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CONSULTANTS, LLC

TREE AND WOODLAND PRESERVATION

ARBORICULTURAL REPORT: JUANITA WOODLANDS REPLANTING PLAN

JUANITA WOODLANDS, KIRKLAND, WASHINGTON

On behalf of

King County Department of Natural Resources and Parks
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Juanita Woodlands Replanting Plan

Following several meetings during 2008 with Juanita Woodlands stake-holder volunteers and King County Department of Natural Resources & Parks a replanting plan has been developed by Arborea Consultants, LLC., in partnership with Ribeiro Tree Evaluations, Inc.

The plan is not intended to treat the entire 40-acre woodland. It is focused on designing replanting within the identified disease centres and in within those centres and areas where recent tree removals have been completed.

Species selection

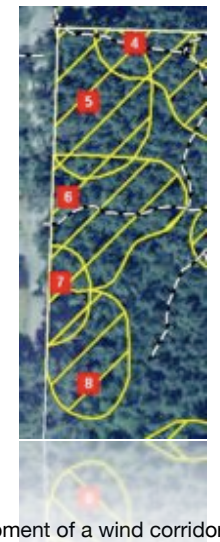
Purpose & Intent

Species selection focuses on creating a species diverse native forest stand. The intention is also to use the disease centres and combination of tree failures and removal to create a multiple tier canopy common in native forest stands.

Selection Considerations

Species selection will be dependant upon the size of the opening in the stand canopy[1] as this affects the light levels available for growth. Selection is also influenced by the pathogen(s) present within each disease centre. As illustrated in figure 2 the intention is to vary the planting centrifugally round each disease centre. If the centre continues to expand then the species mixture will be altered accordingly.

Despite some of the centres being generally circular in form some disease centres have coalesced as is evident, for example, with disease centres 5 through 8. The same approach shall be applied varying species again dependant on the size of the opening and the pathogen present. Factors such as drainage shall also be taken into consideration in selecting appropriate species.



Photograph 1 (1 Photograph): This illustrates the development of a wind corridor from Area 8 to Area 4. This is illustrated in the figure: aerial photograph (right). The left photograph is taken from Area 7 to Area 4
The aerial photograph shows a plan view of the area shown in photograph 1 (left) and also showing how the areas of disease have coalesced between disease centres

[1] The topmost layer of twigs and foliage in a woodland, tree or group of trees (Lonsdale, 1999)

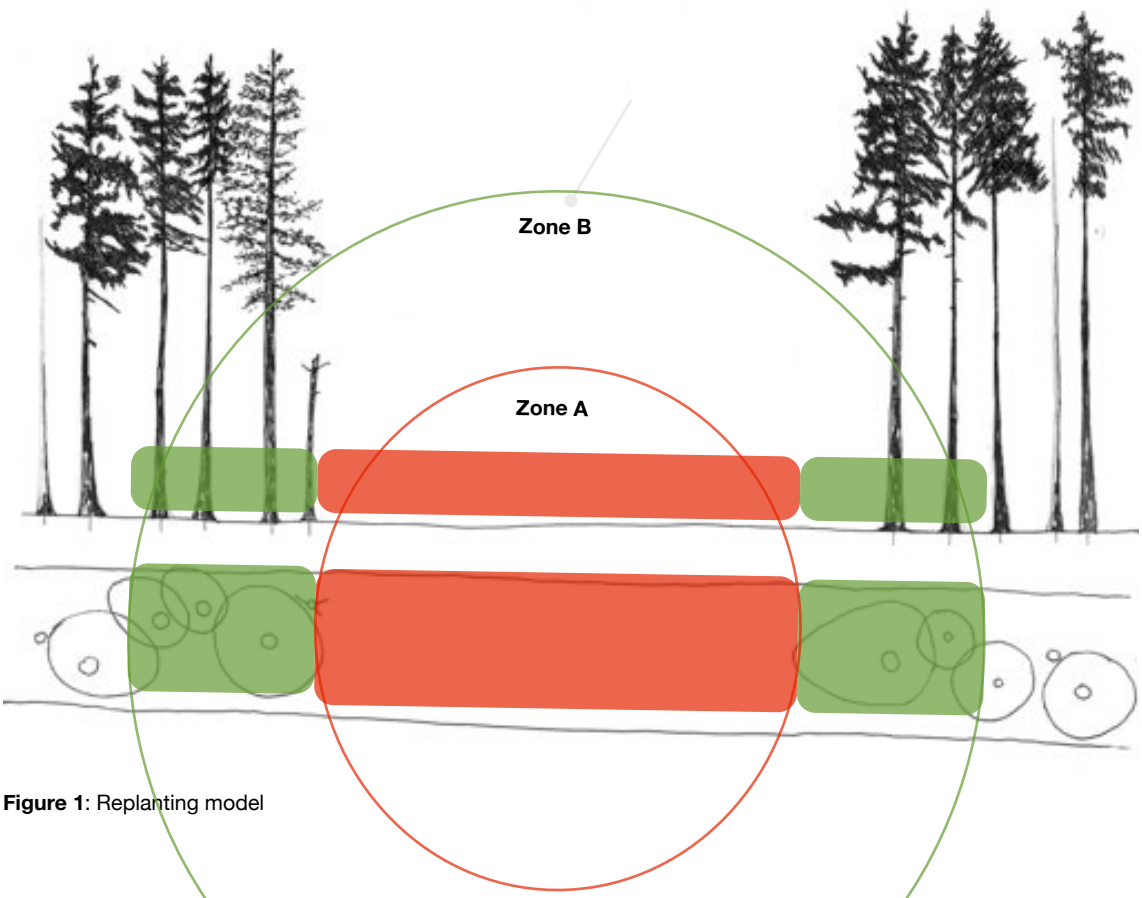


Figure 1: Replanting model

Replanting Model

Figure 1 illustrates the disease centre with concentric areas of planting proposed. To simplify initial planting these are categorised as "Zone A" and "Zone B". It must be noted that this model is not area specific. The zone(s) account for the light levels and this is reflected in the species selection and area of each *Zone*. As a general guideline Zone A will be within an area without overhanging crown and canopy cover of the disease centres central area. Zone B will then encroach into the periphery of the disease centre; under-planting the areas margins.

