City of North Vancouver Invasive Plant Inventory Update 2015

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Submitted to:

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Table of Contents

List of Tables

List of Figures

1 Executive Summary

The City of North Vancouver conducted a baseline invasive plant inventory in 2011 followed by an update to the inventory in 2015. Below is a summary of changes observed when comparing the results from the 2015 inventory update with the results for 2011.

POSITIVE FINDINGS:

- Major reduction in abundance and distribution of giant hogweed (90% reduction of impacted area) and knotweed species (70% reduction of impacted area) after a three year, City-wide treatment program.
- Significant area was cleared of invasive plants and restored with native vegetation. Thirty nine restoration sites were documented during the inventory. Restoration work was carried out by the City during park upgrades or ecosystem restoration projects, by contractors for compensation for development or Port expansion work, and by the Evergreen City Park Stewards program or community volunteer groups.
- Hundreds of impacted trees have been cleared of climbing ivy by City crews, preventing future canopy loss. Only a small number of trees remain impacted.
- Localized reduction in abundance and distribution of the following invasive plant species due to invasive plant control work by City crews, Evergreen City Park Stewards program and community volunteer groups: Scotch broom, butterfly bush, hops, policeman's helmet and Japanese butterbur.
- No new provincially listed noxious weed species, EDRR species (provincially or regionally recognized) or emergent species of major concern were found.
- Drought conditions may have a positive future impact on the reduction of lamium, goutweed and small flowered touch-me-not.

ONGOING CHALLENGES:

- Riparian restriction on use of glyphosate within one meter of the high water mark of watercourses has resulted in occurrences of permanently untreated knotweed. These populations will continue to contribute to knotweed spread. Forty percent of remaining occurrences are within one meter of watercourses.
- Notable expansion in abundance and distribution of English ivy and English holly.

2 Introduction

Diamond Head Consulting was retained by the City of North Vancouver ("City") to conduct an update to the baseline invasive plant inventory from 2011. The survey documents the current abundance and distribution of invasive plant species on City owned property. The survey did not include roads, lanes, rights-of-way or private property.

Since 2011 the City has carried out invasive plant control work including:

- City wide chemical treatment of giant hogweed and knotweed species.

- Removal of climbing ivy and other climbing species (i.e. clematis) from trees in the majority of city parks.
- Invasive plant removal and restoration planting in select areas of park land during park upgrades or ecosystem restoration projects, by contractors for compensation for development or Port expansion work, and by the Evergreen City Park Stewards program or community volunteer groups.

This report provides the results of the survey, showing changes since the 2011 inventory and providing observations on trends and recommendations for future invasive plant control work.

Associated deliverables include:

- Geodatabase containing all collected spatial information.
- Selection of photos from the survey.

3 Methodology

A detailed ground survey was conducted following the same protocol as the 2011 baseline inventory with a few exceptions. Table 1 documents the methodology while noting any deviations from the methodology used in 2011.

Table 1. Methodology details: comparison between 2011 and 2015 inventories.

Methodology Component	2011		2015	
Survey extent	147 ha		163 ha	
GPS device and software	ESRI's ArcMap on Trimble Junos		ESRI's Collector app on iPads	
Orthophoto year	2010		2014	
Points and polygons	</= 20 m^2: point feature > 20 m^2: polygon feature (may include multiple species)		</= 20 m^2: point feature only > 20 m^2: point and polygon feature (restricted to a single species). Point denotes presence of infestation; polygon represents extent of impacted area.	
Timing	April to July 2011		May to July 2015	
Data attributes	POINT	ID (unique)	POINT	ID (unique)
		Species name (single)		Species name (single)
		Area (m^2)		Area (m^2)
		Vine status		Vine status
		Comments		High water mark status (applicable to knotweed species only)
				Comments
	POLYGON	ID (unique)	POLYGON	ID (matches point ID)
		Species name (multiple)		Species name (single)

Methodology Component	2011		2015	
		Percent cover (by each species)		Percent cover (single species)
		Vine status		
		Comments		

All infestation area measurements are visual estimations. The smallest measured unit is one square meter. Area estimations are made as contiguous measurements of impacted square meters (i.e. if there are 10 knotweed stems within two contiguous square meters, the impacted area is recorded as two square meters).

If an infestation crossed out of the survey area boundary onto private property or transportation/utility corridors, the adjacent extent was partially or wholly mapped. This documents the shared ownership of the infestation. These adjacent, non-City owned areas are not included in the results analysis.

3.1.1 Vine Status

In 2011 it was noted whether or not a vine species (e.g. English ivy, clematis, common hops, or blackberry) was climbing trees. In 2015 greater detail is provided on climbing status. Three categories were used:

1. Not climbing
2. Previously treated (by removal from tree stem) or early stage climb (<5 years)
3. Established climb (>5 years); requires treatment

3.1.2 High Water Mark Status

Although the City has been chemically treating knotweed infestations since 2012, herbicide regulations restrict the use of glyphosate to within one meter of the high water mark of a watercourse. For all knotweed the high water mark status is recorded as:

1. <1m from the high water mark
2. Normally <1m from the high water mark, but >1m from the high water mark during extended summer dry periods
3. >1m from the high water mark

3.2 Inventoried Plant Species

Twenty invasive plant species were inventoried (Table 2). These species are all known to pose negative ecological, economic and/or human health risks in the Metro Vancouver region. These are the same species inventoried in 2011. New emergent non-native plant species with the potential to become invasive were also inventoried.

Table 2. Inventoried plant species.

Common Name	Scientific Name	Legal Status
Blackberry – Himalayan	*Rubus armeniacus*	
Butterfly bush	*Buddleia davidii*	
Clematis – old man's beard	*Clematis vitalba*	
English holly	*Ilex aquifolium*	
English ivy	*Hedera helix*	
Giant hogweed	*Heracleum mantegazzianum*	BC Noxious Weed
Goutweed (bishop's weed)	*Aegopodium podgaria*	
Hops (common)	*Humulus lupulus*	
Knotweed – Japanese	*Fallopia japonica*	BC Noxious Weed
Knotweed – Bohemian	*Fallopia x bohemica*	BC Noxious Weed
Knotweed – Giant	*Fallopia sachalinensis*	BC Noxious Weed
Knotweed – Himalayan	*Polygonum polystachyum*	BC Noxious Weed
Lamium (yellow archangel)	*Lamium galeobdolon*	
Laurel – Cherry (English laurel)	*Prunus laurocerasus*	
Periwinkle	*Vinca minor*	
Policeman's helmet (Himalayan balsam)	*Impatiens glandulifera*	
Scotch broom	*Cytisus scoparius*	
Small flowered touch-me-not	*Impatiens parviflora*	
Spurge laurel (daphne laurel)	*Daphne laureola*	

3.3 Additional Collected Data

Three additional datasets were collected during the inventory:

1. Restored Areas: where restoration planting was evident, the extent of the restoration area was recorded as a polygon feature. These areas were classified into three types: newly planted, requiring maintenance, or successfully established (maintenance no longer required).
2. Unsanctioned green waste or debris dumping.
3. Points of note: locations of significant disturbance (unsanctioned bike trails/jumps, park encroachment by adjacent residents) or camps/shelter structures.

