STREAM INVENTORY REPORT

Arvola Gulch

INTRODUCTION

A stream inventory was conducted May 23 to June 14, 2011 on Arvola Gulch. The survey began at the confluence with Chamberlain Creek and extended upstream 0.8 miles.

The Arvola 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 Arvola 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

Arvola Gulch is a tributary to Chamberlain Creek, tributary to North Fork Big River, tributary to Big River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Arvola Gulch's legal description at the confluence with Chamberlain Creek is T18N R15W S28. Its location is 39.3809 degrees north latitude and 123.5466 degrees west longitude, LLID number 1235454393808. Arvola Gulch is a second order stream and has approximately 0.9 miles of blue line stream according to the USGS Northspur 7.5 minute quadrangle. Arvola Gulch drains a watershed of approximately 1.6 square miles. Elevations range from about 500 feet at the mouth of the creek to 1000 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is in the Jackson Demonstration State Forest and is managed for timber production. Vehicle access exists via U.S Highway 20.

METHODS

The habitat inventory conducted in Arvola 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) or 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 Arvola 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". Arvola 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 Arvola 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. 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 Arvola 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. 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 Arvola 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 Arvola 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 Arvola Gulch. In addition, underwater observations were made at 13 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 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 Arvola 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 May 23 to June 14, 2011 was conducted by K. Christen, E. Kantorski, S. Cannon, and K. Nystrom (WSP). The total length of the stream surveyed was 4,214 feet.

Stream flow was measured near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter at 0.56 cfs on May 24, 2011.

Arvola Gulch is a B4 channel type for 4,214 feet of the stream surveyed (Reach 1). B4 channels are moderately entrenched, moderate gradient, riffle dominated channel with infrequently spaced pools, very stable plan and profile, stable banks and gravel-dominant substrates.

Water temperatures taken during the survey period ranged from 49 to 56 degrees Fahrenheit. Air temperatures ranged from 50 to 76 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 36% riffle units, 32% pool units, 31% flatwater units, and 1% culvert units (Graph 1). Based on total length of Level II habitat types there were 46% flatwater units, 33% riffle units, 20% pool units, and 1% culvert units (Graph 2).

Six Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units, 31%; mid-channel pool units, 21%; and step run units, 19% (Graph 3). Based on percent total length, step run units made up 39%, low gradient riffle units 30%, and mid-channel pool units 14%.

A total of 45 pools were identified (Table 3). Main channel pools were the most frequently encountered at 64% (Graph 4), and comprised 73% of the total length of all pools (Table 3).

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Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. Nine of the 45 pools (20%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 45 pool tail-outs measured, 27 had a value of 1 (60%); 16 had a value of 2 (35.6%); and 2 had a value of 3 (4.4%) (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 9, flatwater habitat types had a mean shelter rating of 3, and pool habitats had a mean shelter rating of 24 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 40. Main channel pools had a mean shelter rating of 16 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Arvola Gulch. Graph 7 describes the pool cover in Arvola 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. Gravel was the dominant substrate observed in 76% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 18% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Arvola Gulch was 91%. Nine percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 41% and 59%, respectively. Graph 9 describes the mean percent canopy in Arvola Gulch.

For the stream reach surveyed, the mean percent right bank vegetated was 94%. The mean percent left bank vegetated was 92%. The dominant elements composing the structure of the stream banks consisted of 62% cobble/gravel, 29% sand/silt/clay, 9% bedrock, and 1% boulder (Graph 10). Coniferous trees were the dominant vegetation type observed in 65% of the units surveyed. Additionally, 17% of the units surveyed had deciduous trees as the dominant vegetation type, and 12% had brush as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 13 sites for species composition and distribution in Arvola Gulch on July 12, 2011. The water temperature taken during the survey period of 1345 hours to 1525 hours was 58 degrees Fahrenheit. Air temperatures ranged from 72 to 75 degrees Fahrenheit. The sites were sampled by I. Mikus and M. Groff (DFG).

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In reach 1, which comprised the first 4,214 feet of stream, 13 sites were sampled. The reach sites yielded 20 young-of-the-year steelhead/rainbow trout (SH/RT), two age 1+ SH/RT, and four coho.

The following chart displays the information yielded from these sites:

2011 Arvola Gulch underwater observations.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	SH/RT			Coho	
					YOY	1+	2+	YOY	1+
Reach 1: B4 Channel Type									
07/12/11	1	002	Pool	68	3	0	0	1	0
07/12/11	2	006	Pool	213	2	1	0	2	0
07/12/11	3	010	Pool	370	3	0	0	1	0
07/12/11	4	021	Pool	627	3	1	0	0	0
07/12/11	5	025	Pool	794	2	0	0	0	0
07/12/11	6	029	Pool	898	0	0	0	0	0
07/12/11	7	036	Pool	1,108	0	0	0	0	0
07/12/11	8	040	Pool	1,223	0	0	0	0	0
07/12/11	9	055	Pool	1,568	1	0	0	0	0
07/12/11	10	114	Pool	3,209	4	0	0	0	0
07/12/11	11	120	Pool	3,479	2	0	0	0	0
07/12/11	12	130	Pool	3,818	0	0	0	0	0
07/12/11	13	133	Pool	3,858	0	0	0	0	0

DISCUSSION

Arvola Gulch is a B4 channel type for the entire length of the survey, 4,214 feet. The suitability of B4 channel types for fish habitat improvement structures is as follows: B4 channel types are 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 days May 23 to June 14, 2011, ranged from 49 to 56 degrees Fahrenheit. Air temperatures ranged from 50 to 76 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 46% of the total length of this survey, riffles 33%, and pools 20%. Nine of the 45 (20%) 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 large wood structures that will increase or deepen pool habitat is recommended.

Forty-three of the 45 pool tail-outs measured had embeddedness ratings of 1 or 2. Two 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.

Forty-two of the 45 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 24. The shelter rating in the flatwater habitats is 3. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by large woody debris in Arvola 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 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 91%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 94% and 92%, 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) Arvola 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) 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.

4) 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.

5) Conduct a fish passage assessment at the stream crossing located at 3380'. Replace the crossing if it is determined it does not meet DFG fish passage criteria.

