

Forest Assessment and Management Report
North Creek Forest
Bothell, Washington

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Introduction

This plan identifies current forest health conditions and invasive species concerns. The plan is written to provide the King Conservation District with baseline information for the future development of a Forest Stewardship Program on the property.

Forest Stewardship Vision

The landowner recognizes the multiple values that this rural forested property provides. A forested property of this size within an urban area is rare and warrants protection. Maintaining and enhancing the property's forest resources benefits surrounding properties, the local community, and the overall environment.

Purpose of Plan, Land Owners Objectives and Goals

The purpose of this report or plan is to identify current forest conditions and considerations for management over time. The landowner's primary objective is to manage the property as a forest preserve.

Landowner goals include maintaining and improving forest health, wildlife habitat, maintaining and encouraging a diversity of native trees, shrubs and plants, monitoring and treating invasive species, and protecting sensitive areas.

This forest stewardship plan provides a description of the resources found on the ownership and summarizes management considerations for the future. The plan should be periodically updated and may be amended to reflect the state of the forest resources, current knowledge and understanding of natural resources, as well as changing landowner goals.

Property Description

The property comprises six tax parcels totaling roughly 63 acres. Five tax parcels are located in King County and one in Snohomish County. Three of the parcels are still privately held but are in negotiations with the City of Bothell for their acquisition. The property is accessible from the east off of 112th AVE NE which borders the property. There are also entry points on the west perimeter off of 242nd ST SE and NE 202nd ST.

The property has primarily an east aspect. Slopes are gentle to moderate on most of the property and range between 0% and 40%. Elevation above sea level is approximately 100 feet at the southeast corner rising to roughly 300 feet near the southwest corner.

The forest is an even-aged mixed native species forest. Tree species include in order of prevalence - big leaf maple, Douglas-fir, western red cedar, western hemlock, red alder and black cottonwood.

The extent of understory development is generally low to moderately dense. Understory native shrub species on the property include primarily sword fern, Indian plum, vine maple, salmonberry, and trailing blackberry.

Past Timber Management

The property appears to have been even-age harvested or clear-cut approximately 90 to 100 years ago. The site was not planted and naturally regenerated back to native deciduous and coniferous species. No forest management has appeared to take place since the last harvest.

Resource Category I. Forest Health/ Invasive Species/Wildfire

The overall state of forest health is fair to good. Trees are considered semi-mature to mature. Typical occurrences of root disease were identified across the property. The most commonly found pathogen is *Phaeolus schweinitzii*, Schweinitzii Root and Butt Rot. The pathogen is common in Douglas-fir over 75 years of age¹. Decay initiates in the roots and spreads into the lower trunk. The fruiting bodies of the pathogen emerge as light brown leathery conks, later turning dark brown and brittle. The top of the conk has concentric rings and is velvety in texture. It is often commonly referred to as the ‘velvet top’ fungus or ‘cow patty’ fungus. Several Douglas-fir trees have failed in the past from advanced decay in the lower trunk. One is pictured below. The decay eventually advances to a point where the tree trunk simply collapses, usually during strong wind events.



¹ Dunster, J.A. and Dr.R. Edmonds, Common Fungi Affecting Pacific Northwest Trees – Implications for Tree Risk Assessment 2014. P.17

Fruiting body of Schweinitzii Root and Butt Rot



Isolated incidences of *Heterobasidion occidentale*, Annosus Root and Butt Rot were observed in western hemlock. One incidence of *Phellinus sulphurascens*, Laminated Root Rot was also identified in a wind-thrown Douglas-fir. The extent or degree of these pathogens on the property is typical and not concerning. In most root diseases, crown symptoms indicating infection do not become apparent until the tree is in the latter or advanced stages of the disease.

Fruiting bodies of Annosus Root and Butt Rot on hemlock



The decay pathogens found at the site are native and frequently found in coniferous forests across the Puget Sound Region. These pathogens all play a role in forest succession and their presence does not necessarily suggest an unhealthy forest ecosystem.

There is no evidence of significant insect pest infestations on the property. If any number of trees show sign of rapid decline (loss of needles, heavy cone crops, thin crowns, beetle boring holes, etc.) on the property a local professional forester or arborist should be contacted to assess and diagnose possible insect damage. If there are any reported insect infestations in the vicinity, the Washington Department of Natural Resources forest entomologist should be contacted for advice on the latest techniques, to protect from or treat any outbreak that might affect the property. After consultation with the WADNR entomologist, appropriate measures to protect water quality and indigenous wildlife should be implemented based upon the treatment method.

Invasive Plant Species

The presence of non-native invasive species on the property is low overall. There are significant infestations of Himalayan blackberry and English ivy in the southeast corner, moderate to high blackberry infestations on the south perimeter and a significant infestation of yellow archangel on the west perimeter. There is also a moderate infestation of Japanese knotweed on the east perimeter. Minor infestations of English holly are found scattered across the site, which is typical of forests in this region. These locations are shown on the invasive plant species map found in the supplemental materials section.

Himalayan and evergreen blackberry are European species of blackberry that are highly invasive and difficult to control. Occurrence should be monitored and treated as necessary to limit the site occupancy and spread of these species.

General recommendations for treatment and control of non-native blackberry includes mechanical treatment (mowing) prior to seed set, and or application of herbicides during periods of active growth. Herbicides containing glyphosate, triclopyr, 2,4-D, and metsulfuron are known to be effective. A preferred measure for treatment holly is removal by pulling the plant from the ground. Repeated cutting can also be effective.

Yellow archangel is a perennial ground cover that is fast-growing and competitive in Western Washington forest habitats. It quickly spreads on the forest floor replacing native understory plants. It normally spreads into the forest by stem cuttings that are dumped in or near the forest edge. It is a Class B noxious weed meaning control is recommended but not required. Both hand-pulling and herbicides are effective means of control.

Consult the King County Noxious Weed Control Program for information regarding the control of these exotic invasive species at <http://www.kingcounty.gov/environment/animals-and-plants/noxious-weeds.aspx> This web page provides a list of species along with species profiles (including identification and control methods) in PDF format. Control fact sheets are included in the supplemental materials section for the dominant species on the property.

Animal Damage

No significant signs of animal damage was observed on the property. Trees are of a size and age where they are not targeted by animals that frequently damage forest trees; such as bark stripping from black bears and deer horning or rubbing.

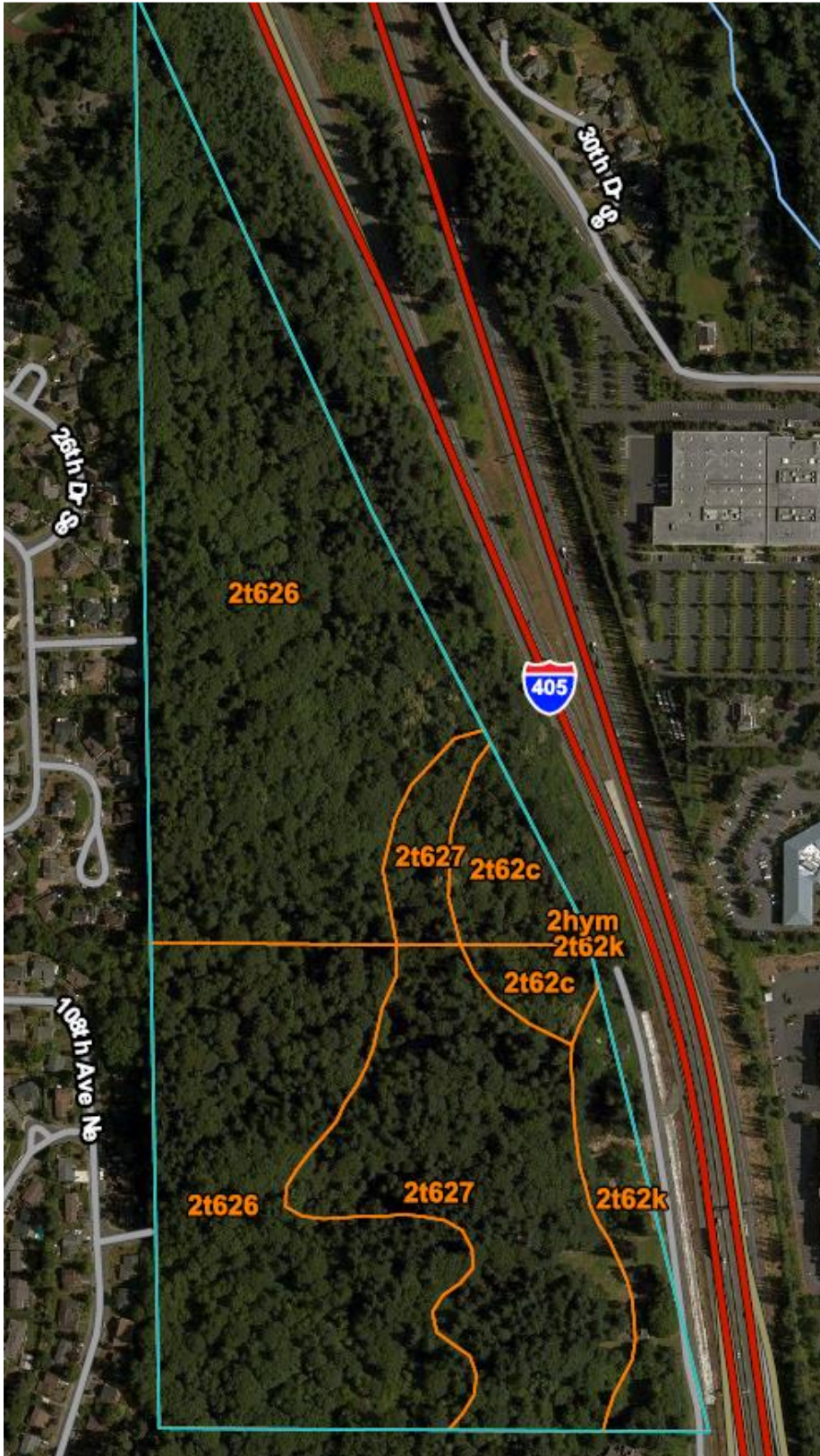
The property does have a significant population of mountain beavers. Mountain beavers burrow and live underground. They primarily eat vegetation and do not affect trees. Problems can exist on steeper slopes where they cause soil erosion from their burrowing around trees. No significant damage was observed.

Wildfire Risk

The current wildfire risk on the property is low. Trees are moderately stocked overall with very low levels of ground or ladder fuels. Under normal weather conditions, the risk of fire spreading through the forest is very low.

The threat of forest fire in 'West-side' forests is becoming increasingly higher. Drier than normal conditions over the last several years have dramatically increased this threat. All management activities should consider this risk and precautions taken to minimize the risk of fire.

Resource Category II. Soils



The property contains basically one main soil type – Alderwood gravelly sandy loams. There are minor components of Everett very gravelly sandy loams and Indianola loamy sand. The following table describes soil types found on the property and some considerations related to forestry. The information displayed was gathered from the Natural Resources Conservation Service (NRCS) web soil survey data. A complete soils report is included in the supplemental materials section at the end of this plan.

Map Symbol/Name	% of Area	% Slopes	50-Year Site Index D-fir	Drainage Class	Potential for seedling mortality
2t626 - Alderwood-gravelly sandy loam	66	8 to 15	108	Moderately well-drained	Moderate
2t627 - Alderwood-gravelly sandy loam	23	15 to 30	108	Moderately well-drained	Moderate
2t62t - Everett-very gravelly sandy loam	6	15 to 30	111	Somewhat excessively drained	Moderate
2t62k- Indianola loamy sand	5	0 to 5	112	Somewhat excessively drained	High

Alderwood gravelly sandy loams are moderately well drained soils on till plains, formed in glacial till. It is moderately deep over a hardpan. Elevation of 50' to 550'. Commonly found tree species include Douglas-fir, western hemlock, western red cedar, and red alder. Common forest understory plants include salal, Oregon grape, bracken fern, and sword fern.

Everett very gravelly sandy loams are deep, somewhat excessively drained soils on terraces and outwash plains, formed in glacial outwash. Elevation is near sea level to 500'. Supporting native vegetation is very similar to the Alderwood gravelly sandy loam.

Indianola loamy sands are very deep, somewhat excessively drained soils on terraces and outwash plains, formed in sandy glacial outwash. Elevation is near sea level to 500'. Supporting native vegetation is very similar to the Alderwood gravelly sandy loam.

Soils across the site are stable. No evidence of mass wasting was observed during the site inspection. Other than normal erosion in stream banks, no significant erosion was observed on the property.

The Douglas-fir 50-year site index ranges from 108 to 112. This means that from the time a tree is planted, on average it will grow to a height of roughly 110 by the time it is 50 years of age. The soils are very productive for growing trees.

Resource Category III. Water Resources

The property is within the Sammamish River WAU (Watershed Administrative Unit) of the Cedar-Sammamish Water Resources Inventory Area. There are approximately five non-fish seasonal streams that flow easterly from the top of the property down to I-405. These mainly exist in the south portion of the property. There is no perennial water source above the subject property. Channels carry primarily storm water runoff from the developed area to the west. Minor erosion of channels was noted, primarily on the west perimeter where runoff concentrations are likely higher. No wetlands were identified on the subject property.

Resource Category IV. Forest Inventory

The forest cover was delineated into four types primarily based on species composition. Ortho-photo and topographic cover type maps are located in the supplemental materials section at the end of this plan, following the summary of forest management recommendations section. All types are generally of the same age class. Dominant or over-story trees are estimated at 80 to 90 years of age.

Type 1 is the largest type and encompasses approximately 24.5 acres. This type is primarily comprised of big leaf maple, with minor to moderate components of Douglas-fir, western red cedar, western hemlock and red alder. Trees are moderately stocked at roughly 150 to 200 trees per acre. Tree diameters range between 12" DBH (diameter at breast height, 4 ½' above ground) and 30" DBH, with total heights of 70' to 100'. There is little regeneration of tree species in the understory, minor components of shade tolerant western hemlock and western red cedar, and big leaf maple in larger openings were observed. Minor components of non-native chestnut were also observed.

Type 1



Understory vegetation density is moderate. The lower shrub layer is comprised of swordfern, creeping blackberry and bleeding heart. The mid-shrub layer is primarily Indian plum and salmonberry; and the upper shrub layer is primarily vine maple and beaked hazelnut.

No significant invasive plant species populations were observed in this type, other than typical Himalayan blackberry infestations on the forest edge. English holly was observed scattered throughout the type.

No obvious hazard or high-risk trees were identified on the west perimeter within this type.

Type 2 is located on the west perimeter and is approximately 8 acres in size. The type is comprised primarily of western red cedar and big leaf maple, with a moderate component of Douglas-fir and lesser components of western hemlock and red alder. Trees are moderately to well-stocked at roughly 200 to 250 trees per acre. Composition is clumpy or patchy. Tree diameters range between 20" DBH and 30" DBH, with total heights of 70' to 110'. There is little regeneration of tree species in the understory, minor components of shade tolerant western hemlock and western red cedar were observed, as well as maple in larger openings. Type 2 is a wetter type with flat topography and very small isolated areas of forested wetlands.

Type 2



Understory vegetation density is moderate. The lower shrub layer is comprised of swordfern, Oregon grape, creeping blackberry and bleeding heart. The mid-shrub layer is primarily Indian plum and salmonberry; and the upper shrub layer is primarily vine maple and beaked hazelnut.

There is a significant infestation of Himalayan blackberry and yellow archangel on the west perimeter, encompassing approximately 2 acres. The infestation spreads into the forest roughly 40' to 60' from the west property line.

