STREAM INVENTORY REPORT

Ray Gulch

INTRODUCTION

A stream inventory was conducted August 24 to August 30, 2011 on Ray Gulch. The survey began at the confluence with Navarro River and extended upstream 2.3 miles.

The Ray 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 Ray 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

Ray Gulch is a tributary to the Navarro River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Ray Gulch's legal description at the confluence with the Navarro River is T15N R16W S07. Its location is 39.1697 degrees north latitude and 123.6621 degrees west longitude, LLID number 1236609391698. Ray Gulch is a second order stream and has approximately 1.9 miles of blue line stream according to the USGS Elk 7.5 minute quadrangle. Ray Gulch drains a watershed of approximately 3.5 square miles. Elevations range from about 10 feet at the mouth of the creek to 1,070 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 128.

METHODS

The habitat inventory conducted in Ray Gulch 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 DFG. This inventory was conducted by a two-person team.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the

parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the *California Salmonid Stream Habitat Restoration Manual*. This form was used in Ray 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". Ray 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.

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 Ray 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. In Ray 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. Next, 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. The shelter rating is 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 densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Ray 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 Ray 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.

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 Ray Gulch. In addition, five 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 2.0.19, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

- Riffle, Flatwater, and Pool Habitat Types
- Habitat Types and Measured Parameters
- Pool Types
- Maximum Residual Pool Depths by Habitat Types
- Mean Percent Cover by Habitat Type
- Dominant Substrates by Habitat Type
- Mean Percent Vegetative Cover for Entire Stream
- Fish Habitat Inventory Data Summary by Stream Reach (Table 8)
- Mean Percent Dominant Substrate / Dominant Vegetation Type for Entire Stream
- Mean Percent Shelter Cover Types for Entire Stream

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Graphics are produced from the tables using Microsoft Excel. Graphics developed for Ray 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 August 24 to August 30 was conducted by I. Mikus, M. Groff, A Blessing, and T. Anderson (DFG). The total length of the stream surveyed was 12,277. A total of 2,850 feet of Ray Gulch were not surveyed due to a large marsh located 2,461 feet upstream from the confluence with the Navarro River. The data included in this report are for the 9,427 feet actually surveyed.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.08 cfs on August 29, 2011.

Ray Gulch is an F6 channel type for 2,461 feet of the stream surveyed (Reach 1), a marsh for 2,850 feet of the stream surveyed (Reach 2), and a C4 channel type for 6,966 feet of the stream surveyed (Reach 3). F6 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and silt-dominant substrates. C4 channels are meandering point-bar, riffle/pool, alluvial channels with broad well defined floodplain on low gradients and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 50 to 58 degrees Fahrenheit. Air temperatures ranged from 53 to 75 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 50% pool units, 37% flatwater units, 9% riffle units, 4% dry units, and 1% culvert units (Graph 1). Based on total length of Level II habitat types there were 64% flatwater units, 32% pool units, 2% riffle units, and 2% dry units (Graph 2).

Nine Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were mid-channel pool units, 45%; step run units, 25%; and run units, 12%

(Graph 3). Based on percent total length, step run units made up 56%, mid-channel pool units 30%, and run units 7%.

A total of 80 pools were identified (Table 3). Main channel pools were the most frequently encountered at 96% (Graph 4), and comprised 99% 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. Seventeen of the 80 pools (21%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 80 pool tail-outs measured, 57 had a value of 2 (71.2%); three had a value of 4 (3.8%); 20 had a value of 5 (25%) (Graph 6). On this scale, a value of 1 indicates the highest quality of spawning substrate. 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 0, flatwater habitat types had a mean shelter rating of 25, and pool habitats had a mean shelter rating of 32 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 70. Main channel pools had a mean shelter rating of 31 (Table 3).

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

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the dominant substrate observed in 68% of the pool tail-outs. Silt/clay was the next most frequently observed dominant substrate type and occurred in 26% of the pool tail-outs

The mean percent canopy density for the surveyed length of Ray Gulch was 97%. Three percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 50% and 50%, respectively. Graph 9 describes the mean percent canopy in Ray Gulch.

For the stream reach surveyed, the mean percent right bank vegetated was 98%. The mean percent left bank vegetated was 97%. The dominant elements composing the structure of the stream banks consisted of 90% sand/silt/clay, 9% cobble/gravel, 1% bedrock (Graph 10). Grass was the dominant vegetation type observed in 54% of the units surveyed. Additionally, 27% of the units surveyed had coniferous trees as the dominant vegetation type, and 13% had brush as the dominant vegetation type (Graph 11).

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BIOLOGICAL INVENTORY RESULTS

Survey teams conducted an electrofishing survey at five sites for species composition and distribution in Ray Gulch on October 12, 2011. The water temperature taken during the survey period of 1020 hours to 1105 hours was 56 degrees Fahrenheit. The air temperature was 57 degrees Fahrenheit. The sites were sampled by S. Monday, I. Mikus, and M. Groff (DFG).

In reach 1, which comprised the first 2,461 feet of stream, five sites were sampled. The reach sites yielded two young-of-the-year (YOY) steelhead/rainbow trout (SH/RT), two age 1+ SH/RT, one coho salmon YOY, one Chinook salmon YOY, one three-spine stickleback, 10 California roach, and 17 sculpin.

The following chart displays the information yielded from these sites:

2011 Ray Gulch electrofishing observations.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Coho	Chinook
					YOY	1+	2+	YOY	YOY
Reach 1: F6 Channel Type									
10/12/11	1	005	Step-run	305	1	0	0	0	1
	2	006	Pool	317	0	0	0	0	0
	3	007	Pool	369	0	2	0	0	0
	4	012	Step-run	762	0	0	0	0	0
	5	013	Pool	865	1	0	0	1	0

DISCUSSION

Ray Gulch is an F6 channel type for the first 2,461 feet of stream surveyed, a marsh for the next 2,850 feet, and a C4 channel type for the remaining 6,966 feet. The suitability of F6 and C4 channel types for fish habitat improvement structures is as follows: F6 channels are good for bank-placed boulders and fair for plunge weirs, boulder clusters, single and opposing wing-deflectors, and log cover. C4 channels are good for bank placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover.

The water temperatures recorded on the survey days August 24 to August 30, 2011, ranged from 50 to 58 degrees Fahrenheit. Air temperatures ranged from 53 to 75 degrees Fahrenheit. This is a suitable 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.

