

# Boeing Creek and Shoreview Parks Vegetation Management Plan

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**Prepared for: City of Shoreline**



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## Executive Summary

Boeing Creek and Shoreview Parks, which together span 88 acres, represent the gem of the Shoreline park system. In 2007, Seattle Urban Nature (SUN) mapped habitat types and conducted a vegetation inventory in Boeing Creek and Shoreview Parks. The goals of the project were to:

- 1) Delineate and map habitats in Boeing Creek and Shoreview Parks
- 2) Provide an inventory of current vegetation conditions in the parks
- 3) Create a management plan based on data collected during the inventory

Six forested and five non-forested habitat types were mapped in the park complex during the survey. Forest types include conifer forest; conifer/deciduous forest; conifer/madrone forest; deciduous forest; riparian forest and landscaped forest. Non-forested habitats include large areas of shrubland, grassland, landscaped grassland, open water (Hidden Lake) and developed areas.

To study the current conditions within the forested areas of Boeing Creek and Shoreview Parks, SUN installed 27 0.1 acre rectangular vegetation plots distributed throughout the park. The plots recorded information about trees, shrubs, vines, herbaceous plants, snags and downed wood present in the park. During the 2007 survey, a total of 98 plant species were found: 24 tree species (13 native and 11 non-native); 28 shrub species (21 native and seven non-native); 35 forb and vine species (25 native, seven non-native and three undetermined); and 11 grass species (eight native, two non-native and one undetermined).

Although Boeing Creek and Shoreview Parks contain many intact forested areas, considerable management challenges exist within the parks. Many steep and erosion-prone slopes are present in the parks, particularly in the riparian forests along the stream corridor. As a result, riparian areas have the lowest densities of trees, snags and shrubs in the park. This is a significant management concern for wildlife using this important habitat type. In addition, an official trail network does not exist and many social trails run along the steep slopes in the parks. The City of Shoreline is working on a master trail plan in the parks, which will be implemented in the next several years.

Invasive species also pose a significant threat to the park complex. One of the most significant management issues lies in Shoreview Park, which contains 12 acres of disturbed shrublands consisting of Scotch broom, Himalayan blackberry and butterfly bush (*Buddleja davidii*). Other invasive species found in the park include English ivy, herb Robert (*Geranium robertianum*) and yellow archangel (*Lamiastrum galeobdolon*). The majority of English ivy is present in an isolated parcel across the street from Northwest 175<sup>th</sup> Street in the northern part of the park complex. Invasive trees present in Boeing Creek and Shoreview Parks include English holly; sweet cherry (*Prunus avium*); cherry laurel and European mountain ash (*Sorbus aucuparia*). These trees are present at densities of 201 stems/acre compared to 190 stems/acre for native regenerating trees.

To aid in conducting restoration activities, SUN identified and mapped management zones throughout the park. Specific recommendations were developed for each management zone as well as overall short-term, medium-term and long-term priorities for the entire park (see Management Recommendations and 15-year plan sections of the report).

## Boeing Creek and Shoreview Parks 15 year plan

Short term management priorities (Years 1-5)	These are actions that are of high importance and could be completed within the first five years
Year	Action
1	Conduct inventory of park assets and create Vegetation Management Plan (VMP) (complete)
2	Using information from VMP, create specific restoration action plans for each management zone. This type of information can include specific planting plans, specific invasive removal techniques to be used, specific maintenance activities that will be necessary, as well as a timeline for implementation, maintenance and monitoring
2-5	Implement specific goals identified as short-term priorities in the VMP
	1) Remove invasive trees in Zones 1, 2, 3 6, 8 and 9 and replant with native species
	2) Remove discrete areas of Himalayan blackberry in Zones 1, 3, 6 and 8 and replant with native species, including conifers
	3) Remove discrete patches of English ivy from Zones 1, 2, 3, 6 and 9 and replant with native species
	4) Remove yellow archangel from Zone 9 and replant with native species
	5) Remove scattered infestations of herb Robert from interior forested areas including Zones 6 and 7 within the park complex
	6) Remove infestations of creeping buttercup and common periwinkle from Zones 6 and 8 and replant with native species
	7) Formalize trail junctions in Zone 7 and replant with native species to avoid further effects of trampling
	8) Create survival rings around trees in Zone 12 within areas covered by English ivy
Yearly	Conduct monitoring and maintenance of areas in restoration
Medium-term priorities	These are actions that will take planning to complete and could be completed within five to ten years
Year	Action
6-10	1) Monitor cherry regeneration in Zone 1

	2) Create and maintain a buffer zone along the eastern and western edges of Zone 2 and along the eastern edge of Zone 5 to maintain the integrity of the forested areas
	3) Remove Herb Robert from Zones 3, 8 and 10 and replant with native species
	4) Remove Himalayan blackberry from Zones 9, 10 and 11 and replant with native species
	5) Remove Scotch broom from Zones 10 and 11 and replant with native species
	6) Remove ivy from Zone 10 and replant with native species
	7) Remove invasive tree species from zone 10 and replant with native trees
	8) Create a master plan for a trail network and close off and re-vegetate unnecessary social trails, particularly in steep slope areas
	9) Conduct a study focusing on stabilizing and re-vegetating eroded slopes and trails in steep slope areas
Yearly	Conduct monitoring and maintenance of areas in restoration
<b>Long-term priorities</b>	These are on-going activities that will take many years to accomplish and can be integrated into other actions
<b>Year</b>	<b>Action</b>
11-15	1) Underplant shrubs and herbaceous species within the conifer/madrone mixed forests in Zones 2 and 3
	2) Augment the shrub layer by underplanting shrubs in Zones 6 and 7
	3) Increase tree and shrub cover in Zone 8
	4) Remove invasive tree species from Zone 12 and replant with native species
	5) Remove English ivy from Zone 12 and replant with native species
	6) Remove Scotch broom, Himalayan blackberry and butterfly bush from Zone 4 and replant with native species
	7) Remove Himalayan blackberry and Scotch broom from Zone 12 and replant with native species
	8) Maintain restored areas which have been replanted with native species
	9) Increase levels of CWD and preserve large snags throughout the park complex.
16	Conduct park inventory and reassess management strategies

**Table of Contents**

1. INTRODUCTION ..... 2  
2. SITE LOCATION AND CONTEXT ..... 4  
3. FOREST ASSESSMENT METHODOLOGY ..... 10  
4. RESULTS AND FINDINGS ..... 13  
5. MANAGEMENT RECOMMENDATIONS ..... 34  
REFERENCES ..... 57  
Appendix A. Average percent density of trees (stems/acre) and cover of shrub, herb and grass species where present (on surveyed plots) and frequency park-wide. .... 60  
Appendix B. Invasive Species BMPs ..... 63  
Appendix C. Stake locations for 27 plots established in Shoreview and Boeing Creek Parks..... 64  
Appendix D. Map of locations for 27 plots established in Shoreview and Boeing Creek Parks..... 65

**Maps**

Map 1. Boeing Creek and Shoreview Parks Habitat Delineations ..... 3  
Map 2. Boeing Creek and Shoreview Parks Management Zones and Invasive Species Locations ..... 6  
Map 3. Boeing Creek and Shoreview Parks Steep Slopes..... 7

**Tables**

Table 1. Habitat types mapped in Boeing Creek Park and Shoreview Park during the 2007 survey..... 15  
Table 2. Overstory and regenerating tree species found in each of the sampled habitat types in Shoreview and Boeing Creek Parks..... 18  
Table 3. Shrub species found in each of the sampled habitat types in Shoreview and Boeing Creek Parks. 28  
Table 4. Herbaceous species, including vines found in each of the sampled habitat types in Shoreview and Boeing Creek Parks..... 31

**Figures**

Figure 1. Dimensions and layout of sampling plots in Boeing Creek and Shoreview Parks .....11  
Figure 2. Average density (stems)/acre of overstory trees in Shoreview and Boeing Creek Parks .....19  
Figure 3. Native overstory and regenerating tree density/acre by height size class in the conifer forest type in Shoreview and Boeing Creek Parks.....1  
Figure 4. Overstory tree density/acre by diameter size class for sampled habitat types in Shoreview and Boeing Creek Parks.....21  
Figure 5. Average density (stems)/acre of regenerating trees in Shoreline and Boeing Creek Parks .....23  
Figure 6. Snag density/acre by diameter size class for sampled habitat types in Shoreview and Boeing Creek Parks. ....25  
Figure 7. Coarse Woody Debris (CWD) volume (ft<sup>3</sup>/acre) for sampled habitat types in Shoreview and Boeing Creek Parks.....26  
Figure 8. Distribution of the ten most prevalent shrubs by forest type in Shoreview and Boeing Creek Park across all plots .....29  
Figure 9. Distribution of the six most prevalent herbaceous and vine species by forest type in Shoreview and Boeing Creek Park across all plots.....33

## **1. INTRODUCTION**

The purpose of this report is to assist the City of Shoreline in their planning efforts for the ongoing stewardship and maintenance of Boeing Creek and Shoreview Parks. Because of the increasing use and pressure from human impact, natural areas require active management to maintain and improve their aesthetic and ecological values. This project provides a survey of forested areas and also establishes baseline information with which future surveys and monitoring may be compared. Specific goals of the project are to:

- 1) Delineate and map habitats in Boeing Creek and Shoreview Parks
- 2) Provide an inventory of current vegetation conditions in the parks
- 3) Create a management plan based on data collected during the inventory

In 2007, the City of Shoreline contracted with Seattle Urban Nature (SUN) to survey and map four parks owned and managed by the City. SUN is a non-profit organization, whose mission is to create tools to empower stewards for healthy urban ecosystems. SUN assists community groups, governments, non-profit organizations and private citizens in their efforts to survey, map, restore and maintain urban forests in the Puget Sound region.

### **1.1 Overview of Parks**

Shoreview Park and adjacent Boeing Creek Park comprise approximately 88 acres of recreational facilities and natural areas within the City of Shoreline, Washington (Map 1). Together, these two parks offer a unique place for local residents to enjoy a significant area of contiguous forest containing mature conifer trees – a rare occurrence in an urbanized area. These forests are part of a substantial natural system that spans more than 50 acres and consists of a variety of habitats that provide important open space for native plants and wildlife species.

Shoreview Park and Boeing Creek Park consist of a series of playfields, forested areas, two converging reaches of Boeing creek, and a manmade lake along the creek. In Shoreview Park, there are a number of park facilities including tennis courts, an all-weather soccer field, ball fields, playgrounds, restrooms, and a large parking area. Boeing Creek Park is mostly forested with a network of trails providing creek access, and also contains a stormwater detention pond with adjacent picnic tables. Together, the parks are used for passive recreational activities such as walking and bird-watching, along with organized sports such as baseball, soccer, and tennis (City of Shoreline 2007). These parks, which were previously owned and maintained by King County, were acquired by the City of Shoreline in 1997, shortly after its incorporation as a city.

Several water features are present in the parks. Two branches of Boeing Creek flow through the northern portion of the park complex, merging into one stream on the western border of the parks, and flowing through Hidden Lake to the southwest (Map 1). Surface water from Shoreline's storm management system also drains into Boeing creek before continuing to Hidden Lake and eventually to Puget Sound.

Shoreview Park and Boeing Creek Park have a diverse history dating back to when the first European settlers arrived to the area in the late 1800s. Logging of the forests occurred in the late 19th century, and the land has had numerous owners over the course of the 20th century. As a result of past management

# Map 1

## Boeing Creek and Shoreview Parks Habitat Delineations



### Legend

- Park Boundaries (87.9 Acres)
- Boeing Creek
- Piped Water Course
- Trails

### Habitat Types (Acres)

- Conifer Forest (16.2)
- Conifer-Deciduous Forest (17.3)
- Conifer-Madrone Forest (5.0)
- Riparian Forest (6.4)
- Deciduous Forest (7.5)
- Grassland (3.7)
- Shrubland (11.7)
- Palustrine Open Water (0.8)
- Landscaped Forest (1.7)
- Landscaped Grassland (6.6)
- Developed (11.0)

Map produced by Seattle Urban Nature 2007. Park boundaries, water course data, and orthoimagery provided by the City of Shoreline, WA.  
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decisions, a majority of the intact forested areas remain in Boeing Creek Park, whereas much of Shoreview Park contains recreational facilities and disturbed open areas.

## **2. SITE LOCATION AND CONTEXT**

### **2.1 Area Description**

Shoreview Park and Boeing Creek Park are located in western Shoreline, Washington, next to Shoreline Community College. Shoreview Park is bordered to the east by Shoreline Community College, to the south by Northwest Innis Arden Way, to the west by Boeing Creek and Hidden Lake, and to the north by Boeing Creek Park. Boeing Creek Park is bordered to the east by Carlyle Hall Road Northwest which turns into 3rd Avenue Northwest, to the southeast by Shoreline Community College, to the southwest by Shoreview Park, to the west by Boeing Creek, and to the north by Northwest 175th Street. An additional open space that is part of Boeing Creek Park is located just north of Northwest 175th Street, bound by residential homes to the west, NW 178<sup>th</sup> Place to the north, and 6th Avenue Northwest to the east (Map 1). The park complex is adjacent to a substantial forested area in private ownership, which connects the parks to the Puget Sound along the Boeing Creek corridor, and provides a travel corridor for birds and wildlife.

### **2.2 Hydrology**

Boeing Creek flows through both Boeing and Shoreview Parks. The Boeing Creek watershed encompasses an area bordered by Northwest 200<sup>th</sup> Street on the north side, Northwest 145<sup>th</sup> Street on the south side, Aurora Avenue North to the east and Puget Sound to the west (Will 1998). Boeing Creek is the main water body in this watershed, collecting surface runoff and carrying it to Puget Sound.

The northern fork of Boeing Creek emerges from a large culvert in the northwestern section of Boeing Creek Park from water piped beneath 6<sup>th</sup> Avenue Northwest. During high flow events, additional water from pipes beneath Northwest 175th Street enters the park from the northeast, flows through the stormwater detention pond, and joins with the northern fork near the 6<sup>th</sup> Avenue Northwest culvert (Map 1). A second tributary of Boeing Creek enters Boeing Creek Park from the southeast along Carlyle Hall Road Northwest and flows through the central portion of the park. This tributary joins with the northern fork on the south western park boundary of Boeing Creek Park and the combined creeks flow south along the western border of Shoreview Park (Map 1). Near the Southwestern corner of Shoreview Park, the creek reaches an earthen dam and creates the manmade reservoir named Hidden Lake before it continues to flow as an open water course and empties into Puget Sound (City of Shoreline 2007a).

Hidden Lake is an important feature in Shoreview Park. Half of the lake is owned by the City of Shoreline while half remains in private hands. Due to heavy development in the surrounding area after World War II, increased runoff into Boeing Creek resulted in upstream erosion of its sandy banks, leading to sediment build-up in Hidden Lake. In the mid-1970s, heavy rains caused sediment to fill Hidden Lake, transforming it into a meadow (Carter, 1997). At this point, the King County Surface Water Division began controlling storm water runoff and building catch basins in an effort to stabilize the area. Finally, after dredging, Hidden Lake was reestablished as a lake in the summer of 1996. However, a storm on January 1, 1997 caused a giant sinkhole and severed sewage lines on Northwest



175th Street, resulting in Hidden Lake filling with sediment again, and requiring a subsequent excavation of the lake (Carter 1997).

### **2.3 Topography, Geology and Soils**

Topography within both Boeing Creek and Shoreview Parks is very steep in many areas of the park. One of the most important features is a ravine which runs through the center of the park in the riparian forest corridor (Map 1). A raised area in the southeastern portion of Shoreview Park is the highest point within the park complex with an elevation of 472 feet above mean sea level. From here, a north sloping ridge runs along the eastern boundary marked by the Shoreline Community College overflow parking lot, with steep slopes to the west and gentler slopes east towards the college. The ridge extends north into the Boeing Creek Park property before descending steeply to the central riparian ravine, with slopes greater than 20 degrees (Map 3). To the west of the ridge, the elevation drops through a series of benches marked by parking lots, playfields, and finally a previously-cleared natural area before descending steeply to the riparian corridor. The riparian corridor forms the north-western boundary of the park complex and has very steep slopes, some approaching 30 degrees (Map 3). These slopes descend to the lowest elevation in the park complex at Hidden Lake at 194 feet above mean sea level. The northeastern section of Boeing Creek Park above the central riparian ravine is more flat, with average slopes of 11 degrees. The small park parcel north of Northwest 175th Street is relatively flat in the central portion, but rises steeply on the northwest side from 340 feet to 420 feet in elevation.

The geology of the Boeing Creek and Shoreview Park complex 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)

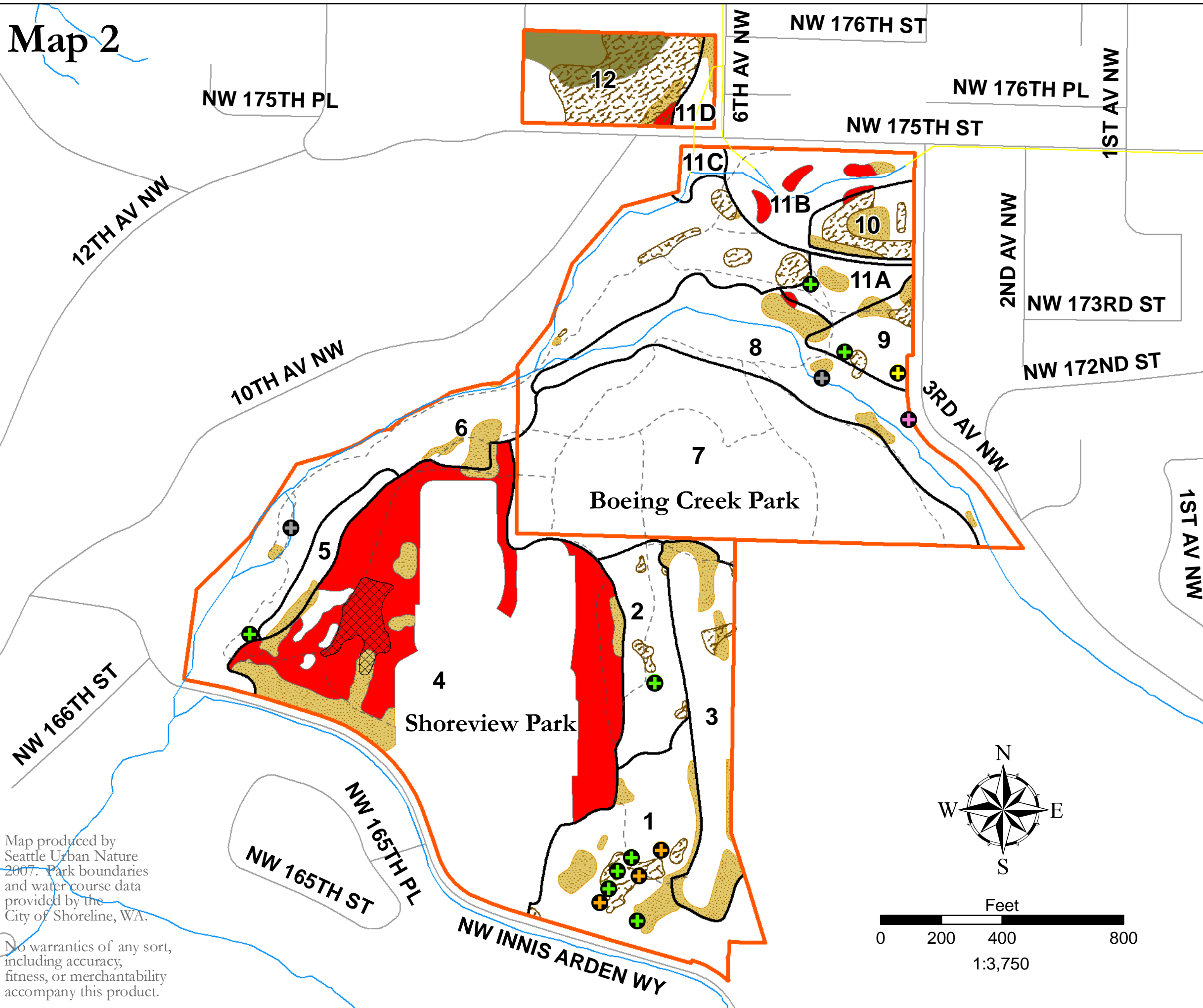
The geologic composition of the park complex consists of three different parent materials;

- 1) Vashon subglacial till - a mixture of rounded silt, sand and gravel particles, which were glacially transported and deposited under ice. This material is located primarily on the eastern side of Shoreview park, to the east of the recreational facilities.
- 2) Advance outwash deposits - a well-sorted sand and gravel deposited by streams issuing from the advancing ice sheet. This material makes up the majority of the park complex.
- 3) Transitional beds - glacially compacted clay and silt deposits (including Lawton clay) that are sometimes interspersed with sand layers. This material is present on the western most side of the park complex, coinciding with the riparian corridor of Boeing Creek (King County 2002).

### **2.4 Volunteer Efforts**

After the sinkhole in 1997, Hidden Lake and Boeing Creek received additional attention from the City of Shoreline and Shoreline Community College. Water quality monitoring and habitat restoration was planned for Boeing Creek and surrounding areas. An education campaign was also launched at this time, with the goal of enhancing appreciation of Boeing Creek and educating people about what they can do to reduce damage to the creek. This included a "Watershed Keeper" training, in which volunteers received hands-on experience in invasive plant removal and native plantings within Boeing Creek Park (Will 1998).

# Map 2



## Boeing Creek and Shoreview Parks Management Zones and Invasive Species Locations

**Legend**

- 12 Management Zones
- Park Boundaries (87.9 Acres)
- Boeing Creek
- Piped Water Course
- Trails

**Invasive Species Contiguous Areas (Acres)**

- English Ivy (4.8)
- Holly & Laurel (1.6)
- Himalayan Blackberry (6.4)
- Butterfly Bush (0.8)
- Scotch Broom (8.5)

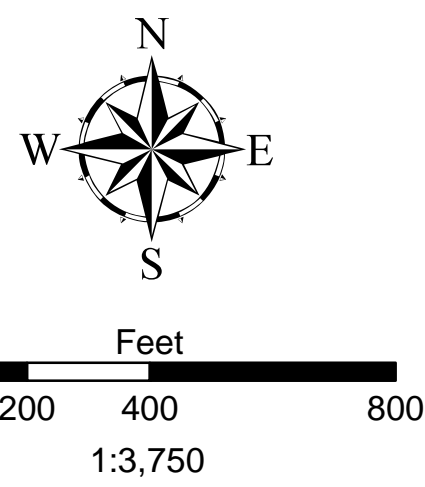
**Invasive Species Isolated Occurrences**

- English Holly
- Cherry Laurel
- Yellow Archangel
- Creeping Buttercup
- Common Periwinkle

Map produced by Seattle Urban Nature 2007. Park boundaries and water course data provided by the City of Shoreline, WA.

