North Creek Forest Restoration

University of Washington Restoration Ecology Network 2015-2016

Location: North Creek Forest - NE 204th Pl & 108th Ave NE, Bothell, WA 98011

Community Partner: Friends of North Creek Forest

Emily Sprong - Executive Director

Team Members:

Eric Carpenter- UW Bothell Environmental Science Major
Kai Farmer - UW Bothell Environmental Studies Major w/ Minor in Restoration Ecology
Thomas Radon - UW Seattle Environmental Science and Terrestrial Resource Management Major
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I. Project Summary

Site overview

This report describes our ecological restoration project implemented in 2015-2016, located in the City of Bothell. The site itself is approximately 1/6th of an acre in the 64 acre mixed evergreen/deciduous canopy of North Creek Forest. The project was completed by a team of 5 University of Washington Restoration Ecology Network (UW-REN) students with the support and assistance of our community partner Emily Sprong, the entire organization Friends of North Creek Forest (FNCF) and the UW-REN professors. By June 2016 this project will be the 5th completed restoration site in an ongoing effort to restore North Creek Forest since 2010.

Before **After**

Fig. 1. Before and after photos of the project site.

Brief Summary Narrative

1. Site Before Restoration and Problems

Much of the site was halted in its stage of succession due to the occurrence of invasive species. The site was overrun with the invasive species: *R. bifrons* (Himalayan blackberry)*, Ilex aquifolium* (English holly)*,* and *Hedera helix* (English ivy)*. H. helix* was observed choking out existing trees and *R. bifrons* was preventing the establishment of native tree seedlings. Without restoration action the likelihood of autogenic repair was very low. This site borders streams that feed North Creek. Our restoration aided to reduce erosion and benefit water quality downstream where salmon are spawning. The restoration of this site greatly increased the amount of habitat and food sources for local native wildlife and insects. Some edible plants and fungi were included in the site allowing foraging opportunities for the local human community. This site also has a trail running through it that will serve as a recreation area for local residents, and as an educational corridor for students. The long-term target is to develop a dense canopy

that will hinder the return of invasive plants, which will allow for long-term increases in ecosystem services for the area.

2. Approach Taken and Summary Goals

- **Goal 1** - Establish native vegetation to initiate site development towards later-successional maturity characteristic of Puget Sound lowland forests prior to extensive logging.
    - Rid the site of invasive species to make room for planting of native species, decreasing existing competition. However, the slope of the site makes the removal of invasive species challenging.
    - Worked with Friends of North Creek Forest (FNCF) to install a silt fence that runs along the eastern border of our site to try and prevent erosion from going into the creek that was caused by foot traffic and digging.
    - Remove lumber and any garbage present
    - Apply an 8-12” covering of wood chip mulch across the site
    - Install biologically and structurally-diverse native species suitable for the current successional stage of site

- **Goal 2** - Improve ecological functions onsite as well as those provided to nearby habitat and the local watershed.
    - Plant native species that would improve water absorption and filtration, aiding in the reduction of surface erosion and assisting the uptake of excess surface water
    - Selected plant species with extensive root systems that would be useful for soil stabilization
    - Increase fungal diversity by inoculating the main mulched trail with wine-cap stropharia

- **Goal 3** - Increase the wildlife value of the site.
    - Create structurally-diverse wildlife habitat to attract local fauna such as birds, bats, insects and amphibians.
    - Install a variety of native vegetation that could be used by wildlife for food, shelter and nesting, as well as integrate a variety of hand-built facilities that would provide additional shelter and nesting opportunities.

- **Goal 4** - Engage the community in restoration efforts and continued maintenance of project site.
    - Informing residents and students in the area of the benefits of restoration activities for their educational opportunities and fun activities.
    - Important that stewardship persists on our site to ensure its progression towards successional maturity.

3. Major Accomplishments

- ⅛ acre of invasive plants were removed
- ⅛ acre was covered with 8” thick layer of wood chip mulch
- Access trails were constructed
- 515 native plants were installed to the site (trees, shrubs, groundcovers)
- The main trail and a fallen alder log were both inoculated with native fungi species
- Numerous habitat features and structures were installed: inundated depression planted with slough sedge to create amphibian habitat, 5 mason bee habitat structures, 4 bumble bee habitat structures, 1 owl house, 1 chickadee house and 1 bat box
- Hundreds of members of the community were involved in the restoration of this site. This includes students from local schools and universities, church groups, neighbors and others.

4. Team Photo

Team members (left to right): Nick Vradenburg, Kai Farmer, Batzorig Tuvshinjargal, Eric Carpenter and Thomas Radon

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5. Acknowledgements

Special thanks to Friends of North Creek Forest, UW Restoration Ecology Network, Bartlett's Tree Experts, Boy Scouts of America (Bothell), Fourth Corner Nursery, Soundview, Fungi Perfecti, and Northwest Arboriculture

II. As-Built Report (Text, Map, Table, & Timeline Revisions / Lessons Learned)

Site Description

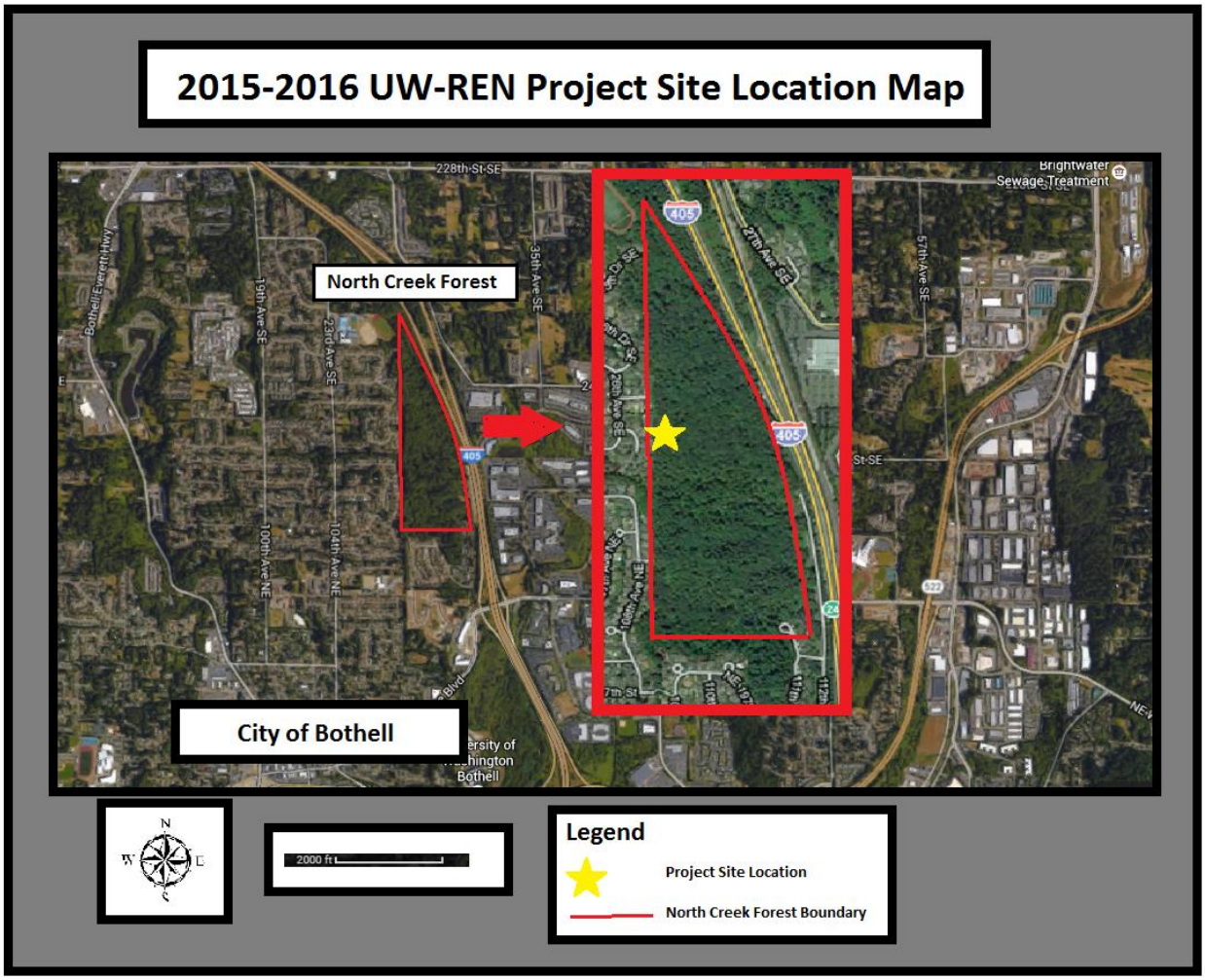
Our ecological restoration project site is located in the center of the City of Bothell (Map 1). It is part of the 64 acre mixed evergreen/deciduous canopy of North Creek Forest that is a prime example of upland forest in the Puget Sound lowlands. Much of our project site is a hillslope wetland within the surrounding upland forest. The eastern edge of the forest borders Interstate 405 and the western edge intersects with suburban housing development.

There are schools in the area, Canyon Park Junior High and Maywood Hills Elementary, both within walking distance of the forest. The project site is located on the western edge of the forest, adjacent to NE 204th Pl. and 108th Ave NE. A residential neighborhood is adjacent to the north and west, with the forest stretching further south where it borders more housing. The project site is a part of the North Creek watershed. Groundwater outflow from within the project site and surrounding forest drains into streams that feed North Creek. Starting from the Western border, our site slopes down, gradually leveling, until you reach the eastern edge, where it flattens out slightly. The site shares its southern border with the UW-REN 2014-2015 restoration site and is within walking distance of the Friends of North Creek Forest (FNCF) headquarters.

The site receives variable amounts of sunlight, but most areas receive partial sun to full sun with seasonal deciduous shade in the summer. Polygon 5 is the exception where some areas are characterized by deep evergreen shade. The site is home to a seep in the hillside, this in combination with few trees keeps the soils on site saturated for much of the year. The soil remains at least moist into August but polygon 5 may be the exception with spots nearly drying out during summer drought. Due to

the seepage a large portion of the site is a delineated wetland which currently contains the wetland obligate species *Lysichiton americanum* (skunk cabbage). Gleyed soil was observed throughout much of the site, further suggesting that most of the site can be considered a wetland. Soils are loamy with soil texture ranging from loam to silty clay loam.

Currently the most abundant vegetation on site is *Rubus bifrons* (Himalayan blackberry), and *Rubus spectabilis* (salmonberry). Existing trees are 20 -100 years in age, representative of second growth forest in the secondary stage of succession. Mature trees present within the site boundary are *Acer macrophyllum* (big-leaf maple), *Rhamnus purshiana* (cascara), *Pseudotsuga menziesii* (douglas-fir), *Thuja plicata* (Western red cedar), *and Alnus rubra* (red alder). The overall community type of the site is a mixture of THPL/RUSP (western red cedar/salmonberry) and ALRU/LYAM (red alder/skunk cabbage) (Kunze 1994). It should be noted that polygon 5 differs greatly from the rest of the site with a PSME-THPL/GASH-MANE/POMU (Douglas-fir-western red cedar/salal-low oregon grape/sword fern) community type.



Map 1. Aerial map of the City of Bothell and North Creek Forest, with inlayed map showing location of project site within North Creek Forest.

Restoration Needs and Opportunities

Much of the site is halted in its stage of succession due to the occurrence of invasive species. The site is overrun with the invasive species: *R. bifrons, Ilex aquifolium* (English holly), and *Hedera helix* (English ivy). *H. helix* has been observed choking out existing trees and *R. bifrons* is preventing the establishment of native tree seedlings. Without restoration action the likeliness of autogenic repair is very low. This site borders streams that feed North Creek. With restoration we can help reduce erosion and benefit water quality downstream where salmon are spawning. The restoration of this site will also greatly increase the amount of habitat and food sources for local native wildlife and insects. Some edible plants and fungi will be included in the site allowing foraging opportunities for the local human community. This site also has a trail running through it that can serve as a recreation area for local residents, and as an educational corridor for students. The long term target is to develop a dense canopy that will hinder the return of invasive plants. This will allow for long term increases in ecosystem services for the area.

Tasks and Approaches

Goal 1: Establish native vegetation to initiate site development towards later-successional maturity characteristic of Puget Sound lowland forests prior to extensive logging

Objective 1 *– Remove invasive species and control their ability to return and re-establish*

Task 1-1A *- Remove invasive species*

We will be taking advantage of the saturated soil across most of our site to thoroughly cut and pull the invasive plants, especially *R. bifrons* which can be hand pulled from the mud. For those anchored in drier, firmer soil we will be using loppers to cut off the canes at a height of 6-12 inches then, using shovels, we will remove the root balls by digging about 6 inches around the canes. *I. aquifolium* seedlings will be removed when possible, larger individuals will be removed by FNCF staff by cutting and herbicide treatment. *H. helix* will be cut off at 5 feet above ground level on existing snags and trees. The basal leaves and rhizomes in the soil below will be thoroughly hand pulled and disposed of offsite.

AD1: Larger specimens of *I. aquifolium* will have their stems injected with Imazapyr by members of FNCF past the project's duration.

Justification: *R. bifrons* is a particularly problematic invasive in our site. They're fast growing, difficult to remove, and re-establish readily so we must not only cut down the canes but also pull out or dig up as much of the root as possible (WeedWise 2013, Ewing 2015a). Pulling up *I. aquafolium* seedlings when the soil is wet is effective but, removing larger plants can disturb the soil so cutting and application of herbicide is the best method for eradication of large specimens (Shaw 2012)

Task 1-1B *- Suppress the ability of invasive plants to return and re-establish*

To prevent the re-emergence of invasives, we will be planting the evergreen coniferous tree species *T. plicata, Picea sitchensis* (Sitka spruce), and *Tsuga heterophylla* (western hemlock), as well as the deciduous trees *R. purshian*a and several *Salix* sp. (willows). We will also be installing dense plantings of fast-growing shrubs like *Physocarpus capitatus* (Pacific ninebark), *Acer circinatum* (vine maple), *Cornus sericea* (red osier dogwood), *Symphoricarpos albus* (snowberry), and *Lonicera involucrata* (twinberry). The spreading of an 8-12 inch thick layer of wood chip mulch across the site will assist in preventing the re-establishment of invasive plants in the short term.

Justification: The installation of our diverse selection of trees will start to establish a long term canopy and all the fast-growing shrubs will work quickly to fill in the understory in the meantime. The resulting shade will keep adequate sunlight from reaching the remaining invasive seedlings, preventing their re-emergence (Leigh 1999). The spreading of mulch (8-12 in) has been shown to suppress or eliminate the return of invasive species (Chalker-Scott 2009).

Objective 2 *– Prepare site through removal of garbage, spreading of mulch, and installation of a fascine*

Task 1-2A *- Remove lumber and other garbage from the site*

To remove the relatively high quantity of discarded lumber and trash strewn throughout the site, we will attentively search all five polygons. We will hand-pull lumber and trash out of the mud and relocate it in a pile by the residential street for pickup. The lumber will be repurposed if possible or taken to the local dump. Treated lumber will be disposed of in appropriate hazardous waste facilities.

AD2: Any available woody debris scattered throughout the site was used to define access trail borders (this does not include treated lumber).

Justification: As is, lumber and trash is covering portions of the soil, leaving them inaccessible to sunlight and limiting penetration of surface water into the ground. Their removal would result in an increase of sunlight availability and water penetration at the soil surface. Clearing out the debris would also be eliminating the serious threat of injury from tripping over submerged trash.

Task 1-2B *- Apply 8-12 inch covering of wood chip mulch across site*

To improve access to the site, we mulched several trails. We will continue to mulch the site after invasive plants are removed. We formed a bucket chain with volunteers to transport the mulch and layer it onto the main access trail. The rest of the site will be covered in a similar fashion, with mulch provided by local entities such as Northwest Arboriculture.

AD3: In order to stabilize access trails, we had to spread an additional 6 inches of mulch (for a total of 18 inches) in certain areas that were more inundated than others.

Justification: An 8-12 inch layer of wood chip mulch has been shown to hold moisture for woody plants, reduce surface erosion, and hinder re-emergence of invasive plants in the Pacific Northwest (Chalker-Scott 2009).

Task 1-2C *- Install a fascine on the western border of Polygon 1 to stabilize soil and slow runoff*

To install the fascine, we will be weaving together *P. capitatus* and *C. sericea* cuttings into a bundle and placing the bundle laterally along the hillside in Polygon 1. The bundle will be staked in place using more live cuttings of the same two species.

