Glenbrook Ravine Park Invasive Plant Management Plan



City of New Westminster
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Submitted to:

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Table of Contents

ACKNOWLEDGEMENTS III

EXECUTIVE SUMMARY 1

1.0 INTRODUCTION 3

1.1 What are invasive plants? 3
1.2 Purpose and Goals 3
1.3 Consultation & Community Engagement 4

2.0 CONTEXT 5

2.1 Land Use & Ownership 5
2.2 Ecology 5

3.0 SITUATION ASSESSMENT: INVASIVE PLANTS 7

3.1 Abundance and Distribution 7
3.2 Impacts on the Ravine 9
3.3 Sources and Modes of Spread 10
3.4 Management Activities to Date 10

4.0 MANAGEMENT PLAN 11

4.1 Detect 11
4.2 Prevent 12
4.3 Restore 15
4.4 Engage 18
4.5 Sustain 20

5.0 SUMMARY OF ACTIONS 21

6.0 REFERENCES 24

APPENDIX 1 SUMMARY OF STAKEHOLDER WORKSHOP 25

APPENDIX 2 GLENBROOK STREAM: HISTORIC MAP AND AERIAL PHOTO 30

APPENDIX 3 GLENBROOK RAVINE PARK INVASIVE PLANT SURVEY 31

APPENDIX 4 INVASIVE PLANT PHOTOS 32

Appendix 4.1 Species present in Glenbrook Ravine Park 32
Appendix 4.2 Species not present in Glenbrook Ravine Park: watch list 36

APPENDIX 5 RESOURCES 42

List of Tables

Table 1. Invasive plant species present in Glenbrook Ravine Park 8
Table 2. Impacts posed by invasive plant species (in addition to ecological impacts) in Glenbrook Ravine Park 9

Table 3. Invasive plant control priorities in Glenbrook Ravine Park....16
Table 4. Summary of Actions....21
Table 5. Invasive plant species present in Glenbrook Ravine Park....32
Table 6. Invasive plant 'watch list' for Glenbrook Ravine Park....36

List of Figures

Figure 1. Stages of invasive plant invasion. 7
Figure 2. Photo of notes taken at community stakeholder workshop, February, 2019....25
Figure 3. Historic City map showing location of Glenbrook Stream. 30
Figure 4. Aerial photo of Glenbrook area 1949 (left) compared with imagery from 2015 (right)....30

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- Participants of the February 2019 community stakeholder workshop
- Participants of the April 2019 staff engagement meeting
- The City's Environment Advisory Committee

Consulting Team

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Executive Summary

Glenbrook Ravine Park has been identified as one of New Westminster's key natural areas and is considered important in terms of its ecological significance and contribution to biodiversity. It is cherished by the local community as one of relatively few intact natural areas in the City. Over the years it has become heavily occupied by invasive plant species which jeopardize the future health and function of the native vegetation community as well as the enjoyment and safety of park users. The control of invasive plants and the re-establishment of native plant species were identified as recommendations in the City's Ecological Inventory Report (2015).

This Plan builds on the dedicated stewardship efforts of community volunteers by providing a strategic and coordinated approach to invasive plant management and ecological restoration. It is an opportunity to define goals, short and long-term actions, roles and responsibilities, and potential costs. The plan is a pilot project for the future development of a City-wide Invasive Plant Management Strategy, which was a recommendation in the City's Environmental Strategy and Action Plan (2018).

The Plan recommends 27 actions which align with five goals identified in the Plan:

1. **Detect** invasive plants early and accurately
2. **Prevent** the introduction and spread of invasive species through increased awareness and education
3. **Restore** the integrity and function of native ecosystems by control of invasive plants and planting native vegetation
4. **Engage** with staff and community stakeholders to foster collaboration, stewardship, and a sense of community
5. **Sustain** long term support, funding and ecological benefits

The highest priority actions include:

- Support long-term funding, staffing and resources for ongoing invasive plant management and restoration.
- Develop an annual work plan for invasive plant control, restoration activities, maintenance, and monitoring.
- Continue to provide opportunities for stewardship partners to work in the Ravine.
- Maintain regular communication with community stakeholders.
- Engage staff and key stakeholders to ensure all are aware of the goals and actions associated with the plan and provide opportunities for them to play an active role.

- Provide regular opportunities for community volunteers, staff and contractors to learn about invasive plants, spread prevention, and best practices for management.

- Educate property owners about the consequences and cost of illegal green waste dumping, and proper disposal options.

- Use signage in the park to raise awareness about invasive plants and highlight local stewardship efforts.

1.0 Introduction

1.1 What are invasive plants?

Invasive species are those that occur outside of their natural range and have significant ecological, social, and/or economic impacts once established. Introduced (i.e., exotic or non-native) plants are common in our landscapes. Most are either unable to adapt to local conditions or, if they do establish, do not cause significant impacts. However, a minority of introduced species are considered invasive because they are able to flourish and spread rapidly in the absence of natural predators and other controls. Climate change is expected to increase our region's vulnerability to the arrival and spread of new invasive species (IUCN, 2017).

SOCIAL IMPACTS	ECOLOGICAL IMPACTS	ECONOMIC IMPACTS
• Pose health and safety risks for humans and domestic animals • Alter and degrade valued landscapes and view corridors • Impede recreation access	• Reduce biodiversity and alter ecosystem function • Reduce wildlife habitat and forage • Increase vulnerability of species at risk	• Damage critical infrastructure (drainage systems, roads, building foundations, etc.) • Increase maintenance costs

Invasive plants spread by a variety of means including horticultural activities, improper disposal of green waste, soil transfer, water movement, wind, and by hitching a ride on vehicles, people, equipment, animals, and birds (ISCBC, 2017). Once established, invasive species are difficult and costly to control because they are very effective at dispersing, establishing, and reproducing.

Successful invasive species management requires a long-term approach. Some invasive plants have long-lived seeds or deep roots that require monitoring and treatment over many years to ensure they are eradicated. In addition, new species are introduced and new infestations develop or expand. This strategy addresses both short- and long-term actions for managing invasive species in Glenbrook Ravine Park.

1.2 Purpose and Goals

The recently adopted Environmental Strategy & Action Plan has a goal to protect and restore the ecological integrity, biodiversity, and connectivity of natural areas and has identified the need to minimize, reduce, and eliminate invasive species via the development of a city-wide invasive species management plan (Action 13.5a). Controlling invasive species was identified in the Urban Forest Management Strategy (2016) and in the City's Ecological Inventory (2015). In 2018 the Environmental Grant Subcommittee noted the need for the City to develop a long-term plan for Glenbrook Ravine Park to ensure the upkeep of the restoration work previously implemented at the site.

The **purpose** of this Invasive Plant Management Plan is to create a strategic plan for the management of existing invasive plant infestations within Glenbrook Ravine Park and to provide direction for the prevention and management of new infestations. The strategy will build on community stewardship

activities and staff management activities already taking place in the ravine, creating greater efficiencies and stability to move this work forward. It will foster communication, consistency, and cooperation in management actions among all staff, community volunteers, and stakeholders in and adjacent to the park. This plan is a pilot project providing a blueprint to replicate for other natural areas in the City.

The **goals** of the Glenbrook Ravine Park Invasive Plant Management Plan are to:

1. **Detect** invasive plants early and accurately
2. **Prevent** the introduction and spread of invasive species through increased awareness and education
3. **Restore** the integrity and function of native ecosystems by control of invasive plants and planting native vegetation
4. **Engage** with staff and community stakeholders to foster collaboration, stewardship, and a sense of community
5. **Sustain** long term support, funding and ecological benefits

1.3 Consultation & Community Engagement

This plan has been developed in consultation with community members, stakeholder groups[1], an interdepartmental team of staff, the Invasive Species Council of Metro Vancouver and Diamond Head Consulting.

A world café type participatory community stakeholder workshop was attended by 25 people on February 21, 2019. Information gathered at the workshop is provided in Appendix 1. The objective of the workshop was to discuss the following:

1. Park history: what's been happening in the ravine.
2. Concerns and challenges in the ravine.
3. Opportunities, solutions and priorities for management.

Staff provided input at an inter-departmental meeting held in April 2019. Staff discussed concerns and opportunities with regard to prevention of invasive plant introduction and spread, and restoration. Many of the ideas brought forth will help form a work plan to implement the recommendations in this plan.

[1] Stakeholder groups included Douglas College staff, Metro Vancouver, New Westminster Environmental Partners, New Westminster Gardening Society, and local residents.

2.0 Context

2.1 Land Use & Ownership

Glenbrook Ravine Park is the traditional territory of the Qayqayt First Nation. The indigenous village of Skiametl is believed to have been located nearby along the foreshore between the historic Glenbrook River and the Brunette River. The ravine was first logged sometime in the 1800s and is likely to have been logged again in the 1900s based on the age of the current forest stand. The main watercourse (formerly known as Glen Brook or Glenbrook stream [2]) was piped underground starting in 1915. Appendix 2 provides a historic stream map and aerial photo. The ravine was historically inaccessible due to the nearby presence of the B.C. Penitentiary (1878-1980). From the 1980s onwards residential subdivisions were built surrounding the ravine and parts of the ravine were used to dump construction materials. This is particularly evident on the northeast side midway up the ravine where steep mounds of soil are now occupied by Himalayan blackberry and very few trees. From the 1980s to the 1990s the ravine was home to an unofficial children's nature playground complete with treehouses and pathways.

