

Llandover Woods Vegetation Management Plan



Prepared for: Friends of Llandover Woods

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Prepared by:

Ella Elman, Ecologist
Nelson Salisbury, Ecologist
Jeff Bash, Executive Director

Seattle Urban Nature Project
5218 University Way NE
Seattle, WA 98105-4495

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I. INTRODUCTION

Overview

Llandover Woods is a 9.1 acre parcel located in northwest Seattle (Map 1). Acquired by the City of Seattle Department of Parks and Recreation in 1995, the open space contains relatively undisturbed conifer forests, which are a unique asset to the surrounding neighborhood. The park-owned property provides recreational opportunities for community members and habitat for numerous species of native plants and wildlife.

Llandover Woods is maintained for passive activities such as hiking and bird-watching. An unpaved walking trail forms a loop through the forest. There are no playfields, picnic areas, restroom facilities, or other recreational amenities associated with the woods. The property is situated approximately .5 miles east of Puget Sound on the south side of a forested ravine. A small stream surfaces just west of Llandover Woods and flows over private property before emptying into the Sound. The forests are comprised primarily of native, second-growth coniferous trees. Few public parks in Seattle contain the relatively intact, second growth conifer forests that can be found in Llandover Woods.

The open space is bordered on the north by approximately 12 acres of heavily forested property owned by The Highlands, a private development (Map 1). Many private residences adjacent to Llandover Woods and The Highlands property include additional tracts of undeveloped forest. These properties account for a significant area of contiguous forestland and a substantial natural system.

The woods and privately owned properties create a nearly unobstructed forested corridor from Northwest 145th Street to the railroad corridor located along the shores of Puget Sound, totaling approximately 35 acres of undeveloped forested habitat. This forest constitutes a unique landscape in a heavily developed metropolitan area.

Due to its location at the fringe of the city limits, Llandover Woods has a relatively intact forest structure and has been able to avoid many of the problems prevalent in Seattle's other parks and open spaces. These issues include the widespread introduction of invasive species, habitat fragmentation, altered hydrologic conditions and general overuse. However, populations of invasive species are present in the woods, likely due to vegetation clearing as part of a proposed development on the property in the early 1990s and encroachment of plantings from surrounding private properties. Some of the issues impacting the current condition of Llandover Woods include trail erosion, invasive species populations, and the lack of natural conifer tree regeneration.

Project goals

The purpose of this report is to assist Friends of Llandover Woods (FoLW) in their planning efforts for the ongoing stewardship and maintenance of Llandover Woods. The report consists of a scientific inventory of forest resources present on site and evaluates the actions required for effective vegetation management in Llandover Woods. This effort also establishes baseline information with which future surveys and monitoring may be compared. Specific goals of the project are:

- 1) To provide an assessment of current vegetation resources and create a management plan based on these findings; and
- 2) To establish a monitoring plan which enables Friends of Llandover Woods to effectively monitor their restoration efforts over time.

This effort was made possible through a grant from the Seattle Department of Neighborhoods Matching Fund.

II. SITE LOCATION AND CONTEXT

Area Description

Llandover Woods is located east of the residential community “Llandover by the Sound” in the Broadview neighborhood of northwest Seattle. There are two public entrances to the woods: one at the junction of Northwest 145th Street and 3rd Ave Northwest, the second at the east end of Sherwood Road Northwest. The entrance off of Northwest 145th Street is bordered to the north by the City of Shoreline. The western edge of the woods is approximately 0.5 miles from the Puget Sound shoreline (Map 1).

The surrounding neighborhoods to the south and west of Llandover Woods are generally comprised of large forested lots, averaging 37,800 square feet (0.87 acres) each. According to the King County Assessor, “It is one of the few areas in Seattle where one can live on acreage parcels with a high degree of seclusion.” (King County Department of Assessments 2004). A total of five residential parcels border the open space along the western and southern boundaries (Map 1). An additional five residences occur on the more densely developed eastern border of the open space. The eastern portion of Llandover Woods is comprised of a narrow right of way between the residences to the east and the undeveloped Highlands property to the west, providing a public access corridor from the junction of Northwest 145th Street and 3rd Ave Northwest.

Hydrology, Geology, and Soils

Llandover Woods generally slopes to the north, towards a pronounced east-west valley. The bottom of the valley demarks the northern boundary of the open space. The valley drains west towards the Sound, and acts as the primary drainage basin for the surrounding properties. Groundwater surfaces just west of Llandover Woods and forms a defined stream channel. The stream flows through The Highlands before discharging into the Sound (Map 1). Slopes in Llandover Woods average 30 to 45 percent and the topography includes numerous side ridges and valleys.

The geology of Llandover Woods is heavily influenced by glacial processes which ended 15,000 to 20,000 years ago in this area. Layers of sands, gravels, and silts were distributed by the movement or compaction from glacial ice and glacial outwash (streams generated from the melting of glacial ice). The terrace above Puget Sound, upon which the woods is located, is a landform heavily influenced by glacial processes. The ravines and valleys in the area are the results of post-glacial stream actions, which are cutting down through the glacial terrace.

The geologic composition of Llandover Woods consists of a relatively thin layer of Vashon subglacial till, a compact diamict (gravel and sand in a silt matrix), overlaying the dominant Vashon advance outwash deposits. The Vashon advance outwash deposits consist of well-sorted sand and gravel material, which makes up the majority of the valleys and hummocks of Llandover Woods. These deposits overlay the Lawton Clay (Qv1c) layer at the very base of the valley (Troost et al. 2005).

Map 1. Llandover Woods location and vicinity

Vegetation Overview

Like most of Seattle's forested areas, Llandover Woods was logged during initial settlement of the area in the late 1800s (Figure 1). Because the slopes and valleys were not further developed and were left nearly undisturbed, natural succession and regeneration has resulted in approximately four acres of second growth conifer forest, with an intact, native understory.

During a citywide survey of Seattle's parks and open spaces in 2000, Seattle Urban Nature Project identified three major forested habitat types in Llandover Woods: conifer forest, conifer/deciduous mixed forest and deciduous forest. The 2005 survey corroborated the findings of the initial survey.

Douglas fir (*Pseudotsuga menziesii*) dominates the conifer forest with scattered occurrences of western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*) and Pacific madrone trees (*Arbutus menziesii*). Slopes and ridges in the woods are generally covered with sword ferns (*Polystichum munitum*) and other native understory plants such as salmonberry, beaked hazelnut (*Corylus cornuta*), creeping blackberry (*Rubus ursinus*), salal (*Gaultheria shallon*), and fringecups (*Tellima grandiflora*).

In the valley bottom, Douglas fir mixes with deciduous trees, predominantly large-diameter big-leaf maples (*Acer macrophyllum*) to form conifer/deciduous mixed forest. Because the soils in these forests remain moist throughout most of the year, moisture-loving plants such as salmonberry (*Rubus spectabilis*), Pacific waterleaf (*Hydrophyllum tenuipes*), stink currant (*Ribes bracteosum*) and swamp gooseberry (*Ribes lacustre*) are found in this forest type.

There is a small section of Llandover Woods (0.8 acres) which is dominated by a dense, immature stand of big-leaf maples, a legacy of a previous development attempt. Prior to the parcel's acquisition by the city, this area was cleared in preparation for development of a 23-house subdivision. The history of this development is discussed in the "History and Development of Llandover Woods and the Surrounding Community" section of this report.

Invasive species found in Llandover Woods include Himalayan blackberry (*Rubus discolor*), evergreen blackberry (*Rubus laciniatus*), Scotch broom (*Cytisus scoparius*), English ivy (*Hedera helix*), English holly (*Ilex aquifolium*), cherry laurel (*Prunus laurocerasus*), herb Robert (*Geranium robertianum*), isolated patches of privet (*Ligustrum spp.*) and common periwinkle (*Vinca minor*). Scotch broom, English ivy and herb Robert are listed as Non-designated Noxious Weeds in King County. These weeds are listed as noxious weeds on the Washington State Weed List but are so widespread in King County that control is highly recommended but not required by law (King County 2006).

Himalayan blackberry, evergreen blackberry, English holly and cherry laurel are designated as Weeds of Concern by King County. Weeds of Concern are widespread, unregulated species which impact and degrade native plant and animal habitat. Control and containment of existing populations is highly recommended but not required by law (King County 2006). While the percentage of the understory covered with invasive species is much less than in many of Seattle's urban forests, there are areas in Llandover Woods where these species have become established

and now dominate. A few species of invasive trees, mainly English holly, are currently spreading as solitary individuals and are scattered throughout Llandover Woods. Other invasive tree species include English hawthorn, cherry laurel, and European mountain ash.

Wildlife

A wide variety of animals take advantage of the extensive habitats created by the complex of large private wooded lots, green belts, and reserves of Llandover Woods and vicinity. Glenn Austin of Friends of Llandover Woods has compiled a list of 8 mammal and over 25 bird species sighted in the woods (Appendix C).

Resident species such as barred owls (*Strix varia*) and sharp-shinned hawks (*Accipiter striatus*) have been observed by Austin, likely feeding on the many song birds and rodents inhabiting the park. A large snag near the trail is heavily used by pileated woodpeckers (*Dryocopus pileatus*). Coyotes (*Canis latrans*) have also been sighted, as well as other mammals such as the Eastern gray squirrel (*Sciurus carolinensis*), Townsend chipmunk (*Eutamias townsendii*), the native Douglas squirrel (*Tamiasciurus douglasii*), and mountain beaver (*Aplodontia rufa*). Mountain beaver have established extensive populations in large portions of the park and surrounding home sites. Mountain beavers browse on the leaves, shoots, and roots of a variety of native plant species. Because of the sandy soil and extensive native food stocks, mountain beaver damage to the woods appears to be minimal. Overall, the intact condition of the forests in and around Llandover Woods provides important wildlife habitat to a variety of animal and bird species.

History and Development of Llandover Woods and the Surrounding Community

The following historical information was compiled from a variety of sources by Glenn Austin of Friends of Llandover Woods (Austin unpublished report 2006).

The character of Llandover Woods today has its roots in the 1890s, when rail lines and development first extended northward from Seattle. Much of the area was cleared by logging of the huge old growth fir and cedar trees, some eight feet in diameter. Many of the logs were skidded to the nearby mill at Bitter Lake. This mill was operated by the Puget Mill and Brown Bay Logging Company until 1913, when the forests were logged out. At this time, farmers dynamited stumps and began to work the most level patches of ground.

Around 1903 The Highlands preserved approximately 12 acres of forested bluff and valley immediately north of Llandover Woods, as a natural buffer for the estates being planned at that time. From 1907 through the early teens homes were built in The Highlands development for many of the prominent figures of Seattle, including the Piggots, Boeings and others. The Olmstead brothers, internationally known landscape and park designers, were hired to design the roads and lots in The Highlands. Nearly 60 acres of south-facing slopes in The Highlands were never fully logged during early development. As a result, a mature Douglas fir canopy and native understory persists today on the northern boundary of Llandover Woods.

The area that is now north Seattle and south Shoreline was settled in the early 1900s, encouraged by the interurban street car and rail lines that punched north from 1906 to 1913. Starting around

1910, homes and farms were settled in the Broadview neighborhood. Around 1913 the Shoreline neighborhood was settled, but not until 1944 was the name "Shoreline" first used. Shoreline and Broadview continued to grow around the forested islands of The Highlands reserve and Llandover Woods. Broadview now has more than 13,000 residents, and Shoreline more than 50,000.

