Brightwater Pumping Station: As-Built Report

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BOTHELL SEATTLE TACOMA

Table of Contents

Project Summary 3

Overview 3

Summary Narrative 4

Brightwater 2016-17 Team 5

Contact info of team members 5

Acknowledgements 6

Participating Organizations 7

As Built Report 8

I. Background 8

Fig. 1 8

Fig. 2 9

Figure 3: Location of each polygon within the restoration site. 11

II. Tasks and Approaches 16

III. Specific Work Plans 23

Figure 4: Brightwater Influent Pumping Station restoration site delineated by polygon23

Table 1: Environmental Conditions by Polygon 24

Figure 5: Invasive vegetation mapped on site. 25

Figure 6: Native vegetation mapped on site. 25

Figure 7: Depiction of Sub-polygons as mentioned in the following Planting Plan 29

Figure 8: Cross section of waddle construction and staking. 30

Figure 9: Polygon 1-A 31

Figure 10: Polygon 1-B. 32

Figure 11: Polygon 2-A 33

Figure 12: Polygon 2-B 34

Figure 13: Polygon 2-C. 35

Figure 14: Polygon 3-A 36

Figure 15: Polygon 3-B. 38

Figure 16: Polygon 4. 39

Figure 17. Experimental Plot planting layout. 40

Fig. 18. Updated polygon 4 planting map 40

Figure 19: Polygon 5. 41

As-Built Map 42

Fig. 19: As-Built Map of the Brightwater IPS Restoration Site 42

Table 2: Budget 43
V. Work timeline 46
Table 3: Planned implementation schedule 46
Table 4: Actual implementation schedule: 47
VI. Design for the Future: 49
VII. Literature cited: 50

Lessons Learned 53

Appendices 54
Appendix 1: Planned Species by type 54
Appendix 2: Beneficial Plants for Wildlife 56
Appendix 3: Plant Ordering Forms for Budget 60

Project Summary

Overview

This report described the restoration of the bioswales and natural areas adjacent to Brightwater Influence Pump Station in Bothell. A team of 5 students in the University of Washington Restoration Ecology Network Capstone assessed the conditions, designed a restoration plan, and implemented the plan with the help of the community partners, Jonathan Shadel and Doug Schmitt of King County Wastewater, and the program instructors. The area restored totals approximately 0.6 acres, and the restoration undertaken by this team ran from October 2015 through May of 2016. Additional stakeholders in the community are engaged in the ongoing restoration and maintenance efforts of the site.

Before **After**

Summary Narrative

The bioswale complex was created as part of the Brightwater IPS construction. It was graded and trenched in order to take water from the impervious surfaces of the pump station and drain them into a detention pond before being discharged to Parr Creek. However, large quantities of invasive species took hold in the disturbed soil, hindering the function of the bioswale and preventing native plant communities from establishing well. Reference sites included other functioning bioswales and pocket wetlands in the same region.
Goals for the restoration included:
Reduce Vegetation Maintenance
Foster Diverse Native Puget Sound Wetland and Upland Communities Within the Site
Preserve and Enhance Quality of Hydrologic Functions in Bioswales and Retention Pond
Engage and Involve Local Community in Education and Stewardship of the Site

The solution attempted began with removing the mature invasive plants that had established, this took place in the later fall and through winter. After several sessions removing the plants, two work parties took place to install native plants and establish native communities. These work parties involved both the team members and volunteers. After these parties maintenance trips including the watering of plants and removal of new invasive growth continued through the duration of the project.
Notable achievements included:
Approximately 130 plants planted, including A shrubs, 4 forbs, and 5 sedges and rushes
Approximately 4 cubic yards of brush removed over multiple work sessions
Food and shelter for animals on the site
0.6 Acre section restored in an urban/suburban setting
Physical and biological methods of weed suppression employed
Experimental wattles employed to aid in water retention and weed suppression

Restoration and maintenance on the site will continue with help from community partners, citizens, and stakeholders around the site.

Brightwater 2016-17 Team

From left to right: Zhehua "Mark" Liu, Ashley Pearson, Javier Carrasquero, David Jackson, Eleanor "Ellie" Pugel.

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the YMCA

The North Creek YMCA was gracious enough to extend the use of their parking lot and their bathroom on multiple occasions, either for a work party or just when we were visiting the site.

UW Restoration Ecology Network

The support and input of our professors and our TA was always appreciated, and in several cases they went above and beyond to ensure we had the resources we needed.

King County Brightwater TREATMENT SYSTEM

Our Community Partner ensured that access and certain materials were always provided.

Across the street from our site, the Vertafore company offered to let us use their parking lots for volunteer parking and meeting space.

Our volunteers! For making it out on rainy days, early morning, and even April Fools. Thanks to everyone who participated.

Participating Organizations

As Built Report

I. Background

1. Site description

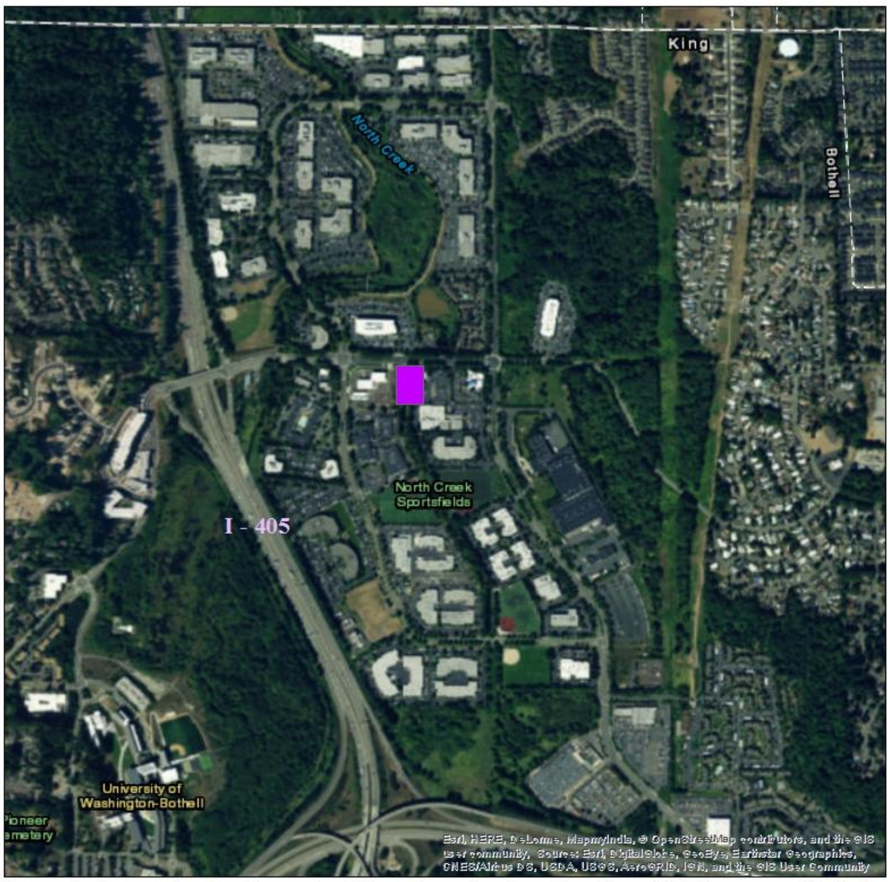
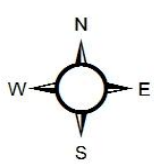
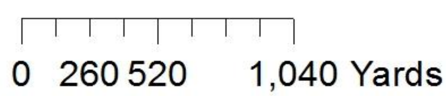


Figure 1: A map showing the regional location of restoration site within the area of Bothell.





Regional location of the restoration site within the area of Bothell
Fig. 1

Figure 2: The Location of the site, light purple, in relation to the Brightwater Influent Pumping Station, light yellow. The border of the Bothell Business Park is shown in blue. Parr Creek is shown as a light green line, directly to the east of the site. In between the site, purple, and Parr creek,light green, is the area which had restoration work completed by King Conservation District, orange.

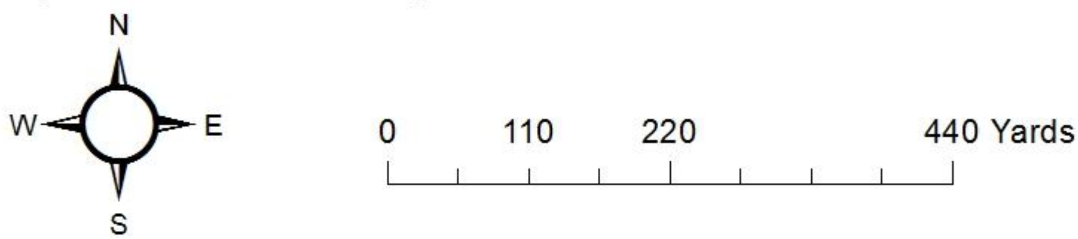


Fig. 2

The Brightwater Influent Pump Station restoration site is a 0.6-acre area located at the intersection of NE 195th St. and North Creek Parkway in the city of Bothell, WA (Figure 1). This restoration area will be referred to as ‘the site.’ It is in a dense urban area, on the grounds of the Brightwater Pumping Station within Bothell Business Park (Figure 2). To the west, between the site and North Creek Parkway, resides the King County Brightwater Influent Pump Station. The north is bordered by the pumping station’s turf area, rain gardens, and finally, NE 195th St. (Figure 2). The east side is bordered by Parr Creek, which lies between the YMCA parking lot and the site. To the south is another parking lot within the Bothell Business Park complex. The creek runs through North Creek Business Park as well as the Woodinville Montessori School before passing by the retention pond, which also dispenses water into the creek through groundwater infiltration. The site collects the runoff from the Brightwater pumping station’s impervious surfaces. This runoff infiltrates into the soil before slowly making its way into Parr Creek and groundwater. The current site is designed to capture, and have infiltrate, a majority of runoff. The water travels through the swales making its way to the retention pond where it is then held. The water infiltrates into the soil, makes its way into Parr Creek, eventually drains into the Sammamish River, feeds into Lake Washington, and subsequently the Puget Sound.

Directly between Parr Creek and the restoration site is a strip of land which has had restoration work completed by King Conservation District. The King County Conservation District is overseeing the Parr Creek Riparian Enhancement Project and planted various native plants in November 2013 with the help of Woodinville Montessori students (Figure 2).

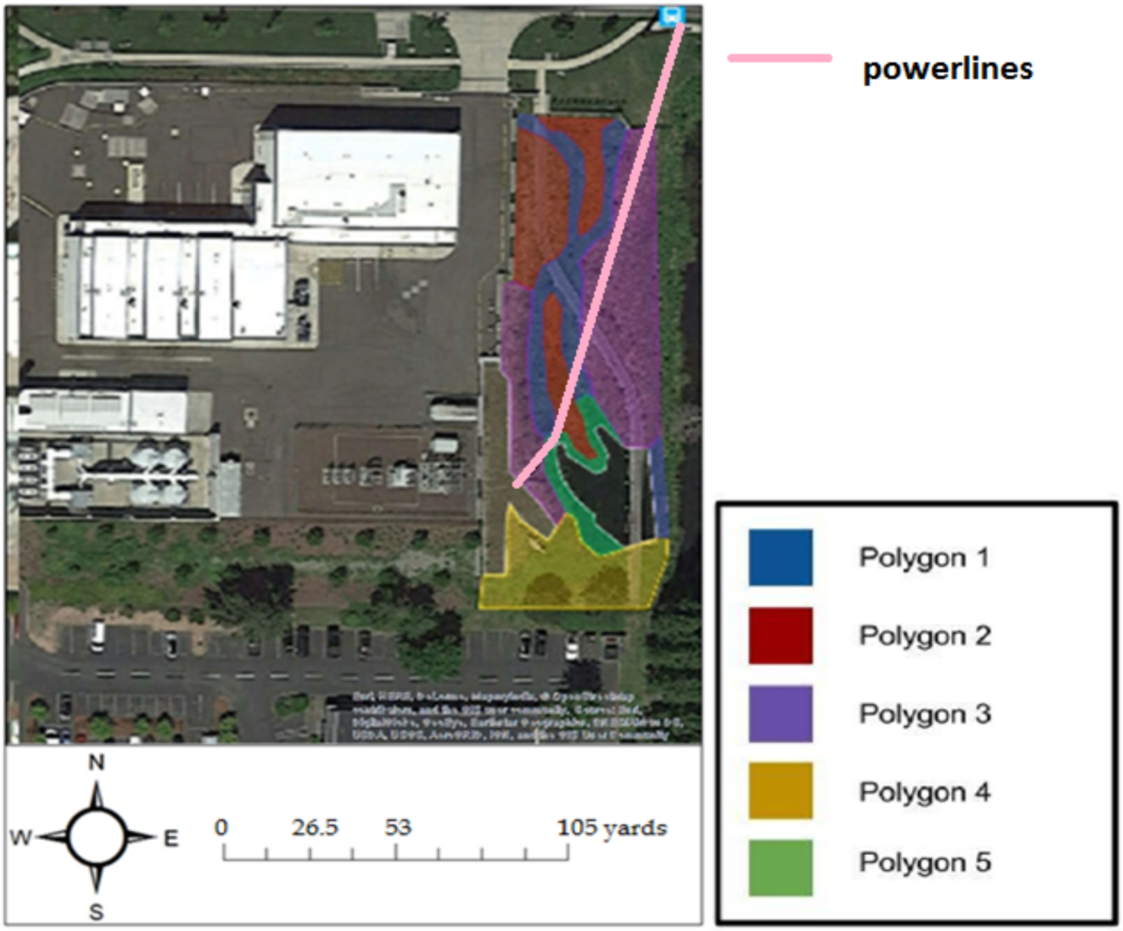


Figure 3: Location of each polygon within the restoration site. Brightwater Influent Pumping Station complex is located directly to the west and provides the runoff the site is designed to manage. The black area located in the southeast corner of the site is the retention pond. It is bordered by polygon 3, 4, and 5.

A main feature of the site are the power lines running from the southwestern corner to the northeastern corner (Figure 3). This will be taken into account by using the guidelines set for by PUD. Due to the power lines, there are existing height restrictions on the plants that can be planted in this area.

Another main features of the site, which we will discuss with more detail below, is the retention pond. The pond lies in the southeast area of the site, bordered on the western edge by polygon 5 and to the north of the east side of polygon 4 (Figure 3). The site has two man-made swales that form two curved lines through the site, polygon 1, that are connected near the center of the site

(Figure 3). On either side of the swales are mounds with a north to south orientation built into the landscape, polygon 2 (Figure 3). This allows water accumulated from rain and runoff to run down the mounded areas and collect into the swales which are then gently sloped towards the retention pond allowing water to infiltrate. These swales in the landscape have the potential to become effective bioswales which will contribute to filtering the rain and runoff of sediment. Water will be also be able to be removed through increased transpiration from the plants. These swales collect runoff off the impervious surfaces from the pumping station and become inundated with water during times of increased precipitation and runoff. The swales also have the capacity to hold the extra water from large rain events preventing the retention pond from overflowing and entering Parr Creek directly.

