WEST HYLEBOS FOREST GAP ASSESSMENT

West Hylebos State Park
Federal Way, Washington

Prepared for:

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1. INTRODUCTION

The West Hylebos State Park in Federal Way, Washington is a large forested wetland complex. The winter storms of 2006 caused significant blowdown of trees in the park in numerous areas, particularly in some areas that appear prone to suffering windthrow.

Natural Systems Design (NSD) was hired by Friends of the Hylebos (FOH) to locate canopy gap areas with tree loss in the park, assess forest health and the risk of these areas for colonization by invasive species. NSD was also asked to determine whether or not tree disease(s) or pests may be a factor in the tree losses, and to make management recommendations for the gap areas. Tree disease assessment was done by Jillian Archer (ISA Certified Arborist).

2. PROJECT SITE

West Hylebos State Park is a 120-acre park located in Federal Way, Washington approximately a mile west of I-5 between SE 348th and SE 356th St. (Figure 1). Most of the park is forested wetland and includes areas of scrub-shrub and emergent wetland as well as pockets of upland forest. A boardwalk loop trail is located in the northeast section of the park, accessed via a trailhead on SE 348th St. The remainder of the park is inaccessible by trail.

3. METHODS

To locate gap areas, transects were laid out in a north-south grid at 200’ spacing starting from the eastern edge of the park. Two hundred-foot spacing was chosen because sightlines through the forest were estimated to be approximately 100’, based on an initial day of fieldwork locating gap areas along the boardwalk. Therefore any gap areas lying within a 200’-width would be seen from either one of the transect lines bounding the 200’-wide area between transect lines. It was anticipated that the entire park would not be surveyed within the scope of this project, but methodology to adequately survey the entire park was developed with the expectation that the remainder of the park would be surveyed at some point to complete the work begun this summer.

Transect lines were followed using a handheld Garmin GPS and compass. All gap areas with tree blowdown were located using the GPS, given a numeric identifier corresponding to the transect line #, and vegetation data was recorded for each site. Data was recorded for the following characteristics: community composition, invasives, canopy condition, soil conditions, invasive threat level, site access, and management recommendations.

A total of 71 acres of the park was surveyed with the six transect lines that were established. This represents approximately 60% of the park – the remaining 40% was not investigated due to budget constraints. Survey work that was completed on the initial site visit was limited to portions of the boardwalk. Gap areas identified along the boardwalk on this initial site visit were numbered with a BW prefix (e.g. BW1, BW2). All other areas were identified with a transect # prefix (e.g. 1.1, 1.2). Scrub-shrub areas that lacked canopy or windthrown trees were not tallied as gap areas, since the focus of the study was to assess canopy health, invasive species concerns, and possible tree disease issues that might threaten the health of the forested portions of the park. An example of an area lacking canopy that was not included as a gap site is the large scrub-shrub wetland southwest of the blueberry field off of SE 356th St. (gap 5.5). This area does not have a canopy component or windthrow indicating that it had one historically.

Fieldwork was performed on June 27, August 9, August 13, and August 16, 2007. Tree disease assessment and follow-up final ground-truthing of some of the data was done on September 24, 2007. A summary of the data is included at the end of this report.

Community Composition

Dominant and sub-dominant species were noted for each stratum. Comprehensive species inventory was not performed for this assessment, so species listed do not reflect all species present at each site.

Invasives

Invasive species presence was noted, and for each species recorded a visual estimate of relative cover was made – high, medium, low, trace.

Canopy Condition

Windthrown trees were counted by species and dbh (diameter at breast height) was measured for all gap areas that had fewer than thirty down trees. Areas with more than thirty windthrown trees were noted as such, and a visual estimate was made of average dbh. In these larger areas, species composition of the windthrown trees was also noted, but no counts were made. Natural regeneration of conifer species was noted, and regenerating species identified. Square footage of large gap areas was not accurately measured in terms of their square footage due to insufficient time to walk the perimeter of each gap area to create a GPS-generated polygon that could be entered into the computer. Square footage of smaller gap areas was more easily field-estimated and these size estimates were recorded.

Tree Disease

Downed trees, roots, and trunk collars were evaluated for source of failure by Jillian Archer (ISA Certified Arborist) in a sub-sample of gap areas.

