

APPENDIX 1 - Topography of Stanley Park

STANLEY PARK FOREST MANAGEMENT PLAN



Base Map - Topography

LEGEND

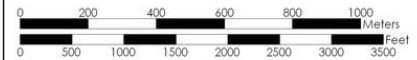
- Major road
- Trail
- Contour line (10 meters)

DATA SOURCE

Orthophoto : City of Vancouver, April 2008
Major roads : Parks & Recreation, 2009
Trails : Parks & Recreation, 2009
Contour lines : Parks & Recreation, 2002

REFERENCE

Projection : UTM Zone 10
Datum : NAD 83



February 2009 - DRAFT
By Vancouver Parks & Recreation and UBC Forestry



APPENDIX 2 – History of Stanley Park Forest Management

Forest Management History

The Stanley Park forest has been the subject of much controversy and discussion concerning stewardship and management. Over the last 140 years, ecological awareness has increased. And there has been a growing understanding of silvicultural practices and a changing appreciation of the impact of forests and natural systems. In much the same way that a forest ecosystem gradually evolves, our vision of the forest has also changed and grown.

Throughout the history of Stanley Park, human and non-human forces have always shaped the forested areas. Many Vancouver residents have long held to a belief that the park is an idealized forest environment, existing in a natural state with little human activity. But there was much human influence and change to the forest structure, starting in the years leading up to the creation of the park in 1888. In the 1860's to 1880's up to five logging companies worked in the park. Trails and rough roadways were carved out of the forest to facilitate these businesses. In 1875, sections of land between Beaver Lake and Lost Lagoon were selectively logged and burned. In 1886, much of Stanley Park was burned, which resulted in fire prevention programs being established. With the creation of the park, fire control became a priority. A network of park trails for hydrants and water delivery system were run through the park, starting in 1910. In 1914, James Swaine conducted surveys



Stanley Park was selectively logged in the 19th century.

of the forest ecosystem. He concluded that that dead or dying trees should be harvested in order to reduce the risk of fungal and insect diseases from spreading. Swaine arranged for replacement of forest tree species with Douglas fir as he felt this was a superior species for the park. Cedar trees were topped to improve aesthetics, underbrush removed and experimental insecticide spray programs were also launched with a view to maintaining a “natural” forest. With all of these changes Stanley Park was being changed into a more homogenous forest, where conifers (especially Douglas fir) dominated the landscape. In 1931, the Park Board approved the first Stanley Park forestry plan which recommended active forest management, endorsing much of the previous work that had been carried out in the forest. The early forest management practices, and their intrusions on natural systems, altered the landscapes to meet the perceptions of wilderness park at the times.

Human activities are not the only forces that have impacted the forest. Natural physical effects, particularly windstorms have resulted in large scale change on a regular basis. Large windstorms that have resulted in significant tree damage have occurred throughout the recorded history of Vancouver. These storms are not unusual occurrences although they may not happen on an annual basis. There is a pattern of storm history that has shaped the landscape of Stanley Park.

Two particularly violent windstorms in 1934, and 1962 (Typhoon Freida), were noted for the severe destruction of large sections of the park forest. Typhoon Freida was the most significant

APPENDIX 2 – History of Stanley Park Forest Management

windstorm event prior to the winter of 2006. After this widespread destruction the Park Board began to reconstruct the forest and remove many of the fallen trees in the same manner as was done for the previous large windstorm in 1934. Cleanup of the damaged forest was a very large task but park forestry practices were carried out without fanfare. The attempt was to provide a “tidy” forest environment with a “natural” appearance.

In 1980, the Park Board approved a plan prepared by Bakewell and Associates for a Forest Maintenance Program for Stanley Park. The principal findings indicated that had been a 25% loss of natural forest acreage between 1933 and 1970. Closed canopy forest had decreased progressively as young coniferous trees were overpowered by deciduous species and underbrush.

The report favoured forest management practices that would maintain a closed canopy forest, considered the natural BC coastal condition for a mature forest. With less sunlight to the forest floor there would be less undergrowth. The forest was perceived as “more park-like, open and self-maintaining.”

This report was the first to recognize park wildlife values, noting that replacing brush and deciduous stands will remove food and protection for the majority of the bird and mammal species. It recommended continuing the present policy of leaving berry bearing trees during clearing and brushing operations.

The Bakewell report recommended establishing a Park Development Plan which would set aside permanent forest reserves to protect the park’s forest resources. It was a progression from the previous forest management plan, a more formalized maintenance program, brushing and thinning of plantations, removal of brush from open canopy stands and a combination of clearing and planting of coniferous species and promoting natural forest regeneration. The report also noted the potential for forest nature interpretation and education.

In 1989, MacMillan Bloedel, Woodland Services Division, approached the Vancouver Park Board with an offer of assistance to create a management plan for the Stanley Park forest. A management review also concluded that the parks’ old growth coniferous forest was steadily reducing, due to storm damage, disease, and, especially, human disturbance. As with the Bakewell report that preceded, the concern was that substantial areas of the forest were being occupied by deciduous trees and shrubs and very young (under 100 yrs) coniferous trees.

This was a comprehensive management plan for forest regeneration in Stanley Park. The key objectives were to maintain a mature coniferous coastal forest in Stanley Park and maintain or enhance wildlife interpretive and scenic values. The report also addressed major disease problems such as dwarf mistletoe and ensured that healthy young trees would replace old growth trees lost to natural causes.

The plan initially called for silvicultural treatments to convert approximately half of the deciduous and mixed stands to coniferous stands. Over a 10 year period, 28,000 trees were to be planted, with priority given to western redcedar. Thinning and fertilization programs were also included to promote the growth of existing immature conifers. Activities were planned to limit the size of individual treatments and maintain as natural appearance as possible.

APPENDIX 2 – History of Stanley Park Forest Management

At the time the total cost for the program was estimated at 3 million dollars. In their agreement with the Park Board, MacMillan Bloedel agreed to pay half of this sum, which included providing much of the expertise and research for the management plan.

This was a thorough management plan, including supporting reports for silvicultural prescriptions for each stand in the 10 year program, ecological classification, and wildlife implications. A forest inventory identified sampling procedures, descriptions of significant trees and stand summary tables.

The report identified potential negative impacts for brushing, deciduous vegetation treatment and hazard tree removal. The report also made recommendations to mitigate negative effects and provide wildlife input into park management.

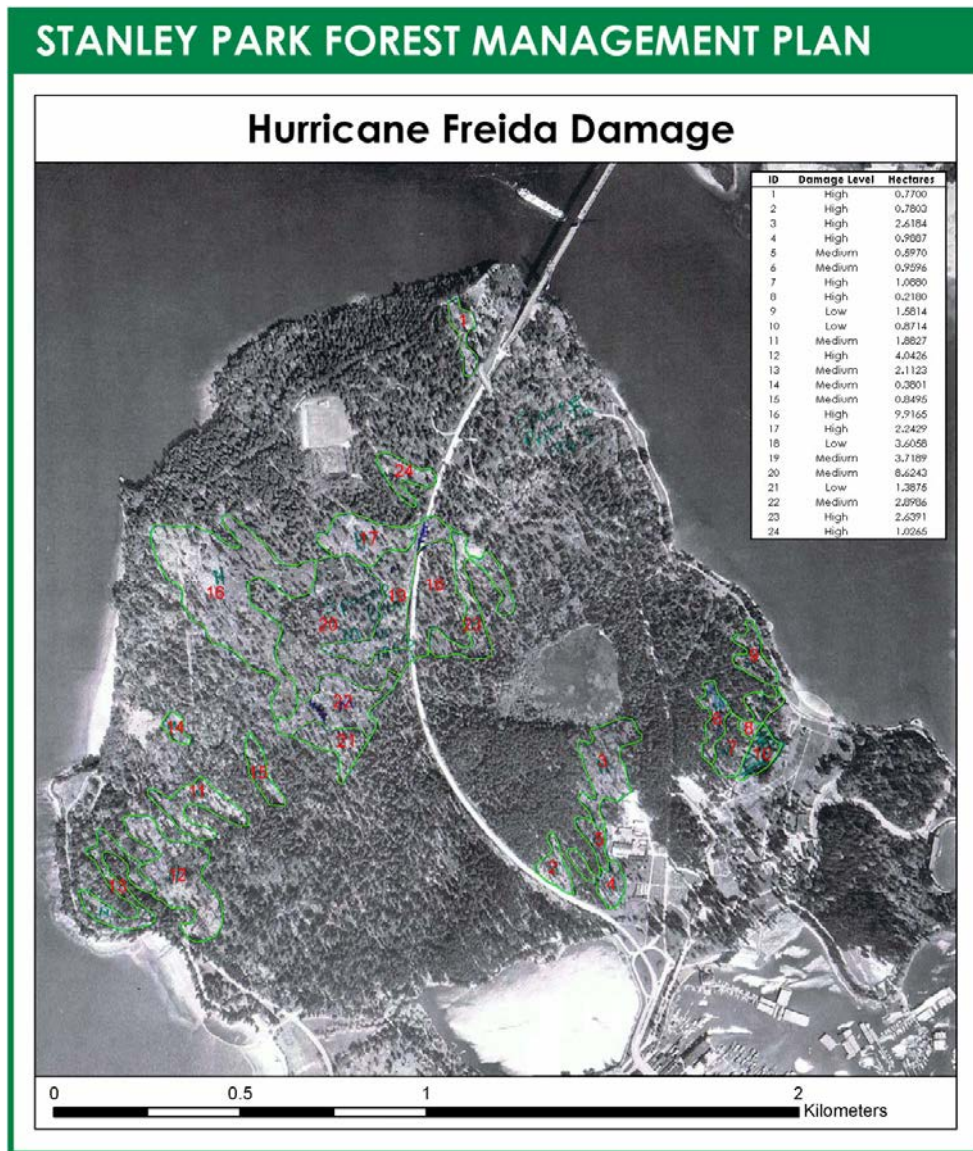
However, several groups began oppose the direction of the program. There were concerns that the forest plan would result in major changes to the park, particularly the intent of creating a closed canopy forest by removal of deciduous growth. There were concerns that the removal or alteration of early seral stages would negatively impact wildlife habitat and biological diversity. The Board did not approve the regeneration program.

The Macmillan Bloedel report provides an excellent synopsis of the park geology, physiography, and natural history, including vegetation, site associations and wildlife inventories. Much of this information remains the same today as when the report was published. However, there are changes to some natural elements, driven by climatic changes, expanding human use of the park, and significant environmental disturbances such as those resulting from the winter storms of 2006.

Even though we may consider Stanley Park as a pristine virgin forest it has been changed by a combination of human activities and natural disturbances over the course of history. Our view and concept for the forest have also changed over time. Such issues as fire control, disease prevention, aesthetics and our idealized vision of what a natural forest should look like have all shaped the direction of management. Improved knowledge and understanding of scientific disciplines such as ecology and silviculture will help to guide the direction for the next forest management plan.

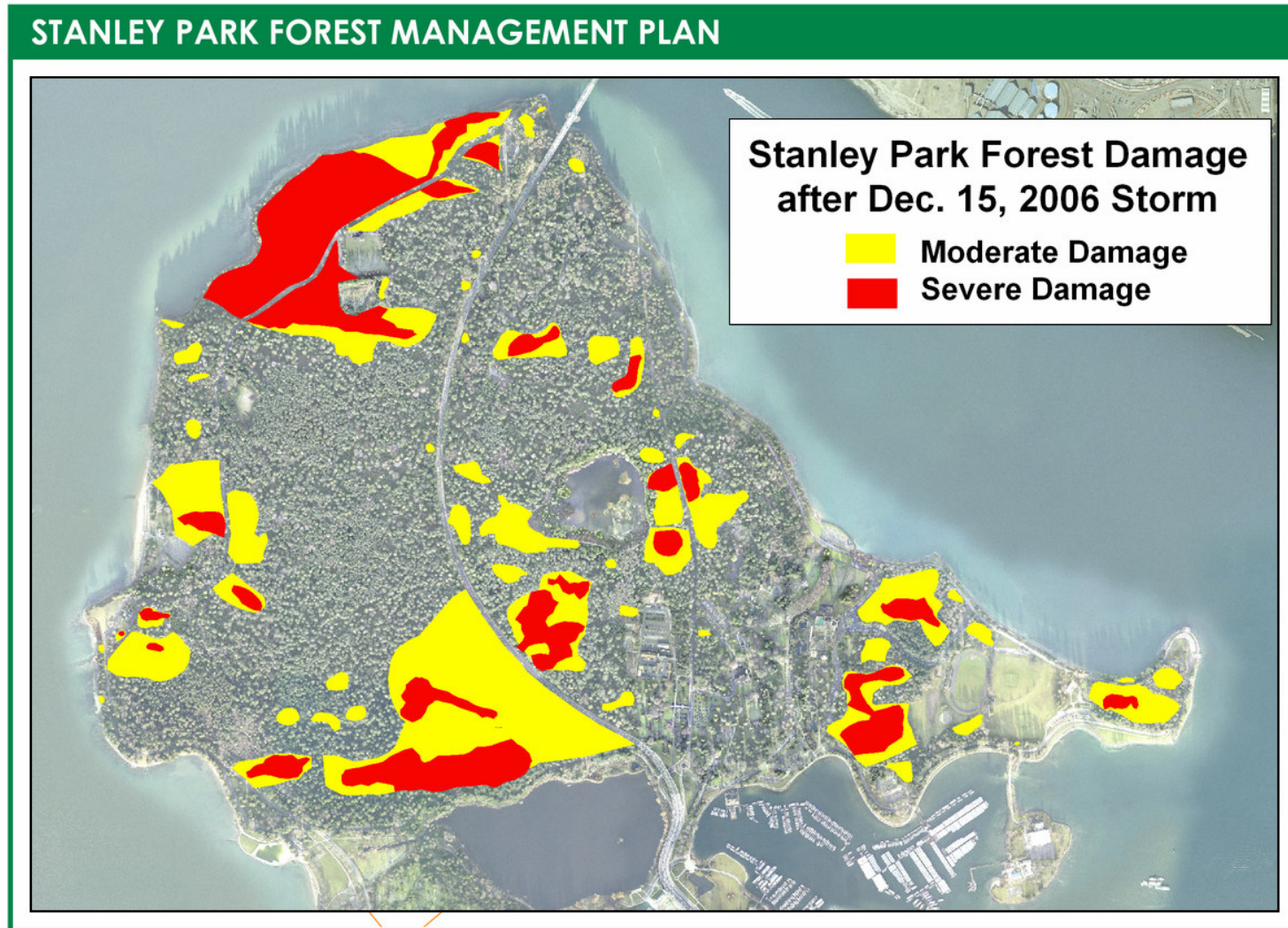
By Mike Mackintosh
Vancouver Park Board
2009

