

# COTTON HILL PARK STEWARDSHIP PLAN

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# **1. INTRODUCTION**

## **1.1 Park Description**

Cotton Hill Park is a 2.2-acre (4.4 acres including associated right-of ways) undeveloped park owned by the City of Kirkland. Located at the intersection of 110<sup>th</sup> Avenue NE and NE 98<sup>th</sup> Street in the Highlands Neighborhood in Kirkland, Washington, the park is surrounded by low-density neighborhoods. The Cross Kirkland Corridor, a 5.75-mile segment of the Eastside Rail Corridor being developed as a multi-modal transportation corridor, forms the western boundary of Cotton Hill Park (City of Kirkland, 2013a; City of Kirkland, 2014).

## **1.2 Park Background**

Cotton Hill Park features both forested upland and lower-lying wetland areas. Human activities have caused significant degradation of these ecosystems. Selective logging of conifer trees, once dominant in upland forests, resulted in a landscape dominated by deciduous trees. Stormwater inputs and changes to the topography forever altered the hydrology of the wetland areas, creating conditions less favorable for the native plant species historically occupying the site. Non-native invasive plant species such as English/Atlantic ivy, Himalayan blackberry, and reed canary grass do well in such disturbed areas, and over the years, this site, like other natural areas in urban locales, has become increasingly overgrown by these introduced species. In 2005, the City of Kirkland and Forterra (then the Cascade Land Conservancy) joined forces to address the declining health of forests and other natural areas in Kirkland parks. The result was the Green Kirkland Partnership, a program that draws on City of Kirkland resources, volunteers, and partners such as Forterra, to restore City-owned forests and other natural areas according to a [20-Year Forest Restoration Plan](#) (City of Kirkland, 2008).

Cotton Hill Park is one of the sites targeted for restoration under this plan. Restoration work at this park has been ongoing since 2008.

## **1.3 Plan Purpose**

The volunteer Green Kirkland Steward program is a critical component of the 20-Year Forest Restoration Plan. The purpose of this stewardship plan for Cotton Hill Park is to assist park managers and volunteer Green Kirkland Stewards with the ongoing restoration and

management of natural areas in the park. The goal of restoration at the park is to cultivate a resilient forest, resistant to invasion by non-native species, which will provide habitat for wildlife and improved ecosystem services, including stormwater retention and reduced flooding, removal of air pollutants, and carbon sequestration. Stewardship objectives include:

- management of invasive plant species
- establishment of native vegetation, including trees, particularly conifers, and understory species
- ongoing monitoring and maintenance of restored areas

## **2. SITE ASSESSMENT**

### **2.1 Organization**

To help organize stewardship efforts and to provide a spatial reference, Cotton Hill Park has been divided into ten restoration management units. These management units were established based on a number of factors including soil characteristics, native vegetation communities, hydrology, disturbance history, and landmark features such as trails.

Hardscape, landscaped and open water areas were excluded, as these areas are not suitable for restoration activities. Figure 1 shows the location, extent, and restoration status of the management units at the park. As of the end of 2013, 3.2 acres of a total of 4.4 acres of parkland and surrounding right-of-way areas had been enrolled in restoration—note that the area targeted for restoration include several right-of-way areas in and around the park that are not included in the official total park acreage.

### **2.2 Social Inventory**

#### **2.2.1 Attractions and Facilities**

Cotton Hill Park is an undeveloped park designated for passive recreational uses. There are no restroom facilities at the park, and limited on-street parking is available. Two trails, both constructed by volunteers, give walkers and joggers access to the stream and forested wetlands in the park, and to Crestwoods Park and the Cross Kirkland Corridor to the west (Figure 1). Interpretive signage installed along the trail explains restoration activities in the park.



Figure 1. Restoration management units at Cotton Hill Park.

## **2.2.2 Demographics**

Park users are mostly residents of the surrounding low-density, single family, residential neighborhoods out for a walk or run. Many students of nearby Peter Kirk Elementary and Kirkland Middle Schools use the trails on their way to and from school.

## **2.3 Ecological Inventory**

### **2.3.1 Methods**

A rapid assessment protocol, developed by EarthCorps and Forterra's Green Cities Program, was used to collect baseline ecological data for each management unit at Cotton Hill Park. This protocol is designed to provide a general overview of site characteristics and vegetative cover. Instead of setting up sampling plots, data is collected by walking through each management unit and assessing average conditions. For each management unit, data was collected on aspect, slope, soil properties, downed and standing dead wood, litter layer, canopy characteristics, understory species, invasive plant species cover, and restoration needs. For more detail on the protocol, see Appendix I.

### **2.3.2 General Site Characteristics**

The general site characteristics are summarized in Table 1. The eastern half of the park consists of a relatively steep west-facing slope with mixed conifer-deciduous forest cover. The topography then flattens out, with deciduous forested and scrub-shrub wetland habitats dominating the low-lying western half of the park (Figure 2). Coarse woody debris cover is low in most management units, and there are few snags in the park.

A small stream traverses the southern part of the park, flowing from east to west through management units 08, 09, and 10. A drainage pipe discharges large amounts of stormwater towards the top of management unit 08, next to the stairway. Stormwater discharges are causing significant erosion, with a gully, several feet deep, extending down the length of the slope.

Table 1: General site characteristics

Management Unit	01	02	03	04
Area (acres)	0.17	0.13	0.30	0.20
Average aspect	west	southwest	west	southwest
Average slope	low	medium	low	low
Elevation low/high (feet)	174/204	200/274	174/178	180/196
Exposure	full sun	partial sun	shade	partial sun
Habitat	scrub-shrub wetland	mixed conifer-deciduous forest	forested wetland	shrubland
CWD cover (%)	0-5	5-10	0-5	10-25
Snag density	low	low	low	low
Special features	wetland; trail	trail & stairs; drainage pipe; yard waste	wetland; trail	trail
Surrounding areas	Cross Kirkland Corridor; residential development	Cross Kirkland Corridor; residential development	Cross Kirkland Corridor	
Management Unit	05	06	07	08
Area (acres)	0.12	0.35	0.27	1.29
Average aspect	southwest	west	southwest	west
Average slope	low	low	low	high
Elevation low/high (feet)	179/184	174/188	180/190	180/254
Exposure	partial sun	partial sun	full sun	shade
Habitat type	scrub-shrub wetland	forested wetland	scrub-shrub wetland	mixed conifer-deciduous forest
CWD cover (%)	5-10	5-10	5-10	5-10
Snag density	low	low	low	low
Special features	wetland; trail	wetland; trail	wetland; trail	stream; trail & stairs; drainage pipe & gully; garbage & construction rubble
Surrounding areas		Cross Kirkland Corridor		road; residential development

CWD=Coarse woody debris

Snag density: low =1-5 stems/acre; medium=5-20 stems/acre; high=>20 stems/acre



Table 2 continued: General site characteristics

Management Unit	09	10
Area (acres)	1.29	0.24
Average aspect	southwest	west
Average slope	low	medium
Elevation low/high (feet)	172/182	182/194
Exposure	shade	shade
Habitat	riparian forest	riparian forest
CWD cover (%)	5-10	5-10
Snag density	low	low
Special features	stream & wetland; trail	stream; trail; tool box
Surrounding areas	Cross Kirkland Corridor; road; residential development	road; residential development

CWD=Coarse woody debris

Snag density: low =1-5 stems/acre; medium=5-20 stems/acre; high=>20 stems/acre



Figure 2. Existing habitat types at Cotton Hill Park

### **2.3.3 Geology & Soils**

The surface geology in the upland areas of the park consists predominantly of glacial till and advance glacial outwash sands, with underlying proglacial clay, silt, and sand deposited in lake and fluvial systems, exposed in the low-lying areas (Washington State Department of Natural Resources, 2014). Field observations (Table 2) suggested the presence of Alderwood gravelly sandy loam along the upper slopes (08 and 02), Indianola and Ragnar loamy fine sand in management unit 10, and Kitsap silt loam in flatter, low-lying areas in the eastern half of the park.

Steep slopes in the park have been identified by the City of Kirkland as potentially high-risk areas for landslides (City of Kirkland, 2003). Field observations indicated that soils are generally stable, but soil disturbance associated with clearing of large areas of vegetation along the slope, may result in erosion and/or landslides. Gully formation in management unit 08 is associated with discharges from a stormwater drainage pipe. Attempts by the City to alleviate the problem have so far been unsuccessful. Minor soil compaction was observed in several areas due to informal trails associated with restoration work.

