California Department of Fish and Game
Petaluma River Watershed
Stream Habitat Assessment Reports

East Washington Creek

Surveyed 2007

STREAM INVENTORY REPORT

East Washington Creek

Surveyed Summer 2007
Report Completed March 2008

INTRODUCTION

A stream inventory was conducted during 9/11/2007 to 9/20/2007 on East Washington Creek. The survey began at the confluence with Washington Creek and extended upstream 3 miles.

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

The objective of this report is to document the current habitat conditions and recommend options for the potential enhancement of habitat for Chinook 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

East Washington Creek is a tributary to Washington Creek, which is a tributary to the Petaluma River which flows into San Pablo Bay, located in Sonoma County, California (Map 1). East Washington Creek's legal description at the confluence with Washington Creek is T05N R07 S27. Its location is 38°15'03" north latitude and 122°37'26" west longitude, LLID number 1226239382508. East Washington Creek is a -second order stream and has approximately 5.12 miles of blue line stream according to the USGS National Hydrography Dataset (NHD). East Washington Creek drains a watershed of approximately 2.24 square miles. Elevations range from about 30 feet at the mouth of the creek to 810 feet in the headwater areas. Mixed hardwood forest dominates the watershed. The watershed is mostly privately owned at 99%. Local government owns 0.6%. The land in the watershed is considered 51.9% natural, 32.6% agriculture and 15.5% for Urban. Vehicle access exists via East Washington Street in the town of Petaluma.

METHODS

The habitat inventory conducted in East Washington 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) personnel and Watershed Stewards Project/AmeriCorps (WSP) members that conducted the inventory were trained in standardized habitat inventory methods by the California Department of Fish and Game. This inventory was conducted by a two-person team.

SAMPLING STRATEGY

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

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

1. Flow:

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

2. Channel Type:

Channel typing is conducted according to the classification system developed and revised by David Rosgen (1994). This methodology is described in the *California Salmonid Stream Habitat Restoration Manual*. Channel typing is conducted simultaneously with habitat typing and follows a standard form to record measurements and observations. There are five measured parameters used to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel characteristics are measured using a 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". East Washington Creek habitat typing used standard basin level measurement criteria. These parameters require that the minimum length of a described habitat unit must be equal to or greater than the stream's mean wetted width. All measurements are in feet to the nearest tenth. Habitat characteristics are measured using a clinometer, hip chain, and stadia rod.

5. Embeddedness:

The depth of embeddedness of the cobbles in pool tail-out areas is measured by the percent of the cobble that is surrounded or buried by fine sediment. In East Washington Creek, embeddedness was ocularly estimated. The values were recorded using the following ranges: 0 - 25% (value 1), 26 - 50% (value 2), 51 - 75% (value 3) and 76 - 100% (value 4). Additionally, a value of 5 was assigned to tail-outs deemed 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 East Washington Creek, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned according to the complexity of the cover. 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 East Washington Creek, an estimate of the percentage of the habitat unit covered by canopy was made from the center of approximately every third unit in addition to every fully-described unit, giving an approximate 30% sub-sample. In addition, the area of canopy was estimated ocularly into percentages of coniferous or hardwood trees.

9. Bank Composition and Vegetation:

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

10. Large Woody Debris Count:

Large woody debris (LWD) is an important component of fish habitat and an element in channel forming processes. In each habitat unit all pieces of LWD partially or entirely below the elevation of bankfull discharge are counted and recorded. The minimum size to be considered is twelve inches in diameter and six feet in length. The LWD count is presented by reach and is expressed as an average per 100 feet.

11. Average Bankfull Width:

Bankfull width can vary greatly in the course of a channel type stream reach. This is especially true in very long reaches. Bankfull width can be a factor in habitat components like canopy density, water temperature, and pool depths. Frequent measurements taken at riffle crests (velocity crossovers) are needed to accurately describe reach widths. At the first appropriate velocity crossover that occurs after the beginning of a new stream survey page (ten habitat units), bankfull width is measured and recorded in the appropriate header block of the page. These widths are presented as an average for the channel type reach.

BIOLOGICAL INVENTORY

Biological sampling during the stream inventory is used to determine fish species and their distribution in the stream. Fish presence was observed from the stream banks in East Washington Creek. In addition one site was electrofished using a Smith-Root Model 12 electrofisher. These sampling techniques are discussed in the *California Salmonid Stream Habitat Restoration Manual*.

DATA ANALYSIS

Data from the habitat inventory form are entered into Stream Habitat 2.0.18, a Visual Basic data entry program developed by Karen Wilson, Pacific States Marine Fisheries Commission in conjunction with the California Department of Fish and 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 East Washington Creek include:

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

HABITAT INVENTORY RESULTS

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

The habitat inventory of 9/11/2007 to 9/20/2007, was conducted by H. Fett (DFG) and B. Nedland (WSP). The total length of the stream surveyed was 15,618 feet.

Stream flow was not measured on East Washington Creek.

East Washington Creek is an E5 channel type for 7,863 feet of the stream surveyed (Reach 1), a NA channel type for 6,752 feet of the stream surveyed (Reach 2) and a G6 channel type for the last 1,003 feet of the stream surveyed (Reach 3).

E5 channels are low gradient, meandering riffle/pool streams with low width depth ratio and little deposition, very efficient and stable, high meander width ratio and gravel dominant substrate. NA channels are characterized as reaches where land owner access was not obtained at the time of the survey and were therefore avoided by DFG and WSP field crew. G6 channels are entrenched "gully" step-pool channels on moderate gradients with low width /depth ratios and silt/clay dominant substrates.

Water temperatures taken during the survey period ranged from 60 to 63 degrees Fahrenheit. Air temperatures ranged from 63 to 74 degrees Fahrenheit.