Type 3 is roughly 17.5 acres in size. This is primarily a Douglas-fir type with a moderate component of big leaf maple and minor component of western hemlock. Trees are moderately to well-stocked at roughly 200 to 250 trees per acre. Composition is clumpy or patchy. Tree diameters range between 16" DBH and 30" DBH, with total heights of 80' to 140'. There is little regeneration of native tree species in the understory. Minor components of non-native chestnut were observed.

Type 3



Understory vegetation density is light. The lower shrub layer is comprised primarily of swordfern, Oregon grape, creeping blackberry and bleeding heart. The mid-shrub layer is primarily Indian plum and salmonberry, with a minor component of devil's club; and the upper shrub layer is primarily vine maple and beaked hazelnut.

There is a moderate infestation of Himalayan blackberry in the southeast corner of the type which is encroaching from the south (Type 4).

Type 4 is roughly 10.7 acres in size and located along the south perimeter. Species composition is primarily big leaf maple, bitter cherry and red alder with a minor component of Douglas-fir. Trees are lightly stocked at less than 100 trees per acre. This type is of a younger age class, estimated at 40 to 50 years of age. Tree diameters range between 8" DBH and 20" DBH, with total heights of 40' to 60'. The alder and cherry is in general decline due to age. There is little regeneration of tree species in the understory.

Type 4



Brush density is high, specifically the mid-shrub layer. Native species include primarily salmonberry and thimble berry.

This type has a dense or high invasive species population. The southeast corner has a major infestation of Himalayan blackberry and English ivy. The ivy is advancing up the slope to the west. The east half of the type has a moderate to high infestation of blackberry, as well as a component of reed canary grass. Invasive cover is lighter in the west half of the type.

The type labeled as 'NF' (non-forest) on the cover type map is currently in residential uses. This area is approximately 2.4 acres in size. The vegetation in this area is generally maintained.

Resource Category V. Roads and Trails

There is an old road grade that extends from one of the private parcels on the east side up to the end of NE 202nd ST. This grade has been approximately mapped and can be seen on the maps in the supplemental materials section. The road grade is periodically mowed by the assumed owner. There have been many Douglas-fir seedlings planted along the road grade

and on the private property where the grade enters the forest from 112th AVE NE. These are of low vigor due to the high degree of shade.

With the exception of a few short interpretative trails recently constructed in areas where restoration work has occurred, there are no maintained trails within the subject forest. There is a rough trail off of 242nd ST SE that could be improved and maintained for good access into the forest.

Resource Category VI. Wildlife

The forest provides valuable wildlife habitat to the area. It is a refuge for mammals such as blacktail deer, bobcats, and other smaller mammals such as red squirrels, raccoons, opossums and mountain beaver. The property may be home to flying squirrels as well.

Snags on the property are important habitat components for various bird species that feed on insects and nest in cavities. Snags should be retained unless they pose a danger to human life or a structure.

The Woodland Workbook “Enhancing Wildlife Habitat on Private Woodlands”, 2002 is included in the supplemental materials section for your use. This publication provides valuable information pertaining to site specific applications to increase wildlife use.

Resource Category VII. Protection of Special Resources

The writer of this plan is unaware of any historic or pre-historic cultural resources on the property.

High conservation value forests are forests of recognized importance due to their environmental, social, biodiversity or landscape values; or their connection with the landowner. An area of relic old growth may be considered a high conservation value forest.

Given the degree of development around this fragmented piece of native second-growth forest, many may consider this forest as ‘High Conservation Value’.

Resource Category VIII. Aesthetics & Recreation

Landowner goals are to maintain a healthy forest which is critical to aesthetics. Because of topography, the property is highly visible from I-405 and areas east.

The subject forest is not open to recreational use at this time. Future recreational activities might include hiking and nature viewing.

Resource Category IX. Special Forest Products

Special forest products are non-timber products that can be produced from a forest. These include but are not limited to floral greens, boughs, Christmas trees, mushrooms, berries, other edibles and medicinal plants.

No considerations were given to other forest products on the property at this time. The size of the property limits large production of special forest products. No value in other forest products was observed during the inspection. The potential opportunities for special forest products shall be re-evaluated from time to time. Most forest landowner field days promoted by the WSU Extension include talks or workshops on special forest products. Please check the WSU Extension/Forestry website for more information on special forest products. No considerations were made for carbon sequestration values at this time, but may be warranted in the future.

Tree Risk Assessment

A tree risk assessment of the west perimeter was conducted. Very few issues of concern were identified. The vast majority of past tree failures in the forest have been to the north – northeast due to the southwest prevailing wind direction and topography. The targets on the west perimeter are not likely to be struck by blown-down trees during unusual or strong wind events from the southwest.

A few problematic tree conditions were identified on the west perimeter at the north end of the Type 2, behind the residence at 24029 26th DR SE. There is a large dead big leaf maple tree that appears to be located on the adjacent private property to the west (24029). In this vicinity, there is a Douglas-fir which appears to be infected with Armillaria root disease, evidenced by heavy resin flows on the lower trunk. There is also an older dead Douglas-fir tree (tagged #5375) next to the diseased Douglas-fir. Habitat snagging of the dead and diseased Douglas-fir trees is recommended to maintain risks at acceptable levels.

There is also a heavy component of volunteer red alder behind 24029 26th DR SE. The property line here is difficult to distinguish. These may likely be on private property. These alders are developing heavy natural leans away from the forest toward adjacent residences. Although these are not considered high-risk at this time, they will become problematic as they mature and increase in size and lean.

Forest Management Considerations

The site is historically a mixed conifer site, evidenced by the presence of old-growth Douglas-fir and western red cedar stumps observed across the property. Douglas-fir requires full sunlight to proliferate so it will not likely be a good candidate for restoration projects unless larger openings are created to allow good exposure to sunlight. The use of shade tolerant species such as western red cedar and western hemlock will be preferred for restoration projects.

There are two small areas where restoration work has recently occurred to remove invasive plant species and establish native shrubs and trees. One is off of 112th AVE NE on the east perimeter and another on the west perimeter at the end of NE 204th PL. At both sites, it appears invasive plant species removal was performed and areas were planted to a wide mixture or variety of native shrubs and trees. The 112th site is roughly a ½ acre in size and the 204th site is roughly a ¼ acre in size.

The ortho-photo and topography cover type maps identify invasive species areas of concern.

Type 1

Invasive plant species are not a large concern in this type. Species composition is primarily deciduous. The largest concern is that as the maple and alder mature and naturally decline over time, there are no trees in the understory to take their place. Brush densities will increase as trees naturally die out and allow more sunlight to reach the forest floor.

Shade tolerant trees species such as western red cedar and western hemlock seedlings should be established in the understory to eventually take the place of the over-story hardwood as it naturally declines and dies out. This will serve two purposes – creating an uneven-aged stand structure and establishing trees for the future to prevent the establishment and spread of shade intolerant invasive plant species like Himalayan blackberry.

Cedar seedlings may need to be protected if deer browse becomes a problem. This is done by protecting the top leader until it reaches a height of roughly five feet, which is above the browse height. A flex tube can be placed over the seedling and held in place by a bamboo pole; or, seedlings can be treated with a product called ‘Seadust’ in the spring and fall to prevent deer browse.

Type 2

There is a large +/- 2 acre area of dense invasive species on the western perimeter, as shown on the attached cover type map. The north portion of this area is primarily a Himalayan blackberry infestation. The blackberry is thriving on the edge of the forest where trees have been removed in the past and exposed to full sun. The south portion is a major yellow archangel infestation that is rapidly encroaching upon the forest. Restoration efforts shall focus in these areas. See the ‘fact sheets’ in the supplemental materials section for control of these invasive species.

Yellow archangel infestation in Type 2



No significant widespread forest health concern issues were identified. The western red cedar which makes up the majority of tree cover is vigorous and in good condition. No significant signs of stress related issues were observed. As mentioned above in the Forest Inventory section, there are a couple problematic trees at the north end of the Type on the west perimeter. Habitat snagging of the two problematic Douglas-fir trees is recommended to maintain risks at acceptable levels.

Type 3

Invasive plant species cover in this type is low to moderate. There is a small Japanese knotweed infestation on the east perimeter near an abandoned homestead. It would appear this infestation has been treated with a chemical in the past which was fairly successful. Unfortunately, a good portion of the stems survived as pictured below. Continued treatments are needed to eradicate it from the site. See the supplemental materials section for control measures.



In the southeast portion, Himalayan blackberry is spreading into the type from the south. It is not all that vigorous due to the lack of available sunlight from over-story tree cover. The infestation is considered low to moderate.

Low concentrations of Himalayan blackberry in southeast portion of Type 3



No significant forest health concern issues were identified. No noteworthy signs of stress related issues were observed. Typical isolated occurrences of tree mortality related to disease are present. Overall vigor of the Douglas-fir is good.

Type 4

Invasive plant species cover in this type is high, specifically on the east side of the type. There is approximately a one acre area that extends from 112th AVE NE comprised of a dense English ivy and Himalayan blackberry infestation.

Dense invasive species infestation off of 122th AVE NE



The east half of the type has a moderate infestation of Himalayan blackberry, with a lesser component of reed canary grass.

Moderate infestation of blackberry beneath hardwood canopy

Type 4 is predominantly a low-stocked hardwood type. This area may have been logged over within the last few decades. This type is a priority for future restoration work. Given the light density of tree cover, invasive blackberry will continue to spread.

Shade tolerant trees species such as western red cedar and western hemlock seedlings should be established in the understory to eventually take the place of the over-story hardwood as it naturally declines and dies out. This will serve two purposes – creating an uneven-aged stand structure and establishing trees for the future to prevent the establishment and spread of shade intolerant invasive plant species like Himalayan blackberry.

Summary of Forest Management Recommendation Priorities**1) Type 4**

Major invasive plant infestation in southeast portion of type. Priority area for restoration work.

Moderate non-native blackberry infestation in central and northeast portion. Prepare 4' to 6' radius planting locations by eradicating blackberry, and then establish shade-tolerant conifer species to eventually replace the hardwood over-story and shade out and kill invasive blackberry.

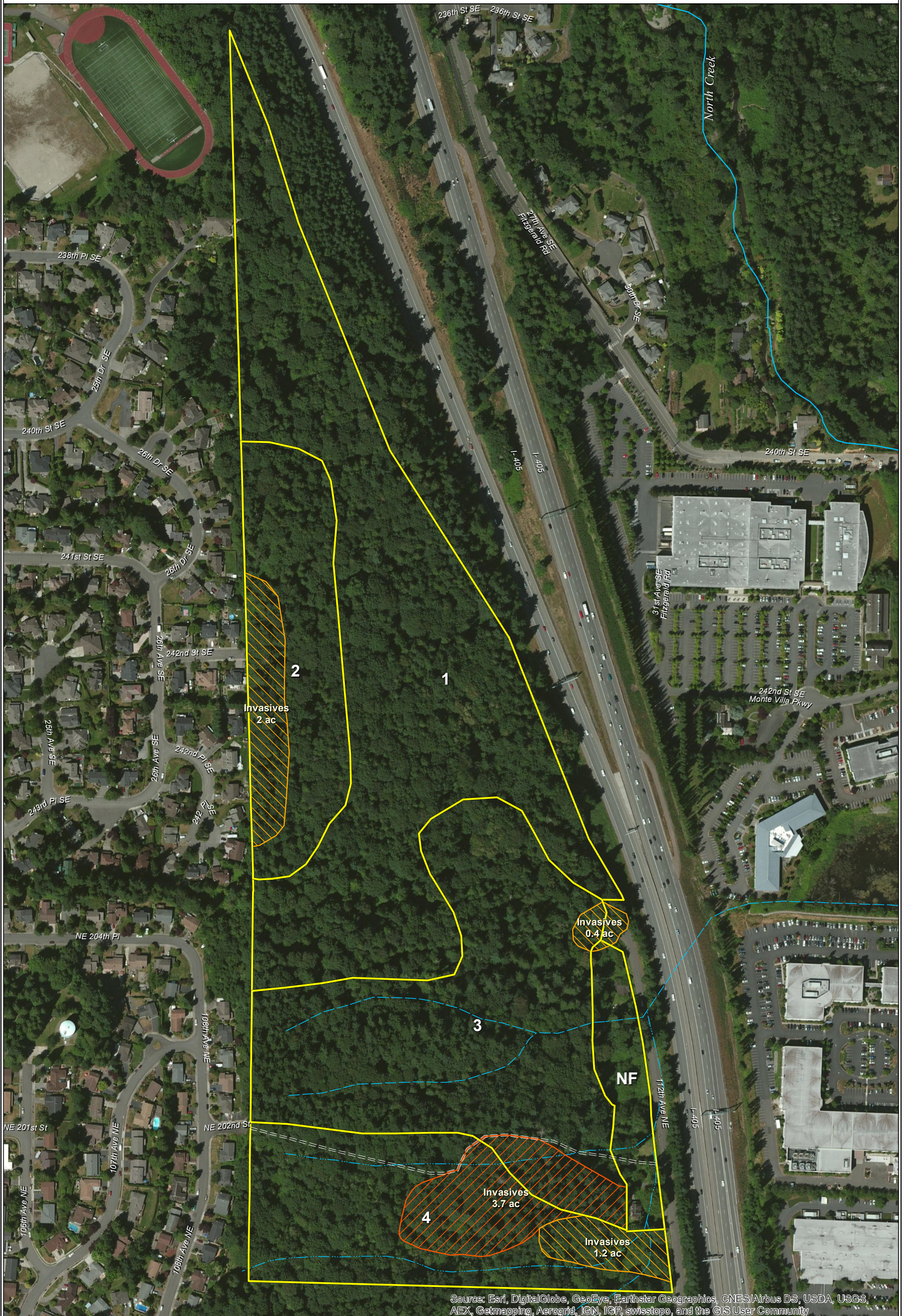
3) Type 3

Eradicate small knotweed infestation and plant area to mix of native trees and shrubs as desired.

4) Type 2

Eradicate yellow archangel and Himalayan blackberry infestations on west perimeter and reforest areas to a mix of native conifers dependent on available sun exposure.

Habitat snagging of the two problematic Douglas-fir trees behind 24029 26th DR SE is recommended to maintain risks at acceptable levels.



