Stream Inventory Report

Thurston Creek

Salmon Creek Watershed
Sonoma County, California

Survey: Summer 2003
Final Report: September, 2004

Revised May 2007

California Department of Fish and Game
Central Coast Region
Watershed Restoration Program

2004

CALIFORNIA DEPARTMENT OF FISH AND GAME
STREAM INVENTORY REPORT

Thurston Creek

INTRODUCTION

A stream inventory was conducted during the summer of 2003 on Thurston Creek, a tributary to Salmon Creek in the Salmon Creek watershed. The inventory was conducted in two parts: habitat inventory and biological inventory. The objective of the habitat inventory was to document the amount and condition of available habitat to fish, and other aquatic species with an emphasis on anadromous salmonids in Thurston Creek. The objective of the biological inventory was to document the salmonid and other aquatic species present and their distribution.

The objective of this report is to document the current habitat conditions and after analyzing historical and recent data, recommend options for the potential enhancement of habitat for coho salmon and steelhead trout. Recommendations for habitat improvement activities are based on target habitat values for salmonids in California's north coast streams.

WATERSHED OVERVIEW

Thurston Creek is located in Sonoma County, California and is a tributary to Nolan Creek which is a tributary to Salmon Creek. The legal description at the confluence with Salmon Creek is T6N, R10W, Section Estero Americano. Its location is 38°21'10.07"N latitude and 122°57'42.03"W longitude. Year round vehicle access exists from Joy Road via Bodega Highway.

Thurston Creek and its tributaries drain a basin of approximately 1.1 square miles. Thurston Creek is a maximum 1st order stream and has approximately 2.4 miles of blue line or dashed blue line stream, according to the USGS Valley Ford 7.5 minute quadrangle. Thurston Creek has 1 minor unnamed tributary, which was not surveyed. Elevations range from about 185' at the mouth of the creek to 804' in the headwaters. Grasslands, mixed hardwood, and coniferous forests dominate the watershed. The watershed is primarily privately owned and is managed for rangeland and recreation. Development is rural residential.

Salmonid fish species historically present include coho salmon (*Oncorhynchus kisutch)*and steelhead trout*(Oncorhynchus mykiss)*. Salmonid fish species currently present include steelhead trout*(Oncorhynchus mykiss)* which is listed as threatened on the

federal endangered species list.

METHODS

The habitat inventory conducted in Thurston Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi, et al., 1998). The California Department of Fish and Game (DFG) field crew that conducted the inventory was trained in standardized habitat inventory methods by DFG. This inventory was conducted by 2 person teams and was supervised by DFGs Watershed Restoration Planner, Gail Seymour.

SAMPLING STRATEGY

The inventory uses a method that samples approximately 10% of the habitat units within the survey reach. All habitat units included in the survey are classified according to habitat type and their lengths are measured. All pool units are measured for maximum depth, depth of pool tail crest (measured in the thalweg), dominant substrate composing the pool tail crest, and embeddedness. Habitat unit types encountered for the first time are measured for all the parameters and characteristics on the field form. Additionally, from the ten habitat units on each field form page, one is randomly selected for complete measurement.

HABITAT INVENTORY COMPONENTS

A standardized habitat inventory form has been developed for use in California stream surveys and can be found in the California Salmonid Stream Habitat Restoration Manual. This form was used in Thurston Creek to record measurements and observations. There are nine components to the inventory form: flow, channel type, temperatures, habitat type, embeddedness, shelter rating, substrate composition, canopy, and bank composition.

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 were also measured or estimated at major tributary confluences.

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1985 rev. 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:

Water and air temperatures, and time, are measured by crew members with hand held thermometers and recorded at each tenth unit typed. Temperatures are measured 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. Thurston 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 were in feet to the nearest tenth. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a hip chain, and stadia rod.

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 Thurston 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), 76 - 100% (value 4). Additionally, a rating of "not suitable" (value 5) was assigned to tail-outs deemed unsuited for spawning due to inappropriate substrate particle size, having a bedrock tail-out, or other considerations.

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. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered is made. All shelter is then classified according to a list of nine shelter types. In Thurston Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the shelter. The shelter rating is calculated for each habitat unit by multiplying shelter value and percent 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 measured habitat units, dominant and sub-dominant substrate elements were visually estimated using a list of seven size classes which are defined in the California Salmonid Stream Habitat Restoration Manual.

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 Thurston Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the top 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 visually into percentages of evergreen or deciduous 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 Thurston Creek, the dominant composition type and the dominant vegetation type of both the right and left banks for each fully measured 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.

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 four basic methods: 1) stream bank observation, 2) underwater observation, 3) electro

fishing, or 4) seine netting. Methods 1-3 are discussed in the California Salmonid Stream Habitat Restoration Manual. Seine netting is a fish capture technique that involves the use of a one meter square net attached to dowels on two parallel sides. The surveyor pushes the seine through the habitat unit to catch aquatic organisms. At the end of the unit the surveyor scoops up the seine and places all captured organisms in a bucket partially filled with stream water for holding. The water is aerated with a bubbler to maintain dissolved oxygen levels and minimize stress on the organisms. All fish, amphibians, and reptiles in the holding bucket are identified to species, counted and returned to the steam. Data is recorded on an electrofishing field form. Seine netting is used to confirm the presence of a species, particularly salmon and steelhead, and is not intended to quantify a population estimate.

IMPACT INVENTORY & ANALYSIS

Problems such as migration barriers, streambed erosion, poor water quality or temperatures are noted in the comments and landmarks section. In some cases measurements are taken, an analysis of what caused the problem is made and restoration potential and alternatives are recommended.

DATA ANALYSIS

Data from the habitat inventory form are entered into Habitat for data storage and analysis. Habitat is a Visual Basic extension to Microsoft Access, developed by Zebulon Young, University of California, Berkeley. This program processes and summarizes the data, and produces the following tables and appendices:

- Summary of riffle, flatwater, and pool habitat types
- Summary of habitat types and measured parameters
- Summary of pool types
- Summary of maximum pool depths by pool habitat types
- Summary of shelter by habitat types
- Summary of dominant substrates by habitat types
- Summary of fish habitat elements by stream reach

Graphics are produced from the tables using Microsoft Excel. Graphics developed for Thurston Creek include:

- Level II habitat types by % occurrence
- Level II habitat types by % total length
- Level IV habitat types by % occurrence
- Level I pool habitat types by % occurrence

- Maximum depth in pools
- Percent embeddedness estimated in pool tail-outs
- Mean percent cover types in pools
- Substrate composition in pool tail-outs
- Mean percent canopy
- Dominant bank composition in survey reach
- Dominant bank vegetation in survey reach

HISTORICAL STREAM SURVEYS:

The Department of Fish and Game has not conducted previous surveys of Thurston Creek.

HABITAT INVENTORY RESULTS FOR THURSTON CREEK

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

The habitat inventory of Thurston Creek, 7/18/2003 - 7/21/2003, was conducted by M. Terry and J. Facendini with supervision and analysis by California Department of Fish and Game (DFG). The survey began at the confluence with Salmon Creek and extended up Thurston Creek to the end of anadromous fish passage at a 42'bedrock sheet. The total length of stream surveyed was 7,824 feet, with 0 feet of side channel.