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 #:	Comment:
0	0001.00	Start of survey at the confluence with Chamberlain Creek. The channel is a B4 for the entire length of the survey, 4,214 feet.
484	0016.00	There is a 1.8' high plunge.
560	0019.00	Log debris accumulation (LDA) #01 contains six pieces of large woody debris (LWD) and measures 4.5' high x 15' wide x 6' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to cobble and measures 7' wide x 30' long x 1' deep. Fish were observed above the LDA.
779	0025.00	LDA #02 contains nine pieces of LWD and measures 7' high x 21' wide x 25' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to large cobble and measures 21' wide x 30' long x 2' deep. There is a 3.3' high plunge over the LDA. Fish were observed above the LDA.
927	0031.00	LDA #03 contains 26 pieces of LWD and measures 8.5' high x 39' wide x 10' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to boulders and measures 23' wide x 50' long x 6' deep. There is a 5.5' high plunge over the LDA. Fish were observed above the LDA.
945	0032.00	There is a 1.3' high plunge.
1725	0055.00	LDA #04 contains 19 pieces of LWD and measures 5.5' high x 26' wide x 25' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to boulder and measures 21' wide x 38' long x 4' deep. Fish were observed above the LDA.

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1834	0059.00	There is a 1.7' high plunge.
1846	0060.00	Two pieces of sheet metal are in the water, creating some shelter.
2088	0063.00	There is a 0.75' high plunge.
2203	0065.00	There is a 0.5' high plunge.
2478	0070.00	There is a 0.7' high plunge.
2556	0074.00	There is a 3' high plunge over bedrock and LWD.
2642	0080.00	There is a 2' high plunge over bedrock.
2904	0090.00	There is a 1.1' high plunge.
2913	0091.00	Dry tributary on the left bank. The tributary enters through a 1.5' diameter culvert 7.5' feet off the ground.
3107	0103.00	LDA #05 contains seven pieces of LWD and measures 7.5' high x 18' wide x 9' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to large cobble and measures 8' wide x 10' long x 5.5' deep. Fish were observed above the LDA. Tributary #01 enters on the left bank. It contributes less than 1% to Arvola Gulch's flow. The water temperature downstream of the tributary is 52 degrees Fahrenheit, the water temperature of the tributary is 50 degrees Fahrenheit, and the water temperature upstream of the confluence is 53 degrees Fahrenheit. The tributary is not accessible to fish because the channel is full of debris and the flow is subsurface at the mouth.
3128	0105.00	There is a 2' high plunge.
3227	0111.00	Tributary #02 enters on the left bank. It contributes less than 1% to Arvola Gulch's flow. The water temperature downstream and upstream of the tributary is 54 degrees Fahrenheit; the water temperature of the tributary is 54 degrees Fahrenheit. The tributary is not accessible to salmonids.
3323	0114.00	There is a 0.7' high plunge.
3380	0118.00	A logging road crosses the channel. The crossing is a 13' high x 12.8' wide x 50.5' long arch culvert. The arch of the culvert is made of corrugated metal pipe (CMP). The bottom of the culvert is concrete. The concrete near the outlet is starting to wear, exposing rebar. The

		culvert has no baffles or weirs. There is a 2.8' high plunge from outlet. It is a possible barrier to juvenile and adult salmonids.
3652	0123.00	There is a dry tributary on right bank.
3966	0133.00	There is a 2.1' high plunge.
4102	0136.00	There is a 1.6' high plunge. LWD is accumulating in the channel and creating a potential LDA.
4145	0139.00	Tributary #03 enters on the right bank. The water temperature downstream of the tributary is 54 degrees Fahrenheit, the water temperature of the tributary is 54 degrees Fahrenheit, and the water temperature upstream of the confluence is 55 degrees Fahrenheit. The tributary is not accessible to fish.
4183	0140.00	End of survey. The channel is clogged with woody debris, due to a landslide. The debris is creating a possible barrier to salmonids. Approximately 500’ upstream of the end of survey point there is an 8 foot plunge over an embedded log that is the end of anadromy.

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: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0

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	0.7	51	51	1.2									
43	11	FLATWATER	30.7	45	1942	46.1	6.5	0.5	0.7	167	7192	69	2952		3
45	45	POOL	32.1	19	837	19.9	8.8	0.6	1.4	153	6886	138	6203	91	24
51	8	RIFFLE	36.4	27	1384	32.8	7.0	0.3	0.6	104	5291	34	1723		9

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
140	64	4214	19369	10879

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0W

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 (%)
43	4	LGR	30.7	29	1254	29.8	7	0.3	0.8	118	5077	34	1481		4	94
8	4	HGR	5.7	16	130	3.1	7	0.4	0.8	89	715	33	265		14	89
17	6	RUN	12.1	18	308	7.3	6	0.5	1	112	1901	50	856		3	92
26	5	SRN	18.6	63	1634	38.8	7	0.4	0.9	234	6078	91	2356		3	91
29	29	MCP	20.7	21	607	14.4	7	0.5	2.4	146	4241	121	3513	75	16	89
16	16	PLP	11.4	14	230	5.5	12	0.7	2.7	165	2645	168	2690	120	40	94
1	0	CUL	0.7	51	51	1.2										

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
140	64	4214	20658	11161

Table 3 - Summary of Pool Types

Stream Name: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0W

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
29	29	MAIN	64	21	607	73	7.1	0.5	146	4241	75	2164	16
16	16	SCOUR	36	14	230	27	11.9	0.7	165	2645	120	1914	40

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
45	45	837	6886	4077

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

Stream Name: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0W

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
29	MCP	64	13	45	12	41	4	14	0	0	0	0
16	PLP	36	1	6	10	63	5	31	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
45	14	31	22	49	9	20	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.4

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011 Dry Units: 0

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0W

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
43	4	LGR	0	38	0	0	0	0	20	43	0
8	4	HGR	0	7	7	0	0	0	47	40	0
51	8	TOTAL RIFFLE	0	19	4	0	0	0	36	41	0
17	6	RUN	0	25	34	0	1	0	0	40	0
26	5	SRN	0	40	3	0	10	0	0	47	0
43	11	TOTAL FLAT	0	31	21	0	5	0	0	43	0
29	29	MCP	10	22	37	7	1	1	4	13	4
16	16	PLP	11	9	27	4	1	0	40	5	4
45	45	TOTAL POOL	11	17	33	6	1	0	17	10	4
1	0	CUL									
140	64	TOTAL	8	19	29	5	1	0	17	17	3

