North Creek Forest Stewardship Plan 2014-2015
Bothell, Washington

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Project Description

The restoration site is located along the western edge of North Creek Forest. The site is approximately 1/3-acre in size and is currently a second-growth forest composed primarily of mixed deciduous/conifer overstory with an understory made up of species commonly associated with second-growth forested riparian sites in the western hemlock ecoregion. The dominant canopy layer includes red alder (*Alnus rubra)* and big-leaf maple (*Acer macrophyllum)*. It has a dominant shrub layer composed primarily of salmonberry (*Rubus spectabilis)*, sword fern (*Polystichum munitum*), and vine maple (*A. circinatum*). The site has elements representative of the wetland, riparian, and upland forested areas found throughout the lower Puget Sound region. Groundwater flows out of a culvert and is cutting through the southern third of our site forming a stream. Groundwater also seeps from the steep slope and is known to be present throughout most of the year (FNCF 2011). A significant portion of the site is located on this steep slope.

Prior to restoration, the site was invaded by three main invasive species including English ivy (*Hedera helix),* Himalayan blackberry *(Rubus discolor)*, and English holly (*Ilex aquifolium*) (see invasive species map). These invasive plants were beginning to dominate the western portion of the site and inhibit the forest from reaching a diverse late successional stage. The first goal was to protect and enhance the establishment of the low-elevation western hemlock forest community within the site. A concentrated effort was made to remove the English ivy and the Himalayan blackberry. Both these invasive species were located on the steep slope portion of the site in polygons one and three. Their removal along with the disposal of the yard waste pile in polygon one created unstable slope conditions. To mitigate for this condition pacific willow (*Salix lucida*) and red osier dogwood (*Cornus sericea*) fascines and wattles were constructed and installed along the slope. Goal two comprised of enhancing the forest ecosystem function and species diversity. A variety of native species was planted and a 15 centimeters (6 inches) thick layer of mulch was applied over the entire site. The English holly (*Ilex aquifolium*) will need to be removed at a later time as the restoration team does not have the authority to use herbicides and they are too large to be removed manually. Goal three was to encourage both short and long-term community involvement. This site restoration could not have been completed without the help of volunteers, so it’s important that stewardship continues.

Post-Installation Site Description with As-Built Map

Polygon One:

Polygon one is located to the east of the residential neighborhood and closest to the 108th NE. The upland area of the site is flat and slopes eastward into the forest for about 12 meters. Himalayan blackberry was the dominant invasive species removed. The yard waste pile along the slope was removed subsequently the slope was stabilized by installing fascines. The fascines were constructed with a mix of pacific willow and red-osier dogwood then staked into a furrow contoured into the hill. Erosion control plants such as sword fern (*P. munisticum)* and Pacific ninebark (*Physocarpus capitatus*) were also installed to help with erosion control and stabilization. These plants develop strong root systems that stabilize the slope by retaining sediment (Dept. of Ecology).

At the request of the community a clump of Himalayan blackberry remains on the southern end of the polygon. A barrier of fill dirt and a vegetation buffer of willow and red osier were installed between the blackberries and the planted native species. The flat upland area was planted with, baldhip rose (*R. gymnocarpa*) and Nootka rose (*R. nutkana*), a variety of berry producing plants such woodland strawberry (*F. vesca*), red-flowering currant (*R. rubrum*), red elderberry (*S. racemosa*), and twinberry (*L. involucrata*). Mulch was applied throughout at a depth of 15 centimeters throughout the polygon. A trail was outlined from the street to the kiosk and over to the stairs to protect the plants from being stepped on.

Polygon Two:

Polygon two is mostly flat and spans from the trailhead north up to the neighbor's yard. Prior to restoration this area was densely covered by lawn grass. The current dominant vegetation buffer that was planted is oceanspray (*H. discolor*) and Pacific ninebark (*P.capitatus*). Mulch was spread at the appropriate depth of 15 centimeters. A large area was mulched, but not planted to provide a gathering area for volunteer and education events.

Polygon Three:

Polygon three is defined by a steep sixty-degree slope that tapers off into the flat area, which becomes polygon four. The trail makes up the southern border of this polygon. The red alder tree canopy as well as the slope were invaded by English ivy, forming a monoculture. The ivy's removal was done by digging out the root system and pulling out the whole plant. Ivy growing up the red alder trees was removed from the ground up, cut at shoulder height, and removed. This ensures that the ivy does not get any water supply for continued growth up the tree. Fascines were constructed as in polygon one to stabilize the slope, reduce erosion, and increase sediment accumulation. The fascines here are composed of a mix of Pacific willow, red osier dogwood, Pacific ninebark, and salmonberry. Wattle fences were built using woody debris and firewood found on-site. Sword fern, red osier dogwood, and Pacific ninebark are among the slope stabilizing

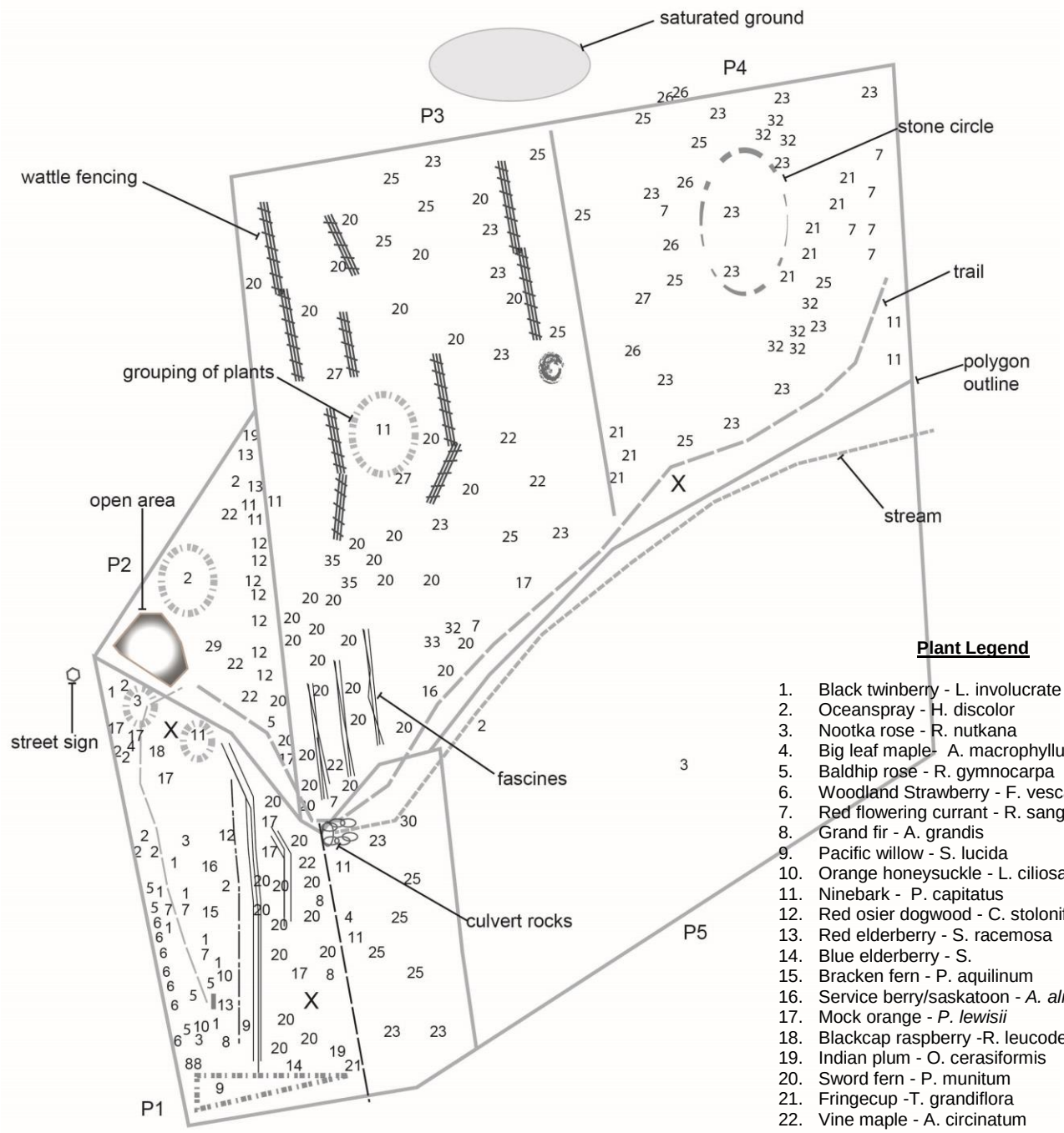
plants installed for their fibrous root qualities. The entire polygon was covered in 15 centimeters of mulch.

Polygon Four:

Polygon 4 is bound by the trail on both sides. It is distinguishable by its relatively flat topography. It has almost no invasive species within its boundaries. The few Himalayan blackberries that occurred on the understory of the site were removed by digging out the roots. In this polygon, the majority of the trees planted were late successional such as western hemlock (*Tsuga heterophyla*) and western red cedar (*Thuja plicata*). Groundcover such as Pacific bleeding heart (*Dicentra formosa*) and fringecup (*Tellima grandiflora*) were placed to enhance plant diversity. A circular gathering area was mulched 15 centimeters and decoratively outlined using stones for use as an interactive educational gathering area.