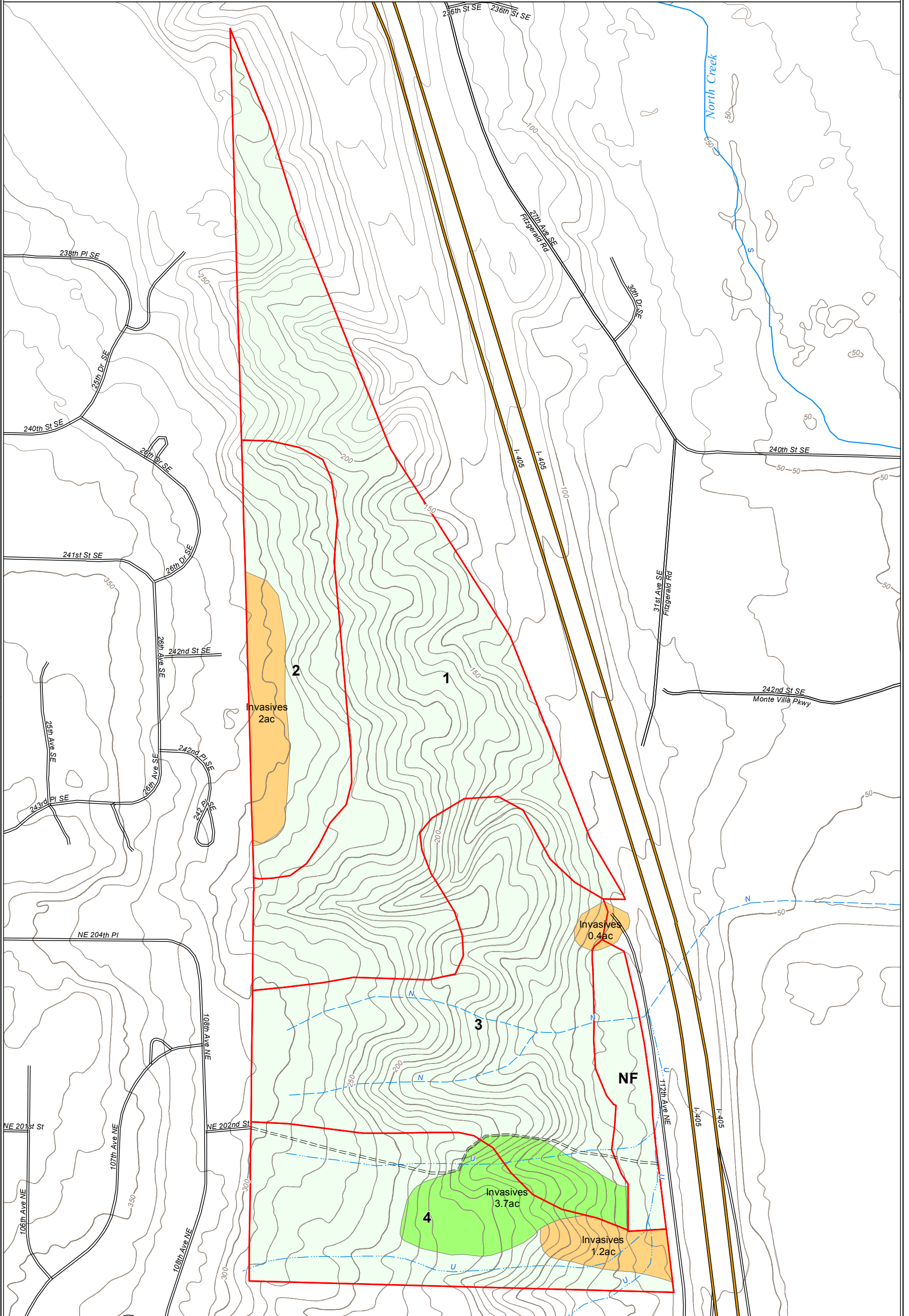
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

1 inch = 275 feet
 0 275 Feet

Map date: 6/16/2016



Cover Type		Water Type	
	1 (24.5 ac)		S. Shoreline of the State
	2 (8 ac)		F. Fish bearing
	3 (17.5 ac)		N. Non-fish bearing
	4 (10.7 ac)		U. Unknown
	NF (2.4 ac)		
	High invasive cover		
	Moderate invasive cover		
	Old road grade		



1 inch = 275 feet
 0 275 Feet

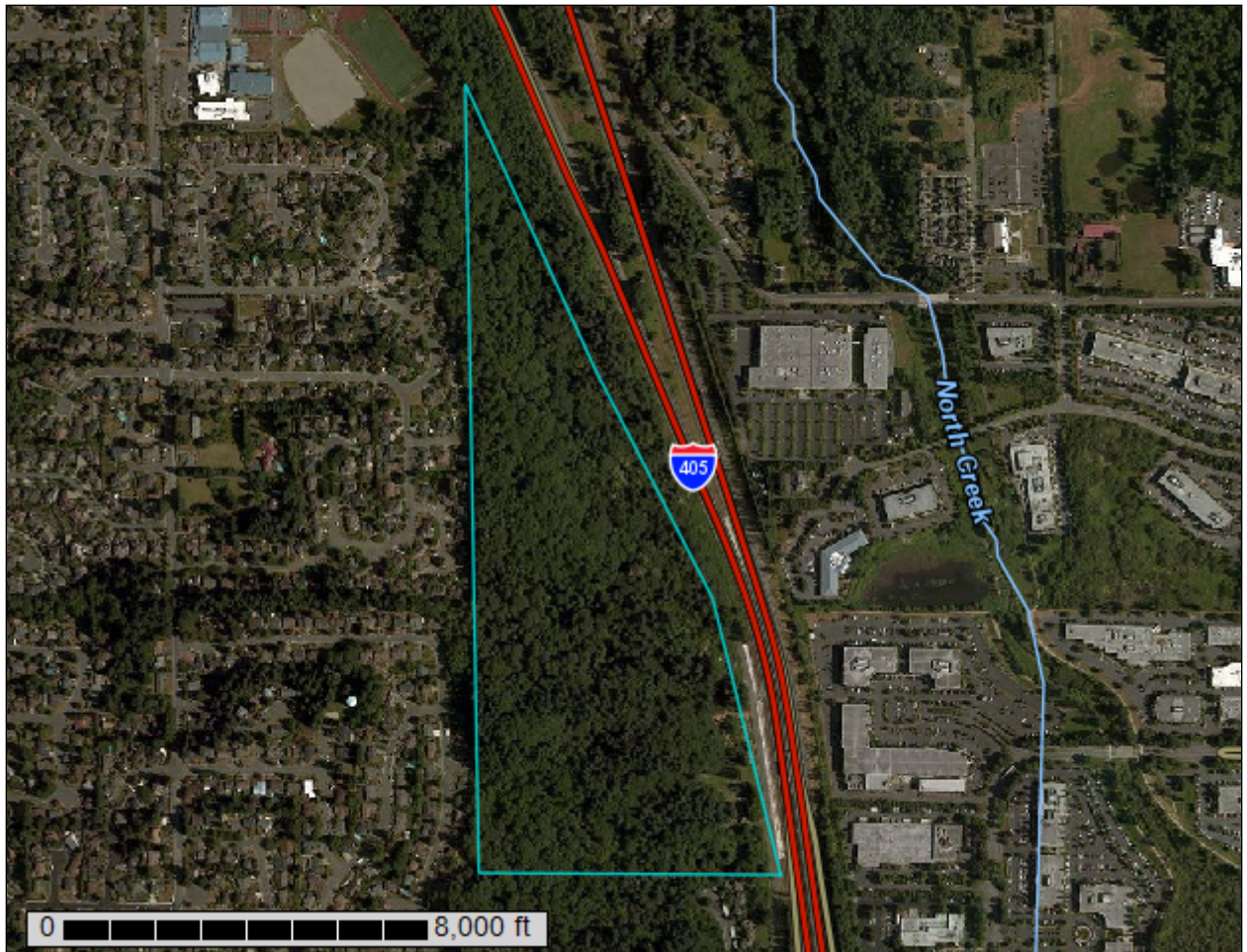
Map date: 6/16/2016



Cover Type		Water Type	
[Red outline]	1 (24.5 ac)	[Orange fill]	High invasive cover
[Orange fill]	2 (8 ac)	[Light green fill]	Moderate invasive cover
[Light green fill]	3 (17.5 ac)	[Blue line]	S. Shoreline of the State
[Bright green fill]	4 (10.7 ac)	[Blue line]	F. Fish bearing
[Red outline]	NF (2.4 ac)	[Blue line]	N. Non-fish bearing
[Dashed line]	Old road grade	[Blue line]	U. Unknown
[Thin grey line]	10' contour		
[Thick grey line]	50' contour		

Custom Soil Resource Report for King County Area, Washington, and Snohomish County Area, Washington

North Creek Forest



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

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individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

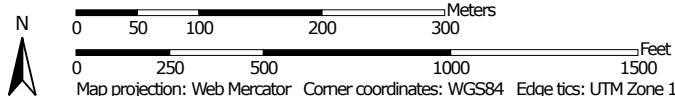
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map




Map Scale: 1:6,150 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84


MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)


Soils


 Soil Map Unit Polygons


 Soil Map Unit Lines


 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit


 Clay Spot


 Closed Depression

 Gravel Pit

 Gravelly Spot


 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water


 Perennial Water

 Rock Outcrop


 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole


 Slide or Slip

 Sodic Spot


 Spoil Area

 Stony Spot


 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals


Transportation

 Rails


 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: King County Area, Washington
 Survey Area Data: Version 11, Sep 14, 2015

Soil Survey Area: Snohomish County Area, Washington
 Survey Area Data: Version 13, Sep 15, 2015

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 7, 2014—Jul 8, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

King County Area, Washington, and Snohomish County Area, Washington			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2hym	Lynnwood loamy sand, 0 to 3 percent slopes	0.0	0.0%
2t626	Alderwood gravelly sandy loam, 8 to 15 percent slopes	23.3	39.6%
2t626	Alderwood gravelly sandy loam, 8 to 15 percent slopes	15.6	26.5%
2t627	Alderwood gravelly sandy loam, 15 to 30 percent slopes	1.6	2.7%
2t627	Alderwood gravelly sandy loam, 15 to 30 percent slopes	11.8	20.0%
2t62c	Everett very gravelly sandy loam, 15 to 30 percent slopes	1.2	2.0%
2t62c	Everett very gravelly sandy loam, 15 to 30 percent slopes	2.2	3.8%
2t62k	Indianola loamy sand, 0 to 5 percent slopes	3.2	5.5%
Totals for Area of Interest		58.8	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified

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by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

King County Area, Washington, and Snohomish County Area, Washington

2hym—Lynnwood loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2hym
Elevation: 50 to 600 feet
Mean annual precipitation: 40 to 65 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Lynnwood and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lynnwood

Setting

Landform: Outwash plains, terraces
Parent material: Glacial outwash

Typical profile

H1 - 0 to 1 inches: loamy sand
H2 - 1 to 29 inches: loamy sand
H3 - 29 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Other vegetative classification: Droughty Soils (G002XN402WA)

Minor Components

Custer

Percent of map unit: 3 percent
Landform: Depressions

2t626—Alderwood gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t626
Elevation: 50 to 800 feet
Mean annual precipitation: 20 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alderwood

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope, talf
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Glacial drift and/or glacial outwash over dense glaciomarine deposits

Typical profile

A - 0 to 7 inches: gravelly sandy loam
Bw1 - 7 to 21 inches: very gravelly sandy loam
Bw2 - 21 to 30 inches: very gravelly sandy loam
Bg - 30 to 35 inches: very gravelly sandy loam
2Cd1 - 35 to 43 inches: very gravelly sandy loam
2Cd2 - 43 to 59 inches: very gravelly sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B

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Other vegetative classification: Limited Depth Soils (G002XN302WA), Limited Depth Soils (G002XS301WA), Limited Depth Soils (G002XF303WA)

2t626—Alderwood gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t626
Elevation: 50 to 800 feet
Mean annual precipitation: 20 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alderwood

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Nose slope, talf
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Glacial drift and/or glacial outwash over dense glaciomarine deposits

Typical profile

A - 0 to 7 inches: gravelly sandy loam
Bw1 - 7 to 21 inches: very gravelly sandy loam
Bw2 - 21 to 30 inches: very gravelly sandy loam
Bg - 30 to 35 inches: very gravelly sandy loam
2Cd1 - 35 to 43 inches: very gravelly sandy loam
2Cd2 - 43 to 59 inches: very gravelly sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B

Custom Soil Resource Report

Other vegetative classification: Limited Depth Soils (G002XS301WA), Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)

2t626—Alderwood gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t626
Elevation: 50 to 800 feet
Mean annual precipitation: 20 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Everett

Percent of map unit: 5 percent
Landform: Eskers, kames, moraines
Landform position (two-dimensional): Shoulder, footslope
Landform position (three-dimensional): Crest, base slope
Down-slope shape: Convex
Across-slope shape: Convex

Indianola

Percent of map unit: 5 percent
Landform: Eskers, kames, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

2t626—Alderwood gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t626
Elevation: 50 to 800 feet
Mean annual precipitation: 20 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Alderwood and similar soils: 85 percent

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Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Everett

Percent of map unit: 5 percent

Landform: Eskers, kames, moraines

Landform position (two-dimensional): Footslope, shoulder

Landform position (three-dimensional): Crest, base slope

Down-slope shape: Convex

Across-slope shape: Convex

Indianola

Percent of map unit: 5 percent

Landform: Eskers, kames, terraces

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

2t626—Alderwood gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t626

Elevation: 50 to 800 feet

Mean annual precipitation: 20 to 60 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 160 to 240 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Alderwood and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Shalcar

Percent of map unit: 3 percent

Landform: Depressions

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

2t626—Alderwood gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t626

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Elevation: 50 to 800 feet
Mean annual precipitation: 20 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Shalcar

Percent of map unit: 3 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

2t626—Alderwood gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t626
Elevation: 50 to 800 feet
Mean annual precipitation: 20 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Norma

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave

2t626—Alderwood gravelly sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2t626
Elevation: 50 to 800 feet
Mean annual precipitation: 20 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Norma

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave

2t627—Alderwood gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t627
Elevation: 0 to 1,000 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alderwood

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, nose slope, talf
Down-slope shape: Linear, convex

Custom Soil Resource Report

Across-slope shape: Convex

Parent material: Glacial drift and/or glacial outwash over dense glaciomarine deposits

Typical profile

A - 0 to 7 inches: gravelly sandy loam

Bw1 - 7 to 21 inches: very gravelly sandy loam

Bw2 - 21 to 30 inches: very gravelly sandy loam

Bg - 30 to 35 inches: very gravelly sandy loam

2Cd1 - 35 to 43 inches: very gravelly sandy loam

2Cd2 - 43 to 59 inches: very gravelly sandy loam

Properties and qualities

Slope: 15 to 30 percent

Depth to restrictive feature: 20 to 39 inches to densic material

Natural drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: About 18 to 37 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Other vegetative classification: Limited Depth Soils (G002XN302WA), Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XS301WA)

2t627—Alderwood gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t627

Elevation: 0 to 1,000 feet

Mean annual precipitation: 25 to 60 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 160 to 240 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Alderwood and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alderwood

Setting

Landform: Ridges, hills

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope, nose slope, talf

Down-slope shape: Linear, convex

Custom Soil Resource Report

Across-slope shape: Convex

Parent material: Glacial drift and/or glacial outwash over dense glaciomarine deposits

Typical profile

A - 0 to 7 inches: gravelly sandy loam

Bw1 - 7 to 21 inches: very gravelly sandy loam

Bw2 - 21 to 30 inches: very gravelly sandy loam

Bg - 30 to 35 inches: very gravelly sandy loam

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Properties and qualities

Slope: 15 to 30 percent

Depth to restrictive feature: 20 to 39 inches to densic material

Natural drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: About 18 to 37 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Very low (about 2.7 inches)

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Other vegetative classification: Limited Depth Soils (G002XS301WA), Limited Depth Soils (G002XF303WA), Limited Depth Soils (G002XN302WA)

2t627—Alderwood gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t627

Elevation: 0 to 1,000 feet

Mean annual precipitation: 25 to 60 inches

Mean annual air temperature: 46 to 52 degrees F

Frost-free period: 160 to 240 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Alderwood and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Everett

Percent of map unit: 5 percent

Landform: Eskers, kames, moraines

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Custom Soil Resource Report

Down-slope shape: Convex
Across-slope shape: Convex

Indianola

Percent of map unit: 5 percent
Landform: Kames, terraces, eskers
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

2t627—Alderwood gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t627
Elevation: 0 to 1,000 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Indianola

Percent of map unit: 5 percent
Landform: Eskers, kames, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Everett

Percent of map unit: 5 percent
Landform: Kames, moraines, eskers
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex

2t627—Alderwood gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t627
Elevation: 0 to 1,000 feet
Mean annual precipitation: 25 to 60 inches

Custom Soil Resource Report

Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Shalcar

Percent of map unit: 3 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

2t627—Alderwood gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t627
Elevation: 0 to 1,000 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Shalcar

