Ministry of Forests, Lands and Natural Resource Operations

Wildfire Management Branch

Discussion Paper

Proactive Wildfire Threat Reduction

Background - Wildfire Threat Reduction Programs

The return on investment of treating high risk stands is conservatively estimated at 3.4/1. This return on investment will increase over time as wildfire threats from mountain pine beetle killed stands and the rapidly increasing effects of climate change result in more wildfire potential over time. Based upon an increase of $4^{0}C$ by 2080, severe future wildfire conditions as a result of climate change are predicted for the southern interior of British Columbia including:

- increased fire size, doubling from an average of 7,961 ha to 19,076 ha;
- increased fire severity by 40% in spring, 95% in summer and 30% in fall;
- increased fire season length and fire frequency by 30%;
- increase in crown fire ignition and severe fire behaviour by 4 to 7%; and,
- a decrease in extent of fire free areas by 39%

Along with increasing wildfire potential, the costs of suppression response and the economic losses will also increase exponentially, including losses to communities, natural resource values and midterm timber supply. The Insurance Bureau of Canada predicts that the incidence of severe wildfires will increase in B.C. by 50% or more over the period to 2050. While the costs of suppression will increase, the effectiveness of response will decrease and the only cost effective way to address the situation is to utilize landscape fire management and wildland urban interface fuel reduction to proactively protect communities and natural resource values.

A comprehensive suite of wildfire threat reduction initiatives requires engagement at all scales including:

- **FireSmart** - individual homeowners must implement "firesmart" activities on private lands;
- **The Strategic Wildfire Threat Initiative** - Local governments need to participate in the Provincial *Strategic Wildfire Threat Initiative* and implement wildland urban interface fuel reduction on municipal lands adjacent to communities; and,
- **Landscape Fire Planning and Management -** Provincial government, industry, local government and First Nations need to participate in landscape level fire planning and management on the provincial landbase.

FireSmart Canada

Firesmart activities at the private landowner scale are guided by the recently initiated FireSmart Canada Program and are implemented voluntarily by landowners or, in association with Municipal programs supported, in part, by the Office of the Fire Commissioner.

The Provincial Strategic Wildfire Threat Initiative
Since 2004, the Strategic Wildfire Prevention Initiative, a collaborative initiative between the Union of BC Municipalities, the First Nations Emergency Services Society, and, the Ministry of Forests, Lands and Natural Resource Operations, have worked cooperatively to reduce wildland urban interface fuels on municipal and first nation lands adjacent to communities. This program has funded 302 Community Wildfire Protection Plans, 412 treatments prescriptions and 234 fuel treatments within 2 km of local government and First Nations communities.

The Provincial Strategic Threat Analysis (PSTA) in 2004 identified potentially 1.73M ha at risk to wildfire, of which 685,000 ha were identified at high risk. An updated PSTA is in-progress in 2012. To date, 43,000 ha have been treated, that also includes adjustments in the Timber Harvest Land Base (THLB). An acceleration of the Fuel Management program, complimented by sustained funding is greatly needed to meet the short and longer term challenges of climate change, forest health issues (mountain pine beetle, spruce budworm, etc), and increasing high risk areas to treat as a result of urban expansion into the wildland urban interface.

The benefit of this initiative was clearly demonstrated in 2009 and 2010 wildfire seasons when 3 communities – West Kelowna, Alexis Creek and Barnhartvale were spared major wildfire damages as a result of successful fuel reduction projects. Direct Fire costs were also significantly reduced and wildfire control crews were able to work safely, quickly, and effectively. It is estimated that the full benefits of wildland urban interface fuel reduction may take up to 25 years to be fully realized, but British Columbia has already realized significant benefits.

Landscape Fire Planning and Management
The impacts of extreme wildfire events and associated losses of communities, critical infrastructure and natural resource values can be further mitigated through landscape fire management. Landscape fuel and fire management extends fire management initiatives from the 2 km area of municipal lands adjacent to communities, to provincial forests to further mitigate impacts to communities, critical infrastructure and natural resource values. The objective of landscape fuel and fire management is to stop the development of extreme “mega” fires by creating landscape level fuel breaks. This can be accomplished by modelling wildfire risk and threat; analysing land management options; and, creating landscape level fuel breaks through targeted harvesting, establishing linear fuel breaks, and, utilizing alternative silviculture practices. Often, even simple management actions such as widening road right of ways or realigning cut block patterns can have significant beneficial effects of mitigating extreme wildfire behaviour. These activities can also support local employment creation, provide harvest opportunities and protect mid-term timber supply as well as support other key programs such as ecological restoration and the emerging biofuel economy in British Columbia.

Funding Requirements

FireSmart Canada

FireSmart Canada has been recently initiated through small funding grants from various provincial fire management agencies. As the program grows, there will be a requirement to support various community planning workshops and associated public information programs. s.13, s.17 In the longer term its hoped that Insurance agencies will start to provide financial incentives for homeowners through reduced premiums where the work is carried out.

Strategic Wildfire Prevention Initiative

The significant impact from wildfires on communities was witnessed in Kelowna in 2003 and the more recent devastation in Slave Lake in 2011. As a result of the 2003 wildfires, and the subsequent 2004 Filmon report, $37M of Provincial and Federal funding was initially allocated to the Strategic Wildfire Prevention Initiative (SWPI). An additional $25M was allocated by the Provincial Government in April 2011 for a combined total of $62M to assist local governments and first nation communities in reducing the risk to wildfires. A maintenance program to ensure previously funded fuel treatments investments are maintained will soon be required. This will require site assessments and remedial treatments (albeit at a much reduced cost than the original investment).

$10M to $12M is allocated annually to local governments and First Nations communities through the SWPI s.13, s.17

s.13, s.17

In addition to the Strategic Wildfire Prevention Initiative, Wildfire Management Branch (WMB) crews are contributing to annual fuel treatments when not on fireline duties. Approximately 1,000 ha per year are being targeted and treated by WMB crews, and there is potential to increase this by extending crews prior to, and after the fire season. The last significant extension of WMB crews was in 2008/2009 when approx $4M was allocated for work in Mountain Pine Beetle (MPB), and non-MPB fuel treatments. In 2011/2012, WMB crews were extended in southern BC with a smaller allocation of <$1M. Much more WMB crew work is possible with annual sustained funding to address the large area requiring treatment s.13, s.17

s.13, s.17

Landscape Fire Planning and Management

The government of British Columbia has recognized the value of proactively reducing wildfire risks and threats and landscape fire planning and management is recognized as key objectives in the *BC Wildland Fire Management Strategy*, *BC Forest Sector Strategy,* and, the *BC Forest Stewardship Action Plan for Climate Change.*

Landscape fire planning and management pilot projects are now beginning in the Cascades, Vanderhoof, and, Sea to Sky resource districts for 2012. Consultation with local communities is beginning and the response to date has been overwhelmingly in favor of this program. While progress is being made, full provincial planning will require program funding commitments.

Landscape fire planning requires Timber Supply Area wildfire risk and threat assessment modelling; evaluation of risks at a district and landscape level; GIS support to build an operational analysis; field work to ground verify potential treatments areas; and, First Nations, stakeholder, industry and local community meetings to identify treatment options and management commitments. s.13, s.17

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Summary

Significant protection to communities, timber resources, and natural resource values will be achieved through proactive fuel treatments in the wildland urban interface and on the landscape level. Direct Fire costs will also be significantly reduced and wildfire control crews will be able to work safely, quickly, and effectively. Although placing a net cost reduction on this work is very difficult all of the current studies or analysis mostly from the USA indicates a conservative 3.4% return on investment. With current climate change predictions going forward this return on investment will only increase.

Estimated funding required for a comprehensive proactive wildfire threat reduction program is summarized as:

Year/Program	12/13	13/14
FireSmart	$25K	$35K
SWPI	*$0	*$8
WMB Crew Extension	$1M	$3M
Landscape	$120K**	$1.53M
Total	$1.145M	$12.535M

s.13, s.17

s.13, s.17

Ministry of Forests, Lands and Natural Resource Operations

Climate Change Adaption Action Plan

for

Wildfire Management

2014 - 2024

April, 2014

INTRODUCTION

Recent wildfire trends in BC and Canada have shown increased costs and damages associated with wildfires. This is an international trend and it is reflected that is affecting all of North America in general. The 2003 wildfire season is estimated to have had an economic cost British Columbia $1.3 billion in direct fire suppression costs and indirect economic losses to affected infrastructure and business.

Even though British Columbia has a world class wildfire response agency, it is not an option to continue to increase fire suppression response resources and associated costs, because even the most aggressive action would neither be safe or effective for the extreme wildfire events. Extreme events, now termed, "mega fires," are predicted to increase as climate change progresses and during these events, suppression response cannot be relied upon to protect communities or natural resource values. Proactive infrastructure, land and resource management is required to meet the challenges of climate change and an ever growing wildfire risk and threat to communities, critical infrastructure and natural values in British Columbia.

The BC Climate Change Adaption Action Plan for Wildfire Management provides a framework for achieving fire resilient landscapes, fire adapted communities and healthy forest and range ecosystems and habitats through a coordinated cross government commitment to fire management planning and action. It also provides a framework for cooperative planning and management with First Nations, Communities, Municipal Governments, the Forest Industry and, private land owners.

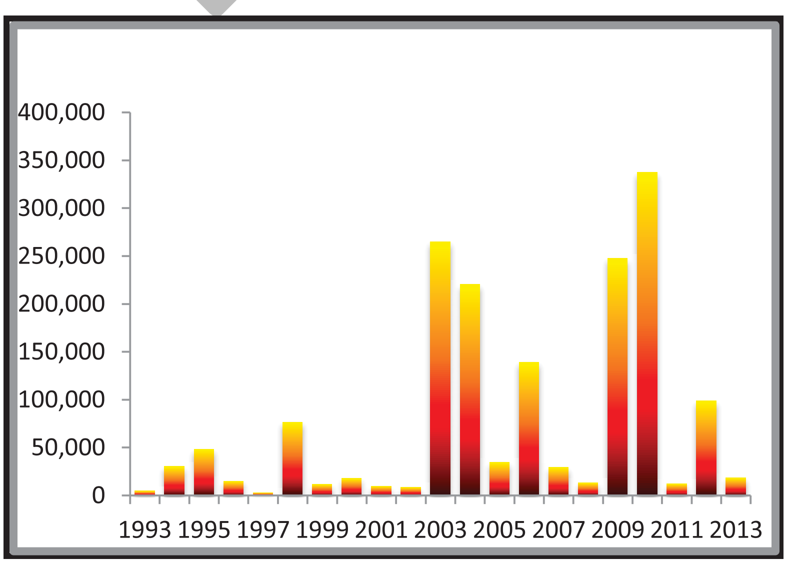
WILDFIRE RESPONSE TO CLIMATE CHANGE

On a yearly basis, weather is quite unpredictable and a specific weather event may not be attributable to climate change. Future climate conditions as a result of climate change, however, can be predicted and while current predictions show little effect on north western British Columbia, significant impacts are predicted for the southern interior including: increased fire size doubling from an average of 7,961 ha to 19,076 ha; increased fire severity by 40% in spring, 95% in summer and 30% in fall; increased fire season length and fire frequency by 30%; increase in crown fire ignition and severe fire behaviour by 4 to 7% and, a decrease in extent of fire free areas by 39%, based upon an increase of 4^{0}C by 2080

(Haughian, S. et al, 2012). Annual area burned is also predicted to increase by 50% to 300% for boreal ecozones in the next 100yrs (Haughian, S. et al, 2012). This estimation is also supported by research done in the US National Research Council that shows an increase in median area burned for a 1^{0}C increase in global average temperature from 241% for northern rocky mountain forest to 428% for cascade mixed forest – both forest types that extend into the southern portion of British Columbia (National Research Council, 2011).

Along with long term changes to the weather, a new fuel type has emerged in British Columbia in the last decade that will also affect wildfire behaviour and impacts. It has been estimated that by 2010 17.5 million hectares of BC had been affected by the Mountain Pine Beetle (MPB) infestation (Westfall and Ebata, 2011) and by 2017, it is estimated that there will be 787.8 million cubic meters of pine that have been killed in the province (Walton, A. 2012). Recent fire behaviour analysis has shown that the observed rate of spread in predominantly MPB affected fuel types is 2.6 times faster than in healthy green stands and can reach rates of 66 meters per minute (Perrakis D., et al 2012). Dead pine stands have created a new fuel type in British Columbia that is estimated to be increasing at a rate of 808,327 ha annually (Hvenegaard, S., 2012) and will be present for decades to come. Changes associated with this fuel type include rapid crown fire initiation, high intensity fires and mass spotting (Perrakis, D., et al, 2012). Since rate of spread can be roughly correlated to fire intensity these fires may be 3 times more intense than what could have been expected for a similar but healthy stands. It can also be expected that wildfires in MPB affected stands will generate extreme wildfire behaviour reducing suppression success and increasing burned area.

Figure 1. Area Burned (ha) in British Columbia 1993 – 2013



MANAGING FIRE

The Beneficial Role of Natural Fire

Under natural conditions, periodic forest and range fires serve to: reduce the build-up of flammable fuels; create a mosaic of young-to-old forest and range conditions and habitats; replace older forest stands susceptible to insects and disease; and limit the occurrence of large fires by creating natural fuel-breaks. When it occurs under appropriate conditions, natural fire can be managed for beneficial ecological effects. Alternatively, controlled fire can be purposefully planned and implemented to meet fuel management, ecosystem restoration, or habitat management objectives through the knowledgeable use of prescribed fire.

The Detrimental Effect of Wildfires

When the natural fire cycle is interrupted, there is a reduction in the health and vigour of the forest and as forests age, forest debris builds up to unnatural levels increasing the risk of catastrophic wildfires that are difficult to control and that may seriously impact communities and resource values. Examples of impacts include: loss of homes, property and critical infrastructure; damage to domestic watersheds; and destruction of commercially valuable timber. Smoke from wildland fires can also interfere with road and air transportation, inhibit tourism, and cause serious public health problems. When a wildfire threatens communities, critical infrastructure and natural resource values, every effort is made to control and extinguish the fire as soon as possible to both reduce costs and damages.

Wildfires, Fire Management and Carbon Emissions

Carbon dioxide balance can be categorized broadly as carbon from biological systems and carbon from fossil fuels. Carbon is both stored and released in biological systems due to biotic functions and natural disturbances – storage includes growth and biomass accumulation; release includes respiration, decomposition, and burning. Biotic carbon storage and release more or less balances out over time and for the most part, it is not realistic to interrupt biotic functions or entirely prevent natural disturbances. Carbon released from the burning of fossil fuels, however, is derived from carbon stored from past millennia, constantly increasing global carbon dioxide amounts. The only realistic way to reduce global carbon dioxide, therefore, is to reduce the use of fossil fuels.

Wildfires also release significant amounts of carbon when an area is burned, with the amount of carbon being released proportional to the size, intensity and duration of the wildfire. The estimated historic area burned in British Columbia is 500,000 ha annually; however, modern wildfire control has reduced this area to an average of 20,000 ha annually, significantly reducing wildfire contribution to carbon release. Burned areas are usually reforested or grow back naturally, and, over time, the carbon that was initially released is slowly reabsorbed in new growth.

Proactive wildfire management can further reduce carbon emissions by reducing the size, intensity and duration of some wildfires. Management activities may result in short term incremental carbon release due to the requirement for harvesting , burning of hazardous forest fuels, or prescribed burning for ecosystem restoration, however, the beneficial result of these activities in reducing catastrophic fires should be realized in the long term management of wildfires. Proactive management, however, can also include other uses of hazardous forest fuels for biofuels or cogeneration and use of these fuels, can in turn, offset the use of fossil fuels, further reducing the use of fossil fuels. Other options include retaining biomass on the landbase in low wildfire risk environments to offset fossil fuel emissions. It will be important to continue research and analyze the benefits of proactive wildfire management to reduce wildfire release of carbon, and, the use of biofuels and biomass accumulation to offset fossil fuel emissions.

SCOPE AND CONTEXT

The requirement for proactive wildfire management to respond to climate change challenges is recognized in the BC Climate Change Action Plan, the BC Forest Stewardship Action Plan for Climate Adaptation, the BC Wildland Fire Management Strategy, and, the Mid Term Timber Supply Action Plan.

This action plan provides a provincial level strategic foundation for achieving fire adapted communities and fire resilient landscapes that are required to address the impacts of climate change from a wildfire management perspective. The actions goals and objectives in this plan encompass all land planning and management activities from those of the private landowner to those of the provincial resource management ministries and agencies. In planning and managing fire, the beneficial role of natural and prescribed fire must be incorporated along with the requirement to suppress undesired wildfires for the province to meet its economic, public health and safety, and, sustainable resource management goals.

VISION

By 2024 British Columbia has wildfire resilient ecosystems and wildfire adapted communities that support healthy and resilient forest and range ecosystems while minimizing the impacts of wildfires on communities, critical infrastructure and natural resource values. This is accomplished by investing in proactive fire planning and management at all scales; considering fire management in all land management decisions; and, recognizing and managing the beneficial effects of fire while maintaining a world-class level of wildfire prevention, response, and suppression.

GOALS AND OBJECTIVES

The vision of wildfire adapted communities and wildfire resilient ecosystems and can be attained by investing in proactive fire planning and management at all scales; considering fire management objectives in all land management decisions; recognizing and managing the beneficial effects of fire; and, maintaining a world-class level of wildfire prevention, response, and suppression.

Goals and associated objectives are summarized as:

Goal # 1: Wildfire Adapted Communities

Objective 1: Fire Planning and Management – The Private Lands Scale

Objective 2: Fire Planning and Management – The Community Scale

Goal #2: Wildfire Resilient Ecosystems

Objective 3: Fire Planning and Management – The Landscape Scale

Objective 4: Fire Management is Incorporated into all Land Management Decisions

Goal #3: World-class Wildfire Prevention, Response, and Suppression.

GOAL ONE: WILDFIRE ADAPTED COMMUNITIES

Objective 1.1: Fire Planning and Management – The Private Landowner Scale

At the private land owner scale, homeowners, landowners, and developers need to embrace FireSmart principles that protect property and private structures from wildfires. This includes consideration of wildfire risks in the physical location, vegetation management and design of new developments along with the use of fire resistant construction material and techniques. Existing developments can also be proactively protected through simple yet effective landscaping and use of wildfire resilient materials. Consideration should also be given by local governments to create bylaws, zoning and development permits that areas that address local wildfire risks. Numerous communities in British Columbia have embraced and implemented both FireSmart principles and/or have implemented bylaws and development permit areas to reduce wildfire threats at the private lands scale. FireSmart Canada provides detailed information for homeowners and communities to address wildfire risks at the private land owner scale. More information is available at: https://www.firesmartcanada.ca/

Logan Lake is recognized by FireSmart Canada as the first FireSmart community in Canada in 2013

Actions

1 - 3 years

1. Settled areas are mapped and assessed for wildfire risk based upon structure density and predicted wildfire threat and communities are informed of their relative wildfire risk;
2. FireSmart Canada is recognized by communities as the national agency to promote firesmart activities with landowners and communities;
3. FireSmart information and training is delivered to communities
4. Settled areas and communities pursue national FireSmart certification;

3 – 10 years

1. All local governments develop and enact bylaws, zoning and development permits for high wildfire risk areas that mitigate address wildfire risks;
2. 10% of all high risk interace areas develop firesmart implementation plans per year with all areas having plans by 2024.

Objective 1.2: Fire Planning and Management – The Community Scale

Local governments and communities must make a commitment to careful planning and fuel management in interface areas. The development of Community Wildfire Protection Plans is essential to guide the inclusion of wildfire risk considerations into the planning and management of wildland urbane interface risks. Proactive fuel reduction in interface areas is key to reducing wildfire threats to communities and critical infrastructure. Other measures such as carefully planning evacuation routes and the deployment of local fire response resources and structure protection units will significantly reduce losses in major wildfire events.

The Strategic Wildfire Prevention Initiative, administered by the Union of BC Municipalities, provides grants to local governments to implement proactive wildfire risk reduction on behalf of the Province. The Provincial Fuels Management Working Group (PFMWG) – comprised of the UBCM, the Ministry's Wildfire Management Branch and the First Nations Emergency Services Society, cooperatively provide guidance to the program. Since 2004, the provincial and federal governments have allocated $62 Million to this initiative and 312 Community Wildfire Protection Plans have been completed or are underway, 443 prescriptions have been completed or are in-progress and 328 Operational Projects have been completed or in-progress (including pilot and demonstration projects). More information on this initiative can be found at: http://www.ubcm.ca/EN/main/funding/lgps/current-lgps-programs/strategic-wildfire-prevention.html

Actions

1 - 3 Years

1. The province continues to support the Strategic Wildfire Prevention Initiative as administered by UBCM and the cooperatively guided by the Ministry's Wildfire Management Branch and the First Nations Emergency Services Society;
2. The Strategic Wildfire Prevention Initiative updates the Provincial Strategic Threat Assessment of community wildfire risk mapping to identify those communities at high wildfire risk;
3. All high risk communities develop a community wildfire protection plans within the next 3 years.

3 – 10 years

s.13

2. All wildland urban interface risks and threats to communities are addressed to through fuel management projects by 2024.

GOAL NUMBER 2: WILDFIRE RESILIENT ECOSYSTEMS

Objective 2.1: Fire Planning and Management – The Landscape Scale

Natural resource management agencies, the forest industry, First Nations, Local Governments and stakeholders, can further mitigate impacts of extreme wildfire events and associated losses of communities, critical infrastructure and natural resource values through landscape fire management planning (LFMP). LFMP extends fire planning and management beyond the urban interface adjacent to communities to the crown land base forests and grasslands.

The objective of LFMP is to stop the development of extreme "mega" fires by creating landscape level fuel breaks. This can be accomplished by modelling wildfire risk and threat; analysing land management options; and, strategically creating landscape level fuel breaks through use of natural features, targeted harvesting, establishment of linear fuel breaks, prescribed burning, and, utilizing alternative silviculture practices. Often, even simple management actions such as widening a road right of way or realigning a harvest pattern can have significant beneficial effects of mitigating extreme wildfire behaviour. These activities can also support local employment creation, protect mid-term timber supply and protect a variety of natural resource values. Landscape fire management can also be supported by other key Ministry programs and initiatives such as the Ecological Restoration program and the emerging biofuel economy in British Columbia.

LFMP has now been completed for 3 resource districts - the *Cascades Resource District - Merritt TSA, Vanderhoof / Fort St. James and Sea to Sky / Chilliwack Resource Districts* and a provincial performance measure has been established for the initiation of 3 plans annually to address resource districts at high risk. Relative risk for resource districts is identified in figure 2, page 11. Resource districts can initiate landscape fire management planning for their districts by working with their local Fire Centre to assess wildfire risks and threats and utilize provincial standards for landscape fire management plans.

Actions

1 - 4 Years

1. Confirm a provincial performance measure of starting 3 new landscape fire management plans annually with a priority for high and very high threat and value at risk districts
2. Downscale predicted climate change envelopes to assess future wildfire risks to communities, critical infrastructure and natural resource values.
3. Form LFMP Steering committees of all land management agencies, First Nations, Local Governments and stakeholders to develop LFMP for all high and very high threat and value at risk districts in the next 4 years.
4. MFLNRO to support integration of LFMP into regional operations by integrating Ministry expertise and resources from all Ministry programs, including: BC Timber Sales, forest industry harvest operations, Forests for Tomorrow, Forest Carbon Partnership Program, the Land Based Investment Strategy, Ecological Restoration Program, habitat management treatments,

prescribed burns and Wildfire Management Branch fire suppression crew projects to implement LFMP treatment objectives.

4 – 10 Years

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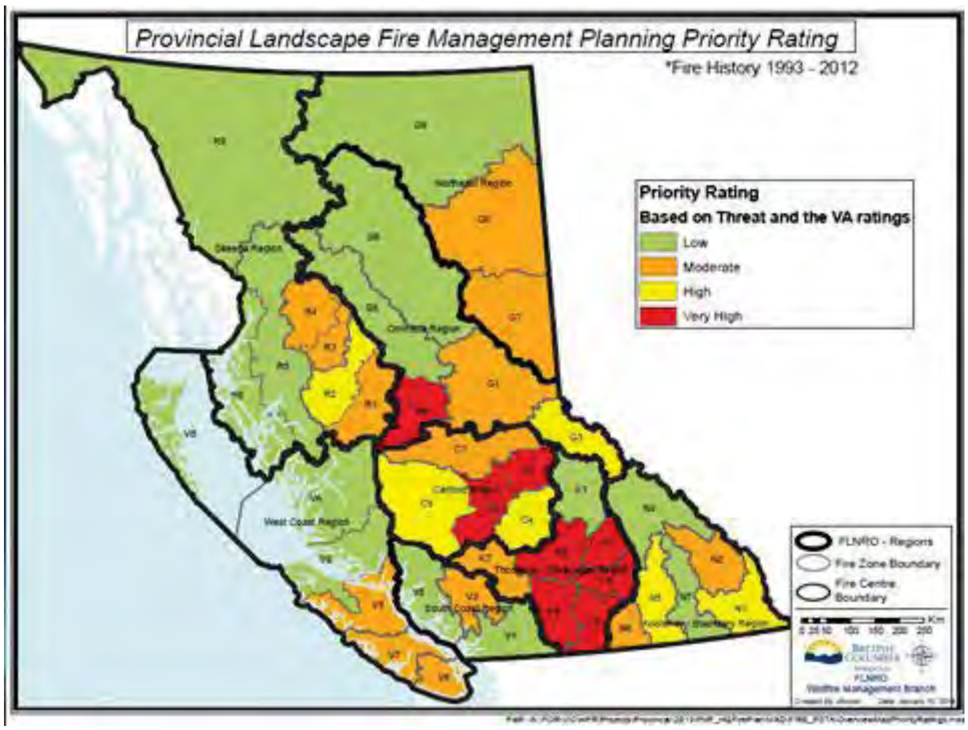
6. Support new uses for hazardous fuels such as biofuels
7. Completed all management activities for high and extreme risk districts by 2024.

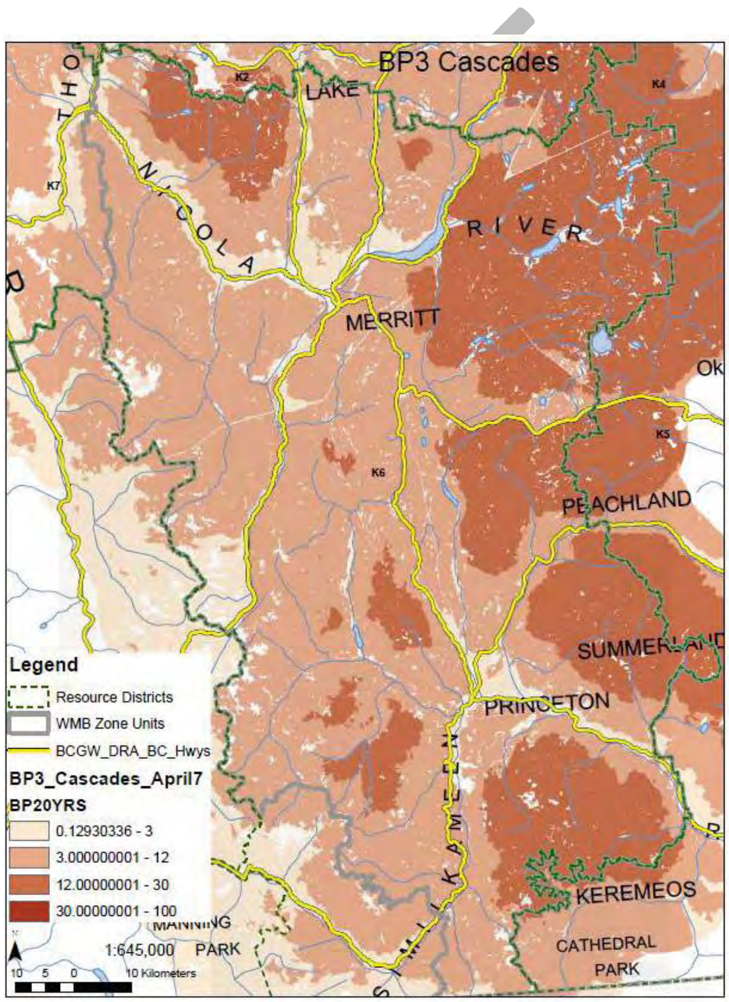
Figure 2: LFMP Planning Priority based on Threat and Values at Risk Ratings



Objective 2.2: Fire Management is Incorporated into all Land Management Decisions

Proactive wildfire threat reduction goes beyond mitigation of current wildfire threats. Planning for any land management activity needs to consider that wildfire threats as a result of climate change are predicted to increase in the coming decades. This may alter ecosystems services and significantly affect natural resource values. For example, critical watersheds can be severely damaged by high intensity wildfires so fire prevention and wildfire threat mitigation needs to be incorporated into the management of these areas. Similarly, long term investments in reforestation and timber supply, or delineation of land reserves for habitat purposes must consider the relative long term probability that these areas may be affected by more frequent and, potentially severe fire, over larger areas. Predictive wildfire threat modelling can be used to identify areas of high probability of wildfire as climate change progresses and proactive planning management can be used to manage risks. Examples of proactive management would include incorporation of fire management objectives into critical watershed management as has recently been done for Capital Regional District Watershed, or incorporation of fire management planning into Type 4 silviculture strategies. A key tool in assessing wildfire risk is Burn Probability Modelling as noted in figure 3.

Figure 3 – 20 year Burn Probability Modelling for the Cascades Resource District.



Actions

1 - 3 Years

1. Downscale predicted climate change envelopes into burn probability models to predict wildfire risks and threats 6 decades into the future.
2. Incorporate future wildfire risk and threat probabilities into all land management planning processes.
3. Set clear long-term management objectives to maintain identified natural resource values and investments through proactive fire planning and management.

4 – 10 Years

1. Completed all management activities for natural resource values and investments predicted risk districts by 2024.

Goal Number 3: World-class Wildfire Prevention, Response, and Suppression.

The B.C. Wildfire Management Branch is the single wildfire agency for the province of British Columbia and has managed wildfires since 1912. Every year, wildfire operations responds to over 2,000 wildfires on over 95,000,000 hectares of the most difficult and challenging terrain in North America. 92% of all fires are contained at 4 hectares or less. The projected impacts of climate change on the wildfire environment, however, include: longer fire seasons, more extreme fire behaviour, and more area burning. Even with proactive wildfire risk reduction through community wildfire protection planning, fuel management and landscape fire management planning, wildfire prevention will be critical to reduce human caused fires, and fast and effective wildfire response and suppression will be critical to protect communities, critical infrastructure and natural resource values when wildfires do occur. To keep pace with the predicted climate change effects and to ensure wildfires are prevented and effectively suppressed, an ongoing investment into prevention programs and response resources is required.

Actions

1 - 10 Years

Wildfire Prevention

1. Prepare communication strategies that include extensive use of social media to inform the public of seasonal wildfire risks and associated burning bans and build awareness of the predicted long-term climate change wildfire risks.
2. Post Strategic Wildfire Threat Analysis and Burn Probability Modelling on public websites to inform public of the relative wildfire risk to their private structures and communities.

Wildfire Response and Suppression

1. Utilize national resource demand models to assess current wildfire risk and downscale climate change predictions into models to predict potential response demands up to 6 decades into the future.
2. Utilize latest wildfire detection and mapping technologies and weather prediction systems to support rapid response.
3. Refine and utilize wildfire response resource allocation protocols with updated values at risk mapping for priority response assignment.
4. Review annual response resource capabilities and invest in upgraded capabilities, training and resources as wildfire threat increases.
5. Develop national and international resource sharing protocols to support fast and efficient resource sharing to respond to extreme wildfire events across North America and around the world.
6. Support innovative research to predict wildfire behaviour in mountain pine beetle killed forests and invest in advanced fire behaviour modelling and training to support the

controlled application of fire as a suppression option.

Wildfire Management Branch

Business Case

Investment in Landscape Fire Management and Wildland Urban Interface Fuel Reduction

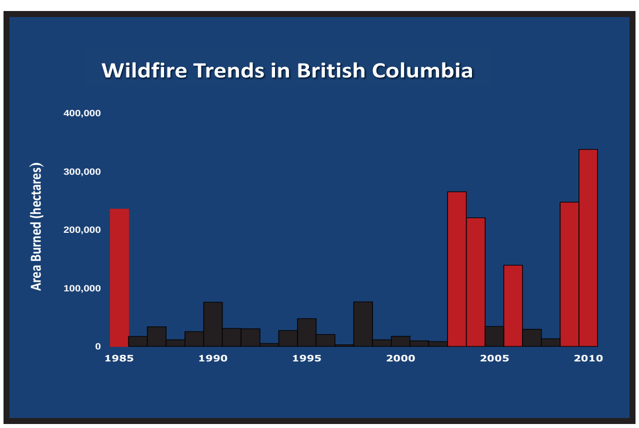
Wildfire Suppression Costs

As a result of climate change; new fuel types created by the mountain pine beetle infestation; and, increasing urban development, it is expected that wildfire threats to communities and natural resource values will increase significantly. The cost of wildfire suppression is also rapidly increasing and resources available to respond are consistently being challenged. Suppression costs were approximately $500 million in 2003, $400 million in 2009 and over $200 million in 2010. 2009 set a record for the most wildland urban interface fires (213) and 2010 set a record for the most area burned in one fire season (330,000 ha).

Wildfire Economic Costs

Along with the suppression costs noted above, the 2003 wildfire season was assessed as costing $400 million in indirect costs, $126.9 million in private losses and the province is still responding to legal challenges seeking over $100 million in damages. The more recent Slave Lake Fire in Northern Alberta has been estimated to be the second largest insurance cost in the history of Canada. Along with these costs, communities faced public health threats, loss of tourism revenues and severe social disruption.

The impact on resource values, particularly, timber supply has also been significant, and 340,000 ha of the timber harvesting landbase were affected by wildfires from 2003 to 2010 alone. These fires resulted in estimated volume impacts of 51,000,000 m3 and reforestation costs of up to $133 million[1].



[1] A complete analysis on the potential impacts of wildfire on midterm timber supply has been submitted to the midterm timber supply review panel at: http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/mid-term-timber-supply-project/Potential_Wildfire_Impacts.pdf

Wildfire Suppression Response

It is not an option to continue to increase fire suppression response and associated costs, because even the most aggressive action would neither be safe or effective for the extreme wildfire events such as those seen in Kelowna in 2003 and Slave Lake in 2010. Extreme events now termed, "mega fires," are predicted to increase as climate change progresses and during these events, suppression response cannot be relied upon to protect communities or natural resource values. The only protection provided will be the protection established prior to the fire provided through wildland urban interface fuel reduction and landscape fire management.

Wildland Urban Interface Fuel Reduction

Since 2004, the Strategic Wildfire Prevention Initiative, a collaborative initiative between the Union of BC Municipalities, the First Nations Emergency Services Society, and, the Ministry of Forests, Lands and Natural Resource Operations, has reduced wildland urban interface fuels on 43,000 ha of municipal lands adjacent to communities. This work is done in an area 2 km or less surrounding communities. The benefit of this initiative was clearly demonstrated in 2009 and 2010 wildfire seasons when 3 communities – West Kelowna, Alexis Creek and Barnhartvale were spared major wildfire damages as a result of successful fuel reduction projects. Direct Fire costs were also significantly reduced and wildfire control crews were able to work safely, quickly, and effectively. It is estimated that the full benefits of wildland urban interface fuel reduction may take up to 25 years to be realized, but British Columbia has already realized significant benefits.