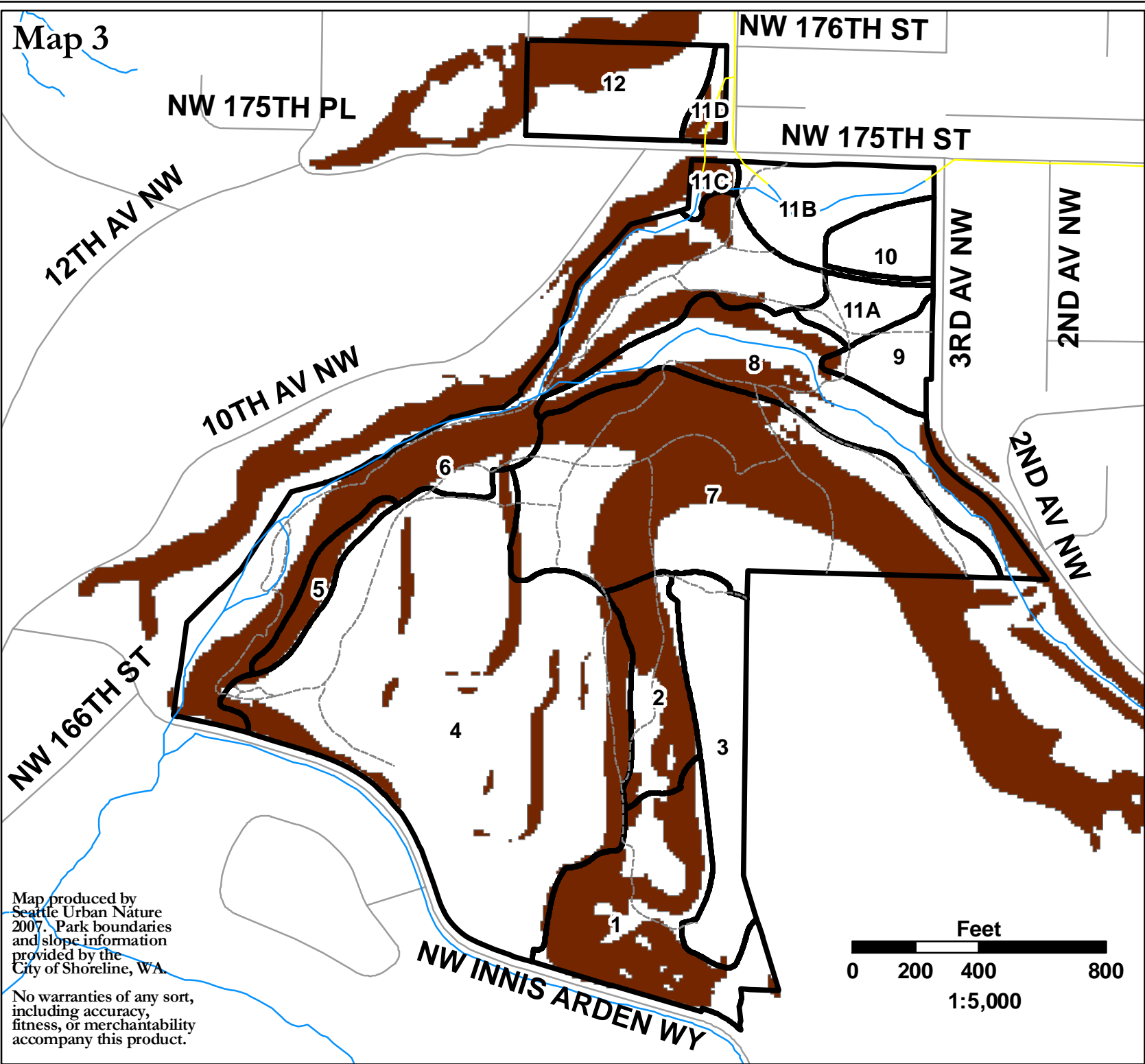
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City of Shoreline logo and Seattle Urban Nature logo.



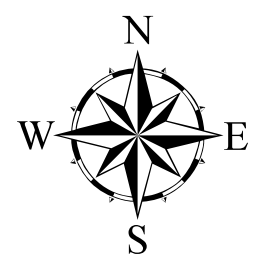
Map 3

# Boeing Creek/ Shoreview Parks Steep Slopes



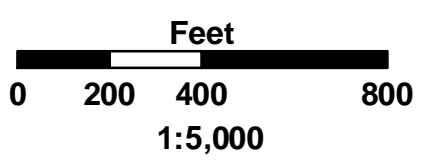
**Legend**

- Management Zones
- Steep Slopes
- Boeing Creek
- Piped Water Course
- Trails



Map produced by Seattle Urban Nature 2007. Park boundaries and slope information provided by the City of Shoreline, WA.

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Other restoration projects have been undertaken by students from King's High School and the Shoreline Community College as well as local organizations such as Volunteers for Outdoor Washington.

## **2.5 History of Shoreview and Boeing Parks and the Surrounding Community**

The area that encompasses both Shoreview Park and Boeing Creek Park was originally owned by William Boeing, founder of The Boeing Company. Boeing used the land primarily as a hunting retreat, with Hidden Lake as his own private fishing pond (Carter 1997; Sykes 2004). In the 1930s, Boeing platted the adjacent 400 acres of land to create Innis Arden. The land was logged and sold to developers and houses were built soon after World War II (Stiles 2007). No specific logging records exist for Boeing Creek Park. A United States Geological Survey map from 1900 shows the area had been logged and was slated for restocking (USGS 1900). However, many mature conifer trees, some over 200 feet tall are still present in Boeing Creek Park. It is possible that the park was selectively logged, but it is also possible that the presence of steep slopes in much of the park prevented access to some areas.

Boeing eventually transferred the land that encompasses Shoreview Park to the Shoreline School District. By the mid-1970s, this site was slated to become Shoreview High School. However, a \$6 million levy to fund the construction of the school failed. Despite \$250,000 of terracing and drainage work on the western portion of the property in preparation for the school's athletic fields, the school district decided not to build on the property, although much of it had already been cleared (McKinney 1977; Stiles 2007). In 1977, King County purchased the land from the School District and the area was established as a park (Hills 1999). The City of Shoreline assumed ownership of Shoreview Park and Boeing Creek Park in 1997.

By the late 1990s, Shoreview Park contained recreational facilities including a baseball field, a soccer field, and tennis courts. Plans to further develop Shoreview Park by constructing an additional baseball field west of the established soccer field, a restroom facility, and parking lot were met with local opposition (Hills 1998). This area had been previously cleared by the school district in preparation for construction and became shrublands, dominated by invasive species (Map 2). Opponents of the construction believed that the shrublands provide habitat for birds and wildlife and an edge environment in close proximity to the forested areas of Boeing Creek Park (Hills 1999). Due to community opposition, the City of Shoreline installed the ball field southwest of the tennis courts near the entrance to the park and adjacent to Innis Arden Way. Other improvements in Shoreview Park included additional parking spaces, restrooms, three children's play areas, new pathways and stairs, a picnic plaza, bus and passenger drop-off areas, and landscaping and habitat restoration areas (City of Shoreline, 2007).

Currently, the City of Shoreline and King County are involved in various projects to improve the safety and reliability of the stormwater facility located in the north end of Boeing Creek Park immediately south of Northwest 175<sup>th</sup> Street. The stormwater facility consists of a newly completed 500,000 gallon underground storage pipe and detention pond, which store water from large storm events and protect Boeing Creek and the surrounding neighborhood from flooding (City of Shoreline 2007). King County is also replacing the Hidden Lake Pump Station, located to the west of Hidden Lake and 12,000 feet of the Boeing Creek Trunk Sewer, running from the north end of Shoreline and connecting to the new storage pipe (to be completed by 2009). These projects will update facilities and pipelines that are more than 40 years old and in poor condition (City of Shoreline 2007; Department of Natural Resources 2007).

Starting in 2008, the City of Shoreline will begin additional park and storm water improvements to Boeing Creek Park. These will involve increasing the capacity of the stormwater detention pond and planting the pond with native vegetation, adding benches and landscaping, improving trails and stream crossings, and adding trail and interpretive signage (City of Shoreline 2007).

### **3. FOREST ASSESSMENT METHODOLOGY**

The purpose of the forest inventory is to:

- 1) Delineate and map habitats in Boeing Creek and Shoreview Parks
- 2) Provide an inventory of current vegetation conditions in the parks

The following section describes methodology used in this forest assessment.

#### **3.1 Habitat Type Delineation**

The project area was initially divided into areas of similar habitat types based on dominant plant species associations. Prevailing habitat types were delineated in the field using recent aerial orthoimagery maps and utilized a GPS unit to locate boundaries and principal reference points. This information was used to create a GIS base layer of the property in order to geographically represent the arrangement of each habitat type and to quantify the spatial area of each individual habitat. The initial delineations were revised and updated during the course of the plot-level survey. The final map displays the locations and distributions of each habitat type accompanied by the corresponding combined acreage for each habitat (Map 1).

#### **3.2 Sampling intensity**

Vegetation sampling to support management plans generally aim to sample three to ten percent of the forested area of interest. Using this guideline, SUN surveyed 27 plots in July and August of 2007. These sample plots (0.1 acre each, with a combined coverage of 2.7 acres) represent approximately 5% of the total forested area of the park (52.1 acres). Non-forested portions of Boeing Creek and Shoreview Parks were not included in the survey. Approximately 35 acres of invasive-dominated shrubland, grassland, landscaped forest and developed areas were not sampled (Map 1).

#### **3.3 Plot Layout**

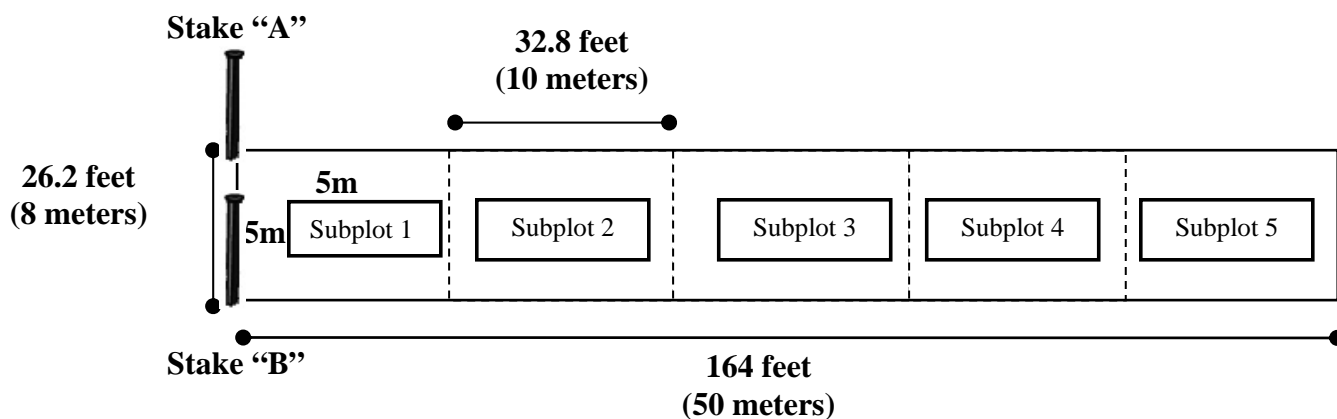
Plots were distributed proportionately among all forest types and randomly located within a particular forest type. Of the 27 sample plots, four were located in the deciduous forest, three in the mixed conifer/madrone forest, three in the riparian forest, eight in the conifer/deciduous mixed forest and nine in the conifer forest (Appendix D).

The plots are rectangular belt transects and cover an area 26.2 feet (8 meters) wide and 164 feet (50 meters) long (Figure 1). 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 the City of Seattle (Jones and Stokes 2002, Sheldon and Associates, Inc. 2003, Seattle Urban Nature 2006). 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. The starting point of each plot was marked with a 1”x 2” x 12” wooden stake driven into the ground and labeled with the plot number followed by “A”. A second stake was placed 26.2 feet from, and perpendicular to the bearing and to the right of the first stake and labeled with the plot number followed by “B”. The belt transect extends 164 feet along the transect bearing from stake “A” and 26.2 feet to the right (Figure 1). GPS point locations have been recorded to within one meter accuracy at each of the “A” stakes (Appendix C).

**Figure 1. Dimensions and layout of sampling plots in Boeing Creek and Shoreview Park\***



\* not drawn to scale

### 3.4 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 estimated and recorded.

**Tree density:** All trees with trunks occurring within the 1/10<sup>th</sup> acre plot were identified and enumerated including non-native tree-like species such as cherry laurel (*Prunus laurocerasus*), English holly (*Ilex aquifolium*) 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 (*Hedera helix*). For trees smaller than 4.5 feet in height, average stem diameter was recorded to the nearest ½ inch.

Snags and coarse woody debris (CWD) greater than 5 inches in diameter, consisting of standing and downed logs and stumps, were measured and placed into one of three decay classes, I, II, or III. Decay class I indicated a branch or trunk that recently died and frequently had intact bark and branches and hard wood. Decay class III characterizes 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 provides 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 (ft<sup>3</sup>/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 1/10<sup>th</sup> acre plot, were identified and percent cover was visually estimated for each species. Vegetation cover was estimated by dividing the 50m x 8m sample area into five 10m x 8m quadrats and randomly sampling five 5m x 5m subplots, one within each quadrat (See Figure 1). These five quadrats represent 31% of the entire 400m<sup>2</sup> area within the plot. Within each subplot, percent cover was visually estimated for all species present, and then these subtotals were combined 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 comprehensive floristic survey (i.e. species richness) for each plot location.

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.

### **3.5 Data Collection and Management**

Data collection was conducted by two staff ecologists at Seattle Urban Nature. Data was recorded using a TDS Recon PDA. Information from the PDA was transferred to a Microsoft Access Database, which was used for data analysis. A Trimble GeoXT unit with a ProXR antenna was used to collect GPS information in the field. Maps were produced using ESRI ArcMap version 9.1, which connects geographic information (e.g., maps, aerial photographs, topography) with tabular information (e.g., data plot information in Access database).



## 4. RESULTS AND FINDINGS

The results and findings section provides a summary and analysis of collected field data for five individual forested habitat types: conifer forest; conifer/deciduous mixed forest; conifer/madrone mixed forest; deciduous forest; and riparian forest. For each forested habitat type, the following information is presented: overstory tree composition and structure (section 4.2); regenerating tree composition and structure (section 4.3); snags (section 4.4), coarse woody debris (section 4.5), shrubs (section 4.6); and herbaceous and vine percent cover (section 4.7). Map 1 shows the locations and extents of mapped habitat types. Locations of established assessment plots can be found in Appendix D.

### 4.1 Park-wide Vegetation Trends

The present character of Boeing Creek and Shoreview Parks is a result of the many diverse land uses that the area was subject to during the past one hundred years. Although the logging history of forests within Boeing Creek Park is not documented, it is likely that most accessible areas were selectively logged. The presence of steep slopes throughout much of the park may explain the existence of large trees in some areas. Recent construction and other uses of the Shoreview Park and in the north of Boeing Creek Park have also resulted in large cleared areas which have been taken over by invasive species.

#### Habitat types

Five forested habitat types were identified in Boeing Creek and Shoreview Parks during the 2007 survey and are discussed in the sections below. Six additional habitat types are non-forested and include grassland, shrubland, palustrine open water, landscaped forest, landscaped grassland and developed areas. The locations and extents of non-forested habitat types are shown on Map 1, but were not surveyed. The forested areas consist of approximately 16 acres of pure conifer forests in the central part of the complex (mostly in Boeing Creek Park), 17 acres of mixed conifer-deciduous forests primarily in the western part of the complex, five acres of mixed conifer-madrone forests in the southern part (located in Shoreview Park), seven acres of deciduous forest in both the south and northern sections of the complex, and six acres of riparian forest in the center of Boeing Creek Park (Map 1).

#### Conifer forest

Conifer forest covers 18.5% of the park area (Table 1). The conifer forest overstory is dominated by Douglas-fir (*Pseudotsuga menziesii*) with smaller components of western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*) and western white pine (*Pinus monticola*). The regenerating layer of this forest type is composed mainly of native conifer trees, but with a considerable amount of English holly and European mountain ash, which have spread throughout the conifer forest. Tall shrub species are almost entirely absent from the forest. However, salal (*Gaultheria shallon*) is very prevalent and robust in this forest type.

#### Conifer/deciduous mixed forest

The conifer/deciduous mixed forest covers 20% of the park area (Table 1). The overstory in this forest type is dominated by western red cedar, with substantial components of Douglas-fir and big-leaf maple (*Acer macrophyllum*). Although the regeneration layer contains both conifer and deciduous trees, it is dominated by English holly and contains the highest density of holly of any other forest type. The shrub layer in this forest type is very sparse, with small amounts of both low and high-statured shrubs. There is

considerable cover of the herbaceous species sword fern (*Polystichum munitum*) present. This forest type also contains the highest percentage cover of English ivy of any forest type.

#### Conifer/madrone mixed forest

The conifer/madrone mixed forest is the smallest forest type, covering 6% of the park complex, and found entirely in Shoreview Park. This forest type is composed of both Douglas-fir and Pacific madrone (*Arbutus menziesii*) trees in the overstory, with a smaller component of big-leaf maples. The regenerating tree layer is composed of a mixture of western red cedar, Douglas-fir, Pacific madrone and big-leaf maple trees. Non-native regeneration in this forest type consists of sweet cherry, English holly, cherry laurel, Portugal laurel (*Prunus lusitanica*) and European mountain ash. The understory of this forest type is dominated by salal, with a sparse herbaceous layer.

#### Deciduous forest

Approximately 8.5% of the park consists of deciduous forests, dominated by big-leaf maple. A small conifer component is also present, consisting of Douglas-fir and western white pine. The regenerating tree layer is composed of native conifer and deciduous trees, along with a number of sweet cherry (*Prunus avium*) and other non-native horticultural cherry species (*Prunus sp.*). The shrub layer in this forest type is dominated by creeping blackberry (*Rubus ursinus*). However, there is also a high amount of Himalayan blackberry present.

#### Riparian forest

The riparian forest makes up 7% of the forested area and is dominated by red alder (*Alnus rubra*) and big-leaf maple trees in the overstory. The regenerating layer is dominated by English holly, which makes up more than half of all regenerating trees. There is also a considerable amount of deciduous trees such as bitter cherry (*Prunus emarginata*) and big-leaf maple regenerating. The fairly sparse shrub layer is dominated by salmonberry (*Rubus spectabilis*). The herbaceous layer is dominated by sword fern and stinging nettle (*Urtica dioica*), along with a high percent cover of herb Robert (*Geranium robertianum*).

#### Non-forested habitat types

A large area of shrubland, consisting mainly of Scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus armeniacus*) make up an additional 13% of the park complex area, mostly concentrated in Shoreview Park around the ballfields and tennis courts. However, patches of both types of shrubs are also prevalent in the northern, sparsely forested portion of Boeing Creek Park (Map 1). Landscaped grasslands present in the Shoreview Park ballfield complex represent 7.5% of the entire park area. An additional 4% of the park complex consists of non-landscaped grasslands, located in the northern section of Boeing Creek Park surrounding the stormwater facility and in the adjacent parcel across the street. A small section of landscaped forest (2% of the park complex area) is present adjacent to the stormwater facility in Boeing Creek Park (Map 1).

#### Species distribution

During the 2007 survey, a total of 98 plant species were found: 24 tree species (13 native and 11 non-native); 28 shrub species (21 native and seven non-native); 35 forb and vine species (25 native, seven non-native and three undetermined); and 11 grass species (eight native, two non-native and one undetermined). Appendix A lists the scientific and common names of all plants identified during the survey, as well as the native/non-native status of these species.

The central forested and riparian areas of Boeing Creek Park feature an intact native ecosystem, mostly free of invasive species. The majority of invasive species distribution is found within disturbed areas in Shoreview Park; in the northern, sparsely forested area of Boeing Creek Park; and in the northern parcel separate from the rest of the parks (Map 2). These species include trees such as English holly; sweet cherry; cherry laurel and European mountain ash; shrubs such as butterfly bush (*Buddleja davidii*); scotch broom; Himalayan blackberry and evergreen blackberry (*Rubus laciniatus*); as well as herbaceous and vine species such as herb Robert, English ivy, yellow archangel (*Lamium galeobdolon*), and creeping buttercup (*Ranunculus repens*).

Butterfly bush, scotch broom, English ivy, herb Robert and yellow archangel 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 2007). Himalayan blackberry, evergreen blackberry, English holly and cherry laurel are classified 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 2007). European mountain ash and creeping buttercup are considered to be invasive but do not have a legal designation at this time.

**Table 1. Habitat types mapped in Boeing Creek Park and Shoreview Park during the 2007 survey.**

Habitat type	Acres	Percentage of total area (%)	Number of plots sampled
Conifer Forest	16.2	18.5	8
Conifer/ Deciduous Mixed Forest	17.3	20	8
Conifer/Madrone Mixed Forest	5	6	4
Deciduous Forest	7.5	8.5	4
Riparian Forest	6.4	7	3
Developed	11	12.5	0
Grassland	3.7	4	0
Landscaped Forest	1.7	2	0
Landscaped Grassland	6.6	7.5	0
Palustrine Open Water	0.8	1	0
Shrubland	11.7	13	0
<b>Park Complex Total</b>	<b>87.9</b>	<b>100</b>	<b>27</b>

## 4.2 Overstory tree composition and structure

The forest overstory refers to the upper and mid-story canopies of a forest. Tree density data were collected during field surveys in the summer of 2007. Only trees with a diameter measuring greater than 5 inches (a standard measure for overstory) were considered for the purposes of this overstory analysis. Mid-story trees in Boeing Creek and Shoreview Parks are generally between 15 and 80 feet in height, whereas overstory trees make up the tallest layer in the canopy. Tree density can be used to draw inferences about overall forest development and succession. In general, older stands tend to have lower tree 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 different 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 forest type in Boeing Creek Park exhibits many of the characteristics of a mature forest, whereas the other forest types appear to be forests in the early stages of maturation and have not retained many large trees. Although no specific logging records exist for this area (see *History of Shoreview and Boeing Parks and the Surrounding Community*), most forests in this area were logged in the late 1800's, indicating that these second-growth stands are approximately 100 years old.