Other forested habitat adjacent to Llandover Woods was settled in the 1940s and 50s, as the communities of Elford, Northwood, and Llandover by the Sound were developed. The smallest lot in these developments is 0.6 acre, and many lots remain undeveloped as private green buffers for existing homes. Additional greenbelt habitat is provided by the railway and coastal rights-of-way to the west. Carkeek Park to the south and Richmond Highlands and Innis Arden Reserves to the north combine to create a considerable natural system.

Figure 1. Brown Bay Logging Company operations in Washington state (Curtis 1911)



Residential Development Averted

In recent years, preparations to develop Llandover Woods for residential housing were initiated. In the early 1990's, lots for 23 homes and later for nine homes were planned by developers under the name Shorewoods LLC. Northwest 145th Street would have been extended westward, isolating the greenbelt of The Highlands from the habitat to the south and eliminating the informal trail. Roadbeds were constructed, lots surveyed and cleared, soil samples taken, and addresses assigned. In 1994 Debby diCaprio and other local neighbors learned of this plan and approached the City of Seattle to inquire whether the City would purchase the land for use as a greenbelt.

The timing was fortuitous for this community intervention, as the City had recently initiated the Conservations Future Fund after several failed attempts to set aside city green spaces. These efforts were based on objectives stated in the 1988 King County land preservation act and the 1989 City of Seattle Natural Areas Bond Issue. To quote the city analysis, "breathing room open space is deficient in the northwest sector of the city." On June 7, 1995, after extensive negotiation, the city purchased 7 of the 9 lots (9.5 acres) for \$1.475 million, leaving for development the two lots that had direct access from 3rd Avenue Northwest.

Volunteer Efforts

Initial volunteer efforts in Llandover Woods included trail construction on top of the developer's roadbeds and wooden stairs at the southern edge of the city property. During the winter of 1995-96, a large landslide spilled sand and rock from the top of the trail all the way to the bottom at Sherwood Road (Map 3). The approach trail is still undercut at the head of this slide.

The Boy Scouts of America installed the wooden stairs near the south-west corner of Llandover Woods and graded the trail. A concrete bench, placed by friends in memory of a neighborhood resident, was placed at the top of the stairs.

Penny Rose, the education naturalist from Discovery Park, started the latest round of volunteer efforts in 2004 in cooperation with Nancy Jaramillo, maintenance lead at Carkeek Park. Since that time, many invasive plants have been cleared, the trail improved, and drainage built along trails. Restoration plantings began in early 2006.

The Friends of Llandover Woods was established in 2005 and holds monthly work parties. The group has primarily focused on clearing invasive species and trail stabilization. In September of 2005, FoLW teamed with Seattle Urban Nature Project to survey Llandover Woods. Glenn Austin, current lead steward of the Friends of Llandover Woods, has photographed many of the woodland creatures and a collection of these photographs will be made available at the Carkeek Park Education Center.

III. FOREST ASSESSMENT METHODOLOGY

Sampling intensity

Vegetation management plans for other parks produced for the City of Seattle Parks Department generally aim to sample three to ten percent of the forested area present. Using this guideline, SUNP surveyed nine plots between October 4, 2005 and October 24, 2005. These sample plots (0.1 acre each, with a combined coverage of 0.9 acre) represent approximately 10% of the total area of the park (9.1 acres). Non-forested portions of Llandover Woods were not included in the survey. Approximately 0.9 acre of invasive-dominated shrubland and the parking area were not sampled. This brings the actual sampling intensity of forested acres (8.2 acres) to 11%.

Plot Layout

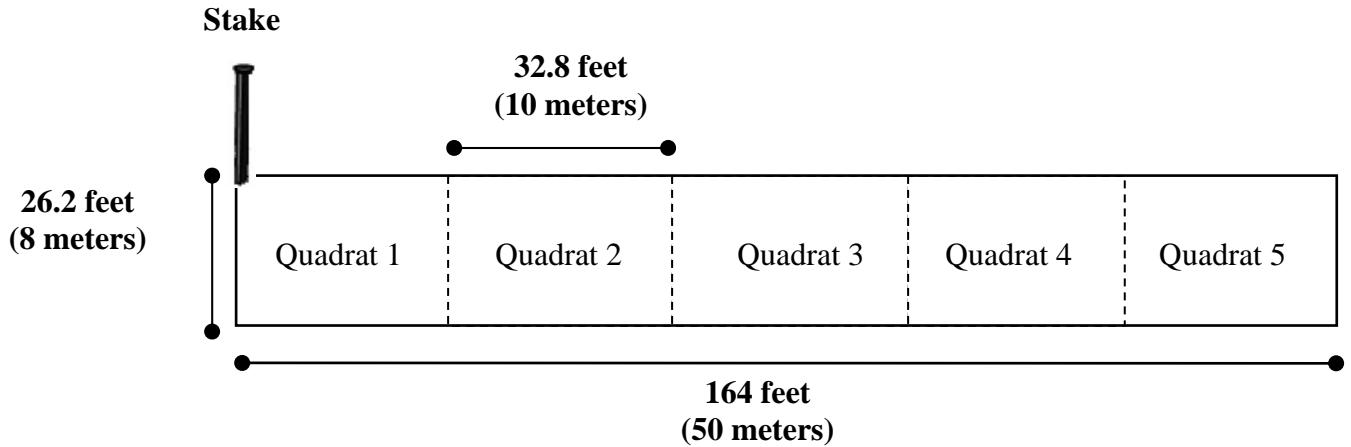
Plots were distributed proportionately among all forest types and randomly located within a particular forest type. Of the nine sample plots, four were located in the conifer/deciduous mixed forest, four were located in the conifer forest, and one was located in the deciduous forest (Map 2).

The plots are rectangular and cover an area 26.2 feet (8 meters) wide and 164 feet (50 meters) long (Figure 2). These dimensions equal approximately 0.1 acre in size, which has been a standard area for sampling units in all recent vegetation management plans (VMPs) written for other parks within Seattle (Jones and Stokes 2002, Sheldon and Associates, Inc. 2003, Seattle Urban Nature Project 2005). Long rectangular plots provide a more accurate sampling of the naturally occurring variation that occurs within clumped distributions of plant species, thereby producing more accurate estimates than round or equal sided plot shapes, particularly for density-related measures (Elzinga et al. 1998).

The majority of plots are either oriented along the north/south or east/west geographical axis. If orientation along these axes did not allow the plot to be fully included in a particular habitat type, the orientation was modified to sample in one specific habitat type.

Plots are intended to serve as permanent, long-term monitoring units. To meet this goal, plot boundaries were marked to facilitate future relocation of the sampling plots. The starting point of each plot was marked with a 1"x 2" x 48" wooden stake driven into the ground. The transect extends 164 feet along the transect bearing and 26.2 feet perpendicular to the bearing on the right side of the stake (Figure 2). GPS point locations have been recorded to within one meter accuracy at each stake (Appendix D).

Figure 2. Dimensions and layout of sampling plots in Llandover Woods*



* not drawn to scale

Assessment Procedures

Two general categories of attributes, tree density and vegetation cover, were recorded at each plot. The average slope and aspect for each plot was also recorded.

Tree density: All trees with trunks occurring within the 1/10th acre plot were identified and enumerated including non-native tree-like species such as cherry laurel, English holly and European mountain ash (*Sorbus aucuparia*). In order for a tree to be included in the sampling plot, more than half of its rooted trunk had to occur inside the plot. Height and diameter at breast height (dbh – breast height is defined as 4.5 feet from the ground surface) were recorded for each tree. In addition, trees were assessed for colonization by English ivy. For trees smaller than 4.5 feet in height, average stem diameter was recorded to the nearest ½ inch.

Canopy cover of overstory and mid-story trees was estimated visually for conifer and deciduous tree types in each quadrat (Figure 2). Canopy cover was defined as the area of ground covered by the vertical projection of the outermost perimeter of the natural spread of foliage of the plants. Small openings within the canopy are included in the canopy cover estimate.

Snags and coarse woody debris (CWD) greater than 5 inches in diameter, consisting of downed logs and stumps, were measured and placed into one of three decay classes, I, II, or III. Decay class I indicates a branch or trunk that recently died and frequently had intact bark and branches and hard wood. Decay class III characterized wood in an advanced state of decay with little to no bark or branches left intact, softened crumbling wood and extensive epiphytes. Decay class II provided an intermediate designation between these two extremes. CWD measurements from sampling plots were used to extrapolate an estimate of cubic feet of wood per acre (ft³/acre) for further analysis.

Tree density was considered a key measure in this survey, as it allows for analysis of several aspects of forest functionality, including tree regeneration, forest structure, conifer to deciduous ratios, and the presence and frequency of exotic tree species.

Vegetation cover: All plant species occurring in, or with foliage overhanging the 1/10th acre plot, were identified and percent cover was visually estimated for each species. Percent cover was estimated by dividing the 50m x 8m sample area into five 10 x 8m quadrats (See Figure 2) and visually estimating cover for all species present within each quadrat, then combining these subtotals to derive an estimate of cover for the entire sample area. Species that were present in trace amounts were given a minimum value of 0.1%. This allowed for a complete floristic survey (i.e. species richness) for each plot location. Because the survey was conducted during October, some emergent species had senesced. Species that were not apparent during this time were not included in the species tally.

Cover and richness were chosen as measurable attributes in order to provide an estimate of species and structural diversity. These attributes can be extrapolated to provide an estimate of the extent that an area has been invaded by non-native species.

Specific restoration areas

Additional vegetation data were collected in four restoration areas identified by Friends of Llandover Woods and SUNP ecologists (Map 3). These areas were not sampled in the nine previously-described survey plots, as those plots were specifically designed to sample the intact forested portions of the park. The information collected in restoration areas was not as comprehensive as the survey plots, and no density information was collected. Rather, the goal of surveys in the restoration areas was to identify all species present in these areas and to collect baseline species coverages. After restoration projects are implemented, the sites may be surveyed to determine how species cover levels have changed. All species found on each restoration area were recorded. Percent cover for each species was estimated over the entire restoration area and placed into one of 4 categories: Trace (<1%), Low (1-25%), Medium (26-50%) and High(>50%).

Data Collection and Management

Data was recorded on data sheets in the field. Two data sheets were used: one for recording species cover information and one for recording tree density information. Data sheets are included in Appendix E. Data collection was conducted by two staff ecologists at Seattle Urban Nature Project. Information from the data sheets was entered into a Microsoft Access database by SUNP staff. Maps were produced using ESRI ArcMap version 8.3, which connects geographic information (e.g., maps, aerial photographs, topography) with tabular information (e.g., data plot information in Access database).

Map 2. Llandover Woods habitat types and assessment plot locations

IV. RESULTS AND FINDINGS

Park-wide Vegetation Trends

The results of the 2005 survey indicate that approximately 44% of the total park area consists of conifer forest, which averages 20 to 30 inches in diameter (Table 1).

Approximately 37% of the park consists of conifer/deciduous mixed forest, of which 80% averages 20 to 30 inches in diameter and 20% averages 15 to 20 inches in diameter. One stand of pure deciduous forest is also located in the park, which covers 9% of the total park area (0.8 acres). (Table 1)

A shrubland area is present on the west side of the park and is dominated by invasive species, mainly Himalayan blackberry, evergreen blackberry and Scotch broom (Map 2). This area is 0.7 acre in size and comprises 8% of the park (Table 1).