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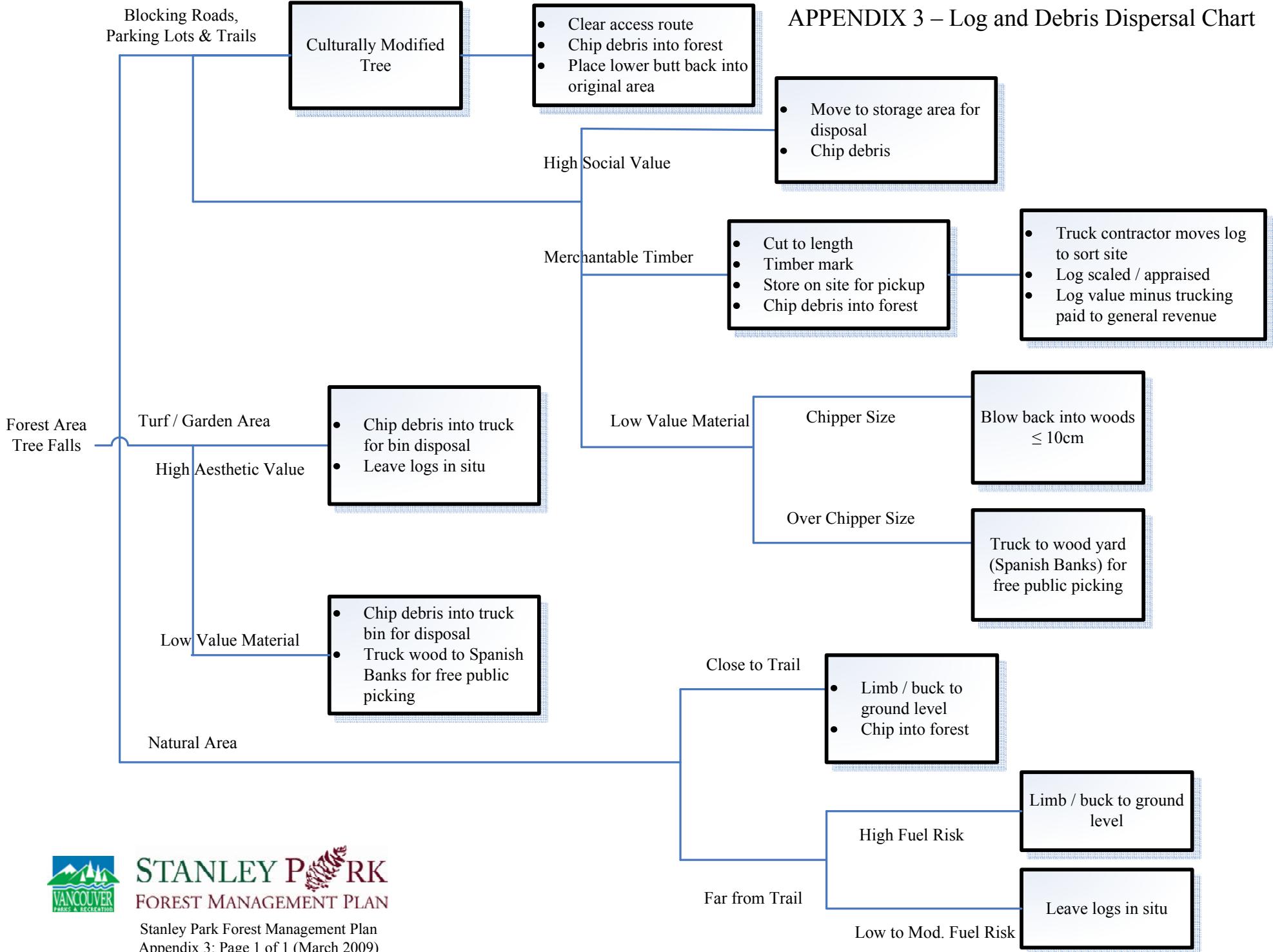
Map 2.1: Hurricane Freida Damage

APPENDIX 2 – History of Stanley Park Forest Management



Map 2.2: Stanley Park Forest Damage after Dec. 15 2006 Storm

APPENDIX 3 – Log and Debris Dispersal Chart



APPENDIX 4 – Sample Windfirming Prescription

Sample prescription

The following is the prescription followed after the 2006 windstorm. It is to be used as a guide for developing new prescriptions, should the need arise.

Rationale

Newly created edges in certain types of forests are unstable. The roots of edge trees are often partially damaged by the storm. Undamaged new edge trees are more susceptible to being blown over because their inherent stabilization processes have not had time to react fully to the increased wind forces. It takes several years for them to become independently wind resistant. There is therefore a tendency for unmanaged windthrow edges to continue to expansively change until limited by improving stand conditions, soil or hydrological dynamics, or lessened wind exposure.

Windthrow events are frequent occurrences in BC's forest. For perspective, there is more timber lost to windthrow every year than is harvested in all logging operations combined. In response; the forestry community has conducted research on its distribution and causes, and are becoming closer to being able to predict and prevent these events. The Park Board is tapping into this developing expertise in order to ensure that the best practices available are applied both effectively and efficiently.

The prediction of windthrow risk is accomplished by inputting known parameters of stand conditions, soil characteristics, topography, and wind data into computer models. Dr Stephen Mitchell at the UBC Faculty of Forestry has been centrally involved in developing and testing these models, and will be generating stand vulnerability maps for the Park Board as the input information becomes available.

The likelihood of windthrow is reduced when newly created forest edges are stabilized by a process called windfirming. In dense stands, this work involves the feathering of the forest edge by selectively falling or stubbing trees most likely to cause further damage. Dense and open stands receive crown reduction pruning within a specified distance from the edge. The intent is to remove enough wind resistance from the crowns of the retained trees to allow them time to react by strengthening their roots and trunks; but not so much that the wind penetrates unimpeded into the trees behind. Done properly, the wind force is dissipated gradually as it enters the new edge. The thinned trees will grow back new branching with time and are intended to become the new adjusted edge trees. Research has shown that this method is effective at reducing post catastrophic event windthrow spread.

Determine susceptible edges and prioritize work

Map out damage

A digital aerial photograph of the park was taken on December 16, 2007. The areas of the forest immediately known to have new openings were approximately marked on the photo. A flyover by helicopter allowed further confirmation of windthrow areas. Foresters Paul Lawson and Jeff Irwin flagged the edges in the field. Diamond Head Consultants were retained to assess danger trees in these openings in preparation for the coming cleanup and silvicultural operations. They used GPS devices to log the flagged boundary coordinates, which were in turn added back in as a layer to Park Board and Diamond head GIS systems.

APPENDIX 4 – Sample Windfirming Prescription

A more detailed map of the windthrow areas was made by Dr Stephen Mitchell, based upon highly zoomed in images of the December '06 photo.

Analysis of the pattern of windthrow within the park looked at a variety of factors: wind exposure, topography, hydrology/soil moisture, and stand conditions. The stand conditions of specific interest were species composition, height, age, density, live crown ratio and trunk taper, as well as observed disease incidence. These inputs are sufficient for Dr Mitchell to begin the preparation of a computer generated windthrow prediction model based upon extensive research of their behaviour in west coast forests.

Several areas are of obvious first concern and are to be treated immediately for safety reasons. These are segments of the forest that have a high target potential and are of moderate to high risk of continued activity. They are at the leading edges of the windthrows near the west side of the causeway, and at the trailing edges of the windthrows on the east side of the causeway which are now exposed to easterly storms. These areas are to be treated as the first phase of the windfirming work, and will be attended to as soon as possible. The second phase addresses areas that are adjacent to recent windthrows and where the probability of it spreading is moderate or high; and where the target rating is moderate or low. Moderate target areas are to be done first within phase 2, though low target areas might also be thinned at the same time if their locale suggests an efficiency gain.

The windfirming of high risk of failure areas that are not adjacent to windthrow areas is being considered, but are not in the work plan at this time. There are other stands within the park that are of moderate risk of wind throw but growth will soon shift them into a high risk rating.

Prescription

Higher exposure: Work within one tree length of the windthrow edge.

For Cedar and Douglas fir, remove 50 % of the original crown of the edge trees using the spiral pruning method, with a slight preference for cutting on the windward side of the crowns. Branches that fell during the storm events count toward the 50 % figure. Trees two crowns in from the edge should be reduced by 40 %, the third crown trees need only be thinned by 30 %. For new edge hemlocks, and those two crowns in, remove the tops of the new edge trees, bringing them down to about 2/3 of their original height. Hemlocks three crowns in will be spiral thinned by 30 %, in the same fashion as the third crown Cedars and Douglas fir

Lower exposure: Work within ½ a tree length from the windthrow edge.

Spiral thin all coniferous species by 30 %, with a slight preference for cutting the windward side of the crowns.

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan

Forward

This appendix is based largely upon the ‘Stanley Park Fire Preparedness Plan for 2007’ (Blackwell, 2007). It has been reorganized and edited for continuity of detail and content, it is available in its original form in the Park Board archives.

1 Introduction

The Stanley Park forest is approximately 250 hectares in size and is visited by approximately 8 million people annually. In all, the park contains approximately 150,000 mature trees.

The most probable fire event in the Park would be associated with an accidental or intentional ignition by a Park visitor. Smoking, illegal campfires and/or a car fire, for example, all have the potential to provide an ignition point for a significant fire event within the Park.

The windstorms of 2006/07 brought severe damage to about 40 hectares of the forest, and moderate damage to another 40 hectares. The amount, size distribution, and arrangement of potential fire fuel caused heightened concerns for an uncontrollable fire during the summer of 2007. A comprehensive fire protection strategy was developed and implemented, and no such fire occurred. Approximately 7000 logs and 15,000 cubic metres of ground wood chips were subsequently removed from the areas of severe damage, with an emphasis placed on removing the more flammable components of the downed material. Pockets of high fire risk fuels within the moderately damaged forest were attended to during the summer of 2008, though some remain due to inaccessibility to equipment.

2 Purpose of the Plan

The objective of this Plan is to detail, for the City of Vancouver (including the Vancouver Park Board and Vancouver Fire Rescue), Metro Vancouver (MV) and Ministry of Forests and Range (MOFR), personnel, procedures used and equipment available for prevention, detection and suppression of forest fires within Stanley Park. The Fire Preparedness Plan is in effect for the fire season, from April 1 to October 31 each year, or as otherwise determined by the Vancouver Board of Parks and Recreation, and will be subject to annual or periodic updates to supersede the previous year’s Plan. This Plan will also form part of the Emergency Preparedness Plan formulated by the City of Vancouver.

2.1 Interagency collaboration

Metro Vancouver (MV), Vancouver Fire and Rescue Services (VFRS), and the Park Board have been coordinating their approaches to fire preparation, prevention, and suppression for Vancouver. This inter-agency team holds regular meetings to strategize about shared resources, training, short and long term planning, public education and communication, along with monitoring and response. Additionally, a regional group called the south Coast Interface Committee (SCIC), which consists of Provincial Ministry of Forests and Rangelands, and other municipalities, meets annually to share information. Such collaborative work should continue.

The most basic product of communication aid is a comprehensive contact list that is kept current. The

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2009 version is as follows:

Table 1 Emergency Phone List

MEDICAL		
Emergency		911
Provincial Ambulance		911
St. Paul's Hospital		604-682-2344 (Main Switchboard)
Vancouver General Hospital		604-875-4111 (General Inquiries)
EMERGENCY RESPONSE		
Vancouver Police Department		911 (Emergency) OR 604-717-3321 (Non-emergency)
Vancouver Fire Rescue		911 (emergency) OR 604-665-6000 (General Inquiries)
West Vancouver Fire Rescue		911 (Emergency) OR 604-925-7370 (Non-emergency)
North Vancouver District Fire Rescue		911 (Emergency) OR 604-980-7575 (Office)
Poison Control Centre		1-800-567-8911 OR 604-682-5050 (Local)
Provincial Emergency Program		1-800-663-3456
BC Hydro		1-888-769-3766 OR *HYDRO (*49376)
Terasen Gas		1-800-663-9911
MINISTRY OF FORESTS AND RANGE		
Ministry of Forests and Range	Fire Calls 24/7	250-951-4200
	Fire Control, Non Emergency	259-951-4201
	If no answer call	1-800-663-5555 OR *5555 from a cellular phone
Fraser Fire Zone	General	604-504-4707
Forest Protection Officer	Rick Kimmerly	604-504-4707
Haig Fire Base	Grant Preston	604-869-5835
METRO VANCOUVER	After Hours	604 432-6308
MV –Watershed Forester	604-341-1473	Pgr. 604-669-6500 #2226
MV – Fire Protection Officer	604-924-1267	Pgr. 604 473-0429
Weekdays 8:30-4:30 MOFR	Dan Morrison (2007 Fire Season Contractor)	250-468-7373
AIRCRAFT		
Talon Helicopters		604-214-3585 (General)
Blackcomb Helicopters		1800 330-4354 604 938-1700
Highland Helicopters (Richmond)		604.273.6161 (General)

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan

Table 2 Stanley Park Supervisors Phone List

Name	Position	Office	Cellular	Home	Pager	Radio
Brian Quinn	Supervisor of Stanley Park Maintenance	604-257-8521	604-841-1564			
Guy Pottinger	Superintendent Stanley Park Gardeners	604-527-8527	604-830-2071			
Paul Montpellier	Supervisor of Arboriculture	604-257-8487	604-830-8546			
Bill Stephen	Superintendent of Stanley Park forests	604-257-6910	604-861-1753			
Joyce Courtney	Manager of Communications	604-257-8699	604-861-4375			

Table 3 Radio Frequencies

Organization	Transmit	Receive	Tone
Stanley Park Operations	151.355	151.355	no tone
Park Lifeguards	408.5235	408.5235	no tone
MOFR – Strategic Interagency Command	155.460	155.460	no tone
MOFR- Tactical fire operations - silver	164.910	164.910	no tone
MOFR – Tactical fire operations - copper	163.890	163.890	no tone
Metro Vancouver	169.62	169.17	Rx 131.8 Rx 110.9

3 Forest Fire Prevention

3.1 Fire Weather

A MOFR fire weather station is maintained at the Capilano dam. Readings are recorded daily from April 1 to October 31. The Canadian Forest Fire Weather Index system is used to determine the fire hazard, which is transmitted by email service to park managers.

