

# STREAM INVENTORY REPORT

## Garcia River

### INTRODUCTION

A stream inventory was conducted September 28, 2004 to August 29, 2005 on the Garcia River. The survey began 12.1 miles upstream from the confluence with the Pacific Ocean and extended upstream 20.1 miles. Stream inventories and reports were also completed for five tributaries to the Garcia River.

The objective of the habitat inventory was to document the habitat available to anadromous salmonids in the Garcia River.

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. Recommendations for habitat improvement activities are based upon target habitat values suitable for salmonids in California's north coast streams.

### WATERSHED OVERVIEW

The Garcia River is located in Mendocino County, California (Map 1). The Garcia River's legal description at the confluence with the Pacific Ocean is T13N R17W S34. Its location is 38°57'18" north latitude and 123°43'56" west longitude. The Garcia River is a fourth order stream and has approximately 36.4 miles of blue line stream according to the USGS Point Arena 7.5 minute quadrangle. The Garcia River drains a watershed of approximately 114.5 square miles. Elevations range from sea level at the mouth of the creek to 2,050 feet in the headwater areas. 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 Highway 1.

### METHODS

The habitat inventory conducted in the Garcia River follows the methodology presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al, 1998). The California Department of Fish and Game (DFG) personnel and Watershed Stewards Project/AmeriCorps (WSP) members that conducted the inventory were trained in standardized habitat inventory methods by the DFG. This inventory was conducted by a two-person team.

### SAMPLING STRATEGY

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

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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 the Garcia River to record measurements and observations. There are eleven components to the inventory form.

#### 1. Flow:

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

#### 2. Channel Type:

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

#### 3. Temperatures:

Both water and air temperatures are measured and recorded at every tenth habitat unit. The time of the measurement is also recorded. Both temperatures are taken in degrees Fahrenheit at the middle of the habitat unit and within one foot of the water surface.

#### 4. Habitat Type:

Habitat typing uses the 24 habitat classification types defined by McCain and others (1990). Habitat units are numbered sequentially and assigned a type identification number selected from a standard list of 24 habitat types. Dewatered units are labeled "dry". The Garcia River 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 the Garcia River, embeddedness was

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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 unsuited for spawning due to inappropriate substrate like bedrock, log sills, boulders or other considerations.

### 6. Shelter Rating:

Instream shelter is composed of those elements within a stream channel that provide juvenile salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition for prey. The shelter rating is calculated for each fully-described habitat unit by multiplying shelter value and percent cover. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All cover is then classified according to a list of nine cover types. In the Garcia River, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. Thus, shelter ratings can range from 0-300 and are expressed as mean values by habitat types within a stream.

### 7. Substrate Composition:

Substrate composition ranges from silt/clay sized particles to boulders and bedrock elements. In all fully-described habitat units, dominant and sub-dominant substrate elements were ocularly estimated using a list of seven size classes and recorded as a one and two, respectively. In addition, the dominant substrate composing the pool tail-outs is recorded for each pool.

### 8. Canopy:

Stream canopy density was estimated using modified handheld spherical densiometers as described in the *California Salmonid Stream Habitat Restoration Manual*. Canopy density relates to the amount of stream shaded from the sun. In the Garcia River, 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 the Garcia River, 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

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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.

## DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat , a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and Game. This program processes and summarizes the data, and produces the following ten tables:

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

Graphics are produced from the tables using Microsoft Excel. Graphics developed for the Garcia River 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

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- Dominant Bank Vegetation by Vegetation Type

### HABITAT INVENTORY RESULTS

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

The habitat inventory beginning September 28, 2004 and ending August 29, 2005 was conducted by Shaun Thompson (DFG), Alex Salyer (DFG), Scott Monday (DFG), and Sarah Ganas (WSP). The total length of the stream surveyed was 106,164 feet with an additional 2,660 feet of side channel.

Stream flow was measured 47 feet upstream of the Hollow Tree Road bridge with a Marsh-McBirney Model 2000 flowmeter at 7.35 cfs on August 8, 2005.

The Garcia River is a C4 channel type for 41,911 feet of the stream surveyed (Reach 1), a C3 channel type for 33,827 feet of the stream surveyed (Reach 2), and an F3 channel type for 30,426 feet of the stream surveyed (Reach 3). C4 channels are meandering point-bar, riffle/pool, alluvial channels with broad well defined floodplain on low gradients and gravel-dominant substrates. C3 channels are meandering point-bar, riffle/pool, alluvial channels with broad well defined floodplain on low gradients and cobble-dominant substrates. F3 channel types are entrenched meandering riffle/pool channels on low gradients with high width/depth ratios and cobble-dominant substrates.

Water temperatures taken during the survey period of September 28 to November 4, 2004 and August 8 to August 29, 2005 ranged from 51 to 78 degrees Fahrenheit. Air temperatures ranged from 48 to 96 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 35% pool units, 32% flatwater units, and 33% riffle units (Graph 1). Based on total length of Level II habitat types there were 40% pool units, 38% flatwater units, and 22% riffle units (Graph 2).

Fourteen Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were low gradient riffle units, 32%; mid-channel pool units, 25%; and run units, 16% (Graph 3). Based on percent total length, mid-channel pool units made up 29%, low gradient riffle units 22%, and step runs 19%.

A total of 199 pools were identified (Table 3). Main channel pools were the most frequently encountered at 74% (Graph 4), and comprised 75% 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. One hundred sixty-nine of the 199 pools (85%) had a residual depth of three feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 196 pool tail-outs measured, 90 had a value of 1 (46%); 46 had a value of 2 (24%); 14 had a value of 3 (7%); one

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had a value of 4 (1%); and 45 had a value of 5 (23%) (Graph 6). On this scale, a value of 1 indicates the best spawning conditions and a value of 4 the worst. Additionally, a value of 5 was assigned to tail-outs deemed unsuited 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 44, flatwater habitat types had a mean shelter rating of 41, and pool habitats had a mean shelter rating of 79 (Table 1). Of the pool types, the scour pools had the highest mean shelter rating at 87. Main channel pools had a mean shelter rating of 76 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Boulders are the dominant cover type in the Garcia River. Graph 7 describes the pool cover in the Garcia River. Boulders are the dominant pool cover type followed by bedrock ledges.

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 39% of the pool tail-outs. Small cobble was the next most frequently observed dominant substrate type and occurred in 29% of the pool tail-outs.

The mean percent canopy density for the surveyed length of the Garcia River was 38%. Of the canopy present, the mean percentages of hardwood and coniferous trees were 66% and 34%, respectively. Sixty-two percent of the canopy was open. Graph 9 describes the mean percent canopy in the Garcia River.

For the stream reach surveyed, the mean percent right bank vegetated was 60%. The mean percent left bank vegetated was 63%. The dominant elements composing the structure of the stream banks consisted of 45% cobble/gravel, 23% bedrock, 22% sand/silt/clay, and 10% boulders (Graph 10). Hardwood trees were the dominant vegetation type observed in 70% of the units surveyed. Additionally, 14% of the units surveyed had brush as the dominant vegetation type, and 14% had coniferous trees as the dominant vegetation type (Graph 11).

## **DISCUSSION**

The Garcia River is a C4 channel type for 41,911 feet of the stream surveyed (Reach 1), a C3 channel type for 33,827 feet of the stream surveyed (Reach 2), and an F3 channel type for 30,426 feet of the stream surveyed (Reach 3). The suitability of C4, C3, and F3 channel types for fish habitat improvement structures is as follows: C4 channel types are good for bank placed boulders and fair for plunge weirs, single and opposing wing-deflectors, channel constrictors, and log cover. C3 channel types are excellent for bank-placed boulders and good for plunge weirs, boulder clusters, single and opposing wing-deflectors and log cover. F3 channel types are good for bank-placed boulders, single and opposing wing-deflectors and fair for plunge weirs, boulder clusters, channel constrictors and log cover.

The water temperatures recorded on the survey days September 28 to November 4, 2004 and August 8 to August 29, 2005 ranged from 51 to 78 degrees Fahrenheit. Air temperatures ranged

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from 48 to 96 degrees Fahrenheit. 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 22%, and pools 40%. The pools are relatively deep, with 169 of the 199 (85%) pools having a maximum residual depth greater than three feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In third and fourth order streams, a primary pool is defined to have a maximum residual depth of at least three 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 for locations where their installation will not be threatened by high stream energy, or where their installation will not conflict with the modification of the numerous log debris accumulations (LDA's) in the stream.

One hundred thirty-six of the 196 pool tail-outs measured had embeddedness ratings of 1 or 2. Fifteen of the pool tail-outs had embeddedness ratings of 3 or 4. Forty-five 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 the Garcia River should be mapped and rated according to their potential sediment yields, and control measures should be taken.

