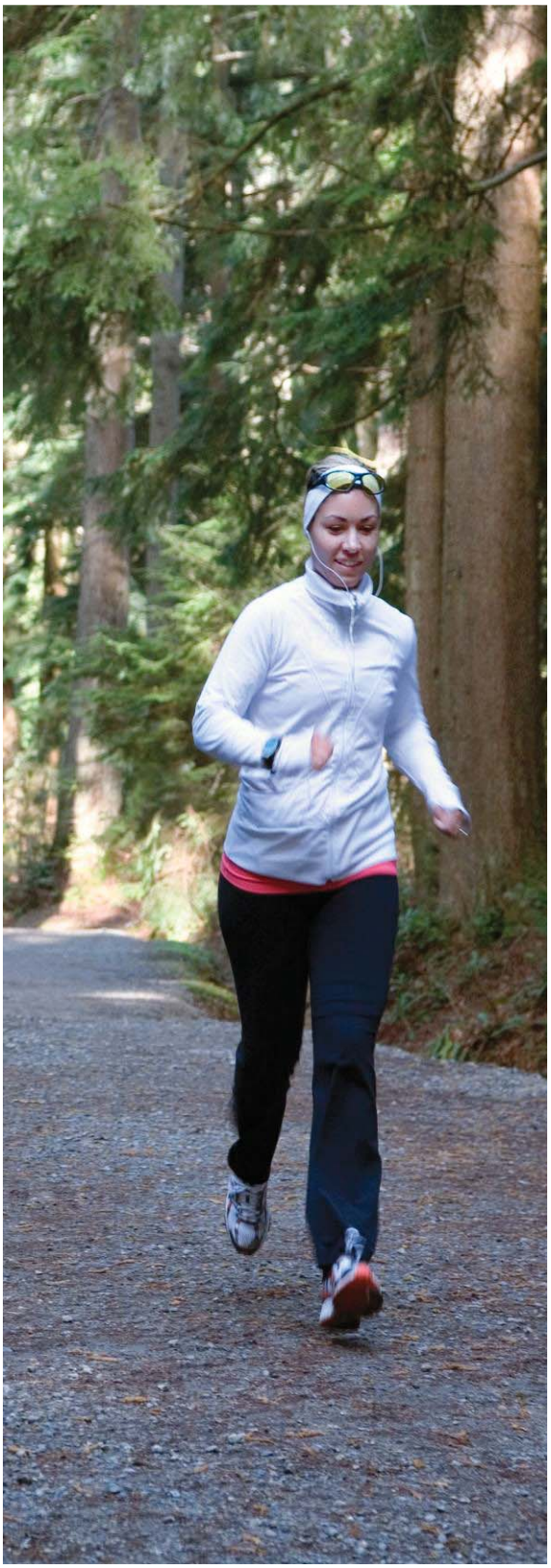
Mundy Park
Forest Management Plan

February 18, 2015



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1 INTRODUCTION

Mundy Park was dedicated as an Urban Forest Park in 1993 and is the largest City-owned park in Coquitlam. The park provides urban forest, open spaces, sports fields and trails but most importantly, it is Coquitlam's natural treasure.

Bylaw 2699 defines an Urban Forest Park as:

> *A large tract of wooded land located within a populous community, dedicated for the public's use and enjoyment and to the management, conservation and enhancement of native flora and fauna.*

Named after George Munday, who purchased the land in 1895, Mundy Park has 400 acres of un-fragmented second growth forest, two lakes and several streams, and is home to a variety of native plant communities and wildlife species. Thousands of residents and visitors regularly enjoy the Park's trail network and facilities.

This study has shown that Mundy Urban Forest is in exceptional condition for a forest situated in an urban setting and is well-positioned to become a model urban Forest and a repository for species at risk. However, there is room for improvement and Mundy urban forest does face a variety of management challenges.

1.1 The Mundy Park Forest Management Plan

This **Forest Management Plan** (FMP) provides a detailed assessment and review of Urban Forest Park resources and their current condition, and sets out the goals and objectives needed to achieve the community supported vision for Mundy Park over the next 10 years. The FMP focuses on the wooded areas of the park within the dedicated urban forest (Figure 1), and does not cover the sports fields, the facilities area or the BC Hydro right-of-way.

Vision Statement

Mundy Park is a regionally significant nature refuge for people and wildlife and a defining landmark in Coquitlam. This sanctuary offers residents and visitors opportunities for recreation, nature appreciation and education. The City of Coquitlam sustains the park for future generations by protecting its wildlife habitat, recreational values and natural heritage through environmental stewardship.

The FMP is organized into six component sections:

1. **Recreation Management**
2. **Natural Features**
3. **Risk Management**
4. **Community Involvement, Public Education and Awareness**
5. **Monitoring Program**
6. **Implementation Plan**

For each component, the current 'baseline' condition of Mundy Park is described and, where improvement is needed, management actions are recommended and prioritized over the next 10 years.

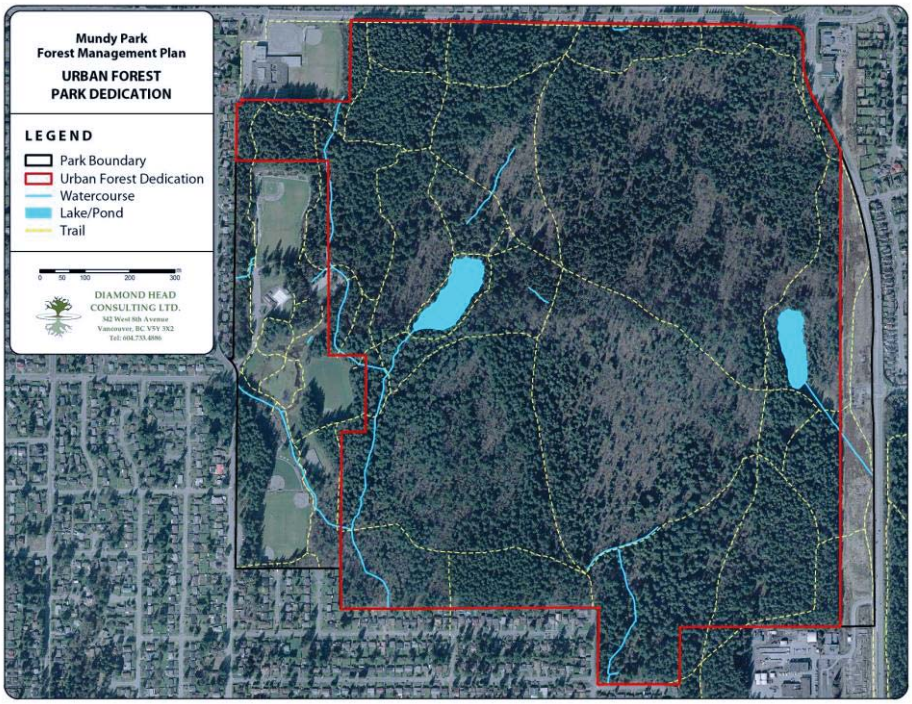
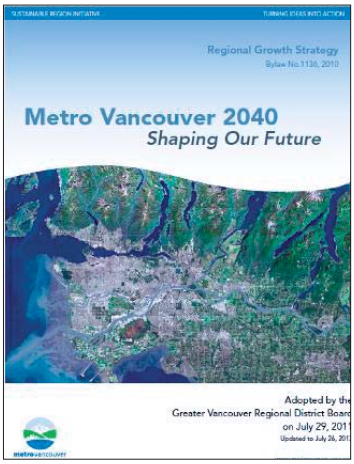


Figure 1. Urban forest park dedication: subject area of the Forest Management Plan.

Several assessments and park management related subjects are not included in the scope of work for the development of the FMP including:

- Dog regulation
- Detailed wildlife and species at risk sampling
- Lake and stream hydrological assessment

1.2 Regional Context and the Green Infrastructure Network Concept



The City of Coquitlam's strategic plan, "Coquitlam 2012-2015: Strategic Plan", states that the City will: Develop a sustainable system of parks and open space that contribute to the ecological, social and economic well-being of our community. The most recent regional growth strategy (RGS), ***Metro Vancouver 2040 – Shaping our Future*** recognizes Mundy Park as a key conservation and recreation area. One of its policy goals is to "Protect and enhance natural features and their connectivity."

The RGS was followed by the release of Metro Vancouver's ***Ecological Health Action Plan***, which proposed 12 projects to maintain and enhance ecosystem services in the region and help

realize the commitments articulated in the ***Sustainable Region Initiative***. One of the *Action Plan's* 12 projects is advancing a regional green infrastructure network[1], which is made up of linked woodlands, wetlands, fields and waterways in Metro Vancouver. This network is composed of hubs and corridors, with the hubs being the larger green spaces, and the corridors being the "pathways" that join them together.

Mundy Park, draining north into Burrard Inlet and south into the Fraser River system, is a critical hub in the regional green infrastructure network and forms the core of a green network that provides important benefits to Coquitlam including a healthier environment and great recreational opportunities.

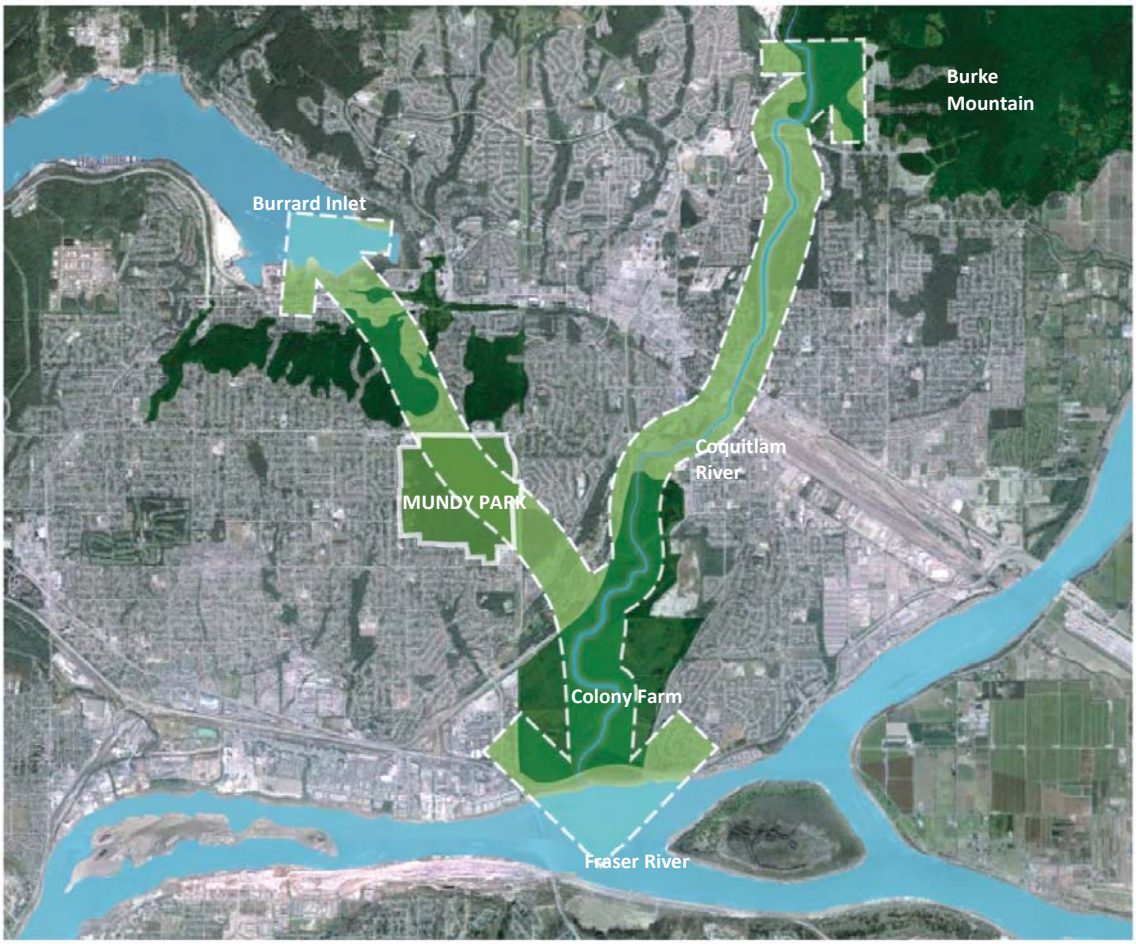


Figure 2. A green infrastructure network concept proposed by Metro Vancouver includes Mundy Park highlighted in the middle, outlined in white.

