



CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

STREAM INVENTORY REPORT

Russell Brook

INTRODUCTION

A stream inventory was conducted June 16 to June 30, 2015 on Russell Brook. The survey began at the confluence with Big River and extended upstream four miles.

The Russell Brook 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 Russell Brook. 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

Russell Brook is a tributary to Big River, which drains to the Pacific Ocean. It is located in Mendocino County, California (Map 1). Russell Brook's legal description at the confluence with Big River is T17N R15W S26. Its location is 39.3088 degrees north latitude and 123.5002 degrees west longitude, LLID number 1234990393089. Russell Brook is a second order stream and has approximately 4.4 miles of blue line stream according to the USGS Greenough Ridge 7.5 minute quadrangle. Russell Brook drains a watershed of approximately 4.1 square miles. Elevations range from about 280 feet at the mouth of the creek to 1,400 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 a private logging road off of Highway 20, east of Fort Bragg, CA.

METHODS

The habitat inventory conducted in Russell Brook follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The Watershed Stewards Project (WSP) members and California Department of Fish and Wildlife (CDFW) personnel that conducted the inventory were trained in standardized habitat inventory methods by CDFW.

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 Russell Brook 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 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". Russell Brook 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 Russell Brook, 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 unsuitable 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

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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 then classified according to a list of nine cover types. In Russell Brook, 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 by multiplying the qualitative shelter value by the percent of the unit covered. 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 Russell Brook, 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 Russell Brook, 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),

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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 Russell Brook. In addition, underwater observations were made at 12 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 2.0.18, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Wildlife. This program processes and summarizes the data, and produces the following ten tables:

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

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Russell Brook 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

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HABITAT INVENTORY RESULTS

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

The habitat inventory of June 16 to June 30, 2015 was conducted by J. Murphrey (WSP), J. Guczek (WSP), M. Groff (CDFW), and J. Lee (WSP). The total length of the stream surveyed was 20,896 feet.

Stream flow was too low to be measured on Russell Brook.

Russell Brook is an F4 channel type for 8,344 feet of the stream surveyed (Reach 1) and a G4 channel type for 12,552 feet of the stream surveyed (Reach 2). F4 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. 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 54 to 65 degrees Fahrenheit. Air temperatures ranged from 48 to 78 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 42% riffle units, 31% flatwater units, 25% pool units, and 2% dry units (Graph 1). Based on total length of Level II habitat types there were 40% riffle units, 38% flatwater units, 20% pool units, and 2% dry units (Graph 2).

Twelve Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units, 39%; mid-channel pool units, 24%; and run units, 19% (Graph 3). Based on percent total length, low gradient riffle units made up 37%, step run units 22%, and mid-channel pool units 20%.

A total of 167 pools were identified (Table 3). Main channel pools were the most frequently encountered at 98% (Graph 4), and comprised 98% 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. Twenty-two of the 167 pools (13%) had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 167 pool tail-outs measured, 19 had a value of 1 (11.4%); 66 had a value of 2 (39.5%); 61 had a value of 3 (36.5%); 14 had a value of 4 (8.4%); seven had a value of 5 (4.2%) (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 unsuitable 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 3, flatwater habitat types had a mean shelter rating of 6, and pool habitats had a mean shelter rating of 25 (Table 1). Of the pool types, the backwater pools had the highest mean shelter rating at 30. Main channel pools had a mean shelter rating of 25. Scour pools had a mean

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shelter rating of 20 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Russell Brook. Graph 7 describes the pool cover in Russell Brook. Boulders are 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 74% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 22% of the pool tail-outs.

The mean percent canopy density for the surveyed length of Russell Brook was 96%. Four percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 48% and 52%, respectively. Graph 9 describes the mean percent canopy in Russell Brook.

For the stream reach surveyed, the mean percent right bank vegetated was 95%. The mean percent left bank vegetated was 95%. The dominant elements composing the structure of the stream banks consisted of 54% sand/silt/clay, 34% cobble/gravel, 7% bedrock, and 4% boulders (Graph 10). Coniferous trees were the dominant vegetation type observed in 54% of the units surveyed. Additionally, 34% of the units surveyed had hardwood trees as the dominant vegetation type, and 11% had brush as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a snorkel survey at 12 sites for species composition and distribution in Russell Brook on August 27, 2015 (Table A). The sites were sampled by I. Mikus (CDFW) and K. Bocast (California Conservation Corps).

In Reach 1, which comprised the first 8,344 feet of stream, 10 sites were sampled. The reach sites yielded 34 young-of-the-year (YOY) steelhead trout (SH), 16 age 1+ SH, three age 2+ SH, and two California giant salamanders.

In Reach 2, two sites were sampled starting approximately 8,692 feet from the confluence with Big River and continuing upstream 870 feet. The reach sites yielded four YOY SH, one age 1+ SH, and one sculpin.

Table A. Summary of results for a fish composition and distribution survey within Russell Brook, 2015.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	Steelhead			Coho Salmon		Additional Aquatic Species Observed
					YOY	1+	2+	YOY	1+	
Reach 1: F4 Channel Type										
08/27/15	1	009	Pool	331	2	0	0	0	0	CGS
08/27/15	2	017	Pool	594	2	2	0	0	0	

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08/27/15	3	020	Pool	725	0	3	0	0	0	
08/27/15	4	026	Pool	1,022	5	1	0	0	0	
08/27/15	5	033	Pool	1,297	11	3	0	0	0	
08/27/15	6	041	Pool	1,591	0	0	0	0	0	
08/27/15	7	078	Pool	3,171	8	4	1	0	0	CGS
08/27/15	8	200	Pool	7,753	2	2	1	0	0	
08/27/15	9	204	Pool	7,866	1	1	1	0	0	
08/27/15	10	211	Pool	8,076	3	0	0	0	0	
Reach 2: G4 Channel Type										
08/27/15	11	232	Pool	8,716	0	0	0	0	0	SCP
08/27/15	12	253	Pool	9,562	4	1	0	0	0	

Species Abbreviations: CGS=Coastal/California Giant Salamander; SCP=Sculpin (Unidentified Species)

DISCUSSION

Russell Brook is an F4 channel type for the first 8,344 feet of stream surveyed and a G4 channel type for the remaining 12,552 feet. The suitability of F4 and G4 channel types for fish habitat improvement structures is as follows: F4 channels are good for bank-placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. G4 channels 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 June 16 to June 30, 2015 ranged from 54 to 65 degrees Fahrenheit. Air temperatures ranged from 48 to 78 degrees Fahrenheit. This is a suitable water temperature range for salmonids. However, 65 degrees Fahrenheit, if sustained, is near the threshold stress level for salmonids. To make any further 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 40%, and pools 20%. Twenty-two of the 167 (13%) pools had a maximum residual depth greater than two feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended.

Eighty-five of the 167 pool tail-outs measured had embeddedness ratings of 1 or 2. Seventy-five of the pool tail-outs had embeddedness ratings of 3 or 4. Seven 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 Russell Brook should be mapped and rated according to their potential sediment yields, and control measures should be taken.

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One hundred fifty-nine of the 167 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 25. The shelter rating in the flatwater habitats is 6. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Russell Brook. Boulders are 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 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 96%. Reach 1 had a canopy density of 96%; Reach 2 had a canopy density of 96%. The percentage of right and left bank covered with vegetation was 95% and 95%, respectively.

RECOMMENDATIONS

Russell Brook should be managed as an anadromous, natural production stream.

Recommendations for potential habitat improvement activities are based on target habitat values suitable for salmonids in California's north coast streams. Considering the results from this stream habitat inventory, factors that affect salmonid productivity and CDFW's professional judgment, the following list prioritizes habitat improvement activities in Russell Brook. Keep in mind, watershed and stream ecosystem processes, land use alterations, changes in land ownership, and other factors could potentially change the order of these recommendations or create the need to remove/add recommendations in the future.

- 1) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from boulders. Adding high quality complexity with woody cover in the pools is desirable.
- 2) Suitable size spawning substrate on Russell Brook is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.
- 3) 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.
- 4) 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 three to five years.