Landscape Fire Management

The impacts of extreme wildfire events and associated losses of communities, critical infrastructure and natural resource values can be further mitigated through landscape fire management. Landscape fire management extends fire management initiatives from the 2 km area of municipal lands adjacent to communities, to provincial forests to further mitigate impacts to communities, critical infrastructure and natural resource values. The objective of landscape fire management is to stop the development of extreme "mega" fires by creating landscape level fuel breaks. This can be accomplished by modelling wildfire risk and threat; analysing land management options; and, creating landscape level fuel breaks through targeted harvesting, establishing linear fuel breaks, and, utilizing alternative silviculture practices. Often, even simple management actions such as widening road right of ways or realigning cut block patterns can have significant beneficial effects of mitigating extreme wildfire behaviour. These activities can also support local employment creation, provide harvest opportunities and protect mid-term timber supply. Landscape fire management can support other key programs such as ecological restoration and the emerging biofuel economy in British Columbia.

Investment in Landscape Fire Management & Wildland Urban Interface Fuel Reduction

On the basis of a 2003 study of dry forests in Washington and Oregon, several papers were published (Mason, L. et al. 2003, 2004, 2006; Lippke et al. 2007) on investment in fuel reduction and the benefits of avoiding forest fires. These publications are based on an assessment of fire-risk and fuel management on the Okanogan National Forest (ONF) in north-central Washington and the Fremont National Forest (FNF) in south-central Oregon - areas climatically and topographically similar to many areas in southern British Columbia.

The results of their work were summarized and analyzed for British Columbia by converting imperial units and US dollars to metric units and Canadian dollars. Present Values of costs and benefits are updated to January 1, 2010, using the discount rate that Mason et al. used in their study (5%). The full summary is included as *Attachment A* pages 5-10 below, but the main table of results is presented for review. Based upon Table 1 below, the ratio of return on investment for treatment benefits for high risk stands compared to treatment costs can be calculated as: $10,767/$3,151 or 3.4/1. In realty, this ratio, however, is no doubt significantly higher because numerous other benefits such as water quality impacts are not quantified in the analysis.

TABLE 1. Present Value costs and benefits associated with investments in fuel removals for fire-risk reduction are expressed in Canadian dollars.

TREATMENT BENEFITS	**Canadian dollar Present Value per hectare**	
	High risk	**Moderate risk**
Firefighting costs avoided	$ 2,613	$ 1,255
Fatalities avoided	54	27
Facility losses avoided	815	391
Timber losses avoided	4,194	2,016
Regeneration and rehabilitation costs avoided	652	315
Community value of fire risk reduction	342	342
Regional economic benefits	2,097	2,097
Habitat	?	?
Smoke and forest and atmospheric carbon	?	?
Energy (e.g., heat, electricity, or co-generation)	?	?
Water quality and quantity	?	?
Erosion	?	?
Other values	?	?
TOTAL BENEFITS	$ 10,767+	$ 6,443+
TREATMENT COSTS		
Operational costs	(2,032)	(2,032)
Forest Service contract preparation costs	(1,119)	(1,119)
Environmental impacts of fuels removals	(?)	(?)
TOTAL COSTS	($ 3,151)	($ 3,151)
POSITIVE NET BENEFITS FROM FUEL REMOVALS	**$ 7,616**	**$ 3,292**

Conclusion

As noted above, the current return on investment of treating high risk stands is conservatively estimated at 3.4/1. This analysis, however, does not include an assessment of increasing wildfire threats from mountain pine beetle killed stands or the rapidly increasing effects of climate change on wildfire potential over time. Based upon an increase of 4^0C by 2080, severe future wildfire conditions as a result of climate change are predicted for the southern interior of British Columbia including:

- increased fire size, doubling from an average of 7,961 ha to 19,076 ha;
- increased fire severity by 40% in spring, 95% in summer and 30% in fall;
- increased fire season length and fire frequency by 30%;
- increase in crown fire ignition and severe fire behaviour by 4 to 7%; and,
- a decrease in extent of fire free areas by 39%

Along with increasing wildfire potential, the costs of suppression response and the economic losses will also increase exponentially, including losses to communities, natural resource values and midterm timber supply. The Insurance Bureau of Canada predicts that the incidence of severe wildfires will increase in B.C. by 50% or more over the period to 2050. While the costs of suppression will increase, the effectiveness of response will decrease and the only cost effective way to address the situation is to utilize landscape fire management and wildland urban interface fuel reduction to proactively protect communities and natural resource values before wildfires occur. It will be essential to utilize both of these tools in combination with "FireSmart[2]" actions completed at the homeowner level to have a complete suite of protection.

The government of British Columbia has recognized the value of proactively reducing wildfire risks and threats and wildland urban interface fuel reduction and landscape fire management are recognized as key objectives in both the *BC Forest Sector Strategy*[3], and, the *BC Forest Stewardship Action Plan for Climate Change*[4]. "FireSmart" is also recognized nationally.

While the Strategic Wildfire Prevention Initiative (wildland urban interface fuel reduction) is a well established program that has been in place in British Columbia since 2004, landscape fire management is just beginning and pilot projects are proposed in the Merritt, Vanderhoof and Squamish Districts for 2012. Program implementation will require a commitment from all land managers, local communities, First Nations and government to participate in a focussed planning and management program to reduce wildfire threats proactively. Legislation, regulation and policy development will also be required to ensure program success.

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[2] https://www.firesmartcanada.ca/
[3] http://www.for.gov.bc.ca/mof/forestsectorstrategy/Forest_Strategy_WEB.PDF
[4] http://www.for.gov.bc.ca/ftp/HFP/external/!publish/ClimateChange/Adaptation/Action_Plan_two-page_summary_Feb_27_final.pdf

APPENDIX A

Investments in fuel reductions and benefits of avoiding forest fires

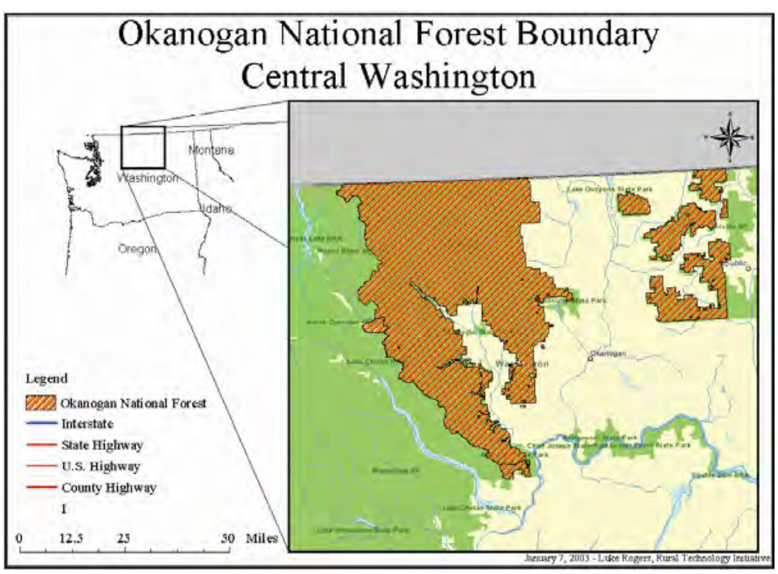
Summary by Patrick Daigle, RPF   March 18, 2010

INTRODUCTION
In BC and elsewhere in western North America, there are concerns about the rising costs of fire suppression; similarly, there are apprehensions about investing in fuel reductions. This brief summarizes the results of a US study demonstrating how investments in fuel reductions can provide numerous benefits while reducing future fire-fighting costs.

AVAILABLE SCIENCE-BASED INFORMATION
On the basis of a 2003 study of dry forests in Washington and Oregon, several papers were published (Mason, L. et al. 2003, 2004, 2006; Lippke et al. 2007). These publications are based on an assessment of fire-risk and fuel management on the Okanogan National Forest (ONF) in north-central Washington and the Fremont National Forest (FNF) in south-central Oregon.

This short summary deals mainly with the data and assessment results from the ONF, providing some information about stand characteristics, alternatives assessed, costs of logging and fire suppression, valuation of the market and non-market benefits of fuel reduction, assessment approach and results (e.g., changed fire risk, avoided costs, other benefits), and concludes with a little bit about the analysis process.

Information contained in the original reports is in Imperial units and US dollars; for this summary, figures have been converted to metric units and Canadian dollars. Present Values of costs and benefits are updated to January 1, 2010, using the discount rate that Mason et al. used in their study (5%).



Study findings were published in the Journal of Forestry in 2006. Here's the authors' abstract:

> *"Forest fuel reduction treatments are needed, as shown by the increased number and cost of devastating crown fires in overly dense forests. Although large trees can be removed for valuable products, the market value for the smaller logs may be less than the harvest and hauling charges, resulting in a net cost for thinning operations. However, failure to remove these small logs results in the retention of ladder fuels that support crown fires with destructive impacts to the forest landscape. A cost/benefit analysis broadened to include market and nonmarket considerations indicates that the negative impacts of crown fires are underestimated and that the benefits of government investments in fuel reductions are substantial."* Abstract from Mason et al. 2006. Investments in fuel removals to avoid forest fires result in substantial benefits. Journal of Forestry 104(1): 27-31.

Information about the Okanogan National Forest.

Stand conditions are similar to those found in south-central interior BC (Okanagan valley).

- Multi-storied stands of interior Douglas-fir (Fdi), lodgepole pine (Pl), ponderosa pine (Py), and some western larch (Lw)
- Basal Area/ha ranges between 6 and 46 m2/ha
- Tree densities range between 615 and 9900 trees/ha (mostly 250-3700 trees/ha)
- These are fire-prone forests; fire exclusion has resulted in extensive fuel build-ups.
- High fire-risk areas have multi-storied canopy and late seral dominant species (Fdi) dominating the understory
- Low fire-risk areas are also dominated by Fdi but contain more Py and Lw and are sometimes contained scattered trees (not so many dense thickets)
- Forest types on the Okanagan NF:
  - Cold dry: mixed-mortality fires; 180 to 2200 m elevation
  - Dry: 7.5 to 50-year fire return intervals; 365 to 1525 m elevation
  - Mesic: weather-driven catastrophic fire every 100 or more years; 550 to 2200 m elevation
  - Moist: 100 to 300 year fire interval; 915 to 1370 m elevation

Management alternative analyzed

During the analysis, six alternatives were examined; four of those were fuel-reduction treatments.

1. **23 cm and under:** harvest all trees under 23 cm dbh (sub-merchantable sizes)
2. **Half Basal Area[5] (BA):** harvest half of total BA per ha (thinning from below)
3. **10.3 BA:** leave a BA of 10.3 m2/ha to simulate restoration of pre-settlement open-stand conditions; favouring retention of ponderosa pine (Py) and western larch (Lw)
4. **30 cm and over:** harvest for maximum economic return by taking largest, most valuable trees (high-grading trees over 30 cm dbh, i.e., thinning from above)
5. **No action:** no harvest and no wildfire for the duration of the simulation period (30 years for high-risk areas, 60 years for moderate-risk areas)
6. **Wildfire:** simulation demonstrates the levels of stand mortality when burn conditions are 20 degrees C, with a 33 km/hr wind, and when nominal moisture levels are "very dry", resulting in a crown fire representative of the forest.

[5] Basal Area: Cross-sectional area of the tree stems (measured at breast height) in a stand, generally expressed as m^2/ha.

RESULTS OF THE ANALYSIS

Results: Change in fire-risk status

High- and moderate-risk classes responded to simulated treatments in the following ways:

1. **23 cm and under** → 35% of high- and moderate-risk stands transitioned to low-risk status.
2. **Half BA**→ 56.2% transitioned to low-risk.
3. **10.3 BA** → 72.5% transitioned to low-risk. (most effective in hazard reduction and left the most fire resistant Py and Lw on site)
4. **30 cm and over** → 17.4% transitioned to low-risk (however, most stands rapidly return to high-risk).
5. **No action** → over time, there'll be an increased number of stands with high-risk status.
6. **Wildfire** → left some surviving trees on the ONF

- High-fire risk stands represent the best opportunities for reducing fuel hazards.
- After initial fuel reductions, future fuel removals will be needed because, as forests continue to grow over time, fuel hazard and fire risk levels will increase.

Results: Economics

The analysis uses 2002 log markets. Costs for logging, pre-commercial thinning (a surrogate for removing small trees in the thin-from-below alternatives), regeneration, and post-fire rehabilitation were gathered through interviews with private contractors and agency staff, as well as from reports and scientific literature.

- Only high-grade logging (the '30 cm and over' treatment) produces positive net revenue in either the low- or high-cost logging/hauling situation.
- The 'Half BA' and '10.3 BA' fuel reductions may be conducted with little or no cost; some stands will result in a positive return, particularly if they are relatively low-cost areas to log (e.g., ground harvest, shorter hauls). Note: the analysis was conducted using 2002 log market values.
- Potential for on-going local employment for forest thinning crews
- Potential for thinned biomass to be used for bio-energy production (e.g., fuels for local schools and public buildings, or co-generation of heat and electricity)
- It's possible to use positive-revenue sites to offset revenue-negative stand treatments.
- Evolving technologies and administrative improvements can help agencies lower operational costs.

SUMMARY OF BENEFITS AND COSTS OF FUEL REMOVALS

Table 1 below "shows present value approximations of some of the anticipated future losses and forgone benefits associated with failure to reduce hazardous fuel loads in at-risk forests. Habitat protection, air and water quality protection, carbon credits, and others, have been listed as credible additional public benefits from fuel reduction investments". (Mason et al. 2006).

The research of Mason et al. used 2003 US dollars (on January 1 2003, the Canadian dollar was worth US$0.64). Dollar figures in this table have been updated using a 5% discount rate between Jan 1, 2003 and Jan 1, 2010.

US$ cost/acre → US$ cost/hectare → Cdn$ cost/hectare → Cdn$ at Jan 1, 1010
US$481/ac (divide by .4047) → US$1188/ha (divide by .64) → Cdn$1857/ha (times 1.4071) → Cdn$2613/ha

TABLE 1. Present Value costs and benefits associated with investments in fuel removals for fire-risk reduction are expressed in Canadian dollars.

TREATMENT BENEFITS[6]	Canadian dollar Present Value per hectare	
	High risk	**Moderate risk**
Firefighting costs avoided[7]	$ 2,613	$ 1,255
Fatalities avoided[8]	54	27
Facility losses avoided[9]	815	391
Timber losses avoided[10]	4,194	2,016
Regeneration and rehabilitation costs avoided[11]	652	315
Community value of fire risk reduction[12]	342	342
Regional economic benefits[13]	2,097	2,097
Habitat[14]	?	?
Smoke and forest and atmospheric carbon	?	?
Energy[15] (e.g., heat, electricity, or co-generation)	?	?
Water quality and quantity	?	?
Erosion	?	?
Other values[16]	?	?
TOTAL BENEFITS	$ 10,767+	$ 6,443+
TREATMENT COSTS		
Operational costs	(2,032)	(2,032)
Forest Service contract preparation costs	(1,119)	(1,119)
Environmental impacts of fuels removals[17]	(?)	(?)
TOTAL COSTS	($ 3,151)	($ 3,151)
POSITIVE NET BENEFITS FROM FUEL REMOVALS	**$ 7,616**	**$ 3,292**

[6] Details about how the dollar estimates are calculated are contained in Mason et al. 2003 - deemed “coarse estimates” by authors.
[7] Estimated future firefighting costs with 5% interest rate during the risk interval mid-point of 15 years (for high risk) and 30 years (for moderate risk). Firefighting occurred in a range of stand conditions and settings (e.g., adjacent to and within the WUI and in more remote locations).
[8] Granted: it’s difficult to put a dollar figure on a fatality. Fatalities from US forest fires between 1990 and 1998 were 11.1 persons per million hectares. In 1999, US EPA assigned a value of Cdn$ 7.5 million per person who died. Using these figures, Present Value of avoided fatalities would be Cdn$ 54/ha for high-risk areas and Cdn$ 27/ha for moderate-risk areas.
[9] Calculated using Insurance Information Association estimates.
[10] Calculation based on average stumpage value of merchantable timber on Okanogan and Fremont national forests.
[11] Average regeneration and post-fire rehabilitation costs for the two national forests.
[12] Public Willingness to Pay to assure reduced fire risk, based on studies of contingent valuation analysis in Michigan and Washington states.
[13] Fire risk-reduction treatments create local employment when scheduled over time. Wildfires also stir economic activity, but much of that goes to imported labour.
[14] Habitat quality will increase for some species and decrease for others.
[15] Removed fuels may be used for heat and/or electricity, and perhaps displace fossil fuel use in local communities and thereby reduce net CO_2 emissions.
[16] For example, degraded visual aesthetics and reduced tourism revenues and real estate values.
[17] For example, soil compaction and sedimentation, damage to leave trees

OTHER INFORMATION ABOUT THE STUDY

Data: Forest data from the Continuous Vegetation Survey on the:

- Okanogan National Forest in north-central Washington: 413 plots
- Fremont National Forest in south-central Oregon: 502 plots.
- This summary focuses on the information gained from the Okanogan National Forest

Costs:

- Logging and hauling costs on ONF: high degree variability because of site conditions, equipment used, etc. Costs are expressed as Present Value as of Jan 1, 2010.
  - Cable harvesting: Cdn$ 1143/ha (low costs) and Cdn$ 1606/ha (high costs)
  - Ground harvesting: Cdn$ 989/ha (low costs) and Cdn$ 1451/ha (high costs)
  - Pre-commercial thinning of sub-merchantable stems: Cdn$ 1627/ha (low costs); Cdn$ 2716/ha (high costs)
- Fire-fighting costs on ONF: high degree of variability. Costs are expressed as Present Value as of Jan 1, 2010.
  - Suppression costs range from Cdn$ 1,282 to Cdn$ ~60,000/ha and include initial attack resources, fire management, heat, light, administrative costs, etc. These do not include state, county and private fire suppressions costs or loss of valuable resources.
  - Usually smaller fires (which are often in the Wildland-Urban Interface (WUI) result in higher costs/ha. However, there are increasing numbers of large fires that incur high overall suppression costs, though per hectare costs are lower than small fires. Fire size and suppression costs on ONF:
    - <2.5 ha → ~Cdn$ 31,000/ha
    - 2.5 - <40 ha → ~Cdn$ 17,000/ha
    - 40 ha → ~Cdn$ 2,700/ha

Analysis:

- To keep it simple, analysts made some basic assumptions -- all high-risk untreated forests will burn within the next 30 years and all moderate-risk forests will burn sometime during the next 60 years (equal probability of all hectares burning in any year within the 30- or 60-year interval). Thus the average time for all hectares to burn is 15 and 30 years respectively.
- 5% discount rate

Simulation and modelling software

- Land Management System (LMS, Courtmanche 2002); Forest Vegetation Simulator (FVS, Wykoff et al. 1982); the Fire and Fuels Extension (FFE, Beukema et al. 1997, 2002; Crookston et al. 2002); and Habitat Suitability Index (US Fish and Wildlife 2001) and others.

MARCH 2010 UPDATE

In a March 2010 phone conversation, co-author Larry Mason pointed out that the analysis methodology is the take-home message. The study provides a credible analysis framework and figures that are reasonable low-bound estimates (e.g., logging or regeneration costs and time until fire consumes a high-risk stand). Mason notes that for some non-market benefits, it's difficult to ascribe a dollar value. Take habitat for example: in Washington habitat reserves have been set aside for Spotted owl. To establish a dollar value for the reserved habitat, the market value of the timber can be used as a surrogate; this is because policy-makers deemed the reserved habitat to be of higher value than the net timber revenues and employment created.

References

Lippke et al. 2007. Applied science and technology transfer for avoided cost and protected forest values. USDA Forest Service, PNW Research Station General Technical Report PNW-GTR-726:15-23

Mason, L. et al. 2003. Investigation of alternative strategies for design, layout and administration of fuel removal projects. University of Washington, College of Forest Resources, Rural Technology Initiative. 78 pages plus 115 pages of appendices.

Mason et al. 2004. Investments in fuel removals avoid future public costs. University of Washington, College of Forest Resources, Rural Technology Initiative, Fact Sheet #28. 4 pages.

Mason et al. 2006. Investments in fuel removals to avoid forest fires result in substantial benefits. Journal of Forestry 104(1): 27-31.

FIRE MANAGEMENT PLAN

CASCADES FOREST DISTRICT
MERRITT TIMBER SUPPLY AREA
MERRITT FIRE ZONE
JUNE 30, 2013

Charles van Hemmen, RPF	AUG 30/13	Steve Schell, RPF	August 30, 2013
District Manager	Date	Fire Centre Manager	Date
Cascades Forest District		Kamloops Fire Centre	

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LIST OF FIGURES

Cover Photo: Lily Lake Fire rapidly approaching the City of Merritt in 1999.

Document Prepared by:

Martin Ponsioen, RFT
Cascades District
Ministry of Forests, Lands and Natural Resource Operations
Merritt, BC

SCOPE AND PURPOSE

There are 3 hard copies of the plan which resides at the following location: Kamloops fire Centre, Merritt Fire Zone and Cascades Forest District.

This Fire Management Plan is applicable to the Merritt Timber Supply Area (TME) within the Cascades Forest District (DCS). The Merritt Fire Zone follows the same boundaries as TME. The DCS covers approximately 2,255,000 hectares in the southern interior region of British Columbia and is bounded by Kamloops District on the north, Okanagan Shuswap District (Salmon Arm) on the east, the Chilliwack and Squamish Forest Districts on the west, and by the Central Cariboo Forest District (Williams Lake), and Chilcotin Forest District to the north- west. The TME covers about 1,130,000 hectares and is the eastern portion of DCS, see further in this document for maps depicting the TME.

There are three main landowners in the Merritt TSA, the Province of British Columbia (Crown), the Government of Canada (Federal First Nations Reserves), and private landowners. On Crown land there are two main Ministries charged with managing in relation to wildfire. These are the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) and Ministry of Parks. The Merritt TSA contains significant areas of each type of ownership. This plan applies only to Crown land under the jurisdiction MFLNRO. Incident command teams are encouraged to understand their authorities and expectations on each of these types of lands

This plan's primary purposes are to assist Incident Command Staff in the decision making/discussion process of wildfire prioritization and suppression and to support in the development of the Fire Analysis (FA) by providing the primary timber and non-timber resources values within the TME boundary. However, this Fire Management Plan does not completely address the complexity of resource management issues and it is highly suggested that further investigation with the DCS district staff be conducted in areas where there are high and important resource values.

This plan is divided by Fire Management Units (FMU) and subunits which follow landscape units which are the basic geographical units for integrated resource management. There are a total of **12 FMUs** in the TME.

This plan does not expire but should be reviewed annually or periodically with respect to its accuracy and relevance as well as to make updates or improvements. Reviews should be completed jointly by Cascades Forest District and Merritt Fire Zone staff. All amendments to this plan will signed off by the appropriate signing authority for both parties.

At the DCS we always strive for continual improvement, to this end we would appreciate your feedback on this plan. If you use this plan, please complete the feedback form contained in **Appendix C** and forward it to Martin Ponsioen at the DCS either in hardcopy or digitally at Martin.Ponsioen@gov.bc.ca

2013 FIRE MANAGEMENT PLAN LIMITATIONS

This plan is an initial a product out of the Landscape Level Fire Management Planning Pilot for the Merritt TSA. There are many ideas being tested for inclusion within a future plan. We want to create a plan that is useful for the primary audience (Incident Command Teams); a plan that provides further in-depth information on values, hazards, and risks; a plan that shows completed and planned fuel modification treatments, regardless of proponent and funding source.

In future versions we want to incorporate population expansion planning. We feel it is important to forecast where we will see additional infrastructure and housing development on the landscape in order to adequately plan the fuel (forest) across the landscape.

We want to incorporate climate change scenarios in future versions, as shifting ecosystem climatic envelopes may have significant impacts to potential wildfire.

Further inclusion of First Nations, local community and public input into this plan is necessary to create a more robust, widely accepted plan.

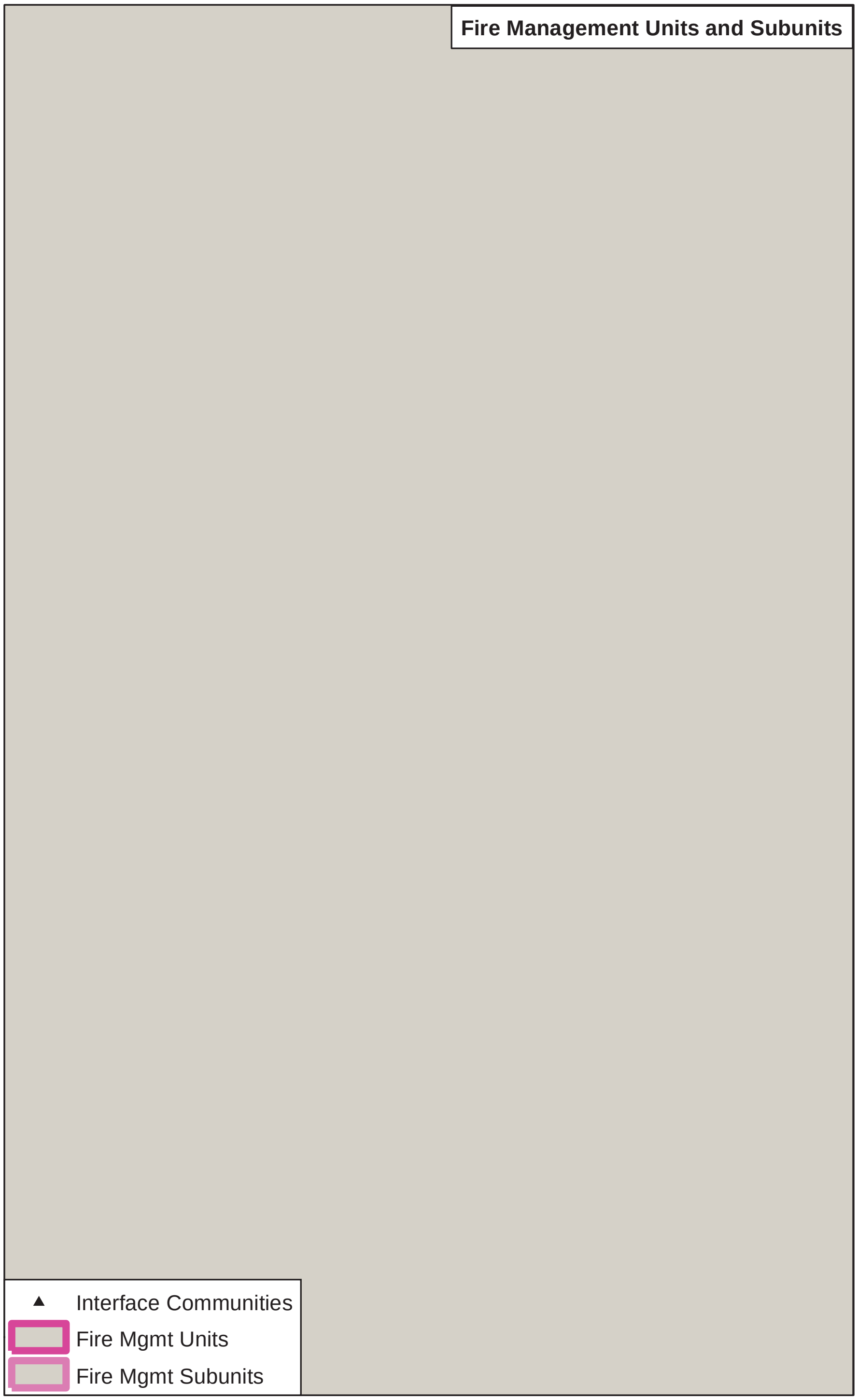


Figure 1 Fire Management Units and Subunits within the Merritt TSA.

INCIDENT COMMAND TEAM SUMMARY – PAGES 6 TO 23

PRIORITIZATION OF VALUES

Prioritization of wildland fire incidents and allocation of resources to those incidents is a complex and dynamic process. That process is part of the role of Wildfire Management Branch staff, with guidance from Fire Management Plans and input from land managers.

Resource allocation, and therefore the ranking of values, within WMB, generally falls within the Resources Sharing and Wildfire Allocation Protocol (RSWAP). The RSWAP ranking is included in **Appendix A**.

LAND MANAGER RANKING OF VALUES

The district manager recognizes the ranking using the RSWAP process, but provides the following input into values prioritization.

The larger communities within the Merritt TSA are dependent upon resource based economies. Therefore, all infrastructure is viewed as extremely important. Much of this infrastructure may not be insured. Loss of this infrastructure may result in a loss of economic activity and ultimately jobs. Job loss may destabilize small communities. In some situations, on a societal basis, this means that protection of infrastructure would have a higher priority than protection of evacuated residences.

We view the operable forest as critical infrastructure. The Merritt TSA is a high value area. In direct stumpage revenue, the Merritt TSA has provided more than $330 million over the past ten years; to support the provincial budget. This dollar value does not begin to account for spin off benefits and other revenue to the Crown. The timber supply has been impacted (reduced) by MPB, and is in a tight situation. The supply of available unconstrained mature timber is close to the Annual Allowable Cut. All areas of Timber Harvesting Landbase (THLB) are extremely important. We view the THLB as a priority 2a value.

THLB could be valued at an average price of $*to be determined (tbd)* per hectare. This is built by using an average stumpage value of $*tbd* per cubic meter, an average log purchase price of $*tbd* per cubic meter, and an average of 275 cubic meters per hectare. This would be placing a purely log value on the forest and ignores other ways to value a forest.

Within the RSWAP Priority Themes we want to ensure that incident command teams recognize that active mine sites and mineral processing facilities are recognized as Priority Theme 2a values.

OBJECTIVES & PRIORITY VALUES FOR FIRE MANAGEMENT UNITS

These objectives have been built independently by the Cascades District and WMB. It is the intent that, in the future, these objectives will be referred to first nations, licencees, stakeholders and the general public. It is hoped that through open dialogue these objectives can be refined to adequately reflect the desires and opinions of the citizens of British Columbia.

These objectives reference Natural Disturbance Type (NDT) objectives, Landscape Level Fuel Break objectives, and values prioritization. The reader is encouraged to cross reference FMU objectives, NDT objectives, Landscape Level Fuel Break objectives, values prioritization, and specific value occurrences to gain a better understanding of the objectives. NDT and Landscape Level Fuel Break objectives are described in their own sections.

Where objectives suggest full suppression to wildfire to protect THLB trees, we are looking to minimize negative impacts to the timber value. This means we prefer that fire suppression tactics reduce the likelihood of crown fire or other fire behavior that would lead to a loss of value, not to guarantee the elimination of crown fire. We recommend fire suppression tactics target minimum overall fire size.

Where objectives suggest a modified response to fire; one must recognize that site specific decisions will have to be made as to expected fire behaviour, fire weather indices of the day or season, level of fuel loading, and proximity to priority values.

Priority theme 1 and 2 values are listed for each unit in the sections following. There always will be important values that are not listed. This is due to human error and the dynamic nature of the creation of these values on the landscape. A specific example of this is communication towers. They are placed by a variety of organizations for a variety of purposes. This includes, but is not limited to, many organizations' repeater stations (MFLNRO, MOTI, RCMP, Ambulance Service, Timber Licencees, Railways, etc) and several organizations' cell towers (Telus, Bell, etc.). They exist in almost every FMU. They are <u>not</u> listed in this section; consult the mapping appendices for our best knowledge of their locations.

See figure 1 or 2 for a map depicting Fire Management Units and Subunits.

LOWER NICOLA

OBJECTIVES

1-1

This unit follows the highway 8 corridor and is populated along its entire length. The objective for this unit is generally full suppression of wildfire. This unit is entirely NDT4. There is some opportunity for a modified response to wildfire. The areas are the Nicola valley sidewalls that are open ponderosa pine stands and generally not THLB. Acceptable conditions will usually occur in early spring, when fire will generally not carry out of the valley onto the plateaus. This unit has a history of traditional burning in the spring, often to remove grass and enhance growth of other species.

1-2

This unit contains significant amounts of NDT3 and NDT4. There is also a significant amount of THLB within this unit. The main objective for this unit is full suppression of wildfire. There is some opportunity for a modified response to wildfire. The areas are the open south and east facing slopes in the Nicola valley and some tributaries like Shackan Creek. These areas are generally not THLB. Acceptable conditions will usually occur in early spring, when fire will generally not carry out of the valley onto the plateaus.

1-3

This unit has extensive areas of THLB. The main objective for this unit is full suppression of wildfire. There is some opportunity for a modified response to wildfire. The areas are the open slopes in the Nicola valley and some tributaries such as Skuhun Creek. These areas are generally not THLB. Acceptable conditions will usually occur in early spring, when fire will generally not carry out of the valley onto the plateaus.

VALUES

1-1

Priority Theme 1 – Shackan, Nooaitch, Town of Spences Bridge, many other small communities and rural subdivisions. The development generally follows Highway 8 along the Nicola River.
Priority Theme 2 – highway 8, Major railway along the Thompson River, Clean Energy Project (CEP) transmission line from Nicomen to Mamit Lake Substation.

1-2

Priority Theme 1 – None.
Priority Theme 2 – CEP transmission line from Nicomen to Mamit Lake Substation.

1-3

Priority Theme 1 – many recreation sites on lakes and small fishing resorts that have high occupancy during fire season.
Priority Theme 2 – this unit is adjacent to Highland Valley Copper, a very high value open pit copper mine. CEP transmission line from Nicomen to Mamit Lake Substation.

SWAKUM

OBJECTIVES

2-1

This unit has significant amounts of Priority Theme 1 values. The objective for this unit is full suppression of wildfires. There is limited opportunity for a modified response to wildfire in the NDT4. The areas are the open slopes above Nicola Lake. These areas are generally not THLB. Acceptable conditions will generally occur in early spring, when fire will generally not carry out of the valley onto the plateaus.

2-2 & 2-3

These units have some significant Priority Theme 2 values. These units are mainly high value THLB, NDT3, plateau areas. The objective for the unit is full suppression of wildfires. There are very limited opportunities for a modified response to wildfire. These would be limited to early spring when high value THLB will not be consumed by fire.

VALUES

2-1

Priority Theme 1 – City of Merritt, Lower Nicola, Lower Nicola Indian Band, Upper Nicola, Monck Park Campground, many other small communities and rural subdivisions.
Priority Theme 2 – Merritt airport, Mamit Lake Substation and associated transmission lines, Fortis pipeline and pump stations, highways 8, 97C, 5A, and 5 (Coquihalla), Craigmont mine (inactive) with associated ore processing facility (active).

2-2

Priority Theme 1 - many recreation sites on lakes that have high occupancy during fire season.
Priority Theme 2 – transmission line from Mamit Lake Substation servicing Highland Valley Copper, CEP transmission line from Nicomen to Mamit Lake Substation, transmission line from Lower Nicola to Mamit Lake Substation, Craigmont Mine (open pit copper, active mill), Kinder Morgan Trans Mountain pipeline, Fortis pipeline.