Percent of map unit: 3 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

2t627—Alderwood gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t627
Elevation: 0 to 1,000 feet

Custom Soil Resource Report

Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Norma

Percent of map unit: 2 percent
Landform: Drainageways, depressions
Landform position (three-dimensional): Dip
Down-slope shape: Linear, concave
Across-slope shape: Concave

2t627—Alderwood gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t627
Elevation: 0 to 1,000 feet
Mean annual precipitation: 25 to 60 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 160 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Alderwood and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Norma

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Landform position (three-dimensional): Dip
Down-slope shape: Concave, linear
Across-slope shape: Concave

2t62c—Everett very gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t62c

Custom Soil Resource Report

Elevation: 30 to 900 feet

Mean annual precipitation: 35 to 91 inches

Mean annual air temperature: 48 to 52 degrees F

Frost-free period: 180 to 240 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Everett and similar soils: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Everett

Setting

Landform: Moraines, eskers, kames

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Sandy and gravelly glacial outwash

Typical profile

O_i - 0 to 1 inches: slightly decomposed plant material

A - 1 to 3 inches: very gravelly sandy loam

B_w - 3 to 24 inches: very gravelly sandy loam

C₁ - 24 to 35 inches: very gravelly loamy sand

C₂ - 35 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 15 to 30 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (K_{sat}): High (1.98 to 5.95 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: A

Other vegetative classification: Droughty Soils (G002XN402WA), Droughty Soils (G002XS401WA)

Minor Components

Alderwood

Percent of map unit: 10 percent

Landform: Ridges, hills

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope, nose slope, tal

Down-slope shape: Linear, convex

Across-slope shape: Convex

Indianola

Percent of map unit: 10 percent

Custom Soil Resource Report

Landform: Eskers, kames, terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear

2t62c—Everett very gravelly sandy loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2t62c
Elevation: 30 to 900 feet
Mean annual precipitation: 35 to 91 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Everett and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Everett

Setting

Landform: Kames, moraines, eskers
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy and gravelly glacial outwash

Typical profile

O_i - 0 to 1 inches: slightly decomposed plant material
A - 1 to 3 inches: very gravelly sandy loam
B_w - 3 to 24 inches: very gravelly sandy loam
C₁ - 24 to 35 inches: very gravelly loamy sand
C₂ - 35 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (K_{sat}): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e

Custom Soil Resource Report

Hydrologic Soil Group: A

Other vegetative classification: Droughty Soils (G002XS401WA), Droughty Soils (G002XN402WA)

Minor Components

Alderwood

Percent of map unit: 10 percent

Landform: Ridges, hills

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope, nose slope, tal

Down-slope shape: Linear, convex

Across-slope shape: Convex

Indianola

Percent of map unit: 10 percent

Landform: Terraces, eskers, kames

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Linear

Across-slope shape: Linear

2t62k—Indianola loamy sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2t62k

Elevation: 0 to 980 feet

Mean annual precipitation: 30 to 81 inches

Mean annual air temperature: 48 to 50 degrees F

Frost-free period: 170 to 210 days

Farmland classification: Prime farmland if irrigated

Map Unit Composition

Indianola and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Indianola

Setting

Landform: Terraces, eskers, kames

Landform position (three-dimensional): Tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Sandy glacial outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material

A - 1 to 6 inches: loamy sand

Bw1 - 6 to 17 inches: loamy sand

Bw2 - 17 to 27 inches: sand

Custom Soil Resource Report

BC - 27 to 37 inches: sand

C - 37 to 60 inches: sand

Properties and qualities

Slope: 0 to 5 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 99.90 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): 4s

Land capability classification (nonirrigated): 4s

Hydrologic Soil Group: A

Other vegetative classification: Droughty Soils (G002XV402WA), Droughty Soils (G002XF403WA), Droughty Soils (G002XS401WA), Droughty Soils (G002XN402WA)

Minor Components

Alderwood

Percent of map unit: 8 percent

Landform: Ridges, hills

Landform position (two-dimensional): Summit

Landform position (three-dimensional): Crest, talf

Down-slope shape: Linear, convex

Across-slope shape: Convex

Everett

Percent of map unit: 5 percent

Landform: Eskers, kames, moraines

Landform position (two-dimensional): Summit, shoulder

Landform position (three-dimensional): Interfluve, crest

Down-slope shape: Convex

Across-slope shape: Convex

Norma

Percent of map unit: 2 percent

Landform: Depressions, drainageways

Landform position (three-dimensional): Dip

Down-slope shape: Concave, linear

Across-slope shape: Concave

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Enhancing Wildlife on Private Woodlands

D.S. deCalesta

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Wildlife is an integral part of woodlands. Where there are forests, meadows, and streams, there is wildlife. Wildlife means many things to people, but for purposes of our discussion we'll divide it into three basic categories. The most common category is *game*—birds and mammals that one hunts for recreation, fur, and food.

Another category is *pest animals*—those that damage conifer seedlings, seeds, and in some cases larger trees.

A third category, a catch-all, is *nongame species*. This includes songbirds, reptiles, amphibians, and other animals that are neither hunted nor do they cause problems. Rather, they are observed by birdwatchers, photographers, hikers, and others enjoying outdoor recreation. Rare or endangered species such as the bald eagle and spotted owl usually are included in this category.

One of the directing forces behind managing natural resources, particularly on small areas such as woodlots, is the benefit received. What sort of benefit(s) can you expect from investing time and money in wildlife?

If you're a hunter managing for game, your benefit would be harvesting more and/or bigger (i.e., trophy) animals. Also, perhaps, if your acreage is sufficiently large (600+ acres, or approximately 1 square mile), you might profit from leasing the right to hunt on your land. If you're a birdwatcher, your objective is to spot more birds and/or more bird species.

This publication discusses managing game and nongame wildlife in order to increase people's use of them. Pest wildlife is discussed only to the extent that land management for game and nongame species does not lead to increased pest damage. Controlling pest animal damage to conifers is covered in *Understanding and Controlling Deer Damage in Young Plantations*, EC 1201, and *Controlling Pocket Gopher Damage to Conifer Seedlings*, EC 1255 (see page 8).

Whether you manage land for game, nongame, or pest species, the objective is to increase, decrease, or maintain numbers of wildlife. Increased use of wildlife usually necessitates increasing numbers or quality of wildlife available for use, which is known as *wildlife enhancement*.



What is enhancement?

Enhancing wildlife populations means causing an increase in number and/or quality of animals within those populations. The objective might be, for example, to produce more deer or quail, to have more trophy-class animals, or to increase diversity (the number of species).

How do we get enhancement?

All wildlife species are products of their environment or habitat. Each species has specific habitat requirements that are different from those of other species. The habitat provides basic life requirements including food, protection from enemies and weather, and a place to rear young.

As the *amount* of specific habitats and the *diversity* of habitats increases, diversity and numbers of wildlife species on a given piece of land also increase. So, the question “How do you enhance wildlife species?” can be rephrased as “How do you enhance habitat?”

Enhancement must provide for year-round wildlife needs. For some species, such as deer and elk in eastern Oregon, quality and quantity of some habitat elements vary seasonally. The quality and quantity of forage in summer and fall determine the amount of fat animals store in preparation for the tough winter.

If forage is not plentiful and of high quality on summer ranges, the animals might starve on winter ranges where food typically is of low quality and quantity. Also, if deer and elk are not in prime condition in fall, they might not breed, and fawn and calf crops could fail in the spring.

Enhancing habitat

Habitat diversity

Vegetation (trees, shrubs, grasses) provides wildlife habitat. Different species live in different places within this structure. Various birds, such as some warblers, live only in the tops of conifer trees. Here they

find food (insects), build nests, and take shelter from weather and predators. Other species, such as pocket gophers, live underground in grassy meadows.

Some species, such as certain frogs and salamanders, have a special requirement for the riparian zone—the moist, often forested area alongside streams. Most species, however, including deer, quail, and chipping sparrows, require combinations of habitat—meadows and other forest openings to feed in and timber for breeding sites and for protection from weather and predators.

Habitat variety is natural when natural events such as fire, windthrow, and insect and disease attacks open portions of forested areas. These areas usually are revegetated in stages, beginning with grasses, progressing to shrubs, then seedling trees, saplings, mature trees, and finally old-growth trees.

With each successive stage, different combinations of wildlife species likewise appear, persist awhile, and then decline (Figure 1a). The diversity of wildlife species depends on habitat diversity associated with these stages. Providing a diversity of habitats (and thus a diversity of wildlife species) requires a diversity of areas in different stages of vegetative development.

Clearcut logging works like nature in opening forest lands and beginning the progression of vegetative stages, starting with grassy meadows. Reforestation (planting conifer seedlings) and brush control provide other vegetative stages, but the time sequence is shortened (Figure 1b). The last stage, old growth, usually is not attained.

Habitat quantity

Can I grow deer on a 10-acre plot? How many acres does a covey of quail require? What quantities of habitat support viable, reproducing populations of wildlife species? The diversity and abundance of wildlife populations that a given parcel of land supports are directly related to the amount and kinds of land available.

Table 1 (page 5) gives minimum space requirements of representative species. Deer require a minimum of 30 acres per animal of combined forest lands and openings.

Quail require a minimum of 5 to 10 acres per bird of open meadows, with brushy

areas interspersed within the meadows and adjacent forest lands. Songbirds, such as chipping sparrows, require about 5 acres per bird, again of open areas adjacent to forested acreage.

The size and timing of timber harvest can be a major tool in simultaneous management of timber and wildlife. Instead of creating large (more than 100 acres) clearcuts in single cuttings, many smaller cuts can be spread over a number of years (40 to 60 acres could be cut every 5 to 7 years). This would even out the flow of dollar returns from timber and the supply of forage and habitat diversity for wildlife. Thinning timber also provides forage and habitat diversity.

Habitat placement

Wildlife species use different habitats to meet different needs (openings for food, forested areas for cover). These different habitats must be close enough to each other that wildlife can move readily from one to the other with minimal exposure to predation and weather. Wildlife species with small home ranges (songbirds, quail, grouse, rabbits, and deer and elk in western Oregon) must have these different habitats close together (mere hundreds of feet for quail and rabbits and usually less than 0.25 mile for deer and elk).

Problems may arise in eastern Oregon with animals such as deer and elk. They

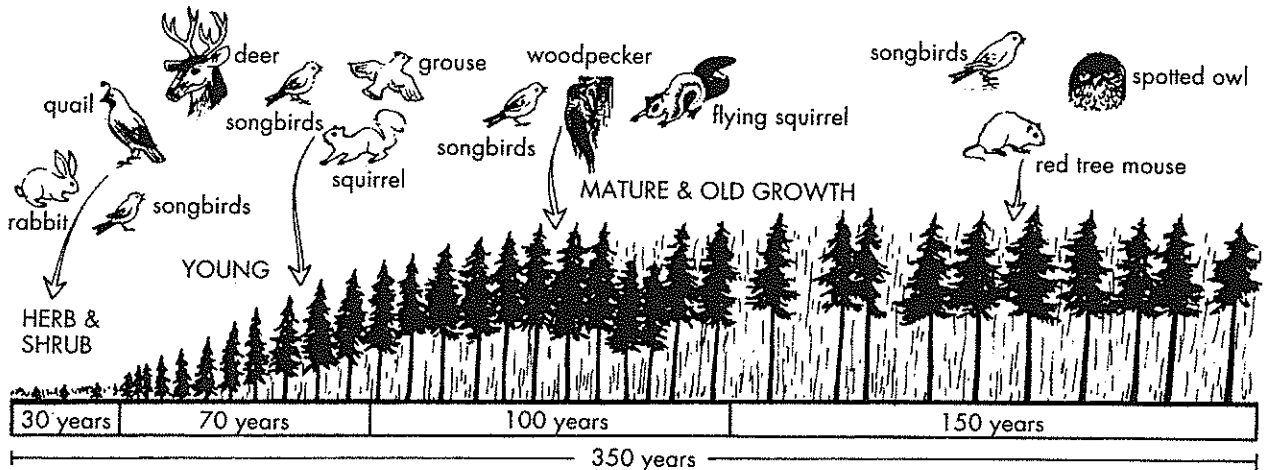


Figure 1a.—Wildlife species that live in a natural, unmanaged forest.

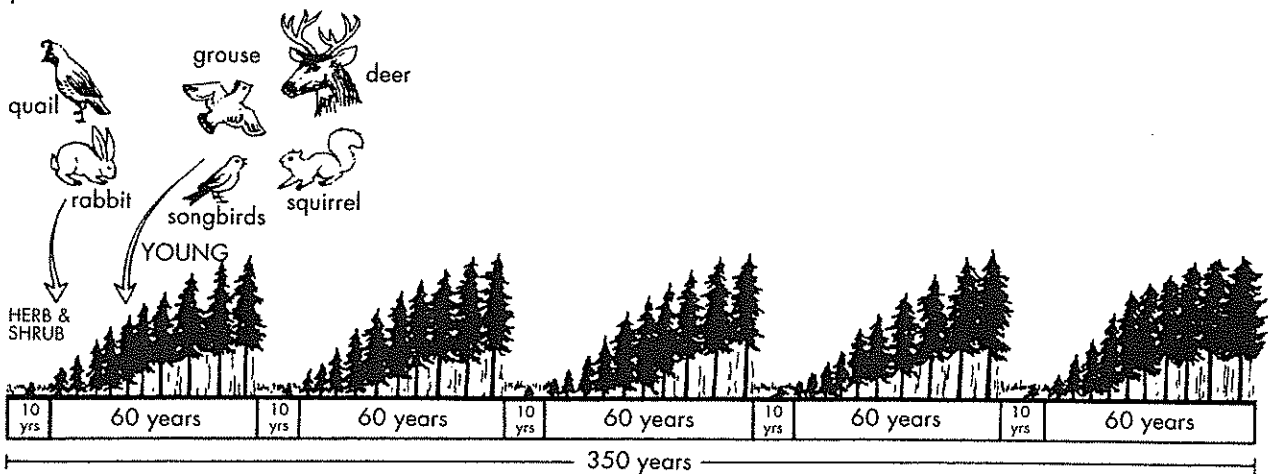


Figure 1b.—Wildlife species that live in a managed forest.

have seasonal habitats that are miles apart—summer range at higher elevations in mountain meadows, winter range down on sagebrush flats. Preserving migration corridors used for traveling to and from such seasonal ranges is another habitat requirement. If these migrating animals have to cross many logging roads, they are exposed to hunters and vehicles.

Deer and elk might be hunted when they are on summer range, on winter range, or traveling on migration corridors. If your property includes only one of these seasonally used habitats, your management of these animals could be influenced by management on land over which you have no control.

Enhancement doesn't stop at merely providing amounts, diversity, and habitat placement. Wildlife have additional habitat needs, primarily food and breeding places, that you can manage and thus indirectly influence wildlife numbers and well-being.

Special requirements

Managing forest lands for timber production generally provides a variety of habitats. However, practices such as brush control and snag removal alter or remove special habitats of some wildlife species. In some cases, one management practice can provide multiple habitat requirements, such as food and cover, for several species.

Leaving a few standing snags and allowing logs to remain on the ground provide nesting sites (cavities in snags) and a food source (insects that burrow into decaying wood) for birds. Slash often is removed from clearcut sites, usually by burning. Small amounts of this slash instead could be piled for quail and rabbits to use as protective cover, breeding sites, and food sources (berries and leaves).

