Invasive Plant Management Strategy

For the Okanagan Centre Greenspace

Prepared For:

District of Lake Country
Parks and Recreation Department

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1.0 INTRODUCTION

1.1 The Invasive Plant Issue

The impact of invasive plants is felt from the local to the global scale. Scientists, land managers, and the general public are becoming more aware of invasive plant impacts. In recent decades there has been a tremendous expansion of invasive plant species infesting natural areas across British Columbia, particularly in the Okanagan valley due to the significant landscape modification. There is an ongoing threat to both natural and managed areas, as new invasive plants or *weeds* arrive in the Okanagan. Invasive plants create large economic losses for agriculture in both cropland and rangeland situations. Weed invasion is considered the second most serious threat to natural habitats, after habitat fragmentation and loss (Randall 1996). Uncontrolled, these species can invade new environments and alter the structure and function of natural ecosystems.

Within the District of Lake Country, invasive plants contribute to reduced productivity of agricultural lands, including ranches and vineyards, and increased management costs for utility companies, government agencies, conservation groups and other stakeholders. Invasive plants also have direct impacts to private landowners; they reduce property values, interfere with recreation, increase fire hazard and decrease the aesthetic appeal of the landscape.

Invasive plants are rapidly becoming one of the most pressing issues for natural area managers. Unfortunately, most natural areas contain many invasive plant species. In the vast majority of cases, there is not enough labor and money to control all the invasive plants that occur in an area. Thus, land managers are forced to prioritize plant species and identify target areas for control activities. This strategy provides a framework for the District of Lake Country to control invasive plant species that are deemed as "high priority" within the Okanagan Centre Greenspace and recommendations to prevent the further spread and establishment of invasive plants within this important riparian corridor.

1.2 Background

In 1993, a sub-committee of the Parks and Recreation Commission (PARC) developed the Okanagan Centre Greenspace Plan at the request of the Regional District of Central Okanagan. The Regional District wanted to ensure that all environmental concerns, recreational opportunities, and public access and convenience in the area were addressed. The plan provided recommendations for the management and development of the foreshore[1] and shoreland[2] of Okanagan Lake along Okanagan Centre Road West and Pixton Road. One of the key recommendations for the shoreland included that PARC determine with local input, what should be removed from shoreland, such as noxious weeds and dead trees. Other recommendations included that no trees, or portions of them, or vegetation be removed unless deemed necessary by PARC, and that all structures on the shoreland be removed, except pumphouses and boathouses (Okanagan Centre website http://www.okanagancentre.net/).

A Foreshore Structures Bylaw was proposed by the sub-committee to include regulations to control any work done on the shoreland to minimize environmental damage, and designation of the foreshore and shoreland as 'Development Permit Areas' to control further uses. The Foreshore Structures Bylaw

[1] Defined as the area from high water mark out into the lake a distance of 200 meters
[2] Defined as all publicly owned land above the legal high water mark and below the main Okanagan Centre Road

was adopted, and it is included in the District of Lake Country Official Community Plan. However, the shoreland recommendations noted above were not implemented.

In 2007, the District of Land Country (hereafter referred to as the 'District') hired a forestry consultant to assess the impacts of the pine beetle epidemic and provide recommendations for ponderosa pine tree modifications or removal, and general information on forest health. The consultant provided additional information on the native plant community, noting the presence of invasive plants in several locations. Knowing that the removal of beetle infected pines would result in a certain amount of soil disturbance and recognizing the importance of invasive plant control in this natural riparian park, the District decided to embark on an invasive plant management plan.

1.3 Terms of Reference

Eco-Matters Consulting was hired in February 2008 to provide environmental services to conduct an invasive plant inventory, and based on the findings of this assessment, prepare an Invasive Plant Management Strategy for the Okanagan Centre Greenspace. The strategy will fit with the District's goal of retaining and enhancing the natural state of this conservation area, with an aim of re-establishing native plants where necessary. Eco-Matters' contract with the District also included:

- An early spring reconnaissance to identify treatment opportunities for 2008; findings to be outlined in a brief report that details target species, infestation locations and recommended treatments.
- Training of selected District staff and contractors (May) – an indoor/outdoor session to provide participants with information on invasive plant identification, management options and best management practices to prevent or mitigate weed spread and establishment
- A neighborhood meeting (late May-early June) – to introduce the project to the community and provide information on invasive plant identification and management options, consistent with the evolving invasive plant management plan.

The boundaries of the project site include the entire Okanagan Centre Greenspace, bordering Okanagan Lake. This includes the riparian corridor and associated trail network with the park, as well as the roadside along Okanagan Centre Road West and Pixton Rd, covering a distance of approximately 4 kilometres.

Figure 1 An image of the park, illustrating the diversity of plants. A pedestrian pathway traverses through the riparian woodland.

2.0 DEFINITION OF INVASIVE PLANTS

Invasive plants can be defined as "plants whose introduction or spread into previously uninfested areas from other countries, or regions within Canada, threatens the environment, the economy, or society, including human health" (Government of Canada 2004). *Invasive plant* is a legislative designation for those species listed under the Forest and Range Practices Act's Invasive Plants Regulation. The term *noxious weed* is a legislative designation reserved for those species listed under the provincial Weed Control Act Regulations (plants) or the federal Weed Seeds Order (weed seeds). The term *alien invasive species* is a legislative designation for those species listed in a Schedule to the Community Charter's Spheres of Concurrent Jurisdiction – Environment and Wildlife Regulation. For the purposes of this document, 'invasive plant' will be used as a general term that includes all species listed as noxious, invasive, or alien invasive in federal, provincial or local regulations.

Although numerous acts, regulations, policies and guidelines provide authority and direction for the control of invasive plants in BC, the Weed Control Act, Integrated Pest Management Act and Forest and Range Practices Act are the most important pieces of legislation governing invasive plant activities on Crown land (Wikeem 2006).

3.0 AN INTEGRATED APPROACH TO INVASIVE PLANT MANAGEMENT

An invasive plant management program requires the development of a straightforward rationale for the planned actions. This is best accomplished using an adaptive management approach as follows:

1. Establish management goals and objectives for the site;
2. Determine which invasive plant species or populations, if any, block or have potential to block attainment of the management goals and objectives;
3. Determine which methods are available to control the invasive plants;
4. Develop and implement a management plan designed to move conditions toward management goals and objectives;
5. Monitor and assess the impacts of management actions in terms of their effectiveness in moving conditions toward these goals and objectives; and
6. Re-evaluate, modify and start the cycle again.

Note that control activities are not begun until the first three steps have been taken. An invasive plant management program is best viewed as part of an overall restoration program, so it is important focus on what is desired in place of the invasive plant, rather than simply eliminating the invasive plan.

For the purposes of this document, the primary management goal is to ensure that the number and abundance of invasive plants presently occurring within the Greenspace decreases over the next five years. A second goal is to ensure that any new priority species introduced into the park are detected early and treated rapidly to prevent establishment (commonly referred to as "early detection, rapid response"), such as the alert species outlined in Section 5.3. These management goals will be realized through the adoption of general Best Management Practices (BMPs) summarized in Section 5.1, the area-specific recommendations in Section 5.4 and the species-specific BMPs outlined in Appendix B.

4.0 INVASIVE PLANT SPECIES

Eco-Matters Consulting inventoried the Okanagan Centre Greenspace for invasive plants on five occasions between May and October 2008, to capture most species at their flowering stage. The assessment was conducted on foot and included both the riparian shore land, with a focus on the walking path, and the adjacent roadside. Individual weeds or patches of weeds were spatially recorded using a hand-held GPS (Garmin Map60Cs). Each data point recorded a UTM coordinate, distribution code and other notations of interest. The inventory protocol and distribution codes followed the guidelines outlined in the MFR Invasive Alien Plant Program (IAPP) Reference Guide (http://www.for.gov.bc.ca/hra/Plants/application.htm). Occurrence or evidence of biological control agents was recorded if observed for diffuse knapweed, Dalmatian toadflax, St. John's-wort and Canada thistle. A total of 51 invasive plant species were identified within the Greenspace (see Table 1). The majority of the invasive plants were forbs, however there were also three tree species, four grass species and one vine.