One hundred thirty-five of the 198 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 79. The shelter rating in the flatwater habitats is 41. A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by boulders in the Garcia River. Boulders are the dominant cover type in pools followed by bedrock ledges. 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 38%. Reach 1 had a canopy density of 41%, Reach 2 had a canopy density of 29%, and Reach 3 had a canopy density of 42%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was 60% and 63%, respectively. In areas of stream bank erosion or where bank vegetation is sparse, planting endemic species of coniferous and hardwood trees, in conjunction with bank stabilization, is recommended.

## **RECOMMENDATIONS**

- 1) The Garcia River should be managed as an anadromous, natural production stream.
- 2) The limited water temperature data available suggest that maximum temperatures are

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higher than the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the July and August temperature extreme period should be performed for 3 to 5 years.

- 3) Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.
- 4) Increase woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from boulders. Adding high quality complexity with woody cover in the pools is desirable.
- 5) 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.
- 6) 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.
- 7) Increase the canopy on the Garcia River by planting appropriate native vegetation like willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. The reaches above this survey section should be inventoried and treated as well, since the water flowing here is affected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

### 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.
4553	0020.00	Rolling Brook Creek enters on the right bank.
9304	0037.00	Right bank tributary.
15560	0064.00	Salmonid observed.
19351	0079.00	Salmonid observed.
35787	0139.00	Left bank tributary. Not a fish bearing stream.

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41911	0159.00	Channel type change.
42936	0162.00	Right bank tributary.
43628	0166.00	Right bank tributary.
45771	0173.00	Two left bank tributaries.
48946	0185.00	Left bank tributary.
49764	0188.00	Right bank tributary.
50018	0189.00	Left bank tributary. Stream not fish bearing.
53927	0204.00	Signal Creek enters on left bank.
55797	0213.00	Wood bridge at end of unit.
57864	0222.00	Left bank tributary. Stream not fish bearing.
61209	0236.00	Graphite Creek enters on the right bank.
63840	0254.00	Right bank tributary.
68308	0278.00	Inman Creek enters on the left bank.
72609	0301.00	Blue Waterhole Creek enters on right bank.
75635	0321.00	Hollow Tree Road bridge.
75738	0321.00	End of Garcia River Forest, end of 2004 survey.
75841	0322.00	Start of 2005 survey at Hollow Tree Road bridge.
77390	0333.00	Dry right bank tributary.
77646	0335.00	Two dry tributaries, one on left bank.
77996	0337.00	Steelhead young-of-the-year (YOY) and 1+ observed.
78242	0338.00	Dry left bank tributary.
78913	0345.00	Steelhead YOY observed.
79087	0346.00	Western pond turtle observed.

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79606	0349.00	Dry right bank tributary.
80598	0351.00	Dry right bank tributary.
80946	0352.00	Dry left bank tributary. Wet crossing.
82663	0364.00	High gradient left bank tributary.
82830	0366.00	Steelhead YOY and stickleback observed.
84389	0372.00	Right bank tributary.
84759	0374.00	Narrow, deep passage upstream.
85082	0377.00	Steelhead YOY and resident trout observed. Trail meets river on right bank.
85193	0378.00	Steelhead observed.
85956	0385.00	Access to road on left bank.
88335	0399.00	Steelhead YOY observed. Access to trail on right bank.
89433	0406.00	Left bank tributary, steep and cascading. Erosion site.
90039	0408.00	Right bank spring.
90111	0409.00	Right bank spring.
90177	0410.00	Right bank erosion site measures 150' long x 180' high. Steelhead YOY and resident trout observed.
91263	0415.00	Dry left bank tributary.
91822	0419.00	Steelhead YOY observed.
93505	0433.00	Right bank tributary.
93684	0434.00	Right bank tributary.
94936	0444.00	Small spring creating pool.
95321	0447.00	Multiple small springs.
95842	0450.00	Dry right bank tributary.
95904	0451.00	Left bank tributary.

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96649	0460.00	High gradient right bank tributary.
96857	0463.00	Larmour Creek enters on the right bank. Fish bearing.
97430	0467.00	Left bank tributary.
100929	0510.00	Steelhead 1+ observed.
101021	0511.00	Right bank erosion site measures 50' high x 30' long.
101701	0515.00	Right bank tributary, dry at the mouth.
102177	0518.00	Steelhead YOY and 1+ observed.
102284	0519.00	Dry right bank tributary.
105459	0546.00	Dry right bank tributary.
106137	0552.00	Left bank tributary.
106267	0553.00	End of survey due to end of access permission.

## REFERENCES

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

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### LEVEL III and LEVEL IV HABITAT TYPES

#### RIFFLE

Low Gradient Riffle	(LGR)	[1.1]	{ 1 }
High Gradient Riffle	(HGR)	[1.2]	{ 2 }

#### CASCADE

Cascade	(CAS)	[2.1]	{ 3 }
Bedrock Sheet	(BRS)	[2.2]	{24}

#### FLATWATER

Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}

#### MAIN CHANNEL POOLS

Trench Pool	(TRP)	[4.1]	{ 8 }
Mid-Channel Pool	(MCP)	[4.2]	{17}
Channel Confluence Pool	(CCP)	[4.3]	{19}
Step Pool	(STP)	[4.4]	{23}

#### SCOUR POOLS

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

#### BACKWATER POOLS

Secondary Channel Pool	(SCP)	[6.1]	{ 4 }
Backwater Pool - Boulder Formed	(BPB)	[6.2]	{ 5 }
Backwater Pool - Root Wad Formed	(BPR)	[6.3]	{ 6 }
Backwater Pool - Log Formed	(BPL)	[6.4]	{ 7 }
Dammed Pool	(DPL)	[6.5]	{13}

#### ADDITIONAL UNIT DESIGNATIONS

Dry	(DRY)	[7.0]	
Culvert	(CUL)	[8.0]	
Not Surveyed	(NS)	[9.0]	
Not Surveyed due to a marsh	(MAR)	[9.1]	

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

**Stream Name:** Garcia River

**LLID:** 1237322389549

**Drainage:** Garcia River

**Survey Dates:** 9/28/2004 to 8/29/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR17WS34

**Latitude:** 38:57:18.0N

**Longitude:** 123:43:56.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	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
186	29	FLATWATER	32.5	221	41157	37.8	27.0	1.0	3.0	4986	927321	5189	965194		41
199	199	POOL	34.7	219	43651	40.1	33.2	2.1	5.0	7853	1562833	21553	4289046	17421	79
188	22	RIFFLE	32.8	128	24016	22.1	22.5	0.7	1.4	1653	310824	1211	227743		44
Total Units	Total Units Fully Measured				Total Length (ft.)						Total Area (sq.ft.)		Total Volume (cu.ft.)		
573	250				108824						2800978		5481983		

## Table 2 - Summary of Habitat Types and Measured

**Stream Name:** Garcia River

**LLID:** 1237322389549

**Drainage:** Garcia River

**Survey Dates:** 9/28/2004 to 8/29/2005

**Confluence Location:** Quad: POINT ARENA

**Legal Description:** T13NR17WS34

**Latitude:** 38:57:18.0N

**Longitude:** 123:43:56.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	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	Mean Canopy (%)
183	18	LGR	31.9	129	23569	21.7	24.0	0.7	2.4	1884	344762	1350	246994		39	33
3	2	HGR	0.5	110	330	0.3	20.0	1.1	2.0	762	2285	838	2514		70	41
2	2	BRS	0.3	58	117	0.1	12.0	0.7	2.0	469	938	340	680		60	6
10	3	GLD	1.7	158	1582	1.5	44.0	0.5	1.2	3799	37992	1850	18495		13	22
91	16	RUN	15.9	208	18908	17.4	28.0	1.0	25.0	5795	527309	6306	573857		30	36
85	10	SRN	14.8	243	20667	19.0	20.0	1.1	7.0	4047	344004	4404	374346		65	38
141	141	MCP	24.6	226	31800	29.2	34.0	2.1	14.8	8189	1154587	21877	3084657	17585	76	42
4	4	CCP	0.7	115	461	0.4	34.0	1.5	5.3	3679	14716	6938	27752	5065	53	17
2	2	STP	0.3	224	447	0.4	34.0	2.4	7.9	8998	17996	28130	56261	26567	125	20
6	6	CRP	1.0	309	1853	1.7	46.0	2.9	13.2	14419	86516	54306	325839	46438	133	26
3	3	LSL	0.5	176	529	0.5	33.0	2.1	8.6	6156	18469	16446	49337	14131	87	14
8	8	LSR	1.4	120	958	0.9	25.0	1.9	6.3	3273	26181	7362	58899	5970	118	48
22	22	LSBk	3.8	260	5718	5.3	31.0	2.4	14.5	8613	189475	26134	574942	20940	83	43
13	13	LSBo	2.3	145	1885	1.7	31.0	1.7	7.4	4222	54892	8566	111358	6488	53	36
<b>Total Units</b>	<b>Total Units Fully Measured</b>				<b>Total Length (ft.)</b>						<b>Total Area (sq.ft.)</b>		<b>Total Volume (cu.ft.)</b>			
573	250				108824						2820124		5505932			