[1] A green infrastructure network is a connected framework of protected natural areas (sometimes called hubs) and corridors that provide benefits to both people and wildlife. Benefits range from provision of important habitat and recreational opportunities to flood attenuation, stormwater management, carbon sequestration, and improved air and water quality.

1.3 Vision and Principles

Vision Statement

Mundy Park is a regionally significant nature refuge for people and wildlife and a defining landmark in Coquitlam. This sanctuary offers residents and visitors opportunities for recreation, nature appreciation and education. The City sustains the park for future generations by protecting its wildlife habitat, recreational values and natural heritage through environmental stewardship.

A workshop with the Mundy Park Community Focus Group (CFG) was held in November 2013 to draft a Vision Statement and supporting Principles. CFG members included one representative from each of the following groups and Committees of Council:

Community Stakeholder Groups

- Animal Shelter Volunteers
- BC Disc Sports Society
- Burke Mountain Naturalists
- Friends of Mundy Forest Heritage Society
- Mundy Mudthudders
- Phoenix Running Club

Council Committees

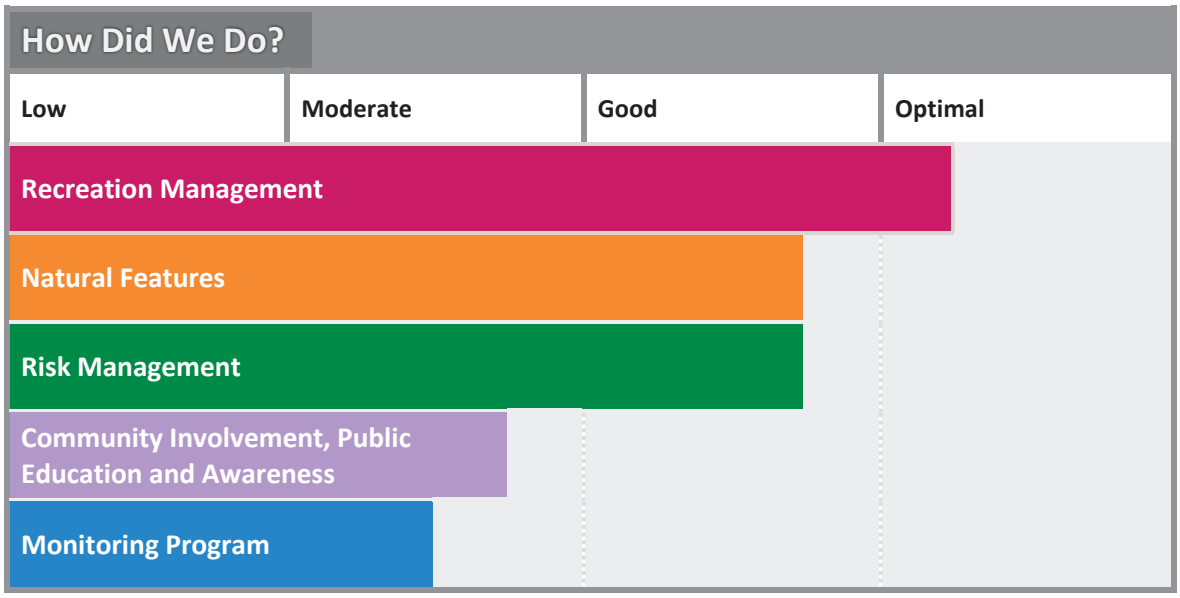
- Arts and Culture Advisory Committee
- Multiculturalism Advisory Committee
- Sport Council
- Sustainability and Environmental Advisory Committee
- Universal Access-Ability Advisory Committee

Principles

The management principles support the intent of the Urban Forest Park Dedication Bylaw and follow the vision drafted for the Park:

	Management Principles
Balanced Values	Management will be guided by a strong commitment to low impact recreational activities, balanced with conservation and environmental stewardship.
Diverse Recreation and Education Opportunities	Recreation and education opportunities will be provided for a range of ages, physical mobility and income groups.
Environmental Protection	Biodiversity will be protected through preservation, restoration and enhancement of important habitat that supports a variety of wildlife.
Education	Educational opportunities will foster community awareness and a sense of stewardship.
Collaboration	Collaborative management will be supported by open communication and engagement between the City, park user groups and volunteers.
Adaptive Management	An adaptive management approach will be used to evaluate the effectiveness of initiatives and emerging best practices.

1.4 Mundy Park's 'Baseline' Condition



1. Recreation Management

Based on 2013 survey data, 97% of visitors are somewhat to very satisfied with the Coquitlam's parks, trails and other green spaces. Surveys conducted in Mundy Urban Forest between 1999 and 2009 showed an average score of 90% when users rated cleanliness, maintenance, access, services, safety and expectations. Sixteen kilometres of surfaced trails have been maintained in good condition. Unapproved trails do exist within the park and require further management action.

2. Natural Features

Home to two small lakes, 400 acres of unfragmented second growth forest, and a wide array of native plant communities and wildlife species, the ecosystems at Mundy Park have been inventoried and assessed in good health. There are opportunities for ecosystem enhancement, forest succession, and species at risk initiatives to further improve the forest health.

3. Risk Management

Wildfire risk has been assessed and is considered low to moderate. Given the overall good health of forest cover the occurrence of potential tree hazards is considered low. Risks associated with human-wildlife conflicts have been identified and are considered low (thanks, in part, to the City's Bear Aware Program). Opportunities for improvement in risk management relate to educating park users about potential risks in the urban forest and continuing the risk assessment and hazard abatement process.

4. Community Involvement, Public Education and Awareness

A number of local community groups are interested and actively involved in the recreational opportunities and long-term stewardship needs of Mundy Park. A “Scan and Discover” trail utilizes Quick Response (QR) codes to provide interpretive information to park users with a specific focus on unique environmental features within the urban forest park. Opportunities for an expanded, coordinated and prioritized approach to nature-based education, volunteerism and community participation exist within Mundy Park.

5. Monitoring Program

A long-term planning approach is appropriate in managing the ecological health of Mundy Park. The base-line assessment has found Mundy Park’s natural features to be in generally good condition. Monitoring of ecological indicator species and water quality will be needed to measure the effectiveness of FMP implementation on natural features, and to enable adaptive management.

6. Implementation Plan

The FMP provides recommendations, targets and indicators for each of the sections described above. These targets and indicators are intended to serve as “vitals” to monitor performance according to recommended management actions. In the event that individual measures trend away from the intended target, management actions should be reconsidered within the adaptive management framework of the FMP.

1.5 What are the Benefits of an Urban Forest Park?

The preservation and ongoing management of Mundy Urban Forest supports the ecological health of the community and Coquitlam's corporate goals of encouraging active participation and conservation of environmental assets.

Mundy forest provides opportunities for people to experience nature and pursue active outdoor recreation in an urban area. Mundy Urban Forest supports community enjoyment of recreational activities such as walking, running, biking, dog walking, orienteering, geo-caching, and bird watching.

Nature advocates and enthusiasts have long maintained that outdoor recreation is beneficial and there is now a growing body of scientific evidence that supports a link between exposure to nature and physical and mental health, community safety and economic vitality[2].

Health: Recreation in a natural environment lowers blood pressure, lowers blood sugar levels in diabetics, reduces the levels of stress hormones and moderates the symptoms of AD/HD, autism, dementia, depression and an array of mental health disorders. These benefits are significantly in excess of those resulting from the same amount of exercise indoors.

Community Safety: Nature and managed outdoor recreation in green surroundings leads to safer communities. Communities with accessible parks and natural areas experience lower crime rates, reduced vandalism, litter and graffiti as well as lower rates of anger and aggression.

Economic Vitality: Mundy Park is one component of what makes Coquitlam a desirable community in which to live and do business. Mundy Urban Forest is a regionally significant ecological and recreational hub that has become a destination for visitors from throughout the region who seek it out for the desirable recreational values that it offers.

[2] The Green Cities: Good Health website collects and summarizes research about the benefits of nature in cities and towns - http://depts.washington.edu/hhwb/Top_Introduction.html

1.6 Forest Management Zones

Forest Management Zones provide a framework within which to understand and balance recreational and environmental features and values when making management decisions. Five management zones have been defined and are illustrated in Figure 3. Their location, scope, intent, and management recommendations are described in Table 1.

Recreational Features
Mundy Urban Forest is a well-used recreational area containing over 16 kilometers of trails, from asphalt/paved multi-use trails to narrower gravel paths. It supports a variety of recreational pursuits including walking, running, biking, orienteering, geocaching, picnicking, wildlife viewing and other light impact activities. It contains a unique interpretive walk that integrates QR codes that users can scan with their smart phone.

Environmental Features
Mundy Urban Forest contains two lakes, three main creek systems and numerous forest wetlands. A variety of forest types exist from mature second growth stands dominated by tall conifers to open, mixed wooded stands with dense shrub communities. It provides a large intact habitat area that supports a high diversity of species including endangered plant communities and fauna.

Figure 3. Forest Management Zones.

Type of Zone	*Riparian Zone*	*Interface Zone*	*Recreation Zone*	*Nature Interpretive Zone*	*Nature Conservation Zone*
Definition	The riparian zone is composed of the ecosystems adjacent streams, lakes and connected forested wetlands	The interface zone encompasses the outer edge of the park. All park entrances and exits are in this zone. This zone is most vulnerable to urban influences	The recreation zone encompasses all the authorized trails in the park. Recreation activities within this zone includes numerous uses that are managed by the Parks department	The nature interpretive zone includes areas near the outer perimeter of the park. This zone contains drier, more resilient ecosystem types which are less susceptible to disturbance than other types found in the park. It includes the highest diversity of trails	The nature conservation zone encompasses the interior ecosystems of the park. A diversity of habitat types are represented, providing valuable refuge habitat for wildlife. This zone has the highest concentration of wetter ecosystem types and lowest density of trails
Scope	Within 15m of all watercourses; within 30m of lakes and ponds, and associated wet ecosystem types (site series 12)	Within 50m of the perimeter of the dedicated urban forest	Within 7.5m of existing gravel and paved sanctioned trail system; existing disc golf course	Drier, mature conifer ecosystem types which are less sensitive to low level disturbance.	Contiguous inner core of the urban forest park dedication which includes majority of wetter ecosystem types (site series 07/12)
Intent	To ensure the ecosystem function of creeks, lakes, ponds, and their associated riparian zones are maintained while providing enjoyment of the natural surroundings	To manage the risk associated with the urban interface while ensuring a natural aesthetic is maintained	To provide low impact, safe recreation opportunities	Manage activities within the forest to ensure the natural surroundings are not unduly impacted such that future generations cannot enjoy them.	Protect the core of the park from preventable disturbance. Provide a contiguous linkage for wildlife between the two lakes and their associated riparian areas, and the northern and southern park edges
Permitted Uses	Recreation on existing sanctioned trail system where trails intersect the riparian zone	Recreation on existing trail system where trails intersect the interface zone	Recreation where the surrounding environment is not impacted by its use (e.g. walking, jogging, cycling, disc golf)	Nature interpretive and educationl activities approved by the City (e.g. orienteering, school groups)	Research or educational opportunities that have been approved by the City
Management	Maintain and enhance trail-side fencing to prevent disturbance, enhancement through restoration where disturbance has occurred, sediment and erosion control measures.	Risk management pertaining to fire, tree hazards, invasive plant species, illegal dumping, encroachment, human/wildlife conflicts, and other interface issues	Maintain the existing trail network; manage risk, maintain infrastructure (culverts, signage, hydrants etc.), enhancement through restoration where degradation has occured	Education and enhancement through restoration where disturbance has occurred. Expansion of recreational needs can occur within this zone	Research and enhancement through restoration where disturbance has occurred. Flora and fauna management. Changes and additions to the trail system can occur within this zone with a focus on avoiding and/or mitigating any impacts

Table 1. Forest Management Zones: location, scope, intent, permitted uses, and management.