AD4: We were unable to create fascines with live stakes because we did not obtain them in time. The desired species *C. sericea* and *P. capitatus* were already in their budding stages when we went to harvest live stakes from them, which meant they were no longer dormant and would not grow new plants from live stakes.

Justification: These plant species will be suited to the partial shade in the fascine location in Polygon 1. Both *C. sericea* and *P. capitatus* show success with live stakes and cuttings making them our best choice for creating a living fascine (Leigh 1999).

Objective 3 *– Obtain and install biologically and structurally diverse selection of native species suitable for the current successional stage*

Task 1-3A *- Acquire a diverse group of native species to install on site*

To acquire our plants, we will be placing orders from both the Snohomish conservation district and King conservation district plant sales. The plants that are unavailable at those sales or unavailable at salvage sites will be purchased through nurseries such as Fourth Corner Nurseries, Tadpole Haven Native Plants, Storm Lake Growers and the Department of Natural Resources Nurseries.

Justification: We were informed of these plant sales and salvaging events by our professors and community partner, who have successfully obtained healthy plants from them in the past.

Task 1-3B *- Determine suitable locations for new plants to maximize survival and productivity in the current successional stage*

Each microclimate has been studied and researched in order to determine what plants best fit their needs. In areas with significant sunlight and high soil moisture content, large conifer trees such as *P. sitchensis, P. menziesii* and *Pinus contorta var. latifolia* (lodgepole pine) will be planted to fill in the canopy and absorb water out of the soil. In drier areas, where shadier conditions are

present, we will plant the tree species *T. heterophylla.* Most of our chosen shrubs are suited to establish in full sun or partial sun, and they will be used to develop a shrub layer throughout our site. Some of our groundcover species are able to grow in various light and moisture conditions, so they will be able to go mostly anywhere onsite. Some of our groundcover species have light restrictions, so they will require some shade in order to establish.

AD5: We were not able to acquire *P. contorta* var. *latifolia.*

Justification: In the early stages of a restoration project, the first thing you want to do is shade out the invasive plant species. The installation of these fast-growing shrubs like *Salix lucida* ssp. *lasiandra* (pacific willow) will do just that (Ewing 2016b). As the forest matures into a later-successional community, the canopy will consist of mostly evergreen species, which will provide consistent shade to the forest floor. This will hinder invasive plants for years to come, and will allow later-successional understory to develop (Leigh 1999).

Goal 2: Improve ecological functions onsite as well as those provided to nearby habitat and local watershed

Objective 1 *– Obtain and install plant species useful for improving site water absorption and filtration*

Task 2-1A *- Obtain native plant species most efficient in improving water absorption and filtration*

We have selected plant species *Carex obnupta* (slough sedge)*, P. sitchensis*, *T. plicata*, *T. heterophylla*, and *S. lucida ssp. lasiandra, Salix sitchensis* (sitka willow)*, Salix scouleriana* (scouler's willow) to install on our site for the purpose of improving site water absorption and filtration. We will be obtaining our plants from community plants sales, salvage events, and local nurseries.

Justification: *C. obnupta* has been shown to filter sediment from surface water (Jurries 2003). Many tree species can reduce the amount of excess surface water or runoff, but *Salix* sp. are especially effective because of high transpiration rates (Fazio 2010, Kuzovkina *et al.* 2004).

Task 2-1B *- Install native species that can aid in reducing surface erosion and uptake excess surface water*

Since the soil onsite is incredibly moist and vulnerable to small amounts of surface erosion we will plant *C. obnupta* at high densities in all appropriate locations in all 5 polygons. *P. sitchensis*, *T. plicata*, *T. heterophylla*, and *S. lucida ssp. lasiandra* will be spread throughout the rest of the site based on canopy coverage and soil moisture.

AD6: We also obtained *Carex hendersonii* (Henderson's sedge) and *Polystichum munitum* (sword fern) to fulfill the same roles.

Justification: *C. obnupta* is an ideal understory species because it has evergreen leaves that can assist in filtering excess sediment from the soil year round during the rainy season, preventing soil disturbance from rain drops (Jurries 2003, Gold 2016). *C. obnupta* has root systems that will bind the soil and are able to thrive in wetter site conditions (Leigh 1999). Once they have been installed they will stabilize and filter water from the soil, preparing it for the development of the larger trees to extract excess water from the soil as the site matures into a late-successional Puget Sound forest.

Objective 2 *– Install plant species beneficial for soil stabilization along slope*

Task 2-2A *- Select plant species beneficial for soil stabilization*

Since the majority of our site is located on a slope, erosion control is one of our top priorities. To solve this, we have chosen *L. involucrata, S. albus, P. capitatus, R. purshiana,* and *S. lucida* ssp. *lasiandra* to plant on our site. We will obtain them from salvage events, community plant sales, and local nurseries. Evergreen ground covers such as *P. munitum, Blechnum spicant* (deer fern) and *C. obnupta* have also been selected to reduce the impact of raindrops and surface erosion during the rainy season.

Justification: *L. involucrata, S. albus,* and *P. capitatus* are all shrub-like species that will do well in wet soils and develop stabilizing root systems (DOE 1994). *R. purshiana* and *S. lucida* ssp. *lasiandra* are larger shrubs that help to reduce surface erosion on the hillside (Leigh 1999). *P. sitchensis* will grow to be a large tree and does well to stabilize soil with its large root system (Leigh 1999). *C. obnupta* is a durable, tufted sedge with a strong root system that will help to stabilize the soil in many areas of our site (Leigh 1999). The evergreen leaves of *P. munitum, B. spicant* and *C. obnupta* assist in reducing surface erosion during the rainy season (Gold 2016).

Objective 3 – *Increase fungal diversity and potential for improved water quality by inoculating the main mulched trail and downed trees with appropriate fungal species*

Task 2-3A *- Acquire plug spawn and wood chip mulch colonized by mycelium*

We will need to go out to a known local habitat that contains plentiful sources of wood chips colonized with *Stropharia rugosso-annulata* (winecap stropharia) and collect them to inoculate the mulch on the trail. We will also acquire *Plearotus ostreatus* (oyster mushroom) plug spawn online from www.fungi.com to inoculate *A. rubra* logs.

Justification: This fruiting bodies of *S. rugosso-annulata* will provide habitat for fly larvae and the mycelium itself will provide earthworm habitat while simultaneously increasing fungal diversity on site (Stamets 2005). The insect habitat provided by these fungi should increase food sources for birds and bats on site. Since *S. rugosso-annulata* can digest coliform bacteria and help prevent erosion (Stamets 2005), the addition of this species will also benefit water

quality downstream by reducing the levels of fecal coliforms such as *Escherichia coli* flowing into the sensitive watershed (Stamets 2005, Thomas *et al.* 2009, Taylor *et al.* 2015).

Task 2-3B *- Spread mycelium-colonized wood chip mulch throughout determined area and inoculate logs*

We have decided to keep all of the fungi on the main trail and on logs nearby the trail so that the fungi are not interfering with the functions and benefits that wood chip mulch will provide to plants elsewhere on site. We will inoculate *S. rugosso-annulata* by simply mixing the colonized mulch with the mulched path in three locations. This will be done in isolated patches to account for the spreading of the mycelium throughout the substrate. *P. ostreatus* will be inoculated into the newly fallen *A. rubra* debris just west of the main trail by drilling holes and hammering the plug spawn into the log.

Justification: By inoculating the mulched trail, we can account for expansion of the growing area for the fungus. The fungi will be able to absorb and filter water, as well as reduce the coliform count in the surface water flowing from our site (Taylor *et al.* 2015, Thomas *et al.* 2009). The addition of both *S. rugosso-annulata* and *Pleurotus ostreatus* (oyster mushroom) will increase the fungal diversity on the site, which can aid the decomposition of excess woody debris, providing plant available nutrients.

Goal 3: Promote wildlife habitat and attract local fauna such as birds, bats, insects and amphibians

Objective 1 *– Install native vegetation used for food, shelter and nesting for birds, small mammals and amphibians*

Task 3-1A *- Obtain suitable native species known to provide food, shelter, and nesting for birds, small mammals, and amphibians*

After researching and compiling our data, we plan on planting *P. capitatus*, *C. sericea*, *R. purshiana*, *S. albus*, *L. involucrata*, and *Ribes lacustre* (black swamp gooseberry) in the form of live cuttings and bare root saplings. We plan to obtain our plants from salvage events, conservation district plant sales, and local nurseries as well as by collecting live stakes.

Justification: In order create habitat for a variety of mammals and birds that inhabit North Creek Forest, we plan to install a structurally diverse array of plant species. Our canopy will consist of the tree species *P. sitchensis*, *R. purshiana, T. plicata, P. contorta* var. *latifolia, S. sitchensis, S. scouleriana* and *S. lucida* ssp. lasiandra. These species will do well to provide nesting sites and shelter for small mammals and bird species (Leigh 1999). The large shrubs and trees will also provide woody debris, a beneficial habitat feature for many wildlife species. The shrub layer will include the plant species *P. capitatus, C. sericea, T. brevifolia, S. albus, L. involucrata,* and *R. lacustre.* These species will act as suitable habitat for a variety of small mammals and birds, they will also provide

a diverse source of food that wildlife can eat. The understory will consist of *C. obnupta*, *B. spicant*, *Vaccinium parvifolium* (red huckleberry), *Dicentra Formosa* (Pacific bleeding heart), and *Mainthemum dilatatum* (false lily-of-the-valley). Having a variety of understory species will serve to provide small rodents, mammals, and amphibians with shelter and cover. The evergreen ground covers such as *B. spicant, P. munitum, C. obnupta* will aid in providing cover year round for small mammals and amphibians. Many of the species listed above are also food sources through twigs, foliage, berries, nectar or seeds to various forms of wildlife (Tesky 1992).

Task 3-1B - *Install selected plant species*

Selected plant species will be installed in the form of live stakes, plugs, and bare root saplings.

Justification: Live stakes are a quick and easy way to create clones and start filling open area. Plugs and bare root saplings, while more complex and expensive, will have a higher success rate. Using the bare root planting method will have a higher long term success rate than "pop and drop" planting of container plants (Chalker-Scott 2009). Plugs will be used for the understory plantings when necessary because that is the cheapest method other than salvaged plants.

Objective 2 – *Integrate a variety of hand-built facilities to provide shelter and nesting*

Task 3-2A - *Determine several beneficial hand-built facility types to provide shelter and nesting to wildlife*

Through talking with our community partners about what has and hasn't worked well in the past, as well as determining which species they would desire on the project site, we decided to install bat boxes, bird houses, and bee boxes.

Justification: Our community partner has made use of many forms of hand-built habitats in the past. They informed us that they desire to see our plans for bat and bird boxes implemented.

AD7: We were unable to install the desired bat boxes during the duration of this course. Our current plan is to provide FNCF with instructions on how to build their own and where to properly install them.

Task 3-2B - *Build and install hand-built bat, bird and bee facilities to provide shelter*

We will use plans obtained from *Bat Conservation International,* Oregon State University Extension and various online sources. We will get together as a group with tools pooled by all of us to put together the boxes before installation.

Justification: By cross referencing instructions for different forms of bee, bird and bat boxes found online and in OSU extension publications we can make

adjustments and be confident in the future success of our built habitat (BCI 2015, Allen *et al.* 2002).

Objective 3 *– Supply food sources for pollinators through incorporation of flowering native plants and mycelium*

Task 3-3A *- Determine flowering plant species attractive to pollinators of the area*

We researched local pollinators, focusing on what native species they were most attracted to and decided that *C. serica*, *S. albus*, *L. involucrata*, *Gaultheria shallon* (salal), *R. purshiana*, *V. parvifolium*, *V. sempervirens* would provide a sufficient diversity of food producing plants, attracting a variety of native pollinators.

AD8: We also added *Aruncus dioicus* (Goatsbeard), *Trillium ovatum* (western trillium), and *Dicentra formosa* (Pacific bleeding heart) to attract pollinators to our site. We were unable to locate *V. sempervirens*, so it was not installed.

Justification: *S. rugossa-annulata* mycelium is a documented food source for bees (Stamets 2005). A large portion of our shrub and understory species are flowering plants. These species will attract pollinators such as birds, flies, bees, and possibly even bats to our site that require nectar as a food source. *L. involucrate* and *Lonicera ciliosa* (Western trumpet honeysuckle) attract hummingbirds (Leigh 1999). *V. ovatum, G. shallon,* and *C. sericea* are good for attracting butterflies (Leigh 1999). *R. purshiana* is a nectar source for bees and *C. sericea* is a nectar source for birds (USDA 2016a).

Task 3-3B *- Install determined species to site*

Our mulched trails should be rich with mycelium sometime after inoculation**.** This will simply involve mixing the colonized wood chips into the existing wood chips on the trail in determined spots. The other listed species will be obtained as either live cuttings, plugs, or bare root saplings to be planted across our site during work parties.

Justification: To avoid overly rapid decomposition of mulch that is serving other purposes, such as moisture retention and invasive plant suppression, we will only inoculate *S. rugosso-annulata* into the walking trail at the eastern edge of the site. The plant species will be installed according to methods described by (Leigh 1999) (Chalker-Scott 2009).

Goal 4: Engage community in restoration efforts and continued maintenance of project site

Objective 1 *- Inform nearby residents and students of restoration goals, benefits, and ways to become involved*

Task 4-1*- Inform local residents and students about work parties and ways to become involved in the project*

To achieve this, we will work with our community partner to post notices on the Friends of North Creek Forest webpage, enlisting the continued assistance of those who already volunteer their time at North Creek Forest. In addition to the methods listed above, we will attend a board meeting, and ask the board members to speak with at least two of their neighbors to engage the local neighborhood in the project.

AD9: The members of FNCF took care of coordinating all volunteer events via their website and social media. We were in charge of coordinating what was going to be taking place onsite during those events.

Justification: Having the dates of work parties published in the FNCF newsletters a couple weeks in advance will allow more community members with the opportunity to volunteer their time. Reaching new people in this way while staying in contact with past volunteers via Facebook will give more people a chance to work at the site, ever increasing the steady following of volunteers that regularly show up for FNCF work parties.

Objective 2 *- Design a maintenance monitoring plan to be studied and enacted by students and volunteers*

Task 4-2A *- Design maintenance and monitoring plan*

We will work with UW faculty and community partners to develop a scheduled plan to nurture installed plants and suppress invasive plant reestablishment. The plan will also include monitoring the success of various plant species.

Justification: Our professors and FNCF have been working with students and volunteers to monitor restoration projects and keep invasive plant species suppressed for years. Using their expertise, along with what we've learned throughout the UW-REN capstone, we will design a monitoring plan that ensures the successful long term conversion of our site into a late successional upland Puget Sound forest.

Task 4-2B *- Implement monitoring plan*

We will work with FNCF to get a schedule of our monitoring plan published and arrange for local residents and students to carry out said plan through work parties hosted by FNCF.

Justification: FNCF has an ever growing following of community members who consistently volunteer their time at FNCF work parties. Just by forming a schedule of work days for site maintenance we gain access to the loyal following our community partner group currently holds. By publishing the maintenance and monitoring plan online we can reach even more people from the community looking to donate their time for a worthy cause.

Specific Work Plans

1. Site Preparation Plan

Current Conditions of Project Site

Our site is located downhill of a residential neighborhood and bordered by steep slopes on the western edge. Our project site is north of and borders the 2014-2015 UW-REN team restoration site. The project site is a part of the North Creek watershed. Surface runoff and groundwater from seepage points within the project site and surrounding forest recharges North Creek. The problem with the site is that it has become overrun by invasive plant species. Erosion is a concern while we are restoring the site, but we have installed a silt fence to address this issue, temporarily, until restoration efforts are complete. Most of the site is an impenetrable thicket, so in some cases divisions of the site are based on trails we created. Polygons 1 and 2 are divided from polygons 3, 4, and 5 due to the topographical differences we see, where 1 and 2 are considerably sloped, 3 and 4 are much less so, but polygons 4 and 5 have the most variability in vegetation and topography. Overall the hill slope within the project site is moderately steep in areas, but we have many other areas where the slope flattens out significantly. The soils are saturated throughout much of the year, but high degrees of variability in slope, elevation, moisture, canopy cover, and vegetation are present throughout.

(For more detailed information regarding the polygon mapping, environmental conditions present in each polygon, and current native and invasive vegetation, see Maps 3 & 4.)

Polygon 1 - Polygon 1 contains native species such as *A. macrophyllum* and *A. circinatum*, but the area is dominated by a carpet of *H. helix* and a thicket comprised of mainly *R. bifrons*. Some native understory species are present in small amounts in sporadic locations. Two soil samples were taken from Polygon 1. We identified the soil in both samples to be silty clay loam.