### Table 3 - Summary of Pools

**Stream Name:** Garcia River

**LLID:** 1237322389549

**Drainage:** Garcia River

**Survey Dates:** 9/28/2004 to 8/29/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR17WS34

**Latitude:** 38:57:18.0N

**Longitude:** 123:43:56.0W

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
147	147	MAIN	74	223	32708	75	33.6	2.1	8077	1187300	17366	2552866	76
52	52	SCOUR	26	210	10943	25	32.1	2.2	7222	375533	17573	913815	87
Total Units	Total Units Fully Measured				Total Length (ft.)					Total Area (sq.ft.)		Total Volume (cu.ft.)	
199	199				43651					1562833		3466681	

### Table 4 - Summary of Maximum Residual Pool Depths By

**Stream Name:** Garcia River

**LLID:** 1237322389549

**Drainage:** Garcia River

**Survey Dates:** 9/28/2004 to 8/29/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR17WS34

**Latitude:** 38:57:18.0N

**Longitude:** 123:43:56.0W

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
3	LSL	2	0	0	0	0	0	0	0	0	3	100
141	MCP	71	0	0	5	4	18	13	37	26	81	57
22	LSBk	11	0	0	1	5	1	5	1	5	19	86
6	CRP	3	0	0	0	0	1	17	0	0	5	83
8	LSR	4	0	0	0	0	1	13	1	13	6	75
2	STP	1	0	0	0	0	0	0	0	0	2	100
4	CCP	2	0	0	0	0	0	0	3	75	1	25
13	LSBo	7	0	0	0	0	3	23	6	46	4	31
Total Units			Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Feet Max Resid. Depth	Total 1< 2 Feet % Occurrence	Total 2< 3 Feet Max Resid. Depth	Total 2< 3 Feet % Occurrence	Total 3< 4 Feet Max Resid. Depth	Total 3< 4 Feet % Occurrence	Total >= 4 Feet Max Resid. Depth	Total >= 4 Feet % Occurrence
199			0	0	6	3	24	12	48	24	121	61

Mean Maximum Residual Pool Depth (ft.): 5

**Table 5 - Summary of Mean Percent Cover By Habitat**

**Stream Name:** Garcia River

**LLID:** 1237322389549

**Drainage:** Garcia River

**Survey Dates:** 9/28/2004 to 8/29/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR17WS34

**Latitude:** 38:57:18.0N

**Longitude:** 123:43:56.0W

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
183	15	LGR	0	1	10	1	12	5	5	60	6
3	2	HGR	0	0	0	0	3	0	50	48	0
2	2	BRS	0	0	0	0	0	0	0	70	30
10	3	GLD	0	0	7	0	37	13	0	43	0
91	14	RUN	1	3	2	0	18	6	0	56	7
85	10	SRN	1	5	8	7	23	16	0	39	1
141	140	MCP	2	8	8	5	13	10	1	39	15
4	4	CCP	0	4	3	0	11	11	3	59	10
2	2	STP	0	10	10	5	10	15	5	25	20
6	6	CRP	0	5	7	10	17	15	0	27	20
3	3	LSL	3	12	57	5	10	0	0	13	0
8	8	LSR	6	17	11	34	9	11	1	8	3
22	22	LSBk	0	8	6	5	18	8	0	21	34
13	13	LSBo	1	3	8	0	14	3	1	54	17

### Table 6 - Summary of Dominant Substrates By Habitat

**Stream Name:** Garcia River

**LLID:** 1237322389549

**Drainage:** Garcia River

**Survey Dates:** 9/28/2004 to 8/29/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR17WS34

**Latitude:** 38:57:18.0N

**Longitude:** 123:43:56.0W

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
183	18	LGR	0	0	44	39	17	0	0
3	2	HGR	0	0	0	50	0	50	0
2	2	BRS	0	0	0	0	0	0	100
10	3	GLD	0	0	100	0	0	0	0
91	16	RUN	0	0	63	25	13	0	0
85	10	SRN	0	0	30	20	30	20	0
141	141	MCP	0	18	50	11	7	9	4
4	4	CCP	0	25	50	25	0	0	0
2	2	STP	0	0	50	50	0	0	0
6	6	CRP	0	67	17	17	0	0	0
3	3	LSL	0	0	100	0	0	0	0
8	8	LSR	0	25	63	13	0	0	0
22	22	LSBk	0	36	55	0	0	9	0
13	13	LSBo	0	8	77	15	0	0	0

## Table 7 - Summary of Mean Percent Canopy for Entire Stream

**Stream Name:** Garcia River

**LLID:** 1237322389549

**Drainage:** Garcia River

**Survey Dates:** 9/28/2004 to 8/29/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR17WS34

**Latitude:** 38:57:18.0N

**Longitude:** 123:43:56.0W

Habitat Units	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
38	34	66	0	60	63

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.



## Summary of Fish Habitat Elements By Stream Reach

**STREAM REACH: 3**

Channel Type: F3	Canopy Density (%): 42.1	Pools by Stream Length (%): 26.7
Reach Length (ft.): 30426	Coniferous Component (%): 25.4	Pool Frequency (%): 31.0
Riffle/Flatwater Mean Width (ft.): 24.8	Hardwood Component (%): 74.6	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Hardwood Trees	< 2 Feet Deep: 8.3
Range (ft.): 42 to 89	Vegetative Cover (%): 68.6	2 to 2.9 Feet Deep: 23.6
Mean (ft.): 57.3146551724138	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 29.2
Std. Dev.: 10.7994113370091	Dominant Bank Substrate Type: Cobble/Gravel	>= 4 Feet Deep: 38.9
Base Flow (cfs): 0	Occurrence of LWD (%): 8.1	Mean Max Residual Pool Depth (ft.): 4.02
Water (F): 64 - 78    Air (F): 66 - 96	LWD per 100 ft.:	Mean Pool Shelter Rating: 49
Dry Channel (ft.): 0	Riffles: 0	
	Pools: 1	
	Flat: 0	
Pool Tail Substrate (%): Silt/Clay: 0.0    Sand: 0.0    Gravel: 36.6    Sm Cobble: 25.4    Lg Cobble: 8.5    Boulder: 22.5    Bedrock: 7.0		
Embeddedness Values (%): 1. 23.6    2. 34.7    3. 9.7    4. 1.4    5. 30.6		

**Table 9 -Mean Percentage of Dominant Substrate and Vegetation**

**Stream Name:** Garcia River

**LLID:** 1237322389549

**Drainage:** Garcia River

**Survey Dates:** 9/28/2004 to 8/29/2005

**Confluence Location: Quad:** POINT ARENA

**Legal Description:** T13NR17WS34

**Latitude:** 38:57:18.0N

**Longitude:** 123:43:56.0W

**Mean Percentage of Dominant Stream Bank**

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Bedrock	52	64	23.2
Boulder	23	29	10.4
Cobble/Gravel	115	109	44.8
Sand/Silt/Clay	60	48	21.6

**Mean Percentage of Dominant Stream Bank**

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Grass	7	2	1.8
Brush	39	29	13.6
Hardwood Trees	176	174	70.0
Coniferous Trees	27	41	13.6
No Vegetation	0	4	0.8