Soil Conditions

Soil conditions in each gap area were categorized qualitatively by level of soil moisture at the time of the survey– standing water (SW), saturated (SAT), mesic (MES), and upland (UPL).

Invasive Threat Level

The relative threat level of invasion for each gap area was estimated based on the condition of the existing plant community (estimated resilience to invasion), the growth characteristics of the invasive species in question (rapidly spreading thicket habit such as blackberry vs. individual plants such as mountain ash or holly), and the current level of cover by that species. Three invasive threat levels were possible – low, moderate, high.

Site Access

Site access was noted to give an estimate of how difficult it might be to get to the site to perform invasive control or install plants. Access in the surveyed portion of the park is greatly enhanced by the boardwalk. Access was recorded as easy, moderate, or remote.

Management Recommendations

Management actions fall into two categories – invasive control and planting. Management recommendations are made based on survey findings, mainly the presence/absence of invasive species, the presence of natural canopy species regeneration, and the overall condition or resilience of the plant community at the given site.

4. FINDINGS

Overall

A total of 28 gap areas were identified along six transects and the boardwalk alignment (Figure 2). Twenty-six of these areas had blowdown; the two areas that did not have blowdown were included in the survey because they had significant invasive species issues or were directly adjacent to blowdown areas. Seventeen (61%) of the sites were located in saturated soils or standing water. The vast majority of tree damage was due to uprooting, less frequently the damage was due to stem failure part way up the tree trunk. Photo examples of typical gap areas can be found in Appendix A.

Plant Community Characteristics

The dominant community type in the forested wetland areas is a cedar/spruce/hemlock canopy (*Thuja plicata/Picea sitchensis/Tsuga heterophylla)* with a vine maple/red osier dogwood/salmonberry understory (*Acer circinatum/Cornus sericea/Rubus spectabilis*). Skunk cabbage (*Lysiciton americanum*) and lady fern (*Athyerium filix-femina*) are ubiquitous herbaceous species in the West Hylebos. Some portions of forested wetland consist of red alder/salmonberry (*Alnus rubra/Rubus spectabilis*) complex. Upland forest areas are generally hemlock/cedar dominated, with a much sparser shrub layer consisting of species such as salal (*Gaultheria shallon*), dewberry (*Rubus ursinus*), bracken fern (*Pteridium aquilinum*), vine maple, and false lily-of-the-valley (*Maianthemum dilatatum*). Cascara (*Rhamnus purshiana*) is a common sub-canopy species in both wetland and upland areas.

Scrub-shrub areas are predominantly wetland and usually present as red osier dogwood/salmonberry/vine maple, Douglas hawthorn/western crabapple (*Crataegus douglasii/Malus fusca*), or spirea/willow (*Spirea douglasii/Salix lucida var. lasiandra*) thickets. These are areas that lack canopy or evidence of historic canopy. They are not included in the gap assessment.

Invasive Species

A total of six invasive species of concern were noted in gap areas. The most commonly occurring species are Himalayan blackberry (*Rubus discolor*) and evergreen blackberry (*Rubus laciniatus*). These two species also have the greatest aerial coverage of all the invasive species noted wherever they appear. Other invasive species that appear in gap areas include: Scots broom (*Cytisus scoparius*), Canada thistle (*Cirsium arvense*), European mountain ash (*Sorbus acuparius*), and English holly (*Ilex aquifolium*). Invasive species only appear in twelve (43%) of the gap areas. In three sites invasive cover is considered high for at least one species, in three sites it is considered moderate for at least one species, and in nine sites at least one invasive species appears at low coverage or in trace amounts.

Overall in the park, invasive species appear in greatest concentration along park edges, which are the most disturbed areas bordering developed areas and street corridors. The edges of the grassland areas in the northern third of Transect #5 and #6 also exhibit large areas of invasive species, mainly Himalayan and evergreen blackberry. Invasive species within the park's interior seem generally to be at fairly low levels with the exception of a few concentrated areas where large canopy gaps occur.