Polygon 2 - Polygon 2 is dominated by dense, impenetrable thickets of *R. spectabilis* and *R. bifrons.* These two species alone account for approximately 80% cover of polygon 2. Some *L. americanum* and *Equisetum* sp. (horsetails) are present, but not common throughout this thicket. Three young (under 40 years old) *T. plicata* are located along the Eastern border of polygon 2. *H. helix* is present in this polygon where it completely covers a snag at the southwestern corner. Two soil samples were taken in this polygon. The northern border sample was identified as a clay loam, while the sample taken from middle the polygon has been identified as loam.

Polygon 3 - Polygon 3 is dominated by *A. rubra* and *T. plicata* but it also contains thickets comprised of *R. spectabilis* and *R. bifrons*. A ground cover of *H. helix* and *Tolmiea menziesii* (piggy back plant) is present in the southeast corner. *Polystichum munitum* (sword fern) and *Equisetum* sp. are located in patches throughout the polygon. Only one soil sample was taken in this polygon. The soil texture was identified as silty clay loam.

Polygon 4 - In Polygon 4 *R. spectabilis* and *R. bifrons* account for approximately 70% cover in the shrub layer. Much of the polygon is dominated by a dense thicket of *R. spectabilis* and *R. bifrons* but *A. rubra*,

T. plicata, *R. purshiana*, *L. americanum, I. aquifolium*, *Equisetum sp*., *V. parvifolium*, and *Corylus cornuta var. californica* (beaked hazelnut) become intermixed with the thicket in spots. In Polygon 4, we took two soil samples from the trail. The first sample was identified as loam and the second sample was identified as silty clay loam. Considerable gleying was observed in both soil samples.

Polygon 5 - In Polygon 5 the dominant vegetation consists of *T. plicata* and *Mahonia nervosa* (low Oregon-grape). The soil here is drier than anywhere else on site. Some gleyed soil was observed but considerably less than other polygons. Much of Polygon 5 has a 2.5 cm of *T. plicata* leaf litter on top of soils. The canopy consists of mature *T. plicata, P. menziesii, and A. macrophyllum*.

Site Preparation Activities

Polygon 1 is on a slope that is near residential housing. Therefore, we will install a fascine on the western border to stabilize soil and help prevent surface erosion. We plan to remove invasive plant species such as *R. bifrons, and H. helix.* We will mulch the site with 8-12" of wood chip mulch and prepare to plant native trees and shrubs.

Polygon 2 is heavily populated with *R. bifrons* and *R. spectabilis* (Map. 6). Before planting we will remove invasive plants and garbage. After invasive plant removal we will mulch the site with 8-12" of wood chip mulch and prepare the site for planting.

Polygon 3 is located next to a trail that runs through North Creek Forest and sits on the eastern border of this polygon. We have installed a silt fence in order to keep the mulch from floating away and prevent soil erosion from entering the nearby stream. We have already mulched the main trail that is located on the eastern border (Map. 4) and created different access trails that stem from here and go through the rest of our site. We will mulch the trail that goes through our site and remove garbage from this polygon. The removal of invasive plant species is imperative, then we can add native vegetation later.

Polygon 4 is heavily populated with *R bifrons* and *R. spectabilis.* Like polygon 3, we already installed a silt fence and mulched the trail that is located on the eastern side of this polygon with 8-12" of wood chip mulch. Other site preparation activities include removing garbage, creating access trails, more mulching if necessary, and invasive plant removal.

Polygon 5 contains no invasive plants but there are some *R. bifrons* near the western edge of this polygon. Site modifications will include mulching trails with 8-12" of wood chip mulch and cleaning up any garbage that may still be in this polygon. The silt fence we have already installed runs along the eastern border of this polygon.

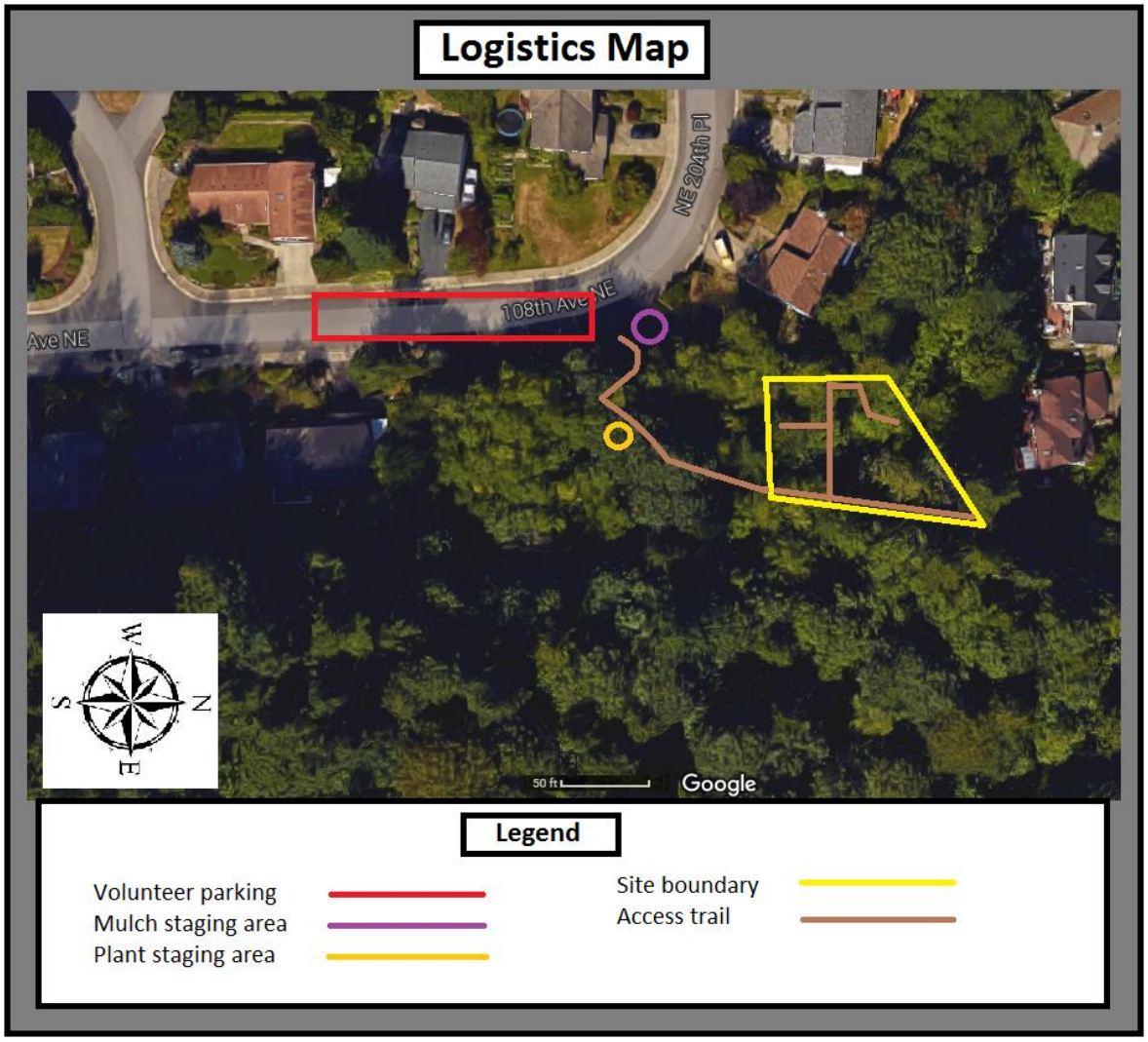
Logistical Considerations

Due to the location of our site relative to the community around it, and the sloping nature of the site itself, we have to consider the logistical implications that come with the amount of work involved in restoration. In order to access the site, there is a stairway leading from 108th Avenue NE down into the

forest, where a trail runs through the 2014-2015 UW-REN restoration site and continues on to become the trail that borders the east side of our site. A silt fence has been installed in the eastern edge of this trail, extending from polygon 5 through part of polygon 4, to help with erosion issues that may occur during our restoration process. The silt fence is made with woven synthetic material that allows the passage of water, but not large silt particles, through the fabric, effectively keeping sediment erosion to a minimum and protecting the waterways adjacent to our site from excessive turbidity levels. This trail is used by many to advance further into the forest, eventually leading down to the east side of North Creek Forest, where restoration sites for previous years can be found, right off Highway 405. We will be using this trail as our main access point into our site. Further access trails have been created, in between polygons 3 and 4 for better entry into the middle of the site for volunteers and the UW-REN team.

The initial stages of mulching the main trail have been completed, and at this time we are looking to mulch the remaining portions of our access trails for easier entry into specific parts of each polygon. Due to the nature of our site having large areas of impenetrable thicket, these access trails are necessary for us to gain entry into areas of the site. Careful consideration was taken in the selection of our trails that branch off the existing trail that borders the eastern edge of our site. Our mulch will be staged right off 108th Ave NE, a few feet from the road, where the mulch can be transferred via bucket and wheelbarrow down the stairs, and on the access trails that lead into our site. This area was chosen for several reasons. First, this is the same staging area that was used for the 2014-2015 UWREN restoration site. Second, this provides the best access for both the truck that dumps the mulch and for us to transfer the mulch into the site.

We are going to have a plant staging area located at the bottom of the stairs leading into the forest, in between the 2014-2015 and 2015-2016 UW-REN sites, allowing us to easily take the plants from trucks and placing in a neutral area until the plants are ready to be planted. Volunteers are able to park on 108th Ave NE**,** where a relatively short walk will lead them to the site.



Map 2. Map shows logistical locations on project site.

2. Planting Plan

Polygon 1: The long-term goal for this polygon is to establish a mixed conifer-deciduous forest with adequately draining soil and habitat for a variety of wildlife. Polygon 1 already contains an established *A. macrophyllum* along the eastern border as well as two *A. circinatum* shrubs along the southern border. This provides some patchy shade, but leaves most of the area open to sun. To help fill in the gaps of our coniferous-deciduous mixed forest canopy, we will be installing 6 *P. sitchensis* in this polygon. Two will be planted adjacent to the start of the western access trail in a moist patch. Two more will be planted at the southeastern corner of Polygon 1 adjacent to the border between Polygons 1 & 3. The last two *P. sitchensis* will be installed along the border of Polygons 1 and 2 in a spot where there is slightly more shade on the northern side of a thick patch of *R. spectabilis*. *P. sitchensis* can establish in moist-to-wet soils and will be able to tolerate Polygon 1's light conditions, providing habitat for wildlife and eventually creating evergreen shade (Scott 1992). There is also enough shade available in portions of Polygon 1 that will do well for the installation of 4 *T. plicata,* which will be able to survive the high moisture

content of the soil and help to begin the process of establishing late-successional evergreen overstory (Pojar 2004). Two will be installed underneath a mature *T. plicata* on the western border of Polygon 1 close to the borderline between Polygons 1 and 2, where it will receive shade year-round. The other two will be planted further south near the western access trail where there is deciduous overstory cover and much wetter soil.

AD10: Only one *T. plicata* was installed in Polygon 1 due to lack of space. In some spots, the soil was too inundated to install *P. sitchensis*. In order to compensate so that we could still install these in the desired locations, we built small mounds using the local soil and mulch to help reduce the standing moisture these trees would be planted in.

A. macrophyllum will be planted as a single individual near the middle of Polygon 1 because the moist-but-not-wet soil conditions and the availability of light will provide suitable growing conditions. It will add more deciduous canopy cover and provide leaf litter and woody debris to the area that will help to absorb water (Fazio 2010). We also plan to install 8 *Salix* sp. throughout the wetter areas of Polygon 1 to help speed the process of further canopy development. There are 3 species of willow that we have chosen to install (*S. lucida* ssp. *lasiandra*, *S. scouleriana,* & *S. sitchensis*), which will all be able to establish in high-light and wet conditions. These species will all grow very quickly and will live stake well in the saturated soil (Leigh 1999).

Because of the mixed levels of available sunlight in Polygon 1, several shrub species will be suitable for installation that are also tolerant of the polygon's moisture conditions. These will help to increase the density of the shrub layer in this polygon to compete against *R. bifrons,* and will provide some shade to try and deter *H. helix.* There are already several *A. circinatum* individuals growing in Polygon 1, so we will install an additional 3 since they will most likely establish. These will all be planted to the left of the western access trail near the western border of Polygon 1 a minimum of 8 ft. apart from each other. Enough of a mixture of shade and light is available in this area where *A. circinatum* will be able to establish and grow, and the soil is not too wet. Adding more *A. circinatum* will provide more leaf litter that the soil can use to absorb water and will also give deer and small mammals a source of browse (WSU 2016b).

AD11: We only planted 1 *A. circinatum* in Polygon 1 due to lack of space and suitable planting locations.

C.sericea and *P. capitatus* are durable, fast-growing shrubs that are tolerant of full sun and partial-sun availability. Both species are good sources of nectar for pollinators and will grow well in wetter soils (Leigh 1999). We will live stake eight *C. sericea* in this polygon. Four of those stakes will be installed just south of the border between Polygons 1 and 2 next to the western access trail. These will help to combat *R. bifrons* and will diversify the shrub layer that is mainly *R. spectabilis.* Another two will be placed south of those four stakes still adjacent to the western access trail, and the last two will be installed in the northeastern corner of this polygon. We will install six *P. capitatus* live stakes in various locations of Polygon 1. The first two will be at the center of the border between Polygons 1 and 2 next to the *R. bifrons* and *R. spectabilis* thickets to help create competition. The other four will be placed in the southern portion of Polygon 1 where they will receive partial sun through the deciduous canopy and add to the shrub layer. Another shrub species that we will put in this polygon is *R. lacustre* which can grow in canopy gaps and do well in moist soils. This species will act as a food source for birds and small

mammals with its berries and from browse (Carey 1995). We will install two from salvage, one near the southern border of Polygon 1 and one fairly close to the center. *Aruncus dioicus* (goat's beard) is a species we decided to incorporate due to its moisture tolerance and production of seeds that birds can eat (USDA 2001). It can grow in a range of light conditions, so we will plant two from containers adjacent to the border between Polygons 1 and 2 where there will be adequate light and a high amount of moisture.

The primary understory species that we will plant in our site is *C. obnupta.* A total of two hundred individuals are planned to be installed since the conditions are ideal and there are none already present. They are extremely efficient at binding the soil together with their root systems (which will help with our site's issue of erosion control), can handle moist to inundated conditions, and can survive in a wide variety of light conditions (USDA 2016b). They are also able to survive through all stages of succession, which be useful as the site continues to mature. (USDA 2016b). In Polygon 1, we plan to install fifty as either plugs or from salvage. These will be placed throughout the middle of the polygon from south to north wherever there is available space. *Oxalis oregana* (red woodsorrel) is another understory species that has an extensive root system for binding soil and can also handle moisture. This species requires shadier conditions (USDA 2016a) so we plan to install three as either plugs or from salvage (if available), placing them somewhere in the center of the polygon where there is room. In order to combat the problem of *H. helix,* a species we decided to plant is *M. dilatatum*, which acts an aggressive groundcover. It will establish in moisture and will be a food source for small mammals (Shebitz 2003). We will install four of this species as plugs in this polygon and they will be intermixed with the *C. obnupta* and *O. oregana.*

AD12: No *C. obnupta* was planted in Polygon 1, but 60 *Carex hendersonii* were installed instead. These were mistaken for *C. obnupta* at a salvage event in February when floral parts were not yet present.

Our final two understory species to be planted in this polygon are *P. munitum* and *B. spicant. P. munitum* is an understory species that is very durable and useful for erosion control. It is also good for water absorption, providing cover for small mammals and birds, and it can grow into dense stands, which would compete against returning *H. helix* and *R. bifrons* (Zouhar 2015). We will install six of these from salvage throughout this polygon in areas where the soil is in need of stabilization. *B. spicant* is a species that requires significant shade, so we will install it in the northeast of this polygon underneath thicker deciduous cover. We will plant a single individual here as a plug. This species will be useful here to absorb water out of soil and provide browse for deer (Matthews 1993).

An additional planting feature of Polygon 1 is the fascine that we will construct and stake into the hill in the southwestern corner. This fascine will consist of an estimated twenty *C. sericea* and twenty *P. capitatus* live stakes, but this number is subject to change dependent on the size of our stakes. The fascine will be about twenty feet long, stretching from slightly within UW-REN Site 4 to where the slope starts to decrease in gradient. It will be installed fairly close to the fascines in Site 4 due to the need to stabilize the east-sloping hillside and prevent further erosion. Currently, the topsoil appears to be mostly washed away in the place where the fascine will go.

