

# GREEN TIMBERS URBAN FOREST WILDFIRE MANAGEMENT PLAN

***Prepared for:***

The City of Surrey  
Parks, Recreation and Culture Department  
14645 66th Avenue  
City of Surrey, BC



***Prepared by:***

Michael Coulthard RPF, RPBio  
Trevor Cox ISA Certified Arborist  
Diamond Head Consulting Ltd.  
3205 West 13<sup>th</sup> Ave.  
Vancouver B.C.  
V6K-2V6

December 2002

## Table of Contents

<b>Table of Contents</b> .....	<b>2</b>
<b>Table of Figures and Tables</b> .....	<b>4</b>
<b>Executive Summary</b> .....	<b>5</b>
<b>Introduction</b> .....	<b>10</b>
THE NEED FOR A PLAN .....	11
DIVISION OF RESPONSIBILITIES .....	11
PURPOSE OF THE PLAN .....	12
<b>Fire History</b> .....	<b>12</b>
<b>Summary of Wildfire Hazard within Green Timbers Urban Forest</b> .....	<b>13</b>
FIRE BEHAVIOR .....	13
STRUCTURES AT RISK .....	14
SUPPRESSION CONSTRAINTS .....	14
HUMAN LIVES .....	14
<b>The Wildfire Hazard Rating System (WHRS)</b> .....	<b>15</b>
FIRE BEHAVIOUR .....	15
<i>Fire Intensity</i> .....	15
<i>Rate of Spread</i> .....	17
<i>Crown Fraction Burned</i> .....	18
<i>Fuel Types</i> .....	19
WEATHER CONDITIONS .....	22
THE RISK OF IGNITION .....	24
STRUCTURES AT RISK .....	26
SUPPRESSION CONSTRAINTS .....	27
FINAL WILDFIRE HAZARD RATING .....	29
<b>Fire Management Zones</b> .....	<b>31</b>
FIRE MANAGEMENT ZONE 1 (FMZ-1): FOREST EDGE STRUCTURES AT RISK .....	33
<i>FMZ 1 Fire Behaviour</i> .....	33
<i>FMZ 1 Risk of Ignition</i> .....	33
<i>FMZ 1 Structures at risk</i> .....	34
<i>FMZ 1 Suppression constraints</i> .....	34
FMZ 1 PRIMARY CONCERNS .....	34
FMZ 1 ACTIONS TO REDUCE WILDFIRE HAZARD .....	34
FIRE MANAGEMENT ZONE 2 (FMZ-2): FOREST EDGE NO STRUCTURES .....	35
<i>FMZ 2 Fire Behaviour</i> .....	35
<i>FMZ 2 Risk of Ignition</i> .....	35
<i>FMZ 2 Structures at risk</i> .....	36
<i>FMZ 2 Suppression constraints</i> .....	36
FMZ 2 PRIMARY CONCERNS .....	36
FMZ 2 ACTIONS TO REDUCE WILDFIRE HAZARD .....	36
FIRE MANAGEMENT ZONE 3 (FMZ-3): CONIFEROUS FORESTS .....	36
<i>FMZ 3 Fire Behaviour</i> .....	37
<i>FMZ 3 Risk of Ignition</i> .....	37
<i>FMZ 3 Structures at Risk</i> .....	37
<i>FMZ 3 Suppression Constraints</i> .....	37
FMZ 3 PRIMARY CONCERNS .....	37
FMZ 3 ACTIONS TO REDUCE WILDFIRE HAZARD .....	37
FIRE MANAGEMENT ZONE 4 (FMZ-4): DECIDUOUS FORESTS .....	38
<i>FMZ 4 Fire Behaviour</i> .....	38
<i>FMZ 4 Risk of Ignition</i> .....	38
<i>FMZ 4 Structures at Risk</i> .....	38
<i>FMZ 4 Suppression Constraints</i> .....	38
FMZ 4 PRIMARY CONCERNS .....	38
FMZ 4 ACTIONS TO REDUCE WILDFIRE HAZARD .....	38

FIRE MANAGEMENT ZONE 5 (FMZ-5): EASTERN WHITE PINE STAND.....	38
<i>FMZ 5 Fire Behaviour</i> .....	39
<i>FMZ 5 Risk of Ignition</i> .....	39
<i>FMZ 5 Structures at Risk</i> .....	39
<i>FMZ 5 Suppression Constraints</i> .....	39
FMZ 5 PRIMARY CONCERNS .....	39
FMZ 5 ACTIONS TO REDUCE WILDFIRE HAZARD .....	39
FIRE MANAGEMENT ZONE 6 (FMZ-6): BLOWDOWN AREA .....	40
<i>FMZ 6 Fire Behaviour</i> .....	40
<i>FMZ 6 Risk of Ignition</i> .....	40
<i>FMZ 6 Structures at Risk</i> .....	40
<i>FMZ 6 Suppression Constraints</i> .....	40
FMZ 6 PRIMARY CONCERNS .....	41
FMZ 6 ACTIONS TO REDUCE WILDFIRE HAZARD .....	41
FIRE MANAGEMENT ZONE 7 (FMZ-7): GRASSLAND MEADOW.....	41
<i>FMZ 7 Fire Behaviour</i> .....	41
<i>FMZ 7 Risk of Ignition</i> .....	41
<i>FMZ 7 Structures at Risk</i> .....	42
<i>FMZ 7 Suppression Constraints</i> .....	42
FMZ 7 PRIMARY CONCERNS .....	42
FMZ 7 ACTIONS TO REDUCE WILDFIRE HAZARD .....	42
<b>Public education</b> .....	<b>43</b>
SIGNAGE.....	43
EDUCATIONAL BROCHURE.....	43
FIRE AWARENESS .....	43
<b>Fire Preparedness</b> .....	<b>43</b>
<b>Fire Detection</b> .....	<b>44</b>
<b>Evacuation Planning</b> .....	<b>44</b>
<b>Suppression</b> .....	<b>45</b>
ECOLOGICAL DAMAGE FROM SUPPRESSION .....	45
POST FIRE EVALUATION .....	46
<b>Bibliography</b> .....	<b>47</b>
<b>Appendix A</b> Surrey Fire Department Operational Guideline # 2.17.13, Fire Suppression - Wildland/Urban Interface. ....	<b>49</b>
<b>Appendix B</b> Description of fire behavior characteristics and fire suppression interpretations according to the MOF Forest Protection (BC Ministry of Forests, 2000). ....	<b>51</b>
<b>Appendix C</b> Description of the Ministry of Forests Protection Branch fire danger ratings. ....	<b>52</b>

## Table of Figures and Tables

Table 1 Summary of the hazards within each fire management zone .....	5
Figure 1 Fire Management Zones .....	6
Table 2 Summary of recommendations by management zone.....	7
Figure 2 Fire intensity .....	16
Figure 3 Rate of spread.....	17
Figure 4 Crown fraction burned .....	18
Figure 5 Fuel types.....	21
Table 3 Fire behavior layers .....	22
Table 4 Fire behavior component.....	22
Figure 6 Fire behavior component.....	23
Table 5 Risk of ignition .....	24
Figure 7 Risk of ignition .....	25
Table 6 Structures at risk.....	26
Figure 8 Structures at risk .....	26
Table 7 Suppression constraints .....	27
Figure 9 Suppression constraints component.....	28
Table 8 Final Wildfire Hazard Rating.....	29
Figure 10 Final Wildfire Threat Rating System.....	30
Table 9 Summary of the hazards within each fire management zone. ....	31
Figure 11 Fire management zones.....	32

## Executive Summary

Managing a large forested area such a Green Timbers Urban Forest within the context of an urban setting presents a number of risks with respect to wildfire. These include a high risk of human caused ignition, the threat to human lives, and the potential damage to structures in and around the park as well as the degradation of the ecological integrity of these ecosystems.

This fire management plan was developed in order to address these risks and minimize the impacts of any fires in the Forest. All of the hazards have been assessed and actions and tasks have been prioritized to mitigate these hazards. The overall goal of this plan is to protect the public, structures and critical ecological features of the Forest through prevention and timely suppression.

This plan is consistent with all higher level plans and objectives set forth by the Parks, Recreation and Culture Department, Parks Division (Parks Division). These include the Parks, Recreation and Culture Commission Policy Manual, 1996 and the citywide Natural Areas Access and Recreation Management Strategy, 2000. Additionally, this plan was developed in conjunction with the attached Recreation and Access Management Plan. It follows a similar format of and is consistent with the fire management plan developed for Sunnyside Acres Urban Forest.

The foundation of this plan is the Wildfire Hazard Rating System. This model is a GIS based model is a standardized means of quantifying the critical factors that contribute to wildfire risk including fire behavior potential, the risk of ignition, structures at risk and constraints for suppression. This assessment was used to develop seven distinct fire management zones (Figure 1) with distinct hazards and subsequent recommendations.

The recommendations for each management zone are summarized in Table 1 and include improving public education and awareness, staff training, fire weather monitoring, improving detection capabilities, ladder and ground fuel manipulation, reducing the chances of ignition and suppression preparedness. The implementation of this Plan is the responsibility of the Parks Division, Urban Forestry and Environmental Services Section and the recommendations within the Plan will be integrated into their annual work plans.

Table 1 Summary of the hazards within each fire management zone

Management zone	Fire Behaviour <sup>1</sup>	Risk of Ignition	Structures at Risk	Suppression Constraints	Overall Wildfire Hazard
1	L-H	M-VH	H	L	H
2	L-H	M-VH	L	L	L
3	M-H	L-M	L	M-VH	M
4	L	L	L	M-VH	L
5	VH	L-M	L	VH	VH
6	H	M	M	M	H
7	L	H <sup>1</sup>	L	L	L

VL = very low L = low, M = moderate, H = high, VH = Very High

<sup>1</sup> In the summer months

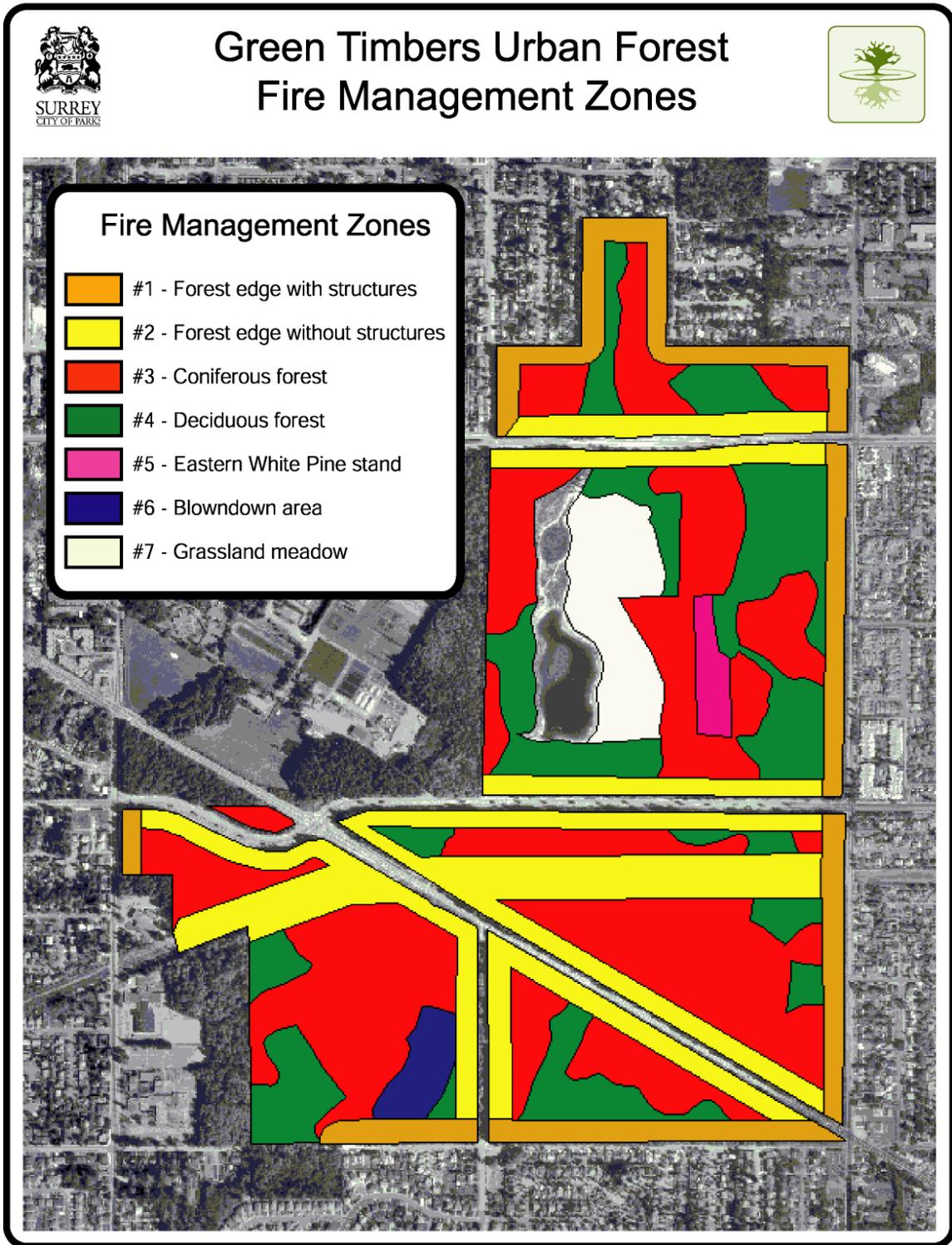


Figure 1 Fire Management Zones

Table 2 Summary of recommendations by management zone

<b>Fire Management Zone</b>	<b>Primary Concerns</b>	<b>Recommended Actions</b>
FMZ 1 - Forest edge structures at risk	<ul style="list-style-type: none"> <li>• The risk of ignition from heavy machinery, vehicles and pedestrian traffic along the adjacent roads and at trail entrances</li> <li>• The risk of ignition from adjacent residential housing</li> <li>• The risk of ignition from trees falling and displacing live wires from adjacent power lines</li> <li>• The buildup of ignition fuels from illegal dumping and cured grass along boulevards</li> <li>• The high fire behavior potential in the primarily coniferous fuel types</li> <li>• The threat of a high intensity fire to adjacent residential housing</li> </ul>	<ul style="list-style-type: none"> <li>• Post fire awareness signage around the park indicating the current fire hazard</li> <li>• Distribute fire safe brochures to adjacent residences to raise wildfire hazard awareness</li> <li>• Ensure all hazard trees are removed adjacent to power lines</li> <li>• Identify and remove all fuel accumulations from illegal dumping</li> <li>• Ensure that grass adjacent to the park is kept short to prevent curing</li> <li>• Remove the ladder fuels along the back yards of the residential lots that back directly onto the forest along the northern boundary of the Forest between 145<sup>th</sup> and 146<sup>th</sup> Avenue</li> <li>• Ensure a fast and effective initial response to all fires in the coniferous fuel types</li> </ul>
FMZ 2 - Forest edge no structures	<ul style="list-style-type: none"> <li>• The risk of ignition from heavy machinery, vehicles and pedestrian traffic along the adjacent roads and trail entrances</li> <li>• The risk of ignition from trees falling and displacing live wires from adjacent power lines</li> <li>• The risk of ignition from pedestrian traffic and the power lines along the BC Hydro right of way</li> <li>• A fire igniting and spreading quickly across unkept grass on the boulevards and BC Hydro right of way</li> <li>• The buildup of ignition fuels from illegal dumping along boulevards</li> <li>• The high fire behavior potential in the primarily coniferous fuel types</li> </ul>	<ul style="list-style-type: none"> <li>• Post fire awareness signage around the park indicating the current fire hazard</li> <li>• Ensure all hazard trees are removed adjacent to power lines</li> <li>• Ensure that grass adjacent to the park and along the BC Hydro right of way is kept short to prevent curing</li> <li>• Identify and remove all fuel accumulations from illegal dumping</li> <li>• Ensure a fast and effective initial response to all fires in the coniferous fuel types</li> </ul>