2-3

Priority Theme 1 - several rural subdivisions, many recreation sites on lakes that have high occupancy during fire season.
Priority Theme 2 – highway 5 (Coquihalla), two major transmission lines, Kinder Morgan Trans Mountain pipeline.

UPPER NICOLA

OBJECTIVES

3-1

This unit is comprised mainly of private land, owned by a few landowners. There are also some significant areas of Crown and first nations' reserves. There are a significant amount of Priority Theme 1 and 2 values. The objective for the unit is broken into several components:

- For the Crown land, in the timbered portions, in the north and east, full suppression of wildfires is the objective.
- For the Crown land in the center and west, modified response to wildfire is the objective. In the grassland ecosystems we want to see low impact fire returned. Fire impacts to the soil that would significantly alter grassland seral stage would be unacceptable. For the THLB portions modified response may be acceptable in some of the open timber types. Decisions would have to be made very carefully, as the some of the Priority Theme 2 values are provincial level importance.

3-2

There are a significant amount of Priority Theme 1 and 2 values. This unit is a plateau, mainly comprised of NDT3 and some NDT4. A significant amount of this unit is high value THLB. The objective for this unit is full suppression of wildfire. There is limited opportunity for a modified response to wildfire in the NDT4. The areas are the grassland ecosystems near Spahomin Creek and Quilchena Creek. These areas are important forage areas. Fire impacts to the soil that would significantly alter grassland seral stage would be unacceptable. Acceptable conditions will usually occur in early spring, when fire will generally not carry out of the grassland into the THLB.

VALUES

3-1

Priority Theme 1 – Quilchena, Upper Nicola Indian Band, Douglas Lake, Glimpse Lake, Peter Hope lake, several other small communities and rural subdivisions, many recreation sites and parks on lakes that have high occupancy during fire season.
Priority Theme 2 – highways 5A and 97C, Nicola Substation and many major transmission lines that service Vancouver.

3-2

Priority Theme 1 - several small communities and rural subdivisions, many recreation sites on lakes that have high occupancy during fire season.
Priority Theme 2 – major transmission line.

SPIUS

OBJECTIVES

4-1

This unit is a mix of NDT2, NDT3, NDT4, and some NDT5. This area is mostly comprised of very high value THLB. The objective for this unit is full suppression of wildfire. There is a small opportunity for a modified response to wildfire. The areas are the open slopes in the lower Spius Creek area and in the higher elevation areas of Stoyoma Mountain. These areas are generally not THLB. Acceptable conditions in the NDT 4 will usually occur in early spring, when fire will generally not carry into high value timber. Acceptable conditions on Stoyoma Mountain will occur late in the fall, when the risk of fire spreading to adjacent THLB is low.

VALUES

4-1

Priority Theme 1 - several small communities and rural subdivisions, many recreation sites on lakes that have high occupancy during fire season.
Priority Theme 2 – major transmission line servicing Vancouver.

COLDWATER

OBJECTIVES

5-1

This unit is a mosaic of all the Values Priority Themes. There are large numbers of Priority Theme 1 and 2 values. Much of this unit is within the NDT4 area. An objective is to see a return to open forest conditions through much of the unit. This will help to facilitate the protection of values at risk. In general the objective for this unit is full suppression of all wildfire. There may be limited opportunities for modified response to wildfire within this unit within the NDT4. Much of the NDT4 is also THLB. Acceptable conditions will only occur in the early spring when the risk of significant tree mortality is very low.

5-2

Much of this unit is NDT2 and NDT3, comprising some very high value THLB. There are some Priority Theme 1 and 2 values. The objective for this unit is full suppression of wildfire. There are some small areas of NDT4 and NDT5 within the unit. These are the south facing slopes near Spearing Creek and the alpine areas around July Mountain. In these areas the objective is a modified response to wildfire. Acceptable conditions in the NDT 4 will usually occur in early spring, when fire will generally not carry into high value timber. Acceptable conditions on July Mountain will occur late in the fall, when the risk of fire spreading to adjacent THLB is low.

VALUES

5-1

Priority Theme 1 - City of Merritt, Coldwater Indian Band, many other small communities and rural subdivision, many recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 - major transmission line servicing Vancouver, Kinder Morgan's Trans Mountain pipeline and Kingsvale Pumping Station, Fortis pipeline and Kingsvale Compressor Station, highway 5 (Coquihalla).

5-2

Priority Theme 1 – Brookmere, many recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – Kinder Morgan's Trans Mountain pipeline, highway 5 (Coquihalla).

OTTER

OBJECTIVES

6-1

This unit has significant amounts of Priority Theme 1 values. The objective for this unit is full suppression of wildfires. There is very limited opportunity for a modified response to wildfire in the NDT4. Most of the NDT4 is also THLB. Acceptable conditions will only occur in the early spring when the risk of tree mortality is very low.

6-2

This unit has limited Priority Theme 1 and 2 values. The unit is mainly NDT3 and immature THLB. The objective for the unit is full suppression of wildfires. There is very limited opportunity for a modified response to wildfire in the NDT4. Most of the NDT4 is also THLB. Acceptable conditions will only occur in the early spring when the risk of tree mortality is very low.

6-3

This unit is comprised of many Priority Theme 1 and 2 values. The unit is mainly NDT4 and has significant amounts of private land. This unit sees significant amounts of abandoned campfire and lightning fire starts. The objective for this unit is full suppression of wildfire. There is very limited opportunity for a modified response to wildfire in the NDT4. Most of the NDT4 is also THLB.

Acceptable conditions will only occur in the early spring when the risk of significant tree mortality is very low.

VALUES

6-1

Priority Theme 1 – Tulameen, Otter Lake, several rural subdivisions, several recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – none

6-2

Priority Theme 1 – Brookmere, several rural subdivisions, several recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – none

6-3

Priority Theme 1 – Aspen Grove, many rural subdivisions, many recreation sites on lakes that have high occupancy during fire season.
Priority Theme 2 – major transmission lines, Fortis pipeline, highways 5A and 97C

SUMMERS

OBJECTIVES

7-1

This unit has significant amounts of Priority Theme 1 and 2 values. Most of this unit is within the NDT4. An objective is to see a return to open forest conditions through much of the unit. This will help to facilitate the protection of values at risk. In general the objective for this unit is full suppression of all wildfire. There may be limited opportunities for modified response to wildfire within this unit within the NDT4. Most of the NDT4 is also THLB. Acceptable conditions will only occur in the early spring when the risk of significant tree mortality is very low.

7-2

This unit has limited Priority Theme 1 values. The unit is mainly NDT3 and THLB. The objective for the unit is full suppression of wildfires. There is very limited opportunity for a modified response to wildfire in the NDT4. Most of the NDT4 is also THLB. Acceptable conditions will only occur in the early spring when the risk of tree mortality is very low.

7-3

This unit has some Priority Theme 1 and 2 values. The unit is mainly NDT3 and THLB. The objective for the unit is full suppression of wildfires. There is very limited opportunity for a modified response to wildfire in the NDT4. Most of the NDT4 is also THLB. Acceptable conditions will only occur in the early spring when the risk of tree mortality is very low.

VALUES

7-1

Priority Theme 1 – Princeton, Missezula Lake, Allison Lake, Coalmont, many other small communities and rural subdivisions, many recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – highways 5A and 3, transmission lines servicing Copper Mountain Mine, Fortis pipeline, China Ridge Ski Area.

7-2

Priority Theme 1 – limited recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – none.

7-3

Priority Theme 1 – many recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – highway 97C.

HAYES

OBJECTIVES

8-1

This unit has significant amounts of Priority Theme 1 and 2 values. Most of this unit is within the NDT4. An objective is to see a return to open forest conditions through much of the unit. This will help to facilitate the protection of values at risk. In general the objective for this unit is full suppression of all wildfire. There may be some opportunities for modified response to wildfire within this unit within the NDT4. Much of the NDT4 is also THLB. The areas of opportunity will be on the steep south facing slopes in the Similkameen valley. Acceptable conditions will usually occur in early spring, when fire will generally not carry off of the steep slopes into the THLB.

8-2 & 8-3

This unit has limited Priority Theme 1 and 2 values. The unit is mainly NDT3 and very high value THLB. The objective for the unit is full suppression of wildfires. There is very limited opportunity for a modified response to wildfire in the NDT4. Most of the NDT4 is also THLB. Acceptable conditions will only occur in the early spring when the risk of tree mortality is very low.

VALUES

8-1

Priority Theme 1 – Bankier, Osprey Lake, many other small communities and rural subdivisions, many recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – highways 40 and 3, Fortis pipeline.

8-2

Priority Theme 1 – several recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – none.

8-3

Priority Theme 1 - many recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – highway 97C, Elk Gold Mine.

MCNULTY

OBJECTIVES

9-1

This unit has significant amounts of Priority Theme 1 and 2 values. Most of this unit is within the NDT4. An objective is to see a return to open forest conditions through much of the unit. This will help to facilitate the protection of values at risk. In general the objective for this unit is full suppression of all wildfire. There may be many opportunities for modified response to wildfire within this unit within the NDT4. Much of the NDT4 is not THLB. The areas of opportunity will be on the steep south facing slopes in the Similkameen valley. Acceptable conditions will usually occur in early spring, when fire will generally not carry off of the steep slopes into the THLB.

9-2

This unit has limited Priority Theme 1 values. The unit is mainly NDT3 and very high value mature THLB. The objective for the unit is full suppression of wildfires. There is very limited opportunity for a modified response to wildfire in the NDT4. Most of the NDT4 is also THLB. Acceptable conditions will only occur in the early spring when the risk of tree mortality is very low.

VALUES

9-1

Priority Theme 1 – Hedley, many other small communities and rural subdivisions, many recreation sites and parks on rivers that have high occupancy during fire season.
Priority Theme 2 – highway 3, Fortis pipeline.

9-2

Priority Theme 1 - several recreation sites on lakes that have high occupancy during fire season.
Priority Theme 2 – none.

TULAMEEN

OBJECTIVES

10-1

This small unit has significant amounts of Priority Theme 1 and 2 values. Most of this unit is within the NDT4. An objective is to see a return to open forest conditions through much of the unit. This will help to facilitate the protection of values at risk. In general the objective for this unit is full suppression of all wildfire. There may be some opportunities for modified response to wildfire within this unit within the NDT4. Much of the NDT4 is also THLB. The areas of opportunity will be on the inoperable slopes in the Similkameen valley and lower portions of tributaries. Acceptable conditions will usually occur in early spring, when fire will generally not carry off of the steep slopes into the THLB.

10-2

Much of this unit is NDT2 and NDT3, comprising some very high value THLB. There are some Priority Theme 1 and 2 values. The objective for this unit is full suppression of wildfire. There are some small areas of NDT4 and NDT5 within the unit. These are the lower portion of the Similkameen valley and the alpine areas around the Cascade Mountains. In these areas the objective is a modified response to wildfire. Acceptable conditions in the NDT 4 will usually occur in early spring, when fire will generally not carry into high value timber. Acceptable conditions around the Cascade Mountains will occur late in the fall, when the risk of fire spreading to adjacent THLB is low.

VALUES

10-1

Priority Theme 1 – Tulameen, Coalmont, many recreation sites on rivers that have high occupancy during fire season.
Priority Theme 2 – adjacent to open pit coalmine (active).

10-2

Priority Theme 1 – many recreation sites on lakes and rivers that have high occupancy during fire season, includes Coquihalla Recreation Area, portion of and adjacent to Manning Park.
Priority Theme 2 – Highway 5, open pit coalmine (active), Treasure Mountain silver mine (active), several placer mining operations (active).

SIMILKAMEEN

OBJECTIVES

11-1

This unit has significant amounts of Priority Theme 1 and 2 values. Most of this unit is within the NDT4. An objective is to see a return to open forest conditions through much of the unit. This will help to facilitate the protection of values at risk. In general the objective for this unit is full suppression of all wildfire. There may be many opportunities for modified response to wildfire within this unit within the NDT4. Much of the NDT4 is not THLB. The areas of opportunity will be in and around communities. Acceptable conditions will usually occur in early spring, when fire will generally not spread into adjacent communities.

11-2 & 11-3

These units have limited Priority Theme 1 values, other than recreation sites. These units are mainly NDT3 and high value THLB. The objective for the unit is full suppression of wildfires. There is limited opportunity for a modified response to wildfire in the NDT4. Much of the NDT4 is also THLB. The areas of opportunity will be on the steep slopes of the Similkameen valley. Acceptable conditions will only occur in the early spring when the risk of tree mortality is low.

VALUES

11-1

Priority Theme 1 – Princeton, Eastgate, many other small communities and rural subdivisions, several recreation sites on lakes and rivers that have high occupancy during fire season, adjacent to Manning Park.
Priority Theme 2 – highway 3, Copper Mountain Mine (active), federal fiber optic line along highway 3.

11-2

Priority Theme 1 - many recreation sites on lakes and rivers that have high occupancy during fire season, adjacent to Manning Park.
Priority Theme 2 – none.

11-3

Priority Theme 1 - several recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – none.

SMITH-WILLIS

OBJECTIVES

12-1

This unit has significant amounts of Priority Theme 1 and 2 values. Most of this unit is within the NDT4. An objective is to see a return to open forest conditions through much of the unit. This will help to facilitate the protection of values at risk. In general the objective for this unit is full suppression of all wildfire. There may be some opportunities for modified response to wildfire within this unit within the NDT4. Much of the NDT4 is also THLB. The areas of opportunity will be on the steep slopes in the Wolfe Creek and Similkameen valleys. Much of the Wolfe Creek valley is not THLB. Acceptable conditions will usually occur in early spring, when fire will generally not carry off of the steep slopes into the THLB or adjacent priority values.

12-2

This unit has limited Priority Theme 1 values. This unit is mainly NDT3 and high value THLB. The objective for the unit is full suppression of wildfires. There is limited opportunity for a modified response to wildfire in the NDT4. Much of the NDT4 is also THLB. The areas of opportunity will be on the lower inoperable slopes of tributaries to the Similkameen River. Acceptable conditions will only occur in the early spring when the risk of extensive fire spread and tree mortality is low.

VALUES

12-1

Priority Theme 1 – Princeton, many other small communities and rural subdivisions, many recreation sites and parks on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – highway 3, Copper Mountain Mine (active), Fortis pipeline.

12-2

Priority Theme 1 - several recreation sites on lakes and rivers that have high occupancy during fire season.
Priority Theme 2 – Navigation Canada Aviation installation.

OBJECTIVES FOR DRAFT LANDSCAPE LEVEL FUEL BREAKS

The main objective for these zones is to drop a running crown fire down to the ground and create defensible spaces which crews can start attacking the fire from. When these fuel breaks follow industrial roads, we recommend relatively fuel free zones within 10 meters of main road running surface. Our preference is to have the 30 m zone adjacent to that fuel free zone with a modified (not necessarily reduced) stocking standard, so that there is a minimum of 2 crown widths between trees or clumps. Within harvested areas we recommend fuel conditions that are close to the FRPA minimum requirements for Coarse Woody Debris. We suggest that this may be achieved through the use of prescribed broadcast fire as a site preparation tool or pile and burn within the dispersed area of cutblocks. s.13 s.13 These generic objectives should be modified to accommodate site specific conditions such as: ecosystems, terrain, and other values.

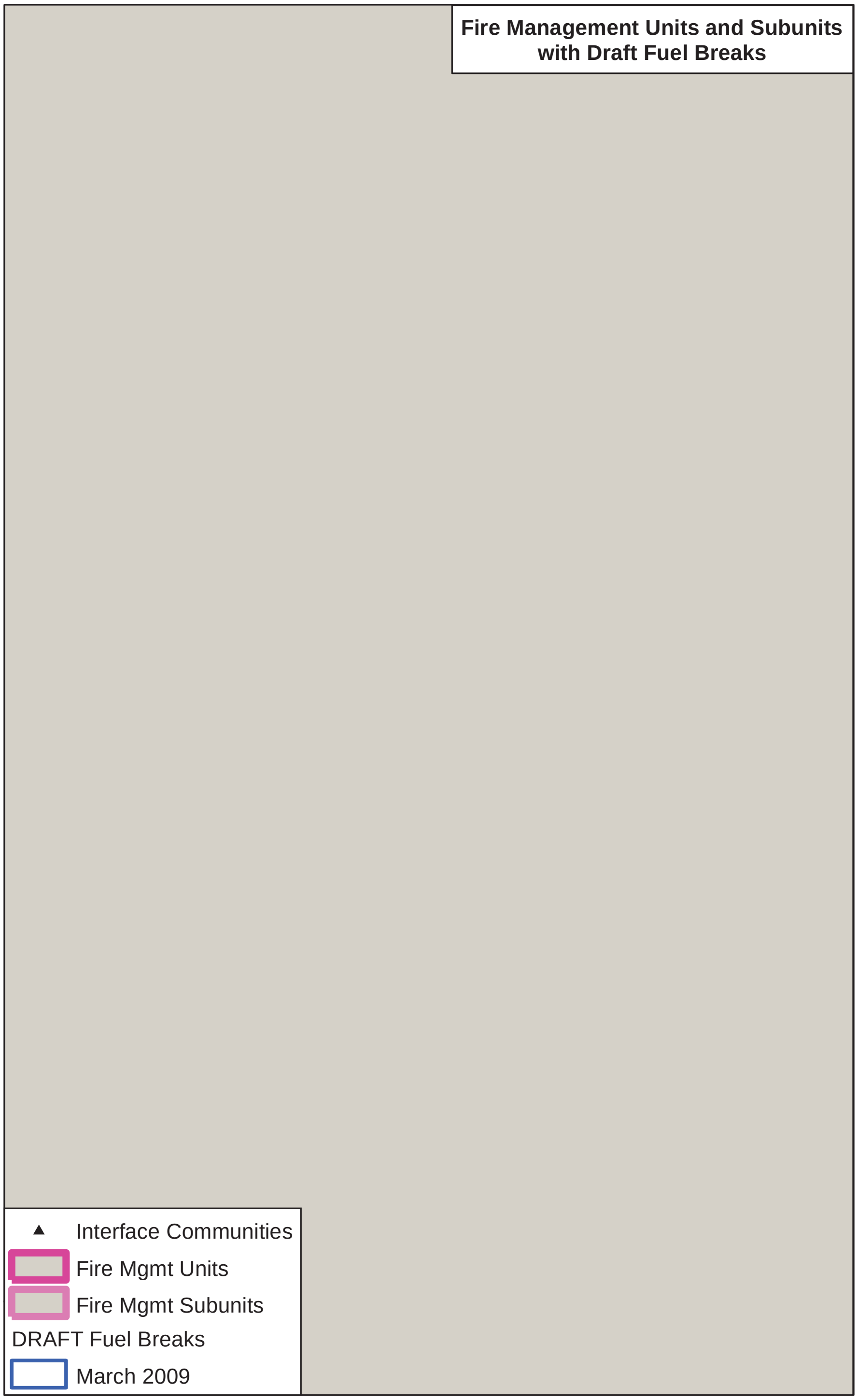


Figure 2 Fire Management Units and Subunits with Draft Fuel Breaks.

OBJECTIVES FOR NATURAL DISTURBANCE TYPES

Natural disturbance types (NDT) as outlined in the *Forest Practices Code* Biodiversity Guidebook (1995) characterize areas with different natural disturbance regimes. Natural disturbance regimes include fire, wind, insects, and disease. There are five natural disturbance regimes recognized in the Biodiversity Guidebook.

Where objectives suggest a modified response to fire; one must recognize that site specific decisions will have to be made as to expected fire behaviour, fire weather indices of the day or season, level of fuel loading, and proximity to priority values.

NDT1 - ECOSYSTEMS WITH RARE STAND-INITIATING EVENTS

This type is less than 1% of the Merritt TSA. Fires in this type were rare (250yrs). No objectives have been created.

NDT2 - ECOSYSTEMS WITH INFREQUENT STAND-INITIATING EVENTS

This type covers over 7% of the Merritt TSA. Historically there were infrequent (200yrs), moderate sized, stand replacing fires within this type. Current forest management is using harvesting to replace these large fires. These large fires are no longer desirable in our current forest management regime. Fire is still an important part of this type; as such, it is acceptable to use modified response to shoulder season fires that are expected to be small in size and impacts.

The objective for this type is to protect the forest from stand replacing fires, so that a healthy forest industry can exist to support and maintain the larger communities within the TSA.

NDT3 - ECOSYSTEM WITH FREQUENT STAND-INITIATING EVENTS

This type covers over 37% of the Merritt TSA. Historically there were frequent (150yrs), large, stand replacing fires within this type. Current forest management is using harvesting to replace these large fires. These large fires are no longer desirable in our current forest management regime. Fire is still an important part of this type; as such, it is acceptable to use modified response to shoulder season fires that are expected to be small in size and impacts.

This type contains vast areas of THLB. Within this type are many of the landscape level fuel break polygons. We prefer that our forest industry partners manage these fuel breaks to minimize fuel loading during harvesting operations. Objectives for the landscape level fuel breaks are described in another section.

The objective for this type is to protect the forest from stand replacing fires, so that a healthy forest industry can exist to support and maintain the larger communities within the TSA.

NDT4 - ECOSYSTEM WITH FREQUENT STAND-MAINTAINING EVENTS

This type covers over 50% of the Merritt TSA. We prefer to see a return to frequent (4-50yrs) stand maintaining fires within this type. We recommend creating open forest conditions that will support a variety of wildlife species traditionally found here. Modified response to wildfire within this type, although desired, may be challenging.

Within this type there has been many years of effective fire suppression. This has modified the fuel conditions, by allowing a significant amount of tree and shrub in-growth. In some situations, fire suppression has created fuel conditions that will produce unacceptable impacts if allowed to burn under most conditions.

Also within this type, there is a significant amount of forage utilization by domestic animals. The seasons of utilization are typically spring and fall grazing. The availability of forage, during these time periods, is often the limiting factor on Merritt TSA ranges. These ranges are often heavily utilized, so the availability of grasses to carry fires may be limited.

This is also the type in which most of the human habitation and development is occurring. There is a large amount of THLB within this type.

Within this type many of the landscape level fuel break polygons tie into the valley bottoms. We prefer that our forest industry partners manage these fuel breaks to minimize fuel loading during harvesting operations. Objectives for the landscape level fuel breaks are described in another section.

The objective for this type is a return to frequent, low impact, stand maintaining fires. Re-introduction of fire into this type is expected to happen through a mix prescribed fire and appropriate wildfire.

NDT5 - ALPINE TUNDRA AND SUBALPINE PARKLAND ECOSYSTEMS

This type covers less than 3% of the Merritt TSA. Fires are rare within this type. Grazing by wildlife and non-native species is the main driver of ecosystem change. In general the objective for this type is a modified response to wildfires, when conditions are appropriate. In severe fire weather conditions modified response may not be appropriate because of deep burns on thin soils causing slope stability concerns. Also during extreme conditions, the risk of fire spreading to other NDT types may be too high.

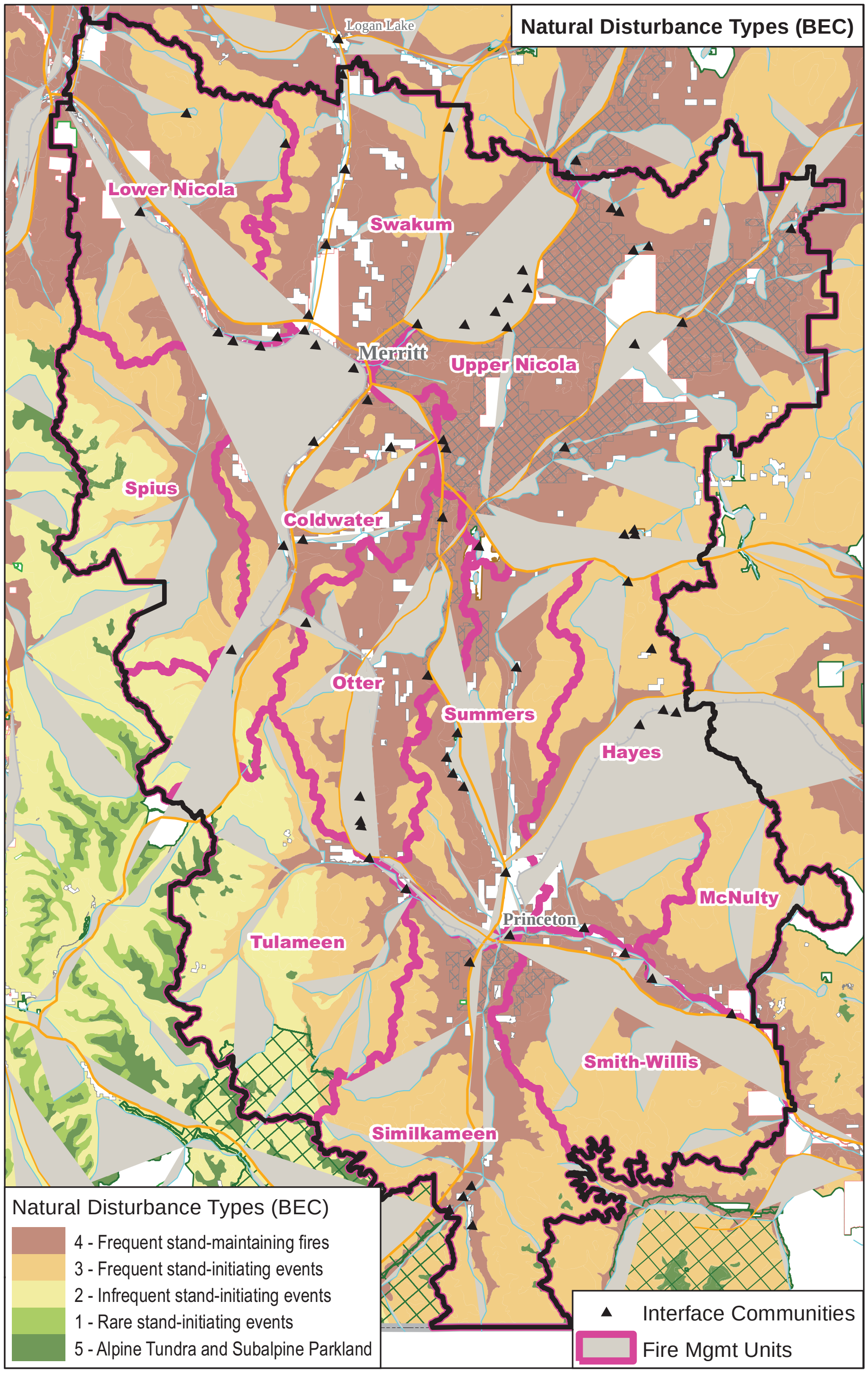


Figure 3 Natural Disturbance Types and Fire Management Units.

CASCADES FOREST DISTRICT STAFF CONTACTS

Cascades Forest District Offices	Merritt (Main) Office - Phone 250-378-8400, Fax 250-378-8481 Lillooet Field Office – Phone 250-256-1430, Fax 250-256-0234

District Management Team	Charles (Chuck) van Hemmen, District Manager 250-378-8402 Dave Horne, Operations Manager 250-378-8401 Chris Walder, Operations Manager 250-378-8403
First Nations Liaisons	Bruce Walter 250-378-8421 Merritt Christine Galliazzo 250-256-1430 Lillooet
Compliance & Enforcement	Bob Warner 250-490-2222 C&E Supervisor
Engineering	Ken Conway-Brown 250-378-8458
Stewardship/Silviculture	Ed Nedokus 250-378-8468
Recreation	Ed Abels 250-378-8433
Tenures (Timber)	Len Marsh 250-378-8444
Range	Rene Garcia-Daguer 250-378-8477
Scaling	Ray Lang 250-378-8485
Woodlots	Ralph Kossinn 250-378-8431
Fire Management Plan Contact	Martin Ponsioen 250-378-8437

TIMBER LICENCEE CONTACTS

Aspen Planers Ltd	Scott Fiddick	250-378-9266
BCTS – Kamloops	Christian Guay	250-378-8466
Interwest Timber Ltd.	Clint Ely	250-256-7782
Tolko Industries Ltd	Dean Jaeger	250-378-2224
Weyerhaeuser Company Ltd.	Cory Yurkowski	250-295-4232 (office) s.22 (cell) s.22 (standby)
Stuwix Resources Ltd.	Shawn Kuzio	250-378-2277
Sungate Timber Ltd	Don Brimacombe	250-819-2254

STRATEGIES AND TACTICS

This could be a section developed by WMB zone staff that provides key direction to incoming ICs.

The following fire response decisions will form the basis of fire suppression action in identified land management areas. Actual initial attack strategies and preparedness levels are outlined in the Kamloops Fire Centre's Fire Operations Plan.

Full Response Fire: a wildfire which requires immediate, aggressive initial attack and/or sustained suppression action until the fire is declared out.

Modified Response Fire: a wildfire that is allowed to burn within set policy and management guidelines or may be actioned in such a manner as to bring the wildfire back within those guidelines. A monitor only fire is a modified response fire that is not receiving suppression action at a specified point in time but has defined parameters which are monitored.

In future versions of this plan we anticipate there will be a fuel management section for where fuel modification activities have been completed and are planned.

FIRE START MODELING

The following three maps are based on actual fire starts and show density modeling. This should give Incident Command Teams an idea of where to expect fire starts from either human or natural causes. We believe that this will help in prioritizing the positioning and workload of Initial Attack crews, when used in conjunction with values mapping.

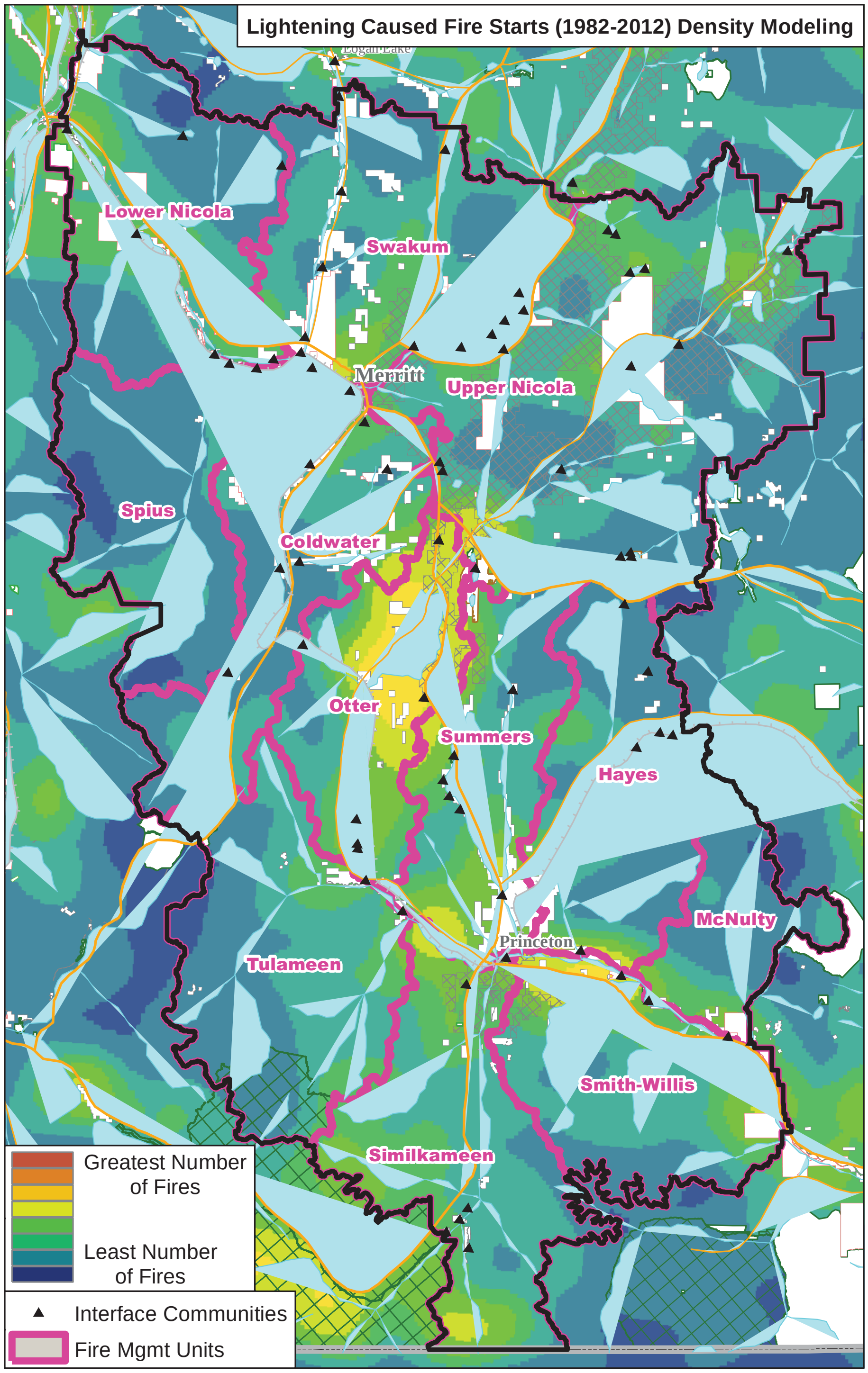


Figure 4 Lightening Caused Fire Starts.