Table 1 summarizes the Level II riffle, flatwater, and pool habitat types. Based on frequency of occurrence there were 26% culvert units, 22% flatwater units, 26% nosurvey_marsh units, 15% dry units, 4% nosurvey units and 7% pool units (Graph 1). Based on total length of Level II habitat types there were 9% culvert units, 15% flatwater units, 15% nosurvey_marsh units, 18% dry units and 43% nosurvey units (Graph 2).

Four Level IV habitat types were identified (Table 2). The most frequent habitat types by percent occurrence were 26% Culvert units, 19% Glide units and 15% Dry units (Graph 3). The most frequent habitat types based on percent total length are 15% Not Surveyed due to marsh units, 18% Dry units, and 43% Not Surveyed units.

A total of 2 pools were identified (Table 3). Scour pools were the most frequently encountered, at 100%, and comprised 100% of the total length of all pools (Graph 4).

Table 4 is a summary of maximum residual pool depths by pool habitat types. Pool quality for salmonids increases with depth. None of the 2 pools had a residual depth of two feet or greater (Graph 5).

The depth of cobble embeddedness was estimated at pool tail-outs. Of the 2 pool tail-outs measured, 2 had a value of 5 (100%) (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. Flatwater habitat types had a mean shelter rating of 2 and pool habitats had a mean shelter rating of 2 (Table 1). Of the pool types, Scour pools had a mean shelter rating of 3 (Table 3).

Table 5 summarizes mean percent cover by habitat type. Aquatic Vegetation is the

dominant cover types in East Washington Creek. Graph 7 describes the pool cover in East Washington Creek. Undercut Banks are the dominant pool cover type followed by aquatic vegetation.

Table 6 summarizes the dominant substrate by habitat type. Graph 8 depicts the dominant substrate observed in pool tail-outs. A silt/clay substrate type was observed in 100% of pool tail-outs.

The mean percent canopy density for the surveyed length of East Washington Creek was 42%. The mean percentages of hardwood and coniferous trees were 100% and 0%, respectively. Fifty-eight percent of the canopy was open. Graph 9 describes the mean percent canopy in East Washington Creek.

For the stream reach surveyed, the mean percent right bank vegetated was 24%. The mean percent left bank vegetated was 26%. The dominant elements composing the structure of the stream banks consisted of 100% sand/silt/clay (Graph 10). Deciduous trees were the dominant vegetation type observed in 60% of the units surveyed. Additionally, 30% of the units surveyed had grass as the dominant vegetation type, and 10% had brush as the dominant vegetation (Graph 11).

BIOLOGICAL INVENTORY RESULTS

One site was electrofished for species composition and distribution in East Washington Creek on September 19, 2007. The water temperature taken during the electrofishing period was 54 degrees Fahrenheit. Air temperature was 62 degrees Fahrenheit. The sites were sampled by B. Nedland (WSP) and J. Hanson (WSP).

In reach 1, one site was sampled starting at approximately Habitat Unit 1 and ending at Habitat Unit 2. The reach site yielded fifty one three-spine stickleback and sixteen unidentified species.

The following chart displays the information yielded from these sites:

2007 East Washington Creek e-fish observations

Date	Site #	Reference Point	Distance From Reference Point (ft.)	Steelhead/ Rainbow Trout			Non Salmonids Name species
				0+	1+	2+	
09/19/2007	616	Culvert	0	0	0	0	51 threespine sticklebacks, 16 unidentified species

DISCUSSION

East Washington Creek is an E5 channel type for the first 7,863 feet of stream surveyed (Reach 1) and a NA channel type for the next 6,752 feet (Reach 2), and a G6 channel type for the remaining 1,003 feet (Reach 3).

The suitability of E5 channel types for fish habitat improvement structures is as follows: good for bank placed boulders; fair for opposing wing-deflectors; and poor for plunge weirs, boulder clusters and single wing deflectors. NA channels are characterized as reaches where land owner access was not obtained at the time of the survey and were therefore avoided by DFG and WSP field crew. The suitability of G6 channel types for fish habitat improvement structures is as follows: good for bank-placed boulders; fair for plunge weirs, opposing wing-deflectors and log cover; and poor for boulder clusters and single wing-deflectors.

The water temperatures recorded on the survey days 9/11/2007 to 9/20/2007, ranged from 60 to 63 degrees Fahrenheit. Air temperatures ranged from 63 to 74 degrees Fahrenheit. To make any further conclusions, temperatures would need to be monitored throughout the warm summer months, and more extensive biological sampling would need to be conducted.

Flatwater habitat types comprised 15% of the total length of this survey, pools 0.4%, and there were no riffles recorded. The pools are relatively shallow, with none of the 2 pools having a maximum residual depth greater than 2 feet. In general, pool enhancement projects are considered when primary pools comprise less than 40% of the length of total stream habitat. In first and second order streams, a primary pool is defined to have a maximum residual depth of at least two feet, occupy at least half the width of the low flow channel, and be as long as the low flow channel width. Installing structures that will increase or deepen pool habitat is recommended 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.

None of the 2 pool tail-outs measured had embeddedness ratings of 1 or 2. None of the pool tail-outs had embeddedness ratings of 3 or 4. Two 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 East Washington Creek should be mapped and rated according to their potential sediment yields, and control measures should be taken.

Two of the 2 pool tail-outs had silt, sand, large cobble, boulders or bedrock as the dominant substrate. This is generally considered unsuitable for spawning salmonids.

The mean shelter rating for pools was 3. The shelter rating in the flatwater habitats was 2.

A pool shelter rating of approximately 100 is desirable. The amount of cover that now exists is being provided primarily by Aquatic Vegetation in East Washington Creek. Undercut Banks are the dominant cover type in pools followed by aquatic vegetation. Log and root wad cover structures in the pool and flatwater habitats would enhance both summer and winter salmonid habitat. Log cover structure provides rearing fry with protection from predation, rest from water velocity, and also divides territorial units to reduce density related competition.