5.0 PRIORITIES FOR INVASIVE PLANT MANAGEMENT

Preliminary findings and recommendations for invasive plant management within the Greenspace or along Okanagan Centre Road West were provided to the District in July 2008. This brief report outlined key invasive plants, their location, and treatment opportunities for 2008. A copy of this report is provided in Appendix A.

As preventing the spread and establishment of invasive plants is the most important management action, an overview of preventative measures is outlined in Section 5.1. This includes a list of Best Management Practices for the trails and roadways. Section 5.2 consists of a list of the highest priority species detected within the project boundaries, while Section 5.3 includes a list of alert species that are not known to occur within the Greenspace but have a high likelihood of invading. Section 5.4 provides an overview of treatment polygons within the project boundaries, while Section 6.0 identifies sites of exposed soil that should be re-vegetated to prevent invasive plant establishment.

5.1 Prevention and General Best Management Practices

The first line of defence and the most cost-effective strategy against invasive species is preventing them from invading and becoming established in the first place. Prevention should be viewed as the highest priority approach to managing invasive plants. Once an infestation becomes well established, management is expensive and eradication is very difficult. Therefore, early detection is one of the most important components of prevention of spreading invasive species. The second most important component is eradication before they produce seed or develop an established root system.

Table 1 A list of all the invasive plants identified during the 2008 invasive plant inventory. An asterisk (*) denotes the highest priority species.

Category	Common Name	Latin Name	Common Name	Latin Name
Trees	Black Locust Tree	*Robinia pseudoacacia*	***Forbs Continued***	
	Siberian Elm	*Ulmus pumila*	Diffuse Knapweed	*Centaurea diffusa*
	Tree of Heaven	*Ailanthus altissima*	Evening Primrose	*Oenothera biennis*
Grasses	Bulbous Bluegrass	*Poa bulbosa*	Field Bindweed	*Convolvuvus arvensis*
	Cheatgrass	*Bromus tectorum*	Hoary Alyssum*	*Berteroa incana*
	Kentucky Bluegrass	*Poa pratensis*	Hoary Cress*	*Cardaria draba*
	Orchardgrass	*Dactylis glomerata*	Hound's-tongue*	*Cynoglossum officinale*
Vines	Himalayan Blackberry	*Rubus discolor*	Kochia	*Kochia scoparia*
Forbs	Alfalfa	*Medicago sativa*	Lamb's-quarters	*Chenopodium album*
	American Vetch	*Vicia americana*	Money Plant	*Lunaria annua*
	Anchusa*	*Anchusa officinalis*	Mullein	*Verbascum thapsus*
	Baby's Breath*	*Gypsophila paniculata*	Mustard sp.	*Sinapis sp.*
	Black Medic	*Medicago lupulina*	Perennial Sow-thistle	*Sonchus arvensis*
	Broad-leaved Dock	*Rumex crispus*	Perennial Sweet pea	*Lathyrus latifolius*
	Broad-leaved Plantain	*Plantago major*	Russian Knapweed*	*Acroptilon repens*
	Bull Thistle	*Cirsium vulgare*	Russian Thistle	*Salsola kali*
	Canada Thistle	*Cirsium arvense*	Scotch Thistle*	*Onopodum acanthium*
	Chicory	*Chichorium intybus*	Shepherd's Purse	*Capsella bursa-pastoris*
	Cleavers	*Galium aparine*	St. John's-wort	*Hypericum perforatum*
	Climbing Nightshade	*Solanum dulcamara*	Stork's-bill	*Erodium cicutarium*
	Coast Fiddleneck	*Amsinckia intermedia*	Sulphur Cinquefoil*	*Potentilla recta*
	Common Burdock*	*Arctium sp.*	Western Salsify	*Tragopogon dubius*
	Common Groundsel	*Senecio vulgaris*	Western Sticktight	*Lappula occidentalis*
	Common Mallow	*Malva neglecta*	White Cockle	*Lynchnis alba*
	Corn Gromwell	*Buglossoides arvensis*	White Sweetclover	*Melilotus alba*
	Dalmatian Toadflax*	*Linaria genistifolia ssp. dalmatica*	Wild Buckwheat	*Polygonum convolvulus*

Prevention involves attention to the most common means of transmission, including contaminated seed, mulch or soils; movement of vehicles, equipment or machinery from an invasive plant contaminated area to a non-contaminated area; and lack of restoration or re-vegetation following activities that result in a soil disturbance. Prevention depends upon limiting the introduction of new invasive plants through:

- Minimizing the disturbance of desirable plants and soils;
- Maintaining desired plant communities through good management;
- Monitoring high-risk areas such as transportation corridors, parking lots and bare ground;
- Re-vegetating disturbed sites with desired plants, using native species whenever possible;
- Evaluating the effectiveness of prevention efforts and adapting plans for future years; and
- Early detection and eradication of small patches of invasive plants through regular inventory and corrective action.

The following section outlines the general Best Management Practices (BMPs) that are applicable to two key movement corridors within the Greenspace: the trail networks and transportation corridors. These recommendations have been adapted from best management practices outlined in two documents (Perron 2008; Chapin and Schultz 2008), and are also based on the author's personal experience in dealing with invasive plants in the Okanagan region for more than a decade. When followed, these BMPs will reduce the likelihood of introducing invasive plants into new areas through people and pet movement along the trail network or via roadside maintenance activities.

5.1.1 Invasive Plants on Trail Networks

- Re-vegetate disturbed soil to optimize establishment of desirable plants for that specific site, particularly along trail edges (a perennial grass mix consisting of both native and agronomic species would be best suited for this purpose; refer to Section 6.0 for more detail).

- Use non-invasive or preferably locally native alternatives for re-planting projects.

- Avoid transportation of soil to the site. If topsoil or soil amendments are required for re-planting projects, be aware of where topsoil is collected and transported from.

- Limit the number of trails and rehabilitate those trails that are deemed unnecessary. This action will require signage to indicate that site rehabilitation is in progress and may necessitate a temporary barrier such as snow fencing. Equally important is advance notification to the local community, so they understand the importance of the District taking such action.

- Install signs in strategic locations that provide information on invasive plants and the importance of staying on the trail to prevent their spread. Signs should include images and information on high priority species and alert species, as well as contact information for questions or to report new sightings.

5.1.2 Invasive Plants Along Roadsides

- Local roadside maintenance staff should be encouraged to participate in annual invasive plant training sessions, so that maintenance activities complement the District's goal of invasive plant management for the Greenspace.

- Minimize soil disturbance whenever possible. Invasive plants readily colonize areas of disturbed soil. Monitor recent work sites for the emergence of invasive plants for a minimum of two years after project completion.

- Time roadside mowing to prevent invasive plants from producing seed.

- Mowing equipment should be cleaned daily. This is particularly important if mowing occurs after seed maturation.

- When it is necessary to conduct soil work in infested roadsides or ditches, schedule treatment activity beforehand, to reduce the potential spread of invasive plant seeds and plant propagules.

- Move sediment to upland or quarantined areas when cleaning around culverts or irrigation ditches.

- Avoid moving infested gravel, rock, sand, topsoil and other fill materials to locations that are free of invasive plants.

- Maintain desirable roadside vegetation. If desirable vegetation is removed during blading or other ground disturbing activities, the area should be re-vegetated with a suitable perennial grass mix.

5.2 High Priority Species

Ten of the 51 invasive plants identified within the Greenspace are considered high priority species. These invasive plants are considered high priority species because they present two or more of the following characteristics: 1) easily spread by people or pets while walking along the trails; 2) easily spread by roadside maintenance activities; 3) high risk to ecosystem integrity due to displacement of native plants; and 4) very difficult to eradicate.

1. Anchusa
2. Baby's-breath
3. Common burdock
4. Dalmatian toadflax
5. Hoary alyssum
6. Hoary cress
7. Hound's-tongue
8. Russian knapweed
9. Scotch thistle
10. Sulphur cinquefoil

All of these species are mentioned in Section 5.4, as occurring within one or more invasive plant polygons; however, these species may also occur outside of these areas. Also, because natural ecosystems are dynamic, long-term planning needs to consider the potential for these species to move to other areas within the park, prior to the implementation of a full-scale management program. The management of these species should be considered highest priority for treatment. Detailed information on the identification, biology, habitat and management options of the high priority species may be found in Appendix B.