3.2 Fire Danger rating and operational constraints

The Canadian Forest Fire Weather Index System is used to determine an index classification which in turn governs operational activities, patrols, strategies, commencement of early shift and operational closure. The Buildup Index (BUI) and the Fire Weather Index (FWI) are combined to indicate the Fire

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan

Danger Class (DGR) as follows.

Table 4 Fire Danger Class for Region 1 (Schedule 2 in the Wildfire Regulation)

BUILDUP INDEX	FIRE WEATHER INDEX				
	0	1-7	8-16	17-30	31+
0 - 19	I	II	II	III	III
20 - 42	II	II	III	III	IV
43 - 69	II	III	III	IV	IV
70 – 118	II	III	IV	IV	V
119 +	III	III	IV	V	V

The Wildfire Act outlines operational requirements related to different levels of fire danger. The application of operating requirements has been modified to better reflect wildfire probability and suppression capability within Stanley Park. These guidelines will apply during the fire season and determined by daily review of the current fire weather and related indices.

Table 5 Operational Requirements based on Fire Danger Classes

Fire Danger Class I	Very Low	Normal Operations
Fire Danger Class II	Low	Normal Operations
Fire Danger Class III	Moderate	Normal operations with some restrictions on use of equipment.
Fire Danger Class IV	High	Maintain a fire watch after work for 2 hours. After 3 consecutive days of DGR IV maintain a fire watch after work for 2 hours.
Fire Danger Class V	Extreme	Maintain a fire watch after work for 2 hours. After 3 consecutive days of DGR V or greater, cease activity between 1 pm and 9 pm local time each day. After 3 consecutive days of DGR V operations may cease and site specific areas or portions of the park may be closed down to all but essential activities.

3.3 Application of the Wildfire Act and Recommended Operating Procedures for Restoration Activities

The *Wildfire Act* [SBC 2004] and the Wildfire Regulation (B.C. Reg. 38/2005) are intended to define the specific responsibilities of all users of forest lands and grasslands in terms of fire management on Crown land in British Columbia. In strict legal terms this legislation does not apply to the City of Vancouver and more specifically to Stanley Park. However, the Wildfire Act and Regulation contains specific fire prevention and fire control measures that are considered best practice. Although the City of Vancouver is not obliged to implement these measures under legislation, following the intent of the Act will reduce the risk of fire and ensure adequate prevention, detection and suppression measures are in place for the 2007

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan

fire season.

3.4 Best Practices for Fire Prevention as per the *Wildfire Act* and Regulation

The following section is adapted from Part 2 of the Wildfire Regulation and has been altered from the original text.

For the purposes of restoration activities within Stanley Park, each of the following activities is included in the definition of "industrial activity":	For the purposes of restoration activities within Stanley Park, each of the following activities is included in the definition of "high risk activity":
	<ul style="list-style-type: none"> Mechanical brushing
<ul style="list-style-type: none"> Mechanical modification of forest debris 	<ul style="list-style-type: none"> Using fire- or spark-producing tools, including cutting tools
<ul style="list-style-type: none"> Silviculture treatments 	<ul style="list-style-type: none"> Operating a power saw other than while doing so on a road or a landing or in a log sort area
<ul style="list-style-type: none"> Operating a power saw on a road 	<ul style="list-style-type: none"> Tree processing, including de-limbing; portable wood chipping.
<ul style="list-style-type: none"> The use of machinery on a road 	<ul style="list-style-type: none"> Operating a vehicle equipped with metal tracks, chains or studs other than operating it for road construction, road maintenance or road deactivation, or on a road or landing or in a log sort area
<ul style="list-style-type: none"> Loading logs on a road 	<ul style="list-style-type: none"> Clearing and maintaining rights of way, including grass mowing

Table 6 Restrictions on High Risk Activities (Schedule 3 in the Wildfire Regulation)

Column 1 Fire Danger Class (DGR)	Column 2 Restriction	Column 3 Duration
II (moderate)	After 3 consecutive days of DGR III or greater, maintain a fire watcher after work for a minimum of one hour.	Until after the fire danger class falls below DGR III
IV (high)	Maintain a fire watcher after work for a minimum of 2 hours	Until after the fire danger class falls below DGR III
V (extreme)	Cease activity between 1 p.m. PDT (Pacific Daylight Saving Time) and sunset each day and maintain a fire watcher after work for a minimum of 2 hours.	Until after the fire danger class falls below DGR IV for 2 or more consecutive days
	After consecutive days of DGR V (as determined by the Director of Stanley Park District), cease activity all day.	Until after the danger class falls below DGR V for 3 or more consecutive days, or falls below DGR IV

The MOFR Protection Branch maintains a website for Danger Class Rating for the Coastal Area that reports up to nine days of Danger Class <http://www.bcwildfire.ca/hprScripts/DgrCls/index.asp?Region=2>

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan

Additional Best Practices for Fire Prevention

The following operational conditions will apply to all industrial and high-risk activities in the Park Forest during the fire season when the fire danger rating is moderate or greater:

Early Shift is defined as industrial operations shutting down at 1 pm noon Pacific Standard Time. All industrial operations will shut down at 1 pm PST as required by the “restrictions on high risk activities” in the MOFR Wildfire Regulation (Table 6).

All industrial activities will be reviewed on the first day of extreme (DGR V). The fire weather readings are taken at 1200 hours (Standard Time). Once extreme fire danger is confirmed, all operations will be reviewed to assess whether they should be shut down. Shut down operations will remain in effect until a minimum of 5 mm of rain has been recorded, and there has been a reduction in Fire Danger Class.

Exemptions: Where a particular activity is unlikely to result in a significant danger of fire occurring or is required for restoration, the Director of Stanley District or a person authorized by him may exempt an industrial operation from all or part of the closure formula.

Patrols/Watchman: Stanley Park personnel or their assigned contractors will patrol all industrial operations as required by the closure formula outlined in Table 6.

Smoking: During the fire season smoking is only allowed in designated areas as directed by the site supervisor. During high and extreme there is to be no on site smoking.

Industrial Operations Responsibilities: All contractors and equipment operators will take all necessary precautions to prevent and suppress fire arising directly or indirectly from their industrial activities. They are also responsible for the following fire preventative measures: machines must be clean and good repair; machines must be shut down while refueling; and, oil must not be drained or leaking.

3.5 Trail access to public vehicles

Although non-service vehicles are not allowed to drive on the interior trails, there is inadequate control. There are many non-controlled ports of entry that are frequently used for a variety of purposes during off hours – often while involved with illegal activities. There is a range of security issues associated with this misuse of trails, an elevated fire ignition risk is but one of them. The compost bin roofs have twice been destroyed by vehicular arsonists in recent years.

4 Detection

Detection of fires is one of the most effective methods of limiting fire risk and catching small fires before they become large. Regular evening and morning patrols focused on areas known for illegal fires and fire starts would be a prudent way to prevent fire escapes and hasten response time. The frequency of patrols should be determined by the fire danger, and the amount of public use. Patrols could be carried out by Vancouver Fire and Rescue Services, or the Vancouver Police Department in well used beach/ forest interface areas.

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5 Special Precautions, Restrictions and Closure

If Vancouver experiences an extended period of drought and fire danger becomes extreme, it may be necessary to take special precautions and/or close portions of the park. This may include other mitigation measures such as watering down debris accumulations in high use areas, installation of sprinklers and or other suppression measures as determined by the Director of Stanley District. While any closure would be considered undesirable, it may be necessary given the amount of fuel, the number of visitors, and protection of human safety and park infrastructure. Analysis of historic fire weather data is summarized in Table 8.

Table 7 Summary of historic fire weather indices

	Vancouver Airport 1978-2004			Vancouver Airport 2003		
	70th	80th	90th	70th	80th	90th
Drought Code	301	353	419	461	547	635
Build-up Index	44	58	79	97	111	137
Fire Weather Index	10	13	17	18	20	22

The average 90th percentile drought code for the period 1875 to 2004 within the Coastal Western Hemlock dry maritime biogeoclimatic unit (CWHdm) was 372 while at Vancouver Airport it is slightly higher at 419. During the 2003 fire season the 90th percentile drought code exceeded 600. Similarly the 90th percentile buildup index averages 114 for CHWdm, 79 at Vancouver Airport during the period 1875 to 2004 and was 137 during the 2003 fire season. Based on these numbers, additional measures including special precautions and closures of trails and roads in the vicinity of the blowdown areas may be required during periods when the drought code exceeds 400 in combination with a buildup index over 100. Coal barbequing and smoking in Stanley Park will be banned if the drought code exceeds 500.

It is recommended that a threshold level of drought code (DC) of 600, a component of the Canadian Fire Danger Rating System, be used to establish specific area closures as determined by the Director of Stanley Park District.

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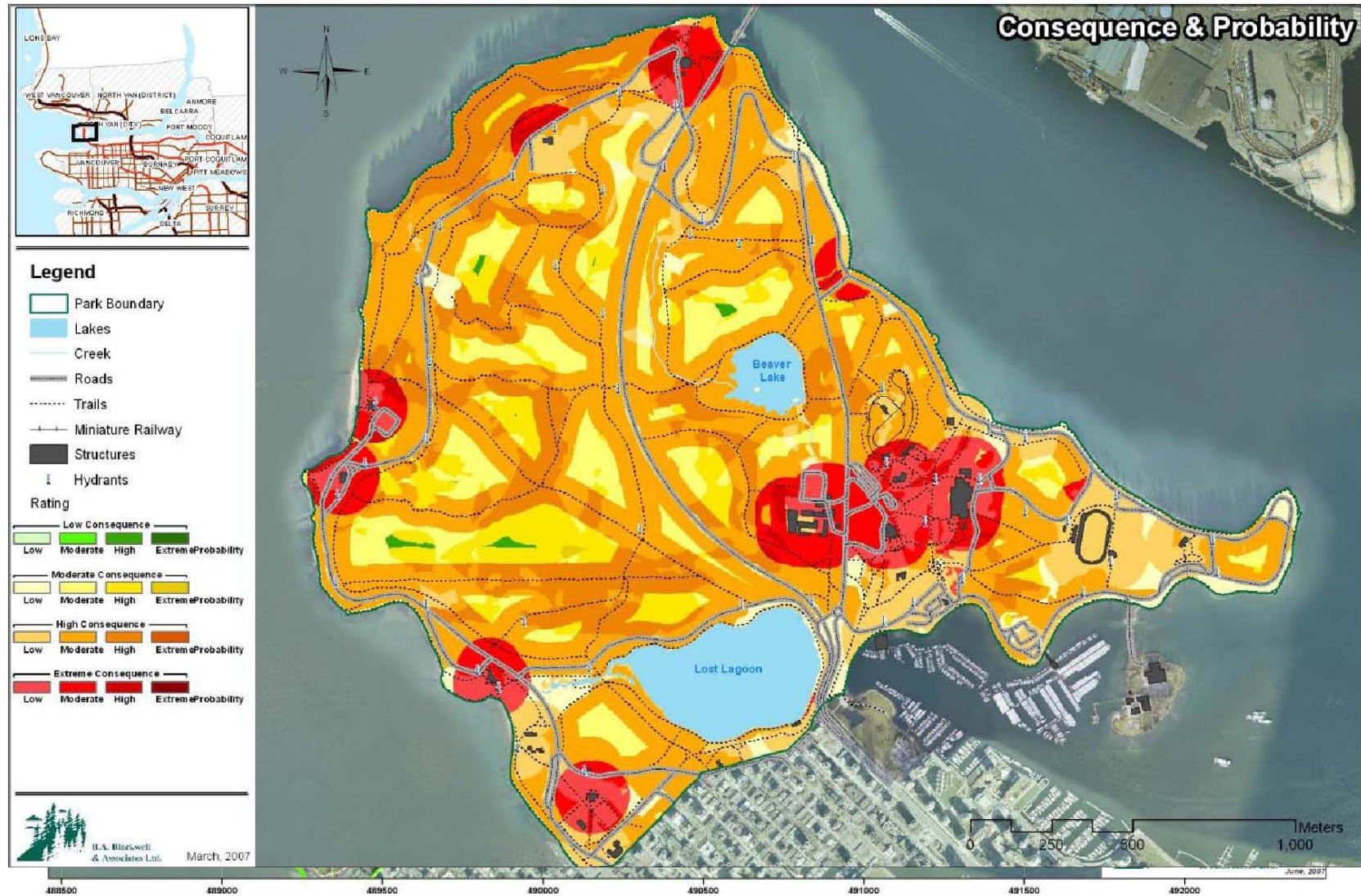


Figure 1 Wildfire risk map showing combinations of probability and consequence as at May 2007

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6 Suppression

During times of very low (DGR I) to moderate (DGR III) conditions the Park Board will have at its dispatch,

Wildland fire equipment is maintained and operated by Vancouver Fire and Rescue Services, and located at Fire Hall No. 8 at 895 Hamilton Street. This equipment will be used to respond to any small fire within the park. Assistance can be requested from the MOFR and may include the Metro Vancouver attack crew at the MOFR's discretion. Vancouver Fire and Rescue will respond to any fire within the park during both daylight and night-time hours. The MOFR Coastal Fire Centre will be notified by the VFRS immediately of any dispatch and will determine additional resource requirements based on current conditions. Where the assessed fire behaviour is greater than rank 3 (Appendix III), air tanker support should be requested immediately by Vancouver Fire and Rescue.

The Stanley Park maintenance crew (approximately 20 plus individuals) should be trained to an adjusted or modified S-100 standard prior to June 15. These resources will provide additional back up to Vancouver Fire Rescue, MOFR and MV crews during a fire event. Additionally, these crews will provide local and immediate fire response to any given ignition in the park prior to the arrival of Vancouver Fire.

6.1 Fire season preparation

The fire season on the south coast typically begins in early summer, but park staff should start preparing in March in case it arrives unseasonably early. A basic checklist of :

- Review fire management plan with staff and VF&R
- Arrange annual S101 training for relevant staff
- Check all equipment and signage for functionality
- Attend South Coast Interface Committee (SCIC)
- Contact Float plane companies regarding 'fire spotting'

6.2 Infrastructure – water access, trails

As of 2008, there are 72 functioning fire hydrants spread throughout the park. They are checked bi-annually by City Engineering – Waterworks Operations. Reversing valves have recently been installed to allow water pressure to be maintained during a significant draw-down. VFRS has stated that the existing water infrastructure is adequate for fighting a ground based suppression.

Most, but not all trails, are accessible to the wildland fire suppression trucks. Accurate maps are kept at Firehall # 8, fire fighters routinely conduct familiarization exercises within the park. The trail system is adequate to access most parts of the forest. Trail markers assist with way finding, but many trail intersections are now lacking markers.