Today the ravine is cherished as one of New Westminster's few remaining natural areas. It is well used by residents, particularly by walkers and joggers. There is a maintained trail extending the length of the ravine with several side trails to allow various access points. At the southern end of the park there is a public garden and pond adjacent to the amenities building and parking lot.

Currently the City owns the lower half of the ravine while the upper half is privately owned. The amenity center at the south end of the park is also privately owned. Metro Vancouver has a sewage system right-of-way running the length of the ravine bottom, beneath the ephemeral watercourse.

2.2 Ecology

2.2.1 Terrain

Glenbrook Ravine Park is a relatively narrow ravine corridor with very steep sides, oriented northwest to southeast. Some sections of the upper ravine are steep enough to be considered cliffs. There is evidence of slope failure and sloughing along the upper sections of the southern ravine wall. The ravine bottom is gently to moderately sloped.

2.2.2 Watercourses and Wetlands

Since Glenbrook stream was piped underground in the early 1900s, all that remains is a small, stormwater-fed ephemeral watercourse flowing through the center of the park. Most water flow is diverted into the stormwater system at its southern end. A small forested wetland exists at the northwestern end of the park as indicated by the presence of skunk cabbage.

[2] Lost Streams of New Westminster, Stephen Ward (2015)

2.2.3 Native Vegetation

Glenbrook Ravine Park is a forested natural area. The forest is an even-aged deciduous stand with low structural diversity. Dominant tree species are red alder and bigleaf maple. Minor amounts of black cottonwood, Douglas-fir, and western redcedar also occur. The forest has a well-developed native shrub community dominated by Indian plum and salmonberry with lesser amounts of other species including vine maple, snowberry, and sword fern.

The alder dominated stand is typical of a young, early seral stage coastal forest that occurs after major disturbance (i.e. logging). Over time natural succession should gradually transition the forest to be conifer dominated; however, there is virtually no understory regeneration of conifer trees at Glenbrook. This is primarily due to a lack of mature conifer trees in the areas to act as a seed source (Ettinger, Lee, & Montgomery, 2017); invasive plant cover may also play a role. Therefore, as is common for urban natural areas in the region, the long-term viability of the forest at Glenbrook is threatened because of low conifer tree recruitment and a forest composed of short-lived deciduous pioneer species (Elman & Salisbury, 2009). Natural forest succession has been interrupted and is unlikely to get back on course without intervention.

2.2.4 Fish and Wildlife

Wildlife present are typically smaller species with reduced range requirements and those that are adapted to urban areas. The forest habitat provides low structural diversity with no large conifer trees or wildlife trees of significant value. Mammals that depend on the ravine for habitat and food include:

- Coyote
- Raccoon
- Striped skunk
- Eastern grey squirrel (introduced)
- Mice
- Voles
- Moles
- Shrews

No wildlife surveys have been conducted to confirm the presence of these or other species in the ravine. In addition, the park provides habitat types that are suitable for a wide variety of both resident and migratory bird species, including owls and songbirds. The wetland at the northwestern end of the forest could potentially provide breeding habitat for amphibians. No fish are supported by aquatic habitat in Glenbrook Ravine Park.

Historically, as part of a larger intact regional ecosystem, the park would have supported large mammals including deer, bears, bobcats, and cougars.

The Ecological Inventory (2015) did not identify any species or ecosystems at risk in the ravine.

3.0 Situation Assessment: Invasive Plants

3.1 Abundance and Distribution

There are three stages of plant invasion (Figure 1):

1. **Introduction**. During the introduction stage the species occurs at relatively low levels of infestation. Populations are small and consist mainly of individual plants. Eradication at this stage is often feasible.
2. **Colonization**. The second phase of invasion is known as colonization, during which the plant begins to spread (patch expansion) and disperse over short distances. As infestation size increases eradication is more difficult, however it is feasible to contain infestations using various mechanical methods to prevent further spread.
3. **Proliferation**. The third stage, proliferation, occurs when the species disperses over long distances and becomes abundant across the landscape. At this stage, infestation size is large and widespread, and it is only feasible to control (treat) the species at specific sites to reduce impact on valued land or assets.

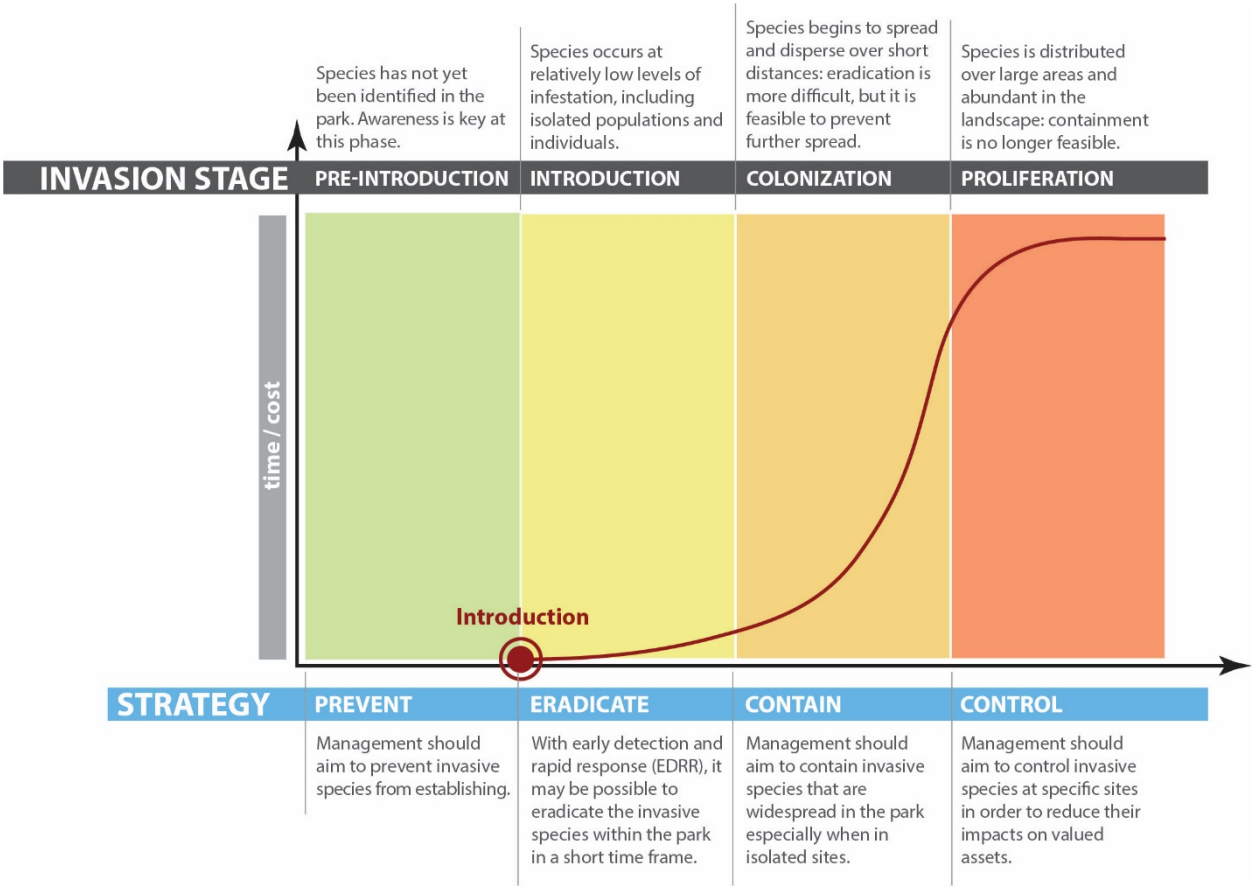


Figure 1. Stages of invasive plant invasion.

To determine the abundance and distribution, and the corresponding stage of invasion of invasive plant species in Glenbrook Ravine Park, Diamond Head Consulting undertook an invasive plant inventory in the winter of 2019. The resulting map is in Appendix 3. Photos of the species are included in Appendix 4.1. Although herbaceous species were dormant, the timing of the survey improved detection of evergreen invasive plant species which dominate the ravine. The survey provides a baseline inventory which can be used to guide restoration activities and monitor future progress. A summer survey is recommended to add herbaceous species.

Invasive plants cover approximately half of the ravine (5.2 ha). Table 1 provides a list of the species present and includes their stage of invasion and area of infestation.

