59% sand/silt/clay, 27% cobble/gravel, 13% bedrock, and 1% boulders (Graph 10). Coniferous trees were the dominant vegetation type observed in 61% of the units surveyed. Additionally, 29% of the units surveyed had brush as the dominant vegetation type, and 9% had deciduous trees as the dominant vegetation type (Graph 11).

## **BIOLOGICAL INVENTORY RESULTS**

Survey teams conducted a snorkel survey at eight sites for species composition and distribution in Booth Gulch on November, 2012. The water temperature taken during the snorkel survey

## Booth Gulch

period of 1136 hours to 1220 hours was 49 degrees Fahrenheit. Air temperatures ranged from 53 to 55 degrees Fahrenheit. The sites were sampled by B. Leonard and T. Anderson (CDFW).

Eight sites were sampled in the first 1,644 feet of Booth Gulch. The sites yielded 11 young-of-the-year (YOY) steelhead/rainbow trout (SH/RT).

The following chart displays the information yielded from these sites:

2012 Booth Gulch underwater observations.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Coho	
					YOY	1+	2+	YOY	1+
G4 Channel Type									
11/7/12	1	008	Pool	143	0	0	0	0	0
	2	010	Pool	228	1	0	0	0	0
	3	017	Pool	438	4	0	0	0	0
	4	022	Pool	847	2	0	0	0	0
	5	026	Pool	931	0	0	0	0	0
	6	047	Pool	1,569	1	0	0	0	0
	7	049	Pool	1,612	1	0	0	0	0
	8	050	Pool	1,644	2	0	0	0	0

## DISCUSSION

Booth Gulch is a G4 channel type. The suitability of G4 channel types for fish habitat improvement structures is as follows: G4 channel types are good for bank-placed boulders and fair for plunge weirs, opposing wing-deflectors, and log cover.

The water temperatures recorded on the survey days September 26 to October 31, 2012 ranged from 49 to 50 degrees Fahrenheit. Air temperatures ranged from 49 to 60 degrees Fahrenheit. This is a good water temperature range for salmonids. To make any conclusions, temperatures need to be monitored throughout the warm summer months, and more extensive biological sampling needs to be conducted.

Flatwater habitat types comprised 38% of the total length of this survey, riffles 31%, and pools 27%. Ten of the 60 (17%) pools had 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. Installing large wood structures that will increase or deepen pool habitat is recommended.

## **Booth Gulch**

Nine of the 60 pool tail-outs measured had embeddedness ratings of 1 or 2. Forty-seven of the pool tail-outs had embeddedness ratings of 3 or 4. Four 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 Booth Gulch should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Fifty-one of the 60 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 is 20. The shelter rating in the flatwater habitats is 14. 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 Booth Gulch. Large woody debris is the dominant cover type in pools followed by small woody debris. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structures provide rearing fry with protection from predation, rest from water velocity, and also divide territorial units to reduce density related competition.

The mean percent canopy density for the stream was 97%. The percentage of right and left bank covered with vegetation was 96% and 95%, respectively.

### RECOMMENDATIONS

- 1) Booth Gulch should be managed as an anadromous, natural production stream.
- 2) 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.
- 3) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from large woody debris. Adding high quality complexity with woody cover in the pools is desirable.
- 4) 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.
- 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.



## Booth Gulch

### 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 (ft):	Habitat Unit #	Comments:
0	0001.00	Start of survey at the confluence with Middle Fork Ten Mile River. The channel is a G4 for the entire length of the survey.
310	0015.00	An erosion site on the left bank measures 30' high x 80' long and is contributing silt and sand to the channel.
612	0020.00	Road 10000 crosses the channel. The crossing is a 13' wide x 15' high x 52' long bridge.
830	0022.00	Log Debris Accumulation (LDA) #01 contains five pieces of large woody debris (LWD) and measures approximately 5' high x 15' wide x 11' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges in size from sand to gravel and measures 44' long x 16' wide x 4' deep. Fish were observed above the LDA.
931	0027.00	LDA #02 contains 11 pieces of LWD and measures approximately 6' x 20' wide x 11' long. Water flows through the LDA and it has no visible gaps. Retained sediment ranges in size from sand to gravel and measures 39' long x 18' wide x 5' deep. Fish were observed above the LDA.
1478	0045.00	LDA #03 contains nine pieces of LWD and measures approximately 9' high x 20' long x 20' wide. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges in size from sand to gravel and measures 70' long x 30' wide x 8' deep. Fish were observed above the LDA.
1524	0047.00	An erosion site on the right bank measures 40' long x 15' high and is contributing silt and sand to the stream channel.
1581	0049.00	Erosion sites on the right and left banks are contributing silt, sand and gravel to the stream channel. The right bank erosion site measures approximately 30' long x 8' high. The left bank erosion site measures approximately 30' long x 5' high.
1612	0050.00	There is a 3' high plunge over a log. An erosion site on the right bank measures approximately 30' long x 15' high and is contributing silt, sand and gravel to the stream channel.

## Booth Gulch

1743	0055.00	An erosion site on the right bank measures 20' long x 10' high and is contributing silt and sand to the channel.
2359	0076.00	An erosion site on the left bank measures 35' long x 12' high and is contributing silt and sand to the stream channel.
2603	0084.00	LDA #04 measures approximately 4.5' high x 15' wide x 4.5' long and contains seven pieces of LWD. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges in size from silt to small cobble and measures 10' wide x 70' long x 2' deep. Fish were observed above the LDA.
3250	0102.00	An erosion site on the right bank measures approximately 80' long x 15' high; it is contributing silt, sand and gravel to the channel. A woody debris accumulation in the channel is exacerbating the erosion. The debris accumulation has two pieces of LWD in it.
3409	0105.00	LDA #05 measures approximately 4.5' high 13' wide x 13' long and contains seven pieces of LWD. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges in size from silt to small cobble and measures 20' wide x 12' long x 2' deep. Fish were observed above the LDA. An erosion site on the left bank measures approximately 20' long x 8' high; it is contributing silt, sand and gravel to the channel.
3545	0111.00	LDA #06 measures approximately 4' high x 13' wide x 7' long and contains five pieces of LWD. Water flows through the LDA and there are visible gaps in it. The LDA is not retaining sediment. There is a 2' plunge over a 3' diameter log. Small woody debris has accumulated directly upstream of the plunge. Fish were observed above the LDA.
3788	0119.00	Dry left bank tributary.
3874	0120.00	LDA #07 measures approximately 5' high x 13' wide x 8' long and contains seven pieces of LWD. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges in size from silt to gravel and measures 8' wide x 60' long x 2.5' deep. There is a 3' high plunge over the LDA. Fish were observed above the LDA.
4510	0137.00	LDA #08 measures approximately 6' high x 14' wide x 14' long and contains nine pieces of LWD. The LDA is primarily composed of two 10' diameter root wads. Water flows through the LDA and there are visible gaps in it. No sediment is being retained by the LDA. Fish were observed above the LDA. Adjacent to the LDA is a slump on the left

## Booth Gulch

		bank which is 90% vegetated. The slump is approximately 100' long x 20' high.
4592	0140.00	An erosion site on the left bank measures approximately 40' long x 10' high. It is contributing silt, sand and gravel to the stream channel.
4646	0142.00	The right bank is 14' high, vertical, and bare for approximately 100'.
4744	0144.00	Small woody debris accumulation.
4781	0146.00	Dry right bank tributary.
4799	0147.00	2.2' high plunge over a log.
4828	0149.00	End of survey due to time constraints and diminishing habitat. At the top of this last unit there is a 3' high plunge over a log. Above the plunge there is a 350' long dry section which contains five plunges over logs ranging in height from 2 to 4 feet. Two more log plunges were observed above the dry section. One plunge was 3' high and the other was 4.5' high. No fish were observed above the end of survey point.