A flow of 0.15 cfs was measured on 7/23/03 at the Joy Road bridge with a Marsh-McBirney Model 2000 flowmeter.

The surveyed section of Thurston Creek has two reaches with two distinct channel types: from the mouth to 5,395 feet a **B3** and from 5,395 feet to 7,824 feet (2,429 feet) a **B1**.

B3 channel types are moderately entrenched, moderate gradient (2-4%), riffle dominated channels, with infrequently spaced pools, a very stable plan and profile, stable banks and have a predominantly cobble substrate. B1 channel types are predominantly bedrock substrate.

Water temperatures on the survey dates ranged from 50°F to 60°F. Air temperatures ranged from 50°F to 78°F.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of ***occurrence*** there were 38.4% Flatwater units, 23.7% Pool units, 22.1% Riffle units and 15.8% Dry units (Graph 1). Based on total ***length*** there were 53.7% Flatwater units, 20.4% Riffle units, 18.4% Pool units and 7.5%

Dry units (Graph 2).

One hundred ninety habitat units were measured and 46% were completely sampled. Twelve Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent ***occurrence*** were Run at 21%, Mid-Channel Pool at 19%, Dry at 16%, Glide at 13%, Low Gradient Riffle at 12%, Bedrock Sheet at 10%, Step Run at 4%, Lateral Scour Pool - Root Wad Enhanced at 2%, Step Pool at 1%, Dammed Pool at 1%, Corner Pool at 1% and Cascade at 1% (Graph 3). By percent total ***length***, Run at 33%, Low Gradient Riffle at 15%, Mid-Channel Pool at 14%, Glide at 10%, Step Run at 10%, Dry at 8%, Bedrock Sheet at 6%, Step Pool at 1%, Lateral Scour Pool - Root Wad Enhanced at 1%, Dammed Pool at 1%, and Corner Pool at 1%.

Forty-five pools were identified (Table 3). Mid-Channel Pool pools were most often encountered at 19% of all habitat types(Table 2), and comprised 78% of the total length of pools.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth.

Twenty-five of the forty-five pools (56%) had a depth of two feet or greater (Graph 5). These deeper pools comprised 11% of the total length of stream habitat.

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. Riffles rated 2, Pools rated 19 and Flatwater units rated 6 (Table 1). Of the pool types, Dammed Pool rated 40, Step Pool rated 25, Lateral Scour Pool - Root Wad Enhanced rated 23, Mid-Channel Pool rated 19 and Corner Pool rated 3 (Table 2).

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were Undercut Banks at 30%, Small Wood at 26%, Boulders at 11%, Large Wood at 11%, Terrestrial Vegetation at 10%, Bedrock at 6%, Root Mass at 5%, White Water at 2% and Aquatic Vegetation at 1%. Graph 7 describes the pool shelter in Thurston Creek.

Table 6 summarizes the dominant substrate by habitat type. In the 9 of the 22 Low-Gradient Riffles surveyed, the dominant substrate was: Small Cobble in five riffles, Gravel in three riffles and Sand in one riffle (Graph 8).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 45 pool tail-outs measured, sixteen had a value of 2

(36%), ten had a value of 3 (22%) and three had a value of 4 (7%). Sixteen (36%) riffles rated a 5 (unsuitable substrate type for spawning) (Graph 6). On this scale, a value of one is best for fisheries. Small Cobble was the dominant substrate observed at pool tail-outs. No mechanical gravel sampling was conducted in 2003 surveys due to inadequate staffing levels.

The mean percent canopy density for the stream reach surveyed was 83%. The mean percentages of deciduous and evergreen trees were 55% and 45%, respectively (Table 7).

For the entire stream reach surveyed, the mean percent right bank vegetated was 13% and the mean percent left bank vegetated was 14% (Table 7). For the habitat units measured, the dominant vegetation types for the stream banks were: 26% Brush, 24% Grass, 18% Bare Soil, 16% Evergreen Trees and 16% Deciduous Trees (Table 8 and Graph 11). The dominant substrate for the stream banks were: 41% Silt, Clay & Sand, 33% Cobble & Gravel, 23% Bedrock and 2% Boulder (Table 8 and Graph 10).

BIOLOGICAL INVENTORY

JUVENILE SURVEYS:

Department of Fish and Game has not conducted previous (prior to 2003) biological inventories of Thurston Creek and there are no records of hatchery releases or fish rescues in the Salmon creek watershed. A biological inventory was conducted in 2003.

On 8/6/03, a biological inventory was conducted at 1 site on Thurston Creek to document fish species presence. The site was electro-fished. At this site, the air temperature ranged from 62°F to 63°F and the water temperature ranged from 56°F to 57°F. The observers were Justin Smith and Mike Shugars (DFG). The inventory began at 1040 hours and ended upstream at 1115 hours. The distance sampled was not recorded. Habitat types sampled were cascades, runs, step-runs, and mid-channel pools. No salmonids or any other fish species were observed. Nine salamanders (species not indicated) were observed.

Habitat surveyors, Terry and Facindini observed 6 young of the year steelhead in Reach 1 and 1 Giant Pacific salamander in Reach 2.

DISCUSSION FOR THURSTON CREEK

Thurston Creek has 2 reaches: from the mouth to 5,395 feet a **B3** and from 5,395 feet to 7,824 feet (2,429 feet) a **B1**.

There are 5,395 feet of **B3** channel type in Reach 1. According to the DFG Salmonid Stream Habitat Restoration Manual, B3 channel types are excellent for low-stage plunge weirs, boulder clusters, bank placed boulders, single and opposing wing-deflectors and log cover. They are also good for medium-stage plunge weirs. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. This channel type has suitable gradients and the stable stream banks that are necessary for the installation of instream structures designed to increase pool habitat, trap spawning gravels, and provide protective shelter for fish.

There are 2,429 feet of **B1** channel type in Reach 2. B1 channel types are excellent for bank-placed boulders and bank cover and good for log cover. Many site specific projects can be designed within this channel type, especially to increase pool frequency, volume and shelter. This channel type has suitable gradients and the stable stream banks that are necessary for the installation of instream structures designed to increase pool habitat, trap spawning gravels, and provide protective shelter for fish.

The water temperatures recorded on the survey days, 7/18/2003 - 7/21/2003, ranged from 50°F to 60°F. Air temperatures ranged from 50°F to 78°F. The warmest water temperatures were recorded in Reach 2. This temperature regime is favorable to salmonids. It is unknown if this thermal regime is typical. To make any further conclusions, temperatures need to be monitored for a longer period of time through the critical summer months, and more extensive biological sampling conducted.

Pools comprised 18% of the total length of this survey. 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. In Thurston Creek, the pools are relatively deep with 56% having a maximum depth of at least two feet. These pools comprised 11% of the total length of stream habitat. In coastal coho and steelhead streams, it is generally desirable to have primary pools comprise approximately 50% of total habitat length.