COMMENTS AND LANDMARKS

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

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Position (ft):	Habitat unit #:	Comments:
0	0001.00	Start of survey at the confluence with Big River. The channel is an F4.
1495	0038.00	There is a 1' high plunge over boulders.
2136	0055.00	There is a 2' high plunge over woody debris.
2307	0060.00	Small left bank tributary. Log debris accumulation (LDA) #01 contains six pieces of large woody debris (LWD) and measures approximately 4.5' high x 24' wide x 5' long. Water flows through the LDA and there are visible gaps in it. Retained silt measures approximately 24' wide x 30' long x 5' deep. There is a 3' high plunge over the LDA. Fish were observed above it.
2362	0062.00	Dry right bank tributary.
3475	0087.00	Small left bank tributary.
4110	0101.00	LDA #02 contains two pieces of LWD and measures approximately 5' high x 28' wide x 4' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures approximately 30' wide x 50' long x 5' deep. There is a 2' high plunge over the LDA. Fish were observed above it.
4889	0120.00	Dry left bank tributary.
5611	0140.00	There is a 1' high plunge.
5677	0143.00	LDA #03 contains nine pieces of LWD and measures approximately 5' high x 27' wide x 9' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures approximately 30' wide x 10' long x 4' deep. There is a 1.5' high plunge over the LDA. Fish were observed above it.
5918	0151.00	Tributary #01 enters on the left bank. The first 50 feet of the tributary were dry. The water temperature of the tributary was 56 degrees Fahrenheit; the water temperature downstream and upstream of the confluence was 60 degrees Fahrenheit. The slope of the tributary is approximately 15% and there is a 4' high plunge at the mouth.
6611	0170.00	LDA #04 contains 19 pieces of LWD and measures approximately 7.5' high x 22' wide x 44' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to cobble and measures approximately 25' wide x 30' long x 5.5' deep. Fish were observed above the LDA.

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6721	0172.00	There is a 2.5' high plunge. Landslide on the right bank.
7609	0197.00	Dry left bank tributary.
8192	0216.00	There is a 2.5' high plunge.
8344	0221.00	The channel changes from an F4 to a G4.
8432	0223.00	A logging road crosses the channel. The crossing is a 15' wide x 50' long x 8.5' high railcar bridge.
8919	0237.00	There is a 1.5' high plunge over cobble and roots.
9037	0240.00	Dry left bank tributary.
9276	0246.00	LDA #05 contains nine pieces of LWD and measures approximately 6' high x 16' wide x 20' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to cobble and measures approximately 10' wide x 60' long x 3' deep. Fish were observed above the LDA.
10025	0270.00	Dry right bank tributary.
10923	0295.00	There is a 1' high plunge over woody debris.
11090	0302.00	There is a 1' high plunge over bedrock.
11181	0306.00	A road crosses the channel. The crossing is a 15' wide x 50' long x 11' high railcar bridge.
11671	0320.00	Tributary #02 enters on the left bank. The water temperature of the tributary was 55 degrees Fahrenheit; the water temperature downstream and upstream of the confluence was 60 degrees Fahrenheit. The slope of the tributary is approximately 30%. It has a culvert approximately 50' upstream from the mouth.
11726	0322.00	There is a 4' high bedrock sheet.
12037	0335.00	LDA #06 contains eight pieces of LWD and measures approximately 8' high x 13' wide x 12' long. Water flows through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures approximately 10' wide x 30' long x 2' deep. Fish were observed above the LDA.
12785	0359.00	Tributary #03 enters on the right bank. It was intermittently dry. The water temperature of the tributary was 54 degrees Fahrenheit; the water

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temperature downstream and upstream of the confluence was 54 degrees Fahrenheit. The slope of the tributary is 6-7%.

13280	0377.00	There is a 4.5' high plunge over bedrock sheet.
13411	0383.00	There is a 3' high plunge over woody debris.
13532	0389.00	Site of old road crossing.
14459	0425.00	Tributary #04 enters on the left bank. The water temperature of the tributary was 54 degrees Fahrenheit; the water temperature downstream and upstream of the confluence was 55 degrees Fahrenheit. The slope of the tributary is approximately 6% for the first 50' to a 4' high plunge. Above the plunge the slope increases to approximately 20%.
14704	0435.00	There is a 1.5' high plunge over woody debris.
15818	0470.00	LDA #07 contains three pieces of LWD and measures approximately 6' high x 15' wide x 18' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to boulders and measures approximately 12' wide x 25' long x 5' deep. There is a 5' high plunge over the LDA. Fish were observed above it.
16064	0481.00	Tributary #05 enters on the left bank. It goes dry 100' upstream from the mouth. The water temperature of the tributary was 58 degrees Fahrenheit, the water temperature downstream of the confluence was 59 degrees Fahrenheit, and the water temperature upstream of the confluence was 60 degrees Fahrenheit. The slope of the tributary is 8-10%.
16168	0483.00	There is a 1.5' high plunge over woody debris.
16395	0490.00	There is a 2' high plunge over woody debris.
16487	0494.00	Tributary #06 enters on the right bank. The slope of the tributary is 20-30%. LDA #08 contains four pieces of LWD and measures approximately 6' high x 24' wide x 13' long. Water flows through the LDA and there are no visible gaps in it. Retained gravel measures approximately 20' wide x 20' long x 3' deep. Fish were observed above the LDA.
16813	0507.00	Last fish observed. Old growth redwood rootwad retaining a large amount of sediment.
17108	0521.00	LDA #09 contains 15 pieces of LWD and measures approximately 6' high x 30' wide x 11' long. Water flows through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to cobble and

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		measures approximately 25' wide x 50' long x 4' deep. There is a 4' high plunge over the LDA. Fish were not observed above it.
17808	0547.00	Dry left bank tributary.
17822	0548.00	Tributary #07 enters on the right bank. The slope of the tributary is 8-10%. Only the first 40' are accessible, then the channel is impacted by road-fill.
18099	0560.00	There is a 5.5' high plunge over boulders and woody debris.
18159	0564.00	There is a 5' high plunge over boulders and woody debris. The channel is dry above it for 33 feet.
18394	0576.00	A landslide on the right bank measures approximately 30' long x 30' high and contributed sediment and woody debris to the channel.
18414	0577.00	LDA #10 contains 10 pieces of LWD and measures approximately 4' high x 13' wide x 7' long. Water does not flow through the LDA and there are visible gaps in it. Retained sediment ranges from silt to gravel and measures approximately 15' wide x 20' long x 3' deep.
18939	0595.00	LDA #11 contains nine pieces of LWD and measures approximately 6' high x 15' wide x 17' long. Water does not flow through the LDA and there are visible gaps in it. Retained sediment ranges from silt to small cobble and measures approximately 20' wide x 40' long x 4' deep. There is a 1.5' high plunge over the LDA.
19783	0636.00	There is a 2' high plunge over woody debris.
20005	0645.00	LDA #12 contains four pieces of LWD and measures approximately 6' high x 18' wide x 7' 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 approximately 18' wide x 20' long x 4' deep. There is a 4' high plunge over the LDA.
20544	0664.00	Tributary #08 enters on the left bank. It contributes approximately 25% to Russell Brook's flow. The water temperature of the tributary was 60 degrees Fahrenheit and the water temperature downstream of the confluence was 61 degrees Fahrenheit. The slope of the tributary is 5-6% for the first 200 feet, then it increases.
20882	0677.00	LDA #13 contains five pieces of LWD and measures approximately 6' high x 15' wide x 8' long. Water does not flow through the LDA and there are no visible gaps in it. Retained sediment ranges from silt to small cobble and measures approximately 20' wide x 50' long x 3' deep.

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There is a 3' high plunge over the LDA. End of survey; multiple LDAs and the channel is dry for over 300 feet.