Polygon Five:

This polygon is located south of the stream and north of the informal trail to Jim Freese's house. This polygon acted as a reference because it has the most intact canopy and is the least disturbed part of our site. Invasive plant species inside this polygon included Himalayan blackberry, English Holly, and European mountain ash (*Sorubus aucuparia*). The Himalayan blackberry was removed by digging out the roots for the best control. Western hemlock and western red cedar were installed with the goal to promote a late successional stage conifer forest as well as provide shade and deter the regrowth of any invasive species. Areas adjacent to the trail that had Himalayan blackberry removed were mulched to 15 centimeters.



Plant Legend

1. Black twinberry - L. involucrate
2. Oceanspray - H. discolor
3. Nootka rose - R. nutkana
4. Big leaf maple- A. macrophyllum
5. Baldhip rose - R. gymnocarpa
6. Woodland Strawberry - F. vesca
7. Red flowering currant - R. sanguineum
8. Grand fir - A. grandis
9. Pacific willow - S. lucida
10. Orange honeysuckle - L. ciliosa
11. Ninebark - P. capitatus
12. Red osier dogwood - C. stolonifera
13. Red elderberry - S. racemosa
14. Blue elderberry - S.
15. Bracken fern - P. aquilinum
16. Service berry/saskatoon - *A. alnifolia*
17. Mock orange - *P. lewisii*
18. Blackcap raspberry -R. leucodermis
19. Indian plum - O. cerasiformis
20. Sword fern - P. munitum
21. Fringecup -T. grandiflora
22. Vine maple - A. circinatum
23. Western red cedar - T. plicata
24. Pacific bleeding heart - D. formosa
25. Western hemlock -T. heterophylla
26. Deer fern - B. spichant
27. Oregon grape - M. nervosa
28. Red huckleberry - *V. parvifolium*
29. Douglas fir - *P. menziesii*
30. Devil club - *O. horridus*
31. Maidenhair fern - *A. pedatum*

Map 1- As-Built Map

Maintenance Plan:

The success of restoration efforts depends largely on continued maintenance after the initial plant installation. The key areas of maintenance will be plant care, invasive removal, structural sustainment and signage up-keep. Goal one was to establish the native species and develop a late-successional western hemlock forest; therefore, the most effort will be put into watering and removal of encroaching invasive species to allow for maximum success of planted natives. Introduction of a palette of diverse species was the second goal and will help establish new plant and animal interactions. New relationships will also be introduced in the ecosystem. This maintenance plan is all encompassing, striving to cover both known and unknown possibilities in furthering the restoration of this site.

I. Plant Care

1. Watering

A) Polygon one and two

Why: The plants in this area receive direct sunlight during the hottest parts of the day, so they require more watering than other areas on site. Additionally, these polygons are situated at the top of the slope resulting in soils, which drain water rapidly, making these areas drier than the lower sites. Plants need watering for two to three years after planting to establish sufficient root systems in these polygons. The first growing season after their installation will be the most influential on the survival rates. Watering each plant deeply a few times a week will help the plants to establish long deep roots which will be able to reach water without assistance after two to three years (personal communication Warren Gold 2014).
Where: Throughout polygon one and two.
When: Water two to three times a week, deeply at the base of each plant from May-September, unless there has been sufficient rain. Watering is best when done in the morning, before the hottest hours of the day, preferably before 11am. If watering in the morning is not feasible, watering in the evening is also an option; however, this means that plants will be wet overnight therefore increasing the risk of fungus and molds, which are detrimental to the plant. Stress from lack of or too much water may be seen in leaves wilting or as leaf scorch (Chalker-Scott 2007). However, ideally, watering will be done before signs of stress are shown. If the watering methods are thought to be unsatisfactory for the plants, assess the moisture levels of the soil. The moisture level of the soil can be assessed easiest by feeling a handful of soil from around the plant. If the soil is dry, it will break apart and leave no stain on the hand. When the soil is optimally moist, it will be able to be formed into a ball which stays together and leaves a stain of moisture on the hands. If there is too much moisture, excess water will drip out of the ball of soil.
Resources & Tools: A hose is connected to the tap at the headquarters of Friends of North Creek Forest. Extension hoses are placed at the top of the slope and at the lower

end of polygon four. Nozzles are on each hose end and should remain set on the 'shower' setting.
How: Connect the main hose at the top of the stairs to the extension hose. Navigate the hose by keeping it on the path, making sure to not drag the hose over any of the plants. While watering, continue to check to make sure that the length of the hose is not damaging any installed plants. Gently, water the plant at the base, getting as little foliage wet as possible. To water deeply, fill the basin around the plant with water to the drip line, slowly allow the water to drain into the soil. Repeat this step three times before moving on to the next plant.

B) Polygon three, four, and five

Why: The plants installed in these polygons receive low to partial sun exposure and have wet to moist soils. For these reasons, these polygons will require less watering for the plants to establish. However, many of the species installed here have higher moisture requirements and should be monitored to ensure they receive enough water throughout the summer months (see moisture level assessment techniques described in the section above).
Where: Polygons three, four, and five.
When: Water each plant in these polygons once per week, deeply at the base of each plant.
Resources & Tools: A hose is connected to tap at the headquarters of Friends of North Creek Forest. Extension hoses are placed at the top of the slope and at the lower end of polygon four. Nozzles are on each hose end and should remain set on the 'shower' setting. Gallon buckets at the FNCF headquarters are also available if necessary for areas the hoses will not reach.
How: See deep watering techniques described above. It should be noted that the larger conifers planted require more water, it may be more beneficial to leave the hose running at the base of the plant for a period of 5-10 minutes.

2. Mulching

A) Entire Site

Why: The purpose of mulching is to retain soil moisture, suppress invasive species, and prevent erosion of the soil. Mulch can impede the movement of water or falling precipitation and thus allow for better recharge into water table (Chalker-Scott 2007). Maintain a depth of 15 centimeters for a period of at least a year to provide maximum benefits to the site. Additionally, maintaining a "donut'" shaped or ring of mulch around the installed plants will be beneficial to the plant by retaining moisture and preventing weeds from competing with the installed species.
Where: In all open areas of the site and around installed plants.
When: Areas of high traffic and areas on the slope may need re-application of mulch more frequently.
Resource & Tools: Order mulch at least a week ahead of time from NW Arboriculture (see Appendix). Acquire wheelbarrow, pitchforks, gloves and buckets for use from the FNCF headquarters shed.
How: The goal for our project is to have a layer of mulch of 15 centimeters over the entire site. Use buckets and wheelbarrows to move mulch to areas needing additional coverage, then spread with rakes.

3. Replacing Dead Plants

A) Trees

Why: As plants die, some will need to be replaced to maintain the desired native species abundance for the site. Trees provide essential ecosystem services like slope stabilization, canopy cover to out-shade invasive species, structural diversification, and habitat for animals.
Where: Use monitoring plots to determine percent cover of invasive species to native coverage. Based on conditions of monitoring plots, adapt planting measures to the rest of each polygon. Search for plants that have dead to yellow/brown leaves throughout the all polygons of the site.
When: Based on baseline monitoring plots, thirty percent native coverage is desired for polygon two and four, forty percent for polygons one and three in the first year; the desired percentage of native cover should increase each year. If percent of native cover does not increase after three to five years and/or invasive cover increases, take measure to increase natives with new plants and decrease invasive species by removal. Species are listed by priority based on the goals for their abundance in the forest.

- **Big-leaf Maple**: priority: moderate. Important areas to replant are: Polygon one and two.
- **Douglas fir:** priority: low. Important areas to replant are: Polygon two.
- **Grand fir:** priority: high. Important areas to replant are: Polygon one and two.
- **Western hemlock:** priority: high. Important areas to replant are: Polygon three, four, and five.
- **Western red cedar:** priority: high. Important areas to replant are: Polygon three, four, and five.

Resources & Tools: Acquire needed plants from native nursery suppliers or salvage events. Suggested suppliers are Go Natives! Nursery in Shoreline and King County or Snohomish County Conservation District at their annual plant sale. Shovels and gloves can be obtained from FNCF headquarters. The water spigot is located at FNCF headquarters as well. The hose is located on site and buckets can be used to water plants out of reach of the hose. Mulch will either be on site, or need to be ordered.

How: The planting method will depend on the type of plant obtained; bare-root, container, or live stake. The roots of bare root plants will be untangled and soaked in water until planted; care must be taken to not let the roots dry out. A shallow, wide hole large enough to fit the plant's roots will be dug. The plant will be inserted then the hole will partially filled, tamped down, and filled to the root crown to prevent impaired growth. Container plants will be removed from the container, the root ball will be broken up to expose the roots and most of the soil should be shaken off. If roots are curving they should be straightened out and encircled roots should be cut off where they begin to circle. The plant will be placed in the hole previously dug and the roots arranged to point outward (like the spokes of a bicycle). The hole will be partially filled with soil, tamped down, filled completely with soil, and then tamped down again. All plants will need to be watered thoroughly after planting (for more specific watering instructions see above watering section). Live stakes of willow should be harvested in the fall by cutting a three-

foot section of branch about a thumb's width. Install live stakes by burying them 1-2 feet into the ground. Take care to not let live stakes dry out between harvesting and installation. Keep live stakes moist and water well after planting for maximum success (Chalker-Scott 2007).