The mean percent canopy density for the stream was 42%. Reach 1 had a canopy density of 13.6%, Reach 3 had a canopy density of 71.2%. In general, revegetation projects are considered when canopy density is less than 80%.

The percentage of right and left bank covered with vegetation was low at 24% and 26%, 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.

GENERAL RECOMMENDATIONS

East Washington 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.

RECOMMENDATIONS

1) Access for migrating salmonids should be assessed, monitored and improved along the stream, particularly at all road crossings and culverts. Where needed crossings and culverts should be replaced or modified to improve fish passage. Potential barriers noted in the assessment were located at the following locations: Adobe Rd and the airport runway culvert.

2) Inventory and map sources of stream bank erosion and prioritize them according to present and potential sediment yield. Identified sites should then be treated to reduce the amount of fine sediments entering the stream.

3) Increase the canopy on East Washington Creek 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.

4) There are sections where the stream is being impacted from cattle trampling the riparian zone. Alternatives should be explored with the grazier and developed if possible.

5) 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.

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 woody cover in the pools and flatwater habitat units. Most of the existing cover in the pools is from Undercut Banks. Adding high quality complexity with woody cover in the pools is desirable.

8) The limited water temperature data available suggest that maximum temperatures are within/above the acceptable range for juvenile salmonids. To establish more complete and meaningful temperature regime information, 24-hour monitoring during the May through October temperature extreme period should be performed for 3 to 5 years.

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	001.00	Start of Survey: Start of survey at confluence with Washington Creek. WP048: 38.25063, 122.62475.
0	001.00	Bio Sample: (Other) Fish were observed inside the culvert.
0	001.00	Access Points / Location: (Culvert) Culvert #1, East Washington Street crossing. Concrete, single box culvert, H6', W12', L125'. The culvert is in good condition and there is no down cutting or gravel being retained.

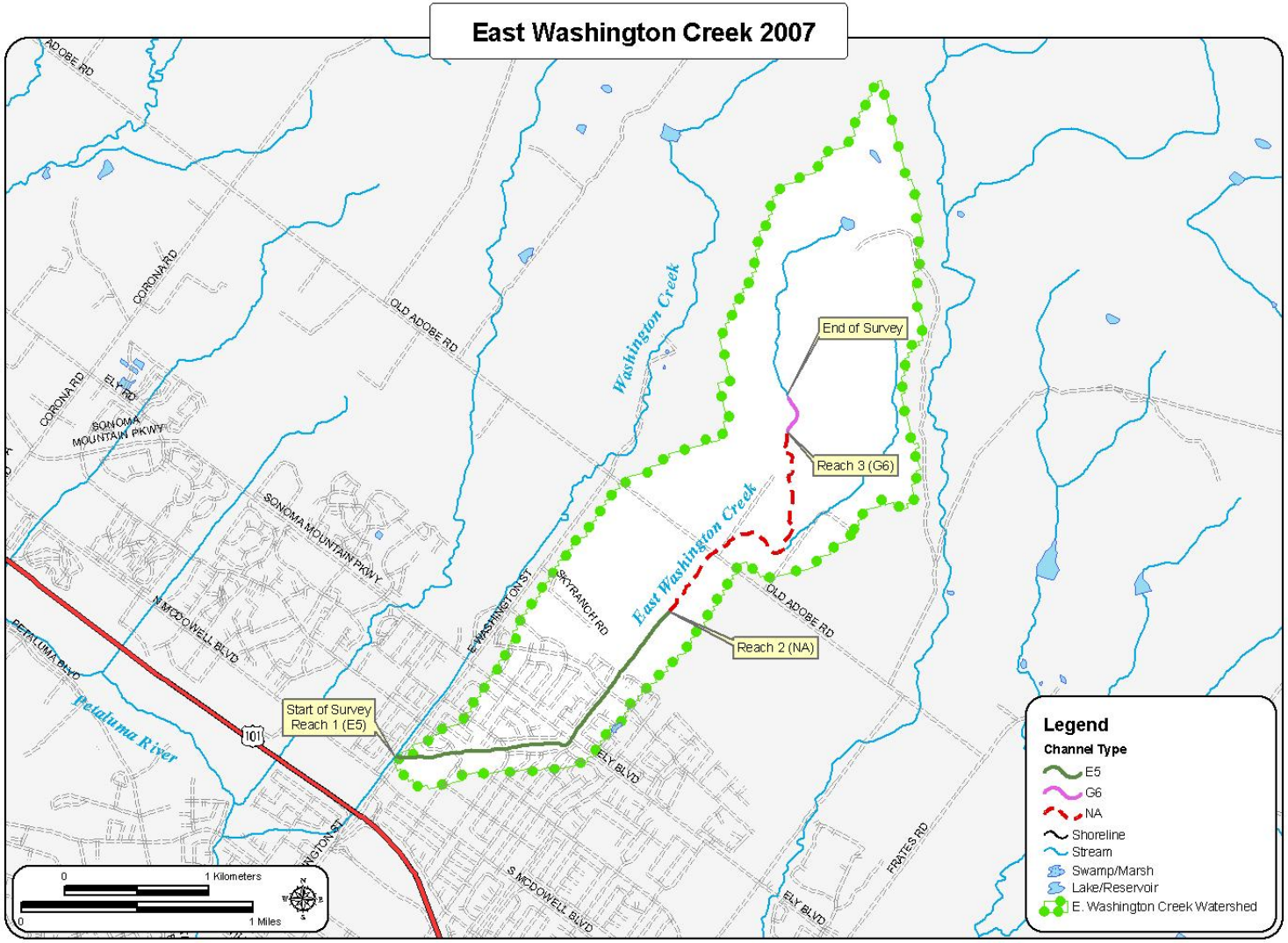
Position (ft)	Habitat Unit #	Comments
1257	003.00	Structures: Culvert #2, Maria Dr., 1 culvert, concrete, H.: 5ft, W.: 12ft, L.: 51ft, max depth w/in 5ft : 1.8ft, slope: 0 This culvert is in good condition and it is not a possible barrier to juvenile or adult salmonids.
2485	006.00	Structures: Culvert #3, McGregor Ave., 1 culvert, concrete, H.:9ft, W.: 12ft, L.: 53ft, plunge height: 0ft, max depth w/in 5ft of outlet: 0.4ft, culvert slope: 0%, This culvert is in good condition and it is not a possible barrier to juvenile or adult salmonids.
3883	010.00	Structures: Culvert #4, Ely Blvd., 1 culvert, concrete, H.: 6ft, W.: 12Ft, L.: 90ft, plunge height: 0ft, max depth w/in 5ft of outlet: 0.9ft, culvert slope: 1.1%, This culvert is in good condition and it is not a possible barrier to juvenile or adult salmonids.
5343	012.00	Structures: Culvert #5, Garfield Dr., 1 culvert, concrete, H.: 2.5ft, W.: 12ft, L.: 51ft, plunge height 0ft, max depth w/in 5ft of outlet: 0ft, culvert slope: approximately 0%. This culvert is in good condition and it is not a possible barrier to juvenile or adult salmonids.
5988	014.00	Structures: Culvert #6, Airport Runway, 2 culverts, concrete, H.: 5.5ft, W.: 12ft, L.: 950ft, Dia.: 5.5ft, plunge height 0ft, max depth w/in 5ft of outlet: 0ft (dry), culvert slope: 1.7%, This culvert is in good condition, but it is a possible barrier to juvenile or adult salmonids.
7494	016.00	Structures: Bridge #1, Rooster Run Golf Course cart bridge, H.: 4.5ft, W.: 27ft, L.: 10ft, material: wood, not a possible barrier to juvenile or adult salmonids.
7863	018.00	General Comment: Channel Type Change: E5 to NA; Reach 1 to 2.
14615	019.00	General Comment: Begin access at fence. (WP001: 38.27162, 122.59438) Channel Type Change: NA to G6; Reach 2 to3. Channel has minimal water, and is completely grown over with grass and other aquatic vegetation.
14803	021.00	General Comment: 45' into unit, a spring trickles into the creek from the left bank.
14894	023.00	General Comment: Creek bed fully overgrown again and at 95' into unit there is a trickle coming from spring on right bank.
15618	027.00	End of Survey: End of Survey due to no access. Ended survey at barbed wire fence marking the end of the accessible property. WP002:38.27375, 122.59445.