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]	

**Map 1
Russell Brook
Big River Watershed
Greenough Ridge Quad, Mendocino County**





Start of Survey

End of Survey

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-  Reach 1: F4 Channel Type
-  Reach 2: G4 Channel Type

0 0.35 0.7 1.4 Miles




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

Stream Name: Russell Brook

LLID: 1234990393089

Drainage: Big River

Survey Dates: 6/16/2015 to 6/30/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T17NR15WS26

Latitude: 39:18:32.0N

Longitude: 123:29:56.0

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
14	0	DRY	2.1	25	345	1.7									
210	28	FLATWATER	31.0	38	7968	38.1	6.3	0.5	0.9	312	65559	171	35830		6
2	0	NOSURVEY	0.3	18	36	0.2									
167	167	POOL	24.7	25	4225	20.2	9.1	0.8	1.4	236	39374	257	42993	210	25
284	32	RIFFLE	41.9	29	8322	39.8	6.0	0.3	0.5	172	48731	59	16882		3
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
677	227				20896					153664			95705		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Russell Brook

LLID: 1234990393089

Drainage: Big River

Survey Dates: 6/16/2015 to 6/30/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T17NR15WS26

Latitude: 39:18:32.0N

Longitude: 123:29:56.0W

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 (%)
262	28	LGR	38.7	30	7779	37.2	6	0.2	0.9	175	45978	53	13951		2	97
19	2	HGR	2.8	27	505	2.4	6	0.7	1.3	254	4817	181	3433		20	95
3	2	BRS	0.4	13	38	0.2	2	0.5	1	35	105	25	75		0	96
1	0	GLD	0.1	28	28	0.1										
126	13	RUN	18.6	27	3445	16.5	7	0.5	1.4	210	26403	106	13358		4	97
83	15	SRN	12.3	54	4495	21.5	6	0.5	1.5	401	33295	227	18808		8	95
163	163	MCP	24.1	25	4109	19.7	9	0.8	4	233	38004	257	41890	210	25	96
1	1	STP	0.1	16	16	0.1	6	0.2	0.8	82	82	41	41	16	20	97
1	1	CRP	0.1	12	12	0.1	7	0.7	1.6	84	84	84	84	59	30	99
1	1	LSBk	0.1	71	71	0.3	9	0.9	1.5	639	639	639	639	575	10	88
1	1	BPL	0.1	17	17	0.1	35	0.4	1	565	565	339	339	226	30	88
14	0	DRY	2.1	25	345	1.7										99
2	0	NS	0.3	18	36	0.2										

Total Units
677

Total Units Fully Measured
227

Total Length (ft.)
20896

Total Area (sq.ft.)
149971

Total Volume (cu.ft.)
92618

Stream Name:	Russell Brook	LLID:	1234990393089	Drainage:	Big River
Survey Dates:	6/16/2015 to 6/30/2015				
Confluence Location:	Quad: GREENOUGH	Legal Description:	T17NR15WS26	Latitude:	39:18:32.0N
				Longitude:	123:29:56.0W

[illegible]

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

Stream Name: Russell Brook

LLID: 1234990393089

Drainage: Big River

Survey Dates: 6/16/2015 to 6/30/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T17NR15WS26

Latitude: 39:18:32.0N

Longitude: 123:29:56.0W

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
163	MCP	98	44	27	97	60	19	12	2	1	1	1
1	STP	1	1	100	0	0	0	0	0	0	0	0
1	CRP	1	0	0	1	100	0	0	0	0	0	0
1	LSBk	1	0	0	1	100	0	0	0	0	0	0
1	BPL	1	0	0	1	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
167	45	27	100	60	19	11	2	1	1	1

Mean Maximum Residual Pool Depth (ft.): 1.4

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Russell Brook

LLID: 1234990393089

Drainage: Big River

Survey Dates: 6/16/2015 to 6/30/2015

Dry Units: 14

Confluence Location: Quad: GREENOUGH

Legal Description: T17NR15WS26

Latitude: 39:18:32.0N

Longitude: 123:29:56.0W

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
262	28	LGR	3	10	2	0	4	0	0	81	0
19	2	HGR	0	10	0	0	10	0	0	80	0
3	2	BRS	0	0	0	0	0	0	0	0	0
284	32	TOTAL RIFFLE	3	10	1	0	5	0	0	81	0
1	0	GLD									
126	13	RUN	6	8	31	11	9	1	0	32	0
83	15	SRN	6	14	15	0	10	2	0	52	1
210	28	TOTAL FLAT	6	11	21	4	10	2	0	44	1
163	163	MCP	14	22	27	2	5	0	1	27	1
1	1	STP	0	10	0	0	0	0	0	90	0
1	1	CRP	30	25	25	0	0	0	0	20	0
1	1	LSBk	10	0	0	0	70	0	0	20	0
1	1	BPL	0	50	25	0	5	0	0	20	0
167	167	TOTAL POOL	14	22	27	2	6	0	1	28	1
2	0	NS									
677	227	TOTAL	13	21	25	2	6	0	1	31	1

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Russell Brook

LLID: 1234990393089

Drainage: Big River

Survey Dates: 6/16/2015 to 6/30/2015

Dry Units: 14

Confluence Location: Quad: GREENOUGH

Legal Description: T17NR15WS26

Latitude: 39:18:32.0N

Longitude: 123:29:56.0W

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
262	28	LGR	0	0	89	11	0	0	0
19	2	HGR	0	0	50	0	0	0	50
3	2	BRS	0	0	0	0	0	0	100
1	0	GLD	0	0	0	0	0	0	0
126	13	RUN	0	69	23	0	0	0	8
83	15	SRN	0	27	67	7	0	0	0
163	163	MCP	4	53	34	2	2	1	4
1	1	STP	0	0	0	0	0	100	0
1	1	CRP	0	0	100	0	0	0	0
1	1	LSBk	0	0	100	0	0	0	0
1	1	BPL	0	0	100	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Russell Brook

LLID: 1234990393089

Drainage: Big River

Survey Dates: 6/16/2015 to 6/30/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T17NR15WS26

Latitude: 39:18:32.0N

Longitude: 123:29:56.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
96	52	48	0	95	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.

Stream Name: Russell Brook	LLID: 1234990393089	Drainage: Big River
Survey Dates: 6/16/2015 to 6/30/2015	Survey Length (ft.): 20896	Main Channel (ft.): 20896
		Side Channel (ft.): 0
Confluence Location: Quad: GREENOUGH	Legal Description: T17NR15WS26	Latitude: 39:18:32.0N
		Longitude: 123:29:56.0W

STREAM REACH: 1															
Channel Type: F4			Canopy Density (%): 96.0				Pools by Stream Length (%): 24.2								
Reach Length (ft.): 8344			Coniferous Component (%): 64.8				Pool Frequency (%): 29.1								
Riffle/Flatwater Mean Width (ft.): 8.1			Hardwood Component (%): 35.2				Residual Pool Depth (%):								
BFW:			Dominant Bank Vegetation: Coniferous Trees				< 2 Feet Deep: 77								
Range (ft.): 11 to 27			Vegetative Cover (%): 97.4				2 to 2.9 Feet Deep: 19								
Mean (ft.): 21			Dominant Shelter: Boulders				3 to 3.9 Feet Deep: 3								
Std. Dev.: 4			Dominant Bank Substrate Type: Cobble/Gravel				>= 4 Feet Deep: 2								
Base Flow (cfs.): 0.0			Occurrence of LWD (%): 23				Mean Max Residual Pool Depth (ft.): 1.6								
Water (F): 54 - 60			Air (F): 48 - 76		LWD per 100 ft.:		Mean Pool Shelter Rating: 26								
Dry Channel (ft): 0			Riffles: 2												
			Pools: 8												
			Flat: 2												
Pool Tail Substrate (%): Silt/Clay: 3			Sand: 0		Gravel: 56		Sm Cobble: 34		Lg Cobble: 6		Boulder: 0		Bedrock: 0		
Embeddedness Values (%): 1. 4.7			2. 31.3		3. 48.4		4. 9.4		5. 6.3						

Channel Type:	G4	Canopy Density (%):	96.4	Pools by Stream Length (%):	17.6
Reach Length (ft.):	12552	Coniferous Component (%):	45.4	Pool Frequency (%):	22.5
Riffle/Flatwater Mean Width (ft.):	5.2	Hardwood Component (%):	54.6	Residual Pool Depth (%):	
BFW:		Dominant Bank Vegetation:	Coniferous Trees	< 2 Feet Deep:	93
Range (ft.):	8 to 25	Vegetative Cover (%):	93.7	2 to 2.9 Feet Deep:	7
Mean (ft.):	15	Dominant Shelter:	Boulders	3 to 3.9 Feet Deep:	0
Std. Dev.:	4	Dominant Bank Substrate Type:	Sand/Silt/Clay	>= 4 Feet Deep:	0
Base Flow (cfs.):	0.0	Occurrence of LWD (%):	21	Mean Max Residual Pool Depth (ft.):	1.2
Water (F):	54 - 65	Air (F):	49 - 78	Mean Pool Shelter Rating:	24
Dry Channel (ft):	345	Riffles:	2		
		Pools:	9		
		Flat:	2		
Pool Tail Substrate (%):	Silt/Clay: 0	Sand: 0	Gravel: 84	Sm Cobble: 14	Lg Cobble: 1
	Boulder: 0	Bedrock: 1			
Embeddedness Values (%):	1. 15.5	2. 44.7	3. 29.1	4. 7.8	5. 2.9