The mean shelter rating for pools was 24. A pool shelter rating of approximately 80 is desirable. The relatively small amount of pool shelter that now exists is being provided primarily by Undercut Banks at 30%, Small Wood at 26%, Boulders at 11%, Large Wood at 11%, Terrestrial Vegetation at 10%, Bedrock at 6%, Root Mass at 5%, White Water at 2% and Aquatic Vegetation at 1%. Log and root wad cover in the pool and flatwater habitats would

improve both summer and winter salmonid habitat. Log cover provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

Eight of the nine low gradient riffles measured (89%) had either gravel or small cobble as the dominant substrate. This is generally considered good for spawning salmonids.

Twenty nine percent of the pool tail-outs measured had embeddedness ratings of either 3 or 4. 0% had a rating of 1. Cobble embeddedness measured to be 25% or less (a rating of 1) is considered best for the needs of salmon and steelhead. In a reach comparison, Reach 1 had the best rating and Reach 2 had the poorest ratings.

The higher the percent of fine sediment, the lower the probability that eggs will survive to hatch. This is due to the reduced quantity of oxygenated water able to percolate through the gravel, or because of fine sediment capping the redd and preventing fry emergence. In Thurston Creek Reaches 1 and 2 sediment sources should be mapped and rated according to their potential sediment yields, and control measures taken.

The mean percent canopy for the survey was 83%. This is very good, since 80 percent is generally considered desirable, however, the riparian buffer is thin or nearly absent in areas with livestock/agriculture/rural development. Riparian removal and intensive grazing within the riparian corridor could all lead to less stream canopy and channel incision causing bank erosion and higher water temperatures. Reach 1 had some areas with low canopy. In the mid section of Reach 1, there are continuous sections with bank erosion problems on the right bank. In Reach 2, cattle have access to the creek. Both reaches could benefit from bio-technical re-vegetation techniques using native species.

Sixteen major large woody debris accumulations were identified which have the potential for becoming barriers or causing erosion. Four major erosion sites and 4 diversions were also noted.

SURVEYORS' OVERVIEW

The lower section of Thurston Creek had numerous debris jams. A dairy is in operation but livestock only have access to the creek at the upper end of the property. There was not visible sign of cattle in the creek during the survey. Willow trees dominated the riparian buffer.

The entire middle stretch of Thurston Creek had a severe erosion problem on the right bank throughout its entirety. Groves of bay trees mixed with a few redwoods were on both banks. Fish were present, but few were steelhead. No frogs, newts or salamanders were present. Substrate consisted of cobble and boulders.

The upper stretch had a dominant bedrock substrate. Canopy was dominated by bay and mixed with alder, pine, and buckeye. A 42 foot bedrock sheet was the end of survey.

GENERAL MANAGEMENT RECOMMENDATIONS

Thurston Creek should be managed as an anadromous, natural production stream.

Winter storms often bring down large trees and other woody debris into the stream, which increases the number and quality of pools. This woody debris, if left undisturbed, will provide fish shelter and rearing habitat, and offset channel incision. Efforts to increase flood protection or improve fish access in the short run, have led to long term problems in the system. Landowners should be sensitive about the natural and positive role woody debris plays in the system, and encouraged not to remove woody debris from the stream, except under extreme buildup and only under guidance by a fishery professional.

PRIORITY FISHERY ENHANCEMENT OPPORTUNITIES

1) There is at least 1 section (Reach 1) where the stream is being impacted from livestock in the riparian zone. Livestock in streams generally inhibit the growth of new trees, exacerbate erosion, and reduce summertime survival of juvenile fish by defecating in the water. Alternatives to limit cattle access, control erosion and increase canopy, should be explored with the landowner, and developed if possible.

2) Map sources of upslope and in-channel 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. Near-stream riparian planting along any portion of the stream should be encouraged to provide bank stability and a buffering against agricultural, grazing and urban runoff.

3) Increase the canopy on Thurston Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade

canopy is not at acceptable levels (portions of Reaches 1). The non-anadromous reach above the survey section should be assessed for planting and treated as well, since water temperatures throughout are effected from upstream. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

4) Where feasible, design and engineer pool enhancement structures to increase the number of pools in both reaches. This must be done where the banks are stable (Reaches 1 and 2).

5) Where feasible, increase woody cover in the pool and flatwater habitat units along the entire stream. Most of the existing shelter is from undercut banks and small woody debris. Adding high quality complexity with larger woody cover is desirable. Combination cover/scour structures constructed with boulders and woody debris would be effective in many flatwater and pool locations in the upper reaches. This must be done where the banks are stable (Reaches 1 and 2).

6) There are several log debris accumulations present on Thurston Creek that have the potential for causing bank erosion. The possible modification of one of these debris accumulations is recommended at this time as it may be a fish passage barrier. On-going monitoring of these debris accumulations may indicate if modification is necessary and if so, it must be done carefully to preserve existing habitat provided by the woody debris.

7) In Thurston Creek, active and potential sediment sources related to the road system need to be mapped and treated according to their potential for sediment yield to the stream and its tributaries.

8) Reach 1 would benefit from the utilization of bio-technical vegetative techniques to re-establish floodplain benches and a defined low flow channel. This would discourage lateral migration of the base flow channel and decrease bank erosion.

9) Conduct gravel sampling. Results of future sampling may indicate the need for structures that decrease channel incision, recruit and sort spawning gravel, and expand redd distribution in the stream. Where existing dams are retaining gravel, sites downstream from dams should be resurveyed for spawning gravel quality and quantity.

COMMENTS AND LANDMARKS

The following landmarks and possible problem sites were noted. All locations(footage) are approximate and taken from the beginning of the survey.