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.

McCain, M., D. Fuller, L. Decker and K. Overton. 1990. Stream habitat classification and inventory procedures for northern California. FHC Currents. No.1. U.S. Department of Agriculture. Forest Service, Pacific Southwest Region.

Rosgen, D.L., 1994. A Classification of Natural Rivers. Catena, Vol 22: 169-199, Elsevier Science, B. V. Amsterdam.



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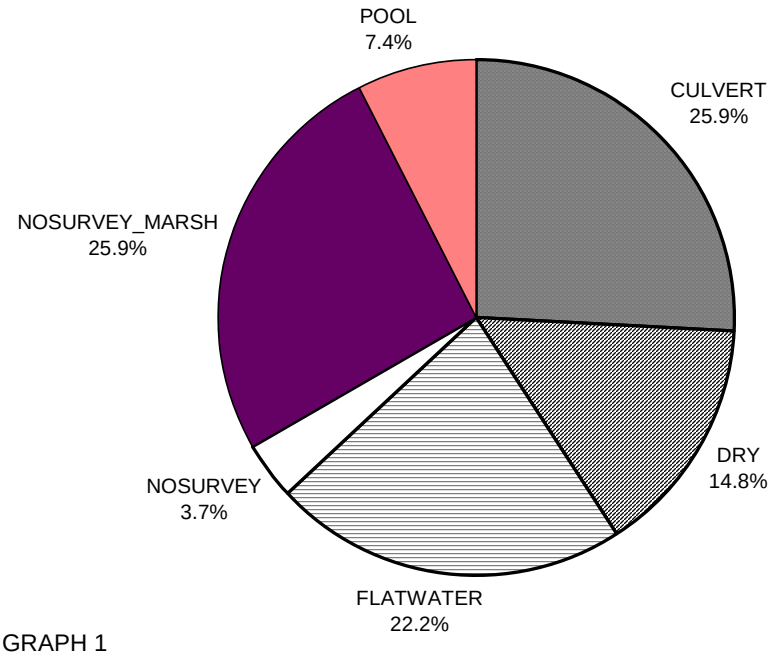
Prepared by: Scott Webb, December 2007

LEVEL III and LEVEL IV HABITAT TYPES

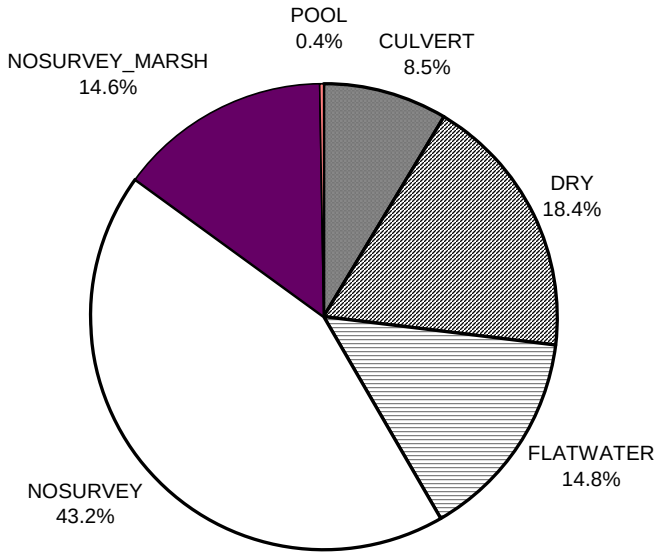
RIFFLE			
Low Gradient Riffle	(LGR)	[1.1]	{ 1}
High Gradient Riffle	(HGR)	[1.2]	{ 2}
CASCADE			
Cascade	(CAS)	[2.1]	{ 3}
Bedrock Sheet	(BRS)	[2.2]	{24}
FLATWATER			
Pocket Water	(POW)	[3.1]	{21}
Glide	(GLD)	[3.2]	{14}
Run	(RUN)	[3.3]	{15}
Step Run	(SRN)	[3.4]	{16}
Edgewater	(EDW)	[3.5]	{18}
MAIN CHANNEL 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]	