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Flatwater habitat types comprised 64% of the total length of this survey, riffles 2%, and pools 32%. Seventeen of the 80 (21%) 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 width. Installing log structures that will increase or deepen pool habitat is recommended.

Fifty-seven of the 80 pool tail-outs measured had embeddedness ratings of 1 or 2. Three of the pool tail-outs had embeddedness ratings of 3 or 4. Twenty 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 Ray Gulch should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Fifty-four of the 80 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 32. The shelter rating in the flatwater habitats is 25. 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 Ray Gulch. Small woody debris is the dominant cover type in pools followed by large woody debris. 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 97%. Reach 1 had a canopy density of 95%; Reach 3 had a canopy density of 97%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 98% and 97%, 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.

RECOMMENDATIONS

1) Ray 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 small 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.

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 the Navarro River. The channel is an F6 (Reach 1). The first couple of units are on the Navarro River's gravel bar.
155	0005.00	Small woody debris is accumulating in the channel.
305	0006.00	A landslide on the left bank measures approximately 50' long x 15' high; it is contributing silt and sand to the channel.
357	0008.00	Small woody debris is accumulating in the channel, creating a potential barrier to adult salmonids.
514	0010.00	Highway 128 crosses the channel. The crossing is a 7.6' high x 7.5' wide x 60' long concrete box culvert. There is no plunge at the outlet and the slope of the culvert is 0%. It is not a barrier, but three pieces of large woody debris (LWD) have accumulated against the inlet. The stream currently flows around or under the wood, but the debris has the potential to become a barrier if more wood is recruited.
623	0012.00	Log debris accumulation (LDA) #01 contains 15 pieces of LWD and measures 4.5' high x 22.5' wide x 30' long. Water flows through the LDA and there are visible gaps in it. The LDA is not retaining sediment. Fish are present above the LDA.
2461	0035.00	Approximately 2,850' of stream were not surveyed due to a large marsh; this unsurveyed length is Reach 2. Roller Gulch enters Ray Gulch in this marsh unit. For more information see the 2011 Roller Gulch Stream Habitat Inventory Report.

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5311	0036.00	End of marsh. The channel is a C4 (Reach 3).
9740	0110.00	LDA #02 contains six pieces of LWD and measures 6' high x 13' wide x 12' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to gravel and measures 8' wide x 35' long x 3' deep. Fish are present above the LDA.
9787	0112.00	LDA #03 contains five pieces of LWD and measures 7' high x 12' wide x 17' long. Water does not flow through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures 10' wide x 90' long x 3' deep. Fish are present above the LDA.
10664	0130.00	LDA #04 contains seven pieces of LWD and measures 6' high x 14' wide x 3.5' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures 6' wide x 10' long x 1' deep. Fish are present above the LDA.
10678	0131.00	LDA #05 contains eight pieces of LWD and measures 5.5' high x 20' wide x 22' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to gravel and measures 4' wide x 6' long x 1' deep. Fish are present above the LDA.
12224	0160.00	White Gulch enters on the right bank. The water temperature of the tributary is 52 degrees Fahrenheit, the water temperature downstream of the tributary is 52 degrees Fahrenheit, and the water temperature upstream of the confluence is 50 degrees Fahrenheit. The slope of the tributary is approximately 1%. The tributary is accessible to salmonids, but no fish were observed.
12277	0162.00	End of survey due to lack of access.

REFERENCES

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

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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: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0

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	0.6	60	60	0.6									
6	0	DRY	3.7	26	159	1.7									
60	11	FLATWATER	37.3	100	6021	63.9	5.5	0.6	0.9	715	42901	403	24197		25
1	0	NOSURVEY_		2850	2850										
80	80	POOL	49.7	37	2992	31.7	8.9	0.7	1.6	344	27489	404	32360	294	32
14	2	RIFFLE	8.7	14	195	2.1	4.3	0.2	0.3	43	601	6	87		0

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
162	93	12277	70990	56643

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0W

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 (%)
14	2	LGR	8.7	14	195	2.1	4	0.2	0.4	43	601	6	87		0	100
1	1	GLD	0.6	56	56	0.6	5	1.0	1.4	280	280	280	280		30	100
19	5	RUN	11.8	35	667	7.1	6	0.6	1.4	152	2886	95	1796		25	99
40	5	SRN	24.8	132	5298	56.2	6	0.5	1	1365	54605	737	29467		25	94
73	73	MCP	45.3	38	2786	29.6	9	0.7	5.3	349	25488	417	30419	300	30	97
1	1	CCP	0.6	8	8	0.1	14	0.8	1.4	112	112	101	101	90	10	100
3	3	STP	1.9	52	155	1.6	9	1.0	3.2	473	1419	480	1440	402	48	95
3	3	PLP	1.9	14	43	0.5	11	0.7	1.4	157	471	133	400	119	70	96
6	0	DRY	3.7	26	159	1.7										
1	0	CUL	0.6	60	60	0.6										
1	0	MAR		2850	2850											

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
162	93	12277	85861	63990

Table 3 - Summary of Pool Types

Stream Name: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0W

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
77	77	MAIN	96	38	2949	99	8.8	0.7	351	27019	301	23166	31
3	3	SCOUR	4	14	43	1	11.0	0.7	157	471	119	357	70

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
80	80	2992	27489	23522

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

Stream Name: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0W

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
73	MCP	91	11	15	48	66	9	12	4	5	1	1
1	CCP	1	0	0	1	100	0	0	0	0	0	0
3	STP	4	0	0	0	0	2	67	1	33	0	0
3	PLP	4	0	0	3	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
80	11	14	52	65	11	14	5	6	1	1

Mean Maximum Residual Pool Depth (ft.): 1.6

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011 Dry Units: 6

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0W

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
14	2	LGR	0	0	0	0	0	0	0	0	0
14	2	TOTAL RIFFLE	0	0	0	0	0	0	0	0	0
1	1	GLD	0	20	0	0	80	0	0	0	0
19	5	RUN	15	59	0	5	21	0	0	0	0
40	5	SRN	3	29	30	3	32	3	0	0	0
60	11	TOTAL FLAT	8	42	14	4	31	1	0	0	0
73	73	MCP	19	37	30	1	7	6	0	0	0
1	1	CCP	0	30	70	0	0	0	0	0	0
3	3	STP	27	33	40	0	0	0	0	0	0
3	3	PLP	0	28	72	0	0	0	0	0	0
80	80	TOTAL POOL	18	37	33	1	6	5	0	0	0
1	0	CUL									
1	0	MAR									
162	93	TOTAL	17	37	30	1	10	5	0	0	0