Fire Management Zone	Primary Concerns	Recommended Actions
FMZ 3 - Coniferous forests	<ul style="list-style-type: none"> <li>• High fire behavior potential in these stands</li> <li>• The risk of ignition along trails by pedestrians (many of which are unauthorized)</li> <li>• The risk of ignition from party goers lighting bonfires in the park</li> <li>• Poor access for suppression resources</li> </ul>	<ul style="list-style-type: none"> <li>• Close all unauthorized trails</li> <li>• Identify areas where partying is frequent and there are remains of past bonfires. Rehabilitate these areas by removing all fire pits and dismantle any shelters. Discourage any future partying by placing obstacles across the area and where feasible plant brush species and small deciduous trees.</li> <li>• Identify and remove all heavy fuel accumulations along trails</li> </ul>
FMZ 4 - Deciduous forests	<ul style="list-style-type: none"> <li>• Poor access for suppression resources</li> </ul>	<ul style="list-style-type: none"> <li>• No actions recommended</li> </ul>
FMZ 5 - Eastern White Pine stand	<ul style="list-style-type: none"> <li>• Stand is a non-native species which is in poor health with abundant standing dead fuels</li> <li>• Very high fire behavior potential in this stand</li> <li>• The stand is located adjacent to flammable coniferous stands</li> <li>• There are accumulations of ignition fuels along the trails</li> <li>• There is poor access for suppression resources</li> </ul>	<ul style="list-style-type: none"> <li>• Consider a management strategy to convert the stand to ecologically suited native species</li> <li>• Post fire awareness signage adjacent to this stand</li> <li>• Remove dead standing fuels within 20 meters of the trails</li> <li>• Remove ignition fuel accumulations along trails</li> </ul>
FMZ 6 - Blowdown Area	<ul style="list-style-type: none"> <li>• There is an abundance of ground fuels in this area from subsequent blowdown events</li> <li>• A ground fire in this area would be difficult to suppress and would threaten to spread into the adjacent coniferous stands</li> <li>• The risk of ignition along trails by pedestrians</li> <li>• The risk of ignition from party goers in the park</li> </ul>	<ul style="list-style-type: none"> <li>• Post fire awareness signage in and adjacent to this stand</li> <li>• Identify and remove accumulations of ignition fuel along authorized trails</li> <li>• Rehabilitate the area where there is evidence of frequent bonfires and partying by removing all fire pits, and dismantling any shelters. Discourage any future partying by placing obstacles across the area and, where feasible, plant brush species and small deciduous trees</li> <li>• Work to close the unauthorized trail running through this area</li> </ul>

<b>Fire Management Zone</b>	<b>Primary Concerns</b>	<b>Recommended Actions</b>
FMZ 7 - Grassland Meadow	<ul style="list-style-type: none"> <li>• There is the highest risk to human lives in this area as it experiences the greatest use</li> <li>• There is a high risk of human caused ignition in this area as it experiences the greatest use</li> <li>• Once cured in the summer, these grasses will readily ignite and support a low intensity ground fire</li> <li>• A grass fire would spread quickly and act as kindling fuel for a larger fire in the adjacent coniferous fuel types</li> </ul>	<ul style="list-style-type: none"> <li>• Post fire awareness signage in this area to raise public awareness of the existing hazards</li> <li>• Continue to allow a strip of deciduous trees to mature between the grass and the adjacent coniferous fuel type</li> <li>• Authorize strategic trails running through the grass area to act as fire breaks</li> </ul>

## Introduction

Green Timbers Urban Forest (the Forest) is a 185 hectare park located within the City of Surrey. It was dedicated in 1988 and 1996 largely in response to the efforts of the Green Timbers Heritage Society and other organized groups that recognized its unique, history, ecological characteristics and recreational opportunities. One of the primary management principles for the management of Urban Forests is that "Natural Succession should be allowed to proceed with minimal intervention or disturbance." Within the context of an urban setting, some natural disturbance agents like wildfire, present serious risks and therefore cannot be allowed to occur naturally. A wildfire within Green Timbers Urban Forest would put at risk the high concentration park visitors and adjacent residents as well as the structures in and adjacent to the Forest. A fire would also dramatically change the ecological succession of the forest. This would threaten to change some plant communities which are currently maturing into rare and endangered forest ecosystems. Within an urban setting there is also a much higher risk of a fire igniting from human activity.

It is important to understand that the purpose of establishing and protecting the Forest is for the enjoyment of residents and visitors whom also value the intrinsic and heritage values of the trees in the Forest. In light of the potential damage that a large scale wildfire could do in such an area, the risk of ignition must be minimized and suppression capabilities and procedures must be well organized so that all fires are controlled in a quick and efficient manner.

A GIS based wildfire hazard model was used to assess the primary components that contribute to the risk associated with wildfire. The model identifies areas with dangerous fire behavior characteristics, hazardous ignition sources, constraints on suppression resources and structures at risk from a wildfire. This assessment provided a platform from which to develop specific fire management zones and to prioritize detailed prescriptions for minimizing these hazards. The recommended strategies for reducing wildfire hazard include improving public education and awareness, staff training, fire weather monitoring, improving detection capabilities, ladder and ground fuel manipulation, reducing the chances of ignition and suppression preparedness.

This plan takes into consideration the policy and objectives of the City of Surrey, analyzes all of the critical factors affecting wildfire risk and prioritizes actions to be taken to help protect the natural and cultural resources in and adjacent to the Forest. All Urban Forests are to be set aside in perpetuity for their intrinsic and heritage values, to provide long-term non-consumptive enjoyment and benefits for the general public.

The management principles for Urban Forest Parks relevant to this plan include:

### ***Natural Succession***

- Natural succession should be allowed to proceed with minimal intervention or disturbance.

### ***Fire Protection and Suppression***

- The lighting of fires is prohibited in Urban Forests.
- All fires shall be immediately suppressed by the most effective means and with the least possible disruption to the forests.
- A specific fire plan will be developed for each Urban Forest and should consider amongst other issues: authority, liaison with the MOF and a non-disruptive suppression program

### **The Need for a Plan**

A wildfire within Green Timbers Urban Forest threatens human lives, valuable structures in and adjacent to the Forest and the ecological integrity of the Forest itself. The best tool for minimizing the potential of damage from a wildfire is through preparedness and education. Management actions that minimize ignition hazards and fire behavior potential, improve fire awareness and establish efficient suppression protocol can make the difference in preventing a large-scale wildfire. This is especially relevant in an area as popular as Green Timbers Urban Forest, where there are large numbers of people and groups using the Forest for a range of activities from picnicking and recreation to educational and organized events.

In 1993, the City of Surrey signed a Memo of Understanding (MOU) with the Ministry of Forests (MOF) stating that they will co-operate in “attacking, controlling and extinguishing forest fire burning within the city of Surrey.” The MOF was identified as the lead agency with the City of Surrey providing support services. It was stated that if the City Fire Department could not control a wildfire within the forested parks within one hour, it would call the MOF for support. As such the City did not require any specialized equipment or training.

This one hour control or extinguishment criteria established in this MOU was eliminated in 1998 when the MOF issued “Operating Guideline #1.06.01 Wildland Suppression and Local Government.” This document placed the responsibility of suppression in forested parks with the City. The Guideline “identifies the key element between the MOF and a local fire department as one of ‘mutual aid’ with the City being the lead agency and the MOF providing support services” As a result, the City is no longer able to rely on the MOF for specialized equipment and techniques for fighting fires in forested areas. Consequently, the City has begun to develop urban/wildland fire management plans to improve its preparedness and suppression capabilities.

### **Division of Responsibilities**

The Parks, Recreation and Culture Department is responsible for all aspects of Fire Management in natural areas except suppression. Fire suppression in all natural area parks, is the responsibility of the City of Surrey Fire Department. This normally includes initial attack, suppression, and mop-up. All suppression efforts within the Surrey Fire Department are in co-operation with the Ministry of Forests, Provincial Forest Protection Branch, following Operating Guideline #1.06.01, Wildland Suppression and Local Government and specifically as stipulated in the operating guideline, #2.17.13, Fire Suppression Wildland/Urban Interface, developed between the City and Ministry of Forests.

### Purpose of the Plan

The purpose of this fire management plan is to analyze the existing and potential fire hazards in and surrounding Green Timbers Urban Forest and to prioritize specific actions to minimize these hazards. The priority for all fire management activities is to protect human lives, followed by the protection of structures and the ecological integrity of the Forest.

Specifically, the objectives of this plan are:

<b>Safety</b>	<ul style="list-style-type: none"> <li>• Firefighter and public safety is the first priority. All fire management activities must reflect this commitment</li> </ul>
<b>Protection</b>	<ul style="list-style-type: none"> <li>• All preventative measures and suppression efforts will work to protect all structures in and around the Forest</li> <li>• All preventative measures and suppression efforts will work to protect all rare and endangered species and other unique natural features</li> <li>• Ensure that post-fire rehabilitation is conducted promptly and appropriately from both an ecological and environmental perspective</li> </ul>
<b>Preparedness</b>	<ul style="list-style-type: none"> <li>• The City Parks, Recreation and Culture Department and the Municipal fire department will develop safe wildland urban interface management strategies through appropriate planning, staffing, training and equipment</li> </ul>
<b>Prevention</b>	<ul style="list-style-type: none"> <li>• All agencies will work together to prevent unauthorized ignition of fires and improve detection capabilities</li> <li>• Minimize fire behavior potential through fuels manipulation, minimizing ignition sources and suppression preparedness</li> </ul>
<b>Interagency Co-operation and Policy</b>	<ul style="list-style-type: none"> <li>• Fire management planning, preparedness, prevention, suppression, ecosystem rehabilitation, and education will be conducted in co-operation between the City Parks, Recreation and Culture Department and the Municipal fire department</li> <li>• Establish clear fire protocol and responsibilities between the City of Surrey Parks, the Municipal Fire Department and the Ministry of Forests</li> <li>• Comply with other existing policies affecting the management of Surrey's natural areas</li> <li>• Minimize the City's potential liabilities associated with wildfire</li> </ul>
<b>Education</b>	<ul style="list-style-type: none"> <li>• Agencies will enhance knowledge and understanding of fire management policies and practices in natural areas through internal and external communication and education programs</li> </ul>

### Fire History

All ecosystems are influenced by periodic disturbances that vary in size, severity and occurrence. Examples of common disturbances include: wildfire, windthrow, ice and freeze damage, water, landslides, insect and disease outbreaks and human caused events such as logging. These disturbances change the progress of an ecosystem along its successional pathway. Wildfire is often the most dramatic disturbance type and has the ability to significantly alter the physical and biological characteristics of an ecosystem. It can change the structure and species composition of a forest, remove some or the entire forest floor organic layer and alter the chemical properties of the soil.

Green Timbers Urban Forest is located in the CWHdm Biogeoclimatic Subzone. Forests in this subzone naturally experience infrequent stand initiating disturbances. The most common stand initiating events are wildfires that range in size from 20 to 1000ha and occur on average every 200 years. The original forest of Green Timbers were harvested and the majority of it was subsequently broadcast burned. As a result there is no old growth forest left in the Forest. Evidence of this harvesting and burning can be found throughout the Forest on remaining stumps with fire scars.

## **Summary of Wildfire Hazard within Green Timbers Urban Forest.**

A GIS based wildfire hazard model was used to assess the primary components that contribute to the risk associated with wildfire. This assessment provided a platform from which to develop specific fire management zones and to prioritize detailed prescriptions for minimizing these hazards. The model identifies areas with dangerous fire behavior characteristics, hazardous ignition sources, constraints on suppression resources and structures at risk from a wildfire. The following is a summary of the findings from this analysis.

### **Fire Behavior**

There is a wide range of fuel types distributed throughout the Forest. The continuity of these stands is broken up by a number of large fuel breaks. The most significant include the Fraser Highway, 96<sup>th</sup> Avenue, 100<sup>th</sup> Avenue, 144<sup>th</sup> Street and the BC Hydro right of way. Additionally there is the lake and King creek located in the center of the Forest and an extensive trail system which form effective fire breaks for ground fires. The distribution of these fire breaks minimize the hazard of any single fire spreading too far within the Forest.

The forested portions of the stand can be separated into two broad types of fuels. There are the more flammable coniferous dominated stands, which are generally growing in drier ecosystem types and there are the more fire resistant deciduous stands that are generally growing in wetter ecosystem types. These fuel types are not continuous and can be found throughout the Forest. The most hazardous fuel types are the coniferous stands with ladder fuels which will support a ground fire moving into the forest crown.

This Eastern White pine stand located to the east of the Lake area as well as the blowdown area located north-west of 144<sup>th</sup> Street and 92<sup>nd</sup> Avenue present unique challenges in terms of fire behavior potential and the risk of ignition. The flammable Eastern White pine stand is in poor health and contains dense dead standing fuels that would easily support a crown fire. It is recommended that work be taken in this area to reduce the ignition fuels and ladder fuels adjacent to all trails. Additionally, a strategy should be implemented that will slowly turn this stand into a healthier native plant community that will be more fire resistant.

The blowdown area contains extensive large and small downed woody fuels that would support a very hot ground fire. This type of fire could threaten to move into the crowns of the adjacent coniferous stands where ladder fuels are present. It is recommended that in this area, ignition fuels adjacent to authorized trails be reduced as much as possible and that unauthorized trails be a priority for closure.

The grassland area located adjacent to the lake experiences the greatest amount of traffic and subsequently is where the greatest risk for ignition exists. This threat is high only in the summer when the grasses in this area have dried out and cured. Under these conditions a discarded cigarette or match could easily start a grass fire. Grass fires tend to spread quickly but do not burn for very long as there are no larger fuels to sustain the fire. The greatest threat from a grass fire in this area is of it spreading into and igniting fuels within the adjacent coniferous stands. Currently the lake and creek located to the west form excellent fire breaks. The north, east and south edges of the grassland area are buffered by either trails and/or fire resistant deciduous stands. It is recommended that some of the unauthorized trails through this grassland area be authorized and maintained as they act as effective fuel breaks against such a fire.

There is also a high risk of ignition from cured grasses along the BC Hydro right of way and on the roadway boulevards. These grasses should be cut regularly and work with heavy machinery should be minimized when the MOF fire hazard rating reaches extreme.

### **Structures at Risk**

The only significant structure at risk from a fire located within the Forest is the restroom building located at the main parking area on 100<sup>th</sup> Avenue. The majority of the structures surrounding Green Timbers Urban Forest have roads separating them from the park. These roads form excellent and effective fuel free buffers. Two small neighborhoods have houses that back directly onto the Forest. One is in the northern most end of the Forest between 102 and 103<sup>rd</sup> Avenue and 145 and 146<sup>th</sup> Street. The second is just south of 92<sup>nd</sup> Avenue at about 142<sup>nd</sup> Street and backs onto a forested area not currently within the Forest but is continuous with it. Additionally the Pacific Forest Center is located within a large tract of forest that runs continuous with the Forest between 100<sup>th</sup> Avenue and 96<sup>th</sup> Avenue and 140<sup>th</sup> and 144<sup>th</sup> Streets. It is recommended that the ladder fuels adjacent to the housing along the northern Forest boundary be removed.

### **Suppression Constraints**

The greatest limitation in terms of fire suppression is accessibility into remote areas of the Forest. The Forest is split up by a number of roadways which provides excellent access to many portion of the Forest. Additionally there is vehicle access through the Lake area and along the B.C. Hydro right of way. The most remote areas in terms of access are south of the B.C. Hydro right of way. Much of this area is designated as a nature reserve and contains few trails. A fire located away from the adjacent roadways would be very difficult to access quickly.