### **2.3.4 Hydrology**

Cotton Hill Park is located in the Moss Bay drainage basin in the Lake Washington-Cedar River Watershed (City of Kirkland, 2013b). The park is dominated by a wetland (named Urban 1 in the [Kirkland's Streams, Wetlands and Wildlife Study Report](#)) (The Watershed Company, 1998a) in the western half of the park. Much of this area is characterized by standing water (parts of 01 and 06) or saturated soils (parts of 03, 05, 07, and 09) for much of the year. Water percolating through sandy deposits along the slope, or flowing along the surface of the slope, accumulates in these low-lying areas where soils are less permeable. This wetland is one of several similar small wetlands scattered through the Moss Bay drainage basin.

The southern half of the park is traversed by a small stream flowing from east to west through management units 08, 09, and 10. The stream originates just to the west of 111<sup>th</sup> Avenue NE (City of Kirkland, 2013b) and appears to be fed by a combination of groundwater and stormwater runoff from developed areas to the north.

To accommodate installation of the raised north-south trail in 2008, the stream was channelized and partially rerouted where it flows through management units 09 and 10. However, high sediment load in the stream caused repeated blockages of the culvert inserted at the trail

intersection, resulting in repeated flooding, uprooting of plants, and deposition of sand along the lower part of management unit 10. Removal of the culvert in 2013 appears to have solved the blockage problem.

Soils in the upland areas of the park (management units 02, 08, and 10) are generally dry, but may be wet along the stream, especially in 10 where the slope is flatter and the stream tends to spread out over a larger area.

### **2.3.1 Wildlife**

Cotton Hill Park provides potential habitat for a variety of terrestrial wildlife, including small mammals, birds, amphibians, and reptiles. A list of wildlife species believed to use natural areas in Kirkland is available in the [Kirkland's Streams, Wetlands and Wildlife Study](#) report (The Watershed Company, 1998a).

Table 3: Soil characteristics

Management Unit	01	02	03	04	05
Soil moisture*	saturated	dry	damp	damp	saturated
Soil stability	stable	stable	stable	stable	stable
Soil texture	clay	silt	silt	silt	clay
Compaction	none	light	none	light	none
Cause of compaction	-	restoration work	-	restoration work, informal trail	-
Litter depth (inches)	0	<1/2	<1/2	<1/2-1	<1/2
Bare ground (%)	0	0	1-5	1-5	1-5
Management Unit	06	07	08	09	10
Soil moisture*	damp	damp	dry	damp	damp
Soil stability	stable	stable	stable; localized erosion associated with stormwater discharge pipe	stable	stable; periodic flooding and deposition of sand
Soil texture	silt	silt	silt	silt	sand
Compaction	none	none	none	light	light
Cause of compaction	-	-	-	informal trail, restoration work	restoration work
Litter depth (inches)	<1/2	<1/2	<1/2	<1/2	<1/2-1
Bare ground (%)	1-5	0	1-5	1-5	1-5

\*Based on conditions during August 2012

### **2.3.2 Native Vegetation Characteristics**

Native vegetation characteristics for each management unit are summarized in Table 3. Scientific names of plant species can be found in Appendix III. Note that only the dominant species present are recorded during the rapid site assessment.

#### Management Units 02 and 08 (upland forest)

The upland areas in Cotton Hill Park are characterized by mixed conifer-deciduous forest. The stream is confined to a narrow ravine in 08, and does not have a significant effect on the vegetation in the rest of the area. The dominant tree species are bigleaf maple, Douglas-fir, and western redcedar. Overstory canopy cover is well developed in 08, but sparse in 02. Conifer and deciduous overstory tree density is variable.

Regenerating tree density is low for both conifers and deciduous trees. Naturally regenerating bigleaf maple saplings are present in both management units. Although naturally regenerating western redcedar and Douglas-fir trees were observed in 08, conifer saplings in 02 were installed during restoration. Installed species include western hemlock, Douglas-fir, grand fir, and shore pine.

Native shrub and herbaceous cover is low in 02, but higher in 08. Dominant species include Indian plum, western sword fern, trailing blackberry, beaked hazelnut, low Oregon-grape, red-flowering currant, western sword fern, and trailing blackberry.

#### Management Units 03, 06, 09, and 10 (riparian forest and forested wetland)

These areas consist of a mosaic of microhabitats characterized by differences in soil moisture and associated plant species, depending on local topography and proximity to the stream. Forest composition ranges from conifer-deciduous mixed forest in 10 to deciduous forest in 03, 06, and 09. Canopy cover and tree density vary, but is low in most areas. Overstory tree species include black cottonwood, red alder, bigleaf maple, willow, and Douglas-fir. Naturally regenerating red alder, bigleaf maple, black cottonwood, and willow commonly occur. Saplings of other tree species such as western redcedar, western hemlock, Sitka spruce, grand fir, Douglas-fir, and Oregon ash have been planted during restoration.

Native shrub and herbaceous cover and composition are variable. Species include Indian plum, beaked hazelnut, salmonberry, twinberry, dull Oregon-grape, willow, snowberry, Nootka rose, cluster rose, red-twig dogwood, mock orange, Douglas' spiraea, Pacific ninebark, vine maple,

horsetail, small-fruited bulrush, piggyback plant, lady fern, western sword fern, trailing blackberry, fringecup, skunk cabbage, and tall mannagrass. Many of these species were introduced during restoration.

Management Units 01, 04, 05, and 07 (shrubland and scrub-shrub wetland)

These areas are characterized by less than 10% overstory canopy cover. The dominant vegetation cover consists of shrubs and regenerating trees, but there are also wetter pockets characterized by the presence of emergent vegetation, particularly in 01.

Overstory conifer trees and naturally regenerating conifer trees are absent from these areas, but conifer saplings have been planted as part of restoration activities. Overstory deciduous tree density is low (<50 stems/acre), but regenerating deciduous tree density, predominantly red alder, is higher at between 50 and 150 stems/acre. Other deciduous tree species include black cottonwood, willow, cascara, and bigleaf maple.

Shrub species include red-twig dogwood, salmonberry, twinberry, willow, Douglas' spiraea, Indian plum, willow, Pacific ninebark, and beaked hazelnut. Herbaceous plant species comprise small-fruited bulrush, cattail, common rush, fireweed, horsetail, trailing blackberry, fringecup, slough sedge, and western sword fern.

Table 4: Native vegetation characteristics

Management Unit	01	02	03	04
Overstory tree canopy cover (%)	0-25	0-25	50-75	25-50
Overstory conifer tree density	none	low	none	none
Regenerating conifer tree density	none	medium	low	medium
Overstory deciduous tree density	low	low	low	low
Regenerating deciduous tree density	medium	low	high	medium
Average overstory tree diameter (inches)	-	15-20	5-15	5-15
Shrub cover (%)	25-50	5-25	25-50	50-75
Herbaceous cover (%)	75-100	5-25	0-5	5-25
Dominant tree species	red alder, willow, black cottonwood	western redcedar, bigleaf maple	black cottonwood, red alder, big-leaf maple	black cottonwood, red alder
Dominant regenerating tree species	willow, black cottonwood, red alder	western hemlock, Douglas-fir, grand fir, shore pine, bigleaf maple	red alder, black cottonwood, bigleaf maple, western redcedar	western hemlock, western redcedar, red alder, cascara
Dominant shrub species	red-twig dogwood, salmonberry, twinberry, willow, Douglas' spiraea	red-flowering currant, low Oregon- grape, Indian plum	Indian plum, salmonberry, twinberry, beaked hazelnut	salmonberry, Indian plum, twinberry, willow, Pacific ninebark
Dominant herbaceous species	small-fruited bulrush, cattail, common rush	western sword fern, trailing blackberry	western sword fern, horsetail, fringecup	fireweed, horsetail, trailing blackberry, fringecup, slough sedge

Stem density: low=0-50 stems/acre; medium=50-150 stems/acre; high=>150 stems/acre



Table 3: Native vegetation characteristics (continued)

