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STREAM INVENTORY REPORT

GRAHAM GULCH

INTRODUCTION

A stream inventory was conducted during the fall of 1993 on Graham Gulch to assess habitat conditions for anadromous salmonids. The 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 Graham Gulch. The objective of the biological inventory was to document the salmonid species present and their distribution. After analysis of the information and data gathered, stream restoration and enhancement recommendations are presented.

There is no known record of adult spawning surveys having been conducted on Graham Gulch. The objective of this report is to document the current habitat conditions, and recommend options for the potential enhancement of habitat for chinook salmon, coho salmon and steelhead trout.

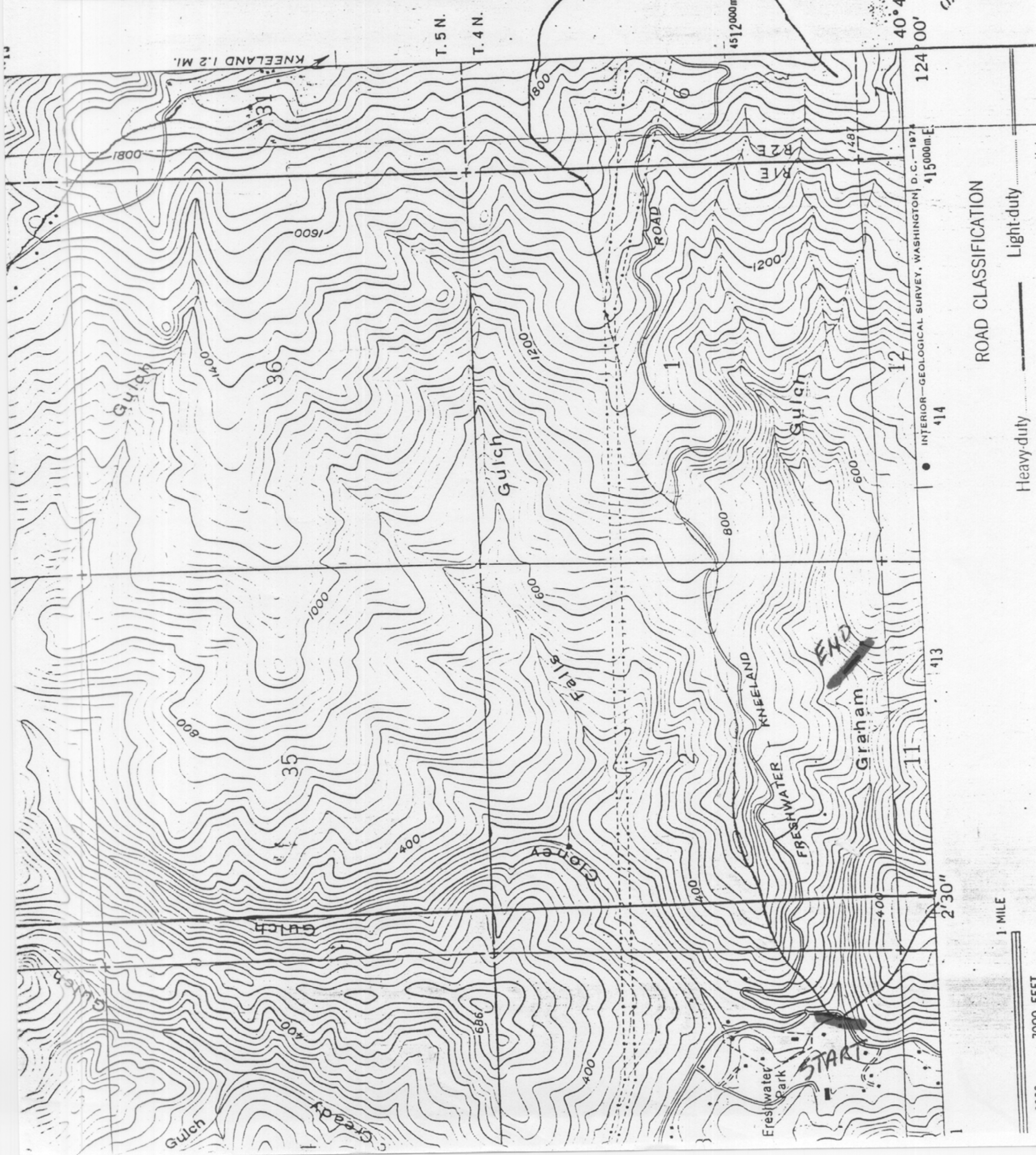
WATERSHED OVERVIEW

Graham Gulch is tributary to Freshwater Creek, tributary to Humboldt Bay, located in Humboldt County, California. Graham Gulch's legal description at the confluence with Freshwater Creek is T4N R1E S03. Its location is 40°45'09" N. latitude and 124°02'50" W. longitude. Graham Gulch is a first order stream and has approximately 1.9 miles of blue line stream, according to the USGS Arcata South and McWhinney Creek 7.5 minute quadrangles. Graham Gulch drains a watershed of approximately 2.3 square miles. Elevations range from about 70 feet at the mouth of the creek to 1,250 feet in the headwater areas. Redwood forest dominate the watershed. The watershed is privately owned by the Pacific Lumber Company (PALCO) and is managed for timber production. Vehicle access exists via Freshwater/ Kneeland Road to an unpaved private road owned by PALCO at mile 9.

METHODS

The habitat inventory conducted in Graham Gulch follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi and Reynolds, 1991). The California Conservation Corps (CCC) Technical Advisors that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game (DFG). Graham Gulch personnel were trained in June, 1993, by Gary Flosi and Scott Downie. This inventory was conducted by two person teams.

GRAHAM GULCH
QUADS: ARCATA SOUTH
McWHINNEY CREEK.



Graham Gulch

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 Graham Gulch to record measurements and observations. There are nine components to the inventory form.

1. Flow:

Flow is measured in cubic feet per second (cfs) at the bottom of the stream survey reach using standard flow measuring equipment, if available. In some cases flows are estimated. Flows should also be measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed by David Rosgen (1985). 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 four measured parameters used to determine channel type: 1) water slope gradient, 2) channel confinement, 3) width/depth ratio, 4) substrate composition.

3. Temperatures:

Both water and air temperatures are measured and recorded at each tenth unit typed. The time of the measurement is also recorded. Both temperatures are taken in 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 (1988). 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". Graham Gulch habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. Channel dimensions were measured using hip chains, range finders, tape measures, and stadia rods. Unit measurements included mean length, mean width, mean depth, and maximum depth. Pool tail crest depth at each pool unit was measured in the thalweg. All measurements were taken in feet to the nearest tenth.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out reaches is measured by the percent of the cobble that is surrounded or buried by fine sediment. In Graham Gulch, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3), 76 - 100% (value 4).

6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide 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. The shelter rating is calculated for each habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In Graham Gulch, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300, and are expressed as mean values by habitat types within a stream.

7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes.

8. Canopy:

Stream canopy is estimated using handheld spherical densiometers and is a measure of the water surface shaded during periods of high sun. In Graham Gulch, an estimate of the percentage of the habitat unit covered by canopy was made from the center of each unit. The area of canopy was further analyzed to estimate its percentages of coniferous or deciduous trees, and the results recorded.

9. Bank Composition:

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 Graham Gulch, the dominant composition type in both the right and left banks was selected from a list of eight options on the habitat inventory form.

Additionally, the percent of each bank covered by vegetation was estimated and recorded.

BIOLOGICAL INVENTORY

Biological sampling during stream inventory is used to determine fish species and their distribution in the stream. Biological inventory is conducted using one or more of three basic methods: 1) stream bank observation, 2) underwater observation, 3) electrofishing. These sampling techniques are discussed in the California Salmonid Stream Habitat Restoration Manual.