2 RECREATION MANAGEMENT

Demand for outdoor recreation[3] is growing. The public place considerable value on outdoor recreation and City of Coquitlam's 2013 Ipsos Reid Citizen Satisfaction Survey supports this with 95% indicating that parks, trails and other green space are important. Coquitlam registration data also show the increasing trend of residents pursuing this type of programming (Figure 4).

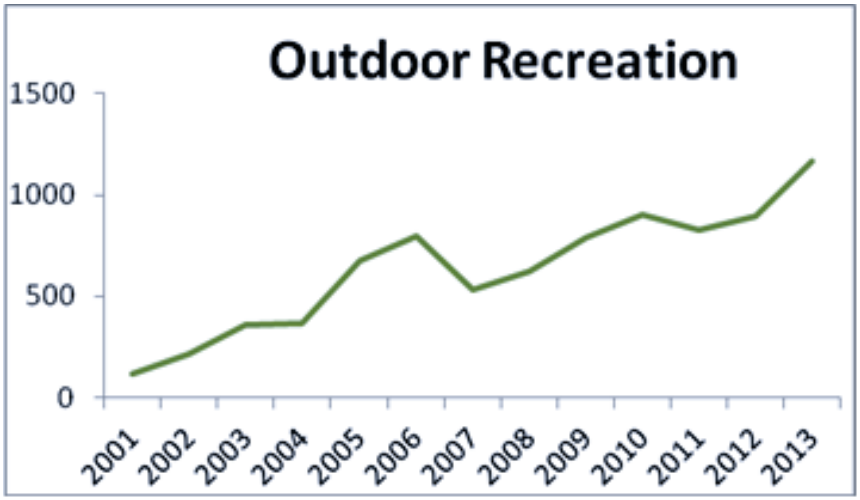


Figure 4. Registration numbers in outdoor recreation programs in Coquitlam.

In the same Ipsos Reid survey, 97% of citizens were somewhat to very satisfied with the parks, trails and other green spaces in the City. This result is higher than Lower Mainland norms, which showed only a 92% satisfaction rating, and 93% province wide.

Between 1999 and 2009 the City also conducted a Gender Equity Project Casual Use Surveys on six Coquitlam Trails including some in Mundy Urban Forest. This survey showed that users of Mundy Urban Forest trails were generally very satisfied with cleanliness, maintenance, access, services, safety and expectations (Table 2).

Table 2. 2009 Gender Equity Project Casual Use Survey Results for Mundy Park (scale 1 - 5).

	Cleanliness	Maintenance	Access	Services	Safety	Expectations
Average	4.59	4.51	4.77	4.54	4.10	4.60

[3] Outdoor recreation involves both programmed and self-directed activities that make use of natural spaces and focuses on the interactive relationship between the natural environment and humans in a recreational context.

The 106 survey respondents at Mundy Urban Forest (surveyed at the playground, sports fields, and on the trails) were asked what park amenities they would *like to see more of in Coquitlam* and the highest number of responses related to trails, washrooms and picnic facilities (Table 3).

Table 3. 2009 Gender Equity Project Casual Use Survey Results: Desired amenities at Mundy Park.

Most Desired Amenities	Number of Responses
Washrooms	54
Walking/Jogging Trails	43
Dog Play Park Areas/Off-Leash Dog Trails	37
Hiking/Forest Trails	30
Picnic Facilities/Shelters	29
Flower Gardens	22
Playgrounds	16
Paved/Fenced Sport Courts	9
Sports fields	8

The intent of the FMP is to balance the needs associated with the public access and recreation while also conserving and enhancing native flora and fauna. Given these two often competing values, it is important to understand the current and future needs of Mundy Urban Forest users. It is also important to identify what, and to which degree, environmental features are sensitive to user impacts.

2.1 Provide Trails, Events and Facilities

The City recently updated the City of Coquitlam Master Trail Plan (2013). This document describes future trail connections to and around Mundy Park, policy, design guidelines, and trail management. Recommendations are provided for managing trail user conflicts, wildlife encounters, education and awareness, waste management and risk. These recommendations should be followed to meet the recreational needs and management requirements for trails at Mundy Park.

A mountain bike skills park is now open to the public on the east side of the Park under the BC Hydro right-of-way as per the City's Off-Road Cycling Strategy. With the future development of a single track mountain bike trail network across the street in Riverview Forest, off-road cycling will be well provided for in the area.

Adopt-a-Trail
The City has a well-organized adopt-a-trail program. All authorized trails have been adopted and are well cared for. Garbage on the trails is regularly picked up, graffiti removed and problems reported.

No toilet facilities are located within the dedicated urban forest portion of Mundy Park. Public toilets are not easily accessible from the trail system on the east side of the Urban Forest. This area experiences a lot of traffic and the amount of garbage from toilet paper in the nearby forest at the main trail intersections demonstrates a clear need for additional facilities. Additional toilets would be most appropriately located in the Interface Zone near park entrances on the east side of the park.

Table 4. Management recommendations for providing trails, events and facilities.

Ongoing	1-2 years	1-5 years	5 – 10 years
Construct and maintain trails as per Master Trail Plan Standards.	Survey Park users (including off-road cyclists) to determine their satisfaction.	Develop a mountain bike trail network in Riverview Forest as per the Off-Road Cycling Strategy.	
	Update information kiosks. Trail difficulty levels and locations of all toilet facilities should be clearly indicated on all maps.	Investigate options for additional toilet facilities.	
		Examine further opportunities for recreation.	

2.2 Provide Safe Recreational Opportunities

Over the past decade, Mundy Urban Forest has likely experienced a dramatic increase in visitor numbers. As urban development and the population increases in the City, the demands on the Urban Forest will continue to grow, potentially increasing the conflicts between user groups. Human-wildlife conflicts are addressed in Section 4, Risk Management.

Conflicts that exist between user groups in the City have been reviewed in the Master Trail Plan; however, the findings are not specific to Mundy Urban Forest itself. Based on the low number of complaints or incidences reported, it appears that there is a low incidence of conflict between the various user groups in the Mundy Urban Forest. The City should continue to log any conflicts to monitor the level of user conflict and their locations to determine if sections of this Plan require updating.

Cycling is currently permitted on all of the authorized trails in Mundy Park, which provides for a low difficulty trail riding experience. The City of Coquitlam Off-Road Cycling Strategy identifies a number of issues relating to off road cycling and discusses both the conflicts with other users and the potential for facilities in nearby Riverview Forest and in the BC Hydro right-of-way in the park.

Table 5. Management recommendations for providing safe recreational opportunities.

Ongoing	1-2 years	1-5 years	5 – 10 years
When conflicts arise utilize the guidelines laid out in Appendices F and G in the Master Trail Plan regarding Trail Management and Conflict Reduction.			
Survey Park users to understand conflicts that may exist.			
Monitor results of Park user surveys over time for changes in conflict levels.			

2.3 Decommission or Adopt Unauthorized Trails

Mundy Urban Forest has numerous trails (see Figure 5) that are classified as either authorized (maintained by the City) or unauthorized (not approved or maintained by the City).

Based on an analysis of trail use, two existing unauthorized trail segments should be recognized and adopted by the City as they represent a nature trail experience that the public is clearly looking for and have minimal impact on the forest. One runs north to south through the northeast corner of the Urban Forest and the second runs through the southwest corner of the Urban Forest (Figure 5).

The remaining unauthorized trails, including several with constructed mountain-bike jumps, present management challenges including safety, fire risk, liability and impacts to the ecology. For this reason they should be decommissioned on a priority basis.

A well-used recreation trail extends around the perimeter of Mundy Lake. There are numerous unsanctioned access points to the lake. The shoreline of Lost Lake is relatively undisturbed with the exception of the south shoreline where trail access has caused extensive degradation to the shoreline. Within the Riparian Zone, there is a need for visitors to view the lakes and access the shoreline. Degradation of creeks and riparian plant communities by Urban Forest users and dogs has occurred where trails (authorized and unauthorized) run adjacent to or cross streams.

Table 6.Length of trail by permitted use and management zone.

Forest Management Zone	Authorized (km)	Unauthorized (km)	Proposed New Trail (km)
Interface	3.2	0.4	0.05
Nature Conservation	3.2	1.9	0.5
Nature Interpretive	4.0	2.1	1.4
Riparian	1.4	0.5	0
Total	**11.8**	**4.9**	**1.95**

Unauthorized trails to be decommissioned have been ranked in priority sequence (Table 7). The ranking assigns highest priority to the forest management zones which are most sensitive to disturbance (i.e. Riparian and Nature Conservation Zones). Trails in the vicinity of newly authorized trails are included in the high priority groups to reduce trail density in those areas.

Table 7. Priority sequence to decommission unauthorized trails

Priority Group	Description
1	Trails within the Riparian Zone
2	Trails connected to or in vicinity of newly authorized trails
3	Trails within Nature Conservation Zone
4	Trails within Nature Interpretive Zone
5	Trails within Urban Interface Zone

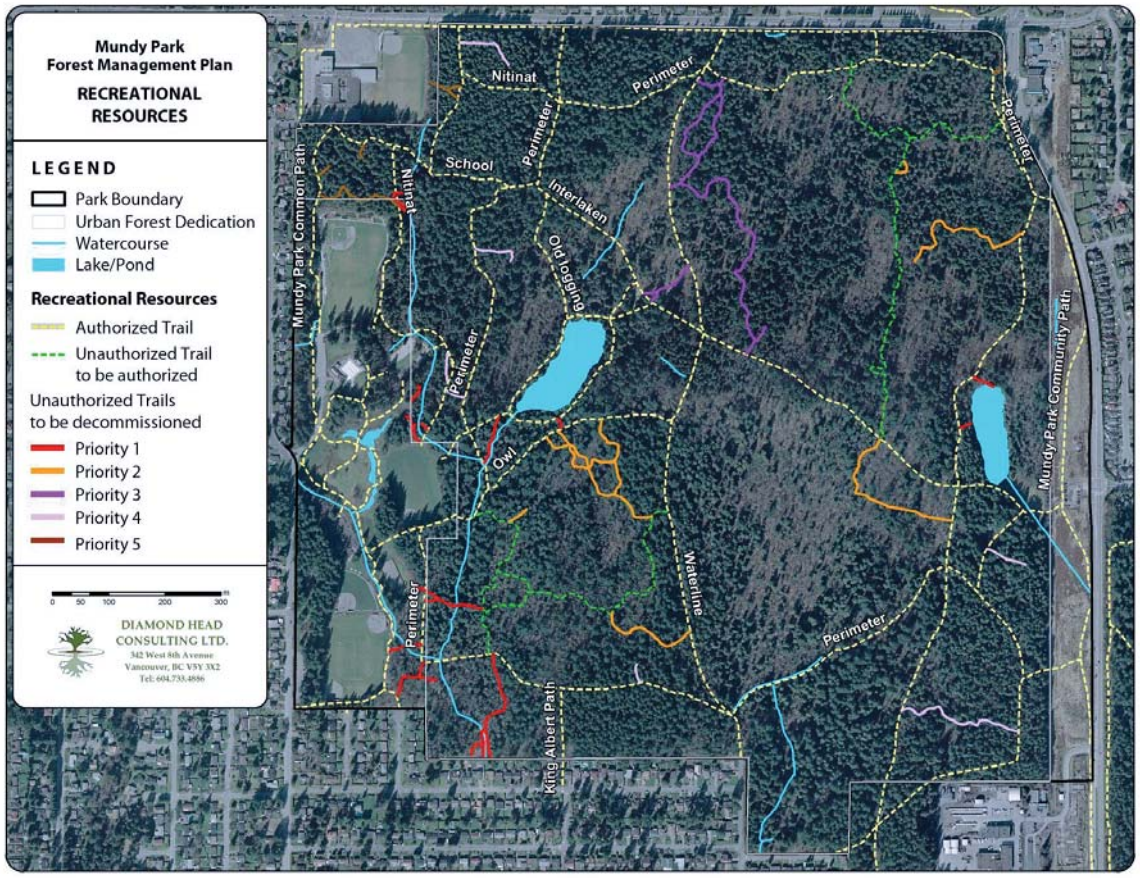


Figure 5. Trail Network.