The retention pond collects stormwater runoff from the bioswales which are responsible for collecting the water running off the impervious surfaces of the pumping station. Water travels from the paved area of the pumping station, into the swales, and finally it enters the retention pond. The retention pond is a low expression of the water table which is made clear by the similar level of the adjacent Parr Creek. Water infiltrates into the ground in the retention pond and enters Parr Creek through coarse rocky material present between the two water features. There is a metal divider on the east side of the retention pond preventing water from running off directly into Parr Creek. This metal has loose, unconsolidated rocks bordering the metal divider. The existing topography including the bioswales and retention pond provide for an area for water to accumulate and infiltrate.

The ecosystem services of the site are currently negatively impacted by the many invasives; due to the inherent low complexity and stature of this type of vegetation within the bioswales. This may be due to the fact that the swales have a higher concentration of silt and clay soil than the sandy clay loam of the rest of the site, so many plants cannot form an effective root system in the soil. Invasive plants, often generalists, outcompete slower growing natives and prevent development of increased vegetation complexity. Creating a shrub layer and canopy will help shade out the invasives and create more complexity increasing the variety of habitat available for fauna. More specifics on the soil is explained at the end of this section. The potential for these swales to act as a more effective bioswales is also talked about in more detail in goal 3, objective 3-2 of the Basic Approach section.

The major disturbances the site seem to be related to erosion. The area bordering Parr Creek on the east sides of polygons 1, 3, and 4 has potential of erosion into Parr Creek during times of heavy rainfall especially since direct rainfall on these areas does not have a chance to infiltrate through the pond or bioswales (Figure 3). The slope on the eastern side is directed toward the Parr Creek. Rainfall on the rest of the site is going to largely be directed into the bioswales then into the retention ponds and the resulting erosional material will be contained at the bottoms on the swales. The site prevents foot traffic due to being fenced off in all directions and having a boardwalk specifically created to allow for people to be able to walk through the center of the site without leaving it. The boardwalk presents another potential disturbance of relevance to the site; the vectors of people or pets carrying invasive seeds over the boardwalk. In addition, animals using the site as habitat may bring in invasive plant species from neighboring areas through waste or transportation on fir or feathers.

The polygons are delineated by topography and soil composition. Polygon 1 denotes two low bioswales which lead into the retention pond and are connected in the center. Polygon 2 denotes upland sections between the bioswales and other wetter lowlands. Polygon 3 denotes gently sloping and exposed areas; one running into retention pond and another running off site into Parr Creek. Polygon 4 is a broad and varied hill, which terminates at the retention pond edge in rocks. Polygon 4 also has more seasonal litter from off-site trees. Polygon 5 is the western pond edge, dominated by common cattail *(Typha latifolia)* and including the southern edges of both the bioswales in Polygon 1.

The site was originally seeded in 2007 with four grass mixtures. The upland slopes; polygons 1, 3, and 4, were seeded with a mix of 75% dwarf perennial ryegrass *(Lolium perenne)* and 25% red fescue *(Festuca rubra).* The embankment, polygons 1 and 3, were seeded with 50% moor grass *(Sesleria autumnalis)*, 30% blue eyed grass *(Sisyrinchium idahoense)*, and 20% red fescue. The bioswales, polygon 1, were seeded with 68% meadow foxtail *(Alopecurus pratensis)* and 32% tufted hairgrass *(Deschampsia cespitosa).* The lowland area, polygon 5, was originally seeded with 81% broadleaf arrowhead *(Sagittaria latifolia),* 10% common spikerush *(Eleocharis palustris)*, and 9% dagger leaf rush *(Juncus ensifolius).*

The site is currently dominated by several invasive plants that have a presence in all polygons; primarily fennel *(Foeniculum vulgare)*, reed canarygrass *(Phalaris arundinacea)*, and Scotch broom *(Cytisus scoparius).* There is a large, dense patch of creeping buttercup *(Ranunculus repens)* which is the dominant vegetation of polygon 4. There are also black locust trees *(Robinia pseudoacacia*), thistle *(Cirsium vulgare)*, and Himalayan blackberry *(Rubus armeniacus)* present at multiple areas throughout the site.

Parr Creek is a shallow body of water and is surrounded by very little canopy cover except for a stand of Lombardy poplar trees *(Populus nigra 'Italica')* to the south of the site which provide some shade to the creek and organic material to polygon 4.

Polygon 1 soil has a texture of silty clay with an overlay of organic materials. Consistent water flow through this polygon likely carried sediment as well as organic matter into the bioswales, deepening the organic horizon. The lowered permeability of the clay soils may contribute to longer standing water in the bioswales. The section to the east of the pond is very wet and rocky with less organic matter and as a consequence, fewer plants are established here.

Polygon 2 is distinguished by a deep layer of organic material with a texture of sandy clay soil. Multiple worms and insects were visible in the extracted sample, indicating soil activity. Due to the denser organic matter in the soil, a large number of mature Scotch broom and fennel can be found growing in this soil. Below approximately 8” the soil become mostly sand.

Polygon 3 has soil of sandy clay, with a thinner organic layer than polygons 1 or 2. Scotch broom and fennel are widely dispersed across both polygon sections. Below approximately 10” the soil develops a sandier composition. The upland grass mixture, previously mentioned, is most widely established in this polygon.

Polygon 4 consists of a sandy clay with an organic layer that is about 3 inches deep on top. Debris from deciduous trees nearby, such as the Lombardy poplars, likely contribute to deepen the organic horizon. There are two well-established shore pines *(Pinus contorta)* on the south side of the site that are estimated to be about 25 feet tall and estimated to be from 15 to 20 years of age due to rapid growth (Kruckeberg 1982). The underlying sandy clay could be a hindrance to establishment of larger plants but the organic material on top may provide enough nutrients for smaller shrubs and groundcover to establish. There is a loose, unconsolidated rock berm surrounding the retention pond along the northern edge of this polygon which lets water drain quickly through.

Polygon 5 is the pond edge, most of the soil in this area is underwater and saturated. No deep soil samples were taken in this polygon. This polygon is vegetated with common cattail and reed canarygrass primarily, both on the sloped western edge of the pond and the north and northwestern edges of the bioswales.

2. Restoration Needs and Opportunities

The presence of invasive species is typically an indication of impairment and low complexity as these generalists’ species can reduce the site’s ability to provide habitat and food for native fauna. The invasive plants do permit the bioswale to function but by suppressing invasive plants we will attempt to increase complexity in the site and this would provide habitat in line with the requests of our community partner. Because of the loss of specialized species there is a Potential for simplification of community structures, micro-climate disruption, losses of beneficial soil properties, reduction in the capacity for mineral nutrient retention, and potential alteration in the moisture regime (Clewell and Aronson 2009).

The three most dominant invasive species are fennel, scotch broom, and reed canarygrass. Fennel and scotch broom are dominant in upland areas and they are actively suppressing any native vegetation that may have seeded there through natural means or during the original site

seeding by the community partner. Removing the invasive plants and performing targeted plantings will allow shrub cover and understory to develop, which will promote the ecological complexity necessary to create habitat. Additionally in the planting selection we will be addressing the lower maintenance and improved accessibility. As the introduced plants mature over time the need for regular maintenance will potentially decrease as invasive plants will have difficulty recolonizing the site due to the formation of canopy and understory. These natural elements will promote conditions that are more favorable for natives plants to succeed, and this subsequently will allow native plants outcompete the invasives. This occurs primarily by shading them out and by making it more difficult to access nutrients. Our focus in this regards is to decrease the intensity of the maintenance necessary to care for this site.
Some of the Native shrubs in this instance would be Pacific ninebark (*Physocarpus capitatus*), redosier dogwood (*Cornus serica*), oceanspray (*Holodiscus discolor)*, low Oregon grape (*Mahonia nervosa*), baldhip rose (*Rosa gymnocarpa*), Nootka rose (*Rosa nutkana*), and serviceberry *(Amelanchier alnifolia)*. Reed canarygrass is found primarily in the bioswales, where its presence suppresses native wetland plants that would otherwise assist in the function of the bioswales. reed canarygrass presents a threat to the success of our restorations efforts because it can grow vigorously and it can eliminate competing native plant species (Apfelbaum 1987). if not kept under control reed canarygrass can become dense and this would create more unwanted maintenance for our community partner as it can increase siltation in the water and in addition it can be detrimental to the site aesthetics. Furthermore, the plant stems can grow too densely impeding adequate cover for wildlife such as small mammals and waterfowl (Apfelbaum 1987).

We will replace the invasive plants with native plant species that would perhaps improve and help to maintain bioswale functionality and possibly the succession of other natives' species in the bioswales. Once planted, the site can potentially filter water more effectively, as well as provide robust habitat for birds, mammals, and other animals already living in the wetlands. Habitat plants in this instance would be low Oregon grape, and serviceberry. In addition, the site will be a model of wetland native plant communities to provide education opportunities for visitors and students.

II. Tasks and Approaches

Goal 1: Reduction of Vegetation Maintenance

Objective 1-1: Remove invasive plants which require constant work to suppress.

Task 1-1a: Remove Himalayan blackberry (*Rubu*s Ar*meniacus).*

Approach: Remove Himalayan blackberry mechanically, including the rhizome, using tools and labor. Use shovels and garden knives to remove the root ball from the soil.

Approach Justification: Removing the rhizome of a Himalayan blackberry plant is shown to effectively suppress it. This is noted as the best method for suppression (King County Weed Control Board 2016)

Task 1-1b: Remove fennel (*Foeniculum vulgare*).

Approach: Harvest the seeds by hand and place them into a container first, and then mechanically remove the root ball with tools and labor. Removal will require shovels to dig out the root ball, as the sizes of the plants are significant. The seeds are taken off site and disposed of.

Approach Justification: Removing the seeds first prevents adding more fennel to the seedbank and uprooting the plant kills it. After removing the root ball, the tap root will be cut. This is the most effective removal and suppression method (Pierce County Weed Board 2015)

Task 1-1c: Remove Scotch broom (*Cytisus scoparius).*

Approach: Mechanically remove with tools and labor. Weed wrenches will be used on nearly all plants since none appear to be less than 3 feet in height. Seed pods will also be cut before removal and placed into a container to be disposed of off-site.

Approach Justification: Weed wrenches are shown to be most effective at removing plants with extensive tap roots, and all the observed plants are mature enough to avoid being pulled by hand. Our project does not take place during the dry season, so cutting near the base of the stem is not an option for suppression. Weed wrench removal and seed pod cutting are the techniques commonly used for removal (King County Weed Control Board 2016).

Task 1-1d: Remove black locust *(Robinia pseudoacacia)*.

Approach: Cut the branches off first followed by sawing the trunk and uprooting the root-ball.

Approach Justification: Black locust have thick, sharp thorns on the branches. Removing these first will make removing the trunks easier and safer to handle. The trunks are heavy and dense, removing them will make digging and uprooting the root-ball easier and safer. These trees are naturalized in Washington state, (Washington State University plant database), but for the purposes of this project they are not preferable to native trees with similar properties. This is in part due to their tendency to displace local vegetation and understory, (Pierce County Weed Control Board 2015).

Objective 1-2: Create a native, self-sustaining plant community.

Task 1-2a: Plant species that provide shade.

Approach: Plant native trees and shrubs to create a low canopy that creates and continues to provide shade across the site.

Approach Justification: The creation of shade is shown to suppress many invasive species, such as reed canarygrass and Himalayan blackberry, which thrive in large amounts of sunlight (King County Weed Control Board 2016). Each of the selected plants are fast growing and provide large amounts of cover quickly.

Task 1-2b: Suppress weeds.

Approach: Create shade and fill niches which will prevent invasive species from readily re-establishing. Native plant species will fill the gaps left by invasive species removal.

Approach Justification: Many species of invasives on site cannot simply be removed but instead require changes in on-site conditions that allowed them to establish and thrive. The conditions that helped them to establish in the first place include disturbed barren soil and open space providing full sun conditions.

Task 1-2c: Replace existing canopy with native canopy.

Approach: After removal of the existing invasive cover created by black locust, fennel, and Scotch broom, add a variety of native plants to create a new canopy cover.

Approach Justification: The canopy is essential, not only for weed suppression but for the establishment of native species. Creating a native cover with specific plants will aid in establishment and subsequent succession.

Objective 1-3: Improve accessibility.

Approach: Remove plants that block easy access for utility maintenance and require maintenance.

Approach Justification: Access to areas, such as for Puget Sound Energy to the power pole, is essential for the function of the site. Creating access pathways with strategic plantings will allow that, while reducing the maintenance will shrink the areas that need to be accessed (Community Partner Conversation) (Guideline Manuals for PUD and PSE).

Goal 2: Foster Diverse Native Puget Sound Wetland and Upland Communities Within the Site.

Objective 2-1: Removal and suppression of invasive species on site.

Task 2-1a: Remove the invasive plant species on site.

Approach: Remove with mechanical methods and labor, suppress with native planting. These methods will use a mix of tools and approaches, dependent on the species being addressed and the best practices noted. The species replacing those removed will also be similarly tailored.

Approach Justification: The removal of invasive plants will free up area and resources which will allow native plants to establish (King County Weed Board 2016). In turn, those native plants will further suppress the invasives which we will initially remove (Washington State University 2015).

Objective 2-2: Plant native communities in appropriate polygons.

Task 2-2a: Build and establish wetland communities.

Approach: Establish wetland plants in the bioswales and the retention pond edge.

We intend to install plants that will create the foundations for this community now and through succession.

Approach Justification: The bioswales and retention pond form the basis for effective wetland communities; they channel water as well as provide habitat to wetland animals. Adding native plants will improve their capacity to perform these tasks.

Task 2-2b: Build and establish upland communities.

Approach: Establish upland plant communities on the hills and mounds between bioswales. Create a low canopy, well-spaced understory, and ground cover.

Approach Justification: The mounds and hills have the potential to host effective upland communities (Leigh 1996), including canopies and upland animal habitats (Pojar 1994). Adding native plant communities will increase their capacity to perform these functions (Washington State University 2015). This will add to the complexity of the area and provide a multilayered canopy to provide habitat for birds and small mammals.

Objective 2-3: Establish services for native animals

Task 2-3a: Plant species that provide food and habitat to native animal species.

Approach: Planting of species that provide shelter, food, and protection for native birds, amphibians, and mammals on the site.

Approach justification: These plants will provide cover and protection for many species living on the site. Many birds and mammals eat the berries, hips, or nectar of these plants. (Pojar 1994). This provides sustenance on the site for many species currently residing there and may encourage others to do so as well (Kunze 1994). These shading plants create microclimates, both inside their branches and under their canopy. This will allow animals to live more effectively on site in more extreme temperatures, such as extremes in temperature in summer or winter (Leigh 1996). (See appendix 1 for services provided by planned species.)

Goal 3: Preserve and Enhance Quality of Hydrologic Functions in Bioswales and Retention Pond.

Objective 3-1: Lower temperature of water in retention pond and subsequent discharge into Parr

Creek.

Task 3-1a: Add shading plants and add canopy cover

Approach: Plant native species and other broadleaf shading plants.

Approach Justification: Shade will lower the temperature of the water as it passes through the bioswales and before it enters the retention pond. Shade along small streams can reduce water temperatures to an ecologically significant degree (Rutherford et. al. 2004). Planting quickly growing plants such as willow aids to speed up the process.

Task 3-1b: Increase bioswale structural complexity.

Approach: Planting of wetland forbs and shrubs in the bioswales.