Management Unit	05	06	07
Overstory tree canopy cover (%)	25-50	25-50	0-25
Overstory conifer tree density	none	none	none
Regenerating conifer tree density	none	none	none
Overstory deciduous tree density	low	medium	low
Regenerating deciduous tree density	medium	low	low
Average overstory tree diameter (inches)	15-20	15-20	20-30
Shrub cover (%)	5-25	5-25	5-25
Herbaceous cover (%)	0-5	0-5	0-5
Dominant tree species	willow, black cottonwood, red alder	willow, black cottonwood, red alder	black cottonwood
Dominant regenerating tree species	willow, red alder, western redcedar	red alder, willow	bigleaf maple, black cottonwood
Dominant shrub species	willow, salmonberry	salmonberry, willow	salmonberry, Indian plum, beaked hazelnut
Dominant herbaceous species	small-fruited bulrush, horsetail	horsetail, small-fruited bulrush, piggyback plant	western sword fern, horsetail, fringecup

Stem density: low=0-50 stems/acre; medium=50-150 stems/acre; high=>150 stems/acre

Table 3: Native vegetation characteristics (continued)

Management Unit	08	09	10
Overstory tree canopy cover (%)	>75	>75	>75
Overstory conifer tree density	medium	low	low
Regenerating conifer tree density	low	low	medium
Overstory deciduous tree density	low	medium	low
Regenerating deciduous tree density	low	high	low
Average overstory tree diameter (inches)	20-30	15-20	20-30
Shrub cover (%)	25-50	50-75	25-50
Herbaceous cover (%)	25-50	50-75	5-25
Dominant tree species	Douglas-fir, western redcedar, bigleaf maple	Douglas-fir, black cottonwood, red alder, bigleaf maple	Douglas-fir, bigleaf maple, red alder
Dominant regenerating tree species	western redcedar, Douglas-fir, bigleaf maple	western hemlock, western redcedar, Sitka spruce, grand fir, Oregon ash, red alder	western hemlock, Sitka spruce, Douglas-fir, western redcedar, bigleaf maple, red alder
Dominant shrub species	beaked hazelnut, Indian plum, low Oregon-grape, evergreen huckleberry, red huckleberry	salmonberry, vine maple, twinberry, Indian plum, snowberry, Nootka rose, cluster rose	red-twig dogwood, twinberry, mock orange, vine maple, beaked hazelnut, Douglas' spiraea, Pacific ninebark
Dominant herbaceous species	western sword fern, trailing blackberry	lady fern, western sword fern, skunk cabbage, horsetail, trailing blackberry, small-fruited bulrush, Cooley's hedge-nettle	fringecup, western sword fern, horsetail, lady fern, skunk cabbage, tall mannagrass

Stem density: low=0-50 stems/acre; medium=50-150 stems/acre; high=>150 stems/acre

### **2.3.3 Non-Native Invasive Vegetation**

Non-native invasive vegetation characteristics are summarized in Table 4. Scientific names of plant species can be found in Appendix III.

Invasive overstory trees are present only in 08 and 09, and consist exclusively of sweet cherry. Regenerating invasive tree species were found in 03, 04, 08, and 09 where they occur at low densities, and include sweet cherry, English holly, European mountain-ash, and Portugal laurel.

The dominant invasive shrub species is Himalayan blackberry. Evergreen blackberry is also commonly present, but, for the purposes of this report, is included with Himalayan blackberry. Blackberry is present in all management units, with cover less than 25% in most areas. More significant cover (up to 50%) was reported for 01, 03, and 04.

Invasive herbaceous species are present in all management units, with more than 75% cover in 02, 03, 05, and 06. Both reed canary grass and false hedge bindweed are widespread in many areas of the park. English/Atlantic ivy is limited to relatively isolated areas. Small populations of knotweed are present in the southern part of 09 and in 04. Other species include creeping buttercup and herb Robert.

Table 4: Non-native invasive vegetation characteristics

Management Unit	01	02	03	04	05
Overstory stem density	none	none	none	none	none
Regenerating stem density	none	none	low	low	none
Shrub cover (%)	25-50	5-25	25-50	25-50	5-25
Herbaceous cover (%)	5-25	75-100	75-100	5-25	75-100
Dominant tree species	-	-	-	-	-
Dominant regenerating tree species	-	-	sweet cherry, European mountain ash	English holly	-
Dominant shrub species	Himalayan blackberry	Himalayan blackberry	Himalayan blackberry	Himalayan blackberry	Himalayan blackberry
Dominant herbaceous species	creeping buttercup, reed canary grass	creeping buttercup, herb Robert, hedge bindweed, reed canary grass	reed canary grass, creeping buttercup	creeping buttercup, herb Robert, ivy, knotweed	hedge bindweed, reed canary grass
Management Unit	06	07	08	09	10
Overstory stem density	none	none	low	low	none
Regenerating stem density	none	none	low	low	none
Shrub cover (%)	5-25	5-25	25-50	5-25	0-5
Herbaceous cover (%)	75-100	5-25	0-5	5-25	25-50
Dominant tree species	-	-	sweet cherry	sweet cherry	-
Dominant regenerating tree species	-	-	sweet cherry, Portugal laurel	sweet cherry, European mountain ash	-
Dominant shrub species	Himalayan blackberry	Himalayan blackberry	Himalayan blackberry	Himalayan blackberry	Himalayan blackberry
Dominant herbaceous species	hedge bindweed	ivy	ivy	creeping buttercup, ivy, reed canary grass, knotweed, hedge bindweed	hedge bindweed, creeping buttercup, reed canary grass

Stem density: low=0-50 stems/acre; medium=50-150 stems/acre; high=>150 stems/acre

### **3. STEWARDSHIP**

The primary management concerns at Cotton Hill Park include:

- the presence of non-native invasive plants
- the scarcity of mature conifer trees and lack of conifer tree regeneration
- the risk of erosion along steep slopes, especially in areas requiring large-scale removal of invasive species

The basic restoration approach followed by the Green Kirkland Partnership is invasive plant removal, followed by planting with native species. Planting a variety of native species is recommended, with planting palettes for forested areas including trees, particularly conifers, to regenerate the overstory, and a variety of shrubs and ground covers to increase structural and compositional diversity in the understory. Continued maintenance and monitoring for several years will be required to ensure restoration success.

#### **3.1 Best Management Practices**

The best management practices for Green Kirkland Steward restoration activities are summarized below. More detailed descriptions of these practices are available in the [Green Kirkland Steward Field Guide](#) (Green Cities Partnerships, 2014). Links to additional resources are included in the discussion below—website addresses for these and other resources are listed in Appendix II.

##### **3.1.1 Invasive Species Removal**

For help with the identification of invasive plants, as well as additional resources about removal and disposal methods, see the [King County Noxious Weed website](#) (King County, 2014). Most control methods need to be applied over several growing seasons to be effective. The best time to manually remove plants by digging or hand pulling, is between fall and spring, when the ground is moist and soft. Minimize soil disturbance to avoid germination of seeds of invasive species. Mulch bare ground, and plant cleared areas with native species, to discourage non-native plants from re-colonizing. Volunteers are restricted from using power tools or applying herbicide in City of Kirkland parks. Such treatments can only be applied by Parks staff or contracted crews. Best practices for removal of specific species are as follows:

### Himalayan and Evergreen Blackberry

Himalayan and evergreen blackberry are robust, thicket-forming shrubs that spread both by seed and by rooting at cane tips. Removal of blackberry consists of a two-step process: cutting the canes, followed by grubbing out the root balls. Blackberry canes are cut about one foot above the ground using loppers or pruners. Root balls are then dug up completely, using a shovel, to prevent regrowth. Removed plant material can be composted on site, but avoid contact with damp soil, since plants can regrow from root and stem fragments. To minimize soil disturbance along steep slopes, dabbing cut canes with herbicide may sometimes be a more appropriate treatment than digging up root balls.

### English/Atlantic Ivy

Ivy is an evergreen vine that spreads both by seed and by rooting at nodes along the vine. Physical removal is the most effective way to control ivy. The top priority is to create lifesaver or survival rings around infested trees. Start by cutting ivy vines at shoulder height and at the base of the tree. Remove all ivy from shoulder-height down to the base of the tree. Do not attempt to pull down vines from higher up the tree; they will die and decompose in time. Pulling vines down from high branches can be dangerous and possibly damage the tree.

Clear ivy in a radius of at least five feet around trees by grubbing out ivy roots. Remove extensive swathes of ivy on the ground by clipping the edges of a five to ten-foot-wide section. Starting from one edge, continue clipping and digging, while rolling the mat of ivy into a log.

Small patches of ground-growing ivy can be removed by loosening the soil with a shovel and pulling by hand. Ivy can be composted on site using a compost pile system that will ensure the ivy does not come into contact with the soil.