Biological inventory was conducted in Graham Gulch to document the fish species composition and distribution. Three sites were electrofished in Graham Gulch using one Smith Root Model 12 electrofisher. Each site was end-blocked with nets to contain the fish within the sample reach. Fish from each site were counted by species, measured, and returned to the stream.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat Runtime, a dBASE 4.1 data entry program developed by the California Department of Fish and Game. This program processes and summarizes the data, and produces the following six tables:

- Riffle, flatwater, and pool habitat types
- Habitat types and measured parameters
- Pool types
- Maximum pool depths by habitat types
- Dominant substrates by habitat types
- Mean percent shelter by habitat types

Graphics are produced from the tables using Lotus 1,2,3. Graphics developed for Graham Gulch include:

- Riffle, flatwater, pool habitats by percent occurrence
- Riffle, flatwater, pool habitats by total length
- Total habitat types by percent occurrence
- Pool types by percent occurrence
- Total pools by maximum depths
- Embeddedness
- Pool cover by cover type
- Dominant substrate in low gradient riffles
- Percent canopy
- Bank composition by composition type

Graham Gulch

HABITAT INVENTORY RESULTS

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

The habitat inventory of September 16, 22, and 23, 1993, was conducted by Erick Elliott, Craig Mesman, Jason MacDonnell and Michelle Rose (CCC). The total length of the stream surveyed was 5,574 feet, with an additional 228 feet of side channel.

Flows were not measured on Graham Gulch.

Graham Gulch is a B2 channel type for the entire 5,574 feet of stream reach surveyed. B2 channels are moderate gradient (1.0-2.5%), moderately confined streams, with stable stream banks and cobble/ coarse gravel channels.

Water temperatures ranged from 49 to 56 degrees Fahrenheit. Air temperatures ranged from 47 to 63 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. By percent **occurrence**, pools made up 37.9%, riffle types 29.3%, and flatwater 28.6% (Graph 1). Flatwater habitat types made up 45.2% of the total survey **length**, riffles 28.7%, and pools 23.1% (Graph 2).

Fourteen Level IV habitat types were identified. The data are summarized in Table 2. The most frequent habitat types by percent **occurrence** were low gradient riffle, 29.3%; step run, 17.1%; and runs, 11.4% (Graph 3). By percent total **length**, step runs made up 37.6%, low gradient riffles 28.7%, and runs 7.6%.

Fifty-three pools were identified (Table 3). Scour pools were most often encountered at 69.8%, and comprised 73.3% of the total length of pools (Graph 4).

Table 4 is a summary of maximum pool depths by pool habitat types. Depth is an indicator of pool quality. Twenty-one of the 53 pools (40%) had a depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 49 pool tail-outs measured, none had a value of 1 (0.0%); 9 had a value of 2 (18.4%); 16 had a value of 3 (32.7%); and 24 had a value of 4 (49.0%). On this scale, a value of one is the best for fisheries (Graph 6).

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. Pool habitat types had the highest shelter rating at 49.1. Flatwater habitats followed with a rating of 26.9 (Table 1). Of the pool types, the main-channel

pools had the highest mean shelter rating at 54.6, and scour pools rated 48.9 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Large woody debris is the dominant cover type in Graham Gulch. Boulders and small woody debris are the next most common cover in nearly all habitat types. Graph 7 describes the pool cover in Graham Gulch.

Table 6 summarizes the dominant substrate by habitat type. Gravel was the dominant substrate observed in 24 of the 41 low gradient riffles (58.5%). Small cobble was the next most frequently observed dominant substrate type, and occurred in 29.3% of the low gradient riffles (Graph 8).

Eleven percent of the survey reach lacked shade canopy. Of the 89% of the stream covered with canopy, 58% was composed of deciduous trees, and 31% was composed of coniferous trees. Graph 9 describes the canopy in Graham Gulch.

Table 2 summarizes the mean percentage of the right and left stream banks covered with vegetation by habitat type. For the stream reach surveyed, the mean percent right bank vegetated was 89.9%. The mean percent left bank vegetated was 87.8%. The dominant elements composing the structure of the stream banks consisted of 4.3% bedrock, 1.1% cobble/gravel, 2.1% bare soil, 7.9% grass, 48.9% brush. Additionally, 17.9% of the banks were covered with deciduous trees, and 17.9% with coniferous trees, including downed trees, logs, and root wads (Graph 10).

BIOLOGICAL INVENTORY RESULTS

Three sites were electrofished on October 5, 1993 in Graham Gulch. The units were sampled by Craig Mesman and Michelle Rose (CCC and DFG). All measurements are fork lengths unless noted otherwise. In the spring of 1993 the Humboldt Fish Action Council planted coho fry throughout Graham Gulch.

The first site sampled was habitat unit 3 and 4, a low gradient riffle and plunge pool, located approximately 186 feet above the creek mouth. The site had an area of 856 sq ft, and a volume of 515 cu ft. Four steelhead were sampled, ranging from 70 to 223mm FL. In addition, fifteen coho were sampled. They ranged from 55 to 84mm FL.

The second site was habitat unit 120, a plunge pool, located 331' downstream of the Graham Gulch bridge, approximately 4,972 feet above the creek mouth. This site had an area of 120 sq ft, and a volume of 156 cu ft. Eleven coho, ranging from 60 to 85mm FL, and one steelhead, 180mm FL were sampled.

Graham Gulch

The third site sampled, a lateral scour pool - log, is located approximately 300' above the end of the survey. This site had an area of 100 sq ft, and a volume of 80 cu ft. The unit yielded 10 coho, ranging from 60mm to 80mm FL.

DISCUSSION

The B2 channel type is excellent for many instream habitat improvement structures, such as low stage plunge weirs, in-channel and bank boulder placement, single and double wing deflectors and submerged shelters in straight reaches to name only a few. B2 channels are moderate gradient, moderate energy stream with stable banks and cobble/ coarse gravel beds.

The water temperatures recorded on the survey days Sept. 16, 22, and 23, 1993 ranged from 49° F to 56° F. Air temperatures ranged from 47° F to 63° F. This is a very good water temperature regime for salmonids. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling conducted.

Flatwater habitat types comprised 45.2% of the total **length** of this survey, riffles 28.7%, and pools 23.1%. The pools are relatively shallow with 21 of the 53 pools having a maximum depth greater than 2 feet. However, in coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat. In first and second order streams a primary pool is defined to have a maximum 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. Therefore, installing structures that will increase or deepen pool habitat is recommended for locations where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream. The LDA's in the system are retaining needed gravel. Any necessary modifications to them should be done with the intent of metering the gravel out to downstream reaches that will trap the gravel for future spawning use. Therefore, gravel retention features may need to be developed prior to any LDA modification.

Forty of the 49 pool tail-outs measured had embeddedness ratings of 3 or 4. None had a 1 rating. Cobble embeddedness measured to be 25% or less, a rating of 1, is considered best for the needs of salmon and steelhead. In Graham Gulch, sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean shelter rating for pools was relatively low with a rating of 49.1. The shelter rating in the flatwater habitats was

slightly lower at 26.9. However, a pool shelter rating of approximately 100 is desirable. The relatively small amount of cover that now exists is being provided primarily by large woody debris in all habitat types. Additionally, small woody debris and boulders contribute a small amount. Log and root wad cover structures in the pool and flatwater habitats are needed to improve 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.

Thirty-six of the 41 low gradient riffles had gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

The mean percent canopy for the stream was 89%. This is a high percentage of canopy, since 80 percent is generally considered optimum in these north coast streams. In areas of stream bank erosion, planting endemic species of coniferous and deciduous trees, in conjunction with bank stabilization, is recommended.

RECOMMENDATIONS

1) Graham Gulch should be managed as an anadromous, natural production stream.