At present the Juanita woodlands forest stand is *predominantly* a single canopy layer. The exception is the south portion of the west block which has a multiple canopy layer and diversity of species with lower levels occupied by natural regeneration of shade tolerant tree species. This latter area is close to a stratified canopy that is the objective of new plantings and layout design in this plan. The stratified canopy shall have faster growing species occupying the upper canopy layers and slower growing occupying the lower canopy. The planted areas may require under-planting and inter-planting (discussed later in the plan) to achieve the stratified canopy sought. The lower canopy shall be occupied by slower growing and more shade tolerant species i.e. Pacific yew (*Taxus brevifolia*), black hawthorn (*Crataegus douglasii*), Cascara (*Frangula purshiana*) and Pacific dogwood (*Cornus nuttallii*) (discussed later in the plan).

The intention is to plant species at extremely close spacing. This will allow for the crowns[2] of individual trees to quickly achieve contact with each other. This prevents light from reaching the ground beneath the trees thereby suppressing competitive plant growth. Competitive plant growth that could overgrow planted trees leading to death of the installed planting stock. This is termed canopy closure. Achieving canopy closure reduces the need for *long-term* manual or herbicide weeding.

Another function of close spacing and the species mixture selected (detailed later in the plan) is to achieve and encourage rapid height growth. This is termed a nurse planting. The intention is to select individual trees of both species for thinning at a later date or selecting a species that will naturally be thinned due to growth competition. Retaining a mixture for the stratified canopy is vital to achieving wildlife habitat objectives discussed in previous group meetings on site.

[2] The foliated main components of a single tree, including secondary order branch framework

Figure 2: *Tree Disease Distribution*, plan of woodland indicating the disease centers. This plan illustrates area 1 through 4 within the red encapsulated area and area 5 through 8 in the red dashed encapsulation

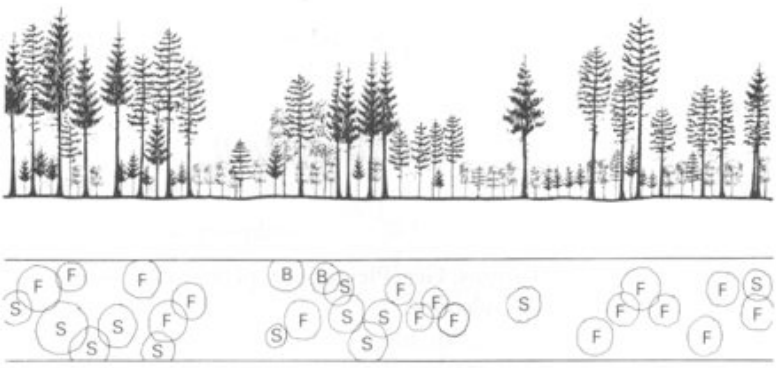


Figure 3: *Selection System*, a diagrammatical illustration of a stratified woodland section. F - Fir, S-Spruce and B-Beech. It is this form of forest structure that this plan intends to replicate through planting and subsequent plantings i.e. under-plantings and use of natural regeneration

Area 1 through 4

The areas 1 through 4 include one the largest grouping of areas affected by root disease. These areas were sampled in November 2006. Pathology testing, completed by Dr. Olaf K. Ribeiro of Ribeiro Tree Evaluations, confirmed infection with *Armillaria* spp., and further inspections during 2007 and 2008 identified *Heterobasidion annosum* and *Phellinus weirii*. A *Phaeolus schweinitzii* fruiting body was also located within this area together with *Phellinus pini* trunk infections. In terms of species selection alone this range of disease and decay pathogens presents extreme restrictions on suitable native species selection.

In effect the presence of these forms of root disease limits the choice of tree species replanting. Each available native tree species is susceptible to one form of the disease or multiple diseases identified. The severity of this susceptibility varies under differing circumstances and to differing degrees. In an effort to control the spread of the disease and to mitigate for risk associated with the trees condition tree removal has been completed. This has included removing remaining stumps from their position in the ground and setting them atop the ground, retaining these and the trunk sections on site. This has the affect of reducing the disease within the soil by removing infected stumps from the soil and exposing these to air. Greatly reducing the survivability of the root disease fungi while also allowing for decomposing fungi to colonise the dead large woody material.

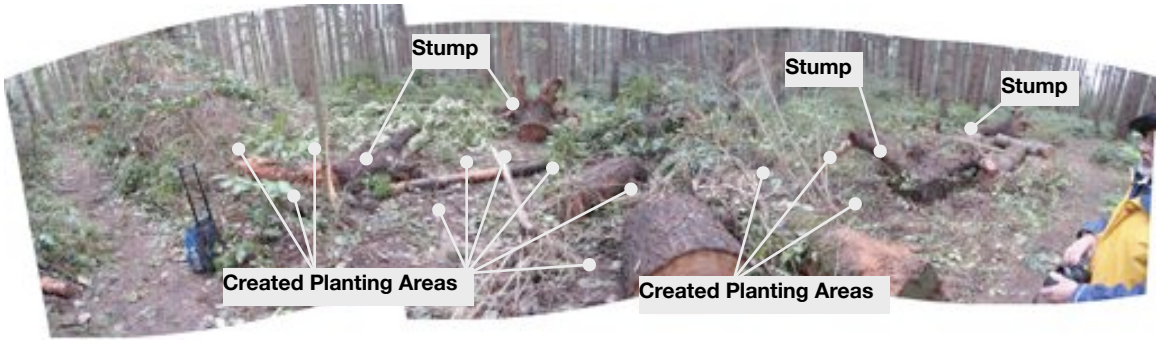
Photograph 2: *Area 2*,

The retention of removed large trunk sections and stumps is shown in photograph 2. It also illustrates some of the open areas now available for planting. Not all available planting areas are illustrated in this photograph. The public trail is shown in the lower left and lower right of photograph 2.

