



CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

STREAM INVENTORY REPORT

Howe Creek

INTRODUCTION

A stream inventory was conducted from June 21 to June 29, 2017 on Howe Creek. The survey began at the confluence with Eel River and extended upstream 4.3 miles.

The Howe Creek inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the habitat available to anadromous salmonids in Howe Creek. The objective of the biological inventory was to document the presence and distribution of juvenile salmonid species.

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for Chinook and 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. This report was finalized in April, 2018.

WATERSHED OVERVIEW

Howe Creek is a tributary to Eel River, which drains to the Pacific Ocean, located in Humboldt County, California (Map 1). Howe Creek's legal description at the confluence with Eel River is T02N R01W S35. Its location is 40.5138° north latitude and -124.1574° west longitude, LLID number 1241559405144. Howe Creek is a second order stream and has approximately 6.0 miles of blue line stream, according to the USGS Fortuna 7.5 minute quadrangle. Howe Creek drains a watershed of approximately 10.2 square miles. Elevations range from about 100 feet at the mouth of the creek to 2,000 feet in the headwater areas. Hardwood and mixed conifer forest dominates the watershed. The watershed is primarily privately owned and is managed for timber production, rangeland, and recreation. Vehicle access exists via Hwy 101 to Blue Slide Road to Howe Creek Road.

METHODS

The habitat inventory conducted in Howe Creek 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. 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. Surveyors also take photos to document general habitat conditions, significant features (landslides, potential barriers, etc.), and end of survey (Appendix II).

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 Howe Creek to record measurements and observations. There are eleven components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) near the bottom of the stream survey reach using a Marsh-McBirney Model 2000 flow meter.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1994). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel characteristics are measured using a hand level, hip chain, tape measure, and a stadia rod.

3. Temperatures:

Water and air temperatures are measured and recorded at every tenth habitat unit using a hand-held thermometer. Both temperatures are taken in degrees (°) Fahrenheit and the time of the measurement is also recorded. Air temperatures are recorded within one foot of the water surface, while water temperatures are recorded (where possible) in flowing water within the habitat unit.

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". Howe Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a clinometer, hip chain, and stadia rod.

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 Howe Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed 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 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 Howe Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. 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 densimeters as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In Howe Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or hardwood trees.

9. Bank Composition and Vegetation:

Bank composition elements range from bedrock to bare soil. However, the stream banks are usually covered with grass, brush, or trees. These factors influence the ability of stream banks to withstand winter flows. In Howe Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully-described unit were selected from the habitat inventory form. Additionally, the percent of each bank covered by vegetation (including downed trees, logs, and rootwads) was estimated and recorded.

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 Howe Creek. In addition, underwater mask and snorkel observations were made at 10 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 Howe Creek include:

- Riffle, Flatwater, Pool Habitat Types by Percent Occurrence
- Riffle, Flatwater, Pool Habitat Types by Total Length

- Total Habitat Types by Percent Occurrence
- Pool Types by Percent Occurrence
- Maximum Residual Depth in Pools
- Percent Embeddedness
- Mean Percent Cover Types in Pools
- Substrate Composition in Pool Tail-outs
- Mean Percent Canopy
- Dominant Bank Composition by Composition Type
- Dominant Bank Vegetation by Vegetation Type

HABITAT INVENTORY RESULTS

* ALL TABLES AND GRAPHS ARE LOCATED IN APPENDIX I *

The habitat inventory of June 21 to June 29, 2017 was conducted by Rachel Karlov (WSP), Kori Roberts (CDFW), Karlee Jewel (WSP), Maddie Hicks (WSP), and Ryan Bernstein (CDFW). The total length of the stream surveyed was 22,875 feet with an additional 389 feet of side channel.

A stream flow measurement 4.77 cfs was recorded on July 6, 2017 near the bottom of the survey reach with a Marsh-McBirney Model 2000 flowmeter.

Howe Creek is a F3 channel type for 16,710 feet of the stream surveyed (Reach 1), and an A2 channel type for 6,554 feet of the stream surveyed (Reach 2). F3 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios, are very stable, and have cobble-dominant substrates. A2 channels are steep, narrow, cascading, step-pool, high energy debris-transporting channels associated with depositional soils, and boulder-dominant substrates.

Water temperatures taken during the survey period ranged from 54° to 64° Fahrenheit. Air temperatures ranged from 54° to 78° Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 40% riffle units, 33% flatwater units, and 26% pool units (Graph 1). Based on total length of Level II habitat types there were 48% riffle units, 35% flatwater units, and 17% pool units (Graph 2).

Eleven Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 36% low gradient riffle units, 21% mid-channel pool units, and 17% run units (Graph 3). Based on percent total length, low gradient riffle units made up 40%, step run units 19%, and run units 16%.

A total of 115 pools were identified (Table 3). Main channel pools were the most frequently encountered at 88% (Graph 4), and comprised 89% 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-eight of the 114 pools (25%) had a residual depth of

two feet or greater (Graph 5). Of the 114 pools, 7% had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 117 pool tail-outs measured, 5 had a value of 1 (4.3%), 53 had a value of 2 (45.3%), 48 had a value of 3 (41%), 3 had a value of 4 (2.6%), and 8 had a value of 5 (6.8%) (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 1, flatwater habitat types had a mean shelter rating of 2, and pool habitats had a mean shelter rating of 14 (Table 1). Of the pool types, the main channel pools had the highest mean shelter rating of 24. Scour pools had a mean shelter rating of 12 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in Howe Creek. Graph 7 describes the pool cover in Howe Creek. Boulders are the dominant pool cover type followed by whitewater.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. Gravel was the most dominant substrate, observed in 53% of pool tail-outs. Small cobble was the next most frequently observed dominant substrate type, observed in 22% of pool tail-outs.

The mean percent canopy density for the surveyed length of Howe Creek was 87%. Thirteen percent of the canopy was open. Of the canopy present, the mean percentages of hardwood and coniferous trees were 89% and 11%, respectively. Graph 9 describes the mean percent canopy in Howe Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 98%. The mean percent left bank vegetated was 94%. The dominant elements composing the structure of the stream banks consisted of 53% cobble/gravel, 30% boulder, 9% bedrock, and 8% sand/silt/clay (Graph 10). Hardwood trees was the dominant vegetation type, observed in 88.7% of the units surveyed. Additionally, 6.3% of the units surveyed had coniferous trees as the dominant vegetation type, and 4.9% had brush as the dominant vegetation type (Graph 11).

BIOLOGICAL INVENTORY RESULTS

Survey teams conducted a mask and snorkel survey at 10 sites for species composition and distribution in Howe Creek on September 7, 2017 (Table A). The sites were sampled by Kori Roberts and Chris Tevini (CDFW).

The survey yielded 79 young-of-the-year (YOY) steelhead trout (SH) and four age 1+ SH.

During the survey, the upstream-most observation of juvenile steelhead trout occurred at 40.4706° north latitude, -124.19589 west longitude, approximately 21,097 feet upstream from the confluence with the Eel River (Map 1). No Coho salmon were observed during the biological inventory.

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Table A. Summary of results for a fish composition and distribution survey within Howe Creek, September, 7, 2017.

Date	Survey Site #	Habitat Unit #	Habitat Type	Approx. Dist. from mouth (ft.)	Steelhead Trout			Coho Salmon		Additional Aquatic Species Observed
					YOY	1+	2+	YOY	1+	
Reach 1: F3 Channel Type										
09/07/17	1	367	pool	19,722	6	0	0	0	0	
	2	370	pool	19,826	3	1	0	0	0	
	3	373	pool	19,891	6	0	0	0	0	
	4	375	pool	20,013	3	0	0	0	0	
	5	377	pool	20,150	0	0	0	0	0	
	6	378	riffle	20,467	2	1	0	0	0	
	7	379	pool	20,477	5	1	0	0	0	
	8	384	pool	20,687	12	0	0	0	0	
	9	386	pool	20,737	40	1	0	0	0	
	10	406	pool	21,412	2	0	0	0	0	

DISCUSSION

Howe Creek is an F3 channel type for the first 16,710 feet of stream surveyed, and an A2 channel type for the next 6,554 feet. F3 and A2 channel types for fish habitat improvement structures is as follows: F3 channels are good for bank-placed boulders, single and opposing wing-deflectors and fair for plunge weirs, boulder clusters, channel constrictors and log cover. A2 channels are generally not suitable for fish habitat improvement projects.

The water temperatures recorded on the survey days June 21 to June 29, 2017 ranged from 54° to 64° Fahrenheit. Air temperatures ranged from 54° to 78° Fahrenheit. This is a suitable water temperature range 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 35% of the total length of this survey, riffles 48%, and pools 17%. Twenty-eight of the 114 (25%) 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 structures that will increase or deepen pool habitat is recommended.

Fifty-eight of the 117 pool tail-outs measured had embeddedness ratings of 1 or 2. Fifty-one of the pool tail-outs had embeddedness ratings of 3 or 4. Eight 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 Howe Creek should be mapped and rated according to their

potential sediment yields, and control measures should be taken.