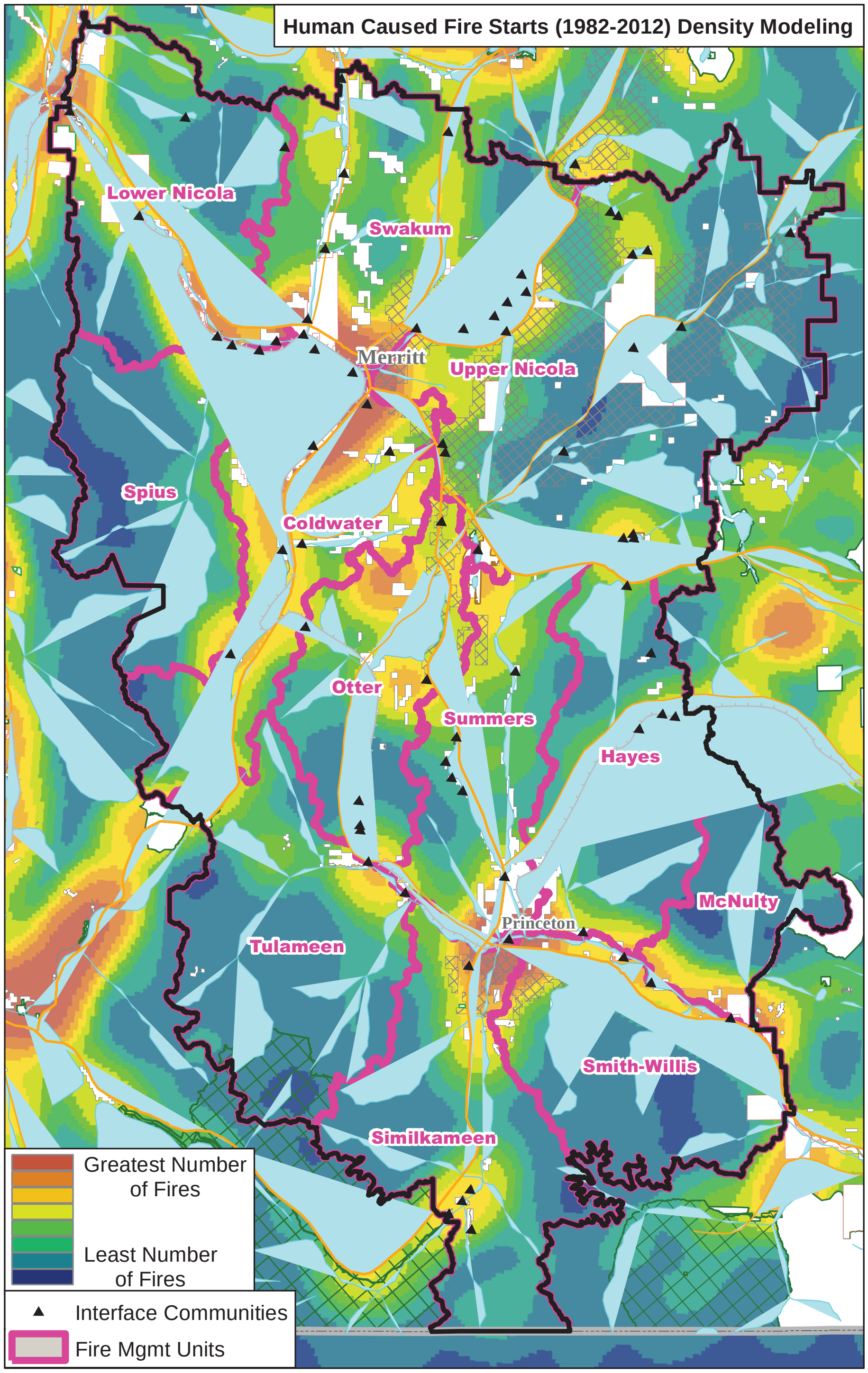


Figure 5 Human Caused Fire Starts.

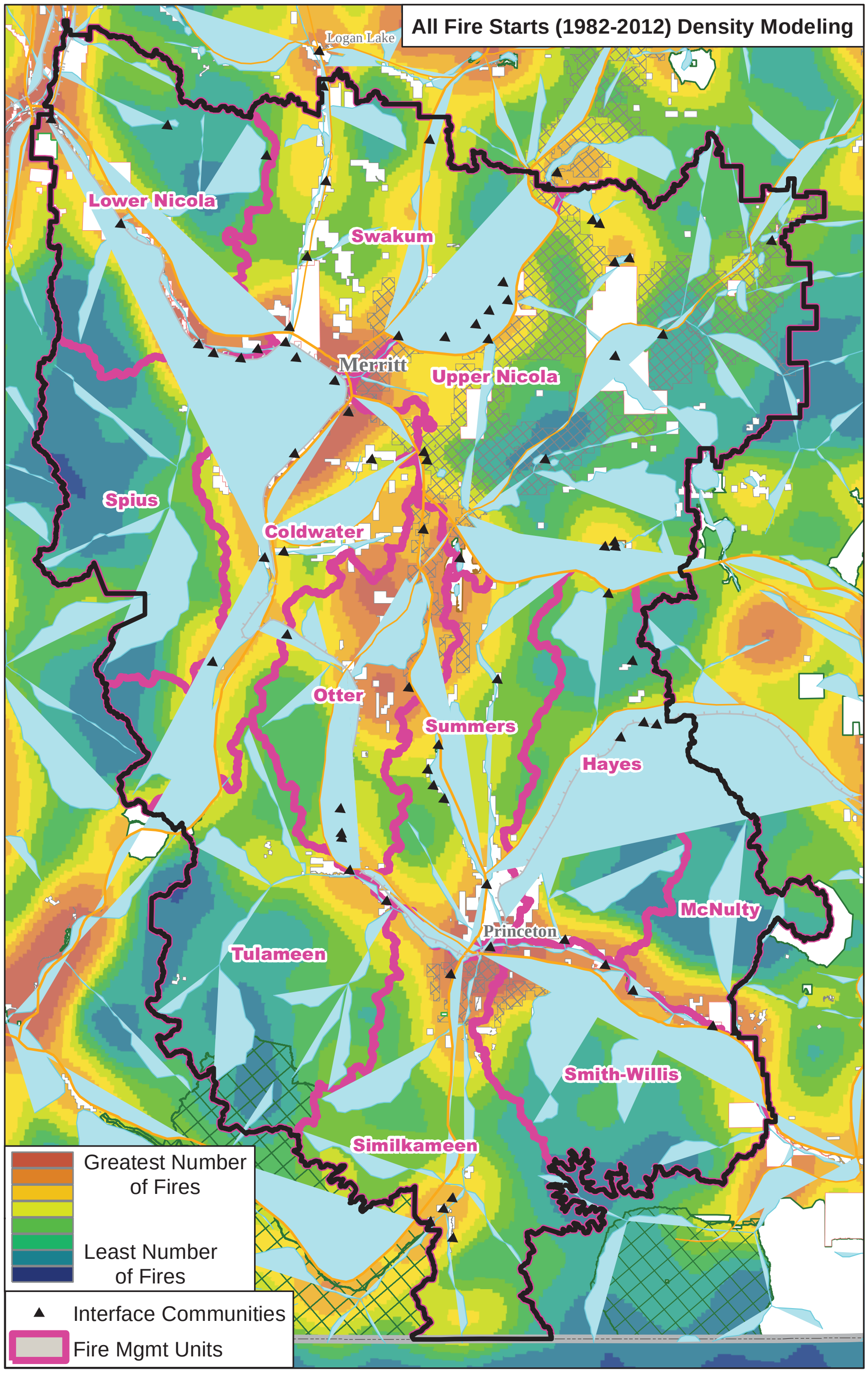


Figure 6 Fire Starts From All Causes.

This is the end of the section designed for incident command teams. If you require further information about a topic, please look further into this document or contact local district and WMB staff.

PLANNING SECTION

This section is intended to more fully describe some of the information that has gone into creating objectives for FMUs and provide background on the directions provided to IMTs.

FIRE ECOLOGY AND NATURAL DISTURBANCE TYPES

Fire is a key process and component of ecosystems in British Columbia. Nearly all ecosystems in British Columbia have evolved with fire and have the capacity to respond to fire as an important natural disturbance event. However, since the early 1900's fire suppression efforts have been focussed towards significantly reducing fire on the British Columbian landscape. Two currently suggested approaches to managing British Columbia's forests and rangelands: ecosystem management and managing for ecosystem resilience, both emphasize the importance of maintaining ecological processes in order to maintain the health and productivity of ecosystems. There is a need to adjust the approach of fire suppression efforts in order to maintain the beneficial presence of fire and thereby help to ensure the health, productivity, and resilience of British Columbia's forests and rangelands.

Land managers and decision makers are required to use fire ecology rationale when they decide where and what type of fire should be maintained on the landscape. Obviously many other values and perspectives than the ecological role of fire must be considered in fire management decisions including human safety, community values, wildlife habitat, species at risk, and so on. These, along with the ecological perspective, must be considered when designating area as "modified response".

Fire has influenced nearly all of British Columbia's grassland and forest ecosystems. However, the types of fire and the resulting ecological effects vary considerably across the province and among ecosystems. Weather, climate, type and condition of fuel, previous fire history, season, aspect, elevation, topography, and ignition source all interact to affect the behaviour of the fire, the intensity and the extent of the burn. This multitude of variables results in fire having highly variable effects on the landscape both within a single fire and between different fires. However despite significant variability, similar ecosystems do tend to exhibit similar fire histories, often referred to as fire regimes.

Natural Disturbance Types (NDTs) are used to classify British Columbia's ecosystems into five broad categories of natural disturbance regimes (BC MOF and BC MELP 1995). Throughout much of British Columbia, the primary disturbance described by the natural disturbance regime is fire. Each NDT describes a natural disturbance regime in terms of disturbance type, intensity, size, and frequency. The description of disturbance regimes was developed using a combination of expert opinion and research. More information on NDT can be found in the biodiversity guidebook at: http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/biodiv/biotoc.htm

NDT 1 – Ecosystems with rare stand-initiating events
NDT 2 – Ecosystems with infrequent stand-initiating events
NDT 3 – Ecosystems with frequent stand-initiating events
NDT 4 – Ecosystems with frequent stand-maintaining fires
NDT 5 – Alpine Tundra and Subalpine Parkland ecosystems

Natural disturbance regimes are useful for describing the disturbance pattern typical for an area; however, these regimes can oversimplify the complexity of fire history. The fire history of many ecosystems is highly variable across both space and time. For example within the boreal forest, numerous small stand level fires maintain a mosaic of stand types until a large fire burns through affecting thousands of hectares and significantly changing the landscape. Most natural disturbance regimes refer to a specific range of fire sizes and frequency. This suggests that fire regimes remain relatively constant over time. However, numerous studies have shown that fire regimes have changed significantly over time independent of the effect of changes in land management accompanying European settlement. Often these changes are driven by changes in climate.

While keeping in mind that use of NDTs results in the simplification of a collection of complex processes, NDTs do provide a useful general description of the average fire regime of an ecosystem and a framework for classifying British Columbia's ecosystems. Descriptions of these ecosystems are available within Ecosystems of British Columbia (Meidinger and Pojar 1991) or on the BEC website: http://www.for.gov.bc.ca/hre/becweb/

Mapping of the NDTs for TME is presented elsewhere in this document.

FIRE HISTORY IN TME

The Merritt TSA has had a long history of fires within it. Fires have been caused by a variety of sources including, traditional burning, lightening, accidental arson and intentional arson. Fires close to communities have been kept to relatively small sizes by effective fire reporting and suppression over the last half century. Fires starting further away from communities have also been kept to relatively small sizes by effective fire suppression over the last few decades. The potential for very large, landscape altering, destructive fires within the TME is an ever present threat.

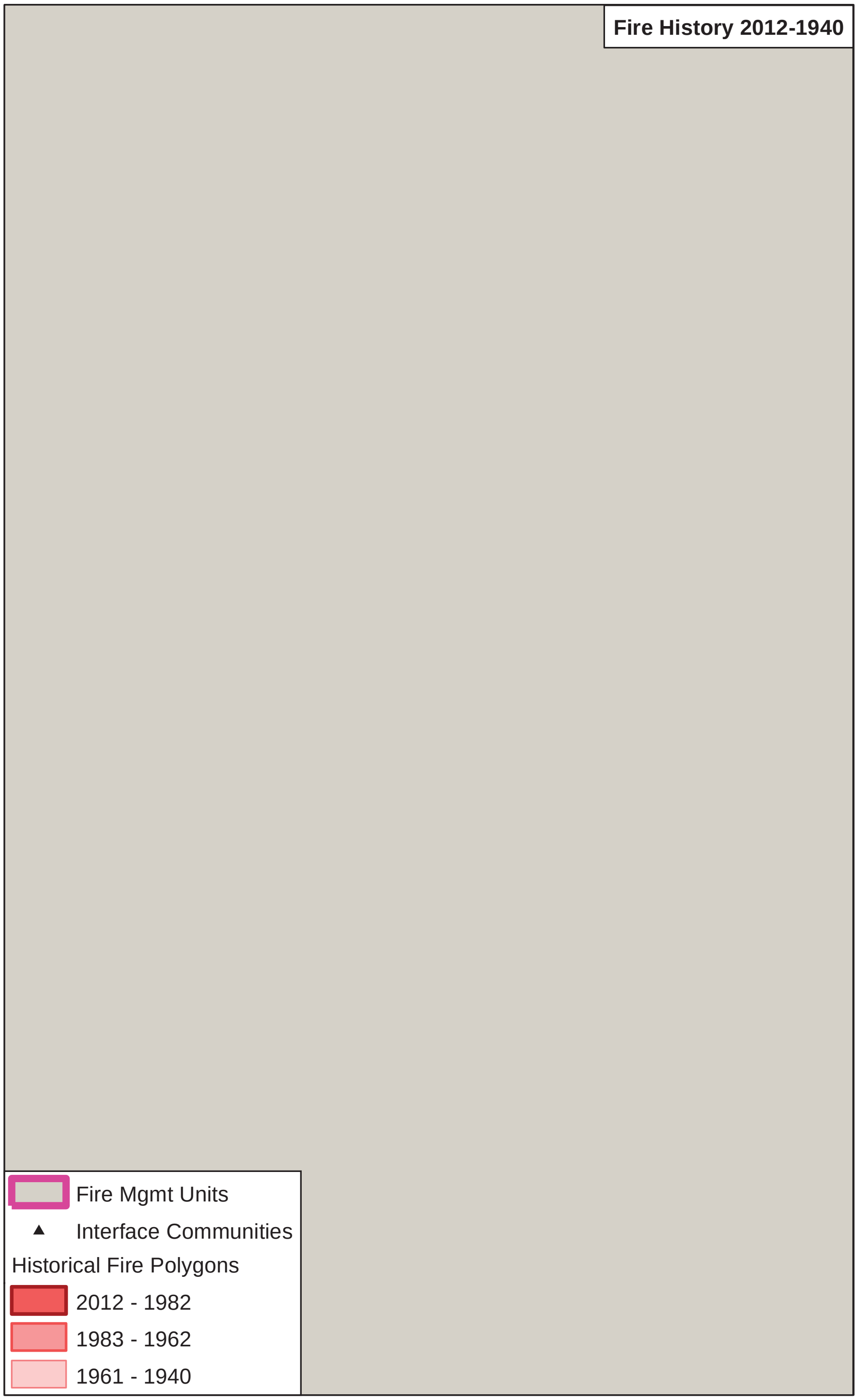


Figure 7 Historic Fires Within The Merritt TSA.

FIRE ENVIRONMENT IN DCS

The fire environment has three principle influences which form that environment. These influences are fuel, weather and topography. These three are also refer to as the fire behaviour triangle. Each influence can develop differing influences depending on the day and part of the season. The biggest change can be made by effect the fuel on the landscape; the other factors are outside of our control.

BIOGEOCLIMATIC ZONES AND FUEL TYPES

A majority of the Interior Biogeoclimatic Zones are present within the TME. These zones range from Ponderosa Pine (PP), Bunchgrass (BG) and Interior Douglas-fir (IDF) in the drier valley bottoms to moister and cooler Montane Spruce (MS), Engelmann Spruce-Sub alpine fir (ESSF), Alpine Tundra (AP), Coastal Western Hemlock (CWH) and Mountain Hemlock (MH) as elevation is gained. See the mapping appendices for a biogeoclimatic map.

All major interior fuel types as represented in the Canadian Forest Fire Danger Rating System are present in the District. Fuel types should be assessed by fire suppression staff at time of fire response.

Fire suppression has been very effective over the past half century. Many forested ecosystems are significantly departed from the condition we would expect by their NDT. This has resulted in s significant amount of tree in-growth and encroachment, especially in IDF ecosystems and in vicinity of communities.

FOREST HEALTH CONSIDERATIONS AFFECTING FUEL CHARACTERISTICS

Currently the landscape level forest health factors in the TME are Mountain Pine Beetle (MPB), Spruce Bark Beetle, and Western Spruce Budworm. Other forest health factors are present at lower levels within the TME, but would only have a localized affect on fire behavior and/or management.

Almost every drainage containing pine within the TME has been impacted by MPB. Mapping depicting current and historic infestations within the TME, as well as the TSA Forest Health Strategy is available on the DCS Forest Health FTP site:
http://www.for.gov.bc.ca/ftp/DCS/external/!publish/Forest%20Health/.

Currently there is a landscape level spruce bark beetle infestation in the southern portion of the TME. The infestation is in the higher elevation spruce stands in the Smith Willis LU and within the east side of the Similkameen LU. A description of the spruce beetle infestation and spruce beetle susceptibility is provided within the TSA Forest Health Strategy available on the DCS Forest Health FTP site.

FIRE WEATHER STATIONS

The TME is covered by approximately 11 weather stations from the WMB Fire Weather Network. It is understood that for the legal purposes of the Wildfire Regulation, it is up to the individual or company to choose a weather station that will represent their operating area and conditions, or establish their own station to best represent their site of operations.

The general flow of wind is from the southwest across the plateaus. Valley bottom winds are usually funneled and follow the direction of the valley.

TOPOGRAPHY

The TME is characterized by gently rolling plateaus of various elevations, intersected by deep u shaped valleys. Most fires will be fought on terrain with lesser slopes. Many of the steeper valley sidewalls are in the NDT4, and not THLB. Therefore there will be opportunities for 'modified response' depending on values and expected burning conditions.

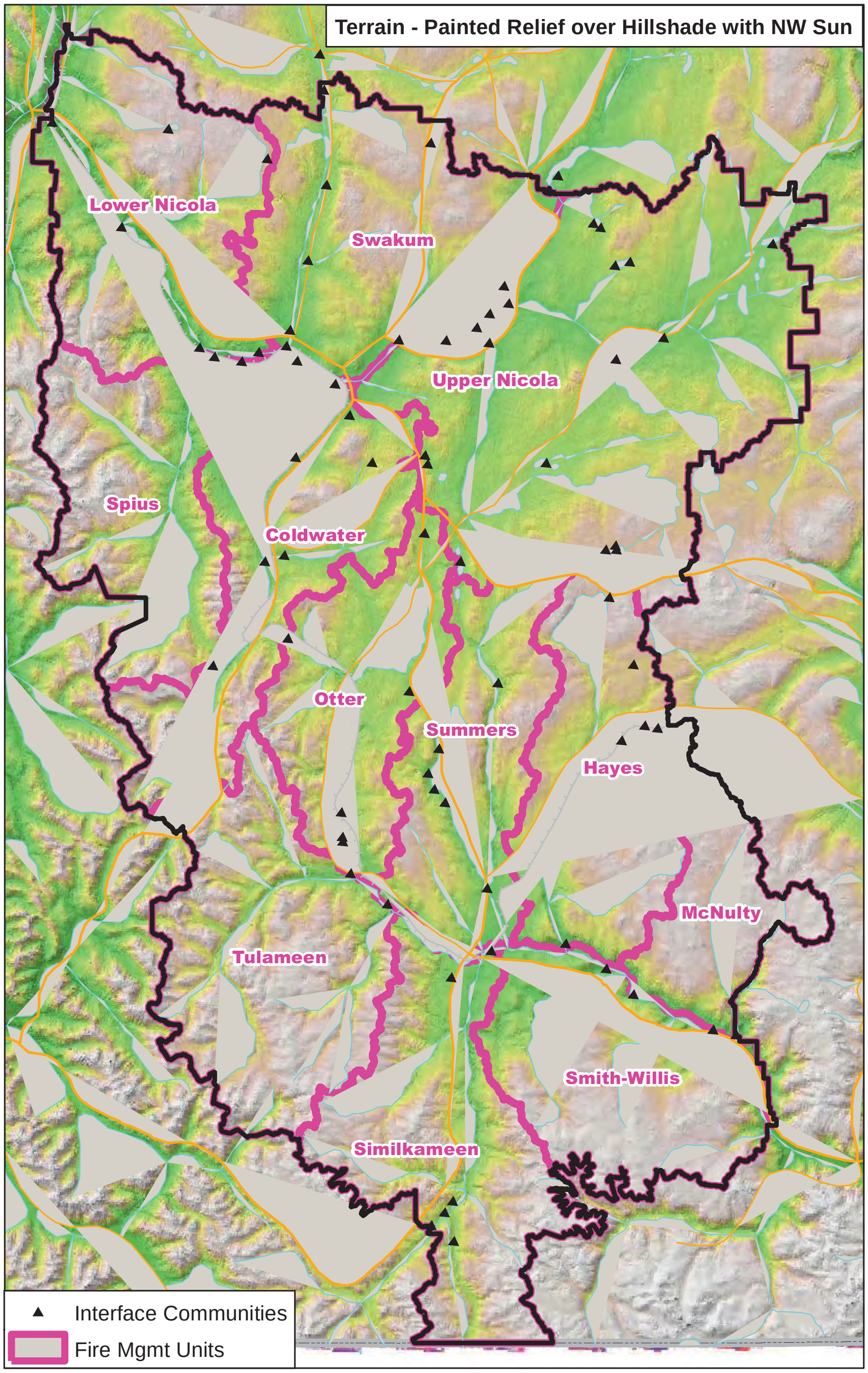


Figure 8 Terrain Modeling for the Merritt TSA.

PLANNING FOR THE OCCURRENCE OF FIRE ON THE LANDSCAPE

BURN P3

Burn-P3 is a simulation model used to evaluate wildfire susceptibility over large fire-prone landscapes. A landscape-level Monte Carlo approach combines deterministic fire growth modeling with probabilistic model inputs. The *Prometheus* fire growth model is used to repeatedly model fire growth, while fire ignitions, spread events, and fire weather conditions are modeled from historical fire and weather data. The resulting approach, called BURN-P3 (probability, prediction, and planning), allows users to map wildfire susceptibility, expressed as burn probability (BP), for a given year. Burn-P3 is available as a Windows-based software application. Parisien *et al.* (2005) describe the Burn-P3 model in detail. http://cfs.nrcan.gc.ca/bookstore_pdfs/25627.pdf

A Burn P3 has been completed for the TME. It is currently at a preliminary stage and not useful for fire planning at this point in time. We have chosen to not include it within this document.

FIRE ANALYSIS

On all fires that escape initial attack, the Zone Wildfire coordination officer/Incident Commander will complete a Fire Analysis (FA) (FS 1144 or short form), in concert with the land manager and/or his designate, and convey it to the Fire Centre. Recognizing the sense of urgency, land managers and other agencies must provide input in a timely manner. **The safety of fire line personnel will be paramount in the consideration of fire suppression options**.

The purpose of the Fire Analysis is to:

- Provide a standardized format to formalize the suppression plan.
- Specifically
  - identify values at risk
  - determine objectives consistent with values at risk and area management objectives
  - clearly outline fire suppression strategies and tactics to be employed, including trigger points where applicable
  - provide consideration of possible benefits of the wildfire.
- Clearly identify and state any constraints to the proposed fire suppression activities.
- Estimate the costs and time to achieve control and the suppression objectives.

VALUES AT RISK

Understanding values and recognizing their importance at the individual, community, regional, provincial, and international scales is critical to fire management planning, fire response options, and fuel management planning.

As stated earlier, the district manager recognizes the ranking using the RSWAP process, but would provide the following input into values prioritization.

The larger communities within the Merritt TSA are dependent upon resource based economies. Therefore, all infrastructure is viewed as extremely important. Much of this infrastructure may not be insured. Loss of this infrastructure may result in a loss of economic activity and ultimately jobs. Job loss may destabilize small communities. In some situations, on a societal basis, this means that protection of infrastructure would have a higher priority than protection of evacuated residences.

We view the operable forest as critical infrastructure. The Merritt TSA is a high value area. In direct stumpage revenue, the Merritt TSA has provided more than $330 million over the past ten years; to support the provincial budget. This dollar value does not begin to account for spin off benefits and other revenue to the Crown. The timber supply has been impacted (reduced) by MPB, and is in a tight situation. The supply of available unconstrained mature timber is close to the Annual Allowable Cut. All areas of Timber Harvesting Landbase (THLB) are extremely important. We view the THLB as a priority 2a value.

MUNICIPALITIES AND COMMUNITIES

The range of development within the TME includes larger communities, smaller communities, concentrated rural development, as well as numerous First Nation communities. Potential is high for interface fires along most of the highway corridors. The TME is represented by the Thompson-Nicola Regional District (TNRD) and the Regional District of the Okanagan Similkameen (RDOS).

Larger Communities	Merritt, Princeton
Smaller Communities and Concentrated Rural Development	Lower Nicola, Tulameen Aspen Grove, Brookmere, Kingsvale (Figlinski Rd in Voght Valley), Coalmont, Douglas Lake, Hedley, Quilchena, , Glimpse Lake, Paradise Lake, Peterhope Lake, Bankier (Osprey Lake area), Eastgate, Summers Creek (south end of Missezula Lake), other areas as indicated in the mapping appendices.
First Nation Communities	Cook's Ferry Indian Band, Coldwater Indian Band, Lower Nicola Indian Band, Shackan Indian Band, Upper Nicola Indian Band, Nooaitch Indian Band, Upper Similkameen Indian Band, Lower Similkameen Indian Band.

COMMUNITY WILDFIRE PROTECTION PLANS

The community wildfire protection program (CWPP) which began in 2004 is a cooperative effort between the BC Union of Municipalities (UBCM) and the Ministry designed to assess and, when needed, mitigate fire hazard and risk within the wildland urban interface (WUI) of communities and municipalities within the Province. The BC Union of Municipalities is the funding body while WMB provides the technical reviews and promotes the CWPP program. A fuels management specialist housed within one of the six fire centers in the province promotes the development of a CWPP with a local community to assess wildfire hazard and risk to the community. Assuming the local community adopts the need for an assessment they develop the CWPP. WMB reviews the hazard and risk assessment and UBCM funds it's development After an assessment is complete the community may then develop prescription(s) for hazardous areas designed to reduce the fire hazard to an acceptable level. The community and UBCM combined to fund the prescription development and work while WMB again provides technical reviews.

Plans are in place in the following communities within the TME:

- City of Merritt
- Town of Princeton
- Thompson Nicola Regional District
- Regional District of Okanagan Similkameen (RDOS)

Merritt Fire Zone and Kamloops Fire Center staff may have information regarding CWPP and where to access the plans.
The City of Merritt has information on their planning here:
http://www.merritt.ca/siteengine/activepage.asp?PageID=110
The RDOS plan is located here:
http://www.rdos.bc.ca/index.php?id=530&no_cache=1&sword_list%5b%5d=community&sword_list%5b%5d=wildfire&sword_list%5b%5d=protection&sword_list%5b%5d=plan

In a fashion analogous to the CWPP process for communities within BC, First Nations Communities also have the opportunity to develop CWPPs for their communities and reserves. The promotion and technical review for First Nations community CWPPs is conducted by specialists within the First Nations Emergency Services Society (FNESS). Early in the program funding was supplied by the Federal government but now funding for First Nations CWPPs comes from the same source as community and municipality CWPPs – UBCM. Numerous First Nations CWPPs have been developed and contacts at FNESS are able to provide information about the First Nation CWPPs within the District. FNESS can be contacted through their website at: http://www.fness.bc.ca

The CWPPs have been incorporated into the Fuel Management section of this plan.

MAJOR INFRASTRUCTURE

INDUSTRIAL INFRASTRUCTURE

- Gas pipelines
- Electrical transmission lines
- Communication towers/repeaters
- Fiber optic lines
- Mines

A major **Terasen Pipeline** runs through the TME. It runs from Logan Lake to west of Merritt, runs south, then proceeds east to Kane Valley and heads towards Princeton. From Princeton it travels easterly towards Keremeos. This pipeline is proposed for twinning and expansion; which is being handled by the Oil & Gas Commission. This may include new right of ways heading to Vancouver. There is another major pipeline; the **Kinder Morgan Trans Mountain Pipeline**. It travels down Clapperton Creek along the Coldwater River enroute to Burnaby. This pipeline is also proposed for twinning at this point in time. Fire suppression activities involving heavy equipment and personnel must consider the proper procedures when crossing or operating on or near a gas line.

There are **electrical transmission lines** (major and secondary) throughout the TME, as well as microwave towers, cell phone towers and repeater sites. One of the major electrical transmission supply lines for Vancouver travels into TME through the Nicola substation and down to the coast via the Lundbom area and through to Uztlius Creek. Construction has already started on twinning this transmission line. Construction has started on another transmission line from the Kwoiek clean energy project to the Mamit Lake substation via the Nicomen and Pimainus areas. Fire suppression activity using air tankers, helicopters for access and bucketing, heavy equipment and ground personnel should be aware of the special hazards and constraints when operating around these sites.

Fiber optic lines are often buried within the existing rights of way of highways and roads.

Mines are a major source of economic activity for the province. Mines also pose special considerations when conducting fire management activities. Mines may have stores of a variety toxic chemicals and explosives onsite in various quantities and storage types. There may be open or partially buried tunnels that pose safety risks to workers. Coal mines, when ignited, have the potential for multiyear underground fires, which come to the surface occasionally.
There is active and historic mining exploration and mines throughout the TME. Some of the known mines include:

- Copper Mountain Mine – active copper mine south of Princeton.
- Treasure Mountain – active silver mine in the Tulameen river area, approximately 100 people employed between the mine and mineral processing facility.
- Blakeburn Basin Coal mine – active coal mine in the Blakeburn creek area south of Coalmont.
- Craigmont Mine – inactive open pit mine for copper northwest of Lower Nicola, the mill is active processing silver ore and reworking the old tailings.
- Elk Goldmine – active goldmine just south of Elkhart exit on Coquihalla Highway.

There are active placer mining operations along the Tulameen River and tributaries to the south of the Tulameen River.

There has been historic coal mining in several areas: the south of Merritt, the Quilchena Creek area, and several areas near Princeton including Blakeburn.

HIGHWAYS

The TME is serviced by the following highways:

Highway	Level of Importance	Location
Hwy 1	**Provincial**	(Trans-Canada Hwy, **Fraser Canyon route**) Travels north from Hope to Spences Bridge where it continues north and enters the Cascades district.
Hwy 3	**Provincial**	(**Hope Princeton route)** Enters Cascades District from Hope on the south end and travels East through to Princeton
Hwy 5	**National**	(Yellowhead Hwy)**: (Coquihalla Phase I+ II)** Enters the Cascades District from Hope and continues north to Kamloops.
Hwy 5A	**Regional**	(**Old Kamloops Hwy**) Travels north from Merritt to Kamloops and south from Merritt to Princeton.
Hwy 97C	**Provincial**	(**Coquihalla Connector Phase III**) Travels East from Merritt to Kelowna.
Hwy 97C	**Regional**	**(Nicola Mamit Hwy)** North of the Hwy 8 junction, Highway 97C goes north to Logan Lake.
Hwy 8	**Regional**	Travels West to Spences Bridge from Merritt.

The Coquihalla Highway Phase I + II has a national level of importance, due to the volume of goods and people from across the country that are transported on a daily basis.

RAILWAYS

There is a small section of very active railway on the east side of the Thompson River from Spences Bridge heading north to the TSA boundary in the TME. This railway has national level of importance due to the volume of goods from across the country that are transported on a daily basis.

AIRPORTS

The TME is serviced by the following paved/unpaved airports/airstrips:

- Merritt airport
- Douglas Lake airstrip
- Quilchena airstrip (unpaved)
- Princeton airport

All of these airports are regional in nature and do not have regularly scheduled flights.

TIMBER

The TME is about 1,130,000 hectares in size; of this about 680,000 hectares are Crown land with forests which are feasible to harvest. This land is commonly referred to as the "Timber Harvesting Landbase", or THLB. The TME provides an Annual Allowable Cut (AAC) of 2.4 million m^3 /year. The AAC supports five major licencees; operating areas are depicted in the mapping appendices, and one Community Forest Licence.

Major Forest Licensees	Aspen Planers, Stuwix Resources, Tolko Industries, Weyerhaeuser, and BC Timber Sales
Community Forest Licensees	Princeton Community Forest

The AAC also supports about 50 issued Non-Replaceable Forest Licenses (NRFLs), 23 Woodlots and additional First Nation licenses are currently being issued.

Within the TME, the current timber supply supports the following major facilities:

- Aspen Planers (Merritt) – Dimensional Lumber
- Tolko (Merritt) – Dimensional Lumber
- Weyerhaeuser (Princeton) – Dimensional Lumber
- Trace Resources (Merritt) – Chips, Dimensional Lumber

Several post and rail mills, value added mills and fiber utilization plants also depend upon the timber resources within the TME.

The TME is still in the process of salvaging as much mountain pine beetle impacted volume as possible. These stands currently have high value for the Crown and tenure holders. As the mountain pine beetle passes through the TME over the next decade or so, pine stands will begin to deteriorate in quality and value. Our current understanding suggests that MPB affected trees have value for dimensional lumber for at least 10-15 years. The value of MPB affected trees for fiber uses is anticipated to extend out as long as the trees stay standing. The most recent Timber Supply Review shows the TME is facing a drop in the midterm timber supply when the mountain pine beetle affected stands lose too much quality and value. Douglas fir and spruce forests will become increasingly valuable as the dead pine stands lose value both locally and provincially. These fir and spruce stands, as well as immature (about 15-65 year old) stands, will be depended upon to provide a steady supply of timber through the coming decades and are therefore especially important to protect at this point in time.

Plantations are another particularly important consideration. The average cost to grow a plantation to a free growing state within the TME is about $1200 per hectare. If a licencee obligation plantation is damaged by fire, they may apply to government (under legislation) to be either have the obligation removed or be reimbursed their costs to get the plantation back to the state it was before being impacted by fire. This can amount to very significant costs to the Crown.

COMMUNITY WATERSHEDS

There are 9 Community Watersheds and a number of Domestic Watersheds throughout the TME. The goal in any fire suppression effort is to minimize impact on present and future water quality and quantity.
Points of diversion should also be considered during wildfire operations. These are for domestic use in rural areas. Maps of Community Watersheds are presented in the mapping appendices.

- Community watersheds are defined in the *Forest Planning and Practices Regulation*.
- Resource management in community watersheds is the joint responsibility of the BC Forest Service District Manager and the Designated Environment Official.

Wildfire response activities in community watersheds should focus on preservation of riparian zones. Riparian zones are typically in proper functioning condition when the ability of a stream, river, wetland or lake and its riparian area can withstand normal peak flood events without experiencing accelerated soil loss, channel movement or bank movement; filter runoff; and store and safely release water. Road or trail construction is improved when the alignment is properly reviewed and there is a good understanding of the terrain that is to be crossed. During fire-fighting activities there is frequently no time for a field review to determine the best alignment and guard construction can be harmful to the health of the riparian zone and affect chemical and physical water quality, water quantity, and channel stability. In community watersheds, entering the riparian zone with machine-built fireguards should be avoided whenever possible.

Wildfire Suppression:

- Initial attack can be undertaken without consulting the District Manager.

- All suppression personnel should be made aware that they are operating within a community watershed.
- Where more stringent standards have been developed in consultation with the municipality, they will be followed, unless values at risk and fire behavior preclude it.
- Fire fighting chemicals (fire retardant and foams) should not be used except in rare cases.
- Resource Managers will be consulted when an initial attack failure occurs and jointly complete a Fire Analysis. Resource Managers will include District Manager, District staff, Fire Centre staff, the Water Purveyor and other affected agencies, as required.

Rehabilitation will be required and will be conducted consistent with the Fire Suppression Rehabilitation Standard Operating Guidelines (SOG).

- Post-Wildfire Erosion Hazard Assessment and Risk Management may be required where increased risks to public safety or critical infrastructure and significant property values exist. Where severe surface erosion, landslide, gully processes, and flood events after wildfire exist on Crown land, the same process will be followed. These activities will be coordinated by the Southern Interior Region (SIR). The Fire Suppression program may fund this.
- Where harvesting operations are carried out in a community watershed the forest licensee is responsible for an appropriate contingency plan.