The majority of the Forest is very flat and relatively easy to travel through for ground crews. Additionally the trail system north of 96<sup>th</sup> St is extensive providing excellent access to these areas of the Forest. There are numerous fire hydrants located along adjacent residential roads. The lake is an excellent water sources for helicopters with belly-tanks and King creek stream provides a water source for ground crews with water pumps.

The access constraints are difficult to improve as no further roads or significant trails are planned to be built through the Forest. There are specifically designed suppression vehicles which can travel along park trails with a water which could be considered by the City for their park system.

The most effective tool for improving suppression capabilities is through preparedness. Proper training, equipment and suppression protocol will ensure the most efficient and effective response to any fire in the Forest.

### **Human Lives**

The area of the Forest that experiences the greatest traffic from visitors and organized events is the section of park between 96<sup>th</sup> and 100<sup>th</sup> Avenue. This area contains an extensive trail system, the lake and grasslands as well as a large forested area. Consequently, this is where there is the greatest threat to human lives. Access concerns and the level of traffic with respect to the trail system are addressed in the Recreation and Access Management Plan. The city should be aware of the types and numbers of visitors which typically use thee Forest. Specifically attention should be paid to special events and those visitors with limitations in communication and mobility.

Additionally there are numerous residential areas adjacent to the Forest. The majority of these residences are separated from the Forest by roadways which form excellent fire buffers. The properties which abut up to the Forest along the northern and southern boundaries are at the greatest risk. All residences adjacent to the forest should be included in an education campaign including recommendations for improving fire safety in and around their houses.

The area to the North of 96<sup>th</sup> Ave. contains an extensive trail system and therefore evacuation is not a significant concern. To the south of 96<sup>th</sup> St there are fewer trails and subsequently fewer effective escape routes. Safe evacuation of the Forest once a fire has started

requires excellent preparedness and communication between an evacuation co-ordinator and a number of evacuation teams.

Prevention and preparedness are the greatest tools in minimizing the risks of a large-scale fire. Improving public education and awareness with regards to wildfire will greatly reduce the chances of fire ignition and improve detection capabilities. This should include fire awareness campaigns, improving signage and distributing educational brochures to adjacent housing.

## **The Wildfire Hazard Rating System (WHRS)**

The “Wildfire Hazard Rating System” is a global information system (GIS) based model that spatially quantifies and analyzes the relationships that exist between the critical factors affecting wildfire risk. The objective of this model is to provide park managers with a decision making tool that spatially identifies the severity of wildfire hazard within a specified area. This information allows managers to analyze and explore the implications of different management activities in relation to wildfire risk.

The four critical factors that are accounted for by this model include:

1. Fire behavior potential
2. The risk of a fire ignition
3. Structures at risk
4. Suppression Constraints

These four components are in turn calculated from a number of contributing factors, each of which is represented by a layer in a GIS environment. The wildfire hazard of each of the four components is calculated by overlaying the relevant contributing factors. The layers representing these four components are in turn overlaid to produce the final wildfire hazard rating

Each of the contributing factors has been designated a maximum possible weight that reflects each layer’s relative importance and contribution towards the overall wildfire hazard. The weighting of the individual layers combine to a maximum of 25 points per component and 100 for the overall wildfire hazard. These numeric weightings are used to categorize the wildfire hazard as low, moderate, high and extreme.

### **Fire Behaviour**

The fire behavior component of the WHRS measures how a wildfire will behave under extreme weather conditions. The Canadian Fire Behaviour Prediction System is a model that provides quantitative outputs of fire behavior characteristics for the major Canadian fuel types. Specific information pertaining to fuel types, topographical attributes, and fire weather was run through this model to calculate three output fire behavior layers:

### **Fire Intensity**

This layer is a measure of the rate of heat energy released per unit time per unit length of fire front. It is based on the rate of spread and the predicted fuel consumption. The units for this layer are kilowatts per meter (Kw/m).

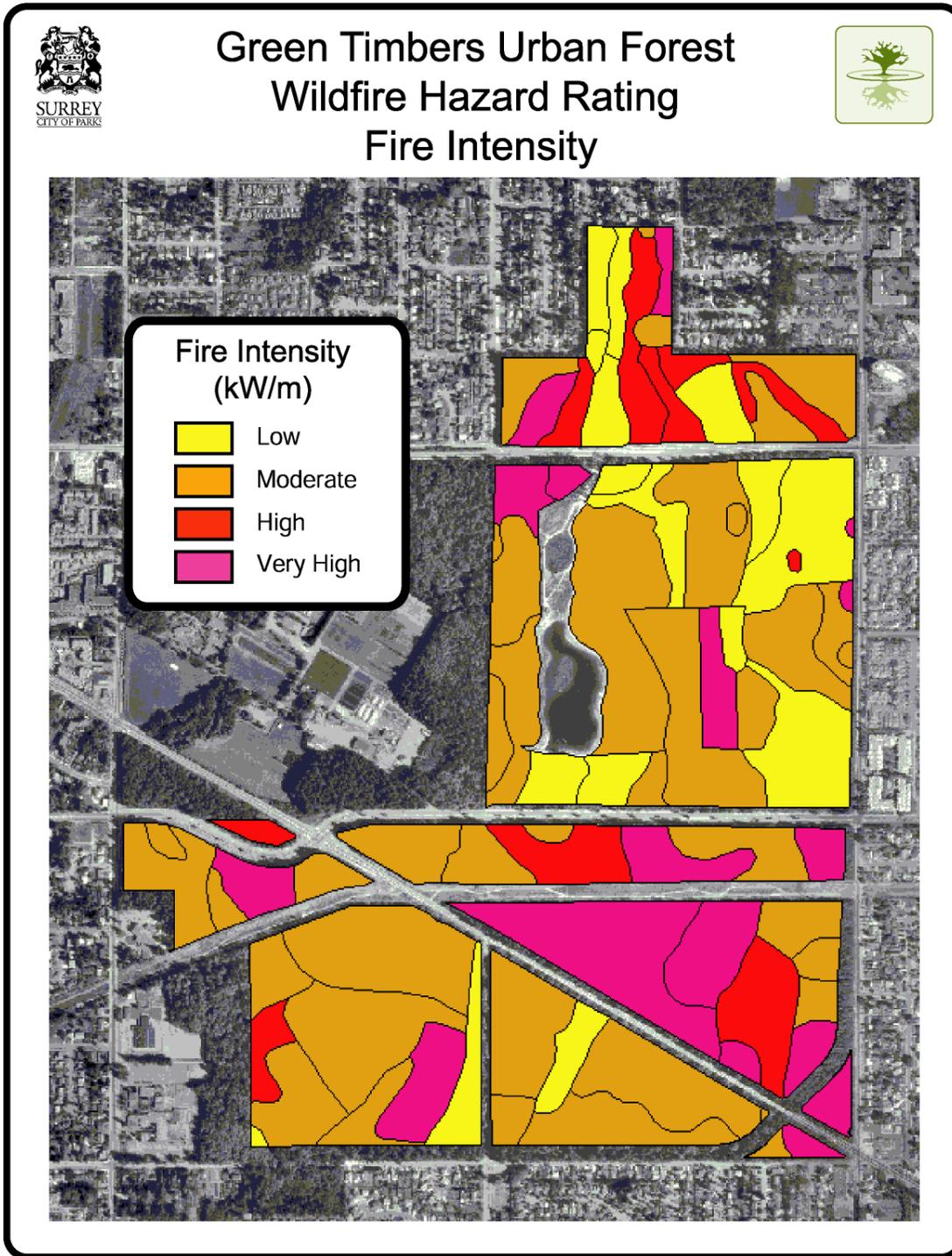


Figure 2 Fire intensity

**Rate of Spread**

This layer is a measure of the speed at which a fire extends its horizontal dimensions. It is based on the hourly Initial Spread Index (ISI) value and is adjusted for the steepness of slope, the interactions between the direction of the slope and wind. The increasing fuel availability is accounted for through the Build Up Index (BUI). The units for this layer are meters per minute (m/min).

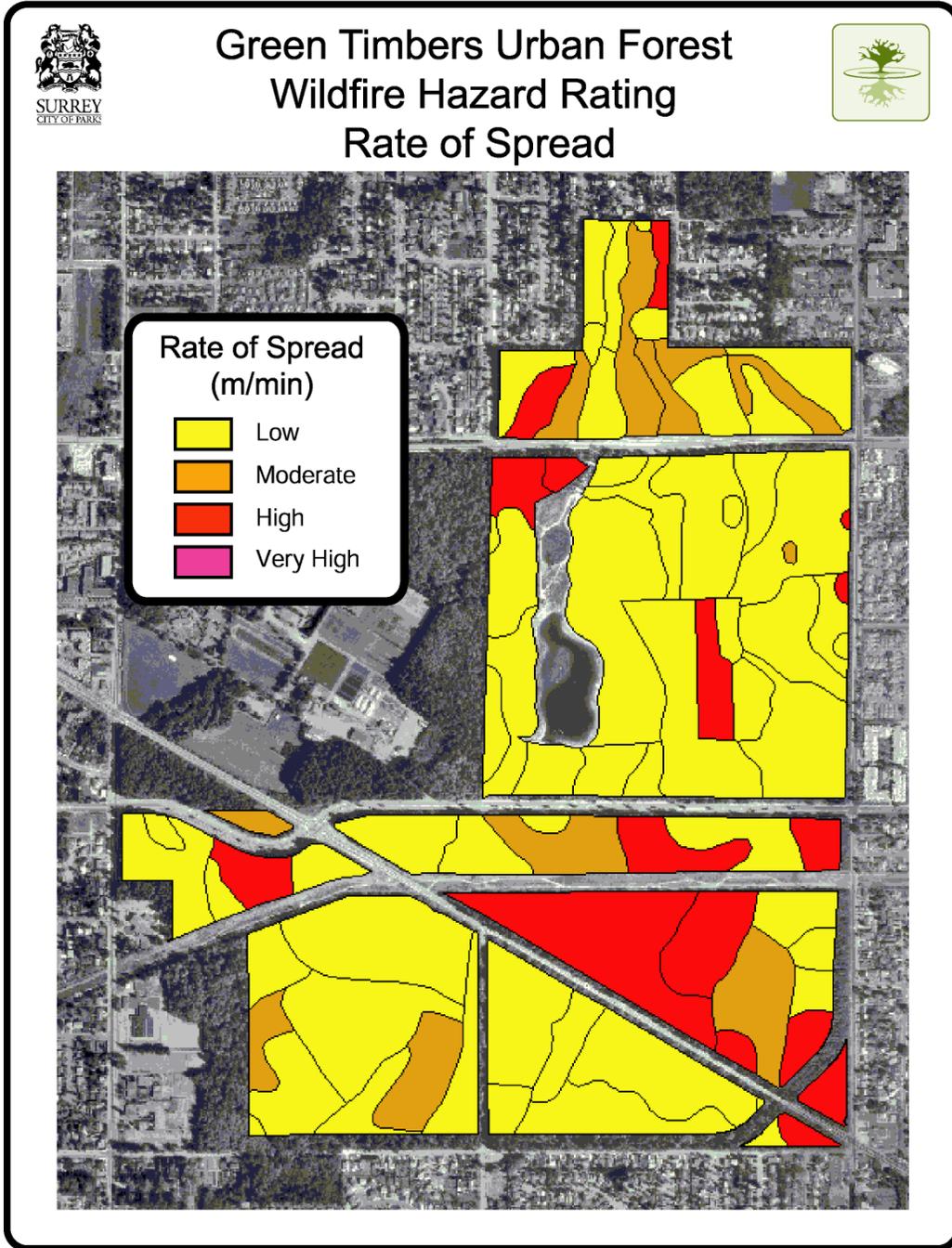


Figure 3 Rate of spread

**Crown Fraction Burned**

This value is a measure of the proportion of the tree crowns involved in the fire. It is expressed as a percentage value and is based on the rate of spread, the crown base height and the foliar moisture content.

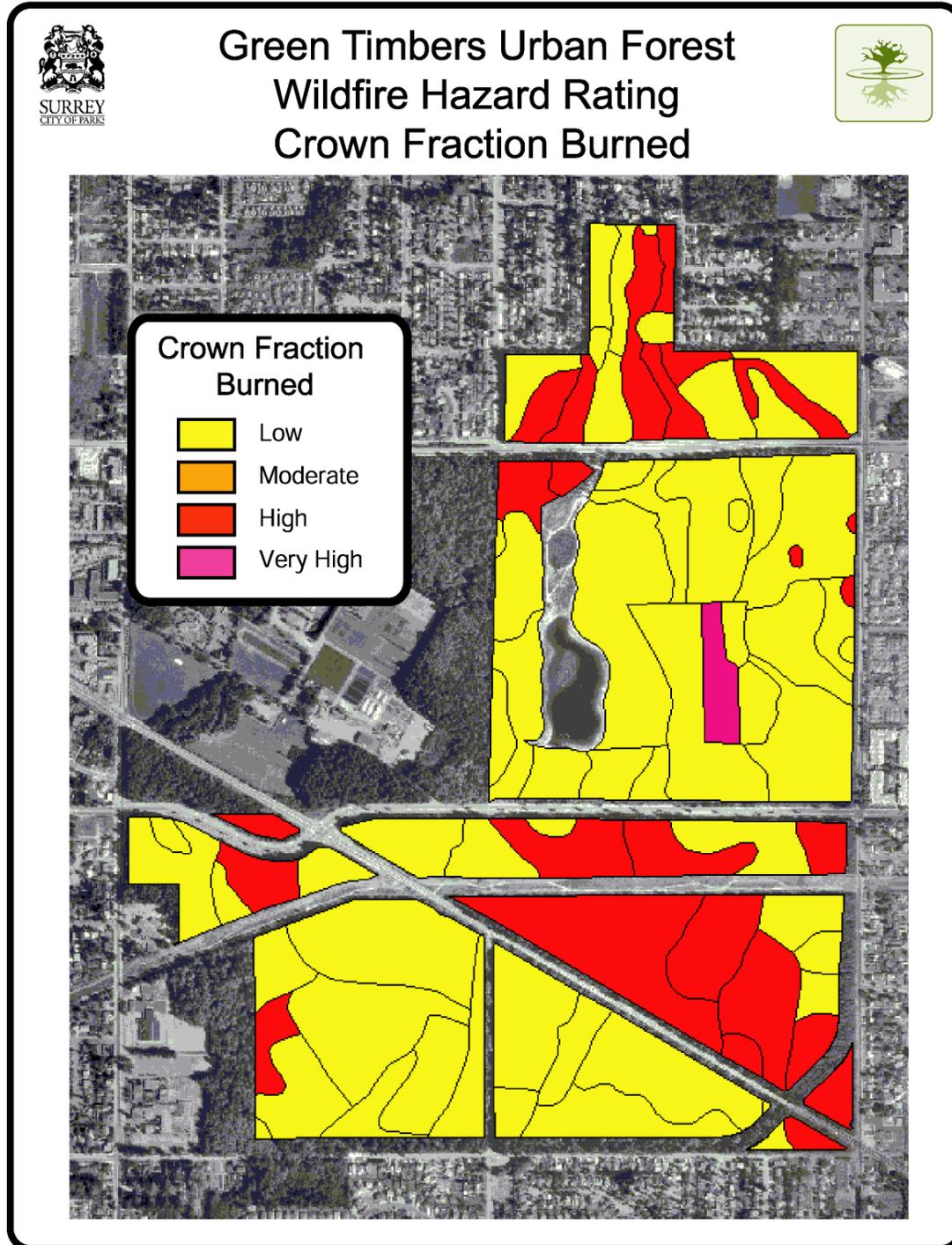


Figure 4 Crown fraction burned

## **Fuel Types**

There are a variety of fuel types found in the forest including grasses, small and large accumulations of ground fuels, dead standing fuels and forested stands ranging in susceptibility from fire resistant deciduous species to dense flammable coniferous stands. Ignition fuels such as dried out grass and fine small woody material will light and spread readily. As such these fuels tend to burn out quickly on their own and present the greatest hazard when they act as kindling for larger fuels. Larger fuels such as logs and stumps and the forest floor organic layer take longer to ignite and spread slower but burn longer and give off lots of heat. Standing dead trees present a unique hazard and are the cause of many forest fires. These fuels dry out quickly and act as effective ladder fuels to spread a ground fire into the crown of a stand. Many forest fires are started when snags are hit by lightning.