Photograph 3: *Area 2 - 3*

Within Area 2 and Area 3, partly shown in photograph 3, a number of trees were identified for removal and this was completed in 2008. This area was not surveyed in the original November 2006 survey and comprises and expansion of both Area 3 and Area 2. As per photograph 2 this particular photograph also illustrates the planting opportunities that now exist following tree removal. In the centre of the photograph is the main trail leading into the south portion of Area 3

A significant advantage of the large woody material is its ability to provide some protection for plantings. This is protection in environmental terms of buffering low temperatures and high temperatures and locally regulating soil moisture but also in terms of pedestrian traffic and recreationalist's. Other attempts at planting that have placed trees close to the edge of the public trail. Unfortunately these planting efforts have been subject to vandalism or direct damage by pedestrians; trampling or soil compaction. This plan calls for a deliberate attempt to avoid planting trees close to the edge of any trail that borders or crosses through a replanting area. An exception would be as illustrated in photograph 3 where trunk sections are likely to control the majority of pedestrian movement and confine this to the public footpath.



Photograph 4: *Area 3*

In photograph 4 a view of the south section of disease centre (Area) 3. The public trail can be seen passing through this disease centre; lower left and lower right corner of photograph 4. At present this is the largest active disease centre in the three woodland compartments shown in figure 2, page 5. Area 3 presents the greatest opportunity for replanting and compartment diversification in terms of stand structure and species diversity. As per photograph 2 through 4 potential planting positions are illustrated.

Photograph 5: *Area 3 (Centre)*

A large central area within Area 3, photograph 4 and 5, provides a fantastic opportunity to plant species that will within a short period diversify the available habitat and begin to create this new stand structure. The high light levels will support species selection that would otherwise not be available in an even aged (single canopy layer) stand of Douglas fir (*Pseudotsuga menzeisii*)

Figure 3 illustrates, a stand that is under selective silvicultural management (John D. Matthews, *Silvicultural Systems*. 1991 Oxford University Press, Oxford). This, system and the group system closely models the type of openings created in the Juanita woodlands by disease. It also creates a forest structure that is close to that desired for the benefit of local wildlife by providing different forms of cover and food sources. both essential elements in habitat creation and conservation. Aesthetically it is closer to what most individuals perceive as a 'natural forest' or an unmanaged forest. The replanting selects species that will replace the single species and single canopy layer of Douglas fir (*Pseudotsuga menziesii*) that predominates in Juanita Woodland. This is completed only where necessary because of the spread of identified root diseases. The aim in this replanting plan is to begin the process of regeneration plantings that is a necessary intervention in a small woodland such as Juanita Woodlands. Over time successive plantings should be planned and completed that will result in an un-even aged population of trees.

In the case of Area 1 - 4 the recommended plantings are predominantly hardwoods since these are not susceptible to the root diseases identified. As described earlier the areas have a broad range of root disease currently limiting species

selection for natives since the majority of conifers are susceptible to those diseases present in the Area. The list of native hardwoods selected is detailed in Table 1 *Trees Species Selection for Area 1 through Area 4.* These plantings should make use of tree shelters to protect the planted trees and to also significantly enhance the growth of plantings until release[3] and canopy closure is achieved. Tree shelters are discussed later in the report. Alternatives to the species selected could include Garry oak (*Quercus garryana*). It is possible for example that bigleaf maple is not easily obtainable as a native tree species. In this event bigleaf maple should be supplemented by Garry oak in planting for Area 1 through Area 4. Garry oak cannot be used in Zone B because of the lower light levels.

Planting in Area 1 through 4 should be completed in 2009. This can either be planted late March through to mid April or mid October to the end of November (fall (autumn) planting).

Table 1: *Tree Species Selection for Area 1 through Area 4*

Species	Plant Zone (Figure 2)	Spacing (Approximate)
Oregon ash (*Fraxinus latifolia*)	**Zone A**	5 feet
Bigleaf maple (*Acer macrophyllum*)	**Zone A**	5 feet
Sitka spruce (*Picea stitchensis*)	**Zone B**	6.5 feet
Western red cedar (*Thuja plicata*)	**Zone B**	6.5 feet

Area 5 through 8

Photograph 6: Area 5, viewer is looking through to Area 6 (towards Area 8)

Area 5 through 8 is illustrated in figure 2 on page 5 of this plan and is also shown in photograph 1 on page 2. Photograph 6 illustrates the north point of Area 5. Recent removals have been felled into the woodland stand with large woody debris retained as requested. To the left of photograph 2 (above) is the beginning of the open area that comprises Area 5 through Area 8. This is a series of coalesced disease centres that now form an almost contiguous opening along the edge of the woodland in the area close to 76th Ave Northeast and 118th Pl. The affect has been to allow high light levels, seeding layered or root system propagation of highly invasive Himalayan blackberry. This plant is highly problematic as it prevents easy access into the areas affected and heavily competes for light with other plants. Planting in this area is extremely difficult without first addressing the widespread cover of the highly invasive blackberry. The entire area should be cleared by cutting the blackberry using mechanised equipment to mulch the above ground portion of the plant throughout the entire area. The area affected by blackberry is shown in figure 3, page 12. Some further information on blackberry is provided which is published by King County.

This invasive plant species is light sensitive and so it will remaining a maintenance problem until the tree planting proposed for Area 5 through 8 is completed and until this planting has achieved canopy closure and release. For this reason the use of tree shelters to protect the planting stock and also significantly increase growth rates is again

[3] The stage at which a tree has attained a height above plants competing for light

recommended for all species planted in Area 5 through 8. The open characteristics of Area 5 through Area 8 and the areas west aspect lends itself to planting light demanding species. The main concern in this area is the presence of *Phellinus weirii* root disease; Area 8. There are few species that are immune to this pathogen except hardwoods. Shore pine (*Pinus contorta*) is tolerant of the root disease and has been selected for planting within Zone A as a mix with paper birch (*Betula papyifera*) on a 1:1 ratio. Oregon ash (*Fraxinus latifolia*) and western red cedar (*Thuja plicata*) are selected for planting on a similar ratio within Zone B. Western red cedar is resistant to *Phellinus weirii* root disease.

Table 2: *Tree Species Selection for Area 5 through Area 8*

Species	Plant Zone (Figure 2)	Spacing (Approximate)
Shore pine (*Pinus contorta*)	**Zone A**	5 feet
Paper birch (*Betula papyifera*)	**Zone A**	5 feet
Oregon ash (*Fraxinus latifolia*)	**Zone B**	6.5 feet
Western red cedar (*Thuja plicata*)	**Zone B**	6.5 feet

Area 5-8 should be planted in 2010 to allow for invasive plant species clearance, specifically the blackberry (see also the enclosed information on blackberry (King County) using specialist equipment. See section in this plan on invasive plant species.