B) Shrubs

Why: As plants die, some will need to be replaced to maintain desirednative species abundance for the site. Shrubs provide important ecological benefits such as habitat, food for birds and small mammals, slope stability, and a physical buffer from invasive species.
Where: Use monitoring plots to determine percent invasive to native coverage. Based on conditions of monitoring plots, adapt planting measures to the rest of each polygon. Search for plants that are dead or have yellow/brown leaves throughout the all polygons of the site.
When: Based on monitoring plots, thirty percent native coverage is desired for polygon two and four, forty percent for polygons one and three in the first year; the desired percentage of native cover should increase each year. If percent of native cover does not increase after three to five years and/or invasive cover increases, take measure to increase natives with new plants and decrease invasive species by removal.

- **Beaked Hazelnut:** priority: moderate. Important areas to replant are: polygon two andthree.
- **Black Twinberry**: priority: high. Important areas to replant are: polygon one and two.
- **Blackcap Raspberry**: priority: low. Important areas to replant are: polygon one.
- **Baldhip rose**: priority: high. Important areas to replant are: polygon one and two.
- **Cascara**: priority: low. Important areas to replant are: polygon three.
- **Devils Club**: priority: low. Important areas to replant are: polygon one.
- **Dull Oregon grape**: priority: moderate. Important areas to replant are: polygon three.
- **Mock Orange**: priority: high. Important areas to replant are: polygon one and three.
- **Nootka rose:** priority: high. Important areas to replant are: polygon one and two.
- **Oceanspray:** priority: high. Important areas to replant are: polygon one and two.
- **Pacific Ninebark:** priority: high. Important areas to replant are: polygon one, two, and three.
- **Red Elderberry:** priority: high. Important areas to replant are: polygon one and three. Note: there is one blue elderberry on the slope of polygon one.
- **Red-flowering Currant**: priority: high. Important areas to replant are: polygon one and four.
- **Red-Osier Dogwood:** priority: low, replace with live stakes if necessary. Could be replace by sword fern, elderberry, or ninebark on the slope of polygon three.
- **Saskatoon/Serviceberry:** priority: low. Important areas to replant are: polygon one.
- **Vine Maple**: priority: high. Important areas to replant are: polygon one, two, and three.
- **Western Trumpet Honeysuckle (Orange Honeysuckle):** priority: high. Important areas to replant are: polygon one.

- **Willow:** priority: high. Replace with live stakes. Important areas to replant are: polygon one.

Resources & Tools: see section above.
How: see section above.

C) Groundcover

Why: As plants die, some will need to be replaced to maintain desired native species abundance for the site. Groundcover species provide important cover and habitat for small insects and amphibians. They also provide additional structural diversity and important competition against shade tolerant invasive species like English ivy.
Where: Use monitoring plots to determine the percent invasive to native coverage. Based on conditions of monitoring plots, adapt planting measures to the rest of each polygon. Search for plants that are dead or have yellow/brown leaves throughout the all polygons of the site.
When: Based on monitoring plots, thirty percent native coverage is desired for polygon two and four, forty percent for polygons one and three in the first year; the desired percentage of native cover should increase each year. If percent of native cover does not increase after three to five years and/or invasive cover increases, take measure to increase natives with new plants and decrease invasive species by removal.

- **Deer fern: priority:** low. Important areas to replant are: polygon one, three, and four.
- **Maidenhair fern**: priority: moderate. Important areas to replace are: polygon one.
- **Fringecup:** priority: high. Important areas to replant are: polygons 1,3,4, 5.
- **Pacific Bleeding Heart:** priority: moderate. Important areas to replant are: polygon three and four.
- **Sword fern:** priority: high. Important areas to replant are: polygon one, two, and three.
- **Redwood Sorrel:** priority: moderate. Important areas to replant are: polygon three.
- **Foamflower:** priority: moderate. Important areas to replant are: polygon three and four.

Resources & Tools: see section above.
How: see section above.

II. **Structural Sustainment:**

1. Trail and Gathering Areas

A) Trail Upkeep

Why: Distinct trail markers outline walking paths to discourage users from going off trail and protect plants at the restoration site from being trampled. By maintaining these markers and keeping the trials well mulched it encourages users to go to specific viewpoints of interest and stay on the paths. Additionally, the gathering and mulch dump

area should be left open for events, but the edges of this area should be maintained so that the surrounding plants do not get trampled or encroached upon by activities at events. Evidence also shows that mulch can prevent compaction of soil, improve water infiltration, and suppress pathogens and pests (Chalker-Scott 2007).
Where: The trail leads from the street in both polygon one and two then goes down into polygons three and four.
When: As needed, check the site regularly for human disturbance such as unauthorized social trails and garbage.
Resources & Tools: Gather the needed tools located in the Friends of North Creek Forest shed: pitchfork, rake, bucket, and gloves to apply mulch. Woody debris and rocks from the site can continue to be used for the trail markers if needed as long there is a healthy amount of woody debris left in the forest.
How: Replace mulch as it naturally wears away or when the ground is visible. Maintain trail markers to keep the trail narrow and give space for installed plants to grow. Remove any trash or dog droppings left at the site. Additionally, remove any downed branches from the pathway to keep a clear walking path.

2. Fascine and Wattle

A) Fascine and Wattle Maintenance

Why: Fascines and wattles were installed on the slopes in polygons one and three to create stability in the slope and prevent erosion. The goal is to have these structures be self-sustaining; however, in the case of structural failure, replacement may be necessary. The wattles located on the slope in polygon three are a temporary structure designed to slow runoff and allow for the establishment of installed species. They only need to last one to two years to fulfill the site goals. In the event a wattle fails early, replacement is not likely necessary unless the failure has damaged the slope. Slope damage that should be fixed with a replacement wattle looks washed out and in disrepair. In this case, replace the wattle to re-stabilize the slope in that area; or take other necessary measures if the failure of the slope is too severe for a wattle fence (i.e. fascines). The fascines on the slope of polygon three adjacent to the stairs and on the slope of polygon one are designed to become a living part of the slope. In the event a fascine dislodges from the slope, depending on the amount of destruction incurred, installation of a new fascine may be the best option. If the slope has stabilized enough from other plant installations, replacing the fascine would not be necessary.
Where: Polygons one and three.
When: Check the stability of the fascines, wattles and the stakes, supporting them once every six months for the first two to three years.
Resources & Tools: Stakes, hammers, and gloves are available at the FNCF tool shed. Live stakes of willow species can be acquired from the UW Bothell or Seattle campuses by request of the head of facilities at each campus during the fall and early winter.
How: When checking the wattles, test the stake stability of each about twice a year. If needed add new, longer stakes to support the wattle as it accumulates more biomass. When checking the fascines, check the stability of the stakes and the erosion beneath the fascine. If the fascine begins to slide out from erosion undercutting the structure, add more wooden stakes to support it upright into position until the fascine has rooted into the slope sufficiently. The fascines should also be kept moist, mulched, and watered during their growth for one to two years as they are living structures of the site and will

provide increased stability with more established root systems. If replacement is necessary follow this protocol: Three foot cuttings will be collected in eight inch bundles and tied into twenty foot sections. A trench will be dug on the hillside following a contour line across the entire slope and the bundle will be placed into it and buried almost entirely (about eighty percent). The live fascine will be held in place with stakes spaced every two feet (WSDOE 1993).

III. **Site Upkeep**

1. Invasive species Removal

*A) **English Ivy** (Hedera helix)*

Why: This introduced plant species quickly spreads and chokes out other plants. Its growth on trees makes them heavy which results in creating "sails" that cause the tree to blow over (King County 2013). The leaves decompose and release a chemical that inhibits the growth of other plants (Warren Gold personal communication 2014). Ivy increases soil erosion and slope failure. This is due to the roots being shallow and the leaves do not catch and slow the rain (King County 2013). It has no natural control, requiring constant vigilance in checking for new plants sprouting.
Where: Watch for reemergence across the site especially on the slopes of polygon one and two with special attention to the base of previously infested trees.
When: Once a week to biweekly, increase in frequency if numerous ivy plants spring-up.
Resources & Tools: Procure gloves and buckets from the FNCF shed. Use loppers for ivy removal on trees.
How: Hand-pull ivy vines and roots, make sure to get all fragments to prevent re-growth. Gather any leaves on the ground. If ivy is growing up the tree, cut and remove ivy from tree trunk to shoulder height. Be careful to remove all ivy growing at the base of the tree. (King County 2013). Bale vines (roll or wrap in a bunch) to compact ivy waste. Dispose of all ivy parts in the temporary waste pile located in polygon two then in a dumpster, when available.

*B) **Himalayan Blackberry** (Rubus discolor) **and Evergreen Blackberry** (Rubus laciniatus)*

Why: These non-native invasive plants vigorously spread and outcompete other plants, forming a monoculture thicket which results in low plant and animal biodiversity. This species also creates unstable slopes, due to the lack of the stabilizing root systems of other native species. Removing the root crowns of Himalayan blackberry offers the most success in the suppression of the species in the long run (King County 2013).
Where: Throughout the entire site, especially polygon three and the remaining patch in polygon one.
When: Diligently search for new shoots once a week, or more often if re-infestation occurs.
Resources & Tools: Shovels, gloves, buckets, and loppers are located at FNCF headquarters.