Approach Justification: Adding native plants in the wet bottoms of the bioswales will slow the flow rate of water by adding obstacles; this reduced flow rate will cause additional oxygenation, reduce temperature, and increase infiltration (NCRI, 2005). Additionally, stream complexity is important for habitat function (NOAA, 2016).

Task 3-1c: Increase bioswale depression storage

Approach: Planting of wetland shrubs, sedges, and grasses in areas that do not follow the normal grade of the bioswales.

Approach Justification: These plantings will create areas where water is stored in shallow depressions instead of following the normal grade from the bioswales into the retention pond (Water on the Web, 2008). This allows the plants around them to thrive there and increases the amount of time the water is in contact with the bottom of the bioswale and increasing infiltration.

Objective 3-2: Reduce flow rate of water into the retention pond and increase infiltration by soil and transpiration by plants.

Task 3-2a: Increase bioswale flow complexity.

Approach: Planting of wetland sedges, grasses, and flowering shrubs at the base of the bioswales. This will complicate the flow, meaning cause it to run in a slower and less direct manner.

Approach Justification: By breaking up the bioswales laminar flow, the rate of water discharge to the retention pond will be decreased. This will increase the water's contact time with the soil and plants, increasing transpiration and infiltration (Agri Info). The increase in shade will ensure the water temperature does not become too high during this process.

Task 3-2b: Increase bioswale depression storage

Approach: Planting of wetland shrubs, sedges, and grasses in areas that do not follow the normal grade of the bioswales.

Approach Justification: The bioswales follow a consistent grade from their start at the north edge of the site down into the retention pond in the southeast. In areas that have flattened out and no longer follow this grade, water can be stored for longer periods especially if aided by plants and additional surface structure. This depression storage will increase the amount of water taken up by plants and the soil. The increase in shading plants will ensure the water temperatures will not become too high during this process.

Goal 4: Engage and Involve Local Community in Education and Stewardship of the Site.

Objective 4-1: Educate volunteers and identify opportunities for future stewardship of the site to provide maintenance.

Task 4-1a: Host volunteer events.

Approach: Create opportunities for community involvement via direct action.

Approach Justification: Engaging the community in action during the restoration will improve chances of its success. Increased involvement will lead to increased interest in maintenance and monitoring after the initial restoration is completed.

Task 4-1b: Host stewardship events including training opportunities.

Approach: Hosting events in which interested locals can learn more about the restoration and maintenance process, as well as the science and methods behind them.

AD1: We have only contacted these organizations remotely so far. In doing this we have connected them to the CP and informed them as to the work that needs to be done.(Appendix, Javi's brochure)

Approach Justification: People that can lead maintenance efforts and have greater knowledge about the methods and science behind the restoration will improve the community efforts. In addition, they can train volunteers for stewardship in the future.

<u>Objective 4-2</u>: Educate the public about restoration and native plant communities at the site and Parr Creek.

Task 4-2a: Partner with nearby educators

Approach: Foster relationships with educators near the site. Include materials and opportunities to give tours of the site and see the restoration and site in action.

Approach Justification: This will create opportunities for engagement by students and help inform the next generation of stewards. Given the site's accessibility to the public and proximity to a major business and residential area, it provides the ideal venue to showcase the importance of wetlands conservation in the region.

III. Specific Work Plans

1. Site preparation plan:

(A) Current conditions:

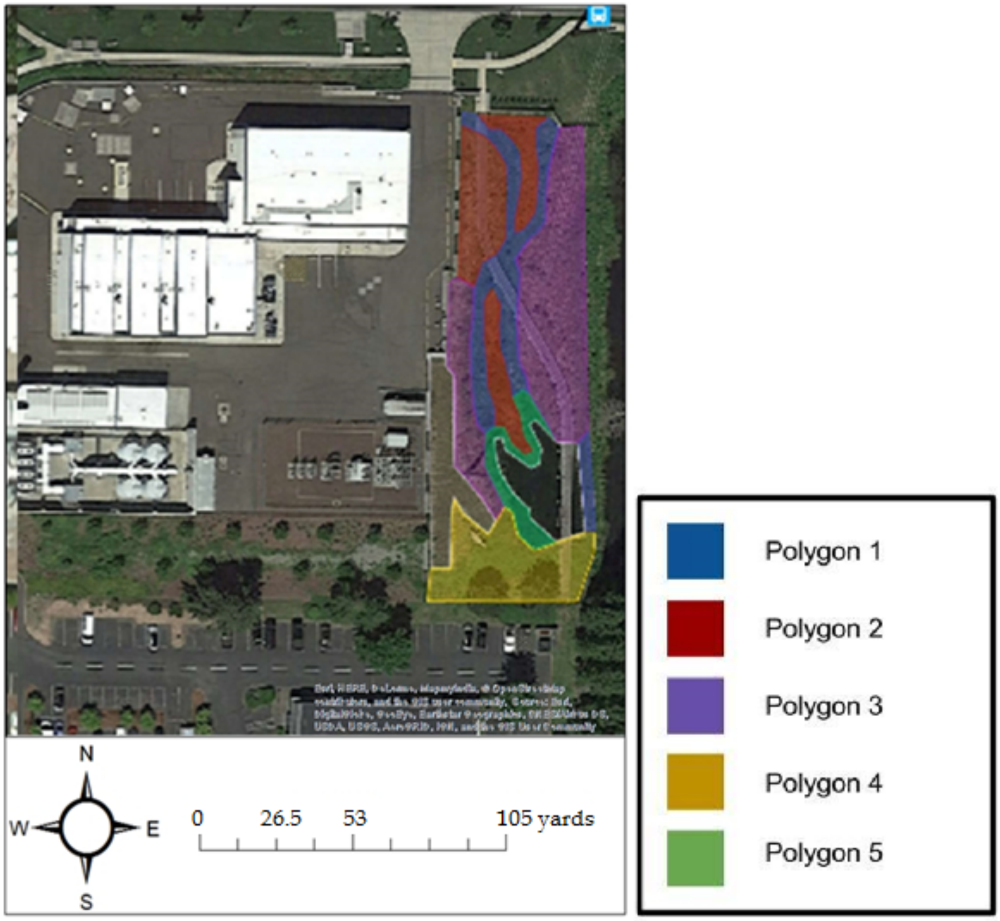


Figure 4: Brightwater Influent Pumping Station restoration site delineated by polygon

i. The polygons shown in Figure 1 above are separated by topography and structure; specifically of the raised areas traversing through the site to the retention pond. As you can see, Polygon 1 of the map is formed in an "X" shape. It is outlined in this shape due to the bioswales that are carving their way through the site, ending in the retention pond. The current vegetation (pre-restoration) of polygon 1 varies from that of Polygon 2 due to the difference in elevation and water soil content, thus why the polygons were formed going off the different areas of the bioswales. Polygon 1 is the low-lying areas of the bioswale. Polygon 2 denotes upland sections between the bioswales and other wetter lowlands. Polygon 3 denotes wide and exposed slopes, one running into the retention pond and another running off site into Parr Creek. Polygon 4 is a broad and varied hill, which terminates at the retention pond edge into rocks. Polygon 4 also has more seasonal litter from off site trees, such as Lombardy poplar. Polygon 5 is the western pond edge, dominated by common cattail (*Typha latifolia*) and including the southern edges of both the bioswales in Polygon 1.

ii. Polygon environmental conditions summary table

Table 1: Environmental Conditions by Polygon

	Polygon 1	Polygon 2	Polygon 3	Polygon 4	Polygon 5
Soil Texture	Silt Clay	Sandy Clay	Sandy Clay	Sandy Clay	Clay and Mud
Soil Moisture	High	Medium	Medium	Medium	Very High
Slope	Steep Edges, Gradual at Bottom	Gradual	Gradual	Mostly Even	Steep, Terminating Underwater
Light Availability	Medium	High	High	Medium	High
Present Vegetation	Reed canarygrass	Fennel and Scotch broom	Fennel and Scotch broom	Creeping buttercup	Reed canarygrass
Human Impacts	Runoff from pump station, ragged edges, grading, and bioswale construction.	Grading to create raised areas running north to south.	n/a	n/a	Encompasses man-made retention pond.
Other Considerations	Water will collect to this polygon then flow into the retention pond. Will be seasonally inundated especially during large rain events.	Will be more susceptible to changes in soil moisture content due to being raised above surroundin g area.	East border susceptible to potential future shading from new saplings planted on adjacent Parr Creek site	Drier uphill soil covered by tall trees on the adjacent south parking lot bordering the site. The south end of the polygon is also bordered by a wire fence.	Will be seasonally inundated, especially during times of high precipitation and runoff

iii. Site vegetation maps:

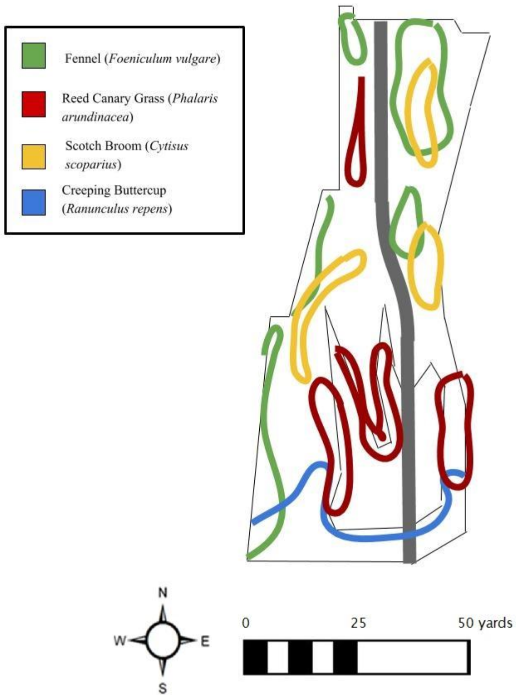


Figure 5: Invasive vegetation mapped on site.

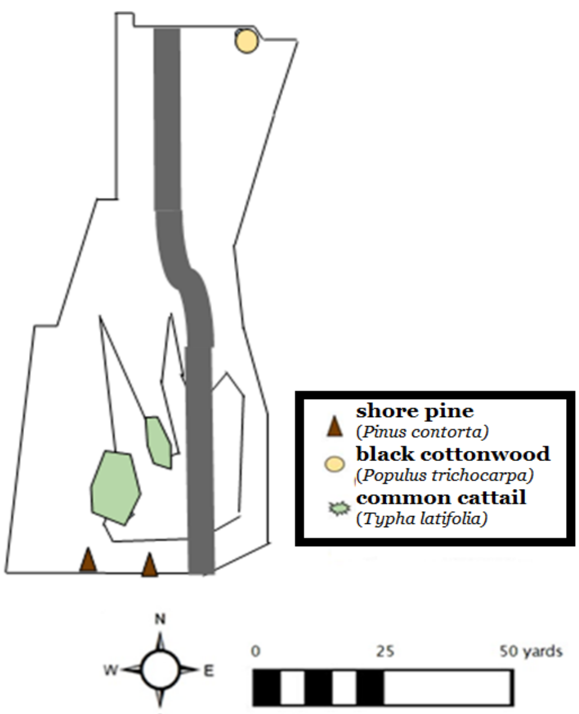


Figure 6: Native vegetation mapped on site.

The site is currently dominated by several invasive plants as shown in Figure 3, primarily fennel, reed canary grass, and Scotch broom. There is a large, dense patch of creeping buttercup dominating polygon 4 (shown in the south border of figure 3). There are also black locust trees, thistle, and Himalayan blackberry present at multiple areas throughout the site in sparse quantities that can easily be removed and suppressed.

Parr Creek is a shallow body of water and is surrounded by very little canopy cover except for a stand of Lombardy poplar trees off site to the south. Polygon 1 (as shown in Figure 3) has a soil texture of silty clay with an overlay of organic materials. Consistent water flow through this polygon likely carries sediment as well as organic matter into the bioswales, deepening the organic horizon. The low permeability of the clay soils may contribute to longer standing water in the bioswales. The section to the east of the pond is very wet and rocky, few plants are established here.

Polygon 2 is distinguished by a deep layer of organic material with a texture of sandy clay soil. Multiple worms and insects were visible in the extracted sample, indicating soil activity. Due to the denser organic matter in the soil, a large number of mature Scotch broom and fennel can be found growing in this soil. Below approximately 8" the soil becomes mostly sand.

Polygon 3 has soil of sandy clay, with a thinner organic layer than polygons 1 or 2. Scotch broom and fennel are widely dispersed across both polygon sections. Below approximately 10" the soil becomes sandier. The upland grass mixture seen in the site is most widely established in this polygon.

Polygon 4 consists of a sandy clay with an organic layer that is about 3 inches deep on top. Debris from deciduous trees nearby, such as the Lombardy poplar trees*,* likely contribute to the deeper organic horizon. Surface water likely moves quickly to drain rock surrounding the retention pond. The underlying sandy clay could be a hindrance to establishment of larger plants but the organic material on top may provide enough nutrients for smaller shrubs and groundcover to establish.

Polygon 5 is at the pond edge, most of the soil in this area is underwater and saturated. No deep soil samples were taken in this polygon. This polygon is widely populated with common cattail and reed canarygrass both on the sloped western edge of the pond and the north and northwestern edges of the bioswales.

(B) Site Preparation Activities:

<u>Polygon 1</u>

In this polygon there are some persistent Himalayan blackberry and Scotch broom along the rocky soils under the walking bridge. This may require more time to remove than the normal invasives out in the open and may require further action by shade suppression detailed in the planting plan. The majority of this polygon besides the rocky edge has less invasives than the other polygons because its seasonally inundated soil that makes it difficult for most plants to establish. Because of the natural varying slopes, some erosion control will be needed on the side of the banks. This will be done in the planting process by using redosier Dogwood (*Cornus sericea)* and Pacific ninebark *(Physocarpus capitatus)* fascines. The fascines will be waddles in structures consisting of mulch and burlap, and staked to the ground.

Polygon 2

In this polygon the fennel and reed canarygrass are the main invasives, with a few scattered Scotch broom. The fennel will have its seeds cut off and then be dug out by its roots and effectively be removed; native plant species that provide quickly establishing shade should be planted before dormant fennel seeds have time to germinate (discussed further in planting plan).

Polygon 3

As seen in Figure 4, this polygon consists mostly of fennel and Scotch broom with a few scattered patches of reed canarygrass and Himalayan blackberry on the south tip near the boardwalk. On the west side of the slope on this polygon there are concrete slope stabilizers to maintain the slope so no digging can be done. This may affect the amount of tall plants and deep rooting plants that we can plant there. All of the Himalayan blackberry has already been removed from our first early work party session on January 16th, and was done so by removing the root crowns of the plant and stacking in a weaved clump (along with the fennel removed as well) at the side of the site near the pump station so that it cannot re-establish. Erosion control of the site will be needed on the west part of the polygon where the flat grass embankment slopes down into our site. This will be done in the planting process by using redosier dogwood live stakes, further detailed in the planting plan.

Polygon 4

This polygon is unique in that it is most solely comprised of creeping buttercup. Due to the amount of it, removal by hand would be an unreasonable method of removal. This will mean invasive removal will be focused on suppression. We will be doing an experiment to determine the best suppression method for creeping buttercup by dividing the section into quadrants and using the following methods: wood chip mulch only, burlap only, wood chip mulch and burlap together, and mechanical removal. This is the main area we will be using mulch on because of the demography of our site. The mulch would most likely be washed away into the bioswales and ‘clog’ the flow of water into the retention pond. The only other areas that could potentially use mulch are the high slope, drier parts of the site, but we will not be using it on them. If there is trouble maintaining the plants that are going to be installed, mulch can be applied around the base of the plants.