PARKS, PROTECTED AREAS AND ECOLOGICAL RESERVES

PARKS AND PROTECTED AREAS

There are a number of Provincial Parks and Protected Areas within the TME. Parks and protected areas are managed for important conservation values and are dedicated for the preservation of their natural environments for the use and enjoyment of the public.

The Protected Area Strategy in the TME has never been supported by an LRMP process, thus these areas should be treated as unencumbered crown land for the purposes of fire fighting and forest protection.

Parks and Protected Areas	**hectares**
Allison Lake	**23**
Bromley Rock	**149**
Coldwater River	**76**
Kentucky-Alleyne	**144**
Monck	**92**
Otter Lake	**51**
Stemwinder	**4**
Coquihalla Summit Recreation Area – Zopkius Ridge / Coldwater River section	**2,730**
Cascades Recreation Area	**11,858**
Total	**15,127**

Many of these are front country parks with campsites. There is often high occupancy during the fire season.

ECOLOGICAL RESERVES

Ecological reserves are areas selected to preserve representative and special natural ecosystems, plant and animal species, features and phenomena. Scientific research and educational purposes are the principal uses of ecological reserves. Ecological reserves are established for the:

- Preservation of representative examples of British Columbia's ecosystems;
- Protection of rare and endangered plants and animals in their natural habitat;
- Preservation of unique, rare or outstanding botanical, zoological or geological phenomena;

- Perpetuation of important genetic resources; and
- Scientific research and educational uses associated with the natural environment.

All consumptive resource uses, such as tree cutting, hunting, fishing, mining, domestic grazing, camping, lighting of fires and removing materials, plants or animals, and the use of motorized vehicles are prohibited in ecological reserves.

Two Ecological Reserves exists within the TME. The requirement to take action would be documented in a FA and the appropriate authority will have been consulted.

Ecological Reserve	Hectares	Comment
Soap Lake Ecological Reserve	884	Located 3km southeast of Spences Bridge, on the Nicomen Plateau. Established to conserve an alkaline lake, its associated flora and fauna, and representative ecosystems of the Interior Douglas Fir zone.
Whipsaw Creek	32	10km southwest of Princeton near Whipsaw FSR. Large, old Ponderosa Pine forest types.
Total	**916**	

WILDFIRE SUPPRESSION IN PARKS, PROTECTED AREAS AND ECOLOGICAL RESERVES:

All action in Provincial Parks, Protected Areas and Ecological Reserves beyond initial attack will be supported by a completed FA, done in consultation with information from the BC Parks website. Where possible, communication will be made with park staff to encourage their input. Initial attack may or may not be desirable according to BC Parks plans. Their plans should be consulted prior to conducting any wildfire suppression activities within Provincial Parks, Protected Areas and Ecological Reserves. The Ministry of Forest and Range District Manager representative will also be consulted, if there is any possibility that a fire will exit the park.

The BC Parks website is located at:
http://iwww.env.gov.bc.ca/wildfire/pre_fire/planning/pre_attack.html

The website has data including general Park information, contact information, pre-attack plans, boundary maps, fire management plans, fire suppression considerations and more.

RECREATION SITES AND TRAILS

Ministry of Forests, Lands, and Natural Resource Operations has an extensive network of recreation sites and trails within the DCS. They include several cabins/huts. Within the TME there are 87 legally established Recreation Sites with infrastructure suitable for camping and day use, 22 legally established recreation trails and numerous recognized sites, trails and areas deemed recreation reserves which may or not be legally established where use of the public is frequent and dispersed.

These sites and trails are moderately used and are located throughout the forested landscape. There are some large well developed sites with easy access, while many are isolated small sites in the back country. Trails are also located near urban settings but others are quite remote. Most trails are multi use, of various lengths and therefore are used all year long. The threat to human life is a real possibility during a wildfire, depending on size, length and location.

Fire suppression activities should be conducted with the appropriate consideration when operating on or near these sites.

In TME there are four Heritage Trails, regulated under the Heritage Conservation Act. These trails are the Hudson's Bay, Watcom, Dewdney, and Hope Pass. The trail reserves are 200 meters wide. These trails are located in the southern portion of the TME. Local recreation managers and Archaeology Branch [(250) 953-3334] should be consulted when fire suppression activities are considered over these trails.

First Nations also have extensive networks of trails within the Cascades Forest District. Discussions with the appropriate First Nations group are needed to ensure that fire suppression activities adequately manage these trails.

COMMERCIAL OPERATIONS

There are many commercial recreation operations within the TME. As stated above this will create risks to people and improvements during the fire season, even though some of the activities are carried out during the winter and shoulder seasons.

A Controlled Recreation Area exists within the TME. A CRA is the area of crown land that encompasses the recreation infrastructure and activity area, the base area and a reasonable buffer area that is directly related to the safe and orderly development of the All Season Resort (ASR). It provides the legal mechanism for the developer to control access and use within the CRA by other persons to ensure the safe and orderly development and operation of the ASR. The CRA is established under section 39 of the *Land Act* as a licence of occupation. Most CRAs have a ski component. The Resort Development Branch of MTCA administers all Land Act and Forest Act activities within the CRAs. The lead on CRAs is Reg Nolander with MOTCA in Kamloops, phone 250-371-3939, fax 250-371-3942, email Reg.Nolander@gov.bc.ca.

The CRA within the TME is called Bear Mountain and is located at the China Ridge Ski Area, west of Princeton. A provincial map depicting CRAs is available at /ftp/!Project/Fire_Management_Planning/.

RECREATION

The TME has developed into a year round destination for many different recreation activities. There is heavy recreational use by the local population and visitors from Alberta. There is also a large compliment of visitors from other parts of BC/Canada, the US, Europe, Asia and other parts of the world.

People pursue a variety of activities on both Crown and private lands as well as within Provincial Parks.

A list of activities would include:

- Camping and/or Fishing (self and professionally guided),
- Hunting (self and professionally guided),
- Boating (motorized and non-motorized),
- Swimming and other water activities,
- Hiking, Sight Seeing (self and professionally guided),
- Mountain biking, Bicycle Touring (self and professionally guided),
- Off road motorcycle and All Terrain Vehicle (ATV) use,
- Snowmobiling, Cross Country Skiing and Ski Touring,
- Wildlife Viewing

While some of the above activities are carried out in the winter or the shoulders of fire season, they often put infrastructure in place that is at risk during the summer. For example, guide outfitter camps and back country ski resorts with their associated development.

RANGE

Crown range supports 77 tenure holders (including grazing leases) and approximately 120,718 animal unit months (AUM) of domestic livestock grazing in the TME. Ranching is an important industry and job creator both in the province and within the TME. Many of the tenure holders have large herds of animals that take time and resources to move in the event of a threatening wildfire. Contacting licencees early and working within the Range Provincial Standard Operating Guideline is strongly advised.

Many of our grassland ecosystems are grazed annually to a point that wildfire will not spread at the same rate as modeling suggests. We are currently working on a map to depict the areas of known heavy annual grazing to assist wildfire managers. In broad terms open grassland areas will be grazed heavily, where open forested areas will be grazed lightly to moderately.

Wildfire can provide benefits to grassland ecosystems. Benefits generally occur when fire is expected to only burn surface fuels and not damage the soils. Fire and fire suppression activities can have an adverse effect on range developments, in particular fences. The Fire Analysis should take into account these potential impacts when considering fire suppression strategies and tactics.

Fire suppression activities, especially fire control lines can contribute to the spread of invasive plants. Provisions for fire rehabilitation incremental activities beyond WMB's mandate, may address those activities with other funding sources.

FIRST NATIONS' ARCHEOLOGICAL SITES/VALUES

Archaeological sites and oral tradition are the only vestiges of a rich history extending back at least 12,000 years. This resource is of great value to First Nations (FN), local communities, and the general public. We need to protect and conserve this rich but fragile legacy. The Provincial Government recognizes the importance of archaeological sites through the Heritage Conservation Act (HCA). Under the HCA, a protected archaeological site must not be damaged or altered without a site alteration permit. Certain criteria are used to determine whether an archaeological site is protected, but it is important to know that protection status applies to archaeological sites on both private and public land. The HCA also protects archaeological sites whether they are known or unknown. If you think you have discovered an archaeological site, stop activities in the area and contact the Archaeology Branch by telephone at (250) 953-3334.

FN values are extremely important, incredibly diverse, and extend much further than just archaeological resources within TME. One should strive to contact appropriate FN groups when activities beyond initial attack are considered. To find the applicable FN groups, check the Consultative Areas Database (CAD), located here:
https://apps.gov.bc.ca/int/cbd/jsp/Ministry/min_main.jsp
DCS or Fire Zone staff may also be able to assist in identifying the applicable FN groups.

Most of the TME has varying potential for archeological sites or may have values present. Currently there is no mapping available for public use. Archeological sites are sensitive information and known sites are available on the restricted access site, Remote Access Archaeological Database (RAAD). Further information may available upon request from applicable FN or the DCS. The information is primarily used if soil disturbing activities are being considered.

High potential areas for archeological sites include riparian zones, benches above river, trails and caves. Fires suppression efforts should take this into account particularly within the high risk areas. Heavy equipment should be used with care or avoided if sites or artifacts could be disturbed.

WILDLIFE

FIRE MANAGEMENT STRATEGIES FOR WILDLIFE AND HABITATS

Fire management strategies for wildlife and habitats have been written by Doug Lewis. These strategies help one to choose appropriate wildfire responses where fire has potential to impact specific wildlife attributes. This paper is included as **Appendix F**. The main management recommendations are presented below:

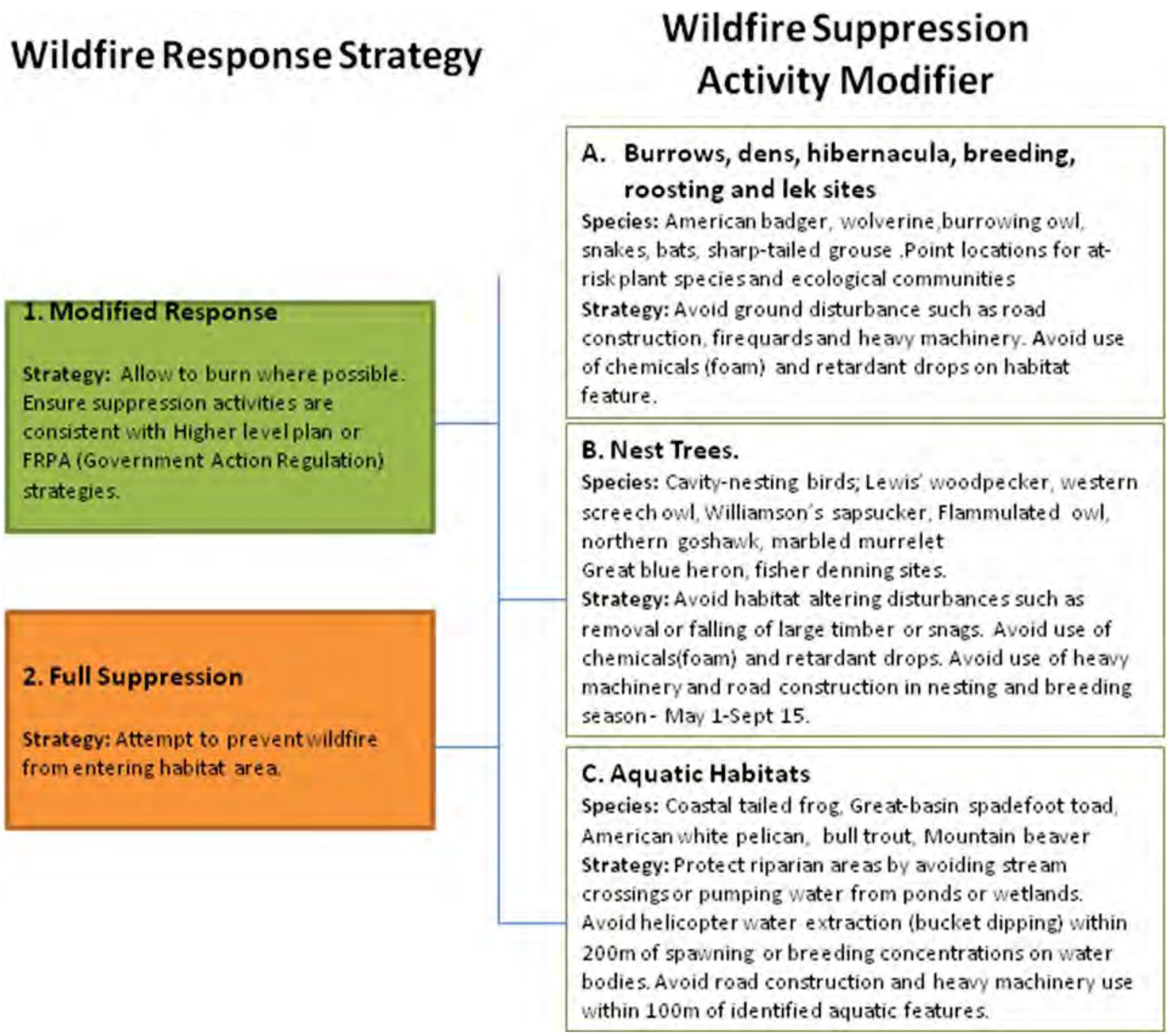


Figure 9 Wildfire Response Strategies for Identified Wildlife

UNGULATE WINTER RANGE

"Ungulates" are hooved mammals, and include whitetail deer, mule deer, moose, and elk. Mule Deer and Moose are prevalent in the TME. Winter range for these two wildlife species has been approved under the *Government Actions Regulation* and is indicated in the mapping appendices.

Areas considered of particular importance as ungulate winter range include lower elevations areas with minimal snow accumulation (ie. south aspects), abundant forage plants, and sufficient snow interception cover to allow hiding or movement. Snow interception cover is made up of high percentage, old Douglas fir, with denser crown closure. Much of the TME ungulate winter range planning cells are in tight condition for stands with these attributes. Therefore these stands are important to protect from stand replacing wildfire.

WILDLIFE HABITAT AREAS

There are approved Wildlife Habitat Areas (WHAs) in the TME. WHAs are approved by the Ministry of Environment under the *Government Actions Regulation*. WHAs are approved with specific management direction for the individual area. The Ministry of Environment has an Identified Wildlife Management Strategy webpage (http://www.env.gov.bc.ca/wld/frpa/iwms/wha.html) where the approved order or spatial information for each WHA may be downloaded. All approved WHAs are indicated in the mapping appendices.

OLD GROWTH MANAGEMENT AREAS

Old growth forests, often over 250 years in age, contain unique habitat structures which typically take a long period of time to develop. Consequently, these structures also take a long period of time to replace if they are removed by logging or wildfire. Old growth management areas (OGMAs) are indicated in the mapping appendices.

At the same time, old forests in the TME rarely escape natural disturbance completely. Stand-replacing wildfires may come infrequently in some of the wetter parts of the TME, but in dry years these areas may have extremely intense burns due to high levels of fuel.

Wildfire activities should if possible, minimize the impact on OGMAs. In general, it is desirable to avoid stand replacing wildfires in OGMAs.

REGISTERED TRAPLINES

Registered traplines exist within the TME. Registered trapline mapping and contact information is contained in **Appendix D**. Traplines are generally a lower priority when wildfire is present on the landbase. They may have some infrastructure present or have people maintaining the lines.

TERRAIN STABILITY

Terrain Stability Mapping Background Information

Terrain Stability Mapping involves inventorying existing features, conditions and processes of the landscape by field observations and by map and aerial photographic analysis and assessing these to make interpretations relating to the stability and erodibility of slopes following conventional logging. Usually completed at the 1:20,000 scale, data and interpretations are suitable for helping plan forestry development, but are not usually detailed enough to provide site-specific, operational recommendations and decisions. The mapping is simply the sub-division of the ground surface into polygons which have similar attributes of provenance (genesis, origin), material texture, surface expression, slope, drainage characteristics and geomorphic process.

There are two main forms of Terrain Stability Mapping: Detailed and Reconnaissance. Detailed Terrain Stability Mapping (DTSM or Terrain Survey Intensity Level C) provides complete sub-division, classification and interpretation of the terrain and usually comes as two maps. The primary map produced is a terrain classification map which has the dominant surficial material with a surface expression, and may include identification of texture, geomorphic process, slope and drainage. Fieldwork is an important and extensive component of this mapping and provides good local knowledge of the area mapped. The interpretive map is based on the classification map and rates each of the terrain polygons for stability following road construction and conventional logging. There are 5 terrain stability classes used in DTSM and these are denoted with roman numerals I to V. Classes I, II and III are varying levels of stability, from no stability issues, through a very low likelihood of instability to a low likelihood of instability. Class IV polygons are expected to have instability problems on marginally stable steep slopes and sensitive surficial materials: natural landslides are rare, but conditions are similar nearby unstable slopes, or show evidence of small-scale instability and/or excessive slope steepness. Class V polygons have significant stability problems with active landslides, very sensitive surficial materials, excessively steep slopes and drainage problems.

Reconnaissance Terrain Stability Mapping (RTSM or Terrain Survey Intensity Level D) is a broader brush approach to mapping the landscape. During the aerial photography work only the potentially unstable or unstable polygons are delineated: the remaining terrain is classified as stable. Fieldwork is less extensive than DTSM and focuses on the delineated polygons. These polygons have the same terrain identifiers as above, but the stability ratings are in three classes: S for stable, P for potentially unstable and U for unstable. Stable approximates DTSM classes I, II and III; potentially unstable is approximately equivalent to DTSM class IV; and unstable is similar to DTSM class V. Due to the reduced field component, and generally more broad scope of the mapping, they therefore tend to be larger polygons that are slightly more conservatively rated.

TSIL A and B are detailed on-site mapping or field specific site investigations.

The old "Kamloops Forest Region" has 100% TSM coverage in the Lillooet District; 20% in the Merritt District; 50% in the Kamloops District; 40% in the Clearwater District; 50% in the Salmon Arm District; 60% in the Vernon District; and , 60% in the Penticton District. The coverages are a mix of TSIL C and D. The old "Nelson Forest Region" has good TSM coverage at TSIL D. The old "Cariboo Forest Region" has a moderate amount of TSM coverage at mixed TSIL C and D.

The Ministry of Environment is the custodian for the TSM data set and can be accessed at the following website: http://www.env.gov.bc.ca/terrain/terrain_files/access.html . MOE personnel involved in TSM data management are Deepa Filatow (250) 861-7675 and Maija Finvers (250) 387-9474.

Wildfire Response Strategies

Class IV or P terrain has slope stability issues and trails or fireguards are especially problematic. Avoid when possible or contact a terrain stability professional to provide site-specific advice. If the ground must be crossed with machinery avoid prolonged straight-down the fall line guards, be wary of seeps or wet ground on steeper slopes, be very careful of gullies (small, but deeply incised watercourses, may be dry in summer but can carry water and debris during other seasons), avalanche tracks or potential rockfall from exposed bedrock. On steep slopes, trees can be good signs of instability, J stemmed, jackstrawed or leaning trees, as well as water-loving vegetation.

Class V or U terrain holds significant slope stability issues. Avoid crossing unless absolutely necessary or contact a terrain stability professional to provide site-specific advice.

Typically, as with most risk mapping procedures, the polygons are generally conservative and especially in areas where accessibility is restricted, thus they are larger than necessary or more cautiously rated than required. Most of the potentially unstable or unstable polygons (IV, V, P and U) do have a majority of ground that is correctly mapped, but due to mapping procedures (lumping vs splitting) and representational purposes the true area of the instability is enlarged, thus site-specific review of the terrain by a qualified terrain specialist may provide viable options for wildfire response activities.

In some cases fireguards can be rehabilitated during construction and may be a valuable savings in time and finances. Proper rehabilitation techniques must be applied on the steeper fireguards, especially to ensure proper drainage control. Additional References:

Provincial Standard Operating Guidelines for Rehabilitation and Heavy Equipment can be found in the internal Wildfire Management Branch Library:
https://icw.for.gov.bc.ca/protect/wmrc/?id=LUID100309
Work Safe BC regulation Part 26.16 regarding steep slope limitations:
http://www2.worksafebc.com/publications/OHSRegulation/Part26.asp#SectionNumber:26.16 .

Terrain stability mapping is predominantly focused on hazards on the slopes and does not highlight areas of increased downslope risk (i.e. alluvial fans below debris flow tracks; talus cones below rockfall initiation areas; enlarged avalanche runout zones). This information can easily be interpreted from the maps by a terrain specialist and can be provide crucial information for protection of public safety, private property and infrastructure that is located within and downslope of the burned area.

DTSM	RTSM	Stability Issues	Strategies
I, II, III	S	Stable to moderately stable; flat to moderately steep terrain; no, very low or low likelihood of forestry-	Sensitive microsites or inclusions of steep slopes may require a field inspection by a terrain stability professional.

		induced instability.	
IV	P	Potentially unstable; marginally stable steep slopes, gullies, sensitive terrain; moderate likelihood of forestry-induced instability.	Avoid when possible. A field inspection by a terrain stability professional is required prior to road development or ground-based harvesting. Special road construction techniques usually recommended.
V	U	Unstable terrain showing evidence of recurrent, natural landslides; high to extreme likelihood of forestry-induced instability.	Avoid crossing unless absolutely necessary. Road building or harvesting normally precluded. A field inspection by a terrain stability professional is required prior to any development. Specifically designed and constructed roads may be feasible.

Terrain Stability Professionals within the Southern Interior Region of the Ministry of Forests and Range include professional geoscientists (P.Geo.), engineers (P.Eng.).

Tim Giles, P.Geo., Kamloops, (250) 828-4168 Peter Jordan, P.Geo., Nelson, (250) 825-1214

Pat Martin, P.Eng., Kamloops, (250) 828-4562

A pre-qualified eligibility list is maintained on a yearly basis by the Engineering Section in Kamloops. This list includes individuals who are qualified for terrain stability assessments, road, trail and fireguard rehabilitation, and post-wildfire risk assessments.

RESEARCH INSTALLATIONS

Need to type a description of this value and link where to find them.

OTHER CONSIDERATIONS

ECOSYSTEM RESTORATION

The DCS endorses Ecosystem Restoration (ER) activities on the landscape. These activities seek to restore grasslands and open forest where forest in-growth and encroachment have occurred.

Initial steps have been taken towards ER activities by a steering committee. To date there have been no parties able to take on leadership of the ER initiative at a strategic level. No strategic plan has been developed for the DCS.

Prescriptions have been developed and treatments occurred in 2010 for several areas totaling close to 1,000 hectares. These areas are:

- Lundbom – South east side of Lundbom Lake
- Brakecheck – Hamilton Hill east of Merritt
- Five Pasture – Hamilton Hill east of Merritt
- Hamilton Commonage – South east of Nicola Lake

Prescriptions have been developed and treatments are planned for the following areas, although there is no proponent at this time:

- Skuhun Creek – West of Merritt
- August Lake – South of Princeton

Once treated, these areas should provide a good control point to fight wildfires from. DCS stewardship staff have further information regarding the specific areas prescribed for ER activities.

Activities to reach the desired results include harvesting, slashing, piling and prescribed burning of piles or broadcast burning. These treatments may be used in combination with each other.

An issue or risk associated with the ER program is that large tracts of heavy slash may created by slashing operations. The intent is to treat the slash once it has cured. This carries a hazard with it until such time as it is treated. The DCS will strive to ensure the following actions are carried out by proponents:

- utilize mitigation strategies that reduce the risk of fires starting and spreading
- notify WMB staff of locations of large areas of slash accumulations. A supporting map should also be submitted.

Wildfire has the potential to provide benefits to ER objectives should it occur under the proper conditions and circumstances. Unmanaged NDT4 areas may have missed many fire cycles. Missed fire cycles may cause excessive fuel loading, forest ingrowth, forest encroachment, and forest health issues. These conditions create the potential for much more volatile fires. Meeting many of ER type objectives will be unlikely and highly variable, based on site specific conditions and burning indices. In conjunction with a FA, fire control strategies could be incorporated to identify where wildfire might be used to compliment or accomplish some of the ER objectives.

Note that wildfires conducive to assisting ER objectives are likely only during times of lesser fire hazard. Also note that these forest types are generally adjacent to or surrounds rural interface areas so careful consideration should be given to this option.

INVASIVE ALIEN PLANTS (WEEDS)

Invasive plants pose a threat to our native environment and are recognized globally as the second greatest threat to biodiversity. They are plants that do not occur naturally in ecosystems in British Columbia and their presence can cause environmental and/or economic harm, and some species can harm human health. These non-native or alien invasive plants reproduce rapidly, are resilient and can overwhelm existing native vegetation. Specific impacts of invasive plant infestations include:

- disruption of natural ecosystem processes,
- alteration of soil chemistry - preventing the regrowth of native plants and economic crops,
- increased soil erosion,
- livestock and wildlife poisoning,
- increased risk of wildfires,
- interference with forest regeneration,
- allergic reactions, severe skin abrasions and burns on people.

Fire managers and Forest Professionals should consider the following information and best management practices when working in the TME.

List of Invasive Plant Species: It is essential to note that there are species that currently do not exist within the TME. The field guide of noxious and other selected weeds may be accessed here: http://www.agf.gov.bc.ca/cropprot/weedguid/weedguid.htm.

Inspection of Equipment: machine and vehicle operators should remove all soil and debris in addition to the removal of observed invasive plant material before moving on to a site or from one site to another.

Identification of Invasive Species Sites: During expanded firefighting operations and planning for rehabilitation activities, invasive species (IS) sites can be identified using the Invasive Alien Plant Program (IAPP) Application. http://www.for.gov.bc.ca/hra/plants/application.htm. Identified IS sites in proximity to a fire, operations base camp or firefighting operations (such as machine guard construction) should be avoided when possible. MFLNRO can provide further best management practices to reduce the spread of the identified species.

New Invasive Species Sites: Newly identified invasive species sites should be reported to either Weeds BC or the Regional Invasive Species Society.

Seeding: Under Federal Legislation, some BC Noxious weeds are permitted in seed mixes. When seeding, it is recommended that Certificates of Seed Analysis be requested from the vendor in order to review and ensure that seed is not contaminated with BC Noxious Weeds.

HARVESTING FOR FIRELINE OPERATIONS

In the event that fire line operations require control line creation and the route of the control line travels through merchantable timber; it is preferable to use harvesting equipment to clear the trees from the control line. The timber will be decked in a manner that is retrievable with normal harvesting equipment.

Where the value of the logs warrants recovery, a security deposit may be required in order to recover the costs of felling, skidding and decking. This timber will then be sold competitively.

There is much potential efficiency to be gained from working with timber licencees when harvesting for fireline operations. An example is location of machine guards matching proposed licencee road locations. There may be a reduced level of rehab needed, if the guard can be upgraded and used in the near future. Timber may also be processed in a manner that makes it suitable for milling, minimizing costly cleanup for the Crown. It is recommended that one strives to work with licencees when possible during these and other types of operations.

COMPLIANCE AND ENFORCEMENT (C&E)

C&E lead and support a variety of activities during fire operations. The roles and responsibilities are detailed in the Wildfire Management/Compliance and Enforcement Roles and Responsibility Matrix April 2010. This document, as well as others related to C&E, is located here: https://gww.for.gov.bc.ca/hpr/fc/kam/Fire_Management/CE_index.htm

RANGE PROVINCIAL STANDARD OPERATING GUIDELINES

There is a Range Resources Wildfire Suppression Planning and Response Agreement for use of range staff in dealing with range licencees. We were unable to locate this provincial guideline on MFLNRO web pages. A copy of the document has been placed on the DCS fire management FTP site, located at: http://www.for.gov.bc.ca/ftp/DCS/gov_internal/!publish/Fire%20Management%20Planning/

ACCESS MANAGEMENT

There are gated roads within the TME; many of these are for roads that cross private or First Nation's reserve land to access Crown land. If you require access, contact Fire Zone staff for locations and keys.

FUEL MANAGEMENT

FUEL MANAGEMENT OBJECTIVES

s.13, s.17

s.13, s.17 Need to think and work with Fuels Mgmt specialist on how this section develops.

Fuel Management with regards to slash hazard is governed by the Wildfire Act and Wildfire Regulation on a site specific basis.

The District, Wildfire Management and local governments use the Community Wildfire Management Plan (CWPP) process to manage fuels within the interface areas and within the 2 km spotting distance. In addition, we should look for proactive opportunities to manage fuels on both a site specific basis and on a larger scale. This could include (but is not limited to) opportunities to modify fuels around interface areas, mitigate hazard created by Mountain Pine Beetle infestations and harvesting, and utilize Ecosystem Restoration treatments to aid in fuel management objectives.

Prescribed burning should be used as a management tool as and where it will assist in the reduction of fire hazards, enhance other values, and enable silviculture activities.

The DCS and the Fire Zone strive to manage the fire risks and fuel loading at the local community level and the broader landscape level. To this end the DCS has allocated volume and issued broad salvage tenures in several of the low elevation valleys. These tenures are for dead or beetle affected stands in the ponderosa pine areas. Generally, ponderosa pine is not currently used for solid wood applications in BC. These salvage tenures have been obtained by licencees with grinders. The stands have been whole tree harvested (including branches) and ground for chips. This style of harvesting has a level of utilization that results in very low fuel loading within these areas. This may provide areas from which fires may effectively be fought. Local ranches have already conducted similar harvesting treatments on their private land. Many of the salvage tenures are in areas that will compliment the harvesting treatments on private land. The areas within TME that have had salvage tenures issued and harvested them are:

- Voght Valley
- Coutlee Plateau (north end)
- Aberdeen Road (near the rifle range)
- Patchett Road (south end of Coutlee plateau)
- Miller Estates (north of Highway 8, west of Lower Nicola)

Many other areas have had harvesting for interface protection reasons conducted on them. These include:

- Bankier (south of Osprey Lake)
- Sunshine Valley (near the Nooaitch Reserve and Spius Creek)
- Eastgate (entrance to Manning Park)
- Merritt (many areas on all sides, including the east side of Coutlee plateau)
- Snowpatch subdivision (Princeton)
- China Ridge Ski trails (heavily used in summer as well)
- Manning Park (Roads, trails and campsites in the Lightning lake area)
- All high use MFLNRO Recreation Sites and Reserves
- Iron Mountain (near the ranches and development surrounding Gwen and Edna Lakes)

In 2013 district manager tenures are planned for use in interface harvesting operations on areas to the southeast and southwest of Merritt.

In 2012, DCS had a contractor develop treatment polygons and prescriptions around communities. These prescriptions have been developed for the zone extending out to 500 meters around communities. Only a limited number could be dealt with using the available funding and time. The priority for prescription development was based out of the ranking of interface hazard that has been developed by the Merritt Fire Zone. These treatment polygons and prescriptions will be used to guide harvesting opportunities within the Small Scale Salvage program and other district manager tenures in the TME.

DCS has also worked closely with the Ministry of Transportation and Infrastructure to issue salvage tenures to protect highways fencing and right of ways. DCS has worked with major licencees and BCTS to allow clearing of widened right of ways on industrial roads and along fencelines that aren't associated with highways. These initiatives have provided safety for travelers and workers as well as providing more effective linear fuel breaks across the landscape.

The DCS and the Fire Zone will strive to continue their efforts and strive to involve all affected parties where and when possible.

This section needs expansion into planned and completed treatments and associated text.

PRESCRIBED FIRE

Prescribed fire is the knowledgeable and controlled application of fire to a specific land area to accomplish planned resource management objectives. These fires are managed in such a way as to minimize the emission of smoke and maximize the benefits to the site.

The success of aggressive fire suppression has resulted in a dangerous build-up of forest fuels, tree encroachment on grasslands, and in-filling of the once open, dry forests of the southern interior. More recently, forest, range, and wildlife managers have been using fire as a land management tool. Prescribed fire can help grow better forests, create better habitat for wildlife and domestic animals, reduce the intensity of naturally occurring wildfires, and return an integral process to some ecosystems.

To plan a burn, resource managers need to have a sound understanding of fire behaviour and its short/long term effects on the environment. In addition, different ecosystems (even different plant species) respond to fire in a different way. Optimum burning conditions are needed to reduce the chance of a fire's escape as well as reducing fuel loading without damaging the forest floor by excessive heat, which could result in erosion.

FIRE REHABILITATION

WMB may be required under Sections 6 and 9 of the *Wildfire Act* and Sections 16 and 17 of the *Wildfire Regulation* to rehabilitate damage related to fire suppression and control activities. Fire suppression activities often create situations that need to be repaired, rectified or restored. Machine guards, sumps, retardant, and opening old roads are examples of items that may have to be addressed in a rehabilitation plan.

Section 17 of the *Wildfire Regulation* specifies the prescribed requirements for a rehabilitation plan. The DCS representative will be available to provide advice and input to the rehabilitation plan. Wherever possible, rehabilitation activities will be carried out so as not to impact salvage harvesting providing the logging is done in a timely fashion.

POST WILDFIRE NATURAL HAZARDS RISK MANAGMENT

Staff in MFLNRO should be aware of this process to understand, identify, and analyze increased post-wildfire natural hazards and risk to public safety, infrastructure and other values related to wildfires on Crown Land to determine whether other agencies, stakeholders or ministries require notification in managing the risk, and where warranted, undertake risk mitigation treatments on Crown land within the scope specified in the Policy 9.X.[1] The flowchart called, "Post Wildfire Natural Hazards Risk Analysis" illustrates the key steps in this process and is included as **Appendix E**.

Following severe wildfires, the ability of exposed mineral soil to absorb intense rainfalls may diminish and the proportion of precipitation (rain and snow) reaching the ground will increase as a result of forest cover loss. These changes may result in increased overland flow and runoff that overwhelms natural and man-made drainage features. Severe soil erosion, landslides, debris flows, and floods may also increase as a direct consequence. These hazards can be initiated within or beyond the wildfire boundary. The occurrence of events, such as landslides or floods, can potentially result in threats to public safety, and/or damage to buildings and infrastructure.

[1] Note that this SOP is distinct and separate from the requirement for BC Wildfire Management Branch under Sections 6 and 9 of the *Wildfire Act* and Sections 16 and 17 of the *Wildfire Regulation* to rehabilitate damage related to fire suppression and control activities, although it may provide helpful input into the level of rehabilitation required under that *Act* and regulation.

This SOP was developed to ensure that a potential increased risk to public safety, buildings and infrastructure from natural hazard events following severe wildfires is systematically identified and appropriately communicated to stakeholders. It draws from the collective experiences of the MFLNRO specialists and external consultants involved in the significant 1998, 2003, 2007 and 2009 wildfire seasons.

The risk management framework underpinning this process is adapted from the Ministry of Forests Land Management Handbook 56 entitled, *Landslide Risk Case Studies in Forest Development Planning and Operations* (2004).

APPENDIX A – RESPONSE PRIORITIES - RSWAP

The Purpose of Resource Strategic Wildfire Allocation Protocol (RSWAP) is to ensure that a transparent provincial prioritization and resource allocation process is in place when resources are, or have the potential to become insufficient to meet the needs of the BC Wildfire Management. This guideline will apply when the Provincial Preparedness Condition (Prep-Con) level 3 is reached. Provincial Prep-Con 3 is defined as "*Increased activities, some fire centers unable to meet local resource demand*". This process prioritizes wildfires and resources assigned to them. The process works based on three reports; *Provincial Conference Call Prep Sheet*, *RSWAP Wildfire Priority* and *Outstanding Resource Needs*.