Area 15 through Area 18

Table 3: *Tree Species Selection for Area 15 through Area 18*

Species	Plant Zone (Figure 2)	Spacing (Approximate)
Shore pine (*Pinus contorta*)	**Zone A**	5 feet
Western red cedar (*Thuja plicata*)	**Zone A**	5 feet
Oregon ash (*Fraxinus latifolia*)	**Zone B**	6.5 feet
Paper birch (*Betula papyifera*)	**Zone B**	6.5 feet

Area 15 through Area 18 is affected by both *Phellinus weirii* and *Phaeolus schweinitzii* root disease and decay pathogens. Species selection reflects the diseases present. It is recognised that shore pine is susceptible to *P.schweinitzii* however this is likely to affect older trees only. This area will require subsequent plantings and it is possible that thinning will allow for the planting of bigleaf maple in created openings or where stocking levels (number of trees within a given area) are low enough to support growth. Other supplemental species selection will be listed at the end of this section.

Photograph 7: *Photographs illustrating the Area 15 through 18*

Area 15 through Area 18 contains blackberry. This must be cleared prior to planting. As a result planting should be realistically scheduled for 2012. The cost of preparing Area 5 through Area 8 and Area 15 through 18 together would be less than preparing each in successive years, in other words individually. The issue with this approach is that if both sites are prepared at the same time planting will be required in the same year to take advantage of the invasive free site. A delay for a year will mean that a large amount of additional work manually weeding the site will be required before canopy closure and release is achieved. Treating both sets of areas separately however will allow for a realistic planting area to be completed in a single planting season. In terms of realistic and successful installation of plants and

maintenance by volunteers the preparation of both sets of areas should be made in successional years; Area 15 through Area 18 in 2012 and Area 5 through Area 8 in 2010.

The removal and retention of large amount of woody debris form clearing in Area 15 through Area 18 provides similar opportunities for planting. Access into this area without site preparation discussed the next section of this replanting plan is difficult. Plantings should take advantage of the felled trunks of Douglas fir on this site. Because of the large size of the felling area and debris generated replanting spacing of 5 feet between plantings in Zone A and 6.5 feet for Zone B may be may be difficult to achieve. It is important to understand that if close spacing is not used invasive plant growth will be far more dense and require more frequent and a longer maintenance period of manual weeding.

As illustrated in photograph 7 site preparation for Area 15 through Area 18 requires a large amount of preparation before it can be planted by volunteers. This should be completed in 2012.

Area 9 through Area 14 & Area 19 through Area 24

These areas are situated and dispersed over a wide part of the Juanita woodland. The areas also include four main diseases i) *Phellinus pini* ii) *Phellinus weirii* and iii) *Phaeolus schweinitzii* iv) *Armillaria* spp.. It is difficult to find a balance of species that are resistant to all three diseases and also suit the sites typical condition.

Photograph 8: This illustrates an area between Area 10 and Area 11

As shown in photograph 8 the areas included in the group Area 9 through Area 14 and Area 19 through Area 24 are relatively small in size with a history of few tree failures and dead or dying trees. This presents an opportunity for underplanting and for replacement planting that models selective systems in silvicultural management of forests and woodlands. The species selection takes advantage of the small canopy opening shown in photograph 8. Table 4 *Tree Species Selection for Area 9 through Area 14 & Area 19 through Area 24* indicates the spacing required for the planting zone; Zone A or Zone B for these sites.

Table 4: *Tree Species Selection for Area 9 through Area 14 & Area 19 through Area 24*

Species	Plant Zone (Figure 2)	Spacing (Approximate)
Sitka spruce (*Picea sitchensis*)	**Zone A**	5 feet
Western red cedar (*Thuja plicata*)	**Zone B**	6.5 feet

Future Plantings

Tree species selection described in this plan only accounts for an initial phase of planting. Subsequent plantings are envisaged for the site in the areas previously planted and where establishment has been achieved. Openings following thinning and following further expansion of the disease centres can be planted with trees that attain a lower height at maturity. This will ensure that the woodland canopy has a variation in form making it more attractive as habitat and aesthetically. Some of the trees that may be considered are as follows:

Pacfic yew (*Taxus brevifolia*)
Black Hawthorn (*Crataegus douglasii*)
Cascara (*Frangula purshiana*)
Pacific dogwood (*Cornus nuttallii*)

The development of wet areas or areas with seasonally wet soils such as Area 11 and Area 16 through 19 may require supplemental planting of trees suited to wet soils and seasonal flooding. Tree planting may include:

Oregon ash(*Fraxinus Latifolia*)
Black Hawthorn (*Crataegus douglasii*)
Pacific willow (*Salix lucida*)
Sitka willow (*Salix sitchensis*)
Western red cedar (*Thuja plicata*)
Sitka spruce (*Pica sitchensis*)

For both forms of planting the spacing and arrangement of plantings would be dependant on the specific situation. This would need evaluating at the time of planting.