How: Using a shovel, dig out entire root. Any remaining root will grow and form a new plant. Large sprawling vines can be cut down, leaving only a one foot stalk, to make digging out the root easier. Watch out for look-alike natives such as small salmonberry shoots, and trailing blackberry. Himalayan blackberry has tall, arching, reddish brown canes with three to five rounded leaflets. Small round green to grey powdery vines indicate trailing blackberry (see guide to identifying invasive species in Appendix). Fragments can be composted on site or disposed of in yard-waste bins/dumpsters. An onsite waste pile will need to be turned every few months to prevent pieces of the plant from re-growing (King County 2013). With any temporary compost on the site, make sure the debris is raised off the ground by building a bed of sticks and wood to lift the material. Place any reproductive structures on the top of the pile. Make sure to maintain the pile so that no invasive species re-grow and neighbors do not add waste to the site. Once the material is dried out and the plants are non-viable, it can be left or moved around in the site to decompose. Mounds of dried plant material can create habitat for animals and would not be detrimental to leave at the site once invasive species are non-viable; however, leaving materials at the top of the site may encourage unwanted dumping activities from neighbors because of the site history. It is suggested that waste piles be made or moved to areas lower in the site away from the public trails.

C) English Holly *(Ilex aquifolium)*

Why: English holly can grow as a large tree or form multi-stemmed thickets. This species encroaches mid-canopy layers and displaces native species through suppression of germination and growth. Dispersion occurs through birds who eat the berries. Unlike many invasive species, holly will grow in undisturbed forest areas and replace conifers as a structural element (King County 2014). Removal has the greatest effect when the plants are young, as holly matures it is increasingly difficult to eradicate. Cutting holly is not effective and the plant will send up new shoots which will vigorously grow.
Where: One large tree in polygon two at the top of the slope. There are also many smaller trees in polygon five across the stream. Look for young seedlings establishing in all other areas of site to remove them when they are young.
When: Holly plants should be removed in the winter for the greatest effectiveness.
Resources & Tools: A licensed pesticide applicator can be contracted to treat large trees in winter.
How: Allow contractor or trained person to cut stump and apply of herbicides (eighteen percent glyphosate), otherwise do not trim large trees disturbance encourages growth. Small trees (about five centimeters) can be hand pulled. Removal is most effective in winter months, be sure to recheck the area every few weeks for new sprouts (Williams and Stokes 2014). Dispose of all plant waste in the invasive in a temporary compost pile or dumpster.

D) Field Bindweed: aka Morning Glory *(Convolvulus arvensis),* ***and Bittersweet Nightshade*** *(Solanum dulcamara)*

Why: Polygons one and two were most disturbed by the removal of
Invasive species and waste from the soils. These areas have now experienced an influx of new invasive species from the site disturbances. Bittersweet nightshade and

field bindweed have been seen in abundance in these areas and should be removed aggressively while they are young to prevent their establishment. Both species grow aggressively and form dense mats of vines, out-competing native tree species, and are even known to grow in creeks interfering with stream flows. The roots of these species forms dense mats making it difficult to eradicate (WA-NWCB 2010). .
Where: Polygon one and two, especially near the dogwood fascine at the top of the hill in polygon one.
When: Check at least weekly, more often if necessary, for emergent shoots and young plants.
Resources & Tools: Gloves, buckets, and hand trowels may be used.
How: Hand pull working to remove entire root, leaves and any other plant matter. Avoid disturbing the soil more than necessary as this can encourage invasive growth. Dispose of in a plastic bag and then a dumpster, do not compost onsite. Watch carefully for any new invasive species. Identify unknown growing plants, if they are invasive follow protocols on King County noxious weed information found in the appendix.

E) European Mountain Ash *(Sorbus aucuparia)*

Why: The mountain ash is not a threat now, but should be under supervision. This plant displaces native species, and has the potential to spread to other areas and out-compete native plants. Birds eat the berries and spread the seed to other areas.
Where: Polygon five near the stream just off the trail, on the east side.
When: Planting is most successful when done in the fall or winter (Chalker-Scott 2007). Flowers/berries need to be removed in the summer to prevent more plants from growing. Seeds in the ground are viable for up to five years (National Park Service 2015).
Resources & Tools: Obtain Oregon ash from nursery, and loppers from the FNCF shed.
How: Unless it begins to overtake an area, leave it alone. It provides habitat, and canopy diversity. Do trim flowers/berries to prevent spreading to other areas by birds. As possible, overtime replace with Oregon ash in the same area, part shade-sun near the stream. (Personal Communications with Professor Ewing, April 2015). See replacing dead plants section for planting instructions based on type of plant; bare root, container, or live stake.

2. Habitat Upkeep

A) Salamander Woody Debris Piles

Why: Increase habitat as well as replace habitat loss from yard waste dump pile that was excavated. Salamanders are poor burrowers and use rodents holes and spaces in rotting wood, roots, and rocks (DNR 2005). Salamanders provide insect control through predation (Slater Museum 2015). Target species at this site include: Western Red-backed Salamander, Northwestern Salamander and Long-toes Salamander.
Where: Polygon five

When: Check on piles occasionally to insure they are not impacted by human disturbance.
Resources & Tools: Logs, decaying wood of various sizes and rocks should be sourced. Gloves are provided in the FNCF shed. Refer to the appendix for additional information on salamander identification, life cycle and habitat.
How: As amphibians, it is essential that they have moisture microclimates to survive. Provide sheltered, undisturbed areas, near places where they can burrow underground. (Slater Museum 2015). Stack rotten wood and rock in small piles to create areas that are sheltered, dark/shady and moist. Protect the muddy wet depression at the base of the slope at the edge of the site in polygon three. This area may be utilized by salamanders and other amphibians for egg-laying and a reprieve from high temperatures during the summer months. Salamanders are best observed and not handled; do not pick up as salts and residue from human hands can cause harm. The exception is to move one off the road (SavetheSalamanders). Discourage the use of chemical fertilizer and pesticides in the neighborhood. These can cause death or major deformities to salamanders. Do not remove leaf litter or bark (however do remove English Ivy leaves).

3. Nuisance Animals

A) Excessive Herbivory *(slugs, rabbits, deer, squirrels,)*

Why: Animals prefer to eat the new seedling growth which can prevent the regeneration or establishment of trees and shrubs.
Where: All polygons
When: If more than thirty percent of the plants on site are affected by herbivory. Refer to replacing dead plants above for more information.
Resources & Tools: Protective tubing and predator formulated deterrents are available in the appendix.
How: If this is observed there are a few options to protect the plants, one of them is to use predator fecal order formulations. Spraying a predators fecal odors such as coyote urine near the plants will invoke fear in the animal so that they avoid those areas (Sullivan 1985). Another way to prevent herbivory is to use applied or protective tubing. See appendix for resources of protective plant tubing.

IV. Signage and Outreach

1. *Information Posted on Interpretive Sign*

A) Informing/Education

Why: Provide relevant information to intrigue and educate visitors. By leaving this information education will continue beyond the scope of this project and make it an enjoyable experience as well. Modern culture has largely forgotten the uses of plants around us, this project hopes to remind the public of human connections to the environment. Tribal understanding of plant uses is a valuable knowledge which is being lost with time. By providing this information to the public the knowledge base will be expanded and it will restore interest in studying the uses of plants by human cultures in everyday life.

Where: At interpretive sign located in polygon one.
When: Exchange information on a regular basis, some information may be permanent.
Resources & Tools: Print out information in the FNCF headquarters and use a stapler to attach the information in an organized and easy to read manner, to the billboard.
How: Garner interest by posting species of the month, invasive species info, ethnobotanical info, and general info on how to get involved. A site map marking each plant installed on site and its ethnobotanical importance for native cultures throughout history (see appendix). These brochures will be at the bulletin board near entry of the site for the public to use as they enter the trail.

B) Outreach

Why: Engage & develop relationships and stewardship ethic with the community. Additionally, information will be posted on the billboard on-site so that the future plans for the area will be relayed to the public. By building relationships with communities in close proximity to the site the hope is to foster stewardship beyond this project to maintain the forest in the future. These communities will have an opportunity to develop personal ties to an ecosystem which affects them on a local scale.
Where: Billboard on site and online webpage.
When: As needed.
Resources & Tools: Informational flyers will be created to share knowledge, the site plans, and announce work parties.
How: Arrange work parties including FNCF, UWB students, neighbors, and local grade schools**.** Task list are provided by age group for volunteer work parties. Having restoration work parties a fixed day a month, so people can schedule ahead of time. Posting information at the trailhead kiosk will show the community that people are actively involved. Sharing information is a good way of passively engaging the community. This will also relay the intentions for the site's future; therefore, gaining public support and curbing waste dumping activities on the site.

Maintenance Timetable: see Appendix 7

Monitoring Plan

Introduction

Monitoring is a crucial component in quantifying and assessing the successes and failures of restoration treatments, and ultimately, whether the goals of restoration are being accomplished. The Society of Ecological Restoration Primer suggests that there is a simple way of determining the success of a particular restoration project, which can be accomplished by asking if all of the goals and objectives of the project have been met (SER 2004). For this particular project, our goals and objectives are listed as a reference for monitoring purposes as they are closely intertwined with the design of this monitoring plan (see Appendix 1). Without monitoring serving as a guiding rubric, practitioners lack a way of assessing whether or not treatment methods are effective, which eliminates any chance of adaptive management (USDA 2005). Quantitative plot analysis and photo monitoring will provide important insight in discerning future site management practices. The purpose of this monitoring plan is three-fold: 1.) to keep a close watch on site areas prone to invasive takeover, 2.) to document the success of species installed on site, and 3.) to follow the progress of the site as it moves through the stages of succession.