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011 Dry Units: 0

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0W

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
43	4	LGR	0	0	75	25	0	0	0
8	4	HGR	0	0	0	50	25	0	25
17	6	RUN	0	0	50	50	0	0	0
26	5	SRN	0	0	40	60	0	0	0
29	29	MCP	3	7	62	21	3	0	3
16	16	PLP	0	6	69	19	6	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
91	59	41	0	94	92

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: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011 Survey Length (ft.): 4214 Main Channel (ft.): 4214 Side Channel (ft.): 0

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: B4
Reach Length (ft.): 4214
Riffle/Flatwater Mean Width (ft.): 6.7
BFW:
Range (ft.): 10 to 18
Mean (ft.): 13
Std. Dev.: 2
Base Flow (cfs.): 0.6
Water (F): 49 - 56 Air (F): 50 - 76
Dry Channel (ft): 0

Canopy Density (%): 91.1
Coniferous Component (%): 58.9
Hardwood Component (%): 41.1
Dominant Bank Vegetation: Coniferous Trees
Vegetative Cover (%): 92.9
Dominant Shelter: Large Woody Debris
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 26
LWD per 100 ft.:
Riffles: 4
Pools: 12
Flat: 3

Pools by Stream Length (%): 19.9
Pool Frequency (%): 32.1
Residual Pool Depth (%):
< 2 Feet Deep: 80
2 to 2.9 Feet Deep: 20
3 to 3.9 Feet Deep: 0
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 1.4
Mean Pool Shelter Rating: 24

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 76 Sm Cobble: 18 Lg Cobble: 7 Boulder: 0 Bedrock: 0

Embeddedness Values (%): 1. 60.0 2. 35.6 3. 4.4 4. 0.0 5. 0.0

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0W

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	3	8.6
Boulder	0	1	0.8
Cobble / Gravel	42	37	61.7
Sand / Silt / Clay	14	23	28.9

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	5	3	6.3
Brush	8	7	11.7
Hardwood Trees	17	5	17.2
Coniferous Trees	34	49	64.8
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values: 1

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

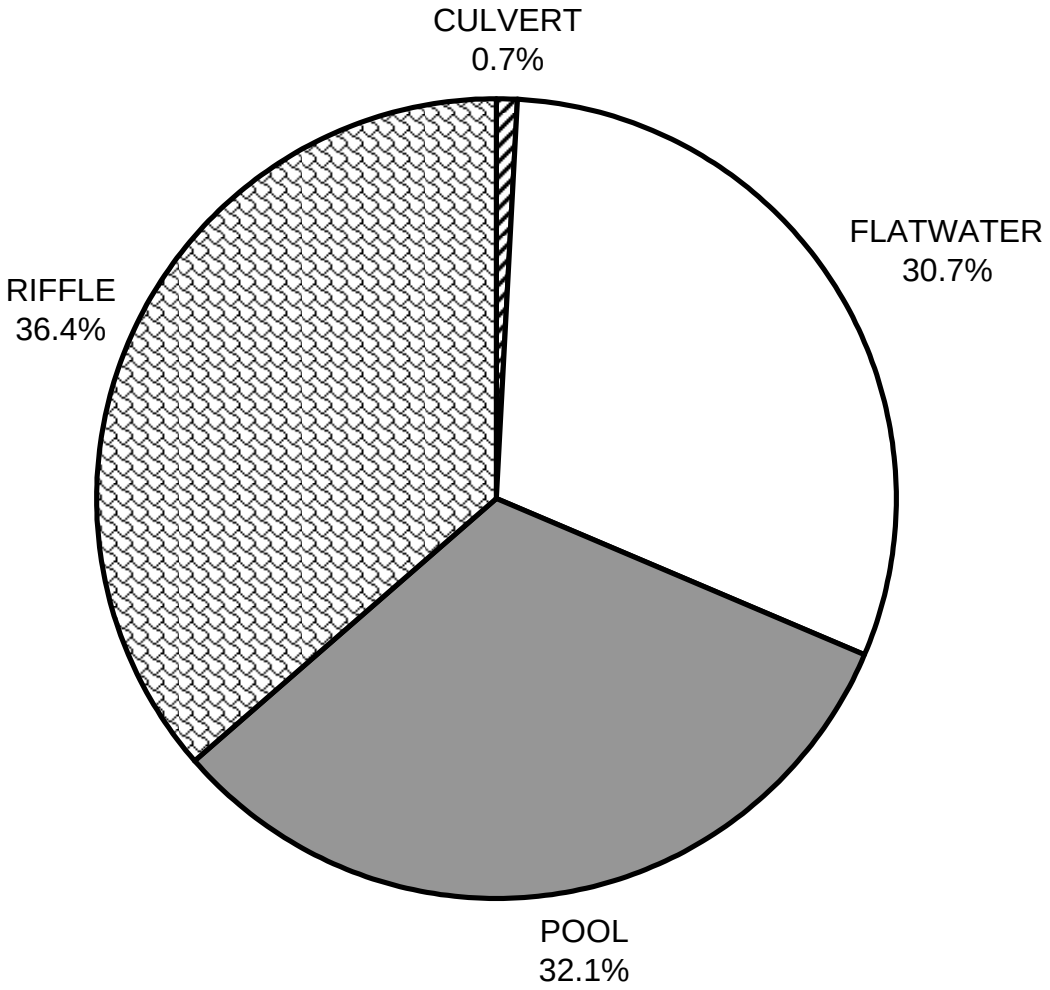
StreamName: 1235454393808 LLID: 1235454393808 Drainage: Big River

Survey Dates: 5/23/2011 to 6/14/2011

Confluence Location: Quad: NORTHSPUR Legal Description: T18NR15WS28 Latitude: 39:22:51.0N Longitude: 123:32:43.0W