Other management practices might provide for only a single need of wildlife. The rapid establishment of conifer seedlings on forested openings (clearcuts, small meadows, etc.) within 3 to 10 years greatly shortens the time that these areas would otherwise provide forage for deer (7 to 25 years). One way to provide additional forage for deer in the shortened time span is to plant forage on parts of clearcuts. Deer

especially like grass and legume seedlings. Quail, grouse, and rabbits also will take advantage of this additional food source.

You can't always maintain snags and other dead standing trees as nesting sites for cavity-nesting birds and mammals such as flying squirrels. However, you can build nest boxes for bluebirds, other songbirds, squirrels, and wood ducks and place the boxes in appropriate locations as an alternative to natural nest sites.

The key to providing special requirements is to identify those animals you wish to enhance, determine whether they have special requirements that current management does not provide and, if so, implement those activities that will benefit the desired populations.

Constraints on enhancement

One manages forest lands for a variety of reasons—for timber production and recreation as well as for wildlife. The manner of management on neighboring private or public lands can influence wildlife on your land. You must account for these factors in your management plan to avoid conflicts and to increase wildlife abundance.

Conifer damage

Game such as deer and elk can damage conifer seedlings. Managing habitat to enhance populations of these animals should not increase amounts of damage. However, habitat enhancement could increase populations of some animals to a level where they deplete normal food sources and begin to damage conifers.

Planting forage crops for deer might increase populations of pest species such as mice; they girdle conifer seedlings and can cause significant economic loss. Building brush piles provides food and cover for quail and rabbits; however, if you have too many brush piles close to conifer seedlings and not much forage available in winter, you could find the rabbits cause significant damage to the seedlings.

Table 1.—Habitat requirements of representative wildlife species.

Wildlife group	Representative species	Required habitats and acreages	Special habitat requirements
Meadow wildlife	California quail, brush rabbit, meadowlark	Open areas with grasses and forbs; some shrubs (15 acres)	Brush piles essential (one per 2 acres)
Meadow/forest	Deer, elk	Openings (50 acres); closed canopy (15+ years old); conifers (150 acres)	Migration corridors between seasonal ranges
	Chipmunk	Opening (15 acres); second-growth timber (15 acres)	
	Junco, bluebird	Opening (5 acres); second-growth timber (5 acres)	Snags with nest cavities
Young forest	Red squirrel	Mixture of 15- to 75-year-old conifer trees; understory of grasses, forbs (100 acres)	Cone-bearing trees for food
	Ruffed grouse	50-50 mixture of conifers and alder (15 acres)	Moist streamside
	MacGillivray's warbler	Mixture of 15- to 75-year-old conifers (15 acres)	
Mature forest wildlife	Flying squirrel	Conifers 75+ years old (100 acres); understory with forbs, small shrubs	Nest cavities in older trees (100+ years old)
	Spotted owl	Conifers 100+ years old (400 acres)	
	Pileated woodpecker	Conifers 100+ years old (100 acres)	Conifer snags; minimum 20 inches diameter at breast height (dbh) for nest trees
Riparian wildlife	Salamanders, frogs, snakes	Moist, streamside vegetation with closed canopy (0.25 to 2 acres); flowing streams	
Large predators	Bobcat, bear, coyote, goshawk	Mixtures of closed canopy with openings (300 to 1,500 acres)	Large (more than 15 inches dbh) trees for nesting or denning

Conflicts with timber production

Often the primary product on forest lands is timber. In some cases, increasing habitat for wildlife will reduce the yield of timber products. Keeping meadows open to produce deer forage precludes producing timber for market. Maintaining stands of old-growth forest for species such as spotted owls and pileated woodpeckers

prevents the short-term rotation (50 to 80 years) required to maximize timber production on forest lands.

Maximizing diversity of wildlife species requires maximizing diversity and location of habitat sites. Altering vegetation to maximize diversity will lower production of timber on forest lands.

Neighbors

Forest management on neighboring land (private and public) could influence the wildlife on your land. If your habitat is an island of deer management surrounded by land with few deer—such as a large clearcut—few deer and elk will move in, and the population that’s already on your land will have to sustain itself.

On the other hand, if the neighboring land is managed for deer and elk as well as for other forest resources, you might be providing an attractive area that will draw additional animals from neighboring lands. The influx could overwhelm your ability to

keep the population low enough to prevent damage to your seedlings.

Matching what you want with what you’ve got

In any enhancement program, you must match desired wildlife with available habitat(s). The first step is to determine what sort of wildlife you desire.

What wildlife do you want?

Usually, if wildlife is to be managed, it most likely will be for you and your friends, with recreation and food as the chief values. Perhaps you wish to emphasize game. In most cases, leasing or selling hunting rights requires large acreages (600+ acres) to provide sufficient numbers of deer, rabbit, quail, and grouse. There is competition from federal lands (U.S. Forest Service and U.S. Bureau of Land Management), where anyone can hunt without charge and probably can find more variety and larger numbers of game animals than on a small, private ownership.

The required habitats for game animals are meadows and young forests (Table 1). This requires that you retain open grassy meadows with little emphasis on older and mature forests, which do not provide for optimum numbers of the primary game species. Note also that you will need fairly large acreages, especially for deer—an expected annual harvest of two to five deer from your land will require at least 100 acres.

If you want other uses of wildlife, such as birdwatching, you should increase habitat diversity. This means providing the full range of habitats, beginning with open meadows,

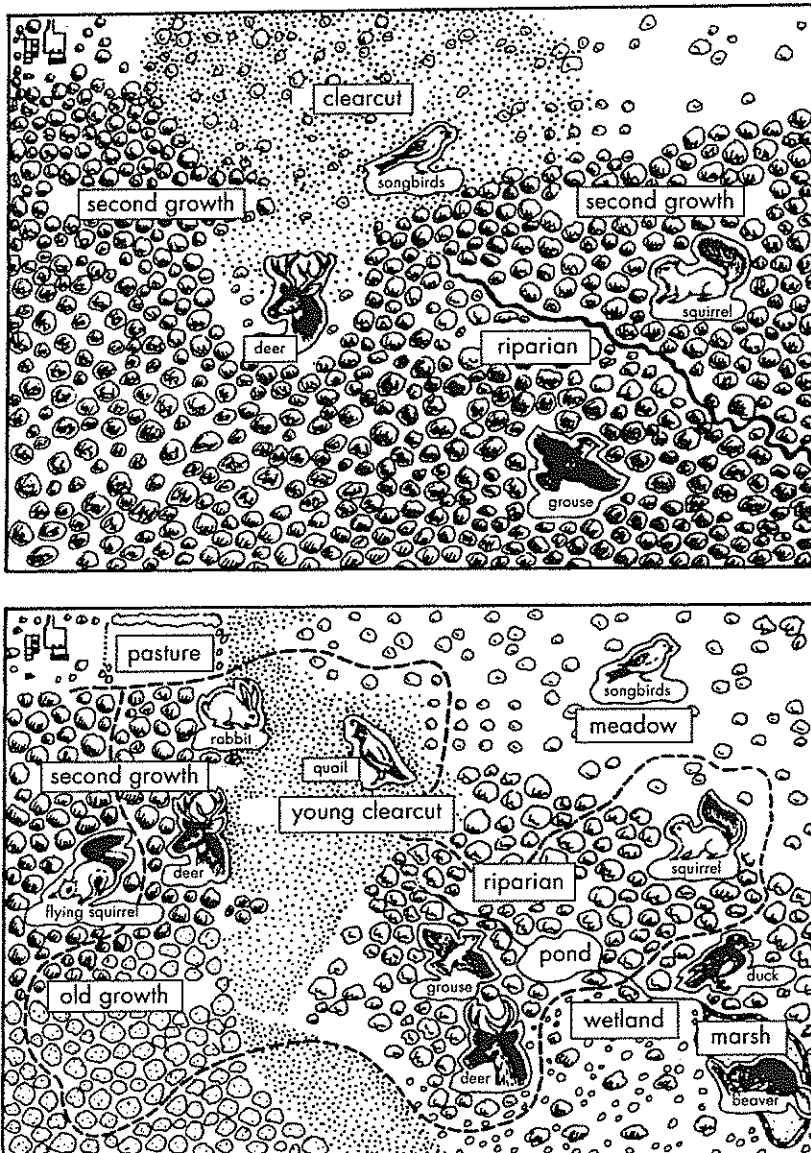


Figure 2.—(top) Wildlife-habitat associations on an undeveloped woodlot and (bottom) on a developed woodlot.

progressing through regeneration, and ending with mature forests.

As for a private game reserve, selling the privilege to observe wildlife on your land will not bring in much money—public lands are available for this.

The best approach is to design habitat improvements around silvicultural practices. The variety of species and numbers of individual species may be less than ideal, but small unused areas, riparian zones, steep slopes, and other areas where timber production cannot be maximized will provide many of the requirements you need for a diversified habitat.

What habitat(s) do you have?

When you decide what kinds of wildlife you want, identify the habitats required and check them against what is available.

Assess the diversity of habitats and acreage of each as well as the habitats of neighboring parcels of land. If the species you want match the type and amount of habitat available, the situation is ideal. If the matchup is not good, you must decide whether to manipulate the habitat to increase species diversity or to increase the number of animals—or perhaps both.

To do this properly, an inventory of your property is essential. Make a sketch of your land with the various habitats roughed out, including acreages. Then list the wildlife species that each type of habitat favors.

Draw habitats that would result from vegetation enhancement and list the wildlife that these modified habitats would favor (Figure 2).

Make a plan

If you intend to enhance vegetation to provide a greater variety of habitats for wildlife, you must make a plan for the desired changes. The plan should include the location and acreage of habitat you desire to manipulate, the expected cost of the enhancement, and provisions for special habitat requirements not provided by typical vegetation manipulation. Table 2 gives an example of such a plan.

Where to go for help

A number of public agencies and private groups in Oregon can provide assistance. The Oregon State University Extension Service has publications that describe how to provide special habitat needs such as nest boxes. The Oregon Department of Fish and Wildlife has information on preferred habitats of wildlife, and the USDA Natural Resources Conservation Service provides help with habitat manipulation. The Audubon Society is an excellent source of information on providing for special needs of songbirds; most large towns have an Audubon Society chapter.

Table 2.—Sample habitat enhancement plan.

Wildlife species	Habitat enhancement and acreages	Provision for special requirements
Deer, elk	Provide openings in forest (20 to 50 acres each); harvest standing timber; suppress tree and shrub regeneration.	Seed 5- to 10-acre patches in meadows with grass-legume mix.
Rabbits, quail	Provide permanent openings (15 acres) and one to two brush piles per acre.	
Songbirds	Maintain a good mixture of meadows, second growth, and old growth (5 to 10 acres for each habitat).	Establish nest boxes; establish a system of trails through all habitats for bird watching.

For more information

OSU Extension publications are available from:

Publication Orders
Extension & Station Communications
Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119
Fax: 541-737-0817

We offer discounts on orders of 100 or more copies of a single title. Please call 541-737-2513 for price quotes.

You can view our Publications & Videos catalog and many of our publications on the Web at <http://eesc.oregonstate.edu>

Bennett, M. *Ecosystem Management: Opportunities and Implications for Woodland Owners*, EC 1469 (Corvallis: Oregon State University, 1996). \$1.25

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Edge, W.D. *Managing Wildlife Habitats in Forested Ecosystems*, EC 1470 (Corvallis: Oregon State University, reprinted 1998). \$2.00

Other publications

The "Peterson Field Guide" series for birds, mammals, animal tracks, trees and shrubs, reptiles and amphibians, insects, and bird nests (Boston: Houghton Mifflin).

deCalesta, D. and M.S. Deusen. *Woodland Fish and Wildlife*. 1988. This series includes a number of separate publications. Order from Washington State University, 1-800-723-1763 or via the Web at <http://pubs.wsu.edu>, then "forestry," then "wildlife and fish."

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The Woodland Workbook is a collection of publications prepared by the Oregon State University Extension Service for owners and managers of private, nonindustrial woodlands. Information has long-range and day-to-day value for anyone interested in wise management, conservation, and use of woodland properties. The Workbook is organized in sections in a 3-ring binder with tabbed dividers for each section. To order, and to get a current list of titles and prices, inquire at the OSU Extension Service office that serves your county.

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King County

Department of Natural Resources and Parks
Water and Land Resources Division
Noxious Weed Control Program
206-296-0290 TTY Relay: 711

BEST MANAGEMENT PRACTICES Evergreen blackberry (*Rubus laciniatus*) and Himalayan blackberry (*Rubus discolor* *syn. Rubus armeniacus*)

Legal Status in King County: Not listed, no legal requirement for controlling obnoxious weeds. The County Weed Board recognizes these plants are invasive and is collecting information and providing education on control. The Board encourages and recommends control and containment of existing populations and discourages new plantings.

BACKGROUND INFORMATION

Impacts and History

- Highly invasive and can be found throughout King County.
- Can be very difficult to control.
- Out competes native understory vegetation and prevents the establishment of desirable native shade intolerant trees such as Pacific Madrone, Douglas Fir and Western White Pine.
- Can limit movement of large animals when forming large impenetrable thickets.

Description

- **Himalayan blackberry** is a robust, sprawling perennial with stems having large stiff thorns.
 - Main canes up to 10 feet long with trailing canes reaching up to 40 feet.
 - Trailing canes typically take root at the tips.
 - Leaves are large, round to oblong and toothed typically come in sets of three (trailing canes) or five (main stems).
 - Individual canes can reach a density of 520 canes per square meter.
 - Flowers are white to pink about one inch in diameter and borne in clusters of about 5 to 20.
 - Develops edible black fruit that clings to the center core when picked.
-
- **Evergreen blackberry** is a robust trailing evergreen shrub that grows into impenetrable thickets.
 - Ribbed reddish stems up to 10 feet in length with large curved thorns.
 - Young canes arch as they grow longer that eventually reach the ground rooting at the nodes.
 - Palmately compound leaves with 3 to 5 deeply lacerated leaflets.
 - Flowers are white to pink about one inch in diameter borne in clusters.
 - Develops edible black fruit that clings to the center core when picked.



Himalayan blackberry



© 2005 Virginia Tech
Evergreen blackberry

Habitat

- Blackberry can be found in a myriad of habitats such as vacant lands, pastures, forest plantations, roadsides, creek gullies, river flats, riparian areas, fence lines, and right-of-way corridors.
- Does not grow well in wetland areas, will grow if cane tip roots.

Reproduction and Spread

- Reproduces vegetatively by root and stem fragments, and by seed.
- Plants begin flowering in spring with fruit ripening in midsummer to early august.
- Daughter plants can form where canes touch the ground.
- Seeds can remain viable in the soil for several years.

Local Distribution

Found throughout King County.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods which reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Plan your control effort including: 1) surveying of the area thoroughly for blackberry, 2) setting priorities for control, 3) selecting the best control method(s) for the site conditions and regulatory compliance issues and 4) monitoring the success of control and implementing follow up control as necessary.
- In unincorporated King County outside of wetlands, aquatic areas, wildlife network areas and their buffers, a Clearing and Grading permit is not required to clear areas of blackberry if: 1) the annual area to be cleared is less than 7000 square feet or 2) if the clearing is conducted in accordance with an approved Forest Management Plan, Farm Management Plan or Rural Stewardship Plan. Within wetlands, aquatic areas, wildlife network areas and their buffers, Clearing and Grading permits are not required if the area to be cleared is less than 7000 square feet and clearing is conducted in accordance with one of the stewardship plans mentioned above or is removed by hand labor. Clearing in excess of these limits will

require a permit, however there will be no cost for this permit provided control practices defined in this BMP and the King County Noxious Weed Regulatory Guidelines are followed.