APPLICATION

This guideline applies when it is necessary to set priorities for:

- Multiple fire initial attack;
- Containment objectives and allocation of resources to fires beyond initial attack; and
- Strategic positioning of resources in anticipation of new fires occurring.

The information set out here provides decision makers with guidance that can be used in conjunction with consequence management plans, local fire management plans and other relevant information.

GENERAL CONSIDERATIONS

When setting priorities and allocating resources, decision makers will normally assess and consider a variety of factors, including:

- Safety of fire responders and emergency personnel
- Present and forecast weather and fire behaviour
- Availability of suitable fire attack resources
- Guidance or information in fire response plans
- Values at risk in the immediate vicinity and surrounding area
- Potential smoke and public health impacts
- Information available from local sources
- The probability of success

PRIORITIES

It is recognized that the degree of risk to defined values (e.g., high, medium, or low), and timing of that risk (e.g., imminent within 72 hours, or longer term) is determined by many variables, and can change in a very short time. When setting objectives and allocating resources according to WMB, priority will be given to protecting values on the basis of the following ranking, in descending order:

PRIORITY THEME 1 - HUMAN LIFE AND SAFETY

a. WUI – (1) SWTA Urban / Interface - Concentrated areas of residences and infrastructure facing imminent threat
    1) Urban >1000
    2) Interface 10 – 1000
b. Areas of high occupancy during fire season
c. Critical Evacuation Corridors - Locally Identified

PRIORITY THEME 2 - PROPERTY AND CRITICAL INFRASTRUCTURE

a. Infrastructure or assets important to public health and safety
    1) public buildings
    2) airports
    3) drinking water sanitation systems
    4) power plant locations

    5) communication cell and radio towers
    6) transmission lines
    7) oil and gas facilities or pipelines
    8) transportation facilities
b. Isolated / Dispersed residences and associated infrastructure facing imminent threat
    a. 1 – 10 /sqkm
    b. Less than 1/sqkm
c. Other infrastructure public and private
    a. Independent Power Projects
    b. Heritage Sites / Property
    c. Park Facilities and Infrastructure / Cabins, Visitor Services
    d. Commercial Properties and Business (Ski Areas, Private Lodges, Warehouses)
    e. High Value recreation infrastructure (ex. kettle creek bike trail, recreation sites)
    f. High Value range infrastructure

PRIORITY THEME 3 HIGH ENVIRONMENTAL AND CULTURAL VALUES

a. Community Watersheds
    1) Points of Diversion
    2) Drinking Water Catchment Areas
b. GAR Orders Group 1
    1) Fisheries Sensitive Watersheds
    2) OGMA /WHA/VQA
c. Species at Risk (SAR) Group 1
d. Cultural Values
    1) Archaeological
    2) Heritage
e. Traditional Use Areas

PRIORITY THEME 4 RESOURCE VALUES

a. Parks, Protected Areas, non THLB
    1) Fire Adapted ecosystems, species, habitat - shown as a positive response to fire hazard (LMH)
    2) Fire Susceptible ecosystems, species, habitat
b. GAR Orders Group 2
    1) Fisheries Sensitive Watersheds
    2) OGMA /WHA/VQA
c. Species at Risk (SAR) Group 2
d. Timber
    1) High Value Timber Areas
    2) Active or Planned Harvesting Areas
    3) Road Layout
    4) Silviculture Investment Areas
    5) Timber Harvesting Land Base (Locally Defined Operability)
e. Research Installations - Growth and Yield
f. Active resource extraction sites
g. Range
h. Other resource values

APPENDIX B – GLOSSARY

APPENDIX C – FIRE MANAGEMENT PLAN FEEDBACK FORM

1. How specifically did you use Fire Management Plans (FM Plans) this season (ie Fire Analysis development? Operational decisionmaking?) Please describe.

2. If you did not use FM Plans, what was the replacement?

3. How did you access FM Plans (pdf's on the FTP site, hard copy binders, both)? Please describe how easy/difficult it was to find what you were looking for.

4. Did you find everything you were looking for in the FM Plan(s)? If not, is it important that it be included in future FM Plans (please describe)?

5. How much value did this FM Plans provide? How important is it to you as a client, that FM Plans contain additional information for the next fire season? Please describe that information as fully as possible.

6. Do you have any additional suggestions (general or specific) for improving FM Plans?

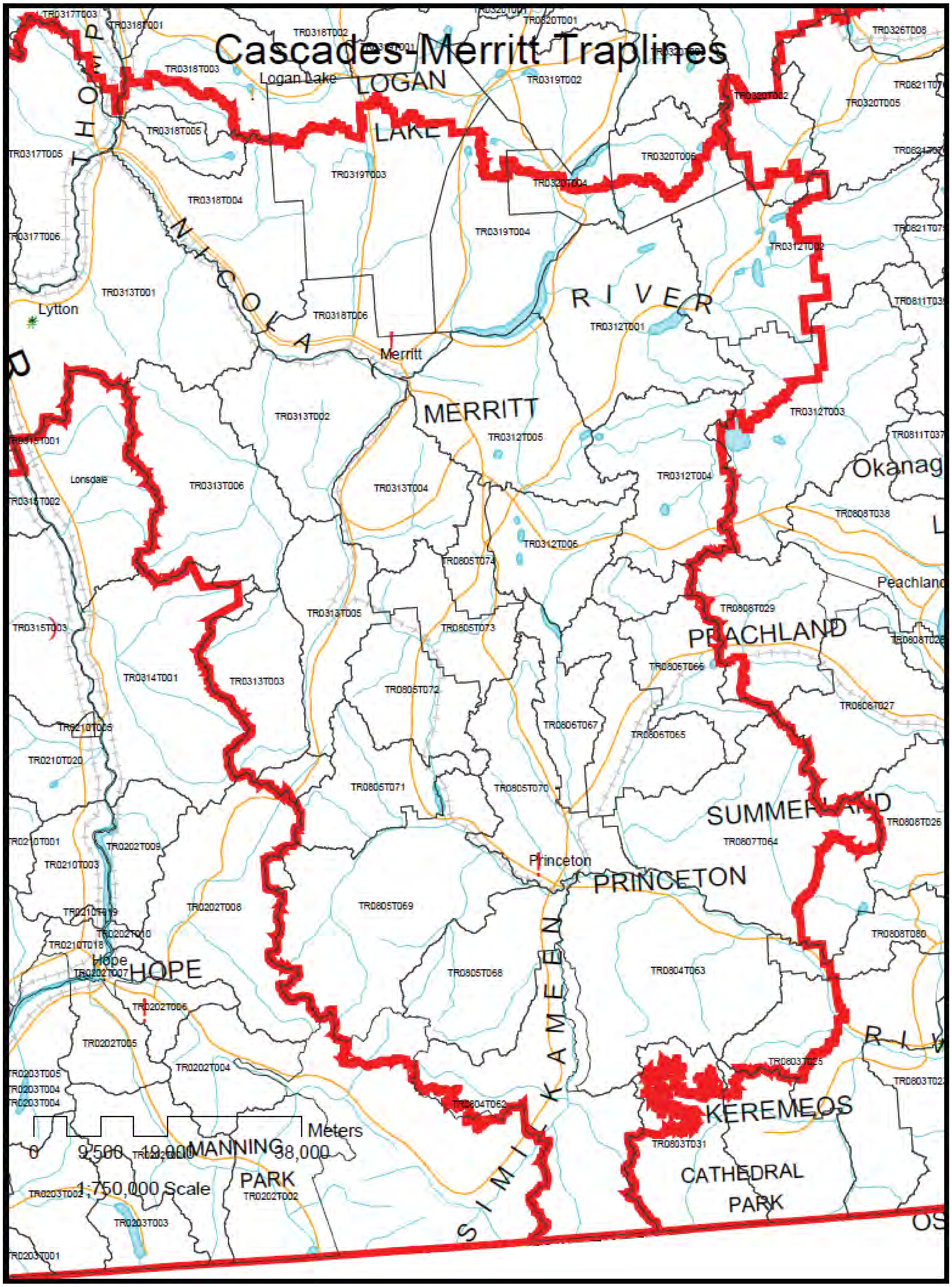
7. If willing, please include your contact information, and you may be contacted for further input

If you have any questions about this or Fire Management Planning in general, please contact the Regional Fire Management Specialist.

Your feedback is valued and will help inform the next phase of planning! Thank you for your time!

Please forward the completed form to Martin.Ponsioen@gov.bc.ca at the DCS as well as the Regional Fire Management Specialist.

APPENDIX D – TRAPLINE MAPPING & CONTACTS

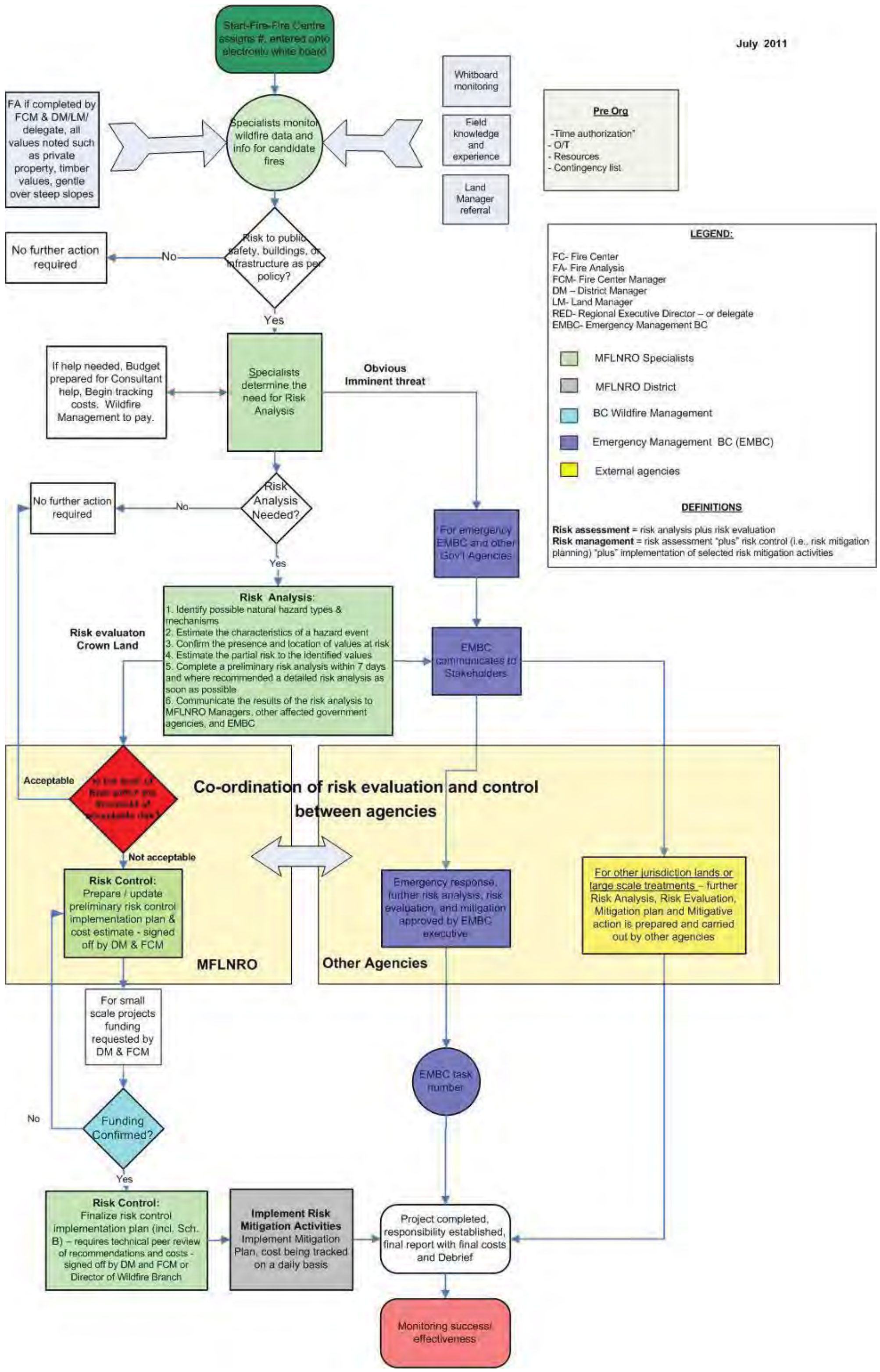


TRAPLINE_1	ATN	STATUS	LAST_NAME	FIRST_NAME	ADDRESS	CITY	POSTAL	PHONE
CLOSED		No Info						
Darcy Co.		No Info						
Lonsdale		No Info						
TR0202T008		No Info						
TR0210T006	210T006	REGISTERED	ANDREW	LEONARD				
TR0210T007		No Info						
TR0211T001		No Info						
TR0211T007	211T007	REGISTERED	CARTWRIGHT	GLEN				
TR0211T008	211T008	REGISTERED	THEVARGE	MARTIN				
TR0211T016		No Info						
TR0214T001		No Info						
TR0312T001		No Info						
TR0312T002	312T002	ASSISTANT	PIFER	William				
	0312T002	REGISTERED	Wise	Holly				
TR0312T003	0312T003	REGISTERED	BEADMAN	BARRY.				
TR0312T004	0312T004	REGISTERED	ARASON	RICK				
	0312T004	REGISTERED	ENSIGN	CHRIS				
TR0312T005	0312T005	REGISTERED	RITCEY	FRANK				
	0312T006	REGISTERED	CEOLIN	MAURO				
TR0312T006	0312T006	ASSISTANT	ROBINSON	KIM				
TR0313T001	0313T001	REGISTERED	MUNRO	Richard A				
	0313t001	ASSISTANT	POLLARD	TYREL				
TR0313T002	0313T002	REGISTERED	ROBINSON	LINDA				
	0313T002	REGISTERED	WEST	NATHAN				
	0313T002	ASSISTANT	POLLARD	TYREL		s.22		
	0313T002	ASSISTANT	ROBINSON	KIM				
TR0313T003	0313T003	REGISTERED	KOLCUN	ALEX				
TR0313T004	0313T004	REGISTERED	RADOM	BRENT H.				
	0313T004	ASSISTANT	POLLARD	TYREL				
TR0313T005	0313T005	REGISTERED	NORGAARD	ERIK				
TR0313T006	0313T006	ASSISTANT	BIGGAR	GARY				
	0313T006	REGISTERED	HARRY	JOHN				
TR0314T001	0314T001	REGISTERED	STRIEBEL	CHRIS				
TR0315T001	0315T001	REGISTERED	LYTTON INDIAN BAND					
TR0315T002	0315T002	REGISTERED	MUNRO	RHODEY				
	0315T002	ASSISTANT	POLLARD	TYREL				
TR0316T001	0316T001	REGISTERED	SETON LK INDIAN BAND					
TR0316T002	0316T002	REGISTERED	YOST	CHRISTOPHER				
TR0316T003	0316T003	REGISTERED	MONTGOMERY	RON				
TR0316T004	0316T004	REGISTERED	STEIN CO OF INDIANS					
TR0317T001	0317T001	REGISTERED	ELLIOTT	W.J.				
TR0317T002	0317T002	REGISTERED	LEHMAN	ALBERT				

TR0317T003	0317T003 (Amalgamated with TR0317T004)	REGISTERED	FLETT	John	
	0317T004	REGISTERED	FLETT	John	
	0317T004	ASSISTANT	Thibeault	Trevor G.	
TR0317T005	0317T005	REGISTERED	ZANNELLA	DORIANO	
TR0317T006	0317T006	REGISTERED	LORING	ALAN	
TR0318T003	0318T003	REGISTERED	OAKES	KEN	
TR0318T004	0318T004	REGISTERED	SAM	CLYDE	
TR0318T005	0318T004	REGISTERED	SAM	DENNIS	
TR0318T006	0318T005	REGISTERED	WALKEM	CHARLES THOMAS	
TR0319T003	0318T006	REGISTERED	COUTLEE	JOSEPH LEONARD	
TR0319T004	0319T004	REGISTERED	WOODMAN	FRED	
TR0320T002	0320T002	ASSISTANT	LINNELL	JIM	
TR0320T004	0320T004	REGISTERED	MCIVOR	ERNEST JR.	
TR0320T006	0320T006	REGISTERED	DESY	MARCEL A.	
	0320T006	REGISTERED	DESY	MAURICE R.	
TR0331T006	0331T006	REGISTERED	AMBLER	BRUCE	
TR0331T007	0331T007	REGISTERED	HALLER	ROSE	
TR0331T009	0331T009	REGISTERED	COLDWELL	CHARLES	
TR0331T010	0331T010	REGISTERED	GRINDER	KEN	
TR0332T002	0332T002	REGISTERED	COLDWELL	RAYMOND	
	0332T002	ASSISTANT	HOLMES	JOHN RICHARD	
TR0332T003	0332T003	REGISTERED	SIEVERS	John	s.22
	0332T003	REGISTERED	SIEVERS	Herb	
TR0332T004	0332T004	REGISTERED	DESROSIER	ROBERT	
TR0332T005	0332T005	REGISTERED	CODY	TIM	
TR0332T006	0332T006	REGISTERED	THOMPSON	THEODORE C.	
TR0332T007	0332T007	REGISTERED	MAGLIOCCO	ALBERT	
TR0332T008	0332T008	REGISTERED	WALITZA	ROLF	
TR0333T001	0333T001	REGISTERED	DAY	BILL	
TR0333T003	0333T003	REGISTERED	PIETILA	BILL	
TR0333T004	0333T004	REGISTERED	John	Brett	
	0333T004	ASSISTANT	MALONE	RANDALL P.	
TR0333T005	0333T005	REGISTERED	BROWN	STEWART W.	
	0333T005	ASSISTANT	BROWN	STEWART M.	
	0333T005	ASSISTANT	MILLWARD	Timothy D.	
TR0503T100	0503T100	Registered	Elkins	Gerald	
TR0504T001	0504T001	Registered	Reuter	Siegfried	
TR0803T025	TR0803T025	Registered	Schneider	Darrell	
TR0803T031	TR0803T031	Registered	Wabnegger	Karl	
TR0804T062	TR0804T062	Registered	Hilton	James	

	TR0804T062	Registered	Hilton	Jesse	
TR0804T063	TR0804T063	Registered	Schneider	Clarence	
TR0805T068	TR0805T068	Registered	Huff	Ken	
TR0805T069	TR0805T069	Registered	Rice	Albert Rice	
TR0805T070	TR0805T070	Registered	Lay	Elaine G.	
TR0805T071	TR0805T071	Registered	Brewer	Myra Y.	
TR0805T072	TR0805T072	Registered	Munro	Donald	
TR0805T073	TR0805T073	Registered	Heppner	Richard	
TR0805T074	TR0805T074	Registered	Peterson	Matthew	s.22
TR0806T065	TR0806T065	Registered	Druck	Norman	
TR0806T066	TR0806T066	Registered	Coutu	Delta J.	
TR0806T067	TR0806T067	Registered	Lay	Jack T	
TR0807T064	TR0807T064	Registered	Brice	Todd L.	
TR0808T026	TR0808T026	Registered	Brice	Terry	
TR0808T027	TR0808T027	Registered	Andrews	Trent	
TR0808T029	TR0808T029	Registered	Hubbard	Marc C.	
TR0808T080	TR0808T080	Registered	Schneider	Darrell Clarence	

APPENDIX E – POST WILDFIRE NATURAL HAZARDS RISK MANAGEMENT



APPENDIX F – FIRE MANAGEMENT STRATEGIES FOR WILDLIFE

Fire Management Strategies for Wildlife and Habitats

Doug Lewis

1. Background/Introduction

Wildlife in North America has evolved in the context of particular fire regimes, and the availability of habitat attributes associated with the patterns of fire occurrence, size and severity (Bunnell, 1995; Lyon et al., 2000a). Managing wildfire on the landscape is an important measure for forest biodiversity conservation; ensuring landscapes contain suitable proportions of post-fire habitats that vary in time-since-fire, intensity, and season of burn (Gill, 1999; Lindenmayer et al., 2006). Managing wildfire response to allow some wildfires to burn can have significant habitat benefits for wildlife where human interventions (i.e. fire suppression) have limited the availability of post-fire habitat conditions. In most circumstances, habitat benefits created by wildfire will have a greater positive influence on wildlife than the direct negative impacts (i.e. injury, mortality or emigration) of the fire itself (Lyon et al., 2000b). In some circumstances, such as in the dry forest ecosystems of south-western U.S., human interventions (i.e. fire suppression, grazing) may have limited wildfire occurrence for a long period of time resulting in forest conditions more dense (i.e. thicker overstory or understory tree density) than pre-European settlement (Covington and Moore, 1994). Consequently, wildfires may result in increased fire severity and tree mortality inconsistent with desired habitat conditions. In these circumstances, fire may best be introduced under more controlled measures (i.e. stand thinning treatments prescribed fire) to meet wildlife habitat and other management objectives.

Despite the potential habitat benefits of managing wildfire response to let some wildfires burn, wildfire suppression may be desired in important habitat areas depending on the proximity of other important resource values (Keith et al., 2002). Likewise, wildfire suppression may also be desired to protect limited habitat remaining for some threatened or endangered wildlife species (i.e. Spotted Owl, or Mountain Caribou) consistent with habitat protection or species recovery objectives. However, wildfire suppression activities (i.e. aerial suppression, back-burning, fire- guard building, snag falling, etc...) undertaken to protect other values adjacent to or overlapping important habitats can have negative impacts on wildlife ranging from minor disturbances to habitat destruction. Thus, identifying appropriate wildfire strategies that include both an appropriate wildfire response and practices that protect habitat features during wildfire suppression can help achieve both habitat (protection, restoration or enhancement) and fire suppression (protection of life and property) objectives.

The goal of this project is to provide information on appropriate wildfire response strategies for wildlife and habitats through Ministry of Forests and Range (MoFR) Forest District Fire Management Plans (FMP). The purpose of a FMP is to provide information on known values on the landscape which will facilitate decision-making processes and help in the development of fire analysis forms, as completed by Wildfire Management Branch. Data will be made available as digital and hard copy map products and fire management strategies available to all MoFR staff in MoFR Forest District FMP's. Plans can be updated annually to include additional species, species locations or alter fire management strategies.

2. Objectives

The objectives of including wildlife habitat information in District Fire Management Plans are:

1) To identify where a fire suppression response[2] is required to support species habitat protection or recovery objectives and protect critical habitat where existing habitat for species at risk may be limiting (i.e. Spotted Owl). Or, identify where a modified fire response[3] strategy is appropriate to allow wildfires to burn and provide habitat benefits or desired conditions (i.e. forage production in UWR or Grizzly bear areas). Modified response strategies can help achieve habitat objectives where prescribed fire has been identified as well as reduce wildfire suppression costs and impacts.
2) Where fire suppression does occur in or adjacent to important habitats, to identify fire suppression activities to avoid (i.e. machine fire guards, fire retardant drops, snag falling...) to protect habitat features (i.e. nest trees, denning sites) for species at risk.

3. Assumptions/Caveats:

3.1 Conceptual Approach to Wildfire Management for Wildlife Habitat

1) Managing wildfire response to allow wildfires to burn is the most desired option for wildlife and biodiversity conservation (Lindenmayer et al., 2006). This assumption is supported by research that suggests wildlife species in BC are adapted to the frequency and severity of natural disturbances such as wildfire (Bunnell, 1995; Lyon et al. 2000a) and/or specifically dependent on post-fire habitat conditions or attributes (i.e. high densities of snags) that develop after wildfires (Bunnell et al., 2002; Hutto 2006).
2) Exceptions to the assumption in 3.1.1. apply under certain circumstances. Therefore, wildfire suppression may be desired when:
    a. Limited suitable habitat exists and needs protection often because other land use activities (i.e. urban encroachment, timber harvest etc...) have reduced habitat supply, or,
    b. Wildfires might result in more intense or severe fires than historically experienced, thus compromising habitat objectives. In certain areas fire may be best introduced under more controlled measures (i.e. stand thinning treatments and/or prescribed fire).
3) Wildfire response activities that involve habitat alterations are likely to cause greater negative impacts to wildlife than wildfire itself. These activities include: building fire guards, building access trails, snag falling, timber removal, or riparian disturbances such as creating sumps in or adjacent to water bodies. The detrimental effects from post-fire treatment (specifically removal of 'danger trees') can often ameliorate or outweigh the potential positive benefits of wildfire. These practices should be managed carefully, especially in areas designated for special wildlife management or in fires that occur in habitats that have a propensity to host rare species (e.g. south Okanagan).

3.2 Data for Wildlife Habitats

[2] Full Response (Suppression) Fire: a wildfire which requires immediate, aggressive initial attack and/or sustained suppression action until the fire is declared out

[3] Modified Response Fire: a wildfire that is allowed to burn within set policy and management guidelines or may be actioned in such a manner as to bring the wildfire back within those guidelines. A monitor only fire is a modified response fire that is not receiving suppression action at a specified point in time.

1) Occurrences of some species at risk are considered 'sensitive data' to protect the species from human harassment, persecution or habitat destruction. Actual locations for 'data sensitive' species are masked to protect exact locations and species information.
2) Data for wildlife species includes occurrences associated with a habitat feature only (dens, nest trees, ponds). Sightings not associated with a habitat feature (i.e. sightings) are not considered. Given limited resources to conduct regular inventory, continued occupancy or site fidelity may be unknown. Thus, continued occupancy and feature integrity (i.e. nest tree is still standing) as confirmed at date of observation is assumed, even though habitat feature may no longer be suitable for occupancy or may be abandoned.
3) Data used is the up-to database currently available on government databases. Additional data likely exists and is included wherever possible.
4) Strategies for mountain caribou are not included in this project. Wildfire response in mountain caribou habitat is addressed in a separate process[4].

3.3. Wildfire Response Approach and Strategies

1) The wildfire response strategies in this document are recommendations only, ultimately forest district staff will need to consider a variety factors when actioning wildfires. Wherever possible forest district wildfire staff are asked to follow these recommendations, however it is recognized that for several reasons these recommendations may not be followed including:
    a. Where wildfire protection resources are limited, resources will likely be allocated to higher provincial priorities such as human life, property or infrastructure, so may limit response options
    b. Suppression cost, lack of resources, fire crew safety and/or cumulative impacts of response may not warrant full suppression to protect habitat.
2) Where suppression and modified response strategies overlap for different species or habitat areas– wildfire suppression to protect habitat supersedes modified response.
3) In provincial parks, BC parks wildfire response plans need to be considered

4. Wildfire Strategies for Wildlife Habitat

The recommended wildfire response strategies for wildlife habitat consist of two components: (Figure 1.);

1) Wildfire Response Strategy - provides recommendations for either a modified or full suppression response recognizing the potential benefits or impacts of wildfire for the particular species.
2) Wildfire Suppression Activity Modifiers - provide recommendations on activities to avoid within a specific habitat area to prevent habitat impacts or destruction. These modifiers have been specifically assigned to protect specific habitat features associated with the species of interest. These modifiers apply where modified or full suppression response occurs assuming full suppression may occur in habitat area, even where modified response has been recommended.

[4] Stock, A., White, K., Armleder, H., McLellan, B., Rivette, N., Betuzzi, C., Jones, J., Fraser, B., and T. McDonald. Mountain Caribou and Forest Health Management. May 16, 2008. Technical report prepared for BC Species at Risk Coordination office, Ministry of Agriculture and Lands. 27 pages

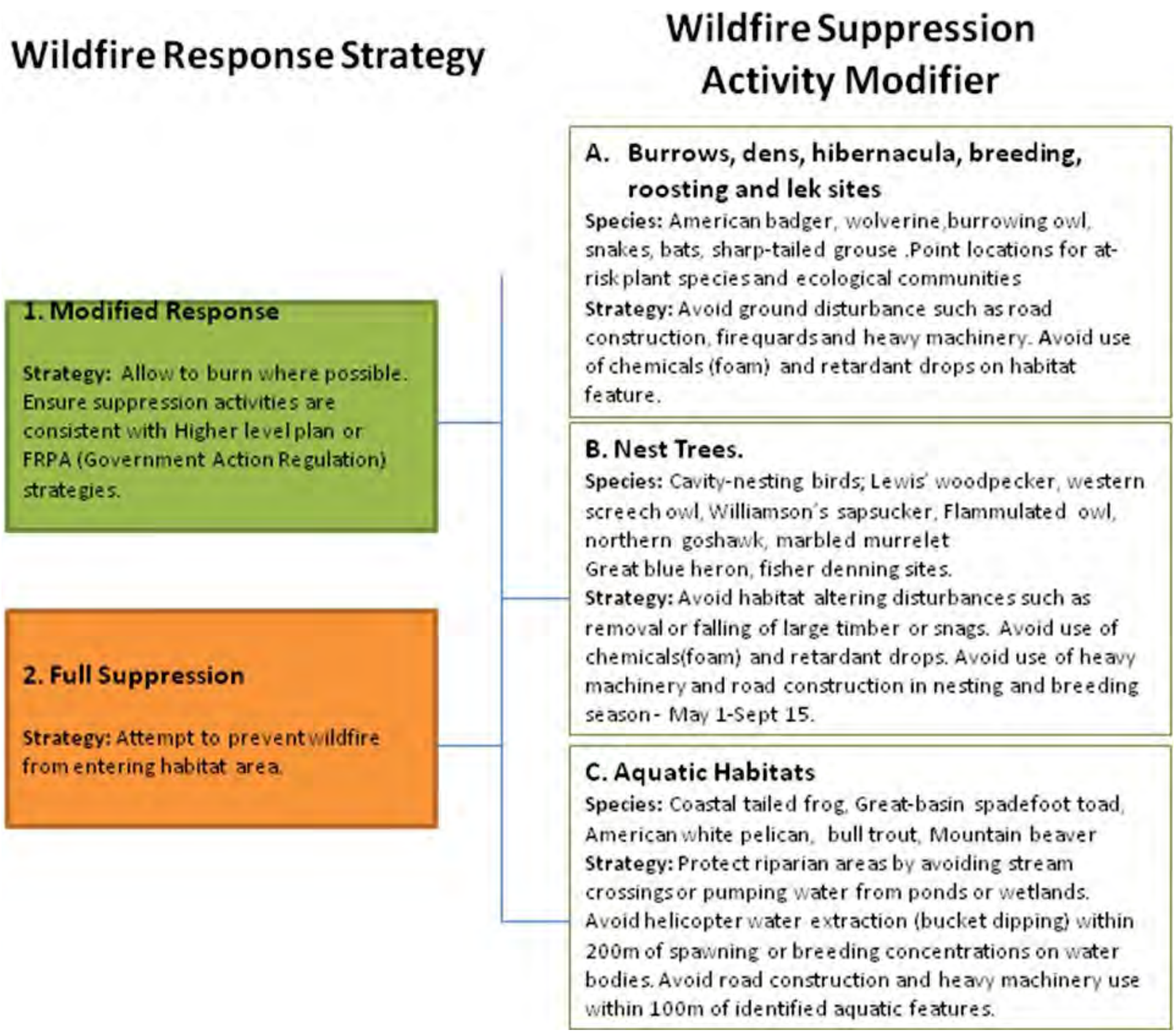


Figure 1. Wildfire response strategy and fire suppression activity modifiers for wildlife habitats.

5.0 Information Resources
Two levels of information available to assist forest district staff;

1) Mapped layers available in MoFR District Fire Management Plans (hardcopy) or as spatial data (ARC coverages) available to district fire centres.
2) A contact list of local experts within Ministry of Environment (MoE) or other qualified professionals available to provide advice, recommendations or specific sensitive data required to avoid impacts in habitat areas.

5.1 Map Layers
Map layers are designed to give forest district as much information as possible to locate and manage their activities to protect wildlife habitats recognizing data limitations and 'sensitivity' around some At-risk species data. The mapped information includes;

1) Known locations of habitat features associated with individual occurrences of individual or groups such as a dens, nest trees or aquatic habitat feature (i.e. wetland or pond). Some uncertainty exists within the map polygon provided to protect the exact location of the feature and species names are not provided.

2) Habitat areas legally designated (or draft) under the *Forest and Range Practices Act* (FRPA) or higher level plans (i.e. LRMP's). Wildlife habitat areas use the draft or legal boundaries and where full wildfire suppression is the desired strategy, a 500-metre buffer around the legal boundary is included.

5.2 Contact List of Local Experts

Often more specific information is required to protect important habitat features given that suppression activities must occur immediately (i.e. such as to protect human life, property) or identified habitat areas overlap with other values that require protection. In these circumstances it is recommended, preferably prior to a wildfire overlapping the habitat area, that MoFR wildfire response staff contact a local qualified expert to discuss management options s.13

s.13

It is recognized that circumstances (i.e. busy fire season or local emergencies) may mean fire suppression activities must proceed before more detailed information on habitat features is available. However, where wildfire suppression is required within or adjacent to identified habitats, wildfire response should make best efforts to contact a qualified professional to locate the habitat feature, and/or provide instruction to prevent direct impacts.

6. Process Steps to identify wildlife features and habitat areas

1) Identify habitat areas
    a. Use the Conservation Framework[5] to identify all wildlife and plant species and ecological communities that rank priority 1 and 2 for habitat protection.
    b. Consult with Ministry of Environment (MoE) region staff to refine the list to add or subtract additional at risk and regionally important wildlife species and or ecosystems in their regions that are susceptible to wildfire and wildfire response activities.
    c. Use the Land and Resource Data Warehouse (LRDW) to identify legal boundaries of WHA's, UWR's etc... – contact regional MoE staff to include draft legal boundaries.
    d. Using input from MoE region and Victoria staff, each wildlife species or ecosystem is grouped by an associated habitat feature or attribute (i.e. dens or burrows, nest trees, aquatic habitat). Each habitat feature is associated with a fire management strategy which is designed to provide MoFR staff with a simple, quick strategy to implement during wildfire response or protect the habitat feature/area.
    e. Wildlife species or ecosystem location data is collected from various sources (Conservation Data Center (CDC) and regional wildlife (SPI) databases or recent Locations from local researchers or MoE staff not yet available in other databases) and screened to ensure locations include only identified habitat features and not random sightings.
2) Develop map layers
    a. Spreadsheet created with data from multiple sources -includes fields with data source, date, UTM coordinates.

[5] http://www.env.gov.bc.ca/conservationframework/

b. Actual habitat attribute location is masked by randomly offsetting known location by random distance (<100m) and random direction.
c. Offset point location is buffered by 100m or 200m buffer such that it and code on map by strategy.

3) Map Outputs
   a. Digital shapefiles by MoFR region.
   b. PDF maps with links to MoFR district Fire Management Plans
   c. Fire management plans provide information on species

7. References

Bunnell, F.L., 1995. Forest-dwelling vertebrate faunas and natural fire regimes in British Columbia; patterns and implications for conservation. Conservation Biology 9 (3), 636-644.

Bunnell, F.L., Houde, I., Johnston, B, Wind, E., 2002. How dead trees sustain live organisms in western forests. In: Laudenslayer, W.F. Jr., Shea, P.J., Valentine, B.E., Weatherspoon, C.P., Lisle, T.E. (Eds.), Proceedings of the symposium on the ecology and management of dead wood in western forests. November 2-4, Reno, Nevada, Pacific Southwest Research Station, USDA Forest Service General Technical Report, PSW-GTR-181. pp. 291-318.