5.3 Invasive Plant Alerts

The following species are known to occur within close proximity to the Okanagan Centre Greenspace, but were not actually identified within the project boundaries. All of these species are considered invasive and possess characteristics that allow them to readily expand to new areas. For these reasons, they are viewed as 'alert' species. If the Best Management Practices outlined in Section 5.1 are fully implemented, these alert species are not anticipated to establish within the park. However, extreme caution will need to be taken in order to ensure this goal is realized.

1. Cypress spurge (*Euphorbia cyparissias*)
2. Leafy spurge (*Euphorbia esula*)
3. Fuki or Japanese Butterbur (*Petasites japonicus*)

5.4 Site Specific Treatment Areas

Patches of invasive plants viewed as high priority for treatment due to their location on the landscape or the high abundance of species and/or presence of high priority species resulted in the delineation of eleven invasive plant polygons. These polygons are typically associated with a particular disturbance or source of aggravation, which will also need to be addressed if management is to be fully effective. The following section provides a description of the location and species occurring within each polygon, and also details specific management recommendations. Polygons are numbered sequentially and begin at the north end of the project site and continue in a southern direction. Figure 2 indicates the locations of these polygons within the project boundaries.

Polygon 1 (IP01): This polygon is located at the northern end of the park, along Pixton Road. Black locust trees and tree-of-heaven dominate the narrow riparian zone, alongside willow trees and a variety of escaped fruit and nut trees from neighbouring properties. Invasive species along the road edge and also under the tree canopy include several patches of burdock, diffuse knapweed and chicory, several sporadically occurring hound's-tongue and broad-leaved dock plants, single patches of Canada thistle and a few individual sulphur cinquefoil plants. Seedhead and root feeding biological control agents were detected on the diffuse knapweed.

Management Recommendation: *Roadside mowing should be carefully timed to prevent seed production. Old stalks of burdock and hound's-tongue should be clipped, bagged and taken to the landfill. Sulphur cinquefoil plants are restricted to the northern end of this polygon and should be manually dug out, as there are very few plants but they have the potential to spread significantly. Biocontrol of diffuse knapweed should be monitored to ensure the plants are being effectively suppressed. The invasive trees should be removed over time, particularly the tree-of-heaven, and replaced with native trees and shrubs, as time and funding permits.*

Polygon 2 (IP02): This polygon consists of a large infestation (~800 m^2) of burdock and Canada thistle, located west of Pixton Road, where the road takes a right angle and heads towards Carr's Landing Road. This is a major seed source for these two species and should be addressed.

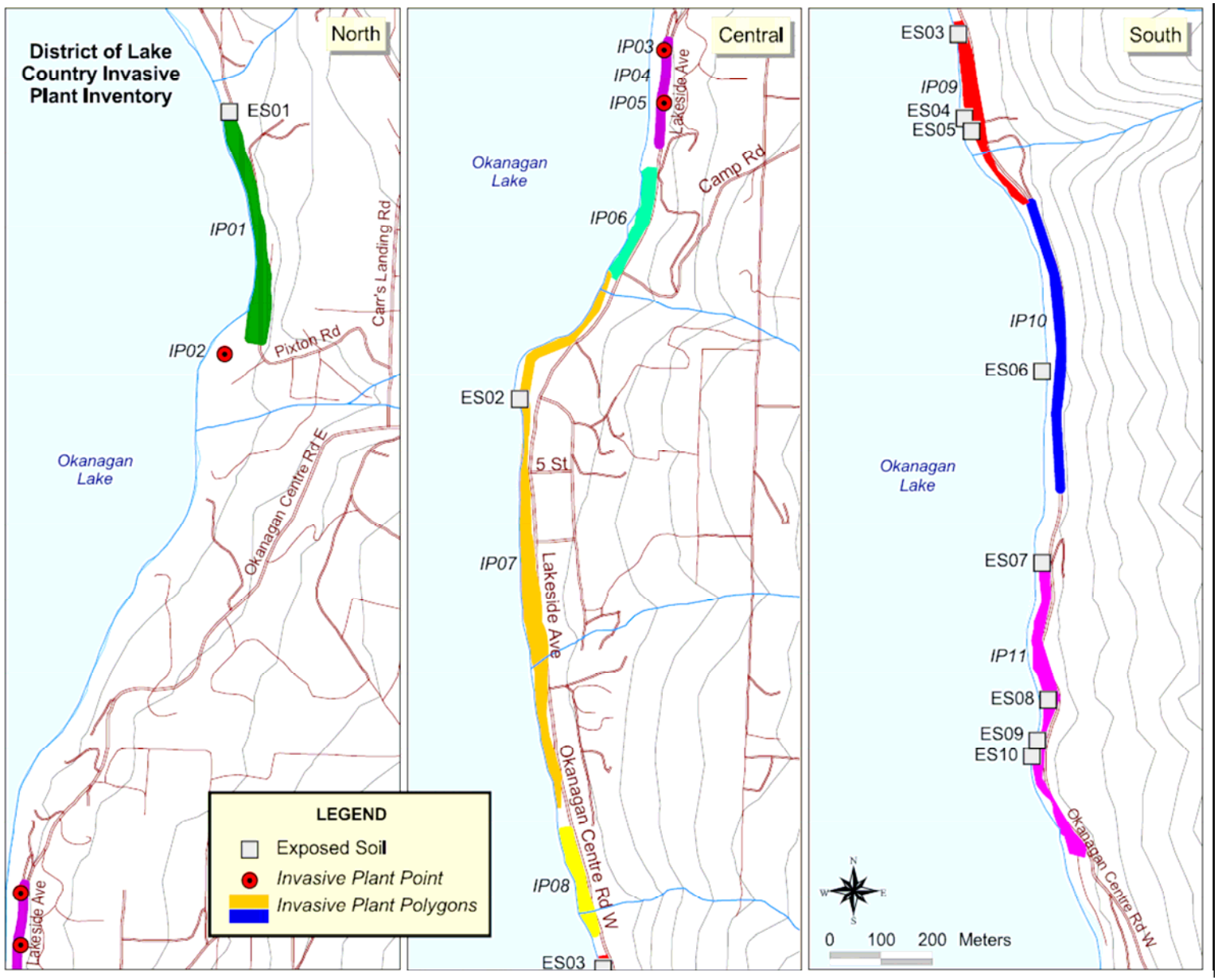

Figure 2 Map illustrating invasive plant polygons and exposed soil locations where rehabilitation is recommended.

Management Recommendation: *Need to confirm land ownership. If the infestation is on private land, the property owners should be contacted and encouraged to control these invasive plants. Due to the size of the infestation, the extensive root system of Canada thistle and the probable seed bank in the soil, the most suitable option would be to spot spray with a glyphosate-based product, followed-up with a heavy grass seed mix to provide competition. The site will need monitoring and re-treatment as required for at least five years.*

Polygon 3 (IP03): This polygon is located at the northern end of Okanagan Centre Road West. There is a fairly large and dense patch of hoary cress and Russian knapweed located on the west side of the road, extending down the bank towards the lake. This is the only known infestation of both of these species, and therefore is a high priority for action. There are also a few sporadically occurring bull thistle, Canada thistle and hound's-tongue plants in this area.

Management Recommendation: *Roadside mowing should be carefully timed to prevent seed production. Old stalks of hound's-tongue should be clipped, bagged and taken to the landfill. The large infestation of hoary cress and Russian knapweed should be treated with a wipe-on application of a glyphosate-based product, followed-up with a heavy grass seed mix to provide competition and stabilize the bank. Hand pulling is not an option here, as it would likely de-stabilize the bank and could result in soil erosion. While multiple cuttings could decrease plant height and reduce seed production, this would be a difficult technique to implement due to the steep slope of the bank, and would also be very labour intensive. The site will need monitoring and re-treatment as required for at least five years.*

Polygon 4 (IP04): The polygon is predominantly located along the roadside, heading south from IP03 and continuing until approximately 250 metres north of Camp Road. There is a fairly healthy, dense riparian zone in this section of the park with a limited number of trails. There are several sporadically occurring invasive species, including burdock, Canada thistle, diffuse knapweed and hound's-tongue. Seedhead and root feeding biological control agents were detected on the diffuse knapweed.