Table 8. Management recommendations for trail planning and maintenance.

Ongoing	1-2 years	1-5 years	5 – 10 years
Remove any constructed jumps outside designated off-road cycling areas.		Deactivate all Priority 1 and 2 unauthorized trails.	Deactivate all Priority 3-5 unauthorized trails.
		Explore the potential for a viewing platform at Mundy Lake to enhance viewing opportunities in conjunction with shoreline habitat protection measures.	

2.4 TARGETS & INDICATORS | Recreation Management

Table 9 identifies target objectives for the Recreation Management component of the Forest Management Plan. The light blue box indicates the current status of each target objective.

Table 9. Target objective and indicators: Recreation Management.

Target	Assessment Criteria	Low	Moderate	Good	Optimal
Provide trails and facilities that meet the needs of Urban Forest user groups	User group satisfaction survey of Urban Forest trails and facilities	<60% of Urban Forest user groups satisfied with Urban Forest trails and facilities	60-75% of Urban Forest user groups satisfied with Urban Forest trails and facilities	75-90% of Urban Forest user groups satisfied with Urban Forest trails and facilities	>90% of Urban Forest user groups satisfied with Urban Forest trails and facilities
	Trail construction and maintenance	Trail network incomplete; no regular maintenance	Trail network incomplete; trail maintenance ad hoc	Trail network complete; trail maintenance ad hoc	Trail network complete; annual trail maintenance
Provide safe recreational opportunities for the public	Number of safety incidents	>10 reported safety incidents per year	5-10 reported safety incidents per year	1-5 reported safety incidents per year	No safety incidents
Decommission unauthorized trails and restore area to functional ecological condition	Inventory and percentage of unauthorized trails restored	Unauthorized trails have not been identified	Unauthorized trails identified. <25% of unauthorized trails have been de-activated	Unauthorized trails identified. 25-75% of unauthorized trails have been de-activated	Unauthorized trails identified. >75% of unauthorized trails have been de-activated

3 NATURAL FEATURES

Mundy Park is a large urban second growth forest, and is fairly flat with many wet areas. There are a number of distinct ecosystems within the park, varying with the forest cover, nearness to water, soil conditions, and other factors. Home to two small lakes and three stream systems, Mundy Urban Forest protects 400 acres of mature second growth forest, and a wide array of native plant communities and wildlife species.

Mundy Urban Forest is located in a mild maritime climate where average temperatures stay above 10 degrees for 4 to 6 months of the year. Summers are generally cool and winters are mild with little snowfall. Soils consist of predominantly thick silts and clays that have been compacted. Generally, the forest is flat with gentle slopes reaching no more than 15%. Most of the runoff is absorbed by the vegetation on the site or is filtered down through the soils. Infiltration is slow in most areas resulting in a number of poorly drained areas that are very wet with high water tables.

The baseline assessment for the FMP included a detailed inventory of Mundy Urban Forest's ecosystems. Overall, the ecosystems were found to be in good health.

3.1 Ecological Health

3.1.1 Forests

Mundy Urban Forest contains a variety of mature forest types (Figure 6) that regenerated naturally following clearing of the original old growth forests. Most of the Mundy Urban Forest consists of even aged mature stands that are between 60 and 110 years old. Stand structure ranges from tall, even aged conifer dominated stands to open mixed forests with large canopy gaps and dense shrub communities.

Conifer stands have generally established on drier ecosystems and consist of a mix of Douglas-fir, western redcedar and western hemlock with occasional Sitka spruce. Wetter ecosystems support a mix of deciduous and coniferous trees that are more tolerant of higher moisture regimes. Trees include mostly red alder, bigleaf maple, black cottonwood, paper birch, western redcedar and western hemlock. The ecology provides a very productive growing environment. The largest trees in the forest include Douglas-fir that reach diameters greater than 1m and heights over 40m.

None of the stands have reached an age that can be classified as old forest. However, some mature conifer stands are reaching an age and structure where they will soon exhibit features indicative of old growth forests; multiple canopy layers, canopy gaps, large trees with large limbs and numerous standing dead trees. Many areas within the Mundy Urban Forest have very little forest regeneration in the understory. This is in large part due to the wet, rich soils and competing shrub layer.

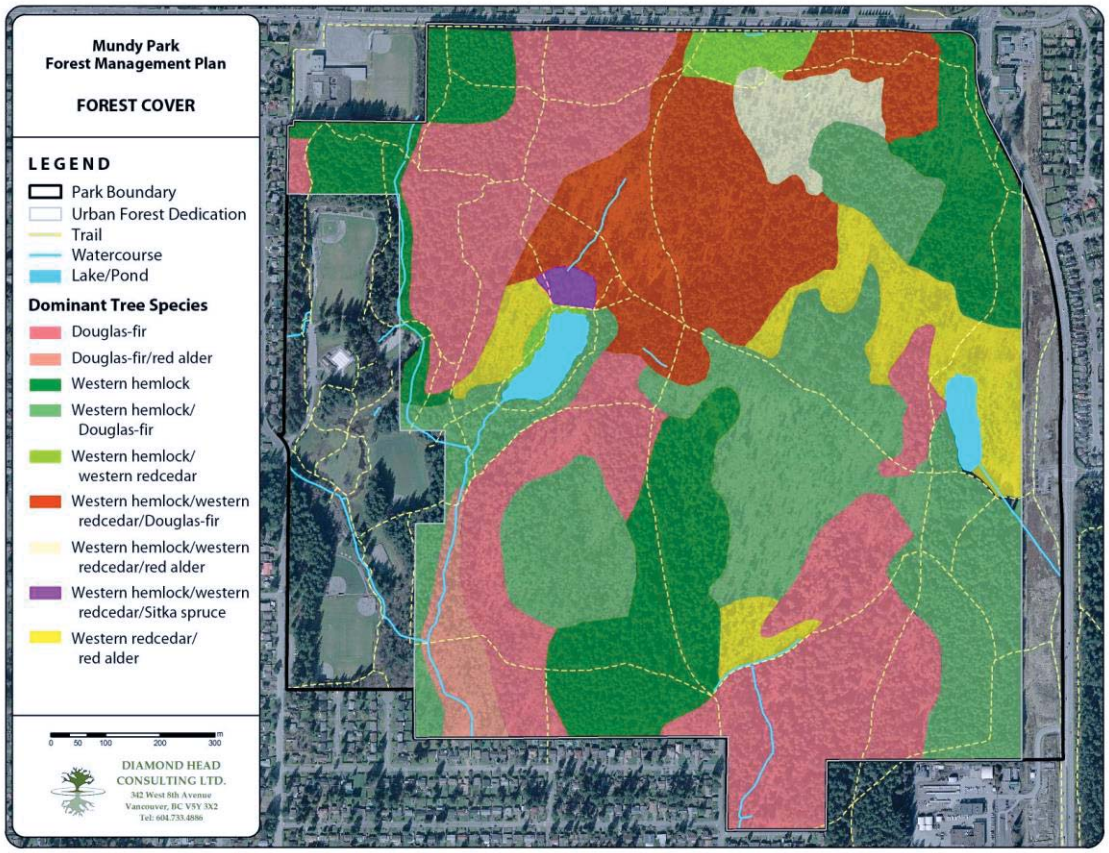


Figure 6. Dominant tree species by ecotype polygon.

3.1.2 Understory Vegetation

Mundy Urban Forest has well established and healthy understory vegetation communities. The ecology is rich providing a productive growing environment. Nutrient loving plants and shrubs such as Indian plum, beaked hazelnut, false azalea, red elderberry, three leaved foamflower, lily of the valley, lady fern, oak fern, and western trillium grow intermittently through the whole Urban Forest. There are other such plants common to these ecosystem types which would have died back for the winter and not been visible at the time of the ecosystem inventory. Members of the lily, saxifrage, evening primrose, and carrot families as well as stinging nettle, Pacific bleeding heart, and sweet-scented bedstraw would be expected to appear in the spring.

Drier ecosystems are dominated by overhead canopies of vine maple. Salal, red huckleberry, sword fern, trailing blackberry, spiny wood fern, and salmonberry are prominent. Patches of moss are fairly common, particularly in denser canopied stands where less light reaches the ground. Common mosses include Oregon beaked moss, step moss, flat moss, and lanky moss.

In wetter ecosystem types, moisture loving plant communities prevail. Salmonberry and hardhack are abundant. In sheltered areas with higher forest cover on fresh sites the occasional Pacific yew can be found. Skunk cabbage is prominent, and occasionally devil's club, where

there is a high water table. Open areas with minimal tree cover have specialized wet ecosystem shrubs and plants such as black hawthorn, Pacific ninebark, crabapple, and red-osier dogwood.

Intermittently along the shore of Mundy Lake there are narrow sections characteristic of a bog plant community that once existed in this area. These plants prefer very wet, but nutrient poor and acidic growing conditions. Species noted during the survey were shore pine, salal, Labrador tea and sphagnum. Other plants such as sundew are likely visible during the growing season.

There are areas of understory vegetation which have experienced degradation due to repeated trampling. Degradation put the area at risk of establishment of invasive plants and soil erosion. This is of particular concern when degradation occurs in fragile ecosystem types such as the bog-like plant community along the shoreline of Mundy Lake.

3.1.3 Forest Health

Pests and diseases include naturally occurring insects, disease, and animals that cause a change in tree health, forest structure or ecosystem dynamics. Many of these agents of change are a natural component of healthy, functional ecosystems. Their impacts are not always negative; they can contribute to increased structural diversity and help create a variety of habitat types and features such as wildlife trees and forest openings. However, their presence within the urban environment or intensively managed landscapes is not always welcome.

In urban settings, natural agents of change can have significant impacts to biodiversity, visual amenity and can create hazards to park users and adjacent development areas. Examples of hazards include large snags and wildfire fuel accumulations.

Mundy Urban Forest has many insect and diseases that are naturally found in ecosystems on the south coast. **None were found to be at levels that are unusual for a forest of this age and condition.** Mundy Urban Forest does support a diversity of tree species and forest types that are naturally resilient to large scale outbreaks of pests and disease. Ongoing monitoring should continue to identify any outbreaks of non-native pest agents. Early detection is critical to control spread, mitigate damage and potentially eradicate any pest species of concern.

Table 10. Management recommendations for ecological health.

Ongoing	1-2 years	1-5 years	5 – 10 years
Monitor for degraded understory vegetation areas throughout Urban Forest.	Restore degraded areas by planting native plants and repairing or enhancing barriers (e.g. fencing, logs). Prioritize areas within fragile ecosystem type (riparian management zone) for restoration.		Implement a tree planting program to ensure forest regeneration.
Monitor forest health for sudden changes to plant communities and health.	Work with the Canadian Food Inspection Agency to develop a forest pest-monitoring program in the Urban Forest.		

3.2 Invasive Species

3.2.1 Invasive Plants

An Invasive Plant Management Strategy was developed by the City of Coquitlam in 2008. Non-native, invasive plants can out-compete native vegetation communities, leading to reduced species diversity, reduced habitat for native fauna and soil erosion along stream banks. Some invasive plants may damage infrastructure, cause tree failures or impact recreation.

Mundy Urban Forest is largely unaffected by invasive plants in comparison to other urban natural areas in the Lower Mainland. Infestations in the Mundy Urban Forest are mainly found in the Interface Zone as a result of illegal green waste dumping (e.g. hanging baskets, yard clippings, etc.) or spread from backyard gardens. Bird dispersal, soil disturbance due to trail works, and human or dog traffic has also probably led to the introduction and establishment of invasive plants.

Most invasive plant species found in Mundy Urban Forest are in the early introduction stage of infestation (Figure 7). They are low in abundance and distribution. Exceptions are blackberry and Scotch broom on the hydro right-of-way and English holly and cherry laurel scattered throughout the Interface Zone.

Certain species have already been targeted by City staff and volunteers. Japanese knotweed in the west side of the Urban Forest is being treating by stem injection of herbicide. Volunteers have carried out sweeps to remove English ivy. The Lower Mainland Green Team has hosted invasive plant removal events at Mundy Urban Forest to target English ivy, English holly, cherry laurel and periwinkle.