Photo Monitoring

A total of seven photopoints were set up to visually monitor changes in structural complexity that occur post-installation, as well as offer a rapid way of assessing potential problem areas on the site (Appendix 2). This particular method will align with the aims of our primary goals and objectives by keeping a close eye to invasive encroachment, protecting and enhancing the establishment of the forest (Goal 1) as well as enhancing forest function and species diversity (Goal 2). Photo monitoring and quantitative analysis will also allow for volunteers to partake in data collection and site observation, incorporating our goal of community involvement (Goal 3). We refrained from installing permanent photo fixtures based on the large number of photopoints taken, and instead took GPS coordinates of the location, accompanied by a compass bearing. In deciding where to locate photo points, preference was given to areas that have foreseeable maintenance needs. We declined to set up a point in polygon five as there are not any maintenance concerns that can be readily assessed by this method. Photo monitoring offers a simple, qualitative look at site conditions which can allow for a problem to be identified relatively quickly. All photo-monitoring photographs included in this report were taken with a Nikon D3100 using a 18-55mm variable zoom lens.

Polygon 1: Photopoint 1-A is located on the street (108th Ave.) directly above the manhole cover (adjacent to the SW corner of the site). Photos should be taken between a height of 1.2 m - 1.5 m, follow a compass bearing of 84 degrees to obtain correct orientation. This point can be used to assess blackberry encroachment from the south and determine whether the willow buffer is proving to work effectively (Objective 1-1). It may be important to live-stake more willow next spring if mortality is high.

Point 1-B is located at the base of the slope in polygon one. It's situated just west and uphill from the drainage culvert and follows a bearing of 234 degrees. This angle offers a glimpse at the health and establishment of the willow/dogwood fascines and fern species installed on the slope (Objective 2-1).

Polygon 2: Point 2-A is located on the curb bordering 108th Ave immediately north of the street sign. Photos should be taken here following a bearing of 62 degrees. The view from this perspective looks at the thicket of oceanspray (*H.discolor*) that was installed on the site border. It can be used to assess the timeframe for mulch application as well as to assess the health of installed oceanspray (Objective 1-1 and 1-4).This area was a grass lawn before, so mulching will be important here as grass continues to grow up through the mulch. As the oceanspray continues to grow, it will outcompete grass for sunlight

Polygon 3: Point 3-A is located just north of the trail, prior to reaching the large big leaf maple on the right. The primary objective for this photopoint is to allow a simplistic way of assessing structural integrity of the installed wattle fencing and overall soil stability. A bearing of 270 degrees and alignment with the biggest red alder in the photo (top center), will find the correct orientation.
3-B is located mid-slope on the northernmost border of polygon three. The house was included in the picture to provide clear orientation. This photopoint will also be important in rapid assessment of non-native encroachment, as the property to the north is an ivy monoculture (Objective 1-1). A bearing of 280 degrees can be used to find the exact orientation.

Polygon 4: Point 4-A is located in the NW corner of polygon four, facing a bearing of 315 degrees. The upturned concrete planter can be used for reference. The idea with this photopoint is to assess the reemergence of ivy and overall health of this depressional wetland area (Objective 1-1 and 2-3).
Point 4-B is taken on the trail facing the rock ring. The rock ring makes a border for the walkway, which will need to be reorganized and/or added to from time to time. This is more of an aesthetic maintenance need, but it falls in line with our objective in keeping the site aesthetically pleasing (Objective 3-1).

It's suggested that photos be collected annually from each location in the late spring (May-June) to resemble the time of year the initial photos were taken.

Quantitative Plot Sampling

Five sixteen-square-meter quadrats (4m x 4m) were dispersed amongst the site at least 10m apart to capture a varied sample of the varied microenvironments that exist across the site. For locations refer to map (Appendix 2). The size of each quadrat was determined to reflect variation in vertical structure, while keeping it feasible for volunteer vegetation assessment in the future. Each square was subdivided into sixteen subplots, which were individually assessed for species, percent cover, number of living individuals, number of dead individuals, signs of recruitment, as well as the floral layer. Only species that were rooted in a subplot were considered in determining percent

cover; if they were overhanging and providing canopy cover, this was noted during data collection. Living and dead individuals were assessed based solely on appearance; if the majority of the leaves of the plant looked green and healthy, it was considered alive. The plants that were considered dead showed obvious signs of stress: wilting, brown leaves, or no leaves at all. Recruitment was assessed by noting any juvenile individuals that hadn't been installed, but were the result of natural regeneration. Finally, shrub layer was determined by the height of the plant at the time the observation was made, no matter how that might change in the future. The canopy layer (C) was considered anything over 10m in height, while the shrub layer (S) constituted as any woody species between 1m-10m in height. The groundcover layer (G) included non-woody herbaceous species such as *P. munitum* and *D. formosa*.

Canopy cover was also estimated for the entire quadrat prior to assessment of individual subplots. We figured that each subplot represented 6.5% of the total coverage area and marked off sixteen individual squares within the plot using a meter stick and flagging. Permanent quadrat markers will be installed using painted rebar. Prior to beginning the data collection, a system of assessment was established between those conducting observations. It's important that those conducting the vegetation assessment communicate their strategy to each other to formulate a standardized approach to data collection. Not taking this step allows for a lot of variability in the data collected, making it difficult to get an accurate representation of what's actually occurring within that subplot, making it harder to draw broader conclusions about what's actually happening on site.

Photo-Monitoring Methods

There is a single monitoring point in polygon one (Quadrat 1-A), which is located on the top of the slope almost immediately above the intersection of the trail that branches off to go to the FNCF office. This particular area was overgrown with grass and various exotics that had been dumped in the neighborhood waste pile that was removed. Willow/dogwood fascines were installed along with fibrous-rooted sword fern in an attempt to stabilize the slope (Objective 2-1). The overhead canopy coverage of this quadrat is ~50%, composed of mostly red alder/big leaf maple, so this polygon receives a fair amount of sunlight during the latter part of the day. Watering in the summer will be important throughout this entire polygon as it is heavily exposed to sunlight. It's important that percent cover of soil-stabilizing species like sword fern and red osier dogwood continue to increase, while that of problem invasive species is kept to a minimum (see Reference Table). This quadrat is quite representative of the remaining hillside, so its analysis can be used to determine when invasive removal and re-vegetation may need to take place. Photopoint 1-B can be used with vegetation data collected from this quadrat to complement numerical data with a visual reference.

Quadrat 2-A is located in the NE corner of polygon two and primarily encompasses the vegetation buffer created between the neighboring yard and entrance to the site. Overall canopy coverage is ~40% and consists primarily of red alder. Ocean Spray was planted densely throughout this area with the intent of maintaining a high percent coverage, so we should expect an increase in percent cover next year (Objective 1-4). The soils are

well drained throughout this polygon so it's important to incorporate species that can handle drought conditions during summer months if re-vegetation needs to take place. Ocean Spray was used specifically for this border area because its dense shrub form is a deterrent for encroaching invasive species. The species also creates shade when densely planted, so it will shade out unwanted invasive species. Competition with grass from neighboring yard will be important in assessing, so information from this quadrat can be used to determine when mulch will need to be re-applied and when re-vegetation should take place, accounting for some mortality (Objective 1-1 and 2-4).

Quadrat 3-A is located in the center of the slope on the south side of polygon three. It encompasses a community of red osier dogwood live stakes which were planted in an area that's may be too shady for them. There also seems to be significant regeneration of Himalayan blackberry within this same plot, so annual analysis will offer important insight for the control and suppression of that particular species. It's likely that red osier dogwood may need replacement with shade tolerant species since sun exposure is limited on this slope. Potentially, sword fern would be a choice species for replacing red osier dogwood live stakes, as it will hold the soil and persist through low-light conditions, demonstrating functional resiliency (Objective 2-4).

Quadrat 4-A is located along the western border of polygon four, almost directly in the center of the polygon itself. This quadrat encloses an area with a developed middle-canopy of vine maple, and a mixed upper canopy of western hemlock/ big leaf maple, representative of an ecological trajectory towards a late successional stage (Objective 1-3).

Quadrat 5-A is located in the NE corner of polygon five almost immediately across the stick bridge that crosses the creek from polygon four to polygon five. This site was chosen as a representation of what we'd expect the forest floor to look like in fifty years, and thus demonstrates a target plant community composition for the other forested polygons three and four (Objective 1-3, 2-3 and 2-4). Youth-on-age (*Tolmiea menziesii*) dominates as a groundcover, while sword fern clumps are ubiquitous throughout the site.

Monitoring Methods

Polygon one is considered a vegetation buffer between North Creek forest and the surrounding urban matrix to the south and west. Prior to site construction this area contained a yard-waste pile that was heavily overgrown with invasive exotic species. The portion of the polygon closest to the road was originally dominated by grass and receives a large amount of sunshine. The southern border is threatened by encroaching Himalayan blackberry, so it will be important to keep the existing gap between the southernmost border and the established blackberry thicket (Photopoint 1-A). False bindweed (*C. sepium*) has also demonstrated rapid regeneration throughout the majority of the polygon after seedbank disturbance, so it is another invasive of serious concern in polygon one.

Polygon two is quite similar to polygon one in the amount of sunlight it experiences, as well as the availability of water for plants within its boundaries. The soils are fairly well-drained upslope, so water percolates through the soil quickly. In addition to this, an open canopy allows for more sunlight to penetrate to the ground, making water a limiting resource. This area was primarily covered in grass before work began on the site, so suppression of grass will remain an important maintenance concern within this polygon. The western border of the site was originally vegetated by ivy and to a minor extent Himalayan blackberry so it will be important to remove those invasive species as they establish.