Eighty-seven of the 116 pool tail-outs measured had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

Thirty of the 116 pool tail-outs had silt, sand, large cobble, boulders or bedrock as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean shelter rating for pools is 14. The shelter rating in the flatwater habitats is 2. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in Howe Creek. Boulders are the dominant cover type in pools followed by whitewater. Log and rootwad 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 87%. Reach 1 had a canopy density of 84.6%, Reach 2 had a canopy density of 92.5%. 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 94%, 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

Howe Creek 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 Howe Creek. 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) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.
- 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) Suitable size spawning substrate on Howe Creek is limited to relatively few reaches. Projects should be designed at suitable sites to trap and sort spawning gravel.

- 5) The limited water temperature data available suggest that maximum temperatures are within the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.
- 6) 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.
- 7) While overall canopy density is 87% on Howe Creek, this canopy density is composed mainly of hardwood trees (89%). In order to provide more structure to the canopy, reduce water temperatures, and increase LWD recruitment consider planting appropriate native coniferous species like redwood and Douglas fir along the riparian corridor. Also where site conditions are appropriate consider cautious thinning of hardwoods to hasten the development of denser and more extensive coniferous canopy component. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is affected from upstream.

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 of the Eel River.
314	0007.00	There is rip rap on the left bank. There are 2 pieces of large woody debris (LWD) from a previous salmon restoration project (SRP).
349	0008.00	There is rip rap on the left bank.
386	0009.00	There is rip rap on the left bank that is part of an SRP.
544	0011.00	There is a landslide on the left bank 45' long x 30' high.
670	0012.00	The landslide on the left bank ends.
1026	0019.00	Bridge #1 is the crossing for Blue Slide Road and it is 26' high x 32' wide x 130' long. It is an automobile bridge made of cement and is not a barrier to salmonids.
1381	0028.00	There are cement blocks on the left bank.

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3200	0059.00	Bridge #2 is the crossing for a private road, and it is 11' high x 10' wide x 50' long. It is an automobile bridge made of iron and is not a barrier to salmonids.
3917	0066.00	There is an old landslide on the right bank that is 60' long x 60' high.
4347	0070.00	Bridge #3 is the crossing for a private road, and it is 11' high x 10' wide x 65' long. It is an automobile bridge made of iron and is not a barrier to salmonids.
4714	0077.00	There is erosion on the right bank.
5614	0087.00	There is rip rap made up of boulders, cement, and LWD on the right bank.
5945	0091.00	Bridge #4 is the crossing for a private road, and it is 11' high x 10' wide x 50' long. It is an automobile bridge made of iron and wood, and is not a barrier to salmonids.
6234	0096.00	There is a landslide on the right bank that is 100' long x 100' high.
6395	0098.00	Bridge #5 is the crossing for Howe Creek Road and it is 14' high x 24' wide. It is an automobile bridge made of cement and is not a barrier to salmonids.
7212	0108.00	There is a rootwad with SWD accumulation spanning the active channel, but not bankfull.
7607	0113.00	There is a landslide on the left bank that is 260' long x 30' high. It continues through the next 4 unit.
7800	0117.00	The landslide on the left bank ends.
8295	0125.00	There is a landslide on the left bank that is 125' long x 25' high.
8479	0128.00	Tributary # 1 is Atwell creek and it enters on the right bank. It contributes to approximately 30% of the Creek's flow. The water temperature of the tributary was 58° Fahrenheit, the water downstream and upstream of the confluence was also 58° Fahrenheit. The slope of the tributary is 1.3%. The tributary is accessible to salmonids. Fish were observed in the tributary.
8948	0134.00	The LWD and boulders on the left bank are from a restoration project.
9128	0140.00	The LWD and boulders are part of a restoration structure.

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9211	0142.00	There are boulders on the right and left bank that are part of a restoration structure.
9284	0144.00	There are boulders on the right and left bank that are part of a restoration structure.
9557	0149.00	There are two pieces of LWD that are part of a restoration project.
10195	0163.00	There is rip rap on the left bank.
10497	0170.00	There is erosion on the left bank.
10738	0176.00	There are boulders on the right and left bank that are part of a restoration project.
10964	0180.00	There is erosion on the left bank.
11216	0185.00	Bridge #6 is the crossing for a private road, and it is 15' high x 10' wide x 30' long. It is an automobile bridge made of iron and is not a barrier to salmonids.
11428	0189.00	Bridge #7 is the crossing for a private road and it is 12' high x 15' wide x 65' long. It is an automobile bridge made of iron and is not a barrier to salmonids.
12650	0207.00	Bridge #8 is the crossing for a Howe Creek Road and it is 15' high x 10' wide x 40' long. It is an automobile bridge made of iron and wood, and is not a barrier to salmonids.
13041	0214.00	There is erosion on the right bank that is 50' long by 15' high.
13100	0215.00	There is erosion on the left bank 80' long by 10' high.
13280	0219.00	There is a gravel road on the left bank and the right bank.
13298	0220.00	Boulders are part of a restoration structure.
13454	0222.00	Bridge #9 is the crossing for Howe Creek Road and is 14' high x 12' wide x 40' long. It is an automobile bridge made of wood and iron and is not a barrier to salmonids.
13606	0225.00	There is a boulder restoration structure.
13997	0235.00	There is a LWD and boulder restoration structure on the right bank.

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14044	0236.00	There is a LWD and boulder restoration structure on the left bank.
14062	0237.00	There is a LWD and boulder restoration structure creating the pool.
14276	0243.00	Bridge #10 is the crossing for Howe Creek Road and is 13' high x 11' wide x 45' long. It is an automobile bridge made of wood and iron and is not a barrier to salmonids.
14590	0249.00	There is erosion on the left bank that is 30' long x 5' high.
14655	0252.00	There is erosion on the right bank.
15272	0263.00	There is erosion on the left bank that is 50' long x 5' high.
15324	0264.00	Tributary #3 enters on the right bank. The tributary was dry.
15581	0266.00	There is a 1' plunge over boulders into the run.
15645	0268.00	There is a LWD and boulder restoration structure creating a pool.
16202	0278.00	There is a 1' plunge into a 1' deep pool.
16439	0282.00	There is erosion on the left bank that is 60' long x 5' high. There is a landslide on the right bank that is 60' long x 200' high.
16710	0291.00	Channel type is A2. Channel type cross-section location is at Habitat Unit (HU) #291.
16775	0294.00	Tributary #4 enters on the left bank. It contributes to approximately 4% of Howe Creek's flow. The water temperature of the tributary was 61° Fahrenheit, the water temperature downstream of the confluence was 60° Fahrenheit, and the water temperature upstream of the confluence was 60° Fahrenheit. The tributary is not accessible to salmonids due to having a very steep slope. Fish were not observed in the tributary.
17046	0300.00	There is erosion on the right bank that measures 40' long x 8' high.
17433	0311.00	Bridge #11 is the crossing for an unnamed road and is 10' high x 10' wide x 50' long. It is an automobile bridge made of wood and iron and is not a barrier to salmonids.
17643	0317.00	Tributary #6 enters on the right bank. It contributes to approximately 50% of Howe Creek's flow. The water temperature of the tributary was 58° Fahrenheit. The tributary is accessible to salmonids. Fish were not observed in the tributary, but it is likely that there could be fish present

in the tributary because it has good access and has similar channel characteristics to Howe Creek.

18273	0329.00	There is a landslide on the left bank, it measures 200' long x 80' high.
18431	0335.00	There is a 3.5' plunge over boulders into a pool that is 1.5' deep.
18521	0339.00	There is a 3' plunge over LWD into a pool that is 1.7' deep.
18624	0342.00	There is a 1' plunge over LWD into a 2.5' deep pool.
18959	0351.00	There is a 3.5' plunge over boulders with 1.5' steps into a 1.1' deep pool.
19281	0360.00	There is a 1.5' plunge over boulders into a pool.
19344	0363.00	There is a 5' plunge over LWD into a pool.
19396	0365.00	There is a landslide on the right bank that measures 20' long x 40' high.
19621	0370.00	There is a 1.5' plunge into a 1' deep pool.
19695	0374.00	Tributary #7 enters on the left bank. It contributes to approximately 10% of Howe Creek's flow. The water temperature of the tributary was 58° Fahrenheit, the water temperature downstream of the confluence was 58° Fahrenheit, and the water temperature upstream of the confluence was 58° Fahrenheit. The tributary is accessible to salmonids. It is very narrow and has lots of boulders. Fish were not observed in the tributary.
20266	0386.00	LDA #1 is 12' high x 40' wide x 100' long and contains 15 pieces of LWD. Water does not flow through the LDA and there are no visible gaps in it. Sediment is being retained in the approximate dimensions of 30' wide, 60' long and 8' deep. The sediment ranges in size from sand to large cobble. The LDA is not a possible barrier to salmonids.
20276	0387.00	There is a 2' plunge over LWD into a run.
20364	0388.00	There is a landslide on the right bank.
20716	0398.00	There is a landslide on the left bank that measures 40' long x 40' high. It ends at unit 400.
20871	0404.00	There is a 5.5' plunge over boulders into a 1.3' deep pool.

