CALIFORNIA DEPARTMENT OF FISH AND GAME
STREAM INVENTORY REPORT
Cloverdale Creek
Report Revised April 14, 2006
Report Completed 2005
Assessment Completed 2002

INTRODUCTION

A stream inventory was conducted during the summer of 2002 on Cloverdale Creek, a stream in the Russian River Basin. 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 Cloverdale 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 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

Cloverdale Creek is a tributary of the Russian River and is located in Sonoma County, California (see Cloverdale Creek map, APPENDIX A). The legal description at the confluence with Russian River is T11N, R10W, S18. Its location is 38°48'24.67"N latitude and 123°00'23.29"W longitude. Access exists from River Road off of Hwy 101 north.

Cloverdale Creek and its tributaries drain a basin of approximately 1238.3 acres (1.93 square miles). Cloverdale Creek is a maximum second order stream and has approximately 17621.4 feet (3.34 miles) of blue line stream, according to the USGS “Cloverdale” 7.5 minute quadrangles. Elevations range from about 289 feet at the mouth of the creek to 1739 feet in the headwaters. The vegetation is primarily hardwood (23%), herbaceous (22%), and mixed hardwood/conifer (21%) with minor amounts of conifer (8%) and shrub (2%). Ten percent of the basin is agricultural and 15% is urban. The watershed is 100% privately owned and managed as vineyards, urban/residential, rangeland, and for timber production. Cloverdale Creek has several minor unnamed tributaries that were not surveyed.

Salmonid fish species historically present include steelhead trout.

METHODS

The habitat inventory conducted in Cloverdale Creek follows the methodology presented in the California Salmonid Stream Habitat Restoration Manual (Flosi, et al., 1998). The AmeriCorp Volunteers and 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 two person teams and was supervised by Derek Acomb, Russian River Planner (DFG).

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 Cloverdale Creek to record measurements and observations. There are nine components to the inventory form: flow, channel type, air and water 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. Temperatures are also recorded using remote temperature recorders which log temperatures every 1.5 hours, 24 hours/day.

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. Cloverdale 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 a 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 Cloverdale Creek, embeddedness was visually 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 Cloverdale 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 Cloverdale 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 Cloverdale 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 three 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 electro-fishing 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 Cloverdale 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 conducted a previous survey of Cloverdale Creek on January 21, 1976. A brief summary of the survey follows. DFG surveyors Jerry March and Charles Holstine walked the creek from the mouth to the old Hwy 101 crossing, approximately one mile, and spoke to local residents to gather information on the whole stream. They found much of the lower reach to be dry or in pools of standing water. Pool shelter consisted of undercut banks and terrestrial vegetation. Pool width ranged 1-4' (avg. 3') and depth ranged 1-3' (avg. 2'). Riffle width ranged 6"-2' (avg. 1') and depth ranged 1-6" (avg. 3"). Where the creek was flowing, the flow was visually estimated to be 0.1 cfs with sluggish velocity.

Canopy in the lower reach was sparse, comprised of willow, oak and berry bushes, as it flowed through vineyards, pastureland, and the city of Cloverdale. The upper reach was reported to have a dense canopy of oak, bay, redwood, and shrubs. The water temperature in the lower reach at 1540 was 52ºF.

Stream substrate was 1% bedrock, 4% boulders, 20% coarse rubble, 30% fine rubble, 15% coarse gravel, 10% fine gravel, 10% sand, 10% mud/clay/detritus. In the mile surveyed, only 5% was potential spawning gravel and no good nursery areas were observed. One barrier, Paradise Falls, 2.3 miles upstream was reported by local residents. Other potential barriers were culverts at the Third St. and Triplett St. bridges, approximately 0.5 miles upstream. Debris, refuse, detergent/oil scum, and sewage odor were observed in the lower reach.

HABITAT INVENTORY RESULTS FOR CLOVERDALE CREEK

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

The habitat inventory of Cloverdale Creek, 9/19/2002 - 9/25/2002, was conducted by Bob Payliuco and Sarah Thompson (DFG) with supervision and analysis by California Department of Fish and Game (DFG). The survey began at the confluence with the Russian River and extended up Cloverdale Creek to a 45' rock fall (45º grade) shortly followed by a 150' rock falls (50º grade). The total length of stream surveyed was 15553 feet.

Flow was estimated to be less than 0.1 cfs during the survey period.

This section of Cloverdale Creek has three reaches with three distinct channel types: from the mouth to 11345 feet a F4, 2676 feet an F3 and 1532 feet an A1.

F channel types are entrenched meandering riffle/pool channels on low gradients (<2%) with a high width/depth ratio. F4 has a predominantly gravel substrate and F3 has a predominantly cobble substrate.

A1 channel types are steep (4-10%), narrow, cascading, step-pool streams with a high energy/debris transport associated with depositional soils and a predominantly bedrock substrate.

Water temperatures ranged from 59ºF to 69ºF. Air temperatures ranged from 80ºF to 98ºF. Summer temperatures were also measured using a remote temperature recorder placed in a pool (see Temperature Summary graphs, Appendix E). The recorder in Reach 1 logged temperatures every 1.5 hours from 7/16/02 to 9/27/02. The highest temperature recorded was 64.2°F on several occasions. The lowest was 53.2°F on 9/14/02. The mean of the daily highs was 62.9°F for the month of July, 62.3°F for August, and 59.9°F for September.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of **occurrence** there were 32.3% flatwater units, 27.4% pool units, 21.0% dry units, 14.5% riffle units and 4.8% culvert units, (Graph 1). Based on total **length** there were 83.3% dry units, 9.4% flatwater units, 3.7% pool units, 2.5% riffle units and 1.1% culvert units, (Graph 2).

Sixty-two habitat units were measured and 23 were completely sampled. Seven Level IV habitat types were identified. The data is summarized in Table 2. The most frequent habitat types by percent **occurrence** were mid-channel pool at 24.2%, run at 22.6%, dry at 21%, low gradient riffle at 14.5%, step run at 9.7%, culvert at 4.8% and step pool at 3.2% (Graph 3). By percent total **length**, dry at 83.3%, run at 6.5%, mid-channel pool at 3.2%, step run at 2.9%, low gradient riffle at 2.5%, and culvert at 1.1%.