Covington, W.W., Moore, M.M. 1994. Southwestern ponderosa forest structure: changes since Euro-American settlement. Journal of Forestry, 92, 39-47.

Gill, A.M., 1999. Biodiversity and brushfires: an Australia-wide perspective on plant species changes after a fire event, *In*: Gill, A.M., Woinarski, J., York, A., (Eds), Australia's biodiversity-responses to fire. Environment Australia Biodiversity Technical Paper 1, pp.9-53.

Hutto, R.L., 2006. Toward meaningful snag-management guidelines for postfire salvage logging in North American conifer forests. Conservation Biology 20, 984-93.

Keith, D., Williams, J., Woinarski, J., 2002. Fire management and biodiversity conservation: key approaches and principles. In: Bradstock, R., Williams, J., Gill, A.M., (Eds), Flammable Australia. The Fire Regimes and Biodiversity of a Continent. Cambridge University Press, Cambridge, pp.401-425.

Lindenmayer, D.B., Franklin, J.F., Fisher, J. 2006. General management principles and a checklist of strategies to guide forest biodiversity conservation. Biological conservation, 131(3), 433-445.

Lyon, J. Brown, J.K., Huff, M.H., Kapler Smith, J. 2000a.Chapter 1: Introduction, Pages 2-7 *I;* Smith, Jane Kapler, ed. 2000. Wildland fire in ecosystems; effects of fire on fauna. Gen. Tech. Rep. RMRS-GTR-42-vol. 1. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 83pages.

Lyon, J, Telfer, E.S., Schreiner, D.S. 2000b. Chapter 3: Direct effects of Fire and Animal Responses. Pages 17-23 *In* Smith, Jane Kapler, ed. 2000. Wildland fire in ecosystems; effects of fire on fauna. Gen. Tech. Rep. RMRS-GTR-42-vol. 1. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 83pages.

Acknowledgments

Original fire management strategies upon which this approach is based developed by ministry of Environment staff Donna Romain, Mark Phillpotts, Becky Bings, and Julie Steciw. Thanks to Merherzad Romer from CDC for providing access to data. Jared Hobbs, Tory Stevens, Graham Suther, Carmen Cadrin, Judy Millar, Lyle Gawalko provided helpful comments on earlier draft versions of this report

APPENDIX G – MAPS

Users of maps must remember that they are only a visual representation of data. There may be many important items out of date and incorrect on the maps. Known government data often only includes completed projects, projects in construction phases may not be shown on maps.

Maps are as per the provincial mapping templates.

Draft Wildfire Risk Options Assessment Paper

March 25 , 2013

Introduction

Climate change, a changing forest industry and changing fuel types are escalating wildfire risks and increasing damages from wildfires. Limited fire fighting resources are increasingly taken up with fighting interface fires, at the expense of the working forest. The forest industry is a key partner and always has been; however, when a fire occurs, timber supplies and revenues are lost, timber activities affected, and communities are at risk.

Both the forest industry and government want to foster and nurture a healthy forest industry and reduce litigious action between parties. Trends indicate that fire seasons are getting longer, fires are larger and more hectares within BC burn each fire season. Escalating trends are increasing the workload for fire fighters: climate changes, geographic challenges, mountain pine beetle, etc. Limited fire fighting resources are increasingly taken up with fighting interface fires, at the expense of the working forest.

This option paper explores opportunities to reduce wildfire losses and litigation risks to industry including considerations of the Wildfire Act (WFA) and regulations, use of professional reliance, and industry prevention planning, preparedness and operational response capabilities.

Vision:

Create options for discussion that will lead to defining/ outlining where we collectively need to be 2 – 5 years from now that reflects our common goals will support moving the process forward.

Shared Principles/Interests:

1. Increased business certainty that contributes to a vigorous, competitive forest industry;
2. Need for prescribed burning to reduce risk;
3. Minimize risk for communities;
4. Government will pursue cost recovery for negligent or wilful actions;
5. Proposed model will be sustainable;
6. Proposed model will be streamlined to reduce costs;
7. Fire management is a shared responsibility;
8. Risk management is a shared responsibility;
9. Need to balance risk with all values (social, economic, environmental) on the land base.
10. Responses to policy issues need to be flexible: high level, low level, recognize geographic areas (coast and interior) and timely.

Objectives:

1) To develop options that look forward to the next 2-5 years that would reduce;
   a) the wildfire risk,

b) liability,
c) losses to Industry and Government,
d) increase business certainty, and
e) where possible, reduce litigation actions between parties

2) Examine existing legislation and regulation, guidance, standards, policies or agreements with the forest industry and other natural resource management operations.
3) Identify relative pro's and con's of the various options.

Background Issues /Challenges with current model identified at a Fire Management Working Group meeting, April 30, 2012:

Challenges:

- The forest industry has fundamentally changed. It relies more on consultants and no longer has the expertise, staff or resources to fight wildfires compared to historic levels, the relationship to government has moved from local focus to a regional approach, margins are smaller using the "just in time" approach, so inventory size is optimized, the land base is more diverse with other industrial sectors have a much greater presence adding additional layers of complexity.
- Wildfire behaviour is escalating. The number, size and severity of wildfires is increasing and expected to continue to increase with climate change and beetle infestations, especially near communities
- Values – both the number and associated users as well as the value of each resource is increasing
- Government and industry are looking for clarity and certainty
- The need for clearly defined roles and responsibilities for all parties operating on the land base
- Finding an acceptable balance between the level of risk government is willing to accept with respect to fire and the associated costs to industry and government, less risk means more cost impacts to industry - need a common understanding and develop a risk framework

Issues Identified:

1. Forest industry cannot afford to shut down for long periods of time.
   - shut downs make it difficult to retain staff
   - create a huge potential for cost impacts
   - large inventories to bridge shutdowns don't exist with "just in time" approach
   - if a shut down occurs the risks can increases due to having with fewer eyes and ears in the forest
   - less of an issue for the coast, but early shifts are common and industry voluntarily decides to shuts down as risk management

Additional comments
How to optimize the balance between need for shutdown and need for continued operations. Does FDC rating provide best local operational decisions / results?

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2. Need to balance wildfire risks when harvesting with industry needs to carry out business;

3. Geographic challenges
   - management and risk have different challenges in the interior than there is on the coast and different challenges for northern vs southern interior.

4. Increasing number of players out on the ground
   - bioenergy interests, first nations (woodland licenses), new licenses NRFL's, O/G, mining, etc

   Additional comments

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5. Increasing values on the landscape, e.g. IPPs, LNG plants, etc. means increased resources needed by government to now have to protect assets out in remote areas of BC

   Additional comment

s.13, s.17

6. Lack of prescribed burning as a management tool used to provide fire management skills to operational staff . Now that it is not used, fire skills and experience have eroded. PB not that applicable for the coast with its small bock size, reserve requirements and proximity to public...maybe better suited to north and interior application.

7.

s.13, s.17

   Additional comments

s.13

8. Indemnification clause is poorly worded – insurance premiums are increasing

Additional comments;

s.13

9. Vicarious liability – proximity between forest licensee and contractor, especially with BCTS

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11. Green trees are becoming more valuable as the mountain pine beetle kills large swathes of trees in BC resulting in loss of value in trees.

Three groups harvesting:
Coast: Less concerns, more flexibility, some industry shuts down well before because they don't want to assume the risk.
S**outhern Interior:** In the interior, harvesting occurs in the higher risk times of the year. More professional judgement is required and applied. Looking at the coarse filter and applying it when it was never intended to be relied upon.
Northern Interior: Less areas at high risk, shorter risk period.

Short term action items from this meeting and current *status of these actions?*

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Longer term action items:

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Analysis of other jurisdictions : Compare/ contrast w.r.t. to industry generated fire starts

Each of the responders were asked a series of questions which identified the following areas are worthy of further follow-upfor more detail.

Saskatchewan - s.22 has been contacted but hasn't called back to discuss

Alberta - Patrick Loewen -

a) Limited liability clauses written into Fire Control agreements with the intent of fostering wildfire prevention partner relationships and minimizing litigation;
b) The forest industry and government work together on wildfire management strategies, including limiting human caused wildfires;
c) The province works with the forest industry during high to extreme wildfire hazards and heavy wildfire suppression loads. There are a number of staff throughout the province such as Industry Liaisons or Wildfire Prevention Officers that are in constant contact with the forest industry. As hazard levels rise we work with industry to minimize heat of the day activity. During fire bans and forest area closures we will work with industry to ensure their needs are met as best as possibly, safely, while not compromising or ignoring current hazards or conditions. Alberta has an excellent wildfire communications group and network which works with industry, the media and public and all other stakeholders, including social media.
d) The province works with the forest industry as a partner in wildfire management – a full partner. This partnership includes training for both government staff and industry staff, including ICS, wildfire orientation, wildfire behaviour, safety, wildfire management, etc.
e) Responsibility for post harvest hazard abatement - Harvest operations must comply with the *Forest and Prairie Protection Act* and Regulations as well as the Debris Management Standards for Timber Harvest Operations. Retention of debris piles in FireSmart Community Zones is not permitted. Alberta is currently engaged with industry and research partners in post harvest debris load studies to determine what levels of scattered debris in harvest blocks are acceptable from a fire intensity/initial attack perspective.

Washington - Darrel Johnston - briefly discussed, will complete answers to questions, ASAP for inclusion on the report

Oregon - Tom Fields

a) Development of a statewide funding mechanism to provide equitable forest protection to all parts of the state. For instance, eastern Oregon has some of the lowest productivity lands but bears the bulk of fire protection costs.

b) All wildland fire protection agencies in the Pacific Northwest promote and adhere to a set of guidelines, regardless of ownership (public or private) that regulates fire prone activities during the course of a fire season. This Industrial Fire Precaution Level(IFPL) system is utilized to mitigate risk as fire danger increases in a geographic area referred to as a “Regulated Use Zones.” Should fire danger reach a point that prohibits certain activities from occurring, like cable yarding, and the operator feels he can work safely on his particular site, he may request a waiver from the forester if first approved by the landowner. The forester may, or may not, grant a waiver based on several factors: Has the operator gone above and beyond the fire prevention requirements to make the operation fire safe; Where is the operation located (south slope, north slope)?; What fuels are involved (felled and bucked, slash,)?; What firefighting resources are available locally, regionally, at that particular time?

c) Between Oregon Department of Forestry (ODF), and other forest management agencies, the forest industry receives annual training on forest management, fire protection and fire prevention. ODF makes a point in providing on-site fire inspections as an opportunity to educate forest landowners and operators.

d) The fire budget is prioritized by fire prevention, detection, and suppression. It is ODF’s objective to keep all fires small with strong initial attack capabilities. The goal is to keep 97% of all fires 10 acres or less. Much of this is achieved at the local district level. Special Purpose Appropriation (SPA) funding is also utilized to preposition additional resources during periods of extreme fire danger. These additional resources include helicopters, contract crews and air tankers immediately available to be deployed when fire strikes in high hazard areas.

e) Costs determined for fighting a fire - Operators accept limited liability for any fire that results from their operation on the land. When a fire occurs and all fire prevention requirements and fire preparedness regulations are followed, they may be required to reimburse the Department up to $300,000 of extra fire suppression costs (costs incurred outside the district protection budget). If compliance is not met, then the operator could be held liable for all fire suppression costs.

Options to achieve reduction of risk, liability, and conflicts

A) Implementation Guidance and Standards

1. In the Results based regime of the Wildfire Act, Fire Management Working Group take a leadership role to prepare and distribute Best Management practices (BMP's) a.k.a. FRPA Bulletins. This would provide issue management by helping reduce risks and provide consistent context for professionals and industry exercising due diligence, context for government staff (C/E) and a continuous improvement mechanism to recommend policy changes through the implementation of the legislation.

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Pages 100 through 102 redacted for the following reasons:
- -
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Ecosystem Health and Disturbance Intended Outcome (IO) Scope
2013–2018

1. **What contribution does this IO make to the Ministry of Forests, Lands and Natural Resource Operations (FLNRO) Strategic Outcomes and Program Activities?**

   This IO Scope describes a program of research that contributes to the scientific understanding of the impacts of natural and man-caused disturbances have on ecosystem health that are relevant to the stewardship mandate of the FLNRO. This research will improve FLNRO's understanding of ecosystem health and plan for, adapt, and possibly minimize, potential impacts of landscape level disturbances affecting multiple resource values managed by FLNRO. The ultimate goal of the research is to support the Ministry's vision of enhancing economic prosperity and environmental stability.

2. **To what extent is this IO consistent with FLNRO's core role?**

   This IO Scope is consistent with FLNRO's high level core roles to maintain economic prosperity and maintain environmental stability. Maintaining ecosystem health (included in the Ecosystem Stewardship IO) ensures a continuous supply of the goods and services and other values managed by FLNRO. Landscape level disturbances are a major factor in disrupting the productivity and stability of ecosystems. Past research on disturbance impacts on ecosystem function have resulted in improved management practices to maintain ecosystem health in the form of operational guidance and procedures designed to improve forest productivity, maintain biodiversity, and reduce risks to catastrophic losses by both biotic and abiotic factors. Continued research will further improve FLNRO's capacity to predict and accommodate the effects of major forest disturbances by improving and adapting management practices, policy and planning.

3. **Why is it important for FLNRO to be focused on this IO?**

   The current Mid-Term Timber Supply (MTTS) crisis in much of the province's central interior highlights the importance of this research IO plan. Understanding the spatial and temporal distribution and potential impacts of large scale disturbances and their management like that caused by the mountain pine beetle outbreak on a wide range of natural resource values is extremely important to the long-term stability of the economy and ecosystem health.

   The MTTS situation also increases the importance of protecting the health and productivity of undisturbed ecosystems to ensure that the anticipated benefits are actually realized.

   This IO also examines the effect of climate change on ecosystem health which may take the extreme form of landscape level insect and disease outbreaks, large-scale blowdown, catastrophic fires, 100 year flooding events, landslides (and other geomorphic events) and other major disturbances. More subtle climate change effects may be observed in alteration of ecosystem functions which will require land managers to adapt practices, alter yield projections and modify management plans.

This IO also examines how ecosystems recover after major disturbance events and also to the cumulative effects of multiple chronic disturbances. Another outcome would be the development of practices to foster ecosystem resilience.

Other good examples of issues related to this IO that have been important to decision makers are:

- The British Columbia Firestorm 2003
- Johnstone's Landing landslides
- 2011 Wildfire in Slave Lake Alberta
- Sensitivity of TSR assumptions on non-recoverable losses due to disturbances
- Sensitivity of Ecosystem Based Management outcomes based on the assumptions of the range of baseline disturbances impacts\
- Climate change leading to grassland expansion followed by the expansion of invasive or undesirable plants (like cheat grass)
- Defoliator outbreaks – western hemlock looper, western spruce budworm, Douglas-fir tussock moth, blackheaded budworm, etc.
- Yellow cedar , Aspen and Birch decline

Overall, investment in this IO will reduce the uncertainty for decision makers who need to make timely management decisions in response to disturbance events.

4. What are the expected achievements of this IO?

Expected achievements of the Ecosystem Health and Disturbance IO flow from three initiatives:

Initiative 1. Increased understanding of biotic natural disturbance processes in focus areas of insects, disease and invasive species.

For the next five years, the following achievements are expected:

- *Assessing impacts:*
  - Stand monitoring and analysis of major forest insect, animal and disease outbreaks to determine their likely causes, periodicity and predictability and potential for management
  - Improved information on the effects of MPB and other pests on ecosystems, timber harvesting, landscape water utilization, biodiversity and communities

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- Assessment of the cumulative effects of biotic disturbance agents (including natural and domestic grazing) to estimate the impact on timber supply and ecosystem function

- Assessment of the effects of invasive plant and animal species including wildlife species such as barred owl, bullfrogs, invasive fish species, deer on Haida Gwaii etc. and how they affect other species and the ecosystem functions.

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- *Developing/improving predictive tools:*
  - An analysis of the distribution and intensity of major chronic (non-episodic) forest health agents to develop predictive tools (i.e., hazard and risk ratings) and management options
  - An analysis of current and historic disturbance data to determine if climate change could be responsible for observed changes in range and intensity of biotic disturbances
  - Maintaining corporate databases containing baseline disturbance data essential for monitoring the effects of climate change
- *Improving management practices:*
  - Development or improvement of management practices that reduce the potential impact from forest health disturbances
  - Identification of priorities for Ecological Restoration planning and management.
  - Assessing effectiveness of Ecological Restoration management activities and development of monitoring protocols for ongoing maintenance of treatment investmenets

Initiative 2. Increased understanding of abiotic natural disturbance processes including wildfire (behaviour and occurrence), climate-related events (drought, wind, snow, ice), and terrestrial disturbance (avalanche, floods, landslides).
For the next five years, the following achievements are expected:

- *Assessing impacts:*
  - Determination of fire behaviour in new fuel types (MPB-affected stands, forest types unique to BC) and predicted wildfire response to climate change.

- Evaluations of fire effects on timber, wildlife, diversity, water, soils, and ecosystems such as boreal forest dynamics (mixed wood, patch and grassland complexes).
- Studies on the effects of specific disturbances on ecosystem processes – treated individually (flooding, drought, wind, etc.) and in interactions (post-fire flooding, effects of harvest and residential development, etc.)
- Determination of the impacts of climate change as an vector of "off site" disturbance killing stands – aka yellow cedar dying out on the coast or drought causing mortality to cedar on the coast. Need monitoring to identify site characteristic changes and predict losses – potentially a new disturbance type. Evaluation of landslides and landslide processes [Note: this initiative is linked to the Water IO and research is lead by this group]
- Impacts of climate change driven drought events or other major impacts such as changes to permafrost.

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- *Developing/improving predictive tools:*
  - Develop and improve fire weather modeling and fire behaviour prediction utilizing provincial, national and international models.
  - Develop and improve fire risk and threat modeling to predict where wildfires will threaten communities, infrastructure and midterm timber supply
  - Downscaling climate change data to inform adaptation management actions.
  - Improved identification of drought prone areas - current and projected due to climate change
- *Improving management practices:*
  - Defining landscape level fuel treatments for mitigating fire risk to communities, infrastructure and mid-term timber supply in the face of climate change
  - Incorporating wildfire risk and threat or other risk and threat models (landslides, floods etc) to inform wildfire response operations, improve staff safety, community protection and fire suppression effectiveness and support proactive natural disaster management from other potential disturbances (flood, landslides etc).

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- Evaluations of prescribed burning techniques and effects for climate change adaptation and wildfire risk mitigation
- Improved post wildfire erosion control strategies
- Incorporating new tools into management practices like Lidar

Initiative 3. Improve understanding of landscape response to disturbance caused by resource development and management activities.

For the next five years, the following achievements are expected:

- *Assessing impacts:*
  - A better understanding of surface development effects on landscapes, including the cumulative effects on soils and ecosystem stability of roads (including orphaned roads), fire guards, timber harvesting, oil and gas development, transmission lines and other industrial activities.
  - Research to support reclamation of roads/landings (Bill Chapmans work) as well as research on other impacts and reclamation of areas such as mines, well heads, oil spills, pipelines, contaminated sites etc.
  - Analysis of the effects of resource development on natural processes of soil ecosystem recovery
  - Studies on abiotic disturbances as they affect resource management in BC's landscapes, particularly their cumulative effects
  - Analysis and monitoring of surface development as a form of facilitated disturbance – eg. Powerlines or corridors are a vector for facilitated movement of invasive plants, roads are a vector for wolves hunting moose and then killing Caribou as a by catch,
- *Developing/improving predictive tools:*
  - Improved spatial information and interpretations on patterns of natural disturbance and resource development as a component of cumulative impacts
  - Studies incorporating spatial information into predictive tools to better understand ecosystem health and disturbance
- *Improving management practices:*
  - Development of strategies to mitigate the effects of resource development on soils, wildlife and ecosystems

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- An improved understanding of disturbance and forest health effects as they can guide resource management practices

- Developing management practices that facilitate ecosystem based reclamation and recovery from spills, mining activities etc.

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5. Performance Assessment and Accountability

This IO plan outlines the high-level expected achievements over the next five years for each the priority initiatives. Progress towards the achievement will be monitored with an annual synthesis report; course adjustments will be made as necessary. As well, expected project results and outputs for the Ecosystem Health and Disturbance IO will be monitored and reported annually.

6. Resources Required

Budget Plan

Initiative Funding ($000's)	2013/14	2014/15	2015/16	2016/17	2017/18
1.	133				
2.	106		s.13, s.17		
3.	150				
	389				

This is a draft budget plan that assumes no increase in resources. However, as engagement occurs it is likely that addressing key sector issues will require a budget uplift – even after leveraging funds from strategic partnerships.

7. Competencies and HR considerations

With a number of retirements pending, it will be important to plan ahead in order to complete knowledge transfer and capacity building in a timely fashion. As we move into new areas and critical issues, it will be important to ensure infrastructure and human resources to support data handling and sharing as well as science-policy interactions are in place.

8. Strategic Partnerships

As the resource sector moves along the path of transformation, there will be a greater need, matched by increasing opportunities, to work creatively and collaboratively with partners, both traditional and non-traditional.

9. Corporate Risk Profile

Within the FLNR business planning process, risks are identified, defined and assessed and then mitigation strategies are devised. Risks that are particularly relevant to this IO include (1) increased disturbance caused by insects and disease in response to climate change (2) increased wildfire risk and other natural hazards associated with climate change and increased concerns in interface zones. (3) increasing competition for access to ecosystem services in response to cumulative effects, conflicting demands, development pressures and public concern over sustainability.

Appendix 1. A listing of current research projects under the three Ecosystem Health and Disturbance IO Initiatives

Initiative 1. Biotic Disturbance

Initiative 2. Abiotic Disturbance

- Experimental burning and assessment of wildfire response in mountain pine beetle killed forest types for impacts on fire rate of spread, intensity and fuel consumption for managing wildfires and reducing ecological impacts from high intensity fires.
-
- Landscape level experimental modelling to predict wildfire probability and intensity over time for assessment of wildfire risk and threat to reduce wildfire risks to communities, critical infrastructure and mid-term timber supply.

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Initiative 3. Landscape response to disturbance caused by resource management and surface development

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Executive Summary (max 500 words) 516 now

Wildfire trends in BC show increased suppression costs and increased threats to communities, infrastructure and high value natural resources; including habitat for species of concern and interest to the HCTF. Climate change is also increasing wildfire variability and severity, adversely affecting many essential habitat characteristics. The exclusion of recurring fires that have historically maintained grassland and shrub ecosystems has led to tree encroachment and a decline in important wildlife habitats (WFMS, 2010). In other areas, excessive fuel loading is resulting in extreme and high intensity fires, potentially damaging habitat for decades.

Current fire management plans (FMP) are used as wildfire response documents that require the land manager (District Manager) to identify and prioritize values for wildfire response options. While land management activities to mitigate wildfire effects and support habitat restoration are underway, other opportunities to incorporate fire and habitat restoration are available. A collaborative approach to landscape fire management planning provides an opportunity to coordinate a wide array of management actions from Ecosystem Restoration (ER), modified response fires, and forest management activities to mitigate these impacts on habitat. It also provides a venue to define what activities at a landscape level should occur to support high value habitats such as elk, moose, mule deer, white-tailed deer, Stone's sheep, and provide management direction to address specific habitat sensitivities to fire – either positive or negative. These high value habitat areas are classified in BC (WHA, UWR, and GAR), however, there is no provincial catalogue of wildfire impacts, nor a prioritized provincial process for managing the habitats both during a wildfire and through a proactive landscape management program.

The project objectives are: (1) Create a provincial priority list of habitat and develop clear criteria for local planning tables to identify and rank habitat areas, in relation to forecasted wildfire impacts, and wildfire mitigation and forest management activities; (2) Develop a habitat value prioritization matrix and detailed mapping for each District in concert with fire management plans; and, (3) Build the operational plan and prescriptions that leads to co-ordinated treatments that contribute to the creation of more fire resilient habitat across the landscape. These activities would include; allowing more modified response wildfires, implementing prescribed fire, mechanical treatments, and coordinating multiple land management programs. The proposed project is 5 years, with the first year devoted to developing a provincial methodology and applying it in 2 pilot areas. In the following years, funds will be used for additional local habitat analysis and operational treatments on the land base.

Total costs, partnership costs, and amount requested in proposal

This project meets HCTF Goal 1 Objective 1.1 at a provincial and local level, whereby a proactive and strategic approach to mitigating the forecasted increasing impacts to habitat from wildfires. This project will prioritize habitat values in relation to wildfire impacts that will allow for the subsequent investment in treatments that will create a more fire resilient landscape. This will result in multiple benefits to multiple species. It also meets Goal 3 by partnering and leveraging funds from existing planning and treatment programs towards creating more resilient ecosystems and habitats in priority 'at risk' areas.

Issue Summary (max 250 words) 268 now

Indentify the problem urgency and risk if not addressed, statement of need, facts and stats / How the project is linked to larger ecosystem benefits and implication for fish and WL populations versus present / Linkages to relevant regional management plans / State how the proposal intends to solve the problem

Habitat areas of concern to ungulate and large mammal populations are subject to changing patterns and impacts, resulting in the loss or degradation of quality habitat. Historically wildfires have always played a role in the evolution of terrestrial landscapes across BC; however, decades of successful fire suppression in fire dependant natural disturbance regimes have altered succession patterns. Walker summarizes that "an overabundance of fuels in the form of dead and dying lodgepole pine and thick stands of regenerating conifers and aspen...reduce the quality and quantity of suitable winter and spring forage for mule deer, while increasing susceptibility of the forest to a large, stand-initiating fire" (Walker, 2008).

By managing the natural role of fire, negative trends from the combined effects of fuel build-up and climate change may be partially mitigated. Thoughtfully applied wildland fire management can be used to maintain habitat and provide resilient ecosystems. Techniques include:

- implementing fire smart forest management activities
- monitoring rather than suppressing certain wildfires
- conducting wildlife related prescribed burns to restore the balance of grassland and forests.

Although science and local knowledge exists regarding habitats that would benefit or not benefit from a fire, there is currently not an organized workflow to plan and implement it on a district/provincial scale.

This project proposes identify and prioritize the use of wildfire to achieve conservation benefits through regional and local workshops that include stakeholders and expertise from within and outside government. The intent is to have a complete integrated fire management plan that includes consideration of multiple values. Subsequent to this, operational treatments can be prioritized to focus on mitigating impacts.

Project Details

Objectives, Activity, *Measure of Success*

s.13

Details about the Objectives

Fire is often considered to have a negative impact upon habitat values; however fire can also have either no impact or a positive impact depending upon fire severity and timing. From this perspective it is important to assess the impact of different kinds of fire upon priority habitat values. There is also a relation to fire response/suppression costs and effectiveness beneficial fires or fires with little to no negative impact upon affected priority habitat values may not necessitate a full response from a suppression perspective. Develop a provincially standardized set of criteria and guidance for the prioritization of the higher value habitat within a defined planning area (e.g. MFLNRO Resource District),

Details about the Activity

A minimum of three workshops will be held across the province (Coast, North, and South) involving MOE, MFLNRO habitat, wildfire, forestry staff, First Nations, Guide Outfitters, and Forest Industry, ER Program, stakeholders to asses' fire impacts upon priority habitat values. These workshops will bring together expertise from both fire and ecological perspectives in developing an appropriate priority/response matrix. The goal would be to identify which areas should encourage more fire to benefit those values, as well as opportunities to implement mitigation and forest management activities to reduce suppression requirements. This may include utilizing attributes such as;

1. vulnerability of the species the habitat supports,
2. the present distribution, extent and state across the landscape and its ability to support the species,
3. vulnerability of the habitat to wildfire both positive and negative (e.g. salvage harvesting, MPB, fuel loading, wildfire risk),
4. responses of the habitat to a low impact or prescribed fire,
5. responses of the habitat to a high intensity fire,
6. the effect of wildland fire, mitigation activities, or modified forest management practices on the value of the habitat,
7. identification of the longer term fire regimes, natural disturbance types for the habitat and how far it may be out of balance,
8. vegetation and topographical features of importance to species (e.g. forage, thermal cover) fire good and fire bad, and
9. currently proximity of the habitat to other values on the landscape e.g. (Wildland Urban Interface, Community Watersheds).

Detail Measures of Success Objective/Activity

a. *A process is developed that guides local fire management planning outlining the steps, and information gathering that is required, and the criterion to be used when building District or regionally based habitat value priority ranking in response to wildland fire, and wildfire mitigation or modified forest management activities . This will, include recognition of the positive effects of fire in certain circumstances along with identification of high values that are at the highest risk of wildfire impacts.*
b. *Completed provincial guidance on the types of activities available to mitigate the risk.*
c. *An initial priority ranking of high value habitat types is created provincially and regionally (Coast, North, and Interior).*
d. *Best practices, templates around habitat are developed that can be integrated into a fully operational multiple-values decision model.*

An evaluation of the impacts of projected wildfire regime(s) on critical habitat areas. Develop a standardized set of planning tools, criteria and guidance for evaluating impacts of wildland fire on habitat.

3 regional workshops
3 Pilot project workshops

Objectives, Activity, *Measure of Success*

1. Develop a habitat value prioritization matrix and detailed mapping for each District in concert with fire management plans. Three Districts in 2013. Five Districts per year starting in 2014.

    a. Develop a prioritized ranking for habitat values in relation to forecasted wildfire impacts both positive and negative, along with supporting documentation and maps within the planning area to support Landscape Fire Management Planning. The goal is to provide habitat related objectives, and information to support restoration treatments on a landscape scale.

        i. *Each Resource District planning group has a habitat/wildland fire strategy developed consistent with the provincial standard developed in Objective 1*

Details about the Objective

Climate change models suggest that predicted conditions for future wildfires could show significant impacts including: increased fire size, fire severity, fire season length and severe fire behaviour, based upon an increase of 4C by 2080 (Haughian, et al. 2012). Dead mountain pine beetle pine stands have created a new fuel type estimated to be increasing at a rate of 808,327 ha annually (Hvenegaard, S., 2012). Changes include rapid crown fire initiation, high intensity fires and mass spotting (Perrakis, D., et al, 2012). An analysis of the impacts of fire intensity upon identified priority habitat values in a fire management plan defined local area is required moving forward under a changed fire regime conditions.

Details about the Activity

At the District level, habitat values of management priority are identified based on the provincial guidance and fire hazard information. This will include reviews of fire regimes – current/predicted and past and the impact of these regimes upon current forest conditions. This kind of analysis can result from either fieldwork or from reviews of existing work with applicability to the area in question. Fire regime analysis provides guidance as to whether or not an area is or has been functioning as it historically has from a fire occurrence and hence effects perspective. It will support the use of fire to enhance traditional ecosystem functioning thus benefiting species use of a priority habitat area dependent upon the effects of fire. Preliminary candidate sites based on the physical attributes are delineated as values of priority. These areas will then be integrated within the broader Fire Management Planning process, outlined below showing where the habitat value information is required.

1. Assessment of the wildfire hazard, and risk to values on the landscape (TSA/Districts):
    a. Apply an already completed fire risk analysis (Burn P3 modelling) for the defined area;
    b. Collection and identification of values at risk habitat and relative initial ranking using suppression priority themes and land manager resource priorities habitat into a WMB GIS data base of values at risk;
    c. Identify where fire has ecological benefit on the landscape and where the highest values habitat are at the highest risk; and
    d. Determine logical management units (e.g. landscape units) and develop fire management objectives habitat for each unit related to the prioritized values at risk.

2. District/TSA based collaborative planning- A landscape planning committee of district stewardship staff, Parks staff, habitat biologist, local guide and outfitters, forest industry, First Nations, local communities, local WMB Staff, ER Program will been formed for the planning area:
    a. Significant consultation with communities, First Nations, and stakeholders will be required to identify landscape fire management actions;
    b. Reaffirm the initial WMB GIS data base of values at risk. This could include identification of economic value of features on crown land habitat: and
    c. Identify and prioritize management activities to reduce risk and threat to highest values at highest risk habitat.

1. Building the plan coordination of resources for fire management treatment activities:
    a. Include all information in a Fire Management Plan for the fire zone. Details to include objectives, identified and prioritized values, modified response areas, prescribed burning areas for **habitat**, a Communications plan and a fuel management plan.

Detail Measures of Success Objective/Activity

a. Completed habitat risk mapping and assessments for habitat areas in the defined planning unit. Details to include habitat and broader ecosystem targeted objectives, identified and prioritized values, modified response areas, and fuel modification treatments areas (prescribed burning, mechanical).

b. Completed habitat risk mapping and assessments are incorporated and integrated with other values (e .g. timber, watershed) *into high-priority landscape-level plans to support strategic fire management decision-making.*

Objectives, Activity, *Measure of Success*

1. Implement treatment activities to positively address the impacts of wildland fire on habitat areas.
    a. Develop integrated implementation plans locally for habitat restoration and maintenance projects where fire management planning is currently piloted 2014 (Merritt, Soo and DVA/DJA portion or the PG TSA) and additional areas in subsequent years.
        i. *Completed operational plans have indentified strategic areas where multiple benefits and objectives are overlapping.*

    b. Implement operational activities to maintain or enhance priority identified habitat opportunities. Implement treatment activities to positively address the impacts of wildland fire on habitat areas. (e.g. Moose, Mule Deer, Elk, Caribou) in partnership with Ecosystem Restoration or other projects such as the Provincial Fuel Management; Forest for Tomorrow, etc. and in areas of high risk for both Habitat and interface of other values.
        i. A target of 3000 ha a year is treated. This will be further refined once the local plans have been developed.

Details about the Objective

Resource management activities such as forest harvesting, prescribed burning, fuel hazard abatement, ER, FFT, can all contribute to wildfire hazard mitigation in areas that have been prioritized and are high value at high risk. Once the habitat wildland fire strategy information is integrated into the fire management plans, multiple benefits gain can be realized through the strategic selection of treatments and modified forest management activities with the ultimate goal building fire resilient ecosystem across the land base. The MOE burn program has been endorsed and partially funded by local hunting organizations and guide/outfitters, and is seen as a credible and effective (Lousier et al 2009). The ER program actively utilities prescribed fire as one of its operational treatments. Prescribed burning and fire management activities can be an effective method to restructure vegetative communities, hence wildlife habitat (Lousier et al 2009); while at the same time reducing the wildfire threat to other values.

Details about the Activity

a. Develop implementation plans locally for habitat restoration and maintenance projects where fire management planning is currently piloted 2014 (Merritt, Soo and DVA/DJA portion or the PG TSA) and additional areas in subsequent years.
   i. Areas identified for modified response in early or late season fire weather conditions that incorporate Provincial Park Fire Management Plans.
   ii. Incorporate proposed and completed treatments (CWPP) from fire zone and district programs (FFT, ER, BCTS), and habitat prescribed burns or proposed prescribed burns in areas such as Parks.
   iii. Propose fuel management treatment priorities at the interface level and the landscape level for each unit looking at areas where high values for interface and habitat overlap.
   iv. Develop a multiyear operational plan for co-ordinated treatments.
b. Implement treatments in partnership with Ecosystem Restoration projects and in areas of high risk for both Habitat and interface of other values.

   i. Fuel treatments for protection of Community and Infrastructure values
   ii. Ecosystem Restoration Projects and Prescribed Burns for fuel reduction, forest health, habitat:
   iii. Prescribed burns for the early seral habitat – wildlife committee. Forest management practices and prescribed fire have been used successfully in BC for enhancing ungulate winter and spring forage (i.e. forage quality and quantity), to restore the natural disturbance cycle within ecosystems and to meet biodiversity objectives (Pooleet al. 2002).
   iv. Landscape level fire management activities that will support multiple objectives such as habitat maintenance, wildfire risk reduction and ecological resilience.