Table 1. Habitat types mapped in Llandover Woods during the 2005 survey.¹

Habitat Type	Diameter range (inches)	Acres	Percentage of Total Area (%)	Number of Plots sampled
Conifer Forest Total	20-30	4.0	44	4
Conifer/Deciduous Mixed	15-20	0.7	7	1
Conifer/Deciduous Mixed	20-30	2.7	30	3
Conifer/Deciduous Mixed Forest Total		3.4	37	4
Deciduous Forest Total	<5	0.8	9	1
Shrubland		0.7	8	0
Parking Area		0.2	2	0
Park Total		9.1	100	9

¹ For each habitat type, the acreage and percentage of total area that the type occupies is given, along with the number of plots sampled in that type during the survey. Some habitat types are further separated by diameter class, where appropriate.

During the 2005 survey, a total of 58 plant species were found: 9 tree species (5 native and 4 non-native), 20 shrub species (18 native and 2 non-native) and 29 herbaceous species (18 native and 11 non-native). Appendix B lists the scientific and common names of all plants identified during the survey, as well as the native/non-native status of these species.

Overall, the forested areas of Llandover Woods are dominated by native species with low concentrations of non-native invasive species present. The bulk of the invasive species are located in the shrubland and other identified restoration areas, as well as along the trails throughout the park.

Overstory tree composition and structure

The forest overstory refers to the upper canopy of a forest. Only trees with a diameter measuring greater than 5 inches (a standard measure for overstory) were considered for the purposes of this overstory analysis.

Tree density can be used to draw inferences about overall forest development and succession. In general, older stands tend to have lower densities due to self-thinning through the process of competitive exclusion. These forests generally exhibit a variety of tree heights and diameters which creates a canopy with high structural diversity (trees of differing ages and size classes). Younger forests, on the other hand, generally have higher tree densities and limited structural diversity (Spies and Franklin 1991).

Based on the above criteria, the conifer and conifer/deciduous mixed forests of Llandover Woods exhibit many of the characteristics of a mature forest. Logging in the area persisted until circa 1913, indicating that these second-growth stands are approximately 100 years old. In comparison, the deciduous forest in Llandover Woods is a young stand roughly 15 years old, which was the result of clearing for a proposed development in 1990. Due to the recent logging in this area of the park, a high density stand of maple stems which suckered from cut stumps is currently present here.

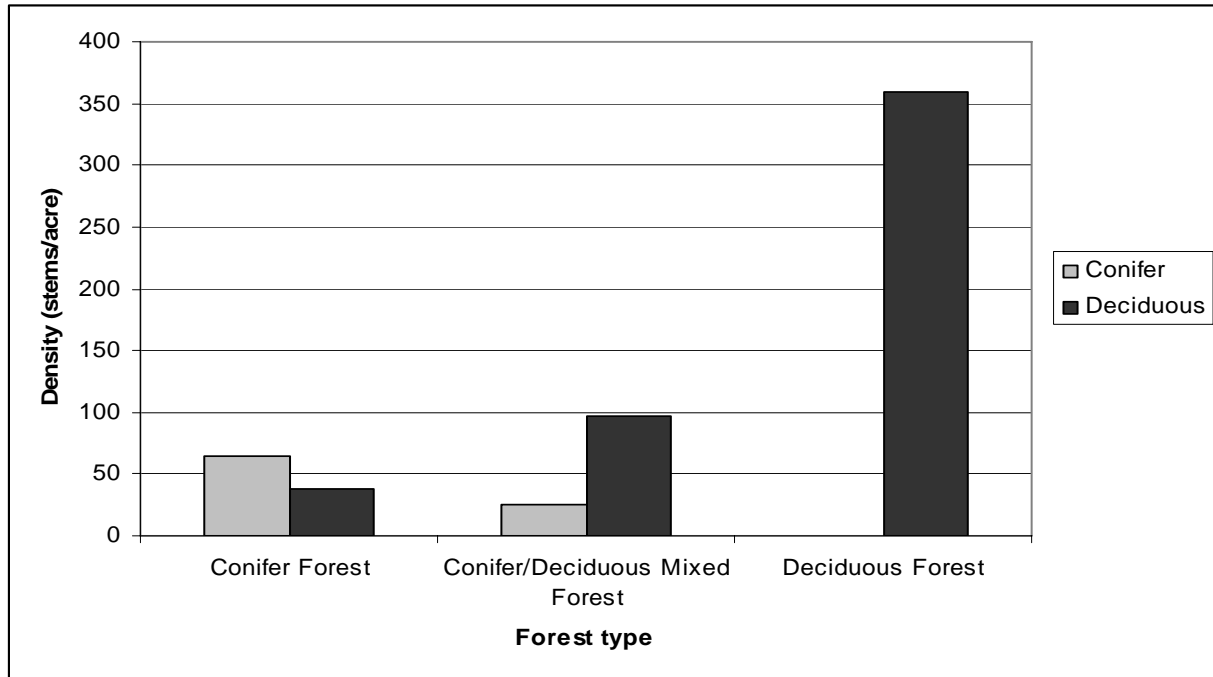
In the conifer forest the canopy is dense and multi-layered, dominated in the overstory by conifer trees and in the mid-story by deciduous trees. Coniferous canopy cover averaged 75% on measured plots. In the conifer/deciduous mixed forest the canopy cover consists of multiple layers with both conifer and deciduous trees in the overstory, and considerable deciduous cover (55%) in the mid-story. The deciduous forest has a single-layer canopy which consists of deciduous trees.

Tree densities are similar in the conifer and conifer/deciduous mixed forests, although trees are larger in the conifer forest. The conifer forest contains an average of 102.5 stems/acre with an average height of 106 feet and average diameter of 19.6 inches. Many trees in the conifer forest are over 150 feet tall and several are approaching 200 feet in height. The conifer/deciduous mixed forest averages 122.5 stems/acre, with an average height of 75 feet and diameter of 12 inches. In comparison, the deciduous forest overstory density is approximately three times greater than the other forest types at 360 stems/acre with an average height of 55 feet and diameter of 5.5 inches (Table 2).

The overstory in the conifer forest consists of 63% conifer and 37% deciduous trees (Figure 3). The conifer component is almost entirely made up of Douglas fir (59% of all trees sampled), with small amounts of western hemlock and western red cedar. The deciduous component is comprised of big-leaf maples (Table 2).

The species composition in the overstory of the conifer/deciduous mixed forest is 80% big-leaf maple and 20% Douglas fir. The deciduous forest overstory is made up entirely of big-leaf maple. There were no non-native species found in the overstory during the survey.

Figure 3. Density of overstory conifer and deciduous trees by forest type¹



¹Average density/acre of overstory species (greater than 5 inch diameter) in three forest types in Llandover Woods.

Table 2. Overstory and regenerating tree species found in each of the sampled habitat types in Llandover Woods. Values represent density (stems/acre) and proportion (in parenthesis) of each species present in each habitat type.

Scientific Name ¹	Common Name	Conifer Forest	Conifer/Deciduous Mixed Forest	Deciduous Forest
OVERSTORY TREES (Density/acre)				
<i>Acer macrophyllum</i>	big-leaf maple	37.5 (37%)	97.5 (80%)	360 (100%)
<i>Pseudotsuga menziesii</i>	Douglas fir	60 (59%)	25 (20%)	
<i>Thuja plicata</i>	western red cedar	2.5 (2%)		
<i>Tsuga heterophylla</i>	western hemlock	2.5 (2%)		
Average density		102.5/acre	122.5/acre	360/acre
REGENERATING TREES (Density/acre)				
<i>Acer macrophyllum</i>	big-leaf maple	56.7 (90%)	112.5 (82%)	540 (93%)
<i>Crataegus monogyna</i> *	one-seed hawthorn			20 (3.5%)
<i>Ilex aquifolium</i> **	English holly		17.5 (13%)	
<i>Prunus laurocerasus</i> **	cherry laurel	3.3 (5%)	2.5 (2%)	
<i>Salix scouleriana</i>	Scouler's willow			20 (3.5%)
<i>Sorbus aucuparia</i> *	European mountain ash		5 (3%)	
<i>Thuja plicata</i>	western red cedar	3.3 (5%)		
Average density		63.3/acre	137.5/acre	580/acre

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program (King County 2005).

Regenerating tree composition and structure

This study considered trees five inches or less in diameter at breast height to be regenerating tree species. The amount and composition of current tree regeneration will substantially influence the future makeup of the forest.

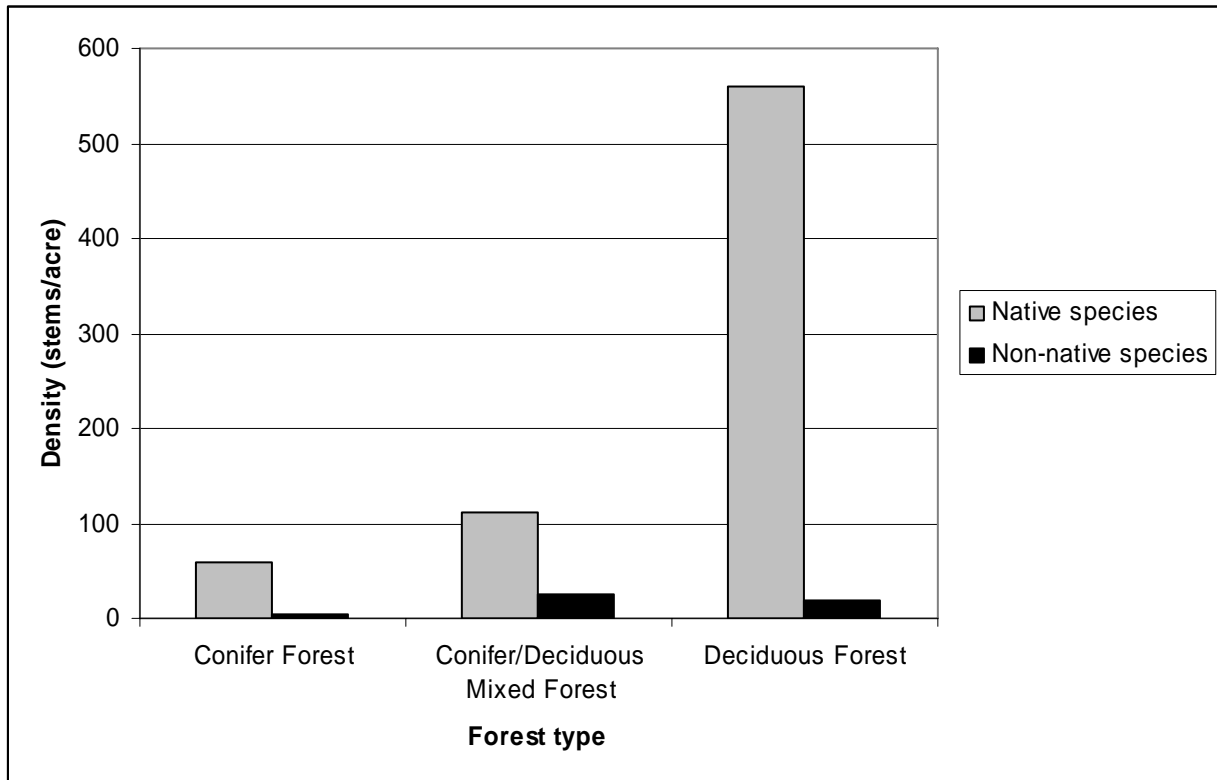
The conifer forest has the lowest regenerating tree densities of the three forest types, with an average of 63.3 stems/acre. The regenerating tree layer is dominated primarily by big-leaf maple, which makes up 90% of all regenerating trees in the conifer forest. Small amounts of cherry laurel are present throughout the forest as scattered stems (Table 2).