## 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.

## Booth Gulch

### 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: Booth Gulch

LLID: 1235980395388 Drainage: Rockport

Survey Dates: 9/26/2012 to 10/31/2012

Confluence Location: Quad: SHERWOOD PEAK Legal Description: T19NR16WS01 Latitude: 39:32:20.0N Longitude: 123:35:53.0W

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
3	0	DRY	2.0	54	161	3.3									
38	5	FLATWATER	25.5	49	1859	38.4	5.8	0.3	0.7	327	12424	123	4685		14
1	0	NOSURVEY	0.7	24	24	0.5									
60	60	POOL	40.3	22	1297	26.8	9.3	0.7	1.5	196	11733	190	11425	143	20
47	6	RIFFLE	31.5	32	1496	30.9	5.7	0.2	0.3	163	7651	37	1761		5
<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>		
149	71				4837					31809			17871		

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

Stream Name: Booth Gulch

LLID: 1235980395388

Drainage: Rockport

Survey Dates: 9/26/2012 to 10/31/2012

Confluence Location: Quad: SHERWOOD PEAK Legal Description: T19NR16WS01 Latitude: 39:32:20.0N Longitude: 123:35:53.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating	Mean Canopy (%)
36	4	LGR	24.2	36	1302	26.9	5	0.2	0.6	206	7414	52	1864		5	96
10	2	HGR	6.7	19	186	3.8	6	0.2	0.4	76	765	9	88		5	100
1	0	CAS	0.7	8	8	0.2										
11	2	RUN	7.4	23	252	5.2	4	0.3	0.9	57	624	19	204		15	100
27	3	SRN	18.1	60	1607	33.2	7	0.4	0.9	507	13692	193	5215		13	97
54	54	MCP	36.2	21	1129	23.3	9	0.7	3.7	192	10375	185	9992	139	20	98
2	2	STP	1.3	46	92	1.9	9	1.4	3.6	357	713	513	1027	381	8	95
1	1	LSL	0.7	18	18	0.4	7	0.2	0.7	126	126	63	63	25	5	100
1	1	LSR	0.7	17	17	0.4	8	0.6	1.2	136	136	95	95	82	30	90
2	2	PLP	1.3	20	41	0.8	8	0.7	1.9	192	383	124	249	108	30	96
3	0	DRY	2.0	54	161	3.3										
1	0	NS	0.7	24	24	0.5										

Total Units  
149

Total Units Fully Measured  
71

Total Length (ft.)  
4837

Total Area (sq.ft.)  
34228

Total Volume (cu.ft.)  
18796

**Table 3 - Summary of Pool Types**

Stream Name: Booth Gulch

LLID: 1235980395388

Drainage: Rockport

Survey Dates: 9/26/2012 to 10/31/2012

Confluence Location: Quad: SHERWOOD PEAK

Legal Description: T19NR16WS01

Latitude: 39:32:20.0N

Longitude: 123:35:53.0W

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
56	56	MAIN	93	22	1221	94	9.4	0.7	198	11088	148	8274	20
4	4	SCOUR	7	19	76	6	8.0	0.6	161	645	81	324	24

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
60	60	1297	11733	8597

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

Stream Name: Booth Gulch

LLID: 1235980395388

Drainage: Rockport

Survey Dates: 9/26/2012 to 10/31/2012

Confluence Location: Quad: SHERWOOD PEAK Legal Description: T19NR16WS01 Latitude: 39:32:20.0N Longitude: 123:35:53.0W

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
54	MCP	90	14	26	31	57	4	7	5	9	0	0
2	STP	3	0	0	1	50	0	0	1	50	0	0
1	LSL	2	1	100	0	0	0	0	0	0	0	0
1	LSR	2	0	0	1	100	0	0	0	0	0	0
2	PLP	3	0	0	2	100	0	0	0	0	0	0

Total Units	Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Foot Max Resid. Depth	Total 1< 2 Foot % Occurrence	Total 2< 3 Foot Max Resid. Depth	Total 2< 3 Foot % Occurrence	Total 3< 4 Foot Max Resid. Depth	Total 3< 4 Foot % Occurrence	Total >= 4 Foot Max Resid. Depth	Total >= 4 Foot % Occurrence
60	15	25	35	58	4	7	6	10	0	0

Mean Maximum Residual Pool Depth (ft.): 1.5



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

Stream Name: Booth Gulch

LLID: 1235980395388

Drainage: Rockport

Survey Dates: 9/26/2012 to 10/31/2012

Dry Units: 3

Confluence Location: Quad: SHERWOOD PEAK

Legal Description: T19NR16WS01

Latitude: 39:32:20.0N

Longitude: 123:35:53.0W

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
36	4	LGR	0	50	0	0	0	0	0	50	0
10	2	HGR	0	0	0	0	0	0	0	100	0
1	0	CAS									
47	6	TOTAL RIFFLE	0	33	0	0	0	0	0	67	0
11	2	RUN	0	60	40	0	0	0	0	0	0
27	3	SRN	0	3	0	0	0	0	0	97	0
38	5	TOTAL FLAT	0	18	10	0	0	0	0	73	0
54	54	MCP	8	31	38	4	0	0	0	17	2
2	2	STP	0	95	0	0	0	0	0	0	5
1	1	LSL	0	40	60	0	0	0	0	0	0
1	1	LSR	0	10	0	60	30	0	0	0	0
2	2	PLP	0	55	45	0	0	0	0	0	0
60	60	TOTAL POOL	7	34	36	4	1	0	0	15	2
1	0	NS									
149	71	TOTAL	6	33	33	4	1	0	0	21	2

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

Stream Name: Booth Gulch

LLID: 1235980395388

Drainage: Rockport

Survey Dates: 9/26/2012 to 10/31/2012

Dry Units: 3

Confluence Location: Quad: SHERWOOD PEAK

Legal Description: T19NR16WS01

Latitude: 39:32:20.0N

Longitude: 123:35:53.0W

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
36	4	LGR	0	0	75	25	0	0	0
10	2	HGR	0	0	0	0	50	0	50
1	0	CAS	0	0	0	0	0	0	0
11	2	RUN	0	0	100	0	0	0	0
27	3	SRN	0	0	33	0	67	0	0
54	54	MCP	2	26	43	9	11	6	4
2	2	STP	0	0	50	0	0	0	50
1	1	LSL	0	0	100	0	0	0	0
1	1	LSR	0	0	100	0	0	0	0
2	2	PLP	0	50	50	0	0	0	0