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Russell Brook

LLID: 1234990393089

Drainage: Big River

Survey Dates: 6/16/2015 to 6/30/2015

Confluence Location: Quad: GREENOUGH

Legal Description: T17NR15WS26

Latitude: 39:18:32.0N

Longitude: 123:29:56.0W

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	16	17	7.3
Boulder	11	9	4.4
Cobble / Gravel	74	82	34.4
Sand / Silt / Clay	126	119	54.0

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	0	0	0.0
Brush	27	24	11.2
Hardwood Trees	76	79	34.1
Coniferous Trees	122	122	53.7
No Vegetation	1	1	0.4

Total Stream Cobble Embeddedness Values: 3

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

StreamName: Russell Brook

LLID: 1234990393089

Drainage: Big River

Survey Dates: 6/16/2015 to 6/30/2015

Confluence Location: Quad: GREENOUGH

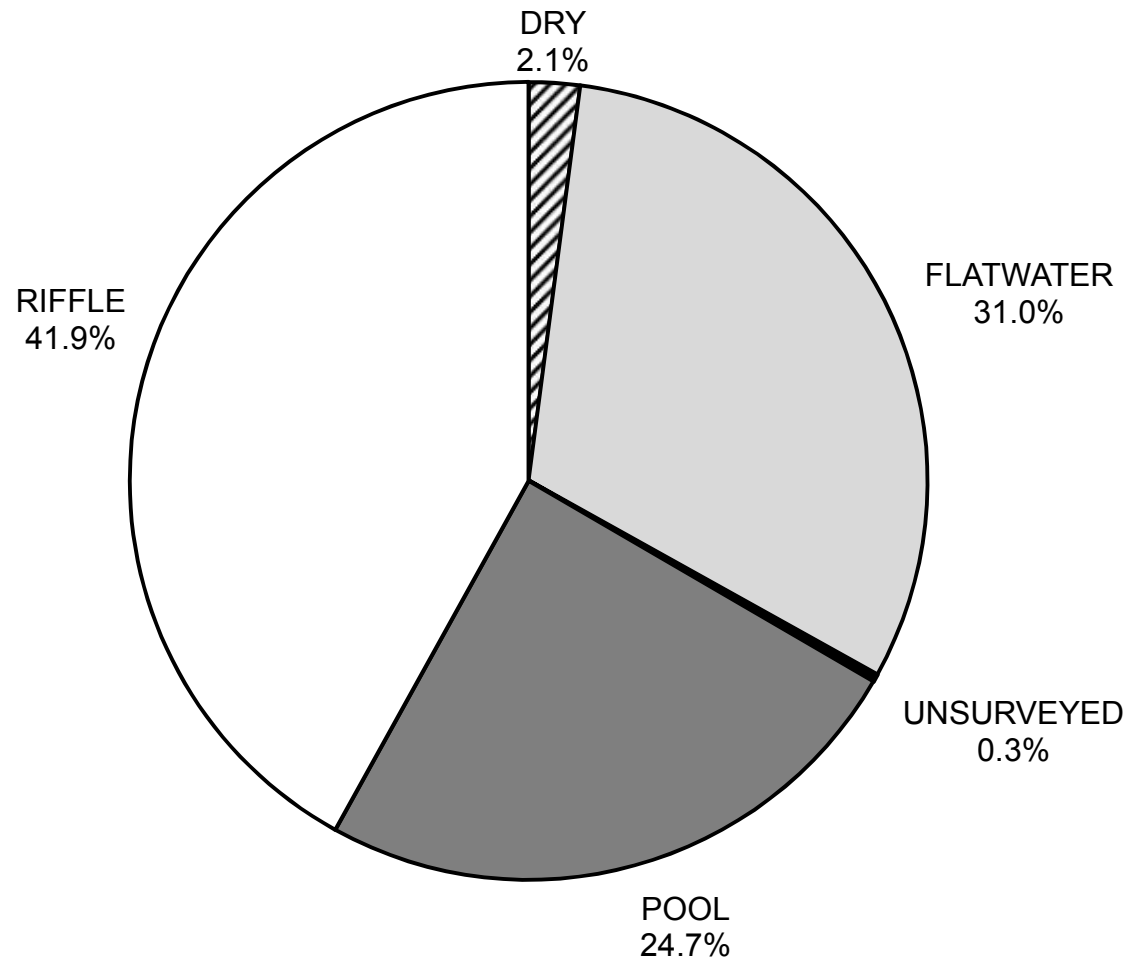
Legal Description: T17NR15WS26

Latitude: 39:18:32.0N

Longitude: 123:29:56.0W

	Riffles	Flatwater	Pools
<hr/>			
UNDERCUT BANKS (%)	3	6	14
SMALL WOODY DEBRIS (%)	10	11	22
LARGE WOODY DEBRIS (%)	1	21	27
ROOT MASS (%)	0	4	2
TERRESTRIAL VEGETATION (%)	5	10	6
AQUATIC VEGETATION (%)	0	2	0
WHITEWATER (%)	0	0	1
BOULDERS (%)	81	44	28
BEDROCK LEDGES (%)	0	1	1

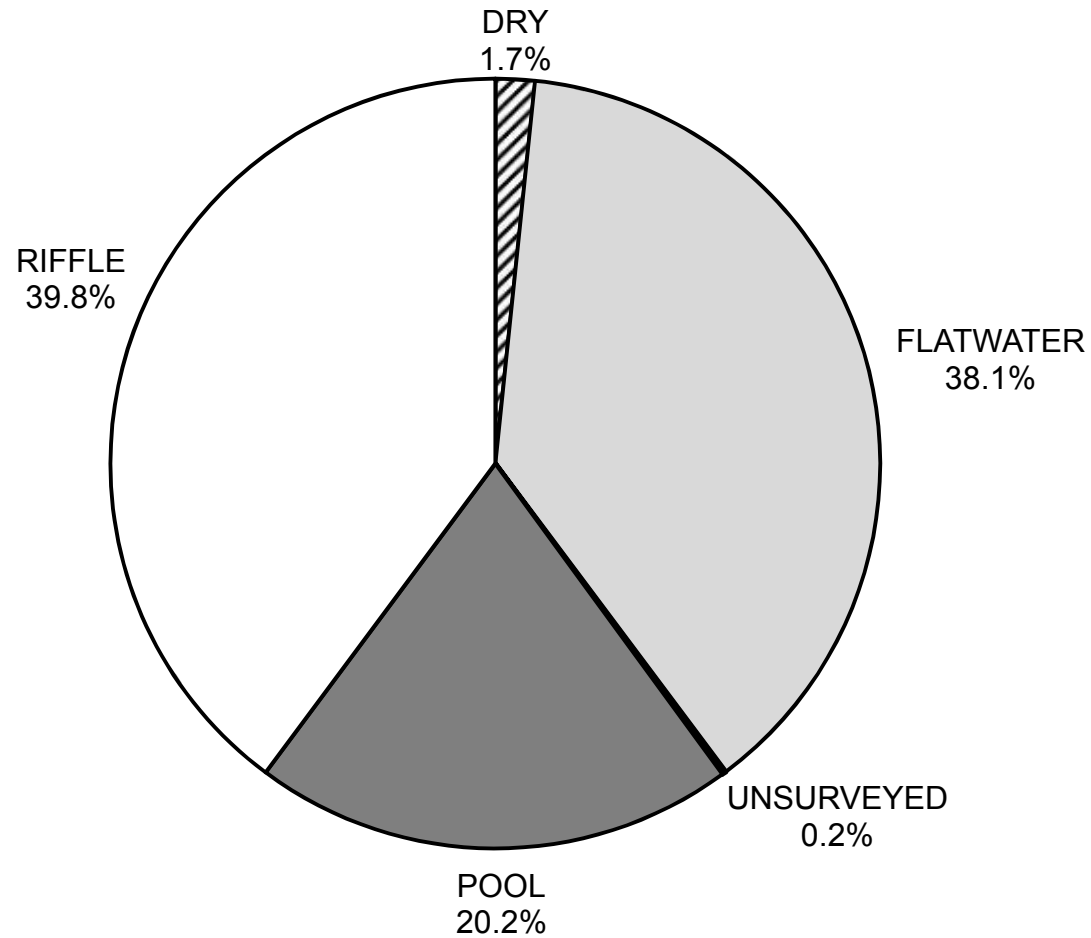
RUSSELL BROOK 2015 HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