Canopy Condition

Windthrown trees are found widely distributed throughout the surveyed area. Seven gap sites had large numbers of trees down that had fallen in a series of events over a number of years. These areas appear to be historically vulnerable to windthrow. Three of these areas (1.2, 1.3,1.4) are adjacent to each other on Transect 1, and comprise a fairly large area altogether. The other four areas are more dispersed (3.3, 4.1, 5.3, BW12). Six of the seven areas with large amounts of windthrow are in saturated soils or standing water. The majority of trees that are damaged in these areas are uprooted trees and not stem failures.

Windthrown tree species represent the dominant canopy tree species in the park: cedar, hemlock, and spruce. Some red alder failures, and one black cottonwood were noted as well. Average tree size for the windthrown conifer species is 20" dbh (diameter at breast height), range 10-36", and the average size of red alder blowdown is 9" dbh, with a range of 6-16". The largest windthrown tree found in the assessment was a black cottonwood with a 48" dbh.

Natural native tree regeneration was noted in sixteen (57%) of the sites. In almost all cases these were coniferous species.

Tree Disease

A sub-set (50%) of the gap areas was evaluated for tree disease. The fourteen gaps that were assessed were: BW2, BW3, BW4, BW5, BW7, BW10, BW12, 4.1, 5.1, 5.2, 5.3, 1.4, 1.3, 2.2. Assessment was done with the goal of determining which disease pathogens might be present in the forest and whether or not those pathogens pose a threat to the overall health of the forest. Detailed evaluation of each gap was not performed. Evidence of three disease pathogens was found in the assessment – *Ganoderma oregonense*, *Armillaria spp*, and *Phellinus weirii.* Blowdown due to stem failure or root failure from saturated soils and strong winds was found in six of the gaps (BW4, BW7, 5.1, BW 12, 1.4, 1.3). Disease was found in all the other gaps assessed, but was not necessarily the cause of all of the blowdown in each of these sites.

Ganoderma oregonense is a pathogen that causes heart rot in living western hemlock trees. Heart rot is decay in roots, butts, and trunks of living trees. Often a diseased tree is windthrown while still alive. Basiocarps (fungal conks) are the first external indicators of disease. Areas with large numbers of trees affected by the pathogen are called 'Root rot hot spots'. These areas increase in size as roots of adjacent trees come in contact with diseased trees and the pathogen spreads from tree to tree. BW5 is a 'Root rot hot spot'. Photos of this gap and examples of the fungal conks that indicate the presence of this pathogen can be found in Appendix A.

Armillaria spp. is a fungal pathogen that decays roots. The fungus grows in a mycelial fan between the wood and the bark. *Armillaria* is one of the most prominent decays of deciduous and coniferous forests. The decay weakens and kills the roots reducing the structure and strength of the tree. *Armillaria* spreads by spores from basidiospores or root to root contact. Good examples of *Armillaria* were found in gap 5.3.

Phellinus weirii is another fungal pathogen common to forests of the Pacific Northwest. As decay progresses, the wood tends to separate (laminate) along annual rings thus the common name, laminated root rot. At this stage, trees are often windthrown, typically leaving all but the stubs of roots in the soil. *Phellinus weirii* spreads through spores, root to root contact and root to decaying wood contact. The large Sitka spruce in BW2 failed due to *Phellinus weirii.*

Soil Conditions

The majority of West Hylebos State Park is wetland, so it is not surprising that the majority of the gap areas (17 areas or 61%) identified are in saturated soils or standing water. Six of the seven large areas of multiple blowdown events are in saturated soils or standing water, even at the time of the fieldwork during the driest months.

Invasive Threat Level

Nineteen (68%) of the twenty-eight gap areas were identified as having a low invasive threat level. Only three have a high threat level – two of these are on park edges (Area 1.1, and BW1), and the third is one of the large blowdown areas along the boardwalk

(Area 1.4). The remaining six sites are in the mid-range of moderate to moderate-high. Transect 1 has a large concentration of vulnerable area; Areas 1.1, 1.2, 1.3, and 1.4 have moderate to high threat levels (Figure 3).

Site Access

Access to the gap areas in the surveyed portion of the park is fairly good due to the presence of the boardwalk. Two sites on Transect 1 were given a moderate-remote rating as far as getting into the site to perform invasive control or planting.