Polygon 5

In terms of invasives, this is another polygon like polygon 1 that is not comparatively as big of a problem. Because of its mostly saturated soil, the only invasive we see here is reed canarygrass (as shown in Figure 4). This may end up difficult to handle though because mulch may not be effective and hand pulling the grass is inefficient. This is a polygon that will most likely not have as much preparation work, and even planting activity, but will change largely as a result of the interactions with the neighboring polygons.

(C) Logistical Considerations for Undertaking the Site Preparation Activities:

Fortunately for our team, there are few logistical constraints we will have to manage. There is a walking bridge that goes throughout the site, so we will be able to effectively transport materials fairly close to where they need to be placed without any significant compaction of the soil from repeated foot or wheelbarrow traffic. There is also ample parking for volunteers on the YMCA parking lot to the east of our site across the creek if we communicate with them as soon as possible to see when they are not holding events. We do not need to worry too much about noise as well because it is a business and retail area on all borders of the site (very little neighboring wildlife to disturb and already a lot of surrounding noise). We do need to be careful, however, of the pipes running along the underside of the boardwalk (these connect to the water lines that run along the edges of our site to the sprinklers), the concrete slope stabilizers on the southwestern edge of the site, and irrigation lines on the northwestern edge of the site. This will be done by notifying all volunteers to watch their step when they walk under the boardwalk and to not dig over by the west end of the site. The bottom of the bioswales are also susceptible to damage from being tread over due to the area's soft soil and sporadic sparse vegetation. Thankfully these areas have high slopes just on either side of them so the easiest way to avoid stepping on the area is to hop across.

The volunteers helping us with installation will meet at the front of the park facing north of the site on NE 195th Street. We will give them an overview of the site there and then they will be able to do a quick glance through the site via the walking bridge. Snacks and water will be available via the walking bridge area near the entrance. Water will also be available on the top of the hill on the east side of the site where the pile of excess vegetation will be collected**. AD 2: Water was collected from the retention pond, the bioswales, and Parr Creek** This pile is routinely taken away from the site as coordinated with the CPs, and is put in an area of easy access to collect adjacent to the gate entering the Brightwater Influent Pump Station. Plants will then be carried from the entrance to the walking bridge on NE 195th St. to the walking bridge and then set down on the closest point to the area in which they are to be planted. These plants can then be grabbed by the workers working on that specific area's planting (the walking bridge is arm's distance from down on the site). **AD 3: We placed them directly where they needed to be based on the planting map. We thought it would go better for the volunteers and for us, given the complexity of our map.** Most likely two polygons will be worked on at once and our team members will be making sure volunteers are planting according to our planting plan. A broom will be needed to sweep off the excess soil shed from the nursery plants on the walking bridge after the planting for the day is done. As our CP will be providing the mulch, they will store it for us indefinitely at the main Brightwater Treatment Plant. It will be moved to the site via our team's personally owned truck, if not by one of our CP's king county owned trucks. **AD 4: It was delivered directly to the site and dumped there** For the plants, they will be temporarily stored at the Douglas Research Center after ordering but will have to be transported up to the site. They will then be stored at the site until installation, and will be watered regularly. The goal is to get them installed as quick as possible in order for them to incorporate into the soil and not have to regularly be watered by irrigation.

2. Planting Plan:

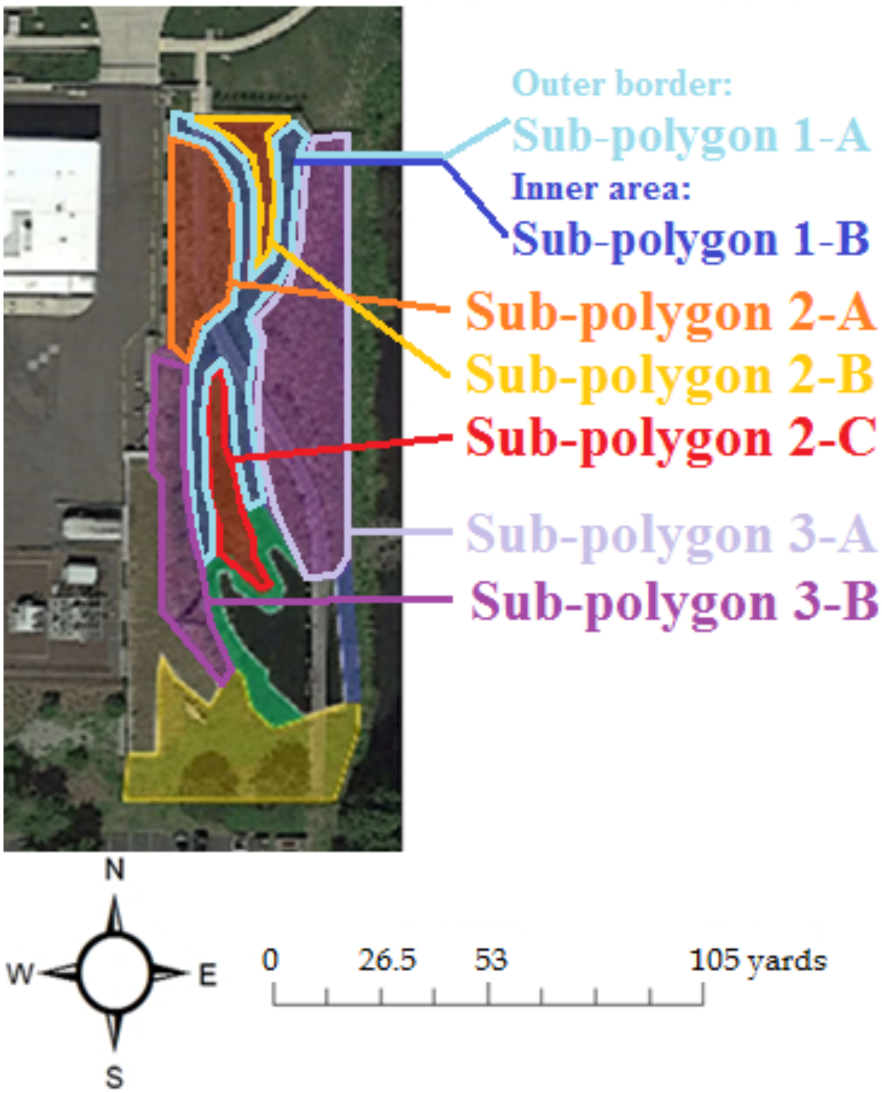


Figure 7: Depiction of Sub-polygons as mentioned in the following Planting Plan

Polygon 1

This polygon consists of multiple bioswales running at an even grade from the north to the retention pond in the south. The base of these swales are populated with invasive reed canary grass. The planting goals in this polygon is to shade the bottoms, both to suppress the reed canary grass and to lower the temperature of the water. This will also complicate the flow of water from the swales to the retention pond increasing infiltration.

1-A.

This sub polygon is made up of the sloped edges of the bioswales. Plantings here revolve around the creation of shade for the polygon.

Fascine "waddles" will be staked into the sides of the edges. Waddles are used in several instances to retain water and sediment. Ours will consist of live stakes of redosier dogwood and Pacific ninebark (along with mulch and soil. They will be wrapped in burlap and pinned into place via Pacific ninebark stakes into the bottoms of the slopes. Over time the burlap will decompose and the live stakes will grow. Burlap will ensure water can be captured and used by the plants and for infiltration.

AD 5: These were built and installed roughly one week before the rest of the plants

Tall Oregon Grape (*Mahonia aquafolium*), Nootka rose (*Rosa nutkana*), and baldhip rose (*Rosa gymnocarpa*) will be planted near the waddles, no closer than 3m, creating understory once the dogwood and ninebark are developed.

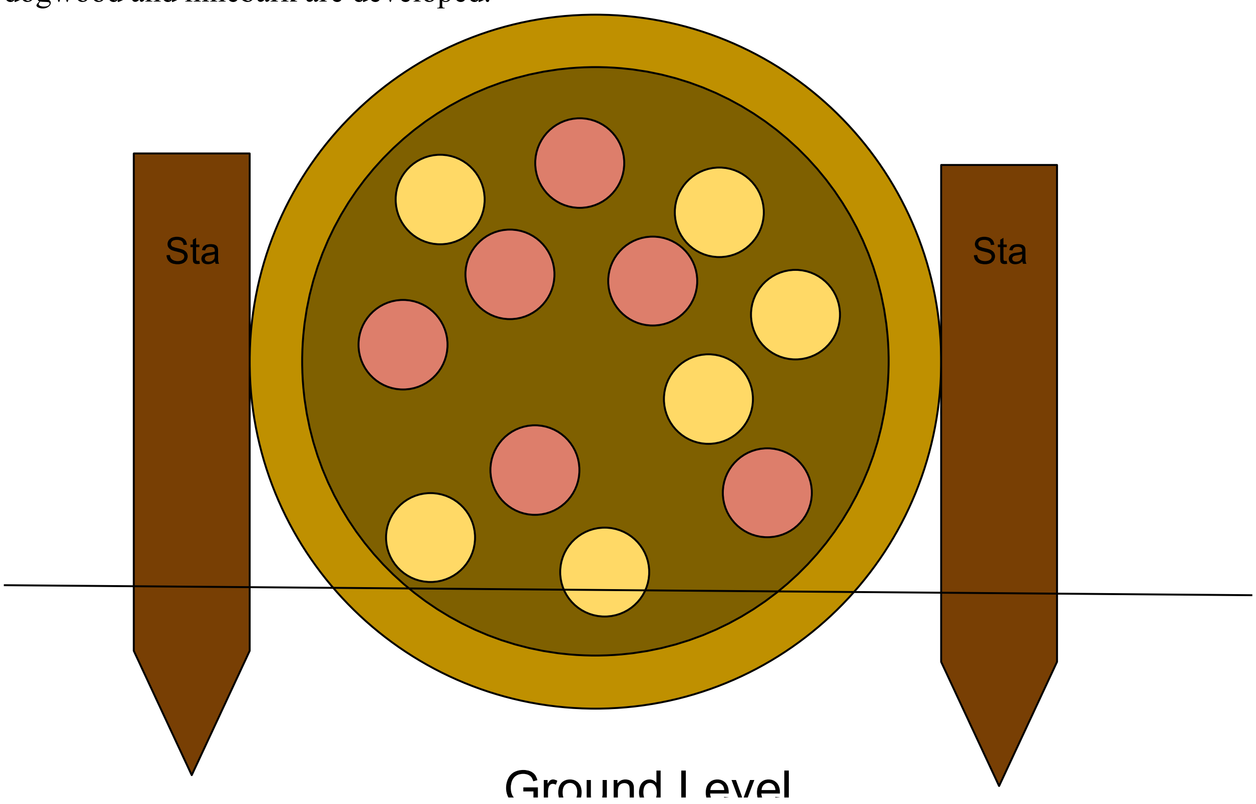


Figure 8: Cross section of waddle construction and staking.

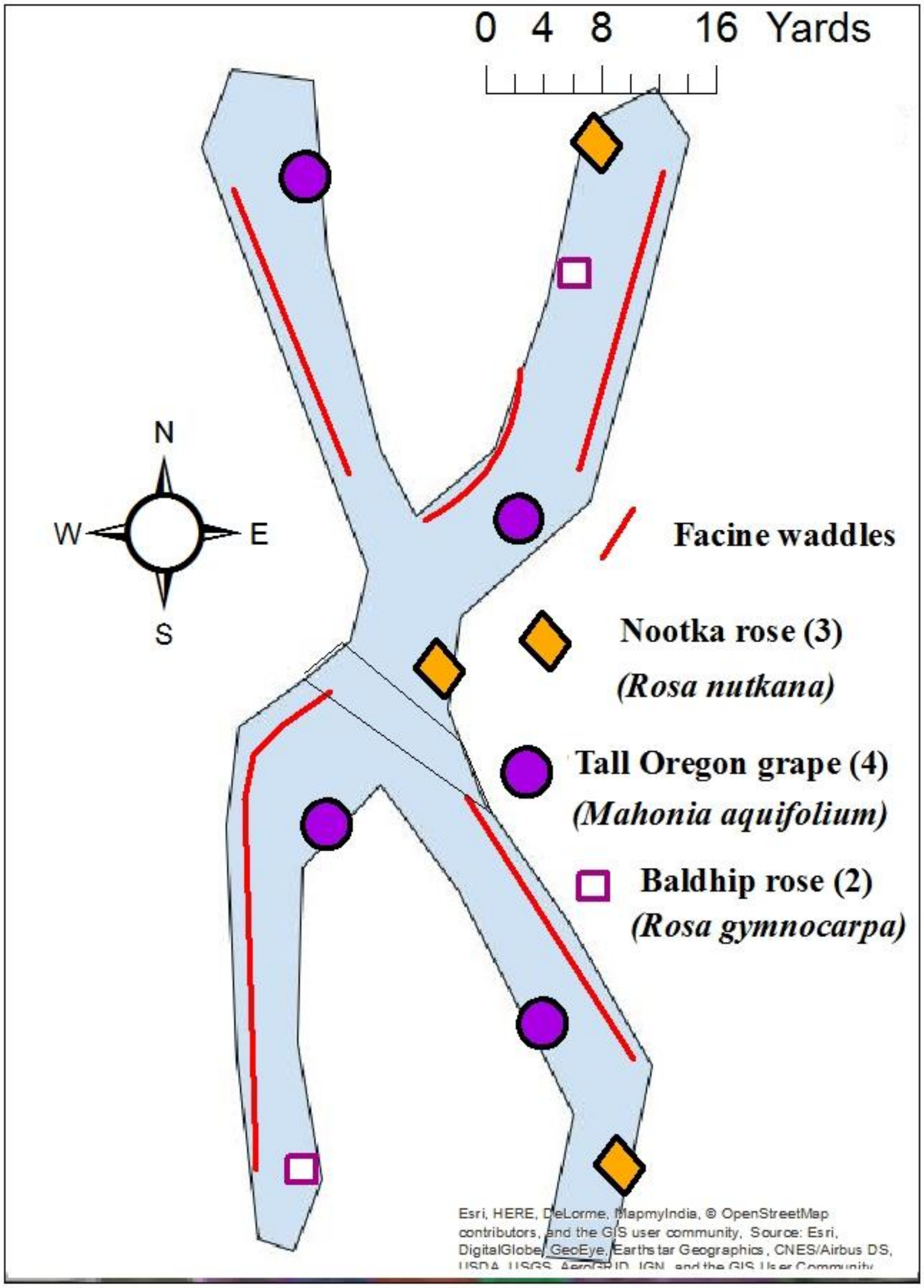


Figure 9: Polygon 1-A

1-B.

This sub polygon is made up of the bottoms of the swales. Plantings here revolve around the complication of the flow from the swales into the retention pond.

Plants selected for this polygon have a range of water tolerances, as the moisture content is variable. They are also flood tolerant as heavy rain events saturate the soil.