Seventeen pools were identified (Table 3). Main channel pools were most often encountered at 100%.

Table 4 is a summary of maximum pool depths by pool habitat types. Pool quality for salmonids increases with depth. Nine of the 17 pools (53%) had a depth of two feet or greater (Graph 5).

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. Pools rated 33, flatwater units rated 30 and riffles rated 140 (Table 1). Of the pool types, mid-channel pool rated 37 and step pool rated 8 (Table 2).

Table 5 summarizes fish shelter by habitat type. By percent area, the dominant pool shelter types were undercut banks at 13%, terrestrial vegetation at 18%, small wood at 24%, root mass at 16%, bedrock at 16%, and boulders at 13%. Graph 7 describes the pool shelter in Cloverdale Creek.
Table 6 summarizes the dominant substrate by habitat type. In the nine low-gradient riffles surveyed, the dominant substrate by percent of the area surveyed was: bedrock in two riffles.

The depth of cobble embeddedness was estimated at pool tail-outs. Of the sixteen pool tail-outs measured, three had a value of 2 (18.75%), two had a value of 3 (12.5%) and five had a value of 4 (31.25%). Six (37.5%) tail-outs rated a 5 (unsuitable substrate type for spawning). On this scale, a value of one is best for fisheries. Gravel was the dominant substrate observed at pool tail-outs (Graph 8). Graph 6 describes percent embeddedness. No mechanical gravel sampling was conducted in 2002 surveys.

The mean percent canopy density for the stream reach surveyed was 89%. The mean percentages of deciduous and evergreen trees were 85% and 15%, respectively. Graph 9 describes the canopy for the entire survey.

For the entire stream reach surveyed, the mean percent right bank vegetated was 77% and the mean percent left bank vegetated was 80%. For the habitat units measured, the dominant vegetation types for the stream banks were: 60.7% brush, 17.9% deciduous trees, 10.7% grass and 10.7% bare soil (Graph 11). The dominant substrate for the stream banks were: 53.6% silt, clay & sand, 42.9% bedrock and 3.6% boulder (Graph 10).

BIOLOGICAL INVENTORY

JUVENILE SURVEYS:

In 1952 and 1954 DFG rescued juvenile steelhead from pools in portions of Cloverdale Creek that were drying up during the summer months. In 1952, 1,016 steelhead were rescued and in 1954 800 were rescued.

In the 1976 DFG survey, fish were first seen 0.1 mile from the mouth. The surveyors visually observed or sampled fish with a dip net. Steelhead trout averaging 3" were observed two per 100'. Roach averaging 1" were observed 20 per 100'. A local resident reported he had not seen steelhead

in the creek for 10 years. Another local resident reported a population of rainbow trout two miles from the mouth. Aquatic food organisms were common and included *Ephemeroptera*, *Odonata*, *Diptera*, and *Coleoptera*. The creek had few aquatic plants but filamentous algae were common. Other vertebrates observed were cattle, domestic animals, and frogs.

Species Observed in Historical and Recent Surveys			
YEARS	**SPECIES**	**SOURCE**	**NATIVE/ INTRODUCED**
1976	STEELHEAD TROUT *(Oncorhynchus mykiss)*	DFG	N
1976	CALIFORNIA OR VENUS ROACH *(Hesperoleucus symmetricus)*	DFG	N
2002	SACRAMENTO PIKE MINNOW *(Ptychocheilus grandis)*	DFG	N
2002	SCULPIN *(Cottus sp.)*	DFG	N

On 11/04/02 a biological inventory was conducted at one site on Cloverdale Creek to document fish species composition and distribution. The site, 1,500' downstream from the South Cloverdale Blvd. Bridge, was triple pass seine netted. Fish from the site were counted by species, and returned to the stream. The air temperature ranged from 66-70ºF and the water temperature ranged from 55-56ºF. The observers were Amy Livingston and Cassie Simons (Americorps).

The inventory began at 1425 hours in Reach 1 and ended at 1540 hours 340' upstream. Habitat types surveyed were lateral scour pool - bedrock formed, mid-channel pools, runs and glides. No steelhead were observed. The following table displays the information yielded from this site.

Species Observed	**Numbers Recorded at Site 1**
SACRAMENTO PIKE MINNOW	95
UNIDENTIFIED ROUGH FISH	6
SCULPIN	6
CRAYFISH	2

On February 19, 2004 at 07:00 Biologist Derek Acomb observed an adult steelhead migrating upstream past the Portofino Road bridge.

DISCUSSION FOR CLOVERDALE CREEK

Cloverdale Creek has three channel types: F4, F3 and A1. Many site specific projects can be designed within an F channel type, especially to increase pool frequency, volume and shelter.

According to the DFG Salmonid Stream Habitat Restoration Manual, F4 channel types are good for bank-placed boulders and fair for low-stage weirs, single and opposing wing-deflectors, channel constrictors and log cover. F3 channel types are good for bank-placed boulders as well as single and opposing wing-deflectors. They are fair for low-stage weirs, boulder clusters, channel constrictors and log cover. Any work considered will require careful design, placement, and construction that must include protection for any unstable banks.

The high energy, steep gradient A1 channel types have stable stream banks and poor gravel retention capabilities and are generally not suitable for instream enhancement structures.

The water temperatures recorded on the survey days 9/19/2002 - 9/25/2002 ranged from 59ºF to 69ºF. Air temperatures ranged from 80ºF to 98ºF. The warmest water temperatures were recorded in Reach 2. Water temperatures above 65°F, if sustained, are above the threshold stress level for salmonids.

Summer temperatures measured using a remote temperature recorder in Reach 1_ ranged from 53.2° to 64.2°F. The Temperature Summary graph (Appendix E) shows that for much of the summer (July through August) the lower watershed exhibited temperatures at the optimal for salmonids. It is unknown if this thermal regime is typical. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, in more locations, and extensive biological sampling would need to be conducted.