2) Inventory and map sources of stream bank erosion, and prioritize them according to present and potential sediment yield. Identified sites, like the site at 2156', 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) 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.

5) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover is from boulders. Adding high quality complexity with woody cover is desirable and in some areas the material is at hand.

6) Spawning gravel on Graham Gulch are limited to relatively few reaches. Projects should be designed at suitable sites

to trap and sort spawning gravel in order to expand redd site distribution in the stream.

7) There are several log debris accumulations present on Graham Gulch that are retaining large quantities of fine sediment. The modification of these debris accumulations is desirable, but must be done carefully, over time to avoid excessive sediment loading in downstream reaches.

PROBLEM SITES AND LANDMARKS

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

0′	Begin survey at 13′ diameter culvert immediately above Kneeland Road. The culvert is 60′ long with baffles. A 3′ plunge is located on the downstream end of the culvert.
1396′	Log bridge crosses habitat unit approximately 3′ above creek. Dimensions of bridge are 11′ long x 18′ wide.
1922′	Log debris accumulation (LDA) in channel causing flow to go subsurface.
2104′	Numerous young-of-the-year coho observed.
2156′	LDA, 9′ high x 12′ wide x 68′ long, retaining gravel, fines, and other debris. Channel is being severally pinched. Water flow is subsurface. Debris slide on left bank 80′ long x 80′ high.
3757′	LDA, 9′ high x 12′ long x 14′ wide, creating possible barrier and retaining gravel 4′ high x 100′ long.
4021′	Logging road on right bank approximately 30′ from stream depositing boulders and fines into channel.
4377′	LDA, 10′ high x 15′ long x 20′ wide. Not a barrier. Second LDA in unit 8′ high x 30′ long x 20′ wide. Combined, LDA's are causing stream to braid and eroded right bank.
4390′	LDA, 5′ high x 20′ long x 40′ wide. Not a barrier.
4467′	Tributary entering from left bank.
5216′	Dry tributary from left bank.

Graham Gulch

5386′ Log bridge crossing channel 5′ high x 40′ wide x 20′ long.

5526′ LDA, 4′ high x 30′ long x 20′ wide, retaining gravel 5′ high x 30′ wide x 20′ long. Not a barrier, water percolates through gravel.

5542′ Flow becomes intermittent for the next 200′ then channels dries up completely. No fish observed above last series of LDA's. END OF SURVEY.

LEVEL III and LEVEL IV HABITAT TYPE KEY:

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6
BACKWATER POOLS		
Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5

Graham Gulch — Drainage: Freshwater Creek

Table 1 - SUMMARY OF RIFFLE, FLATWATER, AND POOL HABITAT TYPES — Survey Dates: Sept. 16, 21, & 23, 1993

Confluence: T4N R1E S3

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA (sq.ft.)	MEAN VOLUME (cu.ft.)	TOTAL VOLUME (cu.ft)	MEAN RESIDUAL POOL VOL (cu.ft.)	MEAN SHELTER RATING
41	RIFFLE	29.29	40.56	1663.00	28.66	7.98	0.23	247.58	10150.90	79.76	3270.00	0.00	15.61
40	FLATWATER	28.57	65.55	2622.00	45.19	6.63	0.31	383.23	15329.20	117.28	4691.00	0.00	26.88
53	POOL	37.86	25.28	1340.00	23.10	10.28	0.96	252.51	13383.10	256.24	13580.60	192.86	49.06
6	DRY	4.29	29.50	177.00	3.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.17

TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq. ft.)	TOTAL VOL. (cu. ft.)
140	5802.00	38863.20	21541.60

Graham Gulch

Drainage: Freshwater Creek

Table 2 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS

Survey Dates: Sept. 16, 21, & 23, 1993

Confluence: T4N R1E S3

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	% TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MAXIMUM DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA	MEAN VOLUME	TOTAL VOLUME	MEAN RESIDUAL POOL VOL (cu.ft.)	MEAN SHELTER RATING	MEAN % RT. BANK VEGETATED	MEAN % LT. BANK VEGETATED	MEAN % CANOPY
41	LGR	29.29	40.56	1663.00	28.66	7.98	0.23	5.00	247.58	10150.90	79.76	3270.00	0.00	15.61	92.44	86.83	90.00
16	RUN	11.43	27.63	442.00	7.62	6.94	0.34	1.50	165.06	2641.00	54.10	865.60	0.00	23.13	93.13	80.00	90.63
24	SRN	17.14	90.83	2180.00	37.57	6.42	0.28	1.80	528.68	12688.20	159.39	3825.40	0.00	29.38	84.58	89.58	85.42
10	MCP	7.14	20.40	204.00	3.52	9.00	0.86	2.70	184.30	1843.00	158.81	1588.10	105.44	54.00	84.00	85.00	92.00
2	STP	1.43	31.00	62.00	1.07	7.50	0.60	1.60	207.60	415.20	133.45	266.90	0.00	57.50	90.00	90.00	90.00
1	CRP	0.71	31.00	31.00	0.53	9.00	0.80	1.90	279.00	279.00	223.20	223.20	195.30	105.00	100.00	100.00	100.00
13	LSL	9.29	30.08	391.00	6.74	9.15	0.84	2.80	273.69	3558.00	229.64	2985.30	177.76	58.08	88.46	86.15	88.46
2	LSR	1.43	24.50	49.00	0.84	9.00	0.70	2.00	218.00	436.00	153.00	306.00	98.80	45.00	100.00	95.00	90.00
5	LSBk	3.57	25.00	125.00	2.15	9.40	1.10	4.80	232.04	1160.20	367.78	1838.90	304.36	45.00	96.00	84.00	90.00
4	LSBo	2.86	27.75	111.00	1.91	11.75	0.93	2.10	306.50	1226.00	288.28	1153.10	212.03	31.25	82.50	95.00	92.50
12	PLP	8.57	22.92	275.00	4.74	12.42	1.35	4.00	276.50	3318.00	374.36	4492.30	321.69	42.50	91.67	94.17	86.67
1	SCP	0.71	15.00	15.00	0.26	9.00	0.80	2.00	135.00	135.00	108.00	108.00	94.50	60.00	100.00	100.00	100.00
1	BPB	0.71	27.00	27.00	0.47	19.00	0.60	1.80	461.70	461.70	277.00	277.00	138.50	5.00	100.00	100.00	100.00
2	DPL	1.43	25.00	50.00	0.86	11.50	0.65	1.80	275.50	551.00	170.90	341.80	0.00	35.00	90.00	100.00	100.00
6	DRY	4.29	29.50	177.00	3.05	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	14.17	86.67	88.33	85.00

TOTAL UNITS	LENGTH (ft.)	AREA (sq.ft)	TOTAL VOL. (cu.ft)
140	5802.00	38863.20	21541.60

Graham Gulch

Drainage: Freshwater Creek

Table 3 - SUMMARY OF POOL TYPES

Survey Dates: Sept. 16, 21, & 23, 1993

Confluence: T4N R1E S3

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	MEAN LENGTH (ft.)	TOTAL LENGTH (ft.)	PERCENT TOTAL LENGTH	MEAN WIDTH (ft.)	MEAN DEPTH (ft.)	MEAN AREA (sq.ft.)	TOTAL AREA (sq.ft.)	MEAN VOLUME (cu.ft.)	TOTAL VOLUME (cu.ft)	MEAN RESIDUAL POOL VOL. (cu.ft.)	MEAN SHELTER RATING
12	MAIN	22.64	22.17	266.00	19.85	8.75	0.82	188.18	2258.20	154.58	1855.00	87.87	54.58
37	SCOUR	69.81	26.54	982.00	73.28	10.51	1.04	269.65	9977.20	297.26	10998.80	241.46	48.92
4	BACKWATER	7.55	23.00	92.00	6.87	12.75	0.68	286.93	1147.70	181.70	726.80	58.25	33.75