In the conifer/deciduous mixed forest, the regenerating tree layer is comprised of an average of 137.5 stems/acre. 82% of the regeneration consists of big-leaf maple, whereas the remaining 18% is comprised of 3 non-native invasive species: English holly (12.5%), cherry laurel (2%) and European mountain ash (3.5%) (Table 2). The conifer/deciduous mixed forest contains the highest proportion of non-native species in the regeneration layer of all the forest types (Figure 4).

The deciduous forest has the highest regenerating tree density of the three forest types. There are 580 stems/acre with an average height of 43 feet and average diameter of 3 inches. Deciduous species make up 100% of the regenerating trees: big-leaf maple (93%), Scouler's willow (*Salix scouleriana*) (3.5%) and one-seed hawthorn (*Crataegus monogyna*) (3.5%) (Table 2). One-seed hawthorn is a non-native invasive species which is often spread by birds dropping seeds in natural areas.

The only conifer regeneration recorded in the park consists of a small amount of western red cedar found in the conifer forest type. Although the overstory in the park contains substantial amounts of Douglas fir, no regeneration was found. This may be due to the fact that Douglas fir is shade-intolerant, and is unable to establish under the dense overstory canopy cover (Burns and Honkala 1990). To promote conifer regeneration, planting shade tolerant species such as western red cedar and western hemlock is recommended. Increasing the amount of coarse woody debris will further the establishment of these species, particularly western hemlock which germinates almost exclusively on downed wood.

Figure 4. Regenerating tree density (stems/acre) of native and non-native trees by forest type¹



¹Average density/acre of regenerating tree species (smaller than 5 inch diameter) in three forest types in Llandover Woods.

Snags

In any discussion of forest structure, it is important to consider the role of standing dead trees (snags). Snags provide important habitat for wildlife, birds, insects, non-vascular plants such as mosses and fungi, and are a store of nutrients for the forest.

Snags were found on 75% of the conifer forest plots surveyed in Llandover Woods at a density of 33 stems/acre (Figure 5). The average snag height is 31 feet tall, with a diameter of 4.3 inches (Figure 5). Similarly, the conifer/deciduous mixed forest has an average of 32.5 snags/acre with a mean height of 19 feet and a diameter of 4 inches.

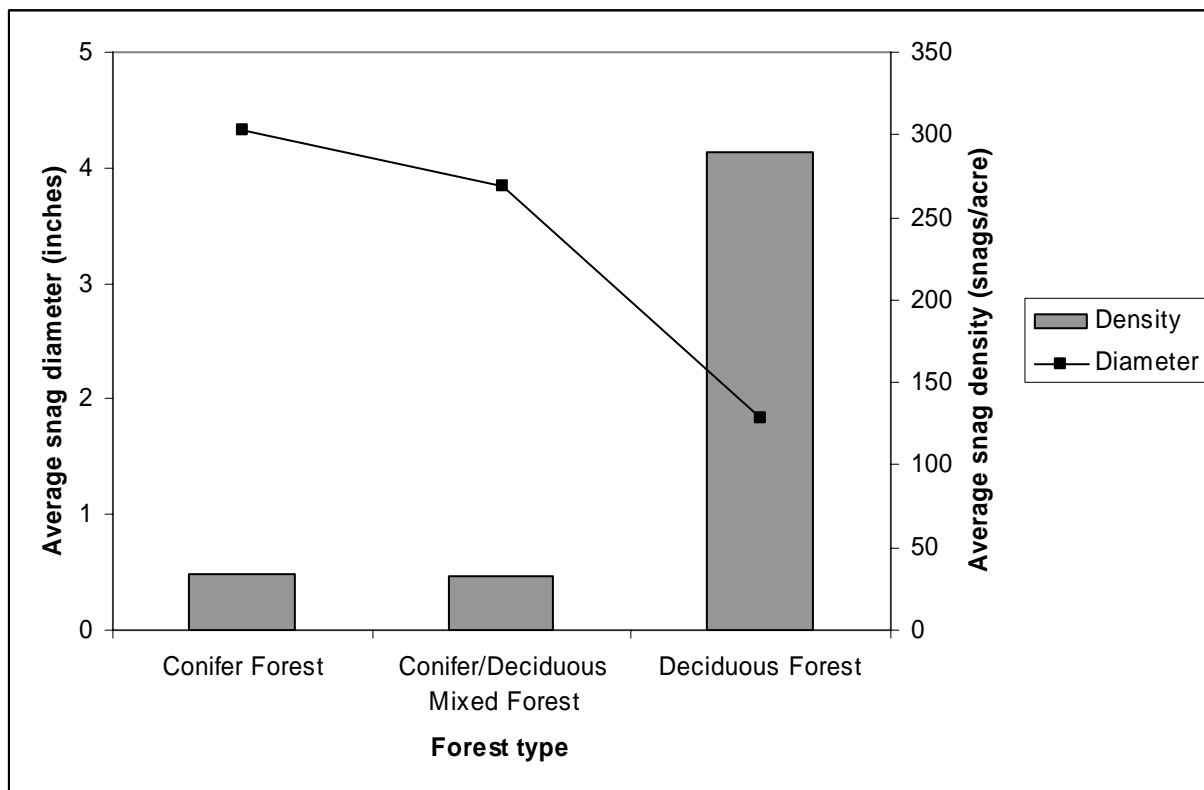
The high density of small maples within the deciduous forest is creating high levels of competition in this forest type. As a result, the deciduous forest has by far the greatest number of snags - 290 stems/acre (Figure 5). The average height is 28 feet and the average diameter is 2 inches. It is expected that further self-thinning will occur in this stand over the next several decades, creating increased small-diameter snag densities. These snags are generally short-lived and quickly become downed woody debris which rapidly decays on the forest floor.

Only one large snag was recorded in the surveyed plots, located in the conifer forest, with a diameter of 22 inches and height of 65 feet. During the survey, one other large snag was

observed near the trail along the northern boundary of the park. This snag is heavily used by pileated woodpeckers and other birds.

In comparison, a study of old-growth Douglas fir forests in Washington and Oregon found densities from 13 to 24 snags/acre, with diameters ranging from 16 inches at 250 years old to 25 inches at over 850 years (Franklin et al. 1981). It appears that the snags in Llandover Woods are much smaller than those found in an old-growth forest. Smaller snags decay quickly and do not remain standing for a long period of time. They also do not have enough surface area to be useful to hole-nesting birds. For instance, Mannan et al. (1980) found that hole-nesting birds use snags over 24 inches in diameter and over 50 feet tall. Preserving large snags when possible will improve wildlife habitat in the park and help to attract species which are currently not present.

Figure 5. Average snag density and diameter by forest type in Llandover Woods¹



¹Average snag diameter (inches) and density(snags/acre) in three forest types in Llandover Woods.

Coarse Woody Debris (CWD)

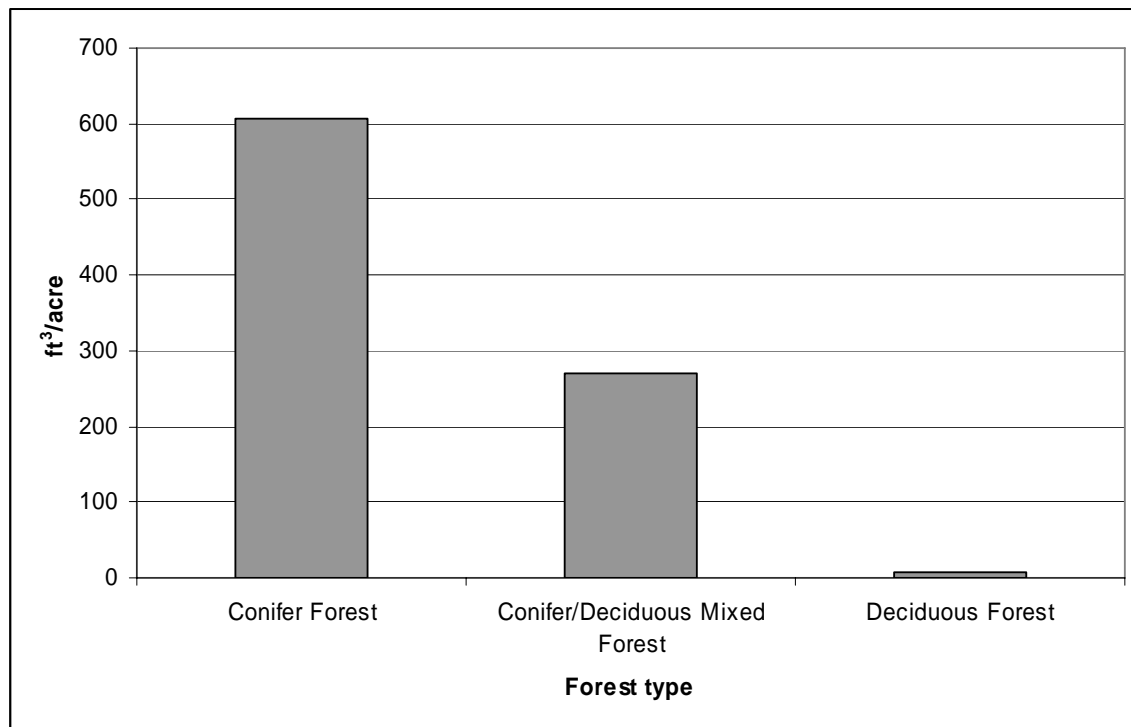
Coarse woody debris (CWD) can be defined as: “Sound and rotting logs and stumps (greater than 3 inches in diameter) that provide habitat for plants, animals and insects and a source of nutrients for soil structure and development” (Stevens 1997). CWD plays a vital role in forests by adding organic material and nutrients to the soil and providing habitat for decomposer fungi, animals, birds, bacteria and insects. CWD also acts as nurse logs for seedlings of plants such as western hemlock and red huckleberry, retains sediment and prevents erosion (Stevens 1997).

The average volume per acre of CWD per acre in the conifer forest is 606 ft³/acre. The average diameter of CWD is 11.5 inches. This represents the highest volume per acre for any forest type in Llandover Woods (Figure 6). In comparison, Douglas fir /western hemlock forests over 250 years old typically contain approximately 6,400 ft³/acre of CWD (Harmon et al.1986).

In the conifer/deciduous mixed forest CWD was present in 75% of sampled plots. An average of 270 ft³/acre of CWD is present in this forest type, with a mean diameter of 17.8 inches. The amount of CWD is approximately half of that which is present in the conifer forest (Figure 6).

Small amounts (7 ft³/acre) of CWD were found in the deciduous forest type (Figure 6). This is possibly due to removal of CWD during clearing operations in the 1990's. It is expected that levels of CWD will accumulate as snags fall down, although large-diameter CWD will not be produced and recruited for many years.

Figure 6. Coarse Woody Debris (CWD) volume per acre (ft³/acre) by forest type in Llandover Woods¹



¹Average volume per acre (ft³/acre) of CWD in three forest types in Llandover Woods.