4 Results: Inventory Analysis

City owned parcels inventoried within the survey area totalled 163 ha. Approximately 100 ha are considered natural area. The total area impacted by invasive species in City parks was approximately 28.6 ha or 17% of the total surveyed area. An additional 3 ha was inventoried immediately outside of parcel boundaries. This area has been excluded from the analysis.

Within city-owned land, a total of 6,028 points features were recorded of which 953 had extents large enough (>20 m^2) to warrant delineating impacted area as polygons. All inventoried invasive plant occurrences are shown in Figure 1.

Figure 1. MAP – All inventoried invasive plant occurrences.

The total area impacted by each inventoried plant species is summarized in Table 3 and compared graphically in Figure 2 and Figure 3.

Table 3. Total impacted area by invasive plant species on City of North Vancouver owned land.

Survey Boundary (spatial extent used)	2015	2011	2011			
SPECIES NAME	2015 Result	2015 Result	2011 Result	Area Change	Percent Change	Suspected Reason for Change
English ivy	16.6 ha	16.3 ha	15.1 ha	+1.2 ha	+8%	Rapid growth habit & distribution through bird droppings
Himalayan blackberry	7.1 ha	6.8 ha	10.0 ha	-3.1 ha	-31%	Land loss to Port (Lower Level Road); further reduction credited to restoration projects
Goutweed	1.0 ha	1.0 ha	1.4 ha	-0.4 ha	-30%	Unknown; some attributable to restoration projects and drought stress. Under-reporting possible due to dieback during 2015 drought.
Lamium	0.8 ha	0.8 ha	0.9 ha	-0.2 ha	-18%	Unknown; some attributable to restoration projects and drought stress. Under-reporting possible due to dieback during 2015 drought.
Periwinkle	0.7 ha	0.5 ha	0.7 ha	-0.2 ha	-24%	Unknown; some attributable to restoration projects and drought stress. Under-reporting possible due to dieback during 2015 drought.
Cherry-laurel	0.5 ha	0.5 ha	0.5 ha	+36 m^2	+1%	Mainly due to addition of occurrences missed in the 2011 inventory.
English holly	0.5 ha	0.5 ha	0.4 ha	+314 m^2	+7%	Partially due to occurrences missed in the 2011 inventory; new growth attributed to suckering and distribution of seed through bird droppings
Small flowered touch-me-not	0.4 ha	0.4 ha	0.4 ha	-280 m^2	-7%	Unknown; some attributable to restoration projects and drought stress. Under-reporting possible due to dieback during 2015 drought.
Clematis species	0.3 ha	0.2 ha	0.2 ha	+0.1 ha	+51%	Rapid growth habit and distribution by seed carried in the wind.
Knotweed species	0.2 ha	0.2 ha	0.8 ha	-0.6 ha	-71%	Treatment project.
Hops	0.2 ha	0.2 ha	0.2 ha	-671 m^2	-28%	Land loss to Port (Lower Level Road)
Policeman's helmet	0.1 ha	0.1 ha	0.1 ha	-182 ha	-15%	Targeted removals.

Survey Boundary (spatial extent used)	2015	2011	2011			
	2015 Result	2015 Result	2011 Result	Area Change	Percent Change	Suspected Reason for Change
Spurge laurel	0.1 ha	0.1 ha	0.1 ha	+97 m^2	+19%	Majority due to addition of occurrences missed in the 2011 inventory.
Scotch broom	292 m^2	285 m^2	342 m^2	-58 m^2	-17%	Targeted removals.
Giant hogweed	95 m^2	93 m^2	1038 m^2	-945 m^2	-91%	Treatment project.
Butterfly bush	88 m^2	41 m^2	131 m^2	-90 m^2	-69%	Targeted removals.
Other species	561 m^2	466 m^2	241 m^2	+225 m^2	+94%	Professional judgement: more included in 2015 which weren't included in 2011.
TOTAL	**28.6 ha**	**27.7 ha**	**30.9 ha**			

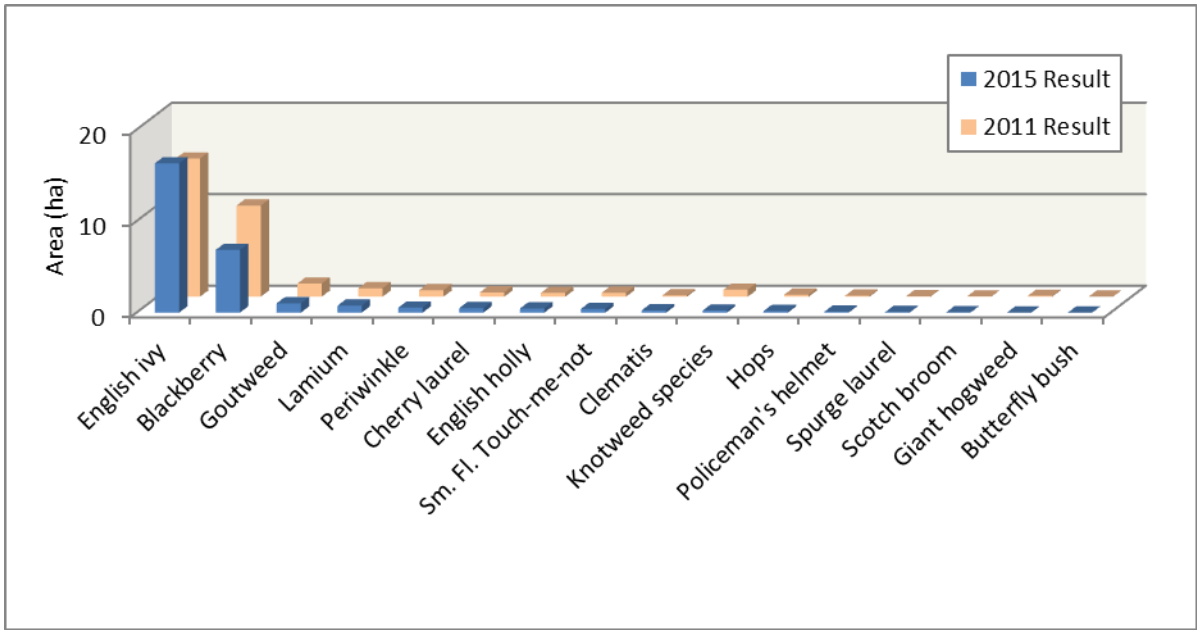

Figure 2. Total area impacted by invasive plant species inventoried in City of North Vancouver owned land (restricted to 2011 survey boundary).