Table 1. Invasive plant species present in Glenbrook Ravine Park

Stage of Invasion	Common Name	Scientific Name	Area
Introduction	Periwinkle	*Vinca minor*	100 m^2
	Spurge laurel	*Daphne laureola*	28 m^2
	Knotweed* (bohemian or Japanese)	*Fallopia x bohemica* *Fallopia japonica*	20 m^2
	Scotch broom	*Cytisus scoparius*	1 m^2
	Hedge bindweed (morning glory)	*Calystegia sepium*	**
Colonization	Yellow archangel	*Lamiastrum galeobdolon*	1,300 m^2
	Cherry laurel	*Prunus laurocerasus*	540 m^2
	Clematis	*Clematis vitalba*	500 m^2
	English holly	*Ilex aquifolium*	140 m^2
Proliferation	English ivy	*Hedera helix* *Hedera hibernica*	2.8 ha
	Himalayan blackberry	*Rubus armeniacus*	2.1 ha

* Not possible to distinguish between bohemian and Japanese knotweed without testing

** Not visible during winter survey

Stage 1: INTRODUCTION (5 SPECIES)

Periwinkle, spurge laurel, knotweed, Scotch broom and hedge bindweed are in the introduction stage of invasion: they are relatively rare in the ravine and eradication is a realistic goal if action is taken to remove them in the near future.

Stage 2: COLONIZATION (4 SPECIES)

Yellow archangel, clematis, cherry laurel and English holly are in the colonization stage of invasion. Eradication of these species may not be possible; however, control of further spread is feasible. Yellow archangel occurs at two prominent patches at either end of the ravine, including one within the forested wetland. Small occurrences of clematis occur throughout the ravine; however, there is one prominent patch in the southeast corner of the ravine where the vine has climbed many trees. Cherry laurel and English holly are distributed in low numbers throughout the ravine.

Stage 3: PROLIFERATION (2 SPECIES)

The two most prolific species are English ivy and Himalayan blackberry. These species are in the proliferation stage of invasion: eradication through any means (mechanical or chemical treatment) is out of the question at this stage. These plants will likely always exist in the ravine but can still be controlled to reduce their impact. English ivy is distributed throughout the forest stands. It is readily apparent through the ravine as the majority of trees in the ravine have ivy climbing up their trunks. Blackberry is also distributed throughout the ravine, most often occurring adjacent to trails. It is the only vegetation cover on several steep northeastern slopes midway through the ravine. This contiguous patch of blackberry is ~0.7 ha.

3.2 Impacts on the Ravine

The invasive plant species found in the ravine are common species found throughout the Metro Vancouver region. They represent the palette of invasive plant species typically present in local natural areas.

By nature, all of the invasive plant species cause ecological impacts; their dominance leads to a reduction in biodiversity and diminished ecosystem function through these affects (Zevit, 2017):

- Reduced light, moisture, nutrients and space for native species
- Loss of natural habitat for native insects, birds, and other wildlife
- Reduced forage potential for insects, birds, and other wildlife
- Changes to soil chemistry

In addition to adverse ecological impacts, several of the invasive plant species present in the ravine cause additional impacts. These are summarized in Table 2.

Table 2. Impacts posed by invasive plant species (in addition to ecological impacts) in Glenbrook Ravine Park[3]

Common Name	Impact	Description
Clematis	Canopy loss; hazard trees	Clematis adds weight and wind sail to tree canopies eventually weakening them leading to branch and/or tree failure (King County, 2018).
English holly	Impede recreation access; scratches & cuts volunteers; necessitates trail maintenance	Holly has sharp, spiny leaves. Sometime confused with native Oregon grape species (*Mahonia nervosa* and *M. aquifolium*)
English ivy	Canopy loss; hazard trees	Climbing ivy adds weight and wind sail to tree canopies eventually weakening them leading to branch and/or tree failure.
Hedge bindweed	Smother newly planted vegetation	Hedge bindweed is common on newly planted restoration sites. Uncontrolled, it will twine around young vegetation impeding establishment. (Mackenzie, 2019).
Himalayan blackberry	Impede recreation access; scratches and cuts	Blackberry canes are covered in large prickles.

[3] Information from Metro Vancouver's Invasive Species Best Management Practices unless otherwise stated.

Common Name	Impact	Description
	volunteers; necessitates trail maintenance	Canes can grow up to 7 m in a single season.
Knotweed	Jeopardize infrastructure; erosion risk; allelopathic	Knotweed rhizomes can damage concrete walls, pavement, bridge and building foundations and drainage works; and cause streambank erosion. Knotweed suppresses other plants from growing through release of biochemicals.
Scotch broom	Allelopathic; wildfire hazard	Scotch broom suppresses other plants from growing through release of biochemicals. The high oil content of broom makes it highly flammable.
Spurge laurel	Toxic	The berries, leaves, and bark are poisonous to humans, cats, and dogs. Handling the plant can cause contact dermatitis. (King County, 2019)

3.3 Sources and Modes of Spread

Invasive plants are likely to have first appeared during the period when the ravine was used as a construction waste dumping site. Since then it is likely that invasive plants have been inadvertently introduced and spread by a variety of means including:

- Expanding out from adjacent gardens and maintained landscape beds
- Illegal green waste dumping
- Hitching a ride on vehicles, equipment, people, and dogs
- Infested substrates (e.g. soil and gravel) imported from on and off-site
- Road and trail vegetation management (e.g., mowing)
- Dispersal of seed by wind, water, wildlife and birds

All but one of these vectors of dispersal (dispersal by wind, water, wildlife and birds) are human-caused and are avoidable through education, awareness, and improved practices.

3.4 Management Activities to Date

Beginning in the spring of 2017, spearheaded by community members, the first invasive plant removal events took place to target blackberry. These first few events were supported by funds raised through both the Neighbourhood Small Grant Program and RiverMarket ONE grants. Evergreen partnered with the City to provide support and guidance for the project and in 2018 New Westminster Environmental Partners (NWEP) joined by taking a lead role in fundraising, marketing and implementing restoration activities. The Invasive Species Council of Metro Vancouver (ISCMV) took over Evergreen's partnership and support role in 2018.

Various other stewardship activities have occurred in the ravine such as garbage clean-up and birdhouse installation by Girl Guides, and the removal of invasive plants by individual community members.

The City has used a licensed contractor to control knotweed (through herbicide application) at two known patches in the ravine since 2014. The locations are monitored annually as knotweed can re-sprout after many years of treatment.

The landscaped area around the Glenbrook Amenities Centre site is maintained by horticultural staff on a regular basis. City presence and regular care of this section of the ravine has led to sporadic removal of invasives mostly in this area (e.g., giant hogweed). Metro Vancouver maintains a right-of-way through the ravine and keeps it clear of vegetation on a regular basis.

4.0 Management Plan

The invasive plant management plan for Glenbrook Ravine Park provides a series of actions each tying into one of the five goals:

1. **Detect** invasive plants early and accurately
2. **Prevent** the introduction and spread of invasive species through increased awareness and education
3. **Restore** the integrity and function of native ecosystems by control of invasive plants and planting native vegetation
4. **Engage** with staff and community stakeholders to foster collaboration, stewardship, and a sense of community
5. **Sustain** long term support, funding and ecological benefits

4.1 Detect

4.1.1 Early Detection

The most effective control of invasive plants is achieved when they first arrive by using an approach called *Early Detection and Rapid Response* (EDRR). The cost of EDRR is miniscule compared to the cost of controlling an invasive plant that has established and spread. The province has an EDRR Plan which outlines how new invasive plant incursions that are of risk to BC can be quickly and effectively addressed[4].

There are invasive plant species which have already established in Metro Vancouver but are not present in the ravine. Early detection of these species in the ravine will enable removal before they have a chance to establish and spread. Appendix 4.2 includes a 'watch list' of invasive plants that could be introduced to the ravine. Most species are already present in our region.

ACTION 1: Devise a process for the City to respond to reports of new invasive plant occurrences in the ravine. Assign staff responsibility for confirming identification, mapping plant locations, and arranging appropriate treatment when necessary. Report occurrences of provincial EDRR species to the Provincial EDRR coordinator and stakeholder groups.

[4] Invasive Plant Early Detection and Rapid Response Plan for British Columbia. 2012.

ACTION 2: Prioritize monitoring and reporting of species on the Glenbrook Ravine Park 'watch list' (Appendix 4.2) and highlight these species in education and training. Share the list at stewardship events and distribute electronically.

4.1.2 Inventory

Spatial data on plant abundance and distribution provides the information required to make informed decisions regarding invasive plant management. The data can be used to identify problematic locations for invasive plant introduction, prioritize treatments, direct operations, and track change over time to measure success.

An initial inventory was carried out in the winter of 2019. This captured all evergreen invasive plant species. An inventory update is necessary to capture herbaceous invasive species not visible in the winter. This addition will complete the inventory in order to provide a comprehensive baseline inventory.

ACTION 3: Complete the baseline inventory with the addition of invasive herbaceous species during spring or summer months. Update the inventory every 5 years.

ACTION 4: Use the baseline inventory to keep track of invasive plant control and restoration activities as well as ongoing monitoring and maintenance at these sites.