Management Recommendation: *Roadside mowing should be carefully timed to prevent seed production. Old stalks of burdock and hound's-tongue should be clipped, bagged and taken to the landfill. Biocontrol of diffuse knapweed should be monitored to ensure the plants are being effectively suppressed.*

Polygon 5 (IP05): This polygon is located on the east side of Okanagan Centre Road West, and extends onto private property. The area supports a dense infestation of several different species, presumably due to previous soil disturbance and there may be some overland flow of water assisting weed growth. An area of approximately 150 m^2 supports sporadically occurring individual plants or single patches of the following species: broad-leaved dock, bull thistle, burdock, Canada thistle, diffuse knapweed, kochia and hound's-tongue. This is the only known occurrence of kochia within the entire project area. Seedhead and root feeding biological control agents were detected on the diffuse knapweed.

Management Recommendation: *Successful invasive plant control at this location will require a cooperative agreement with the private landowner. Roadside mowing should be carefully timed to prevent seed production. Old stalks of burdock and hound's-tongue should be clipped, bagged and taken to the landfill. Biocontrol of diffuse knapweed should be monitored to ensure the plants are being effectively suppressed. The remaining species should be cut or mowed prior to seed production. Due to the extent of the previous disturbance, seeding with a competitive grass mix may help to reduce the abundance of invasive plants over time. If Mogulones cruciger (biocontrol agent)*

is released for hound's-tongue at IP06, this polygon should be closely monitored for the presence of beetles two-three years following the release.

Polygon 6 (IP06): This polygon is located within the park, roughly parallel to the intersection of Okanagan Centre Road West and Camp Road, and extending north for approximately 250 metres. Much of the riparian zone has been heavily modified, with several developed trails and manicured lawns. However, the steep bank still supports some native species interspersed with invasive plants. There is a substantial patch of tree-of-heaven, as well as some Siberian elms. Hound's-tongue, burdock and Canada thistle are fairly prolific, particularly at the southern end of this polygon; bull thistle and diffuse knapweed are also present, but to a lesser extent. Seedhead and root feeding biological control agents were detected on the diffuse knapweed. This area also supports a very large infestation of Himalayan blackberry, the only patch noted during the assessment, covering an estimated 1000 m^2.

Management Recommendation: *This area has the potential to be significantly enhanced, however it requires a long-term commitment and will also require the support of adjacent landowners who have taken considerable ownership of this area. There is an excessive amount of trails through this area, and several of these should be closed and rehabilitated to reduce the potential for further spread of invasive species. Old stalks of burdock and hound's-tongue should be clipped, bagged and taken to the landfill. Biocontrol of diffuse knapweed should be monitored to ensure the plants are being effectively suppressed. A biorelease should be made for hound's-tongue (Mogulones cruciger) and Canada thistle (Larinus planus). Bull thistle and burdock should be cut or dug out annually, prior to seed production. Over time, the Siberian elms and the tree-of-heaven should be thinned out and young plants removed altogether; these should be replaced with native trees. The blackberry is extremely dense and extensive in this area and will be a challenge to control, it should be addressed as this was the only infestation noted during the assessment. Immediate efforts should focus on containment to prevent further spread while long-term management requires a site-specific plan as part of the overall enhancement and re-naturalization of this area. Mowing followed by removal of root crowns and roots, and planting of native vegetation has been found to be an effective approach to managing Himalayan blackberry, however maintenance treatments are an important component of this approach (Bennett 2006).*

Polygon 7 (IP07): This polygon is located between Safe Harbour north to Camp Road. While the dominant tree species are ponderosa pine and cottonwood, invasive tree-of-heaven and black locust trees are prolific in this section of the park. Hound's-tongue is the most prevalent invasive forb in this section. Other invasive species include diffuse knapweed and two escaped ornamentals, money plant and perennial sweet pea. Seedhead and root feeding biological control agents were detected on the diffuse knapweed.

Management Recommendation: *Over time, the tree-of-heaven and locust should be thinned out and replaced with native trees and shrubs; this will be particularly important if there is further attack by pine beetle and resultant losses of ponderosa pine trees in this section of the Greenspace. Perennial sweet pea can threaten the ecological integrity of natural ecosystems, and therefore should be dug out. The money plant should be monitored to determine the invasive potential of this plant. Biocontrol of diffuse knapweed should be monitored to ensure the plants are being effectively suppressed. If Mogulones cruciger is released for hound's-tongue at IP06, this polygon should be closely monitored for the presence of beetles two-three years following the release. In the interim, plants should be cut or mowed at ground level prior to seed production.*

Polygon 8 (IP08): This polygon includes the vegetated areas surrounding the parking lot at Safe Harbour. Several high priority invasive plants occur here, including a few small patches of anchusa,

hoary alyssum and sulphur cinquefoil at the southern end of the polygon. Several sporadically occurring individual diffuse knapweed and broad-leaved dock plants also occur at the harbour. Seedhead and root feeding biological control agents were detected on the diffuse knapweed. Cheatgrass is a dominant invader of the banks between the parking lot and Okanagan Centre Road West, particularly where pedestrian trails have been established.

Management Recommendation: *Anchusa, sulphur cinquefoil, hoary alyssum and broad-leaved dock should be dug out or hand pulled (if soils are loose) prior to seed production; alternatively the dock can be mowed closely to the ground. As the removal of these species will result in soil disturbance, this area should be seeded with a competitive grass mix to reduce the re-establishment of invasive plants, particularly with such a high abundance of cheatgrass in the vicinity. Biocontrol of diffuse knapweed should be monitored to ensure the plants are being effectively suppressed.*

Polygon 9 (IP09): This polygon includes the area south of Safe Harbour, for a distance of approximately 400 metres, and includes the park and invasive plants growing along Okanagan Centre Road West. Several patches of baby's-breath occur within this polygon. Other species occur sporadically as individual plants or a single patch, including anchusa, diffuse knapweed, hoary alyssum, hound's-tongue, St. John's-wort, burdock, Scotch thistle, money plant and tree-of-heaven. Seedhead and root feeding biological control agents were detected on the diffuse knapweed.

Management Recommendation: *Roadside mowing should be carefully timed to prevent seed production. The baby's-breath is somewhat of a controversial species, as neighbours have indicated a desire to retain this species in the Greenspace. There will need to be some outreach conducted with adjacent landowners to clarify the impacts of this invasive ornamental, as well as other escaped horticultural plants. Effective control will require baby's-breath plants to be dug out; due to the soil seed bank, these areas should also be re-seeded to reduce re-establishment of baby's-breath. Anchusa, hound's-tongue, St. John's-wort, hoary alyssum and Scotch thistle should be dug out or hand pulled (if soils are loose) prior to seed production. Over time, the tree-of-heaven and locust should be thinned out and replaced with native trees and shrubs. The money plant should be monitored to determine the invasive potential of this plant. Biocontrol of diffuse knapweed should be monitored to ensure the plants are being effectively suppressed.*

Polygon 10 (IP10): This polygon is located approximately 400 metres south of Safe Harbour, and continues in a southern direction. There are several sporadically occurring individual diffuse knapweed and Dalmatian toadflax plants, a clump of locust trees, and a few baby's-breath and sulphur cinquefoil plants. Seedhead and root feeding biological control agents were detected on the diffuse knapweed, while the stem boring and seedhead weevils were observed on the toadflax.