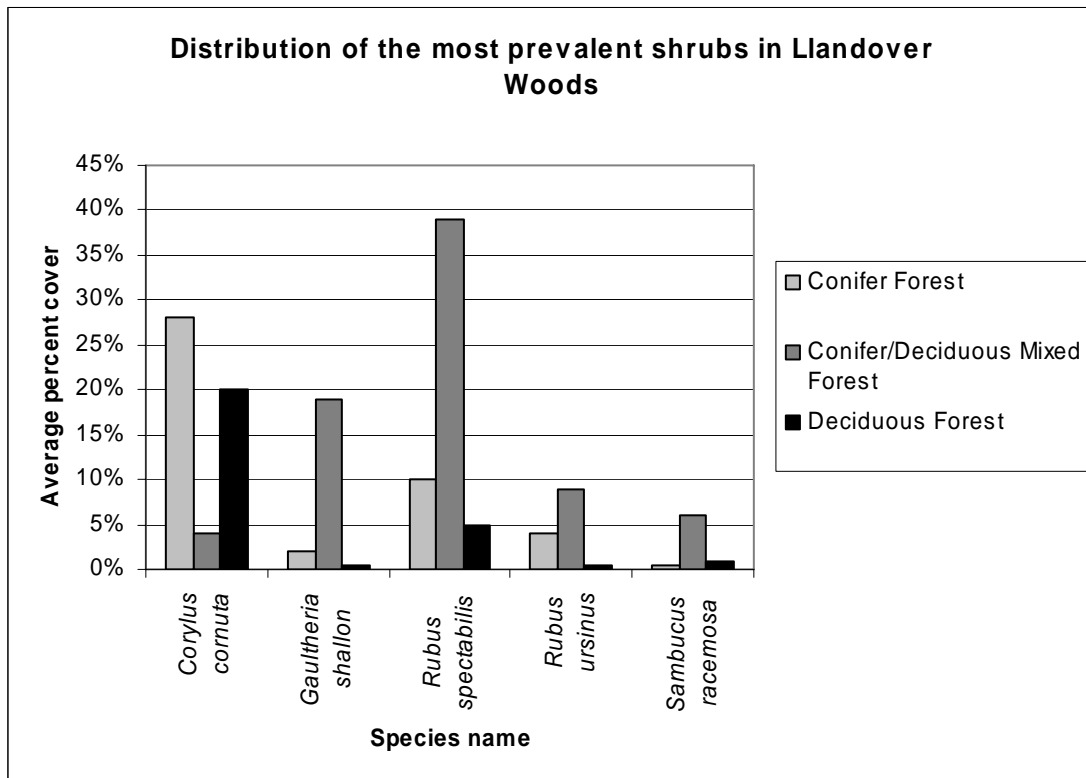
Shrubs

A total of 20 shrub species were identified in Llandover Woods (Table 3). Thirteen species are present in the conifer forest, of which beaked hazelnut is the most prominent, with an average cover of 28% (Figure 7). Salmonberry, oceanspray (*Holodiscus discolor*) and creeping blackberry are present in smaller amounts (10%, 6%, and 4%, respectively) (Table 3). The only non-native invasive species present is evergreen blackberry, which is present in one plot at a cover of 5%.

Seventeen species are present in the conifer/deciduous mixed forest. The understory in this forest type is dominated by salmonberry, with an average cover of 39%. Salal is found on half of surveyed plots at an average percent cover of 19%. Creeping blackberry and red elderberry (*Sambucus racemosa*) are present in smaller quantities (9% and 6% respectively). Beaked hazelnut cover (4%) is less in this mixed forest than in other forest types (Table 3). Several shrub species, such as stink currant and swamp gooseberry, are found only in this forest type. These species grow predominantly on moist or wet sites. The high cover of salmonberry, a plant also typically associated with moisture, also indicates that the conifer/deciduous mixed forest is wetter than the other forest types sampled in this survey. The only non-native shrub in this forest type is Himalayan blackberry, which is present in half of the sampled plots at an average cover of 2%.

A total of eight species of shrubs were recorded in the deciduous forest, the lowest number for any habitat type (Table 3). Beaked hazelnut is the predominant shrub with a cover of 20% (Figure 7). Salmonberry, low Oregon grape (*Mahonia nervosa*), red huckleberry (*Vaccinium parvifolium*), and red elderberry are present in much smaller amounts (5%, 2%, 2%, and 1%, respectively). No non-native shrubs were found in the deciduous forest.

Figure 7. Distribution of the most prevalent shrubs by forest type in Llandover Woods (average percent cover)



¹Average cover of prevalent shrub species in three forest types in Llandover Woods.

Table 3. Shrub species found in each of the sampled habitat types in Llandover Woods. Values represent the percent cover of each species.

Scientific Name ¹	Common Name	Conifer Forest	Conifer/Deciduous Mixed Forest	Deciduous Forest
SHRUBS²				
<i>Amelanchier alnifolia</i>	Serviceberry		T	
<i>Corylus cornuta</i>	beaked hazelnut	28%	4%	20%
<i>Gaultheria shallon</i>	Salal	2%	19%	T
<i>Holodiscus discolor</i>	Oceanspray	6%		
<i>Mahonia aquifolium</i>	tall Oregon grape	T		
<i>Mahonia nervosa</i>	low Oregon grape	3%	T	2%
<i>Oemleria cerasiformis</i>	Indian plum	7%	6%	
<i>Philadelphus lewisii</i>	mock-orange		1%	
<i>Ribes bracteosum</i>	stink currant		T	
<i>Ribes lacustre</i>	swamp gooseberry		T	
<i>Rosa gymnocarpa</i>	bald-hip rose	T	1%	T
<i>Rubus discolor</i>**	Himalayan blackberry		2%	
<i>Rubus laciniatus</i>**	evergreen blackberry	5%		
<i>Rubus leucodermis</i>	blackcap	T	T	
<i>Rubus parviflorus</i>	thimbleberry		T	
<i>Rubus spectabilis</i>	salmonberry	10%	39%	5%
<i>Rubus ursinus</i>	creeping blackberry	4%	9%	T
<i>Sambucus racemosa</i>	red elderberry	T	6%	1%
<i>Symphoricarpos albus</i>	snowberry		T	
<i>Vaccinium parvifolium</i>	red huckleberry	2.5%	2.5%	2%

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program (King County 2005).

²T=Trace presence of species (less than 1 %).

Herbs

Seventeen herbaceous species were found in the conifer forest type, of which 12 are native and 5 are non-native. The herb layer is dominated by sword fern which has an average cover of 68%. Fringe-cup and stinging nettle (*Urtica dioica*) are present in much smaller quantities (1% each). Trace amounts of Siberian miner's lettuce (*Claytonia sibirica*), sweet cicely (*Osmorhiza berteroi*), and starflower (*Trientalis borealis ssp. latifolia*) are found only in the conifer forest type (Table 4). Of the four non-native herbaceous species that were documented in the conifer forest type, two (herb Robert and English ivy) have been given a legal designation by the King County Noxious Weed Program (King County 2005). Both species are listed as Weeds of Concern. Trace amounts of each of these species are present on 75% of the conifer plots surveyed. Foxglove (*Digitalis purpurea*), a non-native species with invasive potential, was found in trace amounts in one plot in this forest type.

The conifer/deciduous mixed forest contains the greatest herbaceous species diversity, with 24 documented species, 15 of which are native. Sword fern has the highest cover of any species (46%). Fringe-cup, piggy-back plant (*Tolmiea menziesii*) and stinging nettle are present in smaller amounts (4.5%, 4.5% and 3% respectively) (Table 4). Several species including ladyfern (*Athyrium filix-femina*) and Pacific waterleaf are indicators of wet or moist soil conditions. Pacific waterleaf was observed growing in the low areas along the trail in this forest type, although the seasonality of our survey failed to detect this plant. Nine of the 24 species found in this forest type are non-native. Three of these non-native species are considered to be invasive: herb Robert, English ivy and creeping buttercup (*Ranunculus repens*). Herb Robert occurs on all plots in trace quantities. Creeping buttercup is present on one plot, also in a trace amount. This species was also observed growing along trails throughout the park. English ivy occurs on 75% of plots at an average cover of 3%. Trace amounts of foxglove are also present in 50% of plots in the deciduous forest.

Only 3 species of herbs occur in the deciduous forest (Table 4). The herb layer is dominated by sword fern (71%), with a small amount of fringe-cup (2%). A trace amount of herb Robert is present in this forest type.

Table 4. Herbaceous species found in each of the sampled habitat types in Llandover Woods. Values represent the percent cover of each species.

Scientific Name ¹	Common Name	Conifer Forest	Conifer/Deciduous Mixed Forest	Deciduous Forest
HERBS²				
<i>Athyrium filix-femina</i>	ladyfern	T	1%	
<i>Bromus vulgaris</i>	Columbia brome	T	1%	
<i>Carex deweyana</i>	Dewey sedge	T	T	
<i>Claytonia sibirica</i>	Siberian miner's lettuce	T		
<i>Digitalis purpurea</i>*	foxglove	T	T	
<i>Dryopteris expansa</i>	wood fern		T	
<i>Epilobium sp.</i>	willowherb	T		
<i>Galium aparine</i>	cleavers		T	
<i>Geum macrophyllum</i>	bigleaved avens		T	
<i>Geranium robertianum</i>**	herb Robert	T	T	T
<i>Hedera helix</i>**	English ivy	T	3%	
<i>Holcus lanatus</i>	velvetgrass		T	
<i>Hydrophyllum tenuipes</i>	Pacific waterleaf		T	
<i>Lapsana communis</i>	nipplewort		T	
<i>Lonicera ciliosa</i>	orange honeysuckle	T		
<i>Lonicera hispidula</i>	hairy honeysuckle		T	
<i>Mycelis muralis</i>	wall-lettuce	T	T	
<i>Osmorhiza berteroi</i>	sweet cicely	T	T	
<i>Polypodium glycyrrhiza</i>	licorice fern	T	T	
<i>Polystichum munitum</i>	sword fern	68%	46%	71%
<i>Ranunculus repens</i>*	creeping buttercup		T	
<i>Rumex obtusifolius</i>	bitter dock		T	
<i>Stellaria crispa</i>	crisp sandwort	T	2%	
<i>Stellaria media</i>	chickweed		T	
<i>Tellima grandiflora</i>	fringecup	1%	4.5%	2%
<i>Tolmiea menziesii</i>	piggy-back plant		4.5%	
<i>Trientalis borealis ssp. latifolia</i>	starflower	T		
<i>Unknown herb</i>		T		
<i>Urtica dioica</i>	stinging nettle	1%	3%	

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program (King County 2005).

²T=Trace presence of species (less than 1 %).

V. MANAGEMENT RECOMMENDATIONS

Structurally and functionally, Llandover Woods consists of a mostly intact, mature, second-growth Douglas fir forest. The conifer and conifer/deciduous mixed forests have substantial amounts of Douglas fir in the overstory and big-leaf maple in the mid-story. In addition, there are substantial shrub and herb layers in both forest types, which add to the structural diversity and health of the forest. A small section of Llandover Woods consists of very young deciduous forest made up of very dense pole-sized trees, with low diversity of shrubs and herbaceous plants.

Unfortunately, as with all urban parks that are surrounded by development, encroachment of invasive species, human activity and other disturbance make active stewardship vital to maintaining and increasing the natural function of the forest. Llandover Woods faces a number of management concerns. Private residences border the west, south and east sides of the park. Numerous social trails from the private residences bisect the park to merge with the main trail system. These trails fragment habitat, allow for the trampling of native plants, and serve as corridors for invasive species colonization.