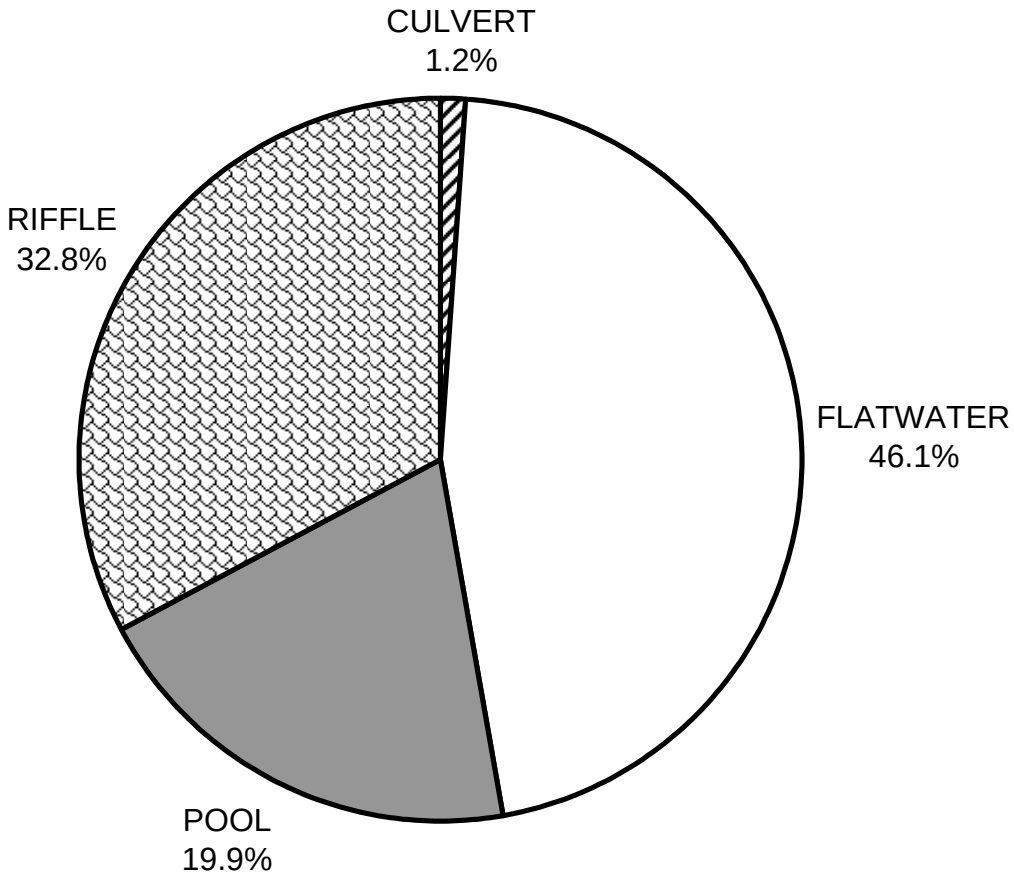
	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	0	11
SMALL WOODY DEBRIS (%)	19	31	17
LARGE WOODY DEBRIS (%)	4	21	33
ROOT MASS (%)	0	0	6
TERRESTRIAL VEGETATION (%)	0	5	1
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	36	0	17
BOULDERS (%)	41	43	10
BEDROCK LEDGES (%)	0	0	4