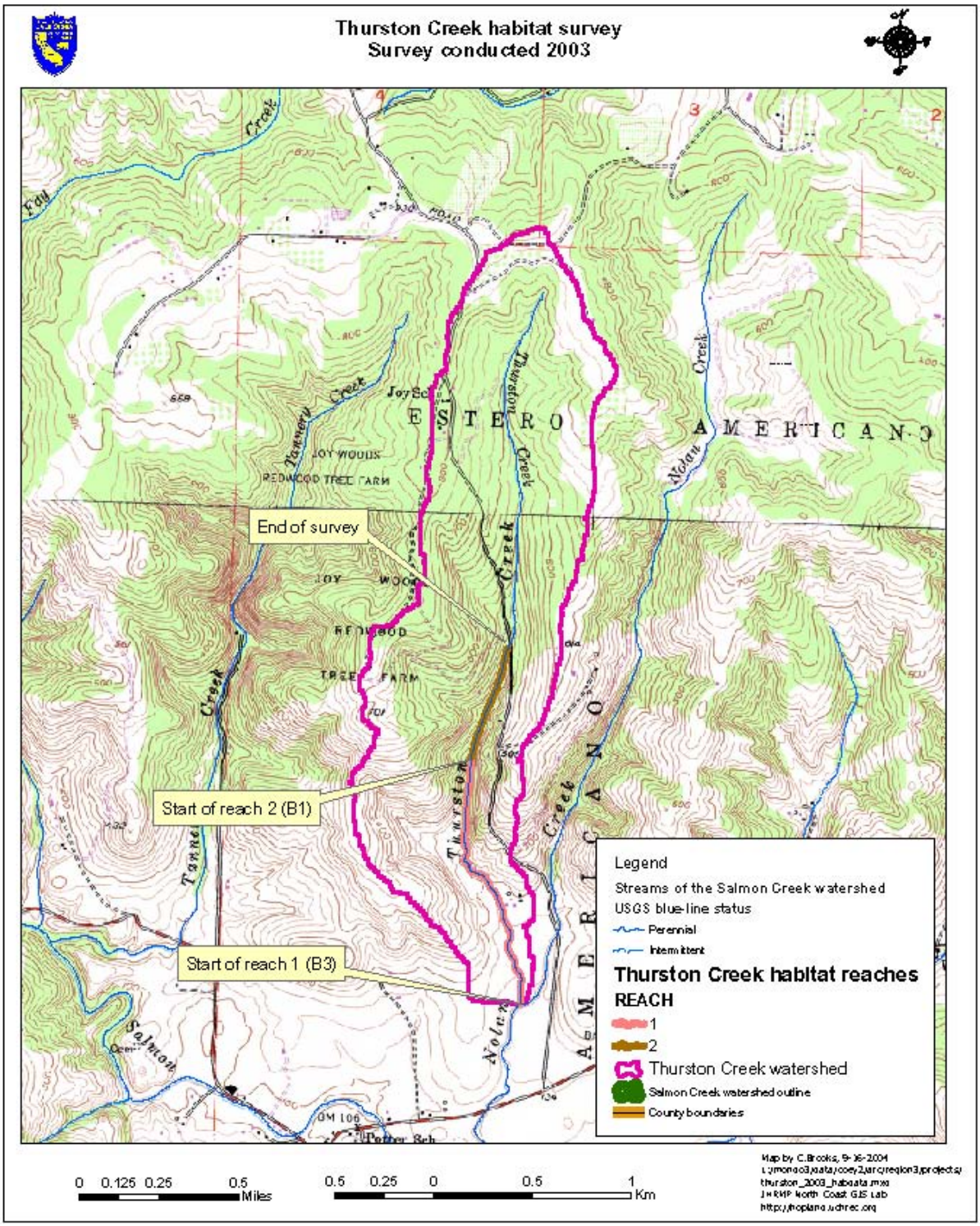
Location (feet)	Notes
015	Waypoint 026
251	Erosion left bank (see form)
257	Erosion left bank
296	Erosion left bank
315	Waypoint 027
417	Erosion left bank
437	*HL; debris accumulation (see form)
470	debris accumulation on left bank and right bank
476	debris accumulation (see form)
607	Waypoint 028
874	Debris accumulation left bank; Waypoint 029
951	trash in creek; debris accumulation (see form)
1,105	Debris accumulation at end of unit
1,140	Waypoint 030
1,185	bobcat prints
1,306	*HL; debris accumulation (see form)
1,454	debris accumulation (see form) Waypoint 031
1,473	debris accumulation 4'high x 5' long x 10' wide
1,558	debris accumulation right bank; *H
1,663	Waypoint 032
1,969	Plunge pool in high flows- 4' jump
2,044	Waypoint 033
2,052	2' jump at end of unit
2,154	Erosion left bank; debris accumulation left bank (pallet collect SWD)
2,261	bridge - Waypoint 035; 4' jump over debris
2,361	gully left bank
2,377	debris accumulation (see form)
2,411	Waypoint 036
2,568	debris accumulation at end of unit (see form)
2,603	gully right bank; car on top of bank
2,960	debris accumulation (see form)
2,988	fish observed
3,078	livestock access
3,290	fish observed; Erosion left bank
3,451	Erosion left bank; wet gully right bank
3,492	Erosion right bank
3,546	Erosion left bank; corner pool
3,568	Waypoint 037
4,017	Erosion right bank (see form)

Location (feet)	Notes
4,101	Erosion right bank
4,270	6 young of the year steelhead; Waypoint 038
4,340	Erosion right bank
4,360	2' jump at end of unit
4,447	Erosion right bank
4,480	debris accumulation - 5' jump (see form); plunge pool in high flow
4,633	Erosion right bank and left bank
4,668	Erosion right bank
4,729	Waypoint 039
4,758	Erosion right bank; bay tree dominant
4,904	gully right bank; Erosion right bank; bay tree dominant
4,924	Erosion right bank; bay tree dominant
5,092	fence line
5,233	debris accumulation (see form); *C
5,395	Waypoint 040; Channel Changes from a B3 to a B1
5,527	Channel type change to B1; Erosion right bank
5,612	4' jump
5,718	debris accumulation (see form)
5,842	3" jump at end of unit; Waypoint 041
5,892	5' jump at beginning of unit
5,944	6' jump at end of unit
6,036	3' jump over dam
6,105	plunge pool in high flows, 3' jump; *H
6,132	DRY; Waypoint 043
6,358	debris accumulation right bank
6,433	wet tributary at 61' into unit - right bank; tributary temp 58 degrees F, confluence 58 degrees F; Waypoint 044
6,552	*C
6,585	no GPS
6,689	debris accumulation at end of unit
6,735	debris accumulation (see form)
6,850	no GPS
7,124	2' jump
7,183	2' jumps between pools
7,289	gully left bank
7,322	Pacific Giant Salamander
7,639	possible barrier; 22 foot jumps/ no steps
7,730	6' jump at end of unit; debris accumulation (see form)
7,824	logging cable; Waypoint 045; END OF SURVEY

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.


Thurston Creek habitat survey
Survey conducted 2003
End of survey
Start of reach 2 (B1)
Start of reach 1 (B3)
Legend
Streams of the Salmon Creek watershed
USGS blue-line status
Perennial
Intermittent
Thurston Creek habitat reaches
REACH
1
2
Thurston Creek watershed
Salmon Creek watershed outline
County boundaries
0 0.125 0.25 0.5 Miles
0.5 0.25 0 0.5 1 Km

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

Thurston Creek — Drainage: Salmon Creek

Table 1 - SUMMARY OF RIFFLE, FLATWATER, AND POOL HABITAT TYPES — Survey Dates: 07/18/03 to 07/21/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Estero Americano LATITUDE: 38.211007′ LONGITUDE: 122.574203′

HABITAT UNITS	UNITS FULLY 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.)	ESTIMATED TOTAL AREA (sq.ft.)	MEAN VOLUME (cu.ft.)	ESTIMATED TOTAL VOLUME (cu.ft.)	MEAN RESIDUAL POOL VOL (cu.ft.)	MEAN SHELTER RATING
42	14	RIFFLE	22	38	1593	20	3.4	0.2	94	3959	21	896	0	2
73	21	FLATWATER	38	58	4198	54	5.2	0.4	275	20088	117	8543	0	6
45	44	POOL	24	32	1443	18	8.0	1.1	249	11194	262	11803	223	19
30	0	DRY	16	20	590	8	0.0	0.0	0	0	0	0	0	0