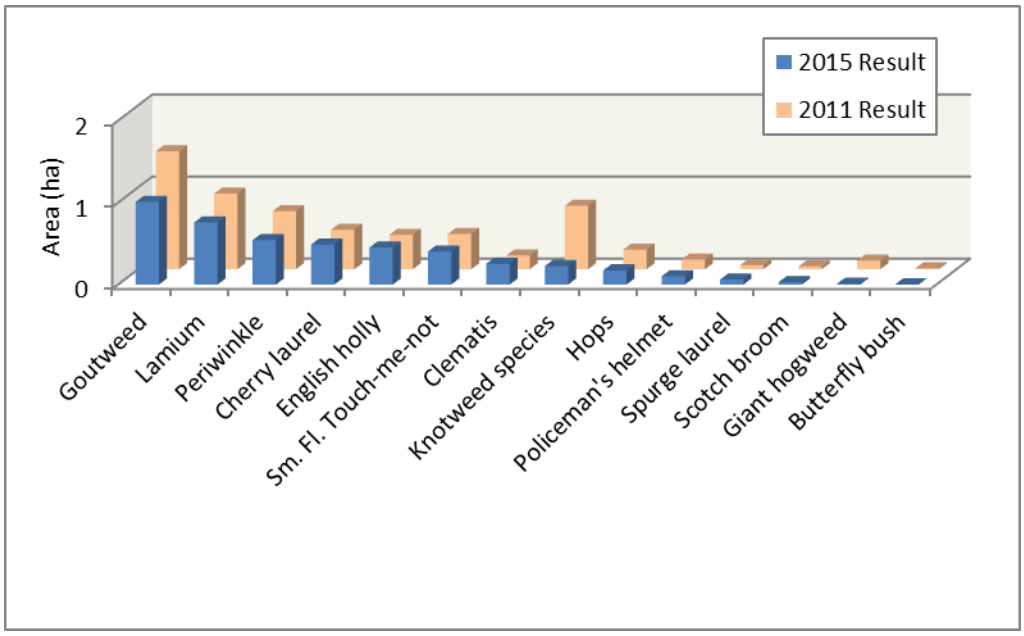

Figure 3. Total area impacted by invasive plant species inventoried in City of North Vancouver owned land (restricted to 2011 survey boundary) – showing species whose total area was under 2.0 ha.

4.1 Changes to Abundance and Distribution Patterns

Changes to abundance and distribution patterns since the 2011 invasive plant inventory are documented by species in Table 4. The table includes a brief description of the most significant risk posed by each species.

Table 4. Changes to abundance and distribution patterns.

Common Name	Changes to Abundance and Distribution since 2011	Highest Risk Impact
Blackberry – Himalayan	Widely dispersed; notable patch expansion in open areas.	Restoration areas, newly disturbed sites and open sites with little or no tree canopy.
Butterfly bush	Major reduction in Kings Mill. Slight increase in distribution elsewhere.	Restoration areas, open shrub communities, foreshore.
Clematis – old man's beard	Increased abundance particularly in lower Mosquito Creek and Mahon, and Tempe Heights. Minimal increase to distribution.	Tree canopy.
English holly	Increased abundance. Continues to be evenly dispersed across all parks and landscaped areas.	Understory native vegetation; a recreational annoyance.
English ivy	Widely dispersed; notable patch expansion in open areas. Dramatic reduction in number of trees impacted by climbing ivy.	Tree canopy and understory native vegetation.

Common Name	Changes to Abundance and Distribution since 2011	Highest Risk Impact
Giant hogweed	Dramatic reduction in abundance and distribution. Remaining occurrences concentrated in Mahon and Tempe Heights.	Human health.
Goutweed (bishop's weed)	Reduction in abundance particularly on exposed, dry sites. Distribution unchanged.	Understory herbaceous vegetation particularly in riparian areas.
Hops (common)	Notable increase in patch extents. New dispersal into Greenwood and Mosquito Creek.	Tree canopy.
Knotweed – Japanese and/or Bohemian	Dramatic reduction in abundance. Distribution reduced particularly in Mosquito Creek, Mahon, Wagg and Greenwood. Forty percent of remaining occurrences are within one meter of watercourses.	Understory vegetation, particularly in riparian areas. Restoration areas, newly disturbed sites.
Knotweed – Himalayan	Remains rare. Abundance reduced where treated, new sites found in Heywood and Mahon.	Restoration areas, newly disturbed sites and sites with tree canopy loss.
Lamium (yellow archangel)	Slight increase in patch extents. Overall abundance reduced. Distribution unchanged.	Understory native vegetation, particularly in riparian areas.
Laurel – Cherry (English laurel)	Small increase in abundance. Continues to be evenly dispersed across all parks and landscaped areas.	Relatively low risk to understory native vegetation.
Periwinkle	Overall abundance reduced. Distribution unchanged.	Understory native vegetation.
Policeman's helmet (Himalayan balsam)	Abundance decreased due to reduction in patch extents. Most patches limited to fewer than 5 individuals. Dispersal spread to lower Mosquito Creek. Dispersal contained to Heywood, Mosquito and Mahon/Wagg corridors.	Understory native vegetation, particularly in riparian areas.
Scotch broom	Abundance decreased. Complete removal from Heywood. Dramatic reduction in Kings Mill (mainly seedlings remain). Dispersal unchanged except expanded in Greenwood.	Restoration areas, open shrub communities, foreshore.
Small flowered touch-me-not	Overall abundance reduced. Distribution unchanged.	Relatively low risk to understory herbaceous vegetation.
Spurge laurel (daphne laurel)	Increased abundance. Continues to be evenly dispersed across all parks.	Understory native vegetation

4.2 New Emergent Species

Several non-native plant species were noted as possible new emergent invasive plants in the City (Table 5 and Figure 4). Not all non-native species will become invasive, nor will all necessarily have negative impacts on City lands. Some of these species are known to be problematic invasive species in other jurisdictions. The table below summarizes the dispersal patterns and recommendations for six non-native species which may be emergent invasive plants in the City. The area inventoried does not necessarily capture all existing infestations.

There were four new species added to the emergent species list since 2011. All would have been present in 2011. They are added now after observing that they are more widely distributed that previously thought and/or they were previously missed.

Table 5. Emergent species inventoried in the City of North Vancouver.

Common Name	Area Inventoried (m^2)	Dispersal pattern and site type	Comment/ Recommendation
Bamboo spp.	113 (36 in 2011) Plus 106 in landscaped areas	Improved documentation since 2011. Widely dispersed but always within short distance of residences/gardens.	**MONITOR**: Not officially documented as an invasive plant in BC. No evidence of spread of occurrences inventoried in 2011. Currently not considered to be a risk to CNV, but warrants monitoring.
Common burdock *Arctium minus*	31	Lynnmouth (3 sites), Sunrise (2 sites), High Place (1 site), Wagg Creek (1 site). Always in disturbed areas.	**NO ACTION**: Documented as an invasive plant in BC. Primarily a risk to range and agricultural habitats. Considered low risk to CNV.
Comfrey *Symphytum officinale*	34 (20 in 2011)	Mahon (1 site), Mosquito Creek (2 sites), Sunrise (1 sites); several sites in small disturbed single lot parcels. Always in disturbed areas.	**REMOVE**: Not officially documented as an invasive plant in BC. Annual herb; easily removed. Monitor re-growth from seed bank.
European hawthorn *Crataegus monogyna*	1	Upper Heywood. One tree.	**NO ACTION**: Documented as an invasive plant in BC. Primarily a risk to riparian habitats surrounding wetlands. Considered low risk to CNV.
Hydrangea spp.	106	Heywood (4 sites), Mosquito Creek (2 sites), Mahon (1 site). Often within a short distance of residences/gardens. May have been intentionally planted.	**MONITOR**: Not officially documented as an invasive plant in BC. Considered low risk to CNV, but warrants monitoring.