TOTAL MEASURED	TOTAL LENGTH (ft.)	TOTAL AREA (sq.ft.)	TOTAL VOL. (cu.ft.)
53	1340.00	13383.10	13580.60

Graham Gulch — Drainage: Freshwater Creek

Table 4 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPES — Survey Dates: Sept. 16, 21, & 23, 1993

Confluence: T4N R1E S3

UNITS MEASURED	HABITAT TYPE	HABITAT PERCENT OCCURRENCE	<1 FOOT MAXIMUM DEPTH	<1 FOOT PERCENT OCCURRENCE	1-<2 FT. MAXIMUM DEPTH	1-<2 FOOT PERCENT OCCURRENCE	2-<3 FT. MAXIMUM DEPTH	2-<3 FOOT PERCENT OCCURRENCE	3-<4 FT. MAXIMUM DEPTH	3-<4 FOOT PERCENT OCCURRENCE	>=4 FEET MAXIMUM DEPTH	>=4 FEET PERCENT OCCURRENCE
10	MCP	18.87	1	10.00	6	60.00	3	30.00	0	0.00	0	0.00
2	STP	3.77	0	0.00	2	100.00	0	0.00	0	0.00	0	0.00
1	CRP	1.89	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00
13	LSL	24.53	0	0.00	10	76.92	3	23.08	0	0.00	0	0.00
2	LSR	3.77	1	50.00	0	0.00	1	50.00	0	0.00	0	0.00
5	LSBk	9.43	0	0.00	4	80.00	0	0.00	0	0.00	1	20.00
4	LSBo	7.55	0	0.00	2	50.00	2	50.00	0	0.00	0	0.00
12	PLP	22.64	0	0.00	2	16.67	5	41.67	4	33.33	1	8.33
1	SCP	1.89	0	0.00	0	0.00	1	100.00	0	0.00	0	0.00
1	BPB	1.89	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00
2	DPL	3.77	0	0.00	2	100.00	0	0.00	0	0.00	0	0.00

TOTAL UNITS
53

Graham Gulch — Drainage: Freshwater Creek

Table 5 - SUMMARY OF MEAN PERCENT COVER BY HABITAT TYPE — Survey Dates: Sept. 16, 21, & 23, 1993

Confluence: T4N R1E S3

UNITS 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
41	LGR	0.24	10.73	5.61	0.00	26.34	0.00	0.00	30.24	0.00
16	RUN	10.00	13.13	38.13	13.75	6.25	0.00	0.00	12.50	0.00
24	SRN	0.42	27.08	29.58	3.33	15.83	1.25	0.00	22.50	0.00
10	MCP	5.00	29.00	45.00	3.00	11.00	0.00	0.00	7.00	0.00
2	STP	5.00	15.00	30.00	0.00	5.00	0.00	0.00	45.00	0.00
1	CRP	20.00	10.00	70.00	0.00	0.00	0.00	0.00	0.00	0.00
13	LSL	1.54	20.00	71.54	1.54	0.00	0.00	0.00	5.38	0.00
2	LSR	0.00	0.00	15.00	65.00	10.00	0.00	0.00	10.00	0.00
5	LSBk	0.00	12.00	34.00	0.00	18.00	0.00	0.00	20.00	16.00
4	LSBo	0.00	10.00	25.00	0.00	17.50	0.00	0.00	35.00	12.50
12	PLP	11.67	8.33	68.33	0.00	3.33	0.00	0.00	6.67	1.67
1	SCP	40.00	30.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00
1	BPB	0.00	0.00	0.00	0.00	40.00	0.00	0.00	60.00	0.00
2	DPL	0.00	15.00	25.00	0.00	5.00	0.00	0.00	55.00	0.00
6	DRY	0.00	6.67	43.33	0.00	0.00	0.00	0.00	16.67	0.00