Pools comprised 4% 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 Cloverdale Creek, the pools are relatively shallow with 53% having a maximum depth of at least two feet. These pools comprised 2% 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 33. However, 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 13%, terrestrial vegetation at 18%, small wood at 24%, root mass at 16%, bedrock at 16%, and boulders at 13%. 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.

Niether of the two low gradient riffles measured had gravel or small cobble as the dominant

substrate. This is generally considered poor for spawning salmonids.

Forty-seven percent of the pool tail-outs measured had embeddedness ratings of either 3 or 4. None 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.

The mean percent canopy for the survey was 89%. 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/urban development. Riparian removal/intensive grazing/vineyard development within the riparian corridor could all lead to less stream canopy and channel incision causing bank erosion and higher water temperatures.

GENERAL MANAGEMENT RECOMMENDATIONS

Cloverdale 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. 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) In Cloverdale 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.

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) Where feasible, design and engineer pool enhancement structures to increase the number of pools in the upper reaches. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

4) Where feasible, increase woody cover in the pool and flatwater habitat units along the entire stream. Most of the existing shelter is from vegetation and undercut banks. 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 or in

conjunction with stream bank armor to prevent erosion. In some areas the material is at hand.

5) Increase the canopy on Cloverdale Creek by planting willow, alder, redwood, and Douglas fir along the stream where shade canopy is not at acceptable levels. 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.

6) There are sections where the stream is being impacted from livestock in the riparian zone. Livestock in streams generally inhibit the growth of new trees, exasperate 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.

7) If riparian areas are not improved temperatures in Cloverdale Creek should be monitored to determine if they are having a deleterious effect upon juvenile salmonids. To achieve this, biological sampling is also required.

COMMENTS AND LANDMARKS

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

115'	Wooden driveway bridge
191'	Salmonids were observed infrequently from 191’ to 1098’ Left bank (LB) is concrete.
297'	Concrete channel culvert (box)
381'	Crayfish observed. Roach observed infrequently from 381’ to 1006’.
455'	3rd Street runs along LB
501'	LB culvert. Vehicle imbedded in LB 90' into HU.
779'	Bent over bamboo covering 100% of pool.
952'	Halfpipe culvert.
1006'	Vehicle bridge
1098'	100 roach observed.
1140'	Hwy 101 N Bridge over creek.
1207'	Hwy 101 S Bridge over creek.
1390'	Right bank (RB) concrete
1507'	Vehicle and foot bridge, footbridge 60' upstream.
1795'	Metal debris in stream.
1840'	Vehicles and metal debris embedded in RB for stabilization. Bamboo on RB, RB stabilized by rip rap.
2431'	Small fish in run.
2476'	Box culvert
2516'	Trash in creek bed, houses on both sides.
2991'	3rd St. Bridge culvert. Trash in pool, water temperature 85°F.

3076' Bridge culvert. Houses on both banks.
3746' Bridge culvert. Houses on both banks.
4065' Creek runs under a concrete wall on RB.
4245' 290' massive erosion on LB. Possible dry tributary. Culvert. At 1500' hot water heater necklace stabilizing LB. Riparian seems unhealthy composed of 70% non-native vegetation (bamboo, blackberry, grapes, mint, eucalyptus) with oak, redwood, and willow. Banks strewn with garbage and metal rip rap. No area available out of influence of man-made structure to determine channel type yet in this HU. At 2250' Concrete vehicle bridge (Cloverdale Blvd Bridge). At 3100' Bridge for housing development, banks throughout composed of rip rap. At 3750' LB culvert, dry at base but water can be heard inside; 3' diameter; strange smell. At 3800' RB culvert, dry; 2' diameter, bridge at culvert. At 4015' culvert on RB, wood and steel wire fence across creek in bad shape, 2'-3' passage during high flow. Exiting city limits, creek channel and substrate looks natural. Cattle fence across creek. At 5050' Barbed wire and steel posts 1' from thalweg. At 5140' dry trib RB, 15' from confluence is a 1.2' diameter concrete culvert choked with sediment on upstream side. At 5507' Dirt/gravel road crosses creek. At 5800' RB erosion downcutting 5', creek running between 2 roads. LB road gravel and well maintained. RB road dirt and poorly maintained. At 5950' Dry trib enters, crosses road, no culvert. Riparian has been mostly brush (poison oak, blackberry, grape, walnut) with 1'-2' diameter Oaks every 100' for the past 1500'.
10695' LB vehicle path. RB steep (30%) bare soil road. Possible channel type change, more entrenched w/ boulders. Living ferns and redwood in dry creek. LB vehicle path to campfire. At 470' beginning to see small (<1' diameter) redwoods in riparian zone. Possible channel type change, more entrenched w/ boulders
11345' At 0'-30' Three small pools of water, max depth 0.5', 2' diameter, no fish. RB steep (30%) bare soil road (no gravel) road. Channel type:F4, observed F3, cobble.
11375' Channel type F3, cobble/gravel substrate. Water temp 60°F, riparian redwood, oak, Douglas fir 1'-3' diameter, grass and boulder would provide cover at high flows.
11566' Spring enters RB at the end of the run.
11801' At 500' Dry scour pool. At 690' RB downcutting and erosion 6' into thalweg. At 820' LB downcutting and erosion 8' into thalweg. At 1020' RB erosion undercutting.
15511' END OF SURVEY because of 45° bedrock.

REFERENCES

California Dept. of Fish and Game, Yountville. Database files regarding history of rescues, transfers, and hatchery plants in creeks of the Russian River basin. Updated 1992.

