Technical Memorandum:
Jacoby Creek Aquatic Habitat Assessment

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List of Abbreviations

CDFW	California Department of Fish and Wildlife
CNDDB	California Natural Diversity Database
IQR	Interquartile range
JCLT	Jacoby Creek Land Trust
LWD	Large woody debris
MLA	Michael Love & Associates
OAR	Old Arcata Road
PTC	Pool tail crest
SWD	Small woody debris
TGAEC	Thomas Gast & Associates Environmental Consultants

1. Summary

This technical memo summarizes an aquatic habitat assessment of Jacoby Creek; data were collected by Thomas Gast & Associates Environmental Consultants (TGAEC) in January and February 2022 following Habitat Inventory protocol described by Flosi et al. (2010). In addition to characterizing aquatic habitat, TGAEC staff also collected general information on large woody debris, small woody debris jams, salmonid redds, carcasses, and freshwater mussel presence.

Analysis of habitat features and characteristics were divided into two stream reaches: downstream of Old Arcata Road (OAR) and upstream of OAR. Overall, Jacoby Creek below OAR was dominated by flat-water habitats, sandy substrates, small woody debris jams, and had the greatest abundance of freshwater mussels. Above OAR, the stream was dominated by gravel and cobble occurrence increased with distance upstream. There were also greater number of redds observed upstream of OAR than downstream. The following report further summarizes data collected during the Jacoby Creek habitat assessment survey.

2. Introduction

Thomas Gast & Associates Environmental Consultants (TGAEC), partnered with GHD, Inc., Michael Love and Associates (MLA), and Baldwin, Blomstrom, Wilkinson & Associates, are assisting the Jacoby Creek Land Trust (JCLT) and Humboldt County with developing the Jacoby Creek Water Sustainability and Anadromous Fish Habitat Enhancement Feasibility Study. As part of Sub-Task 3.6 (Geomorphic and Aquatic Habitat Assessment), TGAEC staff conducted an aquatic habitat assessment to map instream channel morphology, measure channel hydraulic geometry, map large woody debris, and document hydraulic controls. These data will be used as baseline data and support the geomorphic assessment and modeling conducted by MLA.

3. Methods

3.1 Field Methods

Aquatic habitat assessment was conducted following Flosi et al. (2010) methods for Habitat Inventory. This methodology collects data to describe habitat types, and specific channel geometry, shelter values, substrate composition, canopy cover, and bank characteristics within each habitat unit. An outline of all channel parameters collected, and their descriptions are found in Appendix A, Table A1. Following Flosi et al. (2010) protocol, there are four main classification levels for describing stream habitats:

- Level 1: Classifies habitats as riffles or pools
- Level 2: Classifies habitats as riffles, pools, or flatwater
- Level 3: Classifies habitats further, describing riffles based on their water surface gradient (i.e., riffle, cascade), and pools based on their location in the stream channel (i.e., main channel, lateral scour, or backwater)
- Level 4: Classification includes the cause of formation of pools (i.e., obstruction, blockage, etc.), riffles are categorized by gradient, and flatwater by depth and velocity

The habitat assessment survey of Jacoby Creek classified units based on both Level 3 and Level 4 units. For simplicity of analysis, this report only summarizes habitat based on Level 3 classification. Left bank and right bank are identified when looking downstream, following Flosi et al (2010) protocol. Bank substrate is determined by examining banks at the base of the stream bank to the bankfull discharge level. Bank vegetation and overall cover is observed on banks beginning at bankfull level and extending 20 feet upslope. Canopy cover is typically measured using a handheld spherical densiometer; however, due to the survey taking place during leaf-off conditions, the total canopy cover was visually estimated during this survey.

In addition to the habitat inventory, TGAEC staff used a simplified methodology for conducting a large woody debris (LWD) inventory based on Flosi et al. (2010) protocol. The simplified LWD inventory focused on collecting the location of LWD within Jacoby Creek, where the LWD was within the habitat unit (i.e., in stream, on left bank, perched, etc.), and its estimated length. In addition, it was noted whether the LWD was contributing to a "jam" or obstruction in the channel, and whether it was caused by anthropogenic influence.

To provide information on possible hydraulic controls, staff also collected information on small-woody debris (SWD) jams. No specific protocol was used for inventory of SWD jams, but information was collected to describe the jam and whether it had anthropogenic influence. Data collection forms for the habitat inventory, LWD inventory, and SWD jams were transferred to digital format and used in the QGIS field application "QField." Collecting data using QField on a tablet device, TGAEC staff were able to collect and associate GPS locations and photos with each habitat unit. Data collection took place over the course of eight days between 1/31/2022 and 2/17/2022. During the time of survey, flow conditions in Jacoby Creek were below the winter baseflow levels. The average daily discharge at Brookwood stream gauge was 13.9 cfs on 1/31/2022 and 13.4 cfs on 2/17/2022.

3.2 Post Processing Methods

Field data underwent a QA/QC process at the end of the collection period. All records were reviewed for completion and accuracy. Due to poor reception in certain areas of the stream, GPS data collected was not always reflective of measured distances and locations along the stream. Therefore, TGAEC staff used unit lengths collected by hip-chain to correct the geographic location and length of habitat units. Units were numbered in ascending order beginning at the farthest downstream end (near Hwy 101) and ending at habitat unit number 217 at the upper extent of the survey (near Redwood Roots organic farm).

Data were imported and summarized using R version 4.1.2 statistical software (R Development Core Team, 2008). Data were summarized to reflect general trends in habitat units and their characteristics within the two reaches: downstream ("below") and upstream ("above") Old Arcata Road (OAR). This road was used as a reach break because there is a shift in stream characteristics that occurs near this location.

4. Results

4.1 Habitat Units in Jacoby Creek

Overall, 4,741 feet of stream channel were surveyed downstream of Old Arcata Rd. and 8,189 feet were surveyed upstream of Old Arcata Rd. Upstream of OAR, Jacoby Creek was characterized as a C4 channel (Rosgen, 1994). Below Old Arcata Rd., the stream channel is more sand dominated and was therefore characterized as a C5 channel. Sinuosity of the surveyed channel is 1.4, determined using GIS.

The distribution of habitat units is displayed in Figures 1 and 2. The lower portions of Jacoby Creek have a higher number of units characterized as flat-water. Moving upstream, there is a higher occurrence and overall length of main-channel pools and scour pools (Table 1). The occurrence of riffles is similar below and above OAR. More detailed figures and summaries of habitat unit distribution can be found in Appendix A.