Common Name	Area Inventoried (m^2)	Dispersal pattern and site type	Comment/ Recommendation
Japanese butterbur [1] (*Petasites japonicus* var. *gigantea*)	37 (93 in 2011)	Heywood (3 sites), Mahon (5 sites) and Wagg (1 site). Riparian areas. Reduced in abundance since 2011 due to either intentional removal or drought stress.	**REMOVE**: Not officially documented as an invasive plant in BC, but documented as such in Washington and Oregon States.
Unidentified species	33	All contained to one area in lower Mahon (~25 scattered, mature specimens) and one site in lower Mosquito Creek. May have been intentionally planted.	**IDENTIFY**: Determine identity in spring 2016.
Yellow flag-iris (*Iris pseudacorus*)	37	Two sites, both intentional landscape plantings: Lynnmouth and Norseman Parks. Specimens inventoried as iris in 2011 were incorrectly identified.	**REMOVE**: Designated BC Noxious Weed.

[1] Alien Plant Invader: Japanese Butterbur – City of Portland website; http://www.portlandoregon.gov/bes/article/531484


Bamboo sp.


Common burdock


Japanese butterbur


Comfrey


European hawthorn


Unidentified shrub


Hydrangea


Yellow flag-iris

Figure 4. Emergent species in the City of North Vancouver.

4.3 Infestation Sources and Methods of Dispersal

No significant changes to sources or dispersal methods were observed in 2015. As in 2011, the primary sources of invasive plant species are: dispersal of seed by birds, water or wind, spread from adjacent landscapes/gardens, and spread from dumped green waste. Increases in plant abundance and distribution observed in 2015 can be attributed to three factors:

- Growth of existing infestations;
- Spread of seed by birds, water or wind; and
- Plants missed during the 2011 inventory.

Illegal green waste dump sites continue to be a potential source of new infestations. However no new infestations were noted emerging from either historic or new dump sites. A total of 85 dump sites were recorded in comparison to 103 in 2011 (Figure 6). This represents 27 new sites and 58 historic dump sites still being used in 2015. It should be noted that the north side of Sunrise Park (western most parcel) is an extremely active dumping site. Although local residents likely contribute, landscape and construction contractors are frequently observed using the site to dump green waste (Figure 5).

Figure 5. Illegal green waste dumping in Sunrise Park.

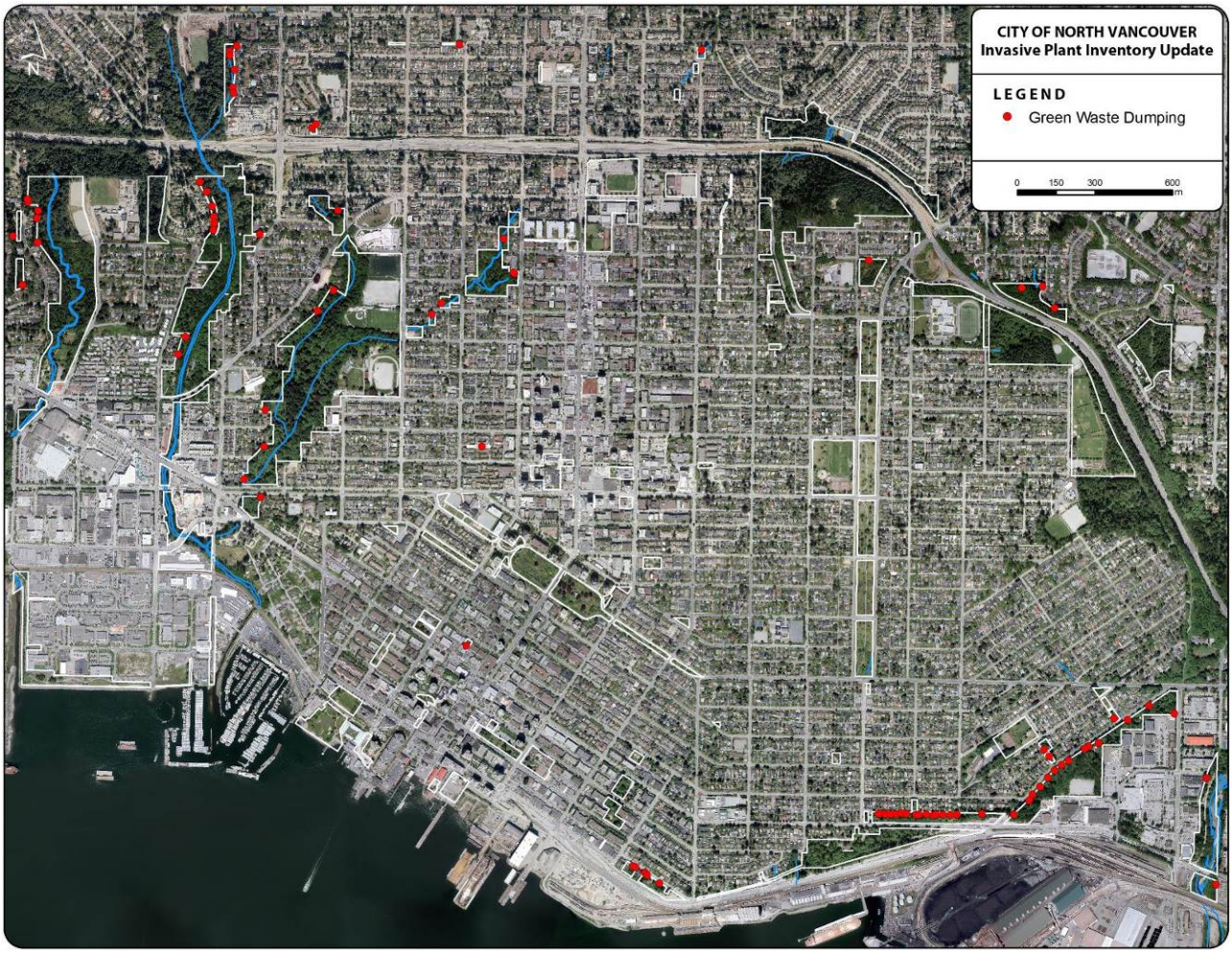

Figure 6. MAP – Inventoried green waste dump sites.

5 DISCUSSION AND RECOMMENDATIONS

5.1 Evaluation: Invasive Plant Control Programs and Restoration Projects

CLIMBING ENGLISH IVY TREATMENT PROJECT

2011 Inventory: 314 sites recorded to have climbing ivy
2015 Inventory: 124 sites recorded to have climbing ivy

Treatment efficacy:
Hundreds of trees were observed to have been treated for climbing ivy. Only a small number remain untreated. Of the 124 sites noted to still have significant climbing ivy, the vast majority have only 1 or 2 untreated trees.

RECOMMENDATIONS:

- Sweep sites for remaining climbing ivy.
- All trees will likely require re-treatment within 5 to 10 years.