**Total Stream Cobble Embeddedness** 2

## Table 10 - Mean Percent of Shelter Cover Types For Entire System

**Stream Name:** Garcia River

**LLID:** 1237322389549

**Drainage:** Garcia River

**Survey Dates:** 9/28/2004 to 8/29/2005

**Confluence Location: Quad:** POINT ARENA

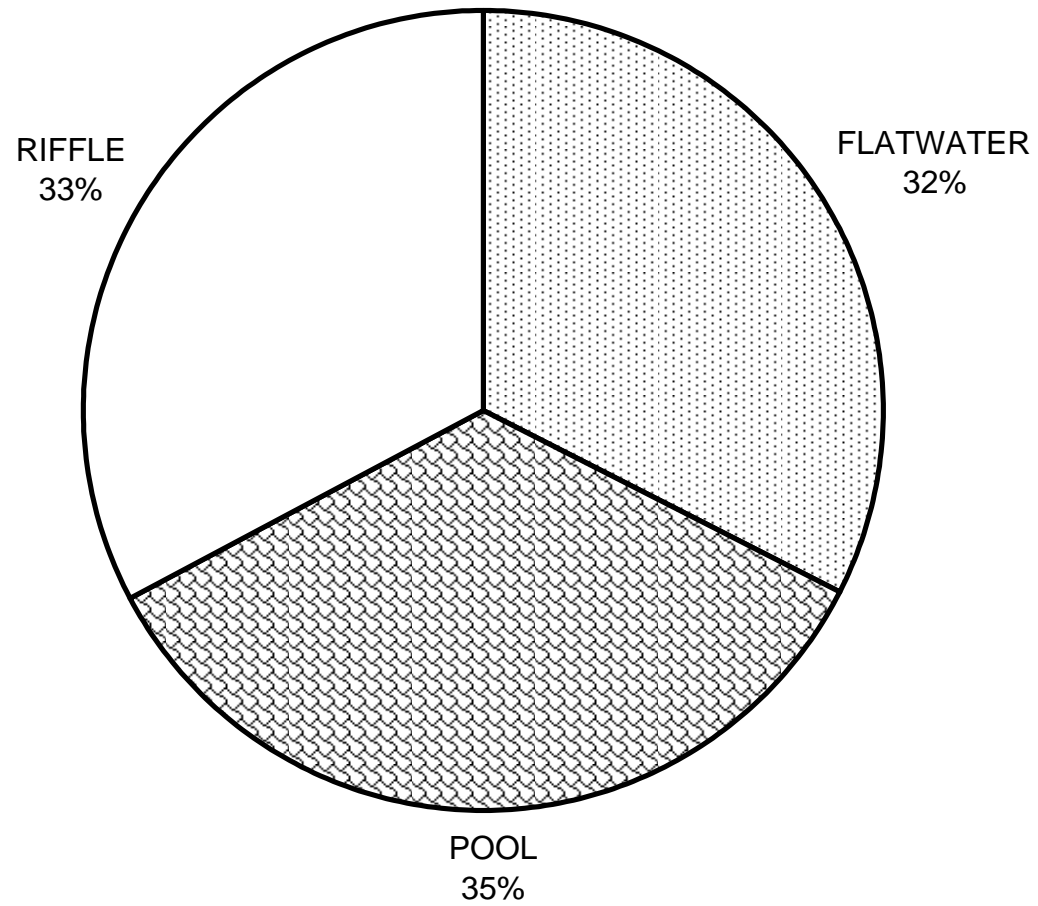
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**Longitude:** 123:43:56.0W

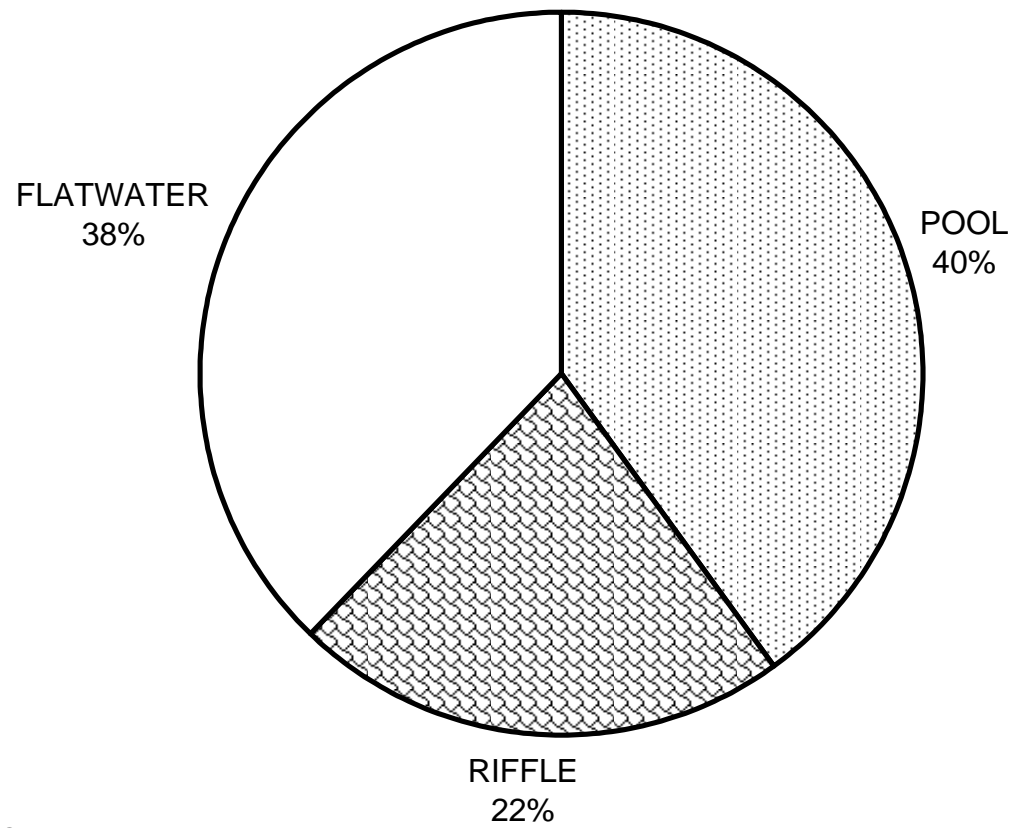
	<b>Riffles</b>	<b>Flatwater</b>	<b>Pools</b>
UNDERCUT BANKS (%)	0	1	2
SMALL WOODY DEBRIS (%)	1	4	8
LARGE WOODY DEBRIS (%)	8	5	8
ROOT MASS (%)	1	3	6
TERRESTRIAL VEGETATION (%)	10	22	13
AQUATIC VEGETATION (%)	4	10	9
WHITEWATER (%)	9	0	1
BOULDERS (%)	59	48	36
BEDROCK LEDGES (%)	8	4	17