### Knotweed Complex

Species in the knotweed complex include Japanese knotweed, giant knotweed, Himalayan knotweed, and Bohemian knotweed, a hybrid between giant and Japanese knotweed. These plants are tall, clump-forming, herbaceous perennials that spread by underground rhizomes and, less commonly, seed. Plants can regrow from stem or root fragments.

Repeated cutting or digging can be used to control small, isolated infestations of knotweed. Dried out stems can be composted, but do not compost roots or rhizomes. Herbicide treatment

(foliar spray or stem injection), applied during the summer months, is recommended for larger infestations. Stewards should discuss appropriate treatment for each site with the Green Kirkland Partnership staff.

#### Field and False Hedge Bindweed

Hand pull at least three times per year (early growing season, mid-summer, and late summer) for at least three growing seasons. Avoid digging or tilling the soil around the roots. Smothering plants with mulch, black plastic, or geotextile fabric is another option, but the covering has to be kept in place for several years. As an interim measure, clear all the bindweed from the native plants first, or at minimum, clip the bindweed away from the base of plants that are trying to establish.

#### Reed Canary Grass

Reed canary grass is a tall wetland grass that spreads by seeds and rhizomes. Small patches of reed canary grass may be hand-pulled or dug out. Thoroughly remove the entire root mass to discourage re-growth. If stems are not underwater, small infestations may be covered by black plastic or non-woven geotextile fabric. This will not completely eliminate reed canary grass, but will reduce the density and allow establishment of native vegetation. Mowing twice a year is an alternative approach.

Large patches may require herbicide treatment. Reed canary grass does not do well in shade—the best long-term management strategy is to establish a shade canopy by planting evergreen trees or fast-growing shrubs such as willows.

#### Herb Robert

Herb Robert is a low-growing winter or spring annual that reproduces solely by seed. Remove by hand by grasping plants firmly at the base and pulling. Monitor the site throughout the growing season and remove any new plants. Large patches can be covered with sheet mulch.

Put flowering plants and those beginning to set seed into a trash bag for disposal. If plants are in full seed, it may be better to leave them in place until the following year when plants can be removed without dispersing seeds. Plants without seeds or mature flowers can be composted on site.

### Suckering Invasive Trees and Shrubs

This category includes Portugal laurel, cherry laurel, sweet cherry, English holly, and common hawthorn. Cutting down these plants without removing the roots causes it to send up suckers, exacerbating the problem. Small, young plants may be hand pulled or removed using a Weed Wrench™ or similar tool. Note that freshly cut stems or branches of some species can re-root if in direct contact with the soil.

Mature invasive trees requires chemical removal methods, such as cut-stump or lance treatment. Cut-stump treatment consists of the application of herbicide to the cut portion of the trunk immediately after cutting. Lance treatment is a newer, less labor-intensive method that involves injecting herbicide shells into the base of the tree trunk.

### Creeping Buttercup

Creeping buttercup is a low-growing perennial plant species. Use a shovel or hand tool to dig up plants—remove all roots, runners, and growing points. Buttercup can sprout from nodes along stem and root fragments. Incomplete digging, or use of a cultivator or other cutting tools may make the problem worse. Large, very dense patches can be sheet-mulched. Spreading mulch over a layer of cardboard is more effective than spreading mulch alone.

### **3.1.2 Composting**

Composting on site is cost effective, helps to leave organic material and nutrients on site, and provides excellent habitat for wildlife, but may not be appropriate for all plant species and/or sites (Green Cities Partnerships, 2014). Guidelines for composting removed plant material are available in the [Green Kirkland Steward Field Guide](#).

### **3.1.3 Planting & Mulching**

Best Management Practices for planting and mulching are available in the [Green Kirkland Steward Field Guide](#). Plant between late fall and early spring to ensure sufficient soil moisture for plant establishment. It may be necessary to water plants during the dry summer months for the first three years after planting.

Mulching around plants serves several purposes: it helps to conserve soil moisture, moderate soil temperatures, deter weed growth, and prevent soil erosion. Organic mulches, such as wood chips, also add organic matter and some nutrients to the soil.



When it comes to plant selection there are a number of factors to consider: In natural ecosystems, specific assemblages of plant species tend to grow together, typically in areas with similar environmental conditions and disturbance history. When developing a plant palette for a site, consider site conditions, particularly soil texture and moisture, slope aspect and position, and exposure (sun or shade). Bear in mind that environmental conditions can change over short distances. Also take into account surrounding land uses, especially in urban areas. For example, it may be necessary to limit plant selections to low-growing species to preserve view corridors, or to maintain visibility along trails for safety reasons.

Then identify the target plant community you will use as a reference. This target plant community could be based on field observations from a nearby relatively undisturbed site, published information, or a combination. Several resources to help with plant selection are listed in Appendix II.

### **3.1.4 Special Considerations**

Special care should be taken when working in geologically hazardous areas, such as steep slopes, or in sensitive areas such as in wetlands or along streams and lakes, or their buffers:

#### Slope Management

Removal of vegetation and soil disturbance along slopes may trigger erosion or landslides. The risk of erosion or landslides depends on many factors, including slope angle and length, soil properties, underlying geology, type and amount of vegetative cover, and the presence of water on the slope. Where large areas have been cleared of invasive plants, the slope may need to be stabilized. Consider the following best management practices:

- Select invasive removal techniques that involve the least amount of soil disturbance.
- Where slopes are not too steep, apply wood chip mulch. If the slopes are too steep to retain mulch, commercially available erosion control products can be applied. WoodStraw® works well on slopes with a grade of up to about 50% (~ 27°); on steeper slopes, coir matting is an appropriate choice.
- Place large woody debris across the slope to divert water flowing down the slope.
- Establishing vegetation on slopes offers long-term protection against erosion. Live-staking with species like willows is a way to establish vegetation cover in a relatively short time, provided there is enough soil moisture. Select plant species with fibrous root

systems that will help bind the soil. Plant trees at the crest or toe of the slope; avoid installing trees that will grow to a large size along the slope itself. Plant species appropriate for slopes are listed on the State of Washington Department of Ecology [Slope Stabilization and Erosion Control](#) website.

For safety reasons, volunteers are not permitted to work on slopes steeper than 40%. When working in areas with medium to high slopes, stewards should discuss appropriate treatments with Green Kirkland Partnership staff.

### Wetlands, Streams, and Lakes

Plants in wetlands and adjacent to streams and lakes perform many functions. Vegetation slows down surface runoff, allowing water to soak into the soil, and intercepts sediments, excess nutrients, and other pollutants. Plant roots also bind the soil, helping to reduce erosion. Trees contribute woody debris to streams, improving fish habitat and slowing down stream flow, and trees and shrubs create shade, reducing stream water temperatures. Vegetation in these areas also provides food and shelter for wildlife.

Take care to minimize impacts to these sensitive areas during restoration treatments by following these general guidelines:

- Stewards should consult with Green Kirkland staff before conducting first time removal of invasive plants or planting within 10 feet of the stream channel or in particularly wet, muddy, or erodible areas of wetlands. It may be necessary to check with the Public Works and/or Planning Departments before working in these areas.
- Limit the number of volunteers working in these areas to reduce the amount of foot traffic.
- Avoid clearing large areas of vegetation at one time, especially in areas sloping down towards the stream channel.
- Minimize soil disturbance during manual invasive plant removal, and cover exposed areas of soil with a layer of mulch.
- Replant exposed areas by installing native plant species that grow fast and have good soil-binding properties. Live stakes of native willows, red-twig dogwood, black cottonwood, black twinberry, Pacific ninebark, red elderberry, and salmonberry work well in relatively wet areas. Consider including native sedges, grasses, and rushes.

- Limit herbicide use in wet areas. If herbicide use cannot be avoided, check permitting requirements and use herbicides specially formulated for such areas. Remember that such treatments can only be applied by Parks staff or contracted crews.

### **3.2 Recommendations**

Restoration status and considerations, as well as recommendations for each management unit, are summarized in Tables 5 and 6, respectively. Approximately 73 percent of the areas targeted have already been enrolled in restoration.

The presence of sensitive wetland and riparian areas in Cotton Hill Park is a particular concern. Work in these areas should involve as little soil disturbance as possible, and should be performed in close consultation with Green Kirkland staff.