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

Stream Name: Booth Gulch

LLID: 1235980395388

Drainage: Rockport

Survey Dates: 9/26/2012 to 10/31/2012

Confluence Location: Quad: SHERWOOD PEAK

Legal Description: T19NR16WS01

Latitude: 39:32:20.0N

Longitude: 123:35:53.0W

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Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
97	70	30	0	96	95

---

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: Booth Gulch LLID: 1235980395388 Drainage: Rockport  
 Survey Dates: 9/26/2012 to 10/31/2012 Survey Length (ft.): 4837 Main Channel (ft.): 4837 Side Channel (ft.): 0  
 Confluence Location: Quad: SHERWOOD PEAK Legal Description: T19NR16WS01 Latitude: 39:32:20.0N Longitude: 123:35:53.0W

**Summary of Fish Habitat Elements By Stream Reach**

**STREAM REACH: 1**

Channel Type: G4	Canopy Density (%): 97.4	Pools by Stream Length (%): 26.8
Reach Length (ft.): 4837	Coniferous Component (%): 70.0	Pool Frequency (%): 40.3
Riffle/Flatwater Mean Width (ft.): 5.7	Hardwood Component (%): 30.0	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Coniferous Trees	< 2 Feet Deep: 83
Range (ft.): 10 to 20	Vegetative Cover (%): 95.5	2 to 2.9 Feet Deep: 7
Mean (ft.): 14	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 10
Std. Dev.: 3	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 0
Base Flow (cfs.): 0.1	Occurrence of LWD (%): 26	Mean Max Residual Pool Depth (ft.): 1.5
Water (F): 49 - 50 Air (F): 49 - 60	LWD per 100 ft.:	Mean Pool Shelter Rating: 20
Dry Channel (ft): 161	Riffles: 3	
	Pools: 11	
	Flat: 4	
Pool Tail Substrate (%): Silt/Clay: 3 Sand: 5 Gravel: 40 Sm Cobble: 45 Lg Cobble: 5 Boulder: 0 Bedrock: 2		
Embeddedness Values (%): 1. 0.0 2. 15.0 3. 61.7 4. 16.7 5. 6.7		

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

Stream Name: Booth Gulch

LLID: 1235980395388

Drainage: Rockport

Survey Dates: 9/26/2012 to 10/31/2012

Confluence Location: Quad: SHERWOOD PEAK Legal Description: T19NR16WS01

Latitude: 39:32:20.0N

Longitude: 123:35:53.0W

**Mean Percentage of Dominant Stream Bank Substrate**

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Bedrock	8	11	13.4
Boulder	0	1	0.7
Cobble / Gravel	20	18	26.8
Sand / Silt / Clay	43	41	59.2

**Mean Percentage of Dominant Stream Bank Vegetation**

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	2	0	1.4
Brush	22	19	28.9
Hardwood Trees	3	9	8.5
Coniferous Trees	44	43	61.3
No Vegetation	0	0	0.0

**Total Stream Cobble Embeddedness Values:** 3

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

StreamName: Booth Gulch

LLID: 1235980395388

Drainage: Rockport

Survey Dates: 9/26/2012 to 10/31/2012

Confluence Location: Quad: SHERWOOD PEAK

Legal Description: T19NR16WS01

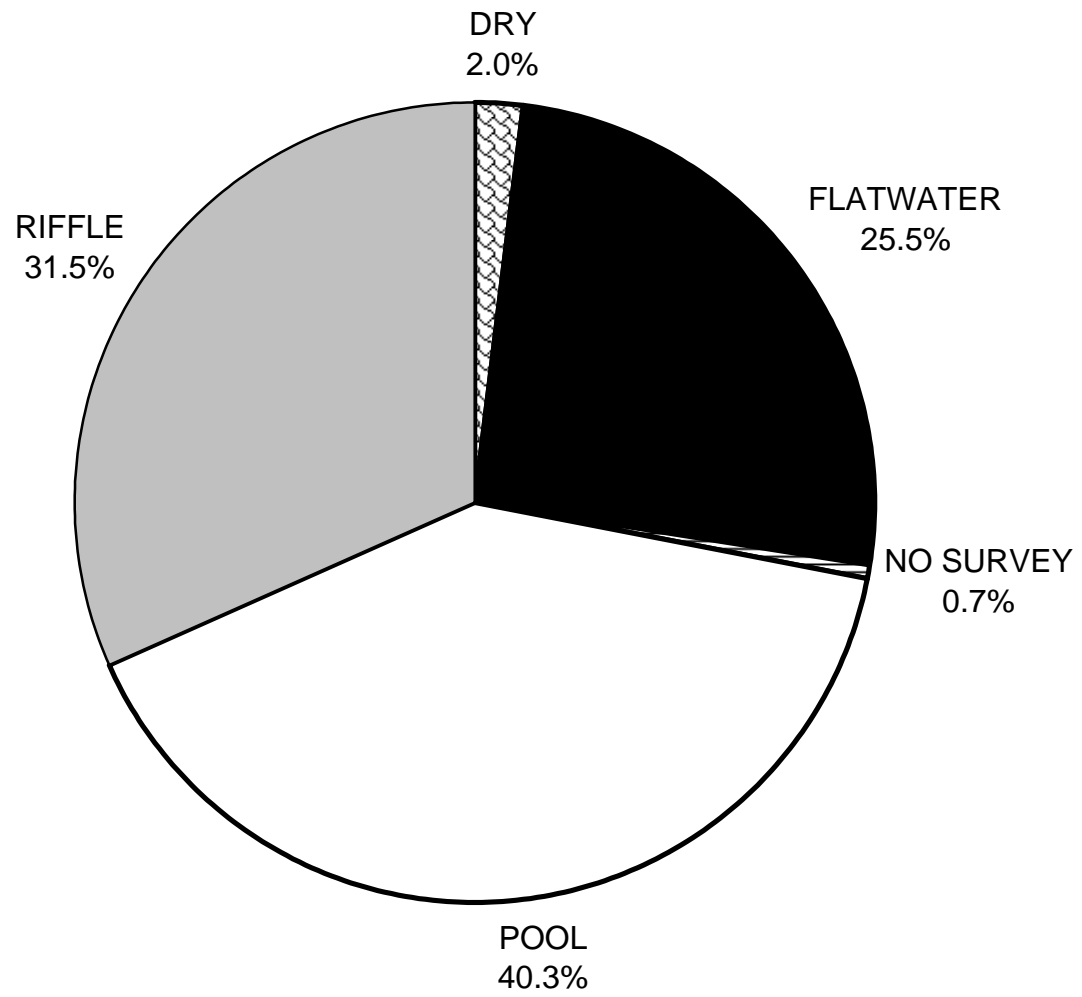
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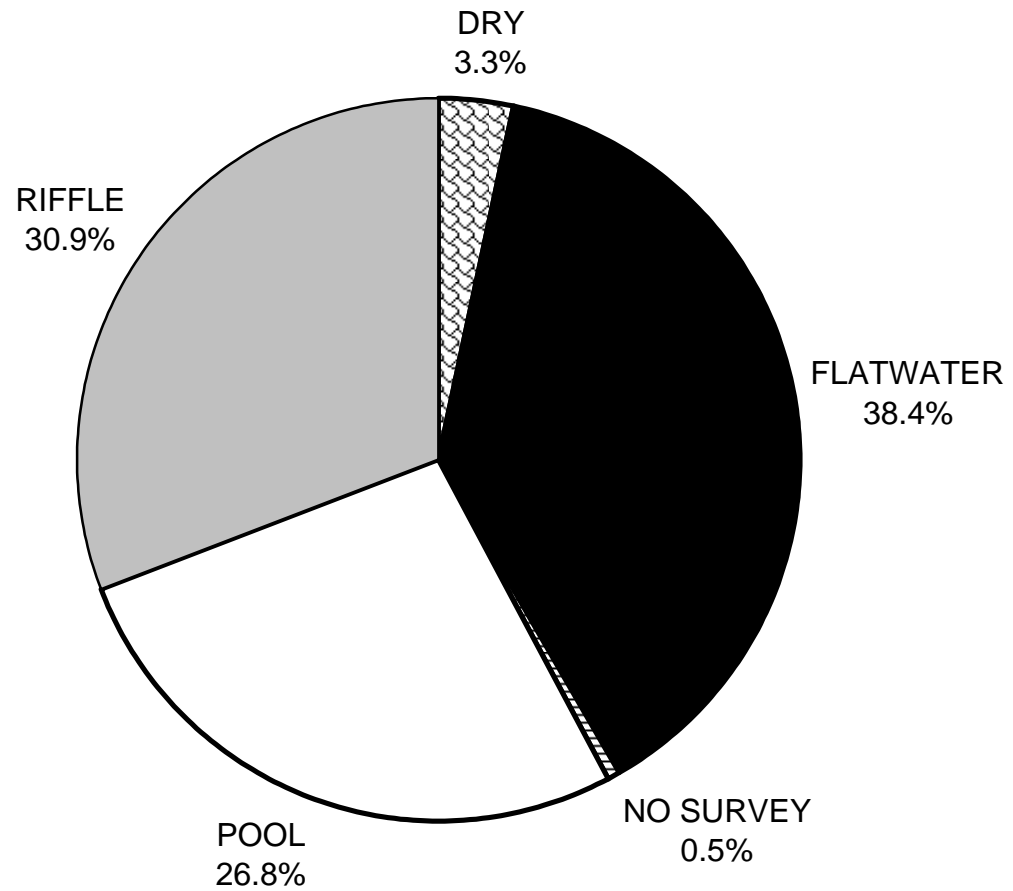
	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
UNDERCUT BANKS (%)	0	0	7
SMALL WOODY DEBRIS (%)	33	18	34
LARGE WOODY DEBRIS (%)	0	10	36
ROOT MASS (%)	0	0	4
TERRESTRIAL VEGETATION (%)	0	0	1
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	0
BOULDERS (%)	67	73	15
BEDROCK LEDGES (%)	0	0	2