#### Park-wide summary

The overstory in the park contains an average of 161 stems/acre and is dominated by native conifer trees, which compose 59% of all sampled trees (Figure 2). The forest also contains a considerable population of deciduous trees and madrones (broadleaf evergreen) which make up 17% and 13% of the overstory respectively. Very small amounts (less than 1%) of non-native trees are present in the overstory layer (Figure 2).

#### Conifer forest

The conifer forest overstory contains an average of 176 stems per acre with an average height of 95 feet and an average diameter of 15.6 inches. The forest contains a well developed multi-layer structure including a mid-story and regenerating component. Fourteen percent of all native trees in this forest type are greater than 120 feet in height (Figure 3). Seven native species were recorded in this forest type during the 2007 survey (Table 2). Almost all of the overstory trees (97%) are conifer, dominated by Douglas-fir (74% of trees), with smaller amounts of western hemlock (12%), western red cedar (6%) and western white pine (5%). Some big-leaf maple and Pacific madrone are also present in this forest type, with an average occurrence of 2% and 1% respectively. The diameter distribution of the trees shows that stems are evenly divided between the 5-10 inch and 11-20 inch categories (35% and 39% of total stems respectively). As the trees get larger, a smaller, but still considerable proportion of stems are present in the 21-30 inch category (22%) and 5% are greater than 30 inches in diameter (Figure 4).

#### Conifer/deciduous mixed forest

The conifer/deciduous mixed forest has lower overstory tree densities than the conifer forest, averaging 114 stems per acre, with an average height of 77 feet and an average diameter of 16 inches. This forest type has a well-developed mid-story layer, composed of both conifer and deciduous trees (Figure 3). Five species of native trees were recorded in the overstory of this forest type during the 2007 survey (Table 2). The overstory is dominated by conifers, which make up 71% of the trees, with the remaining 29% consisting of deciduous trees. Western red cedar is the most dominant species, making up 39% of all trees, followed by big-leaf maple (25%) and Douglas-fir (21%). Western hemlock and red alder represent smaller components in the overstory (11% and 4% respectively) (Table 2). Tall trees (over 80 feet) represent a much smaller proportion in this forest type when compared to the conifer forest with only nine percent of trees measured between 80-120 feet tall and five percent taller than 120 feet (Figure 3). The diameter distribution is similar to that of the conifer forest. Stems are evenly divided between the 5-10 inch and 11-20 inch categories (40% and 36% of total stems respectively), with smaller amounts of larger trees; 14% are between 21-30 inches in diameter and 10% are greater than 30 inches in diameter (Figure 4).

### Conifer/madrone mixed forest

The conifer/madrone mixed forest has the highest overstory density of all forest types in the park, averaging 297 stems per acre, with an average height of 58 feet and an average diameter of 10.4 inches. Five species of native overstory trees were recorded during the 2007 survey (Table 2). This forest type contains a high proportion of Pacific madrone trees, which make up 43% of overstory stems present. Douglas-fir is also prevalent, making up 39% of overstory trees. A smaller amount of big-leaf maple (16%), bitter cherry (1%) and western red cedar (1%) is also present (Table 2). The mid-story is well-developed in this forest type, with 59% of all native trees between 15 and 80 feet in height. Only 4% of trees are greater than 80 feet tall (Figure 3). The diameter distribution shows that the vast majority of trees (69%) are very small, between 5 and 10 inches in diameter, with an additional 25% between 11 and 20 inches. Only 7% of trees are larger than 20 inches in diameter (Figure 4).

### Deciduous forest

The deciduous forest overstory contains an average of 153 stems per acre, with an average height of 62 feet and average diameter of 10.5 inches. Nine species of overstory trees were recorded during the 2007 survey, of which six are native and three are non-native (Table 2). Big-leaf maple is the dominant species, making up 72% of all trees. Small amounts of Douglas-fir (7%), Pacific madrone (5%), western white pine (5%), red alder (3%) and bitter cherry (3%) are also present. This forest type contains nearly all the non-native horticultural species recorded during the survey. Non-native species include true cedars (*Cedrus sp.*), (2%), horticultural holly (*Ilex sp.*) (2%) and horticultural cherry species (2%) (Table 2). The forest structure in the deciduous forest shows a dominance of small trees and a lack of mature trees. The height classes of trees are well distributed, indicating a multi-layered forest structure. However, only 3% of all trees are taller than 80 feet (Figure 3). Likewise, all the trees measured in this forest type are smaller than 21 inches in diameter, with 55% from 5-10 inches and 45% between 11 and 20 inches (Figure 4).

### Riparian forest

The riparian forest type is the least densely forested of all forests in the park complex, averaging 84 stems per acre, with an average height of 66 feet and an average diameter of 15 inches. Four native overstory tree species were recorded in this forest during the 2007 survey (Table 2). Red alder is the most dominant species, and makes up 56% of all trees. There is also a substantial component of big-leaf maple (32%). Western red cedar and bitter cherry are also present in small amounts (8% and 4% respectively) (Table 2). The height classes of trees are well distributed, indicating a well-developed mid-story layer. Very few trees are greater than 80 feet in height and are composed of conifer trees (Figure 3). The diameter distribution shows that the majority of trees are in the 5-10 inch and 11-20 inch categories (48% and 32% respectively). Only 4% of trees are between 21 and 30 inches in diameter. However, this forest type contains the largest proportion of trees greater than 30 inches in diameter of all the forest types in the park, with 16% of trees in this category (Figure 4).

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

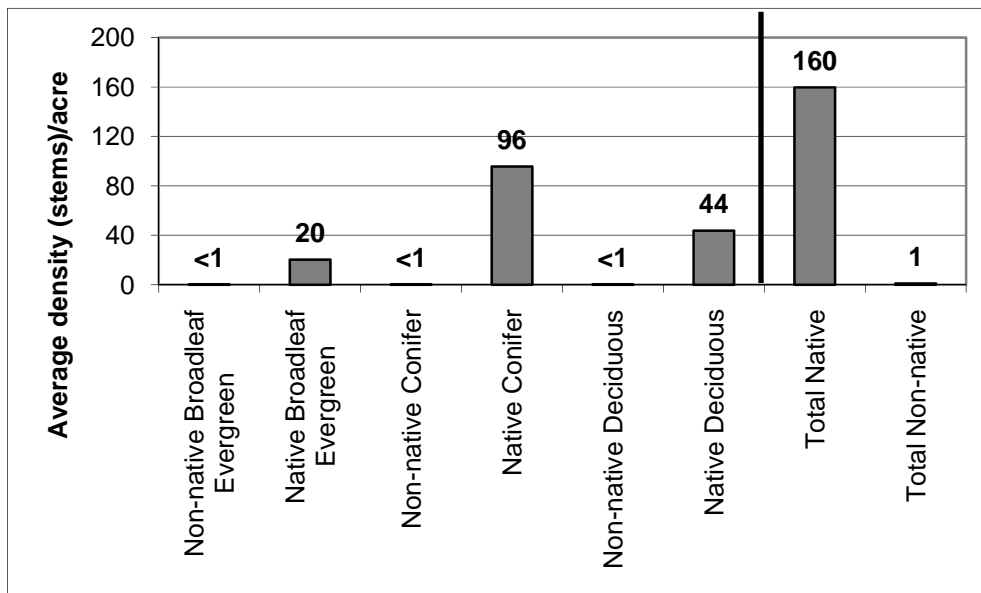
Scientific Name <sup>1</sup>	Common Name	Conifer forest <sup>2</sup>	Conifer/deciduous mixed forest <sup>2</sup>	Conifer/madrone mixed forest <sup>2</sup>	Deciduous forest <sup>2</sup>	Riparian forest <sup>2</sup>
<b>OVERSTORY TREES (Density/acre)</b>						
<i>Acer macrophyllum</i>	big-leaf maple	3 (2%)	28 (25%)	48 (16%)	108 (72%)	27 (32%)
<i>Alnus rubra</i>	red alder		5 (4%)		5 (3%)	47 (56%)
<i>Arbutus menziesii</i>	Pacific madrone	1 (1%)		128 (43%)	8 (5%)	
<b><i>Cedrus sp.</i></b>	true cedar				3 (2%)	
<b><i>Ilex sp.</i></b>	horticultural holly				3 (2%)	
<i>Pinus monticola</i>	western white pine	9 (5%)			8 (5%)	
<i>Prunus emarginata</i>	bitter cherry			3 (1%)	5 (3%)	3 (4%)
<b><i>Prunus sp.</i></b>	horticultural cherry species				3 (2%)	
<i>Pseudotsuga menziesii</i>	Douglas-fir	131 (74%)	24 (21%)	115 (39%)	10 (7%)	
<i>Thuja plicata</i>	western red cedar	11 (6%)	44 (39%)	3 (1%)		7 (8%)
<i>Tsuga heterophylla</i>	western hemlock	21 (12%)	13 (11%)			
<b>Average density</b>		<b>176/acre</b>	<b>114/acre</b>	<b>297/acre</b>	<b>153/acre</b>	<b>84/acre</b>
<b>REGENERATING TREES (Density/acre)<sup>2</sup></b>						
<i>Acer macrophyllum</i>	big-leaf maple	1 (1%)	55 (9%)	40 (7%)	70 (30%)	33 (10%)
<b><i>Acer platanoides</i>**</b>	Norway maple		1 (T)			
<i>Alnus rubra</i>	red alder					10 (3%)
<i>Arbutus menziesii</i>	Pacific madrone	1 (1%)		103 (18%)	8 (3.5%)	
<i>Cornus nuttallii</i>	Pacific dogwood	1 (1%)		8 (1%)		
<b><i>Crataegus monogyna</i>**</b>	one-seed hawthorn			3 (T)	3 (1%)	
<i>Frangula purshiana</i>	cascara	3 (2%)	1 (T)	3 (T)	3 (1%)	
<b><i>Ilex aquifolium</i>*</b>	English holly	19 (12%)	391 (62%)	13 (2%)	8 (3.5%)	183 (54%)
<b><i>Malus sp.</i></b>	horticultural apple species		19 (3%)			
<i>Pinus monticola</i>	western white pine				5 (2%)	
<b><i>Prunus avium</i>**</b>	sweet cherry		15 (2%)	38 (6%)	18 (8%)	
<i>Prunus emarginata</i>	bitter cherry			23 (4%)	3 (1%)	63 (19%)
<b><i>Prunus laurocerasus</i>*</b>	cherry laurel		6 (1%)	5 (1%)	8 (3.5%)	
<b><i>Prunus lusitanica</i>**</b>	Portugal laurel			18 (3%)		
<b><i>Prunus sp.</i></b>	horticultural cherry species				38 (16%)	
<i>Pseudotsuga menziesii</i>	Douglas-fir	16 (10.5%)	5 (1%)	143 (25%)	43 (18%)	
<i>Salix scouleriana</i>	Scouler's willow				8 (3.5%)	
<i>Salix sp.</i>	willow					3 (1%)
<b><i>Sorbus aucuparia</i>**</b>	European mountain ash	16 (10.5%)	48 (7%)	30 (5%)	3 (1%)	13 (4%)
<i>Taxus brevifolia</i>	western yew		1 (T)			

Scientific Name <sup>1</sup>	Common Name	Conifer forest <sup>2</sup>	Conifer/deciduous mixed forest <sup>2</sup>	Conifer/madrone mixed forest <sup>2</sup>	Deciduous forest <sup>2</sup>	Riparian forest <sup>2</sup>
<i>Thuja plicata</i>	western red cedar	34 (22%)	75 (12%)	158 (27%)	13 (6%)	
<i>Tsuga heterophylla</i>	western hemlock	61 (40%)	18 (3%)		3 (1%)	33 (10%)
<b>Average density (stems)</b>		<b>152/acre</b>	<b>635/acre</b>	<b>585/acre</b>	<b>234/acre</b>	<b>338/acre</b>

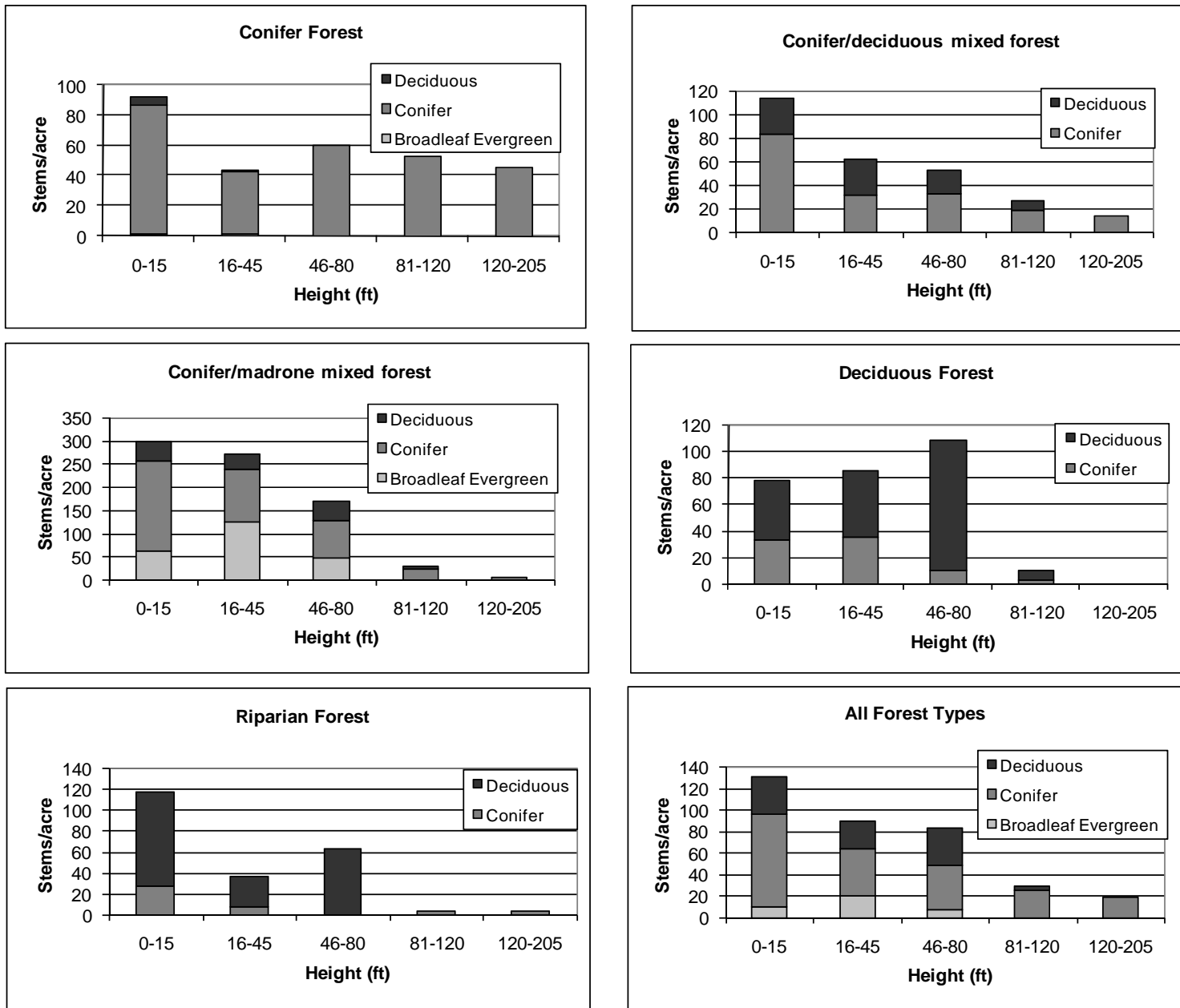
<sup>1</sup> Species in bold are non-native species. Species denoted by \* are species which have been given a legal designation by the King County Noxious Weed Program (King County 2007). Species denoted by \*\* are non-native invasive species which do not have a legal designation at this time.

<sup>2</sup>T=Trace presence of species (less than 1%).

Figure 2. Average density (stems)/acre of overstory trees in Shoreview and Boeing Creek Parks

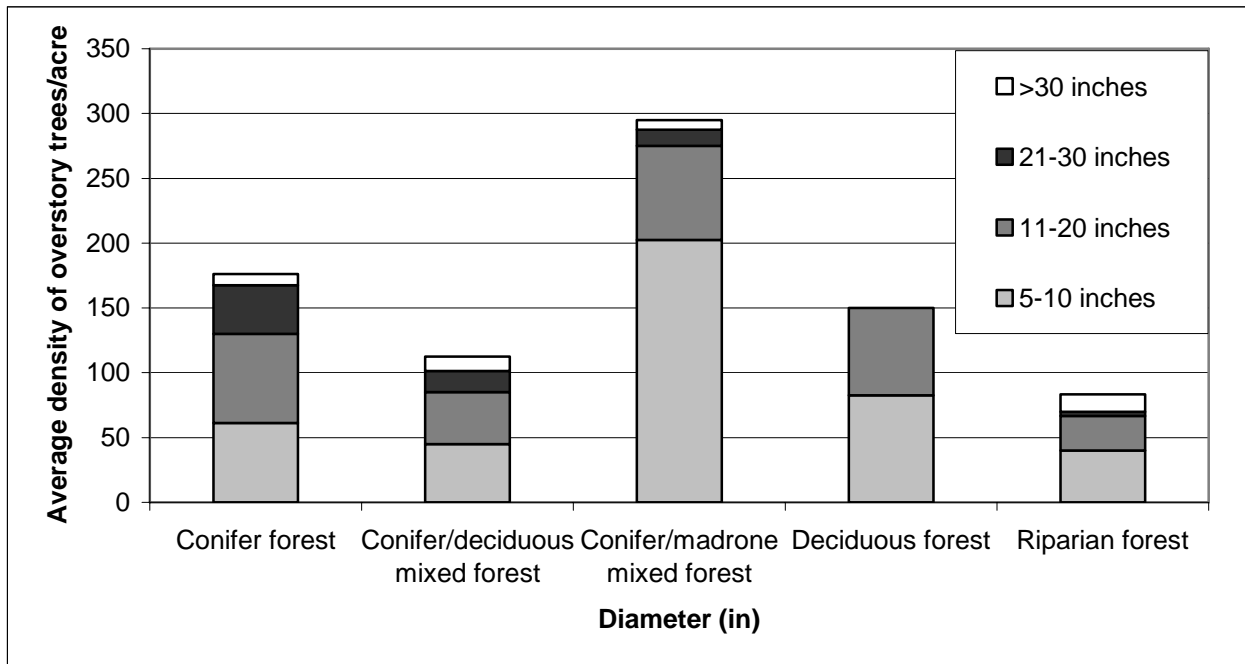


**Figure 3. Native overstory and regenerating tree density/acre by height size class in the conifer forest type in Shoreview and Boeing Creek Parks.**





**Figure 4. Overstory tree density/acre by diameter size class for sampled habitat types in Shoreview and Boeing Creek Parks.**



### 4.3 Regenerating tree composition and structure

This survey 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.

#### Park-wide summary

The regeneration composition in the park complex is evenly divided between native and non-native species. Native conifers compose the bulk of native regeneration, making up 31% of total regeneration in the park. Native deciduous trees contribute 13.5% of total regeneration and madrone trees 4% (Figure 5). Non-native invasive species account for 51% of the total tree regeneration in the park, with English holly contributing the largest proportion (145 stems/acre) or 37% of the total regeneration. Other non-native broadleaf evergreen species include cherry laurel and Portugal laurel which are present in much smaller numbers (6 stems/acre) (Figure 5). Invasive deciduous tree species are also regenerating in the understory. These species consist of Norway maple (*Acer platanoides*), one-seed hawthorn (*Crataegus monogyna*), sweet cherry and European mountain ash (Table 2). A total of 22 species of trees were recorded in the regenerating layer during the 2007 survey, which includes 13 native and nine non-native species (of which eight are considered to be invasive) (Table 2).

#### Conifer forest

The conifer forest has the lowest regenerating tree density of all the forest types with 152 stems/acre (Table 2). The majority of regeneration is native (77%), composed mostly of conifer trees, which are present at 111 stems/acre. Western hemlock is the most dominant regenerating tree, accounting for 40% of all recorded stems, followed by western red cedar (22%) and Douglas-fir (10.5%). A small deciduous

and madrone component consists of cascara (*Frangula purshiana*) (2%), big-leaf maple (1%), Pacific madrone (1%) and Pacific dogwood (*Cornus nuttallii*) (1%). Non-native species make up 23% of all regenerating trees and are evenly divided between English holly (12% of all regeneration) and European mountain ash (10.5%) (Table 2).

#### Conifer/deciduous mixed forest

The conifer/deciduous mixed forest has the highest density of regenerating trees, averaging 635 stems/acre (Table 2). However, the majority of regenerating trees are non-native invasive species which account for 72% of all regeneration. English holly is the most dominant invasive species, present at 391 stems/acre and contributing 62% of all regeneration in this forest type (Table 2). Cherry laurel makes up another 1% of regeneration. Invasive deciduous trees include European mountain ash (7%), sweet cherry (2%) and Norway maple (trace). Native regeneration is present in this forest type, totaling 174 stems/acre and composed of six species, which are mostly conifers. Western red cedar is the most prevalent, totaling 12% of regeneration, followed by western hemlock (3%), Douglas-fir (1%) and western yew (*Taxus brevifolia*) (trace). Deciduous species include big-leaf maple (9% of regeneration) and cascara (trace) (Table 2). Although the native species stem density is relatively low compared to non-native tree regeneration, it is comparable to the other forest types in the park complex, and higher than that found in the conifer forest.