#### Management Units 02 and 08

The target habitat for this area is conifer-deciduous mixed forest (Figure 3). All of management unit 02 has been enrolled in restoration, and most of 08 should be in restoration by the end of 2014. Work along steep slopes in management unit 08 are being done mostly by professional crews, both for safety reasons, and because of the risk of triggering erosion. Volunteers should also avoid working in the vicinity of the drainage ditch—leave a 10 to 15 foot wide buffer on either side of the ditch. Remaining areas of 08 are accessible to volunteers to do restoration work. Management recommendations include:

- Continue manual removal of invasive species, particularly Himalayan blackberry and hedge false bindweed.
- Both these areas have been planted with native plants, and additional large-scale planting may not be necessary. Supplemental planting may be called for if mortality of installed plants is high:
  - Plant trees, especially conifers, where density of regenerating trees are absent or low. Include species like Douglas-fir and grand fir for planting in more exposed areas, and western hemlock and western redcedar in shadier spots.
  - Plant forest understory species. Appropriate species will be determined by local site exposure and soil conditions. Native plant species already growing in the forest are well adapted to site conditions, and are good first choices for restoration plantings (see Table 3).

- Summer watering of plants for the first 3 years after installation may be necessary in some areas, especially along the northern parts of the west-facing slope where canopy cover is low.

### Management Units 03 and 06

The target habitat for 03 and 06 is forested wetland (Figure 3). All of management units 03 and part of 06 have been enrolled in restoration. These areas are accessible to volunteers, but work in wet areas should only occur after consultation with Green Kirkland staff.

Management recommendations include:

- Continue manual removal of invasive species, particularly Himalayan blackberry, reed canary grass, ivy, and hedge false bindweed.
- Additional planting may be necessary where installed plants have died or where new areas have been cleared of invasive vegetation. Recommendations for planting include the following:
  - Install dense plantings of fast-growing shrubs to create shade and compete with non-native plants, especially in areas where reed canary grass infestations are present. Species to consider include willows, red-twig dogwood, and salmonberry, all of which can be installed as livestock stakes.
  - Install additional conifers. In time, the year-round shade created by the slow-growing conifers will help to control invasive weed infestations. Western redcedar and Sitka spruce will do well in wetter areas. Plantings of Douglas-fir, western hemlock, and grand fir should be limited to topographically raised areas where the soil is drier.

### Management Units 09 and 10

The target habitat for 09 and 10 is riparian forest (Figure 3). All of management units 10 and part of 09 have been enrolled in restoration. These areas are accessible to volunteers, but work along the stream and in wet areas should only occur after consultation with Green Kirkland staff.

Management recommendations include:

- Continue manual removal of invasive species, particularly Himalayan blackberry, reed canary grass, ivy, and hedge false bindweed.

- Knotweed in 09 has been treated with herbicide, but repeat treatments will likely be necessary.
- Large areas have already been planted with native plants, but additional planting may be necessary where installed plants have died or where large areas have been cleared of invasive vegetation. Recommendations for planting include the following:
  - Install denser plantings along the stream channel, especially in 10, above the area where flooding is a problem. This will help reduce erosion of the sandy soils which is contributing to the stream sediment load.
  - Install dense plantings of fast-growing shrubs to create shade and compete with non-native plants, especially in areas where reed canary grass infestations are present. Species to consider include willows, red-twig dogwood, and salmonberry, all of which can be installed as livestock.
  - Install additional conifers. In time, the year-round shade created by the slow-growing conifers will help to control invasive weed infestations. Western redcedar and Sitka spruce will do well in wetter areas. Plantings of Douglas-fir, western hemlock, and grand fir should be limited to topographically raised areas where the soil is drier.

#### Management Units 01

The target habitat for management unit 01 is scrub-shrub wetland (Figure 03). All of this unit has been enrolled in restoration. However, cover of non-native invasive plant species is still significant. Recommendations for this area include:

- Continue efforts to control invasive plants by manual removal.
- For more effective long-term control, especially of reed canary grass and Himalayan blackberry, install dense plantings of fast-growing shrubs. Much of this unit may be too wet for successful establishment of trees, but appropriate trees species can be installed in topographically higher parts of this management unit.

#### Management Units 04

This area appears to be drier than the surrounding management units. The target habitat is conifer-deciduous mixed forest (Figure 3). All of management unit 04 has been enrolled in restoration. Extensive plantings has been installed, but invasive plant species cover remain significant. Recommendations for this areas is limited to continued control of invasive plants,

including knotweed, by manual removal. In time, as planted trees and shrubs grow up, the spread of invasive plants should become less of a problem.

#### Management Units 05 and 07

The target habitat for these areas is forested wetland (Figure 3). Except for part of management unit 07, these areas have been enrolled in restoration. Recommendations for these areas are similar to those for management units 03 and 06, with additional emphasis on planting trees.

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Figure 3. Map of target habitat types at Cotton Hill Park.

Table 5: Restoration status and accessibility.

Management Unit	01	02	03	04	05
Target habitat	scrub-shrub wetland	conifer-deciduous mixed forest	forested wetland	conifer-deciduous mixed forest	forested wetland
Area in restoration (%)	100	100	100	100	100
Accessibility	volunteers	volunteers	volunteers	volunteers	volunteers
Special considerations	wetland	drainage pipe; wetland buffer	wetland	wetland buffer	wetland
Management Unit	06	07	08	09	10
Target habitat	forested wetland	forested wetland	conifer-deciduous mixed forest	riparian forest	riparian forest
Area in restoration (%)	58	74	51	74	100
Accessibility	volunteers	volunteers	crew/staff/volunteers	volunteers	volunteers
Special considerations	wetland	wetland	drainage pipe & gully; steep slopes & risk of erosion & landslide; stream & wetland buffer	stream & wetland	stream & wetland



Table 6: Management recommendations for each unit.

Management Unit	Control of invasive plants by manual removal	Knotweed treatment	Ivy lifesaver rings	Invasive tree removal		Slope stabilization/ Erosion control	Plant installation
				Manual removal	Herbicide treatment		
01	large-scale						x
02	large-scale						
03	large-scale			x	x		x
04	spot	x*		x			
05	large-scale						x
06	large-scale						x
07	spot						x
08	large-scale			x	x	x	x
09	spot	x*	x	x	x		x
10	large scale						x

\*Knotweed in management units 04 and 09 have been treated with herbicide. Repeat treatments may be necessary.

### **3.3 Materials**

To request materials for restoration activities, fill out a [Tools, Materials & Event Request Form](#) (click on the Steward Resources link on the [GreenKirkland.org](#) webpage) at least three weeks in advance of the event, and email to [greenkirkland@kirklandwa.gov](mailto:greenkirkland@kirklandwa.gov).

#### Tools

There is a lock box with tools at Cotton Hill Park. For larger volunteer events, the Green Kirkland tool trailer can be requested. An inventory of tools and equipment in the trailer is available at [GreenKirkland.org](#) under [Steward Resources](#).

#### Mulch

For help on calculating the amount of wood chip mulch to order, consult the [Green Kirkland Steward Field Guide](#). Other types of mulch commonly used include burlap sacks and cardboard, usually in combination with wood chip mulch.

#### Plant material

Guidelines for calculating the number of plants needed, as well as tools for selecting appropriate plant species, are available in the [Green Kirkland Steward Field Guide](#). A handy calculator for estimating the quantity of plants needed is available on the [Sound Native Plants Nursery website](#).

### **3.4 Volunteers**

The volunteer Green Kirkland Steward leads small weekly work parties with regular volunteers from the Highlands Neighborhood. Corporate and school groups occasionally have work parties at the park, usually under the guidance of the park steward. As of June 2013, more than 1,000 volunteers had contributed a total of 3,856 hours to removing invasive plant species and installing and mulching native plants at this park.

In addition, a large annual event attracts up to 150 volunteers. Volunteers for these larger events are usually recruited and managed by contracted environmental organizations or professionals. Volunteers at restoration events include park neighbors and community members, youth groups, faith-based groups, corporate groups, and students filling community service hours.

Restoration in several areas of the park were initiated as University of Washington Restoration Ecology Network ([REN](#)) capstone projects. These projects were installed between 2008 and 2011.

### **3.5 Monitoring**

Monitoring is an essential step in restoration, particularly in urban areas surrounded by development. Such areas experience ongoing disturbance and are prone to invasion by non-native, invasive plant species. Monitoring can take different forms, including photo documentation, visual inspection, and scientific monitoring.

#### Visual inspection

The most basic form of monitoring is simply to walk through a site and do a visual inspection. Factors to assess include plant health, invasive plant cover, or anything else that may affect restoration success. Target performance standards are site and species dependent, but for most invasive plant species, cover of more than approximately 5-10% will trigger maintenance actions. The benchmark for survival of installed trees and shrubs is ~85%. Higher mortality should lead to a reevaluation of restoration methods and corrective actions, such as supplemental watering or replanting with species better able tolerate site conditions. In addition to regular site visits by Green Kirkland Stewards, City managers and/or staff visit sites at least once a year as part of developing annual work plans.