Hardhack (*Spiraea douglasii*), sawbeak sedge (*Carex stipata*) and small-fruited bulrush (*Scirpus microcarpus*) will be planted in small irregular clusters across the sub polygon, each cluster will be no closer than 4m. Their goal is to disrupt laminar flow and slow the rate of water traveling through the bioswales. This will increase contact time with both the soil and the plants, allowing for increased transpiration and infiltration (Water on the Web, 2008).

Sword fern (*Polystichum munitum*) will also be planted at wider intervals, as single plants not in clusters. **AD 6: They were also watered a little extra and mulch where possible, as the plants seemed to be in poor health**. They are tolerant of a range of conditions and will provide shade as well as complicating flow (Pojar 1994).

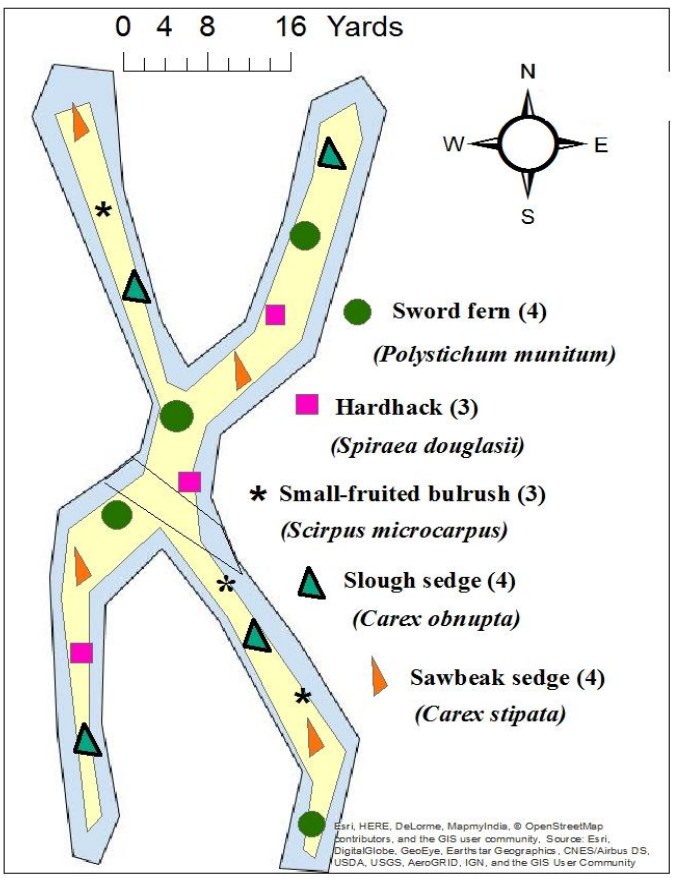


Figure 10: Polygon 1-B.

<u>Polygon 2</u>
This polygon consists of the mounds between the bioswales. They are typically consists of well drained soils in full sun.
The planting goals in this polygon are to suppress the invasive species removed from the polygon, and the establishment of native plants some of which will provide services to native animal species (appendix 2).

2-A
This sub polygon consists of an area smaller than B or C. In addition, its west edge is defined by a wall on the outside edge of the pump station. This creates deeper shade on this sub polygon than on the others.
The edges of this polygon shared with polygon 1-A will be planted with live stakes of redosier dogwood and Pacific ninebark at a minimum distance of 4m. **AD 7: Fascines noted in 1-A are planted in that polygon and others, including this one. We did not have enough live stakes to cover both as described**.The edge will also be planted with small amounts of serviceberry and snowberry at a minimum distance of 4m.
Towards the center of the mound will be Idaho Roemer's fescue (*Festuca roemeri (idahoensis)*) which will help establish native cover. And individual oceanspray (*Holodiscus discolor*) and red elderberry (*Sambucus racemosa*) each will be planted at opposite ends, given their size (Pojar 1994).

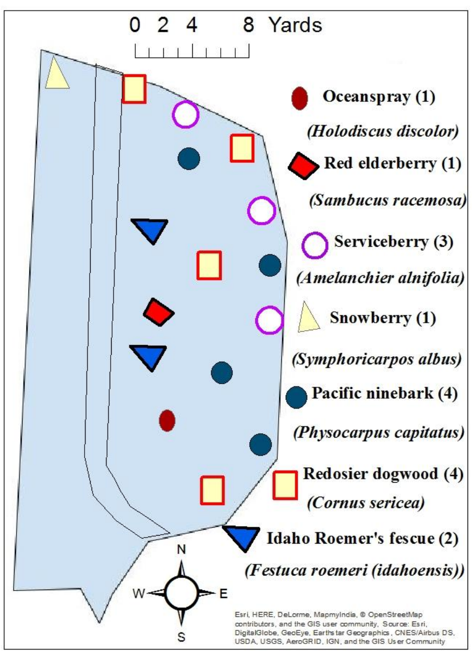


Figure 11: Polygon 2-A

2-B

This sub polygon is a larger size than A or C, it also has more exposure to sun and some height restrictions which require a distance of 20ft from the power-lines above (PUD restrictions)(Figure 3).
The edges shared with polygon 1-A will similarly be planted with redosier dogwood and Pacific ninebark via live stake at a distance of no less than 4m. **AD 8: Fascines noted in 1-A are planted in that polygon and others, including this one. We did not have enough live stakes to cover both as described**.These will be opportunistic and focused on wetter soils and depression storage. Towards the same edges there will be plantings of serviceberry and snowberry to provide food for native animal species.
On the "tops" of the mounds plantings of oceanspray, red elderberry, and red flowering currant (*Ribes sanguineum*) will be irregularly spaced at a minimum of 4m. **AD 9: Oceanspray is planted via bareroot and also has mulch rings placed around them**. Between these plantings Idaho Roemer's fescue at a distance of minimum 2.5m.

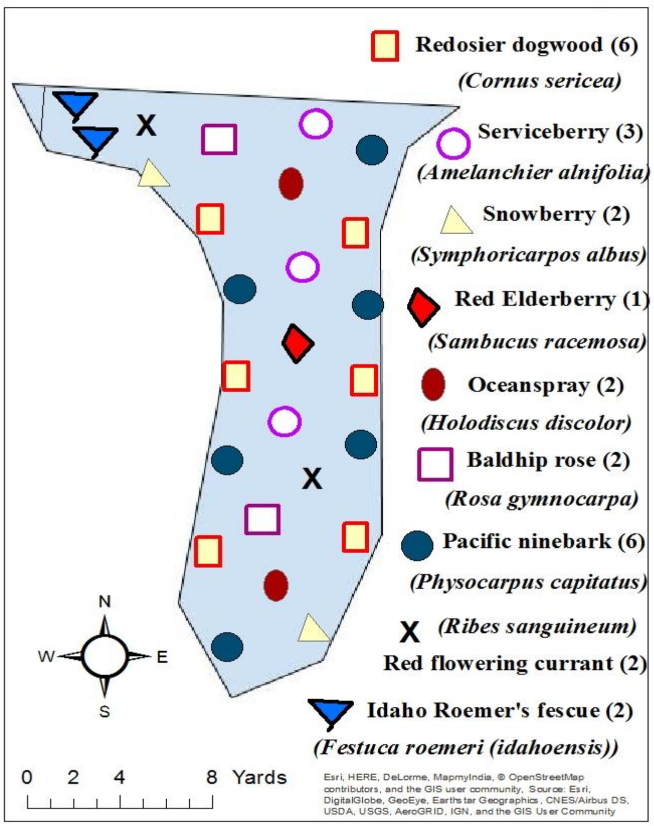


Figure 12: Polygon 2-B

2-C

This sub polygon is smaller than sub polygon B. It is also adjacent to a walkway which restricts the size of the plants here.

The edges shared with 1-A will be similarly planted with redosier dogwood and Pacific ninebark via live stakes. **AD 10: ascines noted in 1-A are planted in that polygon and others, including this one. We did not have enough live stakes to cover both as described.** A single snowberry plant will also be placed on north end of the sub polygon.

On the top a single oceanspray bush to end opposite the walkway, given its eventual size. Idaho Roemer's fescue and will be planted at 3m intervals. **AD 11: Oceanspray is planted via bareroot and also has mulch rings placed around them**

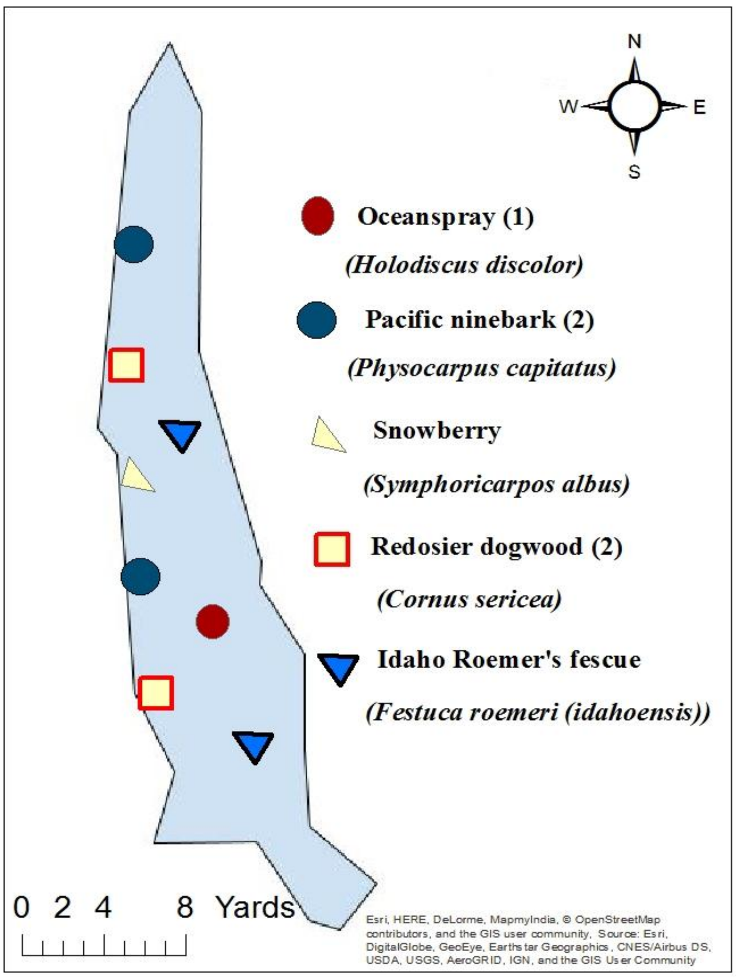


Figure 13: Polygon 2-C.

Polygon 3

This polygon is typified by its east facing slopes and high sun exposure. The soil on this polygon drain relatively quickly.

The planting goals in this polygon are focused on the suppression of the invasive plants removed from the site, through the creation of shade and groundcover.

3-A

This sub polygon is one of the largest and most open on the site. It has a slower grade than B and drains slightly slower. It's eastern edge is adjacent to the Parr Creek restoration project.

Larger shrubs will be planted as wider interval, given the space. Red elderberry, red flowering currant, and oceanspray on a rough grid at 8m intervals. Between them baldhip rose, Nootka rose, and serviceberry at smaller intervals of 6m in order to continue to provide shelter food to native animals on the site. **AD 12: Oceanspray is planted via bareroot and also has mulch rings placed around them**

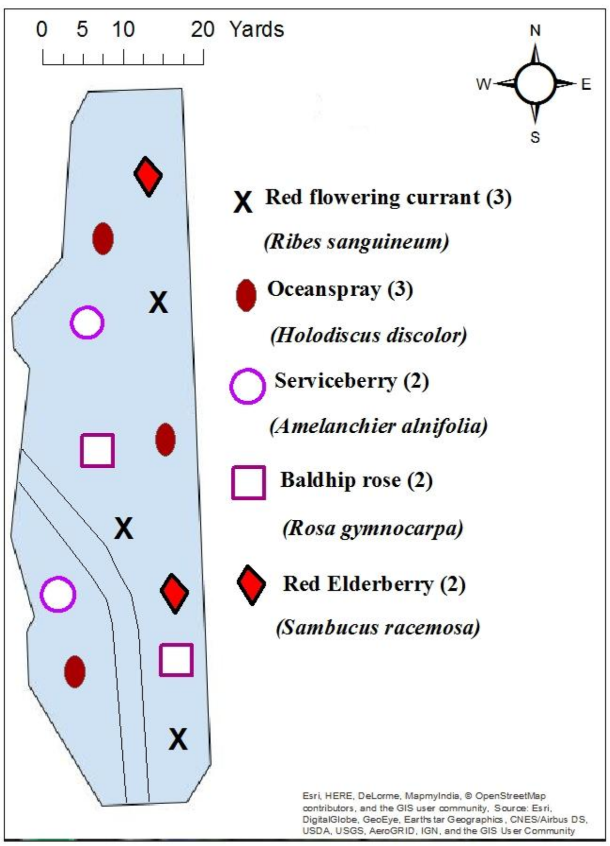


Figure 14: Polygon 3-A

3-B

This sub polygon is smaller than A, more narrow, and has a steeper slope. It is adjacent to a bioswale, polygon 1-A. It drains quickly due to the soil and the slope. Planting goals in this polygon focus on the suppression of invasive species previously removed and providing food and shelter to native animals on the site.

Oceanspray and red flowering currant will be planted near the top of the slope at wide intervals of 6m. Pacific water parsley, sword fern, Nootka rose, and serviceberry, will be planted lower on the slope at intervals of 4.5m. **AD 13: Oceanspray is planted via bareroot and also has mulch rings placed around them**

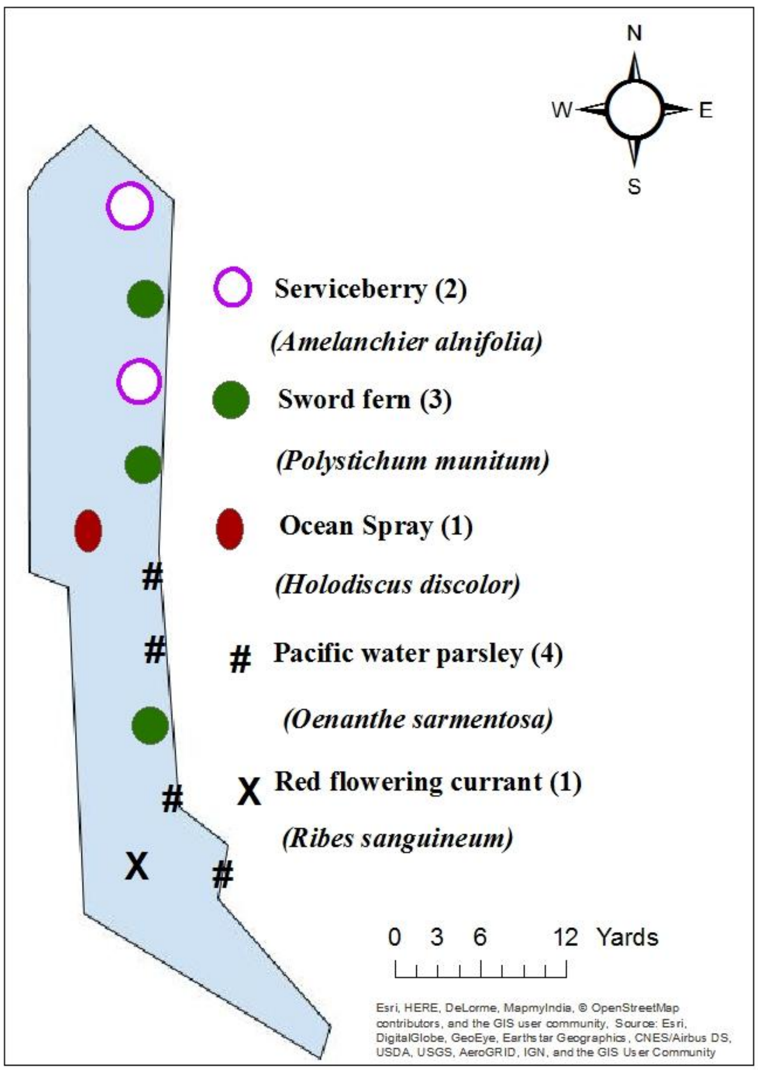


Figure 15: Polygon 3-B.