Sixteen national benchmark fuel types that are divided into five categories are used by the Canadian Fire Behaviour Prediction System to forecast how a wildfire will react. Green Timbers Urban Forest has been stratified into similar fuel types and categorized according to this system. 6 main fuel types were identified in Sunnyside Acres:

### **C-4 Coniferous – “Immature Pine Stand\*\*”**

This fuel type is characterized by pure dense pine stands in which natural thinning has resulted in a large quantity of standing dead trees and downed woody debris. The ground is covered in needle litter with little vegetation. The planted eastern white pine stand located to the east of the lake areas is best classified as this fuel type. It is not as dense as an immature pine stand but due to the poor health of the stand contains an abundance of dead standing trees and downed woody debris.

### **C-6 Coniferous – “Coniferous Plantation\*\*”**

This fuel type is characterized by relatively even aged stands dominated by mature Douglas-fir trees. The tree crowns are close together and are generally located greater than 10 meters above the forest floor. The bark of these trees is thick and resistant to fire although the crowns are flammable. This fire resistant bark and low to moderate ladder fuels reduces the chance of a ground fire spreading to the crowns although if this were to happen, the fire would spread readily and be difficult to control.

### **D-1 Deciduous – “Leafless Aspen\*\*”**

This fuel type is dominated by deciduous tree species. These trees are generally resistant to fire and are located in the wetter portions of the Forest. Ground fuels are generally low in these areas. This fuel type poses the least hazard in terms of fire behavior potential.

### **M-2 Mixedwood – “Boreal Mixedwood-Green\*\*”**

This fuel type is characterized by stand mixtures of both coniferous and deciduous species. In Green Timbers Urban Forest, these stands are composed of primarily Douglas-fir, western redcedar, western hemlock and red alder with minor components of paper birch, cottonwood and bigleaf maple. These stands are generally multistoried and as such contain the critical ladder fuels which will help move ground fires into the crowns of the stands. The potential of this fuel type to sustain and spread a wildfire increases with the percentage component of coniferous species.

### **S-2 Slash – “White Spruce-Balsam slash\*\*”**

In Green Timbers Urban Forest this fuel type is used to represent the heavy fuel accumulations found in the blowdown area located to the north west of 92<sup>nd</sup> Avenue and 144<sup>th</sup> Street. This is an area that was planted with grand fir and has suffered extensive blowdown. Consequently, there are heavy ground fuel accumulations and very few standing trees.

**O1-b Open – “Grass\*”**

This fuel type is characterized by continuous grass cover with scattered trees. In Green Timbers Urban Forest the open grass field located adjacent to the lake and the two heavily disturbed sites located north of 100<sup>th</sup> Avenue have been classified as such.

This fuel type presents unique challenges with regards to fire behavior potential and fire management. In the summertime when grasses dry out they will light readily and spread quickly. As such these fuels tend to burn out quickly on their own and present the greatest hazard when they act as kindling for larger fuels.

\*These fuel types represent a type of behavior pattern. The names do not necessarily describe the type of stand that is found.

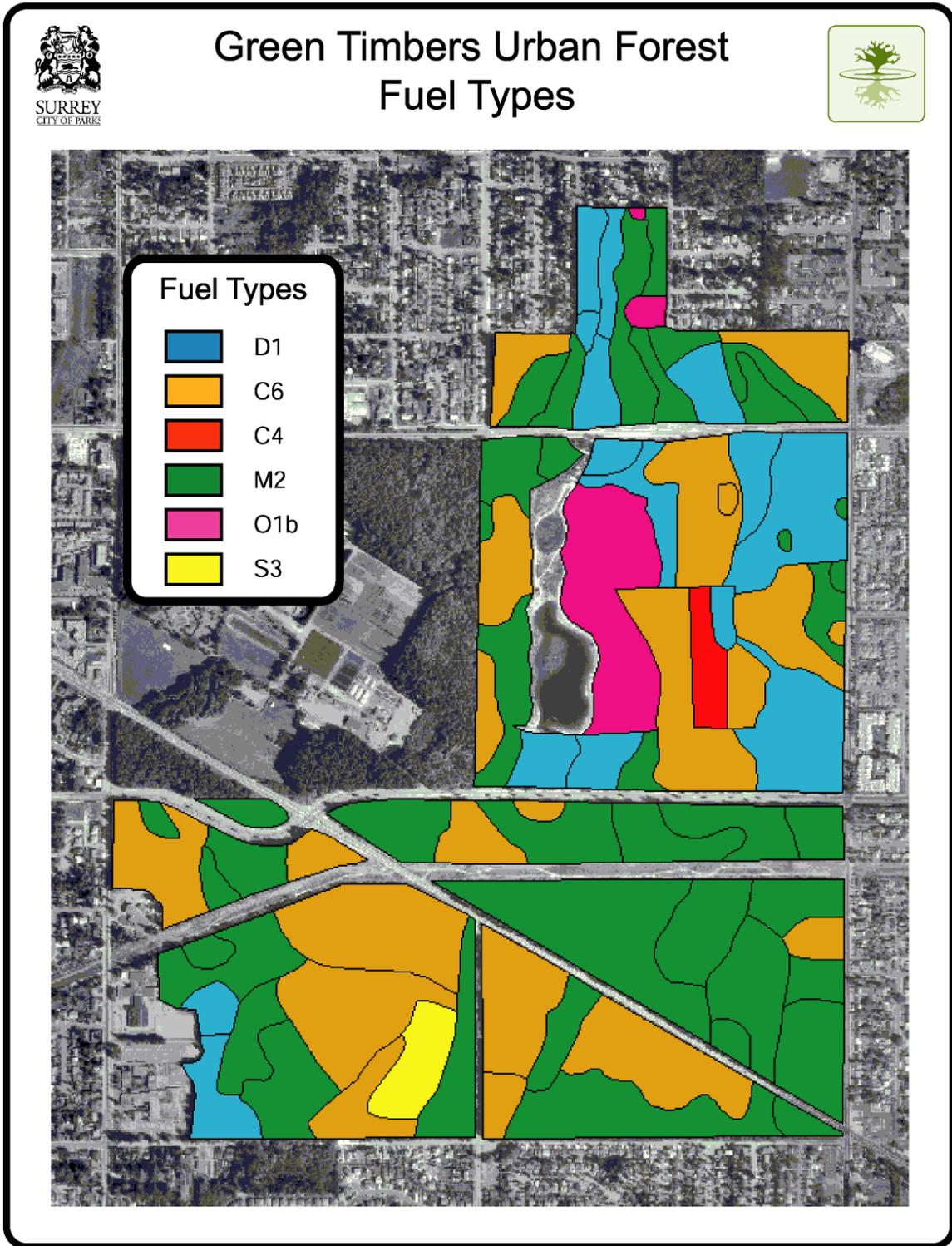


Figure 5 Fuel types

### Weather Conditions

Weather conditions used to calculate these layers were derived from established Ministry of Forests weather stations surrounding the study area. The two closest stations are located at the UBC research station in Maple Ridge and on Saltspring Island. Historic records were compiled and statistically analyzed to determine the 90th percentile fire weather indices for each station. The fire weather indices required include: the fine fuel moisture code (FFMC), the build-up index (BUI) and wind speed. The cardinal wind direction was calculated from aspect so that it was blowing upslope and the elapsed time was set at 24 hours.

The fire weather indices used for the fire behavior calculations are:

- Fine fuel moisture code (FFMC) = 89
- Build-up Index (BUI) = 95
- Wind speed = 15 km/hr

\*Note that these are the same fire weather conditions used to calculate fire behavior potential in Sunnyside Acres Urban Forest.

The outputs from the fire behavior prediction system were categorized and weighted as follows:

Table 3 Fire behavior layers

Layer	Units	Unit Value = Weight
Fire Intensity	Kilowatts per meter (kW/m)	0-500 = 2
		501-2000 = 4
		2001-4000 = 6
		4001-10000 = 8
		10001-30000 = 9
		>30000 = 10
Rate of Spread	Meters per minute (m/min)	0-5 = 1
		6-10 = 2
		11-20 = 3
		21-40 = 4
		>40 = 5
Crown Fraction Burned	Percent of canopy crown burned	0 = 0
		1-9 = 3
		10-89 = 6
		90-100 = 10

Table 4 Fire behavior component

Weight	Category
0-6	Low
7-12	Moderate
13-18	High
>18	Extreme

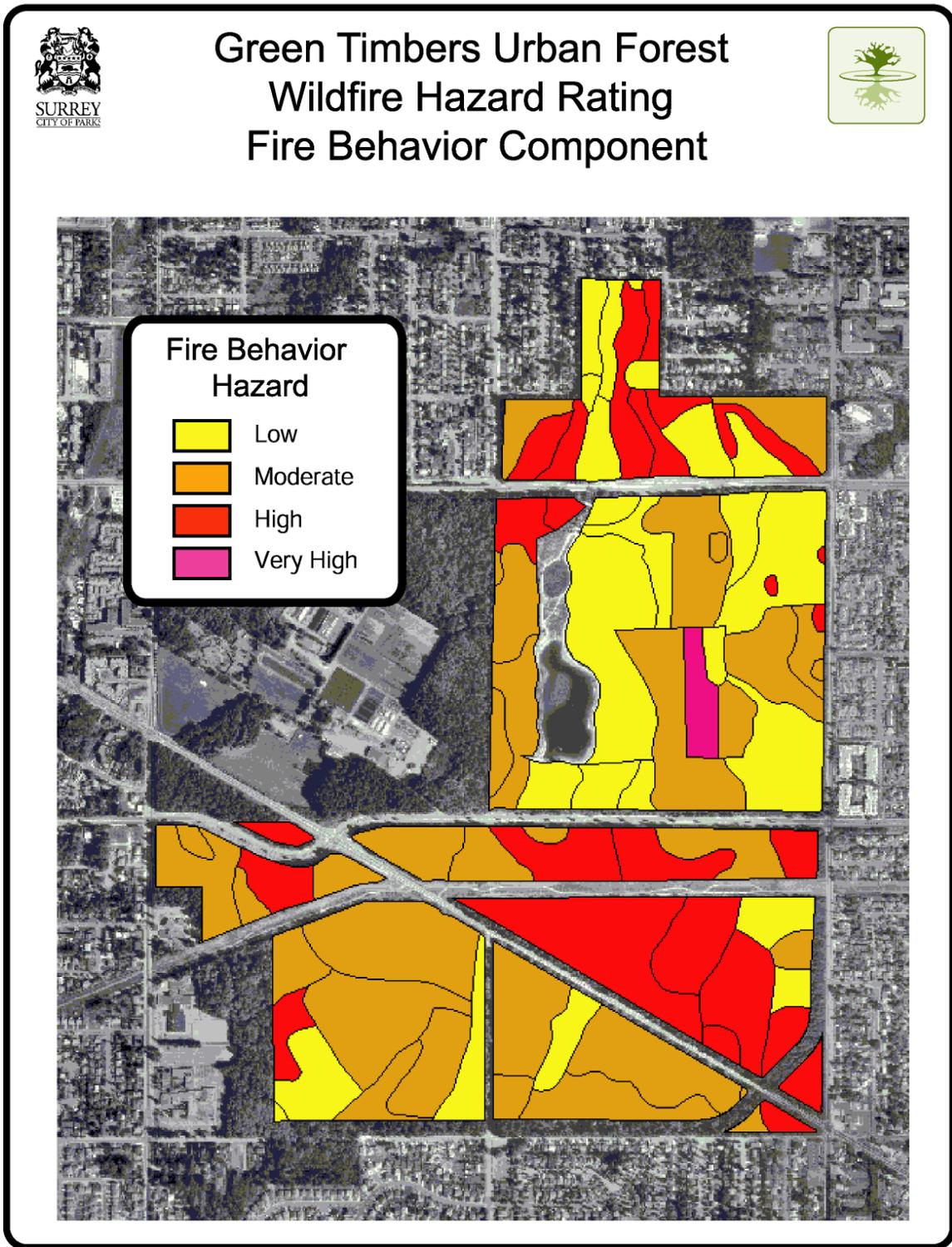


Figure 6 Fire behavior component

## The Risk of Ignition

The risk of ignition in Green Timbers Urban Forest is primarily from human activity. The most common source of ignition includes the use of motorized machinery, discarded cigarettes and matches from smoking, fires started in houses adjacent to the park and from bonfires lit within the park. Additionally there is a low risk of ignition from trees falling and displacing live wires from adjacent power lines.

The risk of ignition has been accounted for by buffering the locations where fires are most likely to be started and assigning them a higher hazard rating. A 10 meter buffer was placed around all trail systems and a 20 meter buffer around all roads adjacent to the park. Buffers of 50 meters were also placed around the interface areas where housing developments have been built up against the forest edge. Areas that are frequented by party goers and where bonfires have been previously lit have been identified and buffered by 20 meters. Additionally a 20m buffer was placed around the forested areas adjacent to power lines. These areas were all given a higher ignition hazard weighting as follows:

Table 5 Risk of ignition

Layer	Weight
Areas within 10 meters of any trail	5
Areas within 20 meters of any roads	5
Areas within 20 meters of power lines <sup>†</sup>	2
Areas within 50 meters of housing	3
Areas within 20 meters of bonfires and spots frequented by party goers	10

<sup>†</sup> weight designation is assigned assuming regular hazard tree assessments are done

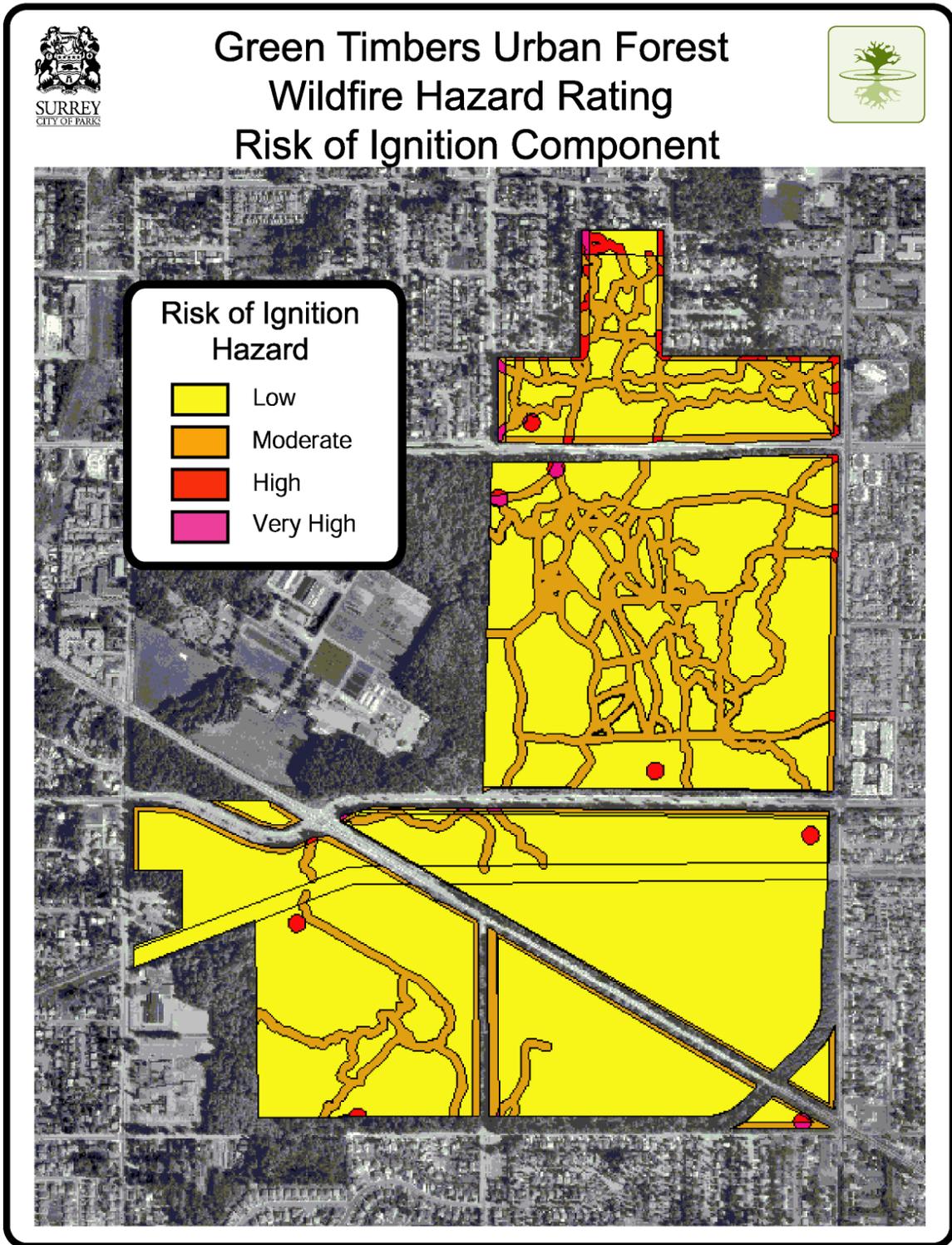


Figure 7 Risk of ignition

**Structures at Risk**

Structures at risk include all human-made structures of significant value that have the potential to be destroyed or damaged by a wildfire. The locations of these structures (primarily housing) were identified from air photos and through ground visits. All areas within 100 meters of these structures were given a higher hazard rating of 25.