#### Conifer/madrone mixed forest

The conifer/madrone mixed forest averages 585 stems/acre and has the highest number of native trees of all the other forest types, averaging 478 stems/acre (Table 2). Conifers are the most dominant trees in the regenerating layer, accounting for 52% of all regeneration, split almost evenly between western red cedar (27%) and Douglas-fir (25%). A large madrone component is also present in this forest type, accounting for 18% of all trees. Deciduous species include big-leaf maple (7%), bitter cherry (4%), Pacific dogwood (1%) and cascara (trace). Non-native invasive species make up 17% of all regenerating stems, of which invasive deciduous trees pose the largest problem in this forest type. These species consist of sweet cherry (6%), European mountain ash (5%) and one-seed hawthorn (trace). However, some broadleaf evergreen species are also present and include Portugal laurel (3%), English holly (2%) and cherry laurel (1%) (Table 2).

#### Deciduous forest

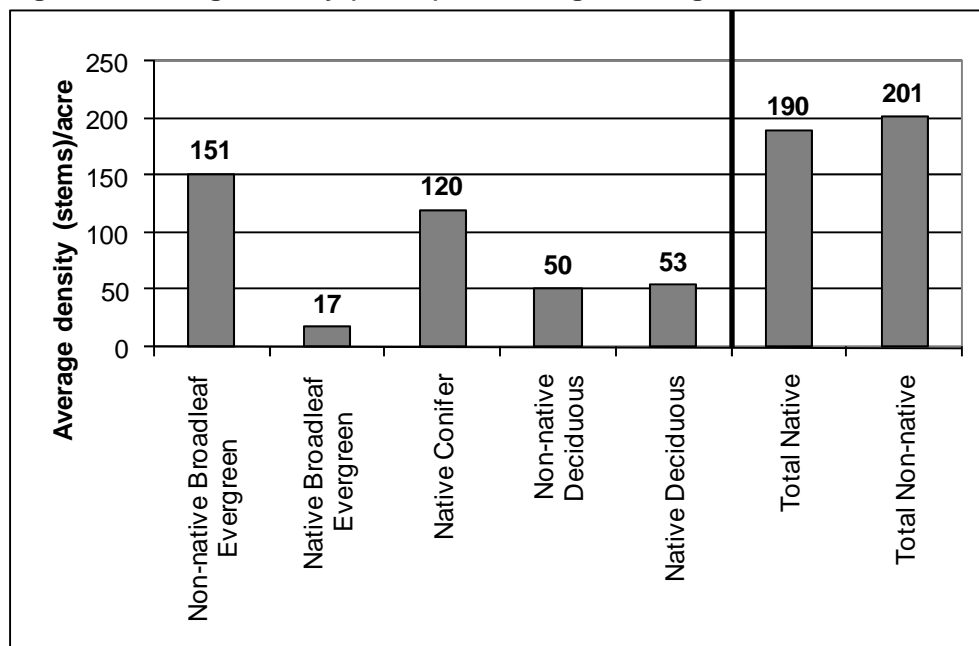
Deciduous forests average 234 stems/acre, of which 66% are native trees (Table 2). Big-leaf maple is the most dominant species, contributing 30% of all regeneration. Horticultural cherry species are also prevalent, accounting for 16% of all regeneration. Most of these regenerating stems are sprouting from several large planted cherries in the southern portion of Shoreview park near assessment plot 3. These species are not currently considered to be invasive, but can potentially spread and should be monitored regularly. Other native deciduous species in this forest type include Scouler's willow (*Salix scouleriana*) (3.5%), cascara (1%) and bitter cherry (1%). Conifers make up a substantial amount of regeneration within the deciduous forest, taking advantage of the light conditions provided by lack of canopy during part of the year. Douglas-fir is the most prevalent conifer species, contributing 18% of regeneration, with smaller amounts of western red cedar (6%), western white pine (2%) and western hemlock (1%). A small madrone component is also present within this forest type, representing 3% of all regeneration. Non-native invasive species total 17% of regeneration within this forest type, composed primarily of deciduous species. Sweet cherry is the most prevalent species, accounting for

8% of all regenerating stems, followed by one-seed hawthorn (1%) and European mountain ash (1%). English holly and cherry laurel are also present, each representing 3% of regeneration (Table 2).

Riparian forest

The riparian forests have an average of 338 stems/acre, of which less than half (42%) are native (Table 2). The regenerating layer in this forest type is dominated by English holly, which is present at average densities of 183 stems/acre. European mountain ash is also present in small quantities (4%). Native species are present at densities of 142 stems/acre, which is similar to those found in other forest types in the park. Native regeneration is a mix of conifer and deciduous trees, but favoring the deciduous component. Nineteen percent of regenerating stems in this forest type were identified as bitter cherry during the survey. However, many of these trees are possibly a newly identified species named *Prunus x Pugetensis*, which is a hybrid between bitter cherry and sweet cherry, as they exhibited morphological characteristics associated with both parents (Jacobson and Zika 2007). Due to the fact that the survey was conducted in August, well past the flowering season, it was not possible to conclusively identify many of these trees, and they were recorded as bitter cherries, which they also closely resemble. According to the findings for this species, published in 2007, these hybrids are sterile and do not produce viable fruit (Jacobson and Zika 2007). Other deciduous species found regenerating within the riparian forest include big-leaf maple (10%), red alder (3%) and a small amount of a willow species that was identified only to genus (*Salix sp.*) (1%). The conifer component consists of western hemlock trees, which make up 10% of all regeneration.

**Figure 5. Average density (stems)/acre of regenerating trees in Shoreline and Boeing Creek Parks<sup>1</sup>**



<sup>1</sup> Non-native broadleaf evergreen species include English holly, cherry laurel and Portugal laurel.

**4.4 Snags**

In a 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. In the Pacific Northwest, 69 vertebrate animal and bird species commonly use cavities excavated in snags (Bunnell et al. 2002).

#### Park-wide summary

The majority of measured snags (72%) are smaller than 10 inches in diameter (Figure 6). These small snags are generally short-lived and quickly become downed woody debris which rapidly decays on the forest floor. The deciduous and conifer forest types have the highest densities of small diameter snags present at 45 and 33 stems/acre respectively. Nineteen percent of snags parkwide were measured between 11 and 20 inches in diameter. Nine percent of snags have diameters greater than 20 inches, present in all forest types with the exception of the riparian forest type. The conifer/deciduous mixed forest contains the highest stem densities of large diameter snags (6 stems/acre) (Figure 6).

#### Conifer forest

Snags were found in seven out of eight of the conifer forest plots surveyed in the park complex at a density of 42.5 stems/acre (Figure 6). The average snag height is 29 feet with a diameter of 9.7 inches. The vast majority of these snags (76%) are smaller than 10 inches in diameter. Approximately 18% are between 11-20 inches and only 6% are larger than 20 inches in diameter (Figure 6).

#### Conifer/deciduous mixed forest

In comparison, the conifer/deciduous mixed forest has half the density of the conifer forest, averaging 21 stems/acre with a mean height of 40 feet and diameter of 18.5 inches. The majority of snags in this forest type (53%) are between 11-20 inches in diameter, and nearly a third (29%) are larger than 20 inches in diameter. This forest type has the highest density of large snags of all the forest types (Figure 6).

#### Conifer/madrone mixed forest

The conifer/madrone mixed forest averages 35 stems/acre with an average height of 30 feet and average diameter of 8.9 inches. The majority of snags (64%) are between 5-10 inches, whereas 29% are between 11-20 inches and only 7% are larger than 20 inches in diameter (Figure 6).

#### Deciduous forest

The deciduous forest has the highest snag densities of all forest types, averaging 47.5 stems/acre. The average snag height is 35 feet, with an average diameter of 8 inches. Almost all of these stems (95%) are in the 5-10 diameter size class, with only 5% larger than 20 inches in diameter. No snags in the 11-20 inch size class were measured (Figure 6).

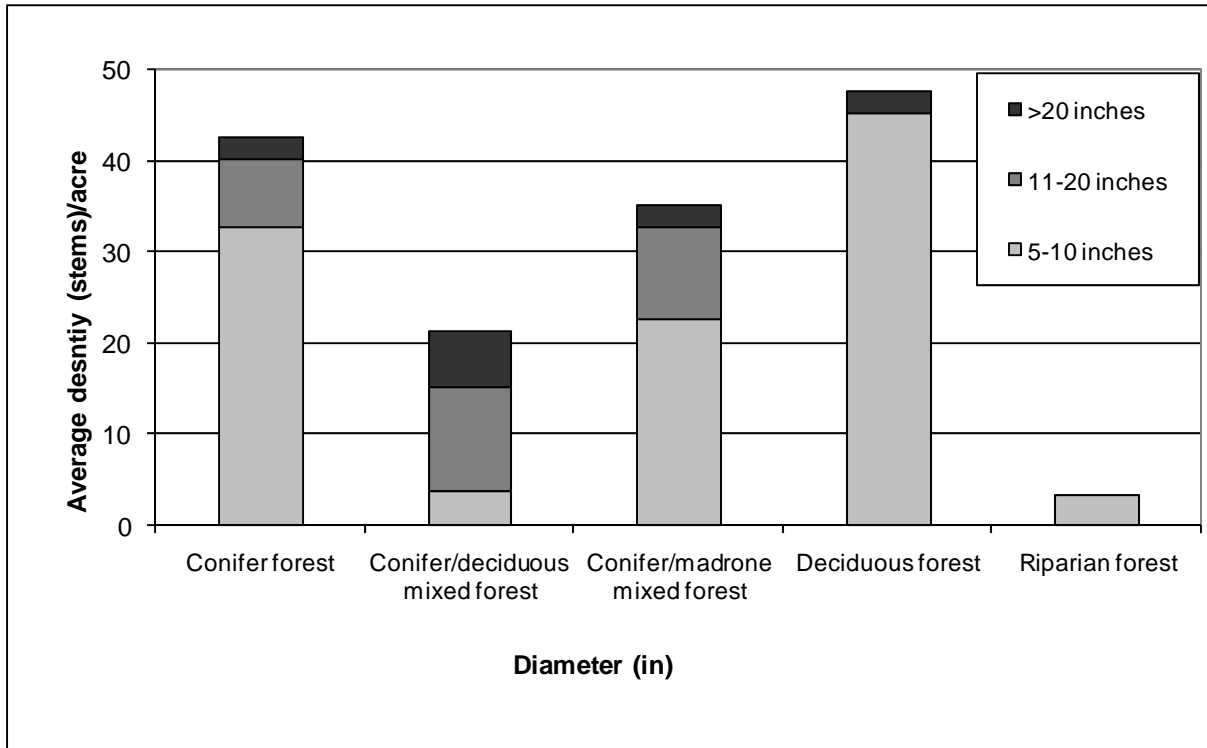
#### Riparian forest

The riparian forest type has the fewest standing snags of any forest type. Only one snag was recorded in the three sampled plots, which translates to a density of 3 stems/acre. The measured snag was 55 feet tall and 6 inches in diameter. It is possible that trees do not remain standing for long due to the extremely steep and unstable slopes in this area, and therefore no snag retention is occurring.

Large diameter snags are an important factor in providing wildlife habitat. A study by Mannan et al. (1981) found that hole-nesting birds use snags over 24 inches in diameter and over 50 feet tall. Data from the overstory analysis show that all forest types with the exception of the deciduous forest contain trees larger than 20 inches in diameter. In particular the riparian forest, which currently has no large

snags, contains the largest proportion of trees (16%) larger than 30 inches in diameter, although it is possible that snags are not retained due to steep slopes. Although it may take many years for these trees to die, large snags should be able to naturally recruit over time. Preserving large snags when possible will improve wildlife habitat in the park and help to attract species which are currently not present.

**Figure 6. Snag density/acre by diameter size class for sampled habitat types in Shoreview and Boeing Creek Parks.**



#### 4.5 Coarse Woody Debris (CWD)

Coarse woody debris (CWD) can be defined as: “Sound and rotting logs and stumps 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. In the Pacific Northwest, 47 vertebrate bird and animal species utilize downed wood for foraging, shelter and cover (Bunnell et al. 2002). CWD also acts as nurse logs for seedlings of plants such as western hemlock and red huckleberry (*Vaccinium parvifolium*), retains sediment and prevents erosion (Stevens 1997).

##### Conifer forest

The average volume of CWD in the conifer forest is 528 ft<sup>3</sup>/acre (Figure 7). The average diameter of CWD is 8 inches. The CWD volume in this forest type is higher than the volumes in the conifer/madrone mixed forest and deciduous forest, although the total amount of downed wood present is very low. In comparison, Douglas-fir/western hemlock forests over 250 years old typically contain approximately 6,400 ft<sup>3</sup>/acre of CWD (Harmon et al. 1986). The only forest type approaching this level

is the riparian forest type, which has the largest CWD volumes (4115 ft<sup>3</sup>/acre with the largest average diameter of 15.7 inches).

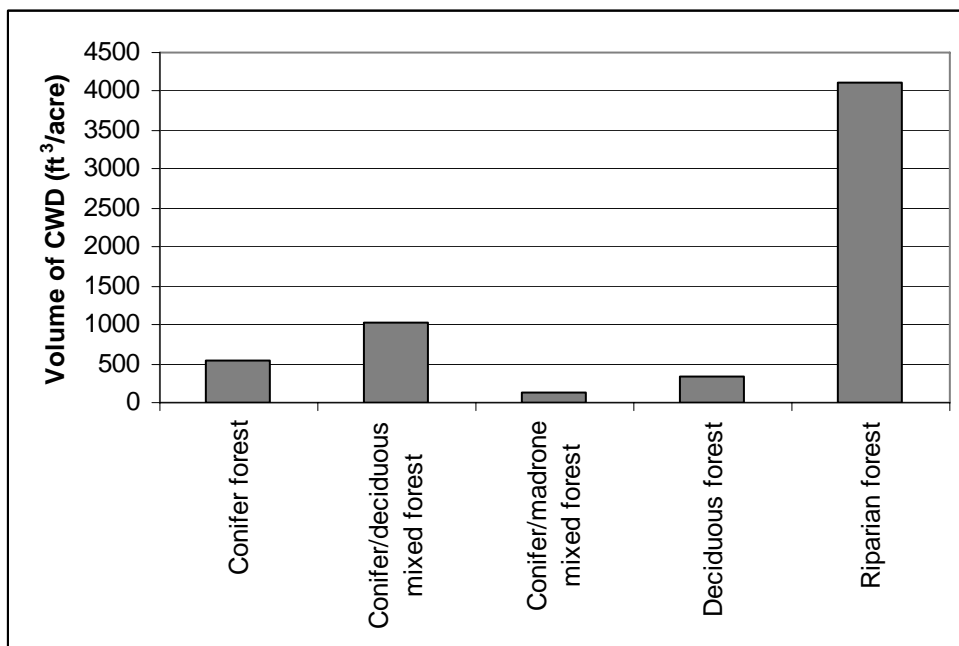
Conifer/deciduous mixed forest, conifer/madrone mixed forest and deciduous forest

The conifer/deciduous mixed forest has twice as much CWD as the conifer forest, averaging 1022 ft<sup>3</sup>/acre, with an average diameter of 11 inches (Figure 7). The conifer/madrone mixed forest has the lowest amount of CWD present, averaging 132 ft<sup>3</sup>/acre, with an average diameter of 10 inches. The deciduous forest also has a low amount of CWD present, with an average volume of 345 ft<sup>3</sup>/acre and the smallest average diameter of 6.5 inches (Figure 7).

Riparian forest

The riparian forest is a natural repository for CWD accumulation due to down-sloping topography and steep slopes leading to Boeing Creek. Likewise, steep slopes in the conifer/deciduous mixed forest facilitate CWD accumulation along the stream banks. These areas will continue to collect dead logs as they fall down into the ravine. The conifer/madrone and deciduous forest types most likely do not have a lot of CWD due to the fact that they appear to have been logged and cleared during the past century and are young stands which do not contain many large trees. However, the relatively low amount of CWD in the conifer forest is puzzling, particularly as this forest type contains a considerable number of trees larger than 20 inches in diameter. It is expected that levels of CWD will accumulate as snags fall down, although in some forest types such as the deciduous and conifer/madrone mixed forest large-diameter CWD will not be produced and recruited for many years.

**Figure 7. Coarse Woody Debris (CWD) volume (ft<sup>3</sup>/acre) for sampled habitat types in Shoreview and Boeing Creek Parks.**



## 4.6 Shrubs

### Park-wide summary

A total of 28 shrub species were recorded in Shoreview and Boeing Creek Parks during the 2007 survey, of which 21 are native and seven are non-native (of which six are considered to be invasive) (Table 3). Salal is the most common and dominant species, present in 85% of all plots at an average cover of 27% parkwide (Figure 8). The second most common species is creeping blackberry which was also found in 85% of plots with an average cover of 11 percent. Other common species measured at low covers parkwide include low Oregon grape (*Mahonia nervosa*), averaging 2.4% cover, red huckleberry 1.5% cover and baldhip rose (*Rosa gymnocarpa*) (1% cover) (Figure 8).

### Conifer forest

A total of 11 species are present in the conifer forest, of which nine are native and two are non-native. Salal is the most dominant species in this forest type, with an average percent cover of 67%. Much of the salal is over five feet in height and forms dense undergrowth throughout the forest. Other native species are present in much smaller amounts and include creeping blackberry (4% cover), low Oregon grape (2% cover), red huckleberry (2% cover), evergreen huckleberry (*Vaccinium ovatum*) (1%), and traces of swamp gooseberry (*Ribes lacustre*), baldhip rose, Nootka rose (*Rosa nutkana*), salmonberry and red elderberry (*Sambucus racemosa*) (Table 3). Although there is considerable native shrub diversity in this forest type, the majority of tall-statured shrubs are present in trace amounts, and a tall-shrub layer is currently very limited. Two non-native invasive species, Himalayan blackberry and evergreen blackberry, are present in the conifer forest in trace amounts (Table 3).

### Conifer/deciduous mixed forest

The conifer/deciduous mixed forest contains 17 different shrub species, of which 15 are native and two are non-native (Table 3). The shrub layer in this forest type is quite sparse, with a combined cover of 36%. Creeping blackberry is the most dominant species (9% cover), followed by salal (7% cover), low Oregon grape (5% cover) and salmonberry (5% cover). Other native species present in small amounts include beaked hazelnut (*Corylus cornuta*) (4% cover), red huckleberry (3% cover), vine maple (*Acer circinatum*) (2% cover), serviceberry (*Amelanchier alnifolia*) (1%), oceanspray (*Holodiscus discolor*) (trace), Indian plum (*Oemleria cerasiformis*) (trace), swamp gooseberry (trace), baldhip rose (trace), blackcap (*Rubus leucodermis*) (trace), thimbleberry (*Rubus parviflorus*) (trace) and red elderberry (trace). Two non-native invasive species, Himalayan blackberry and evergreen blackberry, are present in this forest type in trace amounts (Table 3).

### Conifer/madrone mixed forest

The conifer/madrone mixed forest contains 15 species, of which 11 are native and four are non-native (Table 3). Salal is the most prevalent shrub species, with an average percent cover of 27%. Other species present in smaller quantities include creeping blackberry (7% cover), oceanspray (6% cover), Oregon boxwood (*Paxistima myrsinites*) (5% cover), baldhip rose (3% cover), serviceberry (2% cover), low Oregon grape (2% cover), beaked hazelnut (trace), tall Oregon grape (*Mahonia aquifolium*) (trace), Indian plum (trace) and red huckleberry (trace). Four non-native invasive species were recorded in this forest type. They were all present in small quantities (1% cover or less) and consist of Himalayan blackberry (1% cover), milkflower cotoneaster (*Cotoneaster lacteus*) (trace), scotch broom (trace) and spurge laurel (*Daphne laureola*) (trace) (Table 3). Spurge laurel is classified as a non-designated

noxious weed in King County. Although it considered to be invasive, milkflower cotoneaster does not currently have a legal designation from the King County Noxious Weed Program at this time.

Deciduous forest

A total of 14 shrub species were recorded in the deciduous forest during the 2007 survey, of which 11 are native and three are non-native (Table 3). Creeping blackberry is the most dominant species in this forest type, present at an average cover of 34%. A substantial component of Indian plum is also present, with 13% cover. Native species which are not as abundant include salal (4% cover), oceanspray (3% cover), snowberry (*Symphoricarpos albus*) (3% cover), baldhip rose (2% cover), beaked hazelnut (1% cover), hardhack (*Spiraea douglasii*), serviceberry (trace), low Oregon grape (trace) and blackcap (trace). Two species of non-native invasive shrubs were recorded in this forest type. The most dominant of these is Himalayan blackberry, which is present at an average of 15% cover in the deciduous forest. Small amounts of Scotch broom are also present (1% cover) (Table 3).

Riparian forest

The riparian forest contains 14 shrub species, of which 11 are native and three are non-native (Table 3). This forest type contains the lowest levels of shrub cover in the park complex, totaling 27% combined cover. This situation is rather unusual in riparian areas, which usually have high levels of shrub cover due to abundant water availability. During the survey, numerous areas of bank erosion were noted in and outside of survey plots, which may contribute to the low shrub abundance. Of the shrubs present, salmonberry and creeping blackberry are the most dominant species, with average percent covers of 11% and 7% respectively. Other species present in smaller amounts include thimbleberry (3% cover), beaked hazelnut (1% cover), salal (1% cover), red elderberry (1% cover), red huckleberry (1% cover), oceanspray (trace), Indian plum (trace), swamp gooseberry (trace) and blackcap (trace). Three non-native invasive shrub species were recorded in this forest type. All were present in small amounts and include Himalayan blackberry (2% cover) and traces of butterfly bush and evergreen blackberry (Table 3).