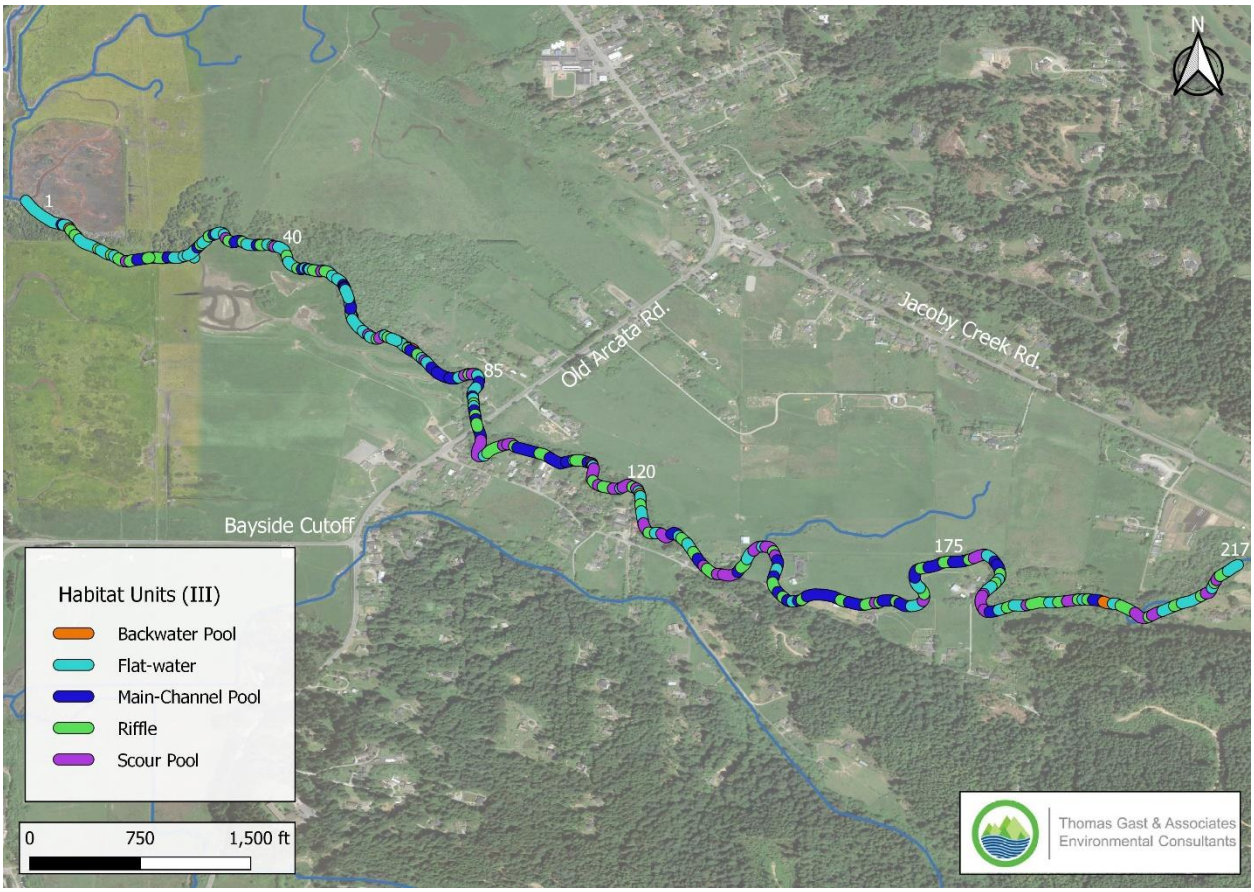

Figure 1: Habitat units in Jacoby Creek, characterized based on Level III habitat classification recommended by Flosi et al. (2010). Numbers displayed above the units indicate the habitat unit number.

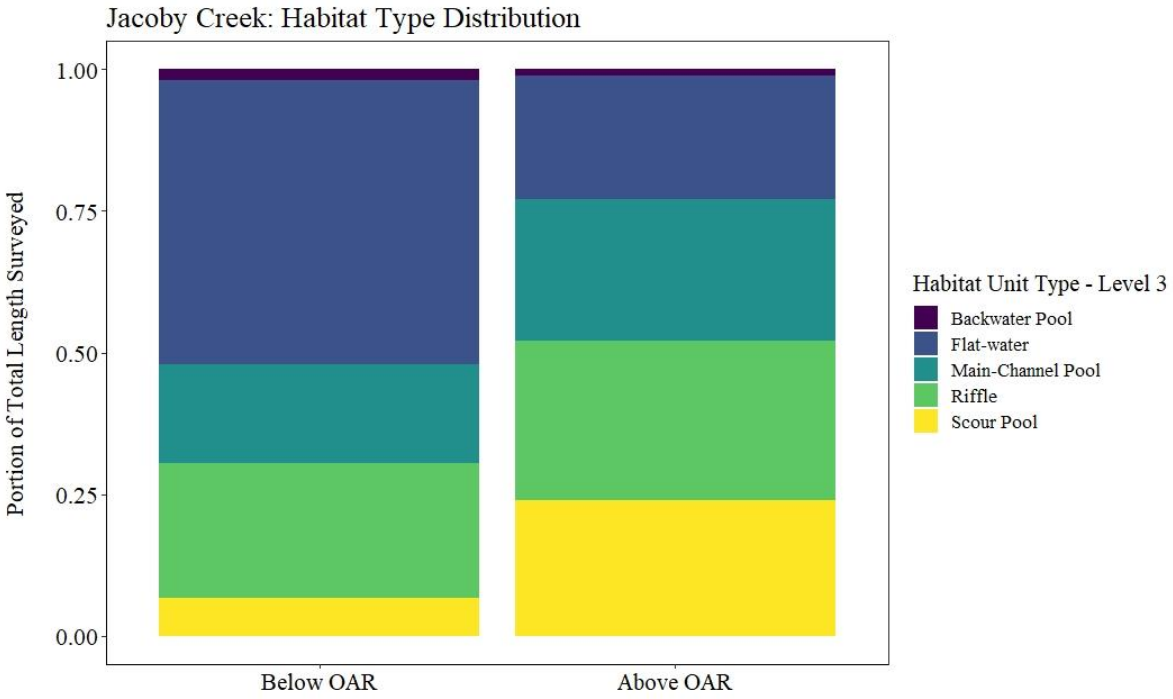

Figure 2: Habitat occurrence above and below Old Arcata Road (OAR), classified based on Level 3 Habitat classification.

Table 1: Summary of habitat units above and below OAR, including the average unit length, total length, and the portion of the entire section that is composed of the specific habitat unit. Habitat occurrence (%) is based on the total length of stream section (i.e., total length below OAR, total length above OAR).

Habitat Unit (Level III)	**Mean Length (ft)**		**Total Length (ft)**		**Habitat Occurrence (%)**	
	Below OAR	*Above OAR*	*Below OAR*	*Above OAR*	*Below OAR*	*Above OAR*
Backwater Pool	13.0	46.0	91	92	1.9	1.1
Flat-water	66.1	63.5	2380	1779	50.2	21.7
Main-Channel Pool	39.1	85.7	822	2056	17.3	25.1
Riffle	40.4	59.2	1132	2309	23.9	28.2
Scour Pool	31.6	65.1	316	1953	6.7	23.8
Total Surveyed Length (ft)			*4741*	*8189*		

4.2 Habitat Unit Characteristics

Geomorphic characteristics measured within each habitat unit include the width, depth, and maximum depth. Width measurements indicate the width of the wetted channel. Geomorphic measurements are summarized in Table 2. Most characteristics for each habitat unit were similar below and above OAR.

Table 2: Average geomorphic characteristics of habitat units, including the mean width, depth, and average maximum depth for two main reaches: below and above OAR.

Habitat Unit (Level III)	**Count**		**Mean Width (ft)**		**Mean Depth (ft)**		**Average Maximum Depth (ft)**	
	Below OAR	*Above OAR*	*Below OAR*	*Above OAR*	*Below OAR*	*Above OAR*	*Below OAR*	*Above OAR*
Backwater Pool	7	2	7.1	17.8	0.8	1.9	1.0	3.0
Flat-water	36	28	16.8	16.4	1.2	0.9	1.9	1.5
Main-Channel Pool	21	24	16.8	18.8	1.7	1.8	2.4	2.8
Riffle	28	39	13.4	13.1	0.6	0.6	1.1	1.0
Scour Pool	10	30	17.6	17.4	1.6	2.0	2.5	3.0

4.3 Pool Tail Characteristics

Pool tail crests (PTC) were only identified within pool habitat units during the assessment (Flosi et al., 2010). Measurements recorded included the depth of water at the pool tail crest, the embeddedness of substrate at pool tail-outs, and the dominant substrate composition. During the time of survey, the average water depth at PTC was 0.58 ft and 0.54 ft below and above OAR, respectively. The most common substrates found in PTC in both reaches were gravel (Table 3). The second most common substrate in PTC was sand in the reach below OAR, and small cobble above OAR. Substrate in PTC was generally more embedded below OAR than above OAR.

Table 3: Pool tail crest (PTC) characteristics in two main reaches of Jacoby Creek, including substrate type and embeddedness levels. Percentage of Pools in Reach (%) is calculated based on the total number of pool units within each reach.