Non-native invasive plant species colonization is a threat to the native vegetation in Llandover Woods. Of particular concern are non-native tree species, such as cherry laurel, English holly and one-seed hawthorn, which are now present throughout the property. In addition, previous land clearing within Llandover Woods has created several areas which have now been colonized by invasive plants and are in need of intensive restoration and replanting.

The most significant concerns regarding forest structure in Llandover Woods are the lack of conifer regeneration and low levels of large diameter snags and CWD present. These issues are interrelated, as CWD and snags provide critical substrate for the regeneration of coniferous species, particularly western hemlock and western red cedar. These two species are also the most likely to regenerate under the intact coniferous canopy present in much of the park. Without adequate conifer regeneration, Llandover Woods will become dominated by short-lived deciduous species, which will substantially change the character and structure of the forest. Due to the fact that these problems are widespread and not limited to a specific forest type, a comprehensive strategy is needed to actively manage forest structure in Llandover Woods.

Past Restoration History

The Friends of Llandover Woods have identified three main areas that are in need of restoration (Map 3, areas 1, 2 and 4). As a result of this field survey, one additional restoration area has been identified (Map 3, area 3). To date, FoLW has primarily focused on trail maintenance and erosion control activities, such as adding gravel and creating erosion bars. Restoration activities have taken place in restoration area 1 (Map 3) and have included invasive plant removal along trails. The group holds monthly work parties and has begun working in other restoration areas. The following recommendations are intended to serve as a guide to assist the FoLW to prioritize future restoration activities. A detailed description of each restoration area with a species list of existing plants is provided below.

Map 3. Llandover Woods restoration areas

Management Recommendations

Management recommendations for Llandover Woods focus not only on invasive species management, but also on human impacts on the forest.

Trails and Human Impacts

Llandover Woods features 0.6 miles of trails, with the main trail branching to form a loop through the property (Map 3). In addition to this official trail system, many social trails bisect the forest, some extending from private residences.

In addition to being conduits for invasive species, social trails cause habitat fragmentation and soil compaction and erosion. It is recommended that whenever possible, social trails be blocked off and replanted. While some of the social trails are heavily utilized and might be considered for conversion to an official trail, there may be instances where it would be possible to block off trails which are not often used or consolidate several adjacent social trails. In some cases, property owners adjacent to Llandover Woods may have concerns about visitors using social trails as shortcuts resulting in trespass on private property. These owners may be willing to work with FoLW to remove social trails that lead to their properties.

The existing trail system has experienced erosion problems, and erosion bars have recently been installed on a significant portion of the trail. The locations of existing erosion bars are shown in Map 3. Additional work is planned in the future to resurface the trails and improve drainage. A significant erosion problem exists adjacent to the trail at the beginning of the right of way (Map 3). This area is the result of a 1995 slide which undercut the access trail to the park. The area of erosion is adjacent to the trail and extends onto The Highlands property. No stabilization measures have been applied to the slide area which is currently fenced off. To prevent further degradation of the access trail, it is necessary to stabilize and replant the slide area.

Much of Llandover Woods, particularly the conifer forest in the central part of the park, is located on steep slopes which are prone to erosion. Fortunately, relatively little restoration activity needs to occur on these slopes as they are generally well vegetated and located in mostly intact forested areas. Several impacted areas near the trail were noted and should be monitored and replanted as necessary. Although the majority of visitors to Llandover Woods who hike and mountain bike stay on the trails, those who go off the trail risk incurring damage to the steep and sandy slopes in the forests. It is encouraged that human impact on and access to these slopes is minimized to avoid future erosion problems. Possible effects of hiking and mountain biking could be offset by posting signs encouraging visitors to stay on the trail.

New trail building in Llandover Woods should be carefully considered from both the perspective of habitat fragmentation and non-native species colonization. New trail construction should be minimized whenever possible to preserve habitat integrity. In addition, any new trail locations should take into account the potential for soil erosion.

The actions of visitors in Llandover Woods also affect conditions within the forest. Llandover Woods is popular for dog-walking and other recreational activities such as hiking and mountain

biking. Unfortunately, many dog owners fail to clean up fecal waste on and near the trails and allow their dogs to go unleashed. Dogs may also trample native vegetation. Placing a garbage can and plastic bags at the entrance along with a clearly worded sign may help to reduce the distribution of fecal waste in the woods.

Invasive Species

Both the official and social trail systems are conduits for invasive species. Plants such as herb Robert and creeping buttercup are ubiquitous along trails in Llandover Woods, especially in areas where there is little canopy cover. Planting shrubs and trees along the main trail system is recommended to provide shade and canopy cover in order to reduce the presence of invasive species. The access trail into Llandover Woods is invaded by non-native species such as Himalayan blackberry.

Private residences border the west, south and east sides of Llandover Woods (adjacent to the access trail). On the north side of the woods, a relatively undisturbed forested buffer extends from The Highlands. Ivy and other invasive species extend into the woods from several private residences and The Highlands. A substantial infestation of common periwinkle and privet appears to be extending from private property in restoration area 3 (Map 3). Working with private property owners that are in the immediate vicinity of Llandover Woods is vital to maintaining the health of the forests. Providing aid to individual landowners in eradicating encroaching weeds may be an effective method of relieving some of the pressure on the forest interior. In addition, many of the invasive tree problems in the woods are the result of seeds being spread from trees in the surrounding area. Encouraging landowners to refrain from planting invasive tree species and providing native alternatives should be a part of any outreach strategy.

Non-native tree regeneration in all forest types is a significant concern in Llandover Woods. These species include: one-seed hawthorn, English holly, cherry laurel and European mountain ash. In addition, shrubs and small trees of Cotoneaster (*Cotoneaster spp.*) were observed throughout the park, mostly bordering trails. These non-native trees and shrubs should be eradicated before they further invade the park.

Regeneration and Coarse Woody Debris

Conifer regeneration is very limited in the park. It is recommended that shade-tolerant species such as western red cedar, western hemlock and grand fir (*Abies grandis*) be planted throughout the park to promote conifer regeneration. Strategic placement of downed wood in these areas would further support the regeneration of coniferous species. This is particularly important in the deciduous stand, which is expected to self-thin over the next several decades. Adding a conifer component will help the deciduous stand transition into a conifer/deciduous mixed forest. A final recommendation that emerged from data analysis concerns the lack of large snags and low levels of CWD present in the park. Large snags and large diameter CWD should be retained whenever possible, both as substrate for conifer regeneration and due to the fact that CWD is beneficial to stabilizing the steep slopes present throughout the woods. Trees cleared in the

vicinity of Llandover Woods (on private property, public rights-of-way, etc.) should be placed within restoration areas whenever possible.

Specific recommendations for restoration areas

Vegetation in restoration areas was sampled using a different methodology than the survey in the forested portions of Llandover Woods (see Forest Assessment Methodology section). The following results and recommendations target each of four restoration areas found in Llandover Woods (Map 3). Restoration areas 1, 2 and 4 were identified by FoLW prior to this survey. Restoration area 3 was located by SUNP ecologists during the survey.

Restoration area 1

Restoration area 1 is a small area located along the access road leading into the park. This area has been the target of previous restoration activities, including ivy removal, and is now mostly free of invasive species. This area has been heavily mulched. A total of 13 plant species are present in this restoration area (Table 5). Only three invasive species are currently present (creeping buttercup, herb Robert and European mountain ash), all in trace quantities. Removal of the European mountain ash trees and regular removal of creeping buttercup and herb Robert is recommended in this area. Planting additional native trees and shrubs will help to establish the canopy cover and exclude invasive species in the future. Suggested species to plant in this area are: sword fern, Douglas fir, western red cedar, grand fir, thimbleberry (*Rubus parviflorus*), salmonberry, red elderberry, and salal.

Figure 8. Restoration area 1



Table 5. Plant species and percent cover found in restoration area 1 in Llandover Woods

Species name ¹	Common name	Percent cover
<i>Geranium robertianum</i>**	herb Robert	Trace (<1%)
<i>Holodiscus discolor</i>	Oceanspray	Medium (26-50%)
<i>Polystichum munitum</i>	sword fern	Low (1-25%)
<i>Pseudotsuga menziesii</i>	Douglas fir	Low (1-25%)
<i>Pteridium aquilinum</i>	bracken fern	Trace (<1%)
<i>Ranunculus repens</i>*	creeping buttercup	Trace (<1%)
<i>Rubus parviflorus</i>	Thimbleberry	Trace (<1%)
<i>Rubus spectabilis</i>	Salmonberry	Trace (<1%)
<i>Sambucus racemosa</i>	red elderberry	Trace (<1%)
<i>Sorbus aucuparia</i>*	European mountain ash	Trace (<1%)
<i>Tellima grandiflora</i>	Fringecup	Low (1-25%)
<i>Urtica dioica</i>	stinging nettle	Medium (26-50%)
<i>Vaccinium parvifolium</i>	red huckleberry	Trace (<1%)

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program (King County 2005).

Restoration area 2

Restoration area 2 is located along the main trail in the southern part of Llandover Woods (Map 3). Twenty six plant species are found in this restoration area, of which 16 are native (Table 6). Big-leaf maple and Douglas fir provide considerable canopy cover in this area, which will be instrumental in shading out many of the invasive species in the future. Additional native species with medium to high canopy cover in the restoration area are oceanspray, sword fern and creeping blackberry. Of the ten non-native species present in the area, eight are considered to be invasive. One-seed hawthorn, European mountain ash and cherry laurel are all present in this restoration area at medium to trace cover. These invasive trees should be prioritized for removal. The invasive shrub species Himalayan blackberry and cotoneaster are present in the area and should also be removed. The invasive herbaceous species creeping buttercup, nipplewort (*Lapsana communis*), foxglove and herb Robert are present in trace amounts in the area and should be removed on a regular basis. Native trees, shrubs, and herbs should be planted after the invasive species are removed. Suggested species to plant in this area are: sword fern, Douglas fir, western red cedar, grand fir, thimbleberry, salmonberry, red elderberry, salal and beaked hazelnut.

Figure 9. Restoration area 2



Table 6. Plant species and percent cover found in restoration area 2 in Llandover Woods

Species name ¹	Common name	Percent cover
<i>Acer macrophyllum</i>	big-leaf maple	High (>50%)
<i>Athyrium filix-femina</i>	ladyfern	Trace (<1%)
<i>Carex deweyana</i>	Dewey sedge	Low (1-25%)
<i>Cotoneaster sp.*</i>	cotoneaster	Trace (<1%)
<i>Crataegus monogyna*</i>	one-seed hawthorn	Medium (26-50%)
<i>Dactylis glomerata</i>	orchardgrass	Trace (<1%)
<i>Digitalis purpurea*</i>	foxglove	Trace (<1%)
<i>Elymus glaucus</i>	blue wildrye	Trace (<1%)
<i>Epilobium angustifolium</i>	fireweed	Trace (<1%)
<i>Gaultheria shallon</i>	salal	Trace (<1%)
<i>Geranium robertianum**</i>	herb Robert	Trace (<1%)
<i>Geum macrophyllum</i>	bingleaved avens	Trace (<1%)
<i>Holodiscus discolor</i>	oceanspray	Medium (26-50%)
<i>Lapsana communis</i>	nipplewort	Trace (<1%)
<i>Polystichum munitum</i>	sword fern	Medium (26-50%)
<i>Prunus laurocerasus**</i>	bay laurel, cherry laurel	Trace (<1%)
<i>Pseudotsuga menziesii</i>	Douglas fir	Medium (26-50%)
<i>Ranunculus repens*</i>	creeping buttercup	Trace (<1%)
<i>Rosa gymnocarpa</i>	baldhip rose	Trace (<1%)
<i>Rubus discolor**</i>	Himalayan blackberry	Low (1-25%)
<i>Rubus parviflorus</i>	thimbleberry	Trace (<1%)
<i>Rubus spectabilis</i>	salmonberry	Low (1-25%)
<i>Rubus ursinus</i>	creeping blackberry	High (>50%)
<i>Sambucus racemosa</i>	red elderberry	Low (1-25%)
<i>Sorbus aucuparia*</i>	European mountain ash	Trace (<1%)
<i>Urtica dioica</i>	stinging nettle	Low (1-25%)

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program (King County 2005).