Polygon 4

This polygon is the southernmost edge with a variable slope facing north and east. It is unique in the two tall shore pines at its south edge, which provide some shade and deposit needles to the soil. The goals in this polygon focus on suppressing the creeping buttercup.

The suppression of the creeping buttercup involves a variety of methods in an experimental grid. To start, the area will have the creeping buttercup mechanically removed and the same mix of native plants will be installed. That mix being 1 evergreen huckleberry (*Vaccinium ovatum*), 2 fringe cup *(Tellima grandiflora)*, and 1 sword fern. The orientation of the plantings would be kept as roughly similar as possible.

Then the area is broken into quadrants:

In plot A, there would be wood chip mulch applied to the area and the native plants mix installed.

In plot B, there would be burlap applied with the native plant mix installed through cuts in the surface.

In plot C, both burlap and wood chip mulch would be applied, with the native plant mix being installed through cuts in the burlap as in B.

In plot D, no burlap or mulch will be applied. The native plant mix will be installed directly after the buttercup is cleared.

Outside of the experimental plots, Idaho Roemer's fescue and red flowering currant will be planted on the southern slope at a spacing to 8m.

Low Oregon grape, baldhip rose, Nootka rose, and snowberry will be planted between these two at a spacing of 4m, to continue providing food and shelter to native animal species on the site.

AD 14: This was not done because part of the area we had set up to use for the experiment was covered with buried pavers. Per the CPs directions we could not disturb that path or plant anything on it. We looked for a new place but could not accommodate the dimensions. Upon further consideration we thought that the additional monitoring did not satisfy the CP's desire for less maintenance. So we mulched the site, as we had planned, eschewing the burlap on the advice of Prof. Gold. The plants were then planted in polygon 4 in a different pattern, based on the site.

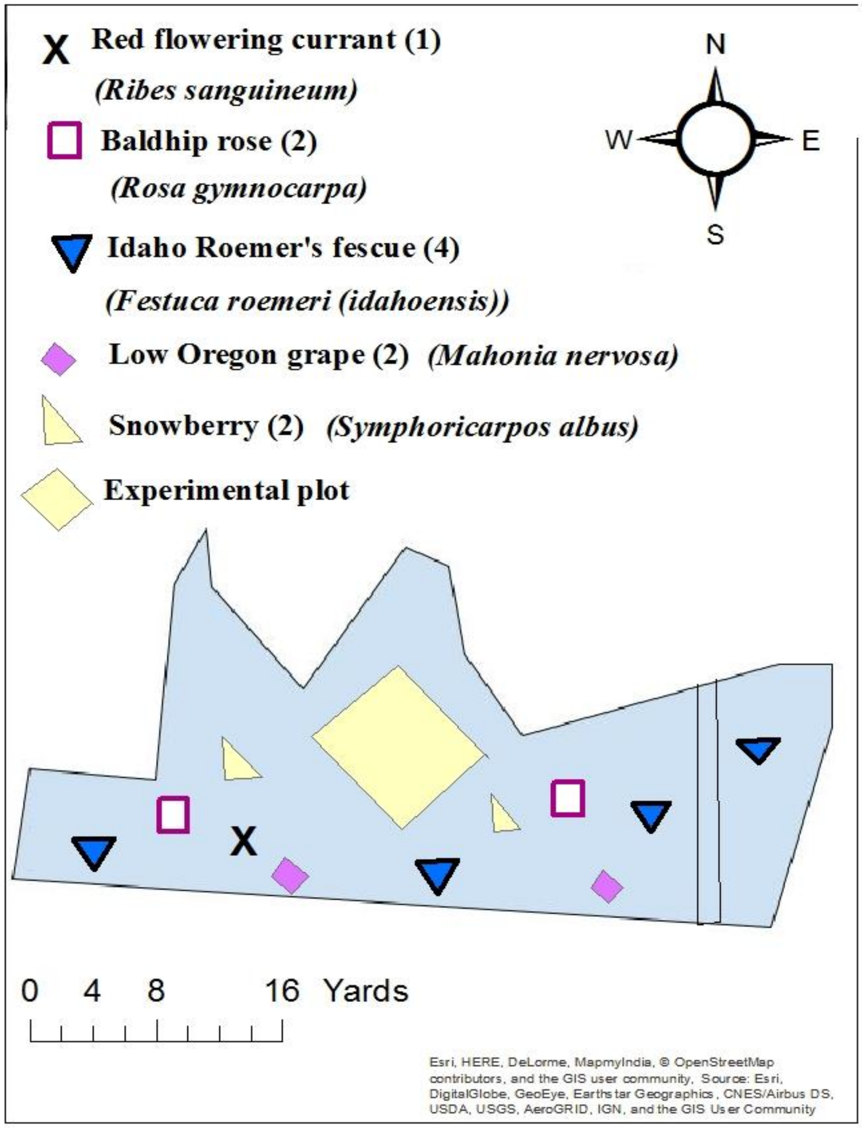


Figure 16: Polygon 4.

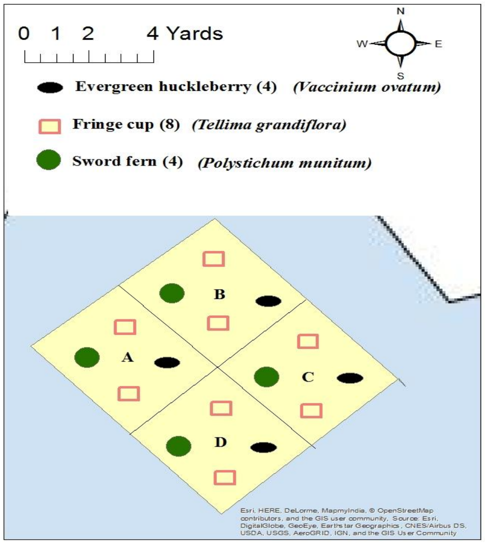


Figure 17. Experimental Plot planting layout.

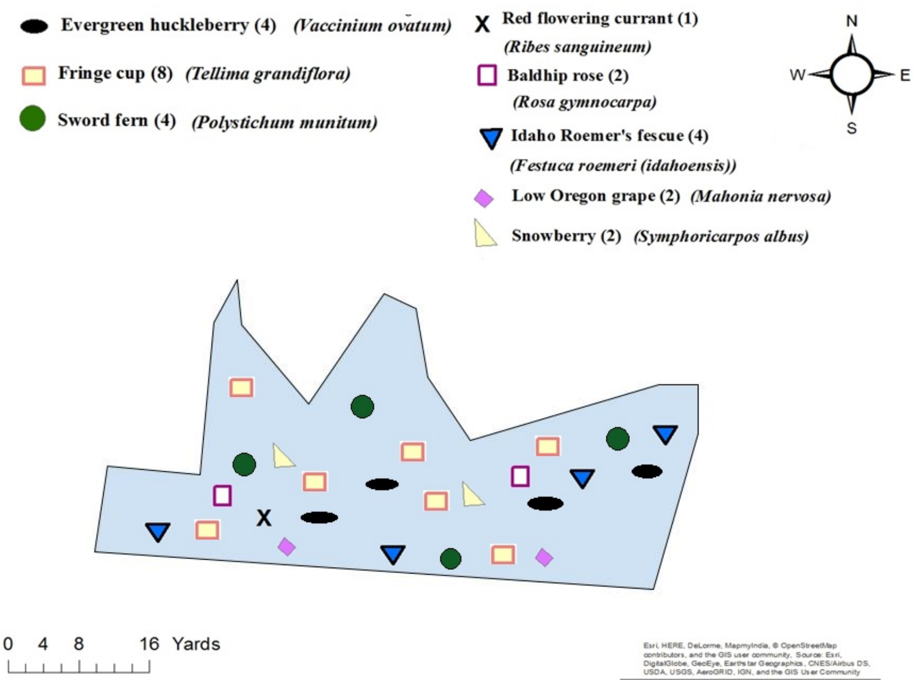


Fig. 18. updated polygon 4 planting map

Polygon 5

This polygon is a long and irregular strip on the edge of the retention pond. Its soil is saturated with little variability in moisture.

This polygon contacts all polygons 1 and 2-C at its northern edge, 3-B at its northwestern edge, and 4 at it's south to southwestern edge.

Natives in this polygon consist of common cattails *(Typha latifolia)* and some invasive reed canary grass. Planting goals in this polygon focus on the water from other polygons entering the suspension pond and the creation of a native pond edge community.

The shape of the polygon makes regular intervals difficult. However, at a minimum space of 2.5m we will plant sawbeak sedge, hardhack, small-fruited bulrush, and slough sedge.

At wider intervals of 4m we will plant Pacific water parsley. And at similar intervals yellow marsh marigold *(Caltha palustris)*.

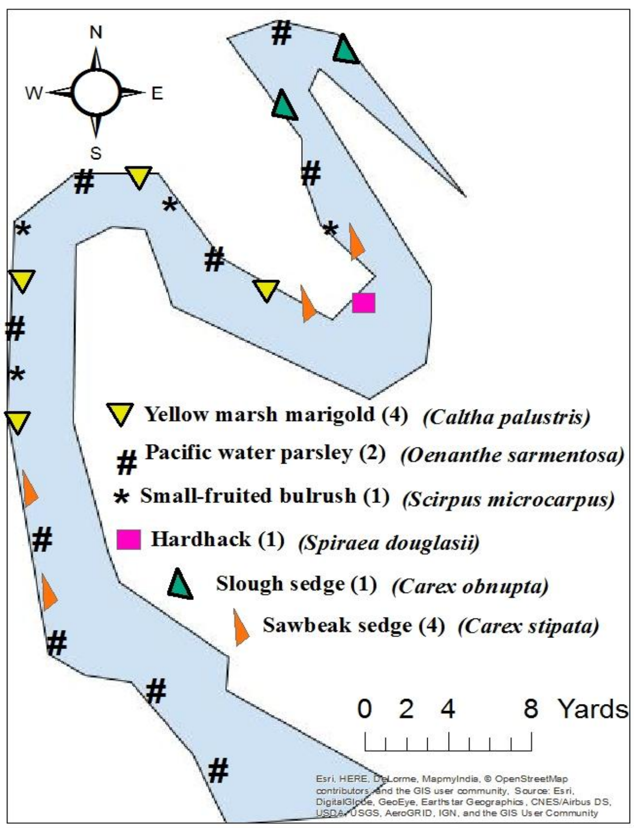


Figure 19: Polygon 5.

As-Built Map

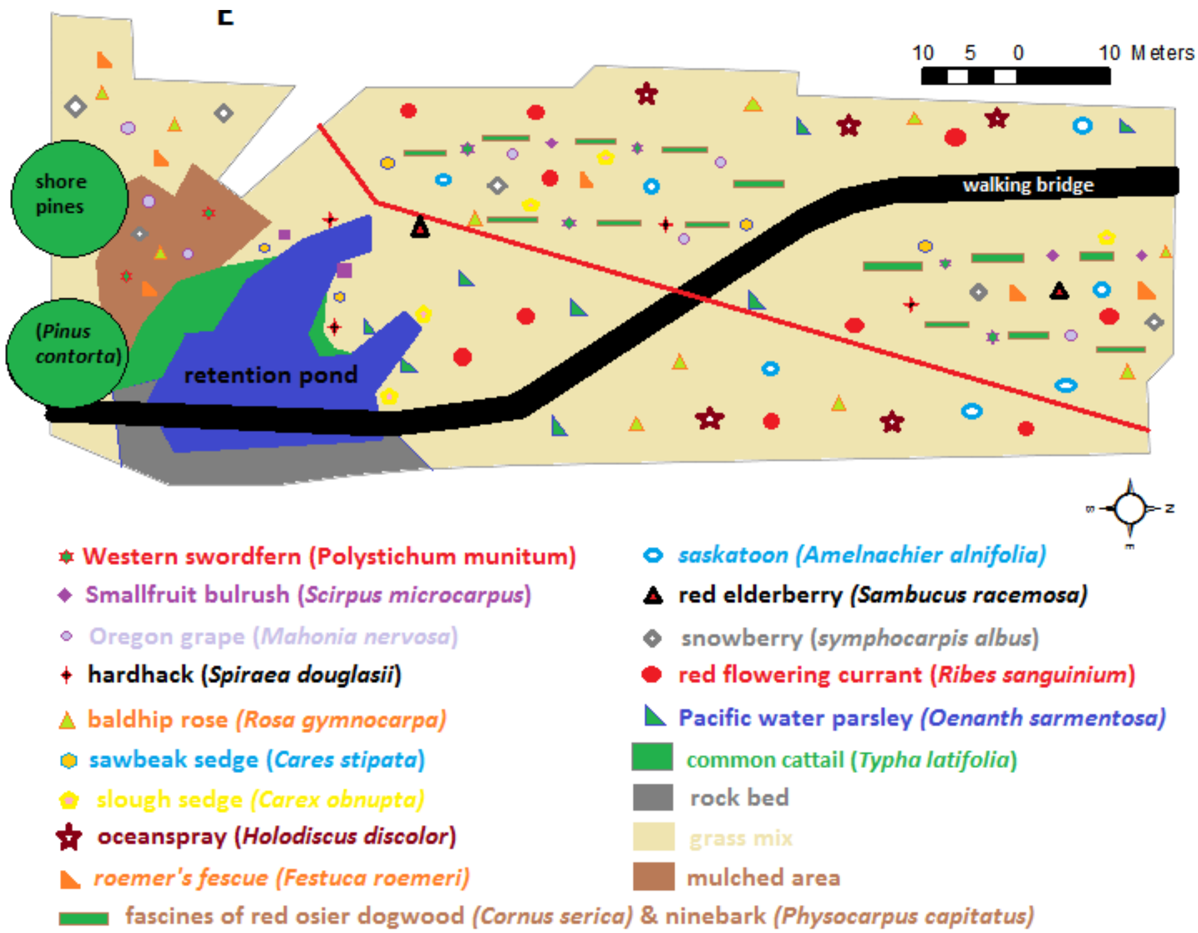


Fig. 20: As-Built Map of the Brightwater IPS Restoration Site

3. Budget Plan:

Table 2: Budget

Budget (Cash)					
	Project Budget				
	UW (cash)	Client (cash)	In kind non-labor	In kind labor	Team Labor
Prepare Site					
Picking up trash	0	0		90	75
Remove Fennel & Blackberry	0	0		0	500
Remove Scotchbroom	0	0		0	500
~~Remove Black Cottonwood~~	~~0~~	~~0~~		~~0~~	~~100~~
Remove other invasives	0	0		72	500
Subtotal	**0**	**0**	**0**	**162**	**1675**
Plant Site					
Plant polygon 1					
Purchase polygon 1 plants (Include tax and delivery)	100.8			0	12.5
Pick up polygon 1 plants (From nursery or salvage)				0	25
Install plants on polygon 1				360	250
Plant polygon 2					
Purchase polygon 2 plants (Include tax and delivery)	68.96			0	12.5
Pick up polygon 2 plants (From nursery or salvage)				0	25
Install plants on polygon 2				360	250
Plant polygon 3					
Purchase polygon 3 plants (Include tax and delivery)	77.25			0	12.5
Pick up polygon 3 plants (From nursery or salvage)				0	25
Install plants on polygon 3				360	250