East Washington 2007
HABITAT TYPES BY PERCENT OCCURRENCE



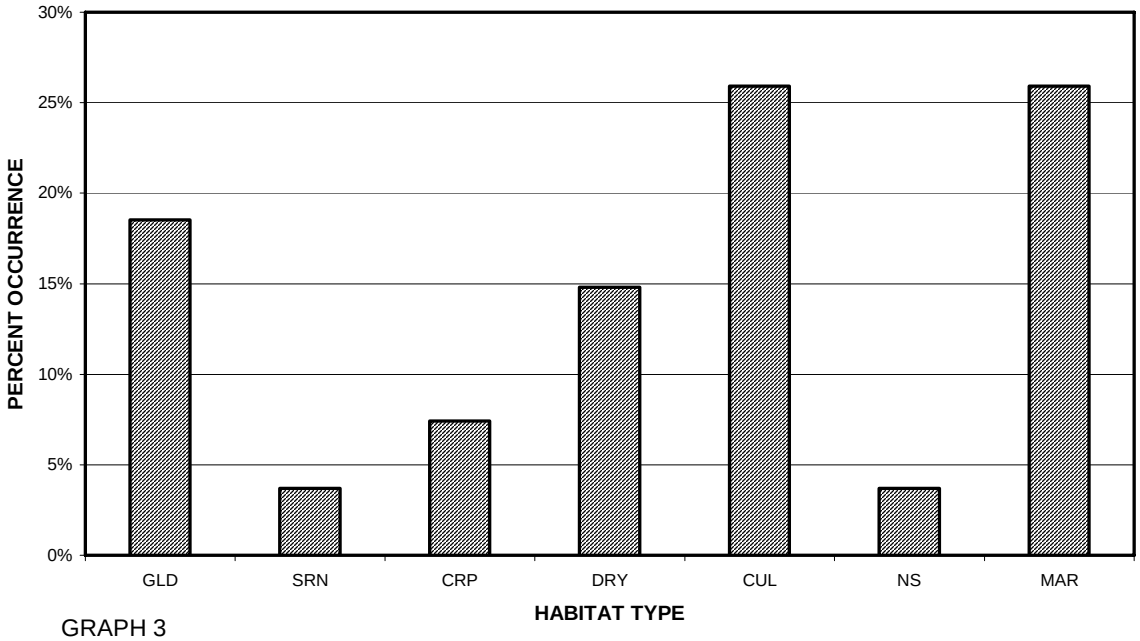
GRAPH 1

East Washington 2007
HABITAT TYPES BY PERCENT TOTAL LENGTH



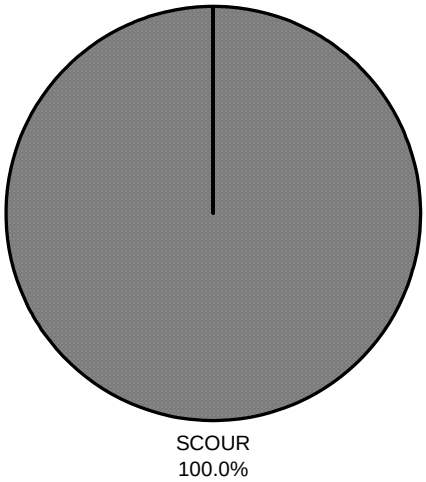
GRAPH 2

East Washington 2007
HABITAT TYPES BY PERCENT OCCURRENCE

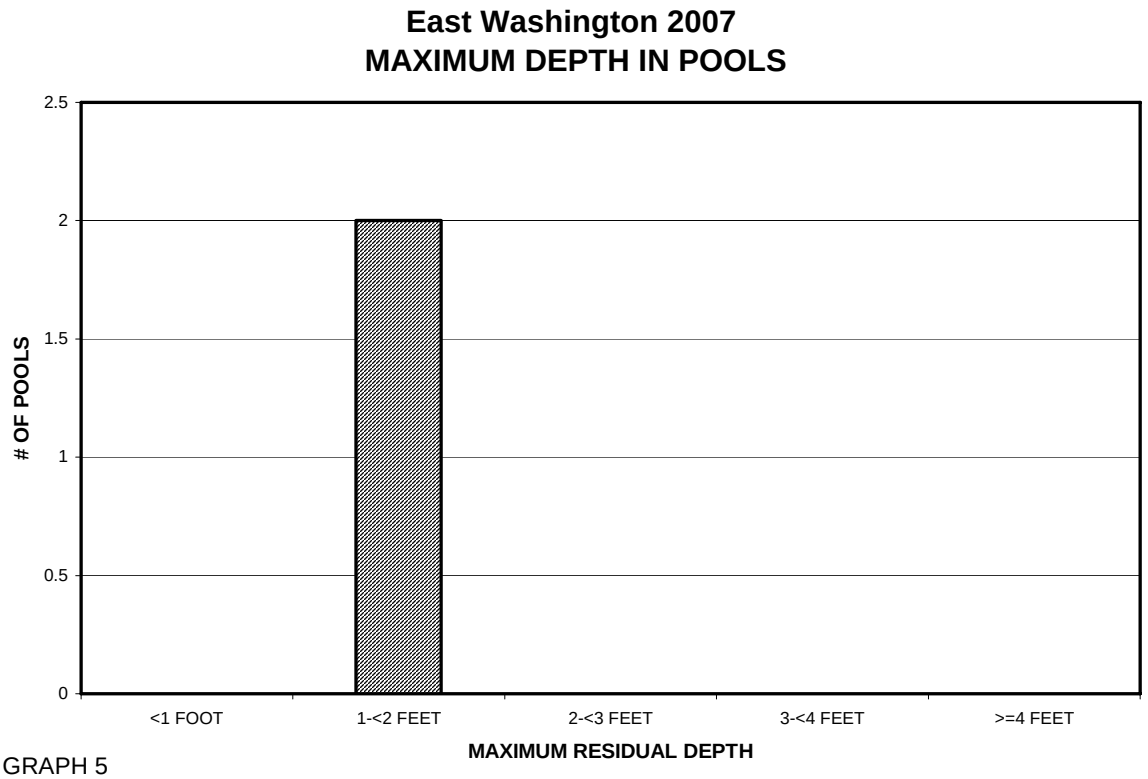


GRAPH 3

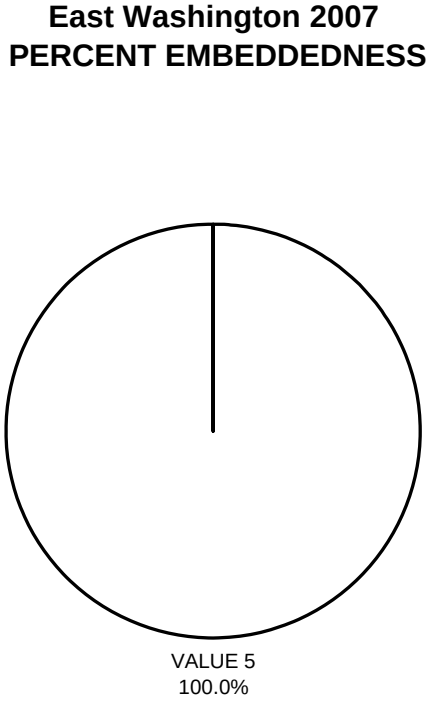
East Washington 2007
POOL TYPES BY PERCENT OCCURRENCE