Management Recommendation: *Roadside mowing should be carefully timed to prevent seed production. Baby's-breath and sulphur cinquefoil should be dug out. Biocontrol of diffuse knapweed and Dalmatian toadflax should be monitored to ensure the plants are being effectively suppressed. Over time, the locust trees should be removed and replaced with native trees and shrubs.*

Polygon 11 (IP11): This is the southernmost polygon and includes infestations noted along Okanagan Centre Road West and on the trail that traverse the park. This area is in fairly good condition with a limited amount of invasive plants. Diffuse knapweed occurs fairly consistently along the road shoulder, however biological control agents were detected. Other invasive species occurring here in relatively low abundance include sulphur cinquefoil, broad-leaved dock, burdock, anchusa, Dalmatian toadflax, money plant and Siberian elm. Stem boring and seedhead weevils were observed on the toadflax. One significant patch of hound's-tongue was detected.

Management Recommendation: *Roadside mowing should be carefully timed to prevent seed production. Old stalks of burdock and hound's-tongue should be clipped, bagged and taken to the landfill. Biocontrol of diffuse knapweed and Dalmatian toadflax should be monitored to ensure the plants are being effectively suppressed. The remaining species should be dug out or pulled prior to seed production. The money plant should be monitored to determine the invasive potential of this plant. Over time, the Siberian elm should be removed and replaced with native trees and shrubs.*

6.0 REHABILITATION AREAS

During the 2008 assessment of the Okanagan Centre Greenspace, a total of 10 sites were identified as having exposed soils and potentially benefiting from re-vegetation. These sites are identified in Figure 2 as ES01 – 10, with the majority of the sites located in the southern portion of the project area. Detailed information on these sites and a photographic log can be found in Appendices C and D, respectively.

Some of the larger rehabilitation sites would benefit from seeding (i.e. dryland grass mix) in addition to planting, predominantly to prevent the invasion of additional invasive plants or expansion of existing invasive plants, and also to reduce erosion. Seeding is considerably less costly and is likely to be more successful in some locations than planting, unless temporary irrigation is installed to assist establishment of the plantings.

Plantings, in general, could consist of the following species. Note that if the site is exposed and soils are low in nutrients, dryland species would likely have the greatest chance of survival. In many locations, a variety of both dryland and more typical riparian species would be best suited for the site. Appendix C provides sit specific recommendations for plantings.

Riparian Species:
Black cottonwood
Douglas maple
Mountain/Sitka alder
Red-osier dogwood
Oregon grape
Common snowberry
Nootka rose
Hemp dogbane

Dryland Species:
Ponderosa pine
Saskatoon
Rabbitbrush
Golden aster
Northern wormwood
Brown-eyed Susan
Pasture sage
Bluebunch wheatgrass

A suitable dryland seed mix should be specifically created for the Greenspace. A potential mix that could be custom blended is included below:

Grass Species	% by weight	% by seed count
Dahurian Wildrye	57.74	25
Bluebunch Wheatgrass	25.48	20
Sheep's Fescue	8.53	30
Sandberg Bluegrass	4.00	20
Annual Ryegrass	4.25	5

Any sites that are selected for rehabilitation should be signed to indicate that the area is being restored and people should refrain from accessing the site or stay on the trail; the message may vary depending on site-specific conditions. As these are locations where the soil has been disturbed, they are highly vulnerable to the establishment of invasive plants; therefore, long-term monitoring is essential to ensure success. Survival of the native plantings should be monitored for two-years years, with additional plantings as required. Moreover, these areas need to be monitored for the establishment of invasive plants; when identified, the most suitable management approaches need to be employed.

7.0 COLLABORATION AND COMMUNICATION

In order to achieve long term effective control of invasive plants in the Okanagan Centre Greenspace, the District's Parks and Recreation Department will need to work closely internally with other departments (namely the Engineering and Public Works Department), and will also need to collaborate with the Regional District of Central Okanagan and local landowners. As Engineering and Public Works is responsible for traffic and transportation planning, and road and drainage maintenance, staff and contractors will need to have an integral role with the management of invasive plants along Okanagan Centre Road West and Pixton Road. As Safe Harbour falls under the jurisdiction of the Regional District, the two governments will need to clearly communicate the actions required to manage the invasive plants at this particular location. The Regional District's Bylaw Enforcement Officer can play a helpful role in providing ongoing assistance with invasive plant identification, recommendations on control options, provision of biological control agents and providing extension and outreach to the local community. The latter activity is extremely important, as neighbouring landowners cherish the Greenspace and want to be involved or at least apprised of its ongoing maintenance. This is especially important if the District decides to close and rehabilitate some of the trails, as recommended in this strategy. Additionally, as invasive plants do not respect boundaries, voluntary involvement of the private landowners bordering the project site is essential to the overall effectiveness of all treatment activities. This holds true particularly for escaped ornamentals (e.g. money plant, perennial sweet pea, baby's-breath), which are numerous within the park. Landowners should be provided information on the high priority invasive plants (identification, threats, control options and the consequence of taking no action), the alert species, and also a list of invasive horticultural species and alternatives for planting.

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APPENDICES

APPENDIX A
Preliminary findings and recommendations for invasive plant management

Okanagan Centre Greenspace – Invasive Plant Inventory and Management Plan Preliminary Recommendations July 11, 2008

- Hand-pull Dalmatian toadflax; most notable site is along Okanagan Centre Rd West at very south end of project boundary
- Dig-out anchusa (common bugloss) at Safe Harbour
- Scotch thistle: dig-out rosettes and hand-cut second year plants, across road from address #10645 Okanagan Centre Rd East
- Dig-out baby's-breath, which is most prolific in area south of Safe Harbour, in the vicinity of #10645 Okanagan Centre Rd West, typically along beach area
- Burdock: dig-out rosettes, hand-cut second year plants and clip/bag dried seedheads from previous years, along northern end of Okanagan Centre Rd West where it starts to climb away from beach area and especially along Pixton Road which is worst patch in park
- Hand-cut hound's-tongue plants; most notable patch is north of Camp Road intersection to northern extent of park along Okanagan Centre Rd West
- Hand-pull hoary alyssum located at the south end of Safe Harbour and immediately south of the harbour

APPENDIX B

Invasive Plant Profiles

Anchusa
Baby's-breath
Common burdock
Dalmatian toadflax
Hoary alyssum
Hoary cress
Hound's-tongue
Russian knapweed
Scotch thistle
Sulphur cinquefoil

Anchusa
Anchusa officinalis

Legal Status
Listed under the *Forest and Range Practices Act* as an invasive plant, and under the *Community Charter* as an alien invasive species.

Identification
Anchusa is a perennial herb. The plant has many branched stems, especially near the flowering portion of the plant, and grows to 0.3-0.8 m tall. The leaves are 6-20 cm long, 1.0 to 5 cm wide, lanced shaped, and occur alternately on the stem. Numerous small (1.5-2 mm), purplish blue flowers occur in clusters at the ends of branches. Each flower produces four cylindrical nut-like seeds. The seeds are small (6 by 4 mm), black, and wrinkled. The roots of mature plants are thickly taproots, and penetrate deep into the soil.

Similar Species
Blueweed (*Echium vulgare*), European bugloss (*Anchusa arvensis*) and Italian bugloss (*Anchusa azurea*), Hound's-tongue (*Cynoglossum officinale*) all resemble Anchusa. The similarities are their blue hued inflorescences.

Biology
Seed is the primary method of reproduction. A mature plant can produce as many as 900 seeds per plant. Fragments of roots can propagate new plants. In spring, seedlings emerge and remain as a single shoot the first year. A single flowering shoot is produced in its second year, and several more stalks and flowers in the following years. Flowers bloom in April through June.

Habitat
Anchusa can be found growing in lime-free dry, sandy to gravely soils, dry pastures, grasslands, rangelands, roadsides, ditches and other disturbed areas.

Management Options Summary

Biological
There are no biological control agents available for anchusa.

Mechanical
Mowing will reduce seed production but will not control existing plants. It is recommended that either pulling or digging the entire taproot from the ground is the most efficient mechanical treatment of anchusa. It is important to bag and properly dispose of the removed plants.

Baby's Breath
Gypsophila paniculata

Legal Status
Listed under the *Forest and Range Practices Act* as an invasive plant, and under the *Community Charter* as an alien invasive species.