Invasive plants found in Mundy Urban Forest are listed below in order of risk posed (from highest to lowest):

- Japanese knotweed: adjacent trails in the west, eastern and southern portions of the Urban Forest and in the hydro right-of-way
- Lamium (yellow arch angel): in a number of areas in the Interface Zone
- English ivy: in a number of locations in the Interface Zone and scattered locations throughout the Urban Forest
- Periwinkle: in a number of locations in the Interface Zone
- Himalayan blackberry: along west and south Urban Forest perimeter, and hydro right-of-way
- Scotch broom: confined to hydro right-of-way
- English holly: scattered intermittently
- Cherry laurel: scattered intermittently
- European mountain ash: scattered intermittently

If these species are not managed, there is a risk they will further spread into the Urban Forest and negatively impact native species and ecosystem function. Species in the early introduction stage are realistic candidates for eradication. Addressing these infestations in the near future will prevent a much more costly and complicated problem from developing if the plants are allowed to spread.

When an urban park abuts residential neighbourhoods or schools there is often no well-defined boundary where the property ownership changes. Without a clearly marked boundary or regular assessments of the boundary edges the park property can be encroached upon. These interface areas also happen to be those threatened by invasive plants and illegal dumping. There are a number of areas along the southern Interface Zone where there is encroachment into the Park boundary but the extent of the encroachment has not been determined.

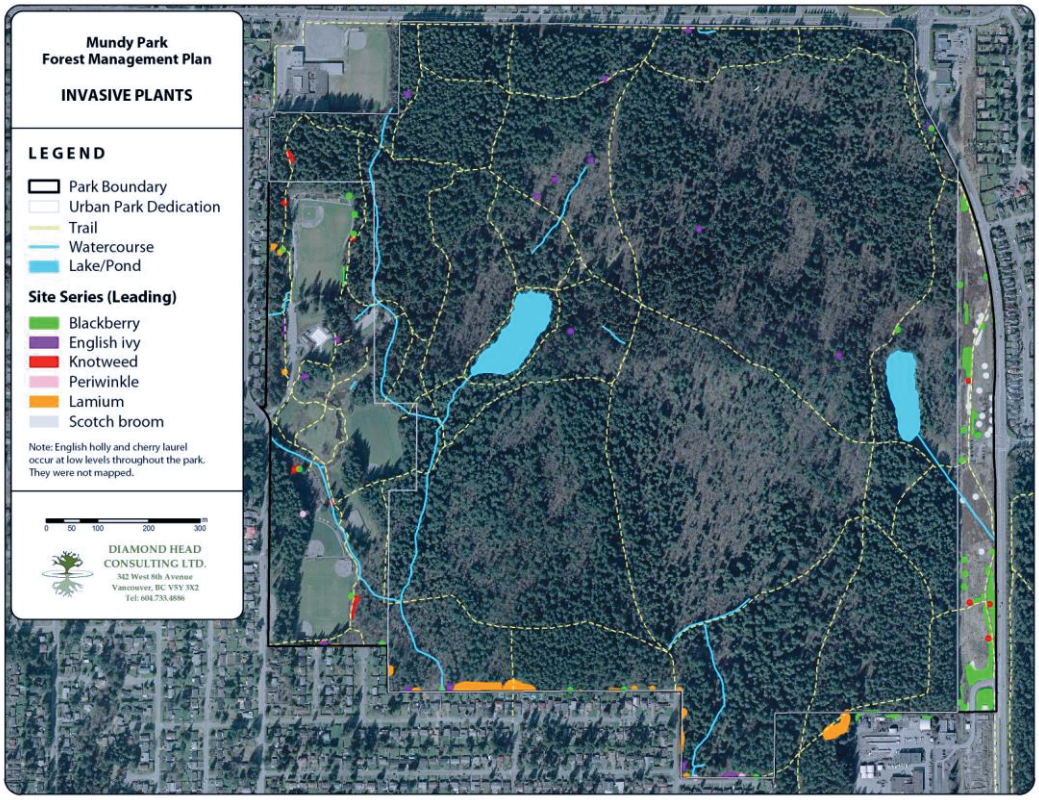


Figure 7. Invasive plant inventory.

3.2.2 Invasive Animal and Insect Species

The Lower Mainland is a major international trading hub and there is a risk that non-native animal and insect species may establish. Introduced species often have no natural predators, competition or controls and can spread quickly over a short period of time causing widespread impacts to our natural ecosystems.

The best strategy for controlling outbreaks of invasive species is early detection and control. The Canadian Food Inspection Agency (CFIA) supports a national program to detect and manage the spread of invasive insects. The City of Coquitlam is currently co-operating with the CFIA by supporting their detection and sampling programs.

Natural areas in Mundy Urban Forest could be at risk from outbreaks of non-native animal and insect species. Mitigation options are available for many of these agents; however success usually decreases with the size and intensity of the outbreak. Effectiveness of control agents often depends on early detection and response.

The American bullfrog (*Lithobates catesbeiana)* is a large, non-native and aggressive frog that has established in the Mundy Urban Forest. This species can be responsible for impacting local wildlife populations (particularly amphibians) through predation and direction competition for food resources. Other invasive animal species present in the Mundy Urban Forest are the grey squirrel (*Sciurus carolinensis*) and red-eared slider (*Trachemys scripta elegans*).

Table 11. Management recommendations for invasive species.

Ongoing	1-2 years	1-5 years	5 – 10 years
Manage all knotweed in Urban Forest (including hydro right-of-way) with chemical treatments. Monitor for re-growth annually.	Manage lamium with chemical treatments. Monitor for re-growth. Restore area with native plants.	Carry out a follow-up invasive plant inventory every 5 years.	Remove Scotch broom on hydro right-of way. The plant poses minimal risk to Mundy Urban Forest ecosystems however its presence will contribute to spread over other parts of the region.
Carry out annual Urban Forest sweeps for early detection with rapid response for removal of English Ivy. During sweeps, any blackberry found in the Urban Forest interior (particularly in open areas) should be removed by digging roots.	Remove periwinkle with manual treatments. Restore area with native plants.	Carry out Urban Forest sweeps to remove English holly and cherry laurel. Shrubs can be cut at base and painted with herbicide. Plant material can be left on site to decompose (ensure no seeds are present).	Monitor the impact of European mountain ash.
Enact a bullfrog management strategy. The objective of a strategy is to reduce bullfrog populations enough to ensure the survival of the red legged frog population. It is recommended that this program include trapping as well as collection of egg masses.	Address the problem of yard waste dumping and plant spread from gardens along the south and west Urban Forest perimeters. This should be done in conjunction with treatment of lamium and periwinkle.	Identify and eliminate encroachment of private property into the park.	
Work with the Painted Turtle Recovery Team to implement a program to manage invasive turtles.		Complete an invasive animal inventory and follow-up every 5 years.	
Continue to co-operate with the CFIA by implementing a detection and sampling program in Mundy Urban Forest.			

3.3 Habitat Features and Species at Risk

Urbanization in the Lower Mainland has caused significant habitat loss and is considered one of the primary factors for the decline of many species and plant communities. Urban areas pose particular challenges as there is a limited amount of unprotected natural habitat and what remains is facing continued development pressure. Mundy Urban Forest provides many of the habitat characteristics including a large natural area, connectivity to adjacent natural areas and a diversity of habitat features that can support some species that are not as tolerant of human activity.

The diversity of plant communities and habitat features along with the mild climate found in the Lower Mainland allows the Urban Forest to support a diversity of mammals, birds and amphibians. A detailed inventory was not completed as part of this project; however, a wildlife inventory assessment report was completed by Robertson Environmental in 2001.

The largest mammals found inhabiting the forest are black-tailed deer (*Odocoileus hemionus columbianus*) and coyotes (*Canis latrans*). Black bears (*Ursus americanus*), bobcat (*Lynx rufus*) and cougar (*Puma concolor*) are likely to use the forest as part of a larger range. Common mammals in the Urban Forest are small species such as squirrel, mice, voles, moles and shrews. Medium size mammals include raccoons, weasel and hares. The lakes provide good habitat for beaver (*Castor Canadensis*); however none have been sighted to date.

Several species and ecological communities at risk have been confirmed, or could potentially exist within Mundy Urban Forest based on the information available from the BC Government's list of species and ecosystems and risk, and the habitat found within Mundy Urban Forest. Mundy Urban Forest is a significant and intact natural habitat area within a highly urbanized landscape. A number of species and plant communities at risk have been confirmed or could potentially inhabit Mundy Urban Forest based on habitat available. This offers an opportunity for the City to position Mundy Urban Forest as a repository for species at risk. Areas within the Riparian Zone and Nature Conservation Zone have the greatest potential for providing intact natural habitat.

Habitat features found in Mundy Urban Forest that are known to enhance species diversity include a variety of forest types, critical water sources (2 lakes and several streams) and the presence of large dead trees "wildlife trees," wet shrub dominated communities as well as extensive large woody debris on the ground.

Resident and migratory bird species utilize habitat features including sites for nesting, cover and forage. There are numerous large trees that provide suitable nesting sites for larger birds of prey. The presence of wetlands, lakes and streams along with the damp litter floor found under the mature stands also provides habitat required by a variety of aquatic and terrestrial amphibians and reptiles. The presence of high value wildlife trees is critical for supporting cavity nesting birds. The number of wildlife trees found in the Mundy Urban Forest is low. There is also a lack of safe nesting refuge areas along the shoreline of Mundy Lake.

A number of bat species likely inhabit the Urban Forest, however roosting sites are limited. Bats are nocturnal predators that feed on some insects that are sensitive to changes in habitat. As such they are good indicators of ecosystem health.

Table 12. Management recommendations for habitat features and species at risk.

Ongoing	1-2 years	1-5 years	5 – 10 years
Conduct bird nesting surveys prior to cutting trees or disturbing understory vegetation within the nesting season. For most birds this is March 1 to August 31. Raptors will nest earlier than March.	Engage volunteers to construct monitor and maintain bird nesting boxes and bat roosting boxes	Create protected floating islands in both lakes. These can be constructed of logs boomed together and covered with a thin layer of organic material.	
Protect the integrity of natural habitat for species at risk within Mundy Urban Forest. All future management actions should consider potential impacts to species at risk.		Create a reservoir of endangered and threatened plants in Mundy Urban Forest.	
Convert all conifer trees that are greater than 30 cm in diameter into wildlife trees when mitigating tree risks in the Urban Forest. The height of these trees should be less than the distance to the closest target. Over time this policy will greatly support cavity nesting species in the Park.		Complete a spatial inventory of species at risk habitat.	
Develop educational programs and volunteer initiatives that focus on keystone or at risk species to engage the public in stewardship of the Park.			

3.4 Aquatic Systems and Fish Habitat

Mundy Urban Forest has two lakes (Mundy and Lost), three main stream systems and a number of wetlands within the Riparian Zone.

The two lakes are in a relatively natural state with healthy riparian plant communities. These lakes provide aquatic habitat that is suitable to support a diversity of fish and amphibian populations. The City's online mapping system shows the lake as fish-bearing based on a report by Scott Resources (1999). The Province of BC's Fisheries Information Summary System (FISS; indicates that the Ministry of Environment (MoE) found cutthroat trout (along with brown catfish) in this lake in 1988. According to FISS, the lake was stocked with cutthroat and rainbow trout in the late 1950s. A 1979 MoE survey found only carp. Goldfish have also been reported. Introduced fish species such as carp and goldfish can predate native fish species and degrade the aquatic habitat.

Numerous wetlands occur throughout the Urban Forest. Most are partially forested with dense shrub communities. Streams in the Urban Forest include both natural watercourses and constructed channels. Three main streams drain out of the watersheds in the Urban Forest. Mundy Creek drains out of Mundy Lake and flows south to a stormwater inlet at the southwest corner. Lost Creek runs southeast from Lost Lake through the Hydro right-of-way into a culvert under Mariner Way. An unnamed creek flows south from the center of the Urban Forest and drains into a stormwater inlet on Haversley Avenue. There are several constructed channels on the west side of the Urban Forest that drain into Mundy Creek. These were installed to manage drainage adjacent to the sports fields and facilities.

