Everest Park

University of Washington Restoration Ecology Network
Capstone 2015-2016
Final Report

Location: 500 8TH Street South. Kirkland, WA 98033

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Campus
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Field of Study
[3] Environmental Science and Resource Management, [4] Biology, [5] Environmental Science, [6] Environmental Studies

Table of Contents

<u>List of Figures</u>

List of Tables

Project Summary

Overview

This report describes the restoration project conducted by six students in the University of Washington Restoration Ecology Network (UW-REN) capstone course at Everest Park from 2015-2016. Everest Park is located in the Everest neighborhood of Kirkland which is less than half a mile from downtown, and consists of 21.51 acres including four baseball diamonds, a gazebo, trails, and picnic areas (Parks of Kirkland 2015). This particular restoration site is located east of one of the baseball diamonds and is roughly 0.53 acres (Figure 4). The park is maintained by The Green Kirkland Partnership, and we have been working in collaboration with the organization's program assistant, Katie Cava (community partner), to help guide us through the restoration process. There are several sites within Everest Park that have been successfully restored within the past two years by previous UW-REN groups and community stewards and, through this project, we intend to continue the success of these restoration efforts in order to create and maintain healthy successional forests in the park.

Figure 1: Before and after photos of restoration in the southern portion of the site

Pre-Restoration Description

The site was separated into four polygons based primarily on differences in vegetation in order to help with the organization of restoration efforts (Figure 3). The site is relatively flat with no major hills or slopes and no significant topographical differences between each polygon. The creek that runs through the site runs from southeast to northwest and has a slope of approximately 1.2 degrees which results in a creek flow with a slow water velocity (Figure 3). The creek bottom mostly consists of sand rather than cobble and rocks.

Before restoration efforts began, the Everest Park site was classified as an ACMA-ALRU/POMU-TEGR plant community (*Acer macrophyllum-Alnus rubra/ Polystichum munitum-Tellima grandiflora*) (Chappell 2006). On this site, Fringecup (*Tellima grandiflora)* was replaced by a more prominent Piggy-back Plant *(Tolmiea menziesii)*. There was also an overall lack of conifer species other than a single Western Redcedar (*Thuja plicata)* on the western edge of Polygon 2. This, coupled with the aging deciduous canopy would indicate a lack of forest regeneration. Polygon 1 had previously been mostly cleared and mulched over while the east edge side primarily consisted of a mix of Salmonberry (*Rubus spectabilis)* and Himalayan Blackberry (*Rubus bifrons*). Polygon 2 was a monoculture of Himalayan Blackberry lined with English Ivy *(Hedera helix)*. Polygons 3 and 4 were more similar, dense brushy midstory vegetation with an aging Bigleaf Maple (*Acer macrophyllum)* and Red Alder (*Alnus rubra)* canopy, containing patches of invasives such as English Holly *(Ilex aquifolium),* English Ivy, English Laurel *(Prunus laurocerasus)*, and Bittersweet Nightshade *(Solanum dulcamara).* The main ecological disturbance in this site was the large patch of *R. bifrons* located in Polygon 2 and *H. helix* located in Polygon 3 (Figure 13). These two species have covered a large part of our site and have outcompeted many of the native species that naturally grow here, resulting in a decrease in structural diversity, habitat complexity, and biodiversity. There is a concern over bank erosion on Everest Creek, likely caused by a low quantity of root structure. Lastly, there is a social trail that forms the edge of our Northeastern site border and has several branches throughout. The social trail currently has facilitated many anthropogenic disturbances, such as leaving a path of compacted soil devoid of ground cover plants, localized bank erosion at creek crossings, as well as the introduction of trash and pet waste.

Ecological Concerns

A primary ecological concern within our restoration site was the overall lack of potential to develop into a late-successional conifer-dominated forest. Having no substantial coniferous presence in conjunction to the site's close proximity to human activity made the site very susceptible to invasive species. Since a majority of the canopy consisted of older deciduous trees, these created seasonally unshaded conditions which allowed invasives such as Himalayan Blackberry to thrive. Before restoration efforts began, approximately one quarter of the site consisted of a dense monoculture of Himalayan Blackberry. In addition, houses in the surrounding neighborhoods historically had ornamental invasives such as English Ivy and English Holly that had also infiltrated our site causing a lack of natural biodiversity. Due to these conditions, there was a very low possibility of autogenic repair. A forested area of Everest Park just southeast of the restoration site was used as a reference site because of its general lack of ecological disturbance from invasive species as well as its intermixed canopy of deciduous and coniferous trees.

Project Goals

1. Create a diverse forest structure with functional wildlife habitat
2. Improve water quality in the creek
3. Promote an inviting environment for community stewardship

General Approach

Our goals consisted of creating a diverse forest structure with functional wildlife habitat, improving water quality in the creek, and promoting an inviting environment for community stewardship. Our site was in need of restoration mainly because of the abundance of invasive species and lack of coniferous species. Over the past several months, restoration events were held to remove Himalayan Blackberry and English Ivy from our site. The majority of these polygons were cleared and mulched, creating the opportunity to introduce native species. Plant material was purchased, salvaged, and collected, and were subsequently planted throughout the site. Faster growing shrub species such as Indian Plum *(Oemleria cerasiformis)* as well as live stakes of willow species will reduce sun availability to underlying invasive vegetation and suppress regrowth. In addition, creating a berm along the southwestern edge of Polygon 1 will not only suffocate the existing patch of invasive Reed Canary Grass (*Phalaris arundinacea*), but it would also aid in preventing the spread of neighboring invasive species. In order to approach our second goal, woody debris and live plant material was collected and placed parallel to the creek flow in order to create a barrier to prevent foot traffic along the creek bank. We will also plant vegetation according to the planting plan along the edge of the creek in order to control erosion including Pacific Willow *(Salix lucida ssp. lasiandra)*, Sitka Willow *(Salix sitchensis)*, Sitka Spruce *(Picea sitchensis)*, and Red-osier Dogwood *(Cornus sericea)*. Finally, a successful restoration project will not only build a healthy ecosystem in Everest Park, but also encourage community stewardship. In order to approach this goal, we effectively promoted our project by creating a Facebook page, planning public restoration events, and providing information and snacks from local sponsors to volunteers. In this process, we built a good relationship with our volunteers and sponsors by sharing our knowledge and passion with the hopes that this will promote awareness and stewardship regarding the restoration project.

Major Accomplishments

After nine months (October 2015 - June 2016) and approximately 500 hours of work, we accomplished:

1. The restoration of approximately 0.53 acres of forested land
2. The installation of roughly 1,000 plants including conifers, shrubs and groundcover species
3. The removal of approximately 0.13 acres of Himalayan Blackberry monoculture followed by mulching
4. The implementation of a 25-foot berm to prevent anthropogenic intrusion and create microhabitats
5. The presentation of four one-hour invasive lessons to 7th grade science students at Kirkland Middle School
6. The usage of our site as an open learning lab for 10th grade students who were volunteering to learn more about invasive removal

Team Members

Figure 2: (Left to Right) Amos Chan, Chao Yang, Maddie Hicks, Paul Parker, Tanner Berglund, and Andrea Fisher

Team Contact Information

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- EarthCorps for teaming up with us to do a shared volunteer work day
- Fourth Corner Nursery for supplying us with many free *R. nutkana*
- King Conservation District
- King County Plant Salvage for allowing us to salvage the majority of our installed plants
- Nooksack Salmon Enhancement Agency for donating several conifers
- Susan Crauer and her 7th grade science students at Kirkland Middle School for participating in our educational outreach
- Hillcrest Bakery for donating enough doughnuts and pastries to supply 24 hungry volunteers with food
- Top Pot Doughnuts for their coffee and food donations during a work party
- Lee Redmond at the US Forest Service for supplying us with a permit to obtain hemlocks
- Gene and Sally Beall for donating the use of their truck to haul plants from every salvage

As Built Report

Site Description

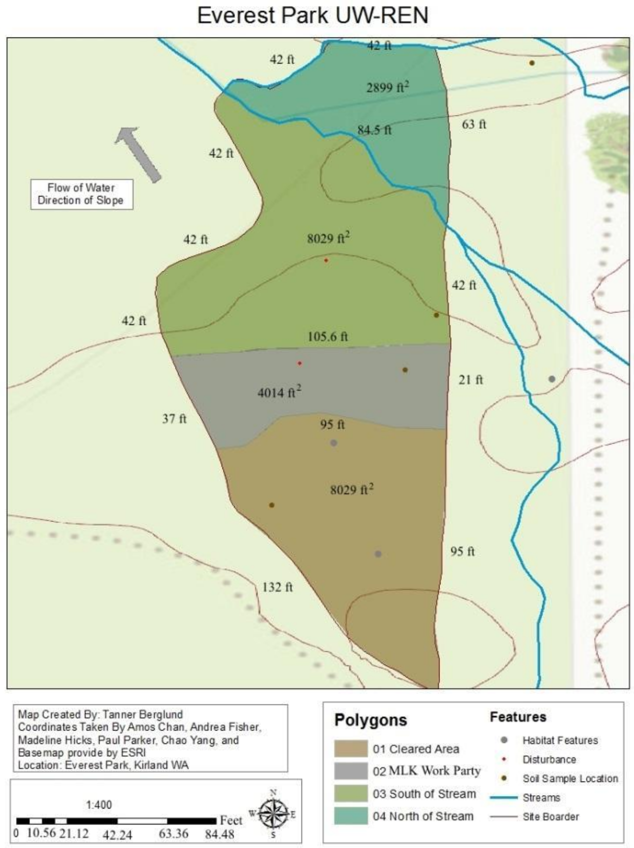

Figure 3: Everest Park site map including habitat features, disturbances, soil sample location, creeks, and polygons representing distinct areas. Note: creek placement on background maps provided by the Green Kirkland Partnership do not accurately depict creek placement.

Figure 4: Site location (in blue) in relation to the rest of Everest Park and 1-405

Location

The restoration site is located in Everest Park, which is in the Everest neighborhood of the city of Kirkland. Everest Park is less than 0.5 miles from downtown Kirkland and consists of 21.51 acres including four baseball diamonds, a gazebo, trails, picnic areas, and natural forest habitat. The south and west sides are surrounded by residential areas and the east side runs along the I-405 freeway. There are two main creeks and multiple tributaries that flow through the natural areas of the park. Our restoration site is located east of one of the baseball diamonds, to the south of recently sector and is roughly 0.5 acres (Figure 4).

Site History

Everest Park was, like most of the Pacific Northwest, logged intensively after European settlement (Cava 2015). Before European settlement, the area was primarily controlled by the Duwamish tribe (Duwamish.org, 2008). After European settlement the land was utilized for farming and served the Seattle area with fresh milk, eggs, fruits and some nuts until the 1940's when the site turned into a housing development called *Project A* to house workers from the shipyards during the war. (Everest Neighborhood 2015). More recently, the land was used to dump garbage until the early 2000's when work started to re-naturalize the park (Everest Neighborhood 2015). In 2000, $25000 in grants were given by the city and Everest Park used it to build a picnic shelter. The other main contributor is Starbucks Coffee Co. who gave $10000 in grants to the Everest Neighborhood Association to use for landscaping and site preparation work. Today the park is maintained by The Green Kirkland Partnership and their volunteers who periodically spend weekends removing invasives at work events (Cava 2015).

Reference Site

The reference site we selected was an appealing model for our restoration site because of its minimal invasives, balance of coniferous and deciduous trees, and close proximity to our own restoration site. Only a small population of *Rubus bifrons* could be found on the reference site. The overall lack of invasive species indicates that the native species are successfully suppressing them. There are varied levels of succession throughout the reference site as evident by the presence of *Tsuga heterophylla* growing in fallen *Thuja plicata*. There is even a mixture of deciduous and coniferous trees including *T. heterophylla*, *T. plicata*, *Acer circinatum*, *Abies grandis*, *Picea sitchensis*, and *Acer macrophyllum.* The reference site is located roughly 1/8th of a mile southeast of our restoration site. Basing our restoration off of a place so close to our site means that they will be in an identical climate, making it a better, more applicable model.

Topography

The site is relatively flat with no major hills or slopes and no significant differences between each polygon. Overall, the elevation is the highest along the southern edge of the site and decreases toward the north edge of the site with a slope of approximately 1.0 degree. The creek that runs through the site runs from southeast to northwest and has a slope of approximately 1.2 degrees. This lack of a substantial slope results in a creek flow with a slow water velocity. The creek bottom mostly consists of fine sediments such as sand and silts with a few areas containing cobble and rocks.

Soils

We obtained four different soil samples at our site. Given the diversity within the restoration site, four soil samples were taken to ensure a greater understanding of the current site conditions. Samples were taken at the most northern (Polygon 4), most southern (Polygon 1) points of our site as well as a sample near the middle of our site (Polygon 3) and finally in an area that is overgrown with invasives (Polygon 2, Figure 6).

Figure 5: Soil sample site location in Polygon 1   Figure 6: Soil sample site location in Polygon 2

Beginning with the first soil sample site, it was taken on a sunny but cold day following a large rainstorm. This sample was collected at the very southern tip of our site boundary in an area that was cleared and mulched in 2015 (Figure 5). In this portion of the site, there is no vegetation nearby and the ground has a layer of leaves and woodchips. As we dug down into the soil we discovered a relatively shallow, 4 cm organic layer followed by the A horizon that consisted of sandy silty loam with low coarse fraction (Appendix I, Table 1).

Our second sample was taken in Polygon 2 amidst a large patch of Himalayan blackberry (*R. bifrons*) (Figure 6). This sample site proved to have almost solid clay with many worms. This is counter to the other polygons within the restoration site which contained sandy soils with little to no clay. After further investigation all of Polygon 2 appears to have this clay type of soil.

The third soil sample was taken from Polygon 3, located near the middle of our east boundary. This site had the most varied vegetation out of all the sites with *Hedera helix*, *R. bifrons*, *Rubus spectabilis and A. macrophyllum* (Appendix I, Table 3). In addition to having the most varied vegetation, this site also contained the most moisture and had a very deep organic layer that continued down 18 cm. Despite the differences, sample three shared the same type of A horizon soil as our first sample as they both contain silt, sand, and loam.

Our final soil sample was collected at the far north edge of our site. Given the sample was taken within 10 feet of Everest Creek the soil has been affected by the presence of running water.

After digging down into the soil we found a 6 cm O layer followed by silty sand as well as a medium amount of coarse fraction. This sample varied from the first by lacking loam and containing more sand and gravel which is conducive to being near running water.

Despite the relatively small size of our site there is significant variety in our soils that range from predominantly sandy soils with good drainage to clay that has been dominated by invasives. A speculation as to why there is so much variation within a site with little topographic variation is the Park's past of being a farm as well as the near proximity to Everest Creek and the small tributary that defines the border of Polygons 3 and 4. The both Everest Creek and the tributary are transporters of sediments that include sand and silts which can offer an explanation as to why Polygons 3 and 4 contained sandy soils. Polygon 2 is the clay soil which could be left over from the site's farming history given that farms tend to have a variety of soils due to the presence of livestock and monoculture crops.

Hydrology

There are many different ways that water affects our site. To begin, Everest Creek runs through and alongside our site which has an impact on where water goes when there is a large rainfall or there is runoff from the nearby baseball fields.

The variety of soils within our restoration site also has an effect on the hydrology in the area due to the varying porosity and permeability characteristics of each soil. For example, Polygon 2 contains clay, clay is characterized by its high porosity and low permeability which causes the soil to remain moist and drain poorly. This means that when water hits the ground in Polygon 2 it gets absorbed into the O horizon, moves to the clay, and then moves downhill towards Everest Creek where it becomes part of the creek system. In other areas such as the east edge of our site where the soil is a sandy silty combination, the soil is moist due to capillary action of water moving laterally from the creek. Precipitation that falls on this soil can enter the ground water easily because sandy soils have such high permeability.

Everest Creek is small, with variable speeds, and variable volumes that are very weather dependent. If you look at a particular section of the creek at the very north end of our site you can see that there is about six inches until the bankfull level and about 3.5 feet until the top of the creek embankment. The six inch gap from the creek's current level to the bankfull line indicates that the creek gets six inches higher often enough to prevent vegetation from growing within that 6 inch gap, most likely this occurs in the spring and winter months when there are long periods of rain. In addition to the variable volume of Everest Creek, it is evident that there are also variable speeds within the creek itself. There are straight areas of this creek in which the sediment is made up of sand alone which indicates that the water is traveling fast enough to carry larger sediment further along down the creek. There are also areas where the creek slows down (Figure 7) where there are sediment deposits on point bars where the water is slowing down and depositing assorted larger sediments. Another contributor to the variable speeds in Everest Creek is the natural deposition of woody debris that fall into the creek and create small dams that alter the creek's flow.

Figure 7: Portion of Everest Creek near Polygon 4 creating shallow pool

Existing Vegetation

Due to the existing plant life within our restoration site, our site can be classified as an ACMA-ALRU/POMU-TEGR plant community (*A. macrophyllum-Alnus rubra/Polystichum munitum-Tellima grandiflora)* despite the fact that the typical slope requirements are not met (Chappell 2006). On our site, *T. grandiflora* is replaced by a more prominent *Tolmiea menziesii*. With the gentle NW slope, sandy soils, and multiple creek channels allowing for consistent moisture, this plant community thrives here. What is not present is any conifer species other than a single *T. plicata* on the outer edge of our site. This, with the apparent age of the canopy would indicate a lack of forest regeneration.

Habitat Features

Although few animal species were observed during the site assessment, mainly only eastern gray squirrels (*Sciurus carolinensis)* there were numerous areas that provided potential habitat for wildlife. The most abundant habitat features in the site are standing or fallen woody debris in the form of snags and logs. Snags can be used as a nesting place for bird species like chickadees, wrens, and crows whereas logs could be used by a wide range of wildlife. Logs closer to the water that are more decomposed are an ideal habitat for salamanders and other amphibians that require moist environments and logs further away from water sources may house raccoons and other rodents. In the open area of Polygon 1 (Figure 3), there are several large boulders which likely encourage insect communities to flourish underneath. There is also a brush pile present in the cleared area of Polygon 1 which could create shelter for ground foraging birds such as Chestnut-backed chickadee (*Poecile rufescens*) (Clapp 2015) and small mammals such as deer mice (*Peromyscus maniculatus)* (Oregon Department of Fish and Wildlife 2014).

There are no fish in Everest Creek or the tributaries that run through our site (Cava 2015). However, if fish populations were to become present (unlikely with the culverts and grates), trees in the riparian corridor have exposed roots, and the extensive shrub cover could provide coverage for salmon and trout as they move upstream. There is also a small pool on the north side of the creek which forms a shallow pool for fish to rest and conserve their energy, therefore increasing survivability.

<u>Disturbance</u>

The main disturbance in this site is the large patch of Himalayan blackberry (*R. bifrons*) located in Polygon 2 and English Holly (*Ilex aquifolium*) located in Polygon 3. These two species have covered a large part of our site and have outcompeted many of the native species that could have grown here. This caused the local diversity to decrease, therefore decreasing the ecological diversity of the site.

The small and minor disturbances are a concrete block, erosion near the creek, and a social trail. The concrete block is very small, measuring three feet by three feet and is located in an open area in Polygon 1, thus it should be easily removed. The erosion on the north bordering creek bank has most likely caused by a low amount of root structure and from running water. Lastly there is a social trail that forms the edge of our northeastern site border. The presence of a social trail discourages wildlife from living within our site as well as increases the likelihood of our newly implemented plants to be trampled.

<u>Matrix</u>

Our site is located within Everest Park in Kirkland Washington. There are four main contributors to the site’s surrounding matrix which include baseball fields, a residential neighborhood, a conjoining forest, and a small creek. Everest Park has three baseball diamonds with one that is directly south of our site. Additionally, having a baseball field so close to the site indicates that there are often large crowds. The presence of people may be a component to the lack of wildlife within our site.

<u>Figure 8</u>: Matrix surrounding Everest Park and restored sites (purple)

The residential area is directly to the east of our site (Figure 8). This residential area has non-native ornamental grasses as well as non-native gardens. Being so close to a residential area has a few potential impacts for our site. The first is unintended planting from non-native propagules, the close proximity makes it very likely for unwanted plants such *Vinca minor,* a common garden groundcover, to invade our site. The second possible impact for our site is the invasion of people and pets. There are several social trails within the entirety of Everest Park as well as the one that runs through our restoration site. These have been created as people have walked through the natural areas of the park, this means that we will have to plant thorny shrubs at the borders and entrances of trails in order to discourage people from entering our restoration site. Lastly, there is Everest Creek and the tributaries that run along/through our site. Everest Creek begins next to Kirkland Ave and ends on 68th street in Kirkland (Google Maps, 2016). Given the path of Everest Creek, it appears that there will be of storm water runoff infiltrating Everest Creek further upstream from our site that will be carried into our restoration area. This will be a source of unwanted nutrients and pollutants entering our site that will be difficult to control.

Restoration Needs and Opportunities

Needs

Our site is in need of restoration mainly due to the abundance of invasive species as well as areas of low permeability and high porosity. Without human interference, this site will most likely be taken over by invasives. Recently, a restoration event was held to remove *R. bifrons* and *H. helix* from Polygon 2. The majority of this polygon has been cleared and mulched, creating opportunity to introduce native species such as *Rosa nutkana, R. spectabilis,* and *To. menziesii*. There are still invasives to be removed in the remaining three polygons which will be done through a combination of work done by the Everest Park UW-REN group and volunteers. After invasive removal is complete, the recently cleared areas will be mulched similarly to the process that was done in Polygon 2. Once the mulching is done, native species will be introduced to create a healthy canopy, midstory and ground cover.

Opportunities

There are several sites within Everest Park that have recently been successfully restored within the past two years. Of these sites, three were restored in 2014-2015 by a UW-REN capstone (Figure 8). Since the initial restoration, there has been some maintenance work performed by the Everest Park Stewards (Cava 2015) to help continue the success of the project. By walking through the site, it is apparent that a majority of their young plants have survived and began establishing themselves. Given the close proximity, this leads us to believe that our site can also create a diverse forest structure with functional wildlife habitat.

Tasks and Approaches

Goal 1 - Create a diverse forest structure with functional wildlife habitat

Objective 1.1: Remove and suppress invasive species

Task 1.1.1: Remove the patch of *R. bifrons* in Polygon 2 and throughout the site

Approach: A north to south configured path will be created by Green Kirkland maintenance staff by matting down vegetation through the patch in order to maximize accessibility for removal. The stems of *R. bifrons* will be removed using loppers and disposed of in a compost pile lying atop multiple layers of burlap sacks to create a barrier between the removed vegetation and the soil. Root balls will be dug out using shovels and will be disposed of in the same manner as the stems.

Approach Justification: Although mowing in conjunction with herbicide application has been proven to be the most effective way of permanently removing *R. bifrons*, herbicide use is restricted at the restoration site. Therefore cutting above-ground biomass and digging out the roots is the next most effective method. Removal will be performed during the winter when the soil is moist which will make the removal of root balls easier and will decrease the likelihood of them breaking in the soil (Bennett 2006).

AD1. Removal continued all the way into spring quarter. There were multiple patches throughout the site that were less evident in the winter time.

Task 1.1.2: Remove and suppress *H. helix* along tree trunks and on the forest floor

Approach: *H. helix* on the forest floor will be removed manually with hand tillers and collected on top of a layer of burlap sacks for disposal to prevent regrowth. *H. helix* vines along tree trunks will be cleared up to approximately five feet from the ground and roots will be excavated.

Approach Justification: *H. helix* has shallow root systems and there is a relatively small amount of this species on the restoration site, so manual removal is sufficient. Generally, simply pulling up on the vines and following them to the end of their roots is an efficient method for removal, but tillers can be used to unearth stubborn roots. *H. helix* should not be removed on tree trunks above five feet because it could disturb bee or bird nests. Removing up to this height also creates an adequate disconnection between any ivy growing above the five feet mark and the roots, causing them to die off quickly (Horticulture 2013).

Task 1.1.3: Identify *Prunus laurocerasus* and *I. aquifolium* for Green Kirkland staff to inject with EZ-ject herbicide bullets

Approach: Green Kirkland staff will walk through the restoration site and inject invasive trees *P. laurocerasus* and *I. aquifolium* with herbicide bullets using an EZ-ject lance. Trees will not be marked because staff members are familiar with the trees that will be injected. Bullets will be injected at the base of the tree and the number of bullets used will be determined based on the width of the tree trunk (EZ-ject 2011).

Approach Justification: The invasive trees that are present on the restoration site have large and complex root systems that would create too great of a disturbance to the existing soil if removed manually. Therefore, using the EZ-ject lance to kill the trees without unearthing them will cause less of a disturbance and as the trees die, they will become snags which provide habitat for a multitude of bird species and other native wildlife.

Task 1.1.4: Plant shrubs and trees to create shade in order to suppress the growth of invasive shade-intolerant shrubs, vines, and grasses

Approach: Evergreen tree species including *T. heterophylla*, *T.* plicata, *Pseudotsuga menziesii*, *P. sitchensis*, and A. *grandis* will be planted to create a long-term source of year-round shade. Faster growing shrub species such as *R. spectabilis*, *Oemleria cerasiformis*, and *Gaultheria shallon* as well as live stakes of willow species will also be planted to reduce sun availability to underlying invasive vegetation.

Approach Justification: Invasive species on the restoration site such as *Phalaris arundinacea* and *R. bifrons* cannot persist in environments with long-term shade provided by evergreen canopies (Snohomish County 2007). While the planted evergreen species mature, the fast-growing shrubs will provide adequate shade to prevent invasive species growth.

Objective 1.2: Identify successful species from the reference site

Task 1.2.1: Collect live stake materials from native plants present in the reference site and prepare them for installation

Approach: Live stakes of desired species such as *R. spectabilis*, *Cornus sericea*, *Salix lucida ssp. lasiandra*, and *Salix sitchensis* will be collected on the reference site using loppers. *C. sericea* and willow species will be cut into 2-3 foot-long pieces that are greater than 1/2" in diameter. Each piece should consist of at least six nodes and will be cut flat on the top and at an angle at the base just below a node. For other species, last year's growth will be used and a cut will be made below a node. Excess branches will also be trimmed off. If not installed directly, live stakes will be wrapped in moist paper and garbage bags and stored in the job box on site where it will remain cool and dark (Wildhorse Riverworks Inc. 2008).

Approach Justification: Live stakes with a diameter less than 1/2" generally have low survivability because the cuttings do not have enough energy and stored reserves to grow, so cuttings with a wider diameter from last year's growth will more adequately provide the resources necessary for sprouting to occur after planting. Storing live stakes in a cool, wet, dark environment can prevent them from desiccation for several months until they are ready to be planted (Wildhorse Riverworks Inc. 2008).

AD2. A portion of live stakes were also taken from our restoration site itself. We felt that we had adequate *S. sitchensis* within our own restoration site that we didn't feel that we had to take our live stakes solely from our reference site.

Objective 1.3: Prepare site for planting by adding wood chip mulch, woody debris, and altering topography

Task 1.3.1: Add a layer of mulch in removal areas

Approach: Mulch will be provided by the Green Kirkland Partnership and will be delivered in two large piles at the southern and northern ends of the restoration site. Mulch from these piles will be transferred using wheelbarrows and 5-gallon buckets to removal areas throughout the site. Approximately six inches of mulch will be applied to the areas of removal to suppress the regrowth of invasive species and provide adequate nutrients.

Approach Justification: Landscapes with mulch have vegetative communities that are more resistant to environmental stressors such as invasive species, soil erosion and compaction, temperature extremes, and disease which results in higher survival rates of native plant species (Chalker-Scott 2009). Using six inches of mulch has been successful for previous restoration projects through Green Kirkland.

AD3. We did not have 6 inches spread across all areas simply because we did not have enough mulch to do that. However, we did focus rings of deeper mulch around newly installed plants and on areas of concern for invasive recursion.

Task 1.3.2: Collect woody debris to provide vegetative growth and streamside bundle material as well as wildlife habitat

Approach: In collaboration with the U.S. Forest Service using a "Forest Product Collection Permit", woody debris will be collected in the Mount Baker-Snoqualmie National Forest near North Bend on land previously used for timber harvest. Collected woody debris will be transferred via a personal pickup truck to the restoration site where it will be used for various restoration purposes.

Approach Justification: Since the restoration site has a limited supply of woody material and removing such organic material from other healthy environments could cause adverse effects on ecosystem function, using woody material leftover from a timber harvest site would be a less disruptive alternative. Native species that will be planted at the site such as *T. heterophylla* and *Vaccinium parvifolium* require nurse logs to establish, so the woody material brought in from external sources will provide the necessary growth environment for these species.

Task 1.3.3: Create a berm along the southwestern edge of Polygon 1

Approach: Using surrounding soil and plant debris, a small berm will be made on top of the patch of *P. arundinacea* on the southwestern edge of Polygon 1 along the paved walkway.

Approach Justification: Creating a berm would not only suffocate the existing patch of invasive *P. arundinacea*, but it would also aid in preventing the spread of neighboring invasive species. Other advantages of creating a berm are wind protection for vegetation, reduced foot traffic on the site, and the development of microclimates (Wilkins and Bennett 2016). We were informed by our CP that there had been previous issues in the Everest Park with the grounds crew mowing down newly planted vegetation along trails and walkways as well as blowing leaves on to small seedlings, therefore reducing their survivability. A berm would create a more apparent boundary between the walkway and the restoration site which would likely reduce these incidences.

AD4. In addition to creating the berm with native soils, we buried large pieces of concrete that we uncovered in other parts of our site. This added to the height of the berm as well as removed the concrete from the surface of our site.

Objective 1.4: Plant appropriate native species, beginning with larger coniferous trees and ending with groundcover plants to create a diverse forest structure with functional wildlife habitat

Task 1.4.1: Design a planting plan that emphasizes structural diversity

Approach: Choose native species that will replace an aging deciduous canopy and accelerate forest regeneration such as *Ps. menziesii*, *T. plicata*, and the local climax species, *T. heterophylla*, while introducing a deciduous midstory of species like *A. circinatum* and *Salix* sp. Additionally, a diverse combination of shrub and groundcover species will be chosen to create vertical as well as horizontal forest complexity and habitat.

Approach Justification: The chosen species are appropriate for planting based on environmental conditions at the restoration site and their varying structures provide a variety of habitat functions such as nesting opportunities, food sources, and cover to avoid predation.

Task 1.4.2: Obtain and store planting material from the Mount Baker-Snoqualmie National forest, plant salvages, and nurseries in addition to the lives takes collected from the reference site

Approach: Using a "Forest Product Collection Permit" obtained from the U.S. Forest Service, small trees and other live plants will be collected for a small fee from land used for timber harvest in the Mount Baker-Snoqualmie National Forest. After being contacted for notice of participation, we will also attend multiple plant salvage events through King County. Remaining plant material will be acquired at local nurseries. All plant material obtained at various external sources will be transported to the Green Kirkland Park nursery via personal pickup truck where they will be stored until ready for planting.

AD5. Many plants were not taken to the Green Kirkland Park Nursery but were instead healed into the ground in a secluded area of Polygon 3. This was done simply for ease of access.

Approach Justification: Plants from Mount Baker-Snoqualmie National Forest and plant salvages will be the least expensive, so as much of the plant material required for the planting plan as possible will be obtained from these sources in order to save money. Any remaining plants that cannot be obtained through these sources or used as live stakes from the reference site will be purchased from local nurseries.

Task 1.4.3: Plant native species at the site according to the planting plan

Approach: For bare root plants and plants grown in pots, holes will be dug with a shovel in the desired location that are no deeper than the root system of each plant and twice as wide. Debris including roots, weeds, and rocks will be removed from the hole and a small mound will be created for the root crown of the installed plants to sit on. Before placing the plants into the hole, roots will be rinsed in water and any deformed roots will be cut. Once they are in the hole, the same soil that was removed from the hole will be backfilled and a small soil berm will be created around each plant.

Approach Justification: All container media for plants grown in soil will be rinsed off before installation because amending the existing soil is a leading cause of plant mortality after planting, partially because amended soil is more porous and dries out the roots of the plants during early stages of establishment. Creating a berm post-installation to helps to increase water retention and decrease erosion (Chalker-Scott 2009).

AD6. Bare root plants were "rinsed" by being placed in 5 gallon buckets full of water before planting. Plants that were bought in gallon buckets were removed from their buckets and then had all of the dirt massaged off of it and randomly distributed around the site to prevent nutrient sinks. These processes were done due to lack of easy access to water.

Goal 2 - Improve water quality in the stream

Objective 2.1: Control erosion and create bank stability.

Task 2.1.1: Plant vegetation according to the planting plan along the edge of the creeks

Approach: Plant species including *S. lucida ssp. lasiandra* and *S. sitchensis*, *P. sitchensis*, and *R. spectabilis* will be planted on the bank of the stream.

Approach Justification: These species generally grow quickly and have expansive root systems that will help to stabilize the soil and reduce erosion. Stabilizing materials will not be used along the slope because we have been informed by our CP that we cannot work within three feet of the water's edge.

AD7: *Lonicera involucrata* was added to this list of bank stabilizing pants, and *R. spectabilis* was excluded.

Objective 2.2: Create woody debris bundles along the edge of the stream.

Task 2.2.1: Make bundles or fascines of live plant material and place them along the edge of the stream in order to create a barrier

Approach: Collect woody debris and live plant material such as *S. lucida ssp. lasiandra*, *S. sitchensis*, and *C. sericea* from the Mount Baker-Snoqualmie National Forest as well as the reference site. This plant material will be greater than 1/2" in diameter and will be tied in 6-8" bundles that are approximately four feet long. Fascines will be placed parallel to the stream flow (InStream Conservation 2015) and will be anchored using dead wedge stakes.

Approach Justification: In addition to creating a barrier to prevent foot traffic along the stream bank, these fascines have the potential to sprout and develop roots that will contribute to bank stability and reduction of soil erosion (InStream Conservation 2015).

AD8. Fascines were not implemented because children were taking existing fascines from other parts of Everest Park and throwing them into Everest Creek. In order to prevent further destruction of the creek we decided not to add more fascines for the children to throw into the creek.

Objective 2.3: Prevent social trails to and along the stream.

Task 2.3.1: Plant thorny and shrubby plants around the entrances of the social trails to discourage usage

Approach: Remove about 100 square feet of *H. helix* from the social trail entrance in Polygon 1 and plant *R. nutkana*, *Oplopanax horridus*, and *R.lacustre*. These as well as similar species will also be planted along the edge of the stream in Polygon 4 where it is exposed to foot traffic from the street on the northern side.

Approach Justification: In a presentation by Carleen Weebers, it was explained that plants can be chosen to manage human movement and said that planting thorny species or planting densely is the best deterrent (Weebers 2015). By creating a dense thorny wall of plants, dogs and humans will not try and move through the thorns to access the social trail.

Task 2.3.2: Revegetate the pathways of the social trails.

Approach: The trail will be scarified using a tiller to a depth of at least 12" and then, starting from the middle of the social trail, planting will be done outward around the trail with appropriate species listed in the planting plan.

Approach Justification: Scarifying the soil allows the reversal of surface soil compaction (Pacific Crest Trails Association 2011). Scarified soil also allows for seed propagation from the existing forest.

AD9: Tilling only occurred at individual planting sites, not along entire trail due to time constraints.

Goal 3 - Promote an inviting environment for community stewardship

Objective 3.1: Create a public Facebook page and update it as site progresses

Task 3.1.1: Manage both text and image posts on the Facebook page

Approach: Any pictures taken at volunteer events will be posted to the Facebook page along with news about restoration events and efforts at the site. The posts will be made by one person and pictures will be posted by the individual who takes the pictures.

Approach Justification: Having one person do all the text posts will make the page more uniform and professional looking. Posting about events will be one avenue for finding new volunteers. The posting of pictures will allow people who volunteered during events to feel more connected to the site and may encourage them to spread the news about future restoration opportunities. The Green Kirkland Partnership Facebook page has been successful in gaining attention and involvement in local projects and events.

AD10. Multiple members wrote posts as well as uploaded pictures rather than just one person. This occurred because multiple people wanted to be involved in the Facebook page. In order to maintain professionalism we used similar writing styles.

Objective 3.2: Plan public restoration events.

Task 3.2.1: Contact local schools about volunteering and use the Green Kirkland Partnership database to find volunteers

Approach: Call elementary and middle school science teachers in the Kirkland area who have either been involved in restoration at Everest Park before or would be interested in coming out for an event or working with us for a class project. By notifying our CP of upcoming restoration events about a month in advance, she can send out emails to the Green Kirkland Partnership volunteer database with information regarding the event.

Approach Justification: When doing restoration work, having more people involved will greatly reduce the amount of time needed for any one task and increase efficiency. Additionally, volunteers will benefit by feeling a sense of accomplishment as well as learning more about the environment that they live in. The more that the community becomes aware of environmental issues and the positive impact that restoration can have, the greater society as a whole will benefit.

Objective 3.3: Provide information and snacks from local sponsors to volunteers.

Task 3.3.1: Go to local stores in the Kirkland area to ask for donations for volunteer events

Approach: We will be going to business in person and asking if they would like to donate to the event while giving a brief overview of our restoration project.

Approach Justification: Acquiring the food in this way will help local businesses gain publicity and we will have the opportunity to educate them about restoration happening in their own community. Having food at the event will also provide a more productive and enjoyable work environment that may encourage volunteers to return for future events.

Current Conditions

Table 1: Environmental conditions in Polygons 1-4

	Polygon 1 (8030 ft^2)		**Polygon 2 (4015 ft^2)**		**Polygon 3 (8030 ft^2)**		**Polygon 4 (2900 ft^2)**	
Soil Texture	O: Humus spongy under woody debris, leaves		O: Decomposed woody debris and clay with sand		O: Decomposed leaves and silty sand		O:Decomposed leaves and sandy silt	
	A: Sandy silty loam		A: Clay		A: Silty sandy loam		A: Loamy sand	
Soil Moisture	Damp		Damp		Very moist		Damp	
Slope	0%		1.5%		1.2%		0%	
Light Availability	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**	**Summer**	**Winter**
	near full sunlight	near full sunlight	50% full sunlight	near full sunlight	25% sunlight	near full sunlight	15% sunlight	near full sunlight
Present Vegetation	See Figures 9-13							
Human Impacts	Recently cleared above/below ground and mulched, near baseball diamonds		Near baseball diamonds but relatively sectioned off from foot traffic		Small social trail caused by frequent foot traffic		Small social trail caused by frequent foot traffic as well as a small footbridge	

Other Considerations	-	-	-	Borders Everest Creek

Canopy Layer

The canopy layer across all Polygons consists of mostly aging *A. macrophyllum* (30%) and *A. rubra* (25%), focused on the northern and eastern sides (Figure 9). With of Polygon 1 and 2 have both large light gaps, 1 having approximately 65% coverage (15% *A. rubra*, 15% *A. macrophyllum*, 20% *Acer saccharinum*, and 15% Oak). While Polygon 2 only has approximately 120% *A. macrophyllum* cover but has more coverage in the midstory. Polygon 3 has 75% coverage (50% *A. macrophyllum*, 24% *A. rubra*, 1% *T. plicata*) with more coverage in the midstory. Polygon 4 has 100% coverage (75% *A. macrophyllum*, 25% *A. rubra*). The canopy of the entire site is approximately 95-106 ft tall on average.

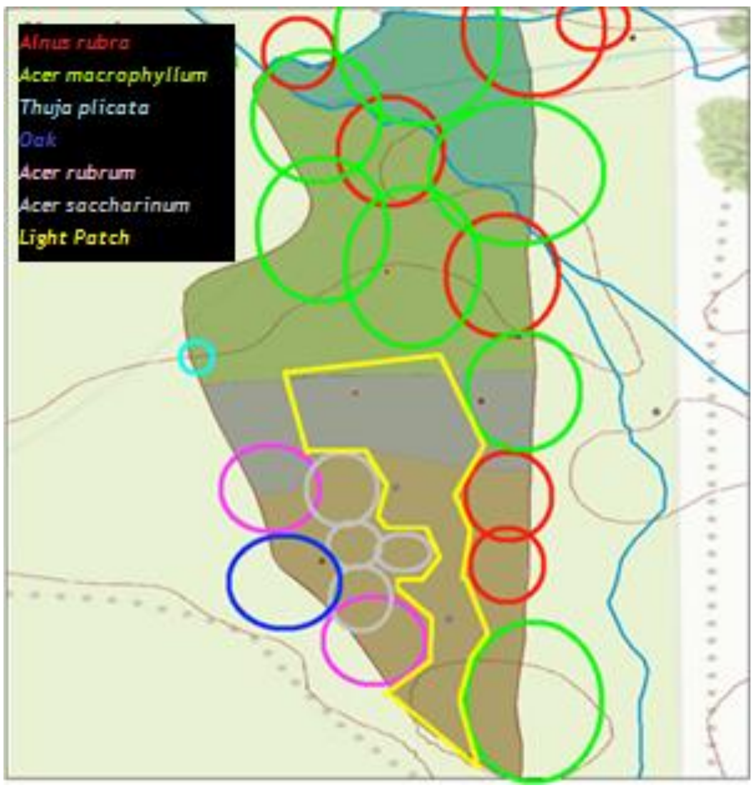

Figure 9: Canopy species composition of restoration site

Midstory

There is a substantial and old midstory (between the understory and overstory canopy) that consists of mostly *Corylus cornuta* var. *californica* with some *A. circinatum* spread across Polygons 3 (25% *A. circinatum*, 20% *C. cornuta var. californica)* and 4 (30% *C. cornuta var. californica*, 20% *A. circinatum*). The western edges of Polygons 2 and 3 have dense stands of *S.*

sitchensis (15%) and *S. lucida* ssp. *lasiandra* (10%), which appear with no canopy over them (Figure 10). Polygon 1 has no midstory, as it has been recently cleared (summer 2015).

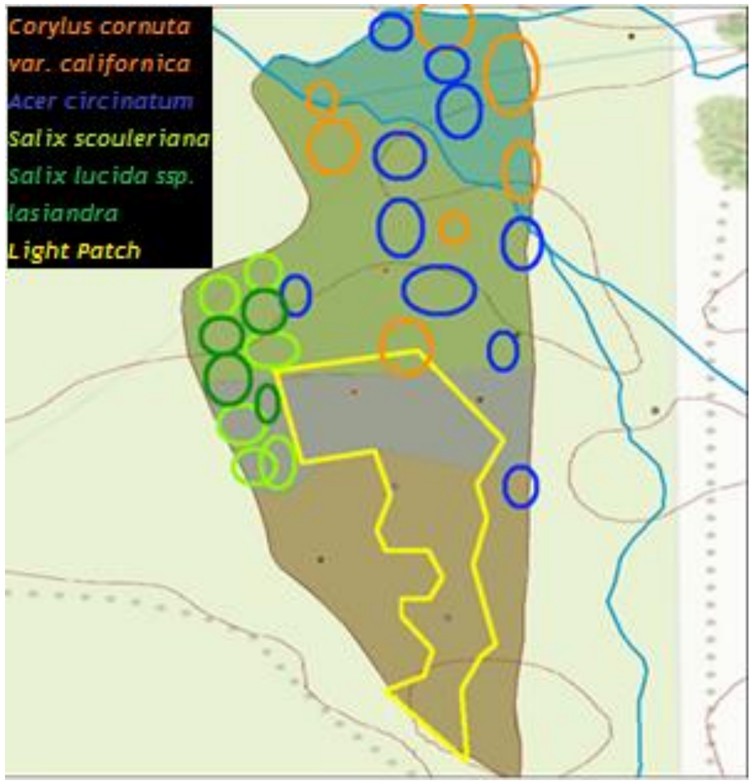

Figure 10: Midstory species composition at restoration site

Shrub Layer

The native shrub layer is fairly consistent in all Polygons. The eastern edge is a nearly unbroken stand of *R. spectabilis* with other large stands throughout (Figure 11). Numerous large *O. cerasiformis* specimens are located throughout Polygons 3 and 4. Polygon 4 also has small stands of *G. shallon* and *C. sericea.* Polygon 1 has 20% cover of *R. spectabilis* and Polygon 2 has 10% *R. spectabilis*, Polygon 3 has 45% *R. spectabilis* and 20% *O. cerasiformis*, and Polygon 4 has 25% *R. spectabilis* and 40% *O. cerasiformis*.

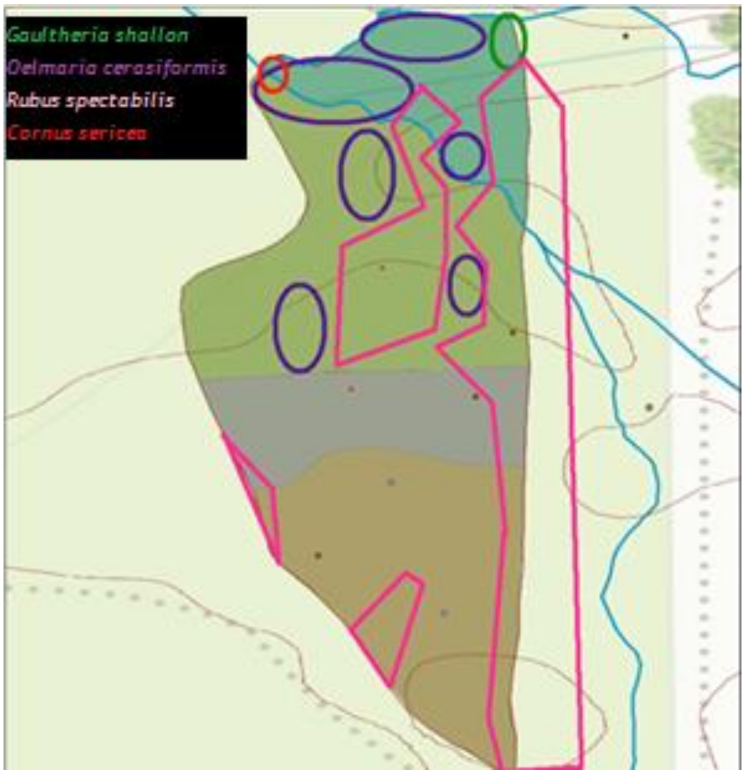

Figure 11: Shrub layer species composition at restoration site

Groundcover Layer

With the dense shrub layer and invasives, there is a less varied groundcover layer. Polygon 4 has approximately 60% coverage of *T. menziesii,* 30% in Polygon 3 with another patch in Polygon 1 (5%). Polygon 3 has approximately 5% *Rubus ursinus* on the northwestern edge. Other groundcovers are well spaced and mostly *P. munitum* (20%) (Figure 12). Polygon 1 has large areas devoid of plants, as it has recently had most of its invasive species removed and much applied.

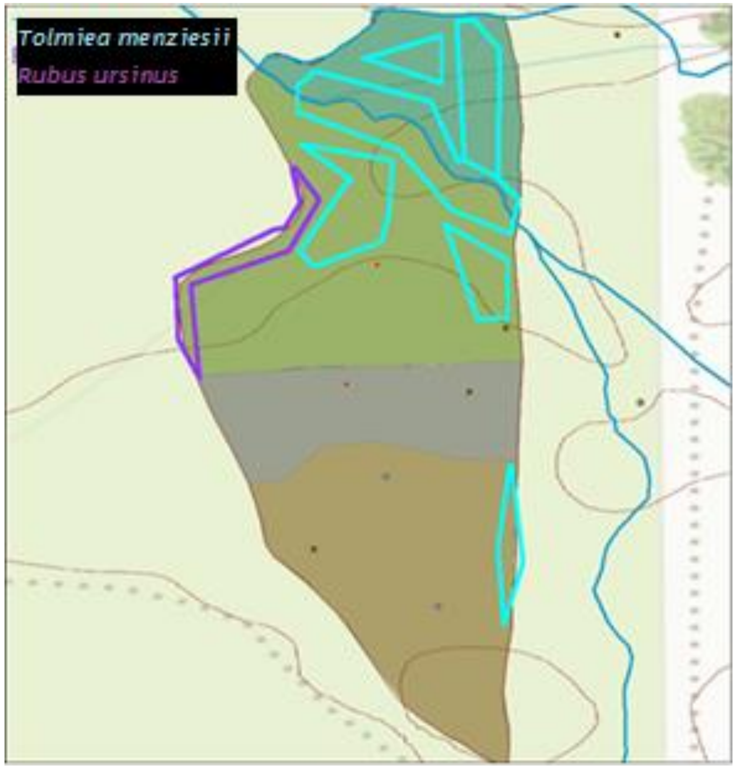

Figure 12: Groundcover species composition at restoration site

Invasive Species

The most prevalent invasives at Everest Park are *R. bifrons* and *H. helix,* which can both be found in large patches, and growing on other plants and habitat features (Figure 13). Numerous *I. aquifolium* and *P. laurocerasus* specimens are also found on site. Polygon 1 has a patch (10%) of *P. arundinacea,* which also appears in small patches in Polygons 3 and 4 (>1%). Polygon 2 has 90% *R. bifrons* coverage with 5% *H. helix.* Polygon 3 has 20% coverage *R. bifrons,* 30% of *H. helix,* 10% *I. aquifolium,* and 7% *P. laurocerasus.* Polygon 4 has 25% *H. helix*, 20% *P. laurocerasus*, and 10% *I. aquifolium.* In the northwest corner are small patches of *Solanum dulcamara* and a few *Conium maculatum.* The areas of biggest concern are the large patches of *R. bifrons* and *H. helix* in Polygons 2 and 3, as they are overtaking other landscape features.

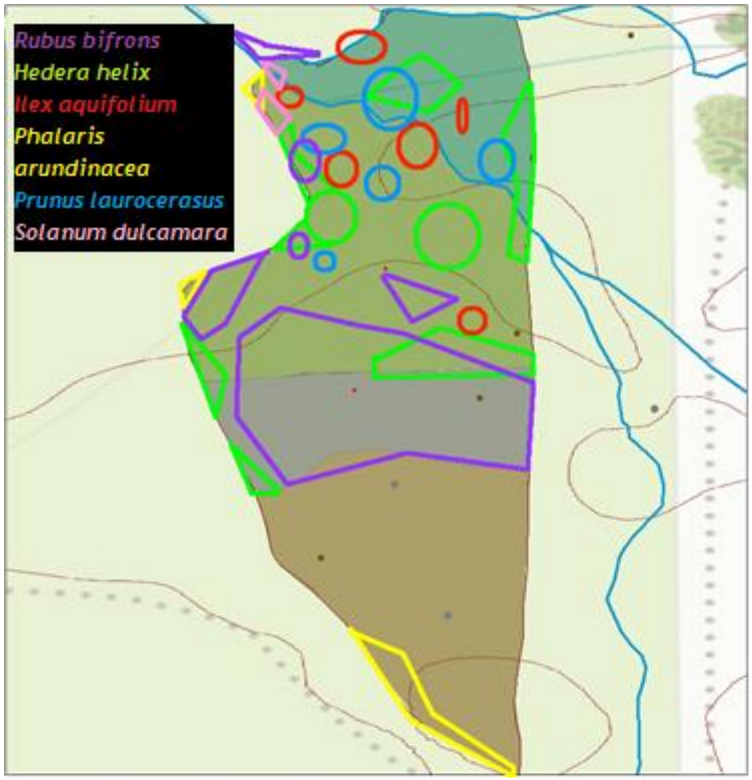

Figure 13: Invasive species composition at restoration site

Site Preparation Activities/Logistical Considerations

The four polygons were selected based on existing environmental, topographical, and vegetative features.

Polygon 1 was selected because it is an area that has been predominantly cleared both above and below ground in an earlier volunteer event in the summer of 2015 done by the Green Kirkland Partnership before we came to the site. It has the most available light and open space, meaning it requires the greatest amount of plant installation. It is the most exposed to public access via the pathway that runs along the southern edge. The eastern edge is bounded by the tributary of Everest creek (not accurate on background map), and the western edge is bounded by a batting cage.

Preparation: Some minor removal of invasive species (*R. bifrons*, *P. arundinacea)* and mulching in those areas. Where the *P. arundinacea* is removed, we will turn the soil under and berm approximately 18" of native soil and much in order to stop it spreading. This will also help act as a physical barrier to public access. Minor tilling may need to take place where volunteer access leads to soil compaction. It also requires introduction of woody debris and nurse log materials.

Polygon 2 was delineated because it had the densest cover of invasive species, namely *R. bifrons* and *H. helix*, requiring the largest amount of mechanical removal. It has since been cleared of approximately 75% of these invasives, leaving a large, open, mulched area similar to Polygon 1 in most ways except for available sunlight. The eastern edge is bounded by the tributary of Everest creek, and the western edge is bounded by a fenced baseball field.

Preparation: Massive manual removal of invasive species (*R. bifrons, H. helix)*, which was approximately 70% completed during our first volunteer event (1/18/16). It also requires introduction of woody debris, nurse log materials, and heavy mulching in cleared areas. .

Polygon 3 was selected due to its unique environmental conditions, as it has two tributaries that run through it, making it the wettest of the polygons. It is densely brushy and well shaded. Its eastern boundary is a social trail that we will be removing, and it is bounded on the western edge by a fenced baseball field. The northern boundary is the main tributary to Everest creek.

Preparation: Removal of invasives, such as (*H. helix,* small *I. aquifolium)* and mulching in the cleared areas. To make room for our conifers some thinning of native brush (namely *R. spectabilis)* will be done.. Fascines will be placed near (~3ft from water edge) tributaries for erosion control.

AD11: Fascines were not included. After viewing site with full spring vegetation, the group decided there was too much shade along the tributaries to facilitate growth of *Salix* species.

Polygon 4 was selected due to it being bounded on its southern side by a creek and by Everest creek on its northern side. Despite its quantity of moving water, it is one of the drier of the polygons, and has the most compacted soil (due to the social trail that makes up its eastern border). Being a popular play area for some children, this polygon requires the most by way of deterrent species and woody debris.

Preparation: Removal of invasives such as *H. helix*, small *I. aquifolium* and, *S. dulcamara.* Tilling will be performed in order to reduce soil compaction along the main social trail, and mulch will be added to tilled and cleared areas.. Woody debris will be brought infor both habitat function and as physical barriers to public access. Additionally, fascines will be created and anchored near (~3ft from water edge) Everest Creek to aid in erosion control.

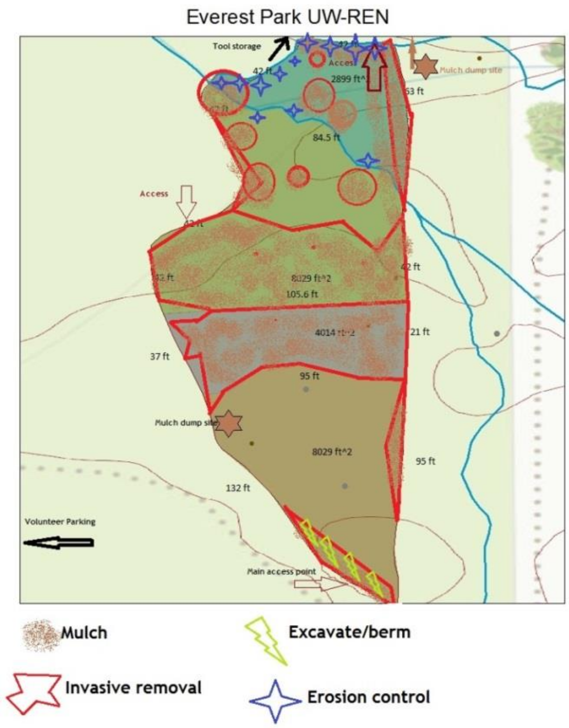

Figure 14: The site modifications that will be done

Planting Plan

Table 2: List of species that will create a diverse forest structure and functioning wildlife habitat in each Polygon with planting details

	Species	Spacing (ft)	Form	Quantity			
				Polygon 1	**Polygon 2**	**Polygon 3**	**Polygon 4**
Canopy	*T. plicata*	12-15	Bare root	6	6	12	5
	A. grandis	12-15	Bare root	~~5~~ **4**	3	5	~~3~~ **2**
	T. heterophylla	12-15	Bare root	~~10~~ **11**	~~6~~ **9**	~~12~~ **16**	~~5~~ **8**
	Ps. menziesii	12-15	Bare root **/1 Gallon**	~~10~~ **12**	~~4~~ **8**	~~3~~ **6**	~~2~~ **3**
	P. sitchensis	12-15	Bare root	~~6~~ **5**	2	8	5

Shrubs/ Midstory	*A. circinatum*	6	Bare root	14	10	10	~~4~~ **2**
	S. lucida ssp. lasiandra	2	Live stake	~~8~~ **0**	~~16~~ **4**	~~10~~ **12**	~~10~~ **0**
	S. ~~sitchensis~~ ***sitchensis***	2	Live stake	~~8~~ **0**	~~16~~ **4**	~~10~~ **12**	~~10~~ **2**
	P. capitatus	4	~~Live stake~~ **Bare root**	12	~~6~~ **8**	~~12~~ **14**	10
	V. parvifolium	4	Bare root	~~12~~ **8**	~~8~~ **6**	~~12~~ **8**	~~8~~ **6**
	R. lacustre	4	Bare root	10	4	4	10
	R. sanguineum	4	Bare root	6	2	~~0~~ **3**	0
	~~*V. edule*~~ ***R. purshiana***	6	~~2 Gallon~~ **Bare root**	~~4~~ **6**	~~2~~ **5**	~~4~~ **8**	~~2~~ **6**
	O. horridus	4	Bare root	0	0	~~4~~ **0**	~~15~~ **10**
	S. racemosa	4	~~Live stake~~ **Bare root**	~~16~~ **6**	~~10~~ **2**	~~10~~ **6**	~~8~~ **3**
	S. albus	2	Bare root **/1 gallon**	~~15~~ **10**	8	~~12~~ **16**	8
	H. discolor	4	Bare root	~~15~~ **2**	~~8~~ **0**	~~10~~ **2**	~~6~~ **0**
	R. spectabilis	4	Live stake	~~4~~ **0**	~~10~~ **2**	~~4~~ **0**	~~10~~ **0**
	O. cerasiformis	4	Bare root	~~25~~ **3**	~~16~~ **2**	~~15~~ **2**	~~10~~ **0**
	G. shallon	4	Bare root	~~18~~ **4**	~~14~~ **0**	~~15~~ **2**	~~10~~ **0**
	C. sericea	2	Live stake	~~15~~ **0**	~~10~~ **2**	~~15~~ **6**	~~12~~ **6**
	M. nervosa	4	Bare root	~~20~~ **4**	~~14~~ **0**	~~10~~ **4**	~~8~~ **0**

	C. cornuta **var. *californica***	**8**	**Bare root**	**1**	**0**	**0**	**0**
	Lonicera involucrata	**4**	**Bare root**	**4**	**2**	**8**	**6**
	R. nutkana	3	~~Live stake~~ **Bare root/ 1 Gallon**	~~25~~ **20**	10	20	~~15~~ **10**
Ground Cover	*P. munitum*	3	~~1 Gallon/~~ Bare root	~~50~~ **20**	10	~~30~~ **20**	~~10~~ **6**
	D. expansa	3	~~1 Gallon/~~ Bare root	~~30~~ **6**	~~20~~ **6**	~~15~~ **10**	~~8~~ **4**
	B. spicant	3	1 Gallon Bare root	~~40~~ **12**	~~20~~ **10**	~~20~~ **18**	~~8~~ **10**
	Dicentra formosa	**2**	**Bare root**	**4**	**2**	**8**	**4**
	~~*P. glycyrrhiza*~~	~~2~~	~~Bare root~~	~~0~~	~~0~~	~~10~~	~~10~~
	R. ursinus	2	Bare root	~~40~~ **10**	~~10~~ **6**	10	~~10~~ **0**
	~~*T. grandiflora*~~	~~2~~	~~Bare root~~	~~60~~	~~30~~	~~30~~	~~8~~
	To. menziesii	2	Bare root	~~60~~ **30**	~~30~~ **10**	~~30~~ **15**	~~8~~ **10**
	T. ovatum ssp. ovatum	2	Bare root	0	~~20~~ **6**	~~10~~ **14**	~~10~~ **8**
Plants per polygon:				~~554~~ **230**	~~325~~ **149**	~~372~~ **279**	~~248~~ **144**

<u>Polygon 1</u>: Our long term goal with this polygon is a *T. heterophylla* - *Ps. menziesii / P. munitum* - *Dryopteris expansa* community. It has the most pre-existing disturbance, likelihood of continued human disturbance (trampling) and has the greatest amount of sun exposure.

In order to prevent the recently disturbed soil from being overtaken by encroaching invasive species, a dense layer (2-4 ft spacing) of shrubs will be planted in order to provide shade until the conifers can take over (Task 1.1.4**)**. This will include 8 (each) live stakes for *S. lucida and S. sitchensis* intermixed in the wetter northwestern corner where some are already present, as well as live stakes of fast- shading species *C. sericea (*16, along edges of the light gap, wetter areas), *Symphoricarpos albus (*15 in small clusters near walking areas), *Physocarpus capitatus*

(12 evenly spaced in open areas).The density of these clusters will vary depending on the needs and conditions of the microsites.

The shade provided by the shrubs will help the young conifers , such as the *T. heterophylla (*10 including nurse log material [Task 1.3.2, Task 1.4.2], spread evenly along areas with more existing shade), *P. sitchensis* (6 spread along the walking path and along the eastern edge/tributary), *A. grandis* (5 bordering the wetter areas in the NW corner and along the tributary), and a few *T. plicata* (5 in the existing shade of the ornamental *Acer* trees in the SW corner*). Ps. menziesii* (10 in the light gap and along the walking path) does not have the same shade requirements as other conifers, and therefore will be more concentrated to the sunnier and more open microsites.

In order to prevent people from entering the site (Task 2.3.2, Task 2.3.1), deterrent species such as *R. nutkana* (25 live stakes in clusters along the walking path to the south, several individuals in the light gap) and *Ribes lacustre* (10 plants along the walking path to the south) will be planted, along with dense thicket forming species such as *G. shallon* (18 bare root clustered behind the other dense clusters along the walking path, in open areas). Without much of an existing midstory, and given their success in our reference site and other polygons, we will include *A. circinatum* (14 bare root, evenly distributed in both shady/open areas) to create a more diverse habitat structure.

One of our main goals is to improve wildlife habitat (Goal 1), which includes structure, nesting opportunities, food, and opportunities for native pollinators. To complete this, we included such species as *V. parvifolium* (12 bare root/nurse log, placed alongside *T. heterophylla* or in shady areas with woody debris [requested by Green Kirkland Partnership]), *Ribes sanguineum* (6 in the sunnier open areas along the walking path), *Viburnum edule* (4 individuals along the tributary to the east and the wet area in the NW), *Sambucus racemosa* (16 in light gap and along its edges), *O. cerasiformis* (25 bare root evenly distributed throughout), *Holodiscus discolor* (15 evenly spaced near/along the walking path/northern border, in light gap), *R. spectabilis (*4 clustered in the light gap), *and Mahonia nervosa* (20 evenly spaced throughout the polygon, with preference towards areas that conifers are placed).

Lastly, with so much recently cleared ground, numerous groundcover species will be planted to defend against invasive from returning. The bulk of this will be made up of ferns such as *P. munitum* (50 evenly spaced in entire polygon), *D. expansa* (30 evenly spaced in existing shady areas in the northern portion), *Blechnum spicant* (40 evenly spaced throughout the polygon), *R. ursinus* (40, spaced along the southern border and in the light gap), *T. grandiflora* (60 placed throughout the polygon in dense clusters), and finally *To. menziesii* (60 placed throughout the polygon in dense clusters).

AD12: S. *lucida ssp. lasiandra S. sitchensis* and *C. sericea* were not included, as we determined that the density of shrubs that are more drought tolerant was high enough. Near the shady tributary on the eastern border, several *L. involucrata* were included in their place.

AD13: *V. edule* was replaced by *R. purshiana* due to availability issues.

AD14: Density and number of most shrub and groundcover species was reduced based on both availability and existing plant structure (existing shrubs provided more shade than anticipated) (See Table 2).

AD15: Additional *P. menziesii* and *T. heterophylla* were included based on availability to allow for potential die off.

AD16: *T. grandiflora* was replaced by *Dicentra Formosa,* but in reduced numbers based on availability.

AD17: A single *C. cornuta* var. *californica w*as added based on availability to increase midstory complexity.

<u>Polygon 2</u>: Our long term goal with this polygon is a *T. heterophylla – Ps. menziesii / P. munitum – D. expansa* community. This polygon has recently had a large patch of *R. bifrons* and *H. helix* removed. It has at least 75% existing shade cover in the canopy, but large open spaces on the ground.

In order to prevent the large areas of disturbed soil from being retaken by invasive species, many shrubs will be planted in order to provide additional shade until the conifers that we plant can mature (Task 1.1.4). This will include 16 (each) live stakes for *S. lucida and S. sitchensis* intermixed the wetter western edge where some are already present, as well as live stakes of fast- shading species *C. sericea (*10 towards the west and eastern edges)*, S. albus (*8 in small clusters on open areas/along borders), and *P. capitatus* (6 evenly spaced in open areas).

The additional shade these provide will help the conifers, *T. heterophylla (*6 including nurse log material [Task 1.3.2, Task 1.4.2], spread evenly throughout the polygon), *P. sitchensis* (2 along the eastern edge/tributary), *A. grandis* (3 bordering the wetter areas on the western edge, along tributary), and with the amount of shade present in this polygon, we can include more *T. plicata* (6 evenly spaced throughout the polygon*). P. menziesii* (4 toward the southern border) will be concentrated in the sunnier and more open areas.

In order to prevent people from using the social trails that have been present in the past (Task 2.3.2, Task 2.3.1), deterrent species such as *R. nutkana* (10 live stakes clustered along the open area that borders polygon 1) and *R. lacustre* (4 plants along the path that connects polygon 2 and 3) will be planted, along with dense thicket forming species such as *G. shallon* (14 bare root in open areas and near trails).With little midstory remaining, and given their success in our reference site and other polygons, we will include *A. circinatum* (10 bare root, evenly distributed in cleared areas) to create a more diverse habitat structure.

One of our main goals is to improve wildlife habitat (Goal 1), which includes structure, nesting opportunities, food, and opportunities for native pollinators. With that in mind, species such as *V. parvifolium* (8 bare root/nurse log, placed alongside *T. heterophylla* or in areas with woody debris [requested by Green Kirkland Partnership]), *R. sanguineum* (2 in the NW and SW corners along the edge of the forest), *V. edule* (2 individuals, along the tributary to the east and the wet area on western edge), *S. racemosa* (10 evenly spaced in cleared areas), *O. cerasiformis* (16 bare root evenly distributed throughout, preference towards cleared areas), *R. spectabilis (*10 spaced in small clusters throughout the cleared areas), and *M. nervosa* (14 evenly spaced throughout the polygon, with preference towards areas that conifers are placed) will be used to fulfill those habitat features.

Lastly, many groundcover species will be planted to defend against invasive from returning. The bulk of this will be made up of ferns such as *P. munitum* (10 evenly spaced in entire polygon), *D. expansa* (20 evenly spaced in open areas), *B. spicant* (20 evenly spaced throughout the polygon), *R. ursinus* (10 spaced evenly along the western border), *T. grandiflora*

(30 placed throughout the polygon, focusing on cleared areas), *To. menziesii* (30 placed throughout the polygon, focusing on cleared areas), and *Trillium ovatum ssp. ovatum* (20, evenly spaced in cleared areas).

AD18: *V. edule* was replaced by *R. purshiana* due to availability issues.

AD19: Density and number of most shrub and groundcover species was reduced based on both availability and existing plant structure (existing shrubs provided more shade than anticipated) (See Table 2). As seen in all polygons, R. ursinus was present in much greater numbers than originally thought and did not require as much planting.

AD20: Additional *P. menziesii* and *T. heterophylla* were included based on availability to allow for potential die off.

AD21: *T. grandiflora* was replaced by *Dicentra Formosa,* but in reduced numbers based on availability.

AD22: *L. involucrata* was added near the eastern tributary.

<u>Polygon 3</u>: Our long term goal with this polygon *T. plicata –T. heterophylla / O. horridus – P. munitum* community, as the density of creeks, tributaries, and wetter soils give different community requirements. This site has large patches of *H. helix* intermixed throughout the native vegetation that will need to be removed, as well as *R. bifrons* and other invasives along the entire western border. The northern border follows one of the tributaries of Everest Creek, and contains an additional tributary.

In order complete our goal of improving water quality (Goal 2), erosion control (objective 2.1) along these areas and their social trail crossings (objective 2.3) will be taken into consideration by planting live stakes for *S. lucida and S. sitchensis (*10 of each, toward the sunnier northwestern forest edge of the main tributary) as well as *C. sericea (*15 evenly spaced in openings along tributaries).We will also make fascines of those same species (task 2.2.1) and place them near more disturbed streambanks.

Polygon 3 already has an estabishd shrub layer in patches and on its borders, but additional shrubs will be planted in order to provide habitat structure and shade for the small conifers (Task 1.1.4**)**. This will include *S. albus (*12 in small clusters on social trails and the border to the west), and *P. capitatus* (12 live stakes evenly spaced in open areas, along eastern social trail).

Since our goal is to restore a healthy forest ecosystem (goal 1) conifers such as *T. heterophylla (*12 including nurse log material [Task 1.3.2, Task 1.4.2], spread evenly throughout the polygon), *Ps. menziesii* (3 spaced along the eastern border), *P. sitchensis* (8 spaced evenly near the tributaries), *A. grandis* (5 placed sparsely throughout the entire polygon), and the shade-loving *T. plicata* (12 evenly spaced throughout the polygon) will be used.

As seen in all of the polygons, we need prevent people from using the social trails that are present, especially when it comes to stream crossings (Task 2.3.2, Task 2.3.1**)**. So, more deterrent species such as *R. nutkana* (20 live stakes clustered along the western border/access opening), *O. horridus (*4, placed at stream crossings) and *R. lacustre* (4 plants near the access point) will be planted, along with thicket forming species such as *G. shallon* (15 bare root in open areas and near trails).This polygon has a well-established midstory, but we will bolster it with *A. circinatum* (10 bare root, near large EZ-Jected invasive shrubs) to fill holes created by the removed invasives.

To improve wildlife habitat (Goal 1) by increasing habitat structure, nesting opportunities, food, and opportunities for native pollinators. To meet that goal, species such as *V. parvifolium* (12 bare root/nurse log, placed alongside *T. heterophylla* or in areas with woody debris [requested by Green Kirkland Partnership]), *V. edule* (4 individuals, spaced out along the tributaries, preferring sunnier sections), *S. racemosa* (10 spaced evenly in cleared areas and along the western edge), *O. cerasiformis* (15 bare root evenly distributed throughout, preference towards cleared areas), *R. spectabilis (*4 in small clusters on social trails), and *M. nervosa* (10 clustered near areas that conifers are placed) will be used to fulfill those habitat features

Polygon 3 has a fair amount of groundcover, but in the areas that *H. helix* is removed or other ground is cleared, more groundcover species will be planted to defend against invasive from returning and to improve the overall diversity of the habitat. This will be made up of mostly ferns such as *P. munitum* (30 evenly spaced in entire polygon), *D. expansa* (15 evenly spaced in wetter spots), *B. spicant* (20 evenly spaced throughout the polygon), *Polypodium glycyrrhiza* (10 bare root fastened to snags where moss has been painted), *R. ursinus* (10 spaced evenly along the western border), *T. grandiflora* (30 placed throughout the polygon, focusing on cleared and disturbed areas), *To. menziesii* (30 placed throughout the polygon, focusing on cleared and disturbed areas), and *T. ovatum* ssp. ovatum (10, clustered in cleared areas).

AD23: Fascines were not included due to logistics and time constraints.

AD24: *V. edule* was replaced by *R. purshiana* due to availability issues.

AD25: Density and number of most shrub and groundcover species was altered based on both availability and existing plant structure. (See Table 2)

AD26: Additional *P. menziesii* and *T. heterophylla* were included based on availability to allow for potential die off.

AD27: *T. grandiflora* was replaced by *Dicentra Formosa,* but in reduced numbers based on availability.

<u>Polygon 4</u>: Our long term goal with this polygon *T. plicata –T. heterophylla / O. horridus – P. munitum* community. This site has some *H. helix* throughout, *R. bifrons* and a cluster other NW corner at the confluence of Everest Creek and the tributaries. The northern border is bounded by Everest Creek, and its southern border is another tributary.

This proximity to Everest Creek makes this the most at-risk polygon for erosion, so keeping with the goal of improving water quality (Goal 2), erosion control (objective 2.1) along these streambanks and their social trail crossings (objective 2.3), there will be plantings of live stakes for *S. lucida and S. sitchensis (*10 of each, toward the sunnier northwestern forest edge at the confluence) as well as *C. sericea (*12 evenly spaced in along Everest Creek). We will also use fascines made of those same species (task 2.2.1) and place them along the highly disturbed streambanks, especially at stream crossings.

Polygon 4 contains a healthy shrub layer in most areas, but shrubs will be planted in the gaps made by soil compaction to create more shade for the conifers (Task 1.1.4**)**. This will include *S. albus (*8 in small clusters on social trails and in openings near Everest Creek), and *P. capitatus* (10 live stakes evenly spaced in openings, and along Everest Creek).

Continuing our goal is to restore a healthy forest ecosystem (goal 1) conifers such as *T. heterophylla (*4 including nurse log material [Task 1.3.2, Task 1.4.2], spread evenly throughout the polygon), *Ps. menziesii* (2 spaced along the eastern border), *P. sitchensis* (5 spaced evenly near along Everest Creek and the main tributary), *A. grandis* (3 placed sparsely throughout the middle of the polygon towards the west), and *T. plicata* (5 evenly spaced throughout the polygon) will be used.

With the main disturbance to Everest Creek happening due to the social trail crossings, we need discourage people from using them (Task 2.3.2, Task 2.3.1**)**. This will be done by using deterrent species such as *R. nutkana* (15 live stakes clustered at the NW corner and at the NE social trail), *O. horridus (*15, placed at stream the main crossing towards the NE and along the streambank of Everest Creek) and *R. lacustre* (10 plants in the clearing and beginning of the social trail that runs the eastern border) will be planted, along with more *G. shallon* (10 bare root in open areas and near trails).

This polygon has a well-established midstory made up mostly of *C. cornuta var. californica*, but we will add to it with small amounts of *A. circinatum* (4 bare root, near large EZ-Jected invasive shrubs) to fill holes created by the removed invasive.

Continuing with our goal of improving wildlife habitat (Goal 1) by increasing habitat structure, nesting opportunities, food, and opportunities for native pollinators, species such as *V. parvifolium* (8 bare root/nurse log, placed alongside *T. heterophylla* or in areas with woody debris [requested by Green Kirkland Partnership]), *V. edule* (2 individuals near the NE streambank), *S. racemosa* (8 spaced evenly in cleared areas toward the NW), *O. cerasiformis* (10 bare root evenly spaced in clearings and along social trails), *R. spectabilis (*10 in clusters to block off social trails), and *M. nervosa* (8 clustered near areas that conifers are placed) will be used to fulfill those habitat features.

Polygon 4 has a healthy groundcover layer except for areas that *H. helix* is to be removed and on the social trail. In those areas, more groundcover species will be planted to defend against invasive from returning and to improve the overall diversity of the habitat. *P. munitum* (10 evenly spaced in entire polygon), *D. expansa* (8 evenly spaced in wetter spots to the south), *B. spicant* (8 evenly spaced throughout the polygon), *P. glycyrrhiza* (10 bare root fastened to snags where moss has been painted), *R. ursinus* (10 spaced evenly along social trail), *T. grandiflora* (8 spaced evenly in cleared and disturbed areas), *T. menziesii* (8 spaced incleared and disturbed areas), and *T. ovatum ssp. ovatum* (10, clustered in cleared areas).

AD28: Fascines were not included due to logistics and time constraints .

AD29: *V. edule* was replaced by *R. purshiana* due to availability issues.

AD30: Density and number of most shrub and groundcover species was altered based on both availability and existing plant structure. (See Table 2).

AD31: *T. grandiflora* was replaced by *Dicentra Formosa,* but in reduced numbers based on availability.

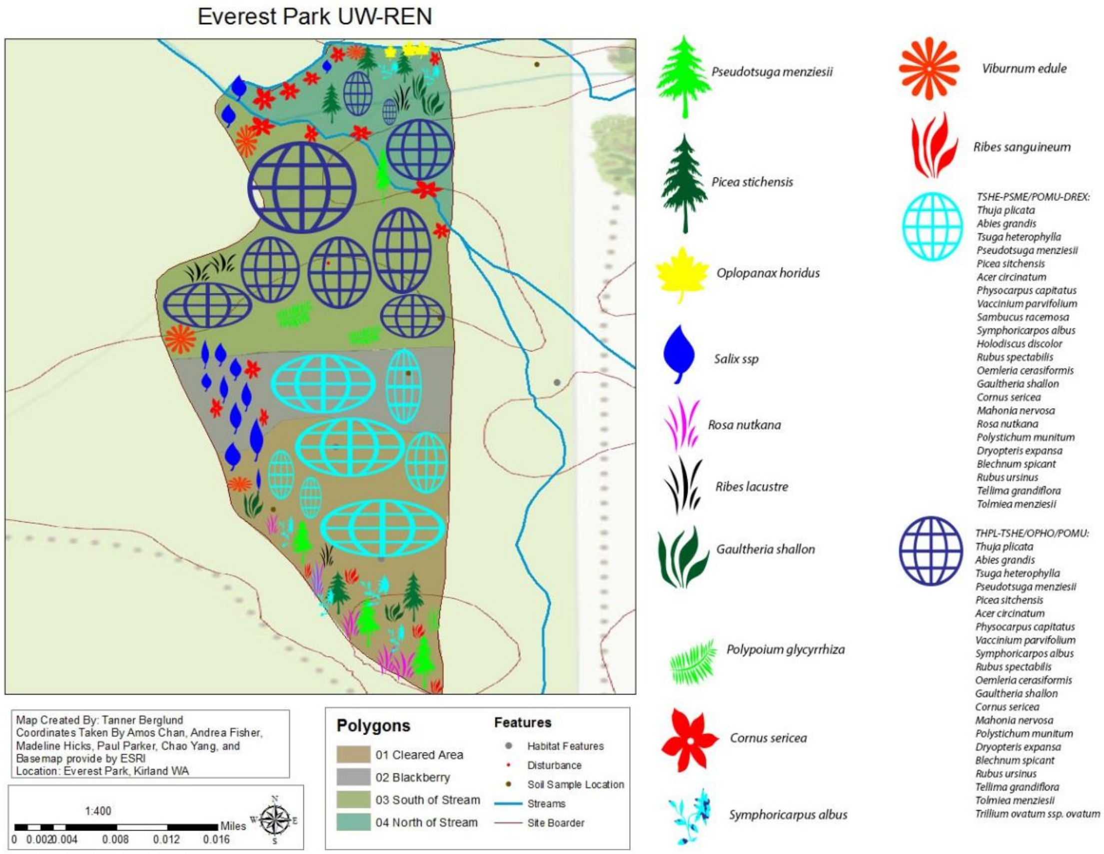

Figure 15: Original planting plan map

As Built Map:

Legend:

Canopy:	
Abies grandis	AG1
Picea sitchensis	PS1
Pseudotsuga menziesii	PM1
Thuja plicata	TP1
Tsuga heterophylla	TH1
Shrub/Midstory:	
Acer circinatum	AC2
Cornus sericea	CS2
Gaultheria shallon	GS2
Holodiscus discolor	HD2
Oemleria cerasiformis	OC2
Oplopanax horridus	OH2
Physocarpus capitatus	PC2
Rhamnus purshiana	RP2
Ribes lacustre	RL2
Ribes sanguineum	RS2
Rosa nutkana	RN2
Rubus leucodermis	RL2
Salix lucida ssp. lasiandra	SL2
Salix stichensis	SS2
Sambucus racemosa	SR2
Symphoricarpos albus	SA2
Vaccinium parvifolium	VP2
Groundcover:	
Blechnum spicant	BS3
Dryopteris expansa	DE3
Mahonia nervosa	MN3
Polypodium glycyrrhiza	PG3
Polystichum munitum	PM3
Rubus ursinus	RU3
Dicentra formosa	DF3
Tolmiea menziesii	TM3
Trillium ovatum ssp. ovatum	TO3

Figure 16: As Built maps species legend by canopy layer

Canopy:

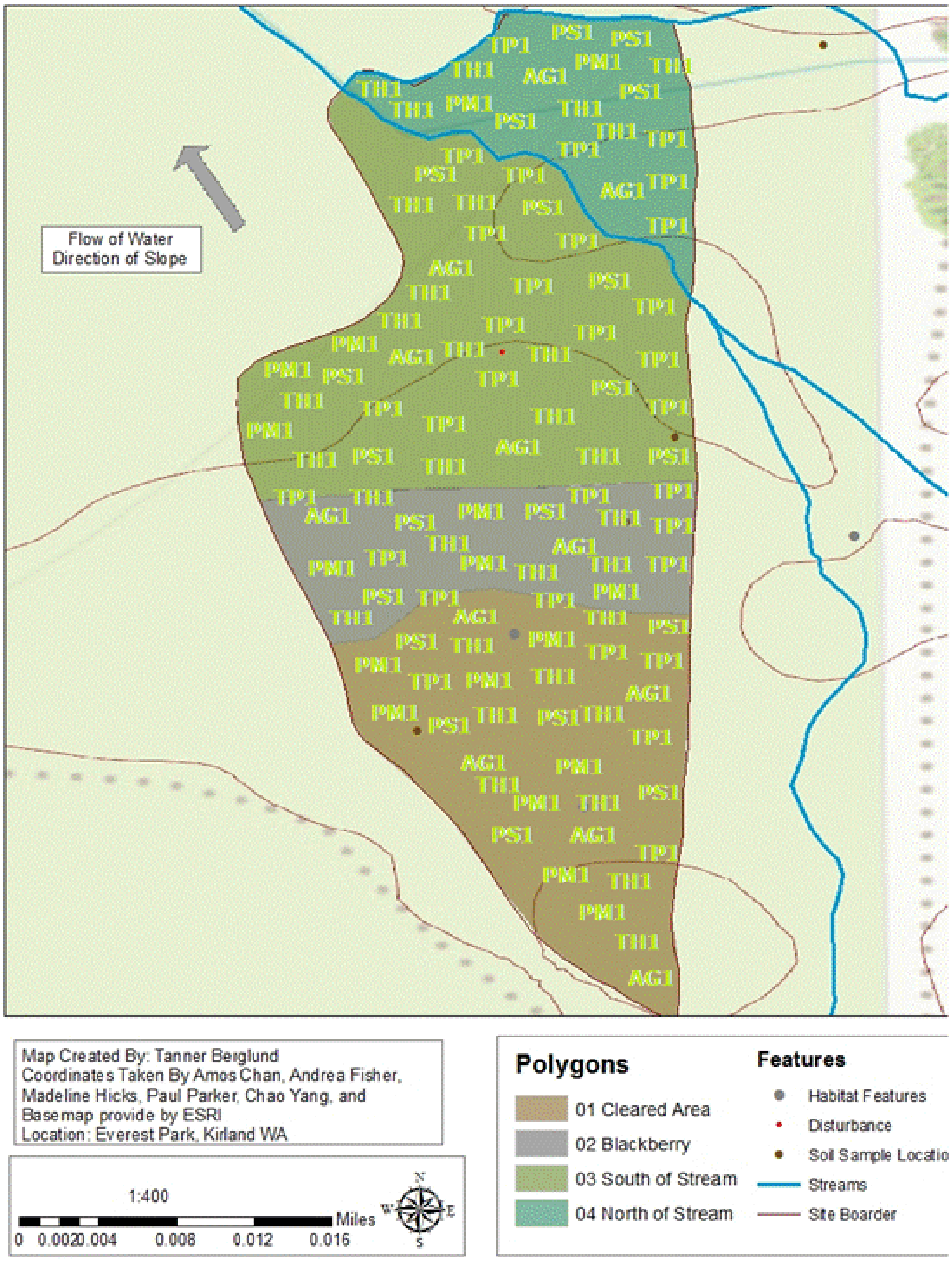

Figure 17: As built canopy layer map

Shrub/Midstory:

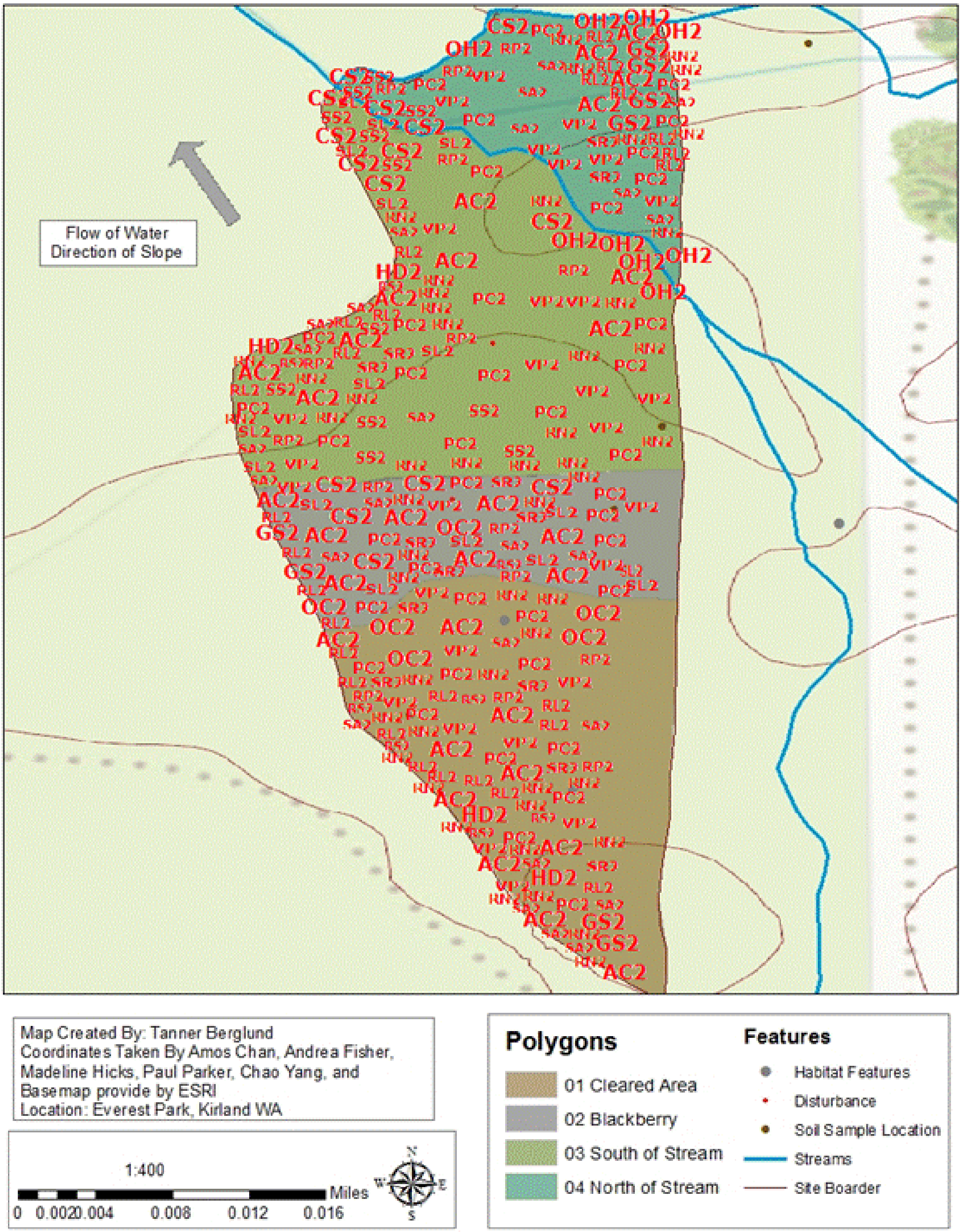

Figure 18: As Built shrub/midstory map

Groundcover:

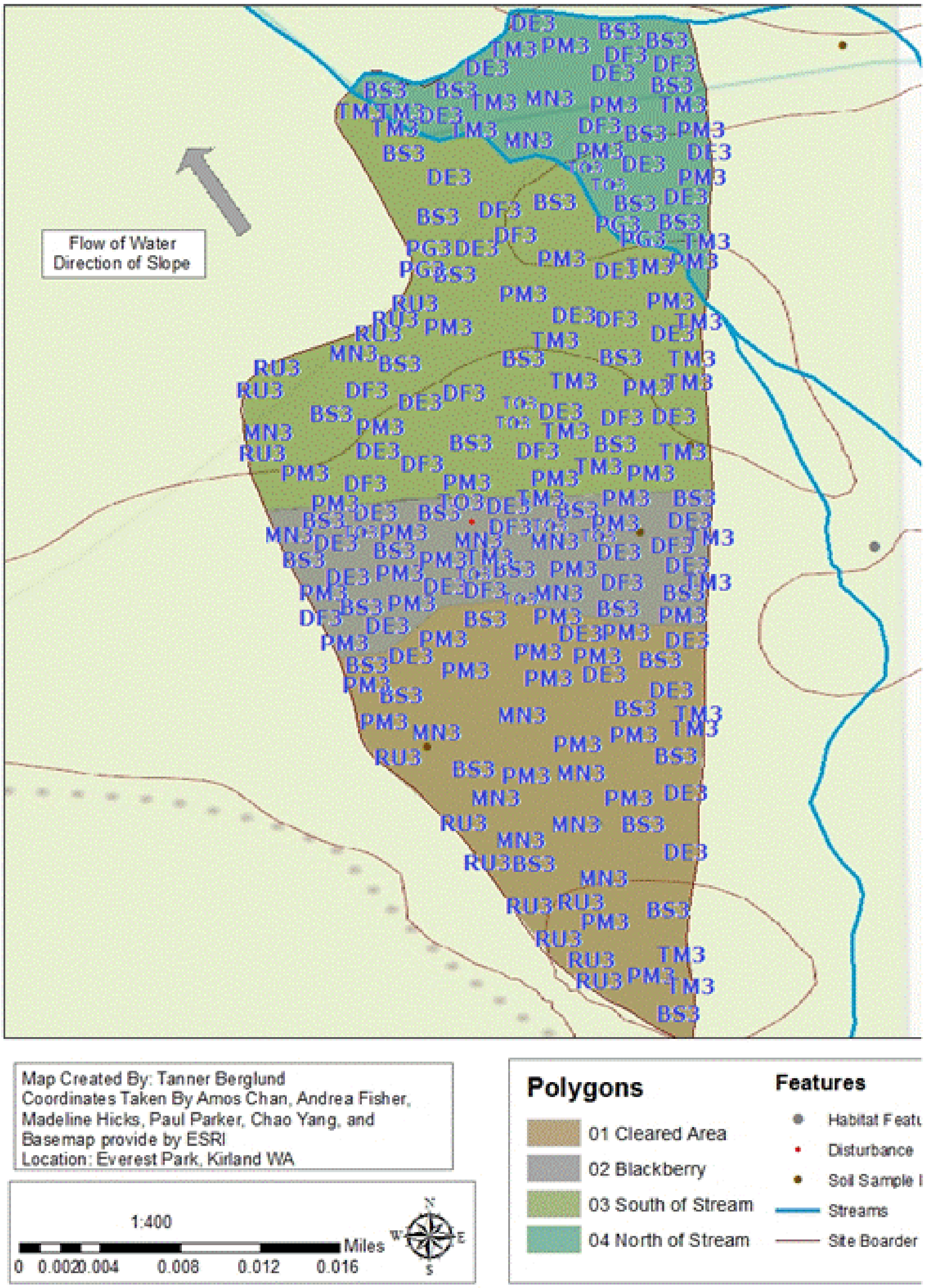

Figure 19: As Built groundcover map

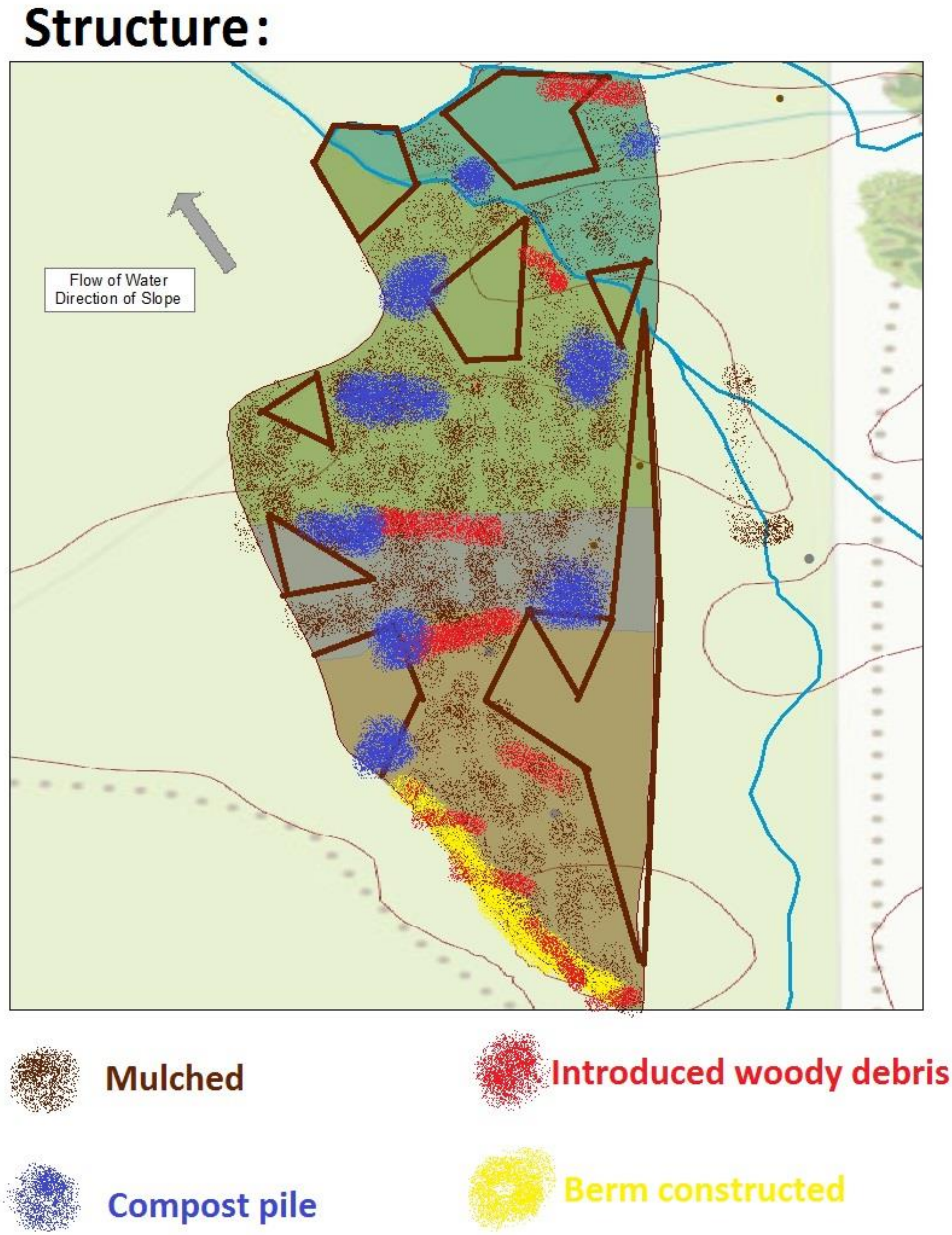

Figure 20: As Built structure map

<u>Table 3</u>: Wildlife services provided by native species listed in Table 2

Species	**Wildlife Services**
T. plicata	Nesting locations
A. grandis	Seeds can be eaten by smaller animals
T. heterophylla	Cover and seed can be food for some birds and mammals
Ps. menziesii	Food and shelter to small birds and mammals along with potential nesting sites for them
P. sitchensis	Nesting space and shelter for birds
A. circinatum	Ground cover for small mammals and birds
S. lucida ssp. *lasiandra*	Ground cover for small mammals and birds cones eaten by some
S. sitchensis	Ground cover for small mammals and birds cones eaten by some
P. capitatus	Berries are food for birds, pollinator opportunities
V. parvifolium	Berries are food for birds and mammals
R. lacustre	Berries are food for birds and mammals, pollinator opportunities
R. sanguineum	Berries are food for birds and mammals, pollinator opportunities
~~*V. edule*~~ ***R. purshiana***	Berries are food for birds and mammals, pollinator opportunities
O. horridus	Shelter for smaller animals
S. racemosa	Berries are food for birds and some mammals
S. albus	Berries are food for some birds, pollinator opportunities
H. discolor	Shelter for birds and insects eaten by birds and nectar for insects
R. spectabilis	Berries are food birds and mammals along with shelter for small mammals, pollinator opportunities
O. cerasiformis	Berries are eaten by birds and some mammals, early blooms for pollinator opportunities
G. shallon	Berries are food for birds and mammals
C. sericea	Berries are food for birds and some mammals, pollinator opportunities
M. nervosa	Berries are food for birds and mammals

R. nutkana	Flowers eaten by deer and other mammals while providing shelter to small birds, pollinator opportunities
P. munitum	Shelter for small mammals
D. expansa	Shelter for small birds and mammals
B. spicant	Shelter for small mammals
~~*P. glycyrrhiza*~~	~~Shelter for small birds and mammals~~
R. ursinus	Berries are food for birds and mammals while providing shelter to both
~~*T. grandiflora*~~	~~Nectar used by pollinators~~
To. menziesii	Seeds eaten by birds
T. ovatum ssp. *ovatum*	Flowers eaten by deer and plants by small mammals

(Palouse Prairie Foundation 2012, United States Department of Agriculture 2016, Washington Native Plant Society 2016)

Table 4: The general materials needed to restore our site per task

Task	Materials	Qty	Source		Tools	Qty	Source
Task 1.1.1	Coffee Sacks	30	CP		Loppers	~~25~~ **10**	CP
	5-Gal. Buckets	25	CP		Shovels	25	CP
					Gloves	60	CP
Task 1.1.2	Coffee Sacks	20	CP		Hand Tillers	10	CP
	5-Gal. Buckets	5	CP		Gloves	20	CP
Task 1.1.3	Flagging Tape	40ft	Us				
Task 1.1.4	Plants	400	Various		Shovels	25	CP
					Gloves	50	CP
Task 1.2.1	50-Gal. Cans	2	Us		Gloves	12	CP
Task 1.3.1	5-Gal. Buckets	25	CP		Shovels	5	CP
	Wood Chip Mulch	~~150~~ **30** yd^3	CP		Gloves	10	CP
					Pitchfork	**1**	**CP**

Task 1.3.2	50 Gal. Can	2	Us		Gloves	12	CP
Task 1.3.3	**Wood Chip Mulch**	~~2~~ **1 yd^3**	**CP**		Shovels	6	CP
					Gloves	12	CP
Task 1.4.1	Tarps	2	Us		Truck	1	~~UW, Us~~ **Beall Family**
					Shovels	2	~~Various~~ **Us**
					Gloves	4	~~Various~~ **Us**
Task 1.4.2	Plants	~~1499~~ **802**			Shovels	25	CP
					Gloves	50	CP
Task 2.1.1	Plants	~~1499~~ **802**			Shovels	6	CP
					Gloves	12	CP

Labor Budget

Table 5: How many man-hours were allocated throughout the project

Labor budget	Team hours	Volunteer hours	Total hours
Site preparation			
Site assignment	15	0	15
Remove invasive plants			
Remove invasive plants on MLK day	31.5	96	127.5
Other invasive removal			
March	**9**	**0**	
April	**71**	**20**	**91**
May	**30**	**40**	**70**
Total invasive removal			**288.5**
Salvage/ Collection			
Salvage on Feb. 6th	~~18~~	0	~~18~~
Salvage on Feb. 6th	**24**		**24**
Salvage on Mar. 5th	~~18~~	0	~~18~~
Salvage on Mar. 5th	**26**	**0**	**26**
Total salvage time	**50**	**0**	**50**
Collect wood debris	10	0	10
Planting			

Planting work party 1	~~30~~	~~120~~	~~150~~
Planting work party 1	**30**	**40**	**70**
Planting work party 2	~~30~~	~~120~~	~~150~~
Planting work party 2	**40**	**40**	**80**
Other planting works	~~25~~	~~0~~	~~25~~
Other planting works	60	0	60
Total planting time	**100**	**80**	**180**
Monitor plants	~~25~~	~~0~~	~~25~~
Monitor plants	**40**		**40**
Others			
Making poster	~~10~~	~~0~~	~~10~~
Making poster	**20**	**0**	**20**
Working on stewardship plan	~~12~~	~~0~~	~~12~~
Working on stewardship plan	**30**	**0**	**30**
Working on as-built report	12	0	12
Working on as-built report	**24**	**0**	**24**
Teaching students	~~20~~	~~0~~	~~20~~
Teaching students	**10**	**0**	**10**
Working on Facebook page	8	0	8
Collection of data	12	0	12
Collection of donation	12	0	12
Total			~~624.5~~
			699.5

Financial Budget

The majority of cost in our project is from the plants. We plan to grow a total of 802 plants at our site. Plants will be collected from multiple sources include plant salvages, free live stakes, purchasing from nurseries, and donation from the Green Kirkland Partnership in order to minimize the cost. We expect to get as many plants as possible from salvages and donations. In addition, the Green Kirkland Partnership provides us with free tools and mulch. Finally, local businesses like Hillcrest Bakery and Top Pot Doughnuts donate free drinks and food for the events. The only revenue we can get for now is from the course fee allotment with some in-kind donation from bakeries.

Table 6: All financial costs incurred throughout the project

Expenditures	**Cost**
Plants	
Conifer	~~91.50~~
	95.27
Shrubs/Midstory	~~218.20~~
	383.72
Ground Cover	~~132.32~~

	0.00
Subtotal for plants	~~442.02~~
Subtotal for plants after tax	~~484.01~~
	478.99
Tools rental	
Subtotal for tools	0.00
Food for volunteer	200.00
Subtotal for food	200.00
Transportation	
~~Gas cost for truck~~	~~50.00~~
~~Subtotal for transportation~~	~~50.00~~
Mulch	
Subtotal for mulch	0.00
Poster	
Printing fee	~~24.00~~
	20
Subtotal for poster	~~24.00~~
	20.00
Others	
~~Materials to mark invasives for treatment by GKP~~	~~10.00~~
~~Twine for fascines~~	~~6.00~~
~~Stakes for anchoring fascines~~	~~10.00~~
~~Markers for installed bare root plants~~	~~12.00~~
~~Subtotal for others~~	~~38.00~~
Total	**698.99**
Revenue	
Course fee allotment	~~596.01~~
	498.99
In-kind donation	
Coffee and doughnuts	200.00
Total	~~796.01~~
	698.99

Other Plans

Local School Involvement

We are planning to contact teachers at Peter Kirk Elementary, Alexander Graham Bell Elementary, Kirkland Middle School, and Lake Washington High School for interest in partnering and helping them use our restoration at Everest Park in their teaching material. We will contact their respective secretaries or office managers if there are none, and have them send our proposal to teachers that may be interested. We are not directly contacting the teachers because of the lack of information on the subjects that they teach. Topics that we are most confident in teaching during the rest of the school year are restoration, native species, and ecosystem succession. We may be able to accommodate for other subjects once we more closely collaborate with the teachers. In addition to teaching the students, they could also help in restoring the site during work party events. The volunteer experience is helpful for students trying to fulfill their community service hours and for exposing to students to the work of restoration. The table shows the schools and the person we will be contacting as a liaison to spreading our plans.

Table 7: Local school contacts

School	**Name**	**Email**
Peter Kirk Elementary	Cheri Wisdom	cwisdom@lwsd.org
Alexander Graham Bell Elementary	Ashley Short	ashort@lwsd.org
Kirkland Middle School	Betty Ann Ray	bray@lwsd.org
Lake Washington High School	Patricia Doherty	pdoherty@lwsd.org

AD28. Presentations were given to Susan Crauer's 7th grade science classes at Kirkland Middle School. The presentations consisted of giving a PowerPoint presentation as well as having the students fill out a worksheet (Appendix II) regarding restoration practices and invasive species. Invasive species samples from our site were also brought into the classroom for the students to see.

Stewardship Plan

The stewards that will take care of this site will be two participants in this capstone project, Tanner Berglund and Amos Chan. They will perform maintenance and monitoring of the site according to a stewardship plan. In addition to maintenance and monitoring, they will also host at least two events a year. These events may be used to continue site restoration work in adjacent areas.

We also plan to use the Green Kirkland Partnership volunteer database to help find someone to become the steward for our site after we are done with the project. The steward will be taught by us on the plans for the site and future maintenance that may be needed. Also we would like to encourage them to expand restoration to the surrounding area. If there is an interested student from those that we would teach, then it that would be great because they could gain valuable experience as a student or in their post high school life.

Donations

We are planning to ask local companies for donations for our work party events. Companies that we have contacted before and plan to contact again are: Hillcrest Bakery and Top Pot Doughnuts. Future companies that we also plan to talk to are Starbucks and PCC Natural Markets located in the Houghton Center, which is very close to Everest Park. The table below shows the companies that we will be contacting for our restoration work party events.

Table 8: Charitable donators contacts

Company	Phone Number	Address	Requested Donations
Hillcrest Bakery	425-486-5292	10010 Main St, Bothell, WA 98011	Day old doughnuts
Top Pot Doughnuts	425-307-1540	11701 97th Ln NE, Kirkland, WA 98034	Day old doughnuts, Coffee
Starbucks	425-893-8661	Houghton Center, 6733 108th Ave NE, Kirkland, WA 98033	Coffee
PCC Natural Markets	425-828-4622	Houghton Center, 10718 NE 68th St, Kirkland, WA 98033	Bakery and fruit snacks

Work Timeline

Figure 21: Winter quarter Gantt chart

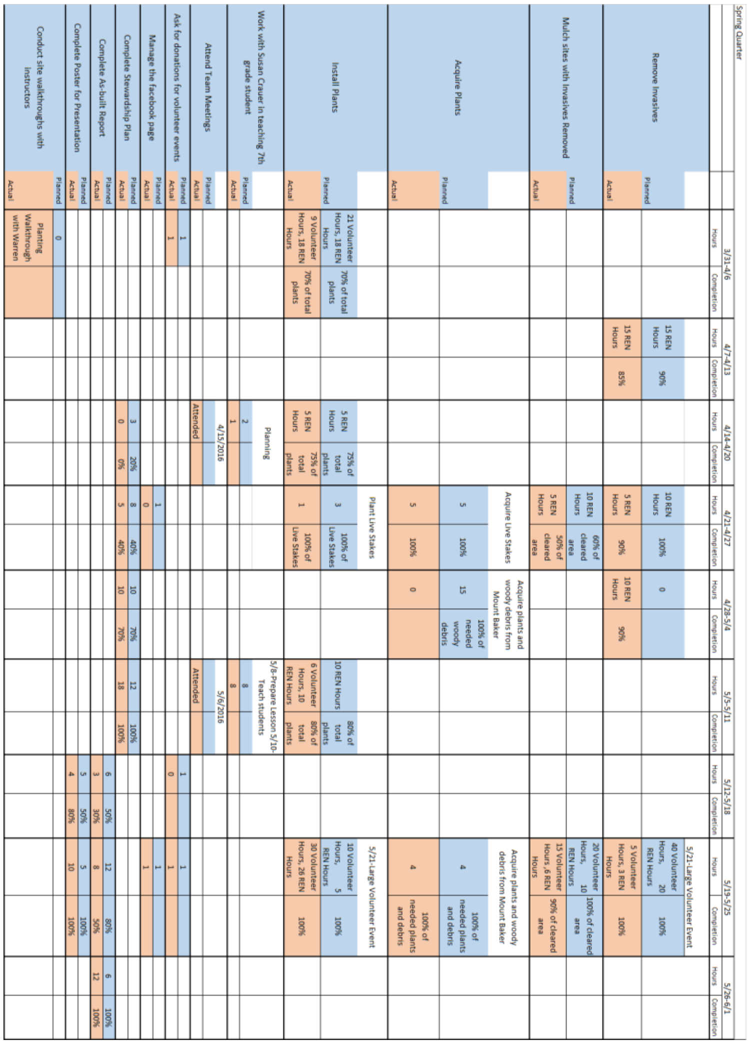

Figure 22: Spring quarter Gantt chart

Design for the Future

The future goal of the site is to have a mature conifer forest. This forest will provide habitat features for local wildlife, erosion control for the small creeks in the site, reduction in the use of social trails, prevention of invasive species from returning, and beauty for the surrounding neighborhood. Until the upper story conifer cover is established, some maintenance will be required, potentially less with active monitoring. This will be carried out by park stewards and occasional volunteers. In 50 years, the maintenance will be drastically reduced as the canopy cover provided by the conifers will shade any new invasive species that would start growing in the area. In 100 years, the conifer layer will be dense enough to require very little additional maintenance aside from what is done by the Green Kirkland Partnership for any other site.

The work done on the site after we leave will mostly consist of ensuring that the trees planted are doing well, preventing social trails from reestablishing, and the removal of invasive species. Until the 50 year mark, most of what is being done will be work towards the removal of invasive species before they have the chance to get established. After the 50 year mark, the site will be mostly self-sufficient in regards to invasive species and will only need occasional removal.

The primary goal for this project is to establish a robust canopy cover consisting mostly of conifers. Currently, there are no conifers at the Everest Park site and it is dominated by an aging deciduous population allowing invasive species to colonize in the winter months and establish before the leaves have returned to the trees that are currently on the site. Although our removal of invasive species may harm habitat features in the short term, the addition of a complex understory will allow for a more diverse habitat for more local animals while providing a larger diversity of food. The erosion control is not currently an issue, but when the currently mature deciduous trees start dying off it will be, which is why the addition of conifers will aid in erosion control. The planting of a diverse understory could reduce the use of social trails but past efforts have been unsuccessful due mostly from the tenacity of the users of these trails.

For the long-term maintenance of the site, we will implement features into the site to reduce the maintenance load on the stewards. Berms and woody debris were two methods discussed with our community partner to help prevent seeds and other unwanted debris from entering our site from the park side. We will need to work with our community partner to identify exactly how much time and frequency our site will be given by the stewards to know how much preventive maintenance our site will have before we can know for certain how many work parties may need to happen. Our mulching efforts should give us a few years if reapplied with regularity until the invasive species really become an issue that need to be removed (Chalker-Scott 2009).

Once the conifer canopy is established, most issues regarding with invasive species will be dealt with and the use of berms and woody debris will prevent more invasive species from entering the site. The use of the berms and woody debris along with thorny plants will help reduce the use of social trails in the area.

Lessons Learned

Throughout this restoration process we have learned that things don’t always go as planned. Between the heat in early spring, the onslaught of wreckage caused by children, and unexpected transactions at certain nurseries we now a list of things to avoid in the future.

The weather in April was one of the hottest and driest years that we have ever had in Seattle which took a toll on our newly installed plants. There were several occasions when we had to go and water plants to try and keep them from drying up. Despite our efforts, end we lost the majority of the first batch of conifers to lack of water. Luckily this set back wasn’t as expensive to remedy as we anticipated because we received a large batch of donated conifers from the Nooksack Salmon Enhancement Association. For future restorations, we will all be sure to check the extended weather forecast before planting and implement a backup watering system in case the worst happens

Going into this restoration we all anticipated that there would be a presence of children due to the social trail and proximity to baseball fields. We did not expect children to be our hardest obstacle to overcome. Every day that we were at the site working we had to ask children to leave. At first they were just looking for baseballs because some coaches had a reward system for finding lost balls. Then the children started getting a bit more brazen and began throwing the log bundles and signs that were meant to dissuade people from entering our site, into the creek. We had to approach coaches to ask them to please keep their players out of our site on the day that we showed up to find many of our plants had been chopped down with sticks, pulled out by the roots and piled up, or simply had their tags removed. As mentioned earlier, we expected kids to be kids in the sense that they would be exploring out site, but we ended up dealing with kids who had no respect for the work that we were doing. In the future, I think we will approach the coaches sooner to inform them about our project and set aside extra money to replace plants that are destroyed.

Finally, without naming names, there was a particular nursery that we tried to purchase plants from but it ended being a stressful and expensive trip. When we first made contact with this nursery they informed us that there would be no way that they could write us up a pre-order invoice but we were assured that all of the plants that we wanted would be around two or three dollars. Upon arrival at the plant sale, the other patrons were aggressive and three inch tall ferns were nine dollars each. We decided not to buy much there because the prices were so steep but it was so inconvenient because we had planned on getting about 200 plants that day. We were able to find all the plants we needed at a later date but the change in schedule was not something we had planned on. In the future, I don't think any of us will try to purchase anything from a nursery that won't provide a pre-order invoice.

Financial Budget

For our financial budget, we purchased plants from 4 different sources and they are matched with our original budget. The 4 purchase of plants are $80, $116.15, $165, and $180 and the poster print cost us $20. The total expense in our project is $561.15. There some lessons what I learned from comparing the data. Firstly, in our original budget, most of plant prices are based on the bundle of 10. During the actual purchasing, we adjust the number of plants we need and make the total expense close to our expected budget. Secondly, purchasing from nurseries is the least economical way of getting plants. Since we have limited budget of $600, we have to develop more ways of getting plants such as salvage. In the future projects, we will also try to gathering plants from different sources to economically finish our tasks.

Labor Budget

During the actual work, the working time is much more than our original budget for our team. For example, we removed the majority of invasive plants in our time with help from volunteers, however, the rest of removal working still lots of our time, especially when we work without out volunteers. During the spring quarter, our team used more than 100 hours to remove invasive in our site. The other things beyond our expectation are working on the posters and stewardship plan; we took roughly doubled time on that even though we have some of the information in our previous work plan. In the future life, we need to be more careful estimate on our work and improve our efficiency because it will strongly affect our work plan.

The other thing we didn't meet the expectation are the volunteers. In our MLK day work party, we had 22 volunteers and they were working very hard which made us finish our task efficiently. However, in the rest of our events, we have fewer volunteers than that and we have to work more by ourselves. The lesson we learned here is that we have to carefully estimate the volunteer time because they are unstable. Fortunately, we have enough time to finish this project, but if we are assigned to do a large project in the future, the overestimate will bring us negative results.

Planting Plan

The main lesson we learned from our planting plan is the importance of knowing what the plant structure will be like throughout each season. Since we started this project in the late Fall, much of the deciduous and herbaceous plants were not present when we did our initial plans. As spring rolled on, many species showed themselves in much greater numbers and coverage than we had originally planned for, and many species that we did not expect also appeared (such as *Lysichiton americanus*). This resulted in changes in our planting structure. Additionally, with our limited plant budget, we had to rely heavily on plant salvages, meaning that we had to go with what was available. This also changed the structure of our site, learning to replace species with ones that fill a similar ecological role, depending on their availability.

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Appendix

Appendix I

Table 1: Soil assessment of site one located in Polygon1 taken in Autumn of 2015

Soil Assessment				
Coordinates 47.6713638, -122.1914991	**Site #** **1**	**Date** **11/2/2015**	**Weather** **(at collection)** **Sunny and cold**	**Weather** **(Prior)** **Heavy rain**
O Horizon	**Litter Layer**		**Humus Layer**	
	Depth	**Composition**	**Depth**	**Composition**
	0-2 cm	**woody debris, leaves, woodchips**	**2-4 cm**	**Spongy and dark**
A Horizon	**Depth**	**Feel Test**	**Moist Cast**	**Ribbon Test**
Type: Sandy silty loam	**4-20 cm**	**grainy w/ moderate amount of floury material**	**forms a weak cast**	**2-5 cm ribbon**
Rooting Depth Range	**Coarse Fraction**	**Macroinvertebrates**	**Disturbances**	**Dominant vegetation**
0-10 cm	**Low**	**a few large Worms**	**Had recently been cleared and mulched**	**None**

Table 2: Soil assessment of site one located in Polygon 2 taken in Autumn of 2015

Soil Assessment				
Coordinates **47.6715106,** **-122.1912694**	**Site #** **4**	**Date:** **11/4/2015**	**Weather** **(at collection)** **Sunny & cold**	**Weather** **(Prior)** **Heavy Rain**
O Horizon	**Litter Layer**		**Humus Layer**	
	Depth	**Composition**	**Depth**	**Composition**
	1 cm	**Leaves & woody debris**	**2 cm**	**Decomposed woody debris &Clay w/ sand**
A Horizon	**Depth**	**Feel Test**	**Moist Cast**	**Ribbon Test**
Type: Clay	**3-20 cm**	**Sticky and smooth**	**Strong cast**	**>5 cm ribbon**
Rooting Depth Range	**Coarse Fraction**	**Macroinvertebrates**	**Disturbances**	**Dominant vegetation**

0-20 cm	**high**	**Many worms**	**none**	***Rubus bifrons***

Table 3: Soil assessment of site one located in Polygon 3 taken in Autumn of 2015

Soil Assessment				
Coordinates 47.675738, -122.1912326	**Site # 3**	**Date: 11/4/2015**	**Weather (at collection)** **Sunny & cold**	**Weather (Prior)** **Heavy rain**
O Horizon	**Litter Layer**		**Humus Layer**	
	Depth	**Composition**	**Depth**	**Composition**
	4 cm	**Leaves & Roots**	**4-18 cm**	**Decomposed leaves &Silty Sand**
A Horizon	**Depth**	**Feel Test**	**Moist Cast**	**Ribbon Test**
Type: Silty, Sandy loam	**18-20**	**Smooth, with grit**	**Strong cast**	**5 cm ribbon**
Rooting Depth Range	**Coarse Fraction**	**Macroinvertebrates**	**Disturbances**	**Dominant vegetation**
0-20 cm	**Low**	**Few worms**	**None**	***H. helix*, *R. bifrons*, *A. macrophyllum*, R. spectabilis**

Table 4: Soil assessment of site one located in Polygon 4 taken in Autumn of 2015

Soil Assessment				
Coordinates 47.6718630, -122.1911226	**Site # 2**	**Date 11/4/2015**	**Weather (at collection) Sunny & Cold**	**Weather (Prior) Heavy Rain**
O Horizon	**Litter Layer**		**Humus Layer**	
	Depth	**Composition**	**Depth**	**Composition**
	2cm	**Leaves/roots**	**2-6 cm**	**Decomposed leaves & Sandy silt**
A Horizon	**Depth**	**Feel Test**	**Moist Cast**	**Ribbon Test**
Type: loamy sand	**6-20 cm**	**Gritty & floury**	**Weak cast**	**2.5 cm ribbon**
Rooting Depth Range	**Coarse Fraction**	**Macroinvertebrates**	**Disturbances**	**Dominant vegetation**
0-20 cm	**Medium**	**None**	**None**	***H. helix*, *C. cornuta*, *R. bifrons***

Appendix II

Worksheets used during presentations at Kirkland Middle School 7th grade classes:

Names____

PNW Restoration Ecology: Introduction to Invasive Species

1. What Does a Healthy Ecosystem look like?: List everything in this picture that you think makes it a healthy ecosystem

- Multiple canopy layers
- Biodiversity
- Sunlight
- Little human interaction
- No litter
- Few invasives
- Etc.

2. Resource Partitioning: List examples of resource partitioning shown on slide

   a. Plant and animal species can share space by growing or living in different layers of the forest.

   b. Plant species can share water, nutrients, and space by having different shaped roots

   c. Animals share food resources by having physical features that make them better at eating some foods but not others.

   d. Both plants and animals species will grow or live in different elevations in order to avoid competition

3. What is an Invasive Plant Species: What do you think native species and invasive species compete over?

- Sunlight
- Water
- Space
- Nutrients

4. Examples of Invasives in the PNW: List as many species as you can think of.

Scotch broom, Thistle, knotweed, dandelions, English ivy, English holly, reed canary grass, Himalayan black berry.

5. Himalayan Blackberry: *Rubus bifrons-Look at the sample given to you in your groups and write down as many traits as you can about it.*
    a. *Stem*- star formation, covered in thorns
    b. *Leaves*-5 of them in a group
    c. *Flowers*-open faced, easy access to pollen covered stamens
    d. *Roots*- hearty root balls
        i. *What makes them so invasive?*
            1. The thorns protect it from predation, the berries and flowers are attractive to pollinators, the root balls help in to reproduce asexually. All of these powers combined means it spreads easily and is hard to get rid of because it isn't victim to herbivory and the roots are difficult to remove. Blackberries often will rob other plants of their resources by taking over their space first and then consequently every other resource until there is a monoculture of blackberry.
6. English Ivy: *Hedera helix*- Look at the sample given to you in your groups and write down as many traits as you can about it.
    a. *Stem*-long, flexible, with roots all along it
    b. *Leaves*-waxy and broad
    c. *Roots*-short but there are many all along stem
        i. *What makes them so invasive?*
            1. The fact that it has so many roots along the flexible stem means that they can grow anywhere. It also means that every part of the vine must be removed in order for it to not repopulate. The wide leaves blanket the trees or other surfaces that they are growing on which rob the tree of sunlight.

7. English Holly: *Ilex aquifolium*-Look at the sample given to you in your groups and write down as many traits as you can about it.
    a. *Leaves- waxy, sharp, poky*
    b. *Berries- Attractive to birds*
    c. *Roots- one main root with runners that stretch laterally*
        i. *What makes them so invasive?*
            1. *Like the blackberry, nothing eats it and it spread really easily through its berry seeds. Holly will also send out runner roots that can grow new trees if it feels that the main plant has been threatened. This makes it outcompete other plants for space.*
8. Reed Canary Grass: *Phalaris arundinacea*- Look at the sample given to you in your groups and write down as many traits as you can about it.
    a. *Stem- tall and flexible*
    b. *Leaves-contain cuticle and contain seeds in spring*
    c. *Roots-rhizomes*
        i. *What makes them so invasive?*
            1. *Reed canary grass share roots which makes it very easy for them to reproduce asexually and take over entire fields by outcompeting natives for soil nutrients and space.*
9. List ways that invasives can be removed
    a. Manually
    b. Chemically
    c. Biologically (plant a stronger plant to out compete it, have something eat it)

Appendix III

Baseline Monitoring Report with data sheet and monitoring photos (5/26/16)

Plot	Polygon	Living (#)	Dead (#)	Cover (%)				Colonization
				Ground	3 feet	10 feet	+10 feet	(Y/N)
1 T	1	47	1	75	75	10	10	N

1 Q	1	20	0	85	22	10	10	N
1 Q	2	34	2	80	70	50	20	Y
1 Q	3	18	0	30	25	50	55	N
1 Q	4	35	0	50	30	20	40	N
2 Q	4	21	0	20	20	40	30	N
Plot	Polygon	Invasive species		Invasive Species (#)			Action	
1 T	1	Reed Canary Grass		4			Mechanical removal	
2 Q	4	English Holly		3			EZ-ject and remove	

Photo 1. Polygon 1. Tanner Berglund

Photo 2. Polygon 2. Tanner Berglund

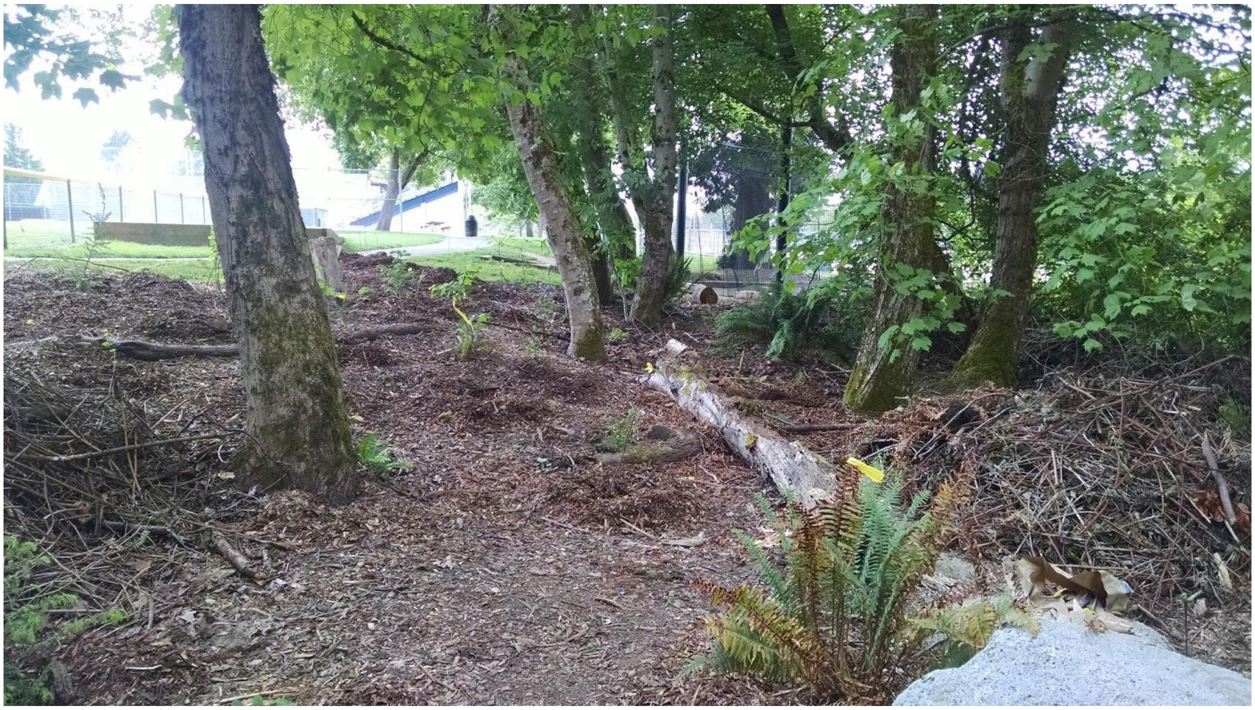

Photo 3. Polygon 2. Tanner Berglund.

Photo 4. Polygon 3. Tanner Berglund.

Photo 5. Polygon 4. Tanner Berglund.

Photo 6. Polygon 4. Tanner Berglund.