Restoration area 3

This restoration area was identified during SUNP's survey of Llandover Woods and is located in the southwest corner of the property. Similar to other restoration areas, the current condition of this site may have been influenced by pre-development clearing in the early 90's. Twenty plant species are present in this area, of which six are considered to be invasive. Invasive tree species include one-seed hawthorn, English holly and European mountain ash. These species should be prioritized for removal due to their relatively low concentrations. There is a considerable amount of Himalayan blackberry present on the site (medium cover) and a trace amount of cotoneaster in the shrub layer. These shrub species should be removed. The main concern in the herb layer is the presence of a large amount of English ivy which should also be removed (Table 7).

Although this restoration area has some invasive species concerns, many native species are present both in the area and in adjacent areas. In particular, there is high cover of big-leaf maple and creeping blackberry, which provide considerable canopy cover as well as a fast-spreading ground cover on the site. Salal and thimbleberry both have medium cover on this site and assist in providing shade (Table 7).

Extending into this area from the west is a large infestation of privet and common periwinkle, which forms a dense groundcover in the forest understory. The southern border of the infestation runs along a private property boundary. Removal of these plants from the park area and replanting with native species is recommended. Creating a buffer of native shrubs along the boundary can help to prevent re-colonization by invasive species. Working with the adjacent land owner will be vital in controlling this infestation and restoring the site.

Due to the size of this restoration area, a sustained approach is recommended over several years. Restoration should begin by clearing invasive species and replanting a core area with native species. This core area can be expanded to include the entire restoration area in the future. Once an area is cleared of invasive species, the site should be replanted with native species and mulched as soon as possible. Sustained maintenance will be necessary to support new plantings and limit encroachment by unwanted plants.

Due to the high amounts of big-leaf maple along the margins of the site, suggested species to plant in this area include conifers such as Douglas fir, western red cedar, western hemlock and grand fir. Understory plants and shrubs can include sword fern, salmonberry, salal, red elderberry, beaked hazelnut, snowberry, oceanspray, Indian plum, mock orange (*Philadelphus lewisii*) and serviceberry (*Amelanchier alnifolia*).

Figure 10. Restoration area 3



Table 7. Plant species and percent cover found in restoration area 3 in Llandover Woods

Species name ¹	Common name	Percent cover
<i>Acer macrophyllum</i>	big-leaf maple	High (>50%)
<i>Agrostis sp.</i>	bentgrass	Medium (26-50%)
<i>Bromus vulgaris</i>	Columbia brome	Trace (<1%)
<i>Cotoneaster sp.*</i>	cotoneaster	Trace (<1%)
<i>Crataegus monogyna*</i>	one-seed hawthorn	Low (1-25%)
<i>Dactylis glomerata</i>	orchardgrass	Trace (<1%)
<i>Elymus glaucus</i>	blue wildrye	Trace (<1%)
<i>Epilobium angustifolium</i>	fireweed	Trace (<1%)
<i>Gaultheria shallon</i>	salal	Medium (26-50%)
<i>Hedera helix**</i>	English ivy	Medium (26-50%)
<i>Holodiscus discolor</i>	oceanspray	Low (1-25%)
<i>Ilex aquifolium**</i>	English holly	Low (1-25%)
<i>Oemleria cerasiformis</i>	Indian plum	Trace (<1%)
<i>Polystichum munitum</i>	sword fern	Low (1-25%)
<i>Prunus sp.</i>	horticultural cherry species	Trace (<1%)
<i>Rubus discolor**</i>	Himalayan blackberry	Medium (26-50%)
<i>Rubus parviflorus</i>	thimbleberry	Medium (26-50%)
<i>Rubus spectabilis</i>	salmonberry	Low (1-25%)
<i>Rubus ursinus</i>	creeping blackberry	High (>50%)
<i>Sorbus aucuparia*</i>	European mountain ash	Trace (<1%)

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program (King County 2005).

Restoration area 4

Restoration area 4 is comprised of a large shrubland on the west side of Llandover Woods. This is another portion of the woods that was previously cleared for a proposed housing development. The area is approximately 0.4 acres in size. This site is dominated by Himalayan blackberry, evergreen blackberry and Scotch broom. In addition to these invasive shrub species, this area also has cherry laurel, cotoneaster and one-seed hawthorn, which should all be prioritized for removal. Trace amounts of herb Robert and bull thistle are also present and should be removed during regular maintenance activities.

Although restoration area 4 is heavily invaded by non-native species, considerable native plant diversity is present in adjacent forests. Thirteen native species are present in the area including Pacific madrone, high-bush cranberry (*Viburnum edule*) and snowberry (*Symphoricarpos albus*) (Table 8). Some canopy cover is provided by big-leaf maple. The restoration area is large and will require a sustained, multiple-year effort. Restoration should begin by clearing and planting a core area that can be expanded in the future. It is vital that the restored area is of an appropriate size to be regularly maintained by volunteers to help the native plants establish and to prevent invasive species from encroaching.

Non-native blackberry species can be removed manually by cutting back stems and digging out roots. If this control method is used, the area should be mulched and replanted with native plants

as soon as possible (King County Noxious Weed Control Program 2005). Mechanical control is also possible by mowing blackberries 3-4 times a year for several years until roots are exhausted and new stems stop growing. Mechanical control should only be used on dense blackberry infestations where native or desirable plants are not present. Once control is achieved, the area should be mulched and replanted with native plants (King County Noxious Weed Control Program 2005).

Scotch broom can be eradicated by using a weed wrench and removing plants from the site. If the entire root is not removed or breaks off, the plant will resprout. In addition, scotch broom seeds can survive in the soil for up to 60 years (King County Noxious Weed Control Program 2004). To ensure complete eradication, regular monitoring over several years is necessary. The site should be replanted with native species and mulched as soon as possible. Suggested species to plant in this area include Douglas fir, western red cedar, grand fir, sword fern, salmonberry, thimbleberry, salal, red elderberry, beaked hazelnut, snowberry, high-bush cranberry, Oregon grape, mock orange and serviceberry.

Brush piles and log piles should be incorporated if possible to provide habitat diversity for wildlife.

Figure 11. Restoration area 4



Table 8. Plant species and percent cover found in restoration area 4 in Llandover Woods

Species name ¹	Common name	Percent cover
<i>Acer macrophyllum</i>	big-leaf maple	Medium (26-50%)
<i>Agrostis sp.</i>	bentgrass	Medium (26-50%)
<i>Arbutus menziesii</i>	Pacific madrone	Low (1-25%)
<i>Cirsium vulgare</i>**	bull thistle	Trace (<1%)
<i>Corylus cornuta</i>	beaked hazelnut	Trace (<1%)
<i>Cotoneaster sp.</i>*	cotoneaster	Trace (<1%)
<i>Crataegus monogyna</i>*	oneseed hawthorn	Trace (<1%)
<i>Cytisus scoparius</i>**	scotch broom	Medium (26-50%)
<i>Dactylis glomerata</i>	orchardgrass	Medium (26-50%)
<i>Gaultheria shallon</i>	salal	Trace (<1%)
<i>Geranium robertianum</i>**	herb Robert	Trace (<1%)
<i>Geum macrophyllum</i>	bigleaved avens	Trace (<1%)
<i>Polystichum munitum</i>	sword fern	Low (1-25%)
<i>Prunus laurocerasus</i>**	bay laurel, cherry laurel	Low (1-25%)
<i>Pseudotsuga menziesii</i>	Douglas fir	Trace (<1%)
<i>Pteridium aquilinum</i>	bracken fern	Trace (<1%)
<i>Rosa gymnocarpa</i>	baldhip rose	Trace (<1%)
<i>Rubus discolor</i>**	Himalayan blackberry	High (>50%)
<i>Rubus laciniatus</i>**	evergreen blackberry	High (>50%)
<i>Rubus spectabilis</i>	salmonberry	Trace (<1%)
<i>Rubus ursinus</i>	creeping blackberry	Medium (26-50%)
<i>Symphoricarpos albus</i>	snowberry	Trace (<1%)
<i>Viburnum edule</i>	high-bush cranberry	Trace (<1%)

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program (King County 2005).

VI. MONITORING

Nine photo points in four restoration areas were established to allow monitoring over time. Two photo points are located in restoration area 1, three in restoration area 2, one in restoration area 3 and three in restoration area 4 (Map 3). The photo points are each marked with a stake. Additional points may be added in the future for restoration areas 3 and 4.

Table 9. GPS coordinates of nine photo points marked by stakes in four restoration areas in Llandover Woods

Photo Point	Northing (US ft)	Easting (US ft)
R1 Photo 1	271227.433	1264218.572
R1 Photo 2	271116.757	1264172.140
R2 Photo 1	271047.142	1263734.839
R2 Photo 2	271052.588	1263624.096
R2 Photo 3	271118.697	1263659.465
R3 Photo 1	270962.187	1263421.724
R4 Photo 1	271067.769	1263424.951
R4 Photo 2	271128.418	1263373.909
R4 Photo 3	270976.915	1263363.745

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Appendix A. Average percent cover of shrub, herb and grass species where present (on surveyed plots) and park-wide (results extrapolated to parkwide level).

Shrub Species: Average Percent Cover

Species Code	Species Name ¹	Common Name	Average Cover in Sampled Plots	Average Cover Park-Wide	Frequency in Sampled Plots
AMAL	<i>Amelanchier alnifolia</i>	serviceberry	0.5%	0.06%	11.1%
COCO	<i>Corylus cornuta</i>	beaked hazelnut	19.9%	15.5%	77.8%
GASH	<i>Gaultheria shallon</i>	salal	6.7%	5.2%	77.8%
HODI	<i>Holodiscus discolor</i>	oceanspray	6.25%	2.1%	33.3%
MAAQ	<i>Mahonia aquifolium</i>	tall Oregon grape	0.1%	.01%	11.1%
MANE	<i>Mahonia nervosa</i>	low Oregon grape	1.9%	1.5%	77.8%
OECE	<i>Oemleria cerasiformis</i>	Indian plum	6.4%	2.1%	33.3%
PHLE	<i>Philadelphus lewisii</i>	mock-orange	1%	0.1%	11.1%
RIBR	<i>Ribes bracteosum</i>	stink currant	0.1%	.01%	11.1%
RILA	<i>Ribes lacustre</i>	swamp gooseberry	0.1%	.01%	11.1%
ROGY	<i>Rosa gymnocarpa</i>	baldhip rose	0.6%	0.4%	66.7%
RUDI	<i>Rubus discolor</i>**	Himalayan blackberry	2.2%	0.5%	22.2%
RULA	<i>Rubus laciniatus</i>**	evergreen blackberry	5.1%	0.6%	11.1%
RULE	<i>Rubus leucodermis</i>	blackcap	0.3%	6.7%	22.2%
RUPA	<i>Rubus parviflorus</i>	thimbleberry	0.25%	.06%	22.2%
RUSP	<i>Rubus spectabilis</i>	salmonberry	20.5%	18.2%	88.9%
RUUR	<i>Rubus ursinus</i>	creeping blackberry	5.7%	5.7%	100%
SARA	<i>Sambucus racemosa</i>	red elderberry	3.0%	2.4%	77.8%
SYAL	<i>Symphoricarpos albus</i>	snowberry	0.25%	.03%	11.1%
VAPA	<i>Vaccinium parvifolium</i>	red huckleberry	2.5%	2.2%	88.9%

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program (King County 2005).