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan



Figure 2 Water sources and accessibility map for suppression purposes

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7 Emergency Evacuation

Evacuations will be managed by emergency response incident command.

8 Air Operations

Harbour stakeholders have been notified by Transport Canada through a Notice to Airman.

9 Stakeholder Notification

If fire risk reaches predetermined thresholds this may require use restrictions and/or closure of some portions of the park as outlined above. Additionally, a fire in the park may require evacuation, access closures and control of the Park and local air space. All of these actions have the potential to negatively impact local businesses and stakeholders. The Park Board, as part of its ongoing communication and education program, needs to clearly articulate these issues to local and surrounding businesses and stakeholders to ensure they are prepared and have contingency plans in place. The burns bog fire of 2005, while not large, had a significant impact on local and regional areas. Smoke, fire operations, and public communications were all major challenges within the urban setting when compared with typical wildland fire operations. It is important that stakeholders recognize that exceptional measures may be required to manage the risk if the fire danger reaches extreme (DGR V).

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan

Appendix I - Stanley Park Fire Preparedness: Communications and Media Plan

A. Preparation and Planning: Fire Risk and Safety

An inter-agency approach to public education and information around fire season in the urban forest will continue, to raise awareness of and improve understanding about fire risks and safety in Stanley Park. Messaging will be coordinated and information shared among Vancouver Park Board, Vancouver Fire & Rescue, Vancouver Police and BC Forest Service communications staff.

Target audiences are: residents, tourists, park stakeholders/partners (such as tour operators, restaurant owners and businesses), elected officials, staff and media.

Key messages are:

- respect signage and regulations around smoking, campfires and BBQs
- direct fire concerns and questions to park staff
- fire risks are heightened significantly after blow down event and a preparedness plan developed accordingly
- report all fires and suspected fires to 9-1-1

Communications tools will include:

- park signage – forest fire hazard rating signs installed in key locations during the summer fire season, with emergency contacts
- Park Board web site and news releases (copy to VFRS web site) – keep the public updated on changes in fire risks and prohibitions; to serve as central source of statistics and facts re hazards, preparedness, responsibilities, protocols, by-laws
- staff updates – keep employees (including parks staff and Rangers) briefed about fire preparedness and safety through crew talks at work sites, intranet and/or fire bulletins if and as required
- stakeholder/partner updates – keep restaurants, concessions and attractions briefed on fire preparedness and safety through stakeholders meeting and/or fire bulletins if and as required

B. In the Event of a Fire Incident

A Site Information Officer will handle all media requests for information as it relates to Stanley Park activities. All media requests will be documented in a Media Log

Background Information may include:

- updates to statistical information, such as the number and type of equipment deployed at a specific site
- status and number of evacuation notifications
- people and structures affected by evacuation notification in effect
- clarification of the role and responsibilities of various emergency response partners

Other requests:

The following requests should be managed by the Information Officer in consultation with the Incident Commander:

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- requests for interviews
- requests for information on operational strategies such as the deployment of equipment
- requests for information specific to VPB (Vancouver Park Board) activities beyond general background information
- requests related to an issue that is receiving significant media attention

The primary spokespersons/media contacts, in order of precedence and ability are:

Captain Rob Jones-Cook VFRS Media Relations

Joyce Courtney – Park Board Communications

Tim Fanning/Howard Chow – VPD Media Relations

Sue Croft – BC Forest Services Communications

The VFRS will take the lead with media, directing inquiries to other agencies as required (e.g. Parks for operational and park information, Police for evacuation and street control etc.)

The site for media meeting place will be determined as the situation unfolds, and be dependant upon the emergency location and situation.

Preference will be given to local media followed by out of town media outlets. Media will be permitted to tour site only after consultation between media spokespersons and the Incident Commander. Local media will be here and dealing with the various agencies long after out of town media leaves.

A media pool may have to be organized by members of the media selecting who will be offered the opportunity to near emergency sites. That information will be shared amongst all media representatives. Media will not be permitted to move around without a media spokesperson accompanying them.

Evacuation Notifications

At some time it may be necessary to issue an evacuation of the park. Evacuation notification will apply to VPB staff, park business staff and management, and park visitors and all others in the park with the exception of emergency staff.

Such notification will be coordinated through the VPD or their designates including

- Park Rangers
- telephone tree
- or combination of above

Four stages of notification are:

- Evacuation Alert – warning of imminent danger and advised to be ready to leave
- Evacuation Order – leave immediately
- Evacuation Rescinded – people may return
- All Clear – advisory that the danger has passed.

Prepared by

Rob Jones-Cook, Joyce Courtney

June 14, 2007

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Appendix II

Vancouver Fire By-Laws

1.4.2.2.(1) Where an emergency arises from a fire hazard or from a risk of explosion that causes the Fire Chief to be apprehensive of imminent and serious danger to life or property, or of a panic, the Fire Chief may order the evacuation of any building or area and may take reasonable and necessary steps to removed or lessen the hazard or risk.

1.4.4.2.(1) Open Air fires

No person shall light or maintain a fire in the open air for any reason without first obtaining a permit from the Fire Chief.

8.2.1.1. Offences

Every person guilty of an offence against the By-Law who:

- a) violates a provision of this By-Law or*
- d) does an act which violates a provision of this By-Law or*
- e) fails to comply with an order or direction given under this Bylaw.*

8.3.1.1. Fines and penalties

Every person who commits an offence against this By-Law is liable to a fine of not more than \$ 2000 and not less than \$ 500 for each offence.

Appendix III - Fire Hazard Reduction

The likelihood of a fire starting, its subsequent rate of spread, and its eventual intensity are dependent on existing fuel conditions as well as weather factors. It is prudent within the Stanley Park forest to take steps to reduce the fire fuel risk factor, particularly in the areas where the fuel type is of the high risk category, or the likelihood of ignition is high (trailsides, roadsides). Strategies that reduce ignition probability, or fire intensity in the event of a fire, include but are not limited to the:

- chipping or removal of trailside / roadside pockets or piles of fine fuels.
- reduction, dispersal, or lowering to ground level of excessive slash in areas with fuel types S-2.
- remove deadfall, wood piles, and shrubs of flammable species from within 10 metres of flammable structures (FireSmart Manual).
- removing low branches that form a fuel ladder effect within areas with fuel types of c2, c3, & c4.
- retention of a 2 metre above ground gap when cutting ivy from trees.

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Appendix IV - Description of the Fire Environment of Stanley Park

The Canadian Forest Fire Danger Rating System (CFFDRS), developed by the Canadian Forestry Service, is used to assess fire danger and potential fire behaviour. The MOFR maintains a network of fire weather stations during the fire season that is used to determine fire danger on forestlands within the Lower Mainland. During the fire season, lower mainland communities monitor fire weather information provided by the MOFR Protection Branch to determine hazard ratings and associated fire bans and closures within their municipalities.

It is important to understand the likelihood of exposure to periods of high fire danger, defined as Danger Class IV (high) and V (extreme), in order to determine appropriate prevention programs, levels of response, and management strategies. Fire danger within Stanley Park can vary from season to season. Stanley Park is defined by the regional climate of the Coastal Western Hemlock dry maritime (CWHdm) biogeoclimatic unit.

Figure 4 is a compilation of available weather station data within the CWHdm biogeoclimatic unit (representative of the study area) that dates back to 1875 and provides a summary of the total number of Danger Class III, IV and V-days from April through to October for each year. This compilation shows that, within any given year, the fire danger can fluctuate substantially. Typically, the most extreme fire weather occurs between the middle of July and the third week of August. When compared to other regional climates of the coast, such as the Coastal Western Hemlock very dry maritime biogeoclimatic unit (CWH xm1 - east coast of Vancouver Island) and Coastal Douglas Fir biogeoclimatic unit (CDF - Southern Vancouver Island and Gulf Islands), the Lower Mainland is not as dry.

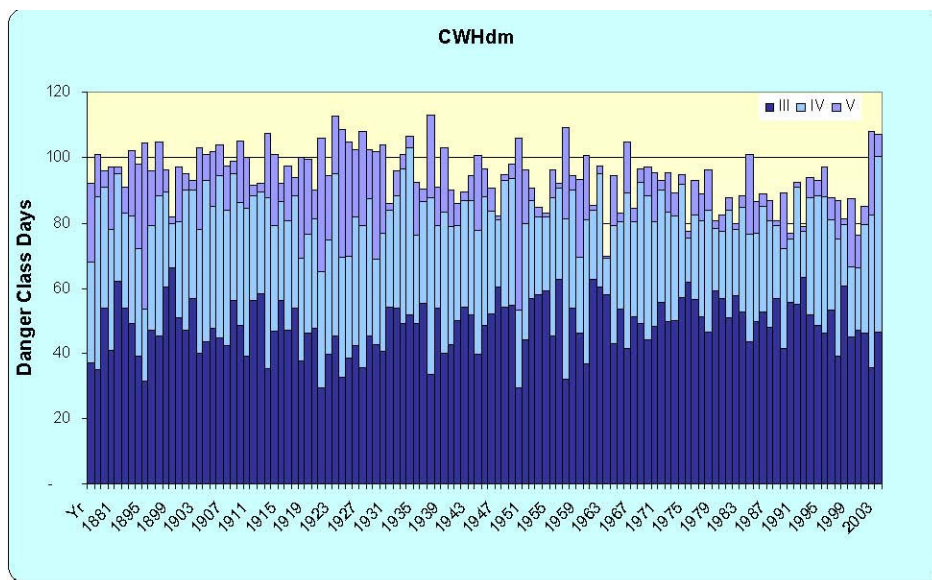


Figure 3 Seasonal variability (April-October) in the number of Danger Class III, IV and V days within the study area as described by the regional climate of the CWHdm

A summary of historic drought codes (Figure 5) provides a similar comparison to danger class days and reinforces the point that the Lower Mainland experiences periods of summer drought (Figure 5). A

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan

drought code that exceeds 500 is considered high and is associated with extreme fire behaviour.

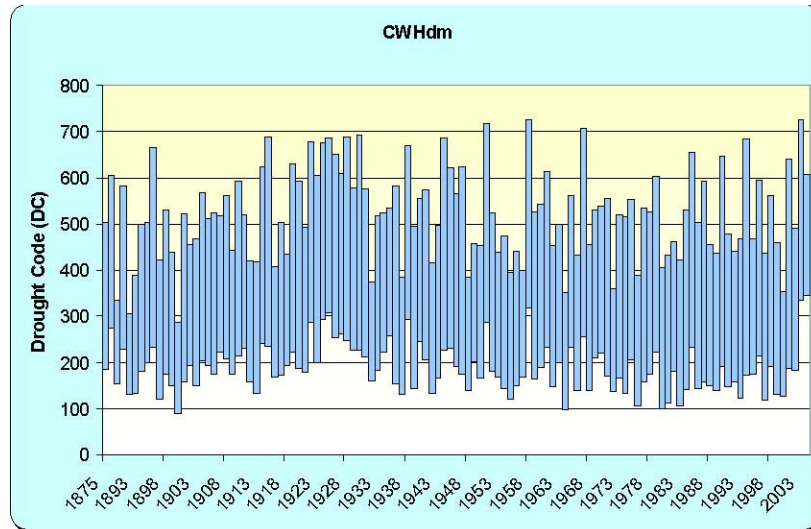


Figure 4 Summary of seasonal (April-October) high and low drought codes by year in the CWHdm within the District

Figure 6, a summary of the Drought Code (DC), Build-up Index (BUI) and Fire Weather Index (FWI) for all weather stations within the CWHdm over the length of the weather record indicates that 90th percentile DC, BUI and FWI were generally within Danger Class IV or V. On average, the number of Danger Class IV and V days within the CWHdm is 46 per year.

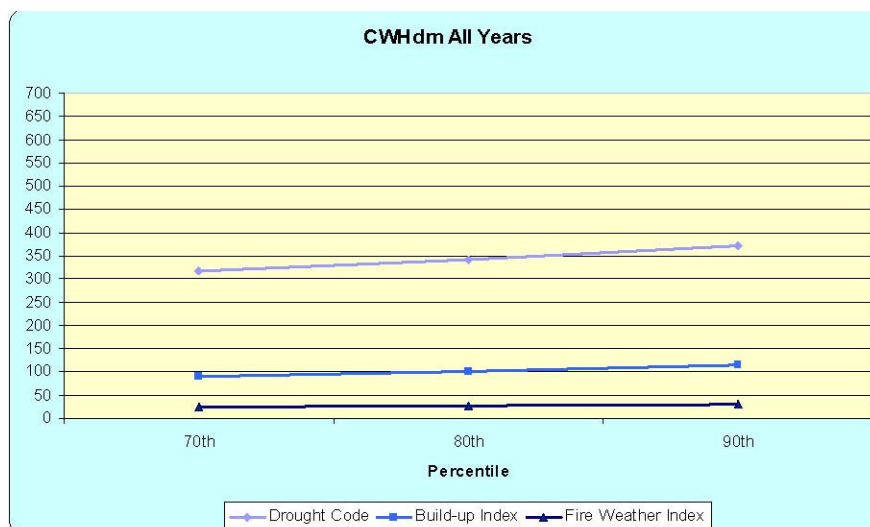


Figure 5 Summary of 70th, 80th and 90th percentile fire weather indices across the CWHdm for the length of the weather records (1875-2004)

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A summary of the Drought Code (DC), Build-up Index (BUI) and Fire Weather Index (FWI) for the Vancouver Airport weather station over the length of the weather record indicates that 90th percentile DC, BUI and FWI were generally within Danger Class IV or V (Figure 7). On average, this station reported 21 Danger Class IV and V days per year.