# GARCIA RIVER HABITAT TYPES BY PERCENT OCCURRENCE



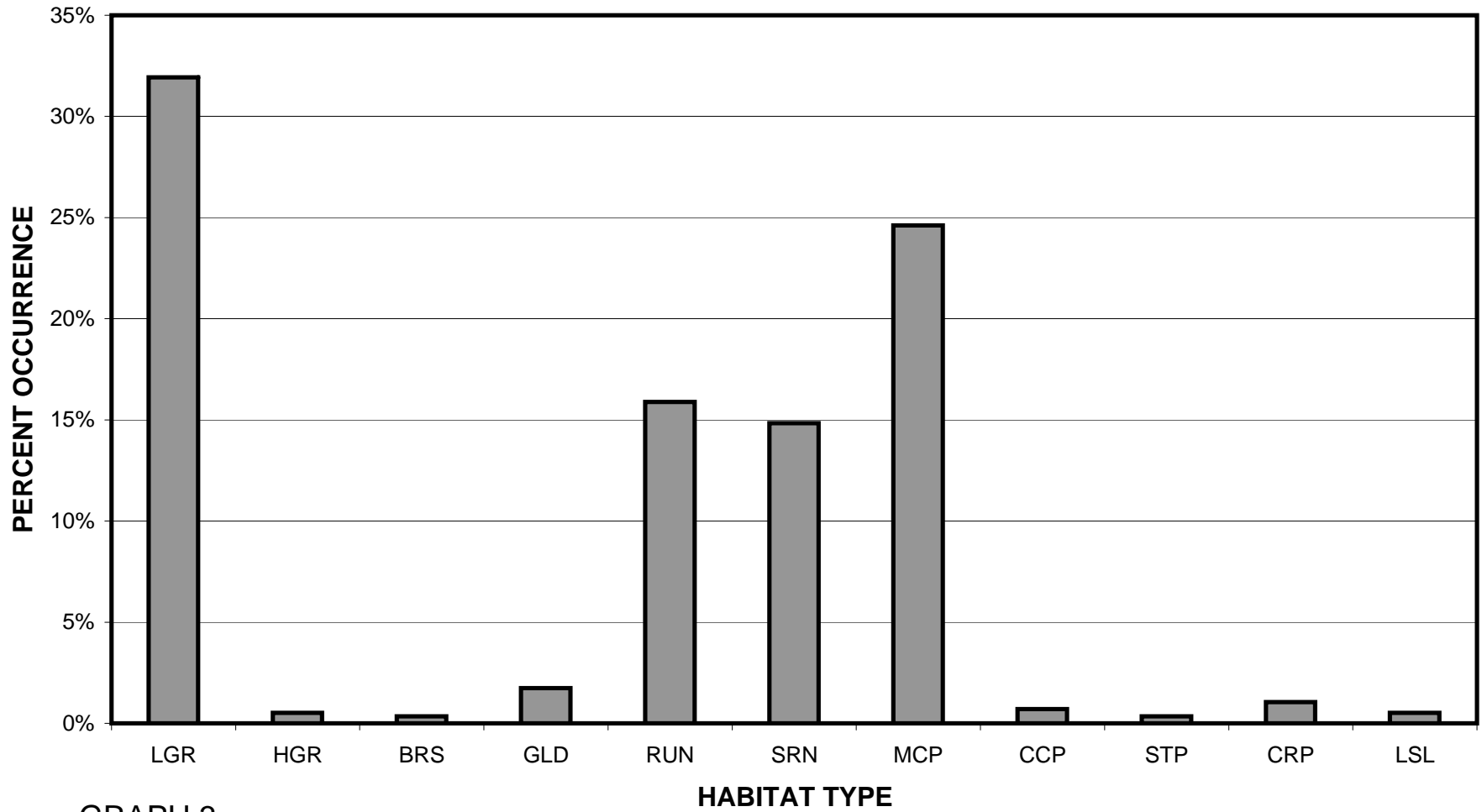
GRAPH 1

# GARCIA RIVER HABITAT TYPES BY PERCENT TOTAL LENGTH



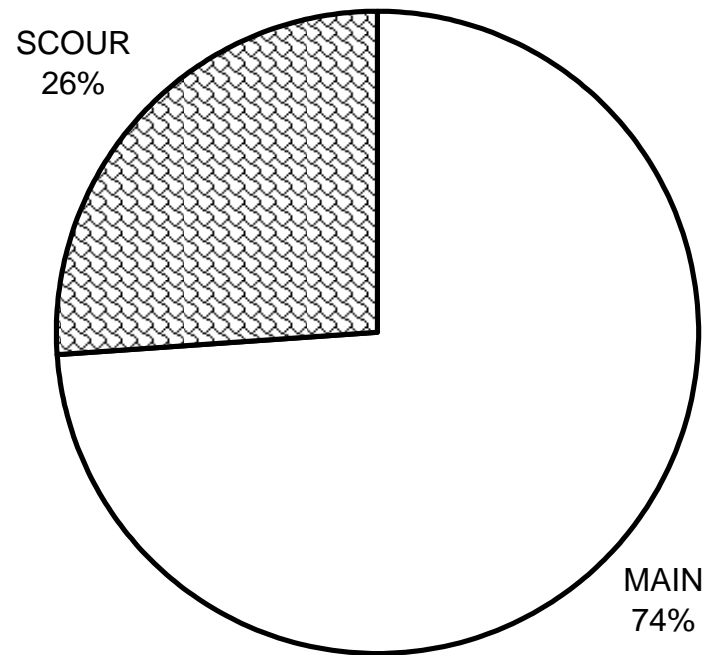
GRAPH 2

# GARCIA RIVER HABITAT TYPES BY PERCENT OCCURRENCE



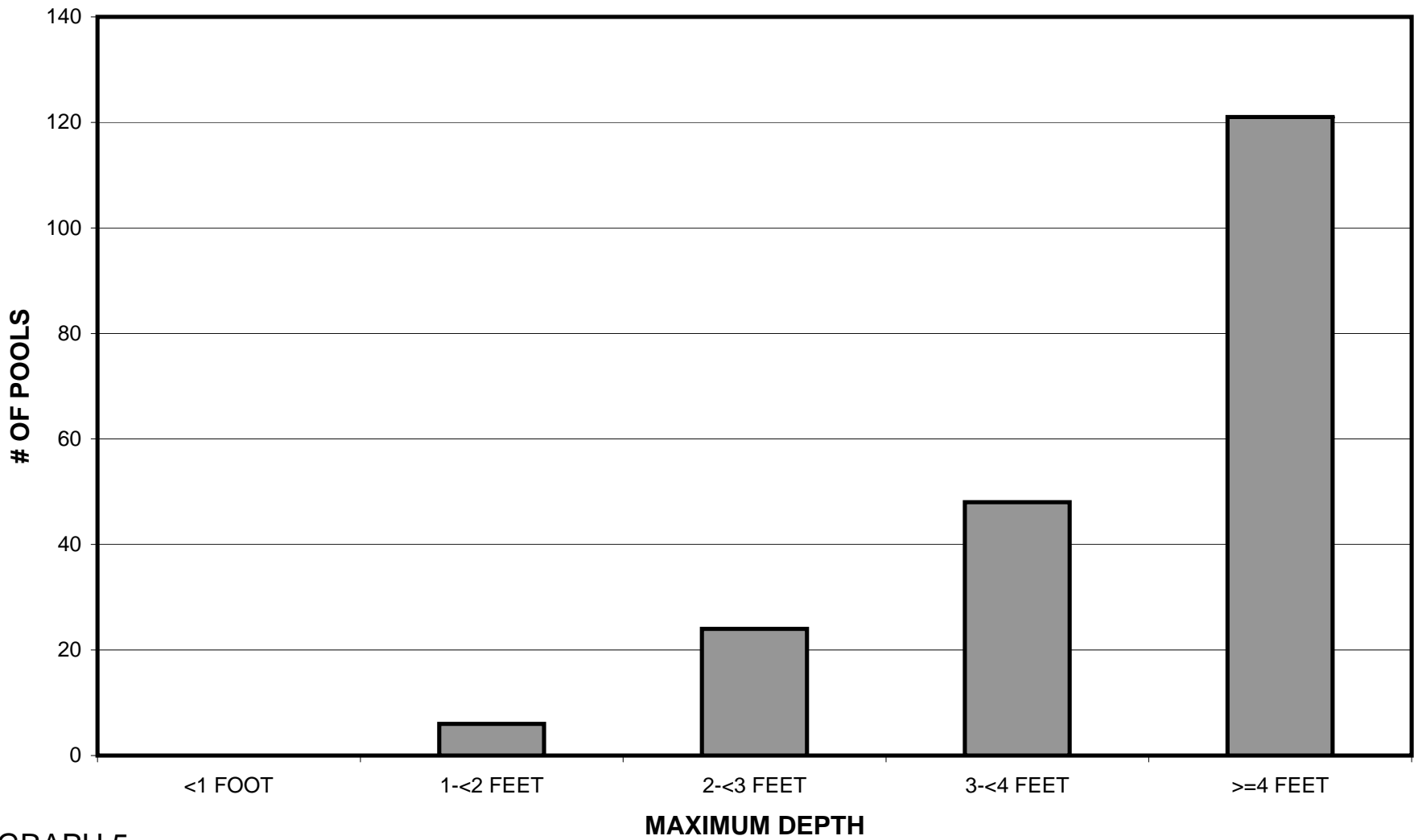
GRAPH 3

# GARCIA RIVER POOL TYPES BY PERCENT OCCURRENCE



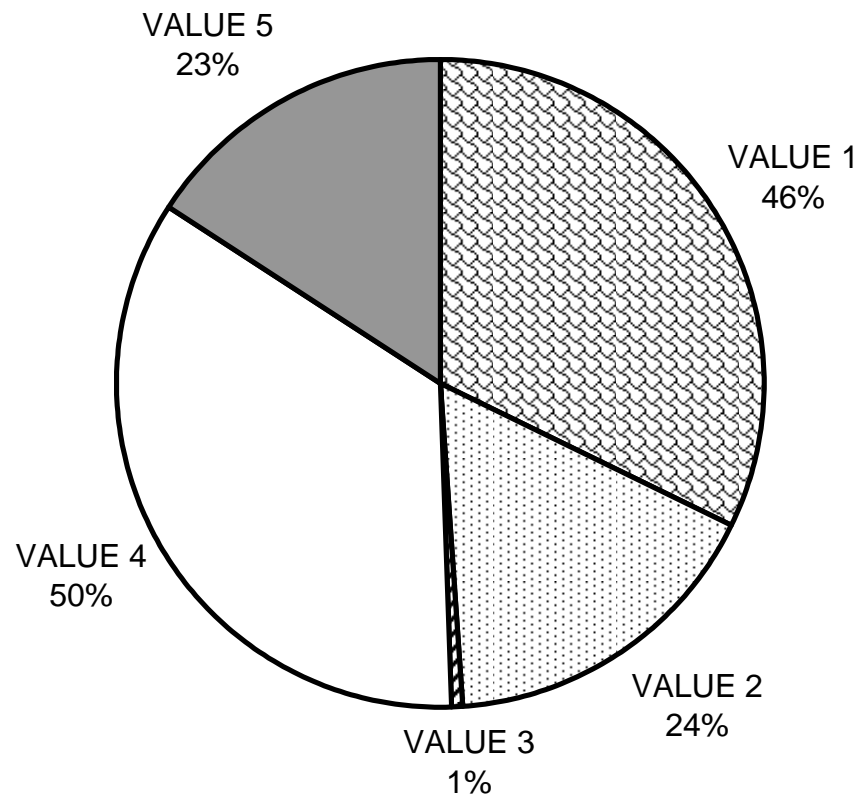