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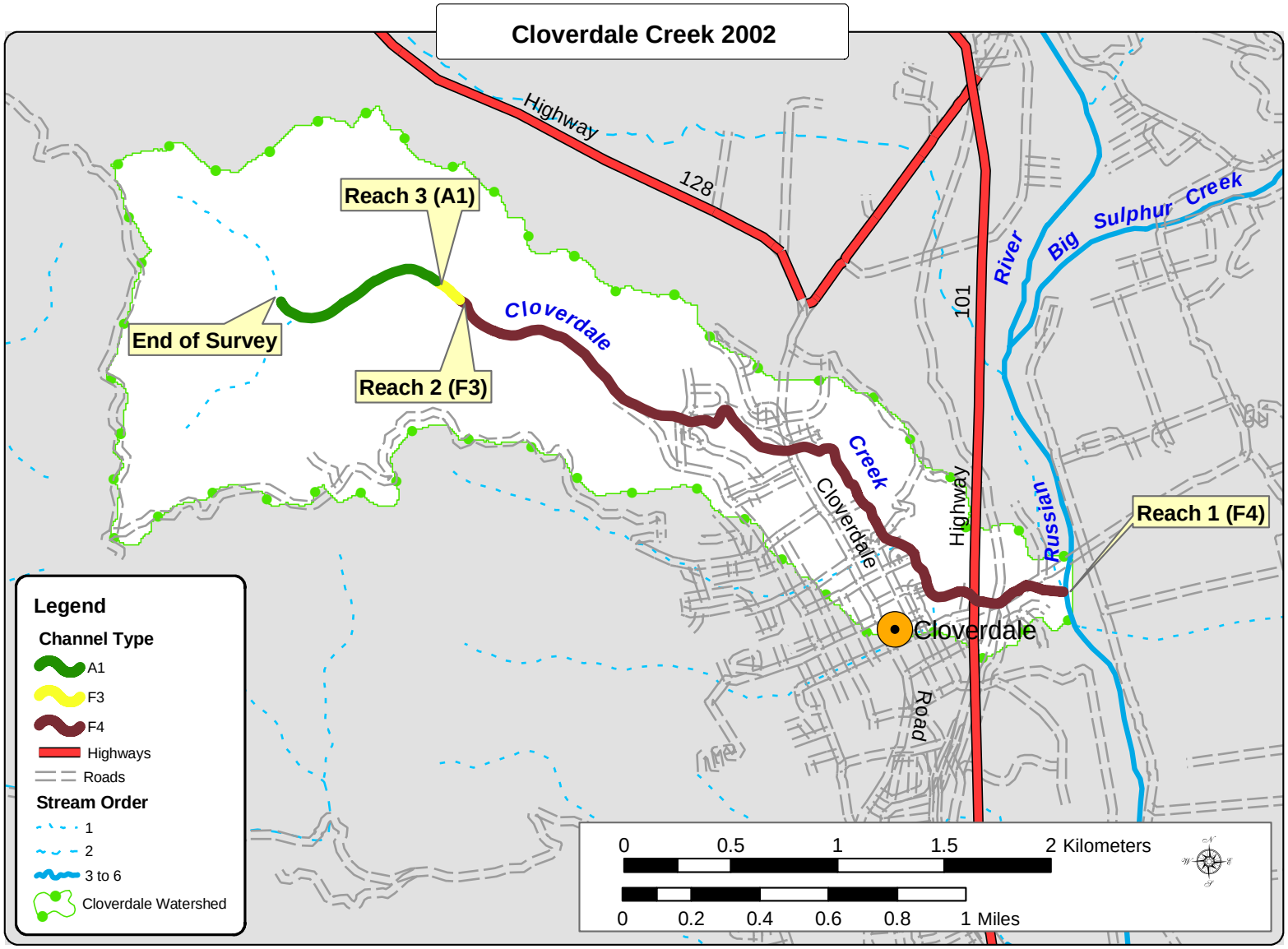
March, J. and C. Holstine. 1976. A Stream Survey of Cloverdale Creek. California Department of Fish and Game, Sacramento, Yountville, California.



Cloverdale Creek Tables Graphs Map
Assessment Completed 2002

APPENDIX B: TABLES

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

Stream Name: Cloverdale Creek

LLID: 1230068388078

Drainage: Russian River - Middle

Survey Dates: 9/19/2002 to 9/25/2002

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

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
3	0	CULVERT	4.8	59	178	1.1									
13	0	DRY	21.0	997	12956	83.3									
20	4	FLATWATER	32.3	73	1456	9.4	5.6	0.4	1.3	426	8512	132	2632		30
17	17	POOL	27.4	34	576	3.7	7.2	1.1	2.1	267	4541	429	6863	379	33
9	2	RIFFLE	14.5	43	387	2.5	3.3	0.2	0.3	216	1943	23	207		140

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
62	23	15553	14996	9702

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: Cloverdale Creek

LLID: 1230068388078

Drainage: Russian River - Middle

Survey Dates: 9/19/2002 to 9/25/2002

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

Habitat Units	Units Fully Measured	Habitat Type	Habitat Occurrence (%)	Mean Length (ft.)	Total Length (ft.)	Total Length (%)	Mean Width (ft.)	Mean Depth (ft.)	Max Depth (ft.)	Mean Area (sq.ft.)	Estimated Total Area (sq.ft.)	Mean Volume (cu.ft.)	Estimated Total Volume (cu.ft.)	Mean Residual Pool Vol (cu.ft.)	Mean Shelter Rating	Mean Canopy (%)
9	2	LGR	14.5	43	387	2.5	3	0.2	0.4	216	1943	23	207		140	92
14	3	RUN	22.6	72	1009	6.5	6	0.3	1.5	464	6494	113	1586		38	88
6	1	SRN	9.7	74	447	2.9	6	0.6	1.7	311	1865	186	1119		5	96
15	15	MCP	24.2	33	501	3.2	7	1.1	3.6	269	4036	398	5972	344	37	92
2	2	STP	3.2	38	75	0.5	6	2.0	3.8	253	506	891	891	891	8	97
13	0	DRY	21.0	997	12956	83.3										81
3	0	CUL	4.8	59	178	1.1	3									81

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
62	23	15553	14843	9775

Table 3 - Summary of Pool Types

Stream Name: Cloverdale Creek LLID: 1230068388078 Drainage: Russian River - Middle

Survey Dates: 9/19/2002 to 9/25/2002

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

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
17	17	MAIN	100	34	576	100	7.2	1.1	267	4541	379	6056	33