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq. ft.)	TOTAL VOL. (cu. ft.)
190	79	7824	35240	21242

Thurston Creek — Drainage: Salmon Creek

Table 2 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS — Survey Dates: 07/18/03 to 07/21/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Estero Americano LATITUDE: 38.211007′ LONGITUDE: 122.574203′

HABITAT UNITS #	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT OCCURRENCE %	MEAN LENGTH ft.	TOTAL LENGTH ft.	TOTAL LENGTH %	MEAN WIDTH ft.	MEAN DEPTH ft.	MAXIMUM DEPTH ft.	MEAN AREA sq.ft.	TOTAL AREA EST. sq.ft.	MEAN VOLUME cu.ft.	TOTAL VOLUME EST. cu.ft.	MEAN RESIDUAL POOL VOL cu.ft.	MEAN SHELTER RATING	MEAN CANOPY %
22	8	LGR	12	52	1147	15	4	0.2	0.6	117	2568	27	588	0	3	79
1	1	CAS	1	11	11	0	2	0.3	0.6	22	22	7	7	0	0	95
19	5	BRS	10	23	435	6	3	0.2	0.6	64	1212	15	277	0	0	89
25	8	GLD	13	32	810	10	5	0.4	1.0	179	4473	76	1892	0	9	***
40	10	RUN	21	65	2618	33	5	0.4	1.3	283	11302	107	4297	0	4	75
8	3	SRN	4	96	770	10	6	0.5	1.6	502	4019	262	2099	0	8	83
36	35	MCP	19	31	1123	14	8	1.1	3.8	249	8961	266	9584	219	19	81
2	2	STP	1	53	105	1	8	1.4	4.6	378	755	385	769	317	25	88
2	2	CRP	1	30	59	1	8	0.8	1.5	223	446	178	357	0	3	80
3	3	LSR	2	32	96	1	6	0.7	2.0	204	612	154	461	50	23	90
2	2	DPL	1	30	60	1	7	1.2	3.3	210	420	318	636	265	40	93
30	0	DRY	16	20	590	8	0	0.0	0.0	0	0	0	0	0	0	80

TOTAL UNITS	TOTAL UNITS	LENGTH (ft.)	AREA (sq.ft)	TOTAL VOL. (cu.ft)
190	79	7824	34789	20967

Thurston Creek — Drainage: Salmon Creek

Table 3 - SUMMARY OF POOL TYPES — Survey Dates: 07/18/03 to 07/21/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Estero Americano LATITUDE: 38.211007′ LONGITUDE: 122.574203′

HABITAT UNITS	UNITS FULLY 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 EST. (sq.ft.)	MEAN VOLUME (cu.ft.)	TOTAL VOLUME EST. (cu.ft.)	MEAN RESIDUAL POOL VOL. (cu.ft.)	MEAN SHELTER RATING
38	37	MAIN	84	32	1228	85	8.2	1.1	256	9715	273	10359	226	19
5	5	SCOUR	11	31	155	11	6.8	0.8	212	1058	164	818	50	15
2	2	BACKWATER	4	30	60	4	6.5	1.2	210	420	318	636	265	40

TOTAL UNITS	TOTAL UNITS	TOTAL LENGTH (ft.)	TOTAL AREA (sq.ft.)	TOTAL VOL. (cu.ft.)
45	44	1443	11194	11813

Thurston Creek — Drainage: Salmon Creek

Table 4 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPES — Survey Dates: 07/18/03 to 07/21/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R10W Estero Americano LATITUDE: 38.211007′ LONGITUDE: 122.574203′

UNITS MAX DPTH 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
36	MCP	80	0	0	15	42	14	39	7	19	0	0
2	STP	4	0	0	0	0	1	50	0	0	1	50
2	CRP	4	0	0	2	100	0	0	0	0	0	0
3	LSR	7	0	0	2	67	1	33	0	0	0	0
2	DPL	4	0	0	1	50	0	0	1	50	0	0

TOTAL UNITS
45

Thurston Creek — Drainage: Salmon Creek

Table 5 - Summary of Shelter by Habitat Type — Survey Dates: 07/18/03 to 07/21/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:T6N R110W Estero Americano — LATITUDE: 38.211007′ LONGITUDE: 122.574203′

UNITS MEASURED	UNITS SHELTER MEASURED	HABITAT TYPE	% TOTAL UNDERCUT BANKS	% TOTAL SWD	% TOTAL LWD	% TOTAL ROOT MASS	% TOTAL TERR. VEGETATION	% TOTAL AQUATIC VEGETATION	% TOTAL WHITE WATER	% TOTAL BOULDERS	% TOTAL BEDROCK LEDGES
22	9	LGR	0	22	0	0	64	0	0	14	0
1	1	CAS	0	0	0	0	0	0	0	0	0
19	5	BRS	0	0	0	0	0	0	0	0	0
25	11	GLD	41	24	2	0	9	17	0	7	0
40	13	RUN	0	0	0	23	3	0	0	75	0
8	4	SRN	0	0	0	0	0	0	0	100	0
36	35	MCP	30	27	4	5	14	1	0	12	6
2	2	STP	33	17	0	0	0	0	17	17	17
2	2	CRP	0	100	0	0	0	0	0	0	0
3	3	LSR	0	27	52	21	0	0	0	0	0
2	2	DPL	40	20	40	0	0	0	0	0	0
30	3	DRY	0	0	0	0	0	0	0	0	0
ALL 190 HABITAT TYPES	90		27	23	9	5	11	2	2	16	5
POOLS 45 ONLY	44		29	26	10	5	10	1	2	11	6

Thurston Creek — Drainage: Salmon Creek

Table 6 - SUMMARY OF DOMINANT SUBSTRATES BY HABITAT TYPE — Survey Dates: 07/18/03 to 07/21/03

Confluence Location: QUAD: Valley Ford LEGAL DESCRIPTION:1229615383527 LATITUDE: 38.211007′ LONGITUDE: 122.574203′

TOTAL HABITAT UNITS	UNITS SUBSTRATE MEASURED	HABITAT TYPE	% TOTAL SILT/CLAY DOMINANT	% TOTAL SAND DOMINANT	% TOTAL GRAVEL DOMINANT	% TOTAL SM COBBLE DOMINANT	% TOTAL LG COBBLE DOMINANT	% TOTAL BOULDER DOMINANT	% TOTAL BEDROCK DOMINANT
22	9	LGR	0	11	33	56	0	0	0
1	1	CAS	0	0	0	0	0	0	100
19	5	BRS	0	0	0	0	0	20	80
25	9	GLD	0	56	44	0	0	0	0
40	10	RUN	0	20	40	30	0	0	10
8	5	SRN	0	20	0	20	0	20	40
36	35	MCP	3	94	3	0	0	0	0
2	2	STP	0	50	0	0	0	0	50
2	2	CRP	0	100	0	0	0	0	0
3	3	LSR	0	100	0	0	0	0	0
2	2	DPL	0	50	0	0	0	0	50
30	5	DRY	0	20	80	0	0	0	0