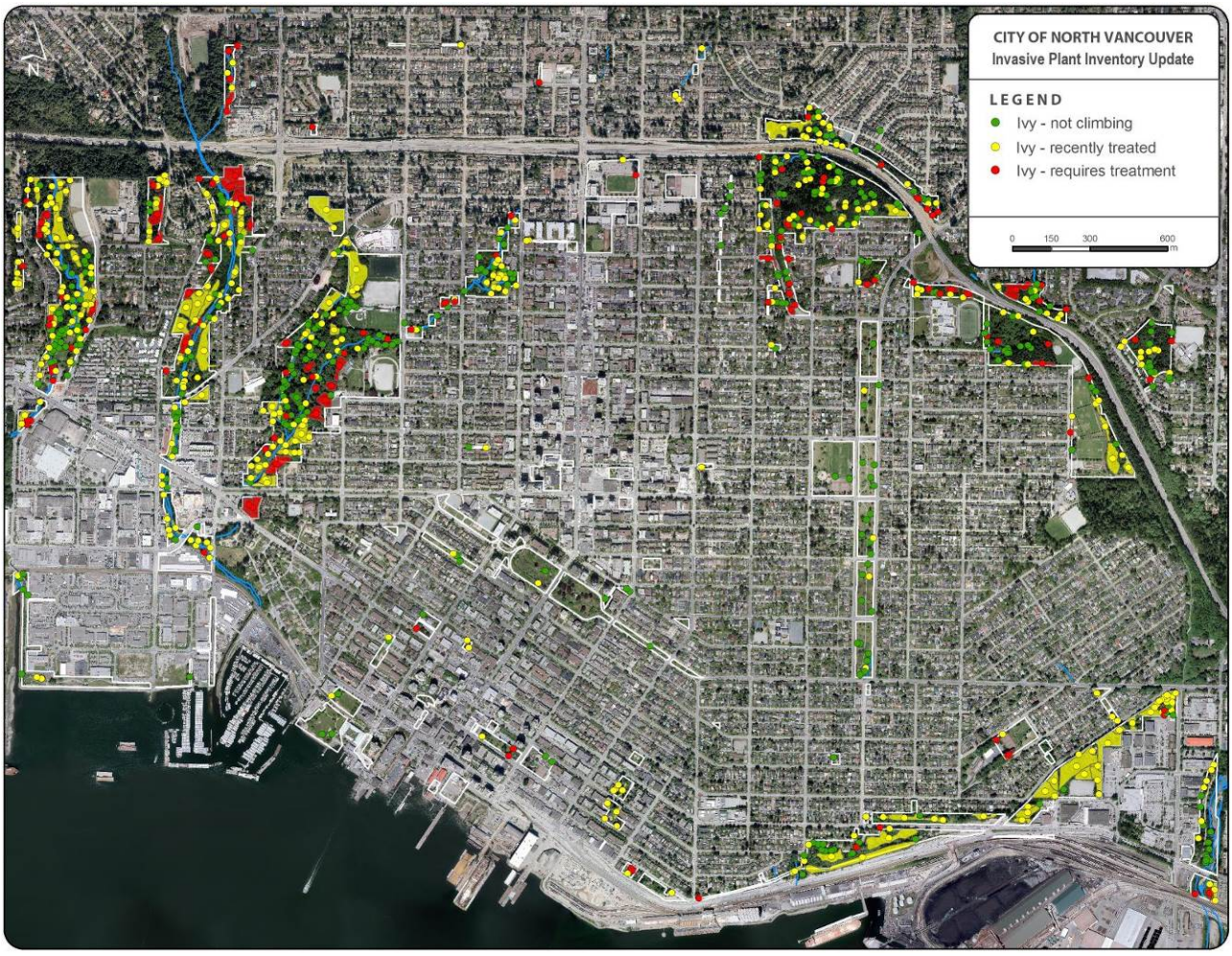

Figure 7. MAP – Inventoried English ivy.

GIANT HOGWEED TREATMENT PROJECT

2011 Inventory: 1,038 m^2 – 471 sites
2015 Inventory: 93 m^2 – 73 sites (13 new sites)
Area reduction: -91%

Treatment efficacy:
Treatment efficacy was high. Ninety percent of remaining sites consist of only 1 or 2 plants.

Restoration:
Only one historic hogweed site was large enough to require restoration. The City has already undertaken restoration at this site in Mahon Park. To date native vegetation is successfully establishing.

RECOMMENDATIONS:

- Treatment crews should use GPS devices (e.g. iPads) to ensure all sites are found. Up to date spatial data of new sites, missed sites, and historic patch were provided to contractor crews in early August 2015. Crews should search for giant hogweed within a 10m radius (minimum) of mapped site extents.
- Continue follow-up treatments. The seed bank is thought to persist for 10 to 15 years or more, therefore monitoring may be necessary for an equivalent length of time. Continue emphasis on first round treatment occurring prior to seed formation.

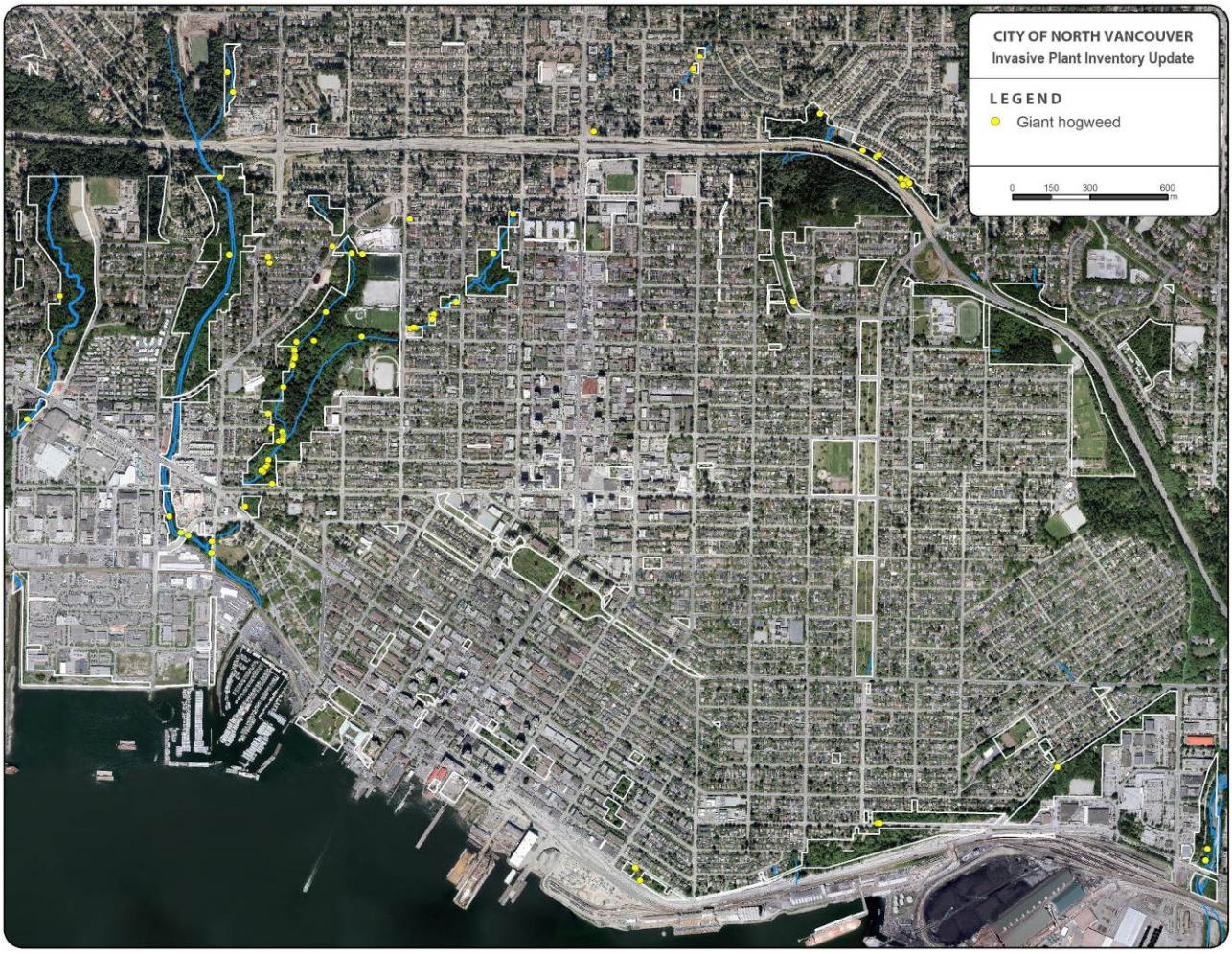

Figure 8. MAP – Inventoried giant hogweed.