GRAPH 4

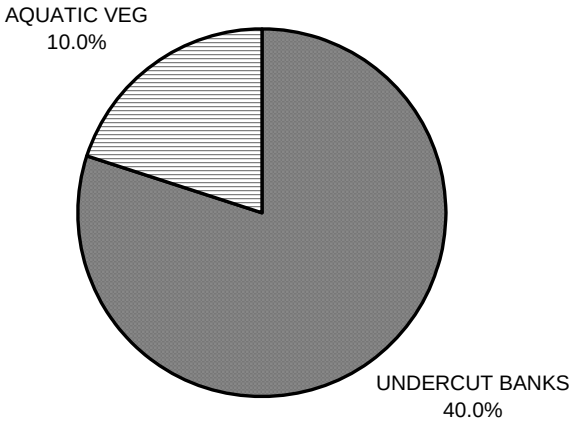


GRAPH 5



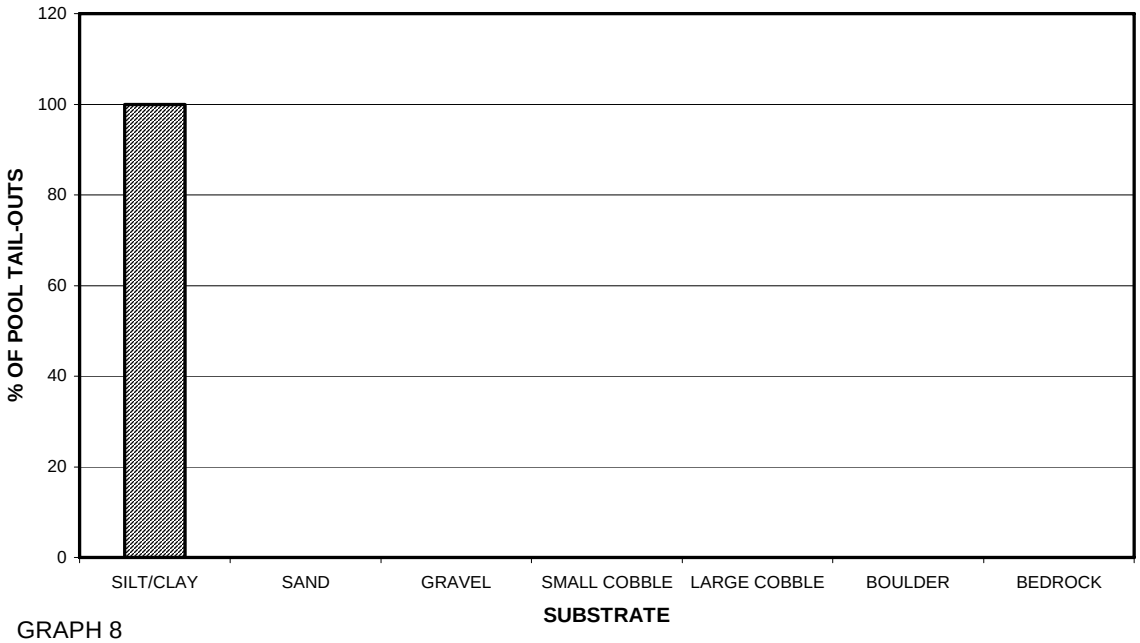
GRAPH 6

East Washington 2007
MEAN PERCENT COVER TYPES IN POOLS



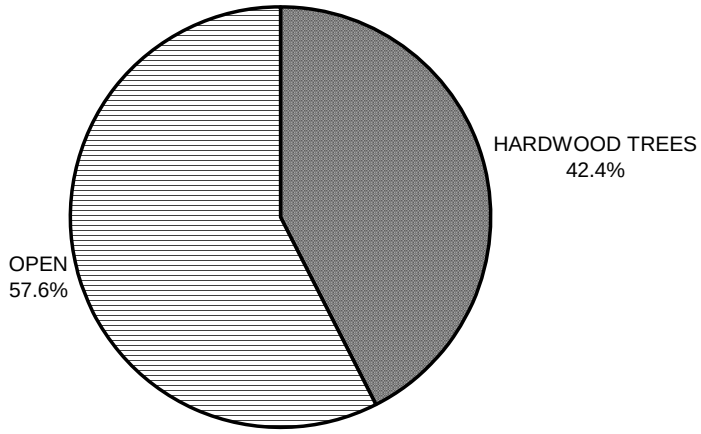
GRAPH 7

East Washington 2007
SUBSTRATE COMPOSITION IN POOL TAIL-OUTS



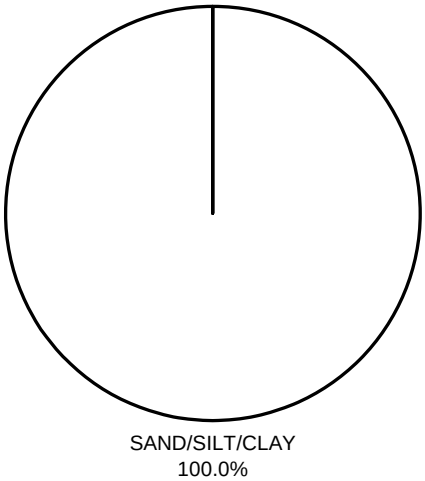
GRAPH 8

East Washington 2007
MEAN PERCENT CANOPY



GRAPH 9

East Washington 2007
DOMINANT BANK COMPOSITION IN SURVEY REACH



GRAPH 10

East Washington 2007
DOMINANT BANK VEGETATION IN SURVEY REACH

GRAPH 11

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

Stream Name: East Washington Creek **LLID:** 1226239382508 **Drainage:** Petaluma River

Survey Dates: 9/11/2007 to 9/20/2007

Confluence Location: Quad: GLEN ELLEN **Legal Description:** T05NR07WS27 **Latitude:** 38:15:03.0N **Longitude:** 122:37:26.0W

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
7	0	CULVERT	25.9	190	1330	8.5									
4	0	DRY	14.8	720	2879	18.4									
6	3	FLATWATER	22.2	384	2306	14.8	4.0	0.5	1.0	2020	12119	2109	12656		2
1	0	NOSURVEY	3.7	6752	6752	43.2									
7	0	NOSURVEY_ MARSH	25.9	327	2288	14.6									
2	2	POOL	7.4	32	63	0.4	5.0	0.8	1.8	158	315	155	311	115	3

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
27	5	15618	12434	12966

Table 2 - Summary of Habitat Types and Measured Parameters

Stream Name: East Washington Creek **LLID:** 1226239382508 **Drainage:** Petaluma River

Survey Dates: 9/11/2007 to 9/20/2007

Confluence Location: Quad: GLEN ELLEN **Legal Description:** T05NR07WS27 **Latitude:** 38:15:03.0N **Longitude:** 122:37:26.0W

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 (%)
5	2	GLD	18.5	449	2243	14.4	4.0	0.7	1.7	2940	14700	3146	15730		3	47
1	1	SRN	3.7	63	63	0.4	3.0	0.2	0.8	180	180	36	36		0	85
2	2	CRP	7.4	32	63	0.4	5.0	0.8	1.8	158	315	155	311	115	3	73
4	0	DRY	14.8	720	2879	18.4										34