Embeddedness Range	**Distribution of PTC embeddedness**			
	Count		*Percentage of Pools in Reach (%)*	
	Below OAR	*Above OAR*	*Below OAR*	*Above OAR*
0 – 25%	7	21	25.0	47.7
26 – 50%	9	22	32.1	50.0
51 – 75%	7	1	25.0	2.3
76 – 100%	4	0	14.3	0
Unsuitable for Spawning	1	0	3.6	0
Substrate	**Distribution of PTC Substrate**			
	Count		*Percentage of Pools in Reach (%)*	
	Below OAR	*Above OAR*	*Below OAR*	*Above OAR*
Sand	5	2	17.9	4.4
Gravel (0.08 – 2.5")	22	33	78.6	73.3
Small Cobble	1	10	3.6	22.2

4.4 Large Woody Debris

Large woody debris was noted during the Habitat Assessment and mapped separately during the survey. Majority of LWD was between 6 and 20 feet in length, with a smaller portion being greater than 20 ft in length (Table 4). Of all the LWD observed, approximately 60% was found below OAR. Field observations indicated that large wood was either not naturally occurring, or was being cut out of the channel and from banks before reaching the stream. The majority of the observed streamside trees were willow, which were below the size requirement to be considered LWD (minimum diameter = 12 inches). There were also observations of large and small wood that were possibly cut from the riparian area, as some of the wood present (either in the stream or on the banks) appeared to have been cut by chainsaws.

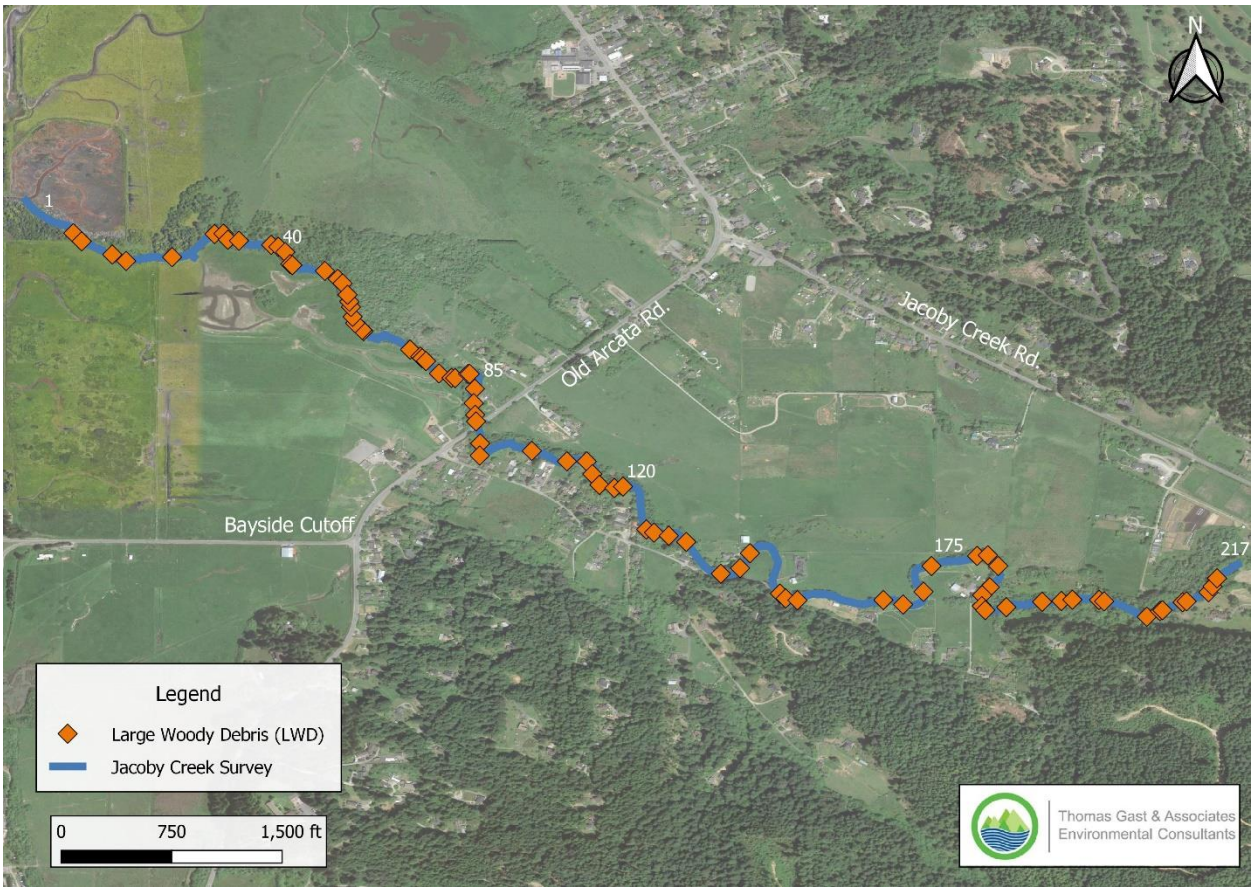

Figure 3: Presence of large woody debris mapped in Jacoby Creek.

Table 4: Large woody debris counts and observance rates below and above Old Arcata Rd.

	Below OAR		Above OAR		Total
LWD Length (ft)	**Count**	**Percent of Total Count (%)**	**Count**	**Percent of Total Count (%)**	**Count**
6 – 20	102	45.5	50	22.3	152
>20	34	15.2	38	17	72
Totals	***136***	***60.7***	***88***	***39.3***	***224***

4.5 Shelter Value Above and Below Old Arcata Rd

Instream shelter complexity is categorized into four rating values (0 – 3) which is intended to describe the complexity of shelter that serves as habitat or provides areas of refugia for salmonids. Shelter values are described by Flosi et al. (2010) in the following way:

- Shelter Value = 0
  - No shelter
- Shelter Value = 1
  - 1-5 boulders
  - Bare undercut bank or bedrock ledge

  - A single piece of LWD
- Shelter Value = 2
  - 1-2 pieces of LWD associated with any amount of small wood
  - 6+ boulders per 50 ft
  - Stable undercut banks with root mass, and less than 12" undercut
  - A single root wad with no complexity
  - Branches in or near water
  - Limited submersed vegetative cover for fish
  - A bubble curtain
- Shelter Value = 3 must have a minimum of two cover types:
  - LWD/boulders/root wads
  - 3+ pieces of LWD combined with SWD
  - 3+ boulders combined with LWD/SWD
  - Bubble curtain combined with LWD/boulders
  - Stable undercut bank (>12" undercut), root mass, or LWD
  - Extensive submersed vegetative cover for fish

Based on these classifications, units both downstream and upstream of Old Arcata Rd were most commonly rated as having shelter values of 1 and 2, with a slightly higher shelter value rating downstream of OAR than upstream (Table 5). Below OAR, 46% of the reach had a shelter value of 2. Above OAR, about 42% of the reach had a shelter value of 1, followed closely by a shelter value of 2 (39% of the reach). Only 5% and 2.4% of the reaches below and above OAR, respectively, were rated as having no shelter.

Table 5: Distribution of shelter value ratings within the surveyed sections of Jacoby Creek.

Shelter Value	Number of Units		Percent of Reach (%)	
	Below OAR	Above OAR	Below OAR	Above OAR
0	5	3	5	2.4
1	26	51	26	41.5
2	46	48	46	39.0
3	23	21	23	17.1

4.6 Habitat Unit Coverage

The amount of structural shelter found within each habitat unit is reflected by the "percentage of unit covered." Of this unit cover percentage, coverage is further characterized into the following categories: aquatic vegetation, boulders, bedrock, bubble curtain, large woody debris, root mass, small woody debris, terrestrial vegetation, or undercut banks.

Table 6 summarizes the average percent of habitat cover found within each habitat unit and reach. Overall, main-channel pools, scour pools, and flatwater had the greatest instream coverage. Main channel pools, riffles, and flat-water units all had greater coverage below Old Arcata Road than upstream of it. Backwater pools, on the other hand, had greater unit coverage upstream of OAR, but this may be caused by low sample size (Table 6).

Table 6: Summary of the average unit coverage (%) between habitat units and location (upstream/downstream of Old Arcata Rd).

Habitat Unit (Level III)	**Count**		**Average of Unit Cover (%)**	
	Below OAR	*Above OAR*	*Below OAR*	*Above OAR*
Backwater Pool	7	2	10.0	50.0
Flat-water	36	28	61.9	50.5
Main-Channel Pool	21	24	71.7	54.0
Riffle	28	39	40.4	31.2
Scour Pool	10	30	60.5	63.0

Specific cover types that make up the total habitat unit cover are summarized in Figure 4. Small woody debris was the predominant cover type found in all habitat units both above and below OAR (Figure 4). Undercut banks were common in all habitat units above OAR. Below OAR, however, there was more terrestrial vegetation providing in-stream cover than undercut banks. Boulders were the least common cover type found during the survey, with most occurring in main channel pools above OAR.