Polygon 2: Polygon 2 has a mostly open canopy and is very wet throughout. This requires that we install species that are able to tolerate both circumstances. Also, we want to remove some of the excess

moisture from the site, so we have chosen a variety of species that will absorb large amounts of water with their roots that they will use for their own growth (Fazio 2010). *P. sitchensis* will be a suitable tree species for this polygon's conditions that we will use to add to the minimal canopy cover in this polygon, as well as help bind the soil. We will install eight in Polygon 2. Two will be placed close to the trail dividing Polygons 1 and 2 in the southeast of this polygon where water has been seen pooling. The other four will be put in the center of this polygon a minimum of 8 ft. apart where they will receive high amounts sun and initiate evergreen canopy development in this area (Scott 1992).

AD13: only 5 *P. sitchensis* were installed in this polygon due to lack of suitable planting locations and excess moisture in the soil.

The two other tree species used for the same purpose of evergreen canopy cover and water absorption in this polygon will be *T. plicata* and *P. menziesii*. Out of the 4 *T. plicata* we plan to plant in this polygon, the first two will be planted next to the northern border in a position where it will receive some shade from the tall *R. spectabilis* thicket and will be in a fairly wet spot. The other two will be placed next to the edge of the evergreen canopy produced by the mature *T. plicata* trees in Polygon 5. We only plan to install two *P. menziesii* in this polygon, and they will be just west of the large *T. plicata* trees. This species is a fast-growing early successional pioneer, so it will quickly add to the canopy layer. The seeds are eaten by birds and small forest mammals, and it can also provide habitat for a variety of species such as the red tree vole and the spotted owl (Uchytil 1991).

AD14: Only three *T. plicata* were installed in this polygon, and we also did not install any *P. menziesii* here.

The most important tree and large shrub species planned for installation in this polygon will be the *Salix* sp. They will fulfill two critical issues that this polygon needs to have addressed. Adding aggressive competition to combat the invasive *H. helix* and *R. bifrons* by growing quickly, developing a quick deciduous canopy, and stabilizing the soil with their extensive root systems (Labbe 1998). We will disperse them throughout most of Polygon 2 in the sunniest portions of this polygon for a total of fourty-eight live stakes. There will be eighteen *S. lucida* (which will grow more as a tree in comparison to the other two *Salix* sp.), fifteen *S. scouleriana*, and fifteen *S. sitchensis* (both of which are more shrub-like and will fill the upper shrub layer), primarily placed on the western half of the polygon and just north of the border dividing Polygons 1 & 2. They will be planted a minimum of 2 ft. apart and will replace the *R. bifrons* that will have been removed. Our final tree species (that can also can be considered a tall mid-story shrub) in this polygon will be *R. purshiana.* There are already some scattered throughout our site but in small numbers, so we will bare root plant four additional individuals a minimum of 6 ft. apart. This species is tolerant of high-sun and wet conditions, and will also be useful for a number of purposes such as binding soil, providing berries as food for birds and small mammals, and acting as a source of pollen for wasps such as yellow jackets (WSU 2016a).

Most of the shrub species that we plan to install in this polygon are tolerant of high-light conditions, with the exception being *A. circinatum.* In the northwestern corner of Polygon 2, there is a large *T. plicata* tree that will provide some shade, so we will plant six *A. circinatum* in this location. Our most frequent shrub species in this polygon will be *P. capitatus.* There will be a total of sixteen live stakes placed throughout the center and northeastern portions of Polygon 2 at least 2 ft. apart from each other, where they will replace the *R. bifrons* thickets in those locations. *S. albus* is a shrub that will be

introduced in Polygon 2. It is smaller shrub that is extremely useful for riparian slope stabilization and it prefers open sites. Also, the berries will continue to be a food source into the late winter months, so it has a high wildlife value (McWilliams 2000). In Polygon 2, we will install ten as live stakes clumped together (about 2-3 ft. apart) in the southwestern corner stretching down the middle of this polygon where it will replace what is currently a large thicket of *R. bifrons*. Mixed together with the *S. albus* will be six live stakes of *C. sericea.* A combination of these shrubs in this position will act as a deterrent to *R. bifrons*. There will also be six more *C. sericea* (for a total of twelve live stakes in Polygon 2) planted primarily in the southwestern portion of this polygon, with some also planted slightly northeast of the center of the polygon. These spots will be wet and provide adequate sunlight. The final shrub to be installed in Polygon 2 will be *L. involucrata*. It is useful for slope stabilization in moist-to-flooded slopes, and will be able to handle a variety of light conditions, except for full shade (Leigh 1999). Also, it provides a source of berries for birds and small mammals, as well as a valuable nectar source for hummingbirds and butterflies (Darris 2011). We will install four as live stakes just northeast of the center of this polygon in wet spots where there will be high amounts of sun.

AD15: We installed an additional ten *S. albus* in Polygon 2 as bare root plants, for a total of 20. Also, we were unable to retrieve any live stakes of *P. capitatus*, so instead we planted sixteen bare root plants of them in this polygon.

There are several areas in the polygon where there is consistent standing water. It is in these spots that the understory species *L. americanus* will become an important understory element. It is a wetland obligate, so it will be able to handle the wettest conditions in our site. The leaves and flowering parts are used by flies for food and mating (NOWPP 2005-16). We plan to salvage this species for planting, and we will install four in Polygon 2 just northeast of the center of this polygon where the moisture levels are appropriate. *C. obnupta* will be a strong addition to the understory of this polygon. We plan to install fifty in various places throughout the northern half of this polygon where there is space and where the soil is in particular need of stabilization, as well as some in the southeastern corner of this polygon along the border dividing Polygons 1 and 2. For the same purpose, we will install six *M. dilatatum* plugs in this polygon intermixed with where the *C. obnupta* will go. In various places of Polygon 2, we will also install five *P. munitum* from salvage. Being able to tolerate the high-light conditions, this species will help build the understory in this polygon and will assist in soil stabilization. In the very northeastern corner of this polygon, we will plant two *B. spicant* as plugs. This spot will provide this species with high levels of shade from the canopy of the mature *T. plicata* trees in Polygon 5.

AD16: No *L. americanus* was installed in this polygon because they were already present in large numbers.

Polygon 3: Because of the existing deciduous canopy covering most of this polygon, we only have two tree species that we will install here. Two *P. sitchensis* will be bare root planted fairly close to the main trail (5-10 ft away) that acts as the eastern border of our site (AKA the eastern access trail) where there is some sun coming through the canopy and a high level of moisture. The other species will be *T. plicata*, and we will bare root four individuals along the border between Polygons 3 and 4 where they will receive some shade and be placed in wet soil. These trees will help to initiate the development of an evergreen canopy in these spots, and will also help to stabilize the soil.

AD17: Only 1 *P. sitchensis* and 1 *T. plicata* were planted in Polygon 3 due to lack of suitable planting locations and space for planting

The southeastern corner of Polygon 3 has a small mound where the soil is slightly less wet than in other spots and where there is already a single *A. circinatum* growing, so we plan to install 2 more here to increase the density of the shrub layer. Along the border between Polygons 3 and 4 in the northeastern corner as well as in the southwestern border of Polygon 3, there is mostly wet, saturated soil. This is where our moisture-tolerant shrubs will be placed. A total of ten live stakes of *S. albus* will go in Polygon 3 along these borders. Also, six out of the eight *C. sericea* live stakes planned for this polygon will go in the same positions. The last two *C. sericea* live stakes will go in the south of the middle of Polygon 3 because there will be more shade in this area and it is a shade-tolerant species (Leigh 1999). Along the border between Polygons 3 and 4 in the northwestern portion, we will install two *A. dioicus.* The final shrub for this polygon will be four additional *P. captitatus,* three which will be installed just slightly south of the border between Polygons 3 and 4, and 1 along the southern border of this polygon. These will assist the other installed shrubs with slope stabilization and mid-story development.

A small shrub that will do well in the shadier portions of Polygon 3 is *V. parvifolium.* It requires high amounts of decomposing wood to grow on as a substrate, so we will salvage the wood that these individuals are growing on as we are salvaging this species. Four will be planted in the deciduous shade in the western area of Polygon 3, and the other two will be in the northeastern corner of this polygon where there will be a little more sun, but still enough shade to where they should be able to establish. This species will be useful to provide cover and nesting sites for small mammals and birds, and will produce red berries that wildlife can use for food (Tirmenstein 1990b).

AD18: We have installed four *V. parvifolium*. Three have been planted in the deciduous shade in the western area and the other one is planted in the northeastern corner of Polygon 3.

An understory species going into Polygon 3 will be *P. munitum*. We will install 6 of this species throughout this polygon. We will also install a single *B. spicant* in this polygon. It will be installed in a shady area to the west of the center of the polygon. 8 *M. dilatatum* plugs will be installed in this polygon as well in various positions east and south of the center. The most common understory species in this polygon will again be *C.* obnupta. There will be 50 installed from salvage or as plugs throughout. Some will be used to create amphibian habitat in the southeastern corner of this polygon (Bohan 2015) along with the final understory species in this polygon *L. americanus.* There is a fallen *A. rubra* tree parallel to the eastern access trail where its stump has been uprooted, which has created a small pocket where water collects. This has created a suitable, wet microhabitat to host *L. americanus* (we will plant 1 individual from salvage).

AD19: No *L. americanus* was installed in this polygon because they were already present in large numbers.

We will install all of our *P. ostreatus* fungi plugs into the fallen *A. rubra* trees in this polygon to increase the fungal diversity and create an interesting feature. These mushrooms are also a good food source for *Homo sapiens* (humans) and *Ariolimax columbianus* (Pacific banana slug) (Arora 1986).

Polygon 4: This polygon is the most open to sun in comparison to the rest, and is the most heavily dominated by both *R. bifrons* and *R. spectabilis*. It is also the polygon that requires the most attention for slope stabilization. These reasons will make Polygon 4 the most densely planted polygon in our site. The pioneer tree species planted in this polygon will initiate canopy development. Because of the high availability of light and moisture, *P. sitchensis* will do well in this polygon (Leigh 1999). The moisture next to the border between Polygons 3 and 4 will have suitable conditions for this species to establish, so we will install four here. *A. macrophyllum* will also do well because of the open canopy. There are none previously established in this polygon unlike Polygons 1 and 3, and North Creek Forest in general has a high number of *A. macrophyllum* trees throughout. We will bare root plant four of these in Polygon 4 through the middle at least 8 ft. apart. *P. menziesii* will be useful to build quick evergreen overstory adjacent to the present evergreen canopy provided by the mature *T. plicata* trees in Polygon 5, so we will bare root plant a row of those along the border dividing Polygons 4 and 5 at least 8 ft. apart for a total of six. The moisture levels along this border are low enough to where they will be able to survive. Another evergreen tree species we will add to this polygon is *T. plicata.* There is one shady spot in the northwestern corner of this polygon where there are several young but fairly tall (15-20 ft.) *T. plicata* trees already present. We will bare root plant four additional *T. plicata* trees from in this location.

AD20: We only installed four *P. menziesii* instead of six and two *T. plicata* instead of four in this polygon because of lack of available planting space.

There are two tree species that are only being placed in this polygon and they will go in the same place along the border between Polygons 4 & 5 due to their shade intolerance. The first is *Populus tremuloides* (quaking aspen), a deciduous tree which can grow in heavy clay soils in upland forests. This species will be useful for binding soil, forage and nesting for small mammals and birds, and forage for ungulates when still young (Howard 1996). Two of these will be installed. The other of these tree species planted in Polygon 4 will be *P. contorta* var. *latifolia*, which is an evergreen tree native to central Washington. We will only install two of these as well. They are very intolerant of shade, but will grow in poorly-drained soil. Also, this species will be useful for water absorption and erosion control (Fazio 2010). This will be part of an experiment testing the success of drought tolerant trees more common in central Washington and the Rockies. Our final 2 deciduous tree species that will be installed in Polygon 4 are *R. purshiana* and *S. lucida*. There is one existing *R. purshiana* in site 4 just east of the center of this polygon, so we will install one additional *R. purshiana* next to it. The *S. lucida* will be installed closer to the center of Polygon 4, used primarily for creation of shade in place of the removed *R. bifrons*. Four of these will be live staked.

AD21: *P. contorta* ssp. *latifolia* was not planted in this polygon because no nursery stock was available for this species.

The shrub species installed in this Polygon will play a role in replacing the shrub layer that will be diminished once we remove *R. bifrons* from our site. This shrub layer will be an improved version of the *R. bifrons* thickets because the chosen native shrubs will perform a variety of functions to support wildlife. Since *R. bifrons* has spread throughout the whole polygon, we will install shrubs throughout as well. Two live stakes of both *S. scouleriana* and *S. sitchensis* (a total of four) will be installed in this polygon around the same area as the *S. lucida.* There will be four live stakes of *C. sericea* installed in the southwestern corner of Polygon 4 next to the border dividing Polygons 3 and 4 where there is ample moisture and a need for slope stabilization. An additional three *C. sericea* live stakes (for a total of

seven) will be installed in various other spots of Polygon 4 where they will receive significant amounts of sun and wet soil conditions.

We will install a total of thirteen *S. albus* live stakes in Polygon 4, and they will be scattered throughout the southern half of this polygon. *L. involucrata* will be the most abundantly planted shrub in this polygon. The tubular flowers that it produces attract hummingbirds and will create an appealing feature to have trailside (Leigh 1999). The conditions will be appropriate, so we will live stake twelve of this species (at least 2 ft. apart) along the eastern border of Polygon 4 next to the trail, and four on the western border of Polygon 3 where there is a ample moisture. Six live stakes of *P. capitatus* will be planted around the middle of this polygon as well to help reduce erosion. One *A. dioicus* will be installed with the *L. involucrata* next to the trail because it also produces visually-appealing flowers, and it will be able to handle the moisture conditions in that location. The final shrub in this polygon will be *R. lacustre,* and 2 of this species will be planted just west of the center of this polygon, and one will be planted in a pocket of moisture found at the southeastern corner of this polygon (for a total of three). This species handle the high levels of moisture on the slope and will tolerate sun behind a *R. spectabilis* thicket.

AD22: Bare root plants replaced live stakes for *S. albus* in this polygon because insufficient numbers of stakes were collected before spring when plants began to leaf out.

The understory in this polygon will be divided based upon the light availability in different areas. The northernmost portion of our polygon that stretches all the way across the border between Polygons 4 and 5 will receive more shade than the rest of this polygon. Therefore, we will plant species there that require more shade. *G. shallon* is a good example, for this evergreen groundcover needs to be in at least some shade in order to establish (Leigh 1999). Most of the hillside that Polygon 5 is located on currently has *G. shallon* present, so we plan to expand its range to the southern part of that hillside. We will install six individuals from salvage along the border, where they will add more sources of berries for wildlife, bind the soil on the hillside, and give small mammals and birds another resource for cover (Tirmenstein 1990a). Another understory species requiring at least some shade is *V. parvifolium* (Leigh 1999), and there are some individuals already present near the border dividing Polygons 4 and 5. We will install 3 more along this border where there is some decaying wood available and suitable conditions for establishment.

A new addition to our species list that will only go in this polygon along the border dividing Polygons 4 and 5 will be *Cornus unalaschkensis* (bunchberry). This species does well in forest floor understories, where it can grow in moist, acidic soil. We chose to place it next to the *P. contorta* var. *latifolia* that we plan to install because this species prefers acidic soils. It is useful in providing berries for birds and it can grow on stumps and tree trunks (Leigh 1999). We will install 5 as plugs at least 1 ft. apart as a clump. In this same clump, we will also install 4 plugs of *O. oregana* because of the moist soil and their requirement of shade. The last understory species needing some shade in this polygon is *B. spicant,* and this will go in the northwestern corner of this polygon where there is a small stand of young but tall western redcedars (Leigh 1999). The rest of the understory will consist of species both more tolerant of sunny conditions as well as useful for slope stabilization. These will be installed throughout most of the site. *C. obnupta* will be the most abundantly planted of all understory species in this polygon with fourty plugs or salvaged plants being spread through the polygon. Within that same range, we will install two plugs of *M. dilatatum* and four salvaged *P. munitum* along the slope. Because *P. munitum* prefers less moisture than *C. obnupta* and *M. dilatatum* (Zouhar 2015), we will place these in some of the less-saturated spots on the slope that still require soil stabilization.

AD23: We were unable to locate *C. unalaskensis,* so it was not installed. Instead, we installed *Oxalis oregana* (redwood sorrel) to fulfill similar ecological roles we installed fifty *C. obnupta* in this polygon instead of fourty.