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011 Dry Units: 6

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0W

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
14	2	LGR	0	0	100	0	0	0	0
1	1	GLD	0	0	100	0	0	0	0
19	5	RUN	20	20	60	0	0	0	0
40	5	SRN	20	0	80	0	0	0	0
73	73	MCP	32	16	52	0	0	0	0
1	1	CCP	0	100	0	0	0	0	0
3	3	STP	0	33	67	0	0	0	0
3	3	PLP	0	67	33	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
97	50	50	0	98	97

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: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011 Survey Length (ft.): 12277 Main Channel (ft.): 12277 Side Channel (ft.): 0

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F6
Reach Length (ft.): 2461
Riffle/Flatwater Mean Width (ft.): 6.5
BFW:
Range (ft.): 11 to 13
Mean (ft.): 12
Std. Dev.: 1
Base Flow (cfs.): 0.1
Water (F): 54 - 58 Air (F): 53 - 70
Dry Channel (ft): 0

Canopy Density (%): 95.0
Coniferous Component (%): 29.0
Hardwood Component (%): 71.0
Dominant Bank Vegetation: Brush
Vegetative Cover (%): 90.7
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 26
LWD per 100 ft.:
Riffles: 0
Pools: 3
Flat: 4

Pools by Stream Length (%): 61.4
Pool Frequency (%): 58.8
Residual Pool Depth (%):
< 2 Feet Deep: 80
2 to 2.9 Feet Deep: 10
3 to 3.9 Feet Deep: 5
>= 4 Feet Deep: 5
Mean Max Residual Pool Depth (ft.): 1.6
Mean Pool Shelter Rating: 18

Pool Tail Substrate (%): Silt/Clay: 90 Sand: 0 Gravel: 10 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 0

Embeddedness Values (%): 1. 0.0 2. 0.0 3. 0.0 4. 15.0 5. 85.0

STREAM REACH: 2

Channel Type: NA
Reach Length (ft.): 2850
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): 11 to 11
Mean (ft.): 11
Std. Dev.: 0
Base Flow (cfs.): 0.1
Water (F): 54 - 54 Air (F): 53 - 53
Dry Channel (ft): 0

Canopy Density (%):
Coniferous Component (%):
Hardwood Component (%):
Dominant Bank Vegetation:
Vegetative Cover (%): 0.0
Dominant Shelter:
Dominant Bank Substrate Type:
Occurrence of LWD (%):
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 0.0
Pool Frequency (%): 0.0
Residual Pool Depth (%):
< 2 Feet Deep:
2 to 2.9 Feet Deep:
3 to 3.9 Feet Deep:
>= 4 Feet Deep:
Mean Max Residual Pool Depth (ft.):
Mean Pool Shelter Rating:

Pool Tail Substrate (%): Silt/Clay: Sand: Gravel: Sm Cobble: Lg Cobble: Boulder: Bedrock:

Embeddedness Values (%): 1. 2. 3. 4. 5. 0.0

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

Channel Type: C4
Reach Length (ft.): 6966
Riffle/Flatwater Mean Width (ft.): 5.3
BFW:
Range (ft.): 6 to 19
Mean (ft.): 13
Std. Dev.: 4
Base Flow (cfs.): 0.1
Water (F): 50 - 52 Air (F): 55 - 75
Dry Channel (ft): 159

Canopy Density (%): 97.0
Coniferous Component (%): 56.1
Hardwood Component (%): 43.9
Dominant Bank Vegetation: Grass
Vegetative Cover (%): 99.8
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 29
LWD per 100 ft.:
Riffles: 0
Pools: 7
Flat: 2

Pools by Stream Length (%): 21.3
Pool Frequency (%): 47.2
Residual Pool Depth (%):
< 2 Feet Deep: 78
2 to 2.9 Feet Deep: 15
3 to 3.9 Feet Deep: 7
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 1.6
Mean Pool Shelter Rating: 37

Pool Tail Substrate (%): Silt/Clay: 5 Sand: 8 Gravel: 87 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 0

Embeddedness Values (%): 1. 0.0 2. 95.0 3. 0.0 4. 0.0 5. 5.0

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0W

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	1	0	0.5
Boulder	0	0	0.0
Cobble / Gravel	12	5	9.3
Sand / Silt / Clay	78	86	90.1

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	51	47	53.8
Brush	14	10	13.2
Hardwood Trees	4	5	4.9
Coniferous Trees	22	28	27.5
No Vegetation	0	1	0.5