#### Photo documentation

Photo documentation is a good method of tracking development of restoration sites. This entails establishing photo points and taking repeated photos of the same area over time.

When establishing photo points and taking photos consider the following:

- Along with photos, provide walking directions to the photo point location and a detailed description of the surrounding area. Include information about landmarks that will make it easier to relocate the site. Also, record the direction of shooting, the park name, management unit number, the date, and the name of the photographer.
- Repeat photos should be taken at the same time of year to allow for meaningful comparisons. Include notes on significant developments or activities at the site that occurred since the previous photo was taken.

- Try to take repeat photos at the same time of day. If possible, take the photo facing south, with the sun behind you and the sunlight shining on the landscape facing you. This helps prevent glare and avoids direct sunlight in the shot. Taking photos on a cloudy but bright day can help avoid strong shadows.
- To ensure consistency when taking repeat photos, take a copy of the previous photos to the site with you, and use it to compare with the field of view.
- Submit photos and recorded information to Green Kirkland Partnership staff for archiving.

### Scientific monitoring

Scientific monitoring involves setting up permanent plots and collecting quantitative data over time. This method is more labor intensive and rigorous than visual inspection or photo documentation, but does allow for in-depth evaluation of site conditions and the effectiveness of management techniques. The Green Cities program has developed a set of [Standardized Monitoring Protocols](#) (Green Cities Partnerships, 2012). Trained volunteers, staff, or contractors collect data on plant survival, vegetative cover, tree density, coarse woody debris, and soil conditions. A permanent restoration plot was installed by EarthCorps and volunteers in management unit 08 during summer 2013.

### **3.6 Timeline**

Restoration at Cotton Hill Park has been ongoing since 2008. The area not yet in restoration in the park is relatively small. However, due to the park's location in an urban environment and continued pressure from invasive plant species, areas already in restoration will require many years of ongoing maintenance and monitoring. An annual work plan, created towards the beginning of each calendar year by stewards, Green Kirkland and other City of Kirkland staff, and contracted crews, lays out what work is planned for each management unit for that year.

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## **APPENDIX I. RAPID ECOLOGICAL ASSESSMENT PROTOCOLS**

These rapid assessment protocols were designed to provide a general overview of the conditions present in each management unit within a park. For each management unit, data collection includes a Site Characteristics Inventory and a Vegetation Inventory.

### **Site Characteristics Inventory**

This inventory assesses attributes such as slope, aspect, soil type, and other features of the management unit that can aid in creating a restoration plan.

#### Aspect

Aspect refers to the direction in which water flows off the site. Options include N, NE, E, SE, S, SW, W, NW, or Flat. A compass is used to determine the predominant direction of slope on the site.

#### Slope

This is a measurement of slope angle. It is measured using an electronic or mechanical clinometer, or it can be visually estimated. Use the following categories:

- low, which is equivalent to 0-8% or 0-5°
- medium, which is equivalent to 8-25% or 5-14°
- steep, which is equivalent to >25% or >14°

#### Soil Moisture

Soil moisture refers to the general moisture conditions of the soil as they appear at the time of measurement, or are most likely to appear on any given summer day. Options include standing water, saturated soil, damp soil, or dry soil.

#### Soil Type

Soil type refers to the dominant size of mineral particles in the sample (sand, silt, clay, or gravel). A small sample of soil is taken from several areas and examined. Sandy soils feel gritty. Clay soils feel sticky. Silty soils feel smooth or slippery. Muck is a special category of soil that consists mostly of decomposed organic matter. Muck is usually black and found in wetlands.

#### Soil Compaction

Soil compaction occurs when the mineral particles in the soil are compressed, often as a result of foot traffic, or vehicles and heavy equipment moving over the soil. During the site assessment, the presence of areas compacted as a result of human activity, such as trails, is

recorded. The general degree of compaction in each management unit is estimated using the following categories: none, light, moderate, or heavy.

#### Soil Stability

The assessment of soil stability consists of looking for evidence of soil movement in the management unit. Categories include none, erosion, slumping, or slides.

#### Litter Depth

A pencil or small ruler is used to probe the depth of the litter layer on top of the soil. The depth of the litter layer is recorded in one of the following categories: <math>\frac{1}{2}</math> inch,  $\frac{1}{2}$ -1", 1-2", 2-5", or >5".

#### Bare Ground

Percent bare ground, or mulch without plants, is recorded in one of the following categories: 0-5%, 5-10%, 10-25%, 25-50%, or >50%.

#### Coarse Woody Debris (CWD)

The percent cover of coarse woody debris (diameter must be greater than 5 inches) on the ground is visually estimated. Record as 0-5%, 5-10%, 10-25%, 25-50%, or >50% cover.

#### Snag Density

The number of standing dead trees with a DBH (diameter at breast height) of greater than 5 inches is estimated. Record as none, low (1-5 stems per acre), medium (5-20 stems per acre), or high (>20 stems per acre).

#### Overstory Tree Diameter

The average diameter at breast height (DBH) of overstory trees, i.e. trees with a DBH larger than 5", in the management unit is recorded in one of the following categories: 5-15", 15-20", 20-30", or >30".

#### Habitat Type

Habitat type is classified as follows:

- Forests are characterized by more than 25% tree canopy cover. To determine forest habitat type, there must be 30% or greater overstory cover of that type of tree present.

The characteristics of different forest types are as follows:

- Conifer forest—overstory dominated by conifer trees
- Conifer-deciduous mixed forest—conifer and deciduous trees each comprise more than 30% of the overstory



- Deciduous forest—overstory dominated by deciduous trees
- Madrone forest—more than 30% of the overstory dominated by Pacific madrone trees
- Madrone-conifer mixed forest—madrone and conifer trees each make up more than 30% of the overstory
- Madrone-deciduous mixed forest—madrone and deciduous trees each make up more than 30% of the overstory
- Forested wetland—more than 30% of trees growing in standing water or saturated soils, or more than 30% of area has small wetlands present entirely beneath overhanging forest canopy
- Riparian forest—forest dominated by the presence of a stream or lake
- Savannah—10-25% tree canopy with unmaintained grass, shrubs, or both
- Oak savannah—10-25% tree canopy dominated by oak trees with unmaintained grass, shrubs, or both
- Shrubland—less than 10% overstory canopy and dominated by shrubs or regenerating trees
- Riparian shrubland— shrubland adjacent to a stream or a lake, with less than 10% overstory canopy, and dominated by shrubs or regenerating trees
- Shrub-scrub wetland—less than 10% overstory canopy, and dominated by shrubs or regenerating trees growing in standing water or saturated soils
- Emergent wetland—herbaceous plants growing in standing water or saturated soils
- Grassland/Meadow—less than 10% tree canopy with unmaintained grass

### Special features

Special features such as wetlands, streams, dumps, encampments, power lines, roads, etc. found on, or adjacent to, the site are listed.

## **Vegetation Inventory**

### Overstory Canopy Cover

The percentage overstory tree (DBH>5") canopy cover present in the management unit is estimated visually. The following categories are used: 0-25%, 25-50%, 50-75%, >75%.

### Tree Density

The relative densities of overstory (>5 inches DBH) and regenerating trees (<5 inches DBH) are estimated. The approximate stems per acre and spacing are used to determine tree density according to the rubric below. Tree density is recorded as none, low, medium, or high.

Stem density	none	low	medium	high
Number of stems/acre	0	0-50	50-150	>150
Spacing (feet on center)	-	43-30	30-17	<17

### Shrub Cover

The area covered by native and invasive shrub species is visually estimated and expressed as a percentage of the total area and recorded in the following categories: 0-25%, 25-50%, 50-75%, or >75%.

### Herbaceous Cover

For the purpose of this assessment, the herbaceous layer includes herbaceous plants, graminoids (grasses, rushes, and sedges), and ferns. The percentage cover of native and invasive species in the herbaceous layer is visually estimated and recorded as 0-25%, 25-50%, 50-75%, or >75%.

### Dominance

Dominance refers to the species of greatest prevalence/biomass and which has the most influence on the plant community. Indicate dominance by placing a number between 1 and 3 after each species, with 1 being most dominant. Species sharing a value of 1 are co-dominant. A value of 2 refers to a prevalent but not dominant species, and a 3 is considered least prevalent. Up to four species of trees, shrubs, or herbaceous plants can be listed for each category.