Identification
Baby's breath is a perennial herb. The plant has many branched stems and grows to 0.4-1.2 m tall.
The leaves are 2-10 cm long, lanced shaped with a prominent mid-vein, and occur opposite on the stem. The stem lacks basal leaves. Numerous small (1.5-2 mm), white flowers occur in clusters at the ends of branches. The seeds are small (1.5-2 mm), black, and wrinkled. The roots of mature plants are thick, and penetrate deep into the soil.

Similar Species
Glandular baby's breath (*Gypsophila scorzonerifolia*) has a similar appearance to baby's breath, but does not occur in the Okanagan.

Biology
Seed is the primary method of reproduction. A mature plant can produce as many as 13,700 seeds per plant. Many seeds fall and remain close to the parent plant, but the wind can carry them far away. A form of vegetative reproduction results in an increase in shoots on mature plants. In early May seedlings emerge and remain as a single shoot the first year. Plants do not flower until their third year. Flowers bloom in early June and fruit begin to develop by mid-July. The fruit will mature and split by late July.

Habitat
Baby's breath can be found growing in dry pastures, grasslands, rangelands, roadsides, ditches and other disturbed areas. The perennial roots prefer coarse textured soils where they can grow large, enabling them to store more food recourses. However, they do occur in fine textured soils as well.

Management Options Summary

Biological
There are no biocontrol agents available for baby's breath.

Mechanical
Digging up individual plants with a flat nose spade is one method of treating baby's breath. The objective is to sever the plant where the taproot becomes the stem (caudex). To remove the caudex, the root must be severed as far below the ground as possible (15-30 cm deep). The spade must be placed near the base of the plant, and thrust at an angle that will contact the root as deep as possible. If the caudex is not removed, the plant may re-sprout from the cut root. Mowing will reduce seed production but will not control existing plants.

Common Burdock

Arctium minus (L.)

Legal Status
Classified as noxious within the Regional District Okanagan-Similkameen. Listed by the *Forest and Range Practices Act* as an invasive plant, and by the *Community Charter* as an alien invasive species.

Identification
Common burdock is a large biennial herb with a large fleshy taproot. The mature plant can grow between 1-3 m tall, with branched and coarse stems. The leaves are heart to egg shaped with woolly undersides and dark green tops. Lower leaves are large, up to 60 cm long and 40 cm wide, with hollow leaf stalks. Upper leaves are alternate and decrease in size with height. The leaf margins are toothed or wavy. Flowers occur in clusters on short stalks scattered along the stem. They are purple and less than 2.5 cm wide. When the flower heads mature they have hooked spines that cling to clothing or animals. The seedlings form rosettes with large heart shaped leaves, and the plant closely resembles rhubarb.

Similar Species
Great burdock (*Arctium lappa*) is another regionally classified noxious weed that is very similar in appearance to common burdock. Great burdock is distinguished from common burdock by its solid lower leaf stalks and individual flowers greater than 2.5 cm wide. The flowers grow from longer stalks and in a flat-topped cluster.

Biology
Common burdock reproduces by seed. A mature plant can produce 6000-16,000 seeds. Mature seedheads or burs readily hook on to fur and clothing and are then distributed to different locations. Plants germinate in early spring and form a large rosette in their first year. Second year plants produces flowers from July to September. Seeds are usually mature by September.

Habitat
Common burdock is found at low to mid-elevations in both grasslands and forests. Wet riparian habitats are preferred with nitrogen rich, fertile soil. Other growing sites include disturbed areas along roadways, ditches, pastures and stream banks.

Management Options Summary

Biological
There are no biocontrol agents available for burdock.

Mechanical
Mowing or cutting the plant after the plant has bolted but before full flowering is effective at controlling seed production. Hand pulling or digging rosettes with a sharp spade will kill the plant as long as the top 5-8 cm of the root are removed (the growing tissue). If the plant has gone to seed, clip and bag the mature seed heads.

Dalmatian Toadflax

Linaria genistifolia spp. *dalmatica* (L.)

Legal Status

Classified as noxious within all regions of British Columbia. Listed by the Forest and Range Practices Act as an invasive plant, and by the Community Charter as an alien invasive plant species.

Identification

Dalmatian toadflax is a perennial herb. It has a deep taproot that can penetrate up to one metre into the soil. As well, lateral roots can reach several metres in length. Stems grow upright between 0.6-1.2 m tall. One plant can have 1-25 stems. The leaves are waxy, green, and narrowly heart shaped. Leaves clasp the stem and are generally crowded. Vibrant yellow, snapdragon-like flowers are 2.5-4 cm long, and are located along the upper stems. The fruit are egg-shaped and the seeds are slightly winged and angular.

Similar Species

Yellow toadflax (*Linaria vulgaris*), another invasive plant, is very similar in appearance to Dalmatian toadflax. Both species invade similar habitats, and can be difficult to distinguish. Yellow toadflax is generally smaller with more pointed, linear leaves.

Biology

Dalmatian toadflax reproduces by seed and vegetative propagation. Vegetative reproduction is common from root buds on lateral roots and small root fragments. One mature plant can produce up to 500,000 seeds, which remain viable for up to 10 years. Seed are dispersed by passing through the digestive system of animals, carried by birds, or hitching a ride on various passers by.

Individual plants live up to five years; life span depends on environmental conditions and the reproductive success of individual plants. Toadflax plants begin emerging in the late winter – early spring, depending on temperature. The first year, the plant will develop a rosette and root system. Later in fall, an upright, leaved stem will grow, but no flowers or seeds will develop. Flowering occurs in the plant's second year from May-August and seeds mature from July-October.

Habitat

Dalmatian toadflax will grow in most dry, open sites including open forest from low to mid elevations. It is most commonly found on sandy or gravely soil on roadsides, railroads, pastures, cultivated fields, rangelands and clear cuts. While toadflax can rapidly colonize disturbed or cultivated ground, plants can also invade healthy native plant communities. Dalmatian toadflax is a strong competitor, quickly colonizing open sites, and adapting to a wide range of environmental conditions.

Management Options Summary

Biological
There are five biological control agents in use in British Columbia:
1. *Brachypterolus pulicarius* – shoot and flower eating beetle
2. *Calophasia lunula*- defoliating moth
3. *Eteobalea intermediella* – root-boring moth
4. *Mecinus janthinus* – leaf and stem eating beetle
5. *Rhinusa antirrhini* – seed eating weevil

Populations of *Mecinus janthinus* are well established in the province and significant reductions of Dalmatian toadflax have been documented.

Mechanical
Hand pulling plants before seed-set at sites where small or new populations occur has proven successful. This method has been especially effective in newer infestations where a seed bank has not yet developed. Hand pulling should be repeated annually.

Mowing or cutting the plants can control or reduce seed production; however, it will not kill the plant. Cutting at the base of the plant can be more effective than mowing. Mowing generally does not cut the stems low enough to stop the plant from re-sprouting from the remaining stocks. These methods should be completed before the plant goes to seed, and should also be repeated annually until the seed bank is depleted.

Hoary Alyssum

Berteroa incana (L.) DC.

Legal Status
Classified as noxious within the Regional District of Kootenay-Boundary. Listed under the Forest and Range Practices Act as an invasive plant, and under the Community Charter as an alien invasive species.

Identification
Hoary alyssum is an annual, biennial or perennial. The entire plant (stem, leaves, and seed pods) is covered in small star-like hairs. Born from a slender taproot, the stems grow upright and branched (0.3-1.1 m tall). Leaves are grey, elliptically shaped and point upwards facing the stem. Lower leaves (3-5 cm) are on small stalks, while the upper leaves are smaller and stalkless. Small white flowers (4-6 mm) are found on the end of stem branches; petals are deeply notched. Along the stem and below the flower are many flattened, oval seed pods that are held close to the upper stems. The seed pods are 5-8 mm long, and contain multiple chambers of 3-7 seeds.

Similar Species
Pale alyssum (*Alyssum alyssoides*), desert alyssum, (*Alyssum desertorum*) and wall alyssum (*Alyssum murale*) all have a similar appearance to hoary alyssum and are all non-native. However, these species usually grow smaller, and have smaller seed pods that are at most 4 mm long. The size of the seed pod helps to distinguish the other *Alyssum* sp. from hoary alyssum, which has larger seed heads (5-8 mm long).