Table 6 Structures at risk

Layer	Weight
All areas within 100 meters of an adjacent structure	25

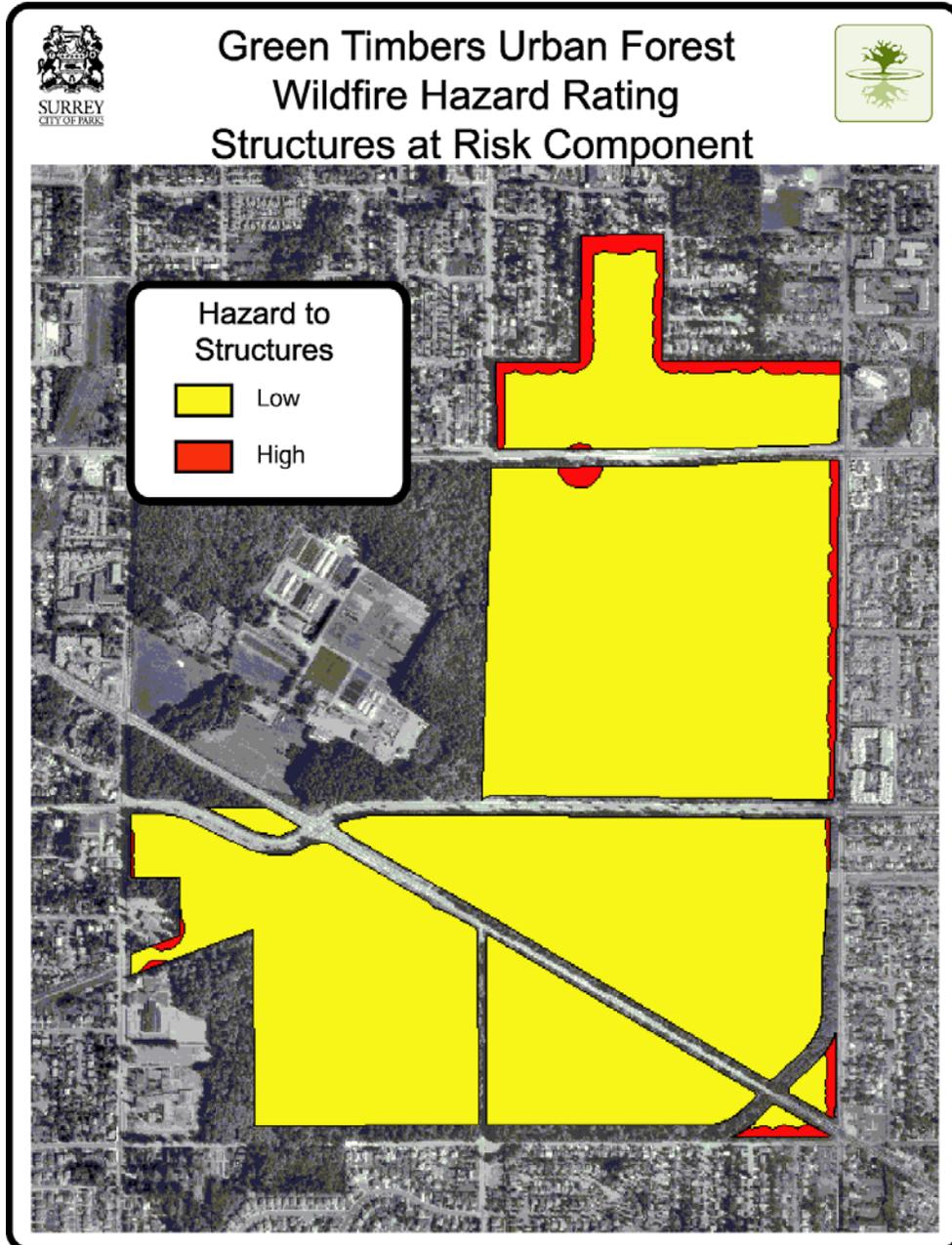


Figure 8 Structures at risk

### Suppression Constraints

The assessment of suppression constraints is based on the availability of suppression resources, access restrictions and topographical features. As this is an urban setting, suppression response will be relatively fast as resources are located nearby. Additionally the terrain is fairly flat and easy to travel through. The greatest constraint is the isolation of the fire within the park and access to water sources (fire hydrants, the lake and perennial streams). Isolation is accounted for by assigning increasing hazard ratings with distance from the roads. Additionally areas further than 100 meters from fire hydrants have been given a higher hazard rating. The weighting scheme used is as follows:

Table 7 Suppression constraints

Layer	Units	Weight
Distance from roads	0 – 50 meters from a road	5
	50-100 meters from a road	10
	>100 meters from a road	20
Availability of water sources	Areas less than 100m from a fire hydrant	0
	Areas greater than 100m from a fire hydrant	5

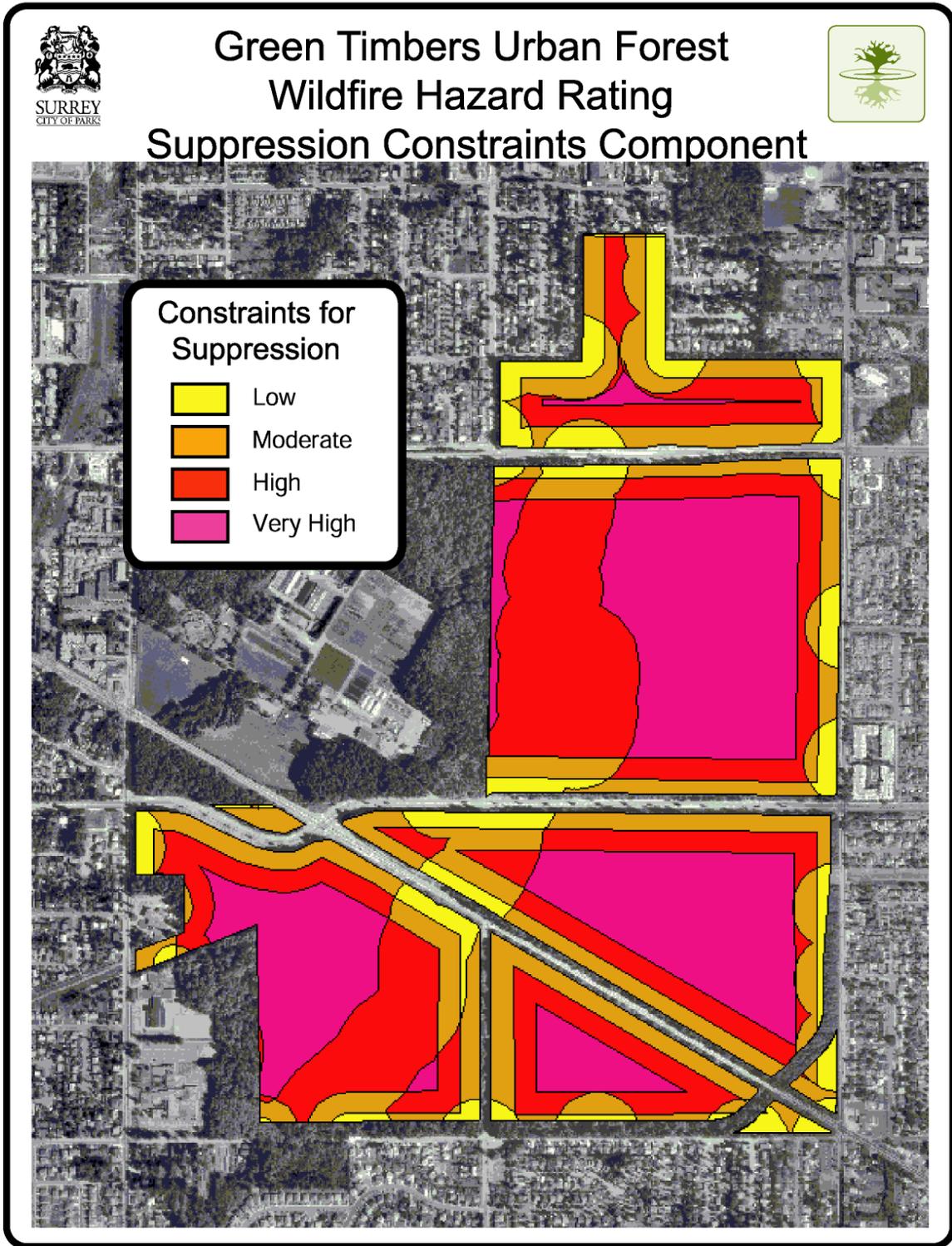


Figure 9 Suppression constraints component

**Final Wildfire Hazard Rating**

The final wildfire hazard rating has been calculated by adding together the ratings of the four primary components. The final weightings are categorized as follows:

Table 8 Final Wildfire Hazard Rating

<b>Weight</b>	<b>Category</b>
0-21	Very low
22-31	Low
32-41	Moderate
42-51	High
>51	Very High

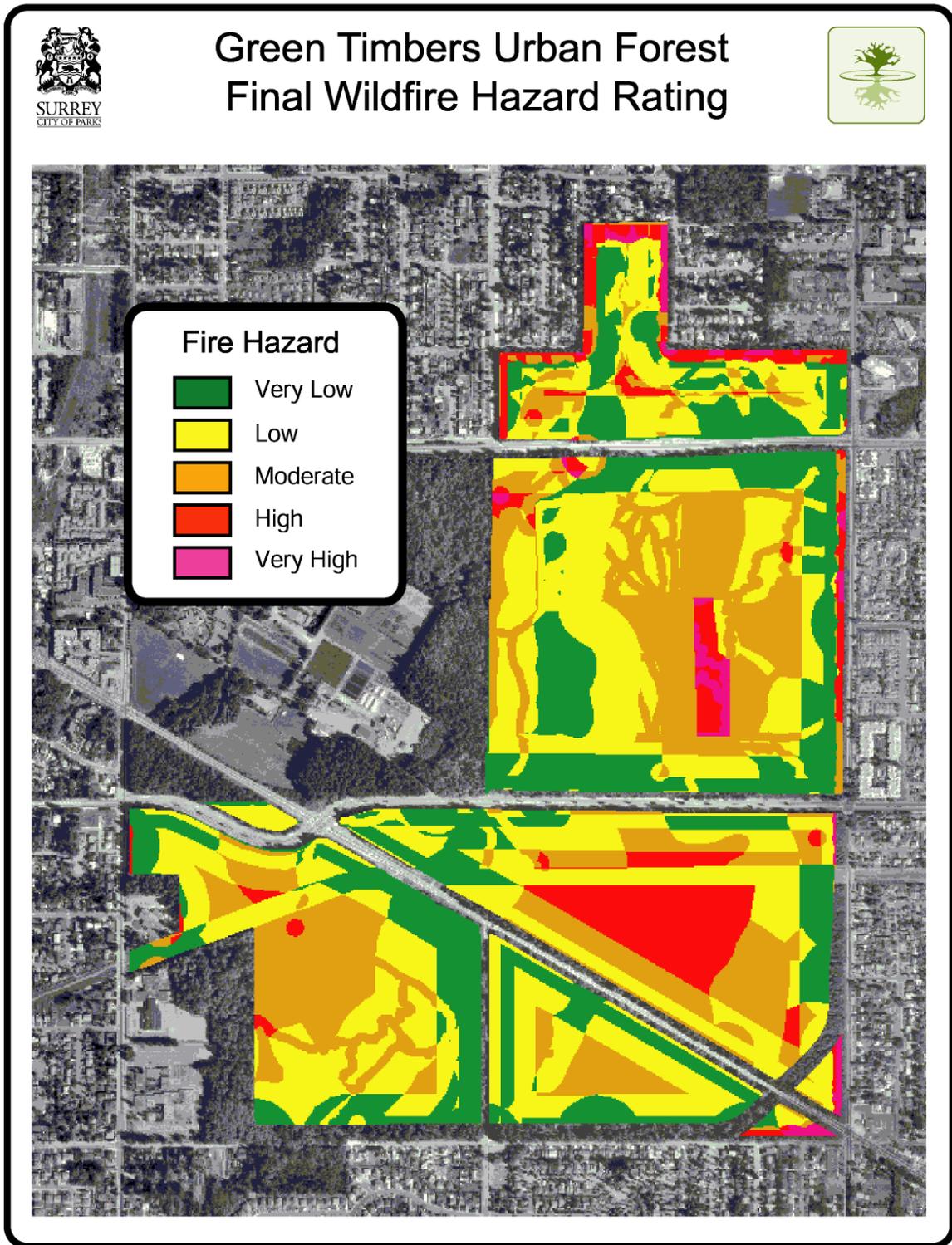


Figure 10 Final Wildfire Threat Rating System

## Fire Management Zones

The Wildfire Hazard Rating for Green Timbers Urban Forest is the foundation for the establishment of seven fire management zones. Each of these zones is characterized by distinct hazards and conditions that require specific stand level management prescriptions. These characteristics have been summarized and actions are recommended for each management zone. The hazard ratings for the Wildfire Hazard Rating System are summarized in Table 9.

The legal boundary of the Forest does not include a small strip of forest along the southern and eastern edge, south of 96<sup>th</sup> Avenue. As they are forested areas, continuous with the rest of the Forest they have been included in the fire management zones and considered in this plan.

Table 9 Summary of the hazards within each fire management zone.