Polygon three is much different from the slope in polygon one because it contains a much denser upper canopy, limiting the amount of sunlight that reaches the floor. The entire northern portion of the polygon was covered in ivy prior to the project, which still remains threatened by the species outside of project site boundaries to the north. Following ivy removal, it was discovered that there is a small depressional wetland located in the north end of the polygon. It will be important to continue removal of ivy as it regenerates in order to protect the functionality of the wetland area. It may be necessary to install shade-tolerant wetland species in the future to vegetate areas ivy had previously dominated.

Polygon four is similar in community composition of polygon three. It's bordered to the west by a low-lying wet area. Ivy may be a concern from the north, but it's less of a concern than in polygons two and three. Since this area has a dense overstory and relatively little threat from invasive species, it's a good location to continue installing western hemlock and western red cedar seedlings to promote the successional trajectory of the forest structure. In areas that lack coverage from ivy removal, the further installment of groundcover species like youth-on-age and Pacific bleeding heart would be beneficial.

Polygon five has the least open canopy cover of all the other polygons and is composed of mixed conifer/deciduous species such as vine maple, Douglas fir, and western hemlock (~85% closed). Therefore, this polygon is undisturbed by Himalayan blackberry. This polygon serves as a model of what the other forested portions of the site should look like in the next decade. The lack of invasive species and the dense upper canopy allow for a variety of native groundcovers to thrive on the forest floor. Percent composition of natives in monitoring plot 5-A should serve as a guiding baseline for what needs to be achieved in the adjacent polygons.

Baseline Monitoring Report

A baseline report of species was conducted on April 29th 2015. As mentioned earlier, information was collected including: species, percent cover, number of living individuals, number of dead individuals, signs of recruitment, floral layer, and overall canopy cover for the entire plot. The majority of the species found in plots are primarily either groundcover or shrub species, disregarding what form they will be in the future. The assessment focused on the form the plant was in when it was witnessed, either

groundcover, shrub, or canopy. There are a few exceptions as some mature individuals were included in some of the plots tested.

Long-Term Site Management Plan

Long-term site management means adaptively managing for succession while protecting that which is being enhanced and managed. It is more passive in nature than the activities in short term maintenance, which require near constant attention. Long-term site management involves observing and recording site and plant conditions, annually or biannually, and adapting actions to meet those conditions. To do this we have set up a checklist of conditions to observe and record. Managing the site over time in this way will help to qualify the value of restoration efforts and assist in achieving the objectives and goals put in place. The ultimate goal being that the site becomes a life-sustaining and resilient forest that provides value to the community and is valued by the community.

Goal 1: Protect and enhance the establishment of the low-elevation western hemlock forest community within the site.

More coniferous trees are being established in the understory to replace the aging maple canopy, as is the natural succession of this forest. These young conifers, western hemlock, western red cedar and grand fir are essential to healthy succession and their survival depends on the annual monitoring and maintenance of their surrounding environment. Three specific conditions will be monitored and maintained until the individual trees become established enough to survive on their own. This is a more passive activity, performed annually that may or may not require further action.

1. Crowding out of saplings from fast growing shrubs

1.1. Coniferous saplings need to be maintained for encroachment from the surrounding faster growing shrubs. This can be performed in the late spring/early summer months. Encroaching shrubs will need to be trimmed accordingly in a natural shape during winter months or early spring. It's important to not remove the larger main branches and to not leave any stubs. Leaving stubs behind will allow for insects and disease to inhabit the shrub (Prime Time for Pruning).

1.2. The grand fir is a fast growing conifer that can reach up to 70.4 meters in the right conditions. This tree will compete with the overstory and is a key component in helping the forest reach a late successional stage. Firs need a moderate or partial overstory shade for optimal growth. After age 20-30 they grow best in the open (Foiles). Some plants that may encroach on the grand firs are the red twig dogwood, willow and Pacific ninebark. The shrubs planted near the grand fir in P1 will need to be closely watched as they may begin to outgrow and over shade the tree. If or when this becomes the case all three plants can be pruned for hardwood cuttings. For more information on pruning refer to "Prime Time for Pruning."

2. Herbivory

2.1. Saplings should be monitored for herbivory until they reach 11.5 centimeters.(Hall, et al.) After at which point herbivory usually is not a nuisance and begins to influenc

ecological processes in a positive way. (Shaw,D, et al 2006) For maintenance techniques refer to Site Upkeep: Nuisance Animals (Sullivan 1985).

3. Plant Distress and Disease

3.1. Plant distress and disease can be identified by the overall condition of the species, drying brown needles, dropped needles, dusty looking, wilting, off colored, etc. Each instant of distress needs to be examined individually and collectively. Is it an isolated incident or are, for example, all of the western hemlocks distressed. In case of the hemlocks it could be an insufficient supply of available nutrients from the organic horizon (Packee) See references for Resources for more detailed information on pests and diseases.

Goal 2: Enhance forest ecosystem function and species diversity.

To enhance forest ecosystem function and species diversity, a variety of plant families and species were installed. To gain a better understanding if and how this goal has been met, measurements and comparisons can be performed annually, or seasonally as the case may be, over the long term.(see Monitoring Plan: Monitoring Methods)

Observation has begun now with the young plants and saplings. If it is continued through maturation, their functions in the ecosystem and progression through the successional stages can be documented and studied. A relatively easy measurement to take would be that of soil composition to track how it changes or affects forest growth. Information on how to assess soil type can be found in resources in Appendix 4. Another interesting study would be to monitor pollinating insect species and quantities over time as some plants will establish themselves quickly and provide relatively instant ecosystem functions while other species, particularly the conifers, will take some time before contributing to ecosystem functions. Western hemlock if observed for its pollinating attributes, does not begin flowering until about age 10 in contrast with the red osier dogwood, which will begin flowering fruit within one or two seasons of being planted, and the mature maples which have been flowering seasonally for years(Rook 2002). In twenty years, when the conifers planted are becoming mature and the mature maple tree numbers have been reduced what will this insect community look like? Has it increased or decreased? Will the community have been diversified? Professor Amy Lambert at the University of Washington Bothell would be a great resource for any pollinator questions (Amy Lambert:alambert@uwb.edu). Also, the Pacific ninebark and red twig dogwood, if properly tended, in a few years will be established and functioning well at self-propagation, while the western hemlock will not begin producing fertile cones until about age 25 or 30 (Packee).

To create wider plant diversity, multiple species from the same genus and families were included in the plantings. For example, both Nootka rose and baldhip rose from the *Rosaceae* family were used. For future plantings it will be beneficial to search for other

more uncommon plant species, specifically from the *Ericaceae* family, which is home to all the blueberries and huckleberries. It may take some time to locate some of these plants so they are included below.

Future Plant List

Trees
- Western yew (*Taxus brevifolia*)
- Oregon/Sitka mountain ash (*Fraxinus latifolia*)
- flowering dogwood (*Cornus nuttalli*)
- beaked hazelnut (*Corylus cornuta*)

Shrubs
- rhododendron (*Rhododendron*)
- pacific crabapple (*Malus fuscua*)
- tall oregon grape (*Mahonia aquifolia*)
- black cap raspberries (*Rubus leucodermis*)
- Alaska blueberry *(Vaccinium alaskaense)*
- big huckleberry *(V. membranaceum)*
- evergreen huckleberry *(V. ovatum)*
- thimbleberry (*Rubus parviflorus*)

Groundcover
- wood sorrel (*Oxalis organa*)
- false lily of valley (*Maianthemum dilatatum)*
- false Solomon's seal (*Smilacina racemosa)*
- vanilla leaf (*Achlys triphylla)*

Flowers and other perennials for educational purposes in polygon one or two
- common camas (*Camas quamassia*)
- native iris (*Iris douglasiana*)
- chocolate lily (*Fritillaria lanceolota*)
- Hooker's fairybell (*Disporum hookeri*)

Goal 3: Encourage both short and long-term community involvement.

The tasks and activities necessary to ensure long-term community involvement are more active and frequent than the long-term strategy for goal one and two.
To encourage both short term and long term community involvement, diverse volunteer work and educational opportunities for both the individual and the community are offered. Through these volunteer efforts, worth and value will be added to both the forest and the community at large. These results will be made visible and celebrated with community work parties, BBQ's, the creative use of the informational kiosk and other related activities.

In twenty to thirty years from now it is expected that this site will be self-sufficient with conifers beginning to dominate the overstory, a diverse native understory with native

ground covers and established perennials and little to no invasive species present. It is expected that the community will be involved with site monitoring activities and/or the simple enjoyment of a natural forest setting with multiple opportunities for foraging and sampling of wild native plant foods.
Volunteer Opportunities through FNCF

- Forest Stewardship / Restoration
- Watering Crew
- Outreach Team
- Marketing / Communication
- Forest Educator
- Forest Ranger
- Forest Research

More potential ways to get involved

- Become certified to remove invasive species
    - Lead invasive species sweeps (semiannual) and removal parties
    - Help with mapping of invasive species
    - Remove invasive species at your leisure
- Train for and help with seasonal watering
- Log volunteer hours - Earn rewards
    - hours = shirt, hat,
- Other tasks indirectly related to restoration work

<u>Volunteer Work Party Tasks by Age Group</u>
Middle School and Younger

- mulching **** (best)
- ivy removal / leaf pickup /dumping invasive species
- removing sod
- planting conifers or other larger/durable plants (spacing, appropriate locations)
- stay off slopes, watch closely to make sure invasive species are being removed correctly,
- do not plant delicate plants, do not water plants (may overspray / harm small delicate plants)

High School and Adult

- can do slope work in small supervised groups
- invasive removal
- mulching
- trail outline
- fascine/wattle improvements (supervised)
- planting (nothing sensitive)
- watering
- monitoring
- build habitat
- update signage

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Appendix 1: Goals and Objectives

Goal 1: Protect and enhance the establishment of the low-elevation western hemlock forest community within the site.