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20951	0407.00	Tributary #8 enters on the right bank. It contributes to approximately 60% of Howe Creek's flow. The water temperature of the tributary was 56° Fahrenheit, the water temperature downstream of the confluence was 56° Fahrenheit, and the water temperature upstream of the confluence was 56° Fahrenheit. The tributary is accessible to salmonids. Fish were not observed in the tributary.
21401	0421.00	There is a landslide on the left bank.
21597	0426.00	There is a series of 2' plunges over boulders.
21701	0428.00	There is a 1' plunge over boulders into a pool.
21788	0431.00	There is a 3' plunge over LWD.
21872	0432.00	There is a landslide on the left bank that measures 100' long x 30' high. The channel is constricted.
22075	0438.00	End of survey due to end of anadromy. There is an approximately 800' long landslide on the left and right banks constricting the channel with lots of debris and branches. At the end of the landslide there is a 14' high waterfall over bedrock. Before the landslide the channel becomes steeper with more boulders, with a greater frequency of step pools and high gradient riffles.

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.

REPORT CONTACT INFORMATION

California Department of Fish and Wildlife
Coastal Watershed Planning and Assessment Program
1487 Sandy Prairie ct., Suite A
Fortuna, CA 95540
www.coastalwatersheds.ca.gov

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

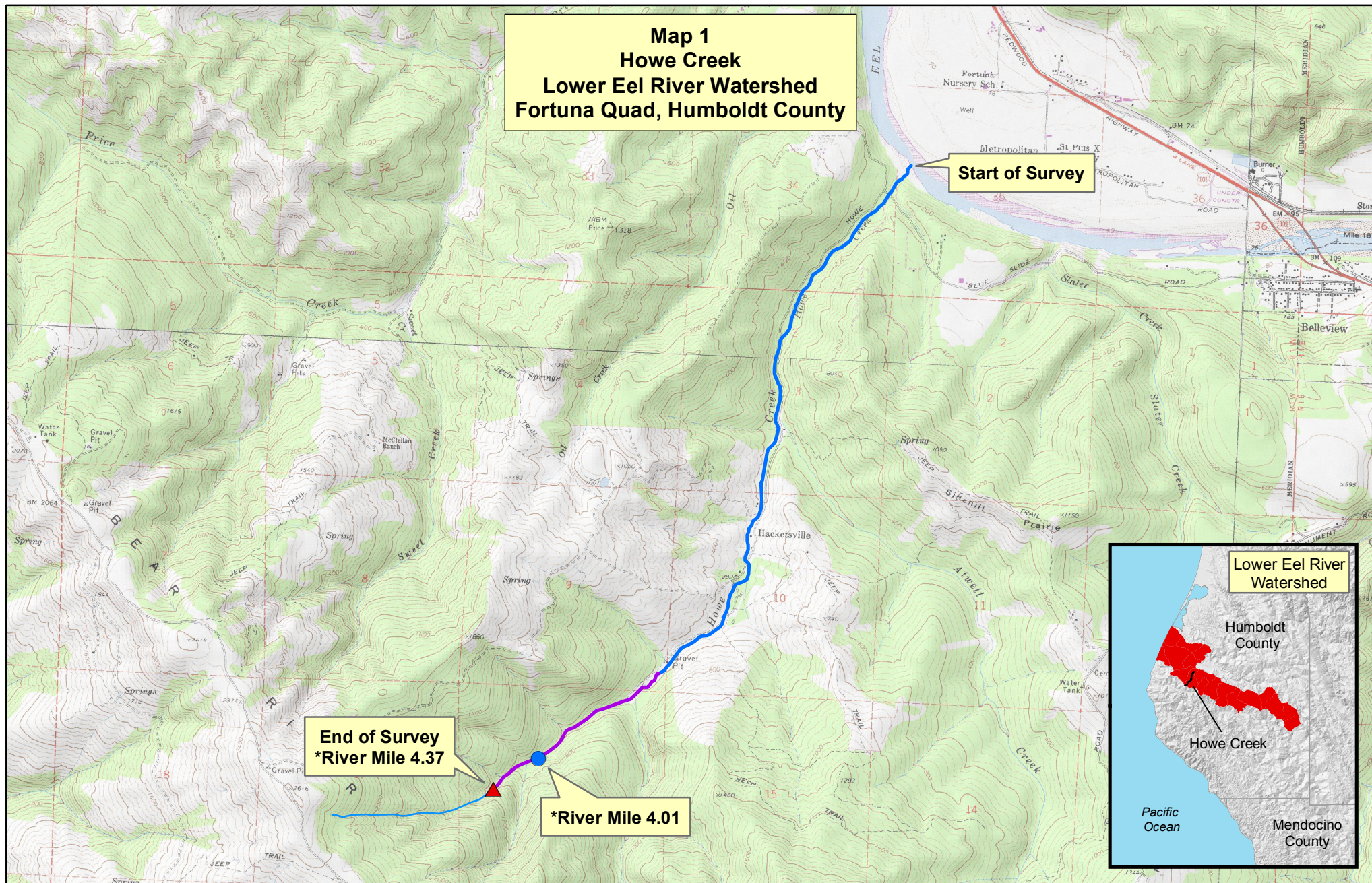
Corner Pool	(CRP)	[5.1]	{22}
Lateral Scour Pool - Log Enhanced	(LSL)	[5.2]	{10}
Lateral Scour Pool - Rootwad Enhanced	(LSR)	[5.3]	{11}
Lateral Scour Pool - Bedrock Formed	(LSBk)	[5.4]	{12}
Lateral Scour Pool - Boulder Formed	(LSBo)	[5.5]	{20}
Plunge Pool	(PLP)	[5.6]	{ 9 }

BACKWATER POOLS

Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Rootwad 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]	



- Reach 1: F3 Channel Type
- Reach 2: A2 Channel Type
- Howe Creek

- Last observed juvenile steelhead trout
- ▲ Total natural barrier



APPENDIX I

TABLES AND GRAPHS

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

Stream Name: Howe Creek

LLID: 1241559405144

Drainage: Eel River - Lower

Survey Dates: 6/21/2017 to 6/29/2017

Confluence Location: Quad: FORTUNA

Legal Description: T02NR01WS35

Latitude: 40:30:52.0N

Longitude: 124:09:21.0

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
148	14	FLATWATER	33.4	55	8089	34.8	12.9	0.5	0.9	831	123025	472	69912		3
1	0	NOSURVEY	0.2	80	80	0.3									
115	113	POOL	26.0	35	4020	17.3	11.1	0.7	1.6	420	48350	442	50844	304	14
179	15	RIFFLE	40.4	62	11075	47.6	9.5	0.4	0.8	475	84990	213	33016		1
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)			Total Volume (cu.ft.)		
443	142				23264					256365			153772		

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Howe Creek

LLID: 1241559405144

Drainage: Eel River - Lower

Survey Dates: 6/21/2017 to 6/29/2017

Confluence Location: Quad: FORTUNA

Legal Description: T02NR01WS35

Latitude: 40:30:52.0N

Longitude: 124:09:21.0W

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 (%)
160	13	LGR	36.1	59	9400	40.4	8	0.5	1	430	68787	231	31305		1	87
19	2	HGR	4.3	88	1675	7.2	6	0.4	1.1	292	5543	112	2120		0	92
77	11	RUN	17.4	48	3727	16.0	14	0.5	1.2	940	72399	537	41322		2	79
71	3	SRN	16.0	61	4362	18.8	9	0.5	1.1	432	30645	237	16806		3	93
94	92	MCP	21.2	36	3352	14.4	11	0.7	4.4	431	40499	467	43866	327	12	87
1	1	CCP	0.2	35	35	0.2	13	0.8	2.3	455	455	455	455	364	40	91
6	6	STP	1.4	35	208	0.9	10	0.5	2	339	2035	243	1457	153	15	96
1	1	LSL	0.2	16	16	0.1	10	0.3	0.7	160	160	96	96	48	30	100
1	1	LSR	0.2	45	45	0.2	20	1.0	3.2	900	900	1620	1620	900	120	98
5	5	LSBk	1.1	56	280	1.2	12	0.6	2.3	713	3564	539	2697	314	1	89
7	7	PLP	1.6	12	84	0.4	9	0.6	1.5	108	758	100	702	68	26	91
1	0	NS	0.2	80	80	0.3										