- Control practices in critical areas should be selected to minimize soil disturbance. Any disturbed areas need to be stabilized to control erosion and sediment deposition. Refer to the King County Surface Design Manual for further information about sediment and erosion control practices. Minimizing disturbance also avoids creating more opportunities for germination of blackberry and other weeds.
- Generally work first in least infested areas, moving towards more heavily infested areas.
- Ensure habitat protection by targeting only blackberry and preserving all native and beneficial vegetation.

Early Detection and Prevention

- Blackberry is easily identifiable throughout the year.
- Manually control new infestations as early as possible .
- Monitor the control site and remove any plants returning from root fragments

Manual

- Hand pull the stem close to the ground and uproot the root ball. This method is most effective with first year plants.
- Manual control works best after rain or in loose soils where the canes are suppressed because the blackberries are growing in a forest understory.
- Digging up root crowns and major side roots is slow but will control blackberry and is effective on small infestations.
- Using a claw mattock or pulaski/mattock is also effective.
- Recheck work area because large root fragments left can re-sprout.
- If removing dense patches, area should be replanted with native plants and mulched, or reseeded with a suitable grass.
- Hand pulling and the use of hand mechanical tools of up to seven thousand square feet annually is allowable without a permit in unincorporated King County, including all critical areas and buffers.

Mechanical

- Mowing, including the use of riding mowers and tractor mounted mowers, can be very effective in controlling blackberries but also may harm desirable plants present.
- Mowing should not be used where soils are highly susceptible to compaction or erosion, or where soils are very wet.
- Several cuttings a year over several years are necessary to exhaust the roots of their reserve food supply.
- If only one cutting is done per year, cut when the plants begin to flower. If no follow-up is done, the blackberry may re-sprout from the root crown at a greater density, and could overgrow any vegetation planted.

- Cultivation in agricultural areas utilizing cultivation machinery can be effective in controlling blackberry either alone or in conjunction with mowing but is not selective and may require specific sediment and erosion control measures (see Control of Large Infestations/Monocultures).

Biological

Biological control is the deliberate introduction of insects, mammals or other organisms which adversely affect the target weed species. Biological control is generally most effective when used in conjunction with other control techniques. Biological control methods that may assist in blackberry control include the use of goats and chickens as follows:

- Goats and pigs may be effective on clearing or controlling blackberry re-growth from a year to four years old. On mature stands, goats tend to only strip leaves off of the canes. Animals may prefer alternative forage available, so reduce opportunities for selective browsing. Grazing must be continuous or else regrowth will occur. Care needs to be taken to fence off or protect any native or other valuable vegetation. The King Conservation District can provide further information of the use and management of goats for weed control.
- Chickens can potentially decrease the seed bank in blackberry cleared areas by grazing on the seeds.

Chemical

- Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label. **Follow all label directions.**
- Herbicide specified in these guidelines may be used in accordance with Federal and State Law in critical areas and their buffers with certain restrictions. Refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current Federal, State and local restrictions and regulatory compliance issues.
- For control of large infestations, herbicide use may be effective, either alone or in combination with mowing. Infested areas should not be mowed until after the herbicide has had a chance to work and weeds are brown and dead.
- For several years following treatment, monitor areas for new plants germinating from the seed bank, or any missed plants.

Specific Herbicide Information

Herbicides are generally described here by the active ingredient. Many commercial formulations are available containing a specific active ingredient. References to product names are as an example only, and other equally, or more effective commercial products may be available.

Glyphosate: can effectively control blackberry. Treatment with glyphosate needs to be combined with effective re-vegetation of the site to prevent re-invasion by undesirable vegetation and to control erosion. Glyphosate is most effective on blackberry in September to October when canes are actively growing and after berries have formed. Fall treatments should be conducted before the first frost.

Selective Broadleaf Herbicides (such as triclopyr, 2,4-D and metsulfuron): most effective when blackberry is growing in a grassy area. Read the label of the product you are using to determine the optimal time to spray. Re-treatment the following year may be necessary to control any returning plants. Continue to monitor for new plants for several years after the initial treatment and following any disturbance to the soil such as tilling or construction. **NOTE: Certain additional restrictions apply for products containing 2,4-D and Triclopyr BEE (e. g. Garlon 4, Crossbow). Refer to the King County Noxious Weed Regulatory Guidelines for more details.**

Selective herbicides that are effective on blackberry include metsulfuron (e.g. Escort, Cimarron, Ally), triclopyr ester (e.g. Garlon 4) or triclopyr amine (e.g. Garlon 3A) and a combination treatment of triclopyr and 2,4-D (e.g. Crossbow).

Metsulfuron should be applied to fully leafed-out blackberry before fall leaf coloration. Good coverage is essential to achieve control.

Triclopyr (amine and ester) and triclopyr + 2,4-D should be applied when actively growing. Foliage must be thoroughly wetted with herbicide.

2,4-D can harm certain grasses, alfalfa, clover and other legumes. The addition of a suitable surfactant may improve the control results.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Properly identify targeted blackberries
- Mark all desirable vegetation around control area, ensuring that no native plants are removed.
- Small infestations of less than 200 square feet can be effectively and relatively easily hand-pulled or dug up. Isolated plants should be removed in order to prevent them from infesting a larger area.

- Cut above ground portion of blackberry with loppers or pruners. Dig up or pull the remaining root ball.
- Pull or dig up the plants when the soil is wet.
- Replace any divots created when removing the plants to lessen the amount of disturbed soil.
- Apply appropriate herbicide with wick wiper or by spot spray to the cut stumps to minimize off target injury.
- Monitor site throughout growing season and remove any new plants.
- If using an herbicide in a grassy area, use a selective herbicide to avoid injury to the grass.

Large Infestations/Monocultures

- Properly identify invasive blackberries.
- Mark all native vegetation in and around the control area, ensuring that no native plants are removed.
- Mow down the blackberry with weed-eaters, brush mowers or machetes.
- Following mowing, either dig up the root-ball if labor is available or treat re-sprouting blackberry regrowth with an appropriate herbicide (See the Chemical section of this BMP).
- Mechanical cultivation is also an option for controlling invasive blackberries in agricultural areas. After initially mowing down the above ground vegetation, deep cultivation of the land can control root balls if done multiple times. Yearly spot control of returning seedlings or re-growth will likely be necessary.
- For large areas, it may be more cost-effective to apply herbicide to the mature blackberry plants and then mow the dead canes.
- When large dense areas of blackberry are removed, the bare areas created need to be stabilized and re-vegetated with native or non-invasive vegetation to prevent erosion and re-invasion of blackberries and other weeds (refer to the King County Surface Water Design Manual or equivalent for incorporated areas). Ensure that a high standard of blackberry control has been achieved prior to revegetating the site.
- If a non-selective herbicide is used in grassy areas, the area needs to be re-seeded to prevent reinvasion by weeds.
- Infested areas will require follow-up management lasting for several years to control plants re-growing from the seed bank and rhizomes.

Riparian and Aquatic Area Control Issues

- Focus on manual removal for small infestations if possible. Follow procedures listed above.
- For larger areas where herbicide use is warranted, apply with a wick wiper or spot spray using low pressure and large droplet size.
- Blackberry shrubs can be found growing along wetland margins but are typically daughter plants off of a main cane. Control can be achieved by cutting the canes down to the ground. The roots can not withstand the anaerobic soil conditions without the supporting canes.
- Pay particular attention to regulatory compliance issues for aquatic areas described in the King County Noxious Weed Regulatory Guidelines.

Road Rights-of-Way Control Issues

- Manually remove infestations if possible.
- If plants are in grassy areas, use a selective broadleaf herbicide; if controlled with a non-selective herbicide, re-seed after control is completed.
- An effective mowing program can control blackberries along a Right of Way. Any blackberries remaining outside the mowed area will quickly re-invade the cleared areas.
- Spot spray blackberries with glyphosate in areas with no desirable vegetation.

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<http://www.cnr.vt.edu/dendro/dendrology/carddetail.cfm?Genus=Rubus&Species=laciniatus>

English ivy - *Hedera helix*

English ivy (*Hedera helix*) and Irish ivy (*H. hibernica* or *H. helix hibernica*) are very similar plants in the Ginseng family (*Araliaceae*), and both are referred to as English ivy in this bulletin.

THE IMPACTS

When English ivy escapes from landscaped plantings it often establishes and spreads in shaded forested lands or natural areas. There it can impact all three zones of a deciduous or conifer plant community – the forest floor, the shrub layer and the canopy.



English ivy climbing a mature tree

- English ivy reaches the tree canopy and shades out deciduous foliage during summer months, suppressing the host tree.
- Dense ivy cover deprives the bark of normal contact with air and microorganisms.
- English ivy adds substantial weight to a tree. The estimated weight of ivy removed from a tree in Olympic National Park was 2100 lbs.
- Mature trees covered with ivy are top-heavy and more likely to blow down.
- Thick ivy mats can accelerate rot and deteriorate structures.



Thick ivy mats smother understory plants and tree seedlings

- English ivy changes the natural succession patterns of forests.
- Ivy limits understory regeneration by blocking sunlight and shading out plants.
- The fast-growing ivy competes for water and nutrients.
- The shallow mat-like root system make it a poor choice for erosion control, and contributes to erosion in some cases.
- Provides hiding areas for rats and other vermin.

IVY CULTIVARS

More than 400 different English ivy cultivars vary in leaf shape, size, color and growth form. While many cultivars are sold as ornamental plants, recent research indicates that several cultivars are invasive and should be avoided as landscape plants in the Pacific Northwest.

Four cultivars of English ivy were added to the 2002 Washington State Noxious Weed List as Class C weeds.

They are: *Hedera helix* 'Baltica';
H. helix 'Pittsburgh';
H. helix 'Star' and
H. hibernica 'Hibernica'

WHAT IS A WEEDY CULTIVAR?

- English ivy is invasive when growing in areas where it was not planted.
- It is invasive when thick mats or vines inadvertently cover plants, trees or structures.
- It is invasive when producing flowers and seeds and rapidly spreading on its own.



King County

Department of Natural Resources and Parks
Water and Land Resources Division
Noxious Weed Control Program

WHAT IS ENGLISH IVY?

This woody, evergreen perennial grows as a vine (climbing or creeping) or as a shrub. English ivy can photosynthesize year-round, and is capable of growth for 9 to 10 months of the year. Older vines can grow over 90 feet long with stems reaching one foot in diameter. English ivy is long-lived with reports of one plant over 400 years old.

Adventitious roots are formed at the leaf nodes of immature plants, and they help ivy climb by adhering or anchoring to surfaces – they do not penetrate the surface. Ivy tolerates a wide range of light conditions but growth is stimulated by light.

The entire plant contains slightly toxic compounds. Berries and leaves are toxic to people or livestock if eaten in a large quantity. The sap can cause dermatitis and blistering.

Hedera is native to Europe and Asia, and was widely introduced into temperate parts of the world. It has a long history as a garden plant. Introductions to the Pacific Northwest date back to at least the 1890's.

There are two distinct forms and growth stages of English ivy – the juvenile and the mature form.



Leaves of juvenile plants

Juvenile form

- Leaves are deeply 3 to 5 lobed, light green and alternately arranged.
- Young shoots and leaves are hairy.
- Stems produce adventitious roots at the nodes.
- Immature plants do not produce flowers.
- This juvenile stage lasts for about 10 years.



Leaves of a mature plant

Mature form

- Leaves are unlobed, or slightly lobed, dark green and leathery and spirally arranged.
- English ivy matures to produce flowers when it begins to grow vertically.
- Mature plants do not produce adventitious roots.

REPRODUCTION AND DISPERSAL

During the juvenile stage ivy only spreads vegetatively. Any stem fragments in contact with the soil can regenerate growth. Mature plants continue with a slower vegetative spread, but they also produce flowers and spread by seed. Clusters of small greenish-white flowers are usually produced in the fall.



The dark colored drupes (berry-like fruits) mature in the spring.

The fruits are high in fat, and they are available in early spring when food is still scarce. Many birds, including blackbirds, European starlings and American robins, disperse the seeds.

CONTROL REQUIREMENTS

English ivy is a Class C Noxious Weed of Concern in King County - control is strongly encouraged although not currently required. The County Weed Board recommends control and containment of existing populations and discourages new plantings of invasive cultivars. For control requirements in other areas, please contact the county noxious weed control program.



Stop buying and stop planting invasive cultivars.

PREVENTION

When planting an area, consider alternative ground covers. The list includes, but is not limited to, the following native plants: wild strawberries, false lily-of-the-valley, bunchberry, fringe cup, wood sorrell, kinnikinnick, low Oregon grape, and sedges. Please contact local nurseries or native plant societies for more suggestions.

PRIORITIZE YOUR CONTROL PLAN

Consider the amount of ivy to be removed and the site you are working on. Also consider the on-site vegetation you want to keep, the time frame for removal and the labor force. Be persistent with your control plan and with follow-up.

- First remove the vertical growing plants to stop flower production and further spread by seed.
- When working in steep areas, the site needs to be considered for slope and any surface erosion.

MANUAL CONTROL

Even though it is labor intensive, the most effective control method is manual removal. Depending on the site, several other manual control options are also effective.

NOTE: Remove all cut stems from soil contact.

Wear gloves and protective clothing. The sap can cause a reaction in some people.

- Remove flowers or seed heads you can reach.
- Hand pull or dig out accessible plants.
- Mowing is effective in areas that are mowed regularly. Clippings need to be removed.
- Mulching – apply an 8” thick mulch layer. The plants can be cut or removed and then mulched, or a mulch layer can be directly applied on top of plants. This is not an option in steep areas.



Cut the vines or pry them off of trees with the aid of a tool at a comfortable height. This will kill the upper vines, but the lower, rooted plant needs to be removed.

CHEMICAL CONTROL

Controlling established English ivy with herbicides is not very successful because of the waxy leaves. There is also a risk to non-target plants from run-off of the waxy leaves. English ivy is considered tolerant of many commonly used herbicides. Some success has been achieved by carefully selecting herbicides and focusing applications on young, actively growing plants. If herbicides are used, make sure that their use is allowed at your site. Certain herbicides can not be used in aquatic areas or their buffers. When using an herbicide follow all label directions. Contact your local noxious weed control program for control guidelines in your area.

DISPOSAL - FOR SMALL AMOUNTS

Remove and dispose as yard waste. Backyard composting is only recommended when the rootlets and the cut stems are dead. Otherwise the ivy stems will root in the other material as it decomposes.

English ivy clippings will break down to 1/5 of its size when left to dry out and die.

- Expose the stems and rootlets to the air for 6 – 7 days until they desiccate.
- Pile the clippings under a covered area, then cover the clippings with a tarp.
- Pack the ivy in black plastic bags and leave in a sunny spot, rotating to heat all the plants.

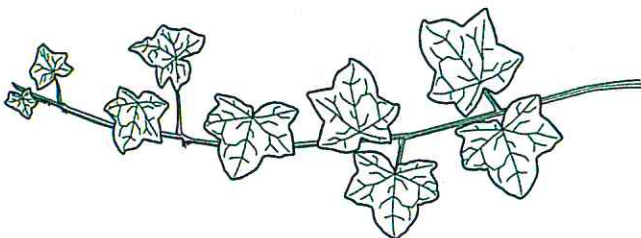


English ivy rootlets from a 4" diameter stem

DISPOSAL - FOR LARGER AMOUNTS

For large projects where the removed ivy can remain on site and out of sight, the cut stems can be balled or stacked on top of itself and left on site. Lift the ivy piles to keep the cut stems and rootlets from soil contact, or regularly turn the clippings to keep exposing the rootlets to the air.

- Pile the ivy and let it dry out or decompose. Cover the piles to speed the process.
- Wrap the pulled vines into medium sized bundles, leave them on site to dry up and die.