RUSSELL BROOK 2015

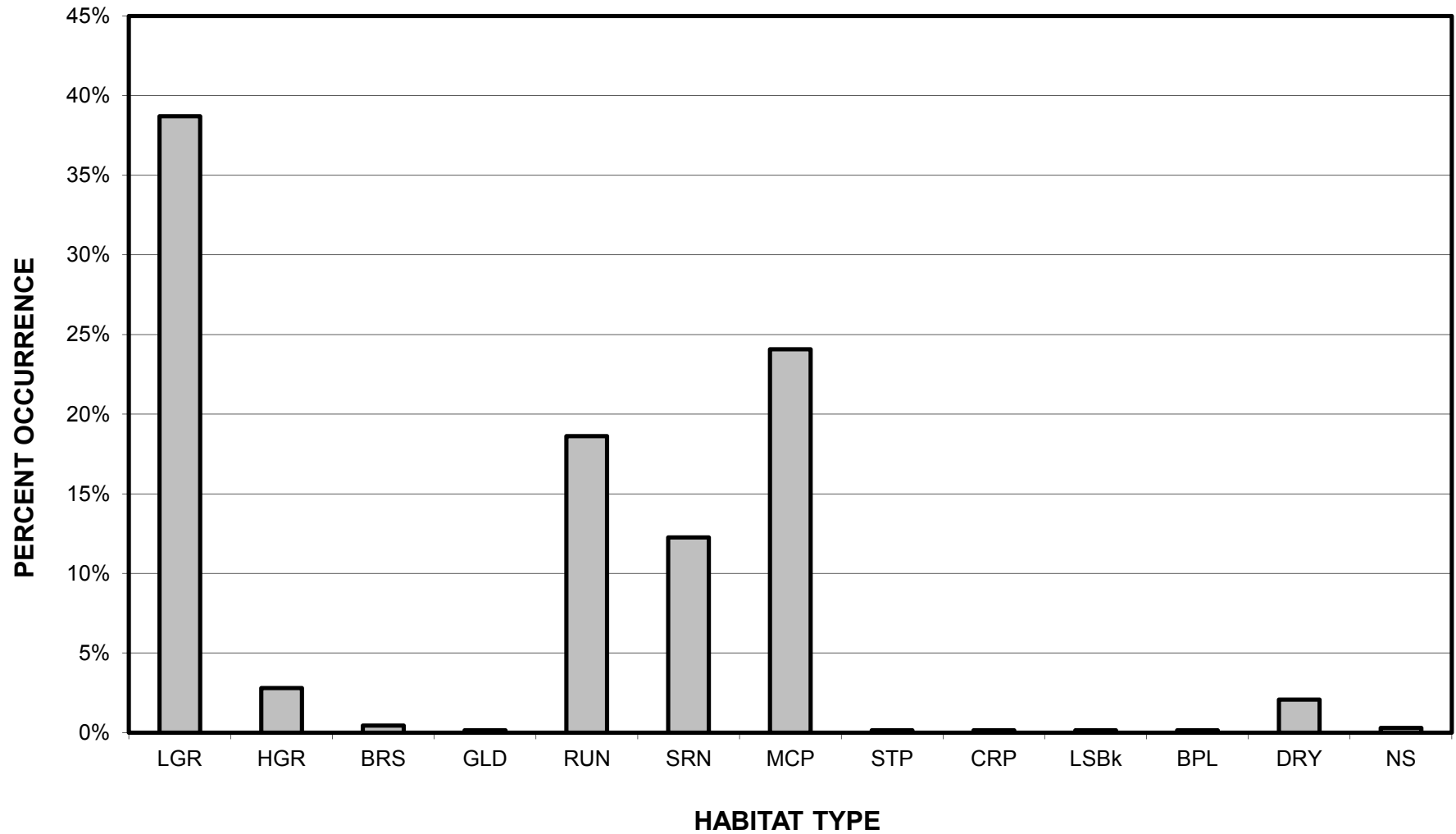
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