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
17	17	576	4541	6056

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

Stream Name: Cloverdale Creek LLID: 1230068388078 Drainage: Russian River - Middle

Survey Dates: 9/19/2002 to 9/25/2002

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

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
15	MCP	94	1	7	7	47	5	33	2	13	0	0
1	STP	6	0	0	0	0	0	0	1	100	0	0

Total Units	Total < 1 Foot Max Resid. Depth	Total < 1 Foot % Occurrence	Total 1< 2 Foot Max Resid. Depth	Total 1< 2 Foot % Occurrence	Total 2< 3 Foot Max Resid. Depth	Total 2< 3 Foot % Occurrence	Total 3< 4 Foot Max Resid. Depth	Total 3< 4 Foot % Occurrence	Total >= 4 Foot Max Resid. Depth	Total >= 4 Foot % Occurrence
16	1	6	7	44	5	31	3	19	0	0

Mean Maximum Residual Pool Depth (ft.): 2.1

Table 5 - Summary of Mean Percent Cover By Habitat Type

Stream Name: Cloverdale Creek LLID: 1230068388078 Drainage: Russian River - Middle

Survey Dates: 9/19/2002 to 9/25/2002 Dry Units: 13

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

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
9	2	LGR	0	0	0	0	100	0	0	0	0
9	2	TOTAL RIFFLE	0	0	0	0	100	0	0	0	0
14	3	RUN	3	53	0	0	13	0	0	13	17
6	1	SRN	0	0	0	0	50	0	0	50	0
20	4	TOTAL FLAT	3	40	0	0	23	0	0	23	13
15	12	MCP	15	24	0	18	21	0	0	7	15
2	2	STP	0	25	0	0	0	0	0	50	25
17	14	TOTAL POOL	13	24	0	16	18	0	0	13	16
3	0	CUL									
62	20	TOTAL	9	25	0	11	27	0	0	14	14

Table 6 - Summary of Dominant Substrates By Habitat Type

Stream Name: Cloverdale Creek LLID: 1230068388078 Drainage: Russian River - Middle

Survey Dates: 9/19/2002 to 9/25/2002 Dry Units: 13

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

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
9	2	LGR	0	0	0	0	0	0	100
14	3	RUN	0	0	0	33	0	33	33
6	1	SRN	0	0	0	0	0	0	100
15	6	MCP	17	17	33	17	0	0	17
2	1	STP	0	0	100	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: Cloverdale Creek LLID: 1230068388078 Drainage: Russian River - Middle

Survey Dates: 9/19/2002 to 9/25/2002

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
89	15	85	0	77	80

Note: Mean percent conifer and hardwood for the entire reach are means of canopy components from units with canopy values greater than zero.

Open units represent habitat units with zero canopy cover.

Table 9 - Mean Percentage of Dominant Substrate and Vegetation

Stream Name: Cloverdale Creek LLID: 1230068388078 Drainage: Russian River - Middle

Survey Dates: 9/19/2002 to 9/25/2002

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Bedrock	8	4	42.9
Boulder	0	1	3.6
Cobble / Gravel	0	0	0.0
Sand / Silt / Clay	6	9	53.6

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percent (%)
Grass	0	3	10.7
Brush	8	9	60.7
Hardwood Trees	4	1	17.9
Coniferous Trees	0	0	0.0
No Vegetation	2	1	10.7

Total Stream Cobble Embeddedness Values: 4

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

StreamName: Cloverdale Creek LLID: 1230068388078 Drainage: Russian River - Middle

Survey Dates: 9/19/2002 to 9/25/2002

Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)	0	3	13
SMALL WOODY DEBRIS (%)	0	40	24
LARGE WOODY DEBRIS (%)	0	0	0
ROOT MASS (%)	0	0	16
TERRESTRIAL VEGETATION (%)	100	23	18
AQUATIC VEGETATION (%)	0	0	0
WHITEWATER (%)	0	0	0
BOULDERS (%)	0	23	13
BEDROCK LEDGES (%)	0	13	16

Appendix C - Fish Habitat Inventory Data Summary

Stream Name: Cloverdale Creek LLID: 1230068388078 Drainage: Russian River -
Survey Dates: 9/19/2002 to 9/25/2002 Survey Length (ft.): 15553 Main Channel (ft.): 15553 Side Channel (ft.): 0
Confluence Location: Quad: CLOVERDALE Legal Description: T000R000S00 Latitude: 38:48:28.0N Longitude: 123:00:24.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4
Reach Length (ft.): 11375
Riffle/Flatwater Mean Width (ft.): 4.8
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 64 - 69 Air (F): 80 - 98
Dry Channel (ft.): 9045

Canopy Density (%): 88.8
Coniferous Component (%): 10.8
Hardwood Component (%): 89.2
Dominant Bank Vegetation: Brush
Vegetative Cover (%): 77.7
Dominant Shelter: Terrestrial Veg.
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 4.8
Pool Frequency (%): 29.4
Residual Pool Depth (%):
< 2 Feet Deep: 42.9
2 to 2.9 Feet Deep: 35.7
3 to 3.9 Feet Deep: 21.4
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 2.23
Mean Pool Shelter Rating: 34

Pool Tail Substrate (%): Silt/Clay: 14.3 Sand: 0.0 Gravel: 64.3 Sm Cobble: 0.0 Lg Cobble: 7.1 Boulder: 0.0 Bedrock: 14.3
Embeddedness Values (%): 1. 0.0 2. 13.3 3. 13.3 4. 40.0 5. 20.0

STREAM REACH: 2

Channel Type: F3
Reach Length (ft.): 4116
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 69 - 69 Air (F): 98 - 98
Dry Channel (ft.): 3869

Canopy Density (%): 95.0
Coniferous Component (%): 50.0
Hardwood Component (%): 50.0
Dominant Bank Vegetation: Grass
Vegetative Cover (%): 89.5
Dominant Shelter: Root masses
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