### Restoration

The general scale and type of restoration that is required in the management unit is noted.

Relevant information includes:

- the percentage of the management unit in active restoration
- the scale of restoration needed, i.e. spot or large-scale
- type of invasive removal needed, i.e. manual removal, invasive tree treatment, herbicide treatment, or survival rings

- other actions needed, such as additional planting, erosion control, existing site maintenance
- accessibility, i.e. volunteer, contractor, steep slopes, etc.

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## **APPENDIX II.        ADDITIONAL RESOURCES**

### **City of Kirkland**

City of Kirkland Comprehensive Plan, Highlands Neighborhood:

<http://www.codepublishing.com/wa/kirkland/>

City of Kirkland, GIS Maps:

[http://www.kirklandwa.gov/depart/Information\\_Technology/GIS/GIS\\_Maps.htm](http://www.kirklandwa.gov/depart/Information_Technology/GIS/GIS_Maps.htm)

Cross Kirkland Corridor:

[http://www.kirklandwa.gov/Community/Cross\\_Kirkland\\_Corridor/About.htm](http://www.kirklandwa.gov/Community/Cross_Kirkland_Corridor/About.htm)

King County iMap (Interactive Mapping Tool) Property Information:

<http://www.kingcounty.gov/operations/GIS/Maps/iMAP.aspx>

### **Green Kirkland Partnership**

20-Year Forest Restoration Plan:

<http://www.kirklandwa.gov/Assets/Parks/Green+Kirkland+Partnership+PDFs/Green+Kirkland+Partnership+20+year+plan.pdf>

### **Restoration Resources**

#### Restoration Tools

Green Kirkland Steward Field Guide:

<http://www.kirklandwa.gov/Assets/Parks/Green+Kirkland+Partnership+PDFs/GKP+Forest+Steward+Field+Guide.pdf>

Green Cities Toolbox:

[http://www.forterra.org/what\\_we\\_do/build\\_community/green\\_cities/green\\_cities\\_toolbox](http://www.forterra.org/what_we_do/build_community/green_cities/green_cities_toolbox)

#### Monitoring

Green Cities Standardized Monitoring Protocol:

[http://www.forterra.org/files/Monitoring\\_Field\\_Guide\\_2013.pdf](http://www.forterra.org/files/Monitoring_Field_Guide_2013.pdf)

Photo Point Monitoring, USDA Forest Service:

[http://www.fs.fed.us/eng/rsac/invasivespecies/documents/Photopoint\\_monitoring.pdf](http://www.fs.fed.us/eng/rsac/invasivespecies/documents/Photopoint_monitoring.pdf)

#### Invasive Plant Species

California Invasive Plant Council: <http://www.cal-ipc.org/ip/management/wwh/pdf/19632.pdf>

King County Noxious Weed Control Board:

<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-control-board.aspx>

Washington State Noxious Weed Control Board: <http://www.nwcb.wa.gov/>

#### Plant Selection

Green Cities Native Plant Guide:

[http://www.forterra.org/files/pdfs/GreenCities\\_Steward\\_Plant\\_Guide.pdf](http://www.forterra.org/files/pdfs/GreenCities_Steward_Plant_Guide.pdf)

Sound Native Plants: <http://www.soundnativeplants.com/species-selection-guide>

Washington Native Plant Society: <http://www.wnps.org/landscaping/herbarium/index.html>

Plant Associations in Washington's Puget Trough Ecoregion, Washington State Department of Natural Resources: <http://www1.dnr.wa.gov/nhp/refdesk/communities/index.html>

Preliminary Classification of Freshwater Wetland Vegetation in Western Washington, Washington State Department of Natural Resources:

[http://www.dnr.wa.gov/Publications/amp\\_nh\\_wetland\\_class.pdf](http://www.dnr.wa.gov/Publications/amp_nh_wetland_class.pdf)

Habitat Descriptions, Northwest Habitat Institute: <http://www.nwhi.org/index/habdescriptions>

Ecosystems, Washington Native Plant Society:

[http://www.wnps.org/ecosystems/eco\\_system\\_home.htm](http://www.wnps.org/ecosystems/eco_system_home.htm)

#### Erosion, Landslides & Slope Stabilization

Greenbelt Consulting:

[http://www.soundnativeplants.com/sites/default/files/uploads/PDF/Unstable\\_slopes.pdf](http://www.soundnativeplants.com/sites/default/files/uploads/PDF/Unstable_slopes.pdf)

Slope Stabilization and Erosion Control, Washington State Department of Ecology:

<http://www.ecy.wa.gov/programs/sea/pubs/93-30/index.html>

Wood Strand Erosion Control Mulch, forestconcepts™: <http://www.woodstraw.com/>

#### **Hydrology, Geology & Soil**

Kirkland's Streams, Wetlands and Wildlife Study, The Watershed Company:

<http://www.kirklandwa.gov/Assets/Planning/Planning+PDFs/Watershed+Report+July+1998+Part+1.pdf>

<http://www.kirklandwa.gov/Assets/Planning/Planning+PDFs/Watershed+report+July+1998+Part+2.pdf>

<http://www.kirklandwa.gov/Assets/Planning/Planning+PDFs/Watershed+report+July+1998+appendices.pdf>

Surface Geology GIS data, Washington State Department of Natural Resources:

[http://www.dnr.wa.gov/ResearchScience/Topics/GeosciencesData/Pages/gis\\_data.aspx](http://www.dnr.wa.gov/ResearchScience/Topics/GeosciencesData/Pages/gis_data.aspx)

Web Soil Survey, United States Department of Agriculture—Natural Resources Conservation

Service (USDA-NRCS): <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>

### **Fish and Wildlife Habitat**

Kirkland's Streams, Wetlands and Wildlife Study, The Watershed Company:

<http://www.kirklandwa.gov/Assets/Planning/Planning+PDFs/Watershed+Report+July+1998+Part+1.pdf>

<http://www.kirklandwa.gov/Assets/Planning/Planning+PDFs/Watershed+report+July+1998+Part+2.pdf>

<http://www.kirklandwa.gov/Assets/Planning/Planning+PDFs/Watershed+report+July+1998+appendices.pdf>

### APPENDIX III. NATIVE PLANT SPECIES

The table below lists native plant species recorded in natural areas of parks in Kirkland during 2012. Non-native plants that are not considered invasive are also included.

<b>Broadleaf trees</b>	
<b>Scientific Name</b>	<b>Common Name</b>
<i>Acer macrophyllum</i>	bigleaf maple
<i>Acer rubra</i> *	red maple
<i>Alnus rubra</i>	red alder
<i>Arbutus menziesii</i>	Pacific madrone
<i>Frangula purshiana</i>	cascara
<i>Fraxinus latifolia</i>	Oregon ash
<i>Fraxinus excelsior</i> *	European ash
<i>Populus deltoides</i> *	eastern cottonwood
<i>Populus trichocarpa</i>	black cottonwood
<i>Prunus emarginata</i>	bitter cherry
<i>Quercus garryana</i>	Garry oak/ Oregon white oak
<i>Quercus palustris</i>	pin oak
<i>Salix</i> spp.	willow tree
<i>Salix matsudana</i> 'Tortuosa'	corkscrew willow
<i>Ulmus americana</i> *	American elm
<b>Conifer trees</b>	
<b>Scientific Name</b>	<b>Common Name</b>
<i>Picea abies</i> *	Norway spruce
<i>Picea pungens</i> *	Colorado blue spruce
<i>Picea sitchensis</i>	Sitka spruce
<i>Pinus contorta</i> var. <i>contorta</i>	shore pine
<i>Pseudotsuga menziesii</i>	Douglas-fir
<i>Thuja plicata</i>	western redcedar
<i>Tsuga heterophylla</i>	western hemlock
<b>Shrubs</b>	
<b>Scientific Name</b>	<b>Common Name</b>
<i>Acer circinatum</i>	vine maple
<i>Amelanchier alnifolia</i>	western serviceberry
<i>Arctostaphylos uva-ursi</i>	kinnikinnick/red bearberry
<i>Berberis/Mahonia aquifolium</i>	tall Oregon-grape
<i>Berberis /Mahonia nervosa</i>	low/dull Oregon-grape
<i>Cornus sericea</i>	red twig/red-osier dogwood
<i>Corylus cornuta</i>	beaked hazelnut
<i>Holodiscus discolor</i>	ocean-spray/creambush
<i>Lonicera involucrata</i>	twinberry/black twinberry