Total Stream Cobble Embeddedness Values: 3

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

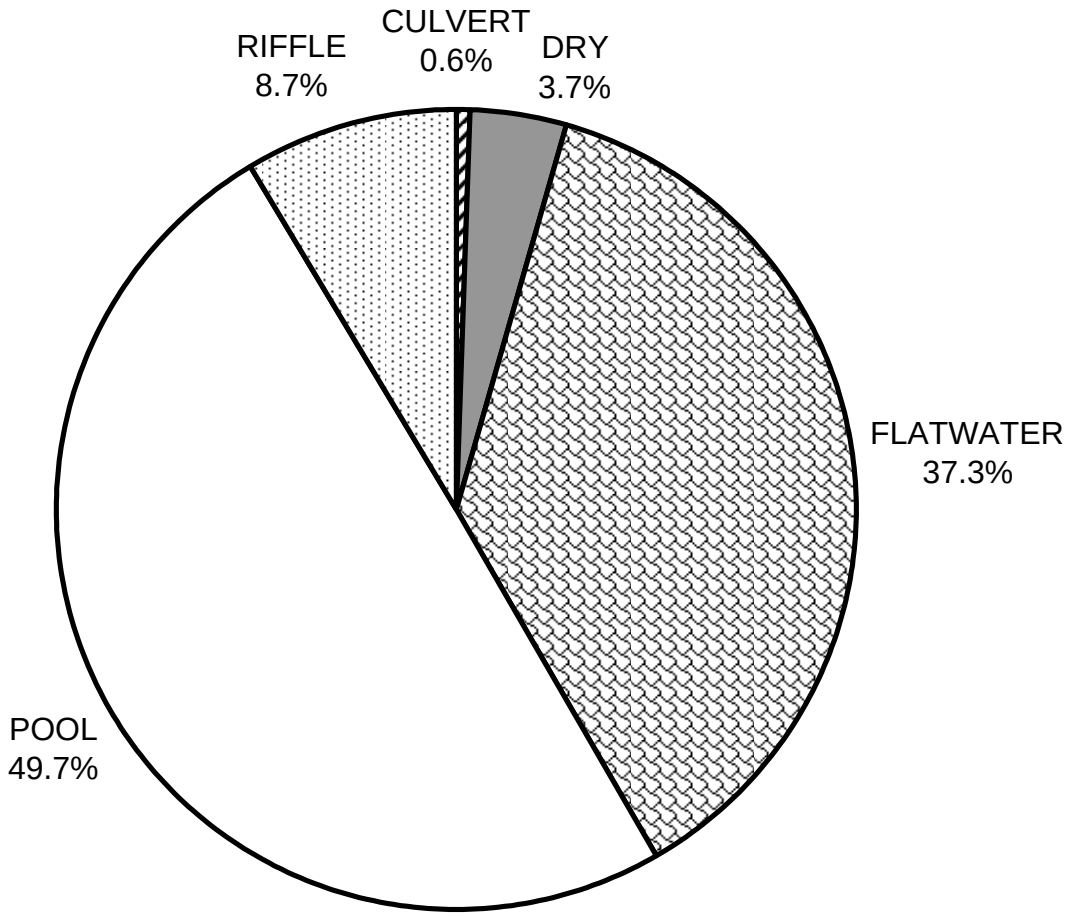
StreamName: Ray Gulch LLID: 1236609391698 Drainage: Navarro River

Survey Dates: 8/24/2011 to 8/30/2011

Confluence Location: Quad: ELK Legal Description: T15NR16WS07 Latitude: 39:10:11.0N Longitude: 123:39:39.0W

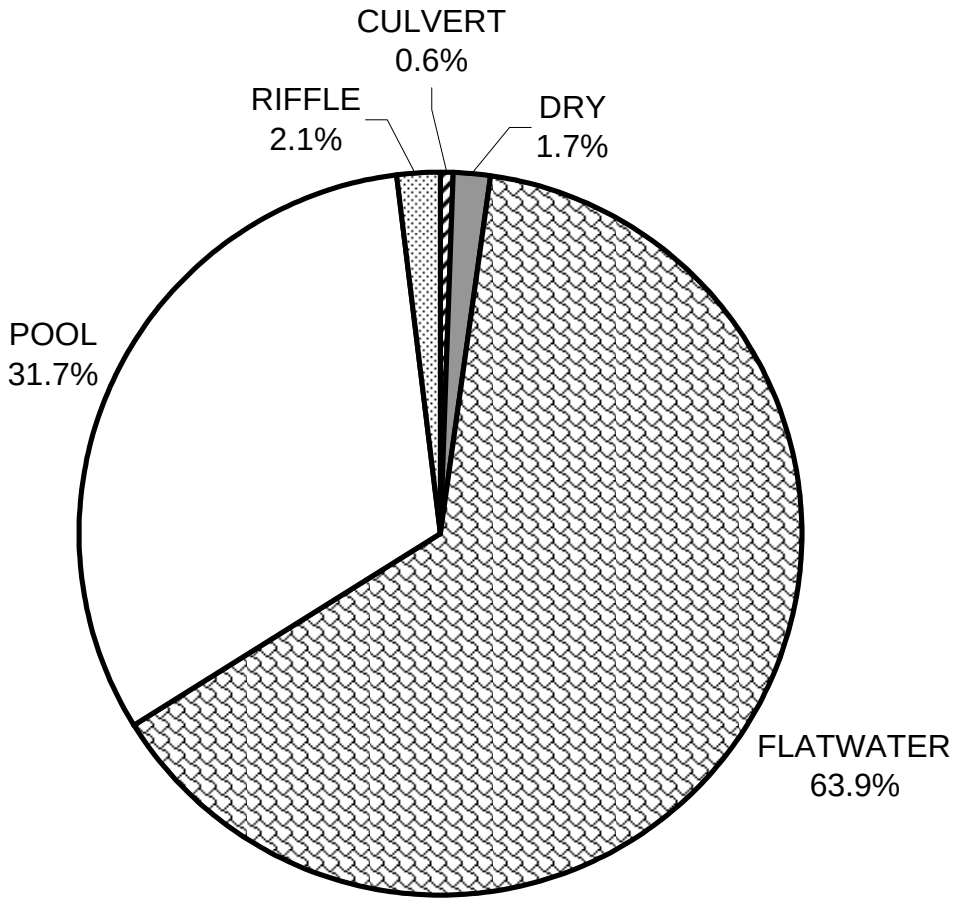
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	8	18
SMALL WOODY DEBRIS (%)	0	42	37
LARGE WOODY DEBRIS (%)	0	14	33
ROOT MASS (%)	0	4	1
TERRESTRIAL VEGETATION (%)	0	31	6
AQUATIC VEGETATION (%)	0	1	5
WHITEWATER (%)	0	0	0
BOULDERS (%)	0	0	0
BEDROCK LEDGES (%)	0	0	0