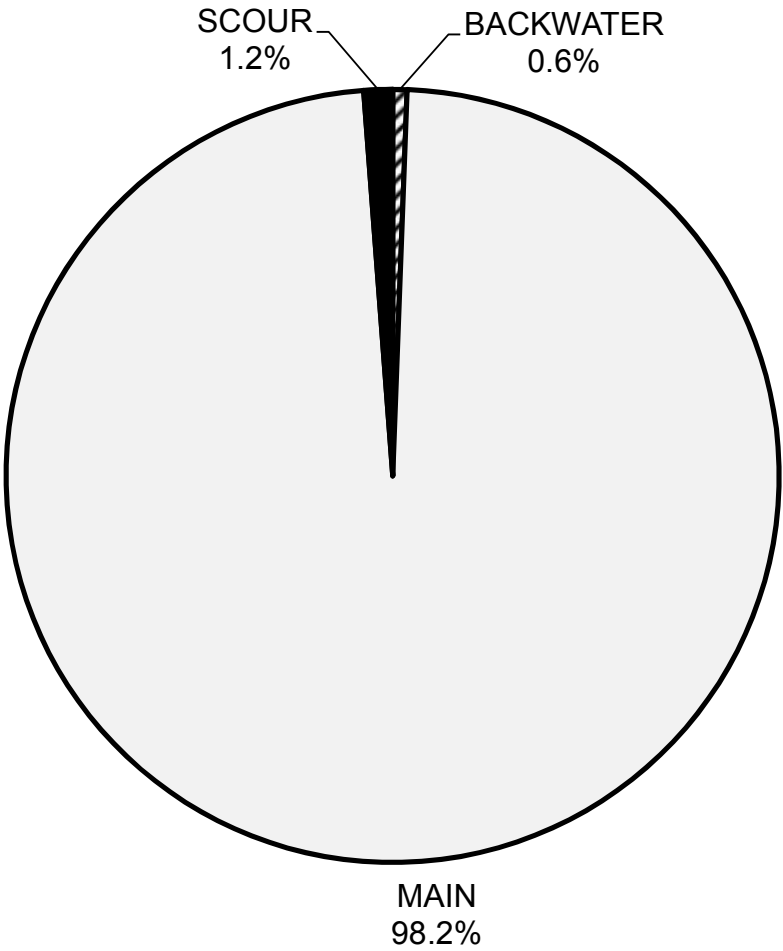
RUSSELL BROOK 2015

HABITAT TYPES BY PERCENT OCCURRENCE



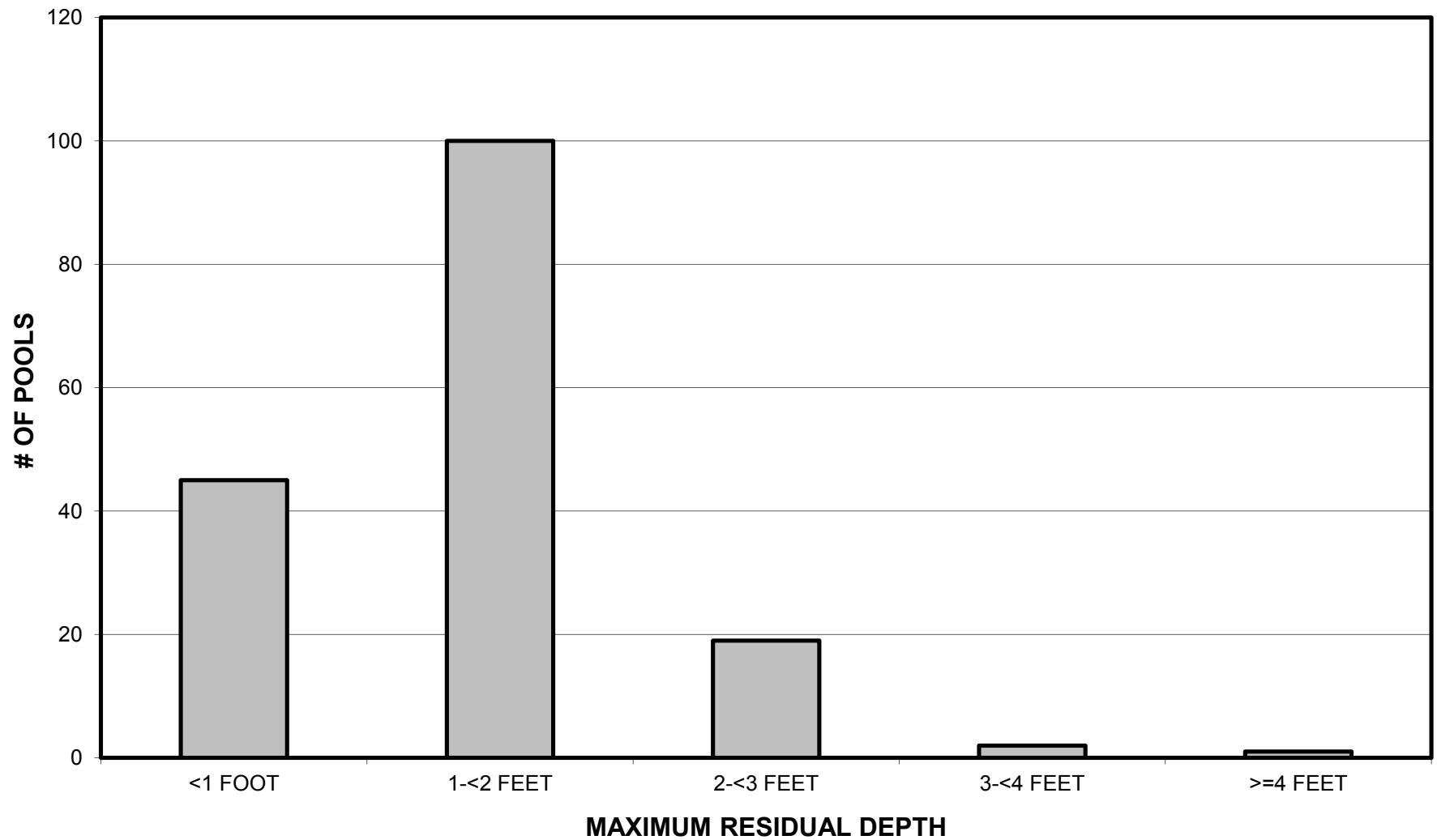
GRAPH 3

RUSSELL BROOK 2015
POOL TYPES BY PERCENT OCCURRENCE



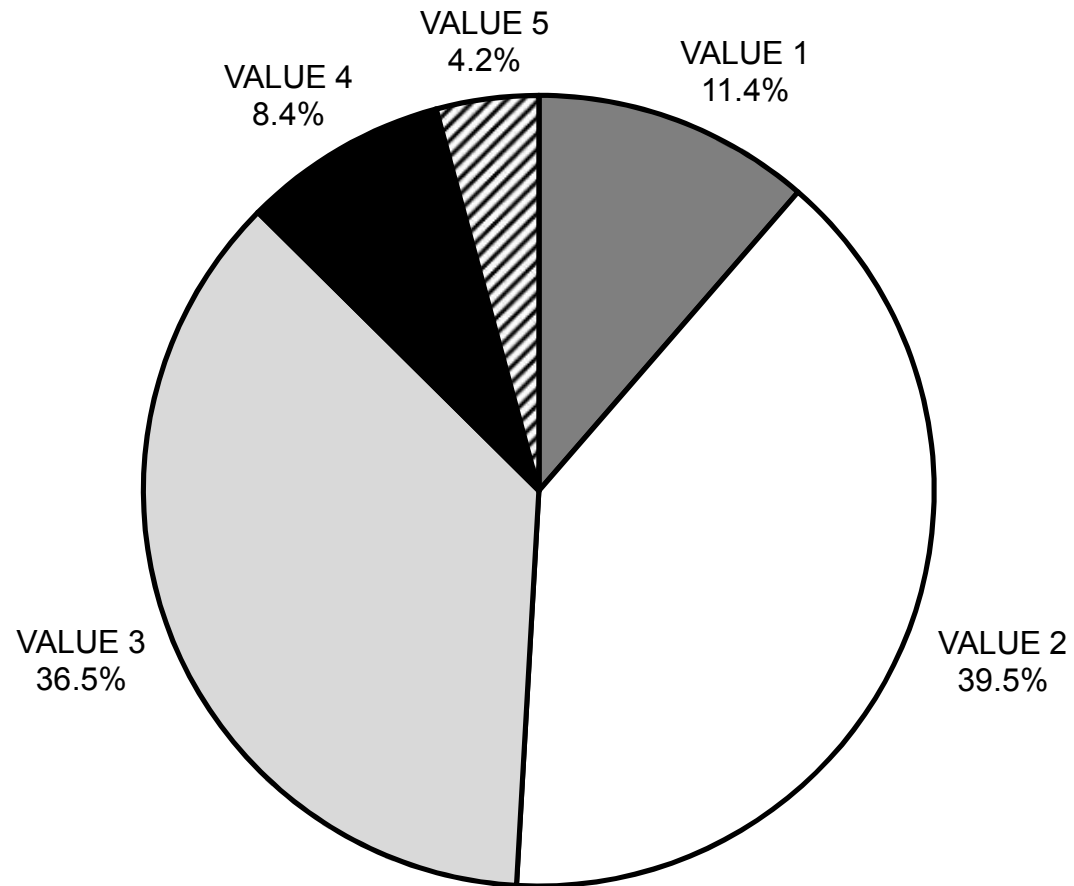
GRAPH 4

RUSSELL BROOK 2015 **MAXIMUM DEPTH IN POOLS**