Arvola Gulch 2011
HABITAT TYPES BY PERCENT OCCURRENCE



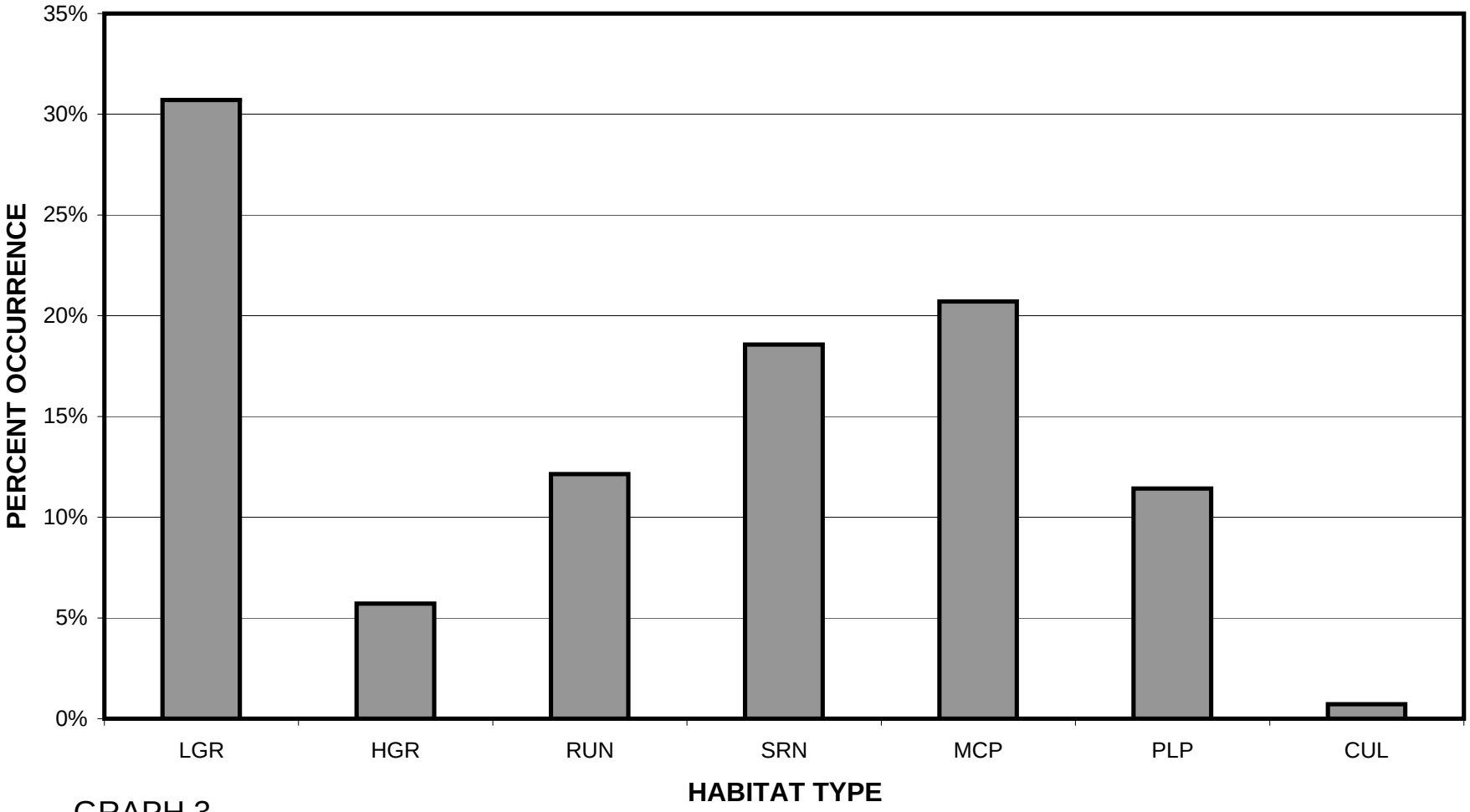
GRAPH 1

Arvola Gulch 2011
HABITAT TYPES BY PERCENT TOTAL LENGTH



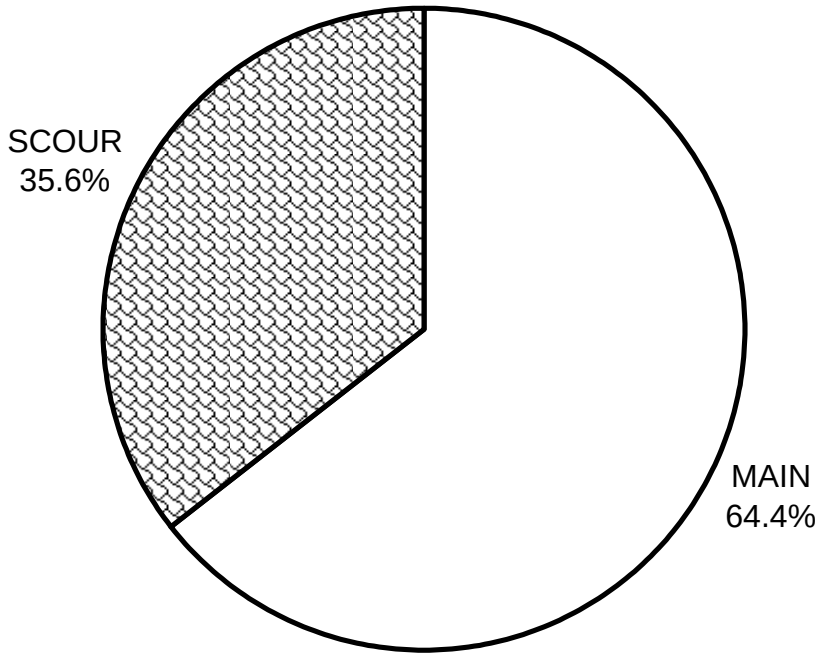
GRAPH 2

Arvola Gulch 2011
HABITAT TYPES BY PERCENT OCCURRENCE