Polygon 5: This polygon has far different conditions than the rest of the site because of how dense the shade is from evergreen stand of mature *T. plicata* trees, and because it is on a separated mound from the rest of the slope. The soil here is slightly drier (but still moist) and there is a higher diversity of native understory species already present here in comparison to other parts of the site. There are two tree species we plan to install here that are not planned for anywhere else on site. The first is *T. heterophylla*, which is a late-successional lowland forest climax species usually found in more mature forest stands as the dominant canopy species. Because of dense shade provided, the conditions in Polygon 5 will be ideal. We will install five as bare root plantings underneath the *T. plicata* stand, and they will provide thermal cover for wildlife in the winter months (Tesky 1992). The second tree species we will install that requires similar shady conditions is *Taxus brevifolia* (western yew). This species will act more as a shrub in Polygon 5 because it does not grow rapidly, but it will act as a source of cover for birds and small mammals and will also be a source of browse (Bolsinger 1988). We will install two of this species in Polygon 5 underneath the *T. plicata* overstory.

AD24: *T. brevifolia* was not planted in this polygon due to a lack of available nursery stock.

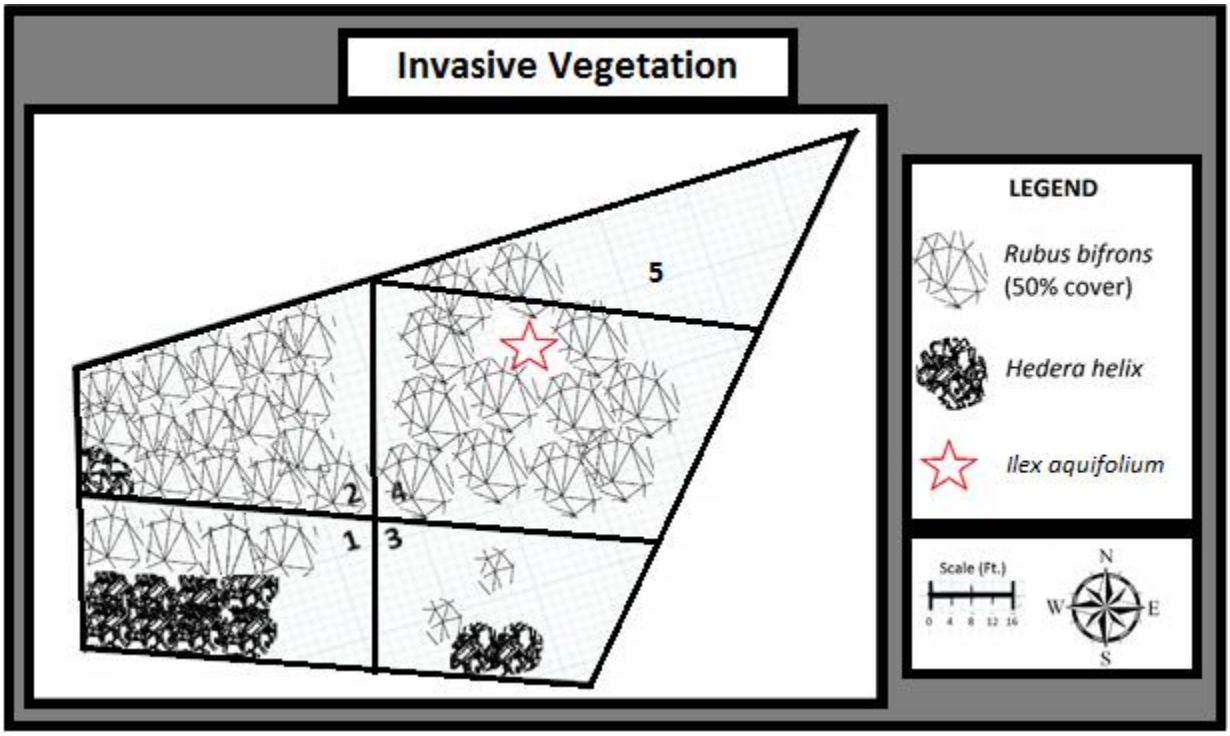
We have two shrub species planned for this polygon, which are *A. circinatum* and *Lonicera ciliosa* (orange trumpet honeysuckle). There are many individual *A. circinatum* already growing in the area, especially just across the stream in the northwestern corner of the polygon, so we plan to install three more individuals as bare root plants south of those to add to the shrub layer. *L. ciliosa* is a deciduous vine that will grow in shady areas and moist soil, and can climb trees to reach heights of up to 20ft. It attracts hummingbirds and butterflies with its flowers (Leigh 1999). We will install five of these from containers in Polygon 5 underneath the shady *T. plicata* canopy.

AD25: *A. circinatum* was not planted in this polygon due to lack of suitable locations. *L. ciliosa* was not planted due to lack of available nursery stock but *Trillium ovatum* was planted as a substitute.

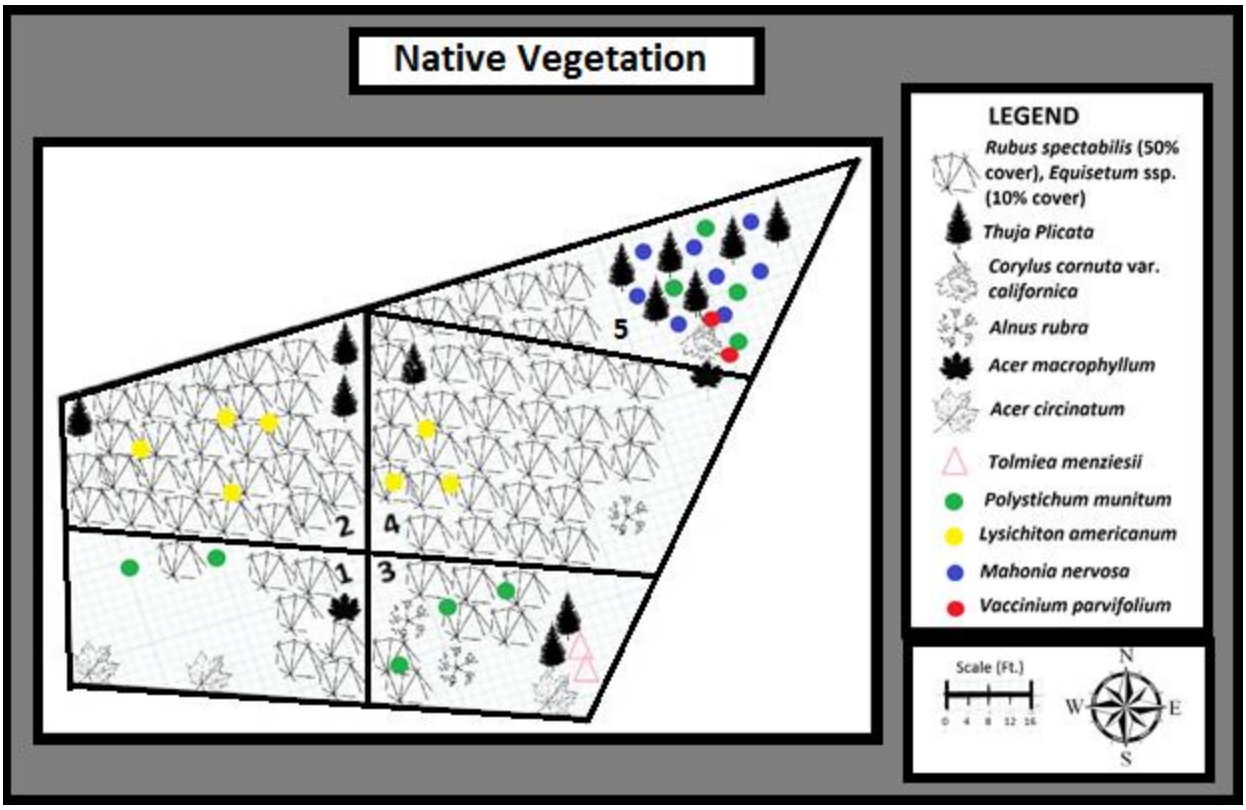
The understory in this polygon will consist of species that can tolerate evergreen shade. *V. parvifolium* is one of those species that will be able to grow on the decaying wood that is spread throughout this polygon. Three will be placed near the border dividing Polygons 4 and 5 just before the edge of the *T. plicata* canopy, and 1 will be placed in the middle of the Polygon underneath thick shade (for a total of four). Another species will be *G. shallon*, which is already fairly common in this polygon, especially on the eastern portion along the slope where it is currently growing with of *P. munitum* and *M. nervosa.* We will install six plants from salvage in this polygon further west of this slope and underneath the *T. plicata* canopy where it is not as abundant. More *C. obnupta* (10 from salvage or plugs) will be planted adjacent to the stream on the northeastern corner of this polygon to provide stabilization of the streambank. Our final understory species that is only going in Polygon 5 is *D. formosa*, which can grow in dense shade and moist soils. This species will be useful for attracting hummingbirds and bumblebees (Brun 2016) and is seen growing throughout many of the lower portions of North Creek Forest. We plan to install 5 as plugs throughout the shadiest areas of the *T. plicata* understory.

AD26: No *C. obnupta* was planted in this polygon near the stream because the banks were very tough and filled with tree roots, and so excess erosion could be avoided.

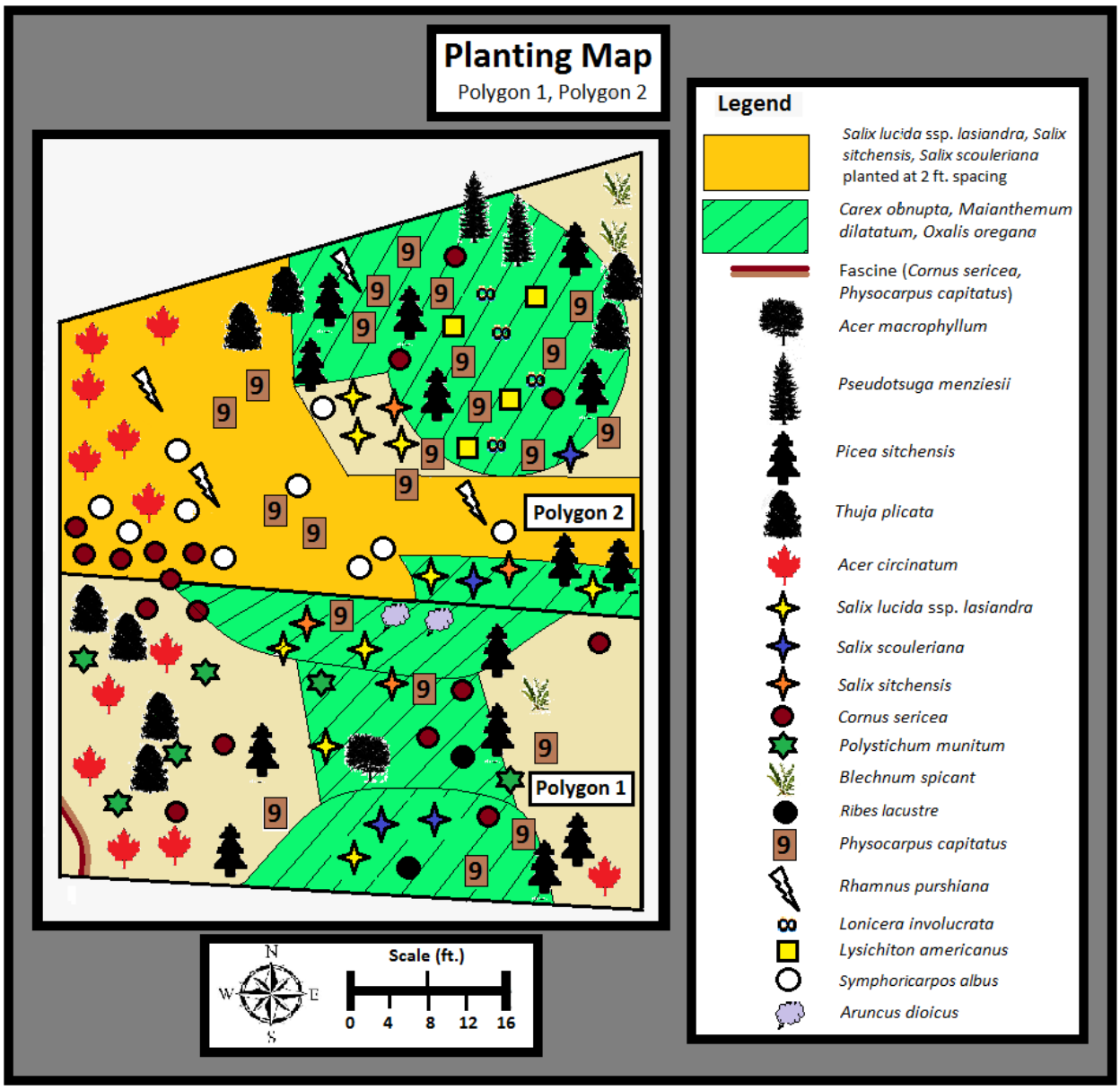
Trail: The trail that borders the eastern edge of the project site has been mulched over in order to provide access to UW-REN team members and volunteers. Within this mulch, we plan to install the fungi species *S. rugossa-annulata. S. rugossa-annulata* mycelium is a documented food source for bees (Stamets 2005). This fungi will also be able to absorb and filter water, as well as reduce the fecal coliform count in the surface water flowing from our site (Taylor *et al.* 2015, Stamets 2005, Thomas 2004). In order to grow this species, we will simply mix colonized wood chips into the existing wood chips on the trail in determined spots. Another fungal species that we plan to install along the trail is *P. ostreatus.* This species will help to increase fungal diversity within our site and will be a food source for *H. sapiens* as well as *A. columbianus* (Arora 1986). We will purchase colonized plugs and hammer them into a fallen *A. rubra* that is adjacent to the trail, and this species will eventually colonize the entire log.



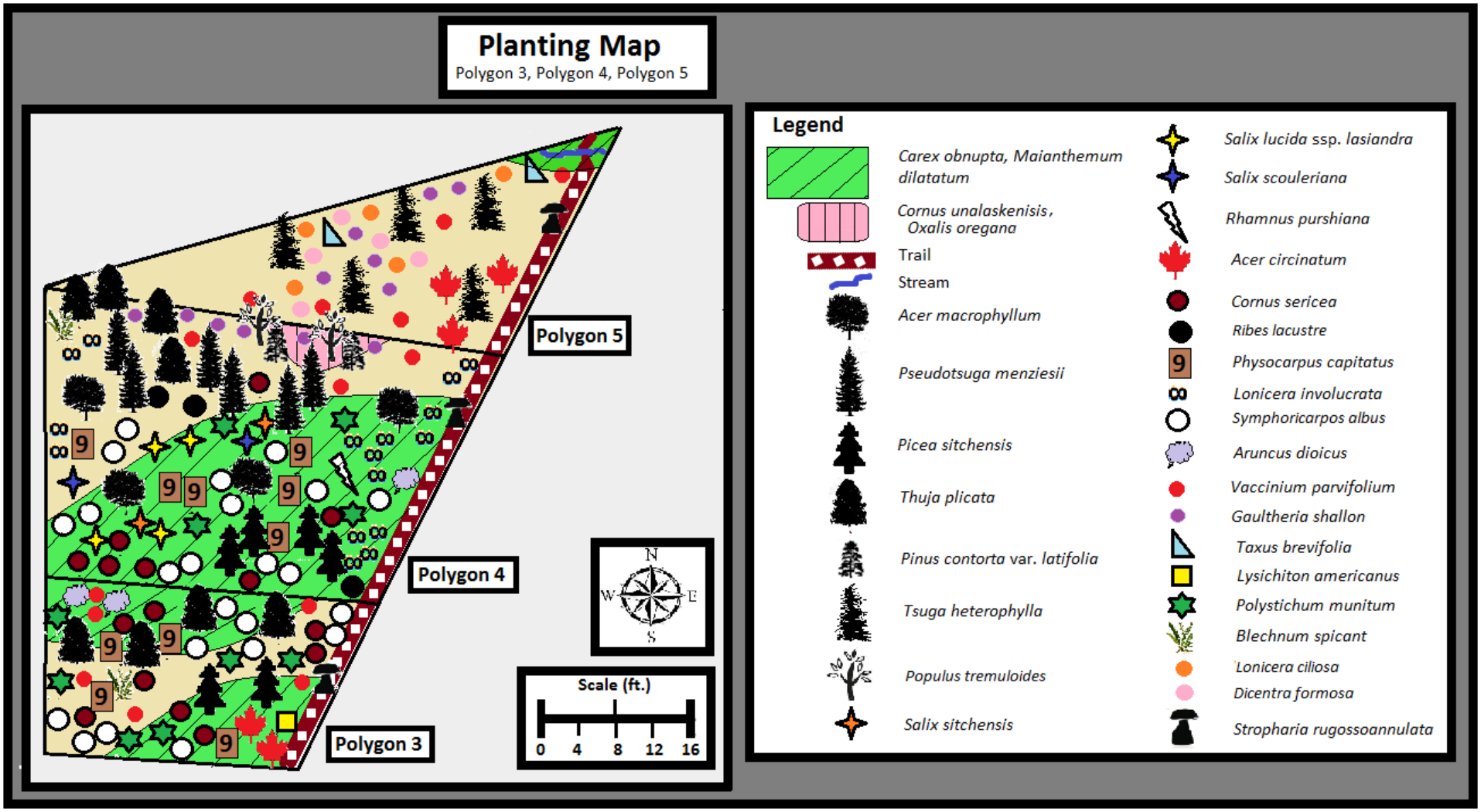
Map 3. Pre-restoration map showing invasive species cover on the site.