# BOOTH GULCH 2012 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

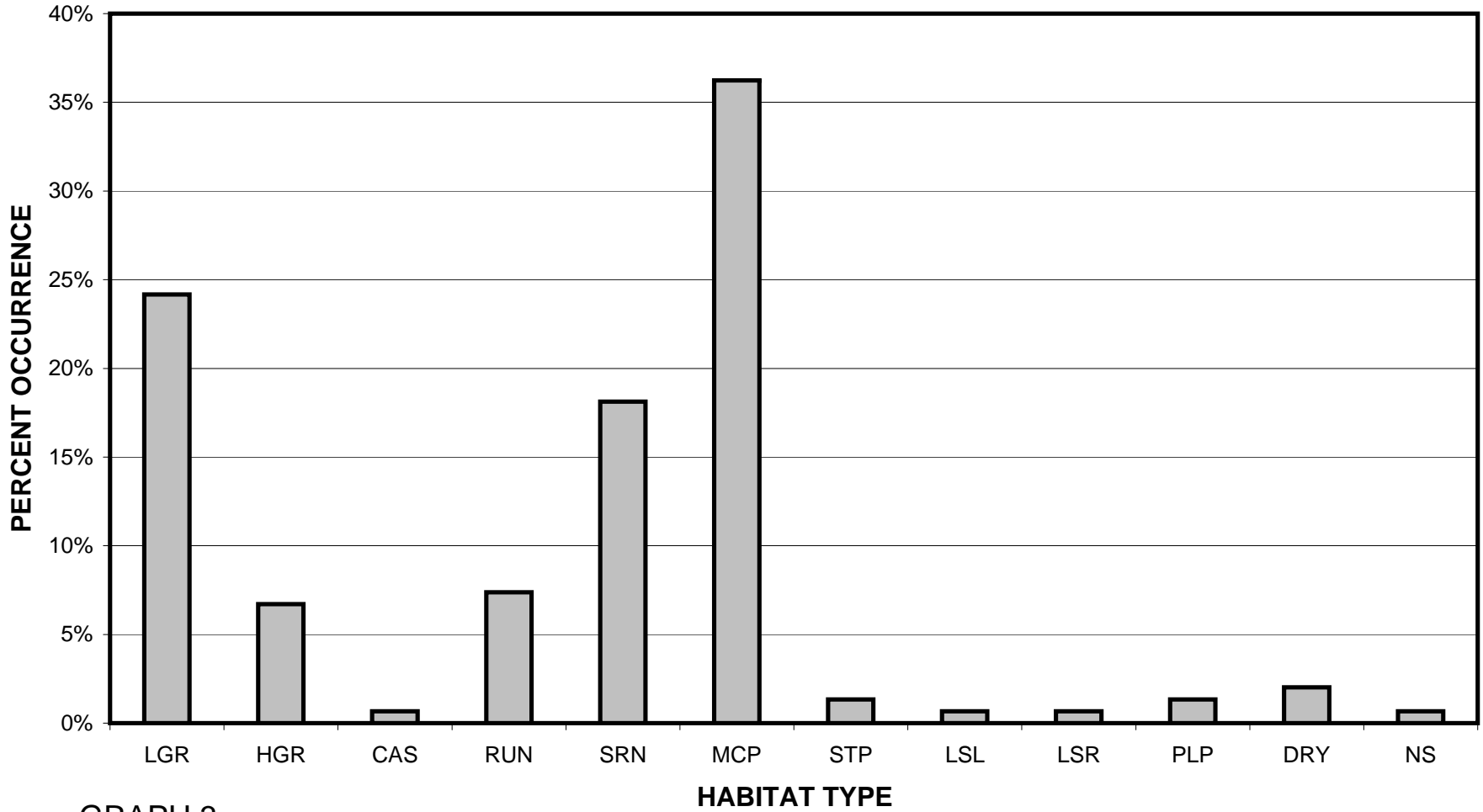
# BOOTH GULCH 2012 HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