**Table 3. Shrub species found in each of the sampled habitat types in Shoreview and Boeing Creek Park. Values represent the average percent cover of each species.**

Scientific Name <sup>1</sup>	Common Name	Conifer forest <sup>2</sup>	Conifer/deciduous mixed forest <sup>2</sup>	Conifer/madrone mixed forest <sup>2</sup>	Deciduous forest <sup>2</sup>	Riparian forest <sup>2</sup>
<i>Acer circinatum</i>	vine maple		2			
<i>Amelanchier alnifolia</i>	serviceberry		1	2	T	
<b><i>Buddleja davidii</i></b> *	butterfly bush					T
<i>Corylus cornuta</i>	beaked hazelnut		4	T	1	1
<b><i>Cotoneaster lacteus</i></b> **	milkflower cotoneaster			T		
<b><i>Cytisus scoparius</i></b> *	scotch broom			T	1	
<b><i>Daphne laureola</i></b> **	spurge laurel			T		
<i>Gaultheria shallon</i>	salal	67	7	27	4	1
<i>Holodiscus discolor</i>	oceanspray		T	6	3	T
<i>Mahonia aquifolium</i>	tall Oregon grape			T		
<i>Mahonia nervosa</i>	low Oregon grape	2	5	2	T	
<i>Oemleria cerasiformis</i>	Indian plum		T	T	13	T
<i>Paxistima myrsinites</i>	Oregon boxwood			5		

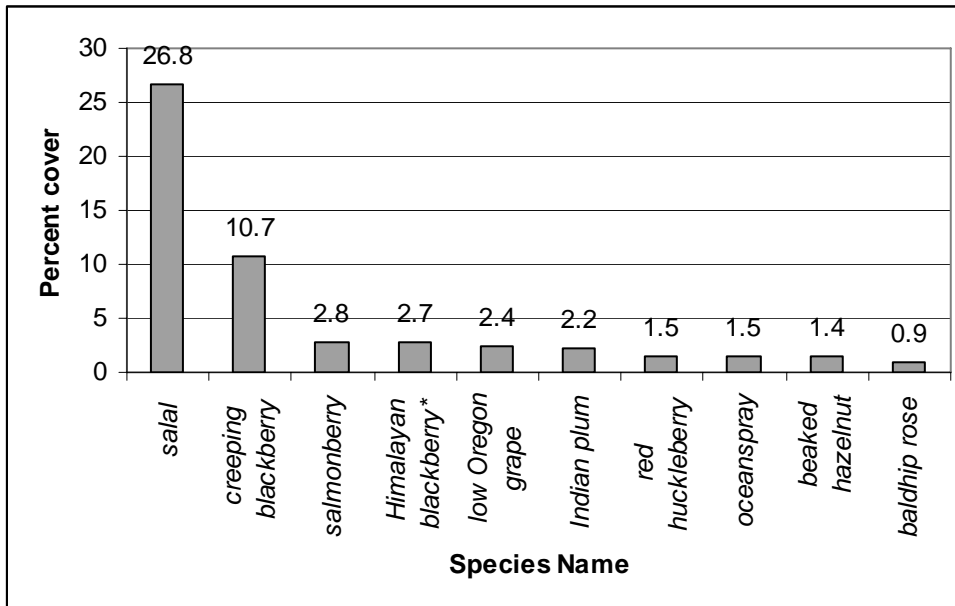


<i>Ribes lacustre</i>	swamp gooseberry	T	T			T
<i>Rosa gymnocarpa</i>	baldhip rose	T	T	3	2	
<i>Rosa nutkana</i>	Nootka rose	T				
<b><i>Rubus armeniacus</i>*</b>	Himalayan blackberry	T	T	1	15	2
<b><i>Rubus laciniatus</i>*</b>	evergreen blackberry	T	T			T
<i>Rubus leucodermis</i>	blackcap		T		T	T
<i>Rubus parviflorus</i>	thimbleberry		T			3
<i>Rubus spectabilis</i>	salmonberry	T	5			11
<i>Rubus ursinus</i>	creeping blackberry	4	9	7	34	7
<i>Sambucus racemosa</i>	red elderberry	T	T			1
<i>Spiraea douglasii</i>	hardhack				1	
<i>Symphoricarpos albus</i>	snowberry				3	
<i>Vaccinium ovatum</i>	evergreen huckleberry	1				
<i>Vaccinium parvifolium</i>	red huckleberry	2	3	T		1
<b><i>Viburnum sp.</i></b>	wayfaring tree				T	

<sup>1</sup> Species in bold are non-native species. Species denoted by \* are species which have been given a legal designation by the King County Noxious Weed Program (King County 2007). Species denoted by \*\* are non-native invasive species which do not have a legal designation at this time.

<sup>2</sup>T=Trace presence of species (less than 1%).

**Figure 8. Distribution of the ten most prevalent shrubs in Shoreview and Boeing Creek Park across all plots (N=27)<sup>1</sup>**



<sup>1</sup> Invasive species are denoted by an \* after the name.

## 4.7 Vines and herbaceous species

### Park-wide summary

A total of 46 herbaceous species were recorded in Shoreview and Boeing Creek Parks during the 2007 survey, of which 33 are native, nine are non-native and four have an undetermined native status. Sword fern is the most dominant and prevalent species, present in 96% of the plots at an average cover of 17% (Figure 9). Herb Robert and English ivy, both non-native invasive species, are the second and third most common herbaceous and vine species present, with average covers of 6% and 5% present in over half of all sampled plots (Figure 9). Both English ivy and herb Robert are classified as Non-designated Noxious Weeds in King County (King County 2007).

### Conifer forest

The conifer forest contains a total of 17 recorded herbaceous and vine species, of which 12 are native, four are non-native and one has an undetermined native status (Table 4). The understory is very sparse, containing a total of 9% cover. Of this cover, the majority is made up of sword fern, which has an average cover of 7% in this forest type. Other native species present include bracken fern (*Pteridium aquilinum*) (1% cover), wood fern (*Dryopteris expansa*) (trace), sweet cicely (*Osmorhiza berteroi*) (trace), foamflower (*Tiarella trifoliata*) (trace), starflower (*Trientalis borealis ssp. latifolia*) (trace), trillium (*Trillium ovatum*) (trace) and evergreen violet (*Viola sempervirens*) (trace). Two notable native species, summer coralroot (*Corallorhiza maculata*) and western rattlesnake plantain (*Goodyera oblongifolia*) are present in this habitat type in trace amounts (Table 4). These species are rarely found in urban forests in the Seattle region. Two non-native invasive species are present in trace amounts. They consist of herb Robert and English ivy.

### Conifer/deciduous mixed forest

The conifer/deciduous mixed forest contains 29 species, of which 23 are native and six are non-native (Table 4). This forest type, along with the riparian forest, contains the highest diversity of native species in the park complex. Sword fern is the most dominant species in the understory, with an average percent cover of 34%. English ivy is the second-most dominant species with an average of 15% cover. This forest type has by far the highest levels of English ivy present in the park complex. Much of the ivy is present in the adjacent northern parcel, where there is a very heavy infestation (Map 2). In addition to English ivy, herb Robert is an additional invasive species present in this forest type at 3% cover. Some of the other native species which are present in smaller quantities include bracken fern (6% cover), Siberian miner's lettuce (*Claytonia sibirica*) (trace), western bleedingheart (*Dicentra formosa*) (trace), orange honeysuckle (*Lonicera ciliosa*) (trace), hairy honeysuckle (*Lonicera hispidula*) (trace), common woodrush (*Luzula multiflora*), small-flowered woodrush (*Luzula parviflora*), Dewey sedge (*Carex deweyana*) and licorice fern (*Polypodium glycyrrhiza*). In addition, some moisture reliant native species are present in trace amounts in this forest type and include ladyfern (*Athyrium filix-femina*) and small enchanter's nightshade (*Circaea alpina*) (Table 4).

### Conifer/madrone mixed forest type

A total of 17 species, of which nine are native, five are non-native and three have an undetermined native status, were recorded in the conifer/madrone mixed forest type (Table 4). The understory is very sparse, with a total cover of 9%, similar to that present in the conifer forest. A 2006 study of conifer/madrone mixed forests in Seattle showed that herbaceous percent cover ranged between 13% and 29%, averaging 19% across all studied plots (SUN 2006). The understory is dominated by the non-

native invasive species herb Robert, which makes up 5% of the total 9% cover. Sword fern is the second most dominant species, contributing 3% cover. Other native species present in trace amounts include Siberian miner's lettuce, blue wildrye (*Elymus glaucus*), orange honeysuckle, hairy honeysuckle, common woodrush, sweet cicely and starflower. Of the five recorded non-native species, two are considered to be invasive. One of the species, herb Robert was already discussed and is the most dominant understory species in this forest type. The other species, English ivy, was recorded in trace amounts (Table 4).

Deciduous forest

The deciduous forest contains a total of 13 species, of which six are native and seven are non-native (Table 4). Sword fern is the most dominant species in this forest type, with an average percent cover of 16%. All other native species were present in very small amounts (1% cover or less), and include bracken fern (1% cover), fringecup (*Tellima grandiflora*) (1% cover), Siberian miner's lettuce (trace), blue wildrye (trace) and cleavers (*Galium aparine*) (trace). Of the seven non-native species, two are considered to be invasive. Herb Robert is present in relatively high amounts throughout this forest type, and has an average percent cover of 7% zone-wide. English ivy is also present at an average cover of 2% (Table 4).

Riparian forest

The riparian forest has the second-highest native plant diversity in the park complex after the conifer/deciduous mixed forest. Of the 29 species recorded during the 2007 survey, 21 are native, six are non-native and two have an undetermined native status (Table 4). Herb Robert is the most dominant species in this forest type, with an average percent cover of 29%, the highest in the park. The riparian areas along the stream corridor are heavily infested with herb Robert, which is also present along many of the trail corridors throughout the parks. Sword fern and stinging nettle, both native species, are also prevalent in this forest type with average covers of 19% and 15% respectively. Other moisture reliant species found in the riparian forest include piggy-back plant (*Tolmiea menziesii*) (6% cover), Dewey sedge (1% cover), ladyfern (trace), slough sedge (*Carex obnupta*) (trace), small enchanter's nightshade (trace), giant horsetail (*Equisetum telmateia*), and tall mannagrass (*Glyceria striata*) (trace). Of the six non-native species recorded in this forest type, two are considered to be invasive. Aside from herb Robert, which was discussed above, there is a small amount of English ivy, which is present at an average of 2% cover (Table 4).

**Table 4. Herbaceous species, including vines found in each of the sampled habitat types in Shoreview and Boeing Creek Park. Values represent the average percent cover of each species.**

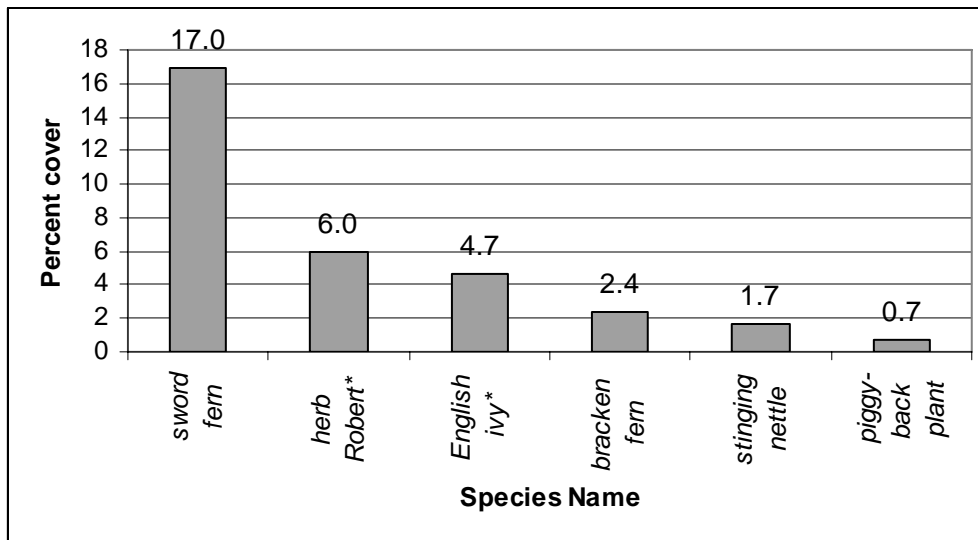
Scientific Name <sup>1</sup>	Common Name	Conifer forest <sup>2</sup>	Conifer/deciduous mixed forest <sup>2</sup>	Conifer/madrone mixed forest <sup>2</sup>	Deciduous forest <sup>2</sup>	Riparian forest <sup>2</sup>
<i>Agrostis stolonifera</i>	creeping bentgrass		T		2	
<i>Athyrium filix-femina</i>	ladyfern		T			T
	bare dirt	3	1	1		
<i>Bromus vulgaris</i>	Columbia brome	T	T			T
<i>Cardamine hirsuta</i>	hairy bittercress			T		T
<i>Carex deweyana</i>	Dewey sedge		T			1
<i>Carex obnupta</i>	slough sedge					T
<i>Circaea alpina</i>	small enchanter's		T			T

	nightshade					
<i>Cirsium sp.</i>	thistle					T
<i>Claytonia sibirica</i>	Siberian miner's lettuce		T	T	T	1
<i>Corallorhiza maculata</i>	summer coralroot	T				
<b><i>Dactylis glomerata</i></b>	orchardgrass			T	2	
<i>Dicentra formosa</i>	western bleedingheart		T			T
<b><i>Digitalis purpurea</i></b>	foxglove		T			T
<i>Dryopteris expansa</i>	wood fern	T	T			T
<i>Elymus glaucus</i>	blue wildrye		T	T	T	T
<i>Equisetum telmateia</i>	giant horsetail					T
<i>Galium aparine</i>	cleavers	T	T		T	T
<b><i>Geranium robertianum*</i></b>	herb Robert	T	3	5	7	29
<i>Geum macrophyllum</i>	bigleaved avens					T
<i>Glyceria striata</i>	tall mannagrass					T
<i>Goodyera oblongifolia</i>	western rattlesnake plantain	T				
<b><i>Hedera helix*</i></b>	English ivy	T	15	T	2	1
<b><i>Lapsana communis</i></b>	nipplewort	T	T	T	T	1
<i>Lonicera ciliosa</i>	orange honeysuckle		T	T		
<i>Lonicera hispidula</i>	hairy honeysuckle			T		
<i>Luzula multiflora</i>	common woodrush		T	T		
<i>Luzula parviflora</i>	small-flowered woodrush		T			T
<i>Luzula sp.</i>	woodrush		T			
<i>Maianthemum stellatum</i>	star-flowered false solomon's seal		T			
<b><i>Mycelis muralis</i></b>	wall-lettuce	T	T	T	T	1
<i>Osmorhiza berteroi</i>	sweet cicely	T	T	T		T
<i>Polypodium glycyrrhiza</i>	licorice fern		T			2
<i>Polystichum munitum</i>	sword fern	7	34	3	16	19
<i>Pteridium aquilinum</i>	bracken fern	1	6		1	
<i>Stellaria crispa</i>	crisp sandwort		T			
<i>Tellima grandiflora</i>	fringecup		T		1	T
<i>Tiarella trifoliata</i>	foamflower	T				
<i>Tolmiea menziesii</i>	piggy-back plant					6
<i>Trientalis borealis ssp. latifolia</i>	starflower	T	T	T		
<i>Trifolium sp.</i>	clover	T		T		
<i>Trillium ovatum</i>	trillium	T				T
	unknown forb species			T		
	unknown grass species			T		T
<i>Urtica dioica</i>	stinging nettle		T			15
<b><i>Vicia hirsuta</i></b>	hairy vetch				T	
<i>Viola sempervirens</i>	evergreen violet	T	T			

<sup>1</sup> Species in bold are non-native species. Species denoted by \* are species which have been given a legal designation by the King County Noxious Weed Program (King County 2007). Species denoted by \*\* are non-native invasive species which do not have a legal designation at this time.

<sup>2</sup>T=Trace presence of species (less than 1%).

**Figure 9. Distribution of the six most prevalent herbaceous and vine species in Shoreview and Boeing Creek Park across all plots (N=27)<sup>1</sup>**



<sup>1</sup> Invasive species are denoted by an \* after the name.

## 5. MANAGEMENT RECOMMENDATIONS

Twelve main management zones have been identified in Shoreview and Boeing Creek Parks and are shown on Map 2. Management goals within the park complex are to:

- 1) Reduce invasive species concentrations within the park complex
- 2) Increase conifer regeneration in the northern section of Boeing Creek Park
- 3) Create an official trail network and block off and revegetate unnecessary trails within the park complex
- 4) Stabilize and revegetate steep eroding slopes in the park complex
- 5) Increase the amount of tall shrubs and multiple shrub strata in the park complex
- 6) Preserve large snags and increase levels of coarse woody debris in many park areas

Boeing Creek and Shoreview Parks contain a wide diversity of habitat types and structural conditions. Some of the forests such as the deciduous and conifer/madrone mixed forests show many characteristics of young, even-aged stands. In comparison, the conifer, conifer/deciduous and riparian forest types show many characteristics of a more mature structure with a multi-layered canopy consisting of many size classes, and the presence of large trees (greater than 30 inches in diameter). Overall, native conifer tree regeneration in the majority of the park appears to be sufficient for long-term canopy tree replacement. Recommended management goals include increasing coverage of tall shrubs and creating conditions to optimize large snag and coarse woody debris recruitment.

As with all urban parks that are surrounded by development, encroachment of invasive species, human activity and other disturbances make active stewardship vital to maintaining and increasing the natural function of the forest. Shoreview and Boeing Creek Parks face a number of management challenges, primarily reducing the high densities of invasive tree species found in the regenerating layer in some areas, and the presence of invasive shrubs, vines and herbaceous species throughout the park. These species pose a serious threat to the future composition of this forest. In addition, previous land clearing within Shoreview Park has created large areas dominated by invasive plants that are in need of intensive restoration and replanting.

Specific recommendations for each of 12 identified management zones will be discussed later in the report. Several park-wide management issues have been identified, and include social trails, invasive species, inadequate conifer regeneration, and supplementing coarse woody debris throughout the park complex. These issues are discussed below.

Specific management recommendations for the park complex are presented in section 5.1, *Management Priorities*.

### 5.1 Management Priorities

Management recommendations for Shoreview and Boeing Creek Parks have been separated into three categories:

- Short-term priorities. These are actions that are of high importance and could be completed within the next two years

- Medium-term priorities. These are actions that will take planning to complete and could be completed within the next three to five years
- Long-term priorities. These are on-going activities that will take many years to accomplish.

#### Short-term priorities

- 1) Remove invasive trees in Zones 1, 2, 3, 6, 8 and 9 and replant with native species.
- 2) Remove discrete areas of Himalayan blackberry in Zones 1, 3, 6 and 8 and replant with native species, including conifers.
- 3) Remove discrete patches of English ivy from Zones 1, 2, 3, 6 and 9 and replant with native species.
- 4) Remove yellow archangel from Zone 9 and replant with native species.
- 5) Remove scattered infestations of herb Robert from interior forested areas including Zones 6 and 7 within the park complex.
- 6) Remove infestations of creeping buttercup and common periwinkle from Zones 6 and 8 and replant with native species.
- 7) Formalize trail junctions in Zone 7 and replant with native species to avoid further effects of trampling.
- 8) Create survival rings around trees in Zone 12 within areas covered by English ivy.

#### Mid-term priorities

- 1) Monitor cherry regeneration in Zone 1.
- 2) Create and maintain a buffer zone along the eastern and western edges of Zone 2 and along the eastern edge of Zone 5 to maintain the integrity of the forested areas.
- 3) Remove Herb Robert from Zones 3, 8 and 10 and replant with native species.
- 4) Remove Himalayan blackberry from Zones 9, 10 and 11 and replant with native species.
- 5) Remove Scotch broom from Zones 10 and 11 and replant with native species.
- 6) Remove ivy from Zone 10 and replant with native species.
- 7) Remove invasive tree species from zone 10 and replant with native trees.
- 8) Create a master plan for a trail network and close off and re-vegetate unnecessary social trails, particularly in steep slope areas.
- 9) Conduct a study focusing on stabilizing and re-vegetating eroded slopes and trails in steep slope areas.

#### Long-term priorities

- 1) Underplant shrubs and herbaceous species within the conifer/madrone mixed forests in Zones 2 and 3.
- 2) Augment the shrub layer by underplanting shrubs in Zones 6 and 7.
- 3) Increase tree and shrub cover in Zone 8.
- 4) Remove invasive tree species from Zone 12 and replant with native species.
- 5) Remove English ivy from Zone 12 and replant with native species.
- 6) Remove Scotch broom, Himalayan blackberry and butterfly bush from Zone 4 and replant with native species.
- 7) Remove Himalayan blackberry and Scotch broom from Zone 12 and replant with native species.
- 8) Maintain restored areas which have been replanted with native species
- 9) Increase levels of CWD and preserve large snags throughout the park complex.

## 5.2 Trails and Human Impacts

Shoreview and Boeing Creek Parks have numerous trails, providing access to all areas of the park complex. Many of these are social trails that run along steep and often unstable slopes, bisecting intact vegetated areas. Some of the main trails are shown on Map 1. In addition to being conduits for invasive species such as herb Robert, social trails cause habitat fragmentation, soil compaction and erosion, particularly in steep slope areas. It is recommended that whenever possible, social trails be blocked off and replanted. Those social and more established trails that are heavily utilized would benefit from a conversion to an official trail system. In some areas, such as along the riparian corridor leading to Hidden Lake, trails run along bluffs and other severely eroded areas. In these cases, trails and adjacent slopes will need to be stabilized. Maximizing use of officially marked trails is very important, especially in sensitive riparian and steep-slope areas to avoid causing further damage to slopes and vegetation.

A secondary issue is the presence of many invasive species, particularly herb Robert, along the trail corridors in the park. One area where the problem is severe is in Management Zone 3, along trails adjacent to the eastern-most parking lot (Map 2). However, herb Robert is also present in many other trail corridors throughout the park complex. Long-term maintenance of the trail corridors, particularly hand-weeding, will be necessary to bring these species under control and to prevent them from spreading further throughout the parks.

## 5.3 Tree Regeneration and Coarse Woody Debris

Conifer regeneration is limited in certain areas of the park, particularly in the deciduous forest areas. It is recommended that shade-tolerant species such as western red cedar, western hemlock and grand fir (*Abies grandis*) be planted in all areas where restoration and re-vegetation activities are taking place. Strategic placement of downed wood, in planting and other restoration areas would further support the regeneration of coniferous species. Large snags and large diameter CWD should be retained whenever possible, both as substrate for conifer regeneration and to provide wildlife habitat for numerous bird and mammal species. Coordination with the parks department or Seattle City Light to bring CWD into the park is recommended, particularly from nearby projects.

## 5.4 Invasive Species

During the 2007 forest habitat delineation, locations of invasive species infestations were mapped within Shoreview and Boeing Creek Parks (Map 2). Invasive species mapped include Scotch broom, butterfly bush, Himalayan blackberry, English holly, cherry laurel, English ivy, yellow archangel, creeping buttercup (*Ranunculus repens*) and common periwinkle (*Vinca minor*) (Map 2). Herb Robert is widespread throughout the park, particularly along in the trail corridors and in the riparian forest but was not mapped. Prior clearing surrounding the ballfields and other recreational facilities in Shoreview Park has resulted in approximately 11 acres of shrubland, dominated by invasive species (Map 2). These areas will require a considerable amount of effort to remove the invasive species and re-vegetate with native plants.