Detail Measures of Success Objective/Activity

a. The priority areas will include targeted landscape and stand level objectives that over time (5 years) after treatments and activities are implemented will create a more fire resilient landscape.
b. The tactical plan will outline the targeted areas for treatments and the associated

Communication Outreach

Project Communication Plan

HCTF Communication Plan (How will your project help HCTF achieve Goal 3 *"HCTF is a recognized leader in fish, wildlife, and habitat conservation"* ; *Objective 3.1 Gain broader recognition of the conservation capabilities and achievements of the HCTF and its contributors, partners, and funding recipients; 3.2 Increase the HCTFs conservation impact through strategic partnerships*, of the Strategic plan?)

This project meets HCTF Goal 1 Objective 1.1 at a provincial and local level, whereby a proactive and strategic approach to mitigating forecasted increasing impacts to habitat from wildfires. The linkage with Goal 1 is met in that this project will prioritize habitat values in relation to wildfire impacts that will allow for the subsequent investment in treatments that will create a more fire resilient landscape. This will result in multiple benefits to multiple species.

In regards to Goal 3, HCTF is being a recognized leader in wildlife and habitat conservation this project contribute to maintaining healthy ecosystems in an era of increasing wildfire hazard and risk. Investing in building a sound understanding of the current relationship and priority of habitat areas as in relation to forecasted wildfire risk, will lead to healthier habitat though direct operational treatments in addition to broader resilient landscapes. FIT also meets objective 3.2 High quality innovative projects that help to meet the strategic goals and objectives by partnering and leveraging funds from existing planning and treatments programs towards creating more resilient ecosystems and habitat in priority at risk areas.

s.13, s.17

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Landscape Fire Management Planning in British Columbia

Since 2005 Regional Operations has been preparing district Fire Management Plans as directed in Policy 9.4. To date, District Fire Management Plans have focussed solely on the identification of suppression priorities for reactive wildfire response. In 2012, Landscape Fire Management Planning (LFMP) was initiated to provide a basis for proactively managing the landscape to reduce wildfire risks and threats on the crown managed land base to communities, critical infrastructure and natural resource values.

Climate change impacts are rapidly accelerating and British Columbia must adapt to a rapidly changing wildfire threat. The requirement for proactive wildfire management to respond to climate change challenges is recognized in the BC Climate Change Action Plan, the BC Forest Stewardship Action Plan for Climate Adaptation, and, the BC Wildland Fire Management Strategy. Landscape Fire Management Planning is also recognized as a key requirement the 2012 Special Committee on Timber Supply recommendation to the Legislative Assembly - Mid Term Timber Supply Action Plan. **Any delay in landscape fire management planning in the short term will mean increased losses, costs and impacts in the long term.**

Resource Requirements: Landscape Fire Management Planning consists of 3 phases: Assessment, Planning and Management. 3 Resource District lead Pilot LFMP's (Assessment and Planning Phases) have now been completed in the *Cascades Resource District - Merritt TSA, Vanderhoof / Fort St. James and Sea to Sky / Chilliwack Resource Districts.* Two planning models were used:

- A planning model largely done by District Regional Operations staff and Wildfire Management Branch (WMB) staff, requires an estimated 0.80 FTE District annually across several positions.
- A planning model that uses more of a contractor supported model is estimated to require about 0.25 of FTE District/WMB time coupled with about $60k to $80k for contractor work. The funding for this model is supported by Land Based Investment Strategy (LBIS) funding under the Fire Management Planning Investment Category.

Fiscal 2014/15: LBIS funding of s.17 has been confirmed to support LFMP in fiscal 2014/15. This funding will support the development of 3 new LFMP's provincially using the contractor supported planning model. Rocky Mountain Resource District has proposed starting a LFMP planning process this fiscal and discussions are underway with other resource districts that have interest/capacity to enter into planning. A January 24th RED/ED call to discuss a performance measure of initiating 3 LFMP's per year resulted in the following decisions and actions:

DECISION: REDs support the PM in principle but resourcing is the restricting issue.
ACTIONS: REDs to prioritise as part of 2014/15 business planning process.

Proposal:

- WMB continue to work with resource districts that have interest/capacity to enter into planning;
- LBIS funding will be used to implement a contractor supported model to minimize district workload;
- Priority should be placed on districts with high risk (see attached map); and,
- The performance measure of 3 LFMP's per year should be maintained.

Provincial priority ranking:

OverviewPriorityRanking1993_2012.pdf

LANDSCAPE FIRE PLANNING AND MANAGEMENT

Background

Current wildfire trends in BC and Canada are leading to increased wildfires, suppression costs, threats to communities and infrastructure. This is being driven by the effects of climate change, the new mountain pine beetle fuel type and increasing community, critical infrastructure, and, natural resource development on the forested landbase.

Recent history has shown that along with increased threats to communities and critical infrastructure, threats to resource values are also increasing. Over the 2004, 2009, and 2010 seasons, wildfires affected 414,000 forested hectares with 340,000 hectares being in the timber harvesting land base. This represents an estimated 51 million cubic meters of timber volume. Some of this impacted area included previous silviculture investments and also resulted in significant payouts to licenses under FRPA s.108.

It is not an option to continue to increase fire suppression response and associated costs, because even the most aggressive action would neither be safe or effective for the extreme wildfire events. Extreme events now termed, "mega fires," are predicted to increase as climate change progresses and during these events; suppression response cannot be relied upon to protect communities or natural resource values. The only protection provided will be the protection established prior to the fire provided through wildland urban interface fuel reduction and landscape fire management.

The overall goal of landscape fire planning and management (LFPM) is to create a more fire resilient landscape to mitigate fire impacts on priority values in an era of increasing fire hazards and risks. Landscape fire management requires a provincial level commitment within the Natural Resources Sector (NRS) to create a framework that can then be implemented by the Land Manager at the District level. The successful integration of wildfire considerations into most aspects of resource management planning will also require a focused commitment by industry, communities and agencies.

The government of British Columbia has recognized the value of proactively reducing wildfire risks and threats and wildland urban interface fuel reduction and landscape fire management are recognized as key objectives in the BC Forest Sector Strategy[1], and, the BC Forest Stewardship Action Plan for Climate Change[2] and more recently the report of the Mid Term Timber Supply Review Committee[3].

What is Landscape Fire Planning and Management?

Landscape fire planning and management extends fire management initiatives from the 2 km area of municipal lands adjacent to communities, to provincial forests to further mitigate impacts to communities, critical infrastructure and natural resource values. The objective of landscape fire planning and management is to stop the development of extreme "mega" fires by creating landscape level fuel breaks. This can be accomplished by modelling wildfire risk and threat; analysing land management options; and, creating landscape level fuel breaks through targeted harvesting, establishing linear fuel breaks, and, utilizing alternative silviculture practices. Often, even simple management actions such as widening road right of ways or realigning cut block patterns can have significant beneficial effects of mitigating extreme wildfire behaviour. These activities can also support local employment creation, provide harvest opportunities and protect mid-term timber supply as well as support other key programs such as ecological restoration and the emerging biofuel economy in British Columbia.

Implementation of Landscape Fire Planning and Management

Successful LFPM on the land base will require a provincial level commitment to create a framework that can then be implemented by the land manager at the local level. A new level of planning that is based on landscape risk and threat analysis combined with a long term landscape fire management objectives that guide operational activities to reduce wildfire risk and threat is required.

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[1] http://www.for.gov.bc.ca/mof/forestsectorstrategy/Forest_Strategy_WEB.PDF
[2] http://www.for.gov.bc.ca/ftp/HFP/external/!publish/ClimateChange/Adaptation/Action_Plan_two-page_summary_Feb_27_final.pdf
[3] http://www.leg.bc.ca/cmt/39thparl/session-4/timber/reports/PDF/Rpt-TIMBER-39-4-GrowingFibreGrowingValue-2012-08-15.pdf

1. **A Provincial Framework for Landscape Fire Management**

    - Establish a fire management vision or provincial target **"Eliminate or mitigate high risk areas across the province in 10 years"**
    - Develop a BC Fire Management Communication Strategy that focuses on increased knowledge of fire management at the home, community and landscape levels
    - Establish a multi division team to review and revise current legislation, regulation for barriers to full implementation e.g. FRPA Fire Objective, tenures, pricing, FPPR
    - Consider the option of an MOU between Industry, Communities and Government to sign onto that speaks to all three of their interests with focus on collectively addressing this mutual concern
    - Establish a forest industry fiber focus on fuel management to expedite work required
    - Incorporate landscape fire planning and management into all Ministry investment decisions, including Type 4 Silviculture Strategies

    Provincial Landscape wildfire risk and threat modeling

    - The goals are to complete burn probability modeling all management units in BC this year. Five Districts were modeled last year.
    - Results of the modeling are to be used to prioritize areas at risk, set objectives for wildfire risk reduction on the landscape, and support subsequent operational management planning over the next few years.

    The wildfire risk and threat modelling processes will be refined to include fire intensity to better identify the resources and hazards presented by crown fires and fires in MPB killed forests.

2. **The Process for Landscape Fire Management Planning at the Local Level**

    a) Assessment of the wildfire hazard, and risk to values on the landscape (TSA/Districts)

    - Wildfire hazard and risk modeling
    - Collection and identification of values at risk and relative initial ranking using suppression priorities
    - Determine fire management objectives for the landscape unit (e.g. reduce risk from extreme (rank 5, 6) and to moderate (rank 3,4) or less

    b) District/TSA based collaborative planning

    - Significant consultation with communities, First Nations, and stakeholders will be required to
        - Applying a relative ranking to the values at risk and prioritizing mitigation options
        - Identify management options to reduce risk and threat to key values (e.g. fuel modification, prevention, increased suppression success)
        -

- Prioritize management activities to protect highest values at highest risk and identify where fire is wanted or unwanted on the landscape

c) Determination of management actions and coordination of resources for fire management treatment activities

- Implement management options and assess results, modify as required
- Develop a multiyear operational plan for co-ordinated treatments
    - Fuel treatments for protection of Community and Infrastructure values
    - Landscape wildfire risk mitigation activities for priority resource values
        - Targeted Harvesting in areas identified as high hazard and risk to values
        - Alternative silviculture regimes to protect values – Targeted Spacing, Stocking Standards
    - ER Projects and Prescribed Burns for fuel reduction, forest health
    - Habitat Burns for habitat management, fuel reduction
    - Line corridor, deciduous and large scale fuel breaks from harvesting

3. Current LFPM Initiatives at the Resource District Level

Landscape level pilot initiatives in the following resource Districts will lead the development of provincial level landscape level fire management. Current initiatives to achieve this objective include:

Cascades Resource District - Merritt TSA

- Full Phase LFPM has been initiated with the support of district stewardship and tenures staff, the fire center fuels specialist, and the fire management planning specialist.
- The goals are to assess wildfire risks and prioritize landscape level values, indentify modified response and targeted prescribed burning areas, and develop a fully integrated fuel management plan for public and stakeholder consultation.

Vanderhoof / Fort St. James and Sea to Sky / Chilliwack Resource Districts

- A landscape planning committee of district stewardship staff, forest industry, First Nations, local communities, local WMB Staff and the regional fire management specialist has been formed for the Vanderhoof District to identify landscape fire management actions for the protection of midterm timber supply.
- A similar structure will be subsequently formed in the Sea to Sky pilot area.

Comment on LBIS 2014_2015 - Fire Management Funding

Risks and Costs

- Wildfire suppression costs were approximately $500 million in 2003, $400 million in 2009 and over $200 million in 2010. 2009 set a record for the most wildland urban interface fires and 2010 set a record for the most area burned in one fire season (330,000 ha). Along with the suppression costs noted above, the 2003 wildfire season was assessed as costing $400 million in indirect costs and $126.9 million in private losses.

- The impact on resource values, particularly, timber supply has also been significant, and 340,000 ha of the timber harvesting landbase were affected by wildfires from 2003 to 2010 alone. These fires resulted in estimated volume impacts of 51,000,000 m3 and reforestation costs of up to $133 million. These costs will continue to escalate in the future as a result of climate change, mountain pine beetle fuel types and increased investment in natural resource values that are at high risk to wildfires.

- A Ministry review of the recommendations of the Special Committee on Timber Supply identified fuel and landscape fire management planning as one of the top 4 implementation priorities for the Ministry. Projected estimated impacts of wildfires on the timber harvesting landbase in the next 4 decades are a total area burned of 2,210,000 ha and a total volume impacted of 331,500,000 m3. Landscape fire management planning (LFMP) is required to reduce catastrophic losses to timber supply, communities and critical infrastructure.

- Without significant investment in Landscape Fire Management Planning:

    a. Wildfire response costs will continue to increase and the provincial budget will be impacted;

    b. Losses to timber values and silviculture investments will continue;

    c. Communities, critical infrastructure and natural resource values will be threatened by wildfire risks;

    d. The provinces economy, infrastructure and mid-term timber supply will be subject to catastrophic future wildfire losses.

Opportunities

- LFMP is a relatively new Investment Category (2011) and the program is ramping up with an increasing requirement for sustained funding from LBIS to support both wildfire fire risk and threat assessments and district based Landscape Fire Management planning (LFMP) and management activities. With adequate funding planning can be completed in the next 5 years and management activities will be ongoing.

- LBIS approved $180,000 only in 2014_2015; this will reduce the amount of project areas supported and slow down the time frame for completion of LFMP in BC. The requirements for a minimum baseline LFMP planning are $250,000 for 2014/2015

- WMB supports an acceleration of LFMP in the short term to allow for this planning information to be available to other LBIS investment categories as soon as possible. This information is absolutely essential to inform where and how land management investments should be managed to reduce losses to communities; critical infrastructure; and, Mid Term Timber Supply values from catastrophic wildfires.

LBIS Funding Options

Activity	
3 new LFMP Project Areas initiated	
Generation 2 Burn p3 completed	
Accelerated time frame 3 project areas	s.13, s.17
Additional LFMP project areas initialed	
Implementation of LFMP pilot activities support	

TOTALS	s.13, s.17

- This funding request only reflects current commitments to preparing LFM Plans. Implementation will include treatment planning and activities on the ground in order to achieve LFMP objectives and this will require additional funding of an estimated s.13, s.17 per year.

- Landscape Fire Management Planning directly supports the LBIS goal of:

  Mitigate impacts from catastrophic disturbances to the economic, social and environmental benefits of natural resources.

- Since no other forest management disturbance is as capable of disrupting the provinces economy like wildfire, LFMP is also a key component of contributing to:

  Act on strategic priorities to enable the use of B.C.'s natural resources and contribute to the achievement of economic, social and environmental objectives of government.

Deferred Benefits

- Wildfire poses a direct threat to the achievement of LBIS goals, and outcomes in almost every Investment Category, most notably in the Mid Term Timber Supply, Forest Health, and Current Reforestation due to the longer term contributions to timber volume assumptions that are used to determine the financial viability of these investments.

- Without a full assessment and mitigation of wildfire risks, significant investment in almost any other category is risky and could be lost well before any economic, ecological or social benefit was derived from the investment.

  Gains from fully funding a landscape fire management planning program include:

  a) FFT funded pressures from FRPA s.108 reduced.
  b) Losses of current reforestation investments to wildfires reduced and new area selected based on a sound understanding of the desired future forest condition (wildfire resiliency, increased grassland, climate change etc).

c) Reduced catastrophic losses from impact to communities by the targeted funding of treatments within and beyond the Wildland Urban Interface. Impact from Slave Lake is over $1Billion.
d) Completed LFMP across the province would also provide information that additional programs including Ecosystem Restoration, Wildfire Habitat, and Range could use to align their program activities and also reduce longer term costly impacts from wildfires on their investments.

- Proactive LFMP and fuel management activities have an estimated return on investment ratio of 4:1 to 250:1 depending on the value being protected and the magnitude of the risk. There is little time to prepare for rapidly approaching climate change effects, and every year of delay in this time period will mean more years of extreme effects in future years.

WILDFIRE MANAGEMENT BRANCH

RESPONSE TO RECOMMENDATIONS OF THE MID TERM TIMBER SUPPLY REVIEW

FUEL AND LANDSCAPE FIRE MANAGEMENT

I. BACKGROUND

As a result of climate change; new fuel types created by the mountain pine beetle infestation; and, increasing urban development, it is expected that wildfire threats to communities and natural resource values will increase significantly. By incorporating climate change predictions, the Insurance Bureau of Canada predicts that the incidence of severe wildfires will increase in B.C. by 50% or more over the period to 2050. The 2010 Slave Lake Fire in Northern Alberta has been estimated to be the second largest insurance cost in the history of Canada. The recent Peachland fire resulted in the loss of 5 structures in less than an hour. With these types of fires communities face public health threats, loss of economic revenues such as tourism and severe social disruption.

The 2003 wildfire season has been estimated to have cost the province $423 M in Wildfire Management Branch costs, $455 M in direct costs to other government agencies, $109 M in lost revenue, and $148 M in indirect costs for a total cost of $1.135 Billion. In 2009, when a record was set for the most wildland urban interface fires (213) the Wildfire Management Branch cost was approximately $440 M and 2010 set a record for the most area burned in one fire season (330,000 ha). The impact on resource values, particularly, timber supply has also been significant with 340,000 ha of the timber harvesting landbase were affected by wildfires from 2003 to 2010 alone. These fires resulted in estimated volume impacts of 51,000,000 cubic meters and reforestation costs of up to $133 million. Without proactive fuel and landscape fire management this trend is expected to continue and climb significantly along with the increased social and economic losses.

While effective suppression response is always a priority, response effectiveness in severe wildfires situations is highly limited, however, proactive wildland urban interface fuel reduction and landscape fire management planning can reduce suppression costs, reduce losses to communities and critical infrastructure and reduce losses to natural resource values. Ignoring the need to carry out these measures given future predictions will result in escalating costs and damages much greater than what has been experienced to date.

Strategic Wildfire Prevention Initiative (Provincial Fuel Management Program)

Since 2004, the Strategic Wildfire Prevention Initiative, a collaborative initiative between the Union of BC Municipalities, the First Nations Emergency Services Society, and, the Ministry of Forests, Lands and Natural Resource Operations, have worked cooperatively to reduce wildland urban interface fuels on municipal and first nation lands adjacent to communities. Between 2004 and 2010, $37M of Federal and provincial funding was allocated to UBCM for local government and First Nations community wildfire protection planning and treatments under the Strategic Wildfire Prevention Initiative (SWPI). In March of 2011, new funding of $25M over 2 years was approved by Treasury Board. This funding was granted to the Union of BC Municipalities over 2 years for continuation of the Strategic Wildfire Prevention Program. This current funding will be fully allocated by the 2nd quarter of 2013 and new funding will be required to maintain the program.

To date, the SWPI has resulted in the development of a total of 302 Community Wildfire Protection Plans, with 189 community wildfire protection plans in collaboration with local governments and 113 with First Nation communities. As result of the plans, over 46,467 hectares of high risk community interface has been treated, with 25,244 ha in Mountain Pine Beetle areas and 19,219 ha in non-MPB areas.

This work is done in an area 2 km or less surrounding communities. The benefit of fuel reduction were clearly demonstrated in 2009 and 2010 wildfire seasons when 3 communities – West Kelowna, Alexis Creek and Barnhartvale were spared major wildfire damages as a result of successful fuel reduction projects. Direct Fire costs were also significantly reduced and wildfire control crews were able to work safely, quickly, and effectively. The return on investment of treating high risk stands is conservatively estimated at 3.4/1. This return on investment will increase as wildfire threats from mountain pine beetle killed stands and the rapidly increasing effects of climate change result in more wildfire potential over time. It is estimated that the full benefits of wildland urban interface fuel reduction may take up to 25 years to be realized, but British Columbia has already realized significant benefits.

Landscape Fire Management

The impacts of extreme wildfire events, commonly called "Mega Fires", and associated losses of communities, critical infrastructure and natural resource values can be further mitigated through landscape fire management. Landscape fire management extends fire management initiatives from the 2 km area of municipal lands adjacent to communities, to provincial forests to further mitigate impacts to communities, critical infrastructure and natural resource values. The objective of landscape fire management is to stop the development of extreme "mega" fires by evolving our landscapes to a more fire resistant state over time. This can be accomplished by modelling wildfire risk and threat; analysing land management options; and, conducting all landbase activities in a manner that aligns with the fire management objectives, creating landscape level fuel breaks through targeted harvesting, establishing linear fuel breaks, and, utilizing alternative silviculture practices.

Often, even simple management actions such as widening road right of ways or realigning cut block patterns can have significant beneficial effects of mitigating extreme wildfire behaviour. These activities can also support local employment creation, provide more harvest opportunities and protect mid-term timber supply.

Landscape fire management can support other key programs such as ecological restoration and the emerging biofuel economy in British Columbia. The government of British Columbia has recognized the value of proactively reducing wildfire risks and threats and landscape fire planning and management is recognized as key objectives in the *BC Wildland Fire Management Strategy*, *BC Forest Sector Strategy,* and, the *BC Forest Stewardship Action Plan for Climate Change.*

II. FUNDING AND RESOURCE REQUIREMENTS

The recommendation of the committee on the Mid Term Timber Supply review is noted below:

3.3	The Committee recommends to the Legislative Assembly that the Ministry: a) Continue to fund strategies and activities for the reduction of fuel in the wildland-urban interface. Where these investments reduce overall fire suppression risks and costs, then the Ministry might best fund these expenditures from the fire suppression budget, thereby reducing overall cost to the Province. b) Ensure that tenure holders help to manage fuels across the broader forest landscape in addition to the urban interface. c) Work closely with tenure holders by linking its fuel management programs to type 4 silvicultural strategies.

Recognizing that the Strategic Wildfire Prevention Initiative (Provincial Fuel Management Program) and the Landscape Fire Management Program require different delivery models with the SWPI being administered through a transfer to the Union of BC Municipalities, and, the Landscape Fire Management Program being delivered through the Ministry of Forests Lands and Natural Resource Operations, the requirements for funding and resourcing each initiative have been also separated.

1. <u>Strategic Wildfire Prevention Initiative (Provincial Fuel Management Program)</u>

***Funding* – Transfer to the Union of BC Municipalities** An acceleration of the Fuel Management program, complimented by sustained funding is essential to meet the short and longer term challenges of climate change, forest health issues (mountain pine beetle, spruce budworm, etc), and increasing high risk areas to treat as a result of urban expansion into the wildland urban interface.

This funding would be directly granted to the Union of BC Municipalities to administer the Strategic Wildfire Prevention Initiative under a Memorandum of Understanding as has been the process for the past 8 years. The short term funding request is for $ 8 M as funding will still be available until the 2nd quarter of 2013, however, the program will utilize $12 M annually for both the treatment of high and extreme risk areas and for ongoing maintenance of previously treated sites as they grow in.

Year/Program	13/14
SWPI	*$8

s.13, s.17

****Funding still available in current SWPI program will run out in 2nd quarter 2013/14.***

***Resource Requirements*:** As this is a well established program, no additional resources are required.

2. <u>Landscape Fire Management Planning and Wildfire Management Branch fire crew extensions to target high priority fuel treatments.</u>

***Funding* – Annual Uplift to Wildfire Management Branch base (Fire Preparedness budget) funded through MFLNRO's Ministry Operations Vote**

Consultation with local communities is beginning and the response to date has been overwhelmingly in favor of this program. Landscape fire planning requires Timber Supply Area wildfire risk and threat assessment modelling; evaluation of risks at a district and landscape level; GIS support to build an operational analysis; field work to ground verify potential treatments areas; and, First Nations, stakeholder, industry and local community meetings to identify treatment options and management commitments. It is estimated that planning for each district requires approximately s.17 per district for 30 districts. s.17

s.17

Operational landscape treatments will be planned to take advantage of harvestable timber volumes to offset costs and bionergy solutions are also being explored that would better utilize woody debris resulting from fuel treatments. Operational treatments, including prescribed burning and intensive fuel reduction activities, however, will also require funding - estimated at s.17 per district (30 districts) spread over the next s.13 ears. Provincially this amounts to s.13, s.17

Year/Program	13/14	
Landscape Fire Management	$1.53M	s.13, s.17

***Resource Requirements*:** Expanding landscape fire management planning to all high risk Timber Supply Areas in the province will require a minimum of s.13, s.17 extra FTE's of full time staff with the associated salary costs s.13, s.17

Wildfire Management Branch (WMB) crews also can contribute to annual fuel treatments when not on fireline duties. Approximately 1,000 ha per year are being targeted and treated by WMB crews, and there is potential to increase this by extending crews prior to, and after the fire season. The last significant extension of WMB crews was in 2008/2009 when approx $4M was allocated for work in Mountain Pine Beetle (MPB), and non-MPB fuel treatments. In 2011/2012, WMB crews were extended in southern BC with a smaller allocation of <$1M. Much more WMB crew work is possible with annual sustained funding to address the large area requiring treatment. s.17

Year/Program	13/14	
Landscape Fire Management	$1.53M	
s.13, s.17 FTE's Staffing	$0.45M	s.13, s.17
Crew Extensions	$2.5M	
Total:	$4.48 M	

III. SUMMARY

Strategic Wildfire Prevention Initiative (Provincial Fuel Management Program)

- *Transfer to UBCM*

Year/Program	13/14	
SWPI	$8M	s.13, s.17

2. Landscape Fire Management Planning and Wildfire Management Branch fire crew extensions to target high priority fuel treatments

- *Annual uplift to Wildfire Management Branch base (Fire Preparedness budget) funded through MFLNRO's Ministry Operations Vote.*

Year/Program	13/14	
Landscape Fire Management	$1.53M	
s.13, s.17 FTE's Staffing	$0.45M	s.13, s.17
Crew Extensions	$2.5M	
Total:	$4.48M	

3. TOTAL FUNDING AND RESOURCE REQUEST: Strategic Wildfire Prevention Initiative and Landscape Fire Management

Year/Program	13/14	
SWPI/Landscape Fire Management	$12.98 M	s.13, s.17

Proposed Provincial Performance Measures
Landscape Fire Management Planning in British Columbia

Background

Since 2005 Regional Operations has been preparing district Fire Management Plans as directed in Policy 9.4. To date, District Fire Management Plans have focussed solely on the identification of suppression priorities for reactive wildfire response. Proactive wildfire risk and threat reduction has only been conducted in some community wildland urban interface zones through the Strategic Wildfire Prevention Initiative (fuel management program), however, this does not address risk and threats from the greater forest landbase and a comprehensive approach to landscape level risk and threat reduction is needed.

In 2012, Landscape Fire Management Planning (LFMP) was initiated to provide a basis for proactively managing the landscape to reduce wildfire risks and threats to communities, critical infrastructure and natural resource values. The objective of LFMP is to establish a district plan that will ensure fire management is a consideration in all land management activities and identify key forest management activities that will reduce wildfire losses and suppression costs. The ultimate goal will be to create fire resilient ecosystems and fire adapted communities. A revised policy 9.4 is being prepared to support this shift from reactive response to proactive management planning.

Landscape Fire Management Planning is recognized as a key requirement in the Provincial Climate Change Action Plan, the Forest Stewardship Action Plan, the BC Wildland Fire Management Strategy and the 2012 Special Committee on Timber Supply recommendation to the Legislative Assembly - Mid Term Timber Supply Action Plan.

Landscape Fire Management Planning

Landscape Fire Management Planning consists of 3 phases: Assessment, Planning and Management.

1. *Assessment*

Assessment is done through landscape level wildfire risk modelling that identifies areas of high wildfire probability and intensity as well as values at risk. This is being done by Wildfire Management Branch. When areas of high wildfire probability and intensity are combined with a values layer, areas of highest values at highest wildfire risk and threat are identified. This allows for prioritization of management actions.

2. *Planning*

Planning is led by Regional Operations in conjunction with other land management agencies, communities, First Nations and stakeholders. This stage will also integrate community wildfire protection planning (the current fuel management program) and other forest management activities such as harvesting, reforestation, road location etc., to create a seamless planning layer from the community to the broad landscape. Identification of management actions to reduce wildfire threats to communities, critical infrastructure and natural resource values at highest risk will be identified at the planning stage.

Management options that reduce wildfire risk and threats to communities, critical infrastructure and natural resource values and increase suppression effectiveness include: utilizing a series of landscape level fuel breaks, alternative silviculture practices, fuel reduction, and the reintroduction of fire (natural or prescribed) to create a fire resilient landscape.

3. Management

Management activities identified through the planning phase will be implemented over time, by appropriate land management agencies, communities and stakeholders based upon a prioritized implementation schedule. Where possible, resource coordination or alignment of existing activities from all agencies will be utilized to increase efficiencies – for example harvesting activities could be conducted by forest companies or BCTS, prescribed burning could be conducted by Wildfire Management Branch and ecological restoration projects and habitat management projects could be planned to support a fire management objective.

These activities can also support local employment creation, provide harvest opportunities and protect mid-term timber supply as well as support other key programs such as ecological restoration and the emerging biofuel economy in British Columbia.

Resource Requirements

1. Assessment and Planning

As noted below, 3 Resource District lead Pilot LFMP's (Assessment and Planning Phases) are underway and will be completed in early 2014. The results of these plans will then be used to develop management priorities and an associated implementation plan. The results of these pilots are being used to create the provincial planning template for future LFMP's, however, District delivery models may vary depending on district resource availability.

Cascades Resource District - Merritt TSA

- This LFPM is being delivered by district stewardship and tenures staff, the fire center fuels specialist, and the fire management planning specialist.

  Resource Requirements:

  As a planning model largely done by District Regional Operations staff and Wildfire Management Branch (WMB) staff, the resource estimate is about s.13, s.17 s.13, s.17 including GIS time plus at least some field time verifying various aspects of the plan. This type of "in house" model would require district resource prioritization

Vanderhoof / Fort St. James and Sea to Sky / Chilliwack Resource Districts

- This LFPM has been initiated by district stewardship and tenures staff, the fire center fuels specialist, and the fire management planning specialist, however, much of the assessment, analysis, identification of priorities and field confirmation is being conducted through contracted resources.

  Resource Requirements

  As a planning model that uses more of a Contractor supported method the estimate is about s.13 time coupled with about s.17 for contractor work. The funding for this model is supported by Land Based Investment Strategy funding under the Fire Management Planning Investment Category.

NOTE: Estimates have the potential to vary depending upon the prioritization complexities and stakeholder discussions associated with geographic variability.

2. Management

To support integration of LFMP into regional operations, a 2 day fire management planning meeting with Stewardship and Regional Operations management staff as well as representatives from WMB, FFT, BCTS, and ER was recently held in Kamloops. New models for planning and management were proposed that would support planning and management by integrating Ministry expertise and resources from all programs, including Community Wildfire Protection Plans, BCTS and Industry harvest operations, FFT and LBIS forest management initiatives, Ecological Restoration Program treatments, habitat management treatments, and WMB crew projects. The Rocky Mountain Resource District has volunteered to pilot this model in 2014. s.13

s.13 The LFMP planning portion of the model resourcing is similar to the pilots as noted above. The requirements for the fuel treatment and implementation model are still unknown and will vary considerable depending on the actual outputs from the planning portion.

Performance Measures

Using historic fire data an initial analysis of: wildfire risk - number and area of fires in the wildland urban interface; and, threat - the most interface area threatened by wildfire, was completed. 13 resource districts have been identified as the highest priority for LFMP (VH and H) based on an assigned rating of the fire history and the interface area threat rating which bring together the probably (fire History) and consequence (interface at risk) concepts. More detail is provided in the attached Landscape Fire Management Priority Rating Sheet. This data will be refined assessment of future wildfire risk probability and updated as Burn P3 mapping is completed. While some resource districts are currently identified as moderate or low risk, climate change or new infrastructure development may change the risk over time.

1. Assessment

Provincial risk and threat assessment for all Resource Districts will be completed in 2014 however, confirmation of values at a District level will be ongoing, and this will require the ongoing participation of current FMP resources to ensure a standardized base program.

2. Planning

It is proposed that 3 new LFMP's are started annually so that the 13 very high and high districts can be completed within the next 5 years (assuming a 2 year planning horizon for each plan with 3 districts currently being piloted). In some areas, it may be more operationally efficient to conduct planning over entire regions due to similar forest type and topographic considerations (for example the Cariboo).

Following the completion of the 13 very high and high risk districts, ongoing planning will take place in the moderate and low risk districts with the objective of completing the whole province in 10 years.

3. Management

Management activities for each plan will be ongoing following plan completion with all management activities with the objective of mitigating the risk to all high priority values in the first 5 years and all remaining values by the end of a decade.

Attachments: Landscape Fire Management Priority Rating

OverviewPriorityRanking1993_2012.pdf

FMP Priority RankingV2 January 9

Assessment of Potential Wildfire Impacts on Midterm Timber Supply

This paper provides a referenced overview of potential wildfire impacts on midterm timber supply in the 23 TSA's currently affected by the provincial mountain pine beetle (MPB) infestation. It incorporates recent wildfire impacts and projects potential losses as a result of wildfire in mountain pine beetle affected areas and predicted climate change scenarios. Although not addressed in this summary, losses in stands outside of MPB zones will also affect provincial timber supply.

Key Elements Influencing Wildfire Impacts on Timber Supply: The 3 key elements that will affect potential wildfire impacts on midterm timber supply are: ***weather and climate***, including the current weather conditions and predicted climate change impacts; ***fuels***, and in particular, fuel types generated by mountain pine beetle killed stands over the course of time; and, ***wildfire suppression success*** in relation to the fire behaviour, but also in relation to wildfire response priorities.

Weather and Climate Change: Weather is the main influencing factor on both fire starts and fire spread as many major fires are the result of a combination of extended drought drying fuels, and, wind that pushes fire spread. Incidence of lightening is a major cause of fire starts. On a yearly basis, weather is quite unpredictable as has been the recent experience in 2009 and 2010 that were record extreme fire years, followed by 2011 that was a record for being a non forest fire year. Future conditions as a result of climate change, however, can be predicted and while predictions show little effect on north western British Columbia, significant impacts are predicted for the southern interior including: increased fire size[1]; increased fire severity[2]; increased fire season length and fire frequency[3]; increase in crown fire ignition and severe fire behaviour[4] and, a decrease in extent of fire free areas[5], based upon an increase of 4^0C by 2080 (Haughian, S. et al, 2012). Annual area burned is also predicted to increase by 50% to 300% for boreal ecozones in the next 100yrs (Haughian, S. et al, 2012). This estimation is also supported by research done in the US National Research Council that shows an increase in median area burned for a 1^0C increase in global average temperature from 241% for northern rocky mountain forest to 428% for cascade mixed forest – both forest types that extend into the southern portion of British Columbia (National Research Council, 2011).

Fuels