Total Units
443

Total Units Fully Measured
142

Total Length (ft.)
23264

Total Area (sq.ft.)
225745

Total Volume (cu.ft.)
142447

Table 3 - Summary of Pool Types

Stream Name: Howe Creek

LLID: 1241559405144

Drainage: Eel River - Lower

Survey Dates: 6/21/2017 to 6/29/2017

Confluence Location: Quad: FORTUNA

Legal Description: T02NR01WS35

Latitude: 40:30:52.0N

Longitude: 124:09:21.0W

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
101	99	MAIN	88	36	3595	89	11.2	0.7	426	42978	317	32015	12
14	14	SCOUR	12	30	425	11	10.7	0.6	384	5382	214	2994	24
Total Units	Total Units Fully Measured			Total Length (ft.)			Total Area (sq.ft.)			Total Volume (cu.ft.)			
115	113			4020			48360			35009			

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

Stream Name: Howe Creek

LLID: 1241559405144

Drainage: Eel River - Lower

Survey Dates: 6/21/2017 to 6/29/2017

Confluence Location: Quad: FORTUNA

Legal Description: T02NR01WS35

Latitude: 40:30:52.0N

Longitude: 124:09:21.0W

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
93	MCP	82	10	11	61	66	15	16	6	6	1	1
1	CCP	1	0	0	0	0	1	100	0	0	0	0
6	STP	5	0	0	5	83	1	17	0	0	0	0
1	LSL	1	1	100	0	0	0	0	0	0	0	0
1	LSR	1	0	0	0	0	0	0	1	100	0	0
5	LSBk	4	0	0	2	40	3	60	0	0	0	0
7	PLP	6	1	14	6	86	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
114			12	11	74	65	20	18	7	6	1	1

Mean Maximum Residual Pool Depth (ft.): 1.6

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Howe Creek

LLID:124155905144 Drainage: Eel River - Lower

Survey Dates: 6/21/2017 to 6/29/2017 Dry Units: 0

Confluence Location: Quad: FORTUNA Legal Description: T02NR01WS35 Latitude: 40:30:52.0N Longitude: 124:09:21.0W

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
160	10	LGR	0	0	0	0	33	0	10	57	0
19	2	HGR	0	0	0	0	0	0	0	0	0
179	12	TOTAL RIFFLE	0	0	0	0	32	0	12	56	0
77	11	RUN	0	0	30	0	68	0	0	3	0
71	3	SRN	0	0	4	0	0	0	25	70	0
148	14	TOTAL FLAT	0	0	21	0	44	0	9	26	0
94	92	MCP	1	10	11	4	9	0	13	49	2
1	1	CCP	0	10	0	0	70	0	0	20	0
6	6	STP	0	0	0	0	0	0	27	73	0
1	1	LSL	0	0	50	0	0	0	50	0	0
1	1	LSR	0	20	60	0	10	0	10	0	0
5	5	LSBk	0	0	0	0	10	0	0	30	60
7	7	PLP	0	0	4	0	3	0	36	57	0
115	113	TOTAL POOL	0	9	11	4	9	0	16	48	2
1	0	NS									
443	139	TOTAL	0	8	12	4	12	0	15	47	3

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Howe Creek

LLID: 1241559405144

Drainage: Eel River - Lower

Survey Dates: 6/21/2017 to 6/29/2017

Dry Units: 0

Confluence Location: Quad: FORTUNA

Legal Description: T02NR01WS35

Latitude: 40:30:52.0N

Longitude: 124:09:21.0W

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
160	12	LGR	0	0	17	42	33	8	0
19	2	HGR	0	0	50	0	50	0	0
77	12	RUN	8	17	25	42	8	0	0
71	3	SRN	0	0	33	33	33	0	0
94	91	MCP	23	32	22	15	7	1	0
1	1	CCP	0	100	0	0	0	0	0
6	5	STP	0	0	100	0	0	0	0
1	1	LSL	0	100	0	0	0	0	0
1	1	LSR	0	100	0	0	0	0	0
5	5	LSBk	40	40	0	0	20	0	0
7	7	PLP	0	29	57	14	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Howe Creek

LLID: 1241559405144

Drainage: Eel River - Lower

Survey Dates: 6/21/2017 to 6/29/2017

Confluence Location: Quad: FORTUNA

Legal Description: T02NR01WS35

Latitude: 40:30:52.0N

Longitude: 124:09:21.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
87	11	89	1	98	94

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: Howe Creek

LLID: 1241559405144

Drainage: Eel River - Lower

Survey Dates: 6/21/2017 to 6/29/2017

Survey Length (ft.): 23264

Main Channel (ft.): 22875

Side Channel (ft.): 389

Confluence Location: Quad: FORTUNA

Legal Description: T02NR01WS35 Latitude: 40:30:52.0N

Longitude: 124:09:21.0W

Summary of Fish Habitat Elements By Stream Reach**STREAM REACH: 1**

Channel Type: F3

Canopy Density (%): 84.6

Pools by Stream Length (%): 19.7

Reach Length (ft.): 16710

Coniferous Component (%): 13.6

Pool Frequency (%): 25.9

Riffle/Flatwater Mean Width (ft.): 12.2

Hardwood Component (%): 86.4

Residual Pool Depth (%):

BFW:

Dominant Bank Vegetation: Hardwood Trees

< 2 Feet Deep: 65

Range (ft.): 13 to 48

Vegetative Cover (%): 94.2

2 to 2.9 Feet Deep: 24

Mean (ft.): 27

Dominant Shelter: Boulders

3 to 3.9 Feet Deep: 9

Std. Dev.: 8

Dominant Bank Substrate Type: Cobble/Gravel

>= 4 Feet Deep: 1

Base Flow (cfs.): 4.8

Occurrence of LWD (%): 12

Mean Max Residual Pool Depth (ft.): 1.8

Water (F): 54 - 64 Air (F): 54 - 78

LWD per 100 ft.:

Mean Pool Shelter Rating: 12

Dry Channel (ft): 0

Riffles: 0

Pools: 2

Flat: 0

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 57 Sm Cobble: 33 Lg Cobble: 8 Boulder: 1 Bedrock: 1

Embeddedness Values (%): 1. 6.5 2. 44.2 3. 48.1 4. 0.0 5. 1.3

STREAM REACH: 2

Channel Type: A2

Canopy Density (%): 92.5

Pools by Stream Length (%): 11.2

Reach Length (ft.): 6165

Coniferous Component (%): 5.1

Pool Frequency (%): 26.1

Riffle/Flatwater Mean Width (ft.): 8.6

Hardwood Component (%): 94.9

Residual Pool Depth (%):

BFW:

Dominant Bank Vegetation: Hardwood Trees

< 2 Feet Deep: 95

Range (ft.): 15 to 34

Vegetative Cover (%): 99.5

2 to 2.9 Feet Deep: 5

Mean (ft.): 25

Dominant Shelter: Boulders

3 to 3.9 Feet Deep: 0

Std. Dev.: 6

Dominant Bank Substrate Type: Boulder

>= 4 Feet Deep: 0

Base Flow (cfs.): 4.8

Occurrence of LWD (%): 3

Mean Max Residual Pool Depth (ft.): 1.3

Water (F): 56 - 60 Air (F): 58 - 68

LWD per 100 ft.:

Mean Pool Shelter Rating: 17

Dry Channel (ft): 0

Riffles: 0

Pools: 3

Flat: 1

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 45 Sm Cobble: 3 Lg Cobble: 25 Boulder: 28 Bedrock: 0

Embeddedness Values (%): 1. 0.0 2. 47.5 3. 27.5 4. 7.5 5. 17.5

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Howe Creek

LLID: 1241559405144

Drainage: Eel River - Lower

Survey Dates: 6/21/2017 to 6/29/2017

Confluence Location: Quad: FORTUNA

Legal Description: T02NR01WS35

Latitude: 40:30:52.0N

Longitude: 124:09:21.0W

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	19	7	9.2
Boulder	40	46	30.3
Cobble / Gravel	68	82	52.8
Sand / Silt / Clay	15	7	7.7

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	7	7	4.9
Hardwood Trees	125	127	88.7
Coniferous Trees	10	8	6.3
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values:

3

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

StreamName: Howe Creek

LLID: 1241559405114 Drainage: Eel River-Lower

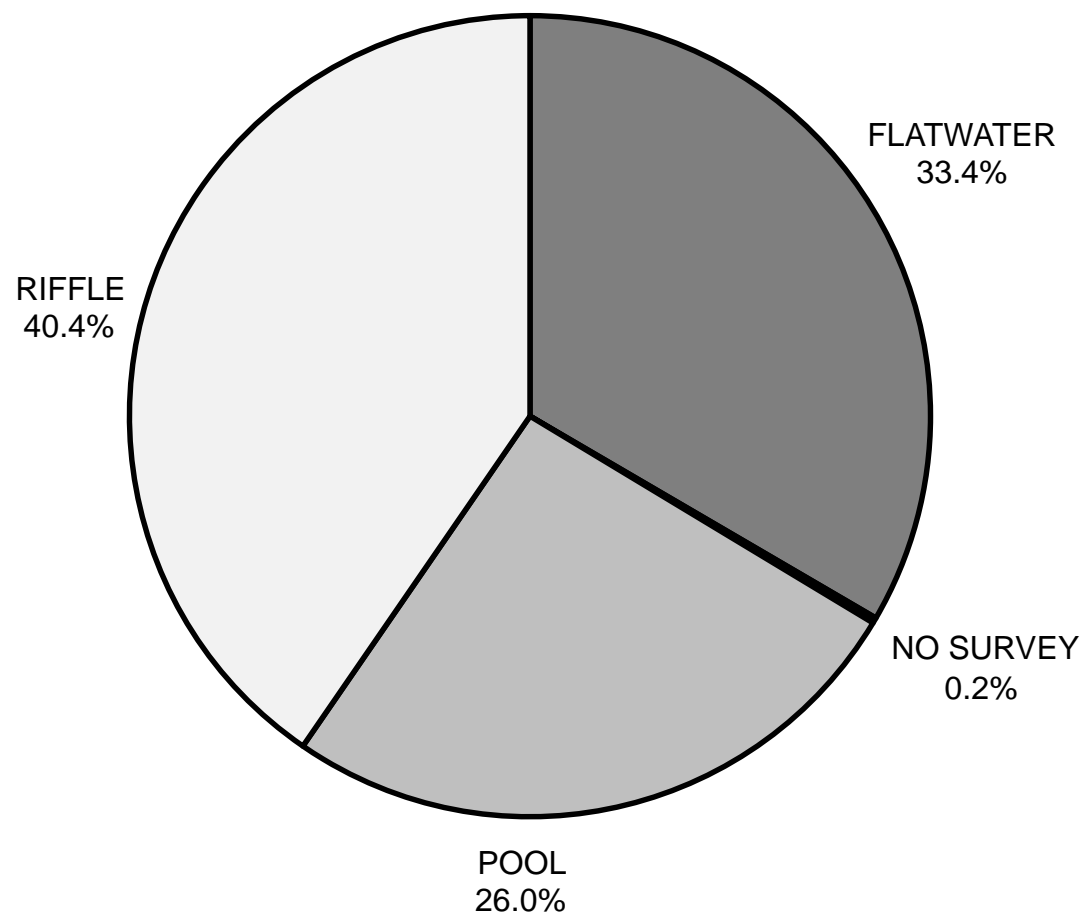
Survey Dates: 6/21/2017 to 6/29/2017

Confluence Location: Quad: FORTUNA Legal Description: T02NR01WS35 Latitude: 40:30:52.0N Longitude: 124:09:21.0W

	Riffles	Flatwater	Pools
UNDERCUT BANKS(%)	0	0	0
SMALL WOODY DEBRIS (%)	0	0	9
LARGE WOODY DEBRIS (%)	0	21	11
ROOT MASS (%)	0	0	4
TERRESTRIAL VEGETATION (%)	32	44	9
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	12	9	16
BOULDERS (%)	56	26	48
BEDROCK LEDGES (%)	0	0	2

HOWE CREEK 2017

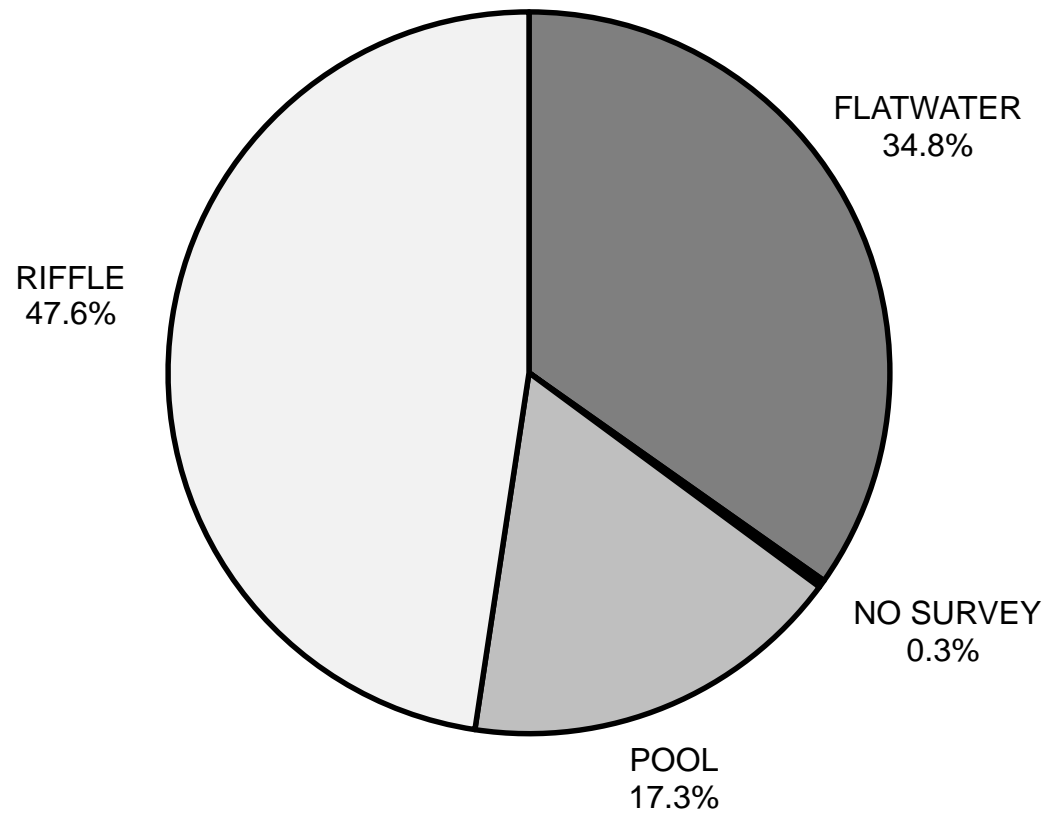
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

HOWE CREEK 2017

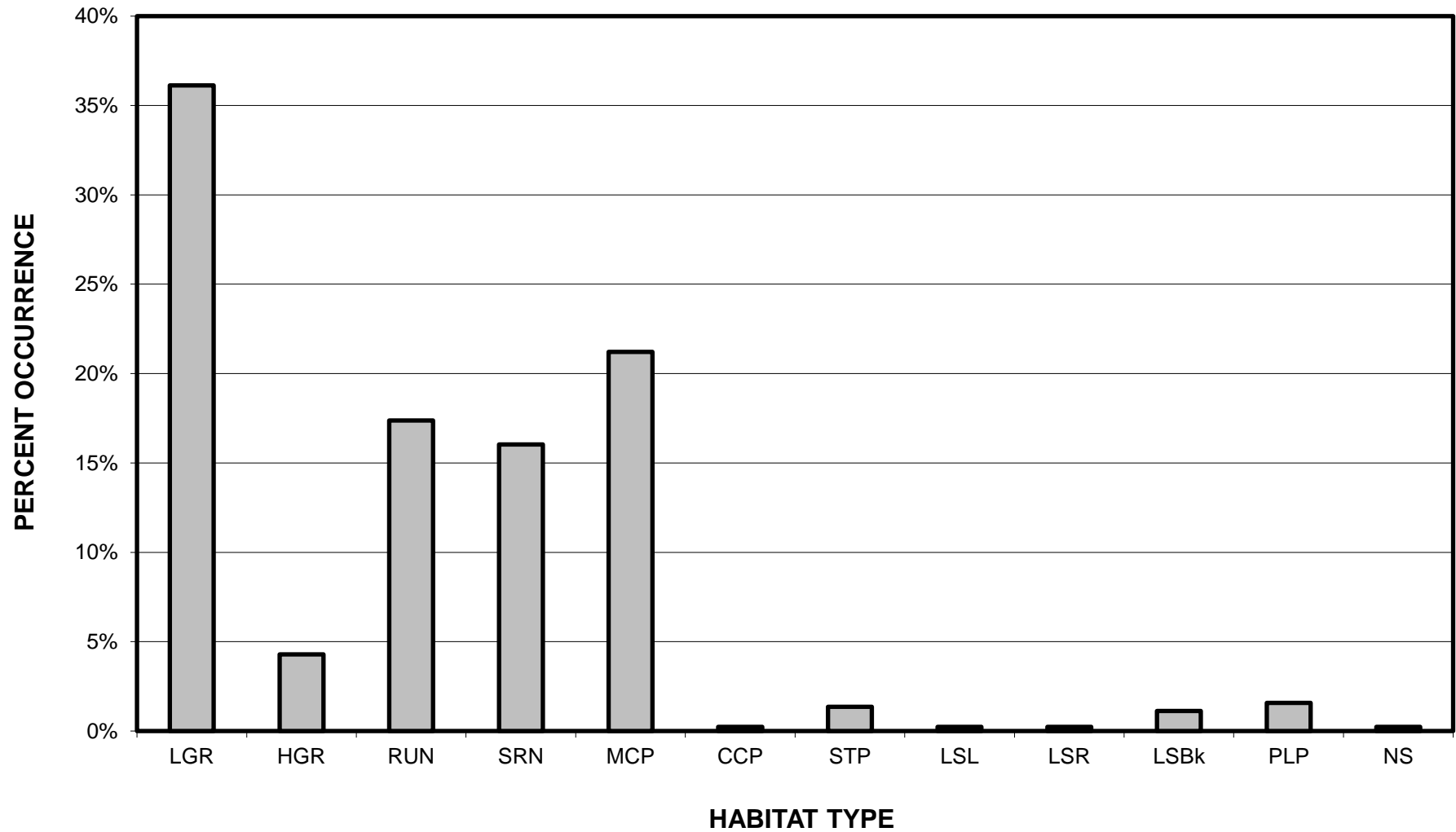
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