Biology
Hoary alyssum reproduces by seed. Rosettes form in early spring. Flowering and seed production is drawn out through the season. Flowers first being forming in lat spring and continue through summer to fall. Seed production occurs from July to October. Plants that act as a perennial overwinter as a rosette. Hoary alyssum is toxic to livestock, and horses are especially sensitive.

Habitat
Hoary alyssum is most common in dry agricultural areas. It favours dry sandy or gravely soils of meadows, hayfields, pastures, and dry open fields. It also grows well on dry, disturbed sites including roadsides, embranchments, and railway tracks.

Management Options Summary

Biological
There are no biocontrol agents available for hoary alyssum.

Mechanical
Small infestations can be killed by hand pulling or dug out prior to seed-set. To control seed production mowing can also be effective; however, mowing will stimulate the plants to put down a larger root and survive longer.

Hoary Cress
Cardaria draba

Legal Status
Listed under the *Forest and Range Practices Act* as an invasive plant, and under the *Community Charter* as an alien invasive species.

Identification
Hoary cress is a perennial herb. It has a branched top ending in numerous white flowers. The plant grows to 0.1-0.6 m tall. The leaves are arranged alternately on the stem, are blue-green in colour, and lance-shaped. The lower leaves are stalked and covered in small hairs, while the upper leaves that surround the flowering head lack hairs. Numerous small, white flowers with 4 petals occur at the ends of branches. There are two seeds per flower produced, and seeds are heart-shaped and reddish brown in colour. The roots are rhizomatous and can penetrate the soil down to 0.8 m.

Similar Species
The lens-podded and globe-podded hoary cress (*Cardaria chalepensis* and *Cardaria pubescens*), perennial pepperweed (*Lepidium latifolium*) and the rosettes of gumweed (*Grindelia squarrosa*) are similar and found in similar habitats.

Biology
Hoary cress reproduces by both seed and vegetative roots. A mature plant can produce as many as 4,800 seeds per plant. Many seeds fall and remain close to the parent plant, but the wind can carry them far away.

Habitat

Hoary cress can be found growing at low- to mid-elevations in open and unshaded areas. The perennial roots prefer alkaline soils that are wet in the late spring, like fields, meadows, pastures, croplands, disturbed areas, and along roadsides.

Management Options Summary

Biological
Sheep are thought to be able to manage hoary cress populations. There are no known insect bioagents available for hoary cress.

Mechanical
Mowing hoary cress several times a year for successive years can decrease the spread and cut seed production. Mowing should be performed during the early bud stage and repeated when the plants re-bud.

Hound's-Tongue
Cynoglossum officinale (L.)

first-year rosette

mature seeds

Legal Status
Provincially classified as noxious within all regions in British Columbia. Listed by the *Forest and Range Practices Act* as an invasive plant, and by the *Community Charter* as an alien invasive species.

Identification
Hound's-tongue is a biennial or short-lived perennial herb with a woody taproot. The upright stem, or stems, grow to 0.3-1.2 m tall and are usually branched. The first year rosette or basal leaves are narrowly elliptic or lance shaped, and taper towards the stalk (10-30 cm long). The stem leaves are alternate, stalkless and gradually reduce in size up the stem. All leaves are rough and hairy lacking lobes or teeth. Rosette leaves resemble a dog's tongue. Dull, purple-red flowers (one centimetre wide) occur in the upper stems at the leaf axils. Each flower produces four nutlets (seeds) that spread wide open when mature. The seeds are triangular to round, grey-brown, and covered in small hooked burrs.

Similar Species
Northern hound's-tongue (*Cynoglossum boreale*) is a native, uncommon plant in the province. The plants are similar looking; however, northern hound's tongue is generally smaller (40-80 cm) with a single, naked upper stem.

Biology
Hound's-tongue reproduces by seed. A mature plant can produce up to 2,000-4,000 seeds each year. Seeds easily cling to the fur of wildlife, livestock, and human clothing, potentially leading to long distance dispersals. Seeds left on the parent plant can be viable for 2-3 years, while seeds in the soil usually survive less than a year. Many seeds fall from the parent plant a few months after they mature, and germinate beneath the parent plant. In its first season, the plant forms a rosette, which dies back after frost. Over the winter, the plant survives as a taproot. In its second year and possibly subsequent years, the plant will bolt and flower. Flowers bloom from May through July.

Habitat
In British Columbia, hound's-tongue grows from low-mid elevation forests. It is associated with soil disturbances, often occurring in 'waste' areas including logging roads and heavily grazed areas, disturbed woods and forest clearings and waterways. The plant is shade tolerant, but grows best in full sunlight given access to sufficient water and nutrients.

Management Options Summary

Biological

Currently one biocontrol is being used with encouraging results in the province. *Mogulones cruciger* is a root-mining weevil. This agent was widely released throughout the Okanagan-Similkameen in 2005-2007. Research also continues on other specialized agents, including two indigenous diseases: one that causes mildew and another that causes brown lesions on the leaves.

Mechanical

Hand pulling and hoeing can be effective for small populations, but must be conducted before the plant sets seed. First-year hound's-tongue plants are difficult to control by aboveground cutting, as nutrient reserves of the taproot allow defoliated plants to survive. Plants that are defoliated at the rosette stage may delay flowering for a year, and thus result in a larger plant with a greater seed output. Mowing or clipping second year plants can reduce seed production, however timing is critical; plants must be cut after plants have fully bolted and the first flowers have formed, but prior to seed production.

Russian Knapweed

Acroptilion repens

Legal Status
Listed under the *Forest and Range Practices Act* as an invasive plant, and under the *Community Charter* as an alien invasive species.

Identification
Russian knapweed is a perennial forb. The plant has branched stems and grows to 0.45-1.0 m tall. The leaves on Russian knapweed are alternately arranged. Leaves on the lower stems are narrow, oblong to lanceolate, and lobed. The upper leaves are oblong, toothed and become gradually smaller towards the inflorescences. Rosette leaves are lance-shaped, tapering at both ends with the broadest part at the tip. The plant has numerous light pink to purple flowers in small pearly bracts with papery margins that are slightly hairy at the tip. The seeds are greyish or ivory, oval and compressed in shape. Seeds have long white bristles at the tip when young, but these fall from the seed as it matures. The rootstock of this plant is long and creeping.

Biology
Extensive creeping rootstocks are the main mode of reproduction for this plant. A mature plant can produce as many as 1,200 seeds per year.

Habitat
Russian knapweed can be found growing in roadsides, riverbanks, irrigation ditches, pastures, clear-cuts, cropland, and disturbed areas. The perennial roots prefer clay soils. However, they do occur in other soil mediums.

Management Options Summary

Biological
Competition with native perennial grasses has been found to decrease infestations. *Subanguina picridis* (a species of nematode) has been experimented with as a biocontrol agent in BC and Colorado but is not available for general distribution (Weeds BC). Seeding an area infested with Russian knapweed has been found to decrease with fall planting of native bunchgrass.

Mechanical
Removing the top portion of the plant can decrease seed production, but since Russian knapweed reproduces best by creeping roots, the plant will not die. However, multiple cuttings of the infestation need to be made to stress the rootstock into decreasing its height and seed production.

Scotch Thistle

Onopordum acanthium (L.)

Legal Status
Classified as noxious within Regional District of North Okanagan. Listed under the *Forest and Range Practices Act* as an invasive plant, and under the *Community Charter* as an alien invasive species.

Identification
Scotch thistle is a biennial herb with a thick fleshy taproot. It has large, numerous, branched stems that can grow upright, between 1.5-3 m tall. The stems have broad spiny wings and woolly hairs. The leaves are large, with irregular lobes covered in yellow spines. Rosettes can have very large leaves up to 60 cm long and 30 cm wide. All leaf surfaces are covered in a mat of woolly hairs, which give the plant a greyish-green colour. Violet flower heads are large (2.5-5 cm wide) and numerous. The tips of the bracts are spiny.

Similar Species
Most closely resembles the native wavy-leaved thistle (*Cirsium undulatum*) but this indigenous plant is much shorter and lacks the spiny wings on the stem.