4.2 Prevent

Preventing the introduction and spread of invasive plants is the most cost effective and efficient way to manage the problem. Increasing the awareness of the issue and providing education opportunities will allow park users, community volunteers, staff, contractors, and other agencies to all play a role in prevention.

4.2.1 Spread Prevention Practices

Everyone who uses and works in the ravine can take action to prevent the spread of invasive plants. Plant fragments and seed can easily be transported on clothing, gear, fur, vehicles, equipment, and in imported substrates. There is a provincial Best Practice guidebook that details prevention measures for parks and protected areas[5]. Below are key prevention measures categorized by activity.

INVASIVE PLANT SPREAD PREVENTION PRACTICES (by activity)

Recreation:

- Stay on trails
- Keep dogs on leash
- Check for soil, seeds and plant fragments on shoes, clothes, and gear at trailhead
- Refrain from picking or moving plants, flowers, or seed heads
- Follow all signage within the park including notifications of invasive plant treatments

[5] Best Management Practices for Invasive Plants in Parks and Protected Areas of British Columbia. 2011.

Invasive plant removal and restoration:

- Mitigate impacts to native plants and wildlife
- Retain native plants in removal areas to encourage natural regeneration and restoration
- Use best management practices for removal of the species in question
- Ensure that removal activities, including timing, disposal, etc., do not result in further spread or environmental damage
- Revegetate disturbed areas, ideally with native plants; invasive-free grass seed mixes can be used as a temporary measure before planting with native plants to prevent re-establishment of invasive plants
- Monitor removal and restoration sites for several years post treatment, and quickly treat any new invasive plants
- Ensure staff, contractors and community volunteers are properly trained and aware of best management practices so their activities are effective and do not inadvertently spread invasive plants or cause environmental damage

Imported materials (e.g. gravel, soil, mulch):

- Inventory site prior to importation and if possible, treat existing invasive plants
- Take steps to ensure that imported materials are free of invasive plants
- Monitor post-importation (one and three years' post-disturbance is recommended in the BC Parks BMPs[4])

Park/trail maintenance:

- Ensure all equipment, clothing, and gear is clean prior to entering trail (free of soil, seeds, and plant fragments)
- Stay on trails as much as possible
- Avoid unnecessary soil disturbance
- Take steps to ensure soil or gravel placed on trails are invasive plant free (e.g., do not move soil from areas where invasive plants exist and do not stockpile materials or store equipment near existing infestations)
- Monitor sites for invasive plants following site disturbance; the BC Parks Best Management Practices (BMPs) for Invasive Plants recommends monitoring one and three years post-disturbance
- Re-vegetate disturbed areas as quickly as possible following disturbance

Roadside, grass areas and right-of-way maintenance:

- Survey the mowing area first to understand where invasive plant infestations are located, and mark or sign problem areas as appropriate
- Evaluate infestations to determine if invasive plants should be left undisturbed to avoid further spread
- Start mowing in areas with no invasive plants and end in areas with the most invasive plants
- Mow at a height of 15 cm above ground level
- Do not mow invasive plants after they flower or have gone to seed

Site disturbance from construction:

- Identify invasive plants in the work area prior to site disturbance and incorporate measures to prevent spread into project (e.g., work in areas with invasive plants last so equipment can remain clean as long as possible)
- Treat invasive plants prior to disturbance or incorporate plant removal into project
- Ensure contaminated soil and plant parts are appropriately managed and disposed of to prevent spread
- Designate an area to clean equipment, monitor this area, and have a plan for treatment and

appropriate disposal of invasive plant material
- Use clean equipment at start of work
- Clean equipment periodically during projects to remove seeds and vegetative plant parts, especially where there are priority invasive plants present and before moving to a new area; clean equipment at end of project
- Re-vegetate disturbed areas as quickly as possible following disturbance
- Avoid using straw or hay for erosion control; if seed mixes are necessary, use invasive-free mixes, and obtain and check certificates of seed analysis from suppliers to ensure that seeds are not contaminated with invasive plants
- Monitor sites for invasive plants following site disturbance; the BC Parks Best Management Practices (BMPs) for Invasive Plants recommend monitoring one and three years' post-construction
- Ensure invasive plant priorities for monitoring and management are consistent with those in this plan

ACTION 5: Provide annual (regular) opportunities for staff and contractors to learn about invasive plants, spread prevention, and best practices that should be part of day-to-day park operations. Ensure all staff, contractors, and anyone involved in activities that could spread invasive plants (including Metro Vancouver) are trained in and are implementing prevention best practices.

ACTION 6: Provide annual (regular) opportunities for community volunteers to learn about invasive plants, spread prevention, and best practices. Ensure all volunteers involved in activities that could spread invasive plants are trained in and are implementing prevention best practices.

ACTION 7: Include prevention practices in management plans, project plans, work plans, park use permit conditions, and contract documents.

4.2.2 Landscaping and Green Waste

Many of the invasive plant species present in the ravine are horticultural species common in the gardens and landscaping surrounding the ravine. They are likely to have acted as sources for some of the infestations in the ravine. In addition, it is not uncommon for green waste to be dumped illegally in local parks and greenspaces, particularly expired hanging baskets. These actions contribute to the infestations in the ravine.

ACTION 8: Discourage planting of known invasive plant species, particularly those listed in Appendix 4, on City owned land, residential lots and new developments.
- Metro Vancouver has two resources available: Help Stop the Spread brochures and the Grow Green Guide.

ACTION 9: Educate property owners about the consequences and cost of illegal green waste dumping, and proper disposal options.
- Mail drops, signage at known dump sites, and information on the City's website are all ways to effectively communicate this message.
- The Hanging Basket Course and Fall Activity Learning brochure offer opportunities to communicate about the proper disposal of hanging baskets.

ACTION 10: Advocate that the Province bans the sale of invasive plant species by local nurseries and other plant vendors.

4.2.3 Communication Tools

New communication tools can be developed and existing tools can be enhanced to build public awareness and knowledge about invasive plants.

ACTION 11: Enhance the City's Invasive Species webpage by including the following information:

- How to report sightings of high-risk invasive species
- Individual and community involvement opportunities;
- Ecological impacts of illegal dumping of invasive plants;
- Alternative non-invasive garden species;
- How to get involved in stewardship work.

ACTION 12: Use signage in the park to raise awareness about invasive plants and highlight local stewardship efforts including:

- Permanent signage at the restoration site recognizing partners, explaining what is happening and how to get involved, including dates for future events.
- "Play, Clean, Go" signage (available through the ISCMV/ISCBC) at trailheads which includes a boot brush and information on key invasive plant species

4.3 Restore

The integrity and function of the Glenbrook Ravine Park ecosystem can be improved by controlling invasive plants, planting native vegetation, and carrying out other important ecological restoration activities.

Successful restoration planning considers the site ecology, biogeoclimatic site series classification (Green & Klinka, 1994) and successional seral stage of the site. The site series (moisture and nutrient regime) determines which native plant species are appropriate for a site. As previously discussed, the ravine is stalled in an early seral stage due to the lack of conifer seed sources. In order to ensure the tree canopy persists in the future, restoration must include planting and seeding with native conifer tree species (which are much longer lived than the current canopy of red alder and bigleaf maple) to help move forest succession along its natural progression.

4.3.1 Invasive Plant Control

The City takes an integrated pest management approach to controlling invasive plant species. This approach discourages reliance on pesticides and encourages a variety of tools and techniques for management. Prevention techniques and regular inspections are encouraged over repeatedly treating a pest. Alternate treatment methods such as manual (digging or cutting), or shading out are promoted, and herbicides are recommended for use only when other treatment methods have failed. The City's pesticide bylaw currently only permits the use of pesticide to treat knotweed because it is classified as a Noxious Weed under the BC *Weed Control Act*. All other invasive plant species must be controlled manually.

Table 3 outlines invasive plant control priorities for the ravine. Given the stage of invasion of blackberry and ivy in the ravine and the steep terrain, it is not feasible or realistic to attempt to eradicate all invasive plant

occurrences. The current stage of invasion and the relative risk posed by each species were considered in order to determine invasive plant control activities and priorities.

Community volunteers, staff, and contractors all have a role to play in carrying out invasive plant control. Volunteer activity is reserved for sites with relatively safe terrain. Any activity occurring on steep and/or treacherous, uneven terrain should be reserved for staff or contractors who can, where possible, complete the work using appropriate safety measures.

The control method varies depending on the species. Consult the appropriate Metro Vancouver Best Management Practice. If a Metro Vancouver BMP does not exist for a particular species, refer to the other BMP resources provided in Appendix 5.

Table 3 summarizes invasive plant control priorities and details who can do the work and the seasonal timing.