\*Not native; introduced in the Pacific Northwest

<b>Shrubs</b>	
<b>Scientific Name</b>	<b>Common Name</b>
<i>Myrica californica</i>	Pacific wax myrtle/bayberry
<i>Myrica gale</i>	sweet gale
<i>Oemleria cerasiformis</i>	Indian plum
<i>Oplopanax horridus</i>	devil's club
<i>Philadelphus lewisii</i>	Lewis' mock orange
<i>Ribes lacustre</i>	swamp currant/swamp gooseberry
<i>Ribes sanguineum</i>	red-flowering currant
<i>Rosa gymnocarpa</i>	baldhip/wood rose
<i>Rosa nutkana</i>	Nootka rose
<i>Rosa pisocarpa</i>	cluster/swamp/peafruit rose
<i>Rosa woodsii</i>	Wood's/pearhip rose**
<i>Rubus parviflorus</i>	thimbleberry
<i>Rubus spectabilis</i>	salmonberry
<i>Rubus ursinus</i>	trailing blackberry
<i>Salix</i> spp.	willow
<i>Sambucus racemosa</i>	red elderberry
<i>Spiraea douglasii</i>	Douglas' spiraea/western hardhack
<i>Symphoricarpos albus</i>	snowberry
<i>Vaccinium ovatum</i>	evergreen huckleberry
<i>Vaccinium parvifolium</i>	red huckleberry
<i>Viburnum edule</i>	squashberry/high-bush cranberry
<i>Viburnum opulus</i> var. <i>Americanum</i>	cranberry tree/American cranberry bush
<b>Ferns</b>	
<b>Scientific Name</b>	<b>Common Name</b>
<i>Blechnum spicant</i>	deer fern
<i>Dryopteris expansa</i>	northern wood fern
<i>Polypodium glycyrrhiza</i>	licorice fern
<i>Polystichum munitum</i>	western sword fern
<i>Pteridium aquilinum</i>	bracken fern
<b>Herbs &amp; Vines</b>	
<b>Scientific Name</b>	<b>Common Name</b>
<i>Anaphalis margaritacea</i>	western pearly everlasting
<i>Aquilegia formosa</i>	western columbine
<i>Armeria maritima</i>	sea-thrift
<i>Aruncus dioicus</i>	goatsbeard
<i>Chamerion angustifolium</i>	fireweed

\*\* Native east of the Cascade Mountains



<b>Herbs &amp; Vines</b>	
<b>Scientific Name</b>	<b>Common Name</b>
<i>Circaea alpina</i>	enchanter's nightshade
<i>Dicentra formosa</i>	Pacific bleeding heart
<i>Epilobium</i> sp.	willowherb
<i>Fragaria chiloensis</i>	beach strawberry
<i>Equisetum arvense</i>	common/field horsetail
<i>Equisetum telmateia</i>	giant horsetail
<i>Fragaria vesca</i>	woodland strawberry
<i>Geum macrophyllum</i>	largeleaved/bigleaf avens
<i>Galium</i> spp.	bedstraw
<i>Hydrophyllum tenuipes</i>	Pacific waterleaf
<i>Lysichiton americanus</i>	skunk cabbage
<i>Penstemon rupicola</i> ***	rock penstemon/cliff beardtongue
<i>Sisyrinchium californicum</i>	golden-eyed grass
<i>Solidago lepida</i>	western Canada goldenrod
<i>Stachys cooleyae</i>	Cooley's hedge- nettle
<i>Symphyotrichum subspicatum</i>	Douglas' aster
<i>Tellima grandiflora</i>	fringecup
<i>Tolmiea menziesii</i>	piggyback plant
<i>Typha latifolia</i>	common/broad-leaf cattail
<i>Urtica dioica</i>	stinging nettle
<b>Graminoids (Grasses, sedges &amp; rushes)</b>	
<b>Scientific Name</b>	<b>Common Name</b>
<i>Carex obnupta</i>	slough sedge
<i>Carex deweyana</i>	Dewey's sedge
<i>Eleocharis palustris</i>	common spikerush
<i>Glyceria elata</i>	tall mannagrass
<i>Juncus effusus</i>	common/soft rush
<i>Schoenoplectus tabernaemontani</i>	soft-stem/great bulrush
<i>Scirpus microcarpus</i>	small-fruited/panicled bulrush

\*\*\*Typically occurs in the Cascade Mountains at mid- to high elevations

## APPENDIX IV. NON-NATIVE INVASIVE PLANT SPECIES

The table below lists the common and scientific names of non-native, invasive plant species recorded in Kirkland parks during rapid site assessments. Note that landowners are required to control certain noxious weed species. These plants are indicated in the list by an asterisk. Noxious weeds are non-native plants that are difficult to control once established, and that may be injurious to agricultural and/or horticultural crops, natural habitats and/or ecosystems, and/or humans or livestock. More information is available from the [Washington State Noxious Weed Control Board](#) and the [King County Noxious Weed Control Program](#).

<b>Trees</b>	
<b>Scientific name</b>	<b>Common name</b>
<i>Acer platanoides</i>	Norway maple
<i>Acer pseudoplatanus</i>	sycamore maple
<i>Aesculus hippocastanum</i>	horse-chestnut
<i>Crataegus monogyna</i>	common/English/one-seed hawthorn
<i>Ilex aquifolium</i>	English holly
<i>Laburnum anagyroides</i>	golden chain-tree
<i>Prunus avium</i>	sweet/bird cherry
<i>Prunus cerasifera</i>	cherry plum
<i>Prunus laurocerasus</i>	cherry laurel/English laurel
<i>Prunus lusitanica</i>	Portugal laurel
<i>Sorbus aucuparia</i>	European mountain-ash
<b>Shrubs</b>	
<i>Buddleja davidii</i>	butterfly bush
<i>Cytisus scoparius</i>	Scot's/Scotch broom
<i>Daphne laureola</i>	spurge-laurel
<i>Rubus armeniacus</i>	Himalayan blackberry
<i>Rubus laciniatus</i>	evergreen/cutleaf blackberry
<b>Herbs &amp; Vines</b>	
<i>Conium macalatum</i>	poison hemlock
<i>Cichorium intybus</i>	chicory/ wild succory
<i>Cirsium arvense</i>	Canada thistle
<i>Cirsium vulgare</i>	bull thistle
<i>Convolvulus/Calystegia arvensis</i>	field bindweed
<i>Convolvulus/Calystegia sepium</i>	hedge false bindweed
<i>Geranium robertianum</i>	herb Robert
<i>Hedera helix</i>	English ivy
<i>Hedera hibernica</i>	Atlantic ivy

<b>Herbs &amp; Vines</b>	
<b>Scientific name</b>	<b>Common name</b>
<i>Hypericum perforatum</i>	St. John's wort
<i>Hypochaeris radicata</i>	hairy cat's ear
<i>Impatiens glandulifera</i>	policeman's helmet*
<i>Impatiens capensis</i>	spotted jewelweed
<i>Iris pseudacorus</i>	yellow iris
<i>Lactuca serriola</i>	prickly lettuce
<i>Lamium galeobdolon</i>	yellow archangel
<i>Lapsana communis</i>	nipplewort
<i>Leucanthemum vulgare</i>	oxeye daisy
<i>Lotus corniculatus</i>	bird's foot trefoil/birdfoot deervetch
<i>Lythrum salicaria</i>	purple loosestrife*
<i>Polygonum x bohemicum</i>	Bohemian knotweed
<i>Polygonum cuspidatum</i>	Japanese knotweed
<i>Polygonum polystachyum</i>	Himalayan knotweed
<i>Polygonum sachalinense</i>	giant knotweed
<i>Ranunculus repens</i>	creeping buttercup
<i>Rumex acetosella</i>	sheep/ red sorrel
<i>Senecio jacobaea</i>	tansy ragwort*
<i>Solanum dulcamara</i>	bittersweet nightshade
<i>Typha angustifolia</i>	narrow-leaf cattail
<i>Verbascum thapsus</i>	common/great mullein
<i>Veronica serpyllifolia</i>	thyme-leaved speedwell
<i>Vinca major</i>	bigleaf/greater periwinkle
<i>Vinca minor</i>	common/lesser periwinkle
<b>Graminoids</b>	
<i>Phalaris arundinacea</i>	reed canary grass

\*Control required by King County and/or Washington Noxious Weed Control Board (King County, 2014).