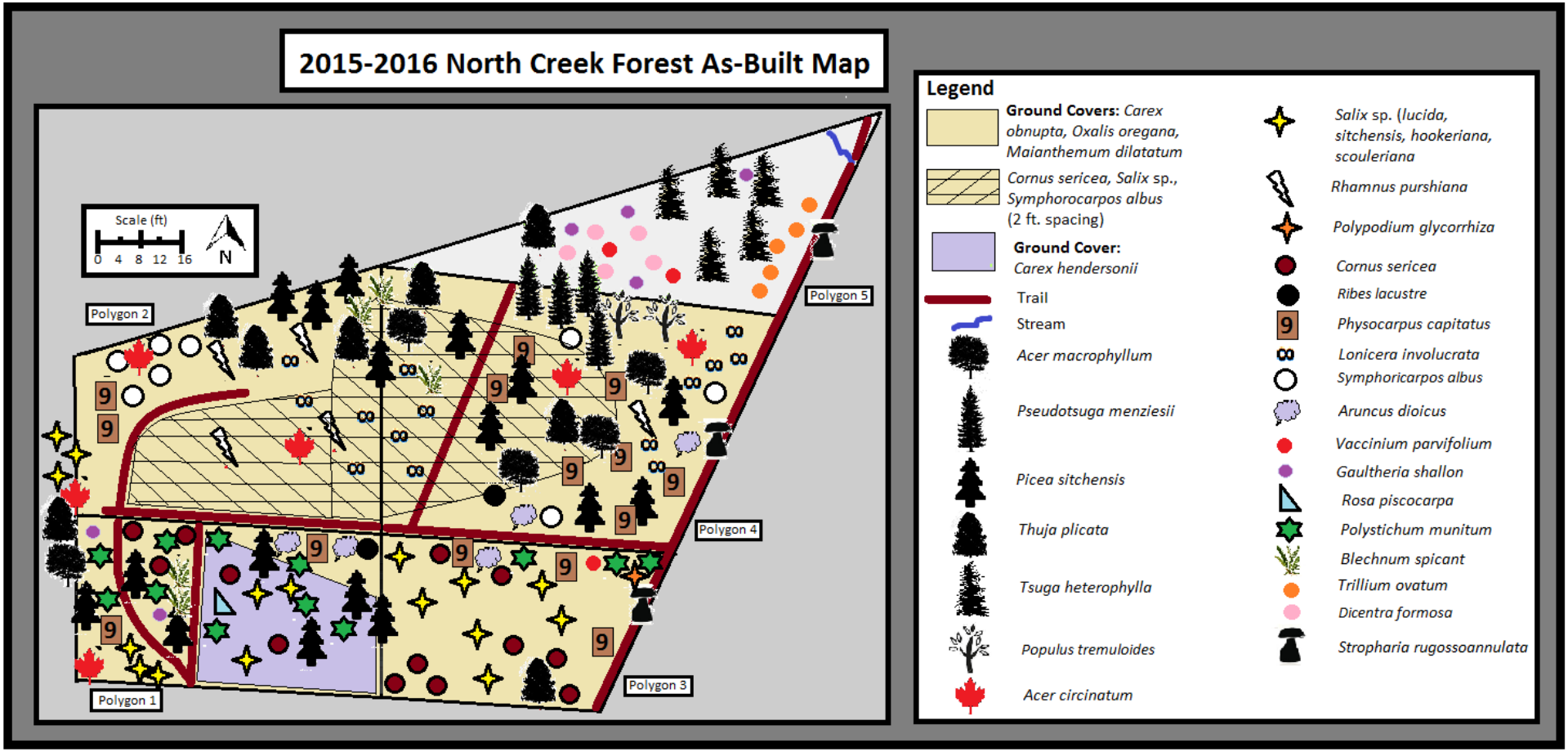
Map 4. Map showing pre-existing native vegetation cover on the site.



Map 5. Original Planting Map for Polygons 1 and 2.



Map 6. Original Planting Map for Polygons 3, 4, and 5



Map 7. As-built map showing locations of installed plant and fungi species on the site.

3. Habitat Structures Plan

We intend to install 12 hand built habitat structures within the project site based upon which locations will best encourage use by specified wildlife. We will install four bat boxes, two bird houses, five mason bee nests and two bumble bee nests. All wooden habitat structures will be made with assistance from a peer currently working as a professional carpenter.

Bat populations have been in decline over the past century due to habitat loss and being killed by humans (Allen 2003). In a study conducted in the UW Bothell Campus wetland, six bat species were confirmed to frequent that area located less than a mile from the southern border of North Creek Forest (Green 2009). The six bat species confirmed were *Eptesicus fuscus* (big brown bat), *Lasionycteris noctivagans* (silver-haired bat), *Myotis lucifugus* (little brown bat), *Myotis californicus* (california myotis), *Myotis yumanensis* (yuma myotis), *Myotis evotis* (long-eared myotis) (Green 2009). It is common for bats like these to roost in caves, snags or old growth trees in Pacific Northwest Forests (Allen 2003). Unfortunately the availability of habitat has decreased as old growth trees have been cut in the region. Attics, such as those in the neighborhood surrounding North Creek Forest can be very suitable roosting locations for bats (Allen 2003). Due to the lack of old growth trees in North Creek Forest and the chances that neighbors will eradicate bats from their attics we have chosen to implement bat roosting facilities.

AD27: We were unable to install the desired bat boxes during the duration of this course. Our current plan is to provide FNCF with instructions on how to build their own and where to properly install them.

We plan assist the recovery of bats by building four wooden four-chamber nursery style bat boxes that are built according to plans provided by *Bat Conservation International*'s Bat House Builder's Handbook (BCI 2015). These bat boxes are suitable for all 12 bat species that are present in the Pacific Northwest coast (Allen 2003). These structures will need to be placed in open areas where bats can fly freely. Having them located in open areas and painted a dark color will keep them warm during the winter (Allen 2003). The four-chamber nursery bat boxes will be placed back to back on two separate posts that are at least 15 feet tall to aid in protection from predators and encourage nursery colonies by having more space to roost (Allen 2003). One set of bat boxes will be placed in Polygon 2 towering above a *R. spectabilis* thicket and the other located on the border of Polygon 4 and Polygon 5. We have determined that these are the most ideal locations for the bat boxes because of the open canopy that will immediately surround them based on current vegetation conditions and on the expected future conditions concurrent with the planting plan.

AD28: In order to build *Bombus* sp. nest we have used moss instead of cotton balls.

We plan to build two separate wooden bird houses of different dimensions and specifications to accommodate different bird species. The boxes will be hung from existing *T. plicata* branches facing east, at least 6 feet above the ground. This placement will protect them from predators, provide additional cover, morning sun and protection from afternoon heat (Allen 2002). One of our bird houses will be built according to size specifications appropriate for *Aegolius acadicus* (Northern saw-whet owl) and *Megasc*ops *kennicottii* (Western screech owl). These two species are the targets we intend to

provide a habitat structure for because *M. kennicottii* has been observed in North creek forest and the dimensions and specifications of its habitat structure are identical to one built for *A. acadicus* (FNCF 2014, Allen 2002). The other bird house will meet specifications for *Poecile atricapillus* (black-capped chickadee) and *Poecile rufescens* Chestnut-backed chickadee). We have chosen to provide a habitat structure for these species because *P. aricapillus* and *P. rufescens* has been observed in nearby St. Edward's park by the East Lake Audobon Society (Koss 2006). One bird house will be placed in Polygon 2 and the other in Polygon 3.

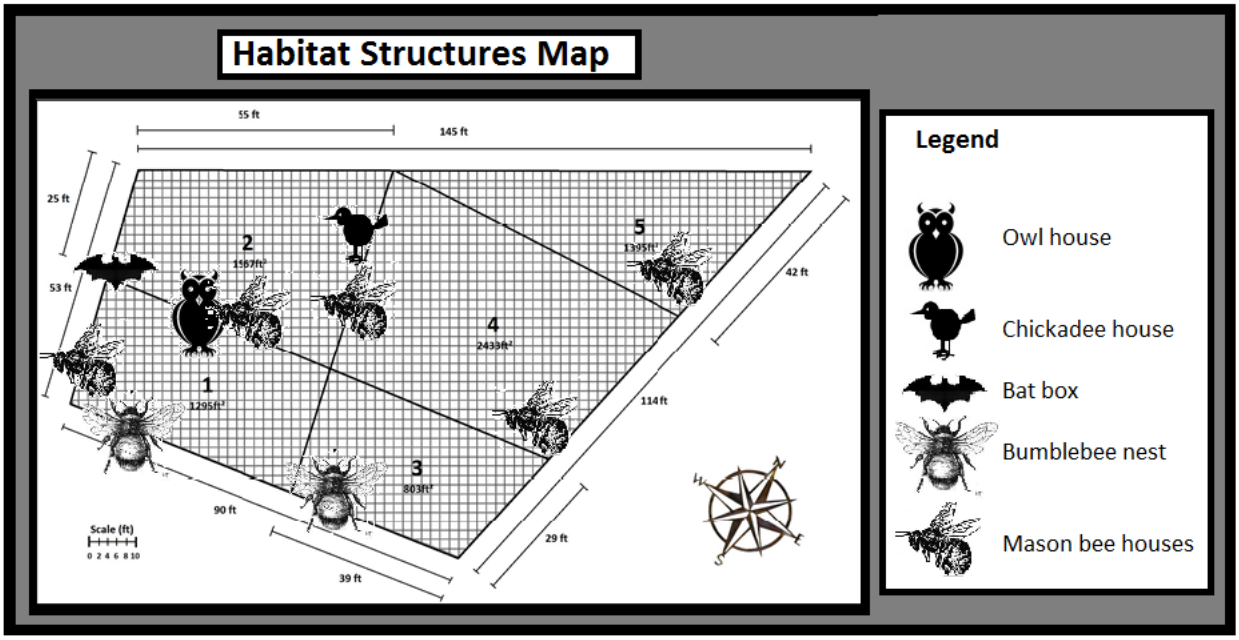
(For locations and dimensions of bird houses, see Map 8 & Table 4)

We will build 5 primitive *Osmia* sp. (mason bee) nests out of found materials. We have chosen an array of bee pollinated plant species as well as fungi species that are fed upon by bees to provide the appropriate food sources. These bees will typically nest in forests such as our site because they prefer dead wood to build nests in (Moissette 2011). After years of growth we expect ample nesting habitat for *Osmia* sp. but providing habitat structures in the meantime can encourage their presence in the forest immediately. Native pollinators such as *Osmia* sp. are excellent for pollinating native plants and this is necessary for plants to reproduce sexually and improve the genetic diversity of plant populations within the forest (Moisette 2011). The ecological benefits of attracting bees outweighs the dangers of maintaining populations near to trails. *Osmia* sp. are much less aggressive and docile in comparison to wasps or yellow jackets.

These *Osmia* sp. nests can be assembled simply out of the dead canes of *Polygonum cuspidatum* (Japanese knotweed) and twine. 8 inch sections of canes are bundled together and tied together with twine. These need to be in full sun at least 3 feet above the ground to provide sufficient heat (Carlton 2015). All of these nests can be fashioned to the mature *P. menziesii* or *A. macrophyllum* located in Polygon 5 with a continued southern exposure.

(For locations of mason bee nests, see Map 8)

We will also build nesting habitat for *Bombus* sp. (bumblebees) to encourage native pollinators on our site and all of the benefits that accompany that. *Bombus* sp. are one of the least aggressive bee species causing little conflict in locating their nests in an area that has trails for human use. Two *Bombus* sp. nests will be placed in the ground with one located in Polygon 1 and the other located in Polygon 3. These will need to be placed carefully in areas that will not become inundated and receive at least filtered shade (Nielson 2009). These nests can be simply fashioned out of 2 terracotta pots, chicken wire, one (5 ft.) section of hose, two small nails, and some cotton balls. One nest each will be placed in Polygon 1 and Polygon 3 because these are the most appropriate locations based upon environmental conditions for the nests. These areas will not become inundated and adequate shade is present.



Map 8. Revised map showing locations of installed habitat structures. The bat box was not installed, but the location marked on the map is where FNCF should install the box if they decide to make one.

4. Budget Plan

We have outlined our specific labor and financial budget needs in the two tables following this paragraph. For our financial budget the majority of the expenditures will be buying plants, with the majority of the cost being spent on plants for ground cover. We will try to acquire plants that can be salvaged or live staked since these are free, with salvage plants requiring some hours of volunteer labor to get. Some of the plants we get will be obtained from King and Snohomish Conservation District plants sales as low-cost bare root material. The total cost we are expecting to spend on acquiring plants is $403.33. We have also indicated in our financial budget table $219.20 for building materials to make our habitat structures. Our community partner will provide us with tools that are needed during labor work, thus, we do not need to rent any tools. Local tree companies such as NW Arboriculture will be donating wood chip mulch, which we believe will be enough for our project. As of now, we have received three truckloads of wood chip mulch donations, with the expectation that many more will be provided from the same company. Often times our community partner provides snacks and refreshments for the volunteer work party, therefore, we don't plan on spending money for refreshments. We have allotted $21.92 in our financial budget that will go towards the poster we will be producing toward the end of the project. This financial budget plan is broken down in our table outlining specific costs, and is based on rough estimates. Our labor budget table highlights the hours estimated for the team and for volunteers, and the total amount of hours for various aspects of labor activities. Some labor amounts may change.