***Objective 1-1*: Remove and suppress invasive species both at its source and within the forest.**

***Objective 1-2:* Remove yard waste pile.**

***Objective 1-3*: Promote ecological trajectory towards a late-successional stage.**

Goal 2: Enhance forest ecosystem function and species diversity.

***Objective 2-1:* Reduce erosion potential from invasive removal.**

***Objective 2-2:* Increase native plant species diversity.**

***Objective 2-3:* Enhance structural habitat diversity.**

***Objective 2-4:* Increase functional resiliency.**

Goal 3: Encourage both short and long-term community involvement.

***Objective 3-1:* Create an aesthetically appropriate trail entrance.**

***Objective 3-2:* Provide educational opportunities including ethnobotanical knowledge.**

***Objective 3-3:* Engage the local community in planting process.**

Appendix 2: Monitoring and Survey Forms

Table 1: Photo Monitoring Points

Polygon 1	Longitude	Latitude	Elevation (ft)	Bearing	Site ID
A	47.77573	-122.19691	330	84	PP1A
B	47.7758	-122.19659	325	234	PP1B
Polygon 2					
A	47.77586	-122.19674	292	326	PP2A
B	47.77594	-122.1969	325	62	PP2B
Polygon 3					
A	47.77594	-122.19675	297	270	PP3A
B	47.77607	-122.1968	315	280	PP3B
Polygon 4					
A	47.77598	-122.19664	287	315	PP4A
B	47.77605	-122.19660	305	264	PP4B

Figure 1: Photopoint Location Map

Figure 2: Photopoint 1A

Figure 3: Photopoint 1B

Figure 4: Photopoint 2A

Figure 5: Photopoint 2B

Figure 6: Photopoint 3B

Figure 7: Photopoint 3A

Figure 8: Photopoint 4A

Figure 9: Photopoint 4B

Figure 10: Monitoring Plot Location Map

Table 2: Species List for Monitoring Plots

Polygon 1	
Quadrat	**Species**
1-A	*C. sepium**
	C. sericea
	S. lucida
	H. discolor
	P. munitum
	A. alnifolia
	P. capitatus
	*P. arundinacea**

Polygon 2	
Quadrat	**Species**
2-A	*H. discolor*
	P. menziesii

Polygon 3	
Quadrat	**Species**
3-A	*S. dolcumara**
	C. sericea
	R. spectabilis
	T. menziesii
	*R. discolor**
	*R. laciniatus**
	P. munitum
	E. arvense
	A. circinatum

Polygon 4	
Quadrat	**Species**
4-A	*A. circinatum*
	A. rubra
	P. munitum
	O. cerasiformis
	R. discolor
	T. heterophylla

Polygon 5	
Quadrat	**Species**
5-A	*P. munitum*
	A. macrophyllum
	R. ursinus
	R. spectabilis
	O. cerasiformes
	D. expanza
	T. menziesii
	T. heterophylla
	A. circinatum

Appendix 3: Project Contact Information

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Appendix 4: Material Sources

Reference to Resources

How to Prune or cut back encroaching shrubs
'Grow Your Own Native Landscape' Written &Edited by Michael Leigh. WSU Native Plant Salvage Project. A comprehensive guide on native landscape propogation, identification and care.

How to Live Stake
Collecting, Installing, Storing, and Caring for Live Stakes, DesCamp,W. Jun 10, 2004 http://depts.washington.edu/propplnt/Chapters/Stakes%20combined.htm

Western redcedar information
http://www.fs.fed.us/database/feis/plants/tree/thupli/all.html#INTRODUCTORY

Applying predator urine to inhibit herbivory
http://www.ncbi.nlm.nih.gov/pubmed/24310276

Information on pathogens, parasites and diseases
http://www.na.fs.fed.us/pubs/silvics_manual/Volume_1/tsuga/heterophylla.htm
https://www.for.gov.bc.ca/hfp/publications/00198/Hemlock_dwarf_mistletoe.htm

Invasive Plant Species:
King County Noxious Weeds
http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds.aspx

Washington State Noxious Weed Control Board
http://www.nwcb.wa.gov/default.asp

Quality Plant Nursery:
Go Natives! Don Norman
http://www.gonativesnursery.com/

Salamander Identification and Information:
Burke Musuem http://www.burkemuseum.org/herpetology/checklist
Save the Salamanders: http://www.savethesalamanders.com/how-you-can-help.html

Where to buy young plant protectors
http://www.nativnurseries.com/p-112-tree-protector-package.aspx

How to identify plant stress
http://www.gardeners.com/how-to/plant-stress/7341.html

How to assess soil composition
http://www.dummies.com/how-to/content/how-to-assess-soil-composition.html

Appendix 5: Identifying Invasive Species

Himalayan Blackberry

- Relatively straight thorns (as opposed to native species with curved thorns)
- 3-5 oval leaflets with serrated leaves
- White-pink flowers in summer
- Stems are rigid and angular (as opposed to native species with round stems)

Figure 10, view of young and mature Himlayan blackberry canes.

Figure 9, close-up of Himalayan blackberry leaf.

Evergreen Blackberry

- Also called cut-leaf blackberry
- Has very incised leaves looks like it has been cut up by scissors

Figure 11, evergreen blackberry from Eva 2006 (Flickr).

English Ivy

- Juvenile leaves: 5 lobed dark green leaves with white veins, dull finish
- Mature leaves: triangular shaped, without lobes, shiny, brighter green
- White flower clusters turn into blue/black berries

Figure 12, flowering English ivy from G.D Carr 2010.

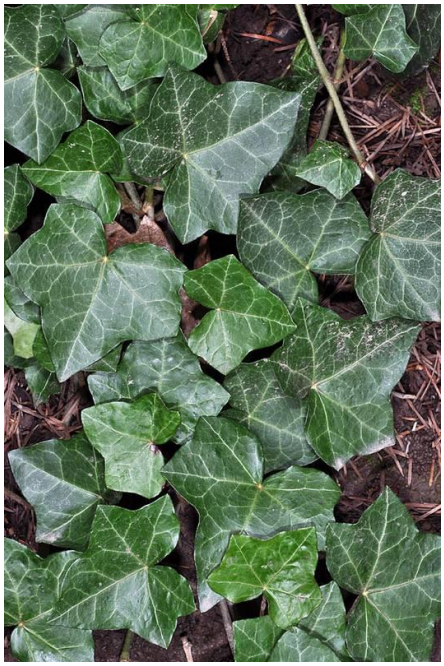

Figure 13, mature English ivy from G.D Carr 2010.

Bittersweet Nightshade

- Alternate, oval leaves can have two shapes: simple and with basal leaves
- Purple flowers turn into poisonous red berries

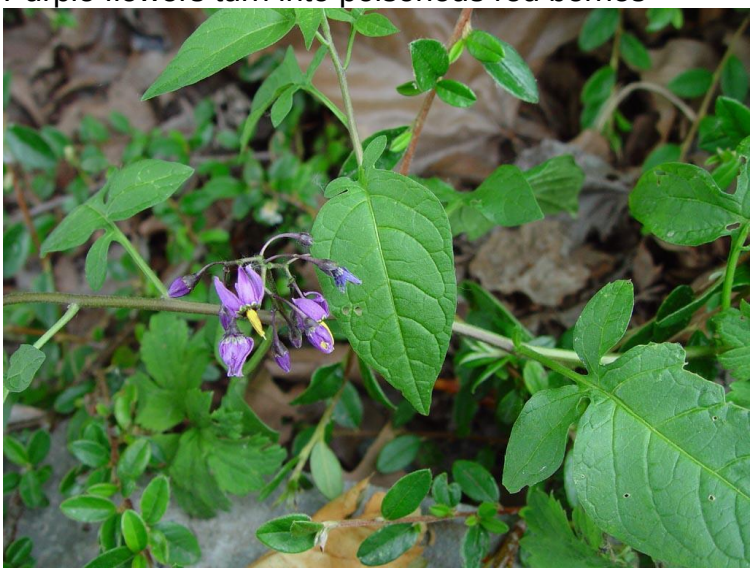

Figure 14, Bittersweet nightshade, from G.D Carr 2010

Field Bindweed

- Trailing, deciduous perennial vine
- Heart shaped leaves
- White-pink trumpet shaped flowers

Figure 15, Morning glory, from G.D Carr 2010

English Holly

- Shiny, dark green wavy leaves with very sharp spines
- Clusters of bright red berries
- Grows as a tree or shrub
- May be confused with native Oregon grape but Holly has simple leaves, whereas Oregon grape has compound leaves with 9-19 leaflets

Figure 16, English holly leaf. From Oregonstate.edu

Appendix 6: Ethnobotany and wildlife benefits

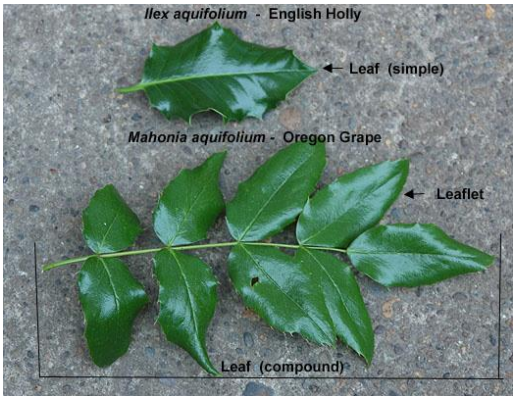

Figure 17, Top: English holly leaf compared to Oregon grape leaf, below.