Graham Gulch

Drainage: Freshwater Creek

Table 6 - SUMMARY OF DOMINANT SUBSTRATES BY HABITAT TYPE

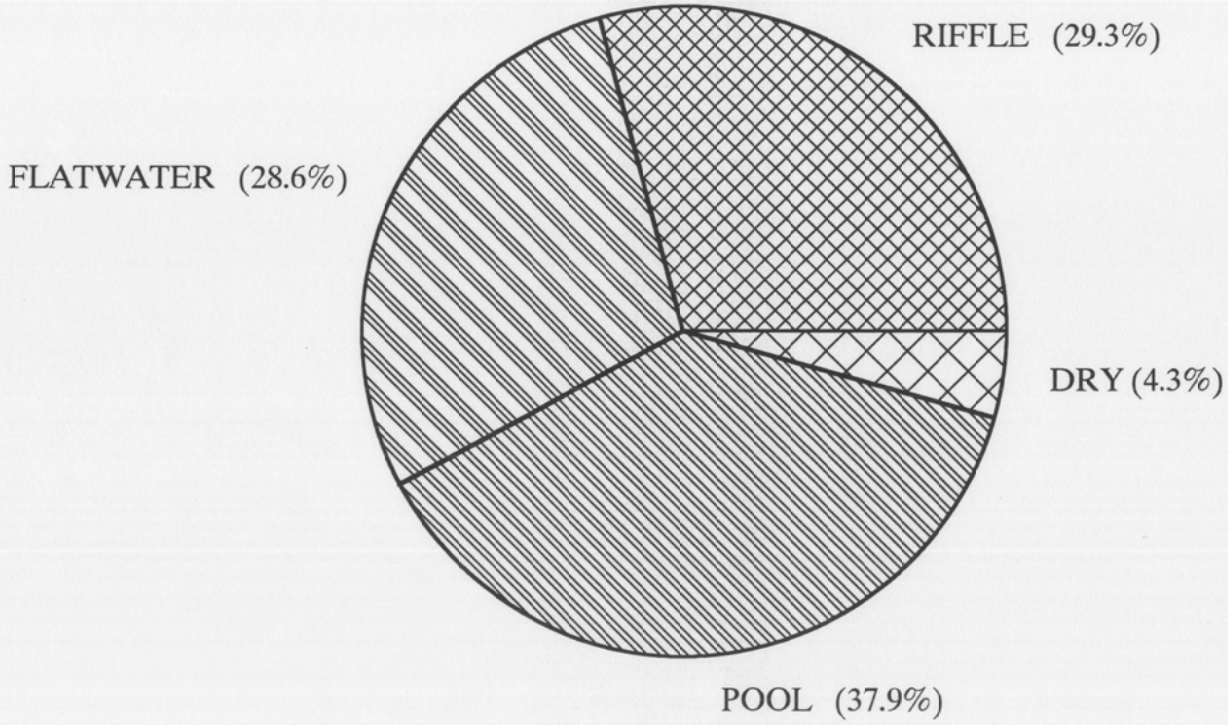
Survey Dates: Sept. 16, 21, & 23, 1993

Confluence: T4N R1E S3

UNITS MEASURED	HABITAT TYPE	# UNITS SILT/CLAY DOMINANT	% TOTAL SILT/CLAY DOMINANT	# UNITS SAND DOMINANT	% TOTAL SAND DOMINANT	# UNITS GRAVEL DOMINANT	% TOTAL GRAVEL DOMINANT	# UNITS SM COBBLE DOMINANT	% TOTAL SM COBBLE DOMINANT	# UNITS LG COBBLE DOMINANT	% TOTAL LG COBBLE DOMINANT	# UNITS BOULDER DOMINANT	% TOTAL BOULDER DOMINANT	# UNITS BEDROCK DOMINANT	% TOTAL BEDROCK DOMINANT
41	LGR	0	0.00	0	0.00	24	58.54	12	29.27	5	12.20	0	0.00	0	0.00
16	RUN	0	0.00	1	6.25	13	81.25	2	12.50	0	0.00	0	0.00	0	0.00
24	SRN	0	0.00	1	4.17	15	62.50	8	33.33	0	0.00	0	0.00	0	0.00
10	MCP	0	0.00	5	50.00	5	50.00	0	0.00	0	0.00	0	0.00	0	0.00
2	STP	0	0.00	1	50.00	1	50.00	0	0.00	0	0.00	0	0.00	0	0.00
1	CRP	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
13	LSL	2	15.38	5	38.46	5	38.46	1	7.69	0	0.00	0	0.00	0	0.00
2	LSR	0	0.00	1	50.00	1	50.00	0	0.00	0	0.00	0	0.00	0	0.00
5	LSBk	0	0.00	1	20.00	2	40.00	1	20.00	1	20.00	0	0.00	0	0.00
4	LSBo	0	0.00	1	25.00	3	75.00	0	0.00	0	0.00	0	0.00	0	0.00
12	PLP	3	25.00	2	16.67	7	58.33	0	0.00	0	0.00	0	0.00	0	0.00
1	SCP	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1	BPB	0	0.00	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
2	DPL	0	0.00	0	0.00	1	50.00	1	50.00	0	0.00	0	0.00	0	0.00
6	DRY	0	0.00	0	0.00	3	50.00	1	16.67	2	33.33	0	0.00	0	0.00

GRAHAM GULCH

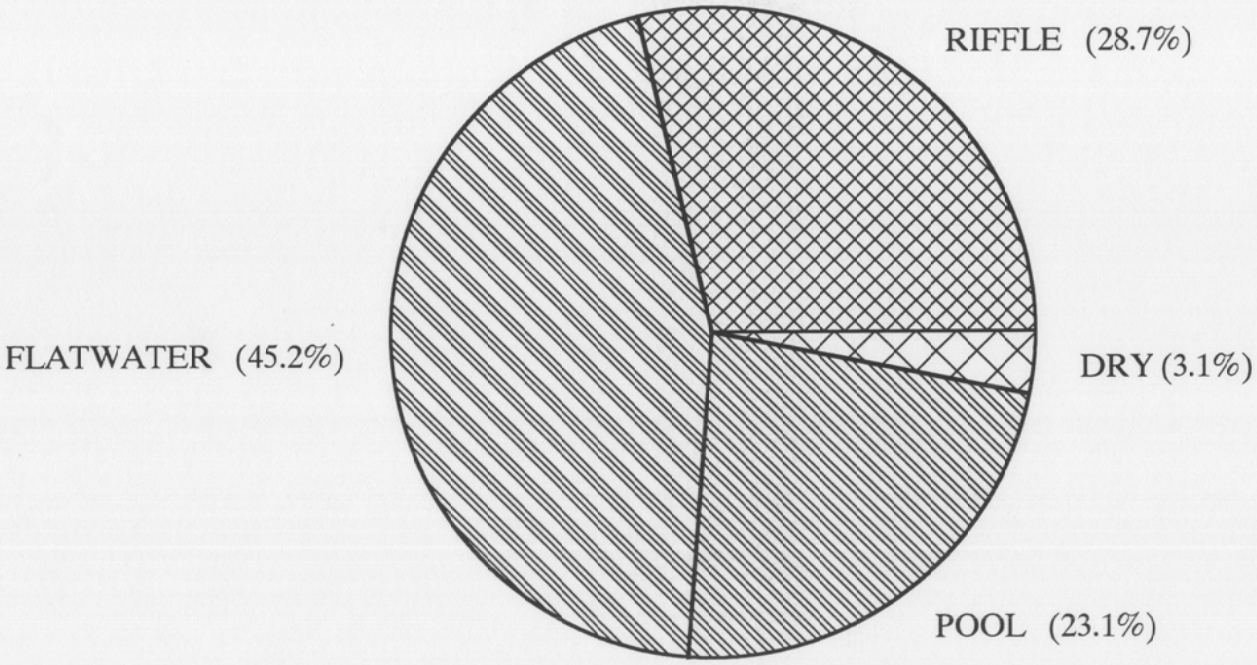
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 1