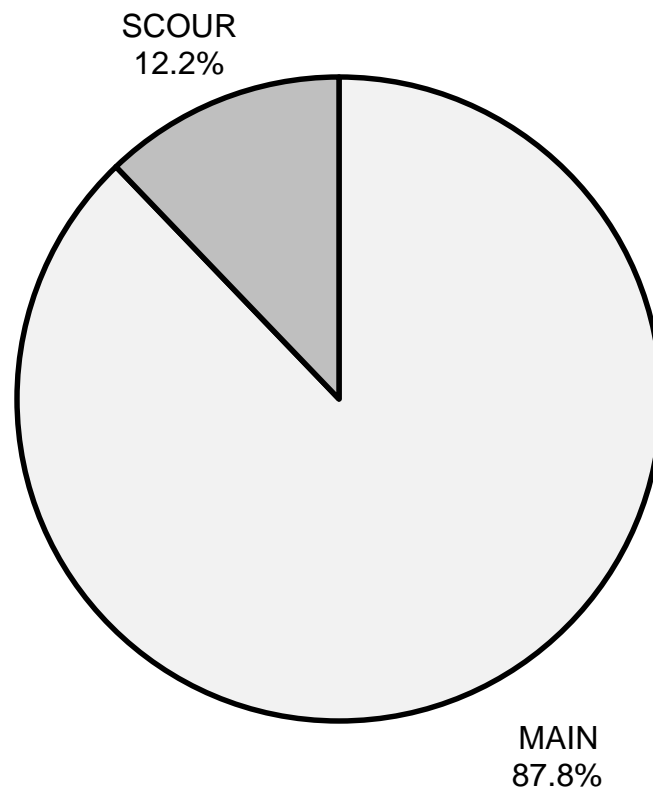
HOWE CREEK 2017

HABITAT TYPES BY PERCENT OCCURRENCE

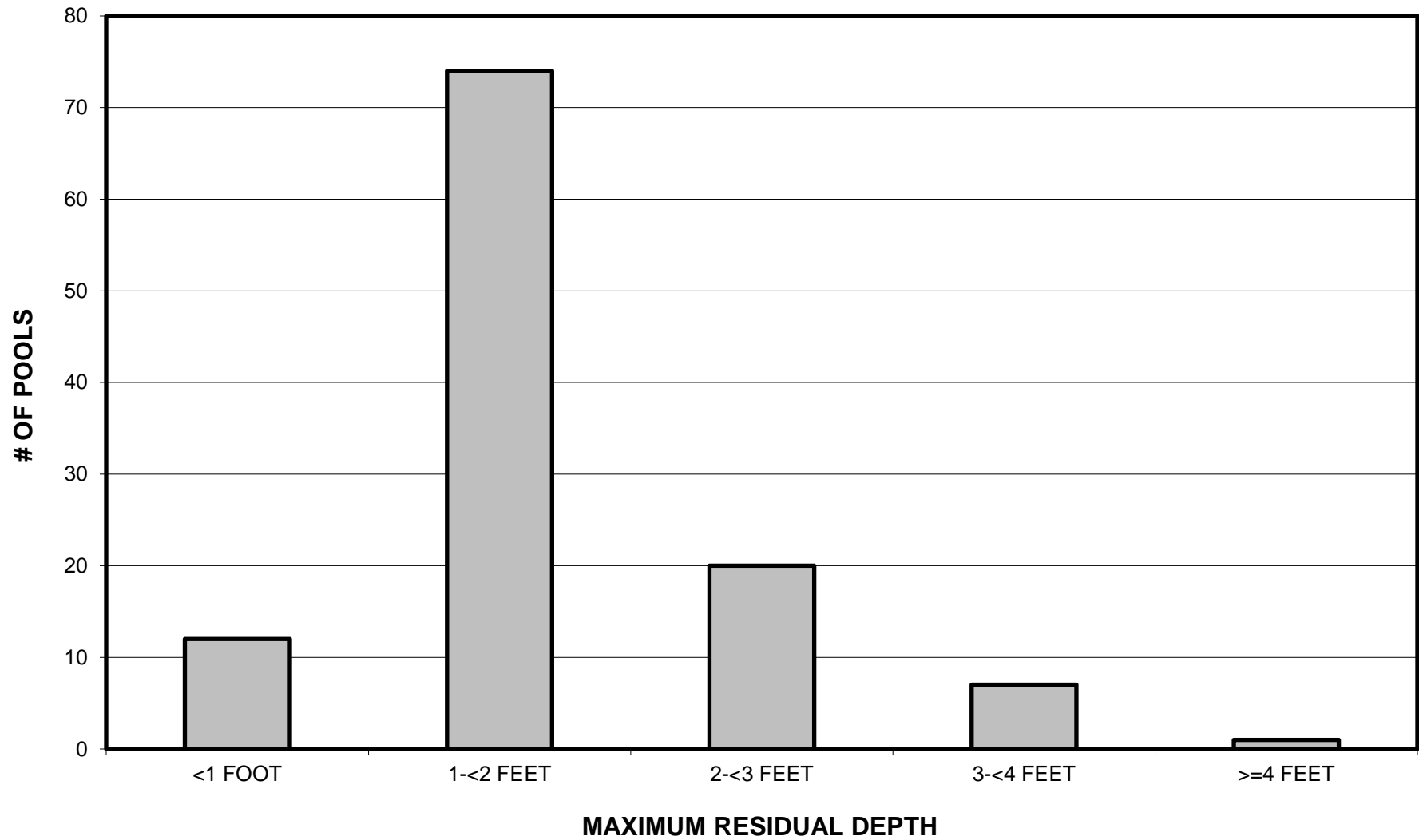


GRAPH 3

HOWE CREEK 2017 POOL TYPES BY PERCENT OCCURRENCE

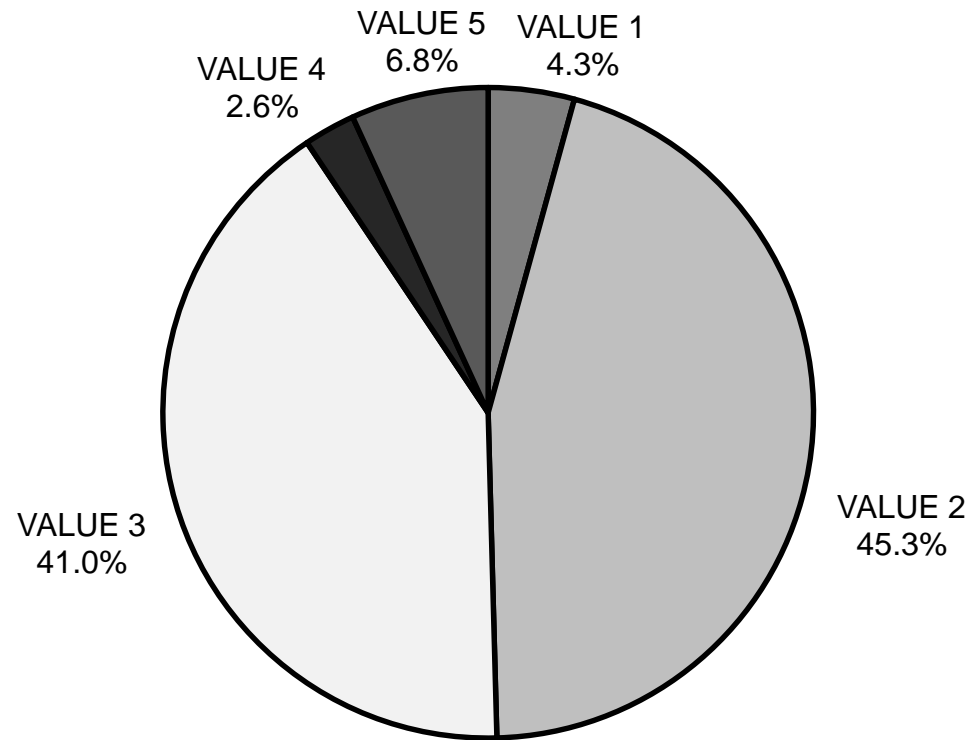