Pools by Stream Length (%): 0.2
Pool Frequency (%): 11.1
Residual Pool Depth (%):
< 2 Feet Deep: 100.0
2 to 2.9 Feet Deep: 0.0
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1.2
Mean Pool Shelter Rating:

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 100. Sm Cobble: 0.0 Lg Cobble: 0.0 Boulder: 0.0 Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 100.0 3. 0.0 4. 0.0 5. 0.0

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 3

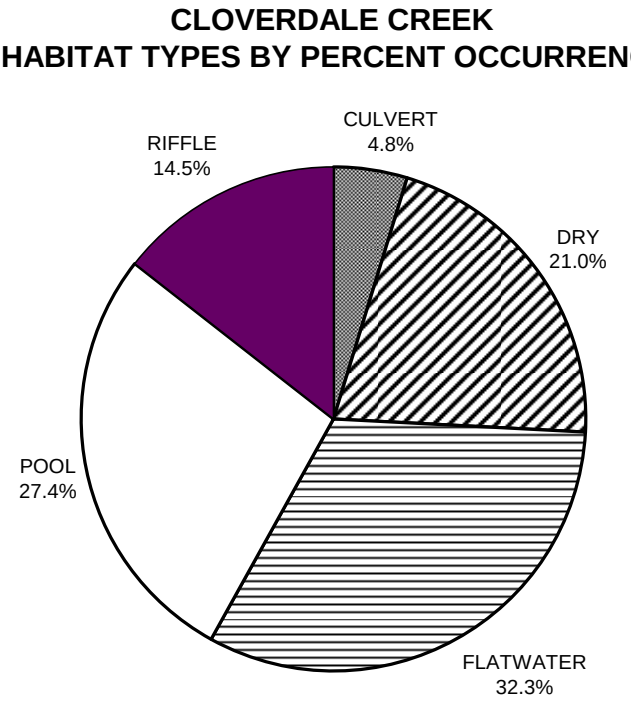
Channel Type: A1
Reach Length (ft.): 62
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs): 0
Water (F): 59 - 59 Air (F): 87 - 87
Dry Channel (ft.): 42

Canopy Density (%):
Coniferous Component (%):
Hardwood Component (%):
Dominant Bank Vegetation:
Vegetative Cover (%): 0.0
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type:
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat:

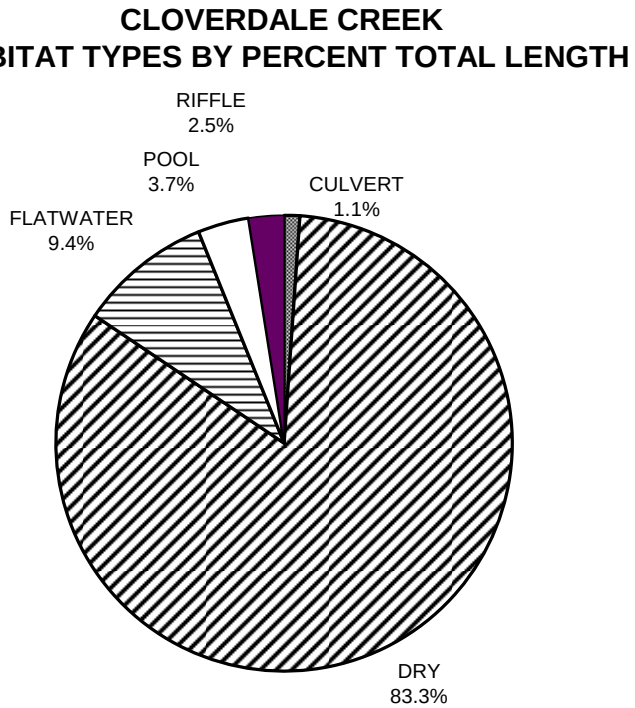
Pools by Stream Length (%): 32.3
Pool Frequency (%): 50.0
Residual Pool Depth (%):
< 2 Feet Deep: 100.0
2 to 2.9 Feet Deep: 0.0
3 to 3.9 Feet Deep: 0.0
>= 4 Feet Deep: 0.0
Mean Max Residual Pool Depth (ft.): 1
Mean Pool Shelter Rating: 20

Pool Tail Substrate (%): Silt/Clay: 0.0 Sand: 0.0 Gravel: 0.0 Sm Cobble: 0.0 Lg Cobble: 100. Boulder: 0.0 Bedrock: 0.0
Embeddedness Values (%): 1. 0.0 2. 0.0 3. 0.0 4. 0.0 5. 0.0