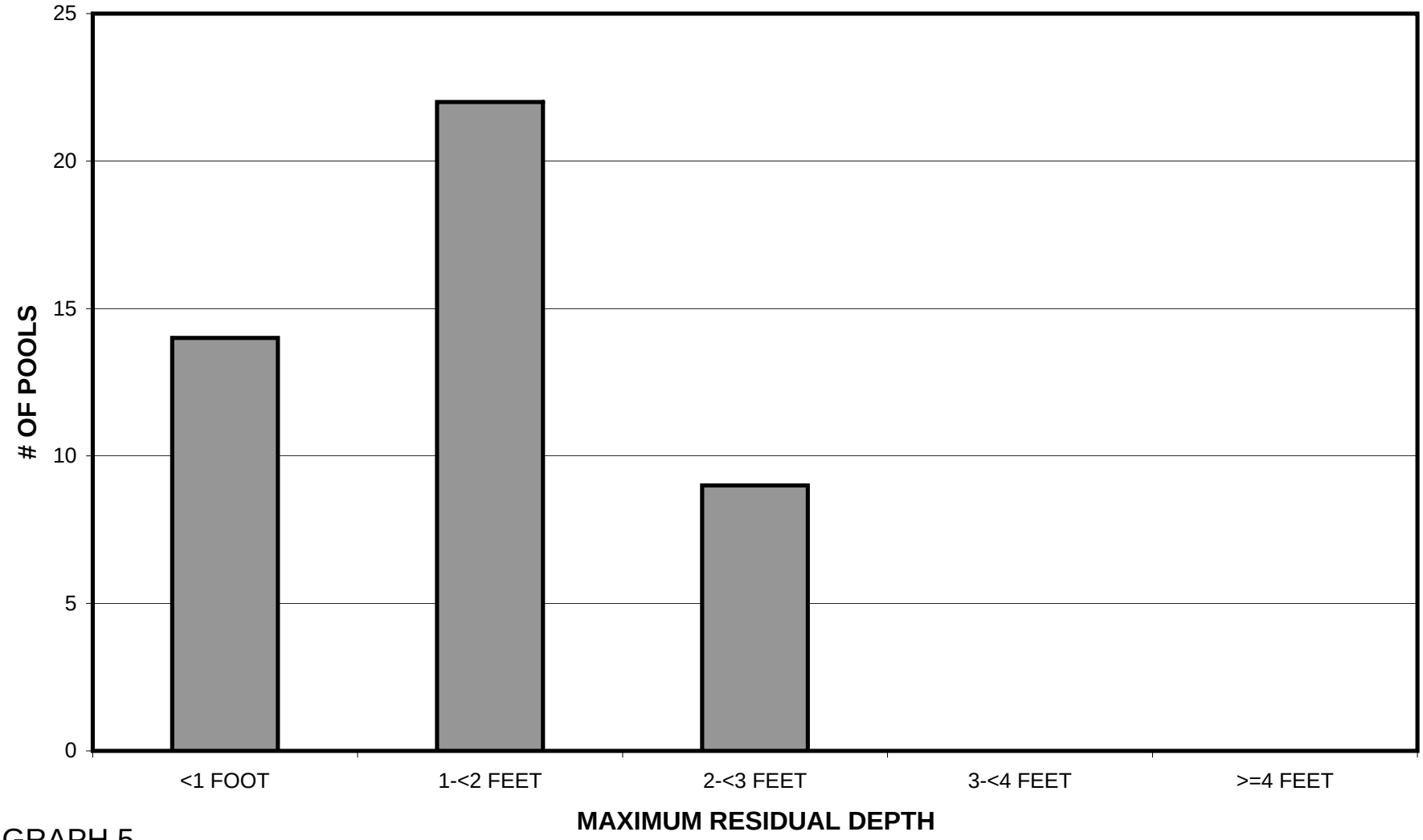
GRAPH 3

Arvola Gulch 2011
POOL TYPES BY PERCENT OCCURRENCE



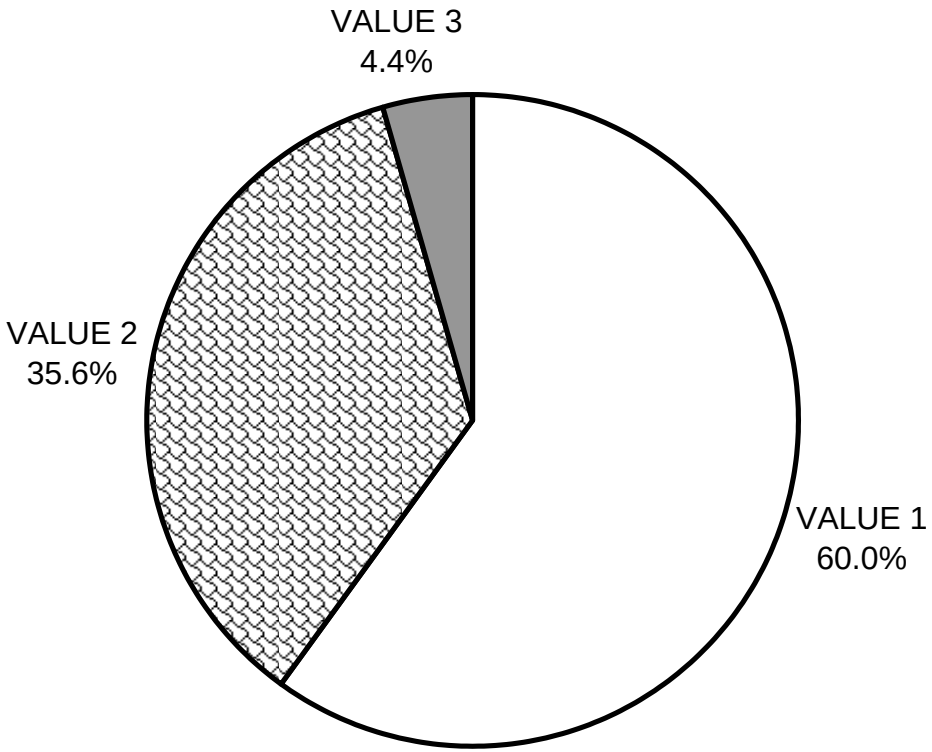
GRAPH 4

Arvola Gulch 2011
MAXIMUM DEPTH IN POOLS



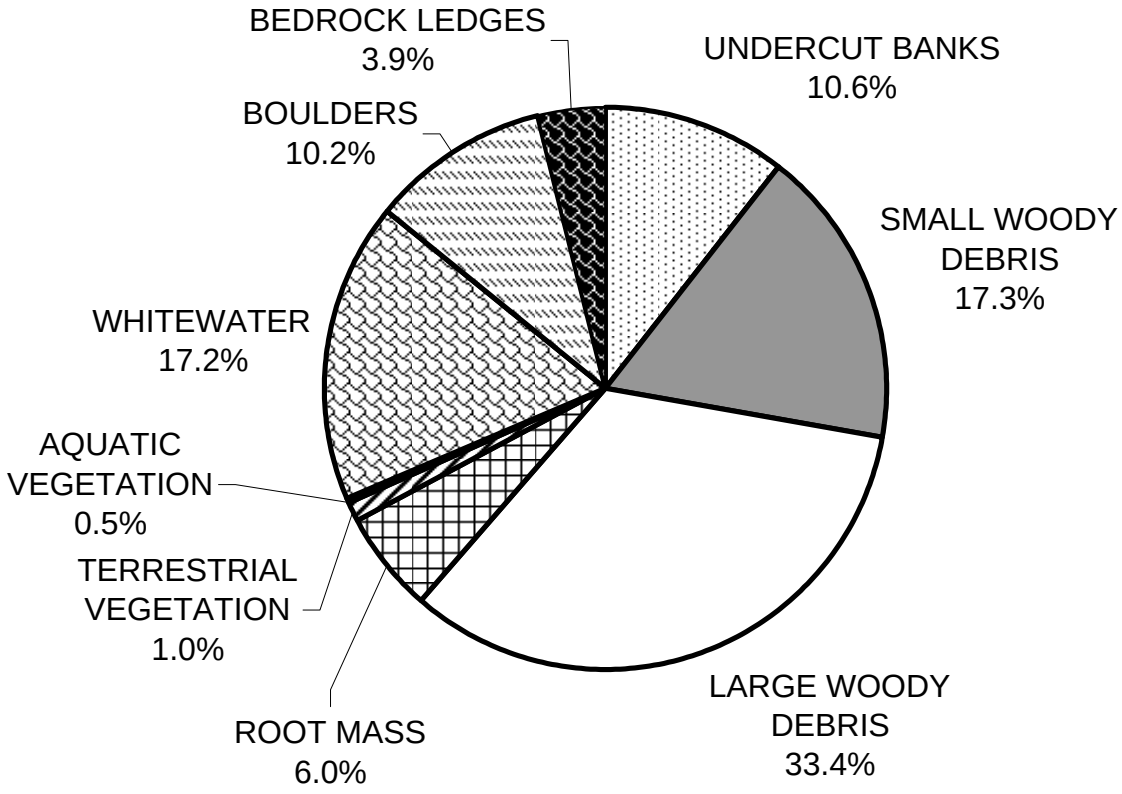
GRAPH 5

Arvola Gulch 2011