Table 3. Invasive plant control priorities in Glenbrook Ravine Park

Priority	Activity	Where	Who	When*
High	Chemically treat **Knotweed**	All occurrences	Certified Pesticide Applicators trained in knotweed treatment	Late spring to late fall
High	Manually remove climbing **English ivy** from tree trunks	Adjacent trails (easy, safe access) where vine diameter is small enough diameter to be cut with hand loppers	Community volunteers	Anytime
		All occurrences; large diameter vines that require a saw to cut	Trained staff or contractors	
High	Manually remove ground **English ivy**	New single occurrences adjacent trails (easy, safe access)	Community volunteers	When soil is moist (not dry or frozen)
High	Manually remove climbing **clematis** from tree trucks and dig out roots	Adjacent trails (easy, safe access) where vine diameter is small enough diameter to be cut with hand loppers	Community volunteers	Spring to fall when the plant has leaves
		All occurrences; large diameter vines that require a saw to cut	Trained staff or contractors	
High	Manually remove **Himalayan blackberry**	New single occurrences adjacent trails (easy, safe access)	Community volunteers	When soil is moist (not dry or frozen)
Moderate	Manually remove ground **English ivy**	Contiguous patches adjacent trails (easy, safe access)	Community volunteers	When soil is moist (not dry or frozen)
Moderate	Mechanically remove **Himalayan blackberry in advance of stewardship events**	Contiguous patches adjacent trails (easy, safe access)	Staff	When soil is moist (not dry or frozen)
Moderate	Manually remove	Contiguous patches adjacent trails	Community volunteers	When soil is

Priority	Activity	Where	Who	When*
	Himalayan blackberry	(easy, safe access)		moist (not dry or frozen)
Moderate	Manually remove **Scotch broom**	All occurrences	Community volunteers	When soil is moist (not dry or frozen)
Moderate	Manually remove **spurge laurel**	All occurrences	Trained staff or contractors wearing appropriate protective gear	When soil is moist (not dry or frozen)
Moderate	Manually remove **yellow archangel** and **periwinkle**	Occurrences at southern end of ravine	Community volunteers	When soil is moist; avoid periods of complete saturation
		Occurrences at northern end of ravine (including wetland)	Trained staff or contractors	
Moderate	**English holly** and **cherry laurel**	Adjacent trails (easy, safe access); Small and medium sized plants (under 10 cm diameter) in which entire root can be removed	Community volunteers	When soil is moist (not dry or frozen); late fall to late winter when plants are most visible
		All occurrences; large diameter plants (>10 cm diameter) that must be cut with a saw**	Trained staff or contractors	

* Always consider whether invasive plant removal could impact breeding birds during nesting season (March 15 to August 15). In cases of possible impact, carry out a nesting survey in advance of removals.

** When large diameter holly trees are cut, the most effective treatment is to paint the cut stem with herbicide, otherwise the roots will continue to send up dozens of new shoots for years to come.

4.3.2 Restoration with Native Vegetation

Any site with exposed, bare soil is at risk of colonization by invasive plants. Bare soil may be the result of invasive plant removal or natural or human caused disturbance. Depending on the degree of disturbance, restoration may be warranted to ensure native plant communities re-establish before invasive plants can colonize.

Important considerations of restoration planting include:

- Site appropriate plant selection
- Inclusion of tree species, particularly conifer species (e.g., as per Urban Forest Management Strategy goals and objectives)
- Stock size: larger stock will fill space more quickly but are initially more vulnerable to drought stress
- Planting density: shrub spacing is typically 0.75 – 1.0 m and tree spacing is typically 5 to 10 m, but exact spacing should be determined based on the species and site.
- Planting timing: typically fall to early spring is best for plant survival
- Application of mulch to retain soil moisture and suppress weed growth
- Addition of coarse woody debris to enhance microclimate conditions for plant growth and provide cover habitat for animals and insects
- Stabilizing slopes

- Erosion and sediment control measures

The South Coast Conservation Program developed Diversity by Design restoration planning guides which provide science-based guidance for stewards, land managers and practitioners.

4.3.3 Monitoring, Maintenance, and Adaptive Management

Monitoring is critical to measure the success. Monitoring for several years may be required to ensure control methods are effective and restoration plantings are successful. Monitoring will also help identify unforeseen responses to the control method or restoration plan and therefore must be conducted with adaptive management in mind. Adaptive management is especially important during the initial stages of the plan's implementation when control and restoration methods are being tested.

Example Monitoring Protocol

The list below encompasses information that could be recorded as part of a monitoring program. The list is not exhaustive nor do all components necessarily need to be recorded in every situation.

- Treatment: date, person in charge, species targets, method, area treated, volume removed, establish photo plots prior to treatment, and cost
- Restoration: date, person in charge, plant species, quantities, spacing, site prep (silt fence, mulch, geo textile, etc.), and cost
- Maintenance: date, person in charge, species targets, method, area treated, volume removed, survival rate, and cost

ACTION 13: Develop an annual work plan for invasive plant control (Table 3), restoration activities, maintenance, and monitoring including target sites and species, timing, who does work, cost, funding sources, etc.

ACTION 14: Follow Best Management Practices for invasive plant control, restoration and green waste disposal (Appendix 5).

ACTION 15: Undertake a terrestrial ecosystem assessment of the ravine to determine the biogeoclimatic sites series in order to prescribe appropriate plant species at restoration sites.

- This could be a simple matrix which lists appropriate plant species for the site types in the ravine (i.e. wet sites, moist sites, and dry sites)

4.4 Engage

4.4.1 Community Engagement

The restoration of Glenbrook Ravine Park offers the opportunity to improve public understanding of the risks posed by invasive plants and to promote stewardship through community involvement. When

volunteers are involved in ecological restoration, they feel a vested interest in the success of the restoration efforts and are more likely to monitor the site over time.

There is already a groundswell of community members dedicated to restoration efforts in the ravine. The involvement of the New Westminster Environmental Partners has been the key component to the success of the restoration efforts to date. Organizing stewardship takes time and resources. Ongoing organizational and financial support from the City is necessary to sustain these efforts.

With this Plan and increasing support from the City, the restoration efforts to date can continue to build on their successes and contribute to achieving the Plan's goals.

There are many sources of community volunteers eager to assist with invasive plant removal and restoration work. These include:

- Local schools and environment clubs
- Service clubs
- Community groups (e.g. Girl Guides of Canada and Scouts Canada)
- Environmental community groups (e.g. NWEP)
- Local resident associations
- Local stratas and housing boards
- Local academic institutions (e.g. Douglas College)
- Regional stewardship groups (e.g. ISCMV, Green Teams Canada, etc.)

ACTION 16: Continue to provide opportunities for stewardship partners to work in the Ravine:

- Use the annual work plan (Action 13) to definite the scope of stewardship activities
- Incorporate assistance from staff and/or contractors to ensure the most efficient use of volunteer time. This includes brushing out blackberry canes in advance of stewardship events to reduce the impact of thorns on volunteers and enable more ground to be covered.
- Provide guidance and parameters to individuals wanting to undertake stewardship activities independently of these events.

ACTION 17: Use City platforms (calendar, social media, newspaper) to inform residents about stewardship events.

ACTION 18: Connect with community groups, organizations, and institutions to increase awareness of volunteer opportunities in the ravine.

ACTION 19: Maintain regular communication with community stakeholders including hosting an annual meeting to review the work plan and provide updates (could be paired with a training opportunity).

ACTION 20: Celebrate/conduct volunteer recognition event and/or establish a webpage to formalize ravine work.

ACTION 21: Investigate the possibility of offering public programming on invasive and native species (e.g. indoor workshops, farmer's market booths, guided walks, invasive species re-purposing such as basket weaving) to tie in with stewardship activities and raise awareness about invasive plants in the ravine.

4.4.2 Staff Engagement

Staff play a key role in implementation of the plan. Staff engagement, interdepartmental collaboration and participation in regional invasive species efforts and research will all yield more coordinated and timely progress towards achieving the goals of the plan.

ACTION 22: Engage staff and key stakeholders (Metro Vancouver, etc.) to ensure all are aware of the goals and actions associated with the plan and provide opportunities for them to play an active role.

ACTION 23: Conduct an annual meeting with interdepartmental staff (relevant) to discuss ongoing implementation of this plan and review the ravine's annual restoration work plan.

ACTION 24: Continue to have staff participate in regional working groups, committees, and other organizations that contribute to invasive species management (e.g. ISCMV Forums, Metro Vancouver Regional Planning Advisory Council Invasive Species Sub-committee).

ACTION 25: Support student or other research efforts on invasive species, with a focus on priority species.

4.5 Sustain

In order for this plan to achieve long term success, stable funding and resources need to be in place to sustain efforts, particularly to support community stewardship activities. Staff need to integrate invasive plant management into work plans and budgets in order to keep the issue at the forefront. Designated staff leads would help champion ongoing efforts.

ACTION 26: Support long-term funding, staffing and resources for ongoing invasive plant management and restoration.

ACTION 27: Explore the possibility of creating of a self-sustaining body to coordinate stewardship activities (e.g. a stewardship committee) modelled off existing programs such as the Jericho Stewardship Group.

5.0 Summary of Actions

The summary includes all actions recommended within the Invasive Plant Management Plan. They appear in the same sequence and sub-sections as the Management Plan section of the document. The summary table identifies the priority, phasing and relative cost of each action.