Management Recommendations

Less than half the sites – twelve out of twenty-eight gaps – require invasive removal, and only seven of those are recommended for subsequent planting, mainly with tree species, but also in some cases with shrub species to replace invasives (Figure 4). An additional eight sites that do not need invasive removal are recommended to be planted as well. Planting is only recommended in sites that have enough invasive cover that removal of the invasives would leave vegetation gaps that would quickly be re-colonized with undesirable species if left unplanted, or in sites that have limited natural tree regeneration (either low density or low species diversity). Planting of tree species should be done if possible using contract-grown conifer species originating from site collected seed sources to maintain site adapted disease resistance.

5. DISCUSSION

Forest Health

Windthrow

Trees growing in saturated or inundated soils develop a variety of morphological adaptations to these soil conditions. Anaerobic conditions in the root zone result in trees with shallow root systems as deep-rooted species cannot survive. Trees with shallow root systems are more vulnerable to wind because they are not deeply anchored. In addition the shear strength of soils decreases as the moisture content of the soil increases, so wet soils provide poor root anchorage for trees. Trees in the West Hylebos have adapted to the site conditions with relatively shallow root systems, and high winds occur most often in the wintertime when soils are wettest. The combination of wet soils, shallow rooted trees, and winter storms make the West Hylebos forest particularly vulnerable to tree loss from windthrow. Indeed, most of the windthrow found in the park in this survey was uprooted with an intact rootball, and far fewer tree losses were stem failures.

A number of other factors influence the vulnerability of trees to damage or loss due to wind. These include: site characteristics such as wind exposure due to adjacent and surrounding land uses, regional climatic conditions, soil moisture, aspect, and slope. Stand characteristics also determine susceptibility to wind: mean tree size/height, stand density, stand age, and species composition. Finally, individual tree characteristics are a factor: tree height, species, tree form, biomechanical resistance to wind stress, and root structure.

Windthrow is a part of the dynamic process of forest succession. Windthrown trees provide wildlife trees, large down coarse woody debris, and nurse logs for tree regeneration. Windthrow also provides microclimate diversity as uprooted trees mix soils, and provide micro-site diversity by creating pit and mound topography.

Disease

Aside from wind, disease is the other major natural disturbance agent in a forest. Some level of disease is normal in a healthy forest and is part of the natural processes of a forest ecosystem. Disturbance creates gaps in the forest canopy that allow additional light to reach the forest floor and stimulate new seedling and shrub growth. Diseased trees are also very important structural elements in a forest, forming standing snags that are hollowed out by cavity nesting wildlife species, then falling and creating down wood for other wildlife species to use on the ground. Finally, the decomposition of the wood enriches the soil and increases microbial activity on the forest floor. Down wood also aids forest regeneration by providing seedling establishment sites.

Any tree disease (root or insect) that weakens a tree will further increase its vulnerability to blowdown. Pests and diseases can weaken a tree by damaging roots, reducing structural integrity by affecting water and food transport, and reducing food production (photosynthesis) and storage (seeds). Diseases and pests can also affect the composition of a stand because some species are more vulnerable to certain diseases and pests than others. Species composition within a stand is another factor that affects susceptibility of a stand to wind.

The three disease pathogens identified in the West Hylebos are common to this region and are found in any typical forest habitat in the Pacific Northwest. Different species of trees have differing resistance to each of these diseases, and therefore different habitat types will also display varying degrees of resistance to any of these diseases. Laminated root rot, for example, tends to be much more damaging to upland forest types with Douglas fir and grand fir. Cedar and spruce are more resistant to laminated root rot and are seldom or not typically damaged at all by its presence, which suggests that forests like the West Hylebos, that are dominated by cedar, spruce, and hemlock are not going to be as negatively affected by this particular pathogen. *Armillaria* is moderately damaging to all three dominant conifer species found in the West Hylebos – western hemlock, Sitka spruce, and cedar.

In addition to the species variability of disease resistance, forests can develop local resistance to endemic diseases by the process of adaptation over time. The forest in the West Hylebos is a mixed species and mixed age forest that also helps its ability to harbor disease pathogens that don't necessarily destroy the forest. Not surprisingly, disease is often much more of a problem in single-species same age stands, for example in forests planted and grown for commercial harvest.