For more information please contact:

King County Noxious Weed Control Program

Department of Natural Resources
Water and Land Resources Division
201 S. Jackson St., Suite 600
Seattle, WA 98104
(206) 296-0290
email: noxious.weeds@metrokc.gov
<http://dnr.metrokc.gov/weeds>

Or contact your local county noxious weed program.

References are available from the King County Noxious Weed Control Program.

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Websites:

King County Noxious Weed Control Program:

<http://dnr.metrokc.gov/weeds>

WA State Noxious Weed Program (with links to counties):

<http://www.wa.gov/agr/weedboard>

No Ivy League: <http://www.noivyleague.com/>

Ivy OUT: <http://ivyout.org>

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Information presented here is available in alternate formats upon request for individuals with disabilities. Call: 206-296-0290. TTY: 1-800-833-6388

Invasive Knotweeds

Bohemian Knotweed

Polygonum x bohemicum (Fallopia x bohémica)

Japanese Knotweed

Polygonum cuspidatum (Fallopia japonica)

Giant Knotweed

Polygonum sachalinense (Fallopia sachalinense)

Himalayan Knotweed

Polygonum polystachyum (Persicaria wallichii)

Polygonaceae – Knotweed/Buckwheat Family

**Class B Noxious Weeds
Control Recommended
(required in selected areas)**

Legal Status in King County: The species of knotweed listed above are classified as Class B noxious weeds (non-native species that can be designated for control based on local priorities) according to Washington State Noxious Weed Law, RCW 17.10. The Washington State Noxious Weed Control Board has not designated these species for required control in King County. The King County Noxious Weed Control Board recommends control of these species wherever feasible, and requires control in selected areas (see current King County Noxious Weed List for details). State quarantine laws prohibit transporting, buying, selling or offering these species for sale or distributing plants, plant parts or seeds.



BACKGROUND INFORMATION

Impacts and History

- Displaces native vegetation due to its fast-growing, dense, aggressive growth.
- Creates bank erosion problems and is considered a potential flood hazard. Despite knotweed's large rhizome mass, it provides poor erosion control.
- Lowers quality of riparian habitat for fish and wildlife. Changes nutrient cycling of rivers and lowers water quality.
- Thickets can completely clog small waterways.
- Forms dense stands that crowd out all other vegetation, degrading native plant and animal



habitat.

- Damages pavement, limits sight visibility along roads, and obscures guard rails and road signs.
- Roots interfere with drainage and septic systems.
- Invades turf and landscaped areas.
- Difficult to control because of extremely vigorous rhizomes and roots that form a deep, dense mat.
- Plants can re-sprout from very small root and rhizome fragments.
- Plant stems and rhizomes that fall into the water can create new infestations downstream.
- Japanese and giant knotweed are native to northeastern Asia. They hybridize to produce Bohemian knotweed. Himalayan knotweed is native to south and central Asia, including the Himalayas.
- All species were introduced into the U.S. and Canada starting in the late 1800s as ornamental plants and for erosion control and have since spread widely.



Description

- Large, clump-forming, herbaceous perennial with 4 to 12 feet tall, round canes with thin, papery sheaths and creeping roots. The hollow stems are jointed and swollen at the nodes, giving a bamboo-like appearance.
- Japanese, giant, Bohemian and Himalayan knotweed are members of the buckwheat family (Polygonaceae).
- Rhizomes can spread at least 23 feet (7 meters) from the parent plant and can penetrate more than 7 feet (2 meters) into the soil.
- Forms large, dense clones of either male or female plants.
- Stems are thick and hollow, resembling bamboo, green to reddish in color, often red-speckled. Young shoots look similar to red asparagus.
- Leaves are alternate, bright green with smooth edges. Leaf shape varies. : Himalayan knotweed leaves are like an elongated triangle, Japanese knotweed leaves are rounded with a flat base and short pointed tip Bohemian knotweed leaves vary from a heart-shaped base to a flat base and variable leaf tip shape, and giant knotweed leaves are huge, “elephant ear” type leaves with a distinctly heart-shaped base and elongated pointed tip. Leaf size also varies, however Japanese knotweed leaves are generally 4 to 6 inches long by 3 to 4 inches wide, hybrid Bohemian knotweed leaves are 7 to 9 inches long, and giant knotweed leaves often exceed 12 inches across, twice the size of Japanese knotweed leaves.
- Flowers are small, white/green on Japanese, Bohemian and giant knotweed and light pinkish-white on Himalayan knotweed and grow in showy plume-like branched clusters. Flowers form in July and August and grow in dense clusters

from the leaf joints. Flowers are either all female (form seeds) or all male (don't form seeds) on each plant.

- Flowers in late July, typically start to form seeds by mid-August.

Habitat

- Can grow in partial shade or full sun.
- Knotweed thrives in any moist soil or river cobble, but can also grow in dry areas.
- Most commonly found in the flood zone along rivers and creeks, it also grows in roadside ditches, railroad rights-of-way, unmanaged lands, wetlands, neglected gardens, and other moist areas.

Reproduction and Spread

- Knotweed typically starts growth in April, but can begin as late as June in higher elevations.
- Reproduces by seed and vegetatively from rhizomes and roots. Knotweed can spread rapidly due to its ability to reproduce vegetatively.
- Invasive knotweeds spread mainly by rhizomes. Rhizome and root fragments are dispersed by natural causes (flood, erosion) or man-made dispersal (roadside clearing, fill dirt).
- Root fragments, as small as ½ in (1 cm) can form new plant colonies and can also be spread in contaminated fill material.
- Cut or broken stems will sprout if left on moist soil or put directly into water, or if moved by beavers or earth-moving equipment. Each node on the plant stock is able to produce roots and new plants.
- Seeds can be viable for as long as 15 years. Seeds in the upper 1 inch (2 cm) of soil generally are viable for 4 to 5 years. Below 1 inch (2 cm), the seeds remain dormant longer. However, knotweed seedlings are not often found in the wild and most dispersal is by root and stem fragments.
- Knotweed canes die back with the first hard frost (Pridham and Bing 1975) and go dormant during the winter. The dead, brown stems may remain standing through the winter with new canes developing in the spring from the same rootstock.

Local Distribution

Found throughout King County. The heaviest concentrations of invasive knotweeds are found along riparian corridors and road rights-of-way. Infestations can also be found in residential gardens, wetlands, and upland areas.

CONTROL INFORMATION

Integrated Pest Management

The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.

Use a multifaceted and adaptive approach. Select control methods that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

The key to controlling knotweed is controlling the rhizomes. What you see on the surface is only a fraction of the problem. "Control measures that fail to address the regenerative capacity of the rhizomes will not control this plant." (Gover et al 2005). Although there are potentially successful mechanical or manual control options for small patches, landscape level projects and large sites will likely require integrating herbicide into the control strategy.

Begin by surveying area for knotweed, setting priorities and selecting the best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines**).

It is possible but not easy to control knotweed, and it is especially difficult on a landscape scale, such as along a river, or when spread over many properties. Because of knotweed's incredibly extensive root system and sprouting ability, landscape level control requires long-term planning and follow-up. Even on a patch-by-patch basis, successful eradication is likely to take several years and multiple treatments.

On rivers and streams, knotweed spreads easily downstream by water, so it is necessary to begin control from the furthest upstream infestation, including all tributaries and other upstream sources of possible re-infestation.

For large, landscape scale projects, outreach to all public and private landowners and the broader community, as well as volunteer recruitment and coordination, will improve the success of the project. Work with volunteers and other organizations in the community to expand the ability to physically get the work done. Landscape

level projects may have a greater chance of success under a coordinated effort such as a Cooperative Weed Management Area (CWMA). Grants are available for invasive vegetation removal, such as knotweed, that benefits public resources, especially for work done through non-profit organizations or government agencies.

Below, each method is first described individually, and then Best Management Method recommendations are provided for different types of infestations.

Early Detection and Prevention

- Monitor for new populations in May and June.
- Dig up isolated or small populations (50 stems or less). If there are more stems than you can remove manually, it may be necessary to treat the area with an appropriate herbicide in the late summer/early fall.
- Prevent plants from spreading away from existing populations by washing vehicles, machinery, and equipment that have been in infested areas.
- Prevent knotweed from entering waterways.
- Do not discard stems or root fragments in waterways or on moist soil.

Manual or Mechanical Control

- **When to use manual methods:** If there is easy access to the site and patches are reasonably small (50 stems or less), commit to following an intensive control regimen.
- **Variations:** Cutting, mowing, pulling, digging, covering.
- Cutting, mowing and pulling stimulates shoot growth and depletes the roots. The more shoots there are per linear foot of root, the more likely it will be to physically pull out the roots, exhaust them by depriving them of energy (i.e. by cutting the shoot off) or eradicating them with an herbicide treatment.
- When controlling knotweed manually, be sure to practice the four T's: timely, tenacious, tough and thorough (Soll 2004).
- Hand pulling and the use of hand mechanical tools to control noxious weeds are generally allowable in critical areas in unincorporated King County (refer to the **King County Noxious Weed Regulatory Guidelines** for details).
- Be aware that repeated cutting tends to produce numerous small stems that may make future treatment with stem injection more difficult.
- **CUT** stems close to the ground **TWICE A MONTH OR MORE** between at least April and August, and then once a month or more until the first frost, over 3 to 5 consecutive years (Soll 2004). This can vary depending on the growth of the plant. The important thing is to keep the plant from storing any new root energy.
 - Keep plants from growing taller than 6 inches.

- Using a machete, loppers or pruning shears, cut the stems to the ground surface. If using a mower/weed-eater is necessary, cut as low and as often as possible. Be sure not to scatter stems or root fragments.
- Rake and pile up the cut stems where they will dry out. Dried stems can be crushed and composted on site or discarded in yard waste.
- Stems or stem fragments left on moist soil or in water may sprout at the nodes, and the area (or adjacent areas) may become re-infested.
- Large piles of composting knotweed stems have been known to self-ignite, so take care not to create large piles and monitor regularly.
- Goats and chickens are reported to eat knotweed and in some circumstances, controlled grazing may be an option similar to intensive mowing. Be aware that goats will eat desirable vegetation as well as knotweed. Grazing should reduce the growth of knotweed, but is unlikely to completely kill the plants. For best results, maintain intense grazing pressure for at least 5 years over the entire knotweed patch or until plants stop growing back.
- Never allow cut, mowed or pulled knotweed vegetation to enter waterways.
- **DIG** up as much root as possible in August over at least three consecutive years; reported to work for small, isolated patches.
 - Roots of established plants may extend down 7 to 10 feet deep, and rhizomes are often very large and woody and difficult to dig up.
 - Be sure to carefully dispose of the roots in garbage. Do not put them in a compost pile because they remain viable for a very long time. Roots and rhizomes dry out very slowly, so burning isn't usually a feasible disposal option for rhizomes.
 - Each time you see new sprouts (start looking a week after you pull), uproot them as well, trying to pull out as much of the root as you can each time.
 - Be sure to search at least 20 feet away from the original patch center for new sprouts.
- **COVER** with heavy duty geo-textile fabric or black plastic.
 - Works better with isolated and smaller patches on open, undisturbed terrain.
 - Plan to leave the covering material in place throughout at least five growing seasons, longer if the soil is wet or the population large and well-established.
 - First, cut stems down to ground surface. Next, cover the area with geo-textile fabric or heavy duty black plastic extending beyond the plant base and stems at least 7 feet beyond the outside stems. Leave covering material loose and clean of debris, weighted down with heavy rocks or cement blocks. Watch for holes in the fabric and at the perimeters for any new growth. Every two to four weeks during the growing season, stomp down re-growth under covering material and clean debris.

- Install covering at the beginning of the year or after cutting the plant down several times during the growing season which will reduce some of the rapid plant growth.

Chemical Control

- Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the herbicide label. **Follow all label directions.**
- For your personal safety, at a minimum, wear gloves, long sleeves and pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
- For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
- Herbicides with the active ingredients glyphosate (e.g. Rodeo, Roundup, Aqua Neat among others), imazapyr (e.g. Habitat, Polaris, Arsenal), triclopyr (e.g. Garlon, Renovate, Element) and aminopyralid (e.g. Milestone) have shown to be variably effective in controlling or suppressing knotweed either separately or in combination. Results vary depending on the timing, rate and method of application. See below for detailed information.
- Aquatic herbicides are Restricted Use Pesticides in Washington and can only be purchased and used for aquatic applications by WSDA licensed pesticide applicators with an aquatic endorsement on their license. Also, state and sometimes local permits are generally required when applying pesticides in water or where herbicides are likely to drift into water.
- Aquatic herbicides that are also labeled for use in terrestrial areas, such as Roundup Custom, can be purchased and used by non-licensed individuals for treating knotweed, as long as the plants being treated are not growing in water and the herbicide is not likely to drift into water, such as with the stem injection method.

Types of Chemical Control Methods

Foliar Application

- Use a backpack sprayer or large volume sprayer.
- Easiest and fastest method, but potentially higher risk of drift onto desirable vegetation and into water and soil.
- Use a systemic herbicide that translocates from leaves to the roots.
- The most effective chemical on knotweed is imazapyr and the second most effective is glyphosate. These products can also be combined to produce

quicker visual signs of treatment, but does not increase the effectiveness of using imazapyr alone.

- The most effective time to spray knotweed with glyphosate or imazapyr is generally July to October, or between bud formation and when the plant dies back after the first frost, with later treatments in that time period generally being more effective than earlier. Early treatments may require a follow-up spray to control re-growth. This will vary with weather and water availability. Usually the most effective time for a single treatment is late August/early September.
- Non-selective herbicides such as glyphosate (e.g. Roundup) and imazapyr (e.g. Habitat, Polaris) kill both grass and broadleaf plants. Selective broadleaf herbicides will not harm most grasses if used according to label. However, there are currently no selective broadleaf herbicides that provide more than one season of knotweed control. Triclopyr and aminopyralid will provide short-term control of knotweed, but generally won't kill the plants. Metsulfuron and dicamba will also control top growth of knotweed although generally don't control the rhizomes. 2,4-D is not effective on knotweed.
- Where it is not possible to spray over the top of the plants due to height and access, spray the stems and the undersides of the leaves and get as much coverage of the plants as possible.
- Avoid spraying knotweed when bees and other pollinators are present on the flowers whenever feasible. When pollinators are present, consider spraying either before full-bloom or after petals begin to drop. You can also spray earlier or later in the day when bees are not as active. If necessary to spray when plants are in full flower, spray the stems and undersides of the leaves and avoid spraying the flowers as much as possible. You may also consider clipping and removing the flowers prior to foliar spray, or using a stem injection method. Alternately, beekeepers can be notified and asked to move bees away from areas being treated if there are concerns about exposure.
- If plants are cut back, allow them to re-grow for at least six weeks, or to about 3 to 6 feet tall, before spraying. If plants are bent over to make them shorter and easier to spray, allow them to recover for one to two weeks before spraying to make sure they are actively growing again. Typically, spraying re-growing or bent knotweed is not as effective as spraying full grown plants, but it is sometimes more efficient and necessary because of land use or visibility issues.
- If it is necessary to keep plants from growing tall for visibility or other reasons, a spring herbicide application or cutting will set back the plant so that it can be sprayed at an effective height and growth stage later in the year.
- Experience in Pennsylvania suggests June 1 as a good cutting date if follow up spraying is planned. They found that regrowth when cut June 1 is

vigorous, but limited in height (6 to 10 ft tall knotweed cut in June resulted in 2 to 4 foot tall re-growth). Cutting too early in the season can result in regrowth that reaches full height and waiting too late in the season can result in almost no regrowth and will limit the ability to spray and control next season's growth (Gover et al 2005).