Priority: The priority has been rated as either very high, high, moderate, or low. Low is relative since all recommendations are important.

Approximate Cost: Capital project costs are per project; ongoing costs are on an annual basis.

- Low – under $2,500
- Mod – $2,500-$5,000
- High – over $5,000

Table 4. Summary of Actions

Action	Action by	Priority	Relative Cost
DETECT – Early Detection			
ACTION 1: Devise a process for the City to respond to reports of new invasive plant occurrences in the ravine. Assign staff responsibility for confirming identification, mapping plant locations, and arranging appropriate treatment when necessary. Report occurrences of provincial EDRR species to the Provincial EDRR coordinator and stakeholder groups.	Staff	Mod	Low
ACTION 2: Prioritize monitoring and reporting of species on the Glenbrook Ravine Park 'watch list' (Appendix 4.2) and highlight these species in education and training. Share the list at stewardship events and distribute electronically.	Staff Community	Mod	Low
DETECT - Inventory			
ACTION 3: Complete the baseline inventory with the addition of herbaceous species during spring or summer months. Update the inventory every 5 years.	Contractors	Very high	Mod
ACTION 4: Use the baseline inventory to keep track of invasive plant control and restoration activities as well as ongoing monitoring and maintenance at these sites.	Staff Community	Very high	Low
PREVENT – Spread Prevention			
ACTION 5: Provide annual (regular) opportunities for staff and contractors to learn about invasive plants, spread prevention, and best practices that should be part of day-to-day park operations. Ensure all staff, contractors, and anyone involved in activities that could spread invasive plants (including Metro Vancouver) are trained in and are implementing prevention best practices.	Staff Contractors Metro Vancouver	Very high	Mod
ACTION 6: Provide annual (regular) opportunities for community volunteers to learn about invasive plants, spread prevention, and best practices. Ensure all volunteers involved in activities that could spread invasive plants are trained in and are implementing prevention best practices.	Staff Community	Very high	Mod
ACTION 7: Include prevention practices in management plans, project plans, work plans, park use permit conditions, and contract documents.	Staff	High	Low

Action	Action by	Priority	Relative Cost
PREVENT – Landscaping & Green Waste			
ACTION 8: Discourage planting of known invasive plant species, particularly those listed in Appendix 4, on City owned land, residential lots and new developments. • Metro Vancouver has two resources available: Grow Me Instead brochures and the Grow Green Guide	Staff Community	High	Low
ACTION 9: Educate property owners about the consequences and cost of illegal green waste dumping, and proper disposal options (emphasizing the use of green waste bins as an alternative to the recently closed recycling depot). • Mail drops, signage at known dump sites, and information on the City's website are all ways to effectively communicate this message. • The Hanging Basket Course and Fall Activity Learning brochure offer opportunities to communicate about the proper disposal of hanging baskets.	Staff Community	Very high	Low
PREVENT – Communication Tools			
ACTION 10: Advocate that the Province bans the sale of invasive plant species by local nurseries and other plant vendors.	Staff Community	Low	Low
ACTION 11: Enhance the City's Invasive Species webpage by including the following information: • How to report sightings of high-risk invasive species • Individual and community involvement opportunities; • Ecological impacts of illegal dumping of invasive plants; • Alternative non-invasive garden species; • How to get involved in stewardship work.	Staff Community	High	Low
ACTION 12: Use signage in the park to raise awareness about invasive plants and highlight local stewardship efforts including: • Permanent signage at the restoration site recognizing partners, explaining what is happening and how to get involved, including dates for future events. • "Play, Clean, Go" signage (available through the ISCMV/ISCBC) at trailheads which includes a boot brush and information on key invasive plant species	Staff Community	Very high	Low
RESTORE			
ACTION 13: Develop an annual work plan for invasive plant control (Table 3), restoration activities, maintenance, and monitoring including target sites and species, timing, who does work, cost, funding sources, etc.	Staff Community Contractors	Very high	Low
ACTION 14: Follow Best Management Practices for invasive plant control, restoration and green waste disposal (Appendix 5).	Staff Community Contractors	Very high	Low
ACTION 15: Undertake a terrestrial ecosystem assessment of the ravine to determine the biogeoclimatic sites series in order to prescribe appropriate plant species at restoration sites. • This could be a simple matrix which lists appropriate plant species for the site types in the ravine (i.e. wet sites, moist sites, and dry sites)	Staff Contractors	Mod	Low
ENGAGE - Community			
ACTION 16: Continue to provide opportunities for stewardship partners to work in the Ravine: • Use the annual work plan (Action 13) to definite the scope of stewardship	Staff Community	Very high	Mod

Action	Action by	Priority	Relative Cost
activities • Incorporate assistance from staff and/or contractors to ensure the most efficient use of volunteer time (e.g. brush out blackberry canes in advance of stewardship events to reduce the impact of thorns on volunteers and enable more ground to be covered). • Provide guidance and clarity to individuals wanting to undertake management activities independently of these events.	Contractors Metro Vancouver		
ACTION 17: Use City platforms (calendar, social media, newspaper) to inform residents about stewardship events.	Staff Community	Very high	Low
ACTION 18: Connect with community groups, organizations, and institutions to increase awareness of volunteer opportunities in the ravine.	Staff Community	High	Low
ACTION 19: Maintain regular communication with community stakeholders including hosting an annual meeting to review the work plan and provide updates (could be paired with a training opportunity).	Staff Community	Very high	Low
ACTION 20: Celebrate/conduct volunteer recognition event and/or establish a webpage to formalize ravine work.	Staff Community	High	Low
ACTION 21: Investigate the possibility of offering public programming on invasive and native species (e.g. indoor workshops, farmer's market booths, guided walks, an invasive species re-purposing such as plant basket weaving) course to tie in with stewardship activities and raise awareness about invasive plants in the ravine.	Staff Community	Low	Low
ENGAGE - Staff			
ACTION 22: Engage staff and key stakeholders (Metro Vancouver, etc.) to ensure all are aware of the goals and actions associated with the plan and provide opportunities for them to play an active role.	Staff Community Metro Vancouver	Very high	Low
ACTION 23: Conduct an annual meeting with interdepartmental staff (relevant) to discuss ongoing implementation of this plan and review the ravine's annual restoration work plan.	Staff	Very high	Low
ACTION 24: Continue to have staff participate in regional working groups, committees, and other organizations that contribute to invasive species management (e.g. ISCMV Forums, Metro Vancouver Regional Planning Advisory Council Invasive Species Sub-committee).	Staff	High	Low
ACTION 25: Support student or other research efforts on invasive species, with a focus on priority species.	Staff Community	Mod	Low
SUSTAIN			
ACTION 26: Support long-term funding, staffing and resources for ongoing invasive plant management and restoration.	Staff	Very high	High
ACTION 27: Explore the possibility of creating of a self-sustaining body to coordinate stewardship activities (e.g. a stewardship committee) modelled off existing programs such as the Jericho Stewardship Group.	Staff Community	High	Mod

6.0 References

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Appendix 1 Summary of Stakeholder Workshop

Glenbrook Ravine Park Stakeholder Workshop, February 21, 2019
Summary of World Café Group Discussions