Streams and constructed channels in the Urban Forest generally provide poor habitat for supporting fish populations. Smaller creeks and ditches are dry in the summer and are not fish bearing. Water flow in Mundy Creek and Lost Creek are low in the summer months with few deep pools for fish refuge. It is expected that there are resident fish populations in the two lakes. There are no significant fish barriers along Mundy or Lost Creeks and it is possible that during high water flows, fish could migrate from the lakes downstream. However, due to low water flow in the summer and the lack of pools or other refuge areas, it is unlikely that these streams could support healthy fish populations year round. These streams do provide water for the Coquitlam River system, which is a very important salmon supporting stream. Ensuring water quality as it exits the Urban Forest is important for this downstream fish habitat.

In the western section of the park outside the urban forest dedication, drainage from parking lots should be monitored to ensure it does not pose a pollution risk for Mundy Creek.

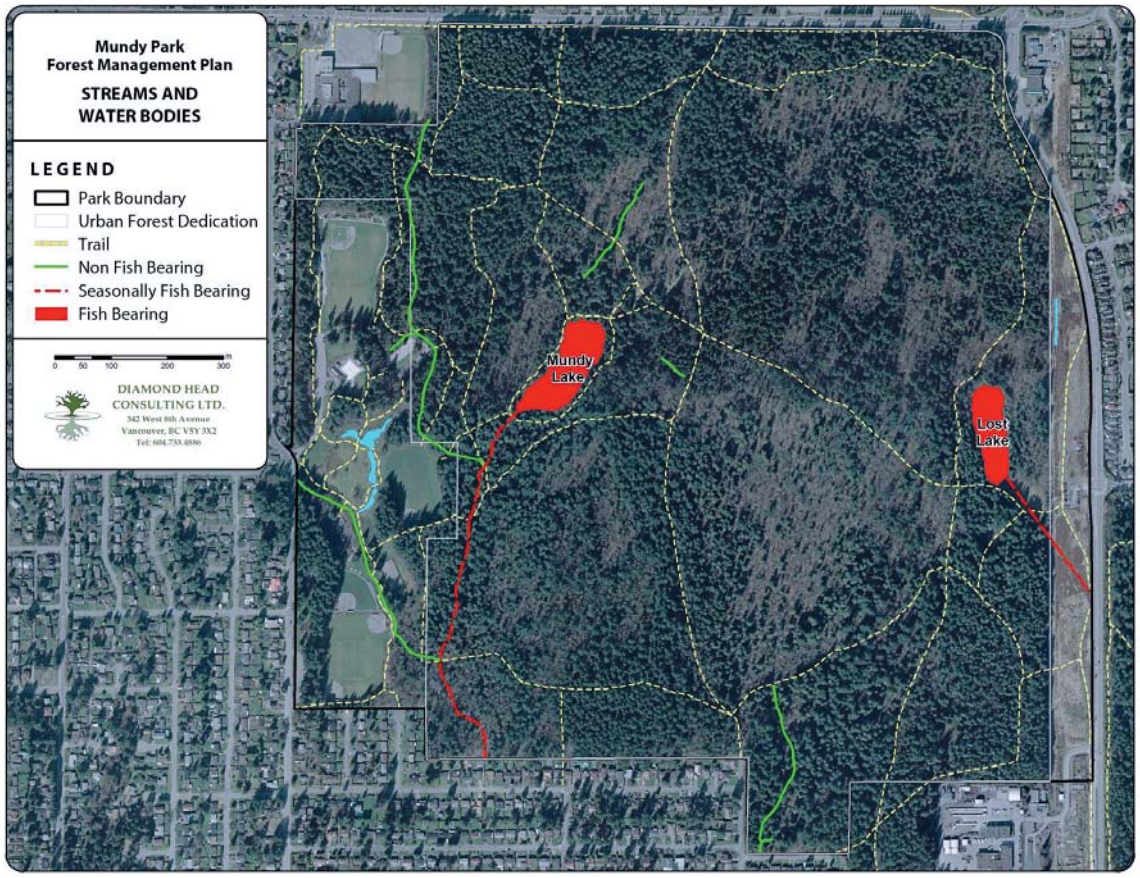


Figure 8. Aquatic features in Mundy Urban Forest

Table 13. Management recommendations for aquatic systems and fish habitat.

Ongoing	1-2 years	1-5 years	5 – 10 years
		Develop a plan for access to the shorelines at both lakes that provides park users with the experience they want while restricting and repairing unauthorized access.	Assess the hydrological inputs and outputs, depth and quality of lake water and substrates.
		Complete an assessment of physical and habitat characteristics of aquatic resources and conduct an invasive aquatic species assessment for the two lakes.	Carry out water quality monitoring to determine if contaminants from parking areas are entering watercourses in the Park.

3.5 TARGETS & INDICATORS | Natural Features

Table 14 identifies target objectives for the Environmental Features component of the Forest Management Plan. The light blue box indicates the current status of each target objective.

Table 14. Target objectives and indicators: Environmental features.

Target	Assessment Criteria	Low	Moderate	Good	Optimal
Understand and protect ecological health	Inventory of forest ecology	No ecological inventory	Partial spatial ecological inventory	Complete spatial ecological inventory updated every 10 years	Complete spatial ecological inventory updated every 10 years; ecological condition and risk assessment completed
	Healthy forest regeneration in each ecosystem polygon	Natural regeneration per ecotype polygon averages <50 stems per hectare	Natural regeneration per ecotype polygon averages 50-74 stems per hectare	Natural regeneration per ecotype polygon averages 75-99 stems per hectare	Natural regeneration per ecotype polygon averages >100 stems per hectare
	Outbreaks of pests and diseases above natural levels	Above natural levels of pest and disease are impacting >15% of the forest	Above natural levels of pest and disease are impacting 5-15% of the forest	Above natural levels of pest and disease are impacting 2-5% of the forest	Above natural levels of pest and disease are impacting <2% of the forest
Understand and minimize the impacts of invasive species	Inventory of invasive plants	No inventory of invasive plants	Incomplete spatial inventory of invasive plants	Complete spatial inventory of invasive plants. Ad hoc mitigation.	Complete spatial inventory of invasive plants; mitigation work conducted annually.
	Presence of invasive plants	Invasive plants present in >2% of Urban Forest natural area.	Invasive plants present in 1-2% of Urban Forest natural area	Invasive plants present in 0.05-1% of Urban Forest natural area	Invasive plants present in <0.05% of Urban Forest natural area

Target	Assessment Criteria	Low	Moderate	Good	Optimal
	Inventory of invasive animals and insects	No inventory of invasive animals and insects	Incomplete spatial inventory of invasive animals and insects	Complete spatial inventory of invasive animals and insects. Ad hoc mitigation.	Complete spatial inventory of invasive animals and insects; mitigation work conducted annually.
	Presence of invasive animals	>5 Invasive animals present.	3-5 Invasive animals present.	1-2 Invasive animals present.	No invasive animals present.
Understand and protect species at risk	Inventory and management of species at risk	No inventory of species at risk	Incomplete spatial inventory of species at risk and their habitat	Complete spatial inventory of species at risk and their habitat. Ad hoc management.	Complete spatial inventory of species at risk and their habitat. Management work conducted as part of a species specific strategy.
Understand and protect aquatic resources	Inventory and understanding of streams, lakes and wetlands	No inventory of watercourses; no assessment of physical and habitat characteristics	Incomplete spatial inventory of watercourses. Incomplete assessment of physical and habitat characteristics	Complete spatial inventory of watercourses. Incomplete assessment of physical and habitat characteristics	Complete spatial inventory of watercourses. Complete assessment of physical and habitat characteristics
	Water quality	No water quality monitoring program	Visual assessment of water quality	Water quality program using physical and benthic parameters; Infrequent monitoring	Water quality program using physical and benthic parameters; Regular seasonal monitoring

4 RISK MANAGEMENT

Making Mundy Park safe for the community is a top priority. Hazardous trees, wildfire and conflicts with wildlife are things that need to be well understood so that visitors can experience the park safely. The City is actively managing Mundy Urban Forest and seeks to create a reasonably safe place for visitors.

Four risk categories were assessed as part of this Management Plan:

- **Wildfire risk** is considered low to moderate given the Urban Forest's tree cover composition and fuel loading.
- **Tree risk** is considered low given the overall good health of the forest.
- **Human-wildlife conflict** are considered low risk
- **Climate change**

4.1 Wildfire Risk

A Community Wildfire Prevention Plan (CWPP) was prepared by the City in 2007. A wildfire risk analysis was provided based on the probability of a wildfire occurring and potential consequences to the park and surrounding community.

Fires are reported annually in Mundy Urban Forest. There is a high risk of ignition from heavy machinery, vehicles and pedestrian traffic along the adjacent roads and trails, and adjacent residential areas within the interface (within 100m of the park perimeter). There is a moderate to high risk of ignition along the well-used recreation areas adjacent to forest stands as well as along the trail system. Most likely sources include discarded cigarettes, matches, illegal bonfires, machinery and vandalism.

Much of Mundy Urban Forest supports forest stands dominated by deciduous tree species characterized as low fire risk. Areas in Mundy Park found to pose the highest risk include the northwest corner and the southern edge. An area ranked as moderate risk in the northwest corner was identified as a high priority fuel type and as being suitable for a potential fuel treatment pilot project. There is a moderate fire behavior potential in the coniferous fuel types and there are numerous structures that could be impacted by a wildfire in the Park including residential housing, recreation facilities, and commercial buildings.

Coniferous forest stands in the Urban Forest are dominated by mature trees that have grown together in clusters and have naturally shed their lower branches. The live crowns are typically well above the forest floor. Although the crown density in many of these conifer stands is high, it would take extreme fire weather conditions to carry a surface fire into the tree crowns.

Most structures next to the Mundy Urban Forest are separated from forest fuel by significant breaks, including roads and the hydro right of way. These areas are less of a concern as there is a defensible space for suppression resources to fight a wildfire. However, there are some residential lots at the south and northwest sides of the park that are located adjacent to conifer dominant stands.

Wildfire Risk and the Union of British Columbia Municipalities (UBCM) Strategic Wildfire Prevention Initiative

The CWPP directed further wildfire risk analysis to be completed as a part of this management plan. The risk that exists from wildfire is based on a number of factors including the probability of a fire igniting, the potential for it to spread, the difficulty in controlling the fire, and the values that it would threaten. All areas around the perimeter of the Urban Forest next to urban infrastructure were reviewed. The objective of this assessment was to identify any areas that are considered high risk and would qualify for funding to complete fuel mitigation works under the Union of British Columbia Municipalities (UBCM) Strategic Wildfire Prevention Initiative.

Comparing the fuel characteristics and fire behaviour potential of stands in the Urban Forest to other areas in the province **they were found to pose an overall moderate.** The Union of British Columbia Municipalities (UBCM) Strategic Wildfire Prevention Initiative is limited to areas rated as High or Extreme wildfire risk. Therefore, these areas would not be candidates for provincial funding for fuel mitigation pilot projects.

Treatment options are available to reduce the risk of wildfire behavior in these conifer dominated stands. However, the risk from crown fuels can only be reduced through extensive tree removals to make the crown discontinuous and this would cause detrimental ecological and aesthetic impacts. A more appropriate alternative would be to selectively remove ladder fuels and reduce surface fuels so that they are discontinuous and would not carry a surface fire into the crown. Treatment would include removal of suppressed conifer trees, pruning of lower branches of mature trees to greater than 4m and reducing accumulations of ground fuels.

Many of the edge conifer trees along the Mundy Park interface with structures have branches that extend close to the ground. Strategic pruning of these trees would further reduce wildfire risk. Many trees are on private property and this type of program would have to be coordinated and completed in partnership with the private land owners.

Table 15. Management recommendations for wildfire risk.