The following information describes the most common methods for removing the most prevalent invasive species in the park.

### Butterfly bush

Butterfly bush is a vigorous, drought-tolerant semi-evergreen shrub which grows to 15 feet and can produce up to 40,000 seeds each year, which are dispersed by wind and water. Due to its recent addition to the King County Noxious Weed List, development of effective methods to control butterfly bush is currently ongoing. Although the seeds have a high germination rate, they are viable for only three to five years. Manual methods of control can be effective, particularly while the plants are small. Seedlings can be handpicked, and adult plants can be removed with tools such as a shovel or pulaski (although this is often too labor intensive for well-established populations). Butterfly bush can resprout when cut at the base, so it is essential to either remove all roots or to apply herbicide to the stump. Well established populations can be treated by cutting the shrubs at the base and applying herbicide to the stump, as previously mentioned. However, other mechanical means of removal may not be successful because butterfly bush thrives in recently disturbed areas, and often seed germination is facilitated by ground disturbance during removal activities. As a result, it is important to monitor removal sites, as well as replant the area with native plants to deter additional invasive plant growth.

Biological methods of control may also be an option, as preliminary studies have shown that adults and larvae of the weevil *Cleopus japonicas* consume butterfly bush leaves. Chemical methods may also be effective in controlling the plant, as studies have indicated that application of glyphosate herbicides without surfactants can deter growth of small shrubs (Washington State Noxious Weed Control Board 2007). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix B.

### Creeping buttercup

Creeping buttercup is a low-growing perennial herbaceous flowering plant in the buttercup family. Although creeping buttercup is not currently listed on the King County Noxious Weed List, it poses considerable problems in many wetland and riparian areas within the Puget Sound region. Creeping buttercup reproduces through seeds and stolons (creeping stems) and can exclude other herbaceous species. It is also toxic when consumed by livestock. Young plants in small patches can be manually removed using a small tool such as a hand tiller. It is important to remove all roots and stem fragments to prevent regrowth. Mechanical methods for control are confined to tilling as mowing is not effective to control this species. Tilling large areas repeatedly during a single season can be effective. However, many areas where this plant grows are too wet to be able to till several times a year. In addition this type of treatment is not appropriate in natural wetland or riparian areas. Chemical methods may also be effective in controlling creeping buttercup, as studies have indicated that application of selective herbicides such as 2,4-D can deter growth of the plant. It is important to select an herbicide that is appropriate for the particular site, either aquatic or terrestrial (Burrill 1992). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix B.

## English Ivy

English ivy is one of the most invasive species in the Pacific northwest. This evergreen climbing vine is capable of forming dense mats in the forest understory and excluding all other understory species. It can also climb up trees, preventing light from reaching the leaves and adding weight to the tree canopy, causing trees to weaken and fall during wind storms.

The most effective method for controlling English Ivy is manual removal. Because English ivy can impact tree health by growing vertically, the first priority is to remove any vines growing on tree trunks and in the canopy. Install "survival rings" around trees by cutting or prying vines at shoulder height with the aid of a hand tool, killing any upper vines on the tree. Lower vines then need to be cleared, along with roots and vines found within at least a five foot radius of the base of the tree. For ivy growing along the ground, use hands or a small tool such as a hand tiller to pull or dig out the leaves and vines growing above the soil, as well as the woody roots growing just below the surface of the soil.

For disposal of hand-removed English ivy, several options are available. Disposal at a municipal vegetation waste facility is preferred. If the site will be monitored regularly, ivy can be piled on site on top of a paved area or tarp to prevent stems from re-rooting. Allow the pile to dry out, flipping periodically to ensure complete decomposition. Chemical methods of controlling English ivy are typically ineffective. The waxy leaves of the plant do not easily absorb herbicides, and herbicide run-off from the leaves results in risk to non-target plants (King County 2004). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix B.

## English holly, cherry laurel and horse chestnut

Cherry laurel and English holly are evergreen trees that can reach up to 50 feet in height, but are usually shorter when present in the forest understory. Horse chestnut is a deciduous tree which can grow to heights of over 100 feet. All three species can form thickets in the forest understory, reproducing in low-light conditions and excluding native plant species. These trees can be difficult to control as they form extensive root sprouts after being cut down. The most effective method of control is to remove the entire root while the plant is small and can be pulled. If the plant is larger, it is possible to remove it using a weed wrench. If the tree is too large to be either hand pulled or removed with a weed wrench, cutting the stem as close as possible to the ground and applying an herbicide such as Roundup directly to the cut portion of the stem as soon as possible is usually effective. Due to the fact that these trees tend to root spout and have many seedlings, monitoring around the infested areas on a regular basis will be necessary for several years after removal. It is very important not to cut the trees down without herbicide application, as this can lead to numerous root sprouts and re-growth from the stem (King County 2007a, USDA Forest Service 2005). Fact sheets including plant descriptions, distribution information and best management practices for control can be found in Appendix B.

## Herb Robert

Herb Robert is a fall and spring annual flowering plant in the geranium family. This low growing ground cover can spread vigorously in the forest understory and displace native plants. It is most often found along trail corridors and other disturbed areas. Herb Robert is most successfully controlled

throughout several growing seasons. In order to prevent spreading, it is necessary to remove the plant before it produces any flowers or seeds. Due to the weak root system of Herb Robert, manual removal methods are often effective. Wearing gloves to prevent skin irritation from the sticky oils of the plant, pull gently at the base to pull up the roots. A mechanical method such as a string trimmer can also be effective if used before the plant sets seed. Do not dispose of Herb Robert in on site compost piles, as seeds can survive and spread from composting. Utilize municipal yard waste facilities, as commercial high heat composting prevents germination of seeds. Chemical methods such as a systemic herbicide can be effective, especially if combined with monitoring for surviving plants. Such herbicides are absorbed by the foliage of the plant and travel through the plant to kill the roots. It is important to select an herbicide that is appropriate for the particular site, either aquatic or terrestrial. Take care to properly identify the plant prior to removal, because bleeding heart (*Dicentra formosa*), a Pacific Northwest native, is a strong look-alike (King County 2007b). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix B.

### Himalayan blackberry

Himalayan blackberry is a vigorous evergreen shrub armed with prickles on the stem. This plant thrives in open, disturbed areas but can also invade forested areas on both wet and dry sites. Himalayan blackberry often forms large thickets that exclude all other species and can also climb and smother trees. Control of Himalayan blackberry requires management over a number of years. Based on the size of the site, various strategies can be effective. For small infestations of Himalayan blackberry, manual removal is appropriate. For larger infestations, mechanical methods such as mowing or brush cutting can be effective. Manual control consists of cutting blackberry canes with loppers or pruners one foot above the ground. Depending on the size of the plants, dig up the root balls using tools such as a hand tiller, shovel, pulaski, or pick mattock. Canes can be piled on site on top of cardboard and left to decompose. Place any root balls on top of the pile to avoid re-rooting. Due to possible vigorous re-sprouting from the root crown, monitoring the infested area on a regular basis will be necessary for several years after removal. Removal procedures are repeated as necessary for complete control. After removing Himalayan blackberry, the area should be replanted with natives and mulched to help deter future invasive growth (King County 2005).

Biological methods of controlling blackberry are also an option. The introduction of animals such as goats or pigs can be useful in controlling infestations from one to four years old. Chemical methods of controlling large blackberry infestations are also known to be effective, especially if combined with other methods such as mechanical control and monitoring (King County 2005). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix B.

### Scotch broom

Scotch broom is a deep-rooted deciduous shrub, reaching up to 10 feet in height. This aggressive plant can rapidly colonized open, disturbed areas and produce seeds that are viable for up to 60 years, making it difficult to control. Control of Scotch broom requires management over a number of years, using a range of control techniques depending on the requirements of the site. Due to banks of seeds in the soil and soil disturbance during manual removal, resprouting is likely and ongoing management of the site will be required during the first few years.

Although often highly labor intensive, manual methods of control can be effective for smaller infestations. Pull or dig up plants and remove as many of the roots as possible in order to prevent re-sprouting. To be fully effective, it is essential to remove all mature plants to prevent seed production. For larger plants, tools such as an axe, machete, loppers, or a weed wrench are useful for removal. For larger infestations, mechanical methods of control such as brush cutting or mowing can be effective if repeated throughout the season or combined with other control methods. Mechanical mowing or cutting of young, green plants is ineffective as this often results in a dense carpet of short Scotch broom plants. Mature plants should be cut when flowering in order to prevent seed production. However, cutting is more effective during the dry season (from July-September) because this can lead to the exhaustion of root reserves and decreased resprouting. In this case, it is essential to reduce the spreading of mature seed pods which can lead to additional infestations. For mature plants, cut near ground level where the stem is more yellow than green. For larger or multi-branched plants, cut at chest height or below and cut off side branches during the dry season. If removing dense patches of Scotch broom, the area should be replanted with natives and mulched to help deter future invasive growth. Biological methods of control are also an option, as grazing by goats and consumption of seeds by chickens have been shown to reduce Scotch broom infestations. Chemical methods such as foliar or basal application of selective or non-selective herbicides are also known to be effective in controlling Scotch broom (King County 2004a, King County 2007c). Fact sheets including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix B.

#### Sweet cherry, Norway maple, European mountain ash and one-seed hawthorn

Sweet cherry, Norway maple, European mountain ash and one-seed hawthorn are all deciduous trees that can form dense thickets in the forest understory and exclude native trees and shrubs. Manual means of controlling these tree species include hand pulling small seedlings and removing young trees with a weed wrench where possible. It is easier to implement manual control when the soil is moist. If the tree is too large for manual removal, girdling can be an effective means of control. Girdling can be accomplished by cutting through the bark and growing layer (cambium) in a complete ring around the trunk. This method is most effective in the spring. Larger trees can also be cut down although re-growth should be monitored and removed for several years after the tree is cut down to prevent resprouting (USDA Forest Service 2004, 2006 and 2007). Fact sheets including plant descriptions, distribution information and best management practices for control can be found in Appendix B.

#### Yellow archangel

Yellow archangel is a low-growing evergreen perennial ground cover that spreads through stolons and can form dense mats in the forest understory, excluding all other plants. Yellow archangel is most successfully controlled throughout several growing seasons because stem and root fragments can resprout. Due to the shallow root system of the plant, manual removal can be effective between fall and early spring. Although labor intensive, when hand pulling plants it is essential to remove all roots and stem fragments to prevent re-rooting. Mechanical control methods such as cutting with a string trimmer are only effective if combined with other methods such as manual removal or chemical control. Chemical methods such as application of selective or non-selective herbicides can be effective if combined with manual control and monitoring for re-growth. It is important to select an herbicide that is appropriate for the particular site, either aquatic or terrestrial (King County 2007d). Fact sheets

including in-depth plant descriptions, distribution information and best management practices for control can be found in Appendix B.

## **5.5 Planting and maintenance**

Planting with native species is recommended following removal of invasive plants in each management zone. Increasing structural diversity within the shrub layer is a key identified goal within the entire park, with a recommendation to plant tall shrubs park-wide. In addition, establishing shade and canopy cover is key to controlling certain invasive species such as Himalayan blackberry and scotch broom, which can colonize disturbed areas. Due to the climate in the Pacific Northwest, the planting season extends from late fall to early spring during the rainy season when sufficient moisture exists to allow plants to establish. Newly installed plants should be monitored and watered during the hot summer months for the first several years to ensure proper establishment.

Maintenance is vital to the success of any restoration project. The removal and control of invasive species is a long-term commitment that requires regular weeding and maintenance for several years. Many of the invasive species present in Shoreview and Boeing Creek (e.g. Himalayan blackberry, Scotch broom, butterfly bush, etc.) have a tendency to re-grow from deep roots and must have regular maintenance at least two or three times a year in order to achieve effective invasive control and protect any installed native plantings. Maintenance can involve removing any regrowing invasive plants (with the roots whenever possible), regular mulching of native plantings, replacing native plants that have died, placing appropriate signs and/or fencing around restored areas and watering newly installed plants throughout at least the first two growing seasons.

## **5.6 Monitoring**

Monitoring is equally important to the success of a restoration project. Regular monitoring is particularly important in urban areas where forested stands are surrounded by development and invasive species are able to encroach from all sides. Monitoring can take many forms including visual inspections, photo documentation and scientific monitoring.

A basic type of monitoring is the visual inspection of restored areas during regular intervals and making note of any maintenance that is required. This type of monitoring can be done by volunteers, staff or contractors in charge of the restoration project. It should be conducted at least twice a year and more often if possible. This type of monitoring can generate information quickly. However, due to the inherent lack of formal documentation associated with this monitoring method, efficient transmission of inspection observations to maintenance staff is essential.

Another type of monitoring that can easily be implemented is establishing photo points throughout specific restoration areas and photographing the same geographic areas each year. Photo monitoring allows for long-term documentation and comparison of site conditions from year to year. This type of monitoring can also be conducted by volunteers, but the photographs must be taken at the same time each year for accurate comparison. Photo monitoring can be effective in documenting site conditions and is not time intensive. However, the photographs must be analyzed and compared to those from previous years to track changes over time. In addition, it is difficult to generate quantifiable data from this monitoring method.

A third type of monitoring, which is more labor intensive and rigorous than the first two types, involves setting up permanent plots and collecting scientific data similar to that gathered during the 2007 forest inventory discussed in this report. The data can include any number of parameters deemed to be useful to the forest stewards but at a minimum should include survival data, tree density data and cover data for native and invasive shrubs and herbaceous species present. This type of monitoring can be conducted by properly trained volunteers, staff or contractors. This type of monitoring can occur on an annual basis for the first three to five years, and then can be conducted on a bi-annual basis or more frequently depending on site conditions. Using permanent plots to monitor restoration sites allows for evaluation of site conditions and regular opportunities to evaluate the effectiveness of management techniques. In addition, it allows for a quantitative comparison of site conditions evaluation of planting and maintenance techniques over time.

## **5.7 Specific Recommendations for Management Areas**

This section discusses specific recommendations for each of twelve management zones in Shoreview and Boeing Creek Parks (Map 2). These zones are based on habitat delineations conducted in the parks (Map 1) as well as locations and extents of invasive species, which are shown in Map 2. Specific recommendations for each zone have been separated into short-term, medium-term and long-term priorities and are presented in section 5.1, *Management Priorities*.

### Zone 1

This management zone corresponds to two deciduous forest stands in the southeast section of Shoreview Park. A small piece of conifer/deciduous mixed forest separates the deciduous areas, and a small piece of shrubland borders the west side of the zone (Map 1). Management Zone 1 is 6.8 acres in size.

The management goals in zone 1 are to:

- 1) Remove English holly, cherry laurel, Himalayan blackberry and English ivy
- 2) Increase conifer regeneration
- 3) Monitor regeneration of horticultural cherry species
- 4) Following invasive species removal, add CWD and replant with native species

Numerous invasive species are present in this management zone. Map 2 shows several areas where English holly and cherry laurel are present in the central area of this management zone. Due to the relatively contained area where these infestations are present, it is recommended that they are removed in the near term and replanted with native species. Several discrete areas of Himalayan blackberry are present in the western section of this zone, adjacent to the southern-most baseball field near the park entrance, and on the eastern boundary, adjacent to the parking lot on the east side of the park (Map 2). It is recommended that these discrete areas of Himalayan blackberry are removed as a priority action and replanted with native species. In addition, a large area of English ivy is present within the central portion of Zone 1 (Map 2). This is one of the few areas where ivy is present in Shoreview Park and should be removed before it spreads further. For control information about these species, please see the invasive species section of the report.

During the survey, many dead and dying native bitter cherry trees were noted in the overstory layer. The cause of this mortality is unclear, although bitter cherry tends to be a short-lived species. A small

amount of bitter cherry regeneration is present, but it is recommended that more is planted during other restoration activities in this area. The majority of cherry regeneration in this zone is from a non-native horticultural species, which is present in this area. It is suggested that these non-native cherry trees be monitored annually to ensure that their sprouting progeny do not escape or expand further into the surrounding forests. Another structural issue of note is that conifer tree regeneration is very low in this area. It is recommended that conifers are incorporated into any re-vegetation activity that takes place in this area.

Removal of invasive tree species should be followed by addition of CWD and underplanting of native conifer and deciduous trees to increase native regeneration and improve structural complexity in the forest. The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, Douglas-fir, western white pine, grand fir, Pacific dogwood, western hemlock, western red cedar, cascara.

Suggested Native Shrubs: Baldhip rose, beaked hazelnut, evergreen huckleberry, low Oregon grape, oceanspray, Oregon boxwood, red elderberry, red flowering currant (*Ribes sanguineum*), red huckleberry, salal, serviceberry, snowberry, thimbleberry and vine maple.

## Zone 2

This zone consists of the conifer/madrone mixed forest stand on the eastern side of Shoreview Park (Map 1), which makes up 2.9 acres of the park area. The forest is bounded by a parking lot on the eastern side (Zone 3) and a shrubland dominated by Scotch broom on the western side (Zone 4) (Map 2). The forested area in this zone is mostly ecologically intact, with considerable conifer and madrone regeneration present.

The management goals in zone 2 are to:

- 1) Remove English holly, European mountain ash, one-seed hawthorn, Portugal laurel, sweet cherry and English ivy
- 2) Create a buffer zone between the forests in Zone 2 and disturbed areas covered with invasive species along the eastern and western boundary of the zone
- 3) Increase cover of tall shrubs
- 4) Increase cover of native herbaceous and vine species in the understory
- 5) Following invasive species removal, add CWD and replant with native species
- 6) Preserve large snags and CWD whenever possible

Structural concerns include the sparse shrub and understory vegetation layers, the lack of tall shrubs within the shrub layer, a small number of large snags and low levels of CWD. Currently in this management zone, native shrubs provide a total cover of 35%. A 2006 study of conifer/madrone mixed forests in Seattle showed that these forests have a very well developed shrub layer with multiple strata, averaging 89% native cover across all studied plots (SUN 2006). The conifer/madrone forests in zone 2 exhibit a much lower shrub cover and have very low covers of some of the most common species such as beaked hazelnut, creeping blackberry, Indian plum, low Oregon grape, oceanspray, red huckleberry and snowberry. Suggestions for underplanting species commonly found in the conifer/madrone forest type can be found in the plant list for this section.

In addition, native herbaceous vegetation and vines provide a total cover of 5% in this zone. Data from a 2006 study of this forest type across Seattle revealed that herbaceous percent cover ranged between 13% and 29%, averaging 19% across all studied plots (SUN 2006). Although understory vegetation tends to be sparse in this forest type, it is on average almost four times as dense as the forests in Shoreview Park. Common species in conifer/madrone mixed forests include sword fern, bracken fern and pink honeysuckle (*Lonicera hispidula*). Most of these species are currently present in low amounts or missing from this forest type. Suggestions for underplanting species commonly found in the conifer/madrone forest type can be found in the plant list for this section.

Invasive species of concern include a variety of invasive tree species in the regeneration layer. These include English holly, European mountain ash, one-seed hawthorn, Portugal laurel and sweet cherry. Removing these species should be a priority in this mostly-intact forest before they spread into adjacent areas. Several discrete patches of English ivy were mapped during the 2007 survey (Map 2). Removing these infestations should also be a high priority in this zone. Finally, this zone is bounded by disturbed areas on both the eastern and western sides, which are covered with invasive species such as herb Robert, Himalayan blackberry and Scotch broom. Creating and maintaining a buffer of native vegetation along the zone edges is important to maintaining the integrity of this forest, especially as the restoration of the shrub-dominated areas on the western side of the park may take many years. In addition, the parking lot along the eastern edge of the zone will continue to function as a seed source for invasive species, adding to the need for a buffer zone. For control information about these invasive species, please see the invasive species section of the report. After clearing of invasive species is complete, CWD should be added and the understory should be replanted with a combination of native trees, shrubs and herbaceous plants. The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, big-leaf maple, cascara, Douglas-fir, western white pine, grand fir, Pacific dogwood, Pacific madrone, western hemlock, western red cedar.

Suggested Native Shrubs: Baldhip rose, beaked hazelnut, creeping blackberry, evergreen huckleberry, Indian plum, low Oregon grape, oceanspray, Oregon boxwood, red elderberry, red flowering currant, red huckleberry, serviceberry, snowberry.

Suggested Native Herbaceous Species and Vines: sword fern, bracken fern, orange honeysuckle, pink honeysuckle.

### Zone 3

Management zone 3 is composed of a parking lot on the eastern side of Shoreview Park and an adjacent small stand of conifer/madrone mixed forest, along with two areas of shrubland forming the north and south boundaries of the zone (Maps 1 and 2). This zone consists of 4.5 acres. Management issues in this zone are very similar to those in Zone 2.

The management goals in zone 3 are to:

- 1) Remove English holly, European mountain ash, cherry laurel, Himalayan blackberry, herb Robert and English ivy
- 2) Increase cover of tall shrubs
- 3) Increase cover of native herbaceous and vine species in the understory
- 4) Following invasive species removal, add CWD and replant with native species



5) Preserve large snags and CWD whenever possible

Structural concerns include the sparse shrub and understory vegetation layers, the lack of tall shrubs within the shrub layer, a small number of large snags and low levels of CWD. Currently in this management zone, native shrubs provide a total cover of 25%, which is well below the 89% average documented in the 2006 conifer/madrone mixed forest study in Seattle (SUN 2006). There are also very few tall shrubs present in this zone. Likewise, native understory vegetation is well below that documented for this forest type and averages less than 1% in this zone. Both the shrub and herbaceous layers should be augmented with native plants. Suggestions for underplanting species commonly found in the conifer/madrone forest type can be found in the plant list for this section.

Invasive species of concern include a variety of tree species in the regeneration layer, of which European mountain ash is the most prevalent. English holly and cherry laurel are also present and should be removed at the same time. Removal of these invasive tree species is a priority management activity in this zone. Several large infestations of Himalayan blackberry are present throughout this zone surrounding the parking lot. Removing the blackberry and replanting with native species, particularly in the northern section of the lot will protect the integrity of conifer forests in adjacent Boeing Creek Park. Specific best management practices on how to control and manage Himalayan blackberry can be found in the invasive species section of the report. In some contiguous patches which do not contain native vegetation, mechanical control or control with goats might be possible. In areas where native trees or other vegetation are present, manual control is recommended. Mulching with cardboard and replanting immediately after clearing and grubbing the blackberry roots is an effective strategy to control this species. Follow-up maintenance will be necessary for several years following blackberry removal (see the maintenance section of the report).