7	0	CUL	25.9	190	1330	8.5										
1	0	NS	3.7	6752	6752	43.2										
7	0	MAR	25.9	327	2288	14.6										11

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
27	5	15618	15195	16076

Table 3 - Summary of Pools Types

Stream Name: East Washington Creek **LLID:** 1226239382508 **Drainage:** Petaluma River

Survey Dates: 9/11/2007 to 9/20/2007

Confluence Location: **Quad:** GLEN ELLEN **Legal Description:** T05NR07WS27 **Latitude:** 38:15:03.0N **Longitude:** 122:37:26.0W

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
2	2	SCOUR	100	32	63	100	5.0	0.8	158	315	115	230	3

Total Units	Total Units Fully Measured	Total Length (ft.)	Total Area (sq.ft.)	Total Volume (cu.ft.)
2	2	63	315	230

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

Stream Name: East Washington Creek **LLID:** 1226239382508 **Drainage:** Petaluma River

Survey Dates: 9/11/2007 to 9/20/2007

Confluence Location: Quad: GLEN ELLEN **Legal Description:** T05NR07WS27 **Latitude:** 38:15:03.0N **Longitude:** 122:37:26.0W

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
2	CRP	100	0	0	2	100	0	0	0	0	0	0

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
2	0	0	2	100	0	0	0	0	0	0

Mean Maximum Residual Pool Depth (ft.): 1.8

Table 5 - Summary of Mean Percent Cover by Habitat Type

Stream Name: East Washington Creek **LLID:** 1226239382508 **Drainage:** Petaluma River

Survey Dates: 9/11/2007 to 9/20/2007 **Dry Units:** 4

Confluence Location: **Quad:** GLEN ELLEN **Legal Description:** T05NR07WS27 **Latitude:** 38:15:03.0N **Longitude:** 122:37:26.0W

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
0	0	TOTAL RIFFLE									
5	2	GLD	0	0	0	0	0	50	0	0	0
1	1	SRN	0	0	0	0	0	0	0	0	0
6	3	TOTAL FLAT	0	0	0	0	0	33	0	0	0
2	2	CRP	40	0	0	0	0	10	0	0	0
2	2	TOTAL POOL	40	0	0	0	0	10	0	0	0
7	0	CUL									
1	0	NS									
7	0	MAR									
27	5	TOTAL	16	0	0	0	0	24	0	0	0