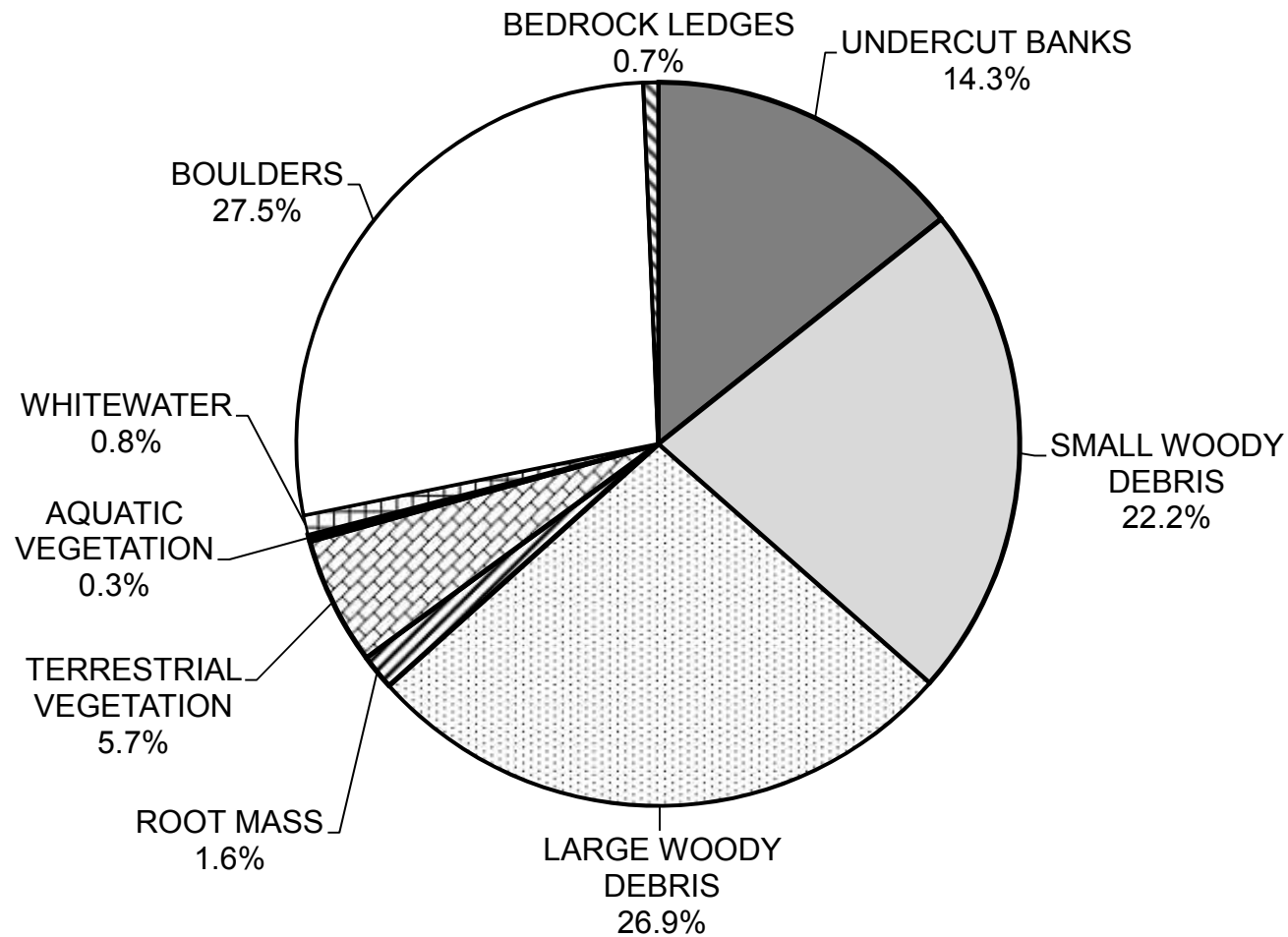
GRAPH 5

RUSSELL BROOK 2015 PERCENT EMBEDDEDNESS



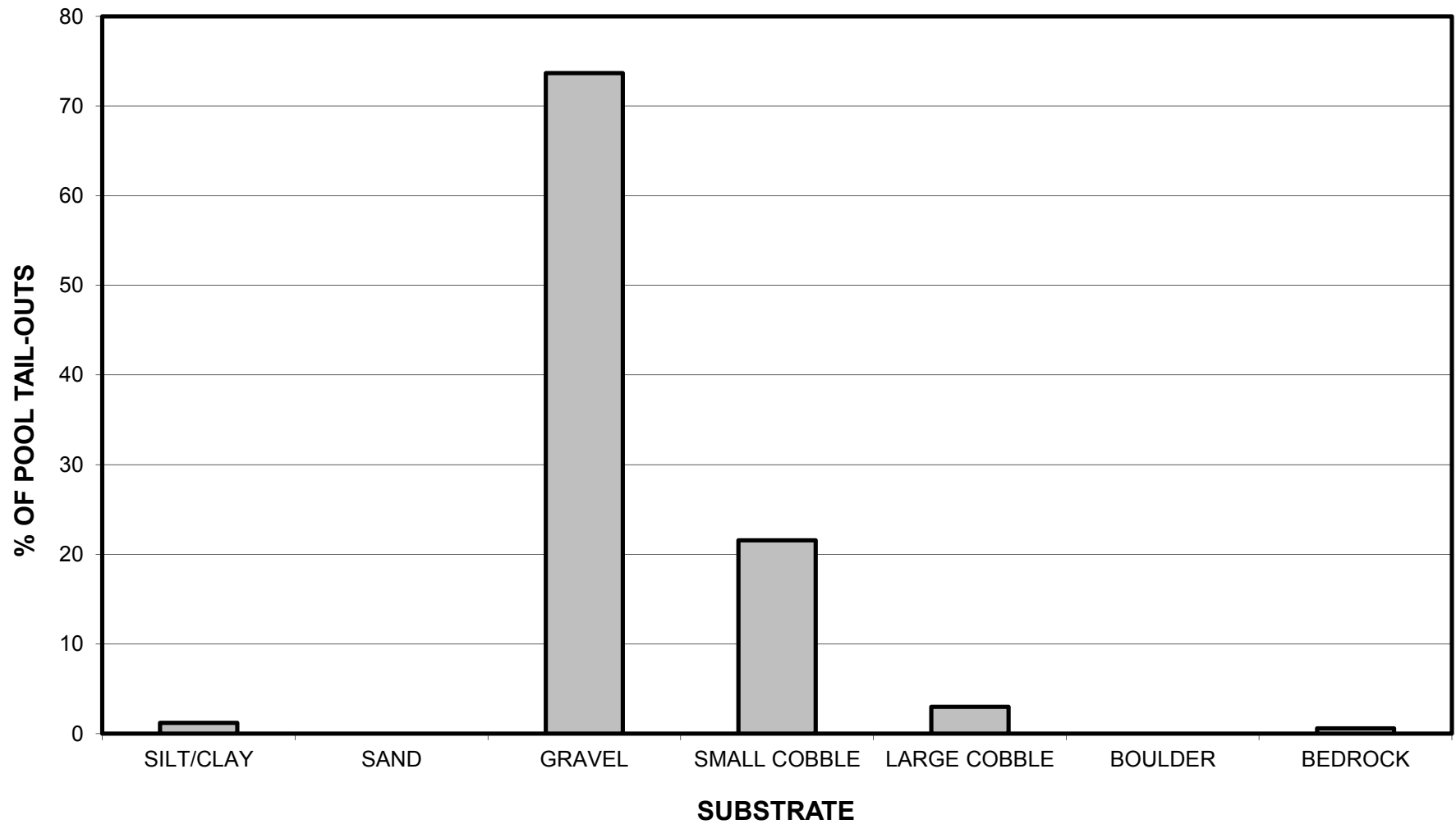
GRAPH 6

RUSSELL BROOK 2015 MEAN PERCENT COVER TYPES IN POOLS



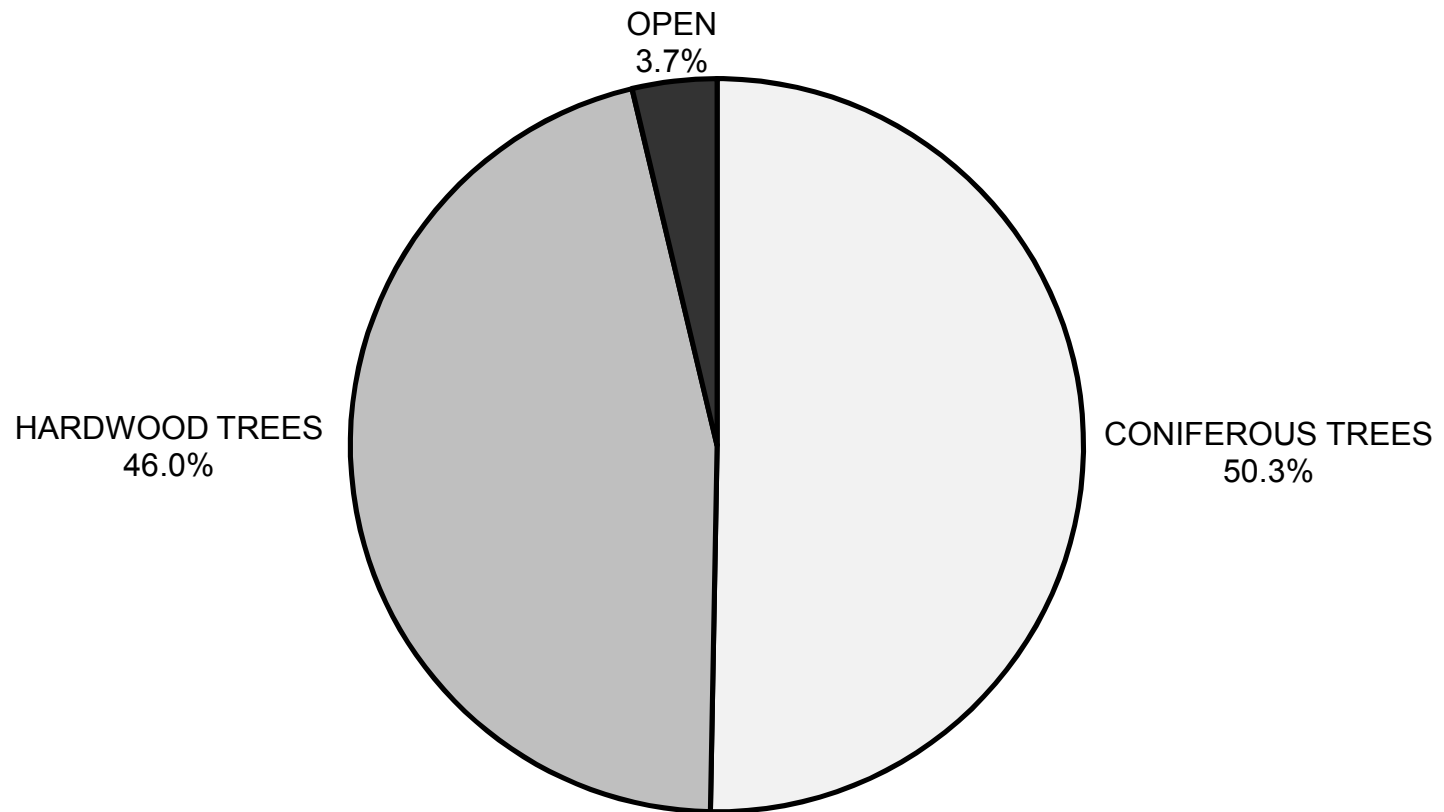
GRAPH 7

RUSSELL BROOK 2015
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