English ivy is present in discrete patches throughout this zone and should be removed at the same time that removal occurs in Zones 1 and 2. Some of the ivy is encroaching into the park from the Shoreline Community College property and removal efforts should be coordinated wherever possible. In addition, herb Robert poses a considerable problem, particularly in the northern section of the zone surrounding the parking lot and along the trail corridor. Removal of this species and replanting with native plants is recommended. For control information about these invasive species, please see the invasive species section of the report. After clearing of invasive species is complete, CWD should be added and the understory should be replanted with a combination of native trees, shrubs and herbaceous plants. The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, big-leaf maple, cascara, Douglas-fir, western white pine, grand fir, Pacific dogwood, Pacific madrone, western hemlock, western red cedar.

Suggested Native Shrubs: Baldhip rose, beaked hazelnut, creeping blackberry, evergreen huckleberry, Indian plum, low Oregon grape, oceanspray, Oregon boxwood, red elderberry, red flowering currant, red huckleberry, serviceberry, snowberry.

Suggested Native Herbaceous species and vines: sword fern, bracken fern, orange honeysuckle, pink honeysuckle.

#### Zone 4

This management zone corresponds to the shrublands surrounding the ballfields and recreational facilities in the center of Shoreview Park. This is a large area, encompassing 25 acres, almost all of which (aside from the developed areas) is covered with invasive plants. This area was not surveyed during the 2007 survey as it is not forested. However, maps of invasive species created during that time show that the area is covered with a mixture of Scotch broom, Himalayan blackberry and butterfly bush (Map 2).

The management goals in zone 4 are to:

- 1) Remove Scotch broom, Himalayan blackberry and butterfly bush
- 2) Following invasive species removal, add CWD and replant with native species

Small pockets of trees are regenerating on the western boundary, which are effectively shading out these invasive species (Map 2). Establishing additional tree islands within this zone could provide further cover and control of these infestations. Control of all these species will require a multi-year effort and long-term commitment involving removal of invasive species, mulching the area and replanting with native species, and providing appropriate on-going maintenance. Due to the large geographic area involved, it is recommended that a contractor be hired to restore all or portions of this area. In some contiguous patches which do not contain native vegetation, mechanical control or biological control with goats might be possible. In areas where native trees or other vegetation are present, manual control is recommended. Due to the proximity of conifer/madrone mixed forests to both eastern and western edges of the shrubland, removal of invasive species in these areas would be most effective to provide a buffer for forested areas. In the area to the east of the parking lot and tennis courts, initial restoration efforts have already taken place that include preexisting enclosure fencing. This area should be a priority for renewed restoration efforts with a commitment to long-term site maintenance and monitoring.

Following invasive species removal in this zone, addition of CWD and replanting with native species is recommended. The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, big-leaf maple, cascara, Douglas-fir, western white pine, grand fir, Pacific dogwood, Pacific madrone, western hemlock, western red cedar.

Suggested Native Shrubs: Baldhip rose, beaked hazelnut, creeping blackberry, evergreen huckleberry, Indian plum, low Oregon grape, Nootka rose, oceanspray, Oregon boxwood, red elderberry, red flowering currant, salal, serviceberry, snowberry, thimbleberry.

Suggested Native Herbaceous Species: Sword fern, deer fern (*Blechnum spicant*), goatsbeard (*Aruncus dioicus*).

#### Zone 5

This management zone corresponds to the western-most conifer/madrone mixed forest, adjacent to the western boundary of Zone 4 (Maps 1 and 2). This small zone is 1.1 acres in size.

The management goals in zone 5 are to:

- 1) Remove English ivy, herb Robert, Himalayan blackberry and Scotch broom

- 2) Create a buffer zone between the forests in Zone 5 and disturbed areas covered with invasive species along the eastern boundary of the zone to prevent further encroachment of invasive species

For the most part, this forested area is in excellent condition, with no invasive tree species recorded, a considerable number of regenerating madrone and conifer trees, and a dense native shrub layer averaging greater than 100% and containing multiple shrub strata. Small amounts of English ivy, herb Robert, Himalayan blackberry and Scotch broom were recorded in this zone, encroaching into the forest from the western edge of Zone 4. Removing existing low levels of invasive species and creating a buffer between the forest and Zone 4 is the main priority in this zone.

For a list of suggested native trees, shrubs and herbaceous species that can be planted in this zone, please refer to species listed for Zone 2.

### Zone 6

This management zone consists of the conifer/deciduous mixed forest along the western edge of Shoreview and Boeing Creek Parks (Maps 1 and 2). This is a large area of 12.5 acres in size. For the most part, this forest is ecologically intact. However, a wide variety of management issues exist in this zone, consisting of erosion and instability of steep slopes, structural issues and invasive species.

The management goals in zone 6 are to:

- 1) Remove English holly, European mountain ash, cherry laurel, Norway maple, sweet cherry, Himalayan blackberry, English ivy, creeping buttercup and herb Robert
- 2) Stabilize steep and eroding slopes and revegetate with native plants
- 3) Formalize trail system and block off unnecessary social trails
- 4) Increase cover of tall shrubs
- 5) Following invasive species removal, add CWD and replant with native species
- 6) Preserve large snags and CWD whenever possible

The largest problem within this management zone is posed by invasive tree, shrub, vine and herbaceous species, which are present within the forested areas. Five invasive tree species are regenerating in this area, of which English holly is the most prevalent. Cherry laurel, European mountain ash, Norway maple and sweet cherry are also present in the understory. One concentrated infestation of English holly was mapped during the 2007 invasive species survey near the eastern boundary of the conifer/madrone mixed forest. These species should be removed as a priority action in this zone. Native deciduous and conifer species in this zone appear to be regenerating in sufficient quantities throughout this zone. Cleared areas should be replanted with shade tolerant tree species to replace the removed invasive trees.

Several discrete patches of Himalayan blackberry are present in this zone, the largest of which are adjacent to Zone 5 on the eastern boundary. It is recommended that the smaller areas of Himalayan blackberry located in the interior of the forest are removed as soon as possible to prevent further spread into the intact forested areas. In addition, four discrete patches of English ivy are present in the northern section of the zone, along with a small infestation in the central interior portion of the forest (Map 2). Herb Robert is also present scattered throughout the riparian corridor along Boeing Creek. One infestation of creeping buttercup was mapped in the southern section of the zone along the short side-

channel off of Hidden Lake (Map 2). This species has the potential to rapidly invade wetland and riparian areas and should be controlled before it spreads further down the stream corridor. Removal of these discrete areas of creeping buttercup, English ivy and herb Robert should be a management priority in this zone. Areas in which these species are removed should be mulched and replanted with native species. Several years of maintenance will be necessary to ensure that these infestations are properly controlled. Specific best management practices on how to control and manage creeping buttercup, Himalayan blackberry, English ivy and herb Robert can be found in the invasive species section of the report.

Much of this zone contains very steep slopes, some of which are unstable and have eroded to create bluffs devoid of vegetation (Map 3). Several heavily used trails and many social trails bisect this area. It is recommended that a study is conducted within this area and in the riparian forest, focusing on methods for stabilizing trails and slopes and blocking off unnecessary social trails to prevent further erosion.

Other structural issues include a sparse shrub layer and lack of large snags. The native shrub layer in this forest type totals 29% cover. In a 2006 study of conifer/deciduous mixed forests in Seattle, SUN found that the total native cover of shrub layers in this forest type averaged 72% across the city (SUN 2006). Although the forests within Shoreview and Boeing Creek Park fall within the lower range of variability, they are much more sparse than the average. Most of the species found within conifer/deciduous mixed forests in the study are present in the park complex, albeit in very small amounts. Therefore, augmenting these species is an important long-term goal within this forest type. In addition, preserving large snags and large pieces of CWD is a long-term goal that will provide additional wildlife habitat as well as nutrients and substrate for conifer trees to continue to regenerate in this forest. Suggestions for underplanting species commonly found in the conifer/deciduous forest type can be found in the plant list for this section.

The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Big-leaf maple, grand fir, western hemlock, western red cedar.

Suggested Native Shrubs: Baldhip rose, beaked hazelnut, creeping blackberry, evergreen huckleberry, Indian plum, oceanspray, Oregon boxwood, Pacific rhododendron (*Rhododendron macrophyllum*), red elderberry, red flowering currant, red huckleberry, salal, salmonberry, serviceberry, snowberry, thimbleberry, vine maple.

Suggested Native Herbaceous Species: Fringecup, starflower, western bleedingheart.

### Zone 7

This management zone consists of the conifer forest located in Boeing Creek Park (Maps 1 and 2). This forested zone encompasses the central portion of the park and is 16.2 acres in size. For the most part, this forested area is in very good condition, with few invasive tree species recorded, a considerable number of regenerating conifer trees, and a dense native shrub layer. However, some management concerns exist in this area, including management of steep slope areas, lack of a tall shrub layer, low levels of CWD, few large snags and low levels of invasive species.

The management goals in zone 7 are to:

- 1) Remove English holly, European mountain ash, Himalayan blackberry, English ivy and herb Robert
- 2) Formalize trail system and block off unnecessary social trails
- 3) Increase cover of tall shrubs
- 4) Following invasive species removal, add CWD and replant with native species
- 5) Preserve large snags and CWD whenever possible

Small amounts of invasive trees were recorded in the regeneration layer of this zone. Species found include English holly and European mountain ash. Small amounts of Himalayan blackberry, evergreen blackberry, English ivy and herb Robert are also present. As in Zone 6, it is recommended that these species should be removed as a priority activity since they are present at low levels and have not yet invaded the forest extensively. Control can be carried out in conjunction with similar activities in Zone 6. Areas in which shrub and herbaceous species are removed should be mulched and replanted with native species. Specific best management practices on how to control and manage Himalayan blackberry, evergreen blackberry, English ivy and herb Robert can be found in the invasive species section of the report.

Much of this zone contains steep slopes, which are bisected by numerous social trails (Map 3). Although slope stability is not an issue in most areas as the slopes are heavily vegetated by salal, the social trails are contributing to erosion and compaction, particularly on steep slopes. It is recommended that all unnecessary social trails are blocked off and revegetated where possible. There are also several cleared areas at trail junctions where the vegetation appears to have been trampled. One of these areas can be found along the main trail entering Boeing Creek Park from the central parking lot in Shoreview Park. Another clearing can be found just inside the park along the trail entering this zone from the Shoreline Community College property to the south. Trail junctions should be formalized in these areas and the clearings replanted with native plants to reduce invasive species establishment.

Very few tall shrubs are present in this forest type. Augmenting the shrub layer with tall-statured shrubs to create more structural complexity within the forest is a long-term goal for this forest type. Other structural issues include lack of CWD and large snags. Recruiting large CWD from outside the park and preserving naturally occurring large diameter snags and logs is a long-term goal that will provide additional wildlife habitat as well as nutrients and substrate for conifer trees to continue to regenerate in this forest.

The following plant list is provided as a starting point, with the understanding that many other upland native species can and should be added to increase diversity in the park.

Suggested Native Trees: Cascara, grand fir, Pacific dogwood, western hemlock, western red cedar.

Suggested Native Shrubs: Baldhip rose, beaked hazelnut, evergreen huckleberry, Indian plum, oceanspray, Oregon boxwood, red elderberry, red huckleberry, serviceberry, snowberry, thimbleberry.

Suggested Native Herbaceous Species: Deer fern, sword fern.

### Zone 8

Zone 8 corresponds to the riparian forest in northcentral Boeing Creek Park, and the small adjacent shrubland on the east side of the park (Maps 1 and 2). This zone is 6.7 acres in size.

The management goals in zone 8 are to:

- 1) Remove English holly, European mountain ash, Himalayan blackberry, Scotch broom, creeping buttercup, common periwinkle and herb Robert
- 2) Stabilize steep and eroding slopes and revegetate with native trees and shrubs
- 3) Formalize trail system and block off unnecessary social trails
- 4) Increase native tree density
- 5) Increase cover of tall shrubs
- 6) Following invasive species removal, replant with native species
- 7) Preserve large snags and CWD whenever possible

Riparian forests provide some of the highest habitat value of all forest types. These areas tend to have high plant species diversity and structural diversity due to high water availability. As a result, many layers of vegetation provide a rich variety of habitats for wildlife and diverse feeding and nesting opportunities. Riparian areas also provide water sources and travel corridors for birds and animals. In addition, many species of insects and fish are found in these areas (Palone and Todd 1997). Due to their importance for habitat, riparian forests along with wetland areas are considered to be priority targets for restoration activities.

Currently, Boeing Creek is not fish bearing within the park complex due to the presence of several fish barriers between Puget Sound and the parks. However, if those barriers are removed in the future, the riparian and conifer/deciduous mixed forests along the creek corridor will provide an intact forested habitat for returning fish. A wide variety of management issues exist in this zone, consisting of erosion and instability of steep slopes, structural issues and invasive species. Most of the identified recommendations would also improve potential fish habitat within the park. However, it is important to note that the vegetation study performed in 2007 is not a fish habitat evaluation and did not look at in-stream conditions or vegetation immediately along the stream corridor. To evaluate salmon habitat, an additional study is recommended looking at morphological conditions such as sediment composition, stream width and depth, water quality parameters such as temperature, flow and nutrient inputs, the presence of in-stream habitats such as pools and riffles, amounts of large woody debris present within the stream channel, and cover directly provided to the stream by vegetation.

The largest problem within this management zone is posed by invasive tree, vine and herbaceous species, which are present within the forested areas. Over half (58%) of regenerating trees in this zone consist of invasive species, primarily composed of English holly, with a smaller amount of European mountain ash. Removing these species and replanting with native trees is a management priority in this area. Several discrete patches of Himalayan blackberry are also present in this zone in addition to a large shrubland on the northern boundary which is dominated by Himalayan blackberry with a small amount of Scotch broom. These areas were mapped during the invasive species survey in 2007, and should be removed to avoid further compromising the integrity of the riparian habitat (Map 2). During the same survey, infestations of creeping buttercup and common periwinkle were also found in this zone (Map 2). Controlling these species should be considered a priority, as their distributions are limited within the park and because creeping buttercup can spread rapidly in wet areas. This forest type also has the highest levels of herb Robert in the park, located along the creek corridor. This is a large infestation that will take considerable effort to control. Herb Robert has the ability to colonize large forested areas and will displace native plants in the understory as is evident in Shoreview and Boeing Creek Parks.

Much of this zone contains very steep slopes, some of which are unstable and have eroded to create bluffs devoid of vegetation (Map 3). Several heavily used trails and many social trails bisect this area. It is recommended that a study is conducted within this area and in the riparian forest, focusing on methods for stabilizing trails and slopes and blocking off unnecessary social trails to prevent further erosion.

It is likely that erosion, steep slopes, sandy soils and the presence of herb Robert and the other invasive species are contributing to the low levels of trees and shrubs present in the riparian forest. This forest type contains the lowest densities of overstory trees (84/acre) and the lowest levels of shrub cover in the park complex (27% cover). Riparian forests usually have lush tree, shrub and herbaceous vegetation layers, which provide shelter, food and nesting locations for wildlife, but are also important for providing large woody debris and leaf litter into the stream corridor and in providing shade to regulate stream temperature (Palone and Todd 1997). Increasing tree and shrub cover is a key management concern in this forest type. The following plant list is provided as a starting point, with the understanding that many other riparian native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, black cottonwood (*Populus balsamifera ssp. trichocarpa*), cascara, Oregon ash (*Fraxinus latifolia*), red alder, Pacific dogwood, paperbark birch (*Betula papyrifera*), western hemlock, western red cedar.

Suggested Native Shrubs: Beaked hazelnut, Hooker's willow (*Salix hookeriana*), Indian plum, mock orange (*Philadelphus lewisii*), oceanspray, Nootka rose, Pacific hawthorn (*Crataegus douglasii*), Pacific ninebark (*Physocarpus capitatus*), Pacific willow (*Salix lucida ssp. lasiandra*), red elderberry, salmonberry, Sitka willow (*Salix sitchensis*), twinberry (*Lonicera involucrata*), western crabapple (*Malus fusca*), vine maple.

Suggested Native Herbaceous Species: Ladyfern, piggy-back plant, slough sedge (*Carex obnupta*), sword fern, hedgenettle (*Stachys chamissonis var. cooleyae*).

### Zone 9

Zone 9 consists of the conifer/deciduous mixed forest on the eastern boundary of Boeing Creek Park (Map 2). It is bounded by the riparian forest (Zone 8) to the south and Zone 11 to the north (Maps 1 and 2). This area is approximately 1.5 acres in size. Based on the species composition of this area, it is evident that it is influenced by the adjacent riparian area and has considerable water availability.

The management goals in zone 9 are to:

- 1) Remove English holly, European mountain ash, sweet cherry, cherry laurel, Himalayan blackberry, English ivy and yellow archangel
- 2) Following invasive species removal, add CWD and replant with native species
- 3) Preserve large snags and CWD whenever possible

The main management issues in this zone are posed by invasive species. This zone has a very high concentration of invasive tree regeneration (an average of 810 stems/acre). Approximately half of these trees are composed of English holly, with a considerable amount of European mountain ash also present. Smaller amounts of sweet cherry and cherry laurel were also recorded in this zone. The prevalence of invasive species may account for the relatively low native tree regeneration levels. Due to the relatively small size of this area, it is recommended that invasive tree species are removed as a high priority action.

It is recommended that native trees are replanted in areas where invasive species are removed, and CWD added where possible. Specific best management practices on how to control and manage invasive trees can be found in the invasive species section of the report.

Much of this zone is influenced by the Himalayan blackberry shrubland along its western boundary with the riparian zone. Two other discrete patches of Himalayan blackberry are present on the northern boundary and are encroaching into the forest interior (Map 2). Removal of the Himalayan blackberry will help to protect both the forest interior and the riparian area that this forest adjoins. In some contiguous patches which do not contain native vegetation, mechanical control or biological control with goats might be possible. In addition, two distinct areas of English ivy are present, one on the southern boundary with the riparian area and one in the northeastern corner of the zone (Map 2). These are relatively small infestations and should be removed as a priority activity, particularly as one of them borders on the riparian area. Finally, one infestation of yellow archangel is present in the southeast corner of this zone. This species has recently been added to the noxious weed list in King County and has the potential to spread quickly in the understory, creating a blanket much like English ivy. Removing the yellow archangel is recommended as soon as possible to prevent spread to other parts of the park. Specific best management practices on how to control and manage Himalayan blackberry, English ivy and yellow archangel can be found in the invasive species section of the report. Removing as much of the roots as possible, followed by mulching and replanting with native plants is an effective strategy for controlling these species. Several years of follow-up maintenance will be necessary to control these infestations effectively.

The following plant list is provided as a starting point, with the understanding that many other native species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, big-leaf maple, cascara, Oregon ash, red alder, Douglas-fir, Pacific dogwood, paperbark birch, western hemlock, western red cedar, western white pine, western yew.

Suggested Native Shrubs: Beaked hazelnut, Indian plum, mock orange, oceanspray, Nootka rose, Pacific ninebark, red elderberry, red flowering currant, salmonberry, thimbleberry, twinberry, vine maple.

Suggested Native Herbaceous Species: Deer fern, sword fern.

### Zone 10

This management zone consists of a small section of deciduous forest in the northeast of Boeing Creek Park, approximately 1.6 acres in size (Maps 1 and 2). The northern section of Boeing Creek Park consists of previously cleared and disturbed areas, which surround this young forest. The central portion of this area is not forested and consists of a large infestation of Himalayan blackberry (Map 2). The outer portions of this zone are forested with a substantial amount of native regenerating trees present.

The management goals in zone 10 are to:

- 1) Remove English holly, European mountain ash, sweet cherry, Himalayan blackberry, Scotch broom, English ivy and herb Robert
- 2) Increase cover of tall shrubs
- 3) Following invasive species removal, add CWD and replant with native species
- 4) Preserve large snags and CWD whenever possible



Management issues in this zone consist of invasive species and structural issues. Invasive species are present in the majority of this zone. Invasive tree species are present in moderate amounts in the regenerating layer and consist of English holly, sweet cherry and European mountain ash. A significant infestation of Himalayan blackberry takes up the central area of the zone, and another smaller patch is present along the southern boundary (Map 2). A small infestation of Scotch broom is present on the northern boundary of the zone. English ivy is present in the forest interior, surrounding the Himalayan blackberry (Map 2). Herb Robert is also present scattered throughout this area, but with greater concentrations in the eastern section. Due to the fact that this forested island is not adjacent to other intact forested areas, removal of these species is recommended as a mid-term priority for the park. After invasive species removal, the area should be mulched and replanted with native trees and shrubs. CWD should be added to the area if possible to promote native conifer regeneration. Specific best management practices on how to control and manage these species can be found in the invasive species section of the report.

Structural concerns in this zone include sparse shrub and understory layers, lack of CWD and low numbers of snags. The shrub and understory layers can be augmented after invasive species are removed throughout the zone during re-vegetation activities. CWD and snags will likely not be present in this area for a number of years until the forest matures. However, they should be preserved whenever possible. If available, large pieces of CWD can be added from other park projects or those outside the park.

The following plant list is provided as a starting point, with the understanding that many other native upland species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, big-leaf maple, cascara, Douglas-fir, grand fir, Pacific dogwood, western hemlock, western red cedar, western white pine.

Suggested Native Shrubs: Beaked hazelnut, creeping blackberry, evergreen huckleberry, Indian plum, mock orange, oceanspray, Oregon boxwood, red elderberry, red flowering currant, red huckleberry, salal, serviceberry, snowberry, thimbleberry.

Suggested Native Herbaceous Species: Deer fern, sword fern.

### Zone 11

Zone 11 consists of four separate non-forested areas in the northern end of Boeing Creek Park, including one small area in the southeast of the separate park parcel located north of Northwest 175th Street (Map 2). These areas total approximately 5.4 acres in size and were not surveyed due to lack of forest cover. They are numbered 11A-11D for ease of reference (Map 2). The southernmost section of this zone (Zone 11A) is classified as a landscaped forest, part of which has been used as a construction staging area during the stormwater facility improvement project, and is bordered by conifer/deciduous mixed forests on the east and west sides, the riparian forest in the south and a stand of deciduous forest to the north (Map 1). The remaining three areas are classified as grassland, the eastern-most of which contains stormwater facilities and a detention pond (Zone 11B).