- Continue to monitor and treat annually in the late summer as long as there is re-growth. Re-growth the following years will be much shorter and sparser, and can be sprayed with considerably less herbicide, although it will take more time to locate all the plants. Re-growing plants can also be dug up once they are very small, although it is still difficult to remove all the roots.
- Regardless of herbicide choice, rate or spray timing, large, established patches (hundreds or thousands of stems) will almost certainly require foliar treatments over at least three years, possibly many more. Similar to treating patches mechanically, be sure to search for new shoots up to 20 feet or more away from the central patch after herbicide treatment begins.

Specific Herbicide Information

Glyphosate: 2% to 5% solution plus surfactant (as recommended on label).

- Apply as coarse spray with complete, uniform coverage.
- Apply when knotweed is actively growing and most have reached the bud to early flowering stage until the first hard frost.
- Roundup Custom/AquaneatRodeo plus surfactant (e.g. Competitor, Agridex) are approved for aquatic sites.
- Roundup ProMax or other products containing glyphosate can be used on terrestrial sites. Add surfactant if advised on label. The concentration of active ingredients can vary by product so make sure to use the rate recommended on the label. The percent rate given here is based on a product such as Roundup ProMax that has 48% active ingredient.

Imazapyr : slow-acting and expensive but highly effective on knotweed.

- 1% solution with 0.25% to 1% surfactant or 0.5 to 1 lb per acre.
- Apply from midsummer after seed set until first killing frost.
- Habitat and Polaris are approved for aquatic sites.
- Arsenal and other imazapyr products are approved for various non-aquatic sites (see label for crop rotation and other restrictions).
- Imazapyr has some soil activity and may impact roots of other plants in the area being sprayed for several months after application. Follow label instructions before planting into treated area and use caution around tree roots and on permeable soils.

Wick Wipe

- Use an applicator wand with a sponge on the end of a reservoir for the herbicide. Wipe the sponge soaked with herbicide on the leaves and stem of the plants.
- Use glyphosate at 33 to 75 % concentration (or as directed on product label).
- Greatly reduces drift.
- Hard to get chemical on leaf surface and seems to increase personal contact with herbicide.
- May be appropriate for small re-growing plants growing near desirable vegetation.

Cut and Pour

- Not very effective and generally not recommended.
- Cut stems between lowest 2 nodes and put 3 ml undiluted (concentrated) glyphosate into stem cavity (can use a large needle with measured reservoir to be precise). Be very careful not to splash herbicide onto the ground.
- Timing best in late summer or early fall.
- Follow label directions on amount applied per acre (i.e. for the 7.5 quart per acre label rate, can only treat 2375 stems per acre at 3 ml per stem).
- Need to remove cut stems away from water where they can dry out and not spread off site.

Hollow Stem-Injection

- Timing is best from late July to end of September (or whenever the stems dry out and start splitting when injected).
- Use a stem injection gun or similar tool that can be calibrated to the required amount.
- Follow directions carefully especially on calibrating and cleaning the equipment.
- Highly effective; usually 95% or more controlled in first year.
- Greatly reduces drift, is highly selective and there are no cut stems to deal with.
- Need to inject every cane in the stand; very time and labor intensive compared with foliar spraying.
- Can only inject stems over ½ inch in diameter so there will always be small stems that can't be injected in a population, especially in the second year of treatment.
- Glyphosate is the only product labeled for hollow stem injection. Aquatic formulations of glyphosate such as Roundup Custom (formerly sold as Aquamaster), Rodeo, or Aqua Neat can be used on or near aquatic sites while Roundup ProMax and other non-aquatic formulations, can be used on non-aquatic sites.

- Inject the concentrated herbicide product into each stem between first and second nodes from the ground, or between second and third node if cane is too woody lower down.
- Most labels recommend 5 ml per cane for knotweed, but our experience and WSU Extension trials have shown that 3ml is just as effective as 5 ml, so we recommend using 3 ml.
- Mark stems immediately after injecting with spray paint or a grease pen to avoid missing stems or doubling up (once stems are injected they won't hold another dose and herbicide will spill out of the stem).
- Make sure to stay within the per acre label rate for the glyphosate product you are using. For example, with a label maximum of 7.5 quarts per acre, at 3ml per cane, you can only inject approximately 2,375 canes per acre.
- For two to three years following stem injection, plan on either spot-spraying or digging up any re-growing plants. Plants will be smaller and sparser, but follow up is essential to long term control.

Combination of Methods

- Using a combination of methods may work better for some site conditions, labor availability or land use needs. However, none of these methods are as effective as spraying full grown knotweed in late summer or using hollow stem injection.
- **Cut/Spray:** Cutting stems, followed by foliar spray 6 weeks later, instead of spraying twice, will reduce overall herbicide input into the watershed and is probably more labor efficient (can use volunteers or unlicensed crews to cut the infestation).
- **Bend/Spray:** Bend stems and then approximately 2 to 4 weeks later, spray plants. Volunteers or unlicensed crews can be used to bend the stems prior to foliar application.
- **Cut/Cover:** This method is moderately effective. Needs constant monitoring and controlling of plants around perimeter and scattered plants that grow through sheet mulch through holes/overlap areas. Every two to four weeks need to stomp down re-growth under covering material and clean off debris.
- **Spray/Spray:** Spring or summer spray followed by fall foliar spray; sets plants back so they can be sprayed at the appropriate growth stage and at the best (easiest) height. This method increases the amount of overall herbicide input into the watershed but takes the least time of the combination methods.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product.

Chemical control options may differ for private, commercial and government

agency users. For questions about herbicide use, contact the King County Noxious Weed Control Program or your local Weed Board or Extension Agent.

Biological Control

- Biological control is the deliberate introduction of insects, mammals or other organisms which adversely affect the target weed species. Biological control is generally most effective when used in conjunction with other control techniques.
- There are currently no biological control agents approved for managing invasive knotweed in the United States, but it is likely that agents will be approved in the near future. In Washington, contact the WSU Integrated Weed Control Project at <http://invasives.wsu.edu/aboutus.htm> for current information.

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Dig up plants or apply appropriate herbicide with wick wiper or by spot spray to minimize off target injury (follow directions above for the method used).
- Monitor site throughout growing season and remove any new plants. Remember to search at least 20 feet from the original infestation.
- If using an herbicide in a grassy area, consider using a selective herbicide to avoid injury to the grass or a wick wiper or stem injector.
- Re-vegetate bare areas with appropriate vegetation or cover with mulch while desirable vegetation becomes established. Do not leave large areas of bare soil.

Large Infestations/Monocultures

- Mowing is not effective for controlling invasive knotweed infestations and can spread infestations further.
- Large infestations can be controlled with herbicides or a combination of methods (follow directions in the appropriate sections above).
- Eradication of knotweed with a single herbicide application is difficult. Typically it takes several treatments, over 4 to 6 years to get an infestation under control.
- If using the covering method, be sure to monitor for knotweed growth on the edges of sheet-mulched sites, at overlapped areas in the sheet-mulch, and where sheet-mulch has been staked. For sprayed sites, monitor annually around the edges of chemically treated areas.
- Use erosion control measures in areas subject to erosion, especially on steep slopes or riverbanks.
- Plan on re-vegetating with desirable vegetation after the initial 2-3 years of treatment, especially in areas likely to be re-infested with knotweed or other

invasive vegetation. Mulch bare areas until vegetation is re-established where feasible.

- Consider replanting with vegetation that is beneficial to bees and other pollinators when clearing large areas of knotweed. Use native or non-invasive plants only.

Control in Riparian Areas

- Additional permits may be required for control of infestations in riparian areas. See the **King County Noxious Weed Regulatory Guidelines** for more information or contact your local jurisdiction.
- Whenever large areas of vegetation are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion. Refer to the King County Surface Water Design Manual for further information about sediment and erosion control practices (call 206-477-4800 or go to <http://www.kingcounty.gov/environment/waterandland/stormwater/documents/surface-water-design-manual.aspx> for information).
- Survey area and document extent of infestation from the headwaters of waterways down.
- Consider manual removal or stem-injection for small (less than 50 stems) infestations if feasible.
- Target the knotweed, retaining and protecting native and beneficial plants.
- Use aquatic formulations where there is any risk of herbicide entering the water.
- Infested areas should incorporate a management plan lasting at least several years to control plants re-sprouting from the rhizome mass, skipped plants and any regrowth.

Control on Road Rights-of-Way

- Mowing is not an effective means of control and can spread knotweed infestations along road rights-of-way.
- Small plants should be dug up or spot sprayed with an appropriate herbicide. Large patches can be sprayed in late summer/early fall or controlled with a combination of cutting and spraying (see instructions above).
- Where necessary for visibility or other issues, plants can be cut down or sprayed in May or June and then sprayed again in late summer or early fall.

Knotweed Disposal Methods

- Knotweed crowns and rhizomes should be collected and discarded with the trash or taken to a transfer station for disposal. Composting crowns and rhizomes is not recommended.
- Knotweed stems can be composted, but they will root on moist soil so they need to be completely dried out and crushed before composting.

- Stems can be left on site to dry out and decompose if they are in a dry area where they will not move into waterways or onto moist soil. The area should be monitored for re-growth and stems should not be moved to an un-infested area.
- Large piles of composting knotweed stems have been known to self-ignite so monitor piles and avoid creating very large stacks. Knotweed stems burn when dry but the hollow compartments can burst and create small explosions when burned.
- Dried out stems may be broken up or chipped into pieces less than an inch long and then composted on site, disposed of in a city-provided yard waste container or in the green recycling at a transfer station.
- Stems of knotweed with seeds should be collected and put in the trash or taken to a transfer station. If removal is not feasible, these stems can be left on site. However, there is a risk of spread from the seeds, so the area should be monitored for several years for seedlings. Stems should be left well away from waterways, shorelines, roads and un-infested areas.
- Never dispose of knotweed plants or plant parts into waterways, wetlands, or other wet sites where they might take root or infest areas downstream.

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Noxious weeds

King County, Washington

You're in: Noxious weeds » Weed identification photos » Yellow archangel

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Yellow archangel

Lamium galeobdolon
Mint family

General description

Fast-growing perennial ground cover that may be either trailing or upright depending on conditions. Yellow archangel, also known as yellow Lamium, is very competitive and fast-growing in the forest habitats of western Washington and western British Columbia. When it is dumped with yard waste or escapes from intentional plantings, it spreads quickly into forested areas and out-competes native understory plants.



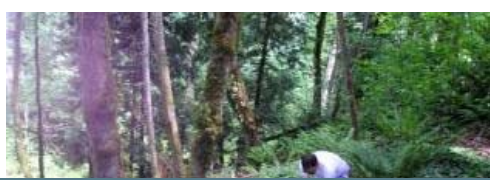
Legal status

Yellow archangel is a [non-regulated Class B noxious weed](#) in King County. Control is recommended but not required. County Noxious Weed Boards in Washington State have the option to specify control areas for this plant but no areas have been designated in King County. Contact the [Washington State Weed Board](#) for more details on designation areas.



Impacts and distribution

The variegated form of this species is a popular ornamental in garden beds and hanging baskets as well as a groundcover for shady sites. In Washington State, yellow archangel has been reported as escaping in many



Related information

- Agriculture in King County, Washington
- Northwest yard and garden
- Animals, plants and habitat

Related agencies

- Dept. of Natural Resources and Parks
- Water and Land Resources Division

Program offices are located at 201 S. Jackson St., Suite 600, Seattle, WA 98104. To contact staff, see the [Noxious Weed Control Program Directory](#), send an email, or call 206-477-WEED (206-477-9333).

To offer a suggestion or report an error on the King County Noxious Weeds website, please contact [Sasha Shaw](#), education specialist.

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Thurston County, Snohomish County, King County and others. When it escapes from residential plantings, it becomes invasive, forming dense patches. Yellow archangel outcompetes native plant species and provides poor food and shelter for native wildlife. It is found in ravines, greenbelts and forested parks as well as residential settings such as flower gardens, rockeries and ornamental borders. Yellow archangel can grow in a wide range of conditions from full sun to full shade and is not deterred by most other plants.



Identification

Leaves are typically variegated with silvery-grey markings and are oval-shaped and toothed. Stems are square, leaves are opposite. Leaves are hairy and coarsely toothed. Flowers are small, yellow and tubular; they grow in pairs of clusters close to stems between leaves on flowering stems that are 1 to 2 feet tall. Distinctive, non-

menthol and somewhat unpleasant odor.

Biology



Fast-growing, herbaceous perennial. Spreads by stem fragments, rooting at nodes, and by seed. Flowers from April to June. The small yellow flowers are perfect and are pollinated by bees. Grows well in a variety of soil types from sandy to heavy clay and from acid to alkaline. Can grow in full shade (deep woodland), semi-shade (light woodland) and full sun. It prefers moist soil but can also tolerate dry shady sites and drought. Usually a groundcover but is also almost vine-like and can climb up and over low-growing plants and up onto stumps and other obstacles.

Spreads readily from cuttings and root fragments. Plants also produce numerous seeds per stem, especially in sunny areas and abundant seedlings have been observed on sites that were cleared and adjacent to existing populations.



Control

Prevention: Avoid planting near parks and natural areas or choose a different ground cover. If you already have this plant and would like to minimize its invasive nature, contain it in flower beds by regular trimming, or dig it up and replant into pots. Because yellow archangel spreads readily by stem cuttings, it is very important to discard plant material in such a way as to prevent spreading. Never dump clippings in parks or natural areas. Don't dispose of plants in backyard compost piles (okay to put into city provided "Clean Green" recycling bins since the yard waste is taken to a commercial composting operation).



Manual: Roots are not deep so plants can be hand-pulled or dug up. However, plants grow densely so hand-pulling is very labor-intensive and not very effective due the plant's ability to sprout from small fragments of root or stem, as well as its tendency to grow into and among desirable vegetation. To fully remove, plants must be pulled up by the roots, being careful to remove all root and stem fragments. This is easiest to do fall through early spring. Sift through soil carefully to find all roots and stem fragments. Cutting alone will not control this plant. Dense infestations can be controlled by sheet-mulching although it is crucial to control any escaping plants and to regularly check for holes in the covering material.

Chemical: Herbicides can be effective on yellow archangel, especially if combined with manual control and monitoring for surviving plants. Take care to avoid native vegetation by selectively spot-spraying. Choose a formulation that is appropriate for the site: either aquatic or terrestrial. Follow the label exactly as written and only use at the rate that is prescribed on the label. Treatment with triclopyr or glyphosate (or a mix of the two for better results) plus a surfactant appears to be somewhat effective although re-treatment is necessary. The herbicides work best when the plants are actively growing and are not wilted from drought-stress. Even small amounts of surviving plants will quickly fill back in if you do not follow up and control the surviving plants. Please [contact our office](#) or refer to the [PNW Weed Management Handbook](#) for more information on effective and safe use of herbicides.

Additional information on yellow archangel

- [Washington State Noxious Weed Control Board](#) (external link)

What to do if you find this plant

Control of yellow archangel is not required in King County, but we would like to know where it is invading into wilderness areas so we can work to prevent serious impacts. If you see yellow archangel growing in or near wilderness areas, please [contact our office](#) or report it on our [online infestation form](#).

We are also gathering information on effective control methods. If you have had any success (or failures) controlling this plant, we would be interested in hearing from you.

Program offices are located at 201 S. Jackson St., Suite 600, Seattle, WA 98104. To

contact staff, see the [Noxious Weed Control Program Directory](#), send an [email](#), or call 206-477-WEED (206-477-9333).

Yellow archangel photos: click for larger images



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