Plant polygon 4					
Purchase polygon 4 plants (Include tax and delivery)	8.5			0	12.5
Pick up polygon 4 plants (From nursery or salvage)				0	25
Install plants on polygon 4				360	250
Plant polygon 5					
Purchase polygon 5 plants (Include tax and delivery)	44.63			0	12.5
Pick up polygon 5 plants (From nursery or salvage)				0	25
Install plants on polygon 5				360	250
Tax (9.5%)	28.51				
Service Charge (15%)	45.02				
Subtotal	**373.6743**	**0**	**0**	**1800**	**1437.5**
Apply mulch					
Find and acquire mulch (provided by CP)	0	0	0	0	75
Mulch Delivery	0	0	0	0	50
Spread mulch on polygon 1	0	0	0	0	0
Spread mulch on polygon 2	0	0	0	0	0
Spread mulch on polygon 3	0	0	0	0	0
Spread mulch on polygon 4	0	0	0	36	100
Subtotal	**0**	**0**	**0**	**36**	**225**
Care for site post-Installation					
Irrigate	0	0	0	0	100
Pull weeds	0	0	0	0	300
Replace plants as needed	50	0	0	0	300
Place stakes for monitoring	**67.97**				**100**
Subtotal	~~50~~ **117.97**	**0**	**0**	**0**	~~**700**~~ **800**
Plan and manage work parties					
Collect and return tools for 2/14/2017 team work party				0	75
Create and distribute promotional material for early March work party	20			0	100

Solicit and obtain refreshment for early March work party				0	50
Collect and return tools for 2/21/17 & early March work party				0	100
4/1 Work Party Planting				**18**	**12**
4/1 Work Party: Mulch				**9**	**6**
4/1 Work Party: Watering				**4.5**	**3**
Subsequent Small/Individual Work Visits					**12**
Subtotal	**20**	**0**	**0**	**0**	**~~325~~ 358**
Prepare and deliver reports and presentations					
Contact CP for Approval				0	25
Develop and deliver presentation to city council				0	375
Produce as built report				0	2000
Weekly Meetings				0	3750
Design, prepare, print final report	20			0	150
Subtotal	**20**	**0**	**0**	**0**	**6300**
Total	**~~463.67~~ 513.67**	**0**	**0**	**1998**	**~~10,662.50~~ 10,800.50**

(See appendix 3 for Plant Order Form showing specific plant costs)

V. Work timeline

Table 3: Planned implementation schedule

Winter Quarter	**February**				**March**			
Tasks & Relative Objectives	1-9	10-16	17-23	24-29	1-9	10-16	17-23	24-31
Complete removal of invasive species (1-1a,b,c,d)	■	■	■					
Complete Final Work Plan	■							
Complete Final Plant Acquisition Request	■							
CP Final Work Plan approval			■					
Confirm project budget and costs	■	■						
Acquire plants, seeds, stakes	■	■	■	■	■	■	■	
Apply mulch where needed on site			■	■	■	■	■	■
Install wetland and bioswale community plants (2-2a)				■	■	■	■	■
Install weed-suppression plants (1-2b)				■	■	■	■	■
Install shrubs to establish new canopy cover & shade (1-2a,c)				■	■	■	■	■
Install native plants for wildlife habitat (3-1)				■	■	■	■	■
Collaborative work party with Intro to Restoration class (5-1a)								
Create optional on-site educational material								
Create and complete As-Built Report								
Form Development of Stewardship Plan (5-2b)								
Conduct field work	■	■	■	■	■	■	■	■
Form and complete final poster presentation (5-2a)								

Spring Quarter	**April**				**May**					**June**
Tasks & Relative Objectives	1-6	7-13	14-20	21-30	1-4	5-11	12-18	19-25	26-31	1-8
Complete removal of invasive species (1-1a,b,c,d)										
Complete Final Work Plan										
Complete Final Plant Acquisition Request										
CP Final Work Plan approval										
Confirm project budget and costs										
Acquire plants, seeds, stakes										
Apply mulch where needed on site										
Install wetland and bioswale community plants (2-2a)	■	■	■	■	■					
Install weed-suppression plants (1-2b)	■	■	■	■	■					
Install shrubs to establish new canopy cover & shade (1-2a,c)	■	■	■	■	■					
Install native plants for wildlife habitat (3-1)	■	■	■	■	■					
Collaborative work party with Intro to Restoration class (5-1a)		■	■							
Create optional on-site educational material						■	■	■	■	
Create and complete As-Built Report							■	■	■	■
Form Development of Stewardship Plan (5-2b)			■	■	■	■	■			
Conduct field work	■	■	■	■	■	■	■			
Form and complete final poster presentation (5-2a)							■	■	■	■

Table 4: Actual implementation schedule:

Winter quarter 2016	February				March			
Tasks	1-9	10-16	17-23	24-29	1-9	10-16	17-23	24-31
Complete removal of invasives								
Complete final work plan								
Complete final plant acquisition request								
CP final work plan approval								
confirm project budget and costs								
Acquire plants, seeds, stakes								
Apply mulch where needed on site								
install wetland and bioswale community plants								
install weed-suppression plants								
Install native plants for wildlife habitat								
collaborative work party w/intro to rest. class (N/A)								
create optional on-site educational material								
form development of stewardship plan								
create and complete AS-BUILT report								
conduct field work								
Complete final poster presentation								

Spring quarter 2017	April				May					June
Tasks	1-6	7-13	14-20	21-30	1-4	5-11	12-18	19-25	26-31	1-8
Complete removal of invasives	■	■	■	■	■	■	■	■		
Complete final work plan						■	■	■	■	
Complete final plant acquisition request										
CP final work plan approval										
confirm project budget and costs										
Acquire plants, seeds, stakes	■	■	■	■	■					
Apply mulch where needed on site	■	■	■	■	■	■	■	■		
install wetland and bioswale community plants	■									
install weed-suppression plants	■									
Install native plants for wildlife habitat	■									
collaborative work party w/intro to rest. class (N/A)										
create optional on-site educational material				■	■	■				
form development of stewardship plan			■	■	■					
create and complete AS-BUILT report							■	■	■	
conduct field work	■	■	■	■	■	■	■	■	■	
Complete final poster presentation							■	■		

Additional information pertaining to the Gantt chart above:

Our team has already completed most of the invasive removal approved by an early work request. For the collaborative work party addressed in the table, our restoration team is collaborating with the students in the "Intro to Restoration Ecology" class run by Professor Amy Lambert for a workparty in the second or third week of April (date still tentative).**AD 15: Due to conflicting schedule this never took place instead we had additional teamwork parties. As seen on the before and after timeline charts above, a few events varied from what was**

originally projected. The mulch application and invasive removal took much longer than originally expected, and the planting of all plants took a shorter amount of time. There was also a slight delay in completing the plant ordering and getting the CP's approval on the final work plan. This will be a significant help to our plant installation and help us have a smooth transition into Spring quarter when our field work will be wrapping up, shifting the focus to producing our final poster and as - built report.

VI. Design for the Future:

Based on our site assessment and our Community Partner feedback, our vision for the future of this site is to restore the ecosystem services through a mature wetland and upland area. This will assist with the filtration of stormwater runoff, the establishment of an urban wildlife habitat, and a recreational and educational space with aesthetics appealing to the community. After the initial implementation of our restoration plan, there will be maintenance necessary to increase the probability of success to bring back ecosystem processes to the site and to enhance the likelihood that native plants will dominate and invasive will be maintained at a negligible level.

Our vision includes the ecological attributes of a restored ecosystem, such as having a functional species composition. Community structure will be developed with the establishment of sufficient species' populations within the site, to facilitate the structural development in the biotic community, such as canopy structure. Lastly, the abiotic environment will have the physical capacity to sustain the biota of the restored ecosystem. Subsequently, we aspire to obtain indirect ecological attributes such as the ecological functionality as natural processes in the site should begin to occur normally at each ecological state through time. We hope that ecological complexity will develop in the site providing various structures to facilitate habitat diversity. Then, self-organization should occur developing feedback loops that would increase the capacity of the site to conserve and increase natural resources. Finally, the site should have resilience and self-sustainability because the site will be able to recover from most severe disturbances and maintain ecosystem integrity and will have the potential to persist indefinitely via self-response to internal flux and external environmental changes. (Clewell and Aronson 2009)

Based on our vision, by the 50-year, mark the trees will be mature enough to provide shade for the bioswales and slopes. This shade will help develop the native wetland plants in the bottom of the bioswales which are more shade tolerant and further suppress invasive species, which are less shade tolerant. In turn, this will create a slower flow from the bioswales into the retention pond, with increased residency focused on the areas of depression storage already present in the bioswales. Native animals already observed on site* will more established, and a part of the functioning ecosystem now developed. Some examples of these species would be: mallard duck, wood duck, blue heron, Oregon spotted frog, Pacific tree frogs, or Northwestern salamanders; this species may vary to some degree depending on the developing of the community structures that we are putting in place.

Between 100-200 years, we will see the wetland canopy developed and mature, this canopy will be shrub-dominated with various native shrubs species such as oceanspray, snowberry, red flowering currant, redosier dogwood, and hardhack, among other species. In addition, there will be some mature Sitka willow, this natural cover will aid the bioswales keep the water cooler during the warmers month of the year . The bioswales funnel water from the pumping station site surface and rainwater into the retention pond, but the speed is slower than it is currently. This is largely due to the depressions that have naturally formed and the plants that are established there which will also improve conditions for the various species of wildlife that call the pond and the pond edges home. Significant litter from the native shrubs and trees contribute to the organic layer of the upland sections, which helps to retain moisture in the mounds and supports the native communities well established there. The invasive species that had been present are effectively suppressed after decades of being managed, shaded, and out competed by the natives plant community structures that we created.

To safeguard the long-term success of this restoration project and to fully realize our vision we will plan for the stewardship of the site moving forward once the proposed restoration is completed (Obj. 4-1). We will attempt to get the local community involved. Due to their proximity to the site, we hope a few local businesses will join efforts with the Brightwater restoration team as well. We will enhance this effort by attempting to engage the two schools adjacent to the site. This includes the Preschool Child Care at the Northshore YMCA Early Learning Center and the Woodinville Montessori School which will offer a unique opportunity to educate children on the importance of restoration and conservation of natural areas. **AD 16: we additionally included in our stewardship plan Woodinville high school and the University of Washington Bothell campus among others as we believe they can potentially become stewards of our site as they would have an opportunity to use the site as a learning lab while earning credits towards classes and volunteering hours.**

To accomplish this, we will create a space that will work as an observation laboratory. The idea is that both schools can walk their students/children over to the site and allow them to observe and interact as much as possible with the site; by observing the native plants, animal species, and how they all interact with each other will provide an opportunity for the space that we are restoring to serve as a nature's classroom to educate children in our community as well as parents and teachers about the importance of such sites. We believe that community education and engagement is fundamental for the success of restoration sites.

VII. Literature cited:

Agri Info: Factors Effecting the Absorption of Water [Internet]. c2015 [Cited 2017 Jan. 23]. Available from: http://www.agriinfo.in/default.aspx?page=topic&superid=7&topicid=11

Apfelbaum, S.I. 1993. An update on the ecology and management of reed canarygrass. Applied Ecological Services, Brodhead, WI
Clewell, A. F J. Aronson 2009 2nd Edition. Chapter 5: Ecological Attributes of Restored Ecosystems. *Ecological principles, Values and Structure* (89-112). Island Press, Washington DC

Darris, Dale C., and Scott M. Lambert. "Field Guide to the Sedges of the Pacific Northwest." *Native Plants Journal* 9.3 (2008): 366-67. *Soil Conservation Service*. United States Department of Agriculture. Web. 26 Jan. 2017. <https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/orpmcrb560.pdf>.

D. Schmitt & J. Shadel, personal communication, January 9, 2017.
D. Schmitt & J. Shadel, personal communication, November 16, 2016.
D. Schmitt & J. Shadel, email communication, January 11, 2017.

Home Advisor, 2017 Guide to Mulch Pricing [Internet]. C2017 [cited 2017, Feb 10]. Available from: http://www.homeadvisor.com/cost/landscape/mulch-delivery-install/#bulk

Earle, Christopher J. "Pinus Contorta (lodgepole Pine) Description - The Gymnosperm Database." *Pinus Contorta (Lodgepole Pine) Description - The Gymnosperm Database*. N.p., 12 Dec. 2014. Web. 26 Jan. 2017. <http://www.conifers.org/pi/Pinus_contorta.php>.

Kern E. 2017. Bioengineering. Presented in class Jan. 20, 2017. University of Washington Restoration Ecology Capstone. Seattle, WA.

King County, Dept. of Natural Resources and Park Water and Land Resources Division. 2014. Guide to Noxious and Invasive Weeds. King County, Seattle WA.

a. Pg. 28
b. Pg. 42
c. Pg. 28
d. Pg. 3

Kruckeberg, AR. Gardening with native plants of the Pacific Northwest. Seattle: University of Washington Press; 1982.

Kunze L.M. Preliminary Classification of Native, low Elevation, Freshwater Wetland Vegetation in Western Washington. Olympia (WA). Washington Department of Natural Resources. Available from: http://file.dnr.wa.gov/publications/amp_nh_wetland_class.pdf

Leigh M. 1999. Grow Your Own Native Landscape: A Guide to Identifying, Propagating & Landscaping with Western Washington Native Plants. Washington State University Press, Pullman WA.

a. Pg. 4
b. Pg. 5-6

NOAA: Stream & Rivers Restoration [Internet]. c2016 [cited 2017 Jan. 26]. Available from: http://www.habitat.noaa.gov/restoration/techniques/srrestoration.html

North Carolina Stream Restoration Institute: Stream Restoration, A Natural Channel Design Handbook. NC State University Press, NC.

Northwest Weed Control Board, Controlling Noxious Weeds [Internet]. c2012-2016 [cited 2017, Jan. 25]. Available from: http://www.nwcb.wa.gov/control-and-disposal

Pierce County Weed Guide [Internet]. c2014-2017, [cited 2017, Jan. 25]. Available from: http://www.piercecountyweedboard.org/

Pojar & Mackinnon 1994. Plants of the Pacific Northwest Coast. Lone Pine Publishing, Vancouver BC.

a. Pg. 19
b. Pg. 185

PSLL: Common Native Plants of Lowland Puget Sound [Internet]. c2016 [Cited 2017 Jan. 25]. Available from: http://depts.washington.edu/propplnt/plantindex.htm

Public Utility District. 2015. Section 3: Overhead Service Requirements, 2015 Update. Snohomish County, WA. PUD.