RAY GULCH 2011
HABITAT TYPES BY PERCENT OCCURRENCE



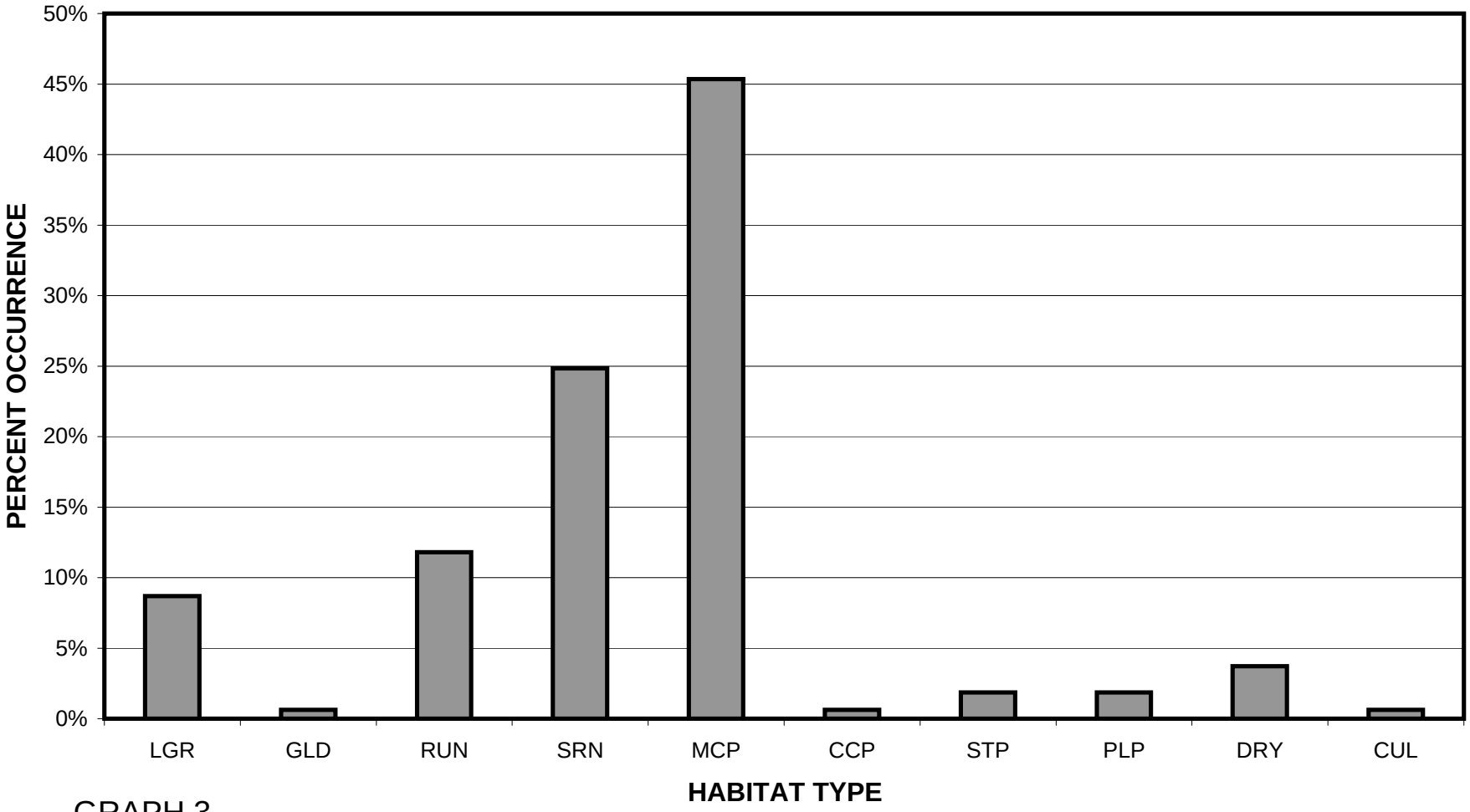
GRAPH 1

RAY GULCH 2011
HABITAT TYPES BY PERCENT TOTAL LENGTH



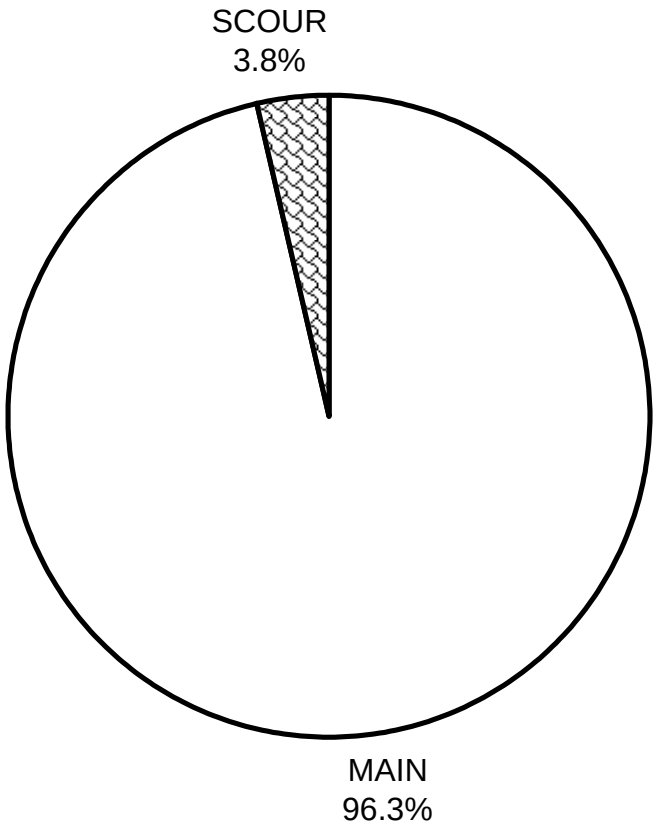
GRAPH 2

RAY GULCH 2011
HABITAT TYPES BY PERCENT OCCURRENCE