Ongoing	1-2 years	1-5 years	5 – 10 years
Ensure that grass within 30 m of the forest is kept short and irrigated where possible during dry summer months.	Rehabilitate areas where there is evidence of past bonfires by removing all fire pits and dismantling any shelters.		Promote the strategic pruning of lower branches on both Urban Forest and private land to create a defensible space between structures (houses, facilities, etc.) and the forest edge.
Educate residents living in the interface areas of the risk of wildfire and ways to prevent ignitions.	Post seasonal fire awareness signage.		
Prune all conifers branches to a height of 4 m above ground within 5 m of the authorized trails in and around the conifer dominated forest (except the nature trails).			

4.2 Tree Risk

All trees have the potential to become dangerous at some stage in their life span as they all eventually fall. There is no tree risk if there is no target. Assessments for tree risk should only be carried out in areas that have potential targets. The most heavily used portions of the Park are the parking lots, neighbouring yards and houses and main trails. These areas should be prioritized based on both the potential to contain a target and by the likelihood for tree failure based on forest type (tree species and age). This correlates to the Interface Forest Management Zone with the yards and houses adjacent to the Park as well the network of authorized trails throughout the Park. It is recommended that when assessing the forested edges in the Park that the BC Parks Wildlife Danger Tree Assessor guidelines be utilized. It allows the user to quickly scan for declining trees or trees with significant defects based off of an expected level of use or disturbance in the area. When budget limitations are one of the limiting factors for a risk assessment then this methodology allows the assessor to cover more ground because it eliminates the need to assess live trees that do not contain co-dominant stems (decay class 1 trees without co-dominant stems).

The conifer dominated forest types in the Urban Forest are all relatively young and in good condition. Trees have grown together as part of a stand and generally contain relatively few defects. Deciduous dominated stands are relatively mature in age and are beginning to show

signs of decline (stress and decay). Site factors such as wet site sites with minimal soil friction and shallow rooting depth can lead to potential tree failures.

Table 16. Management recommendations for tree risk.

Ongoing	1-2 years	1-5 years	5 – 10 years
Ensure trail inspectors are qualified wildlife danger tree assessors.			
Continue to monitor for imminent tree hazards when conducting regular trail inspections.			

4.3 Human-wildlife Conflicts

Conflict with wildlife is rare, though bear and deer are often observed in the Park. There is still the potential for conflicts between wildlife, humans and pets. The greatest concern is those conflicts that involve larger mammals; notably cougar, bear and coyote. The number of reported incidences of conflict between humans and wildlife are very low. The City Bear Aware program is doing a good job in tracking bears and potential conflicts.

Table 17. Management recommendations for human-wildlife conflicts.

Ongoing	1-2 years	1-5 years	5 – 10 years
Establish a wildlife conflict education program for the Urban Forest. Education is the most effective tool to prevent wildlife human conflicts. The Urban Forest is an excellent venue to teach residents how to coexist safely with wildlife.			

4.4 Climate Change

A changing climate is expected to pose risks for human and natural systems. The United Nations Intergovernmental Panel (IPCC) Working Group II Report on Climate Change: **Impacts, Adaptation, and Vulnerability** (2014) cites a large base of evidence on the varying impacts of climate change and the vulnerability of terrestrial and aquatic ecosystems.

Well managed urban forests such as Mundy Urban Forest enhance community resilience to climate change by forming an essential part of green infrastructure that provides a variety of benefits including stormwater management, flood attenuation and groundwater recharge, carbon storage and reduction of GHGs, thereby mitigating climate change impacts.

However the urban forest itself may be vulnerable to changes in climate. Based on the latest scientific data (IPCC, 2014), the IPCC expresses high confidence in several observed climate change related impacts that are relevant to Mundy Urban Forest:

- Significant changes in hydrological systems (e.g. amount of precipitation, snowload, etc.) which can affect tree and vegetation communities, wetlands, the lakes and groundwater;
- Temperatures in North America are expected to rise two to four degrees Celsius by the end of the century;
- Migration and shift in range distribution for different species and ecosystems which can result in local extinctions and arrival of new, potentially invasive species;
- Extreme weather events (heat waves, drought, floods, windstorms, wildlfire) that pose health, safety, environmental, and economic risks.

Increasing temperature and drying trends could potentially have significant impacts to ecological function in Mundy Urban Forest. Being an urban forest, increasing wildfire risk in Mundy Urban Forest is a significant concern with drier and warmer conditions. More frequent and intense windstorms, as witnessed in 2006, can also significantly alter forest structure and cause significant damage to buildings and infrastructure.

Table 18. Management recommendations for climate change.

Ongoing	1-2 years	1-5 years	5 – 10 years
When planning for plantings in the forest the prescriptions must be developed to accommodate the expected climate change for the following 50 years.			

4.5 TARGETS & INDICATORS | Risk Management

Table 19 identifies target objectives for the Risk Management component of the Forest Management Plan. The light blue box indicates the current status of each target objective.

Table 19. Target objectives and indicators: Risk Management.

Target	Assessment Criteria	Low	Moderate	Good	Optimal
Manage wildfire risk	Wildfire risk assessment and management	No understanding of wildfire risk in the Urban Forest	Wildfire risk assessed and documented	All high priority recommendations to reduce wildfire hazard understood and prioritized.	All recommendations to reduce wildfire hazard completed.
Manage tree risk	Tree risk response and mitigation program	Tree risk unmanaged	Tree risk mitigated in response to public request	Tree risk thresholds clearly defined and assessed/ mitigated on a cyclical basis; timely response to public request	Tree risk thresholds clearly defined and assessed/ mitigated every 5 years or less; timely response to public request
	Percentage of area affected by abiotic processes (windstorms, fire, snow damage)	>15% of Urban Forest natural areas affected by abiotic processes	10-15% of Urban Forest natural areas affected by abiotic processes	5-10% of Urban Forest natural areas affected by abiotic processes	<5% of Urban Forest natural areas affected by abiotic processes
Human-wildlife conflicts	Number of Human-wildlife conflicts reported	No management or recording of conflicts	Mapping indicating areas where conflicts have been reported	Mapping conducted of conflicts and education information provided at kiosks	Mapping conducted. Pamphlets and outreach to the community regarding issues and awareness to reduce conflicts.
Climate change	Climate change adaptation planning for both ecological change and fire hazard risk	No understanding of the potential impacts	Limited understanding of the potential change to ecology. Fire hazard risk understood now but not in future	Plans for both a changing fire hazard and ecological change are prepared for the Park	Fire hazard and ecological change plans have been implemented and are being monitored

5 COMMUNITY INVOLVMENT, PUBLIC EDUCATION AND AWARENESS

Mundy Urban Forest offers an ideal setting for outdoor and nature-based education and programming. These programs offer the opportunity to build greater awareness and understanding of the forest ecosystem and foster feelings of shared responsibility and stewardship for the Urban Forest.

5.1 Public Education and Engagement

Many groups and organizations use Mundy Urban Forest as a setting for their educational programs or nature based activities. These programs and activities are most often geared towards children but some are for other age groups as well. Some examples include:

- YMCA summer adventure camps for children;
- Burke Mountain Naturalists botany walks;
- Tri-Cities Young Naturalists Club nature program;
- Student nature walks by nearby elementary schools;
- Friends of Mundy Park Heritage Society nature tours for local school groups;
- Coquitlam Parks, Recreation and Culture summer camping adventure programs; and
- Nature stations developed by the City that use QR codes.

A successful Forest Management Plan relies on engaging the community in its implementation. Doing so allows the community to take pride and ownership in the Urban Forest and stretches available resources to move the plan ahead further than would otherwise be possible. Community support is also essential to ensure the community value is sustained in the long term.

The public has expressed desire in being involved in ecosystem restoration, invasive species removal and/or endangered species recovery projects in the Urban Forest. There is opportunity for public involvement in the creation of Mundy Urban Forest as an observation and education center in wildlife and plant ecology. However, there is currently no coordinated approach to realizing engagement opportunities and determining program priorities. Depending on the activity, engagement activities could take place in any forest management zone. However, high traffic engagement activities should be directed away from riparian and nature conservation zones.

Table 20. Management recommendations for educating and engaging the public in planning and programming.

Ongoing	1-2 years	1-5 years	5 – 10 years
Develop educational programs and volunteer opportunities that focus on keystone or at risk species in the Park.	Develop a park host program to increase presence in the Park and to deliver value added nature interpretation.	Consider the development of outdoor and nature-based educational opportunities and models for delivery. Develop these in partnership with other agencies, schools and community groups.	

5.2 TARGETS & INDICATORS | Community Involvement, Public Education and Awareness

Table 21 identifies target objectives for the Community Involvement, Public Education and Awareness component of the Forest Management Plan. The light blue box indicates the current status of each target objective.

Table 21. Target objectives and indicators: Community Involvement, Public Education and Awareness.

Target	Assessment Criteria	Low	Moderate	Good	Optimal
Engage the public in planning, programming, and enhancement in the Park	Engagement of volunteers in Urban Forest programming and enhancement	No program to involve individuals and community groups	Volunteer programs are ad hoc; no formal programs offered	An organized volunteer program is managed and directed by the City but only implements some sections of the FMP	An organized volunteer program is managed and directed by the City for most sections of the FMP
Educate the public of the benefits of recreational and environmental features provided by Mundy Urban Forest	Educational programming directly at raising public awareness	No formal educational or interpretative programs or dedicated staff	Interpretive media (signage, website, brochures etc.) developed to meet Urban Forest educational objectives	In addition to interpretive media, educational and interpretive programming includes programs delivered in person	Formal education partnerships with other agencies, schools, and community groups.

6 MONITORING PROGRAM

6.1 Adaptive Management

Developing a forest management plan within the context of tree and forest life cycles is challenging. Many trees take decades to grow to what would be considered a substantial size. Many forest ecosystems take centuries to develop fully; some of the older trees in our remaining coastal old growth stands have lived for eight hundred years or longer. These timelines require that a long-term planning approach be adopted.

A long term adaptive management approach should be implemented to integrate new management initiatives, scientific research, monitoring results and community input. The premise of adaptive management is continual learning. Specific management initiatives are monitored and the results are used to better inform and strengthen the plan by making necessary adjustments where appropriate. Periodic review and updating of the plan will facilitate integration of an adaptive management approach. This ensures that the plan continually follows current best management practices and reflects the current vision of the community.

The Forest Management Plan is a living document with recommended plan updates every 10 years. This level of planning presents the opportunity to implement active adaptive management[4].

The 10 year plan acts as the manager's guide to budget allocation and foreseeing what projects will likely be required over that time frame. The level of detail increases moving from the 10 year management plans down to the annual operating plans.

Table 22. Management recommendations for adaptive management.

Ongoing	1-2 years	1-5 years	5 – 10 years
Re-evaluate the performance indicator tables annually to assess progress towards achieving the optimum state.			Update the Forest Management Plan every 10 years.

[4] A systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices. In active adaptive management, management is treated as a deliberate experiment for the purpose of learning. Source: Millenium Ecosystem Assessment (2005). Global assessment reports. World Resources Institute, Washingon, DC.

6.2 Ecological Indicator Monitoring

Ecological indicators are an effective tool for monitoring forest health. They provide a measure of the current condition of an ecosystem and are used to track change whether it is natural or caused by human impacts. Selecting suitable indicator species and monitoring their presence provides a mechanism to detect changes in the health of the ecosystems within Mundy Urban Forest.

Ecological indicators are agents that reflect the functioning of an ecosystem. They typically react quicker to environmental change that other species providing an early warning of changes to ecological health in natural areas. Indicator species that are recommended for Mundy Urban Forest are summarized in Table 24.

Volunteers can be used along with City staff to monitor most species. Annual bird counts should be used for bird species. Small mammals such as voles, shrew and mice can be found by turning over logs and looking for burrows in representative areas throughout the Park. This can be done by staff in representative areas throughout the park. Amphibians are best identified using egg masses in the spring and early summer. Long toed salamanders can also be identified by laying out cover boards and checking under them periodically.

Table 23. Management recommendations for indicator species monitoring.

Ongoing	1-2 years	1-5 years	5 – 10 years
A monitoring program should be established to track annual presence of indicator species.			

Table 24. Indicator species for Mundy Urban Forest.