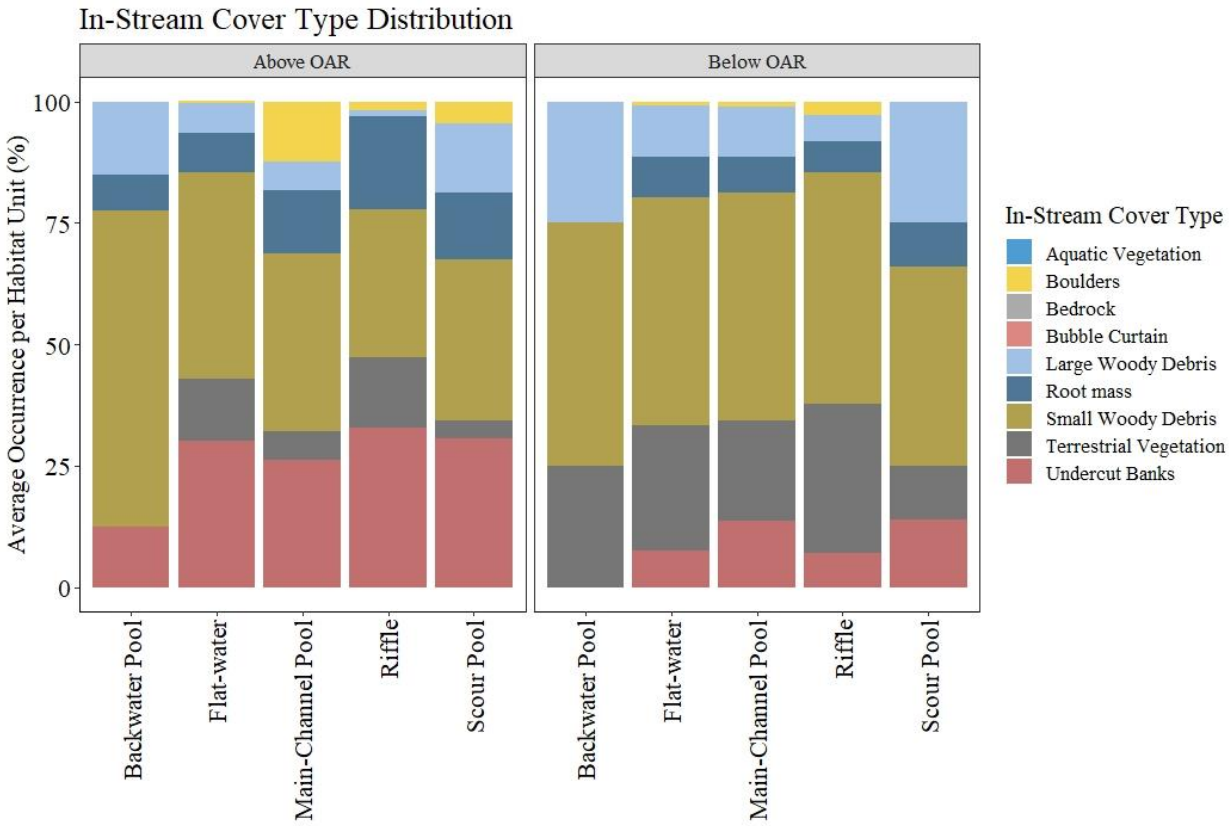

Figure 4: Distribution of cover types found within each habitat unit (percent based on frequency of occurrence within each reach).

4.7 Substrate Composition

Within each habitat unit, the dominant and co-dominant substrate was noted as part of the habitat assessment. The most dominant substrate below Old Arcata Rd. was sand, followed by gravel and silt/clay (Figure 5). Field observations indicated that substrate sizes generally increased with distance upstream. Upstream of OAR, the most dominant substrate type was gravel, followed by sand and then small cobble. There was little to no small cobble present below OAR.

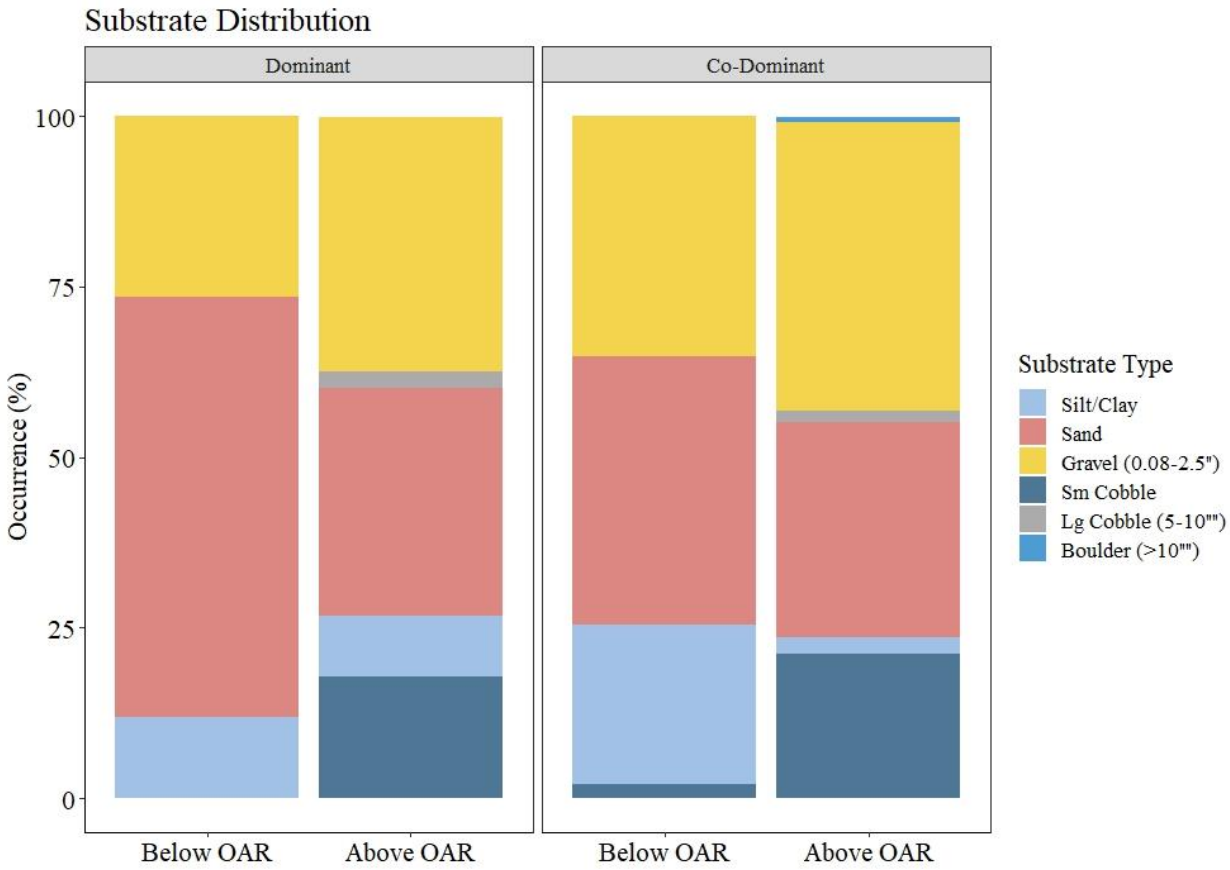

Figure 5: Dominant (left) and co-dominant (right) substrate distributions downstream and upstream of Old Arcata Rd

4.8 Canopy Cover

Canopy cover reflects tree density and indicates how much of the stream channel is shaded from the sun. The mean percentage of canopy cover over the lower reach of Jacoby Creek (below OAR) was 61%, and approximately 48% above OAR. Figure 6 displays the geospatial distribution of canopy cover over the entire surveyed length and shows no distinct pattern in canopy cover. Figure 6 does, however, show the general stream sections that are fully covered and those that are lacking cover, which may influence future restoration efforts.