Biology
Reproduction is entirely by seeds, which spread primarily by wind. Scotch thistle spreads rapidly, producing 70-100 flowering heads per plant, each of which contains 100-140 seeds. A large rosette is formed during its first year of growth, and develops into a tall, spiny plant in the second year. Flowers bloom from mid-June to September. Seeds in the soil may remain viable for up to 30 years.

Habitat
In British Columbia, suitable habitat includes low elevation roadsides and disturbed areas, as well as irrigation ditches and rangelands. Germination is particularly successful in moist areas adjacent to riparian sites, streams, or irrigated lands.

Management Options Summary

Biological
There are no biocontrol agents available for Scotch thistle in BC.

Mechanical
Digging up the taproot can control first-year plants. Mature (second year) plants may be cut at ground level, or preferably 2.5-5.0 cm below the ground to ensure that the growing tissue is removed. Plants can re-grow from cut stems or roots and eventually produce seed; therefore follow up treatments should be conducted. If plants have already produced seeds, cut stems must be bagged and disposed of at the landfill.

Sulphur cinquefoil
Potentilla recta (L.)

Legal Status
Classified as noxious within the Regional District Okanagan-Similkameen. Listed by the *Forest and Range Practices Act* as an invasive plant.

Identification
Sulphur cinquefoil is a member of the rose family (Rosaceae), and is one of over 20 herbaceous cinquefoils in BC. It is a long-lived perennial with a large woody taproot. Plants grow upright with one or more hairy stems, reaching heights of 15-70 cm. Leaves are divided into 5-7 hairy toothed leaflets, each 5-10 cm long. Flowers are pale yellow with five heart-shaped petals around a bright yellow centre.

Similar Species
Sulphur cinquefoil most closely resembles graceful cinquefoil (*Potentilla gracilis*), a native plant which is shorter; has white woolly hair on the undersurface of the leaves; more basal leaves; deeper, less uniform leaf serrations; bright yellow flowers; and a smooth seed coat.

Biology
Sulphur cinquefoil grows very early in the spring from a woody root. The plant begins blooming in mid-June and produces flowers throughout the summer if growing conditions are favourable, until setting seed in late July. Aboveground portions of the plant completely desiccate by late August. Fall re-growth of basal leaves is possible and rapid under moist, mild conditions. Although sulphur cinquefoil reproduces primarily by seed, it also has an unusual method of vegetative reproduction. Annual re-growth each spring causes individual plants to become several closely spaced, independent plants. Each year new shoots appear on the outer edge of the woody roots. The old, central root eventually rots away and can completely disintegrate within 6 to 8 years. The remaining living portions form a ring-shaped clump composed of several new individuals.

Habitat
Sulphur cinquefoil infests disturbed areas, meadows, pastures and rangelands and can dominate a site within two to three years of first appearance.

Management Options Summary

Biological
No biological controls have been approved for sulphur cinquefoil in North America, but surveys for agents have begun in Europe.

Mechanical
Individual plants and small patches of sulphur cinquefoil can be hand-pulled. This treatment is effective only when the upper portion or crown of the root system is removed. Sulphur cinquefoil is not controlled by mowing. Although seed production may be reduced, plants develop low, bulky, spreading roots when mowed and are able to send up new shoots. Sulphur cinquefoil is not a serious weed in crop-land because it does not tolerate frequent cultivation. However, a single cultivation may increase sulphur cinquefoil cover.

APPENDIX C
Detailed information on Potential Rehabilitation Sites

Site Number	Location along Greenspace	General Notations	Rehabilitation Recommendations	Likelihood of Success
ES01	North	various small, cleared areas along narrow riparian strip could be planted to native species; weeds must be removed before planting	plant exclusively with riparian species, such as alder, red-osier dogwood, maple, snowberry, rose	Moderate
ES02	Central located at 4th street	heavily disturbed; weeds include alfalfa, diffuse knapweed, tree-of-heaven; weeds must be removed (or trees thinned) prior to any plantings; likely high seed bank so future weed removal will be necessary	potential for real showcase but requires significant effort; soil amendments will be required; parking area needs to be clearly delineated and planting scheme developed due to size of area; investigate potential for watering plants; could plant with diverse mix of dryland and riparian species	Moderate
ES03	Central/South across from #10715 Okanagan Centre Rd	recently cleared site ~105 m2	could plant both dryland and riparian species such as snowberry, rose, golden aster, bluebunch wheatgrass	High
ES04	South	exposed soils; site ~ 200 m2	could plant both dryland and riparian species such as saskatoon, Oregon grape, snowberry, rose, golden aster, pasture sage, bluebunch wheatgrass	High
ES05	South	exposed soils; weeds must be removed prior to any plantings; ~ 200 m2	could plant both dryland and riparian species such as saskatoon, Oregon grape, snowberry, rose, golden aster, pasture sage, bluebunch wheatgrass	High
ES06	South	location of large ponderosa pine stump; ~ 20 m2	will require soil amendments; could plant both dryland and riparian species such as Oregon-grape, snowberry, rose, saskatoon, bluebunch wheatgrass	High
ES07	South across from #10145 and #10125 Okanagan Centre Rd	location of culvert; site is eroding; appears to have been seeded but limited germination; chicory, sweetclover, western salsify, mullein, cheatgrass and diffuse knapweed are present; ~225 m2	need to formally establish a walkway; rehabilitation should focus on dryland species and soil amendments will be required; should also seed a drought tolerant grass mix; species could include bluebunch wheatgrass, pasture sage, golden aster, wormwood, saskatoon, rabbitbrush, ponderosa pine	Moderate
ES08	South	recently cleared path through shrubs; erosion is already evident;	not necessary for trail to remain open, as there is already established trail ~ 10 metres away; planting species should include Oregon grape, rose, snowberry	High
ES09	South	area opened up by tree falling and has also been used as a beach, so somewhat disturbed; variety of weeds including cheatgrass, diffuse knapweed, western salsify, mullein, vetch, sweetclover; several patches of poison ivy in vicinity, so need to be careful when planting	need to increase tree and shrub cover; could plant with ponderosa pine, snowberry, rose, Oregon grape and dogbane	High
ES10	South	cleared site dominated by sweetclover; weeds must be removed prior to any plantings; likely high seed bank so future weed removal will be necessary; site ~300 m2	plant with predominantly riparian species such as ponderosa pine, Oregon-grape, snowberry, rose, dogwood, alder, maple	Moderate

APPENDIX D
Photographic Log of Sites with Exposed Soil


ES01


ES01

ES02

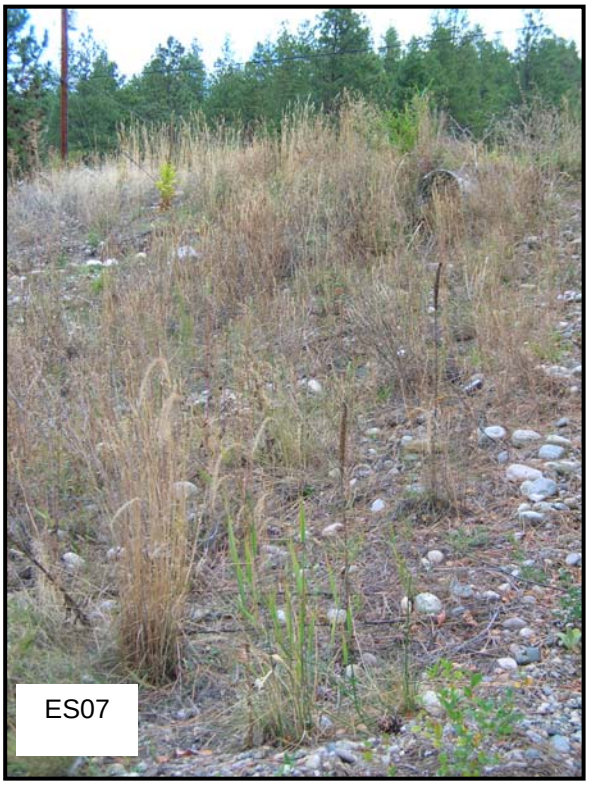

ES02

ES03

ES04

ES05


ES06


ES07


ES07

ES08

ES09

ES10