KNOTWEED TREATMENT PROJECT

2011 Inventory: 7,728 m^2
2015 Inventory: 2,248 m^2 (new sites: 14 Japanese; 6 Himalayan)
Area reduction: -71%

Treatment efficacy:
The first round of treatment in 2015 occurred in early May. All knotweed sites in Mahon, Mosquito Creek, Heywood, Wagg, Larson, Sunset and Lynnmouth Parks were checked 6 to 9 weeks post treatment. Approximately 45 sites appeared to have been missed during the first treatment round. A further 20 sites appeared to have been only partly treated. Evidence of glyphosate treatment is usually apparent within two weeks of application and should definitely be visible by six weeks. It is possible that in some cases new seedlings grew after the first treatment round. However, many of the missed stems were fully mature (4-8 feet tall). This problem is likely attributable to the fact that all crews this year were new individuals not familiar with the sites. Many of the historically large knotweed sites have scattered, low density re-growth, integrated with native vegetation and thus require careful searching.

At least six occurrences of mutated growth were observed. This takes the form of densely packed, very tiny leaves.

Chemical treatment restrictions in riparian areas:
Forty percent of the remaining knotweed was within one meter of the high water mark of watercourses in April/early May. One third of those sites can be treated during extended periods of summer drought when the high water mark recedes.

Japanese vs. bohemian and giant knotweed:
There is some evidence mounting, from research out of the UFV and UBC, that the majority of knotweed in our region may actually be Bohemian knotweed rather than Japanese knotweed. Bohemian knotweed is a hybrid of Japanese and giant knotweed. It is capable of successful seed germination. It is challenging to differentiate between the three species and therefore identification was not conclusive during the inventory. In time further local research will likely shed light on this matter.

Restoration:
Many of the large knotweed polygons, which historically had dense cane growth, are now mostly devoid of vegetation. In some cases other invasive plant species are starting to establish (e.g. blackberry and ivy). Although some knotweed re-growth and follow-up treatment will still be required in the coming years, restoration planting is now warranted.

RECOMMENDATIONS:

- Treatment crews should use GPS devices (e.g. iPads) to ensure all sites are found. Up to date spatial data of new sites, missed sites, and historic patch were provided to contractor crews in early August 2015. Crews should search for giant hogweed within a 10m radius (minimum) of mapped site extents.
- Implement restoration plantings for historically large knotweed sites.
- Continue follow-up treatments. The monitoring schedule recommended by provincial invasive species specialists is at 1,2,3,6,9,15 and 20 years after initial treatment.

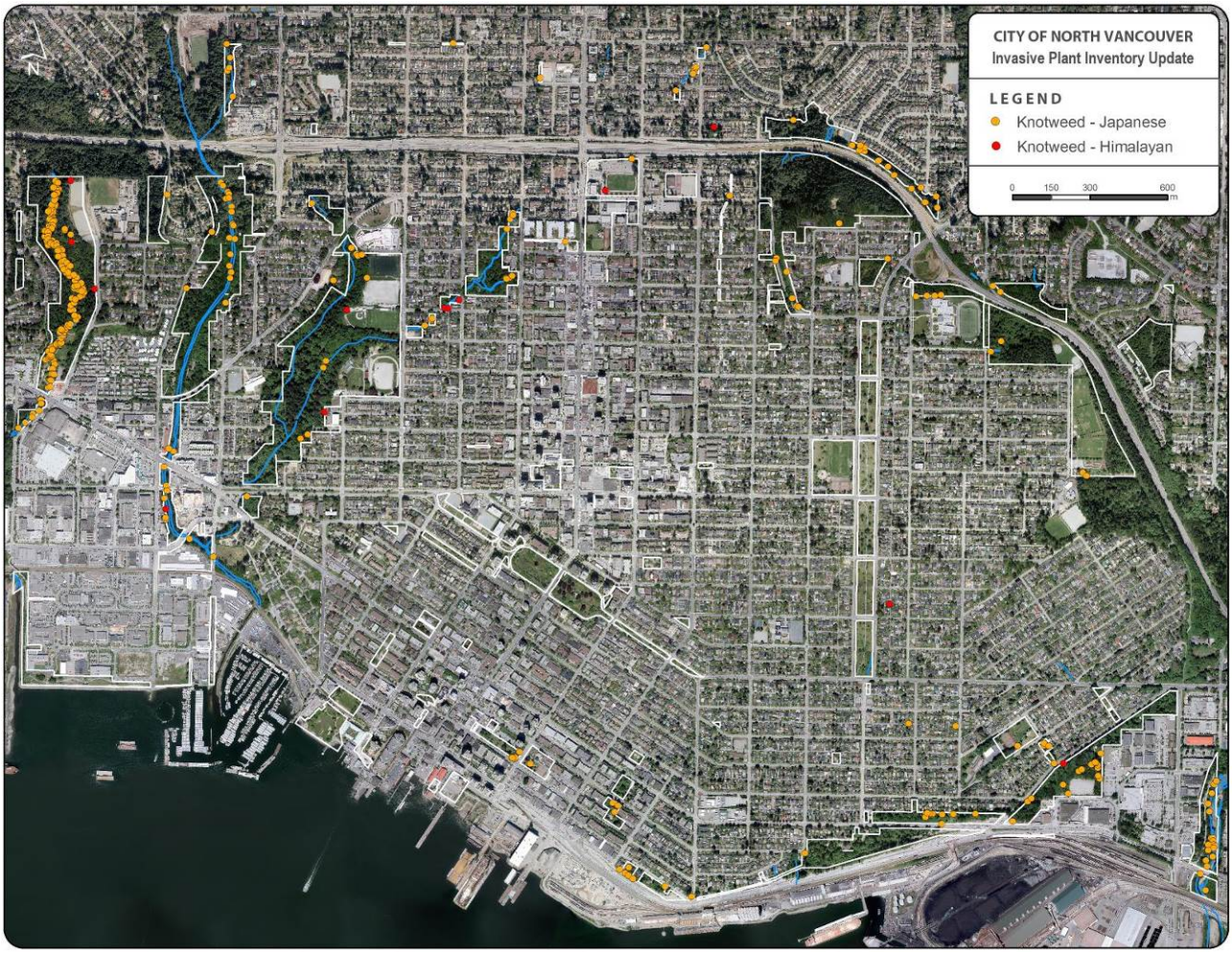

Figure 9. MAP – Inventoried knotweed species.