APPENDIX D: GRAPHS

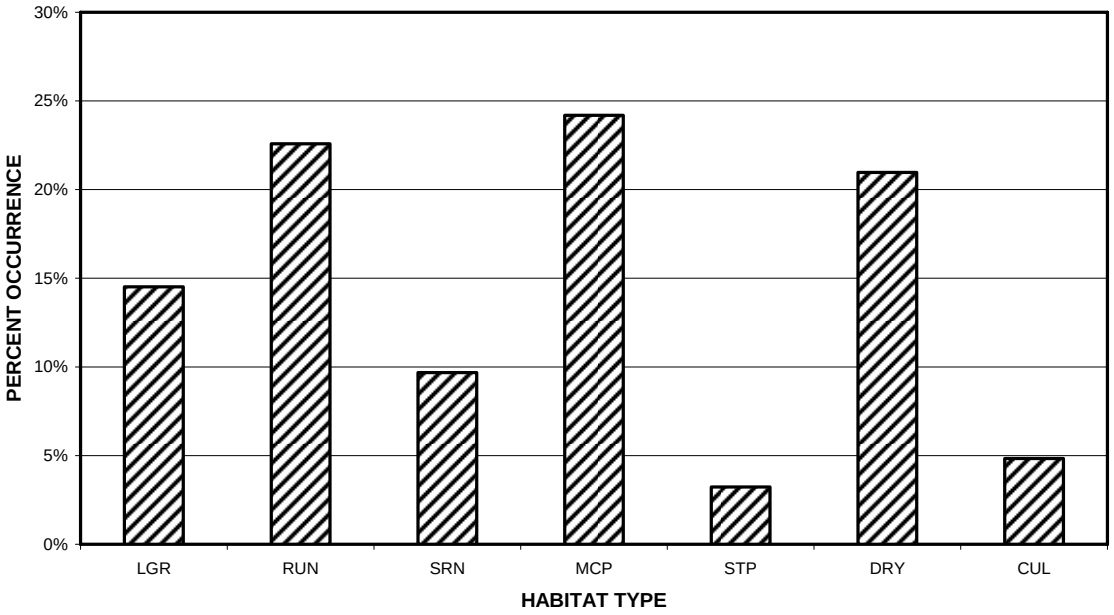


GRAPH 1: Level II habitat types by percent occurrence



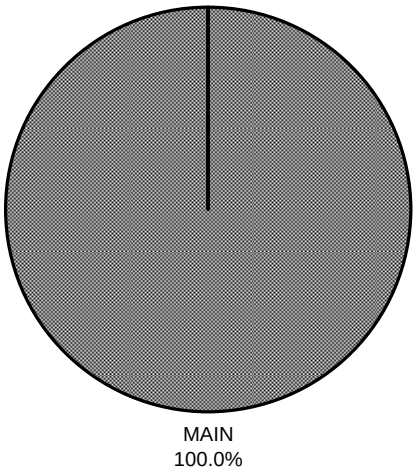
GRAPH 2: Level II habitat types by percent total length

CLOVERDALE CREEK 2002
HABITAT TYPES BY PERCENT OCCURRENCE



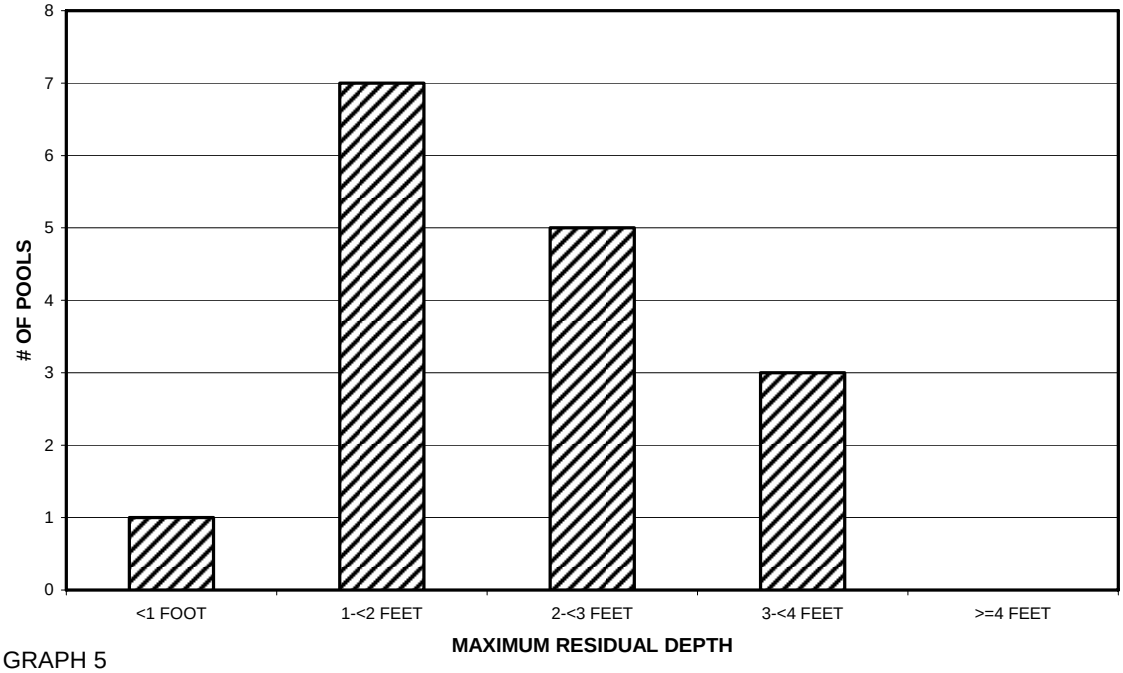
GRAPH 3: Level IV habitat types by percent occurrence

CLOVERDALE CREEK 2002
POOL TYPES BY PERCENT OCCURRENCE



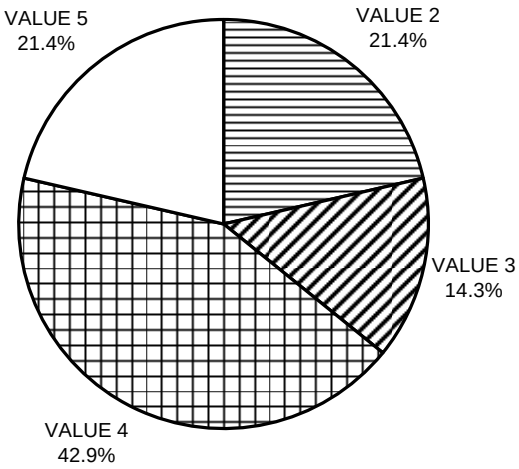
GRAPH 4: Level I pool types by percent occurrence