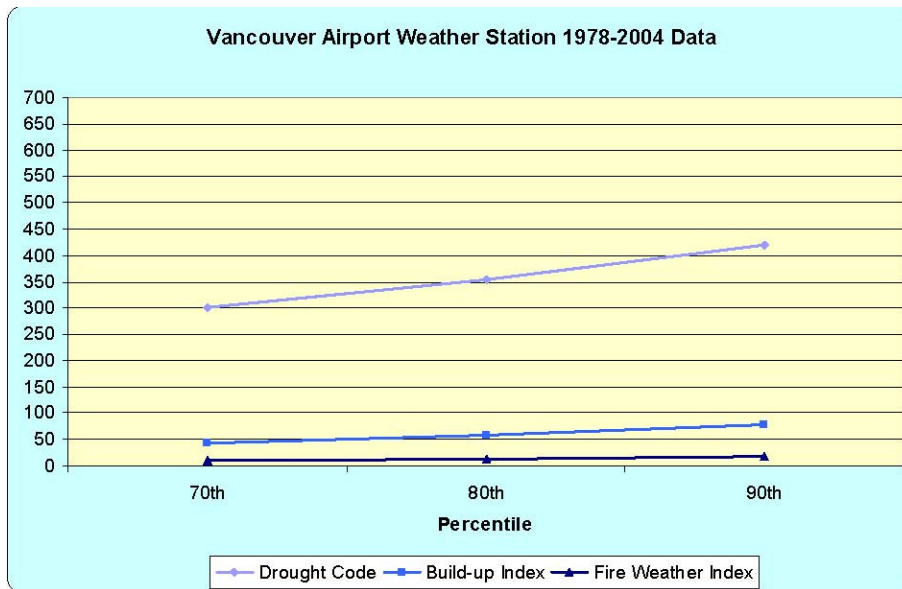


Figure 6 Summary of 70th, 80th and 90th percentile fire weather indices for the Vancouver Airport weather station over the length of the weather record (1978-2004)

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A summary of the Drought Code (DC), Build-up Index (BUI) and Fire Weather Index (FWI) for the Vancouver Airport weather station in 2003 indicates that the 70th, 80th and 90th percentile DC, BUI and FWI were generally within Danger Class IV or V (Figure 8). In 2003 there were 65 Danger Class IV and V days.

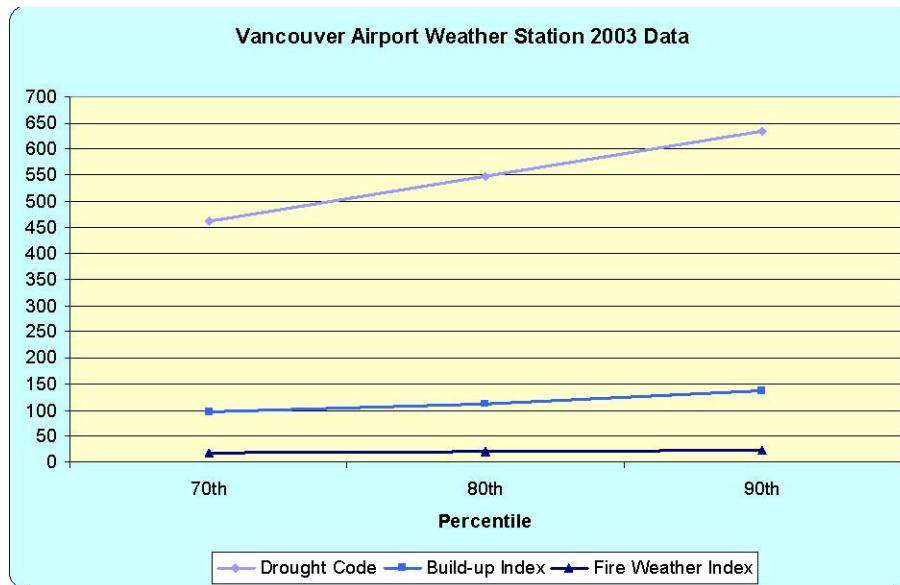


Figure 7 Summary of 70th, 80th and 90th percentile fire weather indices for the Vancouver Airport weather station in 2003

The results of the weather data analysis show that, historically, there have been a number of years when fire danger in Stanley Park has been high or extreme for an extended period during the summer months. Complacency is an inappropriate response to fire risk. Management responses, in terms of fire prevention, mitigation and response, should be adjusted in accordance with the level of risk.

Appendix V - Summary of Fuel Types in Stanley Park

This map reflects the fuel types on the ground after the 2006/07 wind storms, and prior to cleanup. While regular surveys are required for current information, it is expected that most areas mapped here as being S-3 were reduced to S-2 by 2008.

Fuel classification (Figure 9) was based on fuel types in the Field Guide to the Canadian Forest Fire Behavior Prediction (FBP) System. Fuel types were attributed and typed using orthophotographs and data collected during field work.

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Figure 8 Stanley Park fuel types as at May 2007

Summary of areas for fuel types in Stanley Park – pre 2006-07 storm cleanup.

FuelType	C-4	C-3	S-2	S-3	0-1b	O-1a	C-5	M2	D1	
Area(ha)	4.1	0.1	17.9	43.1	0.4	0.7	139.5	56.5	27.7	294.6
%	1.4	0.0	6.1	1.6	14.6	0.1	0.2	47.3	9.4	100

Fuel Type Descriptions

The following is a general description of the dominant fuel types within the study area

C-2 fuel type

Area of Fuel Type (ha)	0.1
Structure Classification	Pole sapling

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Dominant Tree Species	Thuja plicata (western redcedar)
Tree Species Type	> 80% Coniferous
Understory Vegetation	Sparse – None (< 10% cover)
Age	20 – 40 yrs
Height	10 – 15 m
Stand Density	>2000 stems/ha
Crown Closure	80 – 100 %
Height to Live Crown	Average 1-2 m
Surface Fuel Loading	< 3 kg/m ²
Burn Difficulty	Moderate to high; however, if fire is wind driven then there is a high potential for extreme fire behavior and active crown fire.



Figure 9 Example of a high density pole sapling western redcedar stand – classified as a C-2 fuel type.

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C-3 fuel type

Area of Fuel Type (ha)	17.9
Structure Classification	Late pole sapling to late young forest
Dominant Tree Species	<i>Pseudotsuga menziesii</i> (Douglas-fir), <i>Tsuga heterophylla</i> (western hemlock), <i>Thuja plicata</i> (western redcedar)
Tree Species Type	> 80% Coniferous
Understory Vegetation	Low (< 50% cover)
Age	40 – 80 yrs
Height	20 – 35 m
Stand Density	700 – 1,200 stems/ha
Crown Closure	40 – 80 %
Height to Live Crown	Average 8 m
Surface Fuel Loading	< 5 kg/m ²
Burn Difficulty	Moderate; however, if fire is wind driven then there is a high potential for extreme fire behavior and active crown fire



Figure 10 Example of evenly stocked, moderate density second growth stand – classified as a C-3 fuel type

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C-4 fuel type

Area of Fuel Type (ha)	4.1
Structure Classification	Pole sapling
Dominant Tree Species	<i>Pseudotsuga menziesii</i> (Douglas-fir), <i>Tsuga heterophylla</i> (western hemlock), <i>Thuja plicata</i> (western redcedar)
Tree Species Type	> 80% Coniferous
Understory Vegetation	Low (< 25% cover)
Age	20 – 40 yrs
Height	10 – 20 m
Stand Density	700 – 2000 stems/ha
Crown Closure	40 – 100 %
Height to Live Crown	2-4 m
Surface Fuel Loading	< 5 kg/m ²
Burn Difficulty	Moderate to high; however, if fire is wind driven then there is a high potential for extreme fire behavior and active crown fire.



Figure 21 Example of a moderate to high-density second growth stand of western hemlock and Douglas-fir classified as a C-4 fuel type

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C-5 fuel type

Area of Fuel Type (ha)	139.5
Structure Classification	Mature and old forest
Dominant Tree Species	<i>Pseudotsuga menziesii</i> (Douglas-fir), <i>Tsuga heterophylla</i> (western hemlock), <i>Thuja plicata</i> (western redcedar)
Tree Species Type	> 80% Coniferous
Understory Vegetation	Moderate (> 40% cover)
Average Age	> 80 yrs
Average Height	30 – 40 m
Stand Density	700 – 900 stems/ha
Crown Closure	40 – 80 %
Height to Live Crown	Average 18 m
Surface Fuel Loading	< 5 kg/m ²
Burn Difficulty	Low; however, if fire is wind driven then there is a moderate potential for active crown fire



Figure 32 Example of mature forest of Douglas fir, western hemlock and western red cedar-classified as a C-5 fuel type

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D-1- fuel type

Area of Fuel Type (ha)	27.7
Structure Classification	Pole sapling to mature forest
Dominant Tree Species	Acer macrophyllum (bigleaf maple), Populus trichocarpa (cottonwood), Alnus rubra (red alder)
Tree Species Type	> 80% Deciduous
Understory Vegetation	High (> 90% cover)
Average Age	> 20 yrs
Average Height	>10 m
Stand Density	600 – 2,000 stems/ha
Crown Closure	20 – 100 %
Height to Live Crown	< 10 m
Surface Fuel Loading	< 3 kg/m ²
Burn Difficulty	Low



Figure 43 Example of a site dominated by red alder – classified as a D-1 fuel type.

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M-2 fuel type

Area of Fuel Type (ha)	56.4
Structure Classification	Pole sapling, young forest, mature and old forest
Dominant Tree Species	Tsuga heterophylla (western hemlock), Pseudotsuga menziesii (Douglas-fir), Thuja Plicata (western redcedar), Populus trichocarpa (cottonwood), Acer macrophyllum (bigleaf maple), Alnus rubra (red alder)
Tree Species Types	Coniferous 10-80% / Deciduous
Understory Vegetation	variable
Average Age	> 20 yrs
Average Height	> 10 m
Stand Density	400-1500 stems/ha
Crown Closure	40 – 100 %
Height to Live Crown	6 m
Surface Fuel Loading	< 5 kg/m ²
Burn Difficulty	Moderate; however, if fire is wind driven then there is a high potential for extreme fire behaviour and active crown fire.



Figure 54 Example of a mixed coniferous deciduous stand – classified as M-2

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S-2 fuel type

Area of Fuel Type (ha)	4.7
Structure Classification	Moderate coastal cedar/hemlock/Douglas-fir slash
Understory Vegetation	variable
Surface Fuel Loading	10-15 kg/m ²
Burn Difficulty	Moderate to high



Figure 65 Example of moderate slash loading resulting from blowdown - classified as S-2

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S-3 fuel type

Area of Fuel Type (ha)	43.1
Structure Classification	Heavy coastal cedar/hemlock/Douglas-fir slash
Understory Vegetation	variable
Surface Fuel Loading	> 15 kg/m ²
Burn Difficulty	High



Figure 76 Example of heavy surface fuel loading > 15 kg/m² resulting from blowdown – classified as S-3

O-1a fuel type

Area of Fuel Type (ha)	0.7
Structure Classification	Matted grass
Understory Vegetation	variable
Surface Fuel Loading	< 5 kg/m ²
Burn Difficulty	Moderate

O-1b fuel type

Area of Fuel Type (ha)	0.4
Structure Classification	Flammable shrubs and standing tall grass
Understory Vegetation	variable
Surface Fuel Loading	< 5 kg/m ²
Burn Difficulty	High

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan

Appendix VI - Description of Fire Rank

FIRE RANK

A Fire Description

RANK 1 SMOLDERING GROUND FIRE SMOKE WHITE SMOKE SMOLDERING GROUND FIRE	RANK 2 VISIBLE OPEN FLAME SURFACE FIRE ONLY UNORGANIZED FLAME FRONT LITTLE OR NO SPREAD	RANK 3 ORGANIZED SURFACE FLAME FRONT MODERATE RATE OF SPREAD VIGOROUS SURFACE FIRE	RANK 4 ORGANIZED SURFACE FLAME FRONT MODERATE TO FAST BURN ON THE GROUND SHORT AERIAL BURSTS GIVES TO BLACK SMOKE	RANK 5 ORGANIZED CROWN FIRE FRONT MODERATE TO LONG RANGE SPOTTING INDEPENDENT SPOT FIRE GROWTH BLACK TO COPPER SMOKE	RANK 6 ORGANIZED CROWN FIRE FRONT MODERATE TO LONG RANGE SPOTTING INDEPENDENT SPOT FIRE GROWTH PRESENT OF FIRE BALLS AND WHIRLS VIOLENT FIRE BEHAVIOUR
					
		MAY SEE SOME CANDLEING ALONG THE PERIMETER AND/OR WITHIN THE FIRE	SHORT RANGE SPOTTING MAY OCCUR DISORGANIZED CROWN INVOLVEMENT		

DEFINITIONS:

Ground Fire - A fire that burns in the ground fuel layer.

Surface Fire - A fire that burns in the surface fuel layer, excluding the crowns of the trees.

Crown Fire - A fire that advances through the crown fuel layer.

Head - The portion of the fire having the greatest rate of spread and frontal fire intensity.

Flanks - Those portions of the fire perimeter that are between the head and the base.

Base - That portion of the fire perimeter opposite the head; the slowest spreading part of the fire.

Rate of Spread - The speed at which a fire extends its horizontal dimensions, expressed in terms of distance per unit time.

Candleing - A single tree or a small clump of trees is said to candle when its foliage ignites and flames up, usually from bottom to top.

Spotting - A fire producing firebrands carried by the surface wind. A fire wheel and/or convection column that falls beyond the main fire perimeter, and results in spot fires.

Flame Front - The strip of primarily flaming combustion along the fire perimeter; a particularly active fire edge.

Organized Front - A flame front exhibiting all the same characteristics, ROS (Rate of Spread), flame height and length.

APPENDIX 5 – Stanley Park Wildfire Preparedness Plan



Map 5.1: Fuel Types

APPENDIX 6 – Invasive Species Management

Guide to Invasive Species Best Management Practices for Stanley Park

The following guide is intended to provide users with a basic introduction to the most extensive invasive plant species in Stanley Park, species currently expanding their range in the Park, and species that are just becoming established in Stanley Park. The guide is set up with photos, general descriptions of the plants, and information on their habitat/ ecology. Information is also provided on basic treatment options, priorities actions for Stanley Park, and potential replacement native plants for these species.

All of the information provided in this document should be considered options towards an ecological approach to invasive plant management. For example, all methods used should be of minimal disturbance to forest soils and ecosystems. Similarly, all native plant plantings that occur as a result of invasive plant removals should be appropriate for the Biogeoclimatic Zone and Site Series in Stanley Park. Furthermore, monitoring of sites on a regular basis should be considered imperative to the success of any invasive plant management plan.