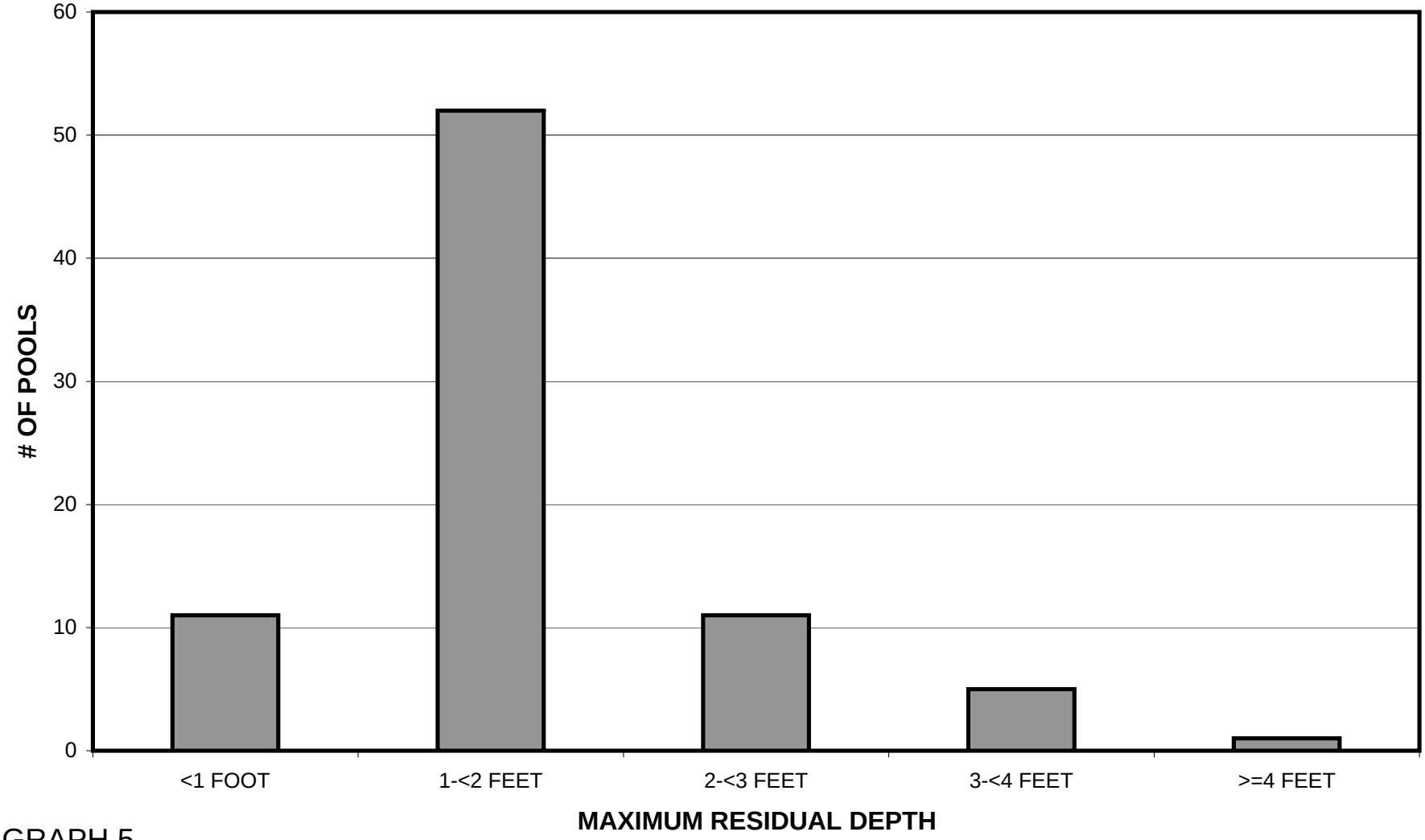
GRAPH 3

RAY GULCH 2011
POOL TYPES BY PERCENT OCCURRENCE



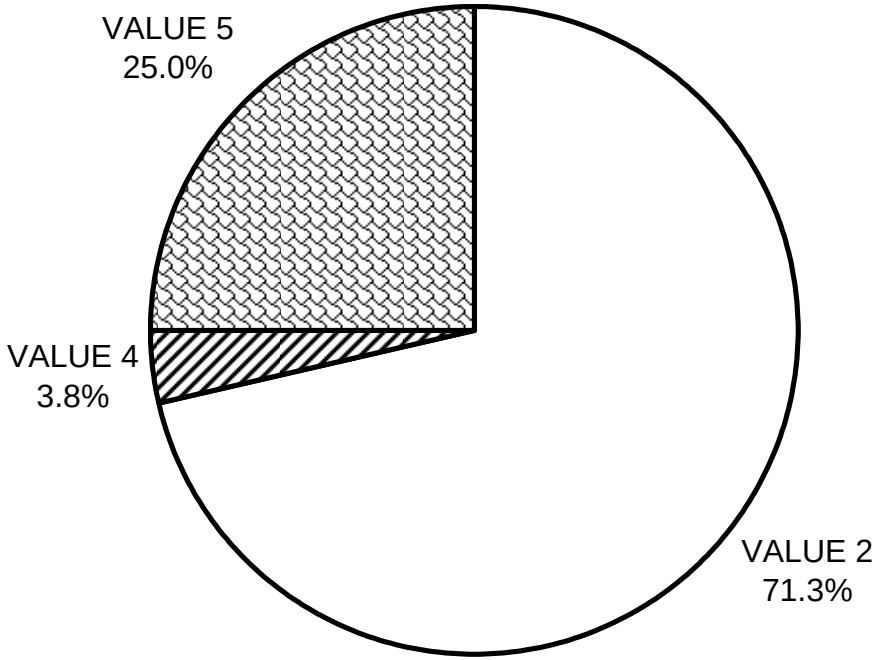
GRAPH 4

RAY GULCH 2011
MAXIMUM DEPTH IN POOLS



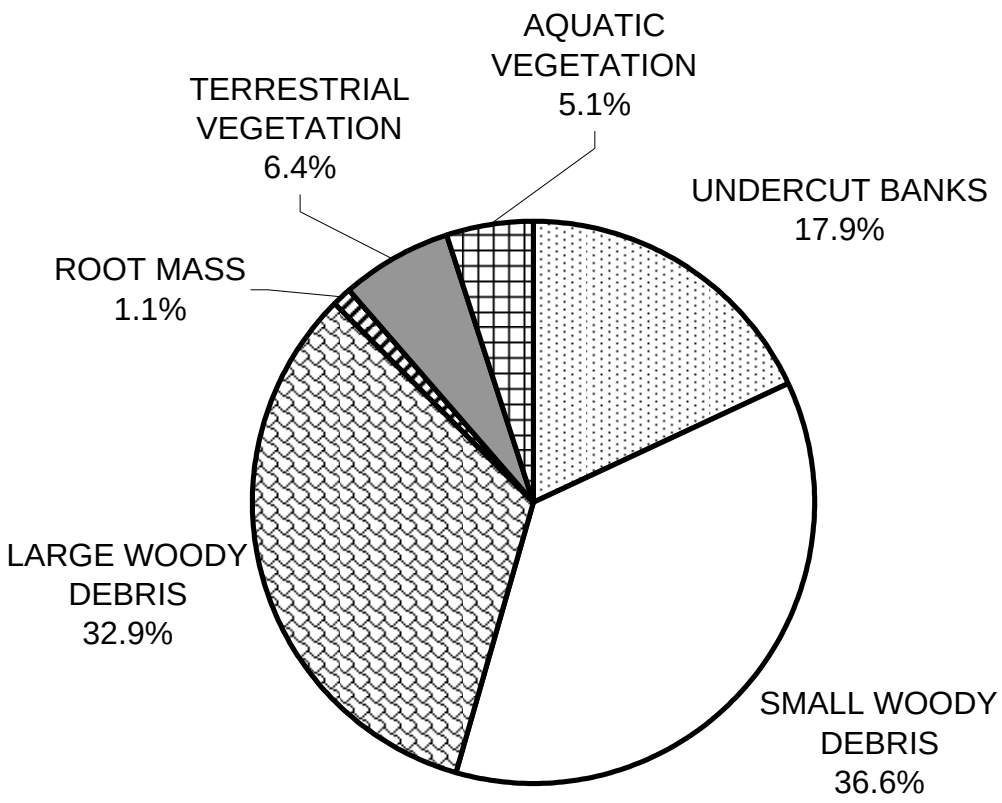
GRAPH 5

RAY GULCH 2011