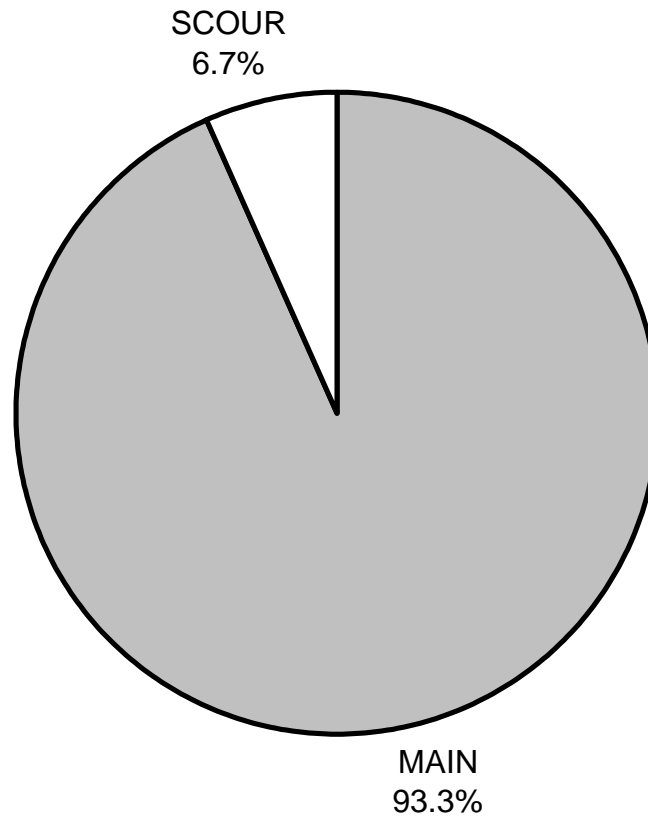


# BOOTH GULCH 2012 HABITAT TYPES BY PERCENT OCCURRENCE



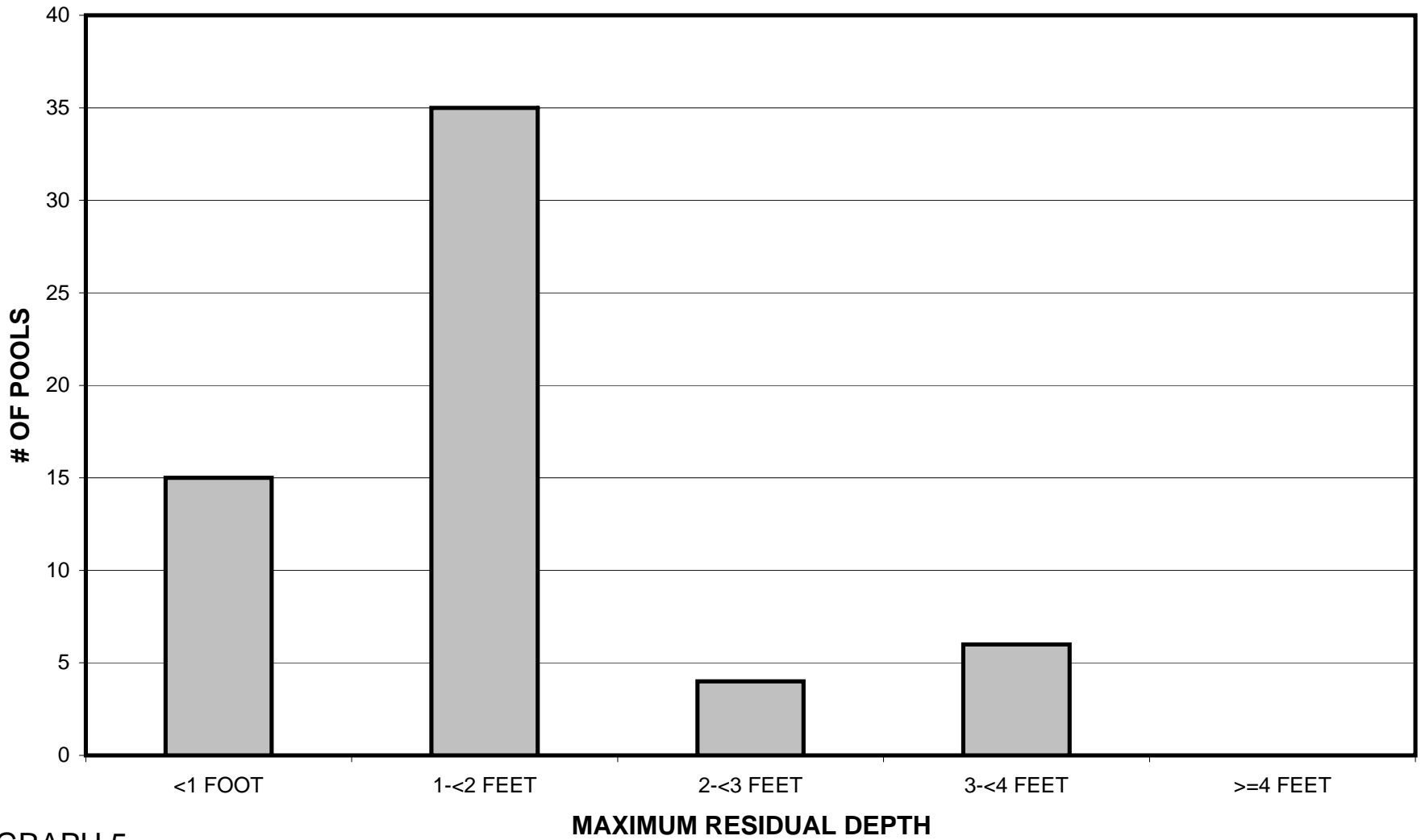
GRAPH 3

**BOOTH GULCH 2012  
POOL TYPES BY PERCENT OCCURRENCE**



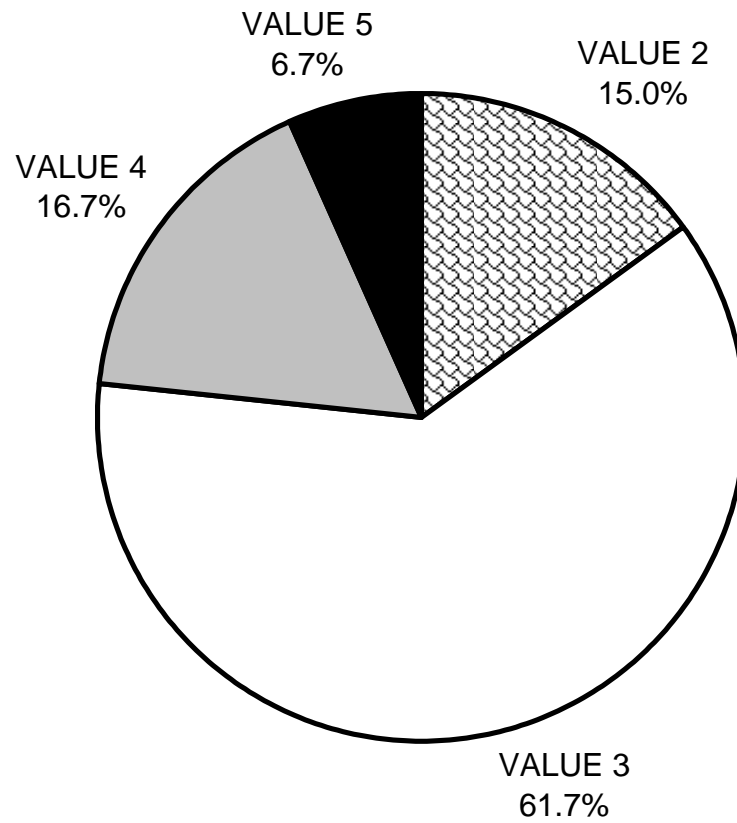
GRAPH 4