Labor Budget

	Team Hours	Volunteer Hours	Total Hours
Site Preparation			
Site assessment	50	0	50
Garbage removal	~~14~~ 15	~~17~~ 30	~~31~~ 45
Mulching	~~38~~ 97	~~65~~ 305	~~103~~ 402
Silt fencing/fascines	20	0	20
Subtotal site preparation	~~122~~ 182	~~82~~ 335	~~204~~ 517
Invasive Plant Removal			
Rubus bifrons	~~54~~ 100	~~180~~ 249	~~234~~ 349
Hedera Helix	~~10~~ 40	~~35~~ 121	~~45~~ 161
Ilex aquifolium	~~3~~ 8	~~10~~ 19	~~13~~ 27
Subtotal invasive plant removal	~~67~~ 126	~~225~~ 411	~~292~~ 537
Plant acquisition			
Planning	~~20~~ 30	0	~~20~~ 30
Nurseries	15	0	15
Salvage	~~30~~ 15	0	~~30~~ 15
Live stake acquisition	20	0	20
Subtotal plant acquisition	~~85~~ 80	0	~~85~~ 80
Planting			
Polygon 1	15	~~8~~ 45	~~23~~ 60
Polygon 2	~~23~~ 21	~~10~~ 65	~~33~~ 86
Polygon 3	15	~~8~~ 45	~~23~~ 60

Polygon 4	~~32~~ 30	~~14~~ 91	~~46~~ 121
Polygon 5	~~5~~ 13	0	~~5~~ 13
Subtotal planting	~~90~~ 71	~~40~~ 269	~~130~~ 340
Hand Built Structures for Wildlife			
Planning	~~5~~ 24	0	~~5~~ 24
Building	~~40~~ 15	~~0~~ 44	~~40~~ 59
Subtotal hand built structures for wildlife	~~45~~ 39	~~0~~ 44	~~45~~ 83
Other			
Informing Local Residents and Students About Work Parties	~~15~~ 5	0	~~15~~ 5
Designing and Implementing a Monitoring Plan	~~55~~ 87	0	~~55~~ 87
Subtotal for Other Categories	~~70~~ 92	0	~~70~~ 92
TOTAL	~~479~~ 590	~~347~~ 1059	~~826~~ 1649

Financial Budget

Expenditures by Major Category	
Plants	Cost
Trees	~~$72~~ $77
Shrubs	~~$63~~ $68
Groundcover	~~$183~~ $188.68
Fungi	~~$50~~ $23.49
Subtotal Plants + tax	~~$403.33~~ 357.17
Mulch	$0
Subtotal Mulch	$0
Habitat Structures	$200
Subtotal Habitat Structures	~~$219.20~~ $0
Tool Rental	$0
Subtotal Tool Rental	$0
Printing	$20
Subtotal Printing	$21.92
Transportation	$0
Subtotal Transportation	$0
Project Total	~~$644.45~~ $379.09

Revenue by Fund Source	
Course fee allotment	$600
Total course fee allotment	$600
Cash Donations from CP	$500
Total cash donations	$500
Project Total	$1100

Work Timeline

Revised Timeline: Grey Square = Inactive, Dark Grey Column = Spring Break, Light Green Square = Planned, Orange Square = Actual

Task name	Category	Start: January 8	January 15	January 22	January 29	February 5	February 12	February 19	February 26	March 4	March 11	March 18	March 25	April 1	April 8	April 15	April 22	April 29	May 6	May 13	May 20	May 27	June 3
Task: Remove invasive species	Planned	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 25, Volunteer: 165	UW-REN: 15, Volunteer: 60	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 15, Volunteer: 0	UW-REN: 15, Volunteer: 0												
	Work Actual	UW-REN: 2, Volunteer: 0			UW-REN: 30, Volunteer: 90	UW-REN: 22, Volunteer: 75		UW-REN: 15, Volunteer: 0	UW-REN: 18, Volunteer: 90	UW-REN: 18, Volunteer: 0	UW-REN: 5, Volunteer: 32				UW-REN: 8, Volunteer: 62		UW-REN: 8, Volunteer: 62					UW-REN: N/A, Volunteer: N/A	
Task: Remove lumber and garbage from site	Planned	UW-REN: 10, Volunteer: 15	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 5	UW-REN: 5, Volunteer: 5																	
	Work Actual	UW-REN: 4, Volunteer: 7			UW-REN: 5, Volunteer: 8	UW-REN: 5, Volunteer: 12									UW-REN: 1, Volunteer: 3								
Task: Apply 8-12" Covering of Wood Chip Mulch Across Site	Planned	UW-REN: 30, Volunteer: 60	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 10, Volunteer: 10	UW-REN: 10, Volunteer: 10	UW-REN: 5, Volunteer: 5	UW-REN: 5, Volunteer: 5															
	Work Actual	UW-REN: 18, Volunteer: 45			UW-REN: 22, Volunteer: 55	UW-REN: 8, Volunteer: 28		UW-REN: 5, Volunteer: 0	UW-REN: 15, Volunteer: 35		UW-REN: 15, Volunteer: 46				UW-REN: 8, Volunteer: 62		UW-REN: 6, Volunteer: 34					UW-REN: N/A, Volunteer: N/A	
Task: Acquire plants to address planting tasks in work and planting plan	Planned			UW-REN: 5, Volunteer: 0	UW-REN: 6, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 1, Volunteer: 0							UW-REN: 1, Volunteer: 0	UW-REN: 1, Volunteer: 0	UW-REN: 1, Volunteer: 0	UW-REN: 1, Volunteer: 0						
	Work Actual					UW-REN: 16, Volunteer: 0		UW-REN: 8, Volunteer: 0	UW-REN: 6, Volunteer: 0	UW-REN: 18, Volunteer: 0	UW-REN: 15, Volunteer: 0			UW-REN: 8, Volunteer: 0	UW-REN: 4, Volunteer: 0	UW-REN: 3, Volunteer: 0	UW-REN: 2, Volunteer: 0						
Task: Planting (To address all planting tasks and objectives outlined in Work and Planting Plan)	Planned					UW-REN: 25, Volunteer: 40	UW-REN: 15, Volunteer: 0	UW-REN: 10, Volunteer: 0	UW-REN: 10, Volunteer: 0	UW-REN: 10, Volunteer: 0	UW-REN: 10, Volunteer: 0			UW-REN: 10, Volunteer: 0									
	Work Actual					UW-REN: 9, Volunteer: 0			UW-REN: 1, Volunteer: 0	UW-REN: 15, Volunteer: 0	UW-REN: 18, Volunteer: 98				UW-REN: 18, Volunteer: 45		UW-REN: 10, Volunteer: 126						
Task: Spread Mycelium-colonized wood chip mulch throughout determined area and inoculate logs	Planned								UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0						UW-REN: 10, Volunteer: 25						
	Work Actual																UW-REN: 15, Volunteer: 32						
Task: Install a Fascine on the Western Border of Polygon 1	Planned									UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0												
	Work Actual																						

Revised Timeline: Grey Square = Inactive, Dark Grey Column = Spring Break, Light Green Square = Planned, Orange Square = Actual

Task name	Category	Start	January				February				March				April					May					June
		8	15	22	29	5	12	19	26	4	11	18	25	1	8	15	22	29	6	13	20	27	3
Task: Build and install Hand-built bat and bee facilities to provide shelter	Planned													UW-REN: 15, Volunteer: 0	UW-REN: 10, Volunteer: 0	UW-REN: 10, Volunteer: 0	UW-REN: 10, Volunteer: 0						
	Work Actual													UW-REN: 12, Volunteer: 0	UW-REN: 9, Volunteer: 0	UW-REN: 18, Volunteer: 0	UW-REN: 6, Volunteer: 44						
Task: Design maintenance and monitoring plan	Planned													UW-REN: 10, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0					
	Work Actual													UW-REN: 15, Volunteer: 0	UW-REN: 15, Volunteer: 0	UW-REN: 12, Volunteer: 0	UW-REN: 10, Volunteer: 0	UW-REN: 35, Volunteer: 0					
Task: Implement maintenance and monitoring plan	Planned															UW-REN: 10, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	UW-REN: 5, Volunteer: 0	
	Work Actual																					UW-REN: N/A, Volunteer: N/A	

Financial Budget

The financial budget provided to us for the duration of the course gave us a great opportunity to learn how to balance the money available to us and to try and find ways to cut costs where possible without detracting from the overall quality of the project. Our original estimated total cost for the restoration project was $644.45. This included $403.33 for all plants (trees, shrubs, groundcover and fungi), $219.20 for materials to construct habitat structures and $21.92 for the printing of our poster that we would use to present our finished restoration project in June. All of these figures have the tax included. We ended up spending much less than we expected. Our final budget came to be $379.09, which is a savings of almost $300. This was due to our diligence in finding ways to limit spending wherever possible, as well as the very generous donations we received of mulch and plants over the restoration process.

What we learned regarding this is that we could and did save considerable money in various areas. For example, we spent $0 on habitat structures when our estimated cost was originally $219.20. Nick on our UW-REN team was able to procure all of the materials required for the structures that we installed on-site from old or unused materials. Another way we saved money was by attending the Issaquah Salvage Event in March, where we retrieved over one-hundred plants suitable for our site. The team also went out and collected almost one-hundred live stakes, which were all installed onsite. Our savings were considerable.

We must also consider the volunteers who donated so many hours of free labor to help with the restoration process. There was no possibility of paying laborers for their efforts because of the lack of available funding, so it was important to build relationships with those who came out to work with us so that we could maintain a strong workforce. The lesson learned here is that there are many people around the Bothell area who have a vested interest in nature and the environment and are happy to donate their time to help support a cause such as ours. Without their help, we certainly would not have such a great looking restoration site.

Labor Budget

Our work with the labor budget opened our eyes to a few things. The main lesson being that things always take longer than expected! In our planning near the start of the year we predicted that it would take less than 300 hours total to completely remove all invasives from the site. However, in actuality it took over 500 hours to finish with removal. Also, there are reemerged invasives already present onsite, which will increase the total amount of time for labor required throughout the course of maintenance. We highly underestimated the invasive re-emergence rate during the spring growing season. Some reemergence was expected to occur, but the level that was actually observed was far above what we predicted. We attribute this miscalculation to the deep mud covering their deep and extensive root systems, as well as the inexperience of the volunteers, which led to more roots being left in the ground than we accounted for. The mulching is another aspect that took a lot more labor hours than anticipated. Our original estimate was 103 hours. Mulching became a regular event during our work parties, with just about every single event having volunteers moving mulch with buckets and wheelbarrows. These hours added up significantly, with our total ending up at 402 hours combined volunteer and team hours.

Another lesson learned, regarding volunteers and the hours they contributed specifically, is just how quickly the total hours accumulate. We had several work parties and each had at least 20-30 volunteers. The Earth Day work party had over 100 volunteers! When you have so many people

working on tasks such invasive removal or mulching during a three or four hour period the total hours for tasks really add up. It is interesting to note that we were fairly accurate at estimating the amount time the UW-REN team alone would spend, but we were way off at predicting the amount of hours volunteers would contribute. Our estimated total of about 800 hours essentially doubled to around 1600 because of how much time volunteers spent on our site. This has helped us grasp the value of volunteer labor. For example, if we were required to pay our volunteers a hypothetical $10 per hour, they alone would have accounted for about $10,000 in labor costs, and our project budget in this case was only $1100. It would have been an additional $6000 if the UW-REN team was also being paid for their time. This high cost for such a small fraction of forest restoration would mean that it would most likely cost millions of dollars to restore the entirety of North Creek Forest, and this cost does not include the amount of money it took for the City of Bothell to purchase the actual land before having any work done. Building strong relationships with volunteers is imperative for organizations like Friends of North Creek Forest to continue their restoration operations, otherwise they would be unable to afford the costs associated with such laborious work.

Planting Plan

Our original planting plan only included a total of 377 plants to be installed throughout the site, but by the end of our project, we had installed 515. This initial number was assumed for multiple reasons. The first was that we overestimated the distance we would need between plantings. Because all of the plants were young and had not yet established in their new environment, there was the possibility of mortality that we did not take into consideration. We decided to decrease the spacing between installed plants (especially with live stakes) so that in the case that some of the desired plants were unable to survive, there would still be more available to take their place and fulfill the roles that we originally chose them for. The second reason that we estimated 377 plants is because we assumed that there would be a fairly high cost associated with purchasing the necessary plants. However, a large portion of the plants we received were either gathered from salvage or were donated to us for free, so this removed a significant amount of the expected costs. This allowed us to increase the density of planting without worrying about exceeding the allotted budget.

Most of the species that we originally wanted to install onsite were available for us to acquire and were installed. However, there were several changes that we had to make for different reasons. Instructor feedback was used to make the initial changes to our Planting Plan in which we added and removed species according to Warren's comments. We attempted to follow this revised version completely, but there were unforeseen circumstances that prevented us from doing so 100%. We were unable to obtain multiple plant species, including *Cornus unalaskensis, Lonicera ciliosa,* and *Pinus contorta* var. *latifolia*. This was due to their lack of nearby availability. We also added three plant species to our site not included in our Planting Plan which are *Trillium ovatum*, *Dicentra formosa*, *Carex hendersonii*. *C. hendersonii* was an accidental planting into our site. We misidentified this species at the Issaquah salvage event and thought it was *C. obnupta*, so we installed it onsite to fulfill those particular ecological duties. Luckily, Warren informed us that this species is not invasive and would not be detrimental to our site, so we left all 60 of them in the ground. The *T. ovatum* that we acquired was a replacement given to us by the SER Nursery because they were out of *L. ciliosa* which we had ordered from them. *T. ovatum* will be able to fulfill a similar role as a native groundcover species. Finally, *D. formosa* was another replacement species given to us from SER Nursery for *C. unalaskensis* that we purchased. There is a high number of this species throughout the more mature parts of North Creek Forest, so the environmental conditions in Polygon 5 should do well to host this species.

There was one particular plant we did not expect would become so dominant throughout the site and that is *Equisetum* sp. (horsetail). This species was minimal-to-nonexistent onsite when we first began to survey pre-existing vegetation in the fall of 2015, but it only first became visible aboveground in early-to-mid spring of 2016. It is now heavily abundant in Polygons 1-4, but still absent in Polygon 5. It is largest and the most abundant in the spots where moisture content is the highest and where there are wide canopy gaps, but it has still grown in partially-shaded areas as long as there is adequate moisture available. The lesson learned from this particular situation is that it would have been be far more revealing for our UW-REN team if we had been able to examine what the site was like through previous years or even just that previous spring. When we first started examining the landscape and the local vegetation, most of the foliage had already fallen off, so what was left available to study were the few evergreen species and the bare stalks and branches of various plants. Because many plants were entering dormancy, it was hard to judge how the site would look during the more productive seasons. Although the widespread horsetail does not seem to be causing any detrimental problems to the installed species and other local vegetation, it does not appear to be a cause for concern. However, it certainly would have been useful to know that *Equisetum* was present everywhere and that it was going to fill any empty spaces that we fill with installed species.

Fig. 2. Picture showing the access trail that acts as a border between Polygons 1 & 2 and Polygons 3 & 4. Horsetail is seen growing throughout all polygons of the site.

With regards to the actual planting onsite that we did, a big lesson we learned was how working with volunteers has both positive and negative impacts on the planting experience. Our first major planting

work party, hosted by our community partner Friends of North Creek Forest, occurred in March. The UW-REN team came with planting maps to direct where the species were chosen to be installed. However, we noted that some of the volunteers were inexperienced (or seemed somewhat uninterested) at putting plants in the ground. Doing so incorrectly may have potentially decreased the survival rate of species on our site. We did take time to give them a quick planting demonstration, but because there was such a high number of volunteers present, it is hard to know if all the plants were planted properly and in the right place. This may have had some effect on the overall plant dispersion and density, affecting the efficiency and execution of our desired site future. At times, it seemed as though relying on volunteers for plant installation was inefficient and that perhaps it would have been more productive if the UW-REN team took on the task alone.

With that said, there were some great positive aspects of having the volunteers available for planting at the work parties. At each work party, there were volunteers who had years of experience working with plants in one way or another, so they were able to contribute significantly. For example, one of the employees from Bartlett's Tree Experts was able to instruct our team on how to create mounds for trees being planted in highly saturated soils. This allowed us to plant several *P. sitchensis* in spots that we had marked in the Planting Plan but had found were actually too wet when it came to installation. Also, working with volunteers was a huge help with manpower. The number of volunteers almost directly correlated with the amount of work being done, especially at the start of the project when transportation of mulch and invasive removal were the two main tasks. Even very young volunteers were able to contribute in some way. Finally, having to communicate the project goals and the methods of implementation to volunteers was useful for reinforcing our knowledge of restoration ecology. It is one thing to do the research and come up with a plan, but it is another to detail that plan orally to a general audience. Communicating our restoration strategies to multiple audiences gave us a better understanding of what we were trying to achieve.