HOWE CREEK 2017 MAXIMUM DEPTH IN POOLS



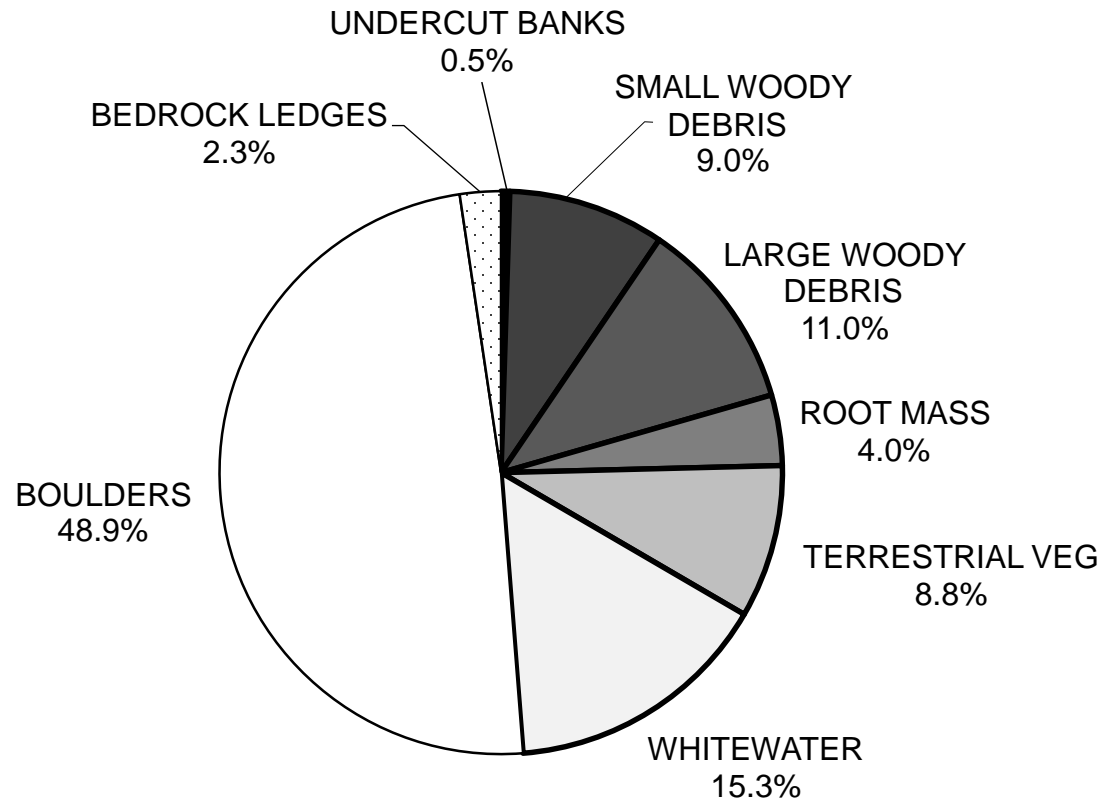
GRAPH 5

HOWE CREEK 2017 PERCENT EMBEDDEDNESS



GRAPH 6

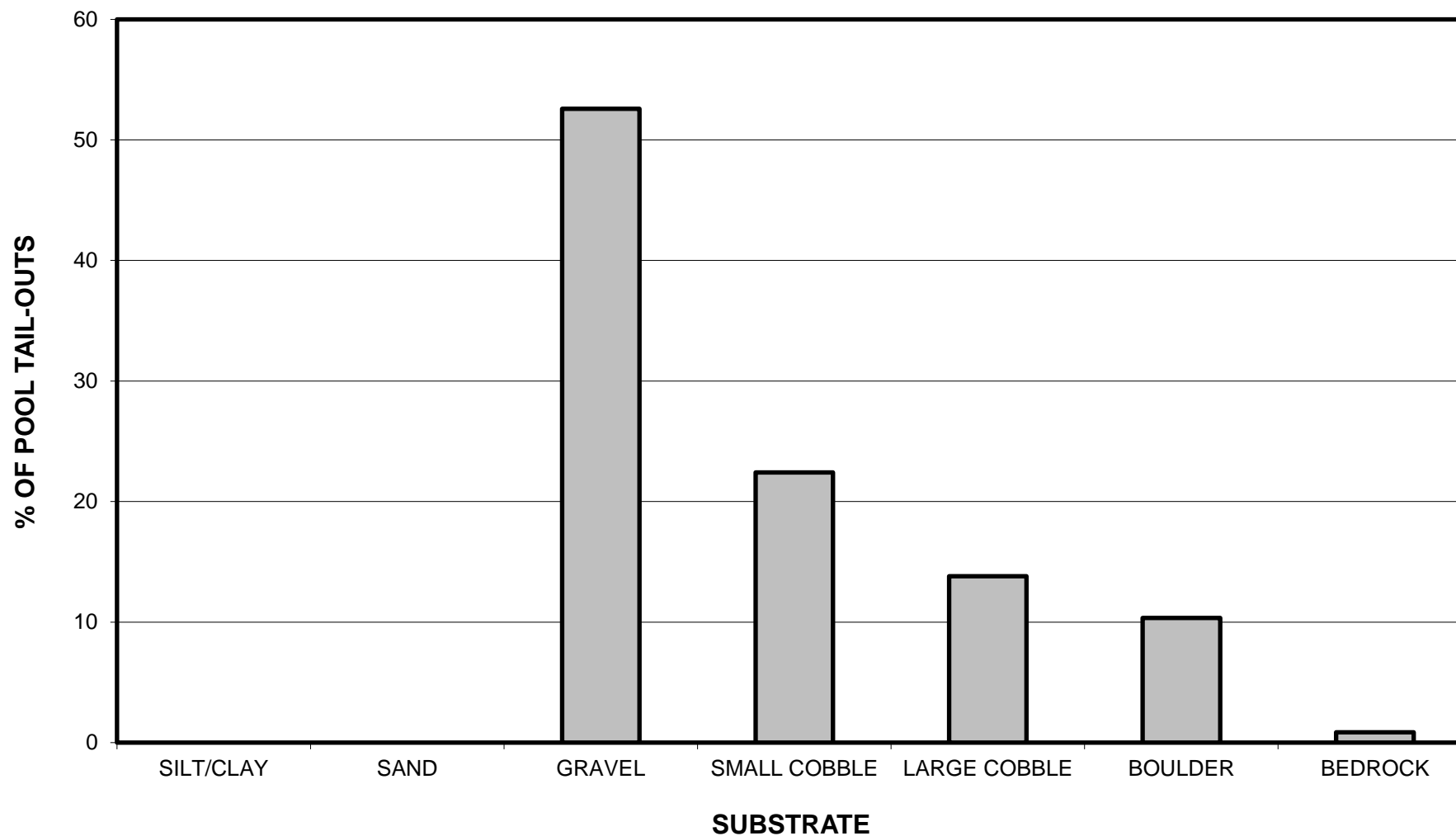
HOWE CREEK 2017 MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