Invasive Plant Species

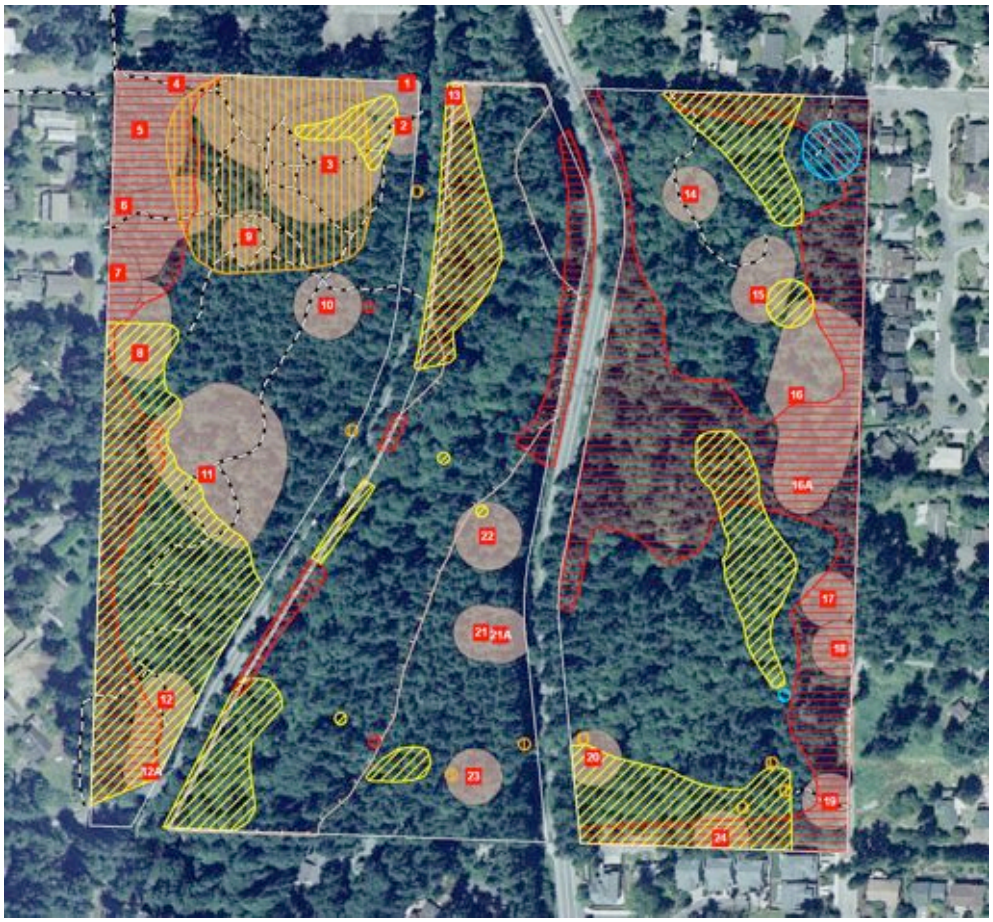


Figure 3: Invasive Species Map, provided by Juanita Woodlands stewardship group

Figure 3 illustrates the distribution of invasive species within the Juanita Woodland site. The control of blackberry and morning glory should be prioritised. Blackberry will inhibit the planting of trees species on site. At present replanting is confined to the disease centre areas. It should be noted that the areas shown include radial 50 foot buffers from each recorded infected tree. These root disease areas were generated using GPS and GIS technology by International Forestry Consultants in collaboration with Ribeiro Tree Evaluations, Inc., in November 2006. Substantial replanting efforts are required in areas 1 through 8 and 16 through 19. Both groups of areas require large scale clearance of blackberry. Mechanical clearance is required initially within these areas. Use of specialist equipment such as the Kaiser Spyder is recommended.

Figure 4: Kaiser Spyder in operation on a steep slope. Such forms of equipment can be fitted with equipment to cut invasive vegetation

In the process of invasive species clearance the retention of large downed and standing woody debris for habitat is required. This is important for Areas 5 through Area 8 where standing and downed woody material is present. Manual clearing may be required where the clearing equipment cannot operate i.e. close to dead standing trees or large woody aggregates and felled trunk sections set in bench formations (atop another trunk section). Wherever possible the equipment should be used to clear invasive plants and weeds.

Manual weeding will be required by volunteers. This is required to address the following issues:

1. Tree death
   1a. over-topping, with heavy shading (light) and physical weight
   1b. severe moisture competition, especially in the weeks immediately following planting
   1c. inducing mildew on some species

2. Growth retardation
   2a. competition for available soil moisture
   2b. nutrients
   2c. light

Once planted the object of weed control, excluding harmful invasive plants, is to flatten competing vegetation or remove it through hoeing or mulching. Use of either flattening technique, hoeing or mulching should treat a radial distance of 3 feet around the planted tree. Cutting the competing vegetation within 3 feet of the plant, again the exception is invasive plants, will increase the soil moisture and nutrient competition.

*This plan assumes that herbicides shall not be used in the control of invasive plants or weeds or maintenance**.*

Information from King County on Himalayan blackberry is enclosed. Other invasive species such as holly (*Ilex*) should be hoed from within 3 feet of the tree planting position. **The presence of morning glory near to Area 15 and Area 16 is a concern. The area of morning glory *must* be treated with a systemic herbicide in 2010 prior to site preparation for planting in Areas 15 through Area 18. At present this plan schedules planting for 2012 in the same group of areas

The interval between weeding will depend on the extent of growth and the form of weeding used. Hoeing will provide the longest interval between weeding work. Flattening the weeds will provide the least amount of time between weeding work. In all instances a 3 foot radial area should be treated. At a minimum each planted area should have at least one weeding per growing season. Ideally three weeding per growing season will give the best results.

Weeding is required until canopy closure is attained or release. Release will be related is assessed based on the surrounding weeds and it is typically related to tree height i.e. no probability that a weed or invasive could grow and over-top the tree or a substantial portion of the crown (reducing growth and placing the tree under strain).

Planting Techniques & Considerations

Planting Instructions

1. This instruction demonstrates the planting of a bare root Sitka spruce (*Picea sitchensis)* plug (P) transplant that is two years old (2); P-2

2. When planting it is important that the planting stock is inspected for quality of the roots, checking for girdling roots, lesions or any other abnormalities. During planting it is important that the root collar be located and that the collar is planted no deeper than the soils finish surface level

3. Select a planting site that is suitable for the tree being planted. This may involve clearing branches (brash, lop and top) and so other tools and equipment may be required. The planter may need to account for spacing if planting multiple trees and planting pattern as well as species mix (order)

4. Clear to one side surface organic matter, retaining this for use as a mulch once planting is completed

5. Note the size of the hole used in this planting. If possible the hole prepared should be larger than shown. In soils that are compacted the hole may need to be far larger to prepare the soil for root growth. No amendments are recommended

Planting Instructions, continued

6. The planting hole should be dug no deeper than the depth of the root system. This depth is measured from the root collar to the base of the root mass. The planter in this photograph is using the handle of the shovel (planting spade, hoe) to gauge depth. It is vital that the tree not be planted below the root collar (too deep)

7. It is also vital that root are not turned upwards or to one side ("J") but are aligned downwards and horizontally. Backfilling should not go above the root collar (See 2.)