PERCENT EMBEDDEDNESS



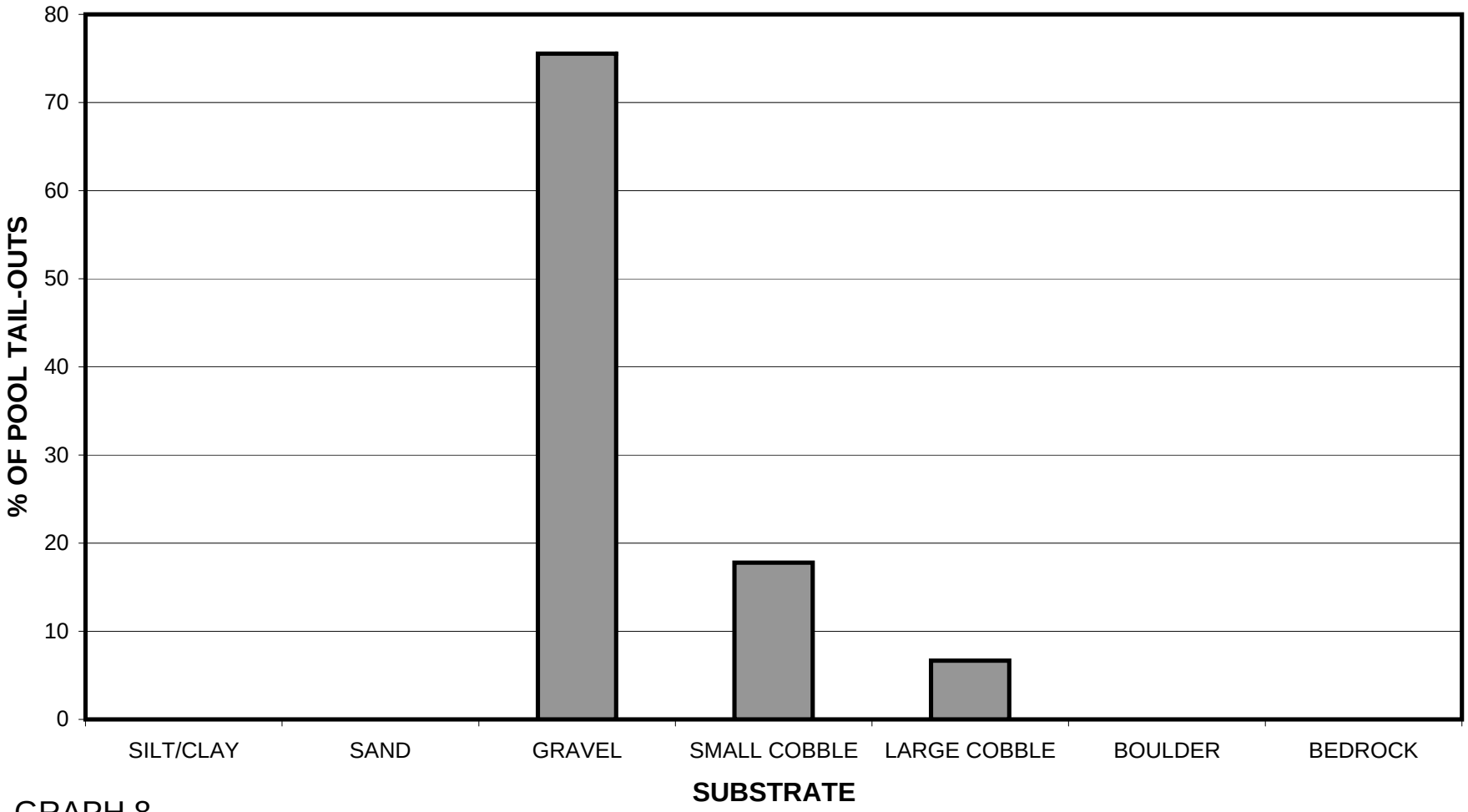
GRAPH 6

Arvola Gulch 2011
MEAN PERCENT COVER TYPES IN POOLS



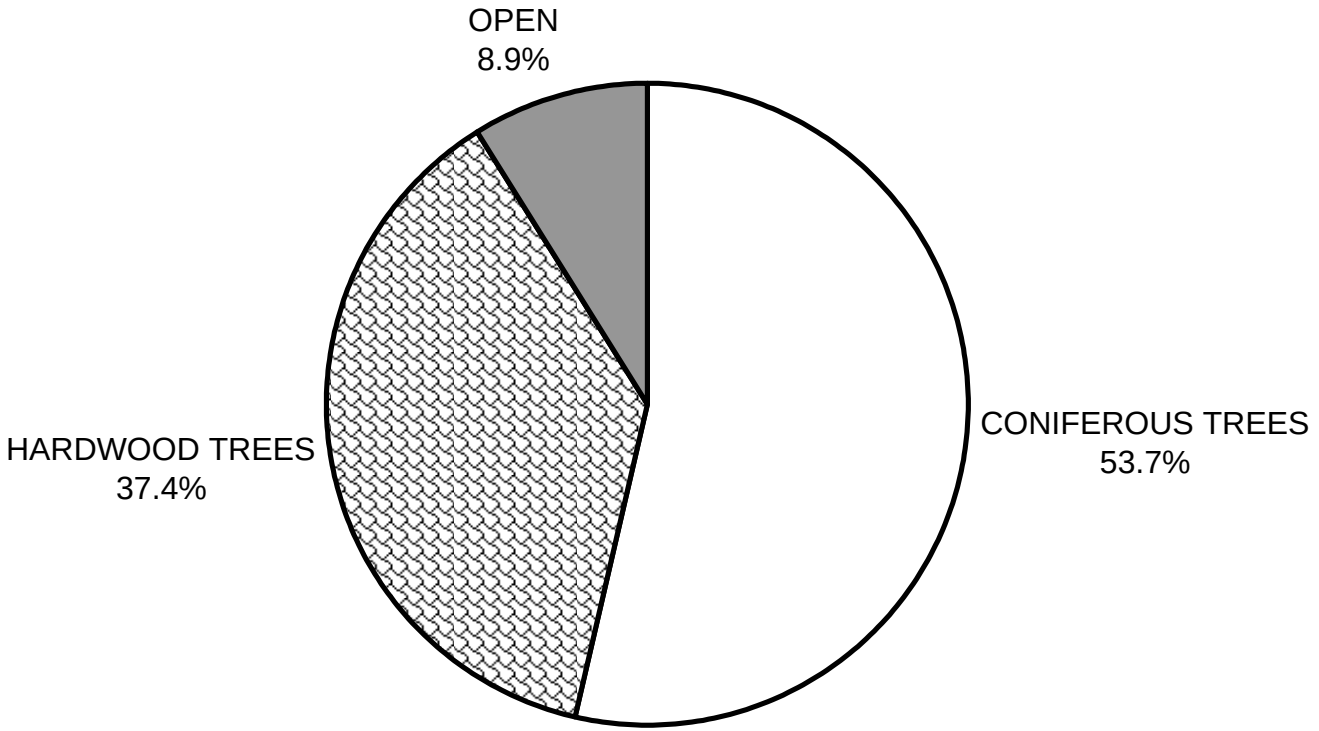
GRAPH 7

Arvola Gulch 2011
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