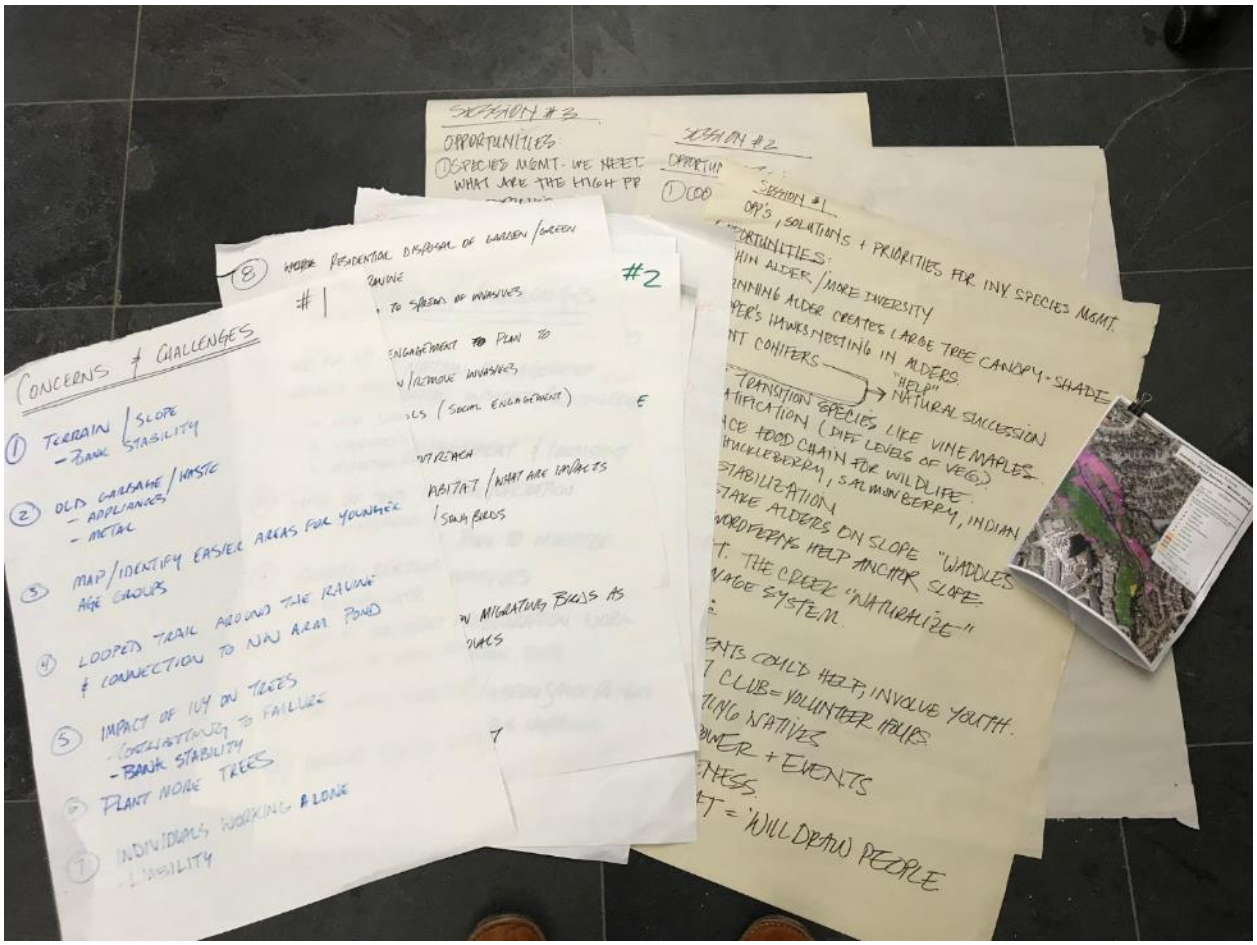


Figure 2. Photo of notes taken at community stakeholder workshop, February, 2019





Discussion 1: Park History (What's Been Happening in Glenbrook Park)

Big Picture

A complete transformation over past two centuries characterized by "Urbanization and Neglect".

- ➔ First nations use (Qayqayt First Nation)
- ➔ Logging and city founding, streams piped underground beginning 1915
- ➔ Historical inaccessibility due to penitentiary (1878-1980)
- ➔ Residential subdivisions, construction dumping ground
- ➔ Public interest
- ➔ Positive community feature
- ➔ Tree loss and increased use

What is the future goal? A manicured park for public events and recreation? Or a restored natural area for wildlife and conservation of biodiversity? These decisions will play into any plans and actions taken as the park design is finalized.

Loss of Historical Wildlife

Many animals are claimed to be greatly reduced or no longer present by park users. These claims are not directly verifiable but likely indicate a loss of biodiversity as urbanization progresses in the city. The animals mentioned include:

- Owls
- Deer
- Coyotes
- Cougars
- Bears
- Deer
- Raccoons
- Skunks
- Songbirds

Community History

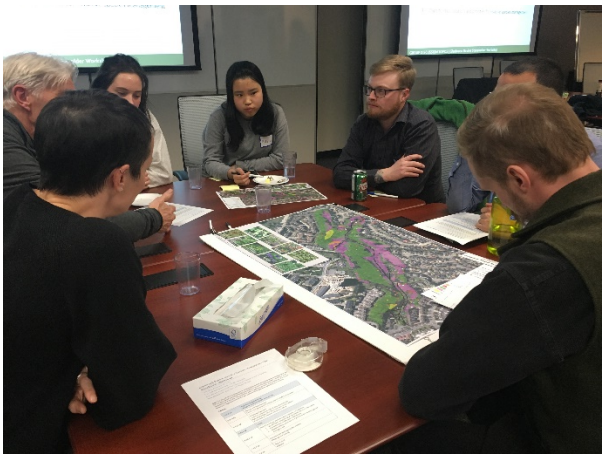
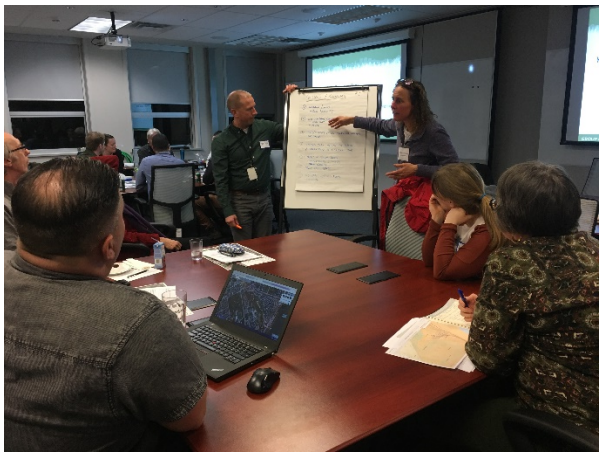
Several historical associations were discussed in relation to the history of New Westminster. There is an opportunity to include the history into the future park design. These include:

- First nations fishing camps (calls attention to lost salmon bearing streams)
- A graveyard site on the western edge of the park
- The history of the B.C. Penitentiary
- Legend of Billy Miner's escape (1907)
- Unofficial kid's nature playground (80s-90s), treehouses and pathways

Volunteer and Citizen Actions in the Park

Community actions have been underway to deal with several park issues. These include:

- Sporadic undocumented ivy removal (park users)
- Garbage clean-up by Girl Guide volunteers (2013)
- Blackberry removal and restoration planting (coordinated by the city)


Discussion 2: Concerns and Challenges in the Ravine

Concerns

- Old garbage / waste: construction debris, appliances, metal
- Ivy on trees: bank stability, tree failure
- Liability for unauthorized restoration activities
- Residential / Landscaper green waste disposal into ravine
- Loss of bird habitat as forest changes
- Undocumented or unauthorized restoration activities
- Climate change effects on park
- Lack of clear short-term and long-term goals
- Lack of maintenance on previous activities
- Disruption of successional forest growth

Challenges

- Terrain: slope and bank stability
- Identify accessible areas for groups/children
- Trail expansion (how to maintain natural environment while increasing access)
- Establishing successional tree layer
- Engagement and coordination for community involvement in invasive removal

- Educating homeowners, developers, landscapers, realtors about green waste dumping
- Educate public concerning benefits of invasive removal (biodiversity, wildlife, etc.)
- Financial resources required for management
- Consistent and scheduled management
- Integrating management practices into larger municipal/regional plan
- Marketing and promotion of plans and actions
- Monitoring and assessing restoration success
- Alignment of goals and activities between City, Metro Vancouver, and Province
- Working around Metro Vancouver sewer and stormwater lines
- Tree inventory to prioritize ivy removal

Discussion 3: Invasive Species Management (Opportunities, Solutions, Priorities)

Opportunities

- First Nations engagement (historical insight/knowledge)
- Thinning alders (increase tree diversity, complexity)
- Assist with natural successional processes
- Planting of transition species (e.g. vine maple) to create stratified canopy
- Enhance understory forage species for wildlife (e.g. huckleberry, salmonberry, Indian plum)
- Slope stabilization: alder or willow stakes for waddles, sword fern to increase stability
- Daylighting creek systems (naturalize engineered drainage system)
- Co-ordinate with Metro Vancouver's plans for line maintenance, changes to system, access requirements
- Public education and awareness (specifically with regards to common household invasive plant species)
- Integrate local management with municipal and regional invasive species control plans
- Education opportunities for best management practices for invasive species removal
- High school and elementary school as a labour source, educational tool, etc.
- Incorporate different groups in New West (musicians, artists, students, etc.)

Solutions

- Involve local youth (New West school system students)
- Increase volunteer numbers at community events
- Raise awareness about challenges and opportunities in the park
- Install signage at park entrances to draw attention to restoration efforts
- Use novel approaches to draw attention (i.e. goats eating invasive species)
- Outreach to stratas, resident associations, homeowners, community center, schools
- Booth at local farmer's market
- Engage dog walkers during peak hours (7-8 pm)
- Goats in the park (for publicity and invasive control)
- Engage existing volunteer groups (i.e. Institute for Urban Ecology)
- Co-operation with Metro Vancouver engineers
- Designate a coordinator for engaging local schools
- Designate central area for native plant demonstration, signage, ceremonies, history information, etc.
- Use natural processes to control invasive species (e.g. canopy shading)

- Use power tools to brush out the bulk of the blackberry canes prior to volunteer events. Volunteers can then focus on digging out the roots. This reduces volunteer exposure to thorns and increases the amount of work that can be accomplished: morale booster!
- Mulching after planting to retain moisture and suppress invasive species
- Find balance (humans as visitors and stewards, not owners)