8. Once soil is backfilled around the root system of the tree being planted is firmed using light pressure from the ball of the boot or rubber boot. Do not use the heel and do not apply a large amount of pressure (light)

*If a tree shelter is not being installed at this stage replace the organic matter around the tree planting (See **4.**) and or apply a composted mulch*

Planting Instructions, continued

~Tree Shelter Installation

9. There are many diiferent forms of shelter available on the market. Shown in the photograph is a 24 inch shelter

10. Shelters come in many different forms i.e. flatpack or tubes. This example is a plastic sheet form that has attachments for shelter stake ties, mat and glossy surface and arrow form tabs and recieving slots

11. To assemble the shelter roll the sheet into a tube with the glossy side inside and the matt facing out. Insert the arrow form tab into the recieving slot

12. Reach inside the shelter and draw the arrow form tab back, pulling firmly. This is done to an additoonal two tabs

13. Fold up the upper most branches of the tree and slide the shelter over and down the tree

Planting Instructions, continued

~Tree Shelter Installation, continued

14. This form of shelter can use bamaboo or smal diameter stake. If using bamboo the stake can be pushed down the spine of the shelter and threaded through the tabs as shown.

14B. Lock ties can also be used to hold the shelter to the stake. Three levels of attachment are provided for on this shelter

15. The stake is then driven into the ground at least 10 inches

16. Replace the surface organic matter evenly around the shelter and if possible apply a composted mulch,

Planting Notes

Adverse conditions, delays in planting, and inexperienced planters may result in a second growing season survival rate of 60% or less (WA - DNR Forestry Board Manual 03/2000, Guidelines for determining acceptable stocking levels, Section 6, M6-4). As a general rule Arborea Consultants, LLC. considers a site or planting area to have been successfully replanted if after a 2 year period following planting 70% of the replanting stock has survived. A simple and quick method of determining if further planting is required is if 1:5 trees have died then replanting, also termed “beatup”, is required. Volunteers for this project will have to monitor the planting for survivability.

Repeated failure of plantings will require a reconsideration of the species used. In general obtaining tree planting stock with a good diameter to height ratio or relatively large diameter trunk is very important. In addition the root:shoot ratio should also be in balance (typically there is *slightly* more length and volume in the shoot).

It is important to arrange roots at planting so that they can develop on all sides, and so that they are oriented downwards or horizontally. A root system stuffed into a narrow slit so that many of the roots point upwards is unlikely to result in rapid establishment and long term stability. This is particularly important with pines, larches and Douglas fir which rarely produce adventitious roots and so are dependent for their root geometry on the distribution of the roots present at planting.

In Sitka spruce planting trials it has been shown that roughly planted trees that are firmed into the ground with the heel of the boot or rubber boot produced fewer new roots during the first growing season than trees planted gently and firmed with the ball of the foot. Gentle, careful planting will result in more reliable establishment than hurried, rough planting.

Photograph 9: This illustrates the use of tree shelters in tree plantings completed by Arborea Consultants, LLC. The right photograph showing a western red cedar following two years growth. The left photograph is a shore pine following a single growing season.

The use of tree shelters as shown in photograph 9 is strongly recommended. A tree shelter is comprised of a plastic tube which can be a single layer of plastic or two layers (corrugated) and are typically semi-transparent as illustrated above. The shelter has been shown to produce significant responses in tree species selected as a part of this plan (J. Evans *Tree Shelters* 1986 Advances in Practical Arboriculture, Forestry Commission Bulletin 65, London, HMSO pp67-76) (J. Evans *Silviculture of Broadleaved Woodland* 1984 Forestry Commission Bulletin 62, London, HMSO pp232) (Warren D. Devine & Constance A. Harrington *Influence of Four Tree Shelter Types on Microclimate and Seedling Performance of Oregon White Oak and Western Redcedar* June 2008 USDA-FS PNW-RP576 pp35). In general the use of a shelter, irrespective of type (Evans, 1986) leads to dramatic differences in growth rates. Other advantages are that the shelter readily identifies the planting location and makes maintenance of the plantings easier. This applies not only to herbicide weeding but also manual. Other benefits are the protection of the tree in the initial 1-2 years from browsing; shelters of greater height can be purchased. However a 24 - 36 inch shelter has proven to be adequate unless a high degree of browsing is noted.

Evans (1986) noted the following when using shelters:

1. When growing broadleaved trees (or conifers) individually or at wide spacing in areas less than ½ acre consider using tree shelters to achieve full tree protection and rapid establishment
2. Ensure a high standard in all aspects of planting practice - plant quality, plant handling and timing and methods of planting
3. Rigourously control competing weeds and invasive plants around each tree, before planting and subsequently. See section on invasive plant species
4. Use a shelter which has at least a 5 year life cycle, and leave the shelter around the tree until the tree forces the shelter open, or destroys/shelter is broken down (depends largely on construction, Arborea Consultants, LLC., prefer shelters that can be re-used or recycled)
5. Ensure stake strength and fastening will withstand the stresses the site will be subjected to (i.e. wind, snow)

Planting Pattern

Spacing between planted trees on this site has been specified as 5 feet for Zone A and 6 ½ feet for Zone B. In some circumstances the planting site requires a large amount of work to prepare the site as noted earlier in this plan. Photograph 10 illustrates Area 15 through Area 18 and the condition of this site during April 2008. The entire area has been clearfelled and the debris retained on site. This is an example of an area that requires preparation prior to planting; scheduled for 2012.

Photograph 10: Area 15 through Area 18

The amount of debris on a site has a direct affect on the planting pattern that can be used. In some instances, such as in the centre of Area 3, no form of pattern can be used due to the fallen debris. It is, however, important to attempt to keep the prescribed spacing for the planting irrespective of pattern.

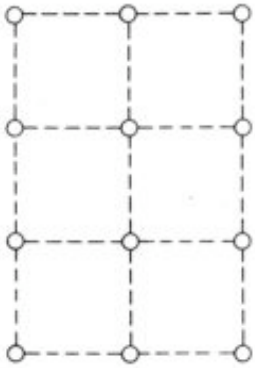


Figure 5: A square planting pattern, each circle representing a planting position with equal spacing from tree to tree in all directions

Tree numbers for square planting:

At 5 feet spacing the number of trees per acre numbers 1,742 (Zone A, Figure 2)
6 ½ feet spacing the number of trees equals 1,031 per acre (Zone B, Figure 2

The planting schedule used in this plan uses the following calculation to determine the number of trees required in each planting area. The number of trees required, as presented in the planting schedule is an estimate only.