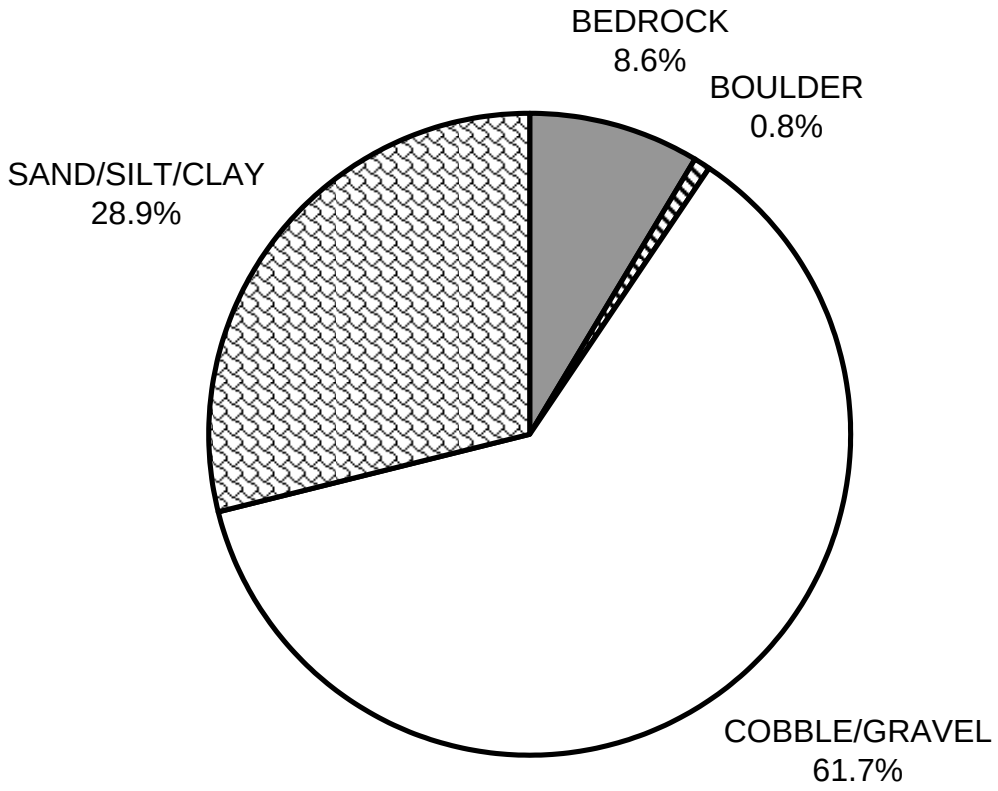
GRAPH 8

Arvola Gulch 2011
MEAN PERCENT CANOPY



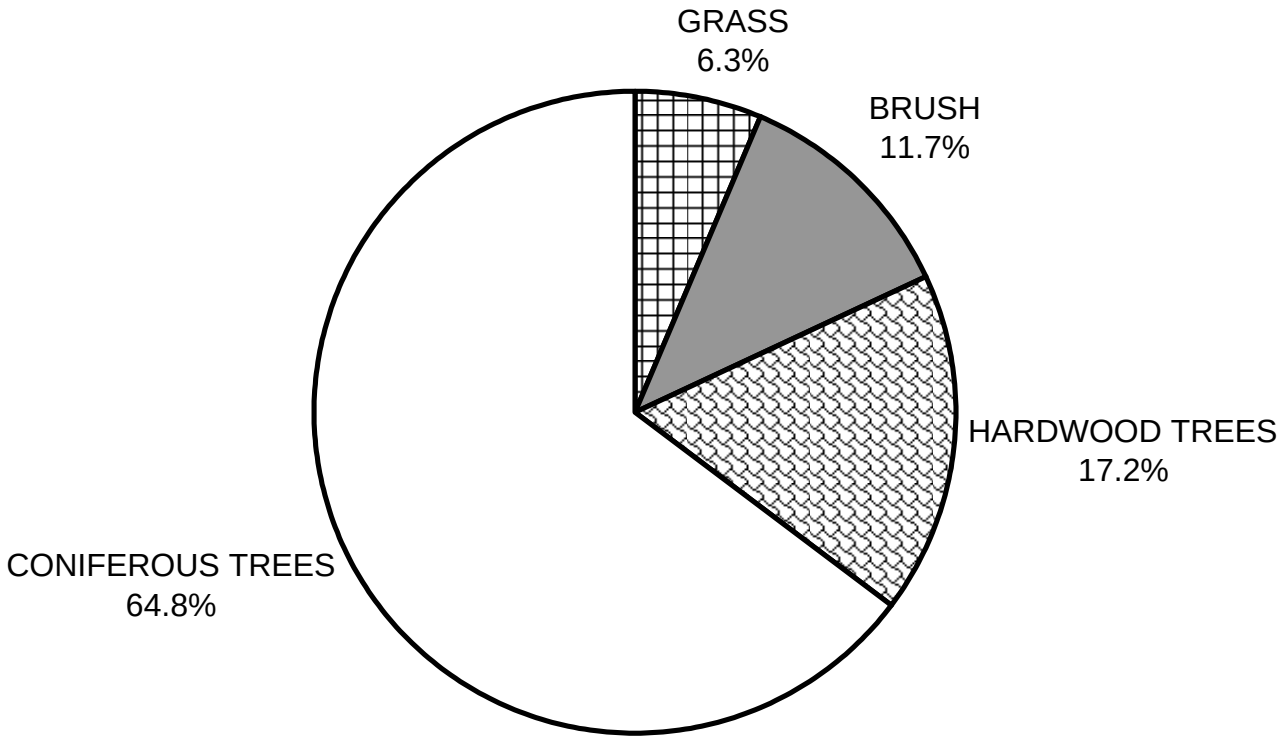
GRAPH 9

Arvola Gulch 2011
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

Arvola Gulch 2011
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11