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Jacoby Creek Site Inventory Assessment and Management Recommendations for Parcel 502-052-022

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Jacoby Creek Parcel 502-052-022 in March 2020 (Photo taken by Aida Tavakoli Ardakanit)

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Applied Ecological Restoration

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Jacoby Creek Land Trust

EXECUTIVE SUMMARY

Jacoby Creek is a 16.6 mi^2 watershed that discharges into Humboldt Bay in Humboldt County, California**.** Legacy use of this watershed consisted of unmanaged logging and diking to create pastureland for agriculture until the 1970's. Currently, 187 acres of the Jacoby Creek watershed is owned by the Jacoby Creek Land Trust (JCLT). JCLT focuses on creating a space for recreation and conservation within the Jacoby Creek watershed.

The parcel (parcel 502-052-022) was assessed to identify social trails, invasive species, tree density, and upland understory vegetation to provide restoration recommendations. Non-native invasive species, such as *Hedera helix* (English ivy) and *Rubus armeniacus* (Himalayan Blackberry), without proper management have the potential to grow and outcompete native flora. A system of social trails were found, most of which lead to less accessible routes. It is recommended that JCLT discourage the use of social trails by covering trail entrances and with online notices and other forms of outreach. A tree density assessment was conducted on the previously logged, second growth forest, showing it is of high density. A variable density thinning treatment is recommended to allow for healthier trees similar to old growth redwood forest conditions.

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INTRODUCTION

The Jacoby Creek watershed is located in Humboldt County on the northwestern coast of California (Figure 1). Jacoby Creek is a 16.6 mi^2 watershed between the cities of Eureka and Arcata and drains into Humboldt Bay (Murray & Wunner, 1980). The Jacoby Creek watershed is located on the Wiyot Tribe's ancestral land and provides vital habitat to Coho Salmon (*Oncorhynchus kisutch*), steelhead (*O. mykiss irideus*) and Cutthroat Trout (*O. clarkii*) (Murray & Wunner, 1988).

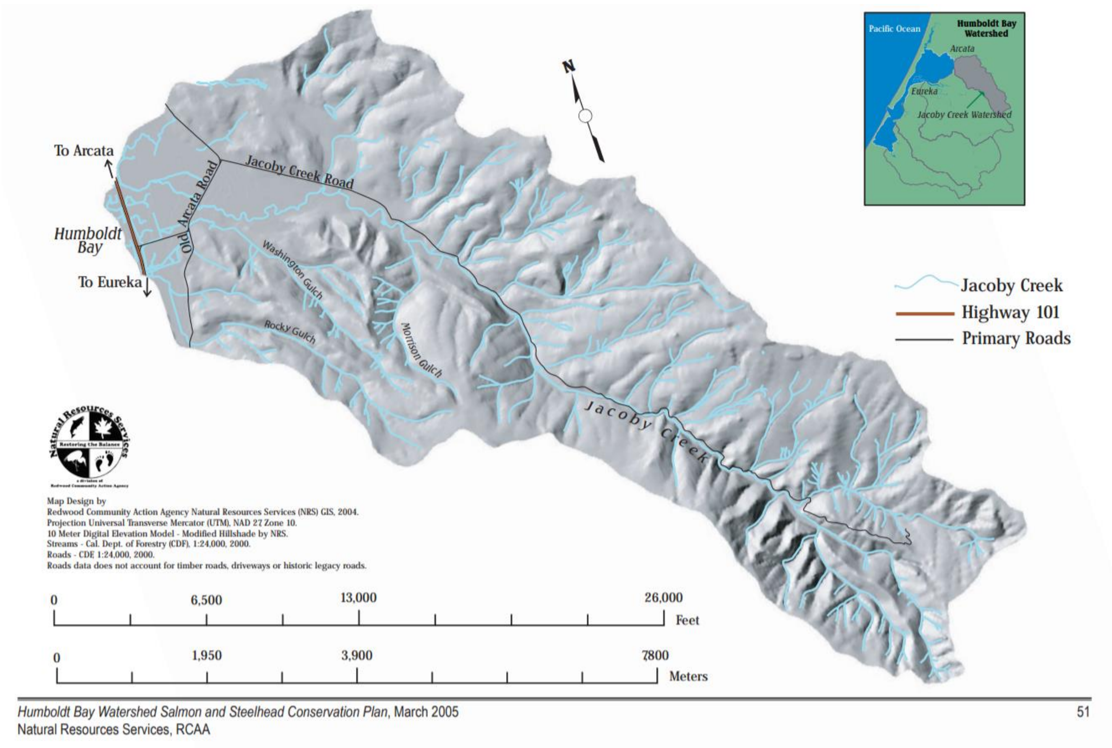

Figure 1: A map of the Jacoby Creek watershed (Source: RCAA, 2005).

Background

European settlement activities had adverse effects on Jacoby Creek and its surrounding watershed (Cottrell et al., 2013). The historical land use was a mix of timber harvest in the upper watershed and agriculture on the flatlands in the lower watershed (Murray & Wunner, 1988). Logging started in the 1850s and tree species harvested consisted of fir (*Abies sp.)*, spruce *(Picea sp.)* and coast redwood *(Sequoia sempervirens)*. The peak of logging activity in the Jacoby Creek watershed occurred between 1880 to 1910 (Murray & Wunner, 1980) (NRS, 2005). Logging impacts resulted in the increase of sedimentation into the creek, which threatened salmonid habitat quality (NRS, 2005).

Salmonids require larger gravels to construct redds and spawn (Kondolf & Wolman, 1993). An increase of sedimentation causes a decline in spawning gravels for salmonids (Soulsby et al., 2001). Logging practices continued after the peak years until California enacted the Forest Practice Act in 1973 (Calfire, n.d). This act enforces laws that will "preserve and protect our fish, wildlife, forests and streams" (Calfire, n.d.). Prior to the 1973's revision of the California Practice Forest Act, over 60% of the upper Jacoby Creek headwaters were clear-cut (Murray & Wunner, 1988). Between the years 1988 to 2000, 26% of the Jacoby Creek watershed was still being harvested by timber companies (NRS, 2005). Understanding the logging history in Jacoby Creek provides context to current conditions.

Jacoby Creek Land Trust

The Jacoby Creek Land Trust (JCLT) was formed in 1992 (Hoover, 2015) with the mission is to "conserves land in and around Northern Humboldt Bay to promote healthy creek environments, watershed protection, and sustainable agriculture that is embraced and valued by the local community" (JCLT, n.d.). Currently, the JCLT owns approximately 187 acres of land and manages 15 conservation easements in the Jacoby Creek watershed (S. Mietz, personal communication, 2020). The Jacoby Creek Land Trust's vision is to manage and maintain the Jacoby Creek and the surrounding area. Their management objective will provide space for the use of recreation and the enjoyment by the local community, while also retaining the ecosystem's integrity (JCLT, n.d).

Social Trails

Social trails can negatively impact an area, causing significant disturbances to sensitive species and increasing fragmentation of natural ecosystems (Bradford & McIntyre, 2007). Some of the prominent impacts of excessive trail use include soil erosion, soil compaction, trail extension, vegetation damage, and aesthetic impacts (Lynn & Brown, 2003). By mapping the available trails for the JCLT, we aim to reduce the adverse impacts of social trails.

Invasive Species

Riparian zones and freshwater wetlands are some of the most heavily used, essential, sensitive, and resilient habitats (Oakley et al., 1985). Some of the same factors that allow riparian zones to support high plant species richness may also increase susceptibility to invasion by exotic species; disturbance facilitates the successful invasion of exotic plants (Hood & Naiman, 2000). Land managers can use vegetation to estimate the relative health of an ecosystem by recognizing plants that should theoretically be present in a particular habitat, given that all other habitat criteria are met. A vegetative assessment will give some indication of the health of the terrestrial ecosystem (Godínez-Alvarez, 20019). By recording the invasive species on site, it can reveal if the introduced species has affected the species richness or structural diversity of the habitat (Fierke & Kauffman, 2006).

Tree Stem Density

Second growth redwood (*S. sempervirens*) forests are likely to be three times denser than old growth forests (O'Hara et al., 2007). Tree density and distribution in the redwood forest affect stem growth and the overall health of individual trees (O'Hara et al., 2017). The reduction of tree density will result in tree growth and further meet the JCLT's goal of restoring the site to historic conditions (O'Hara et al, 2010). This assessment will help identify if the JCLT needs to take further action and conduct thinning.

Project Objectives

Of the 187-acre, our survey area was a 19-acre parcel that is within a 60-acre plot owned by the JCLT (Figure 2). The JCLT's goal for this assessment is to identify the current conditions at this site that identify methods of land conservation and encourage stewardship by the community. The objectives of this project are to conduct a site assessment of the 19-acre site (parcel number 502-052-022) for the JCLT and provide management recommendations on the findings. The scope of this assessment will include: 1) mapping of public trails on the site; 2) a vegetation assessment to identify the dominant and subdominant understory species as well as invasive species; and 3) a stem density assessment to identify if thinning or planting treatments are needed. These assessments will give a current evaluation of the health and condition of the land and provide a baseline for recommendations.

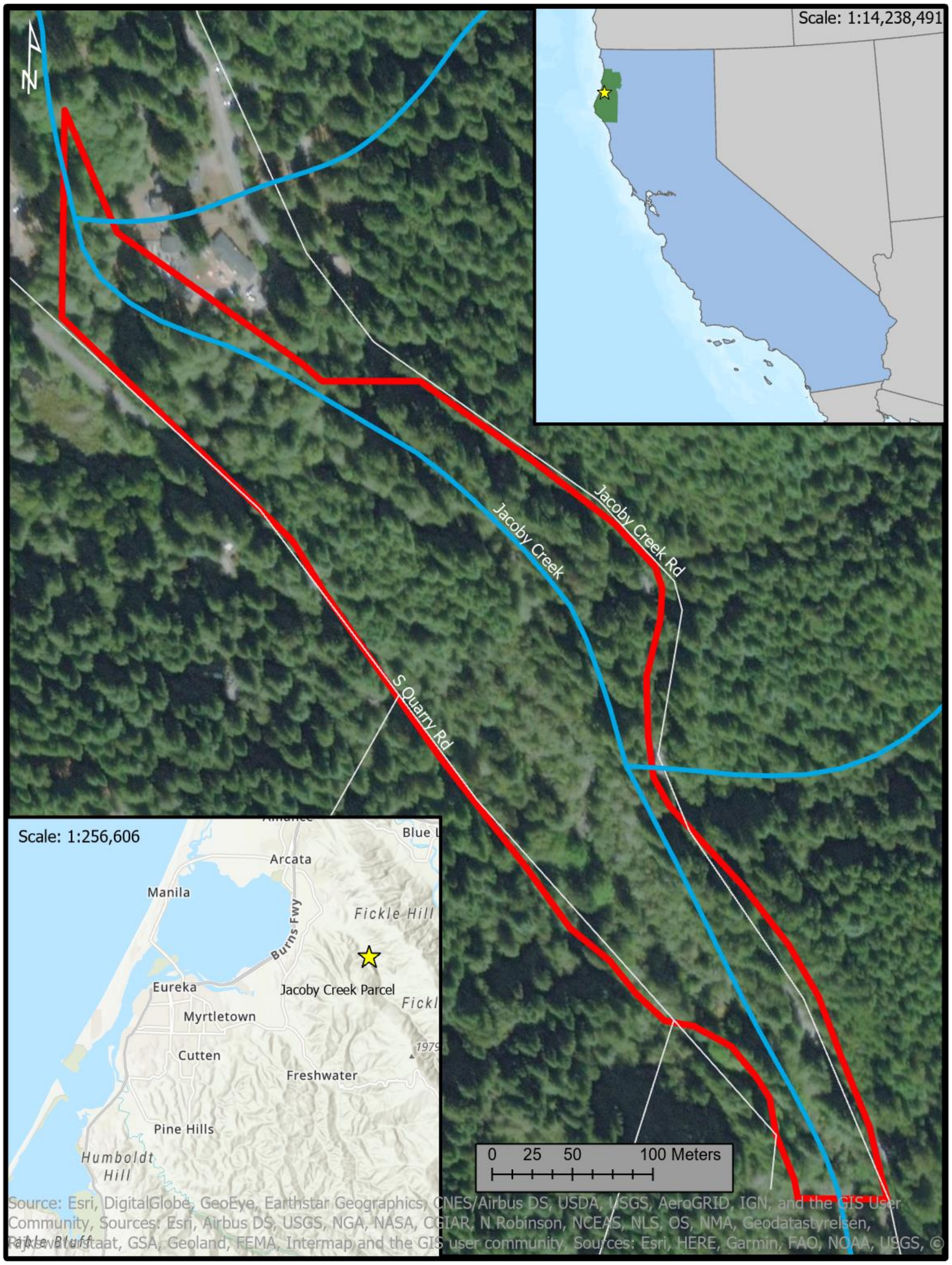

Figure 2: Location map of parcel number 502-052-022 along Jacoby Creek in Humboldt County, CA (upper right), and the location of the parcel relative to its surrounding area (lower left). The center map shows the size and shape of the parcel and its position relative to Jacoby Creek. Map created by Sean Dent in ArcGIS Pro version 2.5.

METHODS

Site Description

The parcel examine for this project is within the Jacoby Creek watershed and consists of a riparian corridor with steep slopes that transition to forested areas. The site is located between Jacoby Creek Road and South Quarry Road where trail entrances can be found. The terrestrial ecosystem transitions from a riparian zone along Jacoby Creek to a mixed-coniferous forested area. The site receives approximately 46 inches of precipitation and the mean annual air temperature ranges from 10-12.8 degrees Celsius (50-55 degrees F) (Web Soil Survey, 2020). The soil within the site is comprised mostly of Lepoil-Candymountain complex, with up to two inches of organic matter; the soil texture within the site is comprised of loam, sandy loam, clay loam, fine sandy loam, and fine sand, however, the northwestern and riparian portions of the site are comprised of mostly silt loam (Web Soil Survey, 2020).

Vegetation at the site is dominated by young coastal redwoods (*Sequoia sempervirens*) mixed with western red cedar (*Thuja plicata*), Douglas fir (*Pseudotsuga menziesii*), tanoak (*Lithocarpus densiflorus*), and Sitka spruce (*Picea sitchensis*). Both the riparian zone and the northwestern portion of the site are comprised of willows (*Salix sp.*), red alder (*Alnus rubra*) and other common riparian trees. The understory vegetation mostly consists of native species such as redwood sorrel (*Oxalis oregana*), deer fern (*Blechnum spicant*), sword fern (*Polystichum munitum*), Pacific trillium (*Trillium ovatum*), salal (*Gaultheria shallon*), California huckleberry (*Vaccinium ovatum*), salmonberry (*Rubus spectabilis*), thimbleberry (*Rubus parviflorus*), stinging nettle (*Urtica dioica*), wild ginger (*Asarum caudatum*), horsetail (*Equisetum sp*.), and California blackberry (*Rubus ursinus*). The nonnative invasive species in the understory include English ivy (*Hedera helix*) and Himalayan blackberry (*Rubus armeniacus*). The English ivy grows in thick mats on the forest floor, keeping relatively close to the stream and creeps high into trees and shrubs with the capability of shading out vegetation (Koepke-Hill & Armel, n.d.).

Mapping

Trail Assessment

Primary trails, used to help maximize the accessibility of the site for users, while minimizing ecological impact, at the site were mapped, using a Garmin GPS unit's by setting waypoints at 5-second intervals to track each route that was traveled. After mapping dominant trails, the delineated social trails can be used to make decisions about which ones to prioritize for decommissioning.

Invasive Species Assessment

GPS points were taken to determine the site's current invasive species coverage. A Garmin GPS unit was used to identify individual areas of interest such as English ivy patches, Himalayan Blackberry bushes, and garbage piles. Waypoints were collected and identified regions within the project area that were encroached by nonnative species. The data collected were then imported and converted into maps of invasive plant species in the parcel.

Tree Stem Density Assessment

A "point-center quarter" method was used to measure the tree density within the study area (Mitchell, 2010). Four 50-meter transects were laid out in the upland forest region spaced apart to capture the tree density of the overall area (Figure 3). A random number generator was used to exclude any biases when picking sampling points along the transect (Stefanov, 2000). For every 10-meters in the 50-meter transect, two sampling points were collected at random. Each sampling point was split into four quarters (Figure 4). At each quarter, the distance of the nearest tree to the sampling point was recorded in meters, a logging tape was used to measure the diameter at breast height (DBH) in centimeters and the tree species was recorded (Figure 3). This process was repeated for all sampling points. A total of 40 tree density samples were taken per transect. The average point to tree distance was converted to square meters in order to identify the approximate average tree unit in the area. The average tree unit in an area was converted into hectares to estimate the approximate tree density in the parcel. A low-density forest is defined as having 125 trees/ha and medium density forest was defined as having 250 trees/ha (O'Hara et. at., 2010). This assessment gives the JCLT a better understanding of the property that will assist in future management decisions.

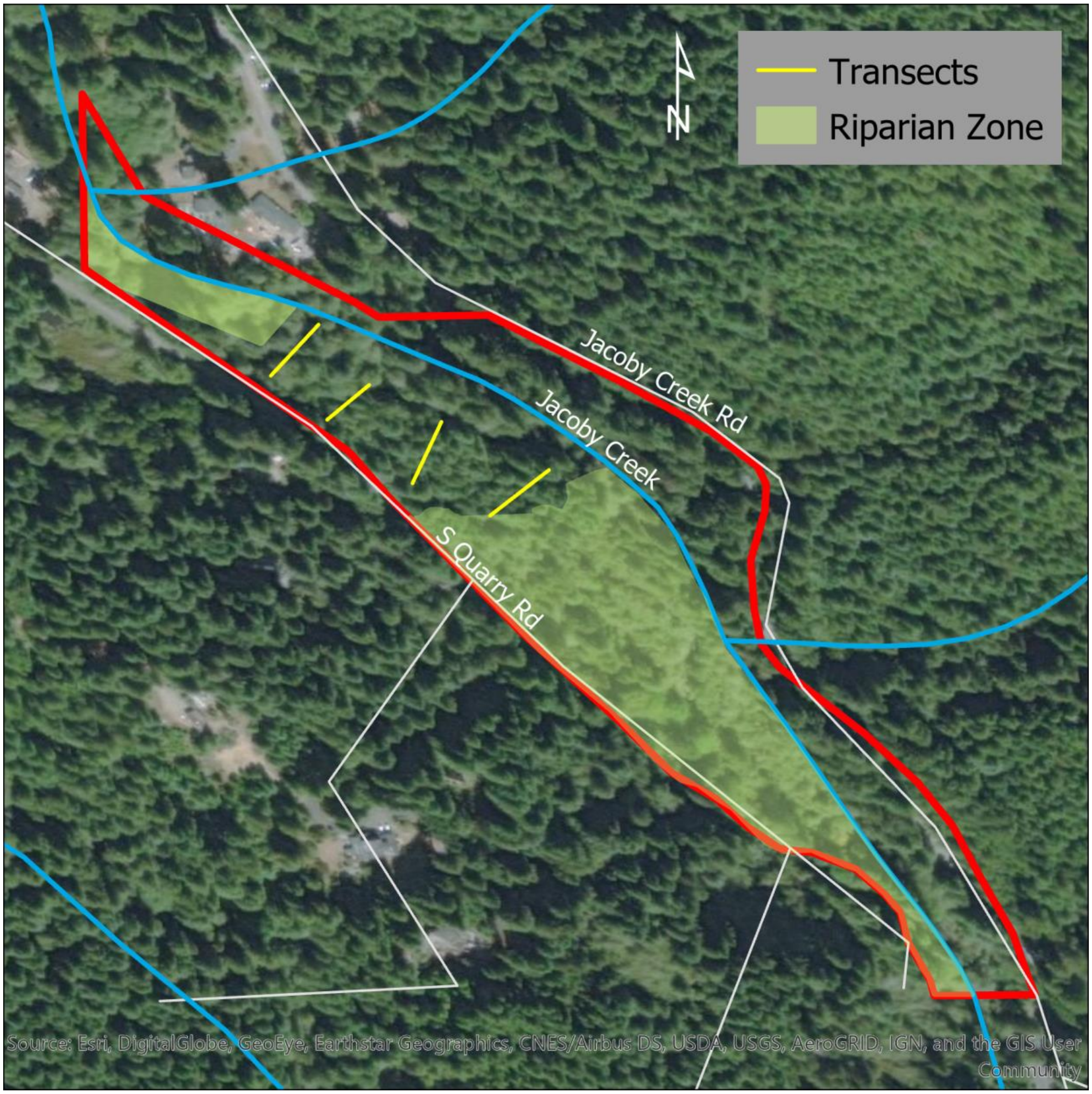

Figure 3: Map of the transect placement in the upland forest. The four transects were intended to be placed equally apart and 50 meters long. Field conditions such as heavy understory, large trees, unnavigable terrain, or the size of the site resulted in the transect not meeting our placement goals for every transect. Map created by Sean Dent in ArcGIS Pro version 2.5.

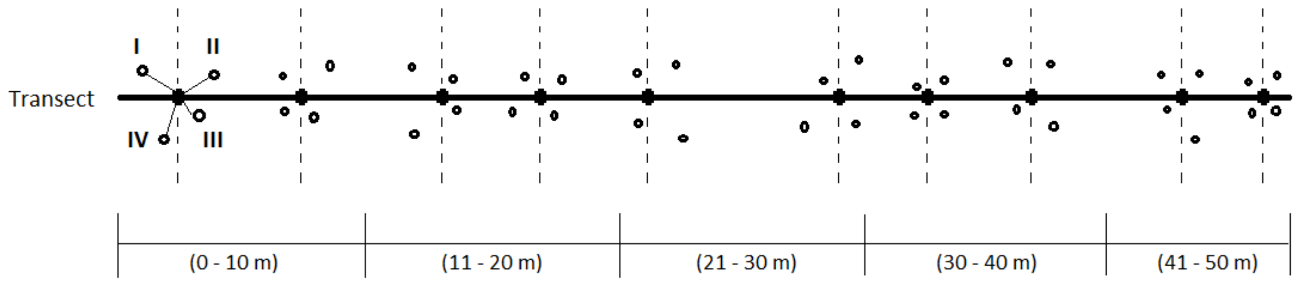

Figure 4: Transect diagram showing sampling points along the transect. The dashed lines represent sectioning the sampling point into four quadrants. The small circles represent the location of the closest tree from each sampling point within each of the four quarters. The data collected using this method were used to estimate the tree density in the upland forest.

Upland Understory Vegetation Assessment

The vegetative composition of the site was assessed quantitatively, covering the northeast section of the parcel between Janes Creek Rd and Old Quarry Rd. Species were identified from the old quarry road entrance to the Jacoby Creek following the predominately established trail. The species were identified onsite and categorized as dominant or subdominant based on their presence on the site. Species will be identified using the 2012 edition of the Jepson Manual (*California Flora, Jepson EFlora Main Page*, n.d.) and the iNaturalist phone application. Representative photographs were taken of each species and added to Jacoby Creek Land Trust's local iNaturalist species list.

RESULTS

Trail Mapping

The primary trails on the Jacoby Creek Parcel are easily recognizable on foot and are suitable for foot traffic only; all-terrain vehicles (ATV), horses, and bicycles should avoid these trails to prevent soil compaction, erosion, and ecosystem degradation. There are a total of approximately 550 m of trails on the parcel (excluding social trails). The trail system offers a variety of easily navigable routes to be taken with several small loops, stream access, a stream crossing, and could be classified as a "beginner" level trail (Figure 5).

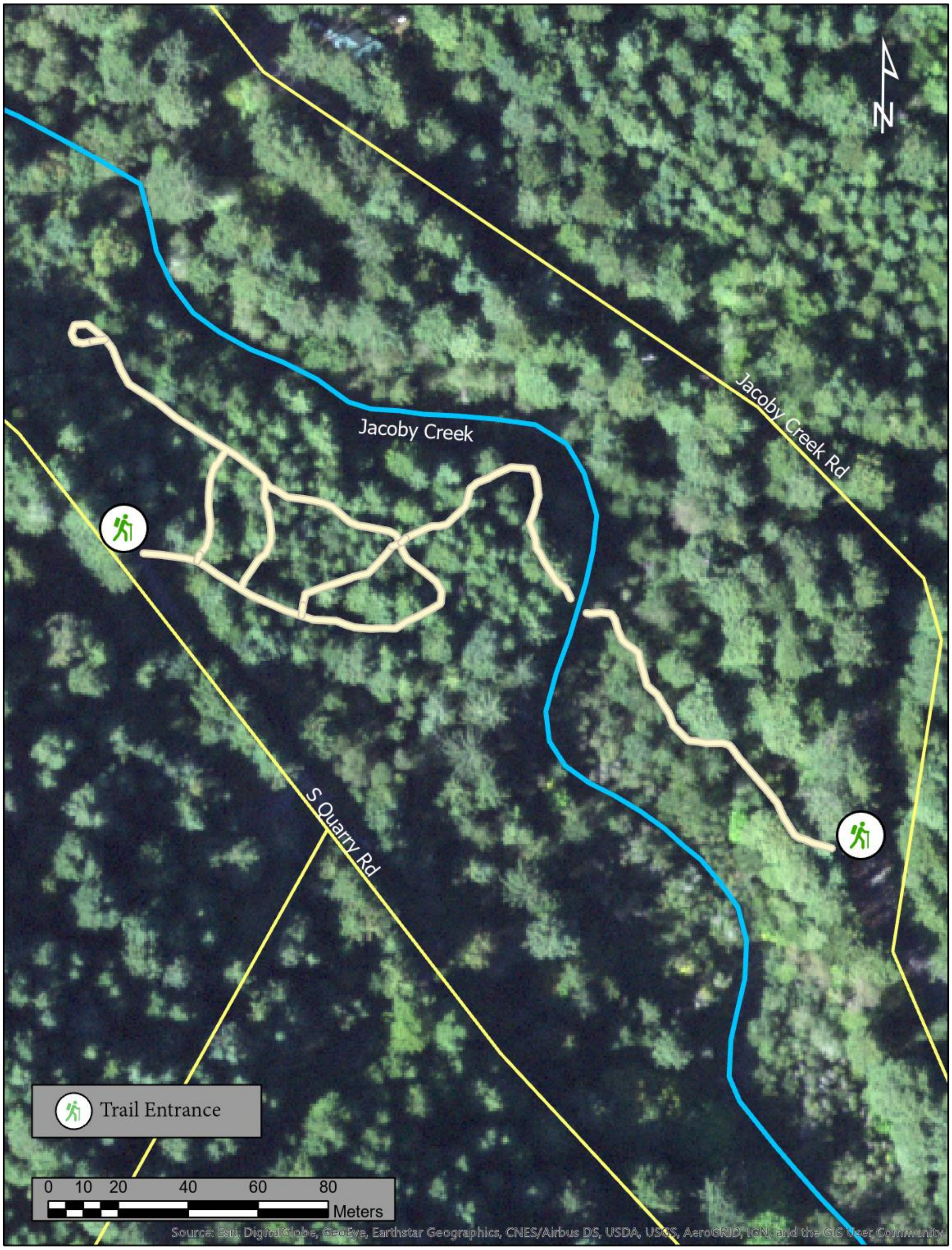

Figure 5: A map showing the primary trails on the Jacoby Creek parcel. Map created by Sean Dent in ArcGIS Pro version 2.5.

Invasive Species

Through the visual assessment of the project site, it was determined that the parcel is in good ecological condition. A total of 17 areas of interest were identified in the parcel, four Himalayan blackberry bushes, 12 English ivy patches, and one pile of garbage (Figure 6). Most of the problematic nonnative species found in the parcel were found in the riparian corridor due to the high level of disturbance and ideal growing conditions such as sunlight and moisture (Fierke & Kauferman, 2006).

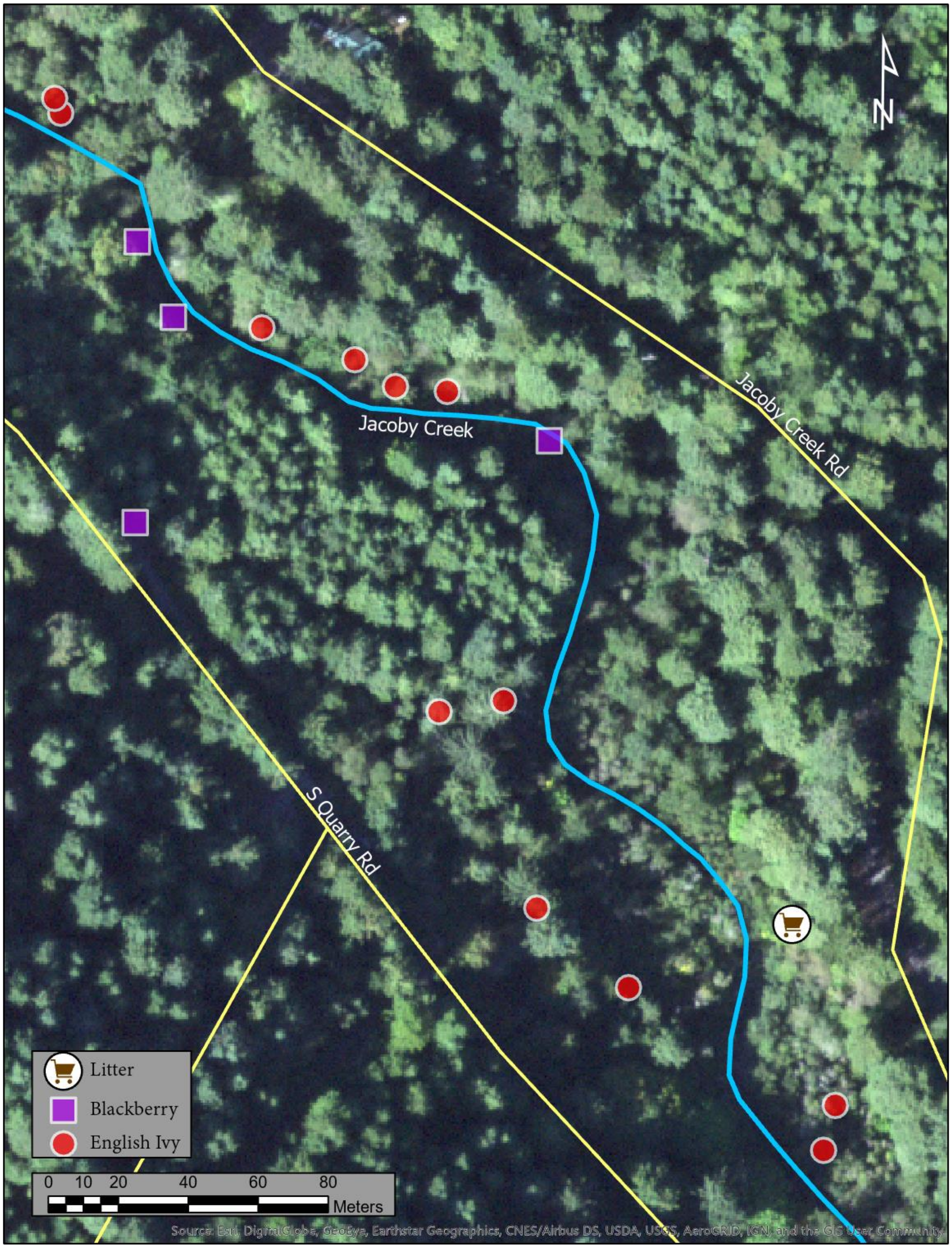

Figure 6: A map displaying the locations of invasive plant species (Himalayan blackberry and English ivy) and one location of a garbage pile within the Jacoby Creek parcel. Map created by Sean Dent in ArcGIS Pro version 2.5.

Tree Density

A total of four transects were used to collect 132 point to tree density samples. Site conditions prohibited collection of all 40 samples per transects due to heavy understory, large trees, unnavigable terrain. Transect one ended up being 36 meters long, resulting in only 28 of the desired 40 samples being collected; the understory at the end of transect one was dense and measurements could not be finished without causing disturbance to the project site (Table 1). Transects two and three both ended at 40 meters resulting in only 38 of the desired 40 samples being collected; the transects reached the end of the plot before making it to 50 meters (Table 1). All transect data are included in Appendix A.

Table 1: Average stem density and totals of all four transects in the Jacoby Creek parcel.

Transect	Number of Samples	Average Point to Tree Distance (m)	Average Tree Unit in Area (m^2)
1	28	5.6	31.4
2	32	4.4	19.4
3	32	2.8	7.8
4	40	4.1	16.8
Overall	**132**	**4.2**	**17.6**

The average point to the tree distance measured to be 4.2 meters. To convert the average distance of trees to tree unit in an area, the average tree distance was squared, resulting in 17.6 square meters. This number suggests that if the trees are evenly distributed by 4.2 meters, the area the tree encompasses is 17.6 m^2 (Figure 7). The average tree unit in the area was converted from square meters to hectares to estimate the approximate tree density for the parcel (Figure 8). The average tree density was approximately 568 trees/hectare (230 trees/acre).

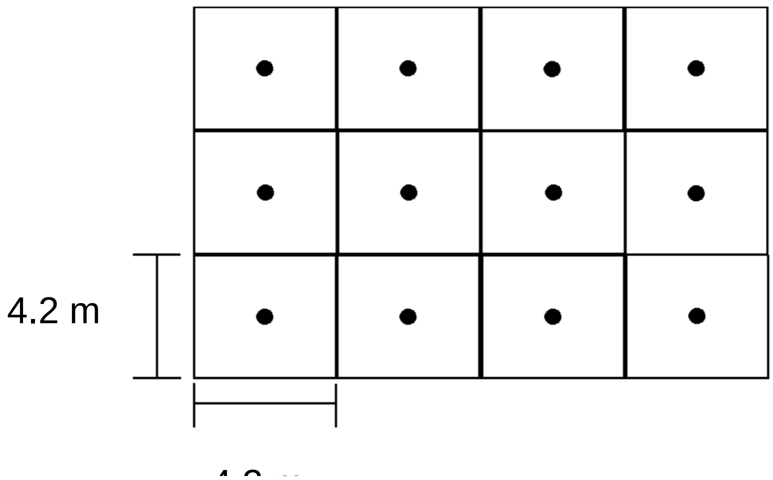

Figure 7: A grid representing the average tree distribution in an area. The dots represent the trees that are 4.2 meters apart. The area in the cell is 17.6 m^2, which represents the average tree unit in the area.

$$\frac{10{,}000 \text{ m2/ hectare}}{17.6 \text{ m2}} = 568 \text{ trees/ hectare}$$

Figure 8: Equation used to convert tree units in the area to tree per hectare. There are 10,000 square meters in one hectare.

The DBH data collected were sorted into five equal interval categories based on the DBH width of the trees (Figure 9). Our surveys revealed that smaller trees were more abundant than larger ones within this parcel (Figure 9). The smallest DBH categories (0-20 cm and 21-40 cm) were most abundant and the largest DBH categories (61-80 cm and 81-100 cm) was the least common. The species composition resulted in 65.5% redwood, 18.6% alder, and 16.9% Douglas fir (Table 2). The complete DBH and species per transect can be viewed in Appendix A.

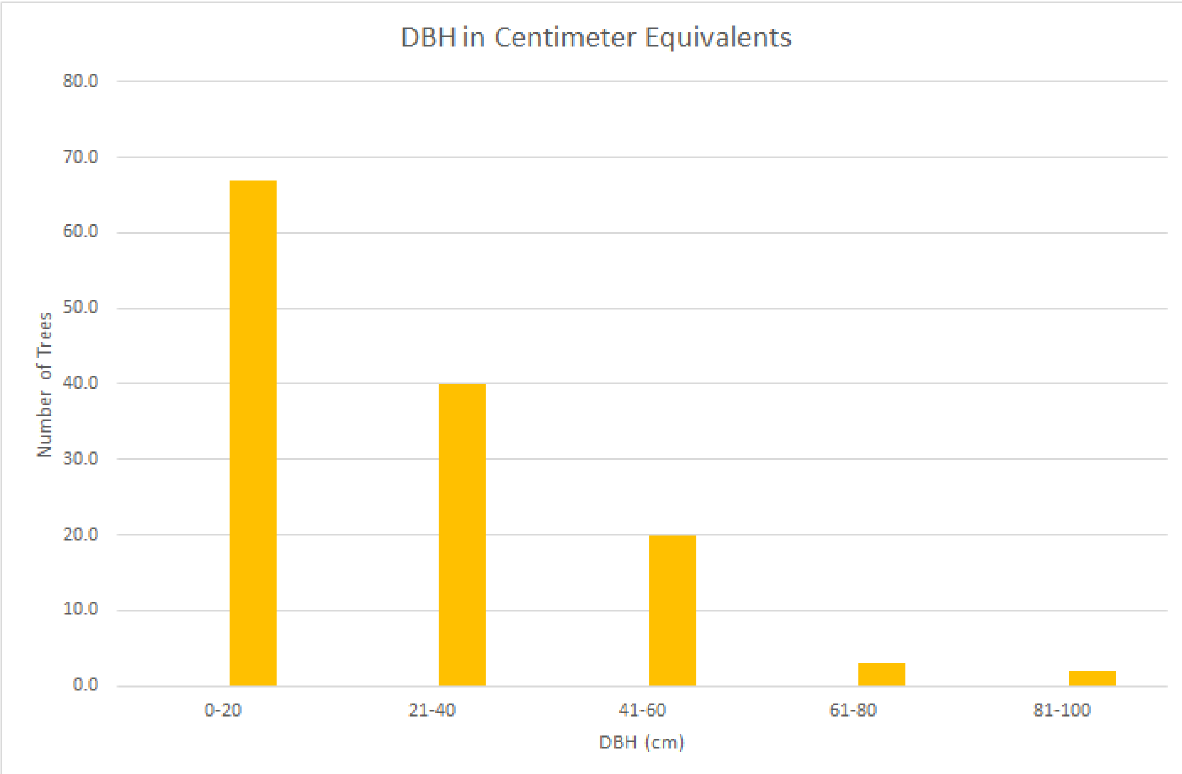

Figure 9: The number of trees measured within each DBH category. DBH measurements were collected in the focal parcel in the Jacoby Creek watershed in March 2020.

Table 2: Percent species composition on each transect

Species Percentage			
Transect	Percent Redwood	Percent Alder	Percent Douglas Fir
1	50	32	18
2	41	31	28
3	72	9	19
4	95	2.5	2.5
Average	65.5	18.6	16.9

Upland Vegetation

The qualitative site assessment noted understory vegetation consisted of four dominant species and seven subdominant species. Initially the subdominant species were prevalent in areas in proximity from recreation areas (trails). In these areas, vegetation was scarce, although in areas proximity to recreation vegetation was abundant. Some species were not included (Table 3) because of the inability to classify due to seasonality. A shift in the plant community was observed in parts of the parcel with minimal recreational use. In the northernmost part of the parcel assessed, species such as wolf lichen (*Letharia vulpine)* was dominant where the understory was closer to water compared to sword fern in the middle of the parcel's understory. Areas with high volume of recreational use tends to have a higher abundance of invasive species as well. Areas in frequent use, such as the JCLT entrance and trails (primary and social) that lead to the Jacoby Creek had invasive species like Himalayan blackberry (*Rubus armeniacus)* present.

Table 3: Dominant and subdominant upland understory vegetation observed in Jacoby Creek.

	Common Name	Botanical Name
Dominate	wolf lichen deer fern redwood sorrel sword fern	*Letharia vulpina* *Struthiopteris spicant* *Oxalis oregana* *Polystichum munitum*
Subdominate	Pacific trillium red huckleberry great horsetail California huckleberry Wild ginger Salal Himalayan blackberry	*Trillium ovatum* *Vaccinium parvifolium* *Equisetum telmateia* *Vaccinium ovatum* *Asarum caudatum* *Gaultheria shallon* *Rubus armeniacus*

MANAGEMENT RECOMMENDATIONS

Trails

Jacoby Creek Land Trust emphasizes the importance of promoting public access to the Jacoby Creek parcel. On the parcel, there is a clearly defined trail system that is often used by dog walkers and local pedestrians. We recommend that the Jacoby Creek trail map be available to pedestrians through a QR code posted at the entrance to the trail and on the JCLT website. It is also recommended that signs be posted around the site and on the website about personal and environmental responsibility to encourage users to practice environmentally friendly behaviors, such as "leave no trace" and staying on the designated trail to preserve the integrity of the parcel and prevent depreciative behaviors (Bradford & McIntyre, 2007).

Invasive Species Removal

The Jacoby Creek parcel is a rich ecosystem with an abundance of native flora and fauna. Our surveys revealed that the riparian corridor along Jacoby Creek included areas of nonnative species (Figure 6). Active management techniques best suit the site's invasive species: English ivy (*H. helix)* and Himalayan blackberry (*R. armeniacus)*.

English ivy (*Hedera helix) Control*

English ivy's (*Hedera helix*) ability to adapt to different light conditions, it's long growth cycle, rapid growth rate and ability to root along the stem makes *H. helix* a difficult and destructive plant in the forest ecosystem (Okerman, 2000). The waxy cuticle of *H. helix* makes it highly resistant to herbicide uptake and are especially tolerant to preemergence herbicides so postemergence herbicides have been proven to be more effective though success varies upon age and of the plant (Okerman, 2000). Herbicides such as Glyphosate have been proven to be 60% ineffective on English ivy and also have negative effects as a contaminant to the surrounding ecosystem in high concentrations (Okerman, 2000). The most effective technique to manage *H. helix* is to cut the ivy vines with pruners, then pull the plants from the trees and from the forest floor, this may need to be done repeatedly as the plant is persistent and could reemerge from the remains (Okerman, 2000). *Hedera helix* vines die after about two weeks to a month from being separated from their roots, note that if any rooted segments of ivy remain in the ground it will likely return. If the vines are too thick and woody to be cut, the bark can be cut enough to expose the inner bark and an application of herbicide can be used to penetrate and eradicate the plant (Okerman, 2000). Another method to remove *H. helix* is fire; repeatedly torching the plant can effectively drain it of energy making it unable to multiply or reproduce. Immediately after removal, native plants should be planted to discourage invasive species and to stabilize the soil (Okerman, 2000).

Himalayan blackberry (*R. armeniacus)* Control

As for *R. armeniacus,* there are several possible management strategies: the area to be treated can be mowed or cut in the mid-growing season, then herbicides (Triclopyr or Glyphosate) can be applied in a broadcast or spot treatment (Bennett, 2006). Herbicide application in September through early November is most effective because the plant is sending energy reserves downward during that season, and the herbicide is translocated easily to the roots (Bennett, 2006). Mechanical removal of plants, roots, and root crowns with a backhoe or repeated tilling is another form of *R. armeniacus* removal (Bennett, 2006). Mechanical removal is most effective when the soil is moist; manual hand removal of plants, roots, and root crowns; repeated mowing, cutting, or hand slashing is another method (this is the least effective method) (Bennett, 2006).

Some variables to consider when removing Himalayan blackberry are the safe and responsible use of herbicides and placement of erosion control practices due to exposed soil. For the Jacoby Creek parcel, repeated tilling and the mechanical removal of *R. armeniacus* is recommended since there are few areas that need to be treated and is the most effective strategy after the mowing/herbicide treatment. Erosion near the riparian zone is the biggest drawback of this method but this can be managed and minimized in the few treatment sites. Erosion control methods include the application of mulch, erosion control fabric, and planting native species in the treatment area (Bennett, 2006).

Thinning Treatment

After the site assessment, it was estimated that there are approximately 560 trees/ha and approximately 50 percent of the trees measured had a DBH that was 20 cm or less. O'Hara (2010) defined a low-density forest as 125 trees/ha and a medium density as 250 trees/ha. In order to restore this previously logged forest to a more natural trajectory, we recommend that the JCLT conduct a variable density thinning (VDT) treatment to reach a medium density of approximately 250 trees/ha. VDT is a thinning treatment that cuts stands in a non-uniform grid that creates a heterogeneous tree distribution (Harrington, 2009). VDT is commonly used to restore redwood forests in Humboldt and Del Norte County (O'Hara, 2012). Post-thinned forests tend to have thicker stems and the understory complexity that is much higher (Rapp, 2002). Monitoring efforts of 1, 5, 10, and 20 years should be placed to assess the success of the project. The success of the thinning treatment can quantitatively be analyzed through comparing the pre-thinning DBH to post-thinning DBH tree stands.

Supporting Upland Understory Vegetation

Supporting biological diversity in upland understory does not only benefit vegetation, but also wildlife. Certain understory species such as huckleberries (*Vaccinium ovatum*) are beneficial ecosystem components of forest communities in the Pacific Northwest (Kerns et al., 2004). Huckleberries is one species present in JCLT (Appendix B) which provides sustenance for species utilizing the area. Some vegetation identified on this parcel can be utilized as browse, cover and a major food source, which is important for ecosystem productivity for different mammals and birds.

Jacoby Creek Land Trust allows public access throughout the parcel for the local community. To continue providing suitable understory vegetation three recommendations should be implemented. (1) raise awareness and concern about users impacts on understory vegetation. (2) provide/seek assistance to help reduce invasive plants JCLT feels unable to control to support wildlife habitat and/or biodiversity; and (3) engaging users in coordinated efforts across ownership boundaries to address disturbance in understory vegetation. (Fischer & Charnley, 2012)

CONCLUSION

In conclusion, the invasive plant removal, vegetation assessment, and trail delineation of the Jacoby Creek parcel will help conserve and restore the site's ecological services and functions while still being open to the public. In the past, redwood forest ecosystems and their adjacent riparian ecosystem have been heavily impacted by human activities. The recommendations provided in this document will assist JCLT in its mission to improve the environmental conditions of this parcel and create resilient, autogenic ecosystems along the Jacoby Creek watershed. Jacoby Creek is considered a vital habitat for endangered and protected salmonids, and other native flora and fauna. The proper care and management of these areas are required to improve the area's ecological integrity and restore the ecosystem as a whole.

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APPENDIX A

Each sampling point was broken to four quarters where the point to tree distance was measured, the DBH was obtained, and the species was recorded. Under species, “RW” stands for Redwood (*Sequoia sempervirens*) , “AL” stands for Alder (*Alnus spp.)*, and “DF” stands for Dougles Fir (*Pseudotsuga menziesii)*.

Transect 1												
	Quarter I			Quarter II			Quarter III			Quarter IV		
Sampling point (m)	Distance (m)	Species	DBH	Distance (m)	Species	DBH	Distance (m)	Species	DBH	Distance (m)	Species	DBH
1	9.5	RW	23.0	4.9	RW	15.4	2.9	RW	30.1	7.8	AL	5.3
9	2.6	RW	27.8	2.9	RW	12.9	1.9	RW	15.4	1.7	RW	6.6
15	2.0	RW	7.2	6.5	RW	37.1	4.7	RW	26.6	2.0	RW	21.1
17	3.3	RW	7.2	4.9	RW	25.2	5.6	RW	29.2	3.2	RW	21.4
20	5.5	RW	36.6	3.9	RW	25.1	3.1	RW	29.2	5.5	RW	26.4
23	4.4	RW	25.2	4.4	DF	6.6	1.5	RW	29.3	1.5	RW	26.7
37	5.7	RW	6.5	4.5	RW	10.3	4.5	RW	2.9	1.9	RW	54.0
39	6.2	RW	0.3	3.3	RW	11.0	2.7	RW	3.0	3.3	RW	54.0
41	3.6	RW	11.0	4.7	RW	10.2	1.9	RW	3.0	5.2	RW	54.0
47	3.3	RW	10.4	3.4	RW	30.0	6.7	RW	29.8	6.1	RW	30.5

Transect 2												
	Quarter I			Quarter II			Quarter III			Quarter IV		
Sampling point (m)	Distance (m)	Species	DBH	Distance (m)	Species	DBH	Distance (m)	Species	DBH	Distance (m)	Species	DBH
1	5.8	DF	52.6	10.4	RW	45.1	7.3	AL	9.4	5.7	AL	67.5
8	8.2	DF	52.6	7.8	RW	45.1	5.5	RW	34.6	9.2	AL	9.4
12	8.4	RW	45.1	4.1	RW	38.5	2.1	RW	34.6	12.1	AL	9.4
19	1.9	RW	41.6	2.2	RW	33.7	3.3	RW	10.5	3.4	RW	8.2
23	2.0	RW	33.7	7.3	DF	39.7	3.6	AL	9.4	2.7	RW	10.7
30	4.5	DF	39.7	9.2	AL	9.9	6.3	RW	81.1	4.8	AL	19.5
36	7.1	DF	39.7	3.7	AL	9.7	1.4	RW	81.1	8.0	AL	19.5
39	-	-	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-
49	-	-	-	-	-	-	-	-	-	-	-	-

Transect 3												
	Quarter I			Quarter II			Quarter III			Quarter IV		
Sampling point (m)	Distance (m)	Species	DBH	Distance (m)	Species	DBH	Distance (m)	Species	DBH	Distance (m)	Species	DBH
6	2.1	DF	16.9	5.1	DF	41.9	1.9	DF	11.0	5.7	DF	19.2
9	5.1	DF	16.9	3.9	DF	41.9	2.9	DF	33.4	3.0	DF	11.0
16	7.3	DF	40.9	4.9	AL	5.4	6.5	RW	48.3	5.1	RW	46.9
19	8.0	AL	18.1	2.7	AL	5.4	5.1	RW	48.3	6.9	RW	46.9
23	3.2	RW	40.0	5.8	AL	4.8	1.8	RW	43.0	5.9	RW	48.3
26	4.7	RW	40.0	4.2	AL	5.0	6.9	AL	9.0	1.2	RW	43.0
33	3.2	AL	10.8	6.0	RW	61.1	3.8	RW	14.0	3.0	AL	9.0
35	3.8	AL	30.1	4.3	RW	61.1	2.4	RW	14.0	3.9	AL	9.0
43	-	-	-	-	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-	-	-	-	-	-

Transect 4												
	Quarter I			Quarter II			Quarter III			Quarter IV		
Sampling point (m)	Distance (m)	Species	DBH	Distance (m)	Species	DBH	Distance (m)	Species	DBH	Distance (m)	Species	DBH
2	2.9	RW	16.6	4.3	AL	8.3	1.7	RW	15.7	3.4	RW	28.8
7	2.4	RW	25.2	2.3	RW	14.1	2.7	RW	12.7	2.1	RW	12.5
13	1.8	DF	19.3	4.1	AL	7.6	3.1	RW	10.2	1.9	RW	12.8
16	3.4	DF	19.3	2.9	RW	24.3	3.2	RW	2.8	3.8	RW	10.2
23	3.3	AL	8.5	3.2	DF	32.1	2.8	DF	30.5	3.1	RW	2.3
27	1.7	DF	32.1	2.6	RW	23.1	4.6	RW	8.2	2.0	DF	30.5
32	3.2	RW	3.2	2.5	RW	38.0	0.5	RW	25.8	0.8	RW	5.7
40	1.7	RW	4.7	0.8	RW	5.1	7.7	RW	49.4	1.9	RW	14.6
43	-	-	-	-	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX B

Site Species Identification list

wolf lichen	*Letharia vulpina*	wild ginger	*Asarum caudatum*
bracken fern	*Pteridium aquilinum*	California blackberry	*Rubus ursinus*
redwood sorrel	*Oxalis oregana*	stinging nettle	*Urtica dioica*
sword fern	*Polystichum munitum*	thimbleberry	*Rubus parviflorus*
Pacific trillium	*Trillium ovatum*	salmonberry	*Rubus spectabilis*
red huckleberry	*Vaccinium parvifolium*	salal	*Gaultheria shallon*
great horsetail	*Equisetum telmateia*	deer fern	*Struthiopteris spicant*
California huckleberry	*Vaccinium ovatum*	willows	*Salix sp*
English ivy	*Hedera helix*	spruce	*Picea sitchensis*
Himalayan blackberry	*Rubus armeniacus*	tanoak	*Lithocarpus densiflorus*
red alder	*Alnus rubra*	Douglas fir	*Pseudotsuga menziesii*
coastal redwoods	*Sequoia sempervirens*	western red cedar	*Thuja plicata*