Thurston Creek

Table 7 - Summary of Mean Percent Vegetative Cover for Entire Stream

Mean Percent Canopy	Mean Percent Evergreen	Mean Percent Deciduous	Mean Right bank % Cover	Mean Left Bank % Cover
83.00	45.00	55.00	12.59	13.45

Thurston Creek

Table 8 - Mean Percentage of Dominant Substrate

Dominant Class of Substrate	Number Units Right Bank	Number Units Left Bank	Percent Total Units
Bedrock	23	17	22.99
Boulder	2	2	2.30
Cobble/Gravel	30	28	33.33
Silt/clay	32	39	40.80

Mean Percentage of Dominant Vegetation

Dominant Class of Vegetation	Number Units Right Bank	Number Units Left Bank	Percent Total Units
Grass	21	21	24.28
Brush	22	24	26.59
Deciduous Trees	13	14	15.61
Evergreen Trees	14	13	15.61
No Vegetation	17	14	17.92

TABLE 9 - FISH HABITAT INVENTORY DATA SUMMARY

STREAM NAME: Thurston Creek (So. Sonoma)
SAMPLE 07/18/2003 to 07/21/2003
SURVEY LENGTH:
MAIN 7824 ft. SIDE CHANNEL: 0 ft.
LOCATION OF STREAM MOUTH:
USGS Quad Map: Latitude:
Legal Description: Longitude

SUMMARY OF FISH HABITAT ELEMENTS BY STREAM REACH

STREAM REACH 01 (Units 1-130)

Channel Type: B3	Mean Canopy Density: 78 %
Main Channel: 5395 ft.	Evergreen 30 %
Side Channel Length: 0 ft.	Deciduous 70 %
Riffle/Flatwater Mean Width: 4.6 ft.	Pools by Stream 20 %
Pool Mean Depth: 1.0 ft.	Pools >=2 ft. Deep: 41 %
Base Flow: cfs	Pools >=3 ft. Deep: 17 %
Water: 50-60°F Air: 50-78°F	Mean Pool Shelter 22
Dom. Bank Veg.: No Vegetation	Dom. Shelter: Small Woody Debris
Bank Vegetative Cover: 15 %	LOD Pool Shelter: 18 %
Dom. Bank Substrate: Silt/Clay/Sand	Dry Channel: 563 ft.

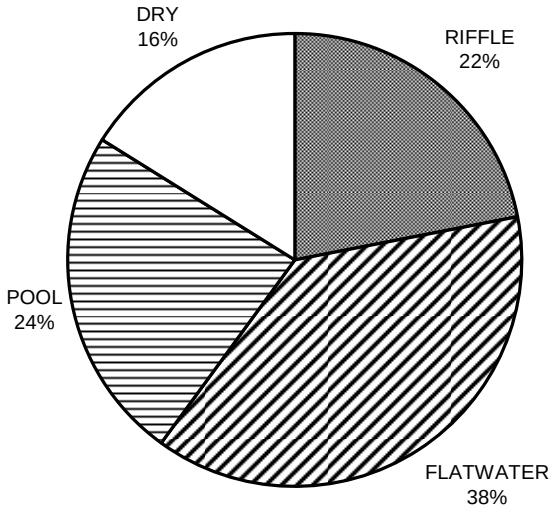
Embeddedness Value: 1. 0% 2. 41% 3. 31% 4. 7% 5. 21%

STREAM REACH 02 (Units 131-190)

Channel Type: B1	Mean Canopy Density: 87 %
Main Channel: 2429 ft.	Evergreen 81 %
Side Channel Length: 0 ft.	Deciduous 19 %
Riffle/Flatwater Mean Width: 4.3 ft.	Pools by Stream 20 %
Pool Mean Depth: 1.1 ft.	Pools >=2 ft. Deep: 81 %
Base Flow: cfs	Pools >=3 ft. Deep: 25 %
Water: 56-60°F Air: 60-70°F	Mean Pool Shelter 30
Dom. Bank Veg.: Grass	Dom. Shelter: Boulders
Bank Vegetative Cover: 10 %	LOD Pool Shelter: 13 %
Dom. Bank Substrate: Bedrock	Dry Channel: 27 ft.

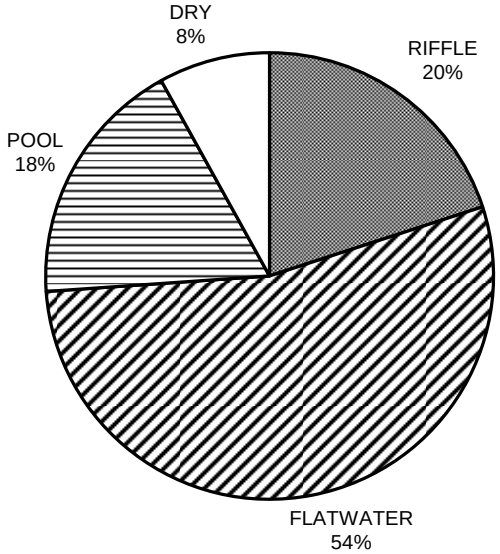
Embeddedness Value: 1. 0% 2. 25 % 3. 6 % 4. 6 % 5. 63 %