Appendix 2 Glenbrook Stream: historic map and aerial photo

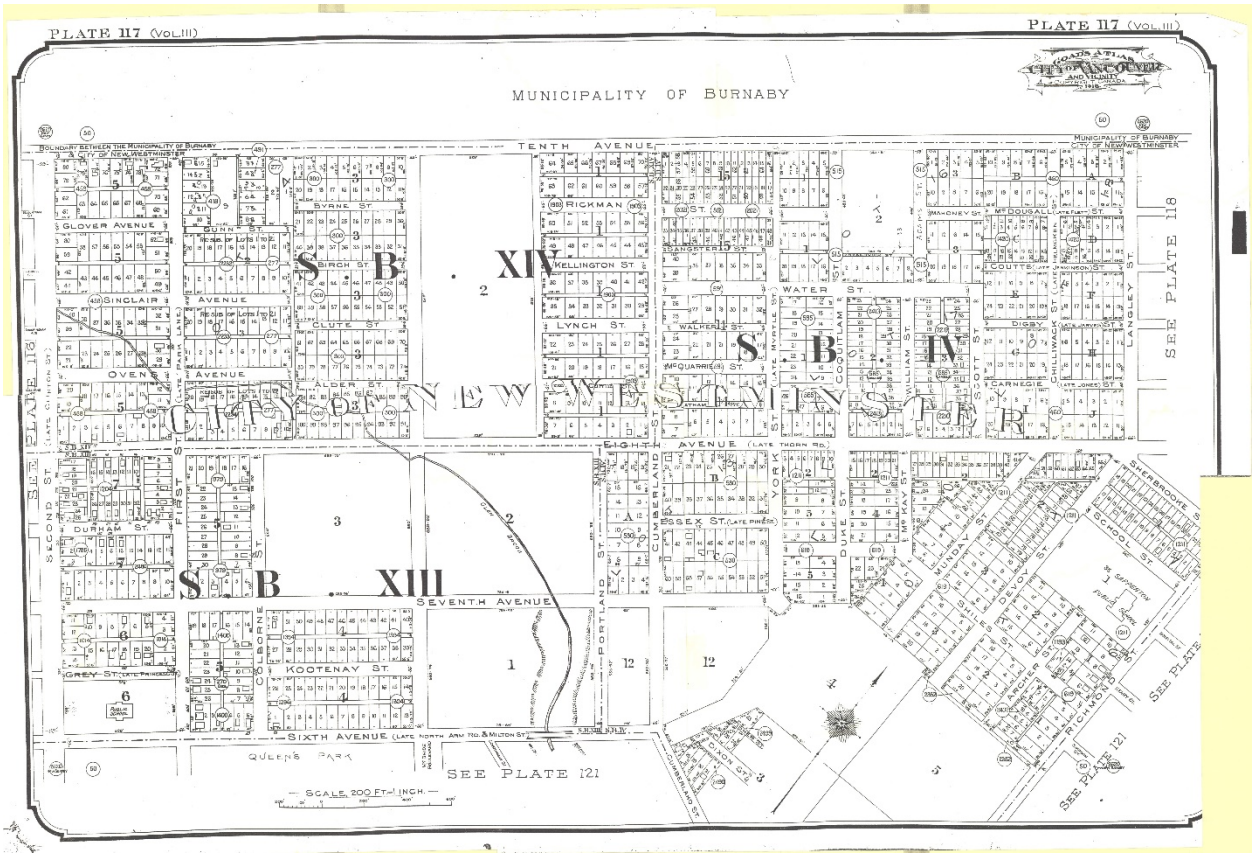


Figure 3. Historic City map showing location of Glenbrook Stream.



Figure 4. Aerial photo of Glenbrook area 1949 (left) compared with imagery from 2015 (right).

Appendix 3 Glenbrook Ravine Park Invasive Plant Survey



Appendix 4 Invasive Plant Photos

Appendix 4.1 Species present in Glenbrook Ravine Park

Table 5. Invasive plant species present in Glenbrook Ravine Park

Common Name	Scientific Name
Cherry laurel	*Prunus laurocerasus*
Clematis	*Clematis vitalba*
English holly	*Ilex aquifolium*
English ivy	*Hedera helix*
Hedge bindweed (morning glory)	*Calystegia sepium*
Himalayan blackberry	*Rubus armeniacus*
Knotweed* (bohemian or Japanese)	*Fallopia x bohemica* *Fallopia japonica*
Periwinkle	*Vinca minor*
Scotch broom	*Cytisus scoparius*
Spurge laurel	*Daphne laureola*
Yellow archangel	*Lamiastrum galeobdolon*

* Not possible to distinguish between bohemian and Japanese knotweed without testing

** Not visible during winter survey



Cherry laurel
Prunus laurocerasus



Clematis
Clematis vitalba



English Holly
Ilex aquifolium



English Ivy
Hedera helix



Hedge bindweed (morning glory)
Calystegia sepium



Himalayan blackberry
Rubus armeniacus



Japanese / Bohemian Knotweed
Fallopia japonica / Fallopia x bohemica



Periwinkle
Vinca Minor



Scotch broom
Cytisus scoparius



Spurge laurel
Daphne laureola



Yellow Archangel
Lamiastrum galeobdolon

Appendix 4.2 Species not present in Glenbrook Ravine Park: watch list

Table 6. Invasive plant 'watch list' for Glenbrook Ravine Park

Common Name	Scientific Name
Butterfly bush	*Buddleja davidii)*
Common reed	*Phragmites australis subsp. australis*
Garlic mustard	*Alliaria petiolata*
Giant hogweed	*Heracleum mantegazzianum*
Giant knotweed	*Fallopia sachalinensis*
Gorse	*Ulex europaeus*
Goutweed	*Aegopodium podagraria*
Himalayan balsam (policeman's helmet)	*Impatiens glandulifera*
Himalayan knotweed	*Persicaria wallichii*
Hops	*Humulus lupulus*
Italian arum	*Arum italicum*
Japanese butterbur	*Petasites japonicus*
Orange hawkweed	*Pilosella aurantiaca*
Poison hemlock	*Conium maculatum*
Purple loosestrife	*Lythrum salicaria*
Wild chervil	*Anthriscus sylvestris*
Yellow flag-iris	*Iris pseudacorus*



Butterfly Bush
Buddleja davidii



Common Reed
Phragmites australis subsp. *australis*



Garlic Mustard
Alliaria petiolata



Giant hogweed
Heracleum mantegazzianum



Giant knotweed
Fallopia sachalinensis



Gorse
Ulex europaeus



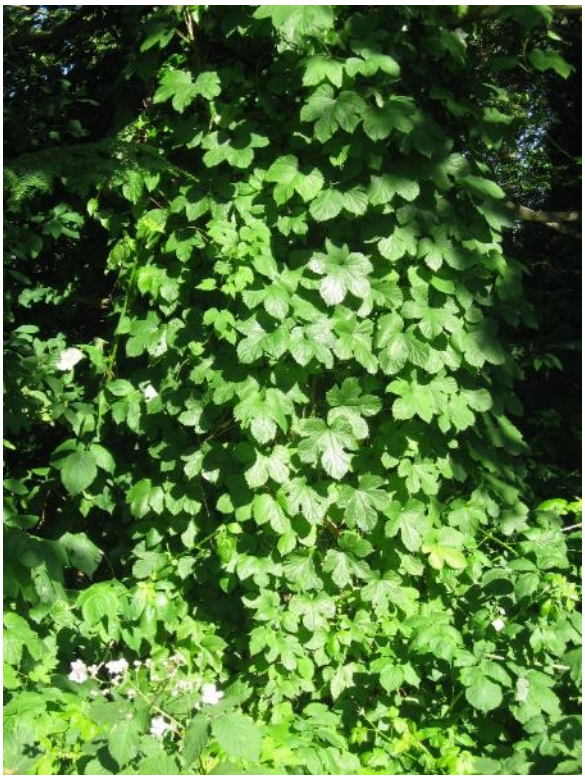
Goutweed
Aegopodium podagraria



Himalayan balsam
Impatiens glandulifera



Himalayan knotweed
Polygonum polystachyum



Hops
Humulus lupulus



Italian arum
Arum italicum



Japanese butterbur
Petasites japonicus



Orange hawkweed
Pilosella aurantiaca



Poison hemlock
Conium maculatum



Purple loosestrife
Lythrum salicaria



Wild chervil
Anthriscus sylvestris



Yellow flag-iris
Iris pseudacorus

Appendix 5 Resources

Metro Vancouver – **Invasive Species Best Management Practices**
http://www.metrovancouver.org/services/regional-planning/conserving-connecting/invasive-species/Pages/default.aspx

Metro Vancouver **Grow Green Guide**
http://www.growgreenguide.ca/

Invasive Species Council of British Columbia – **Publications (including Best Practices Guides)**
https://bcinvasives.ca/resources/publications/

Invasive Species Council of British Columbia – **Factsheets**
https://bcinvasives.ca/resources/tips/

Invasive Species Council of British Columbia **– Grow me Instead brochure for gardeners**
https://bcinvasives.ca/documents/GMI-Booklet_2013_WEB.pdf

King County – **Noxious Weeds Profiles (including treatment methods)**
https://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds.aspx

BC Government – **Invasive Species information**
https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species