Table 6 - Summary of Dominant Substrates by Habitat Type

Stream Name: East Washington Creek **LLID:** 1226239382508 **Drainage:** Petaluma River

Survey Dates: 9/11/2007 to 9/20/2007 **Dry Units:** 4

Confluence Location: **Quad:** GLEN ELLEN **Legal Description:** T05NR07WS27 **Latitude:** 38:15:03.0N **Longitude:** 122:37:26.0W

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
5	2	GLD	100	0	0	0	0	0	0
1	1	SRN	100	0	0	0	0	0	0
2	2	CRP	100	0	0	0	0	0	0
7	0	CUL	0	0	0	0	0	0	0
1	0	NS	0	0	0	0	0	0	0
7	0	MAR	0	0	0	0	0	0	0

Table 7 - Summary of Mean Percent Canopy for Entire Stream

Stream Name: East Washington Creek **LLID:** 1226239382508 **Drainage:** Petaluma River

Survey Dates: 9/11/2007 to 9/20/2007

Confluence Location: **Quad:** GLEN ELLEN **Legal Description:** T05NR07WS27 **Latitude:** 38:15:03.0N **Longitude:** 122:37:26.0W

Mean Percent Canopy	Mean Percent Conifer	Mean Percent Hardwood	Mean Percent Open Units	Mean Right Bank % Cover	Mean Left Bank % Cover
42	0	100	40	24	26

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

Open units represent habitat units with zero canopy cover.

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: East Washington Creek LLID: 1226239382508 Drainage: Petaluma River
Survey Dates: 9/11/2007 to 9/20/2007 Survey Length (ft.): 15618 Main Channel (ft.): 15618 Side Channel (ft.): 0
Confluence Location: Quad: GLEN ELLEN Legal Description: T05NR07WS27 Latitude: 38:15:03.0N Longitude: 122:37:26.0W

Summary of Fish Habitat Elements by Stream Reach

STREAM REACH: 1

Channel Type: E5
Reach Length (ft.): 7863
Riffle/Flatwater Mean Width (ft.): 5.0
BFW:
Range (ft.): 15 to 16
Mean (ft.): 15.41
Std. Dev.: 0.49
Base Flow (cfs): NA
Water (F): 63 - 63 Air (F): 71 - 74
Dry Channel (ft.): 2879

Canopy Density (%): 13.6
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Brush
Vegetative Cover (%): 55.0
Dominant Shelter: Aquatic Vegetation
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools:
Flat: 0

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

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

STREAM REACH: 2

Channel Type: NA
Reach Length (ft.): 6752
Riffle/Flatwater Mean Width (ft.):
BFW:
Range (ft.): to
Mean (ft.):
Std. Dev.:
Base Flow (cfs):
Water (F): Air (F):
Dry Channel (ft.):

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

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

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

Summary of Fish Habitat Elements by Stream Reach

STREAM REACH: 3

Channel Type: G6
Reach Length (ft.): 1003
Riffle/Flatwater Mean Width (ft.): 3.5
BFW:
Range (ft.): 14 to 14
Mean (ft.): 14
Std. Dev.: 0
Base Flow (cfs): NA
Water (F): 60 - 60 Air (F): 63 - 63
Dry Channel (ft.): 0

Canopy Density (%): 71.2
Coniferous Component (%): 0.0
Hardwood Component (%): 100.0
Dominant Bank Vegetation: Hardwood Trees
Vegetative Cover (%): 17.5
Dominant Shelter: Undercut Banks
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 0.0
LWD per 100 ft.:
Riffles:
Pools: 0
Flat: 0

Pools by Stream Length (%): 6.3
Pool Frequency (%): 22.2
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.): 1.8
Mean Pool Shelter Rating: 3

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

Table 9 -Mean Percentage of Dominant Substrate and Vegetation

Stream Name: East Washington Creek **LLID:** 1226239382508 **Drainage:** Petaluma River

Survey Dates: 9/11/2007 to 9/20/2007

Confluence Location: Quad: GLEN ELLEN **Legal Description:** T05NR07WS27 **Latitude:** 38:15:03.0N **Longitude:** 122:37:26.0W

Mean Percentage of Dominant Stream Bank Substrate

Dominant Class of Substrate	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Bedrock	0	0	0.0
Boulder	0	0	0.0
Cobble/Gravel	0	0	0.0
Sand/Silt/Clay	5	5	100.0

Mean Percentage of Dominant Stream Bank Vegetation

Dominant Class of Vegetation	Number of Units Right Bank	Number of Units Left Bank	Total Mean Percentage (%)
Grass	1	2	30.0
Brush	1	0	10.0
Hardwood Trees	3	3	60.0
Coniferous Trees	0	0	0.0
No Vegetation	0	0	0.0

Total Stream Cobble Embeddedness Values 5

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

Stream Name: East Washington Creek **LLID:** 1226239382508 **Drainage:** Petaluma River

Survey Dates: 9/11/2007 to 9/20/2007

Confluence Location: **Quad:** GLEN ELLEN **Legal Description:** T05NR07WS27 **Latitude:** 38:15:03.0N **Longitude:** 122:37:26.0W

	Riffles	Flatwater	Pools
UNDERCUT BANKS (%)		0	40
SMALL WOODY DEBRIS (%)		0	0
LARGE WOODY DEBRIS (%)		0	0
ROOT MASS (%)		0	0
TERRESTRIAL VEGETATION (%)		0	0
AQUATIC VEGETATION (%)		33	10
WHITEWATER (%)		0	0
BOULDERS (%)		0	0
BEDROCK LEDGES (%)		0	0