THURSTON CREEK
HABITAT TYPES BY PERCENT OCCURRENCE

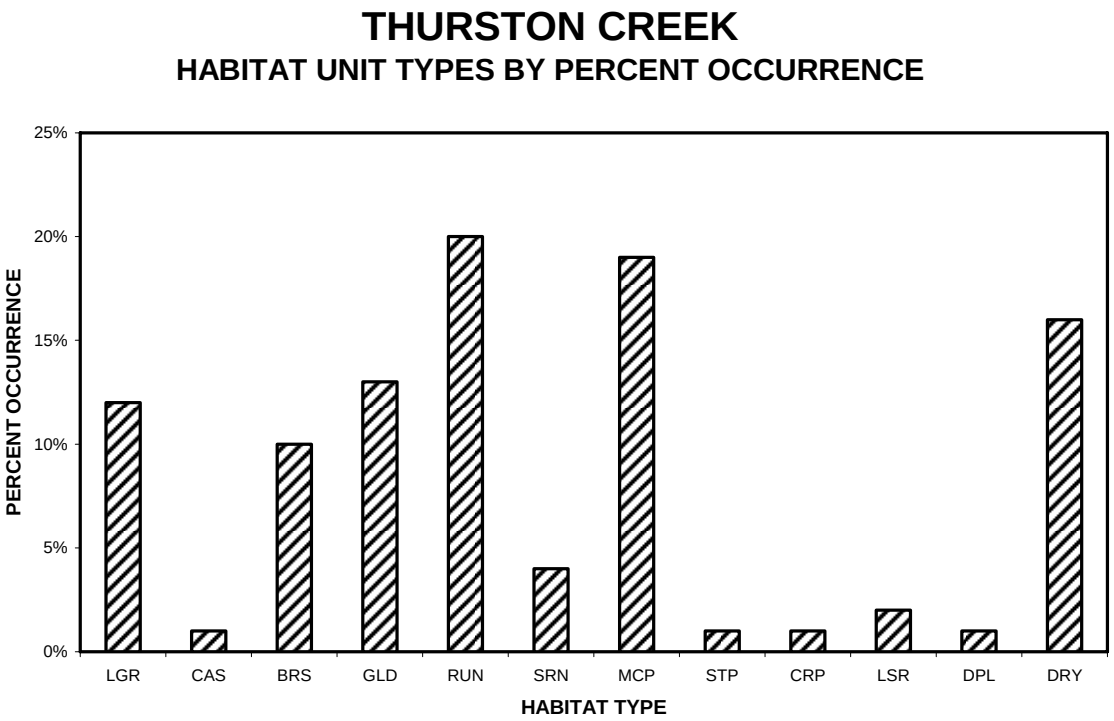


GRAPH 1. Level II habitat types by percent occurrence.

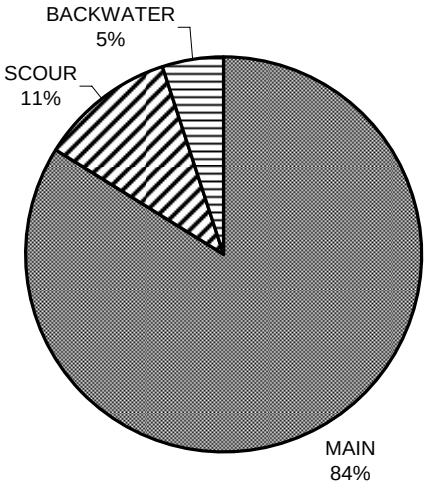
THURSTON CREEK
HABITAT TYPES BY PERCENT TOTAL LENGTH



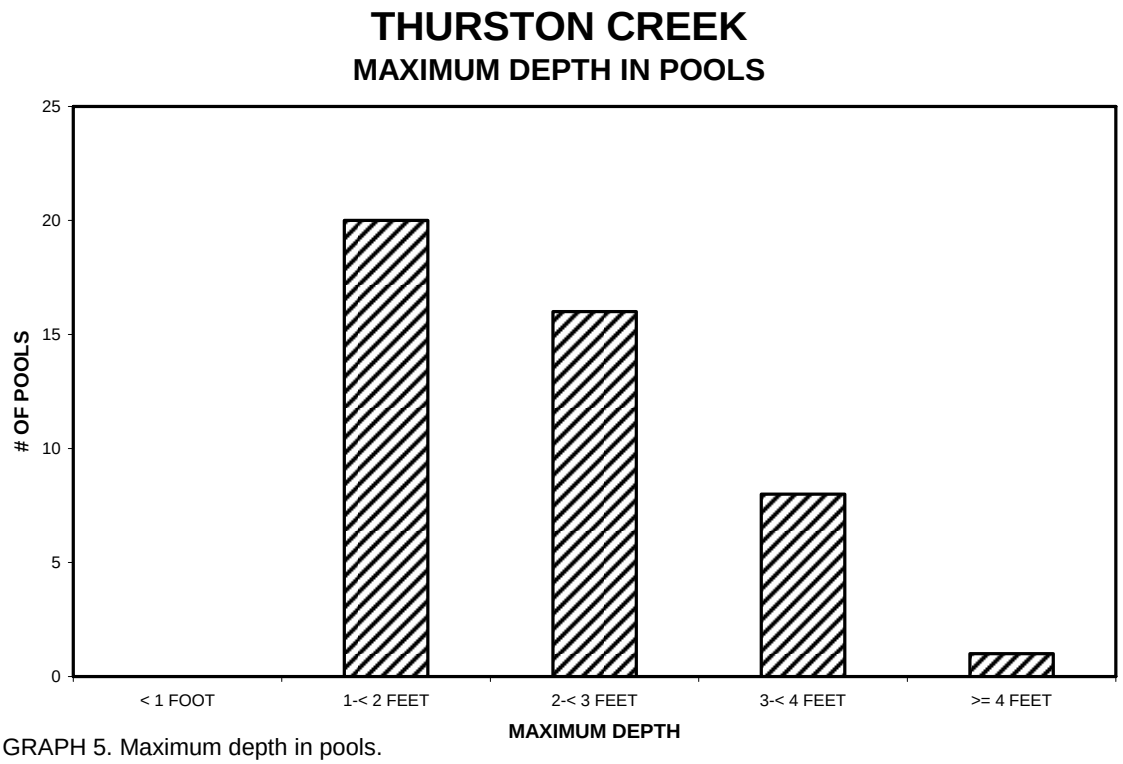
GRAPH 2. Level II habitat types by percent total length.



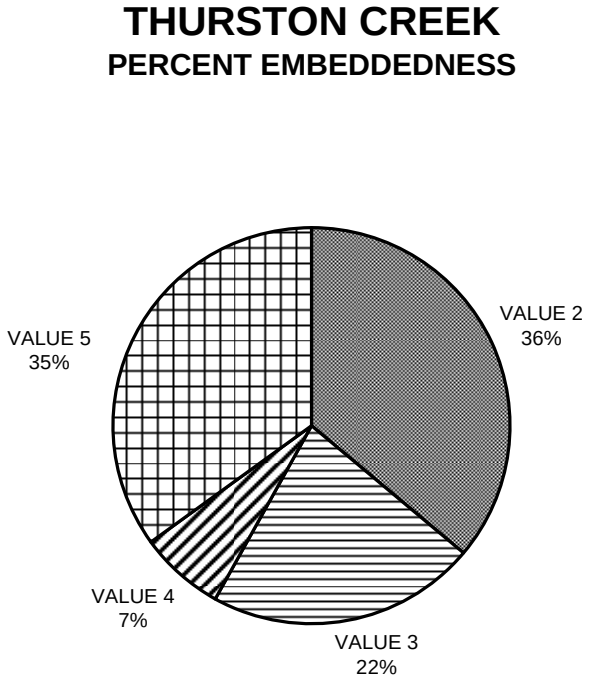
GRAPH 3. Level IV habitat unit types by percent occurrence.



GRAPH 4. Level I pool habitat types by percent occurrence.