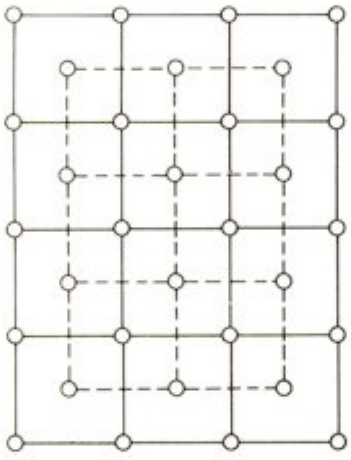
Number of trees per acre calculation:

Square feet in one acre = 43,560

Then $\frac{43,560}{6 \text{ X } 6}$ = 1,210 trees per acre

In this example spacing is set at 6 feet

Figure 6: *Quincunx Planting*



This form of planting pattern is proposed for inter-planting and under-planting discussed earlier in the plan i.e. Cascara

At present this plan does not cover this form of planting. It is advised that it be discussed following successful establishment of current plantings.

Planting Schedule

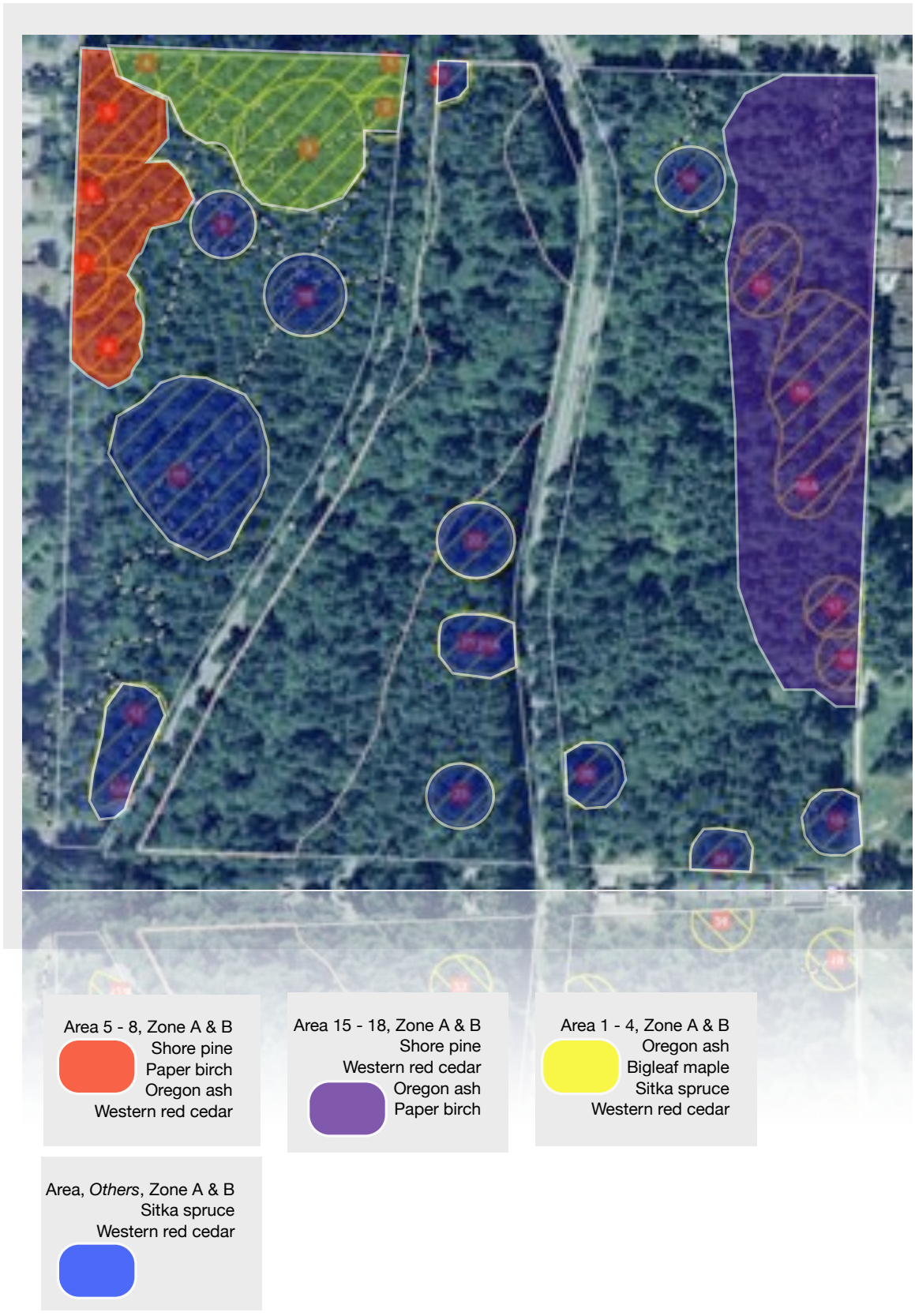
Table 5: *Planting Schedule & Site Preparation Notes*