Species	Ethnobotanical Benefits	Wildlife Benefits
Abies grandis		Cones eaten by small mammals. Birds, including sap-suckers, use for food and habitat. Inner bark eaten by porcupine. Provides thermal cover.[4]
Taxus brevifolia	Wood carved to make bows, clubs, paddles, digging sticks, adze handles, harpoon shafts, spears, dip-net frames, knives, dishes, dowels and pegs, drum frames, snowshoe frames, etc. Needles used to heal wounds and bark made into tea used for internal wounds.[3]	Birds eat berries; form provides cover and habitat for animals.[4]
Thuja plicata	"The cornerstone of Northwest Coast aboriginal culture"; all parts of the tree were utilized in different ways. The wood was used for dugout canoes, house planks, bentwood boxes, clothing, and many tools. The wood is an excellent fuel for drying fish because it burns with little smoke. The inner bark made rope, clothing, and	Provides food, habitat, and thermal cover for birds and small mammals.[4]

	baskets. The branches were twisted into rope and baskets. It was also used for many medicines.[2]	
Tsuga heterophylla	The tannins in the bark were used for cosmetics, tanning hides, and dying/ waterproofing baskets. Bark was also carved into tools and feast bowls. Branches used in bedding and clothing. Parts of the bark were used for medicines.[3]	Provides food, habitat, and thermal cover for birds and small mammals.[4]
Acer circinatum	Wood was used to make bows, baskets, salmon tongs, nets and snowshoes.[3]	Seeds provide food for bird species. Browsed by herbivores.[4]
Blechnum spicant	Used for skin sores.[3]	Browsed by herbivores in the winter.[5]
Cornus sericea	Berries eaten. Bark used to make rope, traps, tools and red paint.[3]	Berries eaten by many bird species and provides cover.[4]
Corylus cornuta	Nuts were eaten raw or cooked and plant parts used to make rope.[3]	Nuts provide food for multiple species of small mammals and birds, including grouse, squirrels, woodpecker, stellar jay, and fox. Provides habitat for insects which provides forage for warblers.[4]
Holodiscus discolor		Habitat for small mammals, browse for large herbivores, seeds eaten by multiple species of birds.[4]
Lonicera ciliosa		Attracts hummingbirds.[5]

Lonicera involucrata		Berries eaten by a wide variety of bird species and by deer.[4]
Philadelphialewisii	Leaves used to make soap and shampoo. Wood used to make arrows, pipes, digging sticks, and breast plate armor.[3]	Attracts butterflies and bees. Provides browse for herbivores.[5]
Physocarpus capitatus		Berries eaten by bears. Forage and cover for birds and small mammals.[4]
Polystichum munitum	Fronds used to line ovens, bedding, and floors. Rhizomes sometimes eaten.[3]	Provides evergreen cover and habitat.[4]
Ribes lacustre	Berries eaten raw and in soups.[3]	Food for a variety of birds and small mammals.[4]
Ribes sanguineum		Food for many birds and mammals. Attracts hummingbirds.[4]
Rubus leucodermis	Berries eaten raw or made into a mash. Leaves used in teas. Young shoots eaten as well.[3]	Food for song-birds and hummingbirds.[4]
Rosa gymnocarpa	Rind of 'hips' eaten raw. Leaves and roots made into teas for medical purposes. Roots usedin weaving nets.[3]	Attracts butterflies and hummingbirds, berries provide food for small mammals and birds.[5]
Salix lucida ssp. lasiandra	The Native Americans had many uses for many of the willow species. For *S.lucida*ssp.*lasiandra*, the leaves were used in ceremonies. The leaves, bark and branches were also essential for the creation of hunting	Provides forage and cover for birds and small mammals.[5]

	bows, tools, jugs, and baskets.[6] The bark was ground into powder and used to make bread while leaves made tea.[1] Additionally, the Native Americans used it in a variety of medical treatment from cold remedies, treating infections and diarrhea, and soaking aid for cramps.[6]	
Sambucus racemosa	Berries eaten only after boiling.[2]	Berries eaten by a large number of bird species.[4]
Vaccinium parvifolium	Berries were eaten raw, with oils, made into jellies, dried, or pressed into cakes for overwintering.[1]The bark of the plant was used to make tea for colds while the leaves make a tea currently used for lowering blood sugar levels. The juice of the berries was used in some areas to make wine or to make a mouthwash type drink to stimulate appetite.[2]	Provides important winter browse for many species of mammals. Berries eaten by species ranging from bears to thrush and woodpeckers. Also provides cover.[4]
Adiantum		Provides cover.[5]

aleuticum		
Dicentra formosa		Hosts and attracts butterflies and hummingbirds.[4]
Fragaria vesca		Hosts and attracts butterflies and hummingbirds and song-birds.[4]
Fragaria viginiana	Berries eaten. Leaves made into tea for anti-diarrheal. Leaves dried and made into powder for many medical uses for babies and children.[3]	Hosts and attracts butterflies and hummingbirds and song-birds.[4]
Maianthemum dilatatum	Berries sometimes eaten. Roots used to make disinfectant.[3]	Attracts song-birds.[4]
Tellima grandiflora		Provides evergreen cover for small organisms.[4]
Tolmiea menziesii		Provides evergreen cover for small organisms.[4]
Viola sempervirens		Hosts butterfly larvae.[4]

Figure x. 1-(USDA 2006), 2-(Pojar and Mackinnon 2004), 3-(Clay-Poole 2015), 4-(Stinson et al 1995), 5-(Leigh 2013), 6- (Native American 2003).

Appendix 7: Maintenance Timetable

Short-term Maintenance Timeline: (3 years: ~June 2018)

January

- ❏ Re-mulching areas of high traffic and areas on the slope during large work party event such as Martin Luther King Jr. holiday.

February

- ❏ Last month to remove invasive holly.

March

- ❏ Check for and remove any invasive species that re-emerge.
- ❏ Last month to plant replacement plants.

April

- ❏ Check for and remove any invasive species that re-emerge.
- ❏ Re-mulching areas of high traffic and areas on the slope during the large work party event such as Earth day

May

- ❏ Get two or three people to conduct monitoring the plants on the set plot by using quantitative and photo monitoring for each polygon. See the steps, worksheet, and plot location monitoring plan in stewardship document
- ❏ Check for and remove any invasive species that re-emerge.
- ❏ Check on fascine and wattle integrity, as well as trail outlines and salamander woody debris piles.
- ❏ Water 2-3 times per a week upland (polygon 1-2) and once a week on the slope and below (polygon 3,4,5), utilizing volunteers on scheduled watering days, Tuesday, Thursday and Saturday or other days as long as they are dispersed equally throughout the week. See maintenance plan in Stewardship document.
- ❏ If more than 30 percent of the plants on site are affected by herbivory. Refer to replacing dead plants information from maintenance plan section on stewardship plan.

June

- ❏ Water 2-3 times per a week upland (polygon 1-2) and once a week on the slope and below (polygon 3,4,5), utilizing volunteers on scheduled watering days, Tuesday, Thursday and Saturday or other days as long as they are dispersed equally throughout the week. See maintenance plan in Stewardship document.
- ❏ Get two or three people to conduct monitoring the plants on the set plot by using quantitative and photo monitoring for each polygon. See the steps, worksheet, and plot location monitoring plan in stewardship document
- ❏ Check for and remove any invasive species that re-emerge.
- ❏ Remove flowers/ berries from European Ash located just west off the trail.(Fraxinus excelsior)
- ❏ If more than 30 percent of the plants on site are affected by herbivory. Refer to replacing dead plants information from maintenance plan section on stewardship plan.

July

- ❏ Water 2-3 times per a week upland (polygon 1-2) and once a week on the slope and below (polygon 3,4,5), utilizing volunteers on scheduled watering days, Tuesday, Thursday and Saturday or other days as long as they are dispersed equally throughout the week. See maintenance plan in Stewardship document.
- ❏ Remove flowers/ berries from European Ash *(Sorbus aucuparia)*
- ❏ Check for and remove any invasive species that re-emerge.

August

- ❏ Water 2-3 times per a week upland (polygon 1-2) and once a week on the slope and below (polygon 3,4,5), utilizing volunteers on scheduled watering days, Tuesday, Thursday and Saturday or other days as long as they are dispersed equally throughout the week. See maintenance plan in Stewardship document.
- ❏ Check for and remove any invasive species that re-emerge.

September

- ❏ Water 2-3 times per a week upland (polygon 1-2) and once a week on the slope and below (polygon 3,4,5), utilizing volunteers on scheduled watering days, Tuesday, Thursday and Saturday or other days as long as they are dispersed equally throughout the week. See maintenance plan in Stewardship document.
- ❏ Check for and remove any invasive species that re-emerge.

October

- ❏ Check for and remove any invasive species that re-emerge.

November

- ❏ Conduct plants replacement, if it cannot be completed at this time, plants may be planted through March. Re-mulching the replaced plants. See maintenance plan in Stewardship document.

December

- ❏ Remove invasive species English holly (*Ilex aquifolium*) until February.