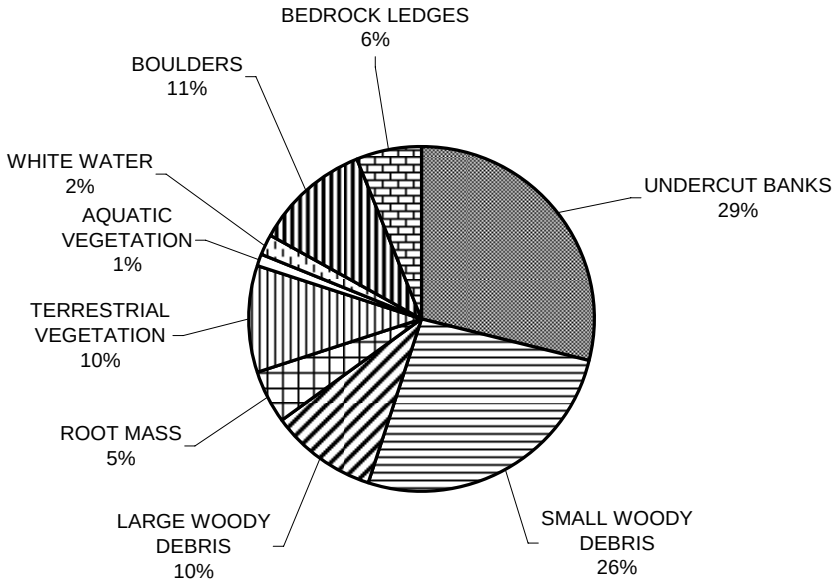


GRAPH 5. Maximum depth in pools.



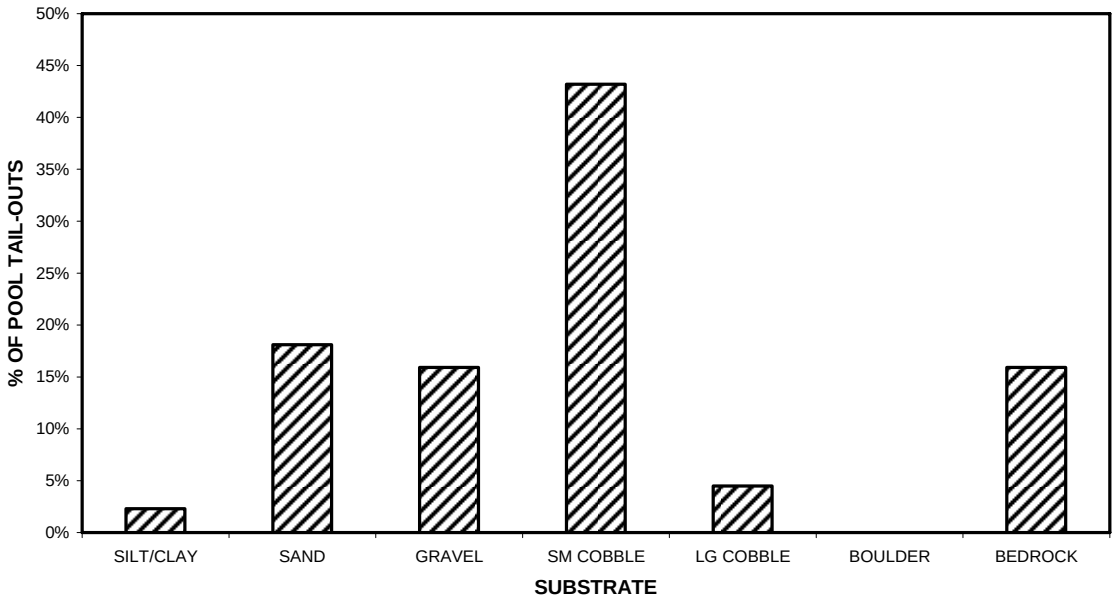
GRAPH 6. Percent embeddedness estimated at pool tail-outs.

THURSTON CREEK
MEAN PERCENT COVER TYPES IN POOLS



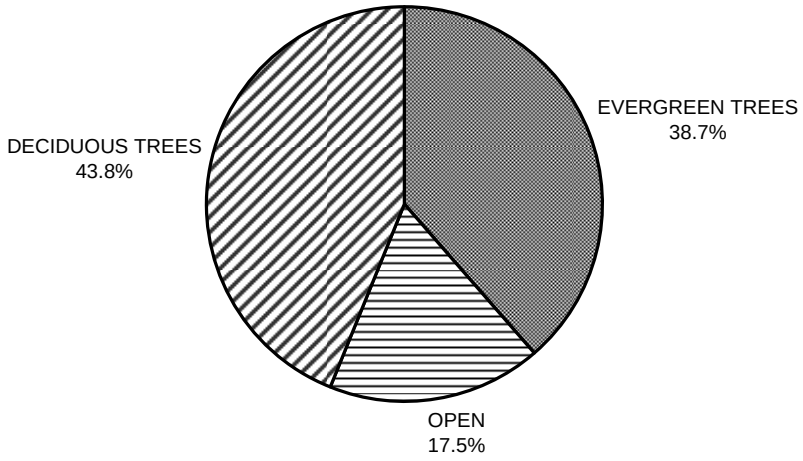
GRAPH 7. Mean percent cover types in pools.

THURSTON CREEK
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



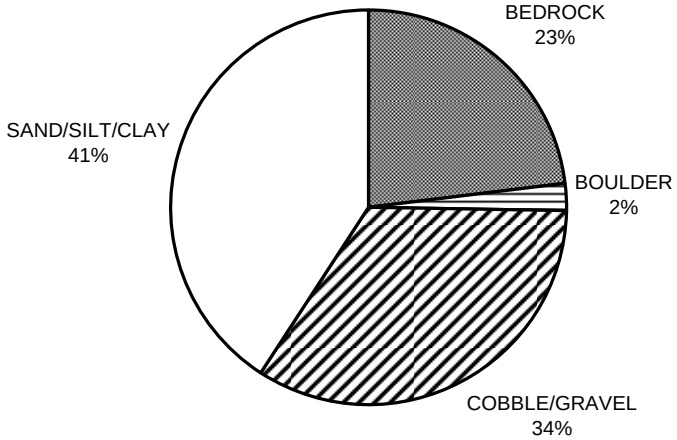
GRAPH 8. Substrate composition in pool tail-outs.

THURSTON CREEK
MEAN PERCENT CANOPY



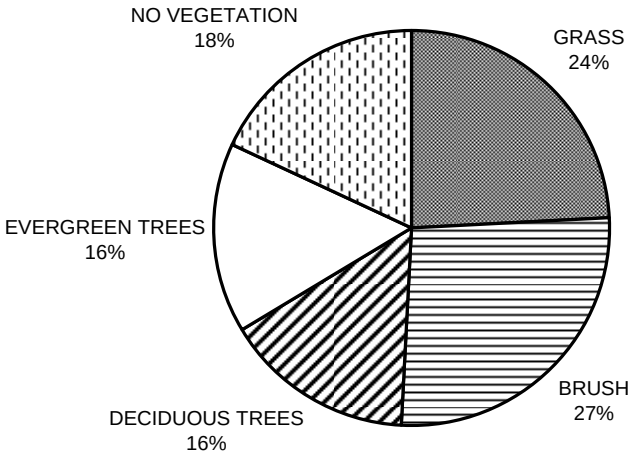
GRAPH 9. Mean percent canopy.

THURSTON CREEK
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10. Dominant bank composition in survey reach.

THURSTON CREEK
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11. Dominant bank vegetation in survey reach.