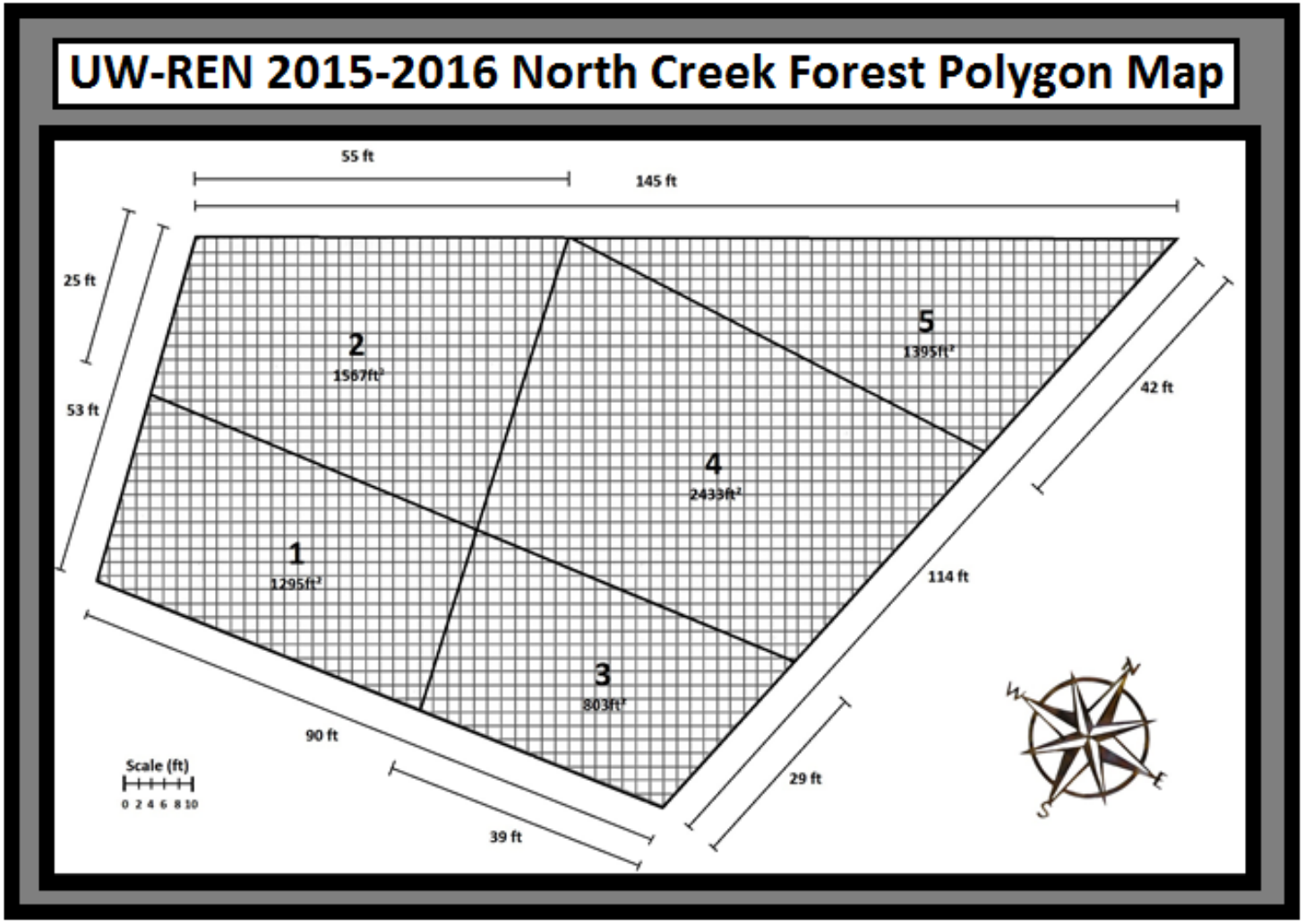
Plan for Future

After the initial restoration of our site into a functioning native forest, it will be monitored and protected against the return of invasive species by an ever-growing base of community volunteers under the guidance of FNCF. This will ensure the continued success of our site, which will give rise to a full canopy of mixed deciduous and evergreen species after 50 years. The lower canopy will be filled in with a variety of native species appropriate to the local environment, offering food and habitat to birds and small mammals. The forest floor will be held firm by a variety of native groundcover, preventing erosion and opening up the site for greater forest function. Our work dedicated to improving surface water and groundwater quality by the implementation of plants and fungi should reduce fecal coliform counts in water flowing into North Creek, a Tier 2 salmon-bearing stream.

The site will be available to be enjoyed not only by community members from the previously established trail, but also the diverse range of wildlife that will have called our manufactured habitat boxes home for generations. In 100-200 years, our site in North Creek Forest will be restored into a mature, native forest. Native vegetation will be abundant throughout canopy and groundcover layers, forming healthy thickets in matrices around maintained trails and wildlife paths. By this time natural habitats (bird nests, rodent burrows, native bee nests, etc.) will have replaced their artificial versions as local species become better established.

We also intend to inform community members of our restoration goals and hold volunteer days to acquaint them with the site. Getting people from the area who can become involved in the restoration will foster community appreciation and ensure that the site will be maintained in the long run by local residents. This continual maintenance will help to keep out invasive species whenever they may creep across the boundaries of NCF from neighboring private lands. We have confidence that the organization *Friends of North Creek Forest* and the surrounding community can provide excellent stewardship to the site based upon observations of their maintenance and monitoring of previous UW-REN sites within North Creek Forest, specifically: removal of invasive plants if they return, providing water to seedlings over the summer drought, and continued trail maintenance

Appendix A



Map 9. Map shows all polygons with dimensions and square footage.

Environmental Conditions Table

	Polygon 1	Polygon 2	Polygon 3	Polygon 4	Polygon 5
Soil Texture	-Silty Clay Loam with some grain	-Loam	-Silty Clay Loam	-Loam	-Silty Clay Loam
Soil Moisture	-Seasonally saturated -Moist on slope	-Seasonally saturated -Inundated depressions	-Seasonally saturated -Inundated depressions	-Seasonally saturated -Inundated depressions	-Slightly moist
Slope	Steep slope	Moderate slope	Gentle slope	Moderate-Gentle slope	Steep slope
Light Availability	Medium-deciduous shade	Medium-deciduous shade	Little to no canopy	Little canopy Some deciduous shade	Low Light, dense coniferous shade
Present Vegetation			See Appendix		
Human Impacts	-Construction debris -Borders private residence	-Construction debris -Borders private residence	-Walking Trail -Construction debris	-Walking Trail	-Walking Trail
Other Considerations		Swampy depression	Swampy depression		Creek channel

Table 1. Environmental conditions in polygons 1-5

Appendix B

Planting Plan Table

	Polygon 1			Polygon 2			Polygon 3			Polygon 4			Polygon 5			Total # Plants
Trees	**#**	**(ft.)**	**Form**	**#**	**(ft.)**	**Form**	**#**	**(ft.)**	**Form**	**#**	**(ft.)**	**Form**	**#**	**(ft.)**	**Form**	
Acer macrophyllum	1	8	1 gal.							4	8	1 gal.				5
Picea sitchensis	6	8	bare root	8	8	bare root	2	8	bare root	4	8	bare root				20
Pseudotsuga menziesii				~~3~~	~~8~~	~~bare root~~				~~6~~ 4	8	bare root				~~10~~ 4
Rhamnus purshiana				4	6	bare root				1	6	bare root				5
Salix lucida ssp. *lasiandra*	4	4	live stake	18	2	live stake				4	4	live stake				26
Thuja plicata	~~4~~ 1	8	1. gal container	~~4~~ 3	8	1. gal container & plugs	~~4~~1	8	1 gal. container	~~4~~ 2	8	~~1 gal. container~~plugs	1		plug	~~16~~ 8
Populus tremuloides										2	8	bare root				2
Tsuga heterophylla													5	8	bare root	5
Shrubs																
Salix scouleriana	2	4	live stake	15	2	live stake				2	4	live stake				19
Salix sitchensis	2	4	live stake	15	2	live stake				2	4	live stake				19
Acer circinatum	~~6~~ 1	4	Salvage & bare root	6	4	Salvage & ~~bare root~~	2	4	Salvage & bare root	3	4	Salvage and bare root				16
Oemleria cerasiformis	2	2	4 in container				2	2	4 in container	1	2	4 in container				~~10~~ 5
Cornus sericea	8	3	live stakes & bare root	~~17~~ 20	2	live stakes & bare root	8	3	live stakes & bare root	~~8~~ 14	3	live stakes & bare root				~~25~~ 40
Gaultheria shallon										6	2	~~salvage~~plugs	5	2	~~salvage~~plugs	11
Lonicera involucrata				4	2	~~live stake~~bare root				~~16~~ 6	2	~~live stake~~bare root				~~20~~ 10
Physocarpus capitatus	6	3	~~live stake~~bare root	16	2	~~live stake~~bare root	4	3	~~live stake~~bare root	~~6~~ 15	3	~~live stake~~bare root				~~21~~ 41

Ribes lacustre	~~3~~ 1	2	~~1 gal container~~salvage							~~3~~ 1	2	~~1 gal. container~~salvage				~~5~~ 2
Symphoricarpos albus				10	2	live stakes & bare root	10	2	live stakes & bare root	~~13~~ 15	2	live stakes & bare root				~~21~~ 35
Vaccinium parvifolium							4	3	salvage	3	3	salvage	5	3	salvage	12
Groundcover																
Bicchoun spicant	1	1	plug	2	1	plug	1	1	plug	1	1	plug			plug	5
Carex hendersonii	60	1	salvage													60
Carex obnupta	~~50~~ 0	1	plug/salvage	50	1	plug/salvage	50	1	plug/salvage	~~40~~ 50	1	plug/salvage	~~10~~ 0		~~Plug/salvage~~	~~100~~ 150
Cornus unalaskensis										~~5~~	~~1~~	~~plug~~				~~5~~
Lysichiton americanum	~~-~~	~~-~~	~~-~~	~~4~~	~~2~~	~~salvage~~	~~1~~	~~2~~	~~salvage~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~6~~
Myrotheroum dilatatum	4	1	plug	6	1	plug	2	1	plug	8	1	plug				20
Oxalis oregana	3	1	plug/salvage				3	1	plug/salvage	4	1	plug/salvage				10
Polystichum munitum	6	3	salvage	5	3	salvage	5	3	salvage	5	3	salvage				21
Dicentra formosa													5	1	~~4 in. container~~plugs	5
~~*Lonicera ciliosa*~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~5~~	~~1~~	~~plug~~	~~5~~
Trillium ovatum													5	2	plugs	5
Fungi																
~~*Strapharia rugoso-annulata*~~							1	N/A	colonized wood chips	1	N/A	colonized wood chips	1	N/A	colonized wood chips	30 gal.
~~*Pleurotus ostreatus*~~							25	N/A	plug spawn	25	N/A	plug spawn				50 plugs
~~**Stakes for Fascines**~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~
~~*Cornus sericea*~~	~~20~~	~~N/A~~	~~live stake/whips~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~20~~
~~*Rhycocarpus capitatus*~~	~~20~~	~~N/A~~	~~live stake/whips~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~-~~	~~20~~

Table 2: Planting Plan Table for Polygons

General Materials Table

Task	Material	Qty	Source		Task	Tools	Qty	Source
1-1A	~~50 gal. buckets~~ 35 gal. buckets	4	UWB Facilities		1-2A	Loppers	5	CP
1-1A	Tarp	1	CP		1-2A	Clippers	5	CP
1-1A	Gloves (pairs)	50	CP		1-2A	Shovels	30	CP
1-1B	Mulch	TBD	Northwest Arboriculture & City of Bothell Boy Scouts Bartlett's Tree Experts		1-1B	Shovels	30	CP
1-1B	Plants	~~316~~ 515	~~Various~~ Fourth Corner Nursery Bartlett's Tree Experts Issaquah Salvage Event Snohomish Conservation District King Conservation District SER Nursery Stormlake Growers		1-1B	Gloves (pairs)	50	CP
1-1B	Marking Tape	1	Us (purchase)		1-1B	Wheelbarrows	1	CP
					1-1B	5 gal. buckets	25	CP
1-2B	Mulch	TBD	Northwest Arboriculture & City of Bothell Boy Scouts Bartlett's Tree Experts		1-2B	Gloves (pairs)	50	CP
					1-2B	Wheelbarrows	1	CP
					1-2B	5 gal. buckets	25	CP
1-2C	Live stakes	40(+)	Us (gather at various sites)					
1-3A	Plants	~~316~~ 515	~~Various~~ Fourth Corner Nursery Bartlett's Tree Experts Issaquah Salvage Event Snohomish Conservation District King Conservation District SER Nursery Stormlake Growers		1-3A	Gloves (pairs)	50	CP
1-3A	Marking Tape	1	Us (purchase)		1-3A	Wheelbarrows	1	CP
					1-3A	Shovels	30	CP
2-1B	Plants	~~316~~ 515	~~Various~~ Fourth Corner Nursery Bartlett's Tree Experts Issaquah Salvage Event Snohomish Conservation District King Conservation District		2-1B	Gloves (pairs)	50	CP

			SER Nursery ~~Stormlake~~ Growers					
	Marking Tape	1	Us (purchase)		2-1B	Wheelbarrows	1	CP
					2-1B	Shovels	30	CP
			~~Various~~ Fourth Corner Nursery Bartlett's Tree Experts Issaquah Salvage Event Snohomish Conservation District King Conservation District					
2-2A	Plants	~~216~~ 515	SER Nursery ~~Stormlake~~ Growers		2-2A	Gloves (pairs)	50	CP
	Marking Tape	1	Us (purchase)		2-2A	Wheelbarrows	1	CP
					2-2A	Shovels	30	CP
			~~Us (purchase)~~					
2-3B	Plugs	50	Fungi Perfecti ~~LoPaPeu~~		2-3B	Gloves (pairs)	50	CP
2-3B	Colonized mulch	30 gal.	Us (in possession)		2-3B	Wheelbarrows	1	CP
					2-3B	5 gal. buckets	25	CP
					2-3B	Hammer	1	CP
			~~Various~~ Fourth Corner Nursery Bartlett's Tree Experts Issaquah Salvage Event Snohomish Conservation District King Conservation District					
3-1B	Plants	~~216~~ 515	~~Stormlake~~ Growers		3-1B	Gloves (pairs)	50	CP
3-1B	Marking Tape	1	Us (purchase)		3-1B	Wheelbarrows	1	CP
					3-1B	Shovels	30	CP
			~~Various~~ Fourth Corner Nursery Bartlett's Tree Experts Issaquah Salvage Event Snohomish Conservation District King Conservation District					
3-3B	Plants	~~216~~ 515	SER Nursery ~~Stormlake~~ Growers		3-3B	Shovels	30	CP
3-3B	Marking Tape	1	Us (purchase)		3-3B	Gloves (pairs)	50	CP
			~~Us (purchase)~~					
3-3B	Plugs	50	Fungi Perfecti ~~LoPaPeu~~		3-3B	Wheelbarrows	1	CP
3-3B	Colonized mulch	30 gal.	Us (in possession)		3-3B	5 gal. buckets	25	CP
					3-3B	Hammer	1	CP

Table 3: General Materials Table Showing Materials Used for Work Done on Site with added revisions

Appendix C

Habitat Structures Materials Table					
Structure	Materials	Material Size	Material Specs.	Quantity	Source
~~4 Bat Boxes~~	~~Plywood~~	~~(4'x4') 1/2"~~	~~AC or BC or T1-11 (outdoor grade)~~	~~1 ea.~~	
	~~Plywood~~	~~(4'x4') 3/8"~~	~~AC or BC (outdoor grade)~~	~~1 ea.~~	
	~~Wood~~	~~1"x6" (3/4"x5-1/2" if finished)~~	~~Pine or Cedar~~	~~4 ea.~~	
	~~Screws~~	~~1-5/8"~~	~~Coated deck or (exterior grade)~~	~~2 lbs.~~	
	~~Screws~~	~~1-1/4"~~	~~Coated deck or (exterior grade)~~	~~40-50 ea.~~	
	~~Screws~~	~~1"~~	~~exterior grade~~	~~40-50 ea.~~	
	~~Dark Stain~~	~~(water based)~~	~~exterior grade~~	~~2 quarts~~	
	~~Primer~~	~~(water based)~~	~~exterior grade~~	~~2 quarts~~	
	~~Flat (paint or stain)~~	~~(water based)~~	~~exterior grade~~	~~4 quarts~~	
	~~latex caulk~~	~~N/A~~	~~paintable~~	~~2 tubes~~	
	~~Black asphalt shingles or galvanized metal~~	~~12"x40'~~	~~black asphalt / galvanized~~	~~1~~	
	~~post~~	~~> 15' (4"x4")~~	~~Cedar/redwood/treated~~	~~2~~	~~Hardware Store / Donation~~
	~~Roofing nails~~	~~7/8"~~	~~roofing~~	~~24-40~~	
2 Bird Houses	Wood screws	1-1/4"	galvanized	40-50	
	Plywood or Cedar/Redwood	(4'x4')5/8" or (4'x4')1"	untreated exterior	1	Hardware Store / Donation
	Staples	standard	exterior grade	20-30	

	Moss and bark	N/A	N/A	N/A	salvage
2 Bumblebee nests					
	chicken wire	8"x8"	N/A	1	Hardware Store / Donation
	terra cotta pots	4-5" diameter	exterior grade	2	
	hose	5' section	rubber/exterior	1	
	nails	small	exterior grade	2	
	moss ball	8" diameter	dry	1	salvage
5 Mason Bee Nests					
	~~Polygonum cuspidatum~~ canes	8" sections	dead	125	salvage / gather
	twine	any	exterior grade	1 roll	Hardware Store / Donation

Table 4: Materials Needed for Building Habitat Structures on Site with added revisions

Birdhouse Specifications Table							
	Species	**Bottom**	**Top**	**Side Height**	**Entrance Diameter**	**Distance of Entrance From Floor**	**Placement**
Birdhouse 1	*Aegolius acadicus* *Megascops kennicottii*	8"x8"	12"x8"	12"-15"	3"	9"-12"	10-20ft high in forest near stream or wetland
Birdhouse 2	*Poecile atricapillus* *Poecile rufescens*	4"-5.5"	8"-5.5"	8"	1"-1.15"	7"	6-15ft high at the edge of a forest

Table 5. Shows appropriate dimensions of wooden birdhouses for desired species (Allen *et al.* 2002)

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