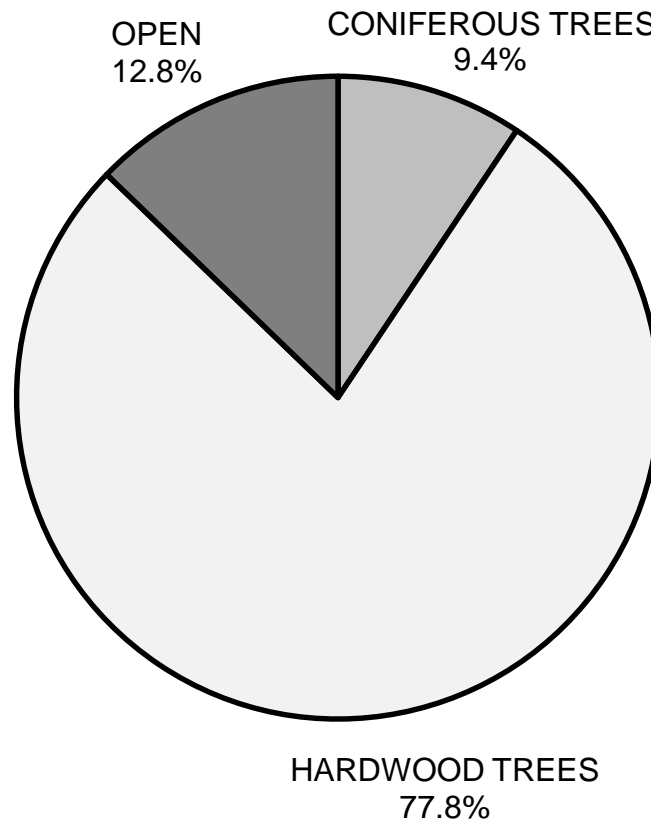
HOWE CREEK 2017

SUBSTRATE COMPOSITION IN POOL TAIL-OUTS

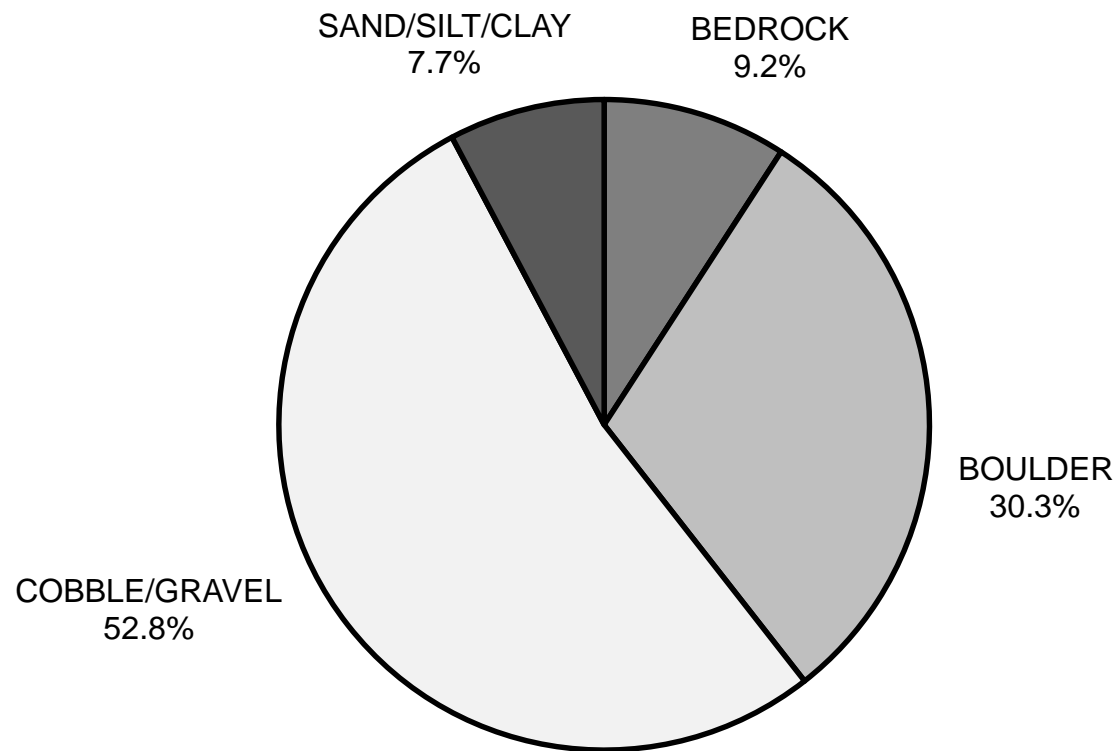


GRAPH 8

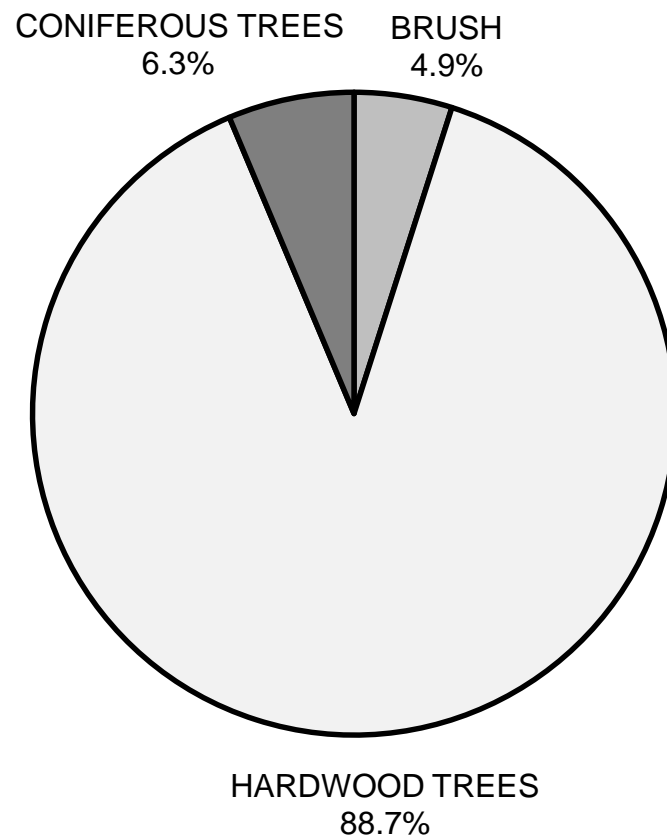
HOWE CREEK 2017 MEAN PERCENT CANOPY



HOWE CREEK 2017 DOMINANT BANK COMPOSITION IN SURVEY REACH



HOWE CREEK 2017 DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

APPENDIX II

STREAM INVENTORY PHOTOS



Photo 1: Run at habitat unit #271, 15,882' upstream of start of survey. (Photo taken 6/27/17)



Photo 2: Mid-channel pool at habitat unit #335, 18, 627' upstream of start of survey.
(Photo taken 6/28/17)

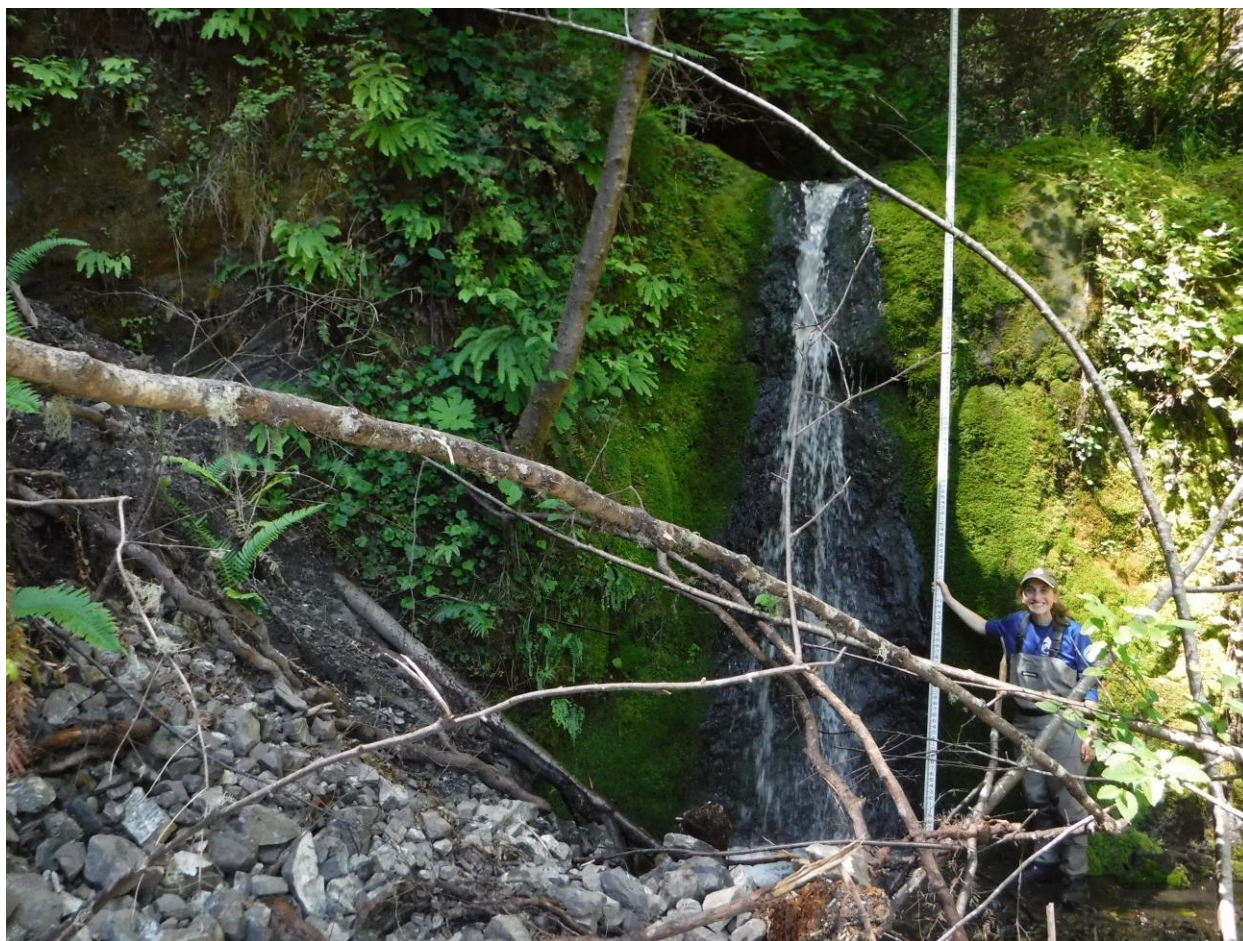


Photo 3: End of survey at habitat unit 438, 22,075' upstream of start of survey.
Pictured: Rachel Karlov. (Photo taken 06/29/17)