Invasive Species

The distribution of the invasive species observed in this study indicates that there are two main mechanisms that determine distribution. Invasives present along park edges are opportunistic and have established in disturbed areas adjacent to openings that favor them. Road edges and developed areas are classic avenues of invasion. This can be seen in the West Hylebos along SE 348th St., along SE 356th St., and along both edges of the park "entrance" in the vicinity of Transects 5 and 6. Invasives are present in high concentrations and at the exclusion of native species. These species will spread inwards as site conditions along edges allow. Tree blowdown along park edges, for example, will give sun-loving species such as blackberry opportunities to move towards the forest interior.

Management (removal and replacement planting) of dense concentrations of invasives is recommended to reduce movement inwards, to establish and maintain a resilient native species edge community, and to promote stewardship of the park by presenting healthy native plant communities along the most publicly and visually accessible portions of the park. Control of invasives where cover is dense will require a greater effort and will in most cases include infill planting and intensive stewardship of plantings until they are well established and able to resist re-invasion.

In the park interior the characteristics of invasive presence is completely different. Aerial cover is typically much lower because disturbance is far less. Species such as holly and European mountain ash are present as individual plants and thicket forming species such as blackberry are less dense in distribution and growth. This pattern indicates that the primary method of spread is likely to be bird dispersal. Control of invasives in these settings should be relatively easy and involves selective removal of individual plants or small areas of plants, in many cases not even requiring infill planting. To some extent, this kind of specific and selective invasive species control will be a part of the longterm and ongoing management in the West Hylebos Park because the mechanism of dispersal will remain constant.

Management Recommendations

Prioritization of management actions will be a key component to successful implementation and desired outcomes of increasing forest health by controlling invasives, maintaining and improving canopy health, and keeping all strata of the plant communities intact and resistant to invasive species. Management actions recommended are: invasive removal and control, planting, and hazard tree evaluation. Management recommendations for each area are shown in the attached summary data sheet (Appendix B).

All recommended actions are important, but some actions are easier to perform right away and will yield immediate benefits for a relatively low level of effort and planning. Others are more labor and cost-intensive and will require more lead time for planning and budget allocation. The following prioritization for invasive control and planting is recommended in descending order of priority from highest to lowest. It is expected that high and medium priority tasks could be performed immediately while lower priority tasks are in the planning and funding stages.

1. **HIGH PRIORITY**: Control invasive species in interior areas of minimal invasion by removing all invasive plants found within identified gap sites. Complete removal should be achieved. The level of effort to accomplish this task should be relatively low and since no planting is recommended, creating a work plan and mobilizing a work crew should be straightforward. These sites include **Areas 1.2, 1.3, 2.2, 3.2, 3.3, 3.4, 5.4, 5.5**, **BW5**.

2. **MEDIUM PRIORITY:** Perform infill planting of tree species where no invasive control is required. These are areas that have canopy gaps and healthy understory, but may not have natural regeneration of canopy species occurring. These sites include **Areas 1.5, 2.1, 3.1, 5.1, 5.2, 5.3, BW2, BW3.** Consider contract growing tree species to be planted so that disease resistant characteristics and genotypes indigenous to the West Hylebos are preserved. This entails propagation done by a nursery using seeds or plant material collected in the West Hylebos. Accomplishment of this task will require some additional planning to determine desired planting density, plant quantities, and species composition. It will also require several years lead time to propagate and grow out plants if contract growing is done.

3. **LOWER PRIORITY:** Control invasives in areas that also require planting of both trees and shrubs. These are the areas that will require the greatest initial effort and the most stewardship to establish healthy native plant communities because invasive species cover is generally highest. Plant establishment will include some ongoing invasive species control as well as plant care for at least three years after initial invasive removal and planting occurs. Accomplishment of this task will require some additional planning to determine desired planting density, plant quantities, and species composition. It will also require several years lead time to propagate and grow out plants if contract growing is done. These sites include
    - **Areas 1.1 and BW1 – to be first priority for this action because access is easiest**
    - **Areas 1.4 and 4.2 – to be second priority because access is moderate**
    - **Areas 1.2 and 1.3 – to be last priority as they are both large, 1.2 is remote, and lessons learned at higher priority sites will inform management of the more difficult site**

4. **LOWER PRIORITY:** Due to public safety concerns, trees in the boardwalk corridor should be evaluated by an arborist for hazard potential and tree risk assessment. If such an evaluation is performed, follow-through on any tree removals recommended will need to be done. The presence and distribution of fungal pathogens found in the West Hylebos is normal within a healthy forest ecosystem. More detailed assessment (i.e. soil samples, detailed evaluation of

each tree within each gap area) is not recommended because the general assessment did not indicate areas of particular concern.