GRAHAM GULCH

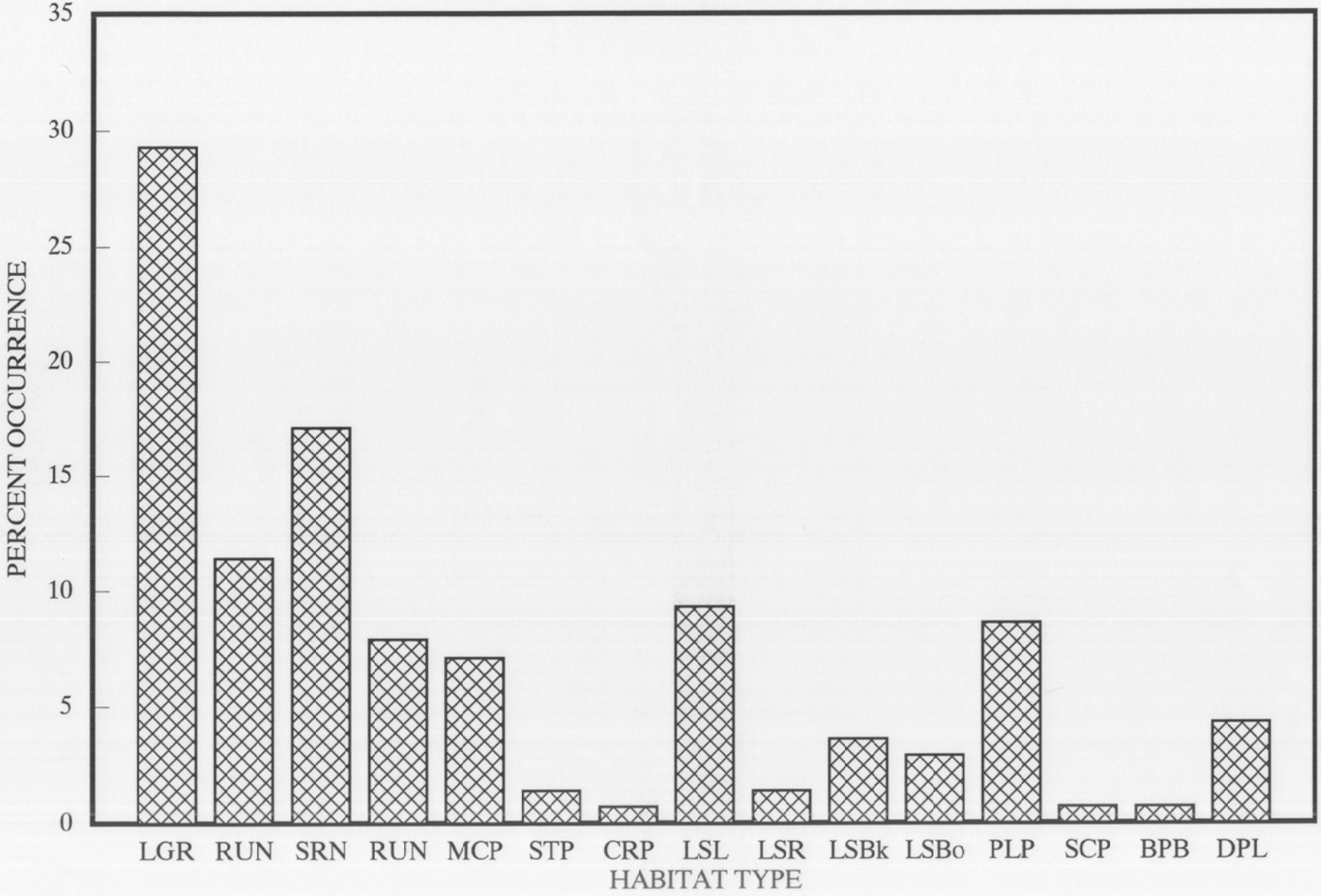
HABITAT TYPES BY PERCENT TOTAL LENGTH



GRAPH 2

GRAHAM GULCH

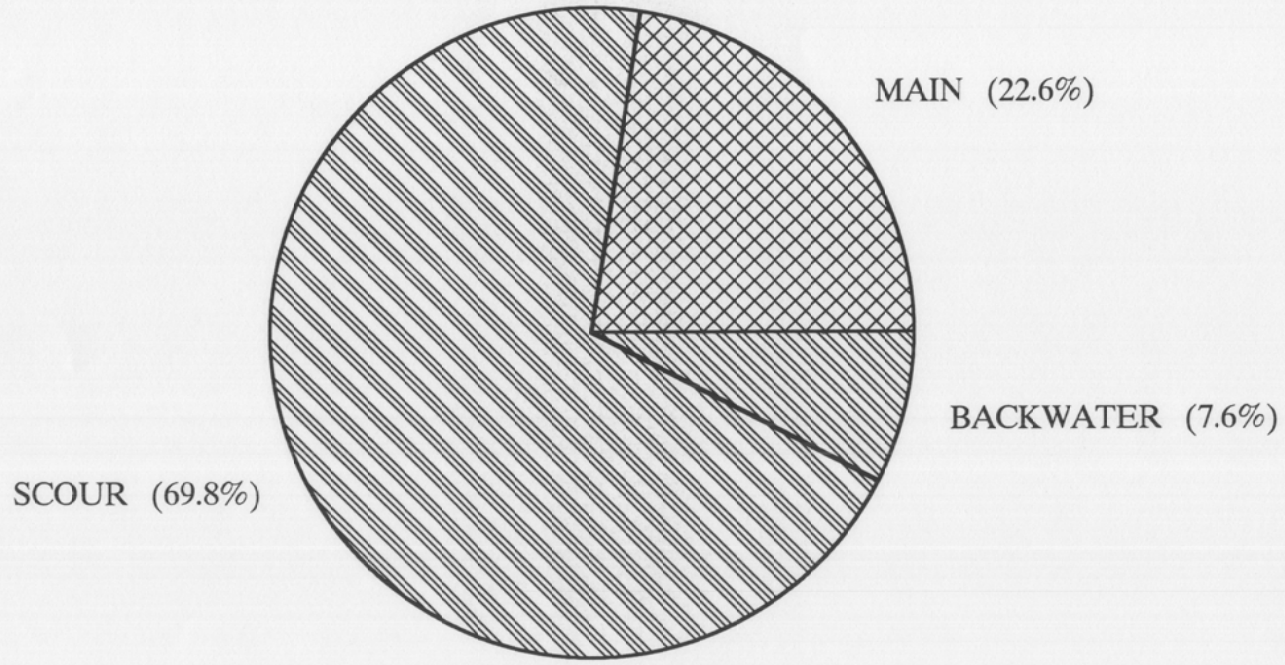
HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 3

GRAHAM GULCH

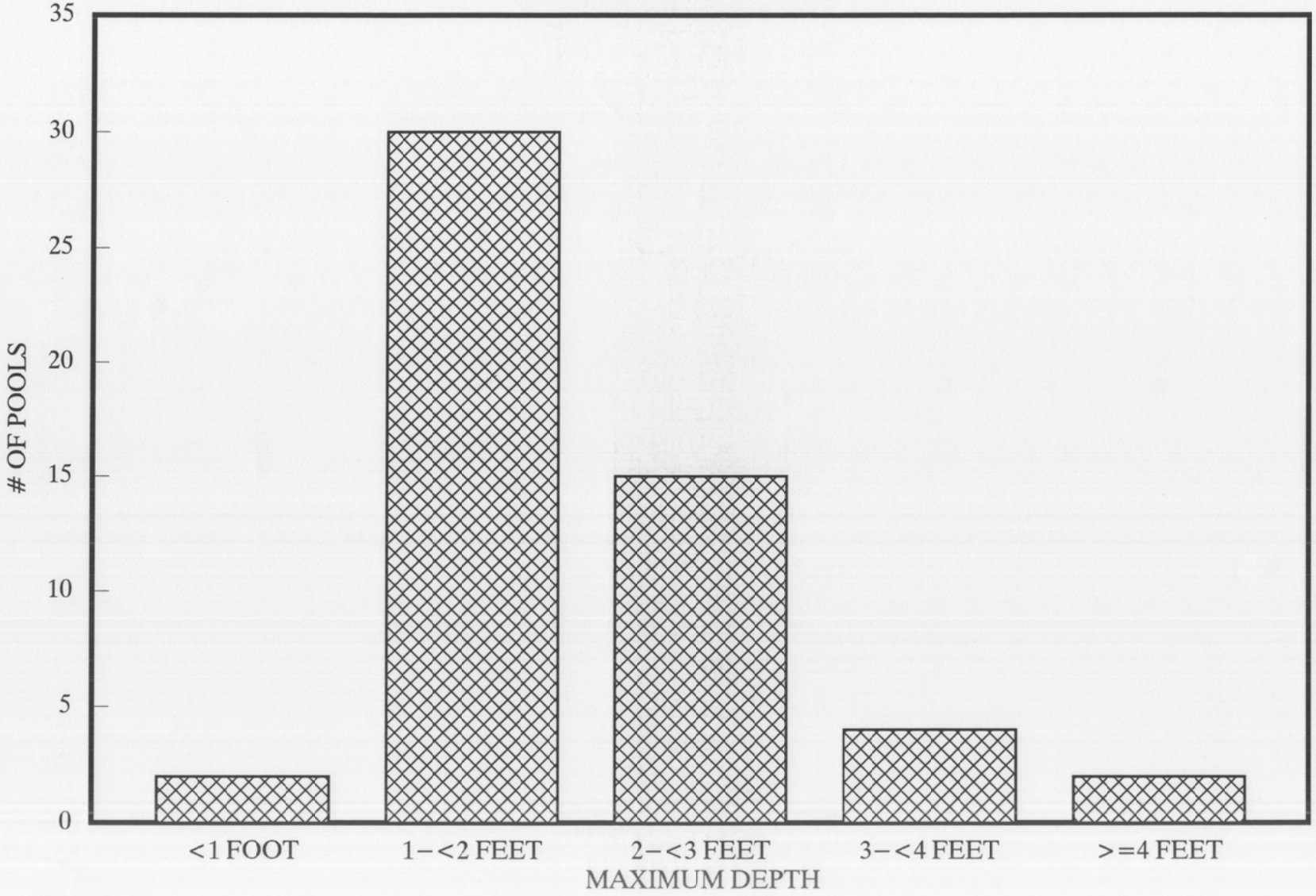
POOL HABITAT TYPES BY PERCENT OCCURRENCE