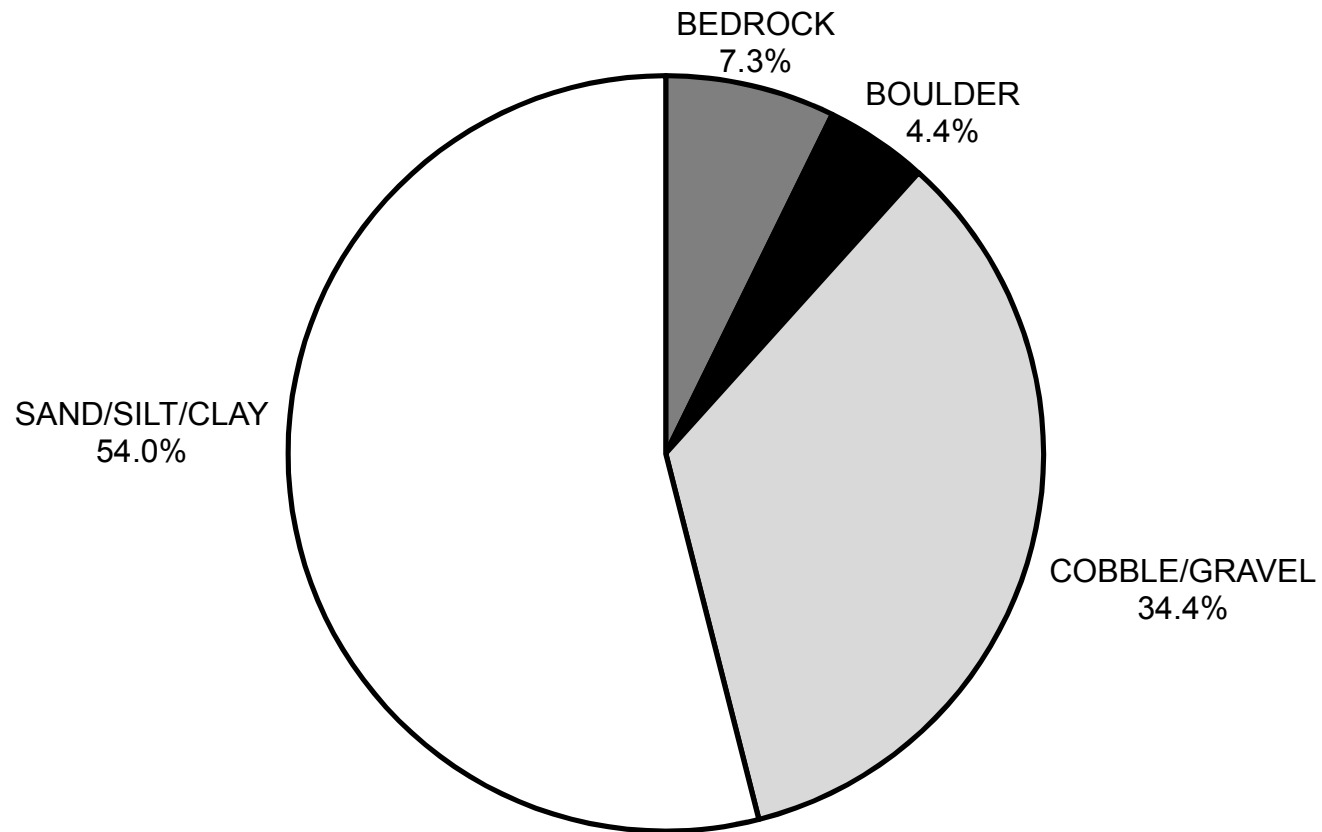
GRAPH 8

**RUSSELL BROOK 2015
MEAN PERCENT CANOPY**



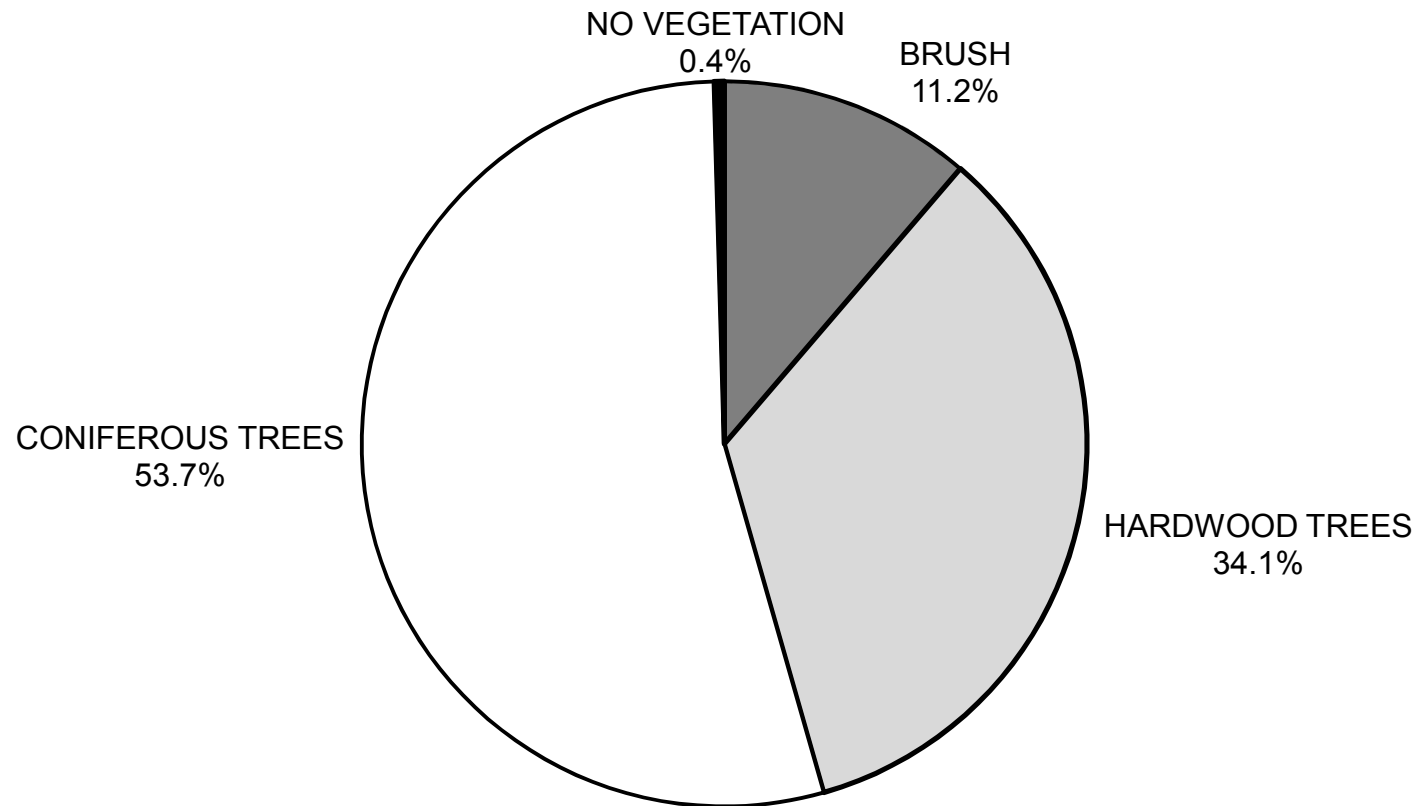
GRAPH 9

RUSSELL BROOK 2015
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

RUSSELL BROOK 2015
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11