5. Completion of the gap assessment project for the western portion of the park is recommended if the data is desired, and if there are resources to perform management actions. Performing management actions such as invasive removal and planting will be more difficult in the western half of the park simply because access is more difficult without a trail. It might be advisable to begin some of the implementation suggested in this report first to get an idea of what might be involved in expanding the implementation area to include the western half of the park. Using this report to determine if the information is adequate to guide management can also help shape the scope of work for further assessment of unsurveyed portions of the park.

   Edge characteristics and management recommendations can easily be determined by quickly surveying the park perimeter, but information about the remaining interior areas can only be gathered by actually getting into these areas on foot. Even the detailed aerial photos of the site that were used as base maps for this study were inadequate for making any assessment of the vegetation or even discerning canopy gaps. Thus, if data for the rest of the park is desired, using transects to survey the remainder of the park is recommended.

APPENDIX A – Photos of Representative Gap Areas

Photos showing typical sites with disease pathogens present

Above and right: Gap BW5 identified as a 'rot pocket' of hemlock trees affected by the root rot *Ganoderma oregonense* with basiocarps visible on standing and down trees. This gap is in a stand of almost exclusively hemlock trees with a sparse understory of cascara and vine maple, and bracken fern, dewberry, and false lily-of-the-valley in the groundlayer. This site is a mesic upland site.

Photos showing typical sites with disease pathogens present (cont'd)

Above: Gap BW3 with a single down hemlock tree affected by *Armillaria spp.* The soils are saturated and surrounding vegetation includes a salmonberry thicket with skunk cabbage and lady fern in the groundlayer. Other canopy tree species are red alder and Sitka spruce.

Below: Gap 5.3 also with hemlock trees affected by *Armillaria spp*. This site has a mixture of hemlock, spruce, alder, and bigleaf maple in the canopy. Soils are saturated. Shrubs and herbs include red osier dogwood, vine maple, skunk cabbage, and lady fern.

Photos showing typical sites with disease pathogens present (cont'd)

Above and below: Gap 2.2 with numerous down hemlock trees. Some of the trees have stem failures, some are windthrown with intact rootball. Some of the trees appear to be affected by rot but others are not. Hemlock regeneration is prolific as shown in the far right of the photo below. Site is hummocky with upland areas of hemlock and salal interspersed with pockets of standing water and skunk cabbage and spirea.

Photos showing typical sites not affected by disease

Top left: Gap 1.3 showing an area of sparse canopy that is typical in this area in the northeastern end of the boardwalk. The reason for the alder decline is not apparent. This area has lost numerous cedars, but also exhibits cedar regeneration. It is an extremely wet site with standing water in the gap area. Invasives are currently not a problem, but this site is adjacent to gap 1.4, which has a high incidence of Himalayan blackberry.

Below left: Gap BW7 with a hemlock stem failure unrelated to disease. There is regeneration of conifers (hemlock and cedar) and no invasives were noted. No action is recommended for this site.

Below right: Gap 1.4 with a close-up of the fibrous roots of a windthrown cedar or hemlock. The roots are not damaged by root rot, and no other signs of fungal pathogens is evident. Trees have fallen due to the roots simply letting go in saturated soils.

Photos showing typical sites not affected by disease (cont'd)

Above: Gap BW10 showing a "healthy mess" of down wood, regenerating young trees, and healthy understory of native species. This site has no invasives present, and due to the good condition of the vegetation in all layers, no action is recommended here.

Right: Gap BW12 showing a site with some stem failures and some windthrown trees. There is evidence of a small rot pocket here, but this is not the cause of the majority of fallen trees. There is regeneration of all three canopy species that are present (alder, hemlock, cedar), no invasives are present, and the understory is diverse and healthy. No action is recommended here.

APPENDIX B – Gap Area Data