GRAPH 4

GRAHAM GULCH

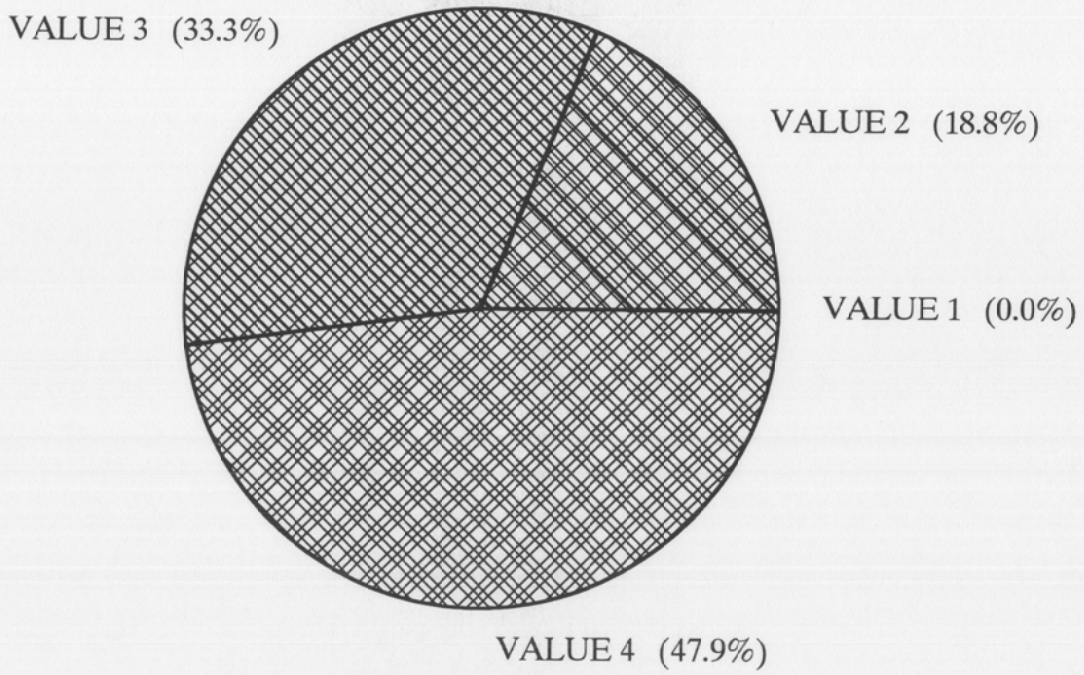
MAXIMUM DEPTH IN POOLS



GRAPH 5

GRAHAM GULCH

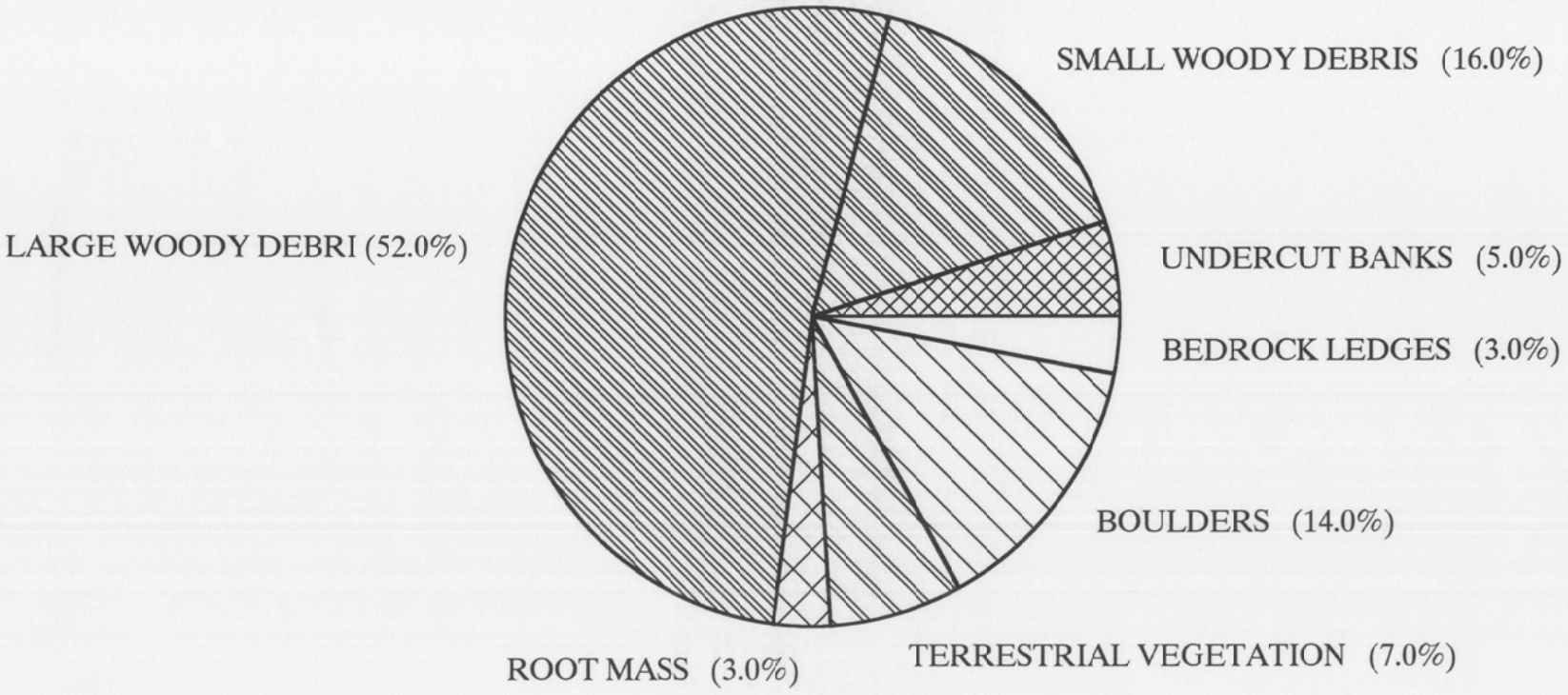
PERCENT EMBEDDEDNESS



GRAPH 6

GRAHAM GULCH

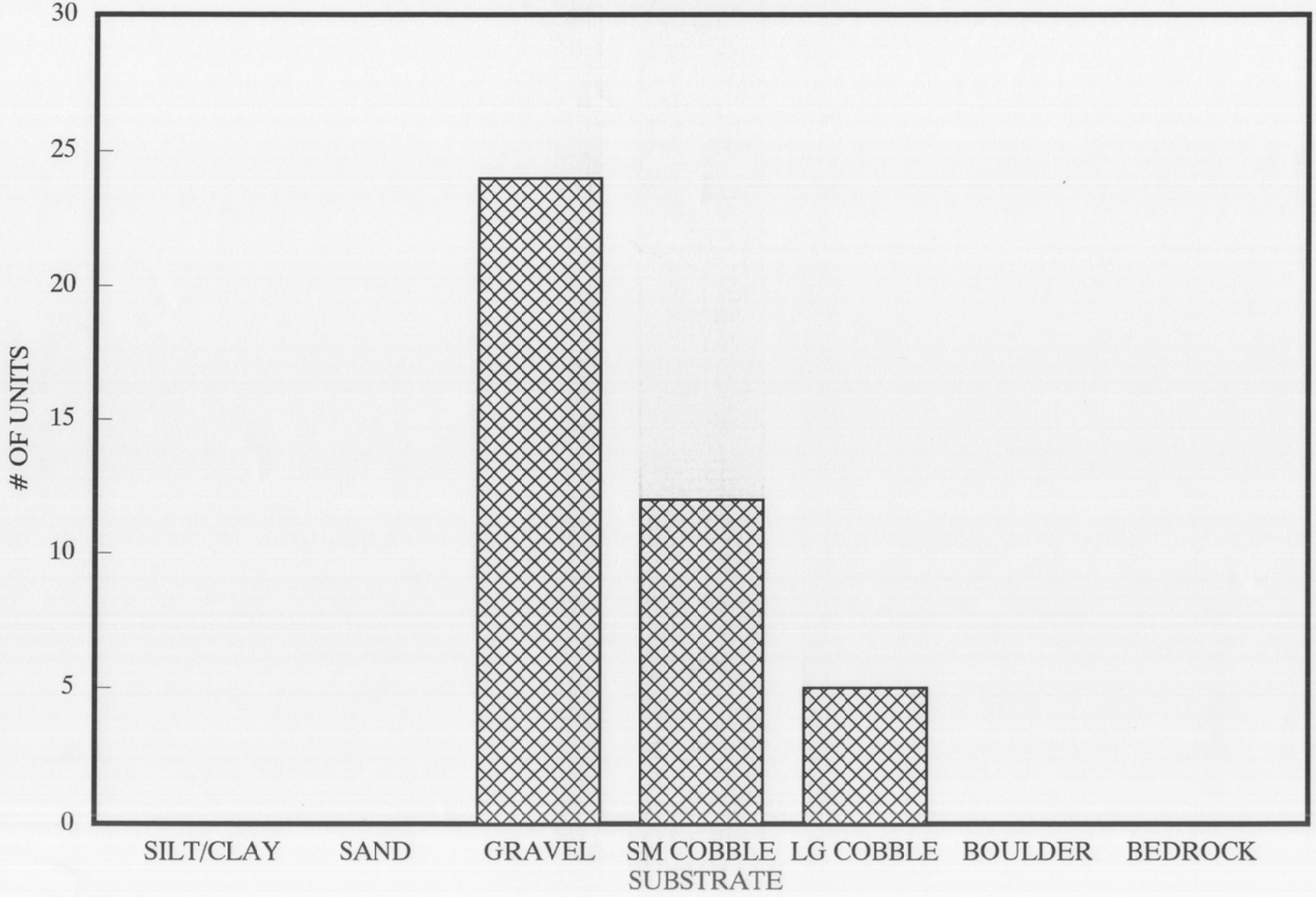
MEAN PERCENT COVER TYPES IN POOLS



GRAPH 7