GRAPH 4

# GARCIA RIVER MAXIMUM DEPTH IN POOLS



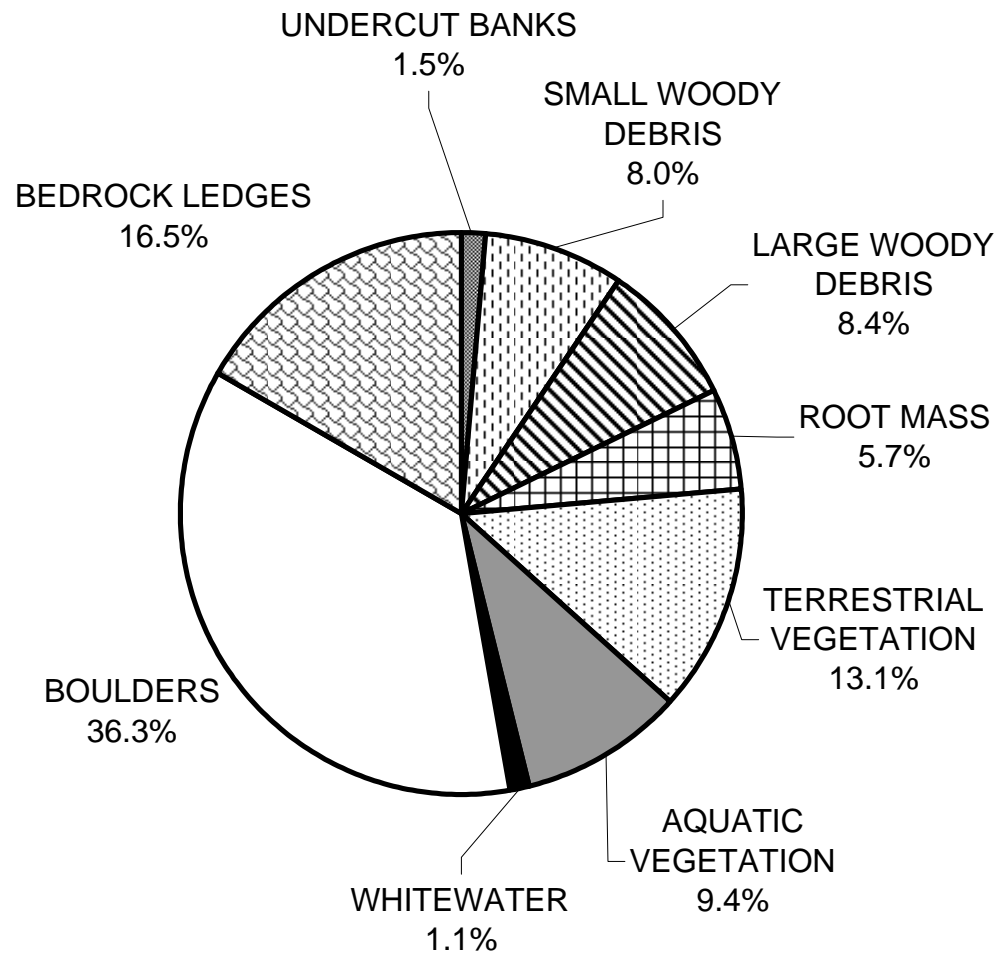
GRAPH 5

# GARCIA RIVER PERCENT EMBEDDEDNESS



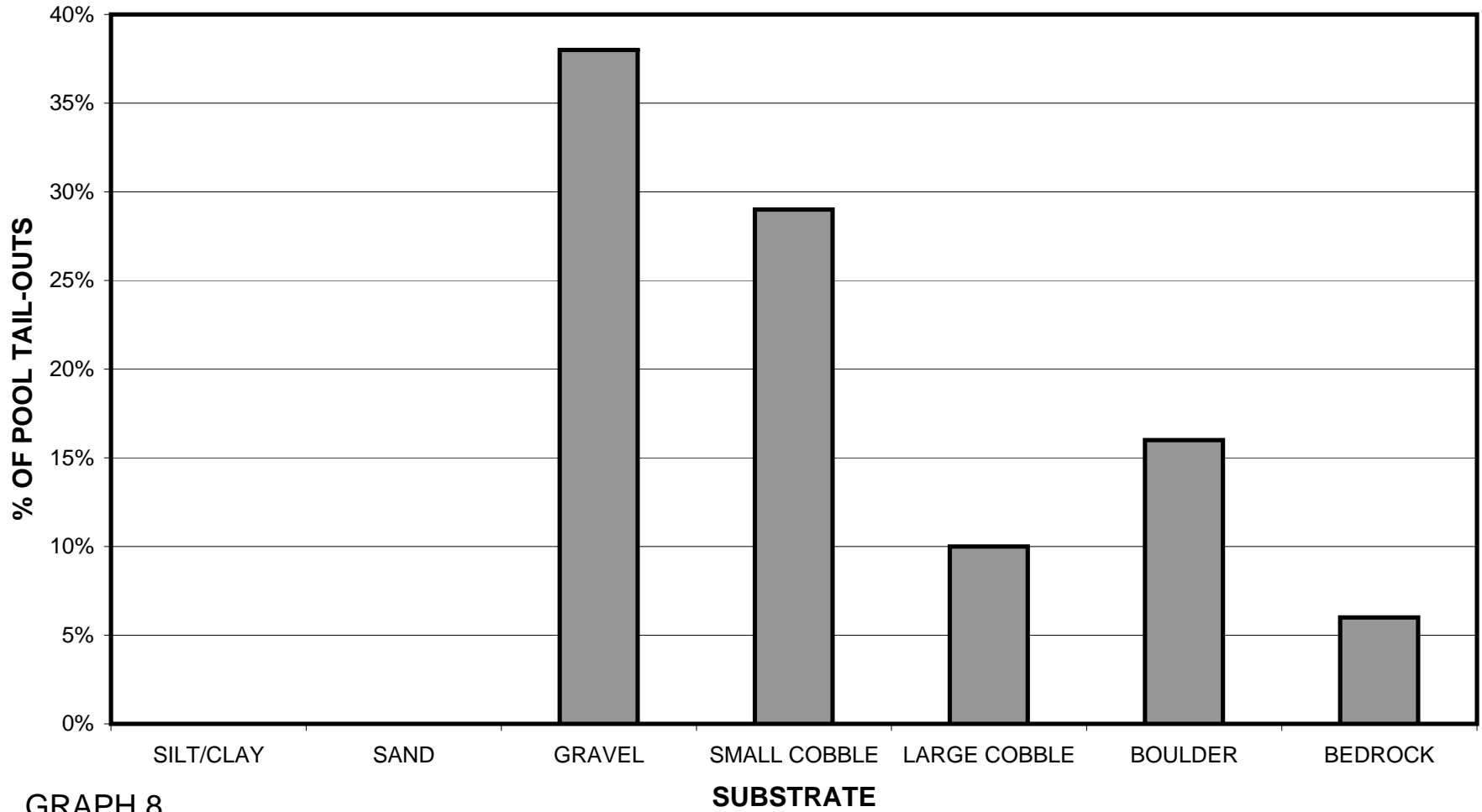
GRAPH 6

# GARCIA RIVER MEAN PERCENT COVER TYPES IN POOLS



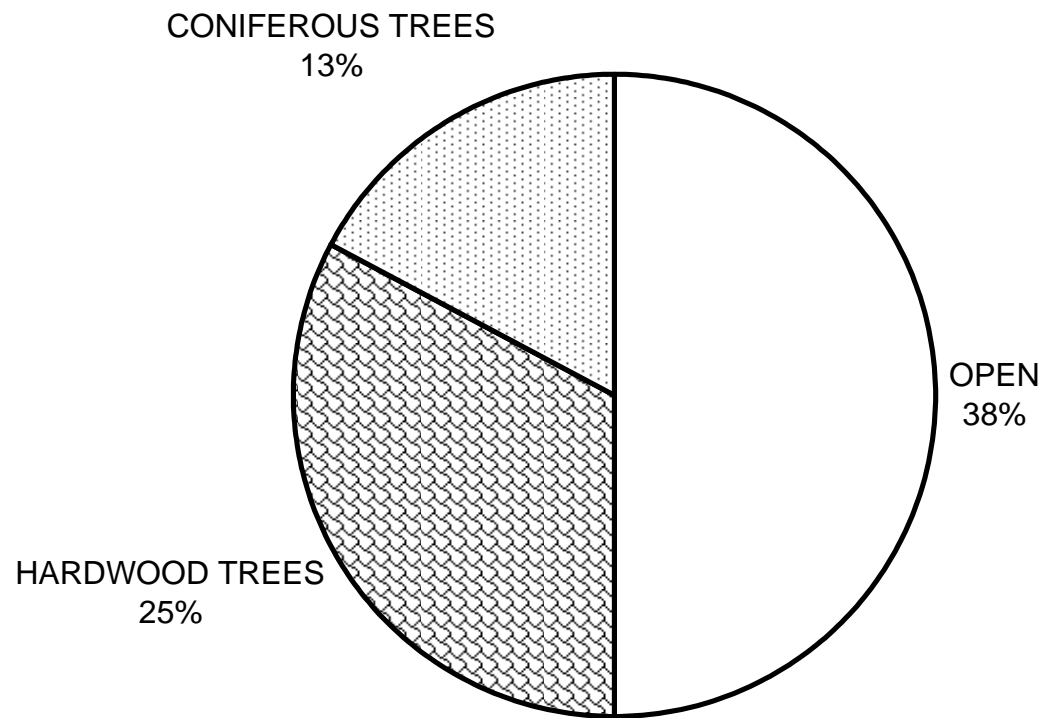
GRAPH 7

# GARCIA RIVER SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



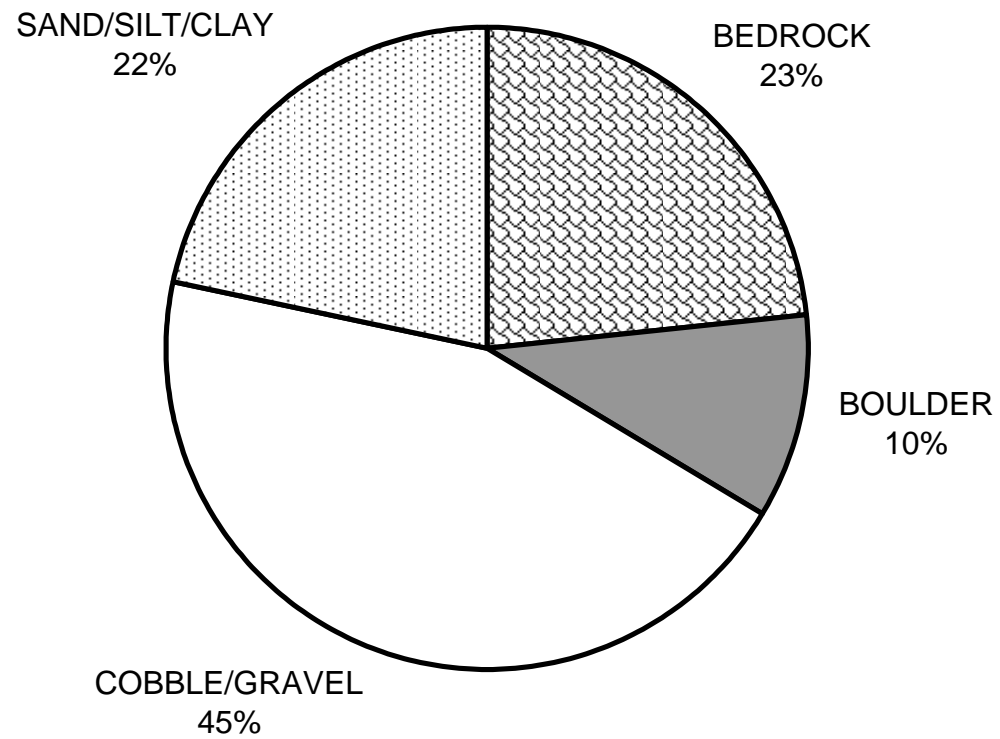