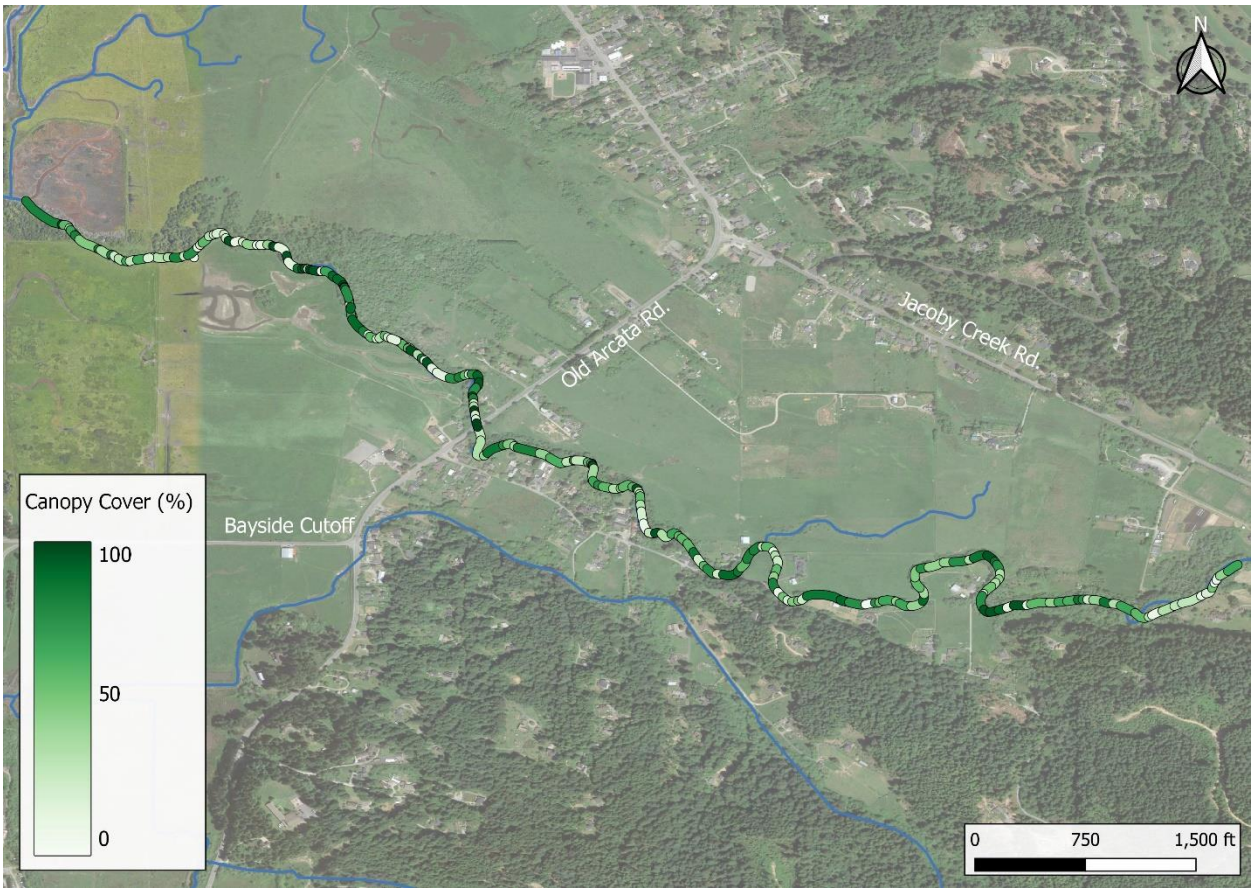

Figure 6: Total canopy cover (%) distribution across the surveyed section of Jacoby Creek.

Of the total canopy density, the percentage of cover that is provided by hardwood and coniferous trees was also estimated. Of the surveyed units, hardwood trees made up an average of 95% of the total canopy cover. Field observations indicate that most of the streamside hardwoods are a willow species (Salix spp.). Downstream of Old Arcata Rd, approximately between habitat units 40 and 85, willow growing on the sides of the bank are encroaching the creek and/or falling across the creek. Fallen willow that span the creek continue to grow and sprout new growth, causing small woody debris to build behind them and "choke" the channel. Upstream of Old Arcata Rd., however, streamside willow are either older, or have been cut by landowners so they are not obstructing flow.

4.9 Bank Composition and Vegetation

The substrate and vegetation composition of banks in Jacoby Creek are summarized in Table 7. The dominant substrate composition of banks both upstream and downstream of OAR was silt/sand/clay. There was a higher occurrence of cobble/gravel and boulders making up the banks upstream of OAR than downstream. The most commonly observed vegetation established on the banks was brush, with a significant presence of Himalayan blackberries (*Rubus armeniacus*) and English ivy (*Hedera helix*) noted. Upstream of OAR, there was a higher occurrence of no vegetation along the banks when compared to downstream of OAR (Table 7). It is important to

note that this parameter reflects the dominant substrate and vegetation present on banks during the time of survey. Therefore, although Table 7 indicates 0% composition of coniferous trees on most banks, it is not to say that coniferous trees were not present altogether - they were simply not the most dominant vegetation type.

Table 7: Average substrate composition and vegetation types along left and right banks, upstream ("above") and downstream ("below") Old Arcata Rd., respectively.

	Left Bank (% Composition)		**Right Bank (% Composition)**	
	Below OAR	*Above OAR*	*Below OAR*	*Above OAR*
Dominant Substrate Type				
Silt/Sand/Clay	100	80.5	97.9	86.2
Cobble/Gravel	0	9.8	2.1	12.2
Boulder	0	9.8	0	1.6
Dominant Vegetation Type				
Brush	72.9	52	55.7	50.4
Coniferous Trees	0	0.8	0	0
Grass	11.5	29.3	14.4	27.6
Hardwood Trees	14.6	12.2	27.8	13.8
No Vegetation	1.0	5.7	0	8.1

In addition to bank substrate and vegetation, the percent of the bank covered was also visually estimated for each habitat unit. Overall, banks downstream of OAR had greater variation in bank vegetation coverage, with the median being at 40% for both the left and right banks (Figure 7). Above OAR, the median bank coverage was 90% and 85% for the left and right bank, respectively. During the time of survey, it was noted that banks downstream of OAR were sparsely vegetated but had a lot of overhanging brush. Therefore, although the overhanging brush did not contribute to bank stability by roots, it is possible the overhanding brush offered some protection from bank scouring.

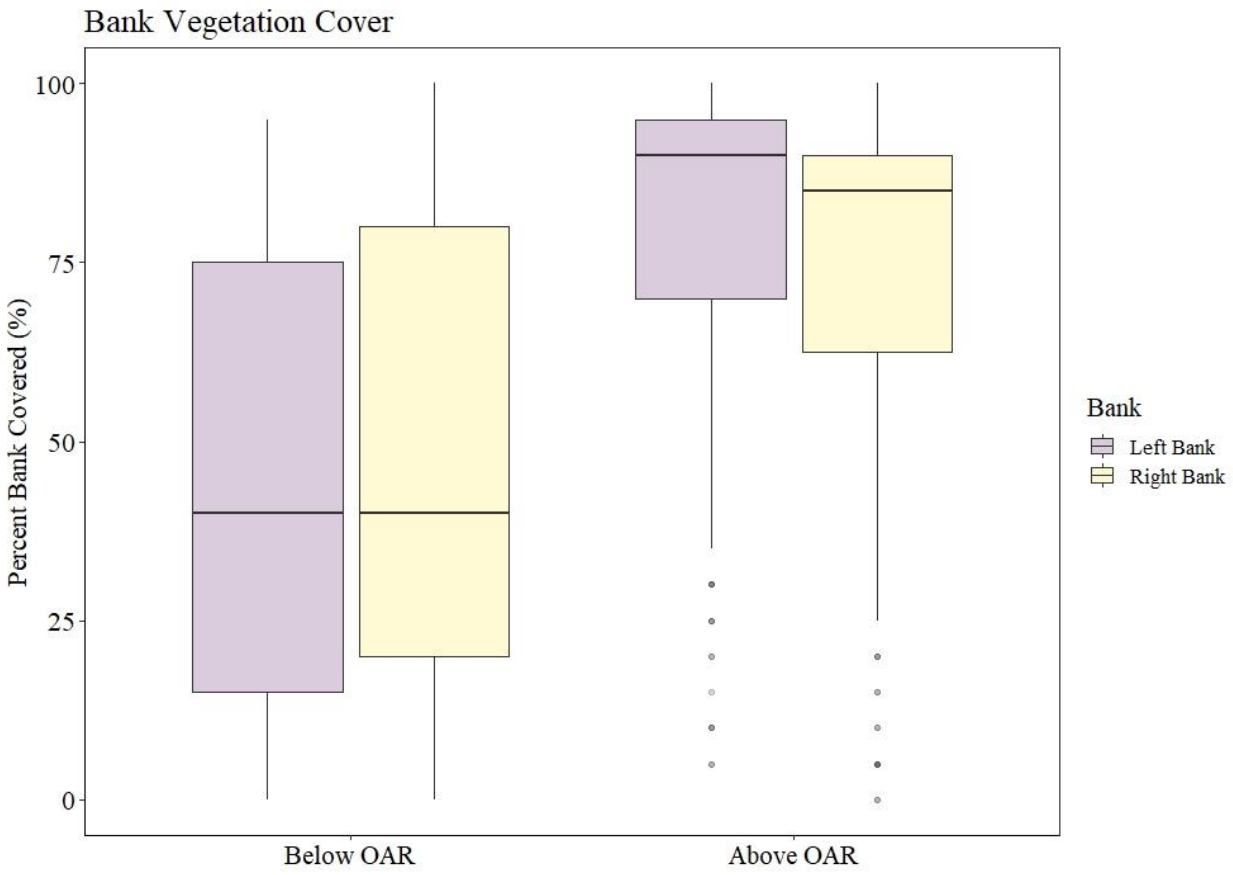

Figure 7: Summary of bank vegetative cover (%) below and above Old Arcata Rd. The line within the box plot indicates the median value of the group, and the upper and lower bounds of the box show the interquartile range (IQR). Whiskers show the range of values outside 1.5*IQR, and individual points show observations outside the 1.5*IQR.

4.10 Small Woody Debris Jams

In addition to habitat assessment, TGAEC staff collected information on the size and location of small woody debris (SWD) jams in Jacoby Creek (Figure 8). During the time of survey, there was a higher occurrence of SWD jams downstream of OAR than upstream OAR. Based on field observations, this appears to be influenced by the spanning willow that are creating small obstructions in the creek. Upstream of OAR, there was evidence of jams and spanning trees being cut out of the stream by landowners, which also may influence the low occurrence of SWD jams observed in that section of the stream.

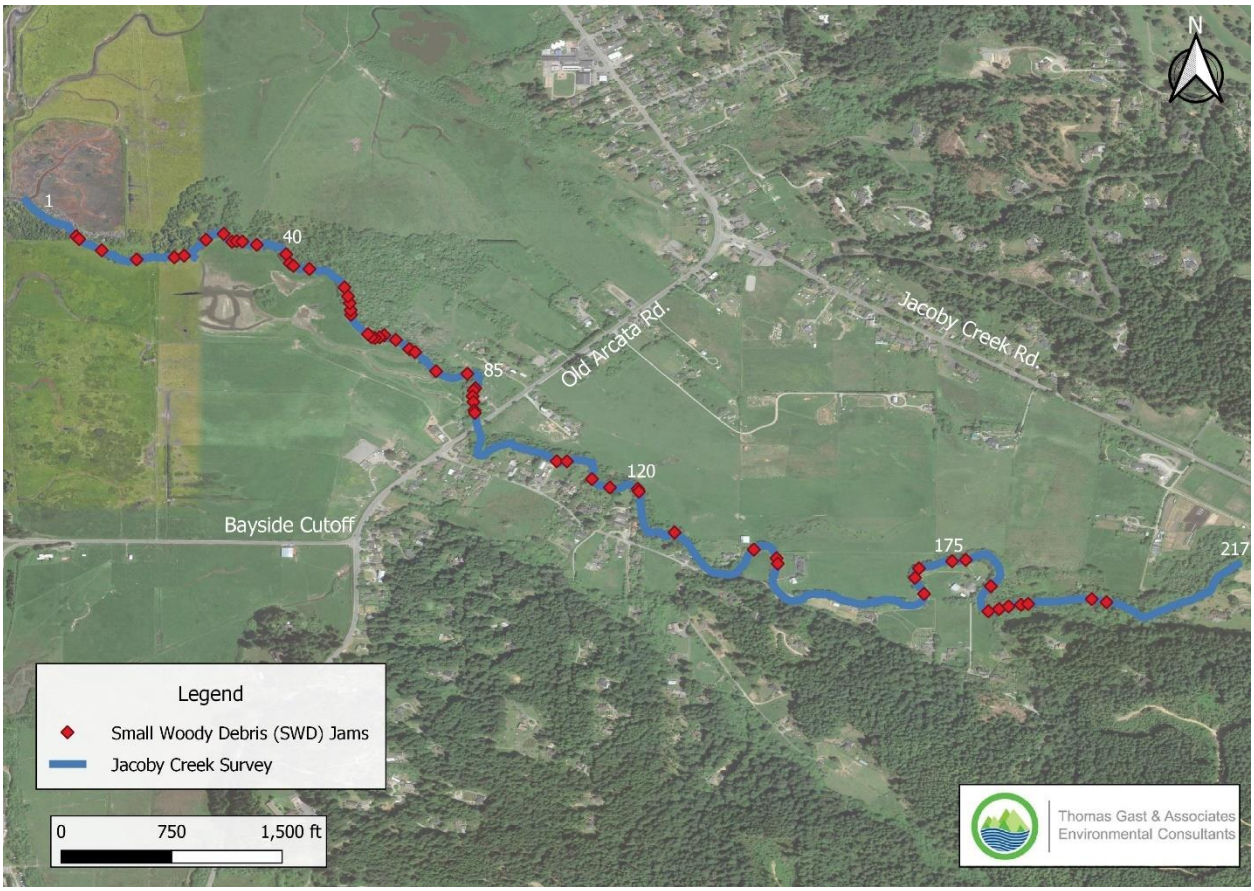

Figure 8: Small woody debris (SWD) jams along the surveyed section of Jacoby Creek.

SWD jams, especially downstream of OAR, oftentimes had incorporated anthropogenic materials into the jam. It was common to find pieces of lumber in these jams, such as two-by-fours, as well as other wood that did not originate from the stream (i.e., pallet board, wooden planter box). It was also very common to find cut rounds in the stream, which were visibly cut by chainsaw, that became trapped in the SWD jams. Aside from wood materials, these jams also collected brush debris, which may or may not have naturally found their way into the stream. Propane tanks, plastic bottles, and metal cans were also found in the SWD jams, particularly near OAR bridge.

4.11 Evidence of Spawning Activity

At the time of survey, there were numerous indicators of successful spawning that occurred in Jacoby Creek. The first units with redds observed were 18 and 33, but redds were scarce below OAR. Redds were far more numerous upstream of OAR, increasing in occurrence above habitat unit 138 (Appendix A, Figure A3). Similarly, Coho salmon (*Oncorhynchus kisutch*) carcasses were found in habitat units below OAR, but it was much more common to find fully intact and parts of carcasses further upstream (Appendix A, Figures A4-A5).

4.12 Freshwater Mussels

During the habitat assessment survey, TGAEC staff noted a significant presence of freshwater mussels in the lower reach of Jacoby Creek (Appendix A, Figure A6). Their presence begins near the upper extent of tidal influence (habitat unit #13) and they were last noted just upstream of OAR (habitat unit #100). It was estimated that there were at least 500 hundred mussels present. Mussels were observed in the stream where there was predominantly sandy substrate. It was also common to see opened mussel shells scattered along gravel bars. Based on observation of opened mussel shells, CDFW staff identified these mussels as Western pearlshell (*Margaritifera falcata*); an official identification is still pending by the Xerces Society. A field survey report was submitted to the California Natural Diversity Database (CNDDB) managed by California Department of Fish and Wildlife.

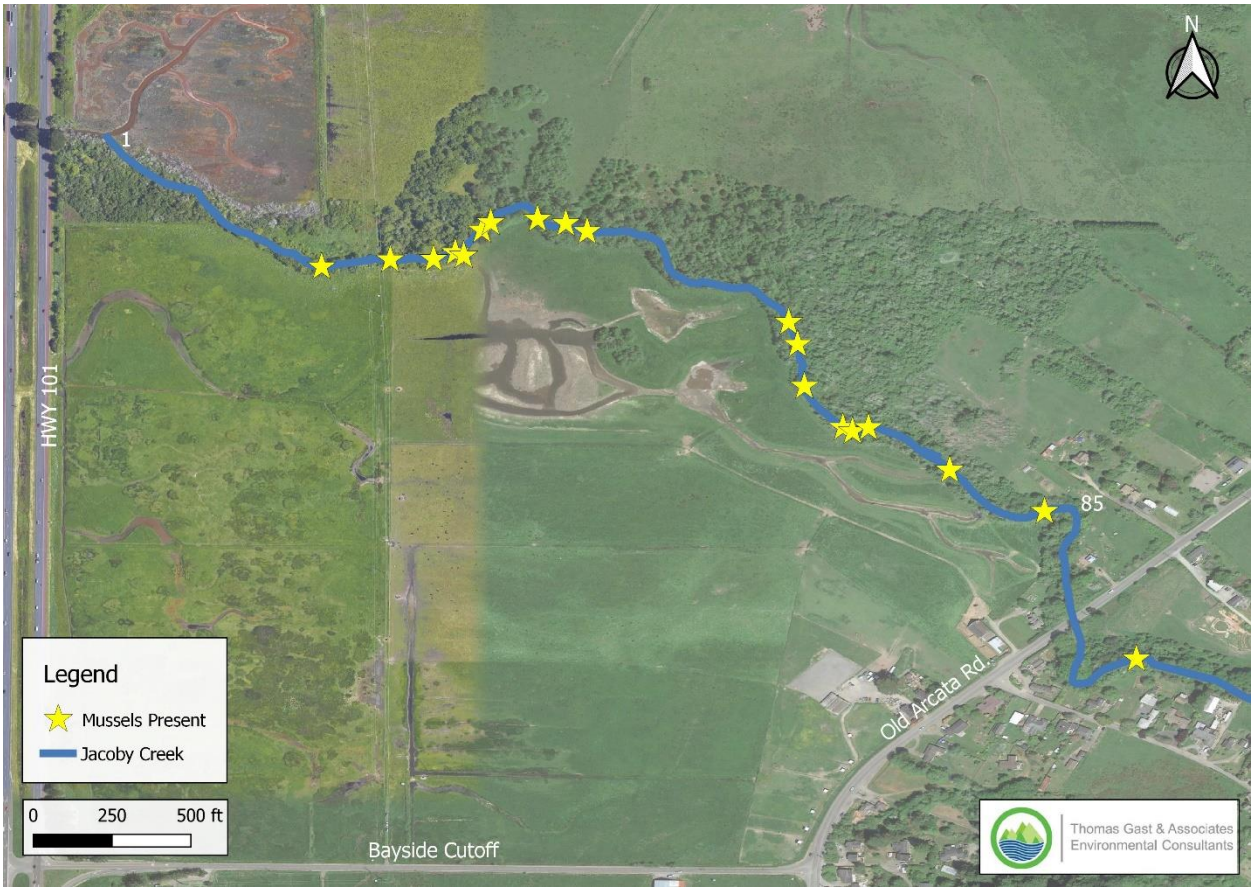

Figure 9: Observations of Western pearlshell mussel (identification pending by Xerces Society) in lower Jacoby Creek.

5. References

Flosi, G., Downie, S., Hopelain, J., Bird, M., Coey, R., and Collins, B., 2010. California Salmonid Stream Habitat Restoration Manual. Fourth Edition. State of California Resources Agency, Department of Fish and Game Wildlife and Fisheries Division.

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Appendix A: Supplemental Tables and Figures

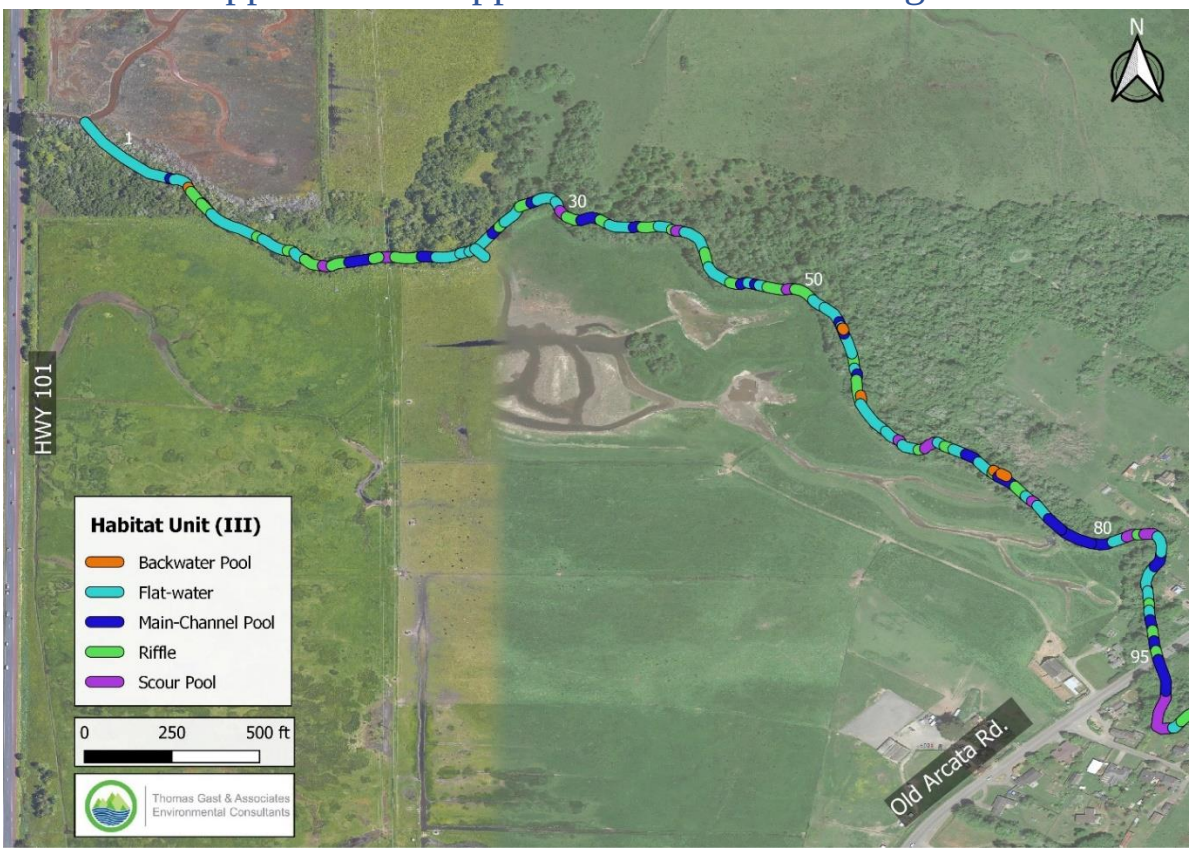

Figure A1: Habitat units below Old Arcata Road

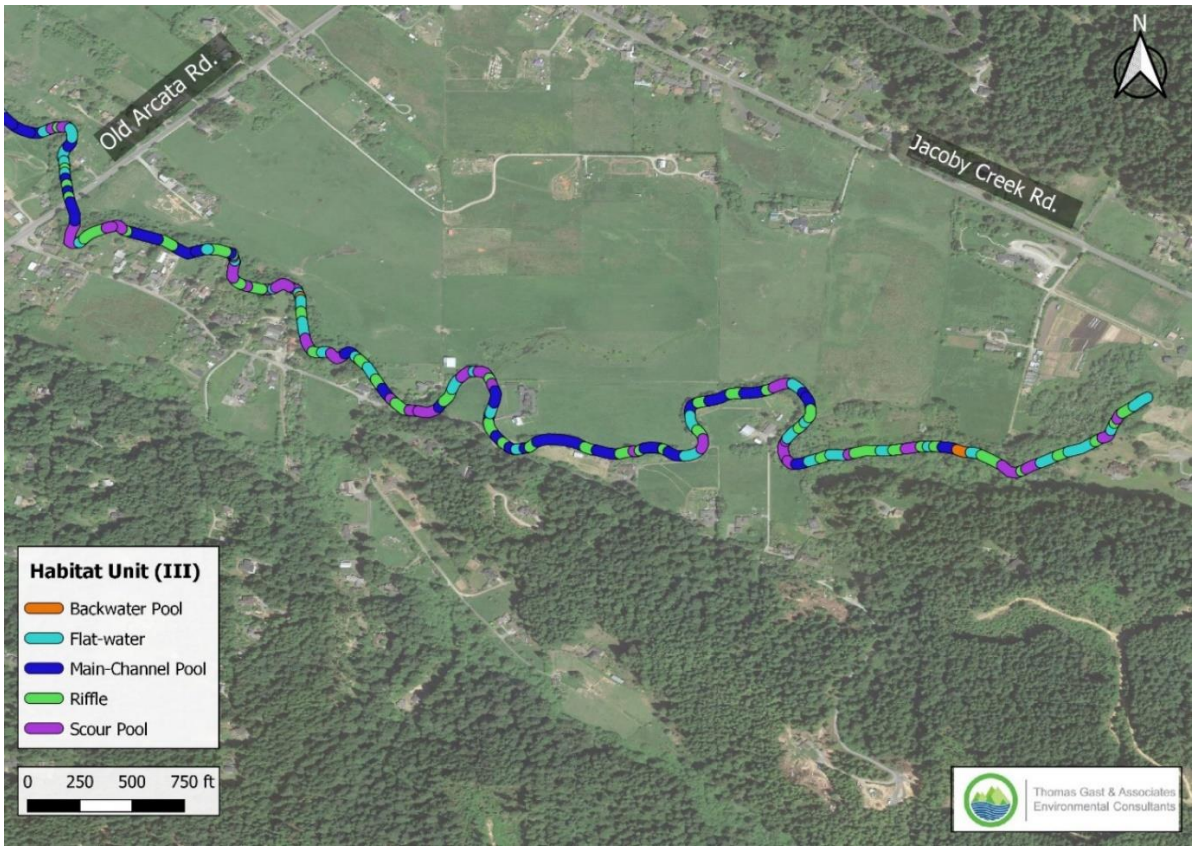

Figure A2: Habitat units above Old Arcata Road

Table A1: Description of parameters collected during aquatic habitat assessment.

Parameter	Field Form Header	Description
Date and Time	datetime	Date and time of data collection
Surveyors	surveyors	Surveyor initials, with note-taker listed first
Habitat Unit Number	hab-u-no	Habitat unit number
Habitat Unit Type, Level 4	hab-u-type-level 4	Habitat unit type, level 4 classification
Habitat Unit Type, Level 3	hab_u-type-level 3	Habitat unit type, level 3 classification
Side Channel Type	sidech-typ	Habitat unit type of side channel, if present
Unit Length (ft), measured by hip-chain	hipchn-length_ft	Thalweg length of unit (ft) recorded by hip-chain
Mean Width (ft)	mean-width-ft	Width of wetted channel (ft) measured in 2+ locations within habitat unit and averaged
Mean Depth (ft)	mean-depth	Average water depth (ft) within unit, taken at several random locations using a stadia rod and averaged
Maximum Depth (ft)	max-depth	Maximum water depth measured within unit (ft)
Depth Pool Tail Crest (ft)	depth-ptc	Maximum thalweg depth at the pool-tail crest (ft); this measurement is taken in pool habitat units only
Pool Tail Embeddedness	pt-embedde	Percent cobble embeddedness at pool tail-outs. Determined by sampling five small cobbles and estimating percent of stone buried in sediment.
Pool Tail Substrate	pt-substra	Dominant substrate composition of the pool tail-out
Large Woody Debris Count Diameter >1’ and Length from 6’ to 20’	lwd-L6-20	Number of pieces of large woody debris, with a diameter greater than 1 foot and a length between 6 and 20 feet. This includes wood that is wholly or partially within the bankfull discharge elevation of that habitat unit.
Large Woody Debris Count Diameter >1’ and Length >20’	lwd-L>20	Number of pieces of large woody debris, with a diameter greater than 1 foot and a length greater than 20 feet. This includes wood that is wholly or partially within the bankfull discharge elevation of that habitat unit.
Shelter Value	shlter_val	Number value code (0-3) that corresponds to the dominant structural shelter type that exists within the unit
Percent Unit Covered	%unit-cvrd	Percentage of unit occupied by structural shelter; 100% of the shelter is then classified into nine shelter types: undercut banks, small woody debris, large woody debris, root mass, terrestrial vegetation, aquatic vegetation, bubble curtain, boulder, and bedrock.
Percent Undercut Banks	%uc-bank	Of the total percentage unit covered, classify how much of the unit is covered by undercut banks
Percent Small Woody Debris (<12” Diameter)	%swd<12d	Of the total percentage unit covered, classify how much of the unit is covered by small woody debris (diameter < 12")
Percent Large Woody Debris (>12” Diameter)	%lwd>12d	Of the total percentage unit covered, classify how much of the unit is covered by large woody debris (diameter > 12")
Percent Root Mass	%rt-mass	Of the total percentage unit covered, classify how much of the unit is covered by root mass
Percent Terrestrial Vegetation	%terr-veg	Of the total percentage unit covered, classify how much of the unit is covered by terrestrial vegetation
Percent Aquatic Vegetation	%aqua-veg	Of the total percentage unit covered, classify how much of the unit is covered by aquatic vegetation
Percent Bubble Curtain	%bubb-curt	Of the total percentage unit covered, classify how much of the unit is covered by bubble curtain
Percent Boulder	%bldr	Of the total percentage unit covered, classify how much of the unit is covered by boulders

Percent Bedrock	%brx	Of the total percentage unit covered, classify how much of the unit is covered by bedrock
Substrate Composition (Dominant)	dom-sub1	Dominant substrate type
Substrate Composition (Co-dominant)	dom-sub2	Co-dominant substrate type
Percent Exposed Substrate	%exp-subs	Estimated percentage of the bottom substrate of the unit that is exposed above the water surface
Percent Total Canopy	%tot-canop	Estimated percent of the stream area that is influenced by the tree canopy; estimated at the upstream end of each habitat unit in the center of the wetted channel
Percent Hardwood Trees	%-hardwd	Estimated percent of the total canopy that is consisting of hardwood trees
Percent Coniferous Trees	%conif	Estimated percent of the total canopy that is consisting of coniferous trees
Right Bank Composition	RB-comp	The bank composition of right bank (when facing downstream) observed from the base of the stream bank to the bankfull discharge level
Right Bank Dominant Vegetation	RB-veg	Dominant vegetation type of the right bank (when facing downstream), from bankfull to 20 feet upslope
Percent Right Bank Vegetated	%RB-veg	Estimated total percentage of the right bank (when facing downstream) covered with vegetation, from bankfull discharge level to 20 feet upslope
Left Bank Composition	LB-comp	The bank composition of left bank (when facing downstream) observed from the base of the stream bank to the bankfull discharge level
Left Bank Dominant Vegetation	LB-veg	Dominant vegetation type of the left bank (when facing downstream), from bankfull to 20 feet upslope
Percent Left Bank Vegetated	%LB-veg	Estimated total percentage of the left bank (when facing downstream) covered with vegetation, from bankfull discharge level to 20 feet upslope

Figure A3 (left): Observed redd in Jacoby Creek, upstream of OAR, on February 3, 2022.

Figures A4 (left) and A5 (below): Coho carcasses observed in Jacoby Creek during the time of survey. Both carcasses were found upstream of OAR.

Figure A6: Freshwater mussels in Jacoby Creek, below OAR. Photograph taken February 10, 2022.

Appendix B: Attachments

- **Attachment_1_Habiat_units.xlsx**
  - This attachment includes the tabular data of the habitat assessment survey
- **Attachment_2_PET22F0001_Freshwater Mussel_CNDDB.pdf**
  - This attachment is a copy of the CNDDB Online Field Survey Report submitted to CDFW to indicate the presence of western pearlshell mussels in Jacoby Creek
- **Attachment_3_GIS.zip**
  - This is a zip folder containing GIS files related to the habitat assessment survey, small woody debris jams, large woody debris, and mussel presence.
  - Included in this folder is a DCIM sub-folder which contains photographs linked to geospatial features collected during the survey.
  - All geospatial files in this folder are in EPSG:4326 – WGS 84 Coordinate System.