The management goals in zone 11 are to:

- 1) Remove Himalayan blackberry and Scotch broom
- 2) Following invasive species removal, replant with native species

Management options for these zones are numerous, and can include use for recreational purposes, incorporating formal landscaping, converting some grassland areas to a native meadow environment or transitioning them into a more forested state. In particular, the area surrounding the detention pond might be appropriate for a native wet meadow environment and would provide some visual interest and offer birds an additional habitat type adjacent to a water source.

Regardless of the management options that are selected, there are large infestations of invasive species present in this zone that need to be addressed. Sizeable patches of Scotch broom are present in the northeastern-most grassland area where the stormwater detention pond is located (Zone 11B) (Map 2). A discrete area of Himalayan blackberry is also present in Zone 11B, along with another large area in the middle of Zone 11A (Map 2). Control of these infestations will involve removing the Scotch broom and Himalayan blackberry with as much of the root as possible, mulching and replanting with native species. Specific best management practices on how to control and manage these species can be found in the invasive species section of the report. The types of native plants selected for revegetation will depend on what type of management activities are selected in these areas. As the landscaped forest in Zone 11A already contains some canopy cover, this area might benefit from additional tree and shrub plantings (see the forest plant palette at the end of the section). Some native shrubs and trees that might be appropriate for formal landscaping, such as in areas 11B and 11C are listed in the landscape plant palette. Plants appropriate for wet meadow environments are listed in the wet meadow palette. Areas of Zone 11B might be appropriate for this type of habitat.

The following plant lists are provided as a starting point, with the understanding that many other native species can and should be added to increase diversity in the park.

**Forest palette:**

Suggested Native Trees: Bitter cherry, Douglas-fir, grand fir, Pacific dogwood, western hemlock, western red cedar, western white pine.

Suggested Native Shrubs: Beaked hazelnut, creeping blackberry, evergreen huckleberry, Indian plum, mock orange, oceanspray, Oregon boxwood, red elderberry, red flowering currant, red huckleberry, salal, serviceberry, snowberry, thimbleberry.

**Formal landscape palette:**

Suggested Native Trees: Cascara, Pacific dogwood, paperbark birch, western hemlock, western red cedar.

Suggested Native Shrubs: Beaked hazelnut, evergreen huckleberry, Indian plum, kinnickinnick (*Arctostaphylos uva-ursi*), low Oregon grape, mock orange, oceanspray, Oregon boxwood, Pacific wax myrtle (*Morella californica*), red elderberry, red flowering currant, salal, serviceberry, silktassel (*Garrya elliptica*), snowberry, tall Oregon grape, vine maple.

Suggested Native Herbaceous Species: Beach strawberry (*Fragaria chiloensis*), deer fern, evergreen violet, pearly everlasting (*Anaphalis margaritacea*), sword fern, western bleedingheart, woodland strawberry (*Fragaria vesca*).

**Wet meadow palette:**

Suggested Native Shrubs: clustered wildrose (*Rosa pisocarpa*), evergreen huckleberry, Nootka rose

Suggested Native Herbaceous Species: arctic lupine (*Lupinus arcticus*), blue wildrye (*Elymus glaucus*), California aster (*Symphyotrichum chilense*), Canada goldenrod (*Solidago canadensis*), common red paintbrush (*Castilleja miniata*), Douglas aster (*Symphyotrichum subspicatum* var. *subspicatum*), farewell to spring (*Clarkia amoena*), fireweed (*Chamerion angustifolium* ssp. *angustifolium*), graceful cinquefoil (*Potentilla gracilis*), Henderson's checker-mallow (*Sidalcea hendersonii*), Idaho blue-eyed grass (*Sisyrinchium idahoense*), Idaho fescue (*Festuca idahoensis* ssp. *roemeri*), large-leaved lupine (*Lupinus polyphyllus*), meadow barley (*Hordeum brachyantherum*), miner's lettuce (*Claytonia perfoliata*), nodding onion (*Allium cernuum*), Oregon iris (*Iris tenax*), Oregon sunshine (*Eriophyllum lanatum*), Pacific silverweed (*Argentina egedii* ssp. *egedii*), pearly everlasting, small camas (*Camassia quamash*), slough sedge, tufted hairgrass (*Deschampsia caespitosa*), western buttercup (*Ranunculus occidentalis*), western columbine (*Aquilegia formosa*), yarrow (*Achillea millefolium*), yellow monkey flower (*Mimulus guttatus*).

### Zone 12

This zone corresponds to the conifer/deciduous mixed forest that makes up the majority of the separate park parcel to the north of Northwest 175<sup>th</sup> Street (Maps 1 and 2). This area is approximately 3.8 acres in size.

The management goals in zone 12 are to:

- 1) Remove English holly, cherry laurel, sweet cherry, European mountain ash, Himalayan blackberry, Scotch broom and English ivy
- 2) Decide an appropriate use for this area with input from stakeholders
- 3) Increase native conifer density
- 4) Increase cover of tall shrubs
- 5) Increase cover of native herbaceous species
- 6) Following invasive species removal, add CWD and replant with native species
- 7) Preserve large snags and CWD whenever possible

Currently this parcel is fenced off and is not open to the public. Due to the fact that this area is not readily accessible, the proliferation of invasive species in this parcel has been unchecked. Most of the area is heavily invaded with a combination of invasive species consisting of cherry laurel, English holly, evergreen blackberry, Himalayan blackberry, Scotch broom and English ivy. Additionally, there is a large grassland area in the northeast corner (Zone 11) and two Himalayan blackberry dominated areas adjacent to the northern and western edge of the grassland which appear to have been horticultural cherry, apple or plum orchards in the past (Map 2).

The City of Shoreline, with input from park stakeholders, should decide the appropriate use for this area. If the area will be opened for public use, it will need to incorporate a formal trail system, signage and points of access into the parcel. In addition, a considerable amount of effort will be required to restore this area.

Management issues within this zone are numerous and will take many years to undertake. Due to the fact that this area is separated from the rest of the park and based on the severity of invasive species infestations, management activities in this zone have been identified as a long-term goal. Structural concerns include low densities of overstory and regenerating native trees, lack of conifer regeneration,

low levels of native shrub cover (averaging 26% cover), and a very low diversity of native herbaceous plants and vines (a total of four species in this area). These problems are likely due to the high levels of English ivy throughout much of the zone, which is known for its ability to suppress native species. In addition, this zone has the highest levels of regenerating English holly in the park, with over 1000 stems/acre.

Removing invasive species will require a considerable amount of effort from this area. The regenerating layer in this zone is overwhelmingly composed of invasive tree species (1105 stems/acre of invasive trees vs. 90 stems/acre native trees), of which English holly makes up the majority. Small amounts of sweet cherry and European mountain ash are also present. The majority of the infestation is present in the northwest corner of the parcel (Map 2). It is recommended that a contractor be hired to control the invasive trees over a number of consecutive years in order to prevent resprouting and/or regrowth. Following invasive species removal in this zone, addition of CWD and replanting with native species, especially conifers is recommended to augment the conifer regeneration in this zone. Specific best management practices on how to control and manage English holly, sweet cherry and European mountain ash can be found in the invasive species section of the report.

English ivy is present throughout the majority of this area (Map 2). Average percent cover of ivy was 45% within the survey plots. During the survey, many trees were observed to be covered with ivy and a number had already fallen down. It is recommended that survival rings are created throughout this entire area as a priority action to prevent further deterioration of the overstory. The bulk of the English ivy infestation can then be removed over several years. Mulching and replanting with native species should take place as soon as a section of English ivy is removed. Specific best management practices on how to control and manage English ivy can be found in the invasive species section of the report.

In addition, several large and discrete areas composed of evergreen blackberry, Himalayan blackberry and Scotch broom are present on either side of the grassland in the southeast corner of the park (Map 2). In some contiguous patches which do not contain native vegetation, mechanical control or biological control with goats might be possible. Following removal, the area should be mulched and replanted with native plants. Several years of maintenance will be necessary to ensure proper control of the infestations. Specific best management practices on how to control and manage these species can be found in the invasive species section of the report.

The following plant list is provided as a starting point, with the understanding that many other native upland species can and should be added to increase diversity in the park.

Suggested Native Trees: Bitter cherry, cascara, Douglas-fir, grand fir, Pacific dogwood, western hemlock, western red cedar, western white pine.

Suggested Native Shrubs: Beaked hazelnut, creeping blackberry, evergreen huckleberry, Indian plum, mock orange, oceanspray, Oregon boxwood, red elderberry, red flowering currant, red huckleberry, salal, serviceberry, snowberry, thimbleberry.

Suggested Native Herbaceous Species: sword fern.

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**Appendix A. Average percent density of trees (stems/acre) and cover of shrub, herb and grass species where present (on surveyed plots) and frequency park-wide.**

Scientific Name <sup>1</sup>	Common Name	Native	Average cover or density in sampled plots <sup>2</sup>	Frequency park-wide (%)
<b>Trees</b>				
<i>Acer macrophyllum</i>	big-leaf maple	Yes	92 stems/acre	78
<b><i>Acer platanoides</i>**</b>	Norway maple	No	10 stems/acre	4
<i>Alnus rubra</i>	red alder	Yes	38 stems/acre	22
<i>Arbutus menziesii</i>	Pacific madrone	Yes	125 stems/acre	30
<b><i>Cedrus sp.</i></b>	cedar	No	10 stems/acre	4
<i>Cornus nuttallii</i>	Pacific dogwood	Yes	20 stems/acre	7
<b><i>Crataegus monogyna</i>**</b>	one-seed hawthorn	No	10 stems/acre	7
<i>Frangula purshiana</i>	casacara	Yes	13 stems/acre	15
<b><i>Ilex aquifolium</i>*</b>	English holly	No	279 stems/acre	52
<b><i>Ilex sp.</i></b>	Holly	No	10 stems/acre	4
<b><i>Malus sp.</i></b>	horticultural apple species	No	150 stems/acre	4
<i>Pinus monticola</i>	western white pine	Yes	40 stems/acre	11
<b><i>Prunus avium</i>**</b>	sweet cherry	No	57 stems/acre	22
<i>Prunus emarginata</i>	bitter cherry	Yes	55 stems/acre	22
<b><i>Prunus laurocerasus</i>*</b>	cherry laurel	No	17 stems/acre	22
<b><i>Prunus lusitanica</i>**</b>	Portugal laurel	No	70 stems/acre	4
<b><i>Prunus sp.</i></b>	horticultural cherry species	No	80 stems/acre	7
<i>Pseudotsuga menziesii</i>	Douglas fir	Yes	120 stems/acre	81
<i>Salix scouleriana</i>	Scouler's willow	Yes	30 stems/acre	4
<i>Salix sp.</i>	willow	Yes	10 stems/acre	4
<b><i>Sorbus aucuparia</i>**</b>	European mountain ash	No	68 stems/acre	37
<i>Taxus brevifolia</i>	western yew	Yes	10 stems/acre	4
<i>Thuja plicata</i>	western red cedar	Yes	92 stems/acre	81
<i>Tsuga heterophylla</i>	western hemlock	Yes	67 stems/acre	56
<b>Shrubs</b>				
<i>Acer circinatum</i>	vine maple	Yes	12	4
<i>Amelanchier alnifolia</i>	serviceberry	Yes	4	11
<b><i>Buddleja davidii</i>*</b>	butterfly bush	No	T	4
<i>Corylus cornuta</i>	beaked hazelnut	Yes	4	41
<b><i>Cotoneaster lacteus</i>**</b>	milkflower cotoneaster	No	T	4
<b><i>Cytisus scoparius</i>*</b>	scotch broom	No	1	15
<b><i>Daphne laureola</i>**</b>	spurge laurel	No	T	4
<i>Gaultheria shallon</i>	salal	Yes	31	85
<i>Holodiscus discolor</i>	oceanspray	Yes	4	33
<i>Mahonia aquifolium</i>	tall Oregon grape	Yes	1	4
<i>Mahonia nervosa</i>	low Oregon grape	Yes	4	59
<i>Oemleria cerasiformis</i>	Indian plum	Yes	5	41



Scientific Name <sup>1</sup>	Common Name	Native	Average cover or density in sampled plots <sup>2</sup>	Frequency park-wide (%)
<i>Paxistima myrsinites</i>	Oregon boxwood	Yes	9	7
<i>Ribes lacustre</i>	swamp gooseberry	Yes	T	11
<i>Rosa gymnocarpa</i>	baldhip rose	Yes	2	59
<i>Rosa nutkana</i>	Nootka rose	Yes	1	4
<b><i>Rubus armeniacus</i>*</b>	Himalayan blackberry	No	7	37
<b><i>Rubus laciniatus</i>*</b>	evergreen blackberry	No	T	15
<i>Rubus leucodermis</i>	blackcap	Yes	1	11
<i>Rubus parviflorus</i>	thimbleberry	Yes	2	19
<i>Rubus spectabilis</i>	salmonberry	Yes	11	26
<i>Rubus ursinus</i>	creeping blackberry	Yes	13	85
<i>Sambucus racemosa</i>	red elderberry	Yes	1	37
<i>Spiraea douglasii</i>	hardhack	Yes	2	4
<i>Symphoricarpos albus</i>	snowberry	Yes	13	4
<i>Vaccinium ovatum</i>	evergreen huckleberry	Yes	4	4
<i>Vaccinium parvifolium</i>	red huckleberry	Yes	2	63
<b><i>Viburnum sp.</i></b>	wayfaring tree	No	T	4
<b>Forbs and Vines</b>				
<i>Athyrium filix-femina</i>	ladyfern	Yes	T	15
<b><i>Cardamine hirsuta</i></b>	hairy bittercress	No	T	7
<i>Circaea alpina</i>	small enchanter's nightshade	Yes	T	11
<i>Cirsium sp.</i>	thistle	X	T	4
<i>Claytonia sibirica</i>	Siberian miner's lettuce	Yes	1	19
<i>Corallorhiza maculata</i>	summer coralroot	Yes	T	11
<i>Dicentra formosa</i>	western bleedingheart	Yes	1	7
<b><i>Digitalis purpurea</i></b>	foxglove	No	1	7
<i>Dryopteris expansa</i>	wood fern	Yes	T	11
<i>Equisetum telmateia</i>	giant horsetail	Yes	T	4
<i>Galium aparine</i>	cleavers	Yes	T	22
<b><i>Geranium robertianum</i>*</b>	herb Robert	No	8	70
<i>Geum macrophyllum</i>	bigleaved avens	Yes	T	7
<i>Goodyera oblongifolia</i>	western rattlesnake plantain	Yes	T	4
<b><i>Hedera helix</i>*</b>	English ivy	No	8	56
<b><i>Lapsana communis</i></b>	nipplewort	No	1	33
<i>Lonicera ciliosa</i>	orange honeysuckle	Yes	1	15
<i>Lonicera hispidula</i>	hairy honeysuckle	Yes	1	4
<i>Maianthemum stellatum</i>	star-flowered false solomon's seal	Yes	T	4
<b><i>Mycelis muralis</i></b>	wall-lettuce	No	T	48
<i>Osmorhiza berteroi</i>	sweet cicely	Yes	T	19

Scientific Name <sup>1</sup>	Common Name	Native	Average cover or density in sampled plots <sup>2</sup>	Frequency park-wide (%)
<i>Polypodium glycyrrhiza</i>	licorice fern	Yes	1	19
<i>Polystichum munitum</i>	sword fern	Yes	18	96
<i>Pteridium aquilinum</i>	bracken fern	Yes	5	48
<i>Stellaria crispa</i>	crisp sandwort	Yes	T	4
<i>Tellima grandiflora</i>	fringecup	Yes	1	19
<i>Tiarella trifoliata</i>	foamflower	Yes	T	4
<i>Tolmiea menziesii</i>	piggy-back plant	Yes	6	11
<i>Trientalis borealis</i> ssp. <i>latifolia</i>	starflower	Yes	1	52
<i>Trifolium</i> sp.	clover	X	T	11
<i>Trillium ovatum</i>	trillium	Yes	T	7
	unknown forb species	X	T	4
<i>Urtica dioica</i>	stinging nettle	Yes	12	15
<b><i>Vicia hirsuta</i></b>	hairy vetch	No	T	4
<i>Viola sempervirens</i>	evergreen violet	Yes	T	11
<b>Grasses</b>				
<b><i>Agrostis stolonifera</i></b>	creeping bentgrass	No	3	7
<i>Bromus vulgaris</i>	Columbia brome	Yes	T	19
<i>Carex deweyana</i>	Dewey sedge	Yes	1	11
<i>Carex obnupta</i>	slough sedge	Yes	1	4
<b><i>Dactylis glomerata</i></b>	orchardgrass	No	5	7
<i>Elymus glaucus</i>	blue wildrye	Yes	T	19
<i>Glyceria striata</i>	tall mannagrass	Yes	T	4
<i>Luzula multiflora</i>	common woodrush	Yes	T	7
<i>Luzula parviflora</i>	small-flowered woodrush	Yes	T	19
<i>Luzula</i> sp.	woodrush	Yes	T	4
	unknown grass species	X	T	7

<sup>1</sup> Species in bold are non-native species. Species denoted by \* are species which have been given a legal designation by the King County Noxious Weed Program (King County 2007). Species denoted by \*\* are non-native invasive species which do not have a legal designation at this time.

<sup>2</sup>T=Trace presence of species (less than 1%).

## **Appendix B. Invasive Species BMPs**

### **Trees**

Norway maple (*Acer platanoides*). [http://www.na.fs.fed.us/fhp/invasive\\_plants/weeds/norway-maple.pdf](http://www.na.fs.fed.us/fhp/invasive_plants/weeds/norway-maple.pdf)

Horse chestnut (*Aesculus hippocastanum*)  
[http://www.na.fs.fed.us/fhp/invasive\\_plants/weeds/horse\\_chestnut.pdf](http://www.na.fs.fed.us/fhp/invasive_plants/weeds/horse_chestnut.pdf)

English holly (*Ilex aquifolium*). <http://dnr.metrokc.gov/wlr/lands/weeds/holly.htm>

Sweet cherry (*Prunus avium*). [http://www.na.fs.fed.us/fhp/invasive\\_plants/weeds/sweet-cherry.pdf](http://www.na.fs.fed.us/fhp/invasive_plants/weeds/sweet-cherry.pdf)

European mountain ash (*Sorbus aucuparia*)  
[http://www.na.fs.fed.us/fhp/invasive\\_plants/weeds/european-mountain-ash.pdf](http://www.na.fs.fed.us/fhp/invasive_plants/weeds/european-mountain-ash.pdf)

### **Shrubs**

Butterfly bush (*Buddleja davidii*)  
[http://www.nwcb.wa.gov/weed\\_info/buddleja\\_davidii.htm](http://www.nwcb.wa.gov/weed_info/buddleja_davidii.htm)

Himalayan blackberry (*Rubus discolor*)  
<http://dnr.metrokc.gov/wlr/lands/weeds/pdf/blackberry-control.pdf>

Scotch broom (*Cytisus scoparius*)  
[http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Scotch\\_Broom\\_factsheet.pdf](http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Scotch_Broom_factsheet.pdf)

### **Herbaceous species and vines**

Creeping buttercup (*Ranunculus repens*)  
<http://extension.oregonstate.edu/catalog/html/pnw/pnw399/>

Herb Robert (*Geranium robertianum*)  
[http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Herb\\_Robert\\_Factsheet.pdf](http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Herb_Robert_Factsheet.pdf)

English ivy (*Hedera helix*)  
<http://dnr.metrokc.gov/wlr/lands/weeds/pdf/english-ivy-control.pdf>

Yellow archangel (*Lamium galeobdolon*)  
[http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Yellow\\_Archangel\\_FactSheet.pdf](http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Yellow_Archangel_FactSheet.pdf)

**Appendix C. Stake locations for 27 plots established in Shoreview and Boeing Creek Parks**

<b>GCS WGS 1984 - Decimal Degrees</b>				
<b>Park</b>	<b>Plot</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Bearing</b>
Boeing Creek/Shoreview	1	-122.36487978261	47.75143731788	0
Boeing Creek/Shoreview	2	-122.36908080109	47.75204394931	210
Boeing Creek/Shoreview	3	-122.36477331475	47.74976295707	0
Boeing Creek/Shoreview	4	-122.36416907364	47.74877178270	270
Boeing Creek/Shoreview	5	-122.36571266473	47.74896221857	90
Boeing Creek/Shoreview	6	-122.36648335553	47.75237545337	0
Boeing Creek/Shoreview	7	-122.36528465933	47.75232797764	0
Boeing Creek/Shoreview	8	-122.36409991087	47.75245556105	0
Boeing Creek/Shoreview	9	-122.36311460708	47.75257033531	0
Boeing Creek/Shoreview	10	-122.36458646361	47.75076776632	0
Boeing Creek/Shoreview	11	-122.36339726976	47.75332151954	270
Boeing Creek/Shoreview	12	-122.36466359018	47.75349657400	270
Boeing Creek/Shoreview	13	-122.36540951925	47.75334547914	270
Boeing Creek/Shoreview	14	-122.36364272768	47.75203457033	180
Boeing Creek/Shoreview	15	-122.36166920596	47.75239955735	0
Boeing Creek/Shoreview	16	-122.36236064126	47.75393842904	120
Boeing Creek/Shoreview	17	-122.36547083650	47.75411678290	70
Boeing Creek/Shoreview	18	-122.36417248589	47.75452599534	100
Boeing Creek/Shoreview	19	-122.36157207863	47.75421784081	270
Boeing Creek/Shoreview	20	-122.36150308584	47.75524996165	270
Boeing Creek/Shoreview	21	-122.36525225696	47.75491802015	210
Boeing Creek/Shoreview	22	-122.36356382140	47.75489022465	270
Boeing Creek/Shoreview	23	-122.37008845839	47.75148180204	45
Boeing Creek/Shoreview	24	-122.36934545668	47.75259749591	45
Boeing Creek/Shoreview	25	-122.36801769267	47.75321252624	60
Boeing Creek/Shoreview	26	-122.36554068732	47.75628769124	90
Boeing Creek/Shoreview	27	-122.36621064975	47.75663139740	90

Appendix D. Map of locations for 27 plots established in Shoreview and Boeing Creek Parks. Points show the origins of plots.