Management zone	Fire Behaviour	Risk of Ignition	Structures at Risk	Suppression Constraints	Overall Wildfire Hazard
1	L-H	M-VH	H	L	H
2	L-H	M-VH	L	L	L
3	M-H	L-M	L	M-VH	M
4	L	L	L	M-VH	L
5	VH	L-M	L	VH	VH
6	H	M	M	M	H
7	L	H <sup>1</sup>	L	L	L

<sup>1</sup> In the summer months

\*VL = very low L = low, M = moderate, H = high, VH = Very High

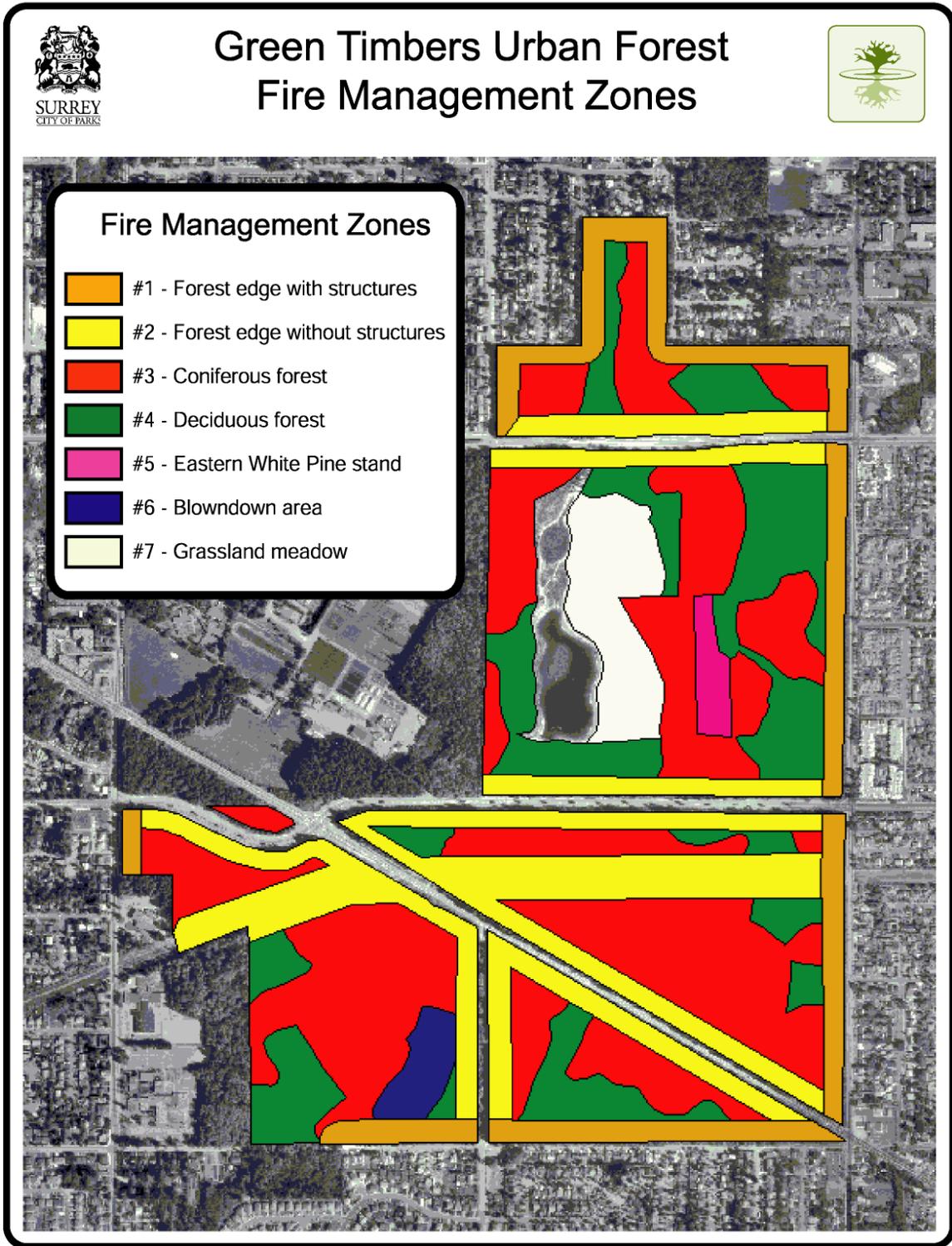


Figure 11 Fire management zones

**FIRE MANAGEMENT ZONE 1 (FMZ-1): Forest edge structures at risk**

Fire Management Zone 1 consists of a 50 meter wide area running along the edges of the park that are located adjacent to structures (predominantly residential housing). This includes the northern, eastern and southern boundaries of the Forest. There is also a small strip along the west edge of the park just south of the Fraser Highway. The southern portion of this zone and the eastern edge south of 96<sup>th</sup> Avenue are not officially Urban Forest but have been included in this plan for management purposes.

The primary concerns in this area are the high risk of ignition, the high fire behavior potential in the coniferous fuel types and the threat that a fire in this area would pose to the adjacent structures.

There is a high risk of ignition in this area from heavy machinery, cars and pedestrians on the adjacent roadways. The greatest risk is from cigarettes and matches discarded from drivers and pedestrians. Additional sources include power lines and residential lots located adjacent to the forest. There are also hazardous accumulations of ignition fuels from illegal dumping of green waste and the curing of boulevard grasses in the summer. Fire behavior potential is highest in the stands consisting of primarily coniferous species.

There are numerous residential structures located adjacent to the Forest in this zone. The majority of these are separated from the forest by roadways although a severe fire could cross this buffer. There are a small number of residential lots that back directly onto the forest along the northern boundary that present a risk of ignition and are at higher risk if a fire spreads into this stand.

There are few serious suppression constraints in this area as a fire would likely be detected quickly by local residents or traffic and would be easily accessible for suppression resources. Additionally there are numerous fire hydrants located along the residential streets bordering this zone.

**FMZ 1 Fire Behaviour**

Under 90<sup>th</sup> percentile fire weather conditions, the fire behavior hazard varies from low to high across this management zone due to the variety of fuel types present. Generally the greater the coniferous component in the stand and the amount of ladder and ground fuels, the greater the fire behavior potential. The lowest fire behavior potential is located in the predominantly deciduous stands along the eastern edge of the forest between 94<sup>th</sup> Avenue and 100<sup>th</sup> Avenue and along 145<sup>th</sup> Street between 102<sup>nd</sup> and 103<sup>rd</sup> Avenue. The greatest fire behavior potential exists in the multistoried stands consisting of predominantly coniferous species. These stands contain enough lower ladder fuels to support a ground fire spreading into the canopy crown. These high hazard areas are located to the north of 100<sup>th</sup> Avenue, and along 148<sup>th</sup> Street between 100<sup>th</sup> Avenue and the BC Hydro right of way and south of about 94<sup>th</sup> Avenue.

The greatest threat with respect to fire behavior is a fire starting in one of these hazardous fuel types and spreading into the crowns of the stand. A fire spreading away from the access roads into the Forest would be difficult to bring under control.

**FMZ 1 Risk of Ignition**

The risk of ignition in this management zone is moderate to very high due to a combination of possible sources. The greatest hazard is from primarily automobile and pedestrian traffic as well as work with heavy machinery along the adjacent roadways. Cigarettes and matches are often discarded from passing cars and from pedestrian walking adjacent to the park. This risk of ignition is compounded where power lines are located along the forest edge on 144<sup>th</sup> Street just north of 100<sup>th</sup> Avenue and at trail entrances.

Along the northern boundary of the Forest between 145<sup>th</sup> and 146<sup>th</sup> Avenue, a number of residential lots back directly onto the Forest. There is a higher risk of ignition here from sources such as barbecues, bonfires and house fires. Most of the trees in this interface area are fire resistant deciduous species although there are a number of western redcedars that should be pruned to reduce the ladder fuels.

The grasses growing on adjacent boulevards present an interesting hazard with respect to the risk of ignition. In the summertime when grasses dry out and cure, they will light readily and spread a fire quickly. As such these fuels tend to burn out quickly on their own and present the greatest hazard when they act as kindling for larger fuels located in the adjacent Forest. Additionally there is extensive dumping of garbage and green waste along this boundary zone. This can create hazardous fuel accumulations that are prone to ignition. Grass should be maintained and cut regularly during the fire season and garbage and green waste should be removed.

### **FMZ 1 Structures at risk**

The majority of the structures at risk from a fire in the Forest are located in this zone. These are primarily residential houses that are separated from the forest by the roads around the perimeter of the Forest. These roads act as an excellent fuel free buffer although, a high intensity fire could threaten these structures. Along the northern boundary of the Forest between 145<sup>th</sup> and 146<sup>th</sup> Avenue, a number of residential lots back directly onto the Forest. These structures are at high risk if a fire spreads into this stand.

### **FMZ 1 Suppression constraints**

The adjacent roads provide good access for suppression resources in this zone. Additionally there are numerous fire hydrants located along all of these roads. Detection of a fire in these areas would likely be quick from adjacent residences and traffic on the roadways.

### **FMZ 1 Primary Concerns**

- The risk of ignition from heavy machinery, vehicles and pedestrian traffic along the adjacent roads and at trail entrances
- The risk of ignition from adjacent residential housing
- The risk of ignition from trees falling and displacing live wires from adjacent power lines
- The buildup of ignition fuels from illegal dumping and cured grass along boulevards
- The high fire behavior potential in the primarily coniferous fuel types
- The threat of a high intensity fire to adjacent residential housing

### **FMZ 1 Actions to reduce wildfire hazard**

- Identify and remove all fuel accumulations from illegal dumping
- Ensure that grass adjacent to the park is kept short to prevent curing
- Post fire awareness signage around the park indicating the current fire hazard
- Distribute fire safe brochures to adjacent residences to raise wildfire hazard awareness
- Remove the ladder fuels along the back yards of the residential lots that back directly onto the forest along the northern boundary of the Forest between 145<sup>th</sup> and 146<sup>th</sup> Avenue.
- Ensure all hazard trees are removed adjacent to power lines
- Ensure a fast and effective initial response to all fires in the coniferous fuel types

**FIRE MANAGEMENT ZONE 2 (FMZ-2): Forest edge no structures**

Fire Management Zone 2 consists of the edges of the Forest which are not adjacent to any significant structures and the BC hydro right of way running through the Forest. This includes a 50 meter wide area running along both sides of 100<sup>th</sup> Avenue, 96<sup>th</sup> Avenue, the Fraser Highway, 144<sup>th</sup> Street south of the Fraser Highway.

The primary concerns in this area are the high risk of ignition and the high fire behavior potential in the predominantly coniferous fuel types. There is a high risk of ignition in this area from heavy machinery, cars and pedestrians on the adjacent roadways. The greatest risk is from cigarettes and matches discarded from drivers and pedestrians. Additional sources include power lines adjacent to the forest and along the BC Hydro right of way. There are also areas in this zone that contain hazardous accumulations of ignition fuels from illegal dumping of green waste and the curing of boulevard grasses in the summer. Fire behavior potential is highest in the stands consisting of primarily coniferous species.

There are few serious suppression constraints in this area as a fire would likely be detected quickly by local residents or traffic and would be easily accessible for suppression resources. There are fewer fire hydrants along this boundary due to the lack of adjacent structures.

**FMZ 2 Fire Behaviour**

Under 90<sup>th</sup> percentile fire weather conditions, the fire behavior hazard varies from low to high across this management zone due to the variety of fuel types. Generally the greater the coniferous component in the stand and the amount of ladder and ground fuels, the greater the fire behavior potential. The lowest fire behavior potential is located in the patches of predominantly deciduous stands located along 100<sup>th</sup> Avenue, the north side of 96<sup>th</sup> Avenue and well as the west side of 144<sup>th</sup> Street. The greatest fire behavior potential exists in the multistoried stands consisting of predominantly coniferous species. These stands contain enough ladder fuels to support a ground fire spreading into the canopy crown. These areas are located primarily to the south of 96<sup>th</sup> Avenue with exception to the deciduous stand located along the west side of 144<sup>th</sup> Street.

The greatest threat with respect to fire behavior is a fire starting in one of these hazardous fuel types and spreading into the crowns of the stand. A fire spreading away from the access roads into the Forest would be difficult to bring under control.

**FMZ 2 Risk of Ignition**

The risk of ignition in this management zone is moderate to very high due to a combination of possible sources. The greatest hazard is from primarily automobile and pedestrian traffic as well as work with heavy machinery along the adjacent roadways. Cigarettes are often discarded from passing cars and from pedestrian walking adjacent to the park and through the trail entrances. This risk of ignition is compounded where power lines are located along the forest edge on the south side of 96<sup>th</sup> Avenue east of the Fraser Highway and south of the Fraser Highway along the eastern side of 144<sup>th</sup> Street. The Hydro lines along the BC Hydro right of way are generally greater than a tree length away from the Forest but still pose a fire threat as the grasses growing under them are a hazardous ignition source during the summer months.

The grasses growing on adjacent boulevards and along the BC Hydro right of way present an interesting hazard with respect to the risk of ignition. In the summertime when grasses dry out, they will light readily and spread a fire quickly. As such, these fuels tend to burn out quickly on their own and present the greatest hazard when they act as kindling for larger fuels located in the adjacent Forest. Additionally, there are areas along 144<sup>th</sup> Street where extensive

dumping of garbage and green waste is creating hazardous fuel accumulations that are prone to ignition.

### **FMZ 2 Structures at risk**

There is only one large structure located within this zone. This is the restroom located at the entrance to the parking area along the south side of 100<sup>th</sup> Avenue. This structure would be at risk from a fire burning in the forested stand to the west.

### **FMZ 2 Suppression constraints**

There is good access for suppression resources in this zone due to the adjacent roads. Additionally the paved pathway along the BC Hydro right of way is wide enough to drive a vehicle for access. There are fewer fire hydrants in this zone as compared to FMZ 1 due to the lack of structures. Detection of a fire in these areas would likely be quick from adjacent residences and traffic on the roadways.

### **FMZ 2 Primary concerns**

- The risk of ignition from heavy machinery, vehicles and pedestrian traffic along the adjacent roads and trail entrances
- The risk of ignition from trees falling and displacing live wires from adjacent power lines
- The risk of ignition from pedestrian traffic and the power lines along the BC Hydro right of way
- A fire igniting and spreading quickly across unkept grass on the boulevards and BC Hydro right of way
- The buildup of ignition fuels from illegal dumping and cured grass along boulevards
- The high fire behavior potential in the primarily coniferous fuel types

### **FMZ 2 Actions to reduce wildfire hazard**

- Post fire awareness signage around the park indicating the current fire hazard
- Ensure all hazard trees are removed adjacent to power lines
- Ensure that grass adjacent to the park and along the BC Hydro right of way is kept short to prevent curing
- Identify and remove all fuel accumulations from illegal dumping
- Ensure a fast and effective initial response to all fires in the coniferous fuel types

### **FIRE MANAGEMENT ZONE 3 (FMZ-3): Coniferous forests**

Fire Management Zone 3 consists of primarily coniferous dominated stands located away from the edges of the park. These stands are scattered throughout the Forest and their continuity is broken up by fuel breaks and deciduous dominated stands.

The fire behavior hazard in this zone is moderate to high due to the coniferous dominated stands. The risk of ignition in this zone is low to moderate with the greatest risk from pedestrian traffic along the existing trails. There are no structures at risk in these stands and suppression is generally difficult due to the isolation from adjacent roads.

The primary concerns in this area are the potential fire behavior characteristics and the poor accessibility for suppression resources. Under extreme fire weather conditions, a ground fire could spread into the crown and move quickly throughout these coniferous stands.

**FMZ 3 Fire Behaviour**

The fire behavior hazard in these stands range from moderate to high. The fuel types are generally C6 and M2 with a coniferous component of greater than 40%. Under 90<sup>th</sup> percentile fire weather conditions, the rate of spread of a wildfire would vary from 3-12 meters per minute. The fire intensity would be from 2500-13000 kW/m. The calculated output for crown fraction burned was 0% in the C6 fuel type and between 30% and 60% in the M2 fuel types. The ground fuel loading is generally moderate for these stands. The ladder fuels are generally low to moderate in the C6 fuel types, as they are even aged stands and moderate in the M2 fuel types.

These stands present the greatest threat in terms of fire behavior potential. A ground fire, which moves into the crowns of these stands under dry and windy conditions, would spread quickly and be very difficult to control.