APPENDIX 6 – Invasive Species Management

English holly (*Ilex aquifolium*)

Established Species in Stanley Park Natural and Sensitive Areas:



Description

- * Broadleaf evergreen shrub/tree with prickly leaves
- * Can grow from 5 to 18 m high
- * Reddish orange berries (poisonous to humans) are found on female trees

Ecology

- * Native to Europe
- * Grows in shade or sun in well-drained soil
- * High water requirements
- * Reproduction by suckering, layering, or by seed

Removal

- * Small plants can be pulled or dug up when soil is moist.
- * Best to remove all of the plant. Cutting at the base usually results in re-sprouting from the crown, monitoring & follow up required
- * Applying herbicide to a cut stump is the most effective for large plants

Priority Actions for Stanley Park

- * Removal of plants from restoration areas. Hand-pulling for small plants, and mechanical removal for larger plants
- * Control of large, fruiting plants in other areas of the Park; control of lower branches to prevent suckering
- * Removal of holly as-seen during field activities elsewhere in the Park

Suggested Alternative Plants

- * native evergreen trees
- * Oregon grape (*Mahonia nervosa*)
- * Tall Oregon grape (*Mahonia aquifolium*)
- * Pacific crabapple (*Malus fusca*)
- * Arbutus (*Arbutus menziesii*) (will only work on the dries, sunniest sites)
- * Salal (*Gaultheria hallon*)

APPENDIX 6 – Invasive Species Management

Himalayan blackberry (*Rubus discolor*)

Established Species in Stanley Park Natural and Sensitive Areas:



Description

- * An evergreen shrub with trailing, arching stems
- * Thick canes and curved thorns
- * Can grow up to 7 m in one season, forming dense thickets
- * Have 3 to 5 oval leaflets that are shiny green on top, pale green with fine hairs underneath
- * Pinkish-white flowers with 5 petals in spring; berries are red, turning a deep purple-black in mid-late summer

Ecology

- * Native to western Europe
- * Sunny to partly shady areas with rich, wet to moist soil
- * Thrives in open, disturbed areas such as roadsides and fields

Removal

- * Properly identify invasive blackberry plants; and mark any native plants in the middle of the infestation
- * Best method is to cut canes down, then remove root-crowns using a pickaxe or shovel
- * Herbicide applications can be used
- * Mechanical mowing can be used, but recommended when the plants are just beginning to flower. Should not be done on soils prone to compaction or erosion
- * Grazing by goats/ pigs is effective at removing re-growth
- * Replanting with native plants is necessary on sites where large infestations have been removed
- * Requires several years of maintenance

Priority Actions for Stanley Park

- * Hand-pulling of all noticeable invasive blackberry plants in blowdown areas
- * Removal of larger patches (late-July through early August) surrounding blowdown areas, replanting with native plants with high habitat value for wildlife
- * Control of blackberry to prevent fruiting in the Park
- * On-going monitoring of all blowdown areas and targeted regions

Suggested Replacement

- * native evergreen trees
- * To prevent re-invasion, replant with native shrubs (such as Salmonberry (*Rubus spectabilis*), tall Oregon grape (*Mahonia aquifolium*), Salal (*Gaultheria shallon*)) appropriate to the site, and monitor re-growth.

APPENDIX 6 – Invasive Species Management

English ivy (*Hedera helix*)

Established Species in Stanley Park Natural and Sensitive Areas



Description

- * Evergreen vine with lobed, waxy leaves featuring juvenile and mature growth forms
- * Inconspicuous white flowers ripen into hard, blackish berries on mature plants
- * Growing at roughly 1m/year, it forms thick mats which can smother other vegetation
- * Commonly seen growing up tree trunks

Ecology

- * Native to the Caucasus Mtns. in Russia
- * Shade-tolerant, but grows under a range of conditions
- * Prefers moist, nutrient rich soils

Removal

- * Pull by hand, removing the whole plant (esp. roots), mulch with 20cm of mulch following removal when possible
- * Climbing ivy is a priority for removal. Vines should be cut at breast height and removed to the ground; and the area around the tree base cleared of ivy
- * If full removal not possible on mature plants, remove flowers to prevent spread by seed
- * Herbicides not recommended due to thick leaf cuticle

Priority Actions for Stanley Park

- * Manual removal of ivy vines/ patches growing in blowdown areas, Wildlife MEA's or buffer areas
- * Target tree-climbing/ fruiting ivy plants
- * Small, isolated patches; and infestations threatening sensitive habitat

Suggested Alternative Plants:

- * Kinnikinnick (*Arctostaphylos uva-ursi*)
- * Salal (*Gaultheria shallon*)
- * Piggy-back plant (*Tolmiea menziesii*)
- * Bunchberry (*Cornus canadensis*)
- * Western honeysuckle (*Lonicera ciliosa*)

APPENDIX 6 – Invasive Species Management

Japanese knotweed (*Polygonum spp.*)*

Expanding Species in Stanley Park Natural and Sensitive Areas:



Description

- * Can grow between 1 to 5 m tall
- * Bamboo-like long, hollow stems and heart-shaped leaves
- * Forms dense thickets through extensive creeping rhizomes
- * Can grow up to 8cm per day!
- * Deep, strong rooting systems are able to break concrete

Ecology

- * Ornamental originally from eastern Asia
- * Able to grow under a range of conditions; tolerates full sunlight to semi-shade
- * Thrives in moist environments
- * In North America, the majority of reproduction occurs vegetatively. The plants can re-grow from 1cm long root-fragments; stem fragments can also take root

Removal

- * Very difficult to control using any method
- * Possible to control small stands with repeated pulling of stems and/or covering the plants with landscape cloth
- * Advised to pull or cut stems as soon as they reach 10 cm in height (about every two weeks during the growing season)
- * The most effective known method is to inject the stems with herbicide
- * Mechanical mowing is not recommended
- * Research in the UK is underway on biocontrols
- * All plant matter should be bagged, and removed from the site; incineration recommended
- * Regular monitoring during the growing season (April through September) is required... checking a radius of 9 meters around the removed areas

Priority Actions for Stanley Park

- * High priority plant for removal and eradication from the Park
- * Target smallest patches, and those in close proximity to wet or open areas first
- * Smaller and accessible patches can be dealt with through volunteer efforts

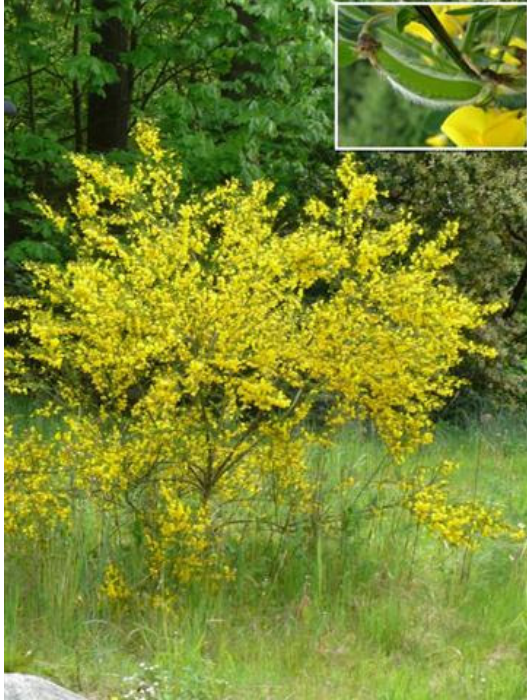
Suggested Alternative Plants

- * Native evergreen trees
- * Salal (*Gaultheria shallon*)
- * Red elderberry (*Sambucus racemosa*)
- * Oceanspray (*Holodiscus discolor*)
- * Mock-orange (*Philadelphus lewisii*)
- * Red-osier dogwood (*Cornus stolonifera*)
- * Thimbleberry (*Rubus parviflorus*)

APPENDIX 6 – Invasive Species Management

Scotch broom (*Cytisus scoparius*)

Emergent Species in Stanley Park Natural and Sensitive Areas:



Description

- * A perennial, woody shrub (up to 2m tall), with green branches
- * Blooms between April and June with pea-like yellow flowers which later become seed pods
- * Seed pods are black and around 5cm long containing numerous seeds (seed producing after 3 years)
- * On a warm summer days you can often hear the seed pods popping open

Ecology

- * Native to Mediterranean areas of Europe
- * Shade intolerant, thriving in disturbed, open areas
- * Sandy, well-drained soils
- * Produces phytotoxins and acidifies soils, inhibiting growth of other/ native plants

Removal

- * Seedlings and small plants can be pulled by hand
- * Seed-producing plants should be removed before seeds set
- * Larger plants can be removed using a weed wrench or by cutting the stem below the soil and covering the cut stem/ root mass with soil
- * All removals should ensure minimal soil disturbance
- * Several bio-controls available
- * Herbicide use possible
- * soils generally contain huge loads of long-lived seeds; any disturbance can release dozens of new germinants

Priority Actions for Stanley Park

- * Mature plants near blowdown areas (especially E1/E2- near the seawall and N1- beside the meadow) should be removed before seeds distributed to reforested areas
- * Other broom infestations in the Park should also be treated in the near future

Suggested Replacement

A good way to prevent re-invasion is to replant with native plants such as:

- * native evergreen trees
- * Salal (*Gaultheria shallon*)
- * Snowberry (*Symphoricarpos albus*)
- * Saskatoon (*Amelanchier alnifolia*)
- * Nootka rose (*Rosa nutkana*)

APPENDIX 6 – Invasive Species Management

Yellow lamium (Yellow archangel) (*Lamium galeobdolon*)

Expanding Species in Stanley Park Natural and Sensitive Areas:



Description

- * A trailing, evergreen, perennial groundcover with square stems
- * The heart-shaped leaves are typically variegated and slightly hairy
- * For a short time, it has small upright yellow flowers

Ecology

- * Very aggressive and well adapted to growing in shaded and open areas
- * Does best in moist shaded sites such as ravines
- * Seeds are typically dispersed by ants, which are attracted to the oils found in the seeds and can carry them up to 70 m from the parent plant

Removal

- * Manual removal by picking the whole plant including roots

Priority Actions for Stanley Park

- * Complete removal of patch near to E2
- * Other patches in close proximity to blowdown (such as near the hollow tree and the Children's Farmyard parking lot) should be second priority

Suggested Replacement

- * Salal (*Gaultheria shallon*)
- * Yerba buena (*Clinopodium douglasii*)
- * Piggy-back plant (*Tolmiea menziesii*)
- * Kinnikinnick (*Arctostaphylos uva-ursi*)
- * Bunchberry (*Cornus canadensis*)

APPENDIX 6 – Invasive Species Management

Common periwinkle (*Vinca spp*)

Emergent Species in Stanley Park Natural and Sensitive Areas:



Description

- * A perennial, evergreen herb with trailing stems
- * The shiny, dark green leaves are 2 to 3 cm long, opposite and oval shaped
- * The flowers are violet to blue in colour

Ecology

- * Native to Switzerland south to much of the Mediterranean basin and across much of north Africa
- * Grows most vigorously in moist soil with only partial sun, but it will also grow in the deepest shade, even in poor soil
- * Often found in gardens and on the edges of parks and natural spaces where garden waste is illegally dumped

Removal

- * By hand, pulling the above ground portion of the plant and digging out its roots

Priority Actions for Stanley Park

- * Removal from forested/ sensitive areas, or gardens near forested/ sensitive areas
- * Control spread into new areas by gardening staff (it is still actively used as an ornamental plant).

Suggested Replacement

- * Wild ginger (*Asarum caudatum*)
- * Smooth alumroot (*Heuchera micrantha*)
- * Piggy-back plant (*Tolmiea menziesii*)
- * Yerba buena (*Clinopodium douglasii*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

Yellow flag iris (*Iris pseudacorus*)

Expanding Wetland Species:



Description

- * A robust, clumping perennial herb
- * Can grow to 40 cm to 1.5 m tall
- * Only yellow-flowered iris found in BC's wildlands

Ecology

- * Native to Europe and the British Isles, Western Asia, North Africa, and the Mediterranean region
- * Grows in a variety of fertile wetland habitats
- * Reproduces via seed or rhizome
- * Can grow aggressively, out-competing native species and altering wetland habitat

Removal

- * Digging out plants or cutting seedpods off plants after flowering
- * Although not recommended for wetlands, spot-applications of herbicides is an option for large infestations
- * Yellow flag produces a substance in its leaves and rhizomes that can cause skin irritation, so it's important to wear gloves and cover skin when pulling, cutting, or digging

Priority Actions for Stanley Park

- * Control spread into new wetlands by gardening staff (it is still actively used as an ornamental plant).
- * Control further spread in Beaver Lake and Lost Lagoon through seed-head removal
- * Dig-out plants when possible to further control infestation

Suggested Replacement

- * Hardhack (*Spiraea douglasii*)
- * Skunk cabbage (*Lysichiton americanum*)
- * Willow spp.

APPENDIX 6 – Invasive Species Management

Spurge laurel (Daphne) (*Daphne laureola*) (potentially eradicated as of July 08)

Emergent Species in Stanley Park Natural and Sensitive Areas:



Description

* A shade tolerant shrub with oblong, evergreen leaves, yellow-green fluted flowers and small, black berries

* Looks like it could be from the rhododendron family and is often mistaken for a native species in the local forested areas

Ecology

* Adapted to shade and semi-shaded areas

* Commonly found in the understorey of Douglas fir dominated forests along coastal BC

Removal

* Pull or dig out whole plant by hand (wearing gloves)

* Considered toxic by Worksafe BC- consult their website for more information

Priority Actions for Stanley Park

* Remove any plants found in the Park

Suggested Replacement

* Kinnikinnick (*Arctostaphylos uva-ursi*)

* Salal (*Gaultheria shallon*)

* Oregon grape (*Mahonia nervosa*)

APPENDIX 6 – Invasive Species Management

Purple loosestrife (*Lythrum salicaria*)*

Emergent Species in Stanley Park Natural and Sensitive Areas:



Description

- * A tall perennial wetland herb
- * Has a square, woody stem with opposite, dark green, lance-shaped leaves and purple-magenta flower spikes
- * Flowers have 5 to 7 petals, which appear from July through October
- * Can grow up to 3 m tall

Ecology

- * Native to Eurasia
- * Found in wetlands such as cattail marshes, sedge meadows and open bogs
- * Occurs along stream and river banks and lake shores
- * Found in ditches and other disturbed wet soil areas
- * Able to produce over 2.5 million seeds per year

Removal

- * Plants can be removed by hand using special hooks to scoop out the roots from the muddy lakeside bottom
- * Biological control using an introduced biological control agent, the Galerucella beetle, to eat the newly produced flower and leaf buds, thereby decreasing productivity of the plants

Priority Actions for Stanley Park

- * Pull or dig-out plants in Beaver Lake and Lost Lagoon
- * Cut off flowers when not possible to remove whole plant

Suggested Replacement

- * Hardhack (*Spiraea douglasii*)
- * Large-leaved lupine (*Lupinus polyphyllus*)

APPENDIX 6 – Invasive Species Management

Giant hogweed (*Heracleum mantegazzianum*)

Emergent Species in Stanley Park Natural and Sensitive Areas:



Description

- * Perennial plant, flowering from late spring to mid summer with numerous large white flowers clustered in an umbrella-shaped head
- * Has large stem which can grow between 5 – 10 cm in diameter and is a dark reddish colour, and a deep tap-root
- * Leaves are large and jagged in shape

Ecology

- * Native to Caucasus Mtns and southwestern Asia
- * Grows in a variety of habitats especially moist areas but commonly found near streams, creeks and roads
- * Produces up to 50,000 winged seeds per year per plant

Removal

- * Phototoxic- can cause skin irritation and even blindness. Protective clothing is recommended, consult Worksafe BC for more information
- * Pull plants, ensuring full removal of roots. Easiest when soil is wet.
- Cutting by hand/ mowing is not recommended, as it stimulates plant growth
- * Bio-control: cattle and pigs both eat hogweed
- * Herbicides can be used for larger infestations. Glyphosate can be used for stem injections.
- * Seeds left behind can germinate 7 – 15 years later; annual monitoring is recommended

Priority Actions for Stanley Park

- * Park Board staff will remove entire plants from all areas of the Park with high traffic areas of highest priority

Suggested Replacement

- * native evergreen trees
- * Red elderberry (*Sambucus racemosa*)
- * Hardhack (*Spiraea douglasii*)
- * Red-osier dogwood (*Cornus stolonifera*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

Fragrant water lily (*Nymphaea odorata*)

Expanding Wetland Species



Description

- * Perennial plant that forms large dense colonies in ponds and wetlands.
- * Leaves are heart shaped and arise on long flexible stalks from large thick rhizomes
- * Leaves usually found on water surface, with fragrant flowers growing on separate stalks with white-pink petals and a yellow center

Ecology

- * Native to eastern North America
- * Found in freshwater aquatic systems such as ponds, streams and lakes
- * Prefers depths of 1-2m
- * Rapidly reproducing plants take over habitat from native aquatic plants, and increase the rate of pond succession

Removal

- * Can be dug up, although physical control is difficult due to reestablishment from seeds and rhizomes
- * For large infestations, cutting of plants is easiest
- * Herbicide use not recommended for waterways

Priority Actions for Stanley Park

- * Cutting of plants in Beaver Lake recommended, but of secondary importance to purple loosestrife and yellow flag iris infestations
- * Control spread into new areas by gardening staff (it is still actively used as an ornamental plant).
- * Beaver (*Castor Canadensis*) presence in Beaver Lake has resulted in the removal of this plant in areas where they are most active.

Suggested Replacement

- * Yellow Pond-Lily (*Nuphar polysepalum*)
- * Watershield (*Brasenia schreberi*)

APPENDIX 6 – Invasive Species Management

Creeping buttercup (*Ranunculus repens*)

Expanding Species in Stanley Park Natural and Sensitive Areas:



Description

- * Hairy perennial with fibrous roots and long stalks
- * Dark green leaves often with white spots and divided into 3 leaflets that are lobed and toothed with hairy texture
- * Flowers are bright yellow and large, typically 10 to 35mm wide
- * Has horizontal stems known as stolons rooting at the nodes, giving rise to several erect flowering stems

Ecology

- * Found in moist disturbed sites, fields, pastures, gardens, lawns, ditches and clearings
- * Common at low elevations, especially in settled areas
- * As with most buttercup species, contains a toxin that can result in pain and inflammation in grazing animals

Removal

- * Pull or dig out whole plant using hands, spade or pitch-fork

Priority Actions for Stanley Park

- * Removal of large patches threatening native species in blowdown areas

Suggested Replacement

- * native evergreen trees
- * Wild ginger (*Asarum caudatum*)
- * Smooth alumroot (*Heuchera micrantha*)
- * Piggy-back plant (*Tolmiea menziesii*)
- * Yerba buena (*Clinopodium douglasii*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

St John's wort (*Hypericum spp.*)

Emergent Species in Stanley Park Natural and Sensitive Areas:



Description

- * A herbaceous perennial which can grow to 1 – 3 feet in length
- * Has erect stems branching in upper part, Roots are short and trailing
- * Leaves are pale green and oblong and are attached directly to the stem, the flower is bright yellow
- * Used for medicinal purposes e.g. to treat depression, anxiety, and sleep disorders

Ecology

- * A common garden plant, it can be found in uncultivated ground, woods, roadsides and meadows
- * Can alter growth form and habit to promote survival
- * Thrives in areas with either a winter or summer dominant rainfall pattern

Removal

- * Manual removal by picking the whole plant including roots
- * Biological control through beetles

Priority Actions for Stanley Park

- * Hand removal of all plants found in forested and sensitive areas of Stanley Park
- * Hand removal of plants found in cultivated/ heavily managed landscapes of the Park
- * Control spread into new areas by gardening staff (it is used as an ornamental plant).

Suggested Replacement

- * Kinnikinnick (*Arctostaphylos uva-ursi*)
- * Salal (*Gaultheria shallon*)
- * Piggy-back plant (*Tolmiea menziesii*)
- * Bunchberry (*Cornus canadensis*)

APPENDIX 6 – Invasive Species Management

English laurel (*Prunus laurocerasus*)

Emergent Species in Stanley Park Natural and Sensitive Areas:

	<p>Description</p> <ul style="list-style-type: none"> * Evergreen shrub which can grow to 5-7 meters in height * Trunk and branches are covered by a smooth blackish bark * Leaves are oval, oblong and are finely toothed. Are green and shiny * Flowers are small and white and have a strong odour <p>Ecology</p> <ul style="list-style-type: none"> * Originally native to south eastern Europe and Asia minor * Grows in sunlight or partially shaded areas * Prefers moist, well drained, acidic soil and tolerates salt spray * Fast growing; seeds distributed by birds
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Removal

- * Hand pull small seedlings
- * Clip plant before it flowers or remove all spent flowers before they can form fruit
- * Berries, leaves and bark are poisonous, wash hands afterwards

Priority Actions for Stanley Park

- * Pulling/ removal of all plants found in forested and sensitive areas of Stanley Park
- * Removal of seeds from plants in cultivated areas of the Park

Suggested Replacement

- * native evergreen trees
- * Ninebark (*Physocarpus capitatus*)
- * Oceanspray (*Holodiscus discolor*)
- * Red Elderberry (*Sambucus racemosa*)
- * Salmonberry (*Rubus spectabilis*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

Portugal laurel (*Prunus lusitanica*)

Emergent Species in Stanley Park Natural and Sensitive Areas:

	<p>Description</p> <ul style="list-style-type: none"> * Small evergreen shrub which can grow to 5m * Young stalks and branches are reddish in colour * Bark on trunk and larger branches is smooth, blackish-brown * Leaves up to 12cm long are pointed at tips and finely toothed. Are green and shiny * Flowers are small and white, scented * Mature fruit are small black drupes <p>Ecology</p> <ul style="list-style-type: none"> * Originally native to Spain and Portugal * Able to grow in forest understory, low light conditions (prefers sunlight) * Prefers moist, well drained soils * Fast growing; seeds distributed by birds
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Removal

- * Hand pull small seedlings
- * Clip plant before it flowers or remove all spent flowers before they can form fruit

Priority Actions for Stanley Park

- * Pulling/ removal of all plants found in forested and sensitive areas of Stanley Park
- * Removal of seeds from plants in cultivated areas of the Park


Suggested Replacement

- * native evergreen trees
- * Ninebark (*Physocarpus capitatus*)
- * Oceanspray (*Holodiscus discolor*)
- * Red Elderberry (*Sambucus racemosa*)
- * Salmonberry (*Rubus spectabilis*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

Butterfly bush (*Buddleja davidii*)

Emergent Species in Stanley Park Natural and Sensitive Areas:

	<p>Description</p> <ul style="list-style-type: none"> * Deciduous shrub with arching branches * Flowers in mid to late summer- showy purple flowers with orange centres * Single flowers can produce up to 40,000 seeds... up to 3 million seeds per plant * Can reproduce vegetatively by sprouting/ suckering * Mature stems have peeling grey-brown bark * Forms dense thickets <p>Ecology</p> <ul style="list-style-type: none"> * Native to China * Typically found on disturbed sites * Grows on sunny sites * Prefers moist, well-drained soils, but is able to grow anywhere
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Removal

- * Hand pull small seedlings; or dig up larger plants, removing as much of the roots as possible (ensure minimal soil disturbance)
- * ‘Mowing’ mature plants when they are flowering (if too large to dig up)
- * Clip plant before it flowers or remove all spent flowers before they go to seed (June/ July)

Priority Actions for Stanley Park

- * Removal of plants in cultivated areas of the Park; especially around Prospect Point picnic area, Lost Lagoon, and Lumberman’s Arch
- * Pulling/ removal of all plants found in blowdown, forested and sensitive areas of Stanley Park
- * Control spread into new areas by gardening staff (it may have been established as an ornamental plant).


Suggested replacement

- * native evergreen trees
- * Red flowering currant (*Ribes sanguineum*)
- * Ninebark (*Physocarpus capitatus*)
- * Oceanspray (*Holodiscus discolor*)
- * Red Elderberry (*Sambucus racemosa*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

Touch forget-me-not (*Impatiens parviflora*)

Emergent Species in Stanley Park Natural and Sensitive Areas:

	<p>Description</p> <ul style="list-style-type: none"> * Annual succulent herb, growing 20-80 cm tall * Alternate leaves are stalked, saw-toothed 3-12 cm long * Pale yellow flowers have pouched sepals with straight spurs directed backwards * Close relative of the highly invasive Policeman's Helmet <p>Ecology</p> <ul style="list-style-type: none"> * Native to Himalayas * Prefers shaded, moist nutrient-rich woodlands * Commonly found in disturbed areas beside forests and ditches
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Removal

- * Manual removal by picking the whole plant including roots
- * Potential seed banks in soil may require up to 3 removals

Priority Actions for Stanley Park

- * Hand removal of all plants found in forested and sensitive areas (especially riparian areas) of Stanley Park
- * Hand removal of plants found in cultivated/ heavily managed landscapes of the Park


Suggested Replacement

- * Wild ginger (*Asarum caudatum*)
- * Piggy-back plant (*Tolmiea menziesii*)
- * Bunchberry (*Cornus canadensis*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

Gorse (*Ulex europaeus*)*

Emergent Species in Stanley Park Natural and Sensitive Areas:

	<p>Description</p> <ul style="list-style-type: none"> * Perennial evergreen shrub growing 1-3 meters tall * Bright yellow pea-like flowers at the end of branches in February and March * Sharp, spiny thorns along branches (more as plant ages) * Primarily reproduces by seed * Oils in the plant cause fire hazard <p>Ecology</p> <ul style="list-style-type: none"> * Fixes Nitrogen, and does well in a range of soil conditions * Does best in moist, well-drained soils * Best in moderate shade to full sun * Commonly found on disturbed sites
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Removal

- * Seedlings and small plants can be pulled by hand
- * Larger plants can be removed using a weed wrench or by cutting the stem below the soil and covering the cut stem/ root mass with soil
- * Herbicides can be used. Replanting recommended following applications
- * Gorse weevil used as biocontrol in some areas, with limited success; goats also used in some cases

Priority Actions for Stanley Park

- * Mature plants near blowdown areas (especially E1/E2- near the seawall) should be removed before seeds distributed to reforested areas
- * Other broom infestations in the Park should also be treated in the near future


Suggested Replacement

- * native evergreen trees
- * Snowberry (*Symphoricarpos albus*)
- * Saskatoon (*Amelanchier alnifolia*)
- * Nootka rose (*Rosa nutkana*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

Morning glory (Bindweed) (*Ipomoea spp*)

Expanding Species in Stanley Park Natural and Sensitive Areas:

	<p>Description</p> <ul style="list-style-type: none"> * Perennial vine, most active growth from late-spring through summer * Tubular flowers have 5 petals, and are white or pinkish-white in colour * Leaves are heart-shaped in appearance * Reproduction by seed and vegetative <p>Ecology</p> <ul style="list-style-type: none"> * Native to Eurasia * Very common invasive plant in gardens and disturbed areas * Form dense mats that out-compete native species, and strangle others
--	--

Removal

- * Manual removal by picking the whole plant including roots- easiest to do this during early summer when the plant is visible, and not yet fruiting. Care must be taken to avoid erosion into waterways
- * Can re-grow easily from left roots. Monitoring required several times per year.

Priority Actions for Stanley Park

- * Pulling/ removal of all plants found in forested and sensitive areas of Stanley Park. Current priority is Lost Lagoon


Suggested Replacement

- * Wild ginger (*Asarum caudatum*)
- * Piggy-back plant (*Tolmiea menziesii*)
- * Bunchberry (*Cornus canadensis*)
- * Western honeysuckle (*Lonicera ciliosa*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

Climbing nightshade (Bittersweet) (*Solanum dulcamara*)

Expanding Species in Stanley Park Natural and Sensitive Areas:

	<p>Description</p> <ul style="list-style-type: none"> * Perennial vine, can also appear semi-woody and shrub-like * Star-shaped purple flowers, with petals pointed backwards * Berries are red, eggshaped or round * Leaves are dark green, with two ‘ear-shaped’ lobes near the base * Strong odour when leaves are crushed * Whole plant contains toxins (member of the nightshade family—same as the ones in green potatoes) <p>Ecology</p> <ul style="list-style-type: none"> * Originally from Eurasia * Found along waterways and open areas * Can form dense thickets, out-competing native plants * Seeds dispersed by birds, or root/ stem fragments carried by water
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Removal

- * Manual removal by picking the whole plant including roots- easiest to do this during early summer when the plant is visible, and not yet fruiting. Care must be taken to avoid erosion into waterways
- * Can re-grow easily from left roots. Monitoring required several times per year.
- * Herbicides are not recommended, however, glyphosate and triclopyr have been used

Priority Actions for Stanley Park

- * Pulling/ removal of all plants found in forested and sensitive areas of Stanley Park. Current priority is Lost Lagoon


Suggested Replacement

- * Wild ginger (*Asarum caudatum*)
- * Piggy-back plant (*Tolmiea menziesii*)
- * Bunchberry (*Cornus canadensis*)
- * Western honeysuckle (*Lonicera ciliosa*)
- * Salal (*Gaultheria shallon*)

APPENDIX 6 – Invasive Species Management

Reed canary grass (*Phalaris arundinacea*)

Expanding Wetland Species:

	<p>Description</p> <ul style="list-style-type: none"> * Perennial, cool-season rhizomatous grass * Creeping rhizomes can form thick layers, out-competing other plants * Stems can grow 2m tall, and leaves are typically 2cm wide, and up to 50cm long * Hollow stems with clasping auricles * Inflorescence are pale purple (rather than pale green) when flowering in may and June <p>Ecology</p> <ul style="list-style-type: none"> * Native to Eurasia (some debate over whether native to interior of the Pacific Northwest of North America) * Found in wetlands, ditches and roadsides * Seeds dispersed easily through a range of means * Highly competitive with native species due to dense infestations
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Removal

- * Manual removal through digging up whole plants in small patches
- * Mowing over 5 times per year for a 10-year timeframe will control the plants (under this amount will not control it)
- * Covering the infestation with shade cloth. Layers of cardboard or through solarization has also worked
- * Herbicide applications have proven successful in some areas

Priority Actions for Stanley Park

- * Monitoring of infestation near Beaver Lake and associated creeks and riparian areas.
- * Pulling/ removal of all plants found in wetland and sensitive areas of Stanley Park

Suggested Replacement

- * Hardhack (*Spiraea douglasii*)
- * Large-leaved lupine (*Lupinus polyphyllus*)
- * Native grass species

APPENDIX 6 – Invasive Species Management

References for BMPs

King County's weed control Best Management Practices page is highly informative, with factsheets on each species and their control.