GRAHAM GULCH

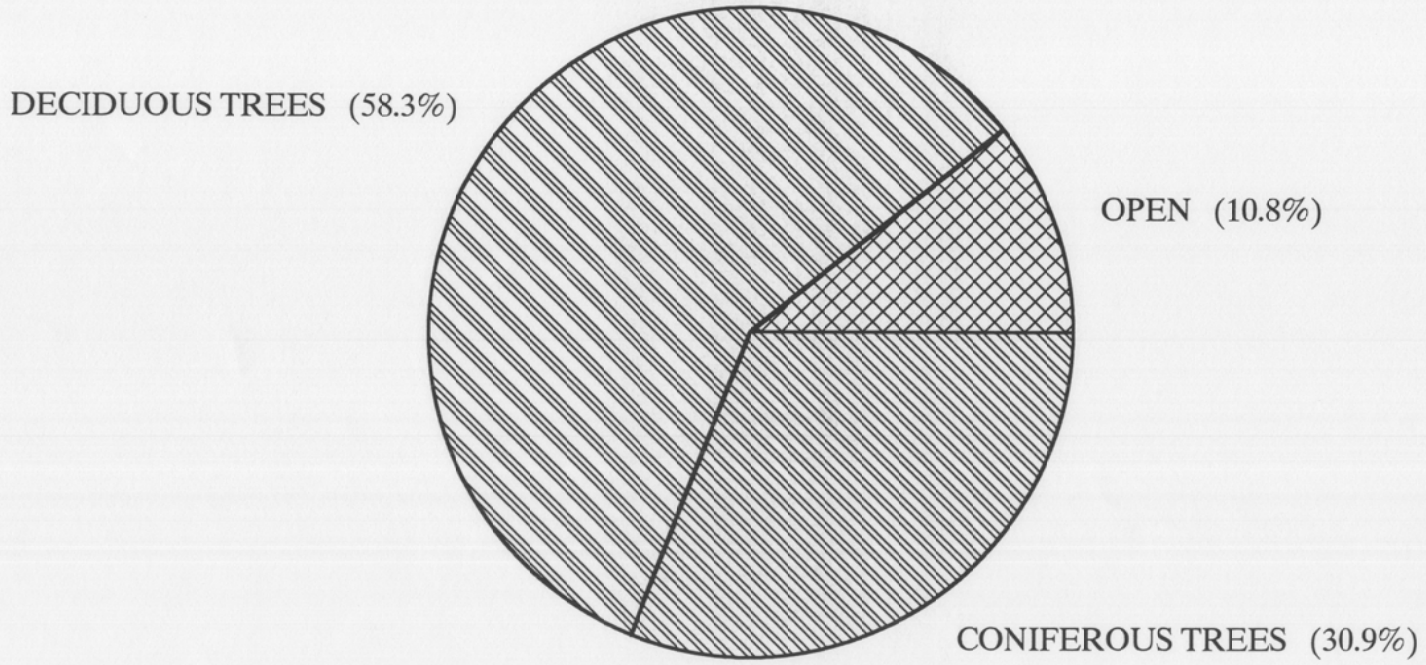
SUBSTRATE COMPOSITION IN LOW GRADIENT RIFFLES



GRAPH 8

GRAHAM GULCH

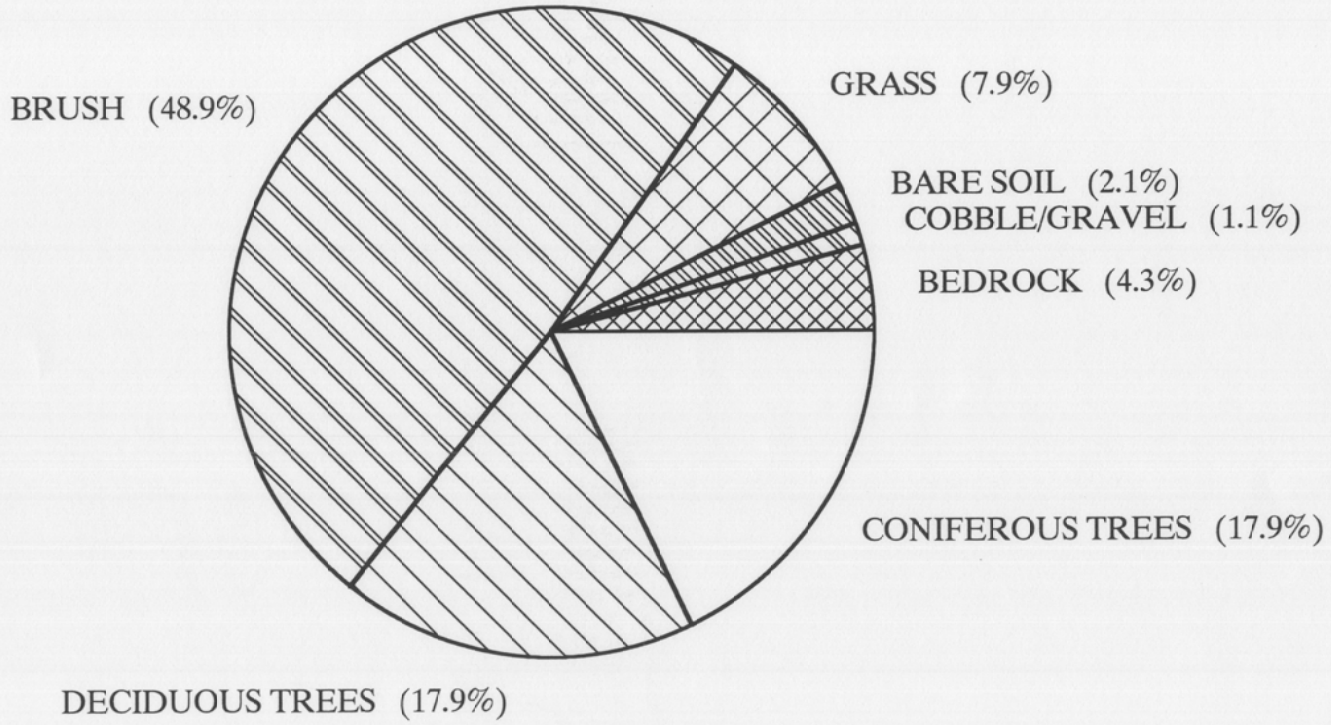
PERCENT CANOPY



GRAPH 9

GRAHAM GULCH

PERCENT BANK COMPOSITION



GRAPH 10

Freshwater Creek Watershed

Map 1