**FMZ 3 Risk of Ignition**

The risk of ignition in this management zone is generally low to moderate with the greatest risk from pedestrian traffic along trails. This threat can be reduced by closing all unauthorized trails. Most of the areas where there are frequent parties and bonfires are located in this zone. Bonfires are the greatest threat of ignition and should be a high priority for rehabilitation.

**FMZ 3 Structures at Risk**

There are no significant structures at risk near this zone as it is located away from the edges of the Forest. There are occasional benches and signs but no special management is required to protect these features.

**FMZ 3 Suppression Constraints**

This area is located away from all roads limiting access for suppression resources. The suppression constraints range from moderate closer to the roads to very high near the center of the Forest. The terrain is relatively flat in the Forest and there are numerous trails facilitating access for ground crews.

**FMZ 3 Primary Concerns**

- High fire behavior potential in these stands
- The risk of ignition along trails by pedestrians (many of which are unauthorized)
- The risk of ignition from party goers lighting bonfires in the park
- Poor access for suppression resources

**FMZ 3 Actions to reduce wildfire hazard**

- Close all unauthorized trails
- Identify areas where partying is frequent and there are remains of past bonfires. Rehabilitate these areas by removing all fire pits and dismantle any shelters. Discourage any future partying by placing obstacles across the area and where feasible plant brush species and small deciduous trees.
- Identify and remove all heavy fuel accumulations along trails.

**FIRE MANAGEMENT ZONE 4 (FMZ-4): Deciduous Forests**

Fire Management Zone 4 consists primarily of the deciduous fuel types located away from the edges of the park. These stands are located primarily in wetter ecosystem types and are scattered through out the Forest. Overall, this zone poses a relatively low wildfire hazard as the site contains a high moisture regime and is dominated by fire resistant deciduous species. The risk of ignition is generally low with the greatest risk from pedestrian traffic along trails. There are few hazardous ignition fuels due to the high moisture regime in these forests. There are no structures at risk in these stands and suppression is generally difficult due to the isolation from adjacent roads.

**FMZ 4 Fire Behaviour**

The fire behavior hazard in this area is low due to the low flammability of the fuel types and the high moisture regime in these ecosystem types. Under the 90<sup>th</sup> percentile weather conditions used in this model, all of the fire behavior characteristics including fire intensity, rate of spread and crown fraction burned were a low hazard. The ground fuel loading is generally low in these stands and the ladder fuels are low to medium. Due to the high moisture regime and fire resistant tree species, a fire would not likely spread very quickly in these stands. As a result they form excellent fuel breaks for containing fires spreading in the more flammable coniferous fuel types.

**FMZ 4 Risk of Ignition**

The risk of ignition in this management zone is generally low with the greatest risk from pedestrian traffic along trails. There are very few hazardous ignition fuels located adjacent to the existing trails and the moisture regime is generally high in these ecosystems.

**FMZ 4 Structures at Risk**

There are no structures at risk near this zone as it is located away from the edges of the Forest.

**FMZ 4 Suppression Constraints**

This area is located away from all roads limiting access for suppression resources. The suppression constraints range from moderate closer to the roads to very high near the center of the Forest. The terrain is relatively flat in the Forest and there are numerous trails making access by foot easier.

**FMZ 4 Primary Concerns**

- Poor access for suppression resources

**FMZ 4 Actions to reduce wildfire hazard**

- No actions recommended

**FIRE MANAGEMENT ZONE 5 (FMZ-5): Eastern White Pine Stand**

Fire Management Zone 5 consists of a stand of Eastern white pine (*Pinus strobus*) that was planted in 1952 by the Pacific Forest Service. This stand is located in the Forest to the east of the lake and managed grassland area.

Eastern white pine is native to the Great Lakes-St. Lawrence Forest Region. It grows well on a variety of sites ranging from sphagnum bogs to rocky ridges and is normally a rapid growing tree. This stand is in poor health indicating that it has not adapted well to this maritime climate. The growth of these trees has slowed dramatically over the past decade. The crowns are thin and comprise only 10% to 15% of the height of the trees. There are about 900 stems/ha and many of the trees are dying out due to competition and poor health of the stand. This has created an abundance of standing dead woody debris.

As with most species of pine, *Pinus strobus* is adapted to a regular fire regime and as such are flammable and burn readily. The poor health of the stand, natural flammability of the species and presence of dead woody debris has created highly hazardous conditions in terms of fire behavior potential. A fire in this area would spread quickly and burn very hot. This would be difficult to control and would likely spread quickly into the adjacent conifer stands.

The risk of ignition in this zone is low to moderate with the greatest risk from pedestrian traffic along the existing trails. There are no structures at risk in these stands and suppression is generally difficult due to the isolation of the stand.

#### **FMZ 5 Fire Behaviour**

This stand presents the highest hazard in the entire Forest in terms of fire behavior potential. The fuel type is classified as C4 and under 90<sup>th</sup> percentile fire weather conditions, the rate of spread of a wildfire would be about 11 meters per minute. The fire intensity would be about 13,500 kW/m and the calculated output for crown fraction burned would be 90%. The ground fuel loading is moderate while the ladder fuels are very high, as there is abundant standing dead trees and dead branches. This stand present the greatest threat in terms of fire behavior potential and difficulty of suppression.

Under dry and hot weather conditions, a fire establishing or spreading into this stand would burn very hot and spread quickly through the canopy crown. This type of fire could easily spread into the crowns of the adjacent coniferous stands and threaten a large proportion of this very popular section of the Forest.

#### **FMZ 5 Risk of Ignition**

The risk of ignition in this management zone is generally low to moderate with the greatest risk from pedestrian traffic along trails. There are areas adjacent to the trails with accumulations of fine woody debris and needles that would act as ignition fuels.

#### **FMZ 5 Structures at Risk**

There are no structures at risk near this zone as it is located away from the edges of the Forest.

#### **FMZ 5 Suppression Constraints**

This stand is located in the center of the Forest away from all roads making access for suppression resources difficult. The terrain is relatively flat and there are numerous trails running through and adjacent to the stand making access by foot easier.

#### **FMZ 5 Primary Concerns**

- Stand is a non-native species which is in poor health with abundant standing dead fuels
- Very high fire behavior potential in this stand
- The stand is located adjacent to flammable coniferous stands
- There are accumulations of ignition fuels along the trails
- There is poor access for suppression resources

#### **FMZ 5 Actions to reduce wildfire hazard**

- Consider a management strategy to convert the stand to ecologically suited native species
- Post fire awareness signage adjacent to this stand
- Remove dead standing fuels within 20 meters of the trails
- Remove ignition fuel accumulations along trails

**FIRE MANAGEMENT ZONE 6 (FMZ-6): Blowdown Area**

Fire Management Zone 6 is located to the north west of 144<sup>th</sup> Street and 92<sup>nd</sup> Ave. It consists of an area which has and continues to experience extensive blowdown. The stand is dominated by Grand fir (*Abies grandis*) which was planted in 1930 with minor components of western redcedar and western hemlock. These trees are growing on a compacted layer which has resulted in shallow rooting systems. A windstorm event within the last decade blew over a number of the trees in this stand. This opened up the stand making it more susceptible to subsequent wind events. A series of windstorms has caused this blowdown area to expand and open up over the past 10 years. This has created an open canopy with scattered standing trees and heavy accumulations of downed woody debris. These conditions make this area highly susceptible to a ground fire. A fire would easily spread through the heavy ground fuels but would not turn into a crown fire as the canopy is very open. The greatest risk in this area is of a ground fuel establishing and spreading into the canopy of the adjacent coniferous stands.

The risk of ignition in this zone is low to moderate with the greatest risk from pedestrian traffic along the existing trails. There are a number of dead standing trees in this open stand which are at risk if struck by lightning. There is also an area in the southern portion of this zone frequented by party goers with signs of recent bonfires.

A block of residential houses is located adjacent to the south of this area. These structures are separated from this area by 92<sup>nd</sup> Avenue although a high intensity fire could cross this buffer and threaten these structures. There is access for suppression resources to the south of this stand along 92<sup>nd</sup> Avenue, although the rest of the stand must be accessed by foot.

**FMZ 6 Fire Behaviour**

There is an abundance of downed woody debris in this area from recent blowdown events. This accumulation of fuels poses a significant threat for a high intensity ground fire. The crown closure is very low making a crown fire very improbable. The fuel type is classified as the slash type S2. Under 90<sup>th</sup> percentile fire weather conditions, the rate of spread of a wildfire would be about 5.5 meters per minute, the fire intensity would be about 21,600 kW/m and the crown closure is too low to support a crown fire. The ground fuel loading is very high while the ladder fuels are low due to the open crown.

A ground fire establishing in this stand would burn very hot and be difficult to extinguish due to the large size of the downed woody debris. The greatest hazard in terms of fire behavior is of a ground fire to establishing in this area and spreading into the crowns of the adjacent coniferous stands.

**FMZ 6 Risk of Ignition**

The risk of ignition in this management zone is moderate. There is a small risk from pedestrian traffic along trails where there are accumulations of fine fuels, which would ignite easily. There are also a number of dead standing trees in this open stand that are at risk if struck by lightning. At the south end of this blowdown area there is a well established party area with evidence of a number of frequently used bonfire pits. This area poses a serious threat due to the abundance of downed woody debris in this area.

**FMZ 6 Structures at Risk**

This area is located adjacent to a residential area to the south. These houses are separated from the Forest by the roads around the park. These roads act as an excellent fuel free buffer, although a high intensity fire could cross this buffer and threaten these structures.

**FMZ 6 Suppression Constraints**

The south edge of this stand is located adjacent and can be accessed by 92<sup>nd</sup> Avenue. However, the majority of the area is located away from roads and has poor accessibility for suppression resources. The terrain is relatively flat and there are two trails (one authorized and

one unauthorized) running through the area making access by foot easier. A high intensity ground fire would be very difficult to completely mop up due to the large size and abundance of downed woody debris.

### **FMZ 6 Primary Concerns**

- There is an abundance of ground fuels in this area from the blowdown events
- A ground fire in this area would be difficult to suppress and would threaten to spread into the adjacent coniferous stands
- The risk of ignition along trails by pedestrians
- The risk of ignition from party goers in the park

### **FMZ 6 Actions to reduce wildfire hazard**

- Post fire awareness signage in and adjacent to this stand
- Identify and remove accumulations of ignition fuels along authorized trails
- Rehabilitate the area where there is evidence of frequent bonfires and partying by removing all fire pits, and dismantling any shelters. Discourage any future partying by placing obstacles across the area and, where feasible, plant brush species and small deciduous trees
- Work to close the unauthorized trail running through this area.

### **FIRE MANAGEMENT ZONE 7 (FMZ-7): Grassland Meadow**

Fire Management Zone 7 includes the grassland area located to the east of the lake. This area is being actively managed as a grassland and as such most of the trees which establish in this area are removed periodically. The grasses found here present an interesting fuel type and fire behavior potential with regards to fire management. In the summertime when the grasses dry out they will light readily and spread quickly. As such these fuels tend to burn out quickly on their own and present the greatest hazard when they act as kindling for larger fuels.

This area experiences the highest use by park visitors and as such poses the greatest threat in terms of the risk of ignition. Many visitors smoke in and around the grass areas and a discarded cigarette could easily ignite these grasses once cured. There are no structures at risk in this area and there are few suppression constraints as vehicles can drive into this area and the lake is an excellent water source for suppression.

### **FMZ 7 Fire Behaviour**

This area is classified as the fuel type O1b. These fuels consist of grasses and very little woody debris. Once these grasses dry out and cure in the summer, they act as effective ignition fuels and will readily ignite and spread quickly. However, the grasses will not sustain a fire for very long and will extinguish quickly. The greatest threat is of a fire igniting in these areas and spreading into the adjacent coniferous fuel types. Under 90<sup>th</sup> percentile fire weather conditions, the rate of spread of a wildfire would be about 4.6 meters per minute and the fire intensity would be about 1,380 kW/m. The most hazardous weather conditions in this area would be dry weather with high winds which would fan and quickly spread a fire towards the adjacent forest fuels.

The numerous trails running throughout this area and the stands of young deciduous trees along the edges of this area act as good fire breaks. Additionally the lake and creek are close water sources and form an excellent fire breaks stopping a fire from spreading to the west of this grass area.

### **FMZ 7 Risk of Ignition**

The risk of ignition in this management zone is generally moderate due to the risk from pedestrian traffic along the numerous trails (both authorized and unauthorized). Additionally this area experiences the greatest number of users with many parties picnicking in this grass area.

Once cured, these grasses would ignite easily from sources such as discarded cigarettes and matches.

**FMZ 7 Structures at Risk**

There are no significant structures at risk in this area although there are a number of park benches and information signs that could potentially be damaged.

**FMZ 7 Suppression Constraints**

This area is easily accessible for suppression resources from the parking lot to the north. The maintained trails in this area are wide enough that vehicles could access most areas in this zone. The lake and King creek provide close water sources for suppression if required.

**MZ 7 Primary Concerns**

- There is the highest risk to human lives in this area as it experiences the greatest use
- There is a high risk of ignition in this area as it experiences the greatest use
- These grasses once cured in the summer will readily ignite and support a low intensity ground fire
- A grass fire would spread quickly and act as kindling fuel for a larger fire in the adjacent coniferous fuel types.

**FMZ 7 Actions to reduce wildfire hazard**

- Post fire awareness signage in this area to raise public awareness of the existing hazards
- Continue to allow a strip of deciduous trees to mature between the grass and the adjacent coniferous fuel type
- Authorize strategic trails running through the grass area to act as fire breaks

## Public education

The Parks, Recreation and Culture Department should work with the Surrey Fire Department to promote public education of wildfire awareness in and around Green Timber Urban Forest. This can be done through a number of sources and media types.

### Signage

A number of signs should be placed in and around the park to raise awareness of the risks of wildfire in the Forest. Along 96<sup>th</sup> Ave. and at the entrance to the main parking lot along 100<sup>th</sup> Ave. fire awareness signs should be posted indicating the current MOF level of fire hazard and the number to call once a fire is detected in the forest.

Fire awareness and no-smoking signs should be posted where ignition and fire behavior hazards are highest including FMZ 5 - The Eastern White Pine Stand, FMZ 6 - The Blowdown Area and FMZ 7 – The Grassland Meadow. Details regarding these signs and their recommended locations can be found in the Recreation and Access Management plan.

### Educational brochure

An educational brochure should be prepared and distributed among the local residents that outlines the hazards associated with wildfire, how to reduce the chances of ignition and how to protect their homes. The Ministry of Forests Protection Branch provides excellent reference material that can be used as a guide for the production of an effective educational brochure. Some of the more useful references include:

- An individual home wildfire hazard assessment checklist (<http://www.for.gov.bc.ca/protect/safety/assessment.htm>)
- Home construction and landscaping standards which minimize the risk from wildfire. (<http://www.for.gov.bc.ca/protect/safety/Construction.htm> and <http://www.for.gov.bc.ca/protect/safety/Landscape.htm>)
- Check lists for ensuring that a home is fire safe. (<http://www.for.gov.bc.ca/protect/safety/outside.htm>)

### Fire awareness

When there are large planned vents to take place in the forest such as the annual teddy bear picnic, a representative from the City Parks department and the fire department could be present to hand out educational material and help raise wildfire awareness. A presence at these large events is the most effective means of emphasizing the importance of fire safety in urban interface areas such as Green Timbers Urban Forest.

### Fire Preparedness

The best means of preventing large-scale wildfires in the Forest is through fire preparedness. This includes ensuring all agencies are well organized and fire suppression protocol is clear. Staff should receive regular training and proper equipment should be ready and maintained.

All Parks Operations Staff who work in the park system should receive basic level fire suppression training at least once every two years. This training will ensure that if a city staff member is the first on site, they will have the knowledge and ability to safely extinguish or control the fire until more resources arrive. There are a number of training courses available through the BC Ministry of Forests Protection Branch. The required level of training is the S-100 “Basic Wildland Fire Suppression and Safety.”