CLOVERDALE CREEK
MAXIMUM DEPTH IN POOLS



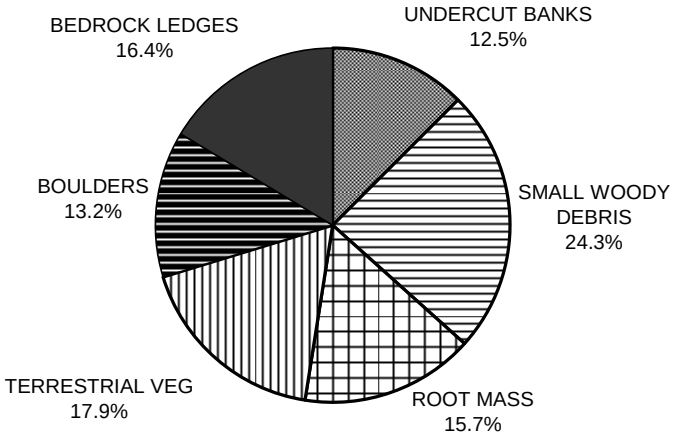
GRAPH 5

CLOVERDALE CREEK
PERCENT EMBEDDEDNESS



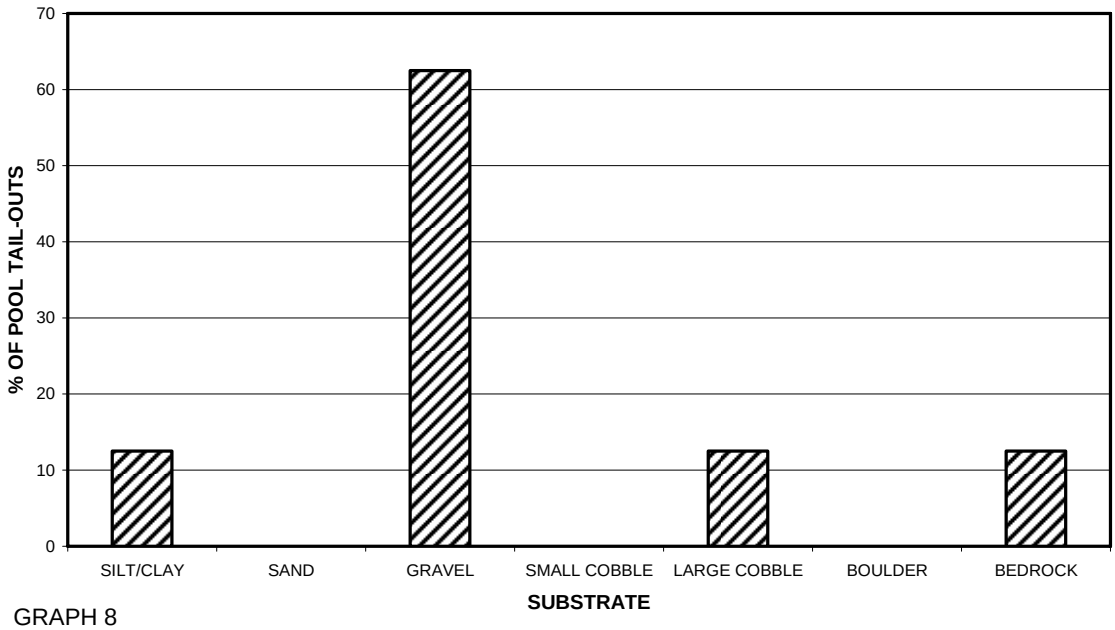
GRAPH 6

CLOVERDALE CREEK
MEAN PERCENT COVER TYPES IN POOLS



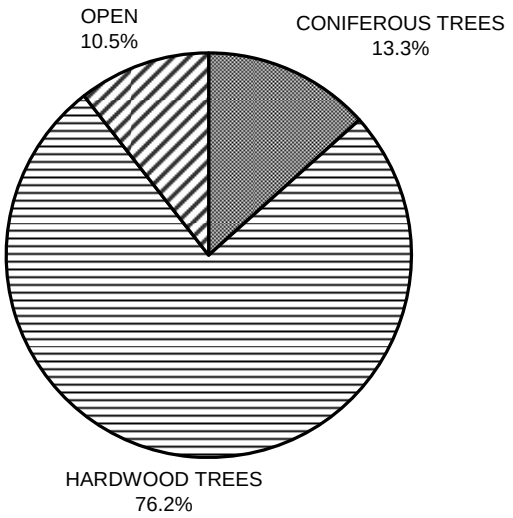
GRAPH 7

CLOVERDALE CREEK
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



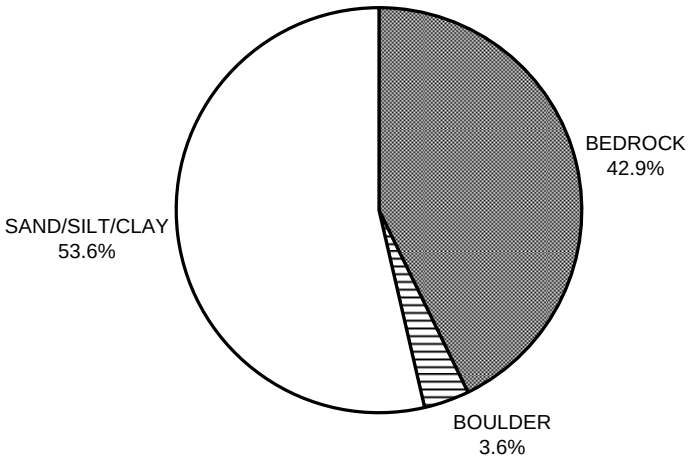
GRAPH 8

CLOVERDALE CREEK
MEAN PERCENT CANOPY



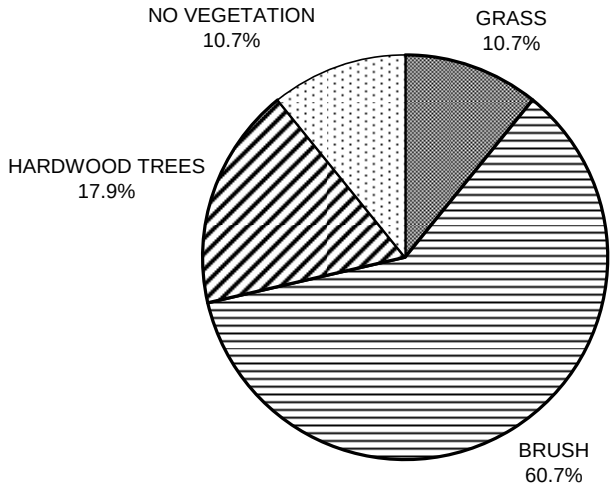
GRAPH 9

CLOVERDALE CREEK
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

CLOVERDALE CREEK
DOMINANT BANK VEGETATION IN SURVEY REACH



GRAPH 11

Cloverdale Creek Water Temperature 2002
(Reach 1)