Herb and Grass Species: Average Percent Cover

Species Code	Species Name ¹	Common Name	Average Cover in Sampled Plots	Average Cover Park-Wide	Frequency in Sampled Plots
ATFI	<i>Athyrium filix-femina</i>	ladyfern	0.5%	0.2%	44.4%
BRVU	<i>Bromus vulgaris</i>	Columbia brome	0.4%	0.3%	66.7%
CADE	<i>Carex deweyana</i>	Dewey sedge	0.2%	0.10%	55.6%
CLSI	<i>Claytonia sibirica</i>	Siberian miner's lettuce	0.1%	0.01%	11.1%
DIPU	<i>Digitalis purpurea</i>*	foxglove	0.1%	0.04%	33.3%
DREX	<i>Dryopteris expansa</i>	wood fern	0.4%	0.04%	11.1%
Epilobium sp.	<i>Epilobium sp.</i>	willowherb	0.1%	0.01%	11.1%
GAAP	<i>Galium aparine</i>	cleavers	0.1%	0.01%	11.1%
GEMA	<i>Geum macrophyllum</i>	bigleaved avens	0.1%	0.01%	11.1%
GERO	<i>Geranium robertianum</i>**	herb Robert	0.2%	0.15%	88.9%

Species Code	Species Name ¹	Common Name	Average Cover in Sampled Plots	Average Cover Park-Wide	Frequency in Sampled Plots
HEHE	<i>Hedera helix*</i>	English ivy	1.7%	1.1%	66.7%
HOLA	<i>Holcus lanatus</i>	velvetgrass	0.1%	0.01%	11.1%
HYTE	<i>Hydrophyllum tenuipes</i>	Pacific waterleaf	0.2%	0.03%	22.2%
LACO	<i>Lapsana communis</i>	nipplewort	0.2%	0.03%	22.2%
LOCI	<i>Lonicera ciliosa</i>	orange honeysuckle	0.1%	.01%	11.1%
LOHI	<i>Lonicera hispidula</i>	hairy honeysuckle	0.5%	0.06%	11.1%
MYMU	<i>Mycelis muralis</i>	wall-lettuce	0.2%	0.03%	22.2%
OSBE	<i>Osmorhiza berteroi</i>	sweet cicely	0.1%	0.01%	11.1%
POGL	<i>Polypodium glycyrrhiza</i>	licorice fern	0.3%	0.07%	22.2%
POMU	<i>Polystichum munitum</i>	sword fern	58.4%	58.4%	100%
RARE	<i>Ranunculus repens*</i>	creeping buttercup	0.2%	0.02%	11.1%
RUOB	<i>Rumex obtusifolius</i>	bitter dock	0.1%	0.02%	22.2%
STCR	<i>Stellaria crispa</i>	crisp sandwort	0.8%	0.3%	33.3%
STME	<i>Stellaria media</i>	chickweed	0.1%	0.01%	11.1%
TEGR	<i>Tellima grandiflora</i>	fringecup	3.3%	2.5%	77.8%
TOME	<i>Tolmiea menziesii</i>	piggy-back plant	4.6%	1.5%	33.3%
TRBO	<i>Trientalis borealis ssp. Latifolia</i>	starflower	0.1%	0.01%	11.1%
Unknown herb sp.		Unknown herb sp.	0.2%	0.02%	11.1%
URDI	<i>Urtica dioica</i>	stinging nettle	1.9%	1.7%	88.9%

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program (King County 2005).

Appendix B. Alphabetical list of all species found in Llandover Woods listing strata, nativity, and whether it is considered to be invasive in Llandover Woods.

Scientific Name ¹	Common Name	Strata ²	Native ³	"Invasive"
<i>Acer macrophyllum</i>	bigleaf maple	T	Yes	
<i>Amelanchier alnifolia</i>	serviceberry	S	Yes	
<i>Athyrium filix-femina</i>	ladyfern	H	Yes	
<i>Bromus vulgaris</i>	Columbia brome	G	Yes	
<i>Carex deweyana</i>	Dewey sedge	G	Yes	
<i>Claytonia sibirica</i>	Siberian miner's lettuce	H	Yes	
<i>Corylus cornuta</i>	beaked hazelnut	S	Yes	
<i>Crataegus monogyna</i>*	oneseed hawthorn	T	No	x
<i>Digitalis purpurea</i>*	foxglove	H	No	x
<i>Dryopteris expansa</i>	wood fern	H	Yes	
<i>Epilobium sp.</i>	willowherb	H	X	
<i>Galium aparine</i>	cleavers	H	Yes	
<i>Gaultheria shallon</i>	salal	S	Yes	
<i>Geranium robertianum</i>**	herb Robert	H	No	x
<i>Geum macrophyllum</i>	bigleaved avens	H	Yes	
<i>Hedera helix</i>**	English ivy	H	No	x
<i>Holcus lanatus</i>	velvetgrass	G	No	
<i>Holodiscus discolor</i>	oceanspray	S	Yes	
<i>Hydrophyllum tenuipes</i>	Pacific waterleaf	H	Yes	
<i>Ilex aquifolium</i>**	English holly	T	No	x
<i>Lapsana communis</i>	nipplewort	H	No	
<i>Lonicera ciliosa</i>	orange honeysuckle	H	Yes	
<i>Lonicera hispidula</i>	hairy honeysuckle	H	Yes	
<i>Mahonia aquifolium</i>	tall Oregon grape	S	Yes	
<i>Mahonia nervosa</i>	low Oregon grape	S	Yes	
<i>Mycelis muralis</i>	wall-lettuce	H	No	
<i>Oemleria cerasiformis</i>	Indian plum	S	Yes	
<i>Osmorhiza berteroi</i>	sweet cicely	H	Yes	
<i>Philadelphus lewisii</i>	mock-orange	S	Yes	
<i>Polypodium glycyrrhiza</i>	licorice fern	H	Yes	
<i>Polystichum munitum</i>	sword fern	H	Yes	
<i>Prunus laurocerasus</i>**	bay laurel, cherry laurel	T	No	x
<i>Pseudotsuga menziesii</i>	Douglas fir	T	Yes	
<i>Ranunculus repens</i>*	creeping buttercup	H	No	x
<i>Ribes bracteosum</i>	stink currant	S	Yes	
<i>Ribes lacustre</i>	swamp gooseberry	S	Yes	
<i>Rosa gymnocarpa</i>	baldhip rose	S	Yes	
<i>Rubus discolor</i>**	Himalayan blackberry	S	No	x
<i>Rubus laciniatus</i>**	evergreen blackberry	S	No	x

Scientific Name ¹	Common Name	Strata ²	Native ³	"Invasive"
<i>Rubus leucodermis</i>	blackcap	S	Yes	
<i>Rubus parviflorus</i>	thimbleberry	S	Yes	
<i>Rubus spectabilis</i>	salmonberry	S	Yes	
<i>Rubus ursinus</i>	creeping blackberry	S	Yes	
<i>Rumex obtusifolius</i>	bitter dock	H	No	
<i>Salix scouleriana</i>	Scouler's willow	T	Yes	
<i>Sambucus racemosa</i>	red elderberry	S	Yes	
<i>Sorbus aucuparia</i> *	European mountain ash	T	No	x
<i>Stellaria crispa</i>	crisp sandwort	H	Yes	
<i>Stellaria media</i>	chickweed	H	No	
<i>Symphoricarpos albus</i>	snowberry	S	Yes	
<i>Tellima grandiflora</i>	fringecup	H	Yes	
<i>Thuja plicata</i>	western red cedar	T	Yes	
<i>Tolmiea menziesii</i>	piggy-back plant	H	Yes	
<i>Trientalis borealis ssp. Latifolia</i>	starflower	H	Yes	
<i>Tsuga heterophylla</i>	western hemlock	T	Yes	
<i>Urtica dioica</i>	stinging nettle	H	Yes	
<i>Vaccinium parvifolium</i>	red huckleberry	S	Yes	

¹Species in bold are non-native species. Species denoted by * are non-native invasive species, ** are species which have been given a legal designation by the King County Noxious Weed Program.

²Life form definitions: T=tree, S=shrub, H=herb, and G=graminoid

³Native: "x" denotes that species nativity is unknown

Appendix C. Wildlife and bird species sighted in Llandover Woods - provided by Glenn Austin of Friends of Llandover Woods

Animals

Townsend Chipmunk (*Eutamias townsendii*)
Cougar (*Felis concolor*) (seasonal reported sightings in The Highlands and surrounding area)
Coyote (*Canis latrans*)
Douglas Squirrel (*Tamiasciurus douglasii*)
Eastern Gray Squirrel (*Sciurus carolinensis*)
Mountain Beaver (*Aplodontia rufa*)
Common Opossum (*Didelphis marsupialis*)
Raccoon (*Procyon lotor*)

Birds

American Goldfinch (*Carduelis tristis*)
American Robin (*Turdus migratorius*)
Anna's Hummingbird (*Calypte anna*)
Bald Eagle (*Haliaeetus leucocephalus*)
Barred Owl (*Strix varia*)
Black Capped Chickadee (*Poecile atricapilla*)
Bushtit (*Psaltriparus minimus*)
California Quail (*Callipepla californica*)
Chestnut Backed Chickadee (*Poecile rufescens*)
Common Raven (*Corvus corax*)
Dark-eyed Junco (*Junco hyemalis*)
Downy Woodpecker (*Picoides pubescens*)
Northern Flicker (*Colaptes auratus*)
Hairy Woodpecker (*Picoides villosus*)
House Wren (*Troglodytes aedon*)
Crow (*Corvus spp.*)
Pileated Woodpecker (*Dryocopus pileatus*)
Red-Breasted Nuthatch (*Sitta canadensis*)
Ruby-crowned Kinglet (*Regulus calendula*)
Rufous Hummingbird (*Selasphorus rufus*)
Sharp-shinned Hawk (*Accipiter striatus*)
Song Sparrow (*Melospiza melodia*)
Spotted Towhee (*Pipilo maculatus*)
Steller's Jay (*Cyanocitta stelleri*)
Varied Thrush (*Ixoreus naevius*)
Winter Wren (*Troglodytes troglodytes*)

Appendix D. List of GPS locations of sampling plots in Llandover Woods

Photo Point	Northing (US ft)	Easting (US ft)
Plot 1	270927.929	1264017.947
Plot 2	271066.855	1263725.186
Plot 3	271055.881	1263589.797
Plot 4	271139.705	1263653.348
Plot 5	270900.683	1263423.045
Plot 6	271356.132	1263294.323
Plot 7	271269.833	1263836.203
Plot 8	271050.455	1263238.362
Plot 9	271216.246	1263544.547