Area	Species	Number of Trees (Species A/ Species B (Total))	Planting Year	Site Preparation
1 - 4, Zone A	Oregon ash / bigleaf maple	960/960 (1920)	2009	No specific instructions
1 - 4, Zone B	Sitka spruce / Western red cedar	142/142 (284)	2009	No specific instructions
5 - 8, Zone A	Shore pine / paper birch	1040/1040 (2080)	2010	Machinery mounted equipment to cut invasive species, large deadwood (standing or down) to be retained
5 - 8, Zone B	Oregon ash / Western red cedar	154/154 (308)	2010	As above
9, Zone A	Sitka spruce	320	N/A	Remove any competing holly
9, Zone B	Western red cedar	47	N/A	-
10, Zone A	Sitka spruce	480	N/A	No specific instructions
10, Zone B	Western red cedar	71	N/A	No specific instructions
11, Zone A	Sitka spruce	1600	2011	No specific instructions
11, Zone B	Western red cedar	236	2011	No specific instructions
12 - 12A, Zone A	Sitka spruce	480	N/A	Remove Himalayan blackberry and clear ivy from planting positions
12 - 12A, Zone B	Western red cedar	71	N/A	Remove Himalayan blackberry and clear ivy from planting positions
13, Zone A	Sitka spruce	160	N/A	Clear ivy from planting positions
13, Zone B	Western red cedar	23	N/A	Clear ivy from planting positions
14, Zone A	Sitka spruce	240	N/A	No specific instructions
14, Zone B	Western red cedar	35	N/A	No specific instructions
15 - 18, Zone A	Shore pine / Western red cedar	800/800 (1600)	2012	Machinery mounted equipment to cut invasive species, large deadwood (standing or down) to be retained
15 - 18, Zone B	Oregon ash / paper birch	118/118 (236)	2012	Machinery mounted equipment to cut invasive species, large deadwood (standing or down) to be retained
19, Zone A	Sitka spruce	240	N/A	Clear Himalayan blackberry
19, Zone B	Western red cedar	35	N/A	Clear Himalayan blackberry
20, Zone A	Sitka spruce	240	N/A	Remove Himalayan blackberry and clear ivy from planting positions
20, Zone B	Western red cedar	35	N/A	Remove Himalayan blackberry and clear ivy from planting positions
22, Zone A	Sitka spruce	320	N/A	No specific instructions
22, Zone B	Western red cedar	47	N/A	No specific instructions
23, Zone A	Sitka spruce	240	N/A	Clear ivy from planting positions

Area	Species	Number of Trees (Species A/ Species B (Total))	Planting Year	Site Preparation
23, Zone B	Western red cedar	35	N/A	Clear ivy from planting positions
21-21A,, Zone A	Sitka spruce	320	N/A	No specific instructions
21-21A,, Zone B	Western red cedar	47	N/A	No specific instructions
24, Zone A	Sitka spruce	240	N/A	Remove Himalayan blackberry and clear ivy from planting positions
24, Zone B	Western red cedar	35	N/A	Remove Himalayan blackberry and clear ivy from planting positions

Table 5 details the *Planting Schedule & Site Preparation Notes* for each disease centre or cleared area. Where a planting year is not provided "N/A" it is to be left to the arrangement of volunteers and King County to make arrangements. The priority is to complete the large open areas first. Other areas can be planted subsequently and as planting stock is available.

Figure 7: *Planting Schedule Plan*



Please contact our office if you have questions or do not understand any of the recommendations detailed in this replanting plan.

Sincerely yours,

Mr. Paul Hans Thompson

ISA Certified Arborist, PN-1838A
Quantified Tree Risk Assessment, Licensed User No.1586
PNW - ISA Certified Tree Risk Assessor, No.249
BTEC HND - Forestry (US, BSc Forestry)
Member American Society of Consulting Arborists
Member International Society of Arboriculture
Member Society of Commercial Arboriculture

Enclosures

Himalayan Blackberry
King County publication

KING COUNTY NOXIOUS WEED CONTROL PROGRAM WEED ALERT

Himalayan Blackberry

Rubus discolor/Rubus armeniacus — Rose Family

Control Recommended

Identification Tips

- Stout, thick arching canes (canes) with large thorns
- Main canes up to 15 feet tall with trailing canes reaching up to 40 feet long
- Small white to pink flowers
- Edible black fruit
- Leaves are large, rounded to oblong, toothed and usually in groups of 5

Biology

- Perennial with one main woody root ball
- Begins flowering in spring with fruit ripening in midsummer to early August
- Reproduces vegetatively by root and stem fragments, rooting at cane tips and by seed
- Seeds can remain viable in the soil for several years

Impacts

- Outcompetes native understory vegetation and prevents the establishment of trees such as Pacific Madrone, Douglas Fir and Western White Pine
- Limits the movement of large animals with impenetrable thickets
- Increases flooding and erosion potential
- Can take over entire stream channels and banks

Distribution

- Found throughout King County including in pastures, riparian areas, vacant lands, open areas, tree farms and along roadsides and right-of-ways
- Prefers full sun and well-drained soils

What You Can Do

While there is no legal requirement for controlling Himalayan blackberry, the King County Noxious Weed Control Board recognizes that this plant is invasive and has a damaging impact on the environment and resources of King County. The Board encourages and recommends control and containment of existing populations, especially for restoration projects or revegetation plans.

Control Methods

For best results, control methods should be adaptive and employed throughout several growing seasons. **Residents of unincorporated King County: If you intend to remove more than 7,000 square feet of blackberries or are removing them from wetlands or other sensitive areas, please contact us for further instructions.**

Hand: Effective on small infestations of less than 200 square feet. Hand pull the canes that are close to the ground and uproot the root ball. For larger more mature stands, cut the canes with loppers or pruners and dig up the remaining root ball. Remove canes and other fragments from the site so no primed vegetative reproduction.

Mechanical: Mowing, including the use of riding mowers and tractor-mounted mowers, can be very effective in controlling blackberries. Mulch the cuttings as much as possible. Do not mow sites that are wet or susceptible to compaction or erosion. If only one cutting is done per year, cut when the plant begins to flower. Make sure to return to the site the following year. If no follow-up is done, plant may re-sprout from the root crown at a greater density than before. Cultivation in agricultural areas can also be effective.

Chemical: Herbicides can be effective on blackberries, especially if combined with manual control and monitoring for surviving plants. **Follow labels exactly as written and only use products appropriate and legal for the site. Herbicides should only be applied at the rates specified on the label.** Products containing glyphosate are most effective when applied in late summer or early fall when canes are actively growing and after berries have formed. Glyphosate is absorbed by the growing leaves (not woody stems). However, glyphosate is "non-selective" and will injure any foliage that it comes in contact with, so make sure not to drip on desirable plants. Selective broadleaf herbicides with the active ingredient of triclopyr, 2,4-D and metsulfuron work well for lawn areas as they won't harm grasses. When using this type of herbicide or one with glyphosate, do not cut down the treated blackberry bushes until they have died completely. This can take two weeks or more. 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.

Native Blackberry
Not all the blackberry bushes in King County are the non-native Himalayan species. There is also a native plant called trailing blackberry (*Rubus ursinus*). It is smaller, has three leaflets (see picture above) and grows along the ground. It can also be weedy but does not grow up and over other plants and is not as aggressive as Himalayan.

King County

Revised April 2008

Questions?
King County Noxious Weed Control Program Line: **206-296-0290**
http://dnr.metrokc.gov/weeds

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