Indicator Species	Survey Method	Survey Reference
Mammals		
Black-tailed deer	Pellet groups	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/grndb/assets/grndb.pdf
Douglas squirrel	Visual sighting	
Mouse/vole/shrew	Runway activity under cover boards	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/smallmammals/smamml20-03.htm
Birds		
Dark-eyed Junco	Wintering numbers	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/
Downy Woodpecker	Wintering numbers	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/woodpeckers/assets/woodml20.pdf
Northern Flicker	Wintering numbers	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/
Pacific-slope Flycatcher	Singing birds	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/songbird/index.htm
Red-tailed Hawk	Active Nests	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/raptors/version2/rapt_ml_v2.pdf
Song Sparrow	Wintering numbers &/or singing birds	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/swallows&swifts/index.htm
Spotted Towhee	Wintering numbers &/or singing birds	
Swainson's Thrush	Singing birds	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/songbird/index.htm
Warbling Vireo	Singing birds	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/songbird/index.htm
Willow Flycatcher	Singing birds	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/songbird/index.htm
Yellow Warbler	Singing birds	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/songbird/index.htm
Reptiles/Amphibians		
Painted turtle	Visual sighting	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/pond/assets/pond.pdf
Long-toed salamander	Cover boards	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/salamanders/index.htm
Northern Pacific treefrog	Singing/calling	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/pond/assets/pond.pdf
Northern red-legged frog	Egg masses	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/pond/assets/pond.pdf
Northwestern salamander	Egg masses	http://www.for.gov.bc.ca/hts/risc/pubs/tebiodiv/salamanders/index.htm
Invertebrates		
Dragonflies	Visual survey for adults	Date, time and location
Plants		
Western Trilium	Visual survey for plants	Date, time and location
Round-leaved Sundew	Visual survey for forb	Date, time and location

6.3 Water Quality Monitoring

Water quality in the lakes and streams in the Urban Forest are critical for the protection of the functioning ecosystems. Water leaving the Urban Forest drains into the Coquitlam River system, which is a valuable salmon supporting stream.

Water quality testing provides a baseline to track the condition and health of the aquatic systems in the Urban Forest. Testing should focus on chemical, physical and biological conditions. Key monitoring locations include both lakes and the outlets of the three main stream systems.

Physical and chemical testing should include flow rate, temperature, conductivity, dissolved oxygen, pH and turbidity. These should be compared to the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQGs). Biological conditions in the stream should be monitored by testing for benthic invertebrates. Methods should follow the Ministry of Environment Guidelines for the Sampling of Benthic Invertebrates in British Columbia Streams (2006)

Table 25. Management recommendations for water quality monitoring.

Ongoing	1-2 years	1-5 years	5 – 10 years
A monitoring program should be established for water quality.			

6.4 TARGETS & INDICATORS | Monitoring Program

Table 26 identifies target objectives for the Monitoring Program component of the Forest Management Plan. The light blue box indicates the current status of each target objective.

Table 26. Target objectives and indicators: Monitoring Program.

Target	Assessment Criteria	Low	Moderate	Good	Optimal
Mundy Urban Forest planning is adaptively managed	Re-assess criteria to ensure that management recommendations are on track to meet targets.	The management plan is updated on a cycle longer than 10 years.	N/A	N/A	The management plan is updated every 10 years.
Monitor ecological health of Urban Forest to assist with present and future management	Monitoring of ecological indicator species (plant communities and animals)	No ecological monitoring program	Ecological indicators identified	Ecological indicators identified; monitoring ad hoc	Ecological indicators identified; annual monitoring
	Water quality	No water quality monitoring program	Visual assessment of water quality	Water quality program using physical and benthic parameters; Infrequent monitoring	Water quality program using physical and benthic parameters; Regular, seasonal monitoring

7 IMPLEMENTATION PLAN

Ongoing	1-2 years	1-5 years	5 – 10 years
Construct and maintain trails as per Master Trail Plan Standards.	Survey Park users (including off-road cyclists) to determine their satisfaction.	Develop a mountain bike trail network in Riverview Forest as per the Off-Road Cycling Strategy.	Deactivate all Priority 3-5 unauthorized trails.
When conflicts arise utilize the guidelines laid out in Appendices F and G in the Master Trail Plan regarding Trail Management and Conflict Reduction.	Update information kiosks. Trail difficulty levels and locations of all toilet facilities should be clearly indicated on all maps.	Investigate appropriate options for additional toilet facilities.	Implement a tree planting program to ensure forest regeneration.
Survey Park users to understand conflicts that may exist.	Restore degraded areas by planting native plants and repairing or enhancing barriers (e.g. fencing, logs). Prioritize areas within fragile ecosystem type (riparian management zone) for restoration.	Examine further opportunities for recreation.	Remove Scotch broom on hydro right-of way. The plant poses minimal risk to Mundy Urban Forest ecosystems however its presence will contribute to spread over other parts of the region.
Monitor results of Park user surveys over time for changes in conflict levels.	Work with the Canadian Food Inspection Agency to develop a forest pest-monitoring program in the Urban Forest.	Deactivate all Priority 1 and 2 unauthorized trails.	Monitor the impact of European mountain ash.
Remove any constructed jumps outside designated off-road cycling areas.	Manage lamium with chemical treatments. Monitor for re-growth. Restore area with native plants.	Explore the potential for a viewing platform at Mundy Lake to enhance viewing opportunities in conjunction with shoreline habitat protection measures.	Assess the hydrological inputs and outputs, depth and quality of lake water and substrates.
Monitor for degraded understory vegetation areas throughout Urban Forest.	Remove periwinkle with manual treatments. Restore area with native plants.	Carry out a follow-up invasive plant inventory every 5 years.	Carry out water quality monitoring to determine if contaminants from parking areas are entering watercourses in the Park.
Monitor forest health for sudden changes to plant communities and health.	Address the problem of yard waste dumping and plant spread from gardens along the south and west Urban Forest perimeters. This should be done in conjunction with treatment of lamium and periwinkle.	Carry out Urban Forest sweeps to remove English holly and cherry laurel. Shrubs can be cut at base and painted with herbicide. Plant material can be left on site to decompose (ensure no seeds are present).	Promote the strategic pruning of lower branches on both Urban Forest and private land to create a defensible space between structures (houses, facilities, etc.) and the forest edge.
Manage all knotweed in Urban Forest (including hydro right-of-way) with chemical treatments. Monitor for re-growth annually.	Engage volunteers to construct monitor and maintain bird nesting boxes and bat roosting boxes	Identify and eliminate encroachment of private property into the park.	Update the Forest Management Plan every 10 years.
Carry out annual Urban Forest sweeps for early detection with rapid response for removal of English Ivy. During sweeps, any blackberry found in the Urban Forest interior (particularly in open areas) should be removed by digging roots.	Rehabilitate areas where there is evidence of past bonfires by removing all fire pits and dismantling any shelters.	Complete an invasive animal inventory and follow-up every 5 years.	

Ongoing	1-2 years	1-5 years	5 – 10 years
Enact a bullfrog management strategy. The objective of a strategy is to reduce bullfrog populations enough to ensure the survival of the red legged frog population. It is recommended that this program include trapping as well as collection of egg masses.	Post fire awareness signage.	Create protected floating islands in both lakes. These can be constructed of logs boomed together and covered with a thin layer of organic material.	
Work with the Painted Turtle Recovery Team to implement a program to manage invasive turtles.	Develop a park host program to increase presence in the Park and to deliver value added nature interpretation.	Create a reservoir of endangered and threatened plants in Mundy Urban Forest.	
Continue to co-operate with the CFIA by implementing a detection and sampling program in Mundy Urban Forest.		Complete a spatial inventory of species at risk habitat.	
Conduct bird nesting surveys prior to cutting trees or disturbing understory vegetation within the nesting season. For most birds this is March 1 to August 31. Raptors will nest earlier than March.		Develop a plan for access to the shorelines at both lakes that provides park users with the experience they want while restricting and repairing unauthorized access.	
Protect the integrity of natural habitat for species at risk within Mundy Urban Forest. All future management actions should consider potential impacts to species at risk.		Complete an assessment of physical and habitat characteristics of aquatic resources and conduct an invasive aquatic species assessment for the two lakes.	
Convert all conifer trees that are greater than 30 cm in diameter into wildlife trees when mitigating tree risks in the Urban Forest. The height of these trees should be less than the distance to the closest target. Over time this policy will greatly support cavity nesting species in the Park.		Consider the development of outdoor and nature-based educational opportunities and models for delivery. Develop these in partnership with other agencies, schools and community groups.	
Ensure that grass within 30 m of the forest is kept short and irrigated where possible.			
Educate residents living in the interface areas of the risk of wildfire and ways to prevent ignitions.			
Prune all conifers branches to a height of 4 m above ground within 5 m of the authorized trails in and around the conifer dominated forest (except the nature trails).			
Ensure trail inspectors are qualified danger tree assessors.			
Continue to monitor for imminent tree hazards when conducting regular trail inspections.			

Ongoing	1-2 years	1-5 years	5 – 10 years
Establish a wildlife conflict education program for the Urban Forest. Education is the most effective tool to prevent wildlife human conflicts. The Urban Forest is an excellent venue to teach residents how to coexist safely with wildlife.			
When planning for plantings in the forest the prescriptions must be developed to accommodate the expected climate change for the following 50 years.			
Develop educational programs and volunteer initiatives that focus on keystone or at risk species to engage the public in stewardship of the Park.			
Re-evaluate the performance indicator tables annually to assess progress towards achieving the optimum state.			
A monitoring program should be established to track annual presence of indicator species.			
A monitoring program should be established for water quality.			

8 APPENDIX B | Glossary

Biodiversity

The variety of plants, animals and other livings things within an ecosystem.

Biogeoclimatic Ecosystem Classification

A system that groups similar segments of the landscape (ecosystems) into hierarchical categories based on climate, vegetation and site conditions.

Carbon sequestration

The process of capturing and storing carbon dioxide from the atmosphere.

Fuel type

An identifiable association of fuel elements of a distinctive plant species, form, size, arrangement, or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.

Hazard Trees

Trees with the potential to cause property damage or personal injury due to failure

Tree Canopy

The upper layer of trees formed by one or more tree crowns growing in an area

Large woody debris

The fallen trees and other woody material (generally larger than 10cm diameter) in various stages of decay on the forest floor which provide habitat for a variety of organisms and is a source of soil nutrients.

Live crown

The total aboveground portion of a woody plant or tree covered by living branches. The live crown ratio provides a rough but convenient index of the ability of a tree's crown to nourish the remaining part of the tree. Trees with less than 30 percent live crown ratio are typically weak, lack vigor, and have low diameter growth, although this depends very much on the tree's age and species.

Dominant trees

Trees with crowns extending above the main canopy level in even-aged groups. These trees receive full light from above and partial light from the sides.

Ecosystem

A biological community of interacting organisms and their physical environment.

Green Infrastructure Network

An interconnected system of open spaces and natural spaces that conserves ecosystems and processes, while providing benefits for people and wildlife.

Interface zone

The forested area located adjacent to buildings and infrastructure.

Invasive species

Non-native organisms introduced by people to areas outside of their natural range, and that cause environmental or economic harm.

Indicator Species

A biological species whose condition or behavior is used to indicate the overall health or changes in an ecosystem. An indicator species can be used to locate or determine the environmental effects on other species more difficult to study.

Ladder fuels

Combustible materials (such as lower tree branches, shrubs or structures) that allow fire to climb from the surface into the tree canopy.

Site series

A category within the Biogeoclimatic Ecosystem Classification system that describes sites capable of producing similar climax plant communities.

Snags

Dead standing trees

Stems per hectare

The number or size of a population (trees) in relation to some unit of space (one hectare). It is measured as the amount of tree biomass per unit area of land.

Succession

Natural process by which one ecological community (plants and associated organism) is succeeded by another that is better adapted to changing ecological conditions. Succession continues until either a climax community is reached or there is a disturbance (e.g. landslide) which sets the process back to an earlier stage.

Suppressed trees

Trees entirely below the main canopy level in even-aged groups. These tree receive no direct light either from above or from the sides.

Understory

Vegetation layer (typically shrubs and small trees) between the main tree canopy layers and the ground.

Wildlife tree

Living or dead trees that provide important or unique wildlife habitat (e.g. cavities or platforms for nesting, perches, etc).