Rutherford JC., Marsh NA., Davies, PM., and Bunn SE. 2004. Effects of patchy shade on stream water temperature: how quickly do small streams heat and cool? Marine and Freshwater Research, 2004, 55, 737-748.

Sound Native Plants: Species Selection Guide [Internet]. [Cited 2017 Jan. 24]. Available from: http://www.soundnativeplants.com

Washington State University, Northwest Plants Database System [Internet]. c2014-2016 [cited 2017 Jan. 24]. Available from: http://pnwplants.wsu.edu/

Water on the Web, Stream Flow [Internet]. C2008 [cited. 2017, Feb. 6] Available from: http://www.waterontheweb.org/under/waterquality/flow.html

Lessons Learned

A: Financial Budget

We had planned for the lion's share of our budget to be used on plants, since we thought we might run short. We had only a small amount left over for the volunteer events, which we mostly funded out of pocket, and for the monitoring supplied which we hadn't accounted for.

B: Labor Budget

Our labor budget accounted for us doing most of the work ourselves in several smaller work parties. This was mostly accurate, with the only real deviation being a series of "one off" sessions where one or two of us would return to the site to do some weeding or spread additional mulch.

C: Planting Plan

Our planting plan was designed to create a large amount of low shade over the site in order to suppress the weeds that had established there. We ended up being much more sparsely planted than we anticipated. In addition to our limited budget we did not get the donated plants we had planned on, and were not able to harvest the live stakes we had hoped for. The state of the plants also caused some concern, either in their size or in health.

Appendices

Appendix 1: Planned Species by type

Grasses, sedges, and rushes

		1		2			3		4	5
Common Name	Species	A	B	A	B	C	A	B		
Idaho Romer fescue	*Festuca roemeri (idahoensis)*			2, 3.5" pots	2, 3.5" pots	2, 3.5" pots			4, 3.5" pots	
Small- fruited bulrush	*Scirpus microcarpus*		3, 1 gal.							1, 1 gal
Hardhack	*Spirea douglasii*		1, 1 gal.							1, 1 gal.
Slough sedge	*Carex obnupta*		1, 2 gal.							1, 1 gal.
Sawbeak sedge	*Carex stipata*		2, 4" pot							4, 4" pots

Shrubs

		1		2			3		4	5
Common Name	Species	A	B	A	B	C	A	B		
Redosier dogwood	*Cornus sericea*	8 Fascine waddles		4 Live stakes	6 Live stakes	2 Live stakes				
Pacific ninebark	*Physocarpus capitatus*	8 Fascine waddles		4Live stakes	6 Live stakes	2 Live stakes				
Low Oregon grape	*Mahonia aquifolium*								~~2~~ **6**, 1 gal	
Tall Oregon Grape	*Mahonia nervosa*	4, 1 gal.								

Serviceberry	*Amelanchier alnifolia*			3, 1 gal.	3, 1 gal.		2, 1 gal.	2, 1 gal.		
Red elderberry	*Sambucus racemosa*			1, 1 gal.	1, 1 gal.		2, 1 gal.			
Ocean spray	*Holodiscus discolor*			~~1~~ **2**, bare root	2, bare root	~~1~~ **2**, bare root	3, bare root	1, bare root		
Baldhip rose	*Rosa gymnocarpa*	2, 1 gal.			2, 1 gal.		2, 1 gal.		2, 1 gal.	
Nootka rose	*Rosa nutkana*	~~3~~ 2, bare root					~~5~~ 4, bare root	2, bare root	2, bare root	
Red flowering currant	*Ribes sanguineum*				~~2~~ **1**,1 gal.		3, 1 gal.	1, 1 gal.	1, 1 gal.	
Snowberry	*Symphoricarpos alba*			1, 1 gal.	2, 1 gal.	1, 1 gal.			2, 1 gal.	
Evergreen huckleberry	*Vaccinium ovatum*								4, 1 gal.	

Forbs

		1		2			3		4	5
Common Name	Species	A	B	A	B	C	A	B		
Yellow marsh marigold	*Caltha palustris*									4, 3.5” pots
Pacific water parsley	*Oenanthe sarmentosa*							4, 1 gal.		2, 1 gal.
Sword fern	*Polystichum munitum*		~~4,~~ **3** 4” pots					3, 4” pots	4, 4” pots	
Fringe cup	*Tellima grandiflora*								8, 4” pots	
Redwood Sorrel	***Oxalis oregana***			**1, 4” pots**	**1, 4” pots**	**1, 4” pots**				**2, 4” pots**

Appendix 2: Beneficial Plants for Wildlife

Plant species	Benefits for Wildlife
Small-fruited bulrush *(Scirpus microcarpus)*	**Other:**Provides valuable food and nesting for wildlife. Birds of all types frequent and depend on it. Small animals such as turtles, muskrats, snakes, and amphibians seek refuge in the dense growth of this plant
Low Oregon grape *(berberis Nervosa)*	**Birds:** The berries are eaten by many birds including grouse, pheasants, robins, waxwings, juncos, sparrows, and towhees. **Insects**: Orchard mason bees and painted lady butterflies use the nectar. **Mammals:** Foxes, raccoons, and coyotes eat the berries. Deer and elk will occasionally browse the leaves and flowers.
Pacific ninebark *(Physocarpus capitatus)*	**Birds:** Fruits eaten by birds. **Mammals:** Twigs, buds and foliage are browsed by herbivores.
Hardhack *(Spirea douglasi)*	**Other:** Provides good cover for birds and small mammals. Grouse apparently eat the dried spikes and other wildlife consume the seed filled capsules. The flowers are a source of nectar for hummingbirds, butterflies, and other pollinator insects
Serviceberry, Saskatoon (*Amelanchier alnifolia*)	**Birds:** The serviceberries are eaten by woodpeckers, crows, chickadees, thrushes, towhees, bluebirds, waxwings, orioles, tanagers, grosbeaks, goldfinches, juncos, grouse, and pheasants. **Insects**: The nectar is used by spring azure butterflies. The foliage is eaten by swallowtail and other butterfly larvae. **Mammal**s: Mammals that eat the berries include

	chipmunks, marmots, skunks, foxes, ground squirrels, raccoons, and bear. Deer and elk browse the leaves and twigs.
Red elderberry (*Sambucus racemosa)*	**Birds**: Fruits eaten by many birds - sparrows, thrushes, warblers, bluebirds, jays, tanagers, grosbeaks, sapsuckers, woodpeckers, and band-tailed pigeons. **Insects**: Provides nectar to be eaten by bees and butterflies. Cavity-nesting bees use broken branches as nest sites. **Mammals**: Fruits eaten by small mammals. Foliage and twigs are consumed by browsers such as deer and elk.
Slough sedge *(Carex Obnupta)*	**Other:** Wildlife: The lens-shaped seeds of sedges are eaten by many kinds of wildlife. Birds known to eat sedge seeds include coots, ducks (such as wood ducks, canvasbacks, mallards, pintails, teal, shoveler), marsh birds and shorebirds (dowichers, rails, and sandpipers), upland game birds (grouse, pheasant, and wild turkey), and songbirds (house finch, junco, sparrow, and towhee). Waterfowl and ducks eat sedge seeds frequently in small to fair amounts. In addition to providing food for many wildlife species, sedges are also valuable for cover. Frequently they provide nesting cover for ducks, and their tufted growth furnishes concealment and bedding for other animals. Beavers, otters, muskrats and minks make their way through the sedges as they go to and from the water
Ocean spray *(Holodiscus discolor)*	**Birds**: During winter months, insect-eating birds such as chickadees and bushtits forage for insects in the shrub. The seeds persist through the winter. Dense branches provide songbirds with shelter and cover. **Insects**: Swallowtail, brown elfin, Lorquins admiral, and spring azure butterflies browse on the foliage. The nectar may be harvested by mature swallowtail butterflies. Many species of insects live in the dense structure of oceanspray. **Mammals:** Deer and elk browse the foliage
Nootka rose *(Rosa nutkana*)	**Birds:** Several bird species eat the hips including grouse, bluebirds, juncos, grosbeaks, quail, pheasants, and thrushes. The seeds are using by birds as a source of grit. Rose thickets are an important shelter and habitat for birds such as pheasants and grouses.

	Insects: The leaves are eaten by mourning cloak butterfly larvae. The leaves are used by the leaf-cutter bee. Young rose shoots are popular with aphids which in turn provide food for a wide range of predators including ladybugs and songbirds. **Mammals:** Mammals that eat the hips include chipmunks, rabbits, hares, porcupines, coyotes, deer, elk, and bear. The Rose thickets provide important shelter and habitat for many mammal species.
Pacific water parsley *(Oenanthe sarmentosa)*	**Other Wildlife:** Used as spawning vegetation by Red-legged frog and Northwestern salamander.
Redosier dogwood *(Cornus stolonifera)*	**Birds:** The berries are eaten by birds such as vireos, warblers, kingbirds, robins, flickers, flycatchers, wood ducks, grouse, band-tailed pigeons, and quail. Insects: The nectar is used by orange sulphur and other adult butterflies. The leaves are used by spring azure and other butterfly larvae. **Mammals:** The berries are eaten by mammals such as bears, foxes, skunks, and chipmunks. The wood is browsed by deer, elk, and rabbits. Beavers and muskrats use twigs to repair dams or build new dams
Baldhip rose (Rosa gymnocarpa)	**Birds:** Several bird species eat the hips including grouse, bluebirds, juncos, grosbeaks, quail, pheasants, and thrushes. The seeds are using by birds as a source of grit. Rose thickets are an important shelter and habitat for birds such as pheasants and grouses. Insects: The leaves are eaten by mourning cloak butterfly larvae. The leaves are used by the leaf-cutter bee. Young rose shoots are popular with aphids which in turn provide food for a wide range of predators including ladybugs and songbirds. **Mammals:** Mammals that eat the hips include chipmunks, rabbits, hares, porcupines, coyotes, deer, elk, and bear. The Rose thickets provide important shelter and habitat for many mammal species.
Red flowering currant *(Ribes Sanguineum)*	**Birds**: The berries are eaten by grouse, pheasants, robins, towhees, thrushes, waxwings, sparrows, jays, and woodpeckers. Several hummingbirds consume the nectar. Insects: The foliage is eaten by zephyr and other butterfly larvae.

	Mammals: The fruits is eaten by coyotes, foxes, mountain beavers, raccoons, skunks, squirrels, and chipmunks. The twigs and foliage are browsed by deer and elk
Snowberry *(Symphoricarpos Albus)*	**Birds**: The berries are eaten by grosbeaks, waxwings, robins, thrushes, towhees, grouse, pheasants, and quails when other food sources are scarce. Snowberry is often a nesting habitat for gadwall ducks. **Insects**: The leaves are eaten by the sphinx moth larvae. Bumblebees and hummingbirds feed on the nectar. **Mammals:** Leaves and twigs are browsed by deer. Snowberry provides low shelter and nesting cover for small animals.
Evergreen huckleberry *(Vaccinium Ovatum)*	**Birds:** Birds eat the berries. **Insects:** Bees and hummingbirds are attracted to the flowers.
Yellow marsh marigold *(Caltha Palustris)*	**Other:** pollinated by Bees, beetles, flies.It is noted for attracting wildlife
Sword fern *(Polystichum Munitum)*	**Other:**Ferns provide cover for wildlife, and serve as a host plant for some butterflies. Elk, deer, black bears and mountain beavers forage on the fronds.

Appendix 3: Plant Ordering Forms for Budget

JW Restoration
Ecology Network

Plant Purchase Form

UW-REN Capstone Course
Academic Year 2016-2017

SER-UW Nursery Conta	Mary-Maragret Greene mmgreene@uw.edu Derek Allen deallen4@uw.edu	Team Info (please fill out):	Team Name: Brightwater IPS Team Contact Name: Ashley Pierson piersonashley27@gmail.com Team Contact Phone #: 971-227-7231
Vendor (please fill out):	Woodbrook Native Plant N 253-857-6808 woodbrk@harbornet.com Vendor Phone	Gig Harbor, WA	SER-UW Nursery Center for Urban Horticulture Pick up Date: February 24, 2017 Unless notified otherwise

woodbrook nursery: http://woodbrooknativeplantnursery.com/plants/inventory/

Species Common Name	Species Latin Name	Form	Qty	Unit Price	Line Total
Idaho Roemer's Fescue	*Festuca roemeri (idahoensis*	3.5" pot from Woodbrook	10	3.98	39.80
Marsh violet	*Viola palustris*	3.5" pot from Woodbrook	4	4.48	17.92
Yellow Marsh Marigold	*Caltha palustris (i.e., caltha*	3.5" pot from Woodbrook (if available)	6	4.48	26.88
Large Leaf Avens	*Geum macrophylum*	3.5" pot from Woodbrook	2	4.48	8.96
				Subtotal	93.56
				Sales Tax (9.5%)	8.89
				Service Fee (15%)	14.03
				Total	**$ 116.48**

Plant Purchase Form

UW Restoration Ecology Network

UW-REN Capstone Course
Academic Year 2016-2017

SER-UW Nursery Contac Mary-Maragret Greene
mmgreene@uw.edu
Derek Allen
deallen4@uw.edu

Team Info (please fill out):

Team Name: Brightwater IPS
Team Contact Name: Ashley Pierson
piersonashley27@gmail.com
Team Contact Phone #: 971-227-7231

Vendor (please fill out): Watershed garden works Longview, WA
http://www.watershedgardenworks.com/nursery
scott@watershedgardenworks.com
360-423-6456

SER-UW Nursery
Center for Urban Horticulture
Pick up Date: February 24, 2017
Unless notified otherwise

woodbrook nursery: http://woodbrooknativeplantnursery.com/plants/inventory/

Species Common Nam	Species Latin Name	Form	Qty	Unit Price	Line Total
Oregon Grape	*Mahonia aquifolium*	1-gallon from Watershed	6	3.25	19.50
Pacific Bleeding Heart	*Dicentra formosa*	4" from Watershed	8	1.35	10.80
Serviceberry	*Amelanchier alnifolia*	1-gallon from Watershed	10	3.50	35.00
Red Elderberry	*Sambucus racemosa*	1-gallon from Watershed	4	3.25	13.00
Oceanspray	*Holodiscus discolor*	cone from Watershed	20	1.00	20.00
Nootka Rose	*Rosa nutkana*	10" cone from Watershed	12	1.00	12.00
Pacific Water-Parsley	*Oenanth sarmentosa*	1-gallon from Watershed	8	1.5	12.00
Red Wood Sorrel	*Oxalis oregana*	4" pots from Watershed	6	1.25	7.50
Red Flowering Currant	*Ribe sanguineum*	38 plug from Watershed	6	1.00	6.00
Small Fruited Bulrush	*Scirpus microcarpus*	1-gallon from Watershed	4	3.25	13.00
Hardhack	*Spiraea douglasii*	1-gallon from Watershed	2	3.25	6.50
Snowberry	*Symphoricarpos ablus*	1-gallon from Watershed	6	3.25	19.50
Slough Sedge	*Carex obnuta*	1-gallon from Watershed	2	3.25	6.50
Sword Fern	*Polystichum munitum*	4" pot from Watershed	10	1.25	12.50
Baldhip Rose	*Rosa Gymnocarpa*	1-gallon from Watershed	4	3.25	13.00
				Subtotal	206.80
				Sales Tax (9.5%)	19.65
				Service Fee (15%)	31.02
				Total	**$ 257.47**