ECOSYSTEM RESTORATION PROJECTS

2015 Inventory:
Restored Areas – newly planted: 8 sites
Restored Areas – needing maintenance: 18 sites
Restored Areas – successfully established: 12 sites

In total, 39 sites restored sites were observed and mapped during the inventory (Figure 10). The majority of the sites were in Greenwood, Mahon, Wagg Creek, lower Heywood, lower Mosquito Creek Parks.

The City has done a significant amount of restoration work either in association with park upgrades or to target areas impacted by invasive plants. The methodology used to undertake and maintain the restoration sites and the native plant species prescribed and planted have resulted in a very high rate of success. A minor amount of maintenance is required on a few newer sites (namely blackberry control), but older sites exhibit very well established native plant communities.

Some sites have been restored by contractors as compensation for development work or the Port expansion. These sites are all under two years old, therefore it is too early to assess their success.

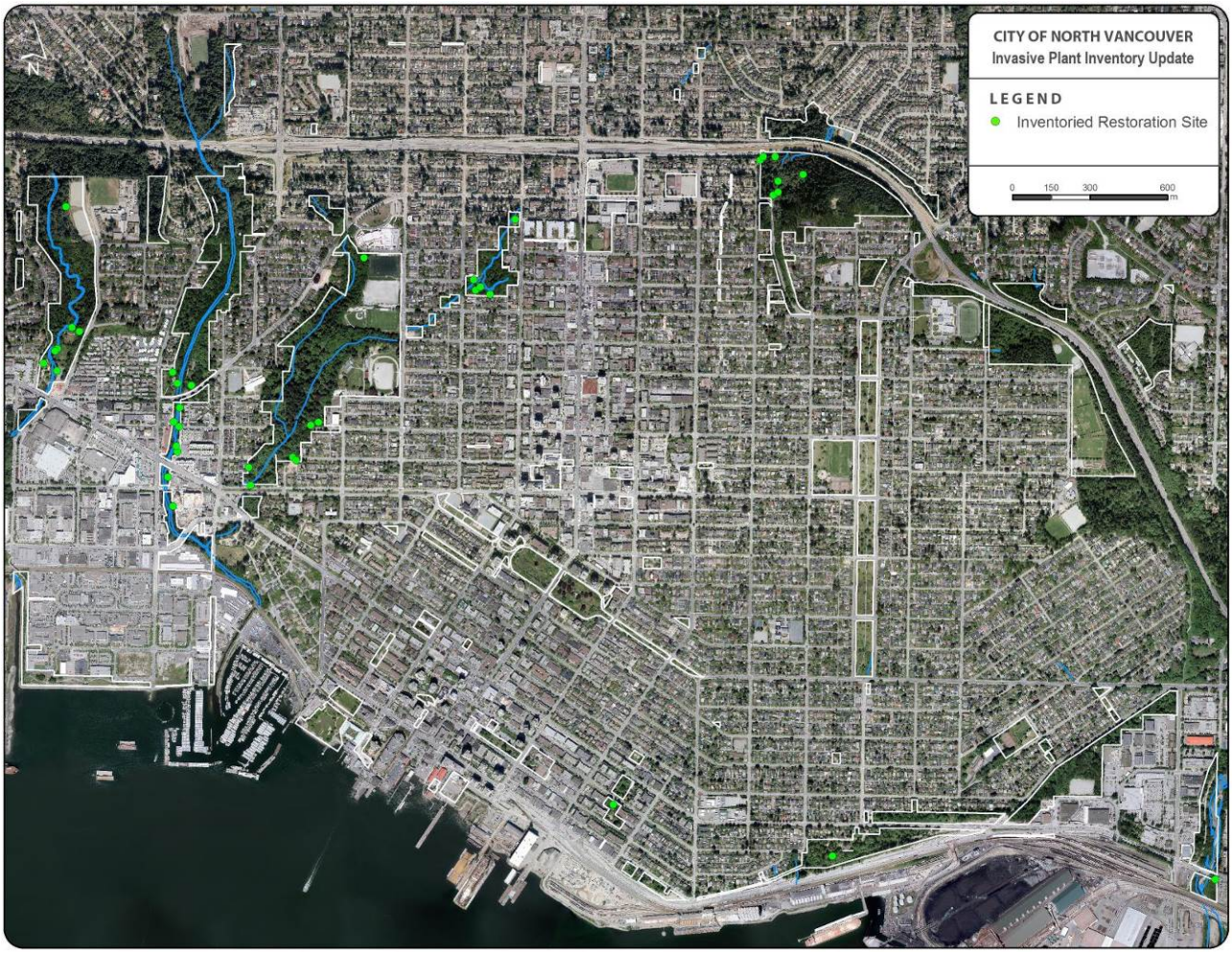

Figure 10. MAP – Inventoried restoration sites.

5.2 Summary of Recommendations

RECOMMENDATION #1: Continue knotweed and hogweed treatment program.

Significant investment has produced excellent results. On-going monitoring and follow-up treatment are the keys to long term success. The eradication of giant hogweed is realistic in the long term. Having these species under control on City lands justifies encouraging control on private lands.

- Continue city-wide treatment program for hogweed and knotweed. The monitoring schedule recommended for knotweed by provincial invasive species specialists is 1,2,3,6,9,15 and 20 years after initial treatment. There is no agreed on monitoring schedule for giant hogweed, however the seed bank is thought to last for 10 to 15 years.
- Implement restoration plantings for historically large knotweed sites. Candidate sites are noted in the inventory database.
- Expand the inventory to include streets and lanes.
- Treatment crews should be made aware to search for knotweed and hogweed regrowth within a 10m radius (minimum) of mapped historic site extents.

RECOMMENDATION#2: Continue program to remove climbing ivy.

The removal of climbing ivy preserves the tree canopy and reduces the number of future hazard trees. The program has succeeded in treating the majority of affected trees.

- Continue city-wide climbing ivy treatment program. Sweep the areas identified in the inventory as having untreated trees.
- Monitor the speed of climbing ivy re-growth. Re-treatment will likely be necessary within 5 to 10 years.

RECOMMENDATION #3: Target specific species for control.

- **English holly**: To avoid re-sprouts, for stems under 5cm diameter, pull roots. For larger holly trees, cut the stem flush to the ground with a chainsaw and cross hatch the cut surface. This promotes rot and reduces the likelihood of new sprouts.
- **Scotch broom, butterfly bush and policeman's helmet**: Eradication is within reach. Continue to target all detected occurrences and monitor for seedlings. Key is removal during blooming period when easy to detect and prior to seed production.
- **English ivy – ground growth**: Prioritize the removal of ground ivy in least impacted parks/parcels. Sweep these areas in a grid like fashion. Focus on removal of new sprouts and small patches. This species continues to be a good candidate for removal by community volunteer groups.
- **Ground cover species**: Tackle isolated, new infestations of invasive ground covers to prevent establishment (i.e. lamium, small-flowered touch-me-not, goutweed and periwinkle).

RECOMMENDATION #4: Build on success of restoration projects.

Once successfully established, restored areas provide pockets of well-established, resilient native plant communities which are less prone to invasion by non-native species. Species selection and implementation observed at restoration sites was excellent in terms of site and ecological suitability.