PERCENT EMBEDDEDNESS



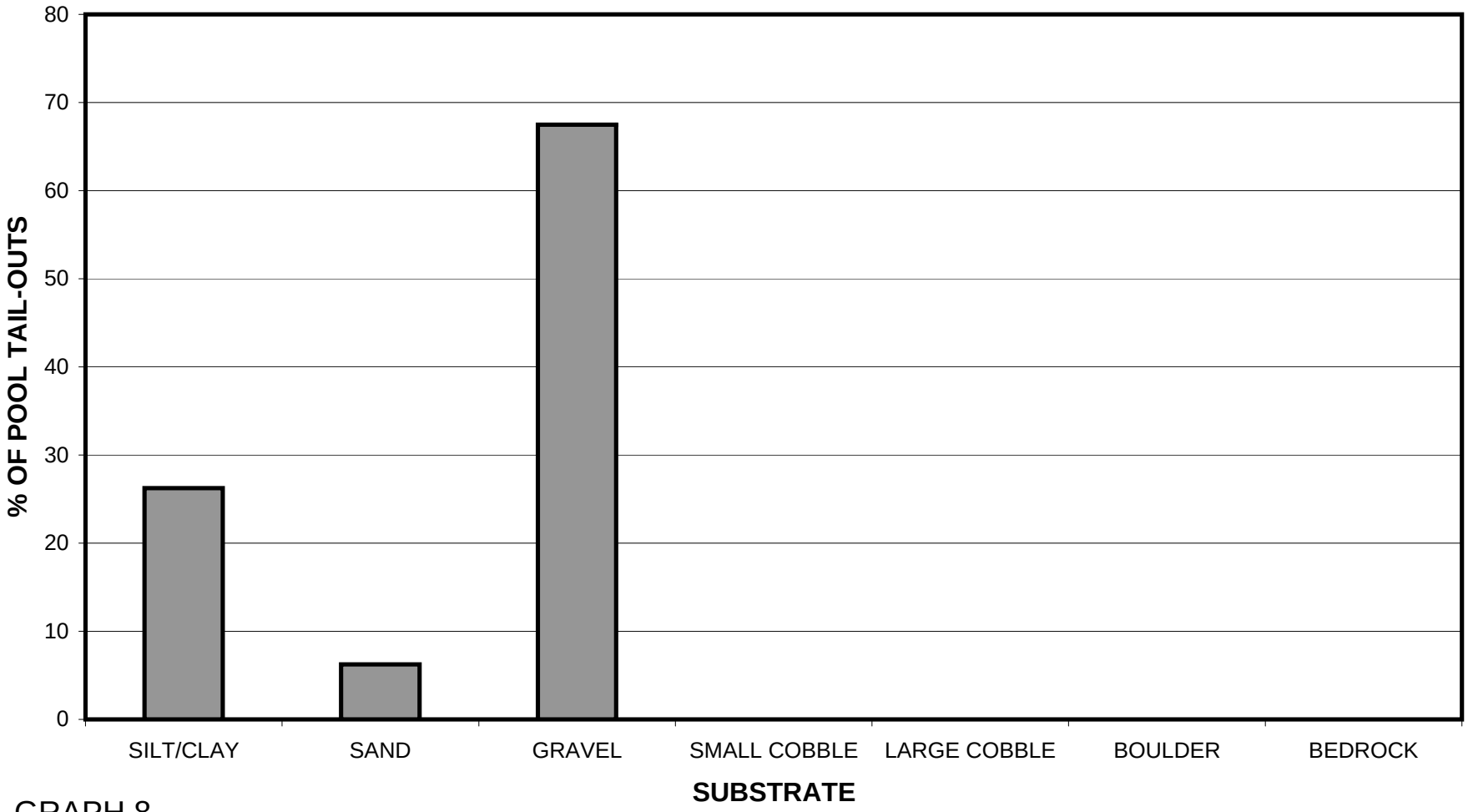
GRAPH 6

RAY GULCH 2011
MEAN PERCENT COVER TYPES IN POOLS



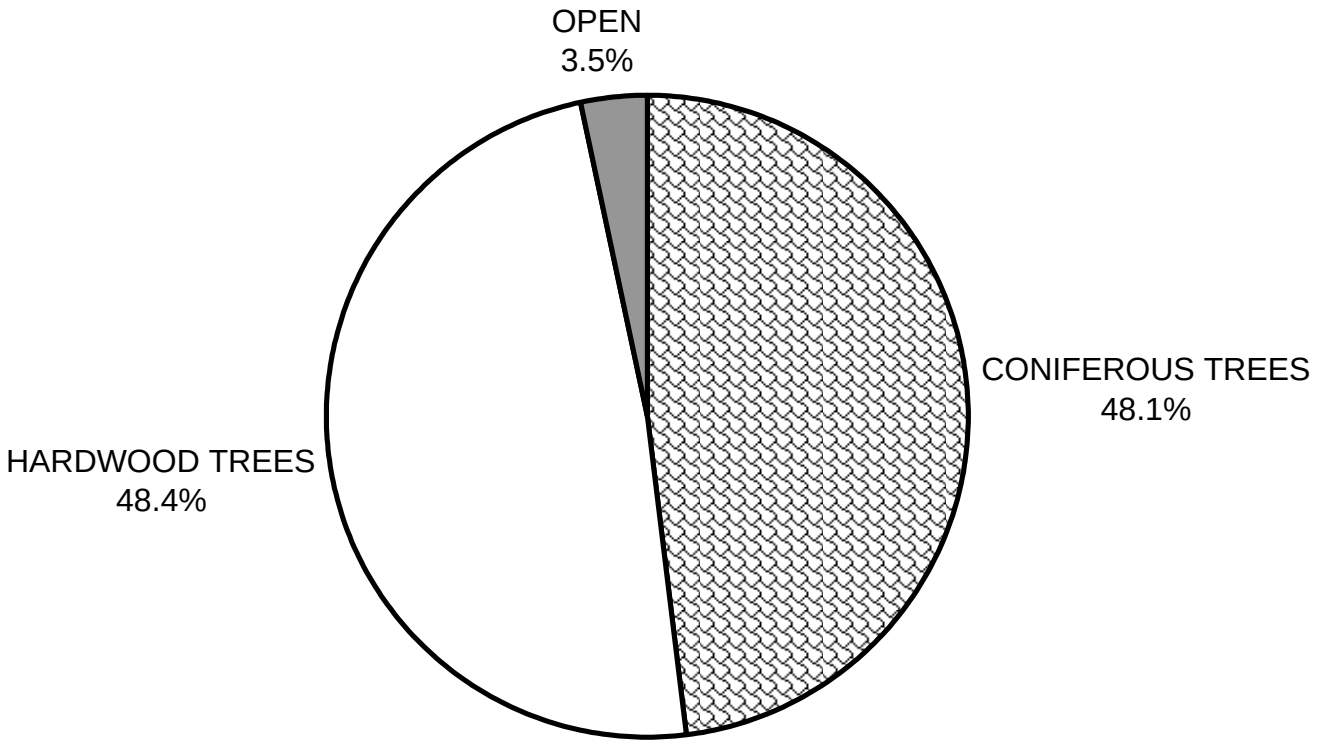
GRAPH 7

RAY GULCH 2011
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