# BOOTH GULCH 2012 MAXIMUM DEPTH IN POOLS



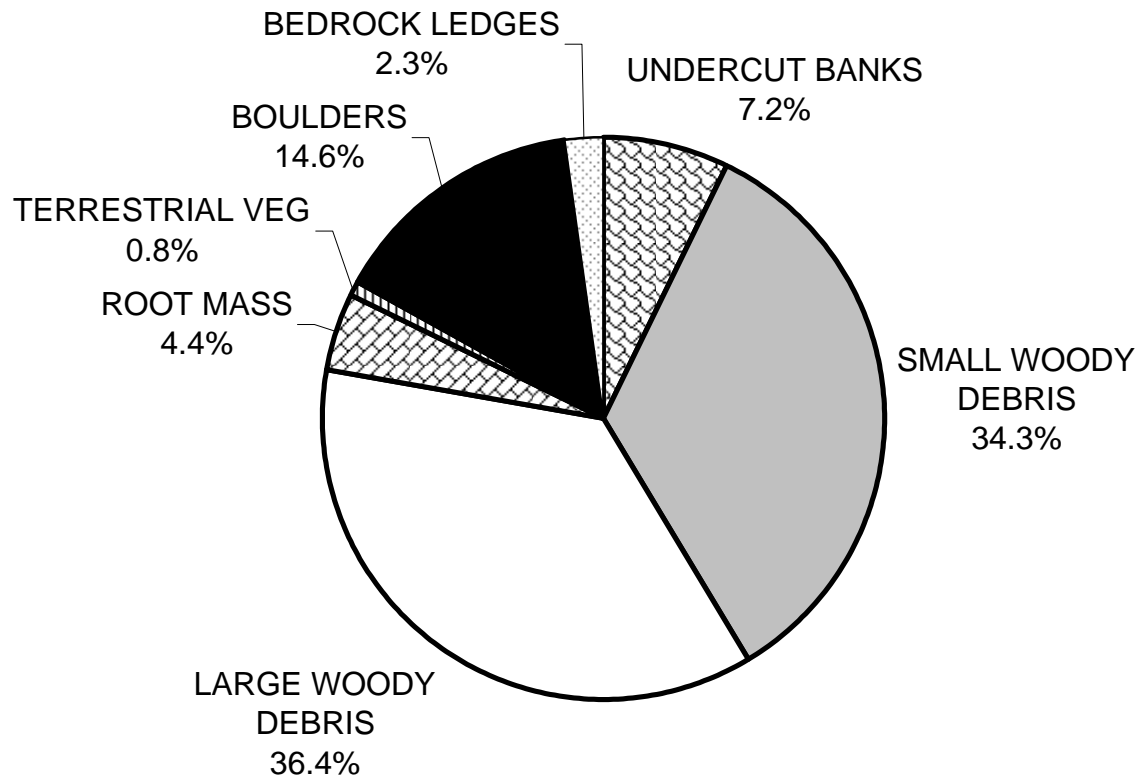
GRAPH 5

# BOOTH GULCH 2012 PERCENT EMBEDDEDNESS



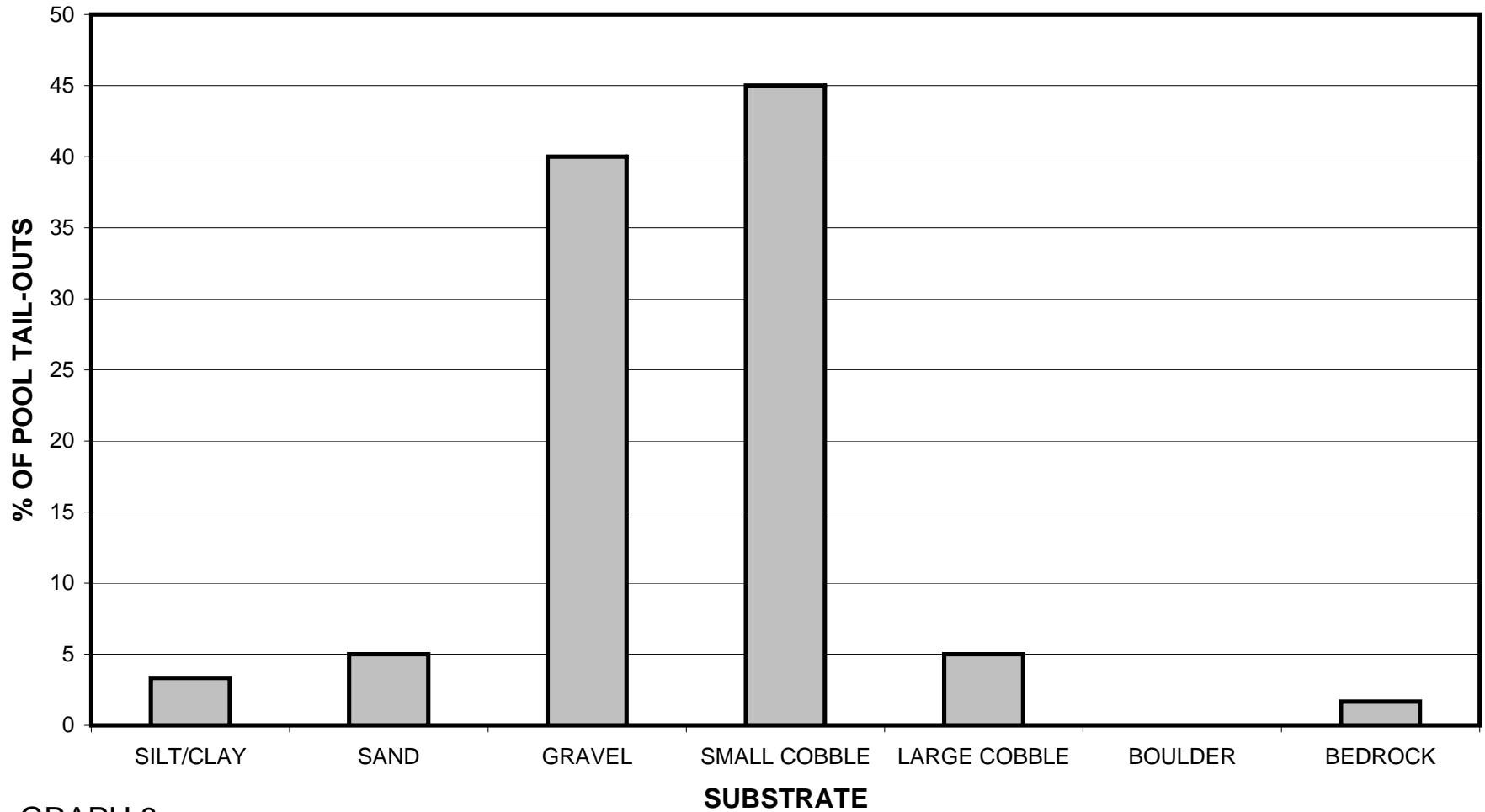
GRAPH 6

# BOOTH GULCH 2012 MEAN PERCENT COVER TYPES IN POOLS



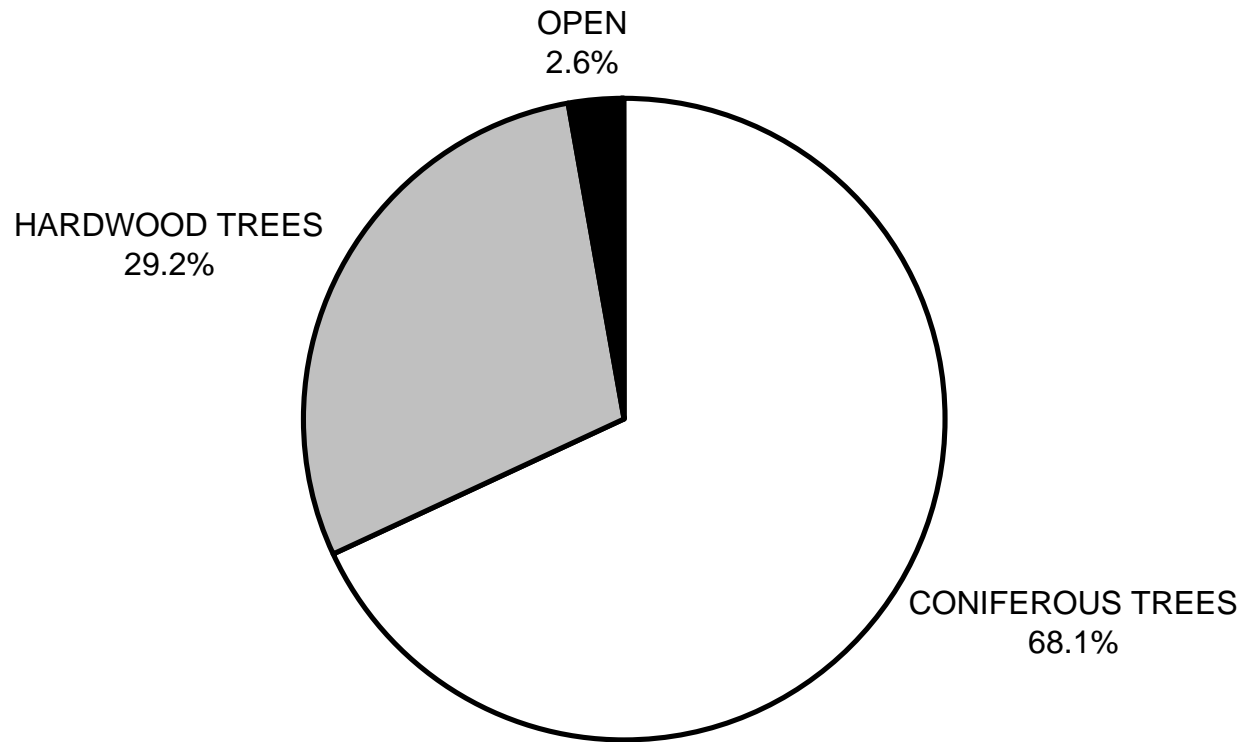
GRAPH 7