The basic hand tools required for fire suppression should be kept on site and in good condition. This should include:

- shovels
- axes
- mattocks
- pulaski tools (combination axe mattocks)
- handtank pump

This equipment should be locked away at a known site within the Forest if possible. This equipment should be inspected and maintained on an annual basis.

## Fire Detection

Prevention of damage from wildfire requires that all fires be detected and reported as quickly as possible and that the response is fast and effective. Detection will most likely fall in the hands of the general public as the city does not have the staffing requirements to monitor the Forest at all times. This Forest is very popular and used frequently by the public. Additionally, there are numerous main roadways running through and adjacent to the Forest. Due to the number of people in and around the Forest, a fire would likely be detected very quickly.

The public should be made aware of what to do if they do find a fire in the Forest. Signage should be posted at the entrance to the main parking area and along 96<sup>th</sup> Ave. indicating the current MOF fire danger rating and the number to call if a fire is detected. Fires should be reported by dialing 911 and reporting to the operator the size and location of the fire. Additionally fire detection should be made a component of the public education campaign and be included in the educational brochure to be distributed to residential housing.

## Evacuation Planning

The primary concern when dealing with a wildfire is always for public safety. After a wildfire is detected within the Forest, the threat that it poses to staff and visitors should be quickly evaluated. The location, direction and rate of spread of the fire will indicate where public safety is at risk. All access trails that lead to areas threatened by the fire should be closed to the public. This can be done by posting signs at the entrances to the trails and if necessary by assigning a staff member to monitor these access points. All of these trails should then be evacuated by an evacuation team where it is safe. Communication between members of the staff and the fire department is critical at all times to ensure the safety of the evacuation team and the public.

In order to be prepared for an evacuation of any size it is critical that the park managers have an idea of the following:

- The number of visitors in the park
- The location of visitors in the park
- The type of visitors in the park, ie. physical conditioning, age, language barriers

Once this has been determined, the issue of locating and notifying these parties must be addressed. This is best done on foot or by riding an all-terrain vehicle. A number of teams should be established to cover the areas at risk in an efficient and thorough manner. An evacuation co-ordinator will oversee the operation and stay in communication with these teams and the municipal fire department at all times.

Parties that are at risk from a fire in the park must be evacuated by the quickest and safest routes possible. Staff should direct visitors away from the fire and preferably into the wind by the quickest and safest route. In order for the evacuation to proceed efficiently, proper communication between staff, the municipal fire department, Forest Protection and visitors is essential. The evacuation teams should be in constant radio communication with each other and the evacuation co-ordinator.

## Suppression

The City's Fire Department will take charge of suppression activities. According to the "Operational Guideline # 2.17.13" for fire suppression in "wildland/urban interface" areas, once a fire exceeds "400 feet from a hard surface" or "cannot be controlled or suppressed within one hour," the Fire Department's Incident Commander will "request immediate assistance from the Ministry of Forests." The guideline further states that for such fires "the Fire Department and the MOF will work within a spirit of Unified Incident Command throughout the duration of the Urban Forest Fire incident."

In the year 2000, all Surrey firefighters received urban forest awareness training. This program instructs structural firefighters how to fight urban/wildland interface fires. The Fire Department also has two service instructors who help provide S-100 training. A number of Surrey firefighters now have S-100 training (MOF standards) and are available as "red carded" Forestry trained firefighters for urban/wildland interface fire incidents.

A fire within Green Timbers Urban Forest would involve the coordinated efforts of local Surrey Firehalls. The first hall to respond would be Hall #6 located at 9049 152<sup>nd</sup> St. Additional resources from other halls would be engaged if the Incident Commander (truck captain) deems it necessary. Those firefighters with the S-100 qualification who have received urban forestry awareness training will be mobilized for the effort. If necessary, additionally air and ground support could be called in from the Ministry of Forests.

Each firehall will have a map of Green Timbers Urban Forest which indicates the fire behavior potential and where the location of trails that will go into the fire truck upon receiving the call. An initial report form and fire-ranking form, with pictures, will also go into the truck. The Fire Department will mount an aggressive manual attack up to 400 feet from the forest's edge.

If the fire continues to grow, the Battalion Chief for the City would take over. If necessary, the Chief would then call for air support and fax a fire report to Victoria. An aerial reconnaissance would be carried out and a subsequent attack strategy decided upon. Sources for helicopter water drops would be from the lake in the Forest.

The MOF Coastal Unit Crew is a contracted forestry firefighting cadre of forestry suppression experts based out of Abotsford. If this unit were busy they would leave a revenue fire (on crown land or land with saleable timber) for a life-threatening or interface fire. Other air support resources could also be called upon, specifically a special operations group, the Emergency Services Detail, dedicated to helicopter response for a 300 mile radius emanating from Langley. This Emergency Services Flight Crew includes both tactical and flight crews and has access to helicopters in Langley; it would coordinate air support with the Rescue Coordination Centre in Victoria and the provincial emergency program. Should the air tankers at Abbotsford Tanker Base be relocated for fires in the interior of the province, a tanker could also be called in from Salmon Arm.

## Ecological Damage from Suppression

Fighting a wildfire can cause an extensive amount of ecological damage by cutting trees, creating fuel breaks using heavy machinery and using foam retardant. Fire suppression should be conducted in a way that will minimize the impact on the Forest's natural and cultural resources without compromising safety or suppression effectiveness. The least impacting techniques should be attempted first. More invasive techniques can be used if they are the only means of stopping the fire and protecting the rest of the Forest and adjacent structures. The use of foams and retardant should be used as little as possible and the construction of fire lines should be minimized. Special care should be taken in and adjacent to the riparian areas of King Creek.

**Post Fire Evaluation**

Once a wildfire or prescribed burn has either been suppressed or has burned out naturally, a post fire ecosystem impact assessment should be completed. Staff should visit the burned area and make observations regarding the impact of the fire on the ecosystem including:

- The estimated area burned
- The percentage of crown burned and distribution of remanent patches
- The species and size of trees which survived the fire
- The distribution and types of vegetation burned and remaining after the fire
- The estimated depth of forest floor burned
- Notes regarding any wildlife using the site

This information will be useful to consult in the following years to determine the long term impacts of the fire. Additionally, a summary of the entire operation should be documented. This should include the management decisions made and actions taken as well as any incidences of concern which occurred. This summary along with the post-fire ecosystem impact assessment should be stored with this management plan for future reference.

**Post Fire Rehabilitation**

Wildfire is a natural disturbance agent in these ecosystems. One of the parks policies is to allow natural ecological processes to proceed whenever possible. Therefore, once all hazards are mitigated, the site should be left to rehabilitate naturally. The only types of damage that should be addressed include those caused by suppression efforts such as the construction of fire breaks and the use of heavy machinery in the forest. This type of damage should be carefully assessed and where possible, work should be done to return these areas to a more natural state. For example, where fire breaks have expose mineral soil, they should be covered over with debris as best as possible.

The fire may create a number of hazard trees that should be assessed. Any hazard trees that pose a danger to adjacent roads and trails should be removed immediately. Staff should pay special attention to any fire damage done in and adjacent to the riparian areas of King Creek. Any erosion concerns that may deposit sediment into the creek should be a priority. These areas should be rehabilitated with native plant species and erosion control matting to minimize the impacts on the creek.

## Bibliography

Agee, J.K. *Fire Ecology of Pacific Northwest Forests*. Washington DC: Island Press, 1993.

B.C. Ministry of Forests, 1997. A Wildfire Threat Rating System for the McGregor Model Forest. Project #: Forest Practices – 3015. Prepared for the McGregor Model Forest Association

B.C. Ministry of Forests, 2000 S-590 Advanced Wildland Fire Behaviour Training Course Manual, CIFFC Environmental Training Center, Hinton Alberta

B.C. Ministry of Forests Protection branch home page. Retrieved 10/01/01.  
URL: [www.for.gov.bc.ca/protect](http://www.for.gov.bc.ca/protect)

BC Ministry of Forests, Protection Branch, Ministry of Municipal Affairs, Office of the Fire Commissioner. *Beware and Prepare Community Planner*, 1994.

BC Ministry of Forests and BC Ministry of Environment. *Forest Practices Code Biodiversity Guidebook*, 1995.

BC Ministry of Forests. *Fire Safe*.

BC Ministry of Forests. *Interface Fire Hazard Form*.

City of Surrey. *Natural Areas Fire Management Strategy*. Surrey: Parks, Recreation and Culture Department, January 2001 (draft).

City of Surrey. *Park Natural Areas Strategic Management Plan*. Surrey: Parks, Recreation and Culture Department, March 2001.

Forestry Canada Fire Danger Group, 1992. Development and Structure of the Canadian Forest Fire Behaviour Prediction System. Information Report ST-X-3, Forestry Canada Science and Sustainable Development Directorate

Hirsch, K.G. 1996. Canadian Forest Fire Behaviour Prediction System: user's guide. Special Report #7 Canadian Forest Service

Justice Institute of BC, Fire and Safety Division. *Wildland Firefighting Basics for the Structural Firefighter*, 1993.

Klinka, K. *Identification of Biogeoclimatic Unit for the Sunnyside Acres Urban Forest Park*. Unpublished manuscript, 2001.

Kozlowski, T.T. and Ahlgren, C.E. *Fire and Ecosystems*. New York: Academic Press, 1974.

Office of the Auditor General of British Columbia. *2001/02 Report 1: Managing Interface Fire Risks*. Victoria: BC, June 2001.

*Regulations—Forest Practices Code of British Columbia Act: Forest Fire Prevention and Suppression Regulation (Schedule 7)*.

Sunnyside Acres Heritage Society. *A Management Plan for Sunnyside Acres*. Unpublished report. October 1989.

Surrey Fire Department. *Operations Guideline 2.17.13: Fire Suppression—Wildland/Urban Interface*. October 12, 1999.

**Appendix A** Surrey Fire Department Operational Guideline # 2.17.13, Fire Suppression - Wildland/Urban Interface.SURREY FIRE DEPARTMENT  
OPERATIONAL GUIDELINE

Fire Suppression Wildland/Urban Interface	O.G. # 2.17.13	Page 1 of 2
	Eff. October 12, 1999	 Init. of FC

- PURPOSE:** To state the response protocol for fires in urban-forested areas.
- SCOPE:** Deputy Chief, Assistant Chiefs, Battalion Chiefs, Fire Suppression Crews, Fire Prevention Inspectors and Communication Personnel.
- POLICY:** To provide a consistent and effective response to all fires in urban forested areas.

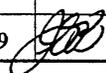
**PROCEDURE:**

1. Upon arrival of Fire Suppression Crews at a fire in an urban-forested area, the IC shall:
  - Conduct a thorough size-up.
  - Determine whether the initial-response suppression crews can control or suppress the fire within one hour.
  - Notify the Battalion Chief, Duty Chief (Assistant Chief), and the M.O.F immediately of the determination.
  
2. If the fire cannot be controlled or suppressed within one hour, or if the fire is more than 400 feet from a hard surface, the IC shall:
  - Request immediate assistance from the Ministry of Forests.
  - Notify the Fire Chief or designate for the purpose of assessing the need to initiate the City's Emergency Plan.

If the fire can be controlled or suppressed within one hour, and is less than 400 feet from a hard surface, but is of significant size, the IC shall:

  - Request assistance from the M.O.F. for a "second opinion".
  - Request assistance from the M.O.F to work in concert with the fire department's investigator for fire cause determination.
  
3. When the IC is reporting a fire and/or requesting assistance the following information (Appendix "C" Ministry of Forest's *Initial Fire Report*) must be provided to the Ministry of Forest's Fire Control Officer in Parksville:
  - Location of fire.
  - Size of fire.
  - Character of fire (open flame at ground or tree tops).
  - Rate of fire spread (slow, moderate, fast).
  - Wind speed/direction (if known).
  - Slope of land (flat, moderate, steep).

SURREY FIRE DEPARTMENT  
OPERATIONAL GUIDELINE

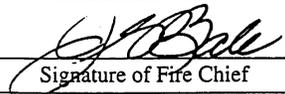
Fire Suppression Wildland/Urban Interface	O.G. # 2.17.13	Page 2 of 2
	Eff. October 12, 1999	 Init. of FC

- What is burning (grass, brush, heavy timber, etc).
  - Water available (hydrants, ponds, etc).
  - Access to the fire.
  - Apparatus, equipment and agencies enroute or on scene.
  - Type of assistance required (Air tanker, ground crew, 2<sup>nd</sup> opinion).
  - Radio frequency and IC.
  - Power lines, gas lines, or other known safety concerns.
  - What is threatened (life, property, environment).
4. The Fire Department and the M.O.F. will work within a spirit of Unified Incident Command throughout the duration of the Urban Forest Fire incident.
  5. The M.O.F. may withdraw its services and return responsibility to the Fire Department when the fire is under control, its services are no longer required, or when its services are required at a higher risk incident.
  6. Once the fire has been suppressed, fire watch is required for a period of two hours, or until the Duty Chief determines that a flare-up is unlikely.
  7. It is the responsibility of the Fire Prevention Division in cooperation with the Ministry of Forests to determine the fire cause and prepare a provincial fire report. It is therefore imperative that all agencies make every effort to preserve and collect evidence.

Reference: Ministry of Forests O.G. #1.06.1 Wildfire Suppression and Local Government

Attachments:

- Appendix A - Map of City of Surrey's major urban forests
- Appendix B - Chart of Response Determination based on flame length. US Forest Service
- Appendix C - Ministry of Forests Initial Fire Report Form

 Signature of Fire Chief	This O.G. Replaces  Issued on:
--	--------------------------------------

**Appendix B** Description of fire behavior characteristics and fire suppression interpretations according to the MOF Forest Protection (BC Ministry of Forests, 2000).

<b>Chart Rank</b>	<b>Frontal fire Intensity (Kw/m)</b>	<b>Description of fire behavior characteristics and fire suppression interpretations</b>
1	<10	Smoldering ground or creeping surface fire. Firebrands and going fires tend to be virtually self-extinguishing unless high Drought Code (DC) and/or Buildup Index (BUI) values prevail, in which case extensive mop-up is generally required.
2	10-500	Low vigor surface fire. Direct manual attack at fire's head or flanks by fire-fighters with hand tools and water possible. Constructed fire guard should hold.
3	500-2000	Moderately vigorous surface fire. Hand-constructed fire guards likely to be challenged. Heavy equipment (bulldozers, pumpers, retardant aircraft, skimmers, helicopter w/bucket) generally successful in controlling fire.
4	2000-4000	Highly vigorous surface fire or passive crown fire (torching). Control efforts at fire's head may fail.
5	4000-8000	Extremely vigorous surface fire or active crown fire. Very difficult to control. Suppression actions must be restricted to fire's flanks. Indirect attack with aerial ignition (ie. helitorch and/or AID dispenser) may be effective.
6	>8000	"Blow-up" or "conflagration" type fire run; violent physical behavior probable. Suppression actions should not be attempted until burning conditions ameliorate.

**Appendix C** Description of the Ministry of Forests Protection Branch fire danger ratings.

Fire danger ratings are calculated for the entire province based on the fire weather indices from a network of automated weather stations ([www.for.gov.bc.ca/protect](http://www.for.gov.bc.ca/protect)). The Danger Ratings are defined as follows:

- |                  |  |
|------------------|--|
| <b>Low:</b>      | Low fire hazard  |
| <b>Moderate:</b> | Carry out any forest activities with caution   |
| <b>High:</b>     | Fire Hazard is serious. Extreme caution must be used in any forest activities. Burning permits and industrial activities may be restricted |
| <b>Extreme:</b>  | Extremely high fire hazard. General forest activities may be restricted, including burning permits, industrial activities and campfires    |