- Monitor restoration sites and carry-out necessary maintenance until the native plant community has established.

6 Appendix A. EDRR 'Watch List'

A **Watch List** of plants likely to be invasive on the North Shore has been provided in the table below. If any of these plants are found in the City, they would be candidates for Early Detection and Rapid Response (EDRR). The list is not exhaustive and should be updated as new information becomes available. The list includes some species that are already present on the North Shore but whose potential impact is unknown, as well as species that may invade in the future.

Species which are listed **Noxious Weeds** under the BC *Weed Control Act* and/or are on the **proposed Prohibited Weed list** of the Provincial EDRR Program are noted. This list has been cross referenced with similar lists produced by the City of Coquitlam, District of West Vancouver and the District of North Vancouver. Plants are listed in alphabetical order.

Table 6. Invasive plant species 'Watch List'.

Common Name	Scientific Name	Listed Weeds	Detection Status
Bighead knapweed	*Centaurea macrocephala*	Prohibited Weed	
Bugleweed	*Ajuga reptans*		
Burr chervil	*Anthriscus caucalis*	Noxious Weed	
Carpet burrweed	*Soliva sessilis*		
Common reed	*Phragmites australis*	Noxious Weed/ Prohibited Weed	Detected in Richmond
Cordgrass – dense flowered	*Spartina densiflora*	Noxious Weed/ Prohibited Weed	
Cordgrass – Common	*Spartina anglica*	Noxious Weed/ Prohibited Weed	Detected in the Fraser Delta (multiple locations)
Cordgrass – Smooth	*Spartina alterniflora*	Prohibited Weed	
Dalmatian toadflax	*Linaria dalmatica*	Noxious Weed	
False brome	*Brachypodium sylvaticum*	Prohibited Weed	
Garlic mustard	*Alliaria petiolata*	Noxious Weed/ Prohibited Weed	
Giant reed	*Arundo donax*	Prohibited Weed	
Gorse	*Ulex europaeus*		Detected in West Vancouver at Horseshoe Bay ferry terminal
Kudzu	*Pueraria montana*	Prohibited Weed	
North Africa grass	*Ventenata dubia*	Prohibited Weed	
Yellow loosestrife	*Lysimachia vulgaris*		Possibly detected in DNV
Wild chervil	*Anthriscus sylvestris*		Detected in Vancouver and Richmond; Noxious Weed in Fraser Valley Regional District

7 Appendix B. GIS Data Dictionary

Inventory Date: May to July 2015
Surveyors: Fiona Steele and Mike Coulthard
GIS Data Compilation: Fiona Steele

List of Species Inventoried:

Code	Common Name	Scientific Name
BD	Butterfly bush	*Buddleia davidii*
BO	Knotweed – Bohemian	*Fallopia x bohemica*
CP	Periwinkle	*Vinca minor*
EI	English ivy	*Hedera helix*
GH	Giant hogweed	*Heracleum mantegazzianum*
GK	Knotweed – Giant	*Fallopia sachalinensis*
GO	Goutweed (bishop's weed)	*Aegopodium podgaria*
HI	Blackberry – Himalayan	*Rubus armeniacus*
HO	English holly	*Ilex aquifolium*
HP	Hops (common)	*Humulus lupulus*
IM	Policeman's helmet (Himalayan balsam)	*Impatiens glandulifera*
IT	Small flowered touch-me-not	*Impatiens parviflora*
JK	Knotweed – Japanese	*Fallopia japonica*
LC	Laurel – Cherry (English laurel)	*Prunus lauroceracus*
OM	Clematis – old man's beard	*Clematis vitalba*
PO	Knotweed – Himalayan	*Polygonum polystachyum*
SB	Scotch broom	*Cytisus scoparius*
SL	Spurge laurel (daphne laurel)	*Daphne laureola*
YA	Lamium (yellow archangel)	*Lamium galeobdolon*
YI	Yellow flag-iris	*Iris pseudacorus*

Geodatabase:

CNV_Invasive_Inventory_2015	Description
CNV2015_GreenWasteDumping	Green waste dump site location
CNV2015_InvasiveEmergentSpecies	Invasive plant – emergent species
CNV2015_InvasivePoint	Invasive plant – point inventory (MASTER: contains all occurrences)
CNV2015_InvasivePolygon	Invasive plant – polygon (patch extent of occurrences >20 m^2)
CNV2015_PointOfNote	Points of interest (e.g. park encroachment, potential restoration site)
CNV2015_RestoredAreas_Point	Restored area – recorded as point
CNV2015_RestoredAreas_Polygon	Restored area – recorded as polygon

- **CNV2015_GreenWasteDumping**

Data Fields

Field	Attribute Description
ID	ID Number
COMMENTS	
PARCEL	Park parcel name

- **CNV2015_ InvasiveEmergentSpecies**

Data Fields

Field	Attribute Description
ID	ID Number
SPECIES	Species name
AREA	Area of infestation (m^2)
COMMENTS	
PARCEL	Park parcel name

- **CNV2015_ InvasivePoint**

Data Fields

Field	Attribute Description
CNV_ID	ID Number
ASSO_POLY	Y = patch extent is mapped by an associated polygon with identical CNV_ID)
SP_CODE	Species name
AREA_M2	Area of infestation (m^2)
VINE_CODE	0 - Not climbing 1 - Previously treated (by removal from tree stem) or early stage climb (<5 years) 2 - Established climb (>5 years); requires treatment
HWM_CODE	0 - >1m from the high water mark 1 - <1m from the high water mark 2 - Normally <1m from the high water mark, but >1m from the high water mark during extended summer dry periods
PARCEL	Park parcel name
COMMENTS	

- **CNV2015_ InvasivePolygon**

Data Fields

Field	Attribute Description
CNV_ID	ID Number
ASSO_POLY	Y = patch extent is mapped by an associated polygon with identical CNV_ID)
SP_CODE	Species name
PRECENTCOV	Percent cover
AREA_M2	Area impacted by invasive plant (m^2)
POLY_AREA	Total area of polygon (m^2)
VINE_CODE	0 - Not climbing 1 - Previously treated (by removal from tree stem) or early stage climb (<5 years) 2 - Established climb (>5 years); requires treatment
HWM_CODE	0 - >1m from the high water mark 1 - <1m from the high water mark 2 - Normally <1m from the high water mark, but >1m from the high water mark during extended summer dry periods
PARCEL	Park parcel name
COMMENTS	

- **CNV2015_PointOfNote**

Data Fields

Field	Attribute Description
ID	ID Number
COMMENTS	
PHOTO_ID	Photo number (photos are contained in digital deliverables folder)
PARCEL	Park parcel name

- **CNV2015_RestoredAreasPoint**

Data Fields

Field	Attribute Description
SITE_ID	ID Number (corresponds with SITE_ID for RestoredAreaPolygon)
AREA	Restored area (m^2)
STATUS2015	1 – Newly planted 2 – Maintenance required 3 – Successfully established
COMMENTS	
PARCEL	Park parcel name

- **CNV2015_RestoredAreasPolygon**

Data Fields

Field	Attribute Description
SITE_ID	ID Number (corresponds with SITE_ID for RestoredAreaPoint)
AREA	Restored area (m^2)