GRAPH 8

# GARCIA RIVER MEAN PERCENT CANOPY



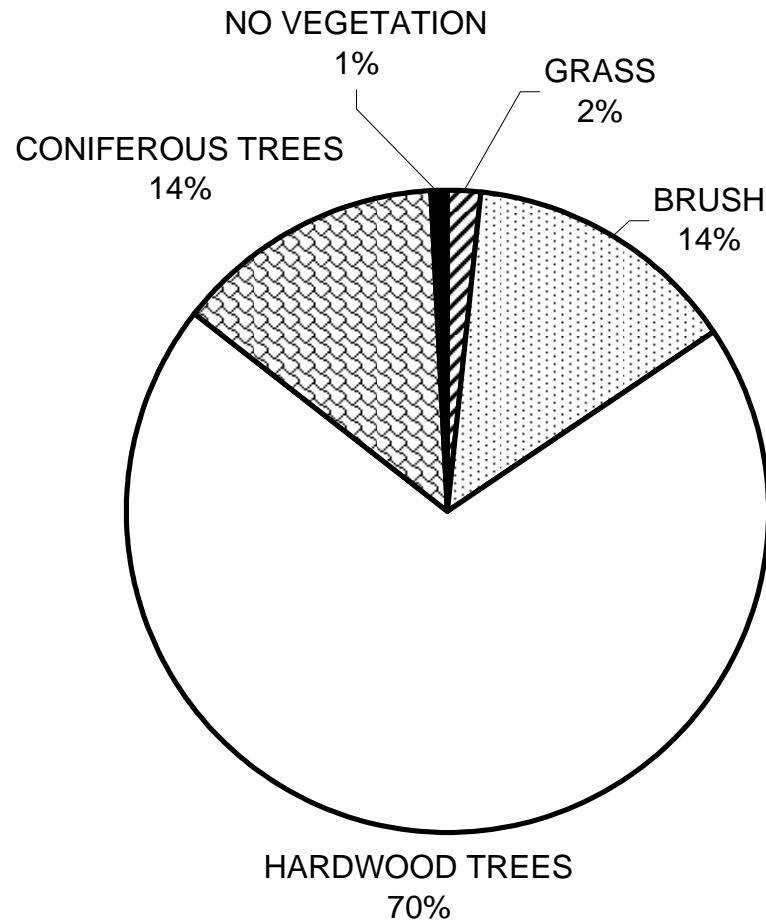
GRAPH 9

# GARCIA RIVER DOMINANT BANK COMPOSITION IN SURVEY REACH



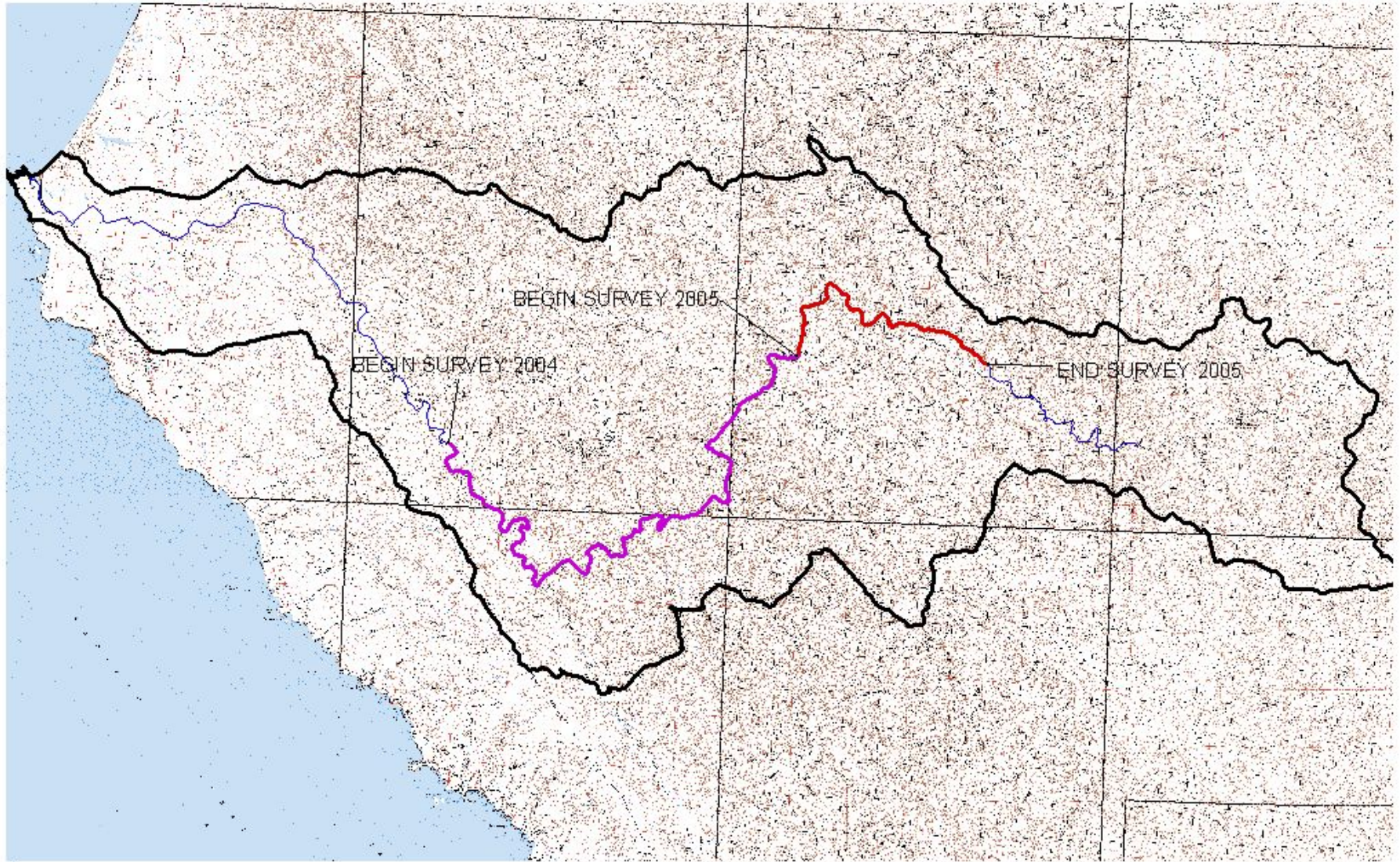
GRAPH 10

# GARCIA RIVER DOMINANT BANK VEGETATION IN SURVEY REACH







GRAPH 11

# Garcia River

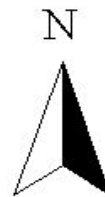