<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/weed-control-practices/bmp.aspx>

The Nature Conservancy's Invasive Plant Database and Documents- detailed information on control for a wide range of species.

<http://tncinvasives.ucdavis.edu/esadocs.html>

Invasive Plant Species in Stanley Park

Definitions

Emergent Species:

- Limited distribution or a new invader
- Serious potential threat
- Goal: eradication

Expanding Species:

- Abundant in some areas; unrecorded or of limited distribution in other areas
- Serious threat to uninfested areas
- Goal: control and eventual eradication

Established Species:

- Abundant or widespread
- High impacts in areas already infested, serious threats uninfested areas
- Goal: control and containment/management in priority areas

Watch List:

- Species yet-to-be identified within the Park, but have caused problems elsewhere in the Region
- Candidates for an Early Detection Rapid Response (EDRR) management approach
- Goal: to monitor for species and implement EDRR plan immediately upon sighting

Trailside Species:

- Non-native species considered a nuisance, but of minimal concern to natural area biodiversity
- Goal: to minimize spread into forest understory

Classified Species Lists

Emergent Species in Stanley Park's Natural and Sensitive Areas:

Butterfly Bush (*Buddleja davidii*)

Touch forget-me-not (*Impatiens parvifolia*)

St John's Wort (*Hypericum spp.*)

Common periwinkle (*Vinca spp*)

Spurge Laurel (Daphne) (*Daphne laureola*) (potentially eradicated as of July 08)

Giant Hogweed (*Heracleum mantegazzianum*)

English Laurel (*Prunus laurocerasus*)

Portugal Laurel (*Prunus lusitanica*)

Gorse (*Ulex europaeus*)*

APPENDIX 6 – Invasive Species Management

Scotch Broom (*Cytisus scoparius*)
Purple Loosestrife (*Lythrum salicaria*)*

Expanding Species in Stanley Park Natural and Sensitive Areas:

Japanese Knotweed (*Polygonum spp*)*
Yellow Lamium (Yellow Archangel) (*Lamium galeobdolon*)
Creeping Buttercup (*Ranunculus repens*)
Morning Glory (Bindweed) (*Ipomoea spp*)
Climbing Nightshade (Bittersweet) (*Solanum dulcamara*)

Expanding Wetland Species in Beaver Lake and/or Lost Lagoon:

Fragrant Water Lily (*Nymphaea odorata*)

Yellow Flag Iris (*Iris pseudacorus*)
Reed Canary Grass (*Phalaris arundinacea*)

Established Species in Stanley Park Natural and Sensitive Areas:

Himalayan Blackberry (*Rubus discolor*) *
Evergreen Blackberry (*Rubus laciniatus*)*
English Ivy (*Hedera helix*)
English Holly (*Ilex aquifolium*)

Watch List

Himalayan Balsam (Policemen's Helmet) (*Impatiens glandulifera*)
Common Hop (*Humulus lupulus*)
Clematis (syn. traveller's joy) (*Clematis vitalba*)
Garlic Mustard (*Alliaria petiolata*)
Leafy Spurge (*Euphorbia esula*)*

Trailside Species (Examples of most extensive trailside plants):

Pineapple Weed (*Matricaria discoidea*)
Broad Leaved Plantain (*Plantago major*)
Sow Thistle (*Sonchus spp*)
Canada Thistle (*Cirsium arvense*)
Burdock (*Arctium spp*)
Common Tansy (*Tanacetum vulgare*)
Sorrel/ Dock (*Rumex spp.*)
Rose Campion (*Lychnis coronaria*)
Great Mullein (*Verbascum thapsus*)
Common Foxglove (*Digitalis purpurea*)
Wall Lettuce (*Lactuca muralis*)
Nipplewort (*Lapsana communis*)
California Poppy (*Eschscholzia californica*)
Herb Robert (*Geranium robertianum*)

* Species have been identified by the International Union for Conservation of Nature in the 'Top 100 worse invasive species in the world'

APPENDIX 6 – Invasive Species Management

Stanley Park Invasive Species Control Calendar

Table 1. Summary of effectiveness for a range of control methods for some invasive plants found in Stanley Park. The effectiveness of each control method is rated on a scale of 0–3, with 0 being ineffective and 3 demonstrating proven effectiveness. Boxes designated with an -1 indicates treatments that may worsen the infestation by increasing seed germination or dispersing root fragments. An asterisk (*) indicates control methods which are generally inappropriate for the type of habitat in which the species is found (e.g., forested areas cannot be mowed). The terms “n/a” means *not applicable* and “n/i” mean *no information*. Green boxes indicate control methods that are considered effective (rated 2 or 3). All potentially effective strategies are explored here, but not all are appropriate for use within Stanley Park (e.g. grazing).

The information included in this chart is slightly adapted from: Page, N and P Lilley. 2008. City of Coquitlam Invasive Plant Management Strategy, March, 2008. Prepared by Raincoast Applied Ecology. Vancouver, BC.

Control Method	Himalayan Blackberry	English Ivy	Yellow Lamium	Knotweed (+ others)	Morning Glory	Purple Loose-strife	Scotch Broom	Giant Hogweed
Mowing	2	1*	0*	-1	1	1*	1	1
Pruning	2	3 ^f	0	0	0	1 ^k	1	1 ^h
Raking	n/a	1	1	n/a	1	n/a	n/a	0
Brushcutting	2	1*	0	-1	0	0*	1	1
Grazing ^a	2*	n/i*	n/i*	n/i*	n/i*	n/i*	n/i*	2*
Root pulling ^b	1	2	2	0	2	2	3	0
Root cutting	1	1	1	-1	2	n/a	1	3
Tilling	2	1*	1*	-1*	2	2*	-1	2
Excavating ^c	3	2*	2*	3	2	2*	2	3
Woodchips ^d	2	n/i*	1	0	1	0	1	1
Geotextile	2	n/i*	n/i*	2	2	0	0	2
Insect pest	n/a	n/a	n/a	n/a	n/a	3 ^g	n/a	n/a
Stem injection ^e	n/a	n/a	n/a	3 ⁱ	n/a	n/a	n/a	3

Symbols

- ^a pigs, cattle, goats, sheep
- ^b by hand
- ^c excavation of both roots and surrounding soil
- ^d deciduous or mixed chips approx. 30 cm in depth
- ^e injection of glyphosate into the stem using specialized equipment
- ^f ivy removal from trees only
- ^g introduction and maintenance of Galerucella beetles
- ^h prevents flower development
- ⁱ depends on the age of knotweed plants (established plants may be difficult to kill with herbicides)

APPENDIX 6 – Invasive Species Management

Table 2. Recommended timing for prescribed control methods. In most cases, work is recommended during the growing season when plants are visible and have put energy into leaf and flower development. The early growing season is recommended for some species such as Scotch broom to prevent the dispersal of seed. All control method timing should take into account breeding bird season, fisheries window and potential seasonal impacts of control methods.

The information included in this chart is slightly adapted from: Page, N and P Lilley. 2008. City of Coquitlam Invasive Plant Management Strategy, March, 2008. Prepared by Raincoast Applied Ecology. Vancouver, BC. *Permission for use granted by Lanny Englund, City of Coquitlam.*

Control Method	Himalayan Blackberry	English Ivy	Yellow Lamium	Knotweed	Morning Glory	Purple Loose-strife	Scotch Broom	Giant Hogweed
Mowing	Late July-Sept	n/a	n/a	Late July-Sept ^b	May-Sept	July-Sept	May-June ^a	May-June ^a
Pruning	Late July-Sept	n/a	n/a	Late July-Sept ^b	n/a	July-Sept	May-June ^a	May-June ^a
Raking	n/a	All year	n/a	n/a	May-Sept	n/a	n/a	0
Brushcutting	Late July-Sept	n/a	n/a	n/a	n/a	n/a	May-June ^a	May-June ^a
Grazing	Late July-Sept	n/i*	n/i*	n/i*	n/i*	n/a	n/i*	May-Sept
Root pulling	Late July-Sept	All year	All year	n/a	May-Sept	* May-June ^a	Dec-June ^c	n/a
Root cutting	Late July-Sept	All year	All year	n/a	May-Sept	n/a	n/a	Apr-June
Tilling	Late July-Sept	All year	All year	n/a	May-Sept	n/a	n/a	Apr-June
Excavating	All year	All year	All year	All year	May-Sept	* May-June ^a	All year	Apr-Aug
Woodchips	Late July-Sept	n/a	n/a	All year	May-Sept	n/a	May-June	n/a
Geotextile	Late July-Sept	n/a	n/a	All year	All year	n/a	n/a	All year
Insect pest	n/a	n/a	n/a	n/a	n/a	All year ^e	n/a	n/a
Stem injection	n/a	n/a	n/a	Aug-Sept ^d	n/a	n/a	n/a	May

Symbols

- ^a before seeds have formed
- ^b mowing or pruning must be accompanied by removal of stems from the site to prevent resprouting or collection and on-site mulching/composting during hot weather
- ^c Scotch broom can be pulled at any time of the year except when seeds are present (to prevent dispersal)
- ^d herbicide use after cutting and 1 m high regrowth
- ^e repeated introductions of *Galarucella* may be required for successful establishment (or re-establishment)
- * Purple loosestrife must be removed during the breeding bird season and outside of the fisheries window because this is the only time it is visible, but also before the seeds have set. Extreme care should be taken when working in wetlands and riparian areas at this time.

APPENDIX 6 – Invasive Species Management

Stanley Park Ecology Society Invasive Species Calendar

		Winter	Spring	Summer	Autumn	Winter								
Weed		January	February	March	April	May	June	July	August	September	October	November	December	
English Ivy <i>Hedera helix</i>	Present	[Yellow bar]												
	Flowering	[Blue bar]										[Blue bar]		
	Reproduction	[Yellow bar]			[Yellow bar]									
	Removal	[Green bar]												
Policeman's Helmet <i>Impatiens glandulifera</i>	Present	[Yellow bar]		[Yellow bar]						[Yellow bar]				
	Flowering	[Blue bar]							[Blue bar]					
	Reproduction	[Yellow bar]						[Yellow bar]			[Yellow bar]			
	Removal	[Green bar]			[Green bar]									
Purple Loosestrife <i>Lythrum salicaria</i>	Present	[Yellow bar]		[Yellow bar]						[Yellow bar]				
	Flowering	[Blue bar]							[Blue bar]					
	Reproduction	[Yellow bar]						[Yellow bar]			[Yellow bar]			
	Removal	[Green bar]			[Green bar]									
English Holly <i>Ilex aquifolium</i>	Present	[Yellow bar]												
	Flowering	[Blue bar]				[Blue bar]				[Blue bar]				
	Reproduction	[Yellow bar]		[Yellow bar]						[Yellow bar]				
	Removal	Optimum November to June. Take care to avoid spreading seeds during removal in October-December												
Himalayan Blackberry <i>Rubus discolor</i>	Present	[Yellow bar]												
	Flowering	[Blue bar]				[Blue bar]				[Blue bar]				
	Reproduction	[Yellow bar]				[Yellow bar]				[Yellow bar]				
	Removal	[Green bar]				Optimum removal time				Fruit Ripens / Fruit Dispersed				

APPENDIX 6 – Invasive Species Management

Weed		January	February	March	April	May	June	July	August	September	October	November	December
Japanese Knotweed <i>Polygonum cuspidatum</i>	Present	[Yellow bar]											
	Flowering	[Blue bar from August to October]											
	Reproduction	Not known to set viable seed in North America. Spreads by Rhizomes and from plant fragments											
	Removal	Digging can be undertaken year round. Stems can be cut April through October when leaves are present.											

Weed		January	February	March	April	May	June	July	August	September	October	November	December
Common periwinkle <i>Vinca spp</i>	Present	[Yellow bar]											
	Flowering	[Blue bar from March to August]											
	Reproduction	Does not set viable seed. Spread by runners which root at the nodes and by Dumping of garden waste.											
	Removal	[Green bar]											

Weed		January	February	March	April	May	June	July	August	September	October	November	December
Spurge / Daphne Laurel <i>Daphne laureola</i>	Present	[Yellow bar]											
	Flowering	[Blue bar from February to April]											
	Reproduction	[Yellow bar from February to April] [Yellow bar from June to August] [Yellow bar from November to December]											
	Removal	[Green bar from February to April]											

Weed		January	February	March	April	May	June	July	August	September	October	November	December
Yellow Lamium <i>Lamium galeobdolon</i>	Present	[Yellow bar]											
	Flowering	[Blue bar from April to July]											
	Reproduction	[Yellow bar from June to August]											
	Removal	[Green bar from February to March]											

Weed		January	February	March	April	May	June	July	August	September	October	November	December
Morning Glory <i>Ipomoea spp</i>	Present	[Yellow bar]											
	Flowering	[Blue bar from June to September]											
	Reproduction	Can spread from fragments. Peak germination of seed is mid Spring to Summer											
	Removal	Hand pull and dig out year round but especially during flowering periods before seeds are produced.											

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Weed		January	February	March	April	May	June	July	August	September	October	November	December	
Scotch Broom <i>Cytisus scoparius</i>	Present	[Yellow bar spanning all months]												
	Flowering		[Blue bar spanning Feb to May]				Peak							
	Reproduction						[Yellow bar spanning June to July]		Peak					
	Removal	[Green bar spanning Jan to May]									[Green bar spanning Oct to Dec]			

Useful Links

[Vancouver Plant Calendar](#)

[Five Year Invasive Species Management Plan for Royal Roads University](#)

[Invasive Plants of Southwestern B.C.](#)