# BOOTH GULCH 2012 SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



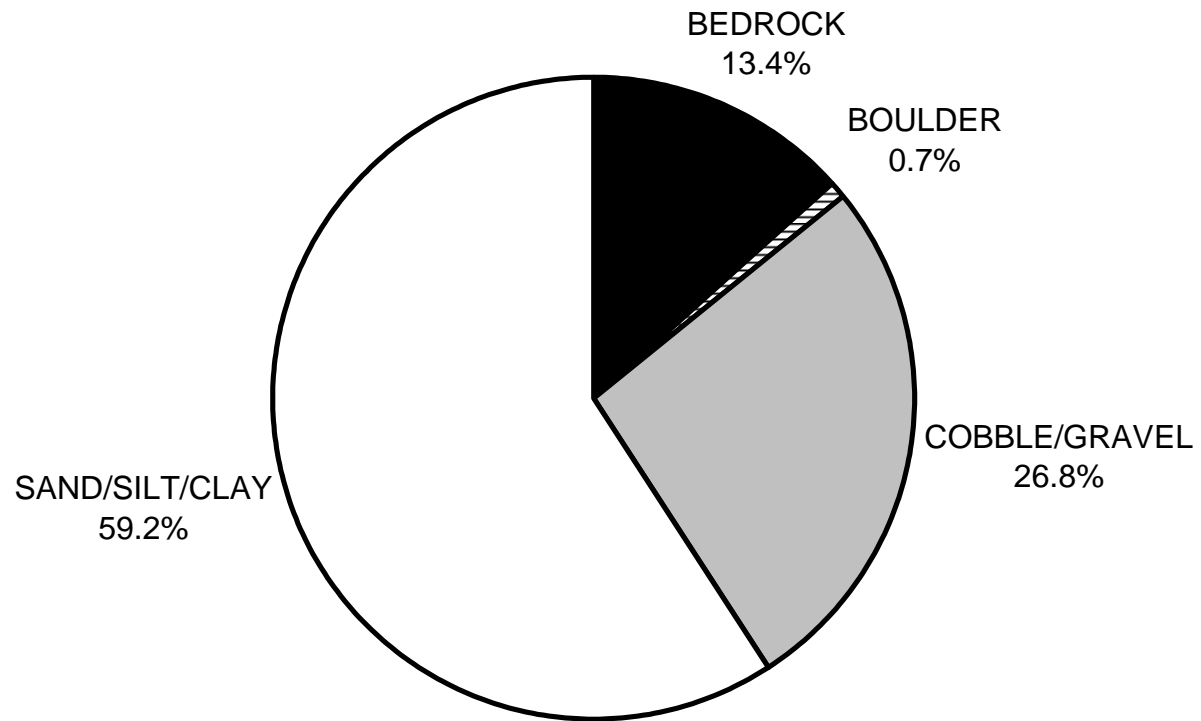
GRAPH 8

# BOOTH GULCH 2012 MEAN PERCENT CANOPY



GRAPH 9

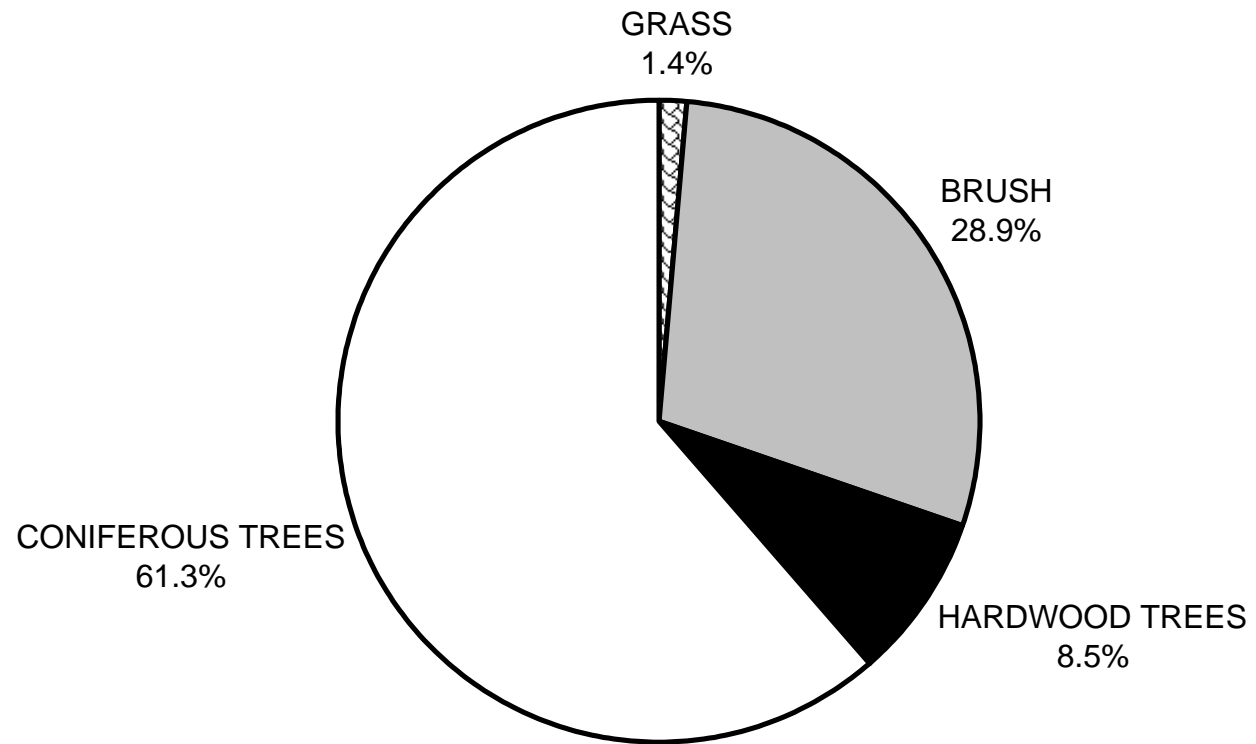
**BOOTH GULCH 2012**  
**DOMINANT BANK COMPOSITION IN SURVEY REACH**



GRAPH 10



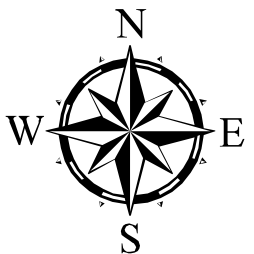
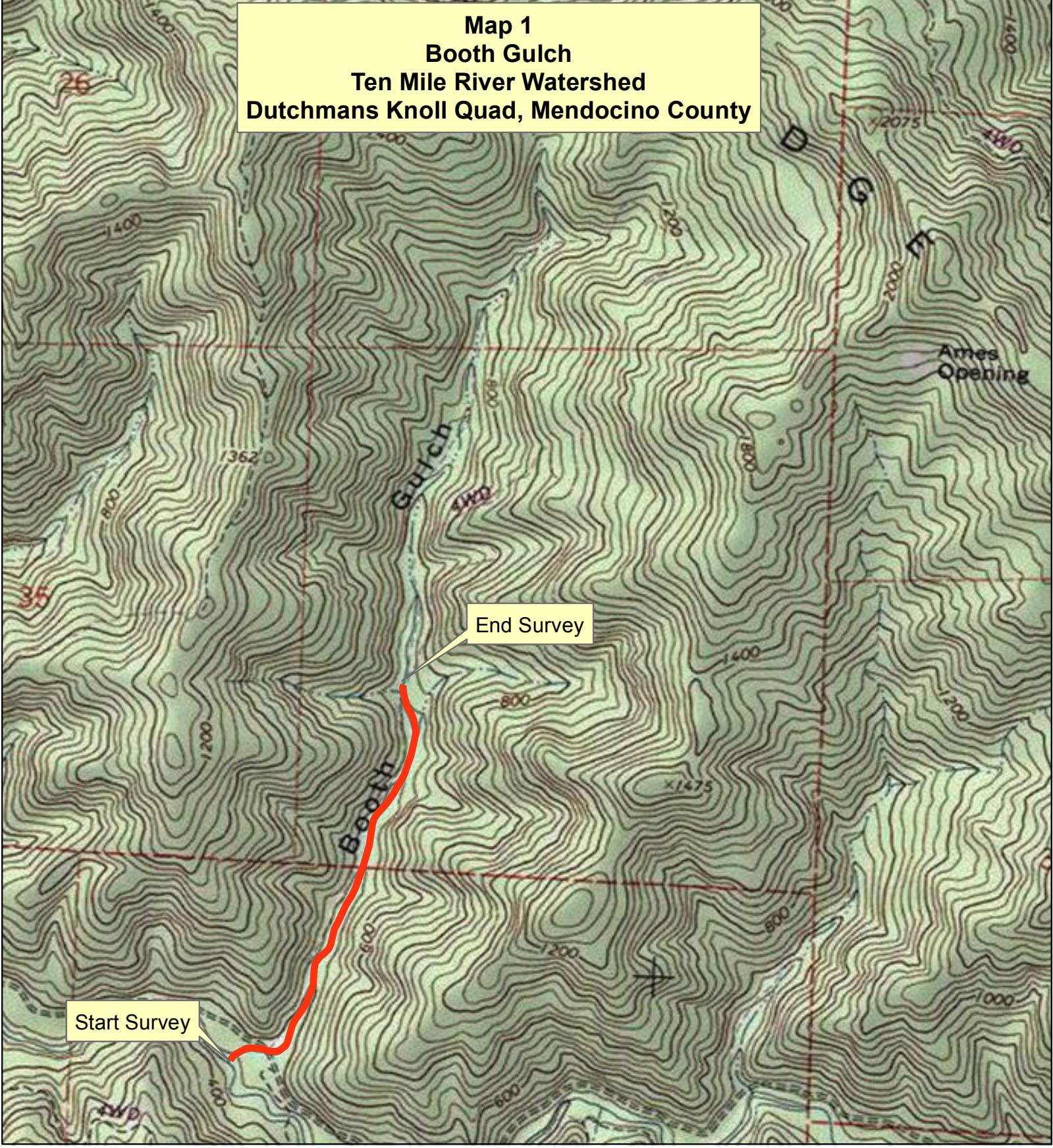
**BOOTH GULCH 2012  
DOMINANT BANK VEGETATION IN SURVEY REACH**



GRAPH 11



**Map 1**  
**Booth Gulch**  
**Ten Mile River Watershed**  
**Dutchmans Knoll Quad, Mendocino County**



— Reach 1, G4 Channel Type