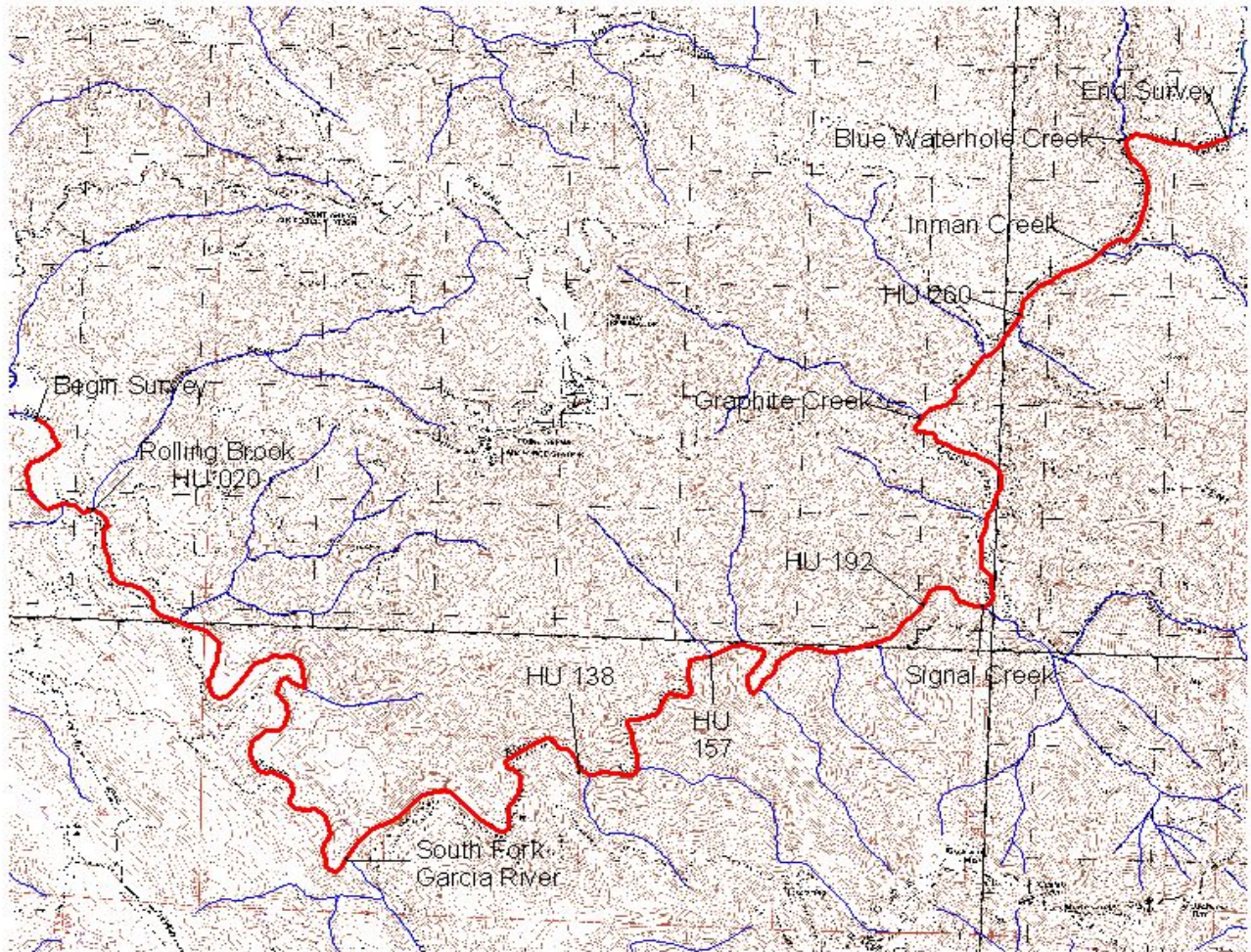


Garcia River Stream Habitat Survey

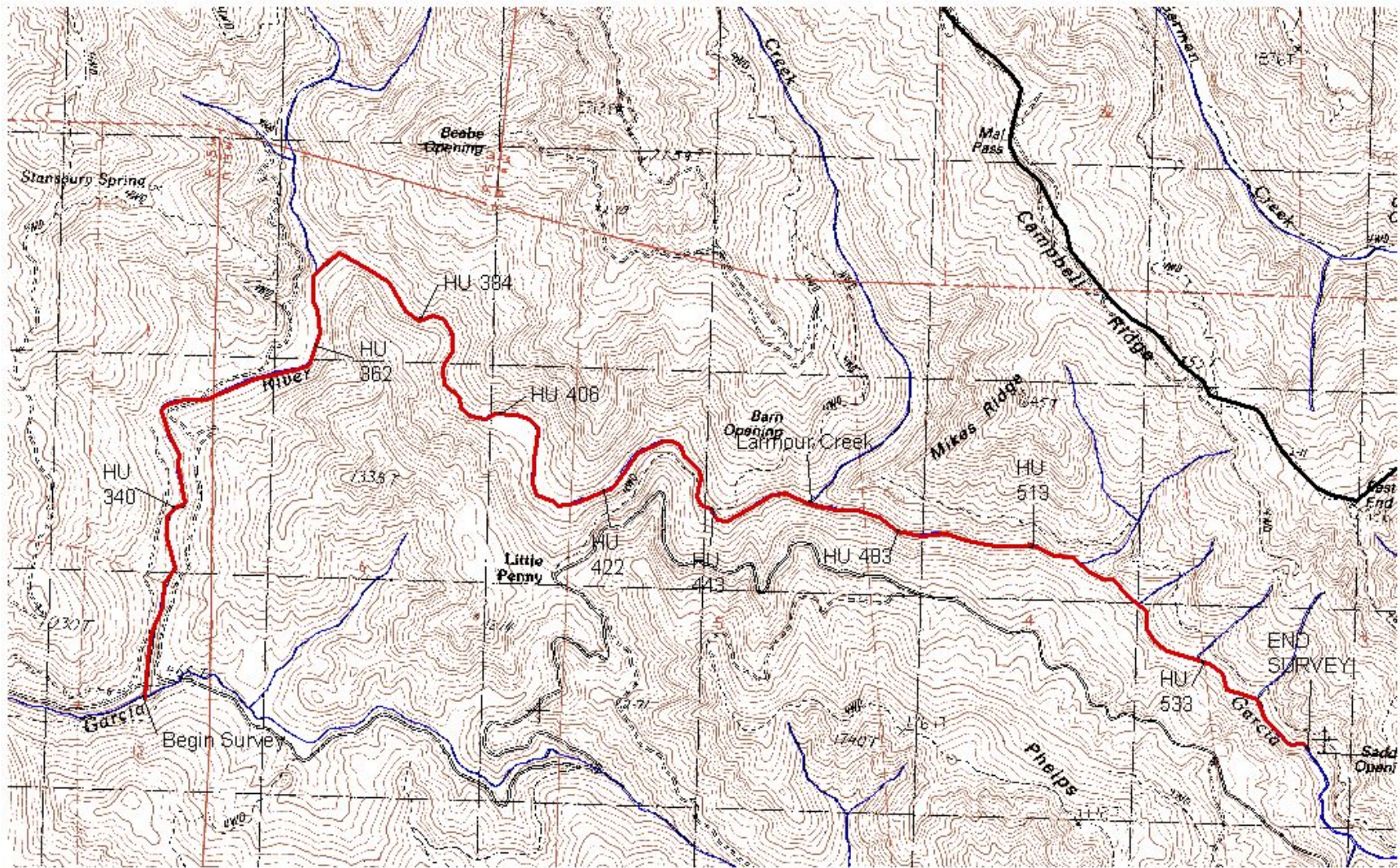
	Garcia Watership
	Garcia River Stream Reach 2004
	Garcia River Stream Reach 2005
	Garcia River Unsurveyed




# Garcia River




# Garcia River



**Garcia River Stream Habitat Survey**

 Garcia River Unserved

 Garcia River Survey Reach 2005