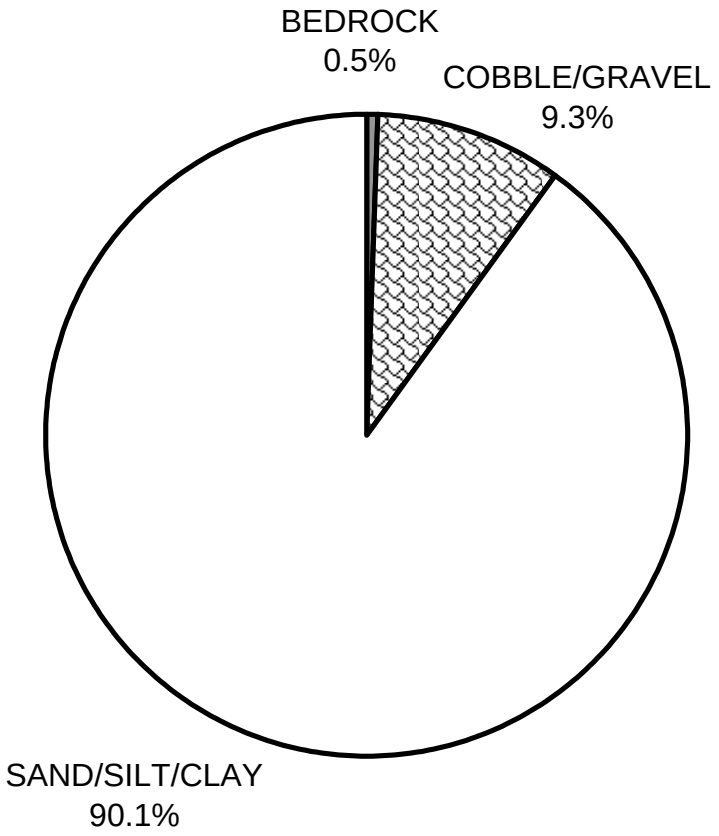
GRAPH 8

RAY GULCH 2011
MEAN PERCENT CANOPY



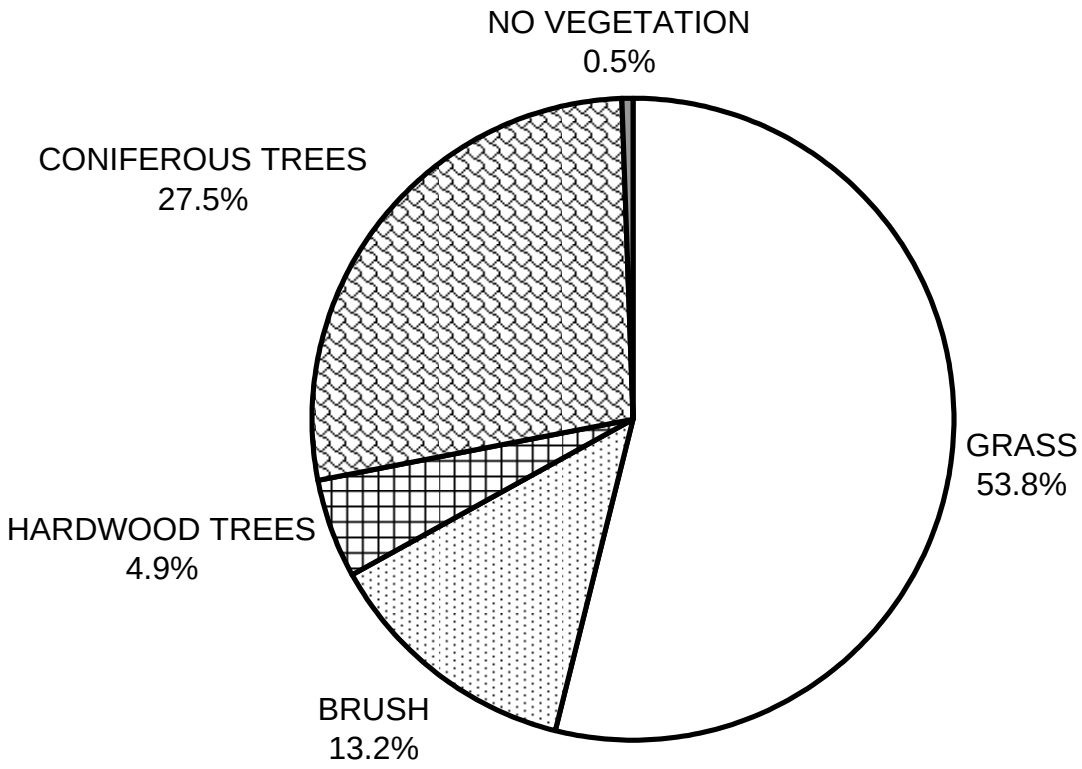
GRAPH 9

RAY GULCH 2011
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

RAY GULCH 2011
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11