Yesler Swamp
University of Washington Restoration Ecology
Restoration Capstone Project 2016-2017

Location: Yesler Swamp, NE Union Bay Pl and NE 41st St, Seattle WA 98105

Clients:

Fred Hoffer for Friends of Yesler Swamp

Society for Ecological Restoration

Team Members:

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Table of Contents

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1 Project Summary

1.1 Pre-Restoration Description

Before the restoration project, the invasive species were growing freely in the open space, the native plants' growth was suppressed, the excessive wood chips applied by previous restoration project were decreasing the site's water retention. Our two polygons contained an abundance of invasive species, and lacked native vegetation. The invasive species our group mainly focused on were English ivy (*Hedera helix*), Reed canarygrass (*Phalaris arundinacea*) and Himalayan blackberry (*Rubus armeniacus*)

Before:

After:

1.2 Ecological Concerns

Yesler Swamp experiences annual seasonal flooding. The site is degraded by an excess of Reed canary grass and other invasive species like Himalayan blackberry and English Ivy. The presence of these species has resulted in the impediment of native plant growth at the site. The competition created by the invasive species is a major disturbance, of which is one of the highest priorities in the restoration goals. Limitations of the site includes the deposition of highly-saturated soil, as well as weak propagation by native plants, unless aided by wind dispersal. Additionally, there are extremely dense patches of Himalayan blackberry that disturb the

northeastern boundary of the swamp, which is another force standing against the relatively low native plant propagation. The high growth rate of the Himalayan blackberry and other invasive species results in the present native species being crowded out and/or prevented from becoming established.

1.3 Project Goals and approach

Our group chose a wide variety of plant species that are expected to survive well at Yesler Swamp and it is our expectation that the vegetation selected will help foster a riparian ecosystem capable of sustaining and recruiting native flora and fauna.

Goal 1: Provide and sustain an enhanced area for Skunk Cabbage (*Lysichiton americanum*) in the UBNA Yesler Swamp Polygon 2

For the first goal of this restoration project, we aimed to suppress the growth of invasive species, we recruited volunteers to help us to remove invasive species include Himalayan blackberry, English Ivy, and reed canary grass. Beside this one time invasive removal, we used clippers to snip around the *R. armeniacus* near 8-12 inches. Using a shovel dig a circle 3-5 inches deep and dig out a root ball/mass, we planted tall canopies of native plants by bare roots or live stakes, which would expect to shade out the shade-intolerant *Phalaris arundinacea*.

We also would like to plant a mixture of shrub, coniferous, and deciduous species including *Thuja plicata, Physocarpus capitatus, Acer circinatum.* Making sure that trees are at least on 15' centers. We will also plant *Salix lasiandra* at site, in less shaded areas consider it would not thrive in shaded area. With many of these planting will also come dense shrub plant species such as *Athyrium felix-femina, Sambucus racemosa, Rubus spectabilis, Rubus parviflorus, etc.* We will be using shrub species that spread quickly and are close to the ground as another means of shading out Reed canarygrass, these shrubs should be on 5' centers.

One of the major goal is helping the establishment of skunk cabbage, which is a native plant that adapt to this environment very well. Having the skunk cabbage at least 3-inches in the water provides the plant species with the proper hydrophilic conditions for the plant to assimilate into the riparian ecosystem. Mulch and woodchips will be avoided near the skunk cabbage plantings as it would not be ideal because it would likely enable the flow of water to less saturated areas i.e. (mulch and woodchips). Though this will play a larger role in site 1 as well as other areas of Site 2, since there are studies showing that mulch and woodchips enhance rhizosphere conditions including mycelium recruitment and water retention.

Goal 2: Restore habitat to desirable riparian ecosystem capable of sustaining and recruiting native flora and fauna.

We selected plants based on potential benefits to the ecosystem i.e. (root competition, hydrophilic plants, food source, herbivory, etc.). This should be based on the needs of native animals as well as the long-term site projection goal.

Our group has found that planting a variety of species including trees, shrubs, ferns, and hedges can aid in the recruitment of local fauna. As the site progresses through time, it is our goal that larger trees e.g. *(Picea sitchensis and Physocarpus capitatus)* will assist with providing woody debris, habitat, shade, flood control, and erosion control along the project site. This should also lead to different microclimates as well as an overall cooling effect along the pond.

Goal 3: Provide training, educational tools, and long-term stewardship plan for future stewards of Yesler swamp at UBNA.

Through research our group has found that shrubs can significantly inhibit the spread of grasses with a p-value < 0.001. This study also demonstrated that shrubs have a faster response ratio rather than tree cover. Additionally, shrubs can have an effect of increasing total soil carbon with a $p < 0.001$ and have been associated with a slight decrease in soil pH with a p-value < 0.013. The soil pH is an important characteristic to evaluate when doing a riparian site restoration as this can lead to eutrophication in ponds as well as fluctuation in insect population; important to note, microclimates involving temperature (p-value < 0.032) can also aid in change in population dynamics.

Our group has decided to plant red-osier dogwood, pacific ninebark, thimbleberry, and snowberry along the boardwalk as to discourage human traffic into the project site. However, since the goal of the community partner is to enhance the viewing and habitat of the skunk cabbage, it is important that we maintain an area that oversees that new plantings of skunk cabbage. Overall, one of the main goals in our site is to reduce the Reed Canary grass cover.

Goal 4 : Create or encourage a neighbor/student-run community stewards that are interested in prolonged sustainability of Yesler Swamp

We recruited volunteers from environmental courses (ESRM 100, ESRM 101, ENV100, etc.), provide a concise and definitive way (email, Facebook group, and social media) which allows people to become engaged and involved in regular check-up of the site, as well as, for finding out requirements needed to run a smooth restoration project.

Our group has found that people in current and future generations are becoming more technologically capable, so it seems ideal that restoration projects and stewardship plans venture in these arenas. This tool should serve as a means of connecting with people and

communities at large; similar to roots and the abundant recruitment of microorganisms, fungi, and macroinvertebrates. The internet could serve as a human created root system.
To increase the efficiency of the volunteer event, we obtained sponsored food and drinks from local stores such as Domino's Pizza, Papa John's Pizza. We Speak to local store managers and receive their contact information, then send the managers a letter with the University of Washington federal tax ID (6-8 weeks prior to volunteer events for best response). Ideally, a discussion takes place before, which lists potential foods available for donations. Identify the number of potential volunteers attending the event, estimate tool pickup requirements, food availability, weather conditions, etc.

1.4 Major accomplishments

1. We have removed much of the invasive plants from the site, plant native canopies that would further suppress the growth of the invasive plants.
2. We have successfully held several volunteer event, and get sponsored food, finished the field work ahead of schedule.
3. Made stewardship plan that give instructions for future restoration teams.
4. Installed more than 262 native plants and live stakes.

1.5 Team Contact Information

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1.6 Acknowledgements

We are grateful and want to thank those who helped us during this restoration project, some local business generously offered their sponsorship to support our volunteer events, some people offered excellent advice to keep this project on the right track, and volunteers helped were truly the backbone for achieving our restoration goals.

We would like to acknowledge:

- **Friends of Yesler Swamp**
- **Society for Ecological Restoration**
- **ESRM 100 class volunteers**

- **Evergreen Middle School Volunteers**
- **Instructors: Kern Ewing, Warren Gold, Jim Fridley, Cynthia Updegrave**
- **Teaching Assistant: Shannon Ingebright**
- **Community partner: Dr. Fred Hoffer**

2 As-Built Report

2.1 Background

2.1.1 Site Description

2.1.1.1 Location

Yesler Swamp is located just east of the University of Washington's Center for Urban Horticulture on the northwestern edge of Lake Washington. It is southwest of the intersection of Surber Drive and NE 41st street, in between the Laurelhurst neighborhood and the Center for Urban Horticulture. Once the outfall for the now disconnected Yesler Creek, this marshy region abuts Union Bay, an inlet of Lake Washington. Our project site sits on the eastern side of Yesler Swamp, just downhill of Surber Drive and within the wetland demarcation. The site can be characterized as seasonally submerged swampland, the area of land covered in water fluctuating with the level of the lake and amount of rain received. The site is mapped out on the attached map of a portion of Yesler Swamp, comprising the eastern parts of areas W6, W7, and W1.

2.1.1.2 Site History

Yesler Swamp and the surrounding area of Seattle have had a colorful history. Roughly a century ago, the current site of Yesler Swamp laid underneath the water level of Lake Washington. It was not until Lake Washington was connected to Lake Union by the Montlake Cut in 1916 that Lake Washington's water level dropped by 10 feet, exposing the land on which Yesler Swamp and the Center for Urban Horticulture now stand.

Long before the lowering of Lake Washington, the edges of Union Bay

were thickly forested with hundred-foot-tall fir trees. After the land was exposed, it became the site of Henry Yesler's second mill (Arnold). In the late 1880's, the forest land around Lake Washington was being swiftly logged and Yesler's mill was ideally situated. Logs cut from the forests around the lake were floated to Yesler's mill, where they were milled into lumber and then put onto train cars at Yesler Junction, a railroad depot that sits just behind present-day University Village. In 895, Yesler's mill on Union Bay was destroyed in what was called a "spectacular" fire. The mill was not reconstructed and in 1927, the land of present-day Yesler Swamp was bought by the University of Washington (Arnold).

Yesler Swamp is the easternmost 6 acres of the Union Bay Natural Area. The western part of the Union Bay Natural Area was once the Montlake Landfill (Ewing). After closing in the 1960's, the dump lay fallow until it was capped over by the City of Seattle, each layer of refuse was covered as it was deposited. Later on the site was re-envisioned by the University of Washington as a site for environmental and horticultural education (Ewing). The history of this part of Seattle has important implications for what will and will not grow on the soil in UBNA, due primarily to what now lies below the soil.

The unique urban wilderness was not always a swamp, instead, it was once the hub of a saw mill and lumber business that owned by two-time Seattle mayor Henry Yesler, trackback history further, it was not a swamp, it was part of the union bay and water level at only 16 or 17 feet at its deepest (Friends of Yesler Swamp).

The site is though litter with wood waste from the mill site in specific locations. The scatter wood branches have not posed a significant threat instead they provide habitat for local small mammal species.

2.1.1.3 Topography

Yesler Swamp overall is relatively uniform in its topography, with a gentle slope downward toward the southern end, where it meets Lake Washington. The restoration site in particular does have a significant depression near its center, which is where a pond has formed and water is generally the deepest. Just to the east of our restoration site, on the opposite side of the elevated boardwalk, is a steep slope upward to where the property of Yesler Swamp ends and meets the edge of Surber Drive. The top of the slope is approximately 15 feet above the boardwalk, and as it is elevated, runoff from precipitation and any materials carried with it, organic or inorganic, are likely to flow into our site. Significant impacts to our site related to topography are likely to come from this steep slope. Storm water runoff will pose the largest threat by causing erosion and spreading pollutants and garbage from the road above.

2.1.1.4 Soils

The soil in the north side of Yesler Swamp is very moist due to the water pooling there in the winter, and samples taken had higher moisture contents when they were west of the boardwalk, closer to the pond. The average depth of the organic layer is fairly thin, likely due to a relatively thin canopy cover above the restoration site and regular movement of water on top of the soil. The soil is composed of organic matter on the surface, a majority of it decomposing leaves. Below the organic layer, the soil is fairly uniform except for its water content. The drier soil is dark and grainy with small rocks and fine sand mixed in. Lower down it is more clay-like with even finer granules of sand. The soil is wettest deeper down, and because of its silty-clay texture, moisture is easily stored in the ground.

2.1.1.5 Hydrology

Yesler Swamp is within close proximity to Lake Washington and as a result, soils within the swamp are very moist and groundwater is close to the surface. In the summer, when precipitation is low, the swamp receives much of its water from the ground in the north and remains wet in the southern end due to the lake rising, where precipitation being a great contributor in the fall and winter months. The water level in Yesler Swamp is primarily variable with the lowering and raising of Lake Washington due to the operations of the Hiram M. Chittenden Locks. This changes in the rainier months of winter and fall, however, when precipitation is the greatest influence hydrologically. Lake Washington's Union Bay abuts the southern portion of Yesler Swamp, approximately 100 meters away, so while the lake's groundwater is a major contributor to the restoration site's hydrology, much of the above-ground water at the site is from precipitation. Soil within the restoration site is a very grainy, silty clay which holds considerable moisture. The soil is almost always wet and contains a large amount of groundwater, creating a perfect habitat for water-loving understory plants to grow. During drought season, the restoration site would be a lot drier than any other time, however, the plants will not be stressed, because we plan to install woody shrubs that provide shade, and to an extent prevent evapotranspiration from drying the soil.

2.1.1.6 Vegetation

Vegetation within Yesler Swamp, as well as the specific restoration site, is composed almost exclusively of plants native to the region, along with a relatively small number of invasive species, those of which will be removed in the coming months. It is a goal of the Friends of Yesler Swamp that the natural area be restored in such a way that the vegetation represents those plants native historically. The vegetation of this riparian ecosystem contains species native to Pacific Northwest wetlands, with an over story composed largely of Willow (*Salix spp.),* black cottonwood (*P. balsamifera ssp trichocarpa*), and red alder (*Alnus rubra*), with some Sitka spruce (*Picea sitchensis)*, Oregon Ash (*Fraxinus latifolia),* Red-osier dogwood (*Cornus sericea),* Big leaf maple (*Acer macrophyllum).* The midstory and understory contain native, yet invasive species including Himalayan blackberry (*Rubus armeniacus),* Reed

canarygrass (*Phalaris arundinacea),* Giant horsetail (*Equisetum telmateia).* Also in the understory, non-native species present include bindweed (*Calystegium sepium),* hawthorn (*Crataegus monogyna*), holly (*Ilex aquifolium),* English ivy (*Hedera helix),* Bittersweet nightshade (*Solanum dulcamara),* and Creeping buttercup (*Ranunculus repens.)* The native species present include Western skunk cabbage (*Lysichiton americanus),* lady fern (*Athyrium filix-femina),* common rush (*Juncus effusus),* small fruited bulrush (*Scirpus microcarpus).*

2.1.1.7 Habitat

Habitat features present include a willow tree that has splintered roughly halfway up its trunk and fallen over, its roots still in the ground. Also within the site are areas with complete canopy cover, some open areas with little to no canopy overhead, and a wetland with varying water depths on the ground. Some large portions of the site are fully submerged by more than twelve inches of water, while others fluctuate between being submerged and dry as the water level changes. The site contains a variety of microclimates, with large woody debris and other organic features which allow for great diversity in ecological functions.

The restoration site is within a wetland ecosystem where organic material present in the soil provides a perfect condition for the growth of extensive vegetation in all vertical realms, from the understory and mid story to the tall canopy overhead. Understory features harbor riparian wildlife including amphibians and insects while taller features are home to a variety of bird species. Friends of Yesler Swamp have recorded over 100 species of birds within the swamp, many of which are known to inhabit the property. Additionally, although it is outside the restoration site, one of five active beaver lodges in Union Bay sits just east of the trail. The beavers within this lodge will likely have little impact on the site to be restored, but these ecosystem engineers create habitat for other wildlife that may pass through our site. Enhancing and incorporating the natural habitat features of the swamp will likely guide our plans and our work in achieving our restoration goals.

2.1.1.8 Disturbance

One disturbance brought to our attention that is human error as a result of a previous restoration attempt. Adjacent to our restoration site, a previous capstone group had brought more wood chips than required with the goal of burying and shading out some of the overabundant reed canary grass within Yesler Swamp. While the restoration group succeeded in removing some of the invasive grass, depressions in the swamp's topography were ultimately filled in and a stream running through the eastern side of Yesler Swamp was disconnected, as shown in the adjacent image. As a result, our community partner Fred Hoffer has requested us to refrain from using wood chips in implementing our restoration goals.

Another human-caused disturbance to the restoration site is the reason that our portion of Yesler Swamp is classified as mitigation. Beginning in 2012, a handicapped-accessible elevated boardwalk was built throughout the Yesler Swamp property. Installation of the boardwalk trail through the wetland allows members of the public to tour the swamp, observe birds and other wildlife, and enjoy the aesthetic qualities that Yesler Swamp provides. While the construction of the boardwalk has itself been somewhat of a disturbance, it also reduces some negative human impacts on the swamp. Prior to the presence of the elevated boardwalk, a dirt trail encircled Yesler Swamp and made natural areas much more accessible to visitors, resulting in social trails, litter, and trampling of vegetation.

Yesler Swamp faces several natural disturbances in addition to those caused by humans. The mid story and understory of the restoration site feature an abundance of invasive plant species including English Ivy and Himalayan Blackberry, which are self-perpetuating and can potentially dominate a natural area. Removing these species will allow the native vegetation to thrive without the threat of being overrun by invasive vegetation. Additionally, as the Puget Sound region enters a rainy autumn, having just experienced the wettest October on record, the sudden increase in precipitation is likely to cause an abiotic disturbance at the restoration site. The heavy rainfall is expected to fill the pond and raise the water level throughout the site, leaving the soil flooded and saturated with water for an extended period.

2.1.1.9 Matrix

Yesler Swamp is surrounded to the north and to the east by the residential neighborhood of Laurelhurst. This means that the areas surrounding Yesler Swamp are affected by extensive human activities, and feature a network of impermeable surfaces including roads, parking lots, driveways, walkways, and other ground manicured ground cover. The Yesler swamp serve as a giant Rain Garden or bio swale that collect rainwater from surrounding and treat it in a natural way.

Yesler Swamp abuts the University of Washington's Center for Urban Horticulture on its west side, where it is immediately adjacent to the Douglas Research Conservatory and a large parking lot. Even though the parking lot is often populated by vehicles, and there is a possibility that spilled oil, grease, and other fluids would be washed into the swamp, we believe this would not exert a major influence on the ecosystem, which plants thrive in swamp would take up majority of these pollutants before they reach the lake. To the north of Yesler Swamp is NE 41st and to the west is Surber Drive, which are two main roads.

The swamp is bordered to the south by Lake Washington's Union Bay. Close proximity to a body of water maintains the swamp's mild climate, water area serve a insulator and adjust the temperature of near environment. However, in the mid of summer, soil start to lose its moisture and bring stress onto plants, watering the area that away from the water area become

necessary during the drought season. Therefore, we plan to install a tall canopy, which not only provide shades for plants in summer and reduce the stress, but also eliminate those persisted invasive species, such as reed canary grass.

AD1: The statement about Yesler Swamp serving as a "giant Rain Garden or bioswale" was found to be false and therefore removed from the matrix section along with the second paragraph. Due to the only connections between the rainwater from the parking lot and the swamp passing completely through the swamp and emptying into the lake (Ewing).

2.1.1.10 Human Context

The most significant human influence on the swamp is the community-run group for the public and local community, Friends of Yesler Swamp, which has been organized by Laurelhurst neighbors who care deeply for the natural area. As the swamp is a completely public natural area, open for observation and enjoyment, there is consistent human presence around and within the swamp. In fact, over $400,000 was raised by the 'Friends' to build the wheelchair-accessible boardwalk that now meanders throughout the swamp, and was designed by SB&A Architects. The elevated trail gives visitors of all abilities access to the heavily vegetated area, while preventing disruption of the riparian ecosystem. Yesler Swamp is utilized as a place for environmental education for students from the University as Washington as well as other schools in the neighborhood (Burger, 2002). The Friends of Yesler Swamp hope to make the swamp into a place where the public can enjoy its natural beauty and a place where people can learn about wetland and riparian ecosystems. This means that the human presence in the swamp will likely not be lessening any time soon, though it will hopefully have a smaller impact on the functions of the ecosystem, thanks to the elevated path.

Some human activity within Yesler Swamp has also resulted in improvements in ecosystem functioning. University of Washington student groups, capstone groups, and faculty members have been restoring sections of the swamp as restoration projects for many years. This stewardship and involvement with the property helps to build connections between the Friends of Yesler Swamp, the UW community, and the public, connecting people who share similar interests in the environment and its conservation (Burger, 2002).

2.1.1.11 Likelihood of Autogenic Repair

Yesler Swamp experiences annual seasonal flooding, and there are many areas with standing water, but the water level tends to change in response to the seasonal changes. An excess of Reed canary grass and other invasive species like Himalayan blackberry and English ivy degrade the site. The habitat function is impaired due to the presence of several invasive

species mentioned above. The extent of their growth outcompetes lots of native plants, invasive species such as English ivy would not only occupy nutritious soil, but also tend to climb up native trees, and lay their weight on those trees and, eventually, kill them when trees are unable to sustain ivy's weight and increased windthrow. Presence of these invasive species also increase the difficulty of accomplishing our restoration goals, for example, the reed canary grass spreads across the working area, which limits our access to the soil, so removal of Reed canary grass must take place before native plant installation happens. These invasive species proliferate and compete with much of the light, space, nutrients, and water available at the project site. Also, Reed canary grass and Himalayan blackberry take away from the natural beauty that this site possesses. The education that could be encompassed in Yesler Swamp's wetland habitats is also being impaired because it is difficult to display the value of wilderness when there is masses of invasive species in the view, which do not provide as much ecological benefits as native plants, and have a greater potential in degrading habitat in the long-term. The presence of these species results in the impediment of growth of native species at the site. The competition created by the invasive species is a major disturbance, so removing these invasive species is one of the highest priorities in the restoration goals. The other limitations include the highly-saturated soils, as well as weak propagation by native plants, unless aided by wind dispersal (anemochory) or animal dispersal (zoochory); we expect fewer seed's will be dispersed through water (hydrochory).

2.2 Restoration Needs and Opportunities

Furthermore, polygon 2 is designed as a skunk cabbage viewpoint, since there are only a few western skunk cabbage plants *(Lysichiton americanus)* that are currently present, the site and community partner would like to see our team install more western skunk cabbage as part of the restoration design. The planting of the western skunk cabbage will improve the sites aesthetic qualities and improve the native species habitat. The restoration will address the removal of invasive species and the enhancement of native species in the site. Also, this site is normally visited by neighbors, students, and the many other patrons of Yesler Swamp, which calls for continued restoration of the site. Further restoration should increase knowledge of the importance of restoration to the native Pacific Northwest ecosystems. The stewardship portion of the restoration plan will produce many volunteer opportunities and provide education programs for the community.

2.3 Tasks and Approaches

Goal 1: Provide and sustain an enhanced area for Skunk Cabbage (Lysichiton americanum) in the UBNA Yesler Swamp Polygon 2

Objective 1-1: Remove and suppress invasive species throughout site

Task 1-1a: Remove invasive species, above and below ground e.g. *(Rubus armeniacus, Hedera helix)*

Approach: We will use loppers to snip around the *R. armeniacus* near 8-12 inches. Using a shovel dig a circle 3-5 inches deep and dig out a root ball/mass. If possible, we will attempt removing by pulling. When dealing with the *H. hedera* we will cut any ivy on trees at about 5-6 feet on the trunk. Also, removing as much of it on the ground as possible. We will not be using any herbicide on the project site.

Approach Justification: Digging out the root crowns or pulling the *R. armeniacus* by hand has proven to be a very effective means of removal. Cutting the *H. hedera* on trees can help a tree's stability, at 5-6 feet this can help cut nutrients to the English Ivy and eventually the ivy should slough off.

Task 1-1b: Use live stakes of native trees

Approach: Live-stakes and nursery plants provided will be an essential technique used for shading out the shade-intolerant *Phalaris arundinacea.*

Task 1-1c: Plant species that will shade out *R. armeniacus* and *Phalaris arundinacea*

Approach*:* Plant a mixture of shrub, coniferous, and deciduous species including *Thuja plicata, Physocarpus capitatus, Acer circinatum*. Making sure that trees are at least on 15' centers. We will also plant *Salix lasiandra* at site, in less shaded areas consider it would not thrive in shaded area. With many of these planting will also come dense shrub plant species such as *Athyrium felix-femina, Sambucus racemosa, Rubus spectabilis, Rubus parviflorus, etc* (Pojar, 1994). We will be using shrub species that spread quickly and are close to the ground as another means of shading out Reed canarygrass, these shrubs should be on 5' centers.

Approach Justification: *Phalaris arundinacea* proliferates and outcompetes many plants through rhizomes in their root structure that spread in the soil. It is not ideal to try digging the Reed canarygrass. Therefore, creating an understory layer and a multi-cohort stand could help in suppressing *Phalaris arundinacea* and *R. armeniacus* (Kim, 2006).

Objective *1-2: Prepare site for Lysichiton americanum and locate areas with prominent hydrologic activity.*

Task 1-2a: Locate skunk cabbage through nurseries and plant five feet apart along a 3-inch water line leaving the leaves above water level.

Approach: Along the submerged areas of polygon 2 make sure to estimate a proper number of skunk cabbage plants that could be planted along a 3-inch water level.

Approach Justification: Having the skunk cabbage at least 3-inches in the water provides the plant species with the proper hydrophilic conditions for the plant to assimilate into the riparian ecosystem. Mulch and woodchips will be avoided near the skunk cabbage plantings as it would not be ideal because it would likely enable the flow of water to less saturated areas i.e. (mulch and woodchips). Though this will play a larger role in site 1 as well as other areas of Site 2, since there are studies showing that mulch and woodchips enhance rhizosphere conditions including mycelium recruitment and water retention.

Task 1-2b: Create a buffer between the non-saturated area of Site 2 and the pond where skunk cabbage will be planted.

Approach: Alternating between shrubs and trees in the planting plan, plant several 10-15' apart from the pond. Once the plant buffer is established, mulching and wood chips could be used as a means of aiding the tree root system though assistance of mycelium and other rhizosphere benefits.

Approach Justification: In restoration, buffers are often used as a means of transitioning between two different locations, specifically when two different ecological systems are involved. In this case, it is our intention that the trees and shrubs planted near the skunk cabbage will assist with shading out invasive *Phalaris arundinacea* and *R. armeniacus.* Additionally, this serves as a way of adding flora and fauna to the pond's edges as it should attract other animals.

Goal 2: Restore habitat to desirable riparian ecosystem capable of sustaining and recruiting native flora and fauna.

Objective 2-1: Provide diverse plants and planting arrangement contingent on research done on the needs and benefits stemming from recruitment of potential insect, bird, amphibian, reptile, and/or small mammals; ones capable of living and flourishing in restored site.

Task 2-1a: Select plants based on potential benefits to the ecosystem i.e. (root competition, hydrophilic plants, food source, herbivory, etc). This should be based on the needs of native animals as well as the long-term site projection goal.

Approach: Implement above mentioned criteria and locate plants and animals capable of co-existing in target site.

Approach justification: Our group has found that planting a variety of species including trees, shrubs, ferns, and hedges can aid in the recruitment of local fauna. As the site progresses through time, it is our goal that larger trees e.g. *(Picea sitchensis)* will assist with providing woody debris, habitat, shade, flood control, and erosion control along the project site (Briers, 2004). This should also lead to different microclimates as well as an overall cooling effect along the pond (Pearson, 2001).

Task 2-1b: Ordering Plants and obtain them before the planting activities.

Goal 3: Provide training, educational tools, and long-term stewardship plan for future stewards of yesler swamp at UBNA.

Objective 3-1: Design the site in a manner that reduces and discourages human disturbance on riparian ecosystem.

Task 3-1a: Plant a variety of shrubs and tree species near the boardwalk to prevent/reduce human impact on project site.

Approach: Our group has decided to plant red-osier dogwood, pacific ninebark, thimbleberry, and snowberry along the boardwalk as to discourage human traffic into the project site. However, since the goal of the community partner is to enhance the viewing and habitat of the skunk cabbage, it is important that we maintain an area that oversees that new plantings of skunk cabbage. Overall, one of the main goals in our site is to reduce the Reed Canary grass cover.

Approach justification: Through research our group has found that shrubs can significantly inhibit the spread of grasses with a p-value < 0.001 (Eldridge). This study also demonstrated that shrubs have a faster response ratio rather than tree cover. Additionally, shrubs can have an effect of increasing total soil carbon with a $p < 0.001$ and have been associated with a slight decrease in soil pH with a p-value < 0.013. The soil pH is an important characteristic to evaluate when doing a riparian site restoration as this can lead to eutrophication in ponds as well as fluctuation in insect population; important to note, microclimates involving temperature (p-value < 0.032) can also aid in change in population dynamics.

Objective 3-2: Lead a workshop that emphasizes the learning and provisioning of nearby resources that the community can access in order to sustain stewardship at project site.

Task 3-2a: Contact and create a strategy that involves potential members of Friends of Yesler Swamp and future stewards of UBNA, the Society for Ecological Restoration as well as the University of Washington Botanical Gardens.

Approach: Encourage the use of social media as well as current tools available to provide future resources for care-taking of the Yesler Swamp polygon 1 and Polygon 2 sites.

Approach Justification: The site may change overtime due to influxes of urban runoff, water needs, and overall site maintenance (pruning, invasive removal, and recording of target metrics e.g. invasive cover reduction, microclimates, animal migration, etc.)

Objective 4-1: Create or encourage a neighbor/student-run community of stewards that are interested in prolonged sustainability of Yesler Swamp for future years after the project.

Task 4-1a: Find and encourage the local community to become involved with the UBNA.

Approach: Attend a few environmental courses e.g. (ESRM 100, ESRM 101, ENV100, etc) with field requirements and invite people to work party events. Provide a concise and definitive way (email, facebook group, and social media) which allows people to become engaged and involved in regular check-up of the site, as well as, for finding out requirements needed to run a smooth restoration project.

Approach Justification: Our group has found that people in current and future generations are becoming more technologically capable, so it seems ideal that restoration projects and stewardship plans venture in these arenas. This tool should serve as a means of connecting with people and communities at large; similar to roots and the abundant recruitment of microorganisms, fungi, and macroinvertebrates. The internet could serve as a human created root system.

Objective 4-2: Contact local stores for the donation of perishables and non-perishable food items.

Task 4-2a: Provide an adequate amount of food to volunteers as well as tools, and a sign-up table (paperweights).

Approach: Speak to local store managers and receive their contact information, then send the managers a letter with the University of Washington federal tax ID

(6-8 weeks prior to volunteer events for best response). Ideally, a discussion takes place before, which lists potential foods available for donations. Identify the number of potential volunteers attending the event, estimate tool pickup requirements, food availability, weather conditions, etc.

Approach Justification: It is our group's responsibility to provide food, tools, weather predictions, and potential areas for breaks to take place (bathroom locations). These characteristics of a restoration event are vital for ensuring that a work party is run successfully.

2.4 Specific Work Plans

2.5 Current Conditions

The Yesler Swamp 1 restoration site is divided into 2 polygons. The site contains the Yesler Swamp boardwalk which allows visitors to look at the scenery from a distance which minimizes anthropogenic disturbance. Both polygons have a variety of native species as well as invasive species but the species composition of each polygon differs from each other. The soil at the site is very moist due to the presence of a pond at the swamp and is also affected by Seattle's annual rainfall receiving an average of 38" each year, based on data collected from 1948-2015.

Polygon 1 contains moist, dark and grainy soil with small rocks mixed in. There is a thin layer of organic matter which is mostly dead leaves. This polygon does not contain the pond. The vegetation consists of a dense layer of trees, mainly willow (*Salix sitchensis*) and black cottonwood (*Populus balsamifera ssp trichocarpa*), as well as many understory species. Some sunlight gets filtered through the areas with a thin upper canopy layer. The most abundant invasive species are reed canary grass and Himalayan blackberry.

Polygon 2 contains a large pond to the west of the boardwalk and is on the western boundary of the polygon. The soil is moist and the texture is loamy. There is a thin organic layer consisting of dead leaves and there is less shade at this polygon compared to polygon 1. The most abundant invasive species present are English ivy, Himalayan blackberry and Reed canary grass. However, there are also many different native species at this site. The most notable being the western skunk cabbage and slough sedge, which will be the main attraction at the site.

	Polygon 1	Polygon 2
Polygon area (m2)	46.112 m2 (496.35ft2)	259 m2 (2787.86ft2)
Soil texture	Thin organic layer with a majority of decomposing leaves, below is dark and grainy soil mixed with rock	Rich organic layer with plenty of water content, loamy soil in general
Soil moisture	The soil moisture and hydrologic profile of polygon 1 is moist. The hydric periods and hydric level will vary throughout the year and will be recorded at different points in time.	The soil moisture and hydrologic profile of polygon 2 is saturated with water in some areas. The hydric periods and hydric level will vary throughout the year and will be recorded at different points in time.
slope	No slope in general	No slope in general
Light availability	Medium sunlight, partially shady areas, areas with thin upper canopy allows light to pass through	Medium sunlight partially shady areas, areas with thin upper canopy allows light to pass through, less shade than polygon 1
Present vegetation	Himalayan blackberry *(Rubus armeniacus)* Black cottonwood *(Populus balsamifera ssp trichocarpa)* Pacific Willow *(Salix lucida)* English ivy *(Hedera helix)* English holly *(Ilex aquifolium)* English laurel *(Prunus laurocerasus)* Field bindweed *(C. Sepium)* Canada thistle *(Cirsium arvense)* Red-twig dogwood *(Cornus sericea)* Reed canary grass *(Phalaris arundinacea)* Small-fruited bulrush *(Scirpus microcarpus)*	*Red-twig dogwood (Cornus sericea)* *Pacific ninebark (Physocarpus capitatus)* *Douglas spirea (Spiraea douglasii)* *Giant horsetail (Equisetum telmateia)* *Creeping buttercup (Ranunculus repens)* *English ivy (Hedera helix)* *Reed canary grass (Phalaris arundinacea)* *Himalayan blackberry (Rubus armeniacus)* *Western skunk cabbage (Lysichiton americanus)*
Human impacts	Visitors on the trail, boardwalk, urban runoff, littering.	Visitors on the trail, boardwalk, urban runoff, littering.

Other considerations	There are not many challenges on this polygon. However, since we were planning on setting our polygon 2 as a skunk cabbage viewing point, we could also take the extra plants and plant them in polygon 1 to make it look better.	This polygon has a pond and roughly a 3”-6” layer of wood chips in some areas placed by a previous group. This site contains the majority of the skunk cabbage flora. Therefore, it is important to address this polygon slightly differently, as the restoration effort should focus on enhancing the current state in which the skunk cabbage resides.

2.6 Site Preparation Activities

In polygon 1, site preparation activities include removal of invasive species, planting live-stakes and mulching. We will use thimbleberry and red osier dogwood live stakes to shade out the *Phalaris arundinacea* because Pacific willow and other willow species do not do well when they are planted in shaded areas while thimbleberry and red osier dogwood do well. Mulch will be applied in rings because it helps the soil maintain moisture and serves as an effective medium to suppress neighboring invasive species and reduce their competition with live stakes.

In polygon 2, we plan to remove invasive species, plant live stakes, add mulch and use pin flags to mark the high-water line at a time of high precipitation. This polygon is less shaded than polygon 1. We are planning to live-stake Pacific ninebark and red osier dogwood because they are native species and grow large to shade out invasive species. Pacific ninebark does well in the sun or shade, prefers moist soil and can grow to 15 feet tall and wide, making it a perfect fit for this site (*WSU Clark County Extension PNW Plants*). Red osier dogwood can grow well in partially shaded areas with moist soils (*Missouri Botanical Garden*). The mulch will be used in the same way as in polygon 1 although less will be used because this polygon contains the pond. The pin flags will be helpful in determining where the skunk cabbage can be planted. Skunk cabbage will be planted outside of the line of pin flags, in 4 inches or less of water, because the skunk cabbage will survive as long as the top of the plant is dry and above the water.

AD2: We didn’t use Pacific ninebark live-stakes, only red osier dogwood because we were unable to obtain them. On the University of Washington campus, there was an abundance of red osier dogwood to cut live-stakes but only a little of Pacific ninebark so we couldn’t cut any.
AD3: We did not live-stake thimbleberry, but we did plant them.

2.7 Logistical Considerations

The volunteers can use the parking lot that is to the west of the entrance to Yesler Swamp and about 30 yards away. We expect our work parties to be 20 to 30 people at most, so parking

space should not be an issue. At the entrance, we will distribute tools and other items that would be necessary for the volunteers to perform their tasks. This way, it would be easier and faster to distribute the tools rather than doing it in the swamp on the thin boardwalk. For demonstrations, we will stand on the soil while the volunteers spread out on the boardwalk, which is at a slightly higher elevation than the soil. There are five of us in the group so we can spread out and do 5 demonstrations at once. This will allow all the volunteers to get a good view of how to properly plant the plants or how to remove invasive species. The staging areas will be on the boardwalk for quick and easy access but they will not cover more than half of the width of it so that visitors and volunteers and move along the boardwalk. However, mulch can be messy and we do not want the brand-new boardwalk to look dirty so the mulch containers will be on soil, right next to the boardwalk to minimize the chance of them being knocked over.

We hope to minimize human disturbance from volunteers by marking the plants that the volunteers should be careful of with tape so that they don't step on them or remove them on accident. This method will be used in areas where native and invasive species are close together. Areas without invasive species can be marked with a few flags or tape to indicate a boundary which the volunteers should not enter while they are doing invasive species removal. Erosion will not be a problem at our site because the ground is relatively flat.

AD4: Using Google Maps, we found that the parking lot was 39.3 yards away from the entrance to Yesler Swamp.

2.8 Planting Plan

Polygon 1:

It is important to recognize that the western skunk cabbage plays a significant role when addressing the restoration target site of polygon 2. For this reason, the planting of native trees has been scaled back in polygon 1 as compared to polygon 2. However, it is important to note that it is still ideal to create a multi-level cohort stand because this will provide the site with greater resilience against potential pioneer invasive species as well as serve as a buffer for future herbivory posed by the North American beavers and other herbivorous animals including insects. While the site provides many of the same features polygon 2 has to offer, it appeared to contain a greater magnitude of invasive species cover by area. By creating tree cover using bigleaf maple, this will act on shade-intolerant species such as the reed canary grass; while also posing as a competitor to other invasive species attempting to colonize. The multi-cohort stand should be achieved by planting several fern species, shrubs, and trees (Briers, R. A., & Gee, J. H. 2004). Additionally, our group intends on using roughly 3” of mulch and/or woodchips as a means of suppressing secondary succession in areas that encompass the native plantings; as both a means of protection for the plants as well as a suppressor of invasive plant competition. This is a much smaller polygon compare to polygon 2, so the overall quantity of vegetation would be much less. Live-staking red osier dogwood (*Cornus sericea*) and thimbleberry would beautify the site. Also,

these two species are native and did well in grow on this site. Tall canopies would consist of Bigleaf maple and Western redcedar.

AD5: No trees were planted at the site because we were told not to by the client, Fred Hoffer.
AD6: We planted thimbleberry, not live-staked them.

Polygon 2:

The main difference between this polygon and polygon 1 is that there is standing water, which is beneficial for skunk cabbage survival. The site is also designed as a viewpoint for skunk cabbages. We plan on planting skunk cabbage around the edge of the water with one meter apart and 20 of them in total. We do not want the skunk cabbages too close to each other to ensure that they have the best for survival and also provide decent visual view from the watch point.

Despite the presence of invasive plants and reed canary grass, it seems impossible to remove all of them physically. Dogwoods and ninebarks are growing well in this habitat, so we plan to use live-stake red osier dogwoods and Pacific ninebarks to make a canopy layer and create shade to suppress the growth of these invasive species, so there will be a dense dogwood and Pacific ninebark population. We estimate that only one third of polygon 2 needs to have vegetation installed, excluding the water area and areas that are occupied by other native plants (Darris Dale C.2002). There is native vegetation already in this habitat, which provide natural services to humans and other wildlife such as thimbleberry (*Rubus parviflorus)* , this species adapted to the habitat, and we would plant more of them at site.. To minimize disturbance effects from our restoration activities, we would plant vegetation only in areas that is currently occupied by invasive plants or places where vegetation is currently absent. We are not able to obtain enough skunk cabbage as planned, due to the limit supply of this plant from nursery, so we will plant as much as possible. Also, we might not be able to install the ideal number of plants that make the site function the max due to limited budget, so we will try to plant enough plant that accomplish the objectives.

AD7: Unfortunately, we were unable to find ninebark stakes, we only had Red osier dogwood live-stakes in both sites. We also used bare-root stink currant plants to create shade and provide food source for wildlife.

2.9 Lessons Learned

2.9.1 Financial Budget

Our expenditures on the final site design were less than we anticipated early-on in our work plan report. Initially our group intended to plant a few deciduous and non-deciduous trees but this option had to be changed due to safety concern for pedestrians.

	QTY	Date	Cost
Snohomish CD	160 bareroots pots	January 31st, 2017	$241.11
Go Natives! Nursery!	50 1” gallon containers	February 20th, 2017	$240.90
King CD	20 bareroots	February 21st, 2017	$36.14
King CD	30 bareroots	March 2nd, 2017	$54.25
Woodbrook Nursery	10 bareroots	March 10th, 2017	$96.92
Ucar Rental		February 11th, 2017	$81.50
Total			$750.82

One of the reasons our budget expense was decreased was because our group live-staked. There were a few plant salvaging options made available to our group through the UW-REN faculty, but our group decided to harvest some live-stakes from a nearby site that contained an array of Red-Osier dogwood woody-shrubs. In the future, it would be ideal to attain an early plant inventory of the site as well as a compilation of plant species that would survive and thrive at the selected project site. Our team will be returning roughly $100 back to the University of Washington since some money was allocated from our community partner, Friends of Yesler Swamp.

2.9.2 Labor Budget

Altogether, our team expected to hold around five to six work party events that each had around ten people. We ended up having five work party events and two preliminary events that required our team to prepare the site and do some live-staking. Our work parties often extended between to four hours, however, we did host some events that oversaw 10-20 people and on some occasions held events with parents and children; which required a more tailored approach to restoration. This was expected as we often prepared food and beverage donations in between that range of volunteers. The first work party our team held required much Himalayan blackberry removal as well as English ivy, our team began removing such plant species during the early

winter months as this time frame tends to be more productive for the removal of the listed invasive species.

A significant emphasis of our project design required us to both increase the ground cover by planting shrubs, graminoids, and woody-species as well as to enhance the ecosystem by planting hydrophilic vegetation such as Slough sedge and western Skunk cabbage. When our group initially started working on the site, there was a subsection within our site that contained a significant amount of English ivy. This area within our site was viewed as problematic to our restoration as it was a large nexus of English ivy encroaching in part of the area where many of hydrophilic plants would be installed. Regarding the skunk cabbage budget, this new subsection allowed for new saturated terrain to be cover, however, there was roughly 10% saturated terrain that was left without vegetation.

2.9.3 Planting Plan Lessons

In the original planting plan, our team intended to plant specific deciduous and non-deciduous tree species to increase canopy cover as a means for shading-out Reed canary grass. This approach was not allowed due to the heavy pedestrian traffic Yesler Swamp maintains. Planting trees within the two polygons was considered a hazard as there could be potential branches that fall on pedestrians and the newly installed boardwalk. Our site was fairly unique as it contained a significant amount of water and it was considered to be in the mitigation boundary for the City of Seattle, it was expected that there be contact with Seattle Green Partnership, Society for Ecological Restoration, and Friends of Yesler Swamp. Due to the large extent of soil saturation, our community partners expected there to be a large emphasis on restoring native hydrophilic vegetation to the site.

Another lesson our group learned surrounded the large English ivy prevalence. At first our community partner had stated that an area infested with English ivy, in the middle of Polygon 2 would not require removal. However, our group concluded that if left alone it would continue to enter the polygons our group were working on and this was problematic to the hydrophilic plants. Once our group removed a large extent 80-90% of the English ivy in that zone in between our team's polygons, the area slowly turned into a natural mineral water retention pond where ducks began to enter, swim, and feed on small invertebrates.

One assumption our group made was that Reed canary grass would not be easily controlled unless a canopy cover were to be created. Therefore, our team changed the planting inventory of tree species (negated) into woody shrubs and live-stakes to provide a great shading effect. These species consisted of Red-osier dogwood, Red elderberry, Pacific ninebark, Vine maple, salmonberry, etc. The main lessons our group took away from the planting plan was that our site could have supported some more woody shrubs or even live-stakes. Additionally, our

live-stakes were installed near the boardwalk, and this may have been supplemented if we planted more of the Pacific ninebark among the live-stakes. The planting required 3 ft. centers for sedges and ground cover plants and for the woody shrubs they were placed with 5 ft. centers to provide the best outcome for the installed plants and to prevent competition for water, light, and nutrients. In the end, our site contained a significant number of resilient wetland plant species and it is our expectation that maintenance of the site should allow for the installed plants to maintain an advantage over the invasive species.

2.10 Other Plans

Our team worked with Evergreen Middle School and helped teach children of the age 8-12 the importance of invasive species and how they impact native plants and wetland ecosystems. This on-hand learning experience took place twice and one had a large focus on English ivy removal as well as Stink currant and Red elderberry planting. The second group mainly focused on skunk cabbage planting and was slightly over-crowded to be working in muddy conditions.

In the past, the Evergreen Middle School has been known to reach out to friends of Yesler Swamp and the University of Washington for ecology work and volunteer experience. One unfortunate and unexpected problem that arose was the fact that much of the project had been completed before the school volunteered so the time spent volunteering was cut short about two hours for the final Evergreen school volunteers. Future groups should consider laying out their sites with flags around every previously installed plant, especially if children within this age group are participating in the volunteer event; above all, it should be a learning experience for this age group.

A brief tour and history of the site was provided by Dr. Fred Hoffer. This was done for the students as means of: 1) Learning about the history and ecological context of Yesler Swamp; 2) to better acquaint themselves with the site and present vegetation; 3) to observe and understand the environment that influences the conditions on-site; and 4) to recognize the impact of invasive species as well as to understand the ecological values that arise from both removing these species and planting native species on-site.

It is our intention that future groups will continue to maintain a good relationship with Evergreen Middle School and that there may be more in-classroom activities that accompany the site restoration of Yesler Swamp. In general, it would have been more ideal to have the school volunteers attend earlier volunteer events as there would have been more activities and less concerns with damage to the plants installed. If future group are to implement teaching of students, it would be advised to begin this portion of the project in either Fall or Winter; however, it is possible to achieve this goal in the Spring. Altogether, our team values the

contribution the Evergreen Middle School volunteers provided and their assistance is greatly appreciated while also contributing to the long-term goals of the site, and stewardship plan.

2.11 Design for the Future

Part of our vision for the site involves establishing a healthy multi-cohort stand with mixed deciduous-conifer forested areas while also providing an array of shrub and herbaceous native plants. In five years, we expect that the invasive plants removed at the beginning of the project will be significantly suppressed by the new shrubs meant to establish a shade-out effect; specifically targeting reed canary grass. During the first initial years, it is expected that volunteers and site-overseeing members will maintain and mitigate invasive plant succession, as this will likely be the main obstacle to native plant establishment. Mitigation sites will be under the oversight of the Society for Ecological Restoration; previously overseen by Friends of Yesler Swamp.

The challenges we expect going into the future includes maintaining proper irrigation, non-native invasive species recolonization, and inflated groundcover expectations. In Polygon 1, there seems to be an abundance of plantings that were installed prior to our group's restoration endeavors and many may be too difficult to identify before leaf-out in the spring and summer months. Furthermore, most of the emphasis of plantings was placed in Polygon 2, as it was significantly over-run by reed canary grass and English ivy while also slightly impacted by English holly and Himalayan blackberry. While Polygon 2 did not seem to require as many plants, our shrub and herbaceous plant inventory significantly changed when we were alerted that by no-means tree plantings were to be installed in either polygons for reasons surrounding the boardwalk and pedestrians.

In some regards, it was difficult to engage with the future overseeing body while working with the current community partner as they expected different outcomes of the restoration project. Altogether, our group's shrub and herbaceous inventory increased once alerted about this stipulation; however, some plant sales could not be reached in the timely manner for the large demand our group had surrounding shrubs and herbaceous species. For this reason, it is possible our group slightly underplanted in Polygon 1. Therefore, it should be monitored for stand openings and promptly filled with any of the above-mentioned species. Our group also moved around medium woody debris in a manner that may prevent some of the recolonization of the above mentioned invasive species. Finally, it is necessary to address that bordering sites contained many of the removed invasive species in Polygon 1 and 2 and if those species border our project site, they will continue to invade and colonize near some of the bordering plantings that were installed.

2.12 Literature Cited

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3 Appendix A

3.1 List of Figures

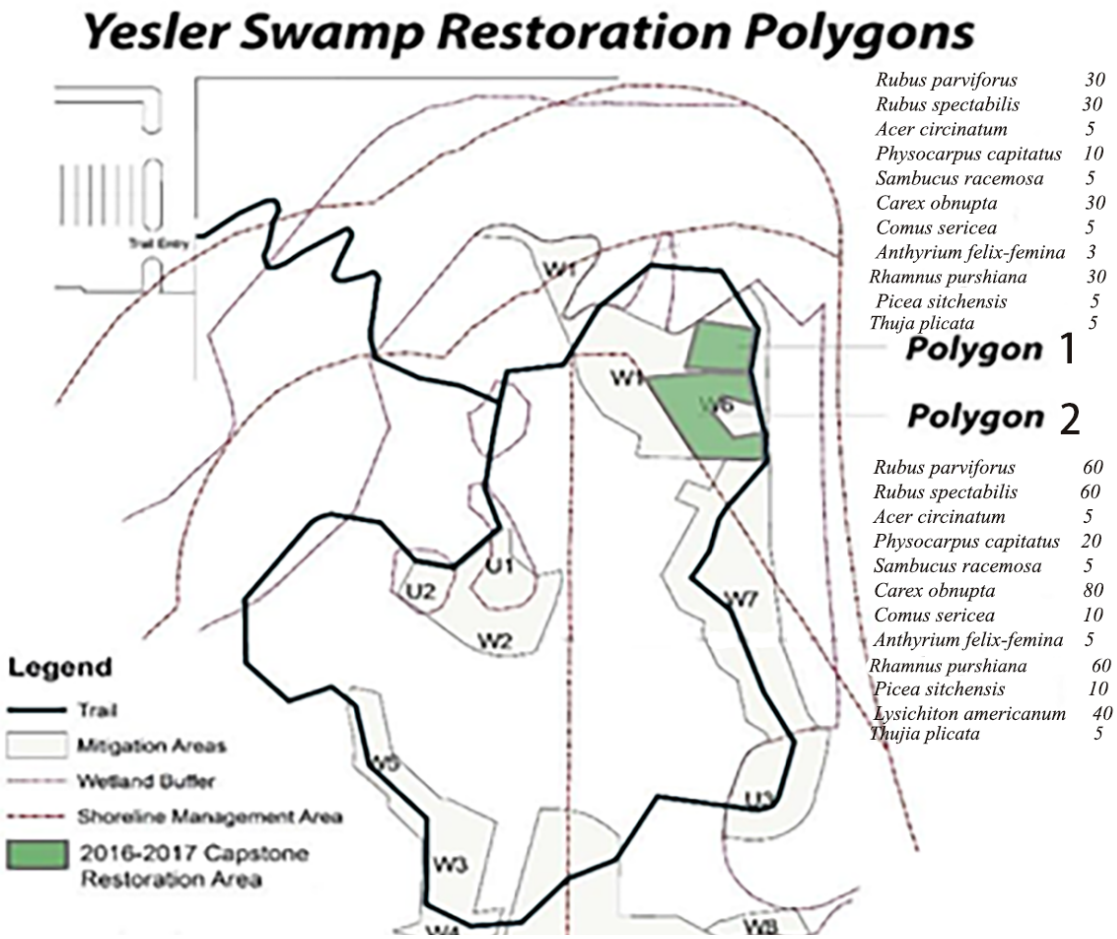
3.1.1 Figure 1 and 2: Before and After Photos of the Site

3.1.3 Figure 4: Topographic Map of Yesler Swamp (**USGS Topographic Map)**

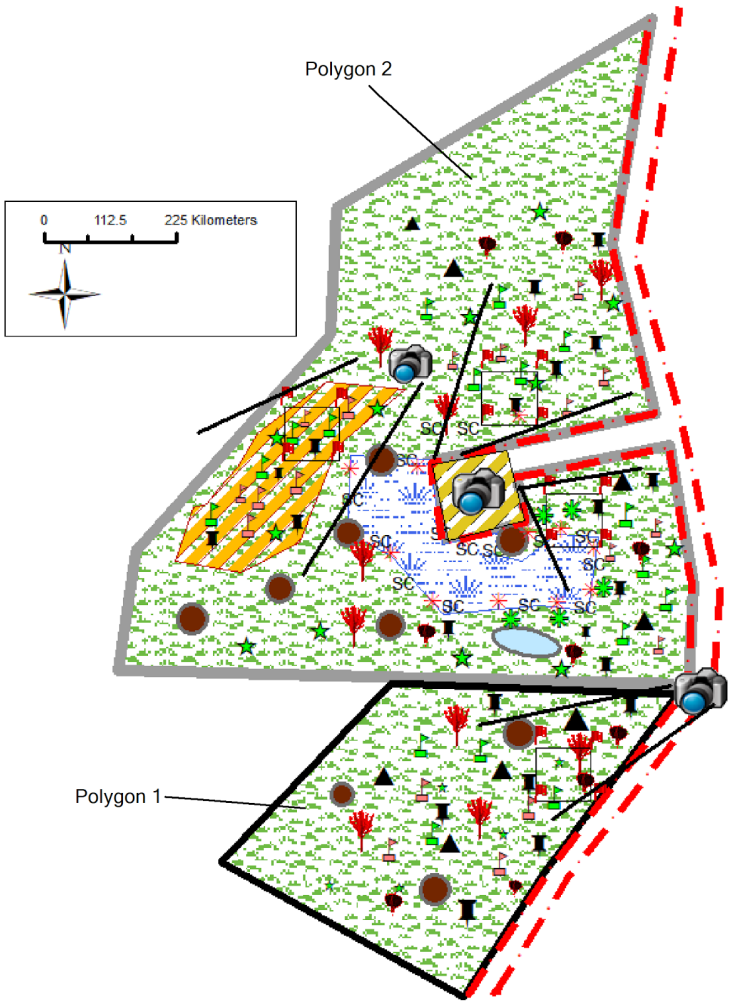
3.1.4 Figure 5: Aerial Map of Yesler Swamp


DRC Parking Lot
Irrigation Hose
Tool Cage
DRC
Yesler Swamp
Union Bay Natural Area
© 2016 Google
Google Earth
1977
47°39'25.52" N 122°17'23.03" W elev 23 ft eye alt 1837 ft

3.1.5 Figure 9: Original Planting Plan For Polygons 1 and 2



3.1.6 Figure 10: As-Built Map for Polygons 1 and 2



Red Alderberry
Red Osier Dogwood
Cornus sericea
Thimbleberry
Rubus parvilorus
Red alder
Alnus rubra
Pacific ninebark
Physocarpus capitatus
Stink currant
Ribes bracteosum
Vine maple
Acer circinatum
Lady fern
Athyrium filix-femina
Salmonberry
Rubus spectabilis
Slough sedge
Carex obnupta
Pond
Wooden Viewpoint
Swamp
Relative Drier Area
SC
Skunk Cabbage
Symplocarpus foetidus
Board Walk
Photo monitoring point

3.2 List of Tables

3.2.1 Table 2: Plant List

	Polygon 1			**Polygon 2**		
	#	**Form**	**Spacing (ft)**	**#**	**Form**	**Spacing (ft)**
Rubus parviflorus (thimbleberry)	20	12-18" bareroot	4	70	12-18" bareroot	13
Rubus spectabilis (salmonberry)	~~15~~ **5**	12-18" bareroot	4	~~75~~ **15**	12-18" bareroot	13
Acer circinatum (Vine maple)	5	12-18" bareroot	8	5	12-18" bareroot	26
Physocarpus capitatus (Pacific ninebark)	10	12-18" bareroot	4	20	12-18" bareroot	4
Sambucus racemosa (red elderberry)	5	12-18" bareroot	4	~~5~~ **15**	12-18" bareroot	4
Carex obnupta (Slough sedge)	~~30~~ **6**	1 gallon container	1.5	~~80~~ 12	1 gallon container	1.5
Lysichiton americanum (Western skunk cabbage)	-	-	-	~~60~~ 50	1 gallon container	1.5
Cornus sericea (red osier dogwood)	~~5~~ **3**	~~12-18" bareroot~~ **Live stake**	4	~~10~~ **3**	~~12-18" bareroot~~ **Live stake**	4

Athyrium felix-femina (Lady fern)	3	4" pot	1.5	5	4" pot	1.5
~~*Thuja plicata* (Western redcedar)~~	~~5~~	~~12-18" bareroot~~	~~8~~	~~8~~	~~12-18" bareroot~~	~~8~~
~~*Picea sitchensis* (Sitka spruce)~~	~~5~~	~~12-18" bareroot~~	~~8~~	~~10~~	~~12-18" bareroot~~	~~8~~
~~*Rhamnus Purshiana* (Cáscara)~~	~~30~~	~~12-18" bareroot~~	~~4~~	~~60~~	~~12-18" bareroot~~	~~4~~
***Ribes bracteosum* (Stink currant)**	**3**	**1" gallon**	**4**	**7**	**1" gallon**	**4**

AD8: The nursery we ordered from was short in Salmonberry and Slough sedge, so we ordered more red elderberry and added Stink currant on our list instead. Also, for skunk cabbage we only could get 50. As for Red osier dogwood, we could not find anywhere selling it in any forms, yet we were able to locate some in the backyard of CUH building. For Western redcedar, Sitka spruce, and Cascara, they were all out of stock in the nurseries we ordered from.

Task	% Complete	Deadline	Projected Hours Team : Volunteer	Actual Total Team : Volunteer	Effort	January 3-6	January 9-13	January 16-20	January 23-27	Jan/Feb 30-3	February 6-10	February 13-17	February 20-24	Feb/March 27-3	March 6-10	March 13-17	April 3-7	April 10-14	April 17-21	April 24-28	May 1-5	May 8-12	May 15-19	May 22-26	May/June 29-2	June 5-9
Task 1-1a					Actual																					
Remove and suporess invasive species throughout site	100%	6/6/2017	88 Hours: 100Hour	59 Hours: 48Hours	Team																					
					Volunteer																					
Task 1-1b					Actual																					
Use live-stakes of native plants	100%	2/25/2017	10 Hours: 0 Hours	10 Hours: 0 Hours	Team																					
					Volunteer																					
Task 1-2b					Actual																					
Create a buffer between the non-saturated area of	100%	4/22/2017	20 Hours: 20 Hours	9 Hours: 12 Hours	Team																					
Site 2 and the pond where skunk cabbage will be planted					Volunteer																					
Task 2-1a					Actual																					
Select plants	100%	1/13/2017	2 Hours: 0 Hours	1.5 Hours: 0 Hours	Team																					
					Volunter																					
Task 2-1b					Actual																					
Ordering Plants and obtain them before planting	100%	3/16/17	10 Hours : 0Hours	8 Hours : 0 Hours	Team																					
					Volunteer																					
Task 3-1a					Actual																					
Plant shrubs and trees near boardwalk	100%	Ongoing	10 Hours: 10 Hours	9 Hours : 12 Hours	Team																					
					Volunteer																					
Task 4-1a					Actual																					
Find and encouraae the local community to become	0%	5/5/2017	2 Hours : 0 Hours	ongoing	Team																					
involved with the UBNA					Volunteer																					
Task 1-1c					Actual																					
Install other plants	80%	4/22/2017	10 Hours: 10 Hours	5 Hours: 6 Hours	Team																					
					Volunteer																					
Task 1-2c					Actual																					
Install skunk cabbage	0%	4/22/2017	10 Hours: 12 Hours	20 Hours: 10 Hours	Team																					
					Volunteer																					
					Actual																					
Final Packet		5/26/2017			Team																					
					Actual																					
Posters for printing		5/25/2017			Team																					
					Actual																					
Stewardship Plan		5/5/2017			Team																					
					Actual																					
Stewardship Training		6/6/2017			Team																					
					Actual																					
Setup viewing board					Team																					

3.2.3 Table 4: General Material Table

Task	Materials	Qty	Source		Tools	Qty	Source
Task 1-1a, c	-	-	-		Gloves	20	CP
					Shovels	20	CP
Task 1-1b					Loppers	20	Cage inventory
					Gloves	20	Cage inventory
					Shovels	20	Cage inventory
Task 1-2a	Color tags	1	UW		-	-	-
Task 1-2b	Mulch	#	CP				
	Woodchips	#	At site				
					Measure tape	1	Cage inventory
					Wheel barrel	1	Cage inventory

3.2.4 Table 5: Financial Expenditure

Expenditures by major category	Cost
Plants	
Conifer trees	~~$33.30~~ **$0.00**
Deciduous trees	~~$16.50~~ **$16.00**
Shrubs	~~$531.75~~ **$363.31**
Ground Covers	$24.00
Sedges	~~$183.70~~

	$30.00
Herbaceous	~~$264.00~~ **$240.90**
Subtotal plants + tax	**$ ~~1153.31~~** **$669.32**
Mulch	
Woodchips	$0.00
Subtotal mulch and woodchips	$0.00
Tool rental	
Tool rental 1/28/2017	$0.00
Food volunteer events	
Event on 4/22/2017	$0.00
Subtotal for food	**$0.00**
Transportation	
Subtotal for transportation	~~**$100.00**~~ **$81.50**
Printing	
Subtotal for printing	~~**$50.00**~~ **$20.00**
Project Total	~~**$2, 150.00**~~ **$770.82**

AD9: Major change of our expenditure was we did not really get the $1000 value nursery coupon due to our miscommunication with our formal community partner Fred. We had to cut some of our plants purchases, and for some of the shrub species shortages, we did not get as many shrubs as we planned to. The main herbaceous Skunk cabbage in our project, we tried our best to find 50 of them instead 60. We did not spend as much money in transportation and in printing as we estimated, which was good for us.

3.2.5 Table 6: Revenue Sources

Revenue by fund source	
Course fee allotment	~~$600.00~~ $500.00
Fundraising	$0.00
N/A	
Cash donation	
Cash donation by team members	$0.00
Cash donations by sponsor/CP	$500.00
Cash donations by neighborhood group	$0.00
Total Cash donation	**$500.00**
In-kind donations	
Plant purchase coupon ($ value)	~~$1,000.00~~ **$0.00**
Tool rental waiver ($ value)	$0.00
~~Coffee and donuts~~ ($ value) Food donation	~~$50.00~~ **$100.00**
Total in-kind donations	~~**$1,050.00**~~ $100.00
Project total	~~**$2,200.00**~~ $1100.00

AD10: At the beginning, we were given $600.00 as our course fee allotment, then we realized we did not need that much with the $500.00 cash donation from Friends of Yesler Swamp. Thus, we relinquished $100.00 from our course allotment. The $1000.00 value coupon was a result of miscommunication between us and our formal community partner Fred. He suggested KCD as one of the plant source to us, though there was never a cash value coupon for our team. It did not matter to our team that much because of the generous cash donation from Friends of Yesler swamp. As for in-kind donations, because our volunteer work parties usually hosted around noon,

and people get hungry around that time, we asked Domino's Pizza for donations about two times, and they gave us about 15 pizzas for free.

3.2.6 Table 7: Labor by Activity

Project Labor(hours of effort) budget and actual

		Project Budget	
		Team	Volunteers
Tasks		(hours)	(hours)
Prepare Site (Arturo)			
	Demarcate polygon border	4	
	Remove Garbage	~~4~~ **3**	~~0~~ **10**
	Remove Himalayan Blackberry	~~10~~ **12**	~~0~~ **12**
	Remove English Ivy	~~8~~ **12**	~~0~~ **22**
	Remove horsetail	**2**	**2**
	Subtotal	~~**26**~~ **29**	~~**0**~~ **59**
Plant site (Xiaofeng & Jia)			

Live-staking on Polygon 1	~~10~~ 6	~~30~~ 0
Live-staking on Polygon 2	~~30~~ 6	~~90~~ 0
Plant Polygon 1		
Purchase Polygon 1 Plants	2	0
Pick up polygon 1 plants (from nursery or salvage)	4	0
Install herbaceous on Polygon 1	4	20
Install shrubs on Polygon 1	~~3~~ 5	~~15~~ 25
Install trees on Polygon 1	~~2~~ 4	~~10~~ 0
Plant Polygon 2		
Purchase Polygon 2 Plants	2	0
Pick up polygon 2 plants (from nursery or salvage)	~~4~~ 8	0
Install herbaceous on Polygon 2	~~12~~ 15	~~60~~ 24
Install shrubs on Polygon 2	~~9~~ 8	~~45~~ 30
Install trees on Polygon 2	~~6~~ 4	~~30~~ 0
Subtotal	~~**88**~~ 48	~~**300**~~ 79

Apply Mulch (Jia)	

	acquire mulch	~~2~~ 5	~~0~~ 6
	Spread mulch on Polygon 1	~~10~~ 5	~~20~~ 6
	Spread mulch on polygon 2	~~15~~ 5	~~30~~ 6
	Subtotal	~~**27**~~ 15	~~**50**~~ 18

site maintenance after plant-Installation (Drew)			
	Irrigate on Polygon 1	~~2~~ 0	0
	Irrigate on Polygon 2	~~6~~ 0	0
	pruning on Polygon 1	~~2~~ 0	0
	pruning on Polygon 2	~~6~~ 0	0
	remove invasives on Polygon 1	~~10~~ 0	0
	remove invasives on Polygon 2	~~30~~ 0	0
	Subtotal	**56** 0	**0**

Plan and manage work parties (Arturo)			
	Collect and return tools for 2/11 team work party	~~2~~ 1	0

	Create and distribute promotional material for 2/11 VWP	~~12~~ 1	0
	Solicit and obtain refreshments for 2/11 VWP	~~8~~ 1	
	~~Collect and return tools for 3/25 team work party~~ **Collect and return tools for 3/4 team work party**	1	
	~~Create and distribute promotional material for 3/25 VWP~~ **Create and distribute promotional material for 3/4 VWP**	1	
	~~Solicit and obtain refreshments for 3/25 VWP~~ **Solicit and obtain refreshments for 3/4 VWP**	1	
	~~Collect and return tools for 4/2 team work party~~ **Collect and return tools for 4/1 team work party**	1	
	~~Create and distribute promotional material for 4/2 VWP~~ **Create and distribute promotional material for 4/1 VWP**	1	
	~~Solicit and obtain refreshments for 4/2 VWP~~ **Solicit and obtain refreshments for 4/1 VWP**	1	
	Collect and return tools for 4/22 team work party	1	
	Create and distribute promotional material for 4/22 VWP	1	
	Solicit and obtain refreshments for 4/22 VWP	~~2~~ 0	0
	Subtotal	~~**24**~~ 11	**0**

Prepare and deliver reports and presentations (Tuan)			
	Produce as-built report	5	
	Design, prepare, print final poster	5	0

	Subtotal	**10**	**0**
	TOTAL	~~**195**~~ 113	~~**350**~~ 156

AD11: For every volunteer work party, we thought it would be nice to ask volunteer start with something easy, like removing invasive species on our site. Also, we did not have a lot of live stakes source, so we just live-staked on our own. As for the maintenance for the site, we were expecting to take some of the maintenance over the summer 2017 including irrigation and pruning, after then it will be resumed by the SER nursery. We also had some of our volunteer dates changed. The hours spent on taking the tools and refreshments did not take as long as we expected to.

3.2.7 Table 8: Labor by Source

Labor by source (revenue)	Total hours
Team	~~**208**~~ 113
Volunteers	
~~ESRM 100, 101~~ **ESRM 100 and team member's friends**	~~248~~ 64
~~Evergreen School Volunteer 4/22/2017~~ **Evergreen School Volunteer 4/1/2017&4/22/2017**	~~36~~ 92
Total	~~**284 hours**~~ **269 hours**

AD12: We have hosted four work parties so far, one was with ESRM 100 students, one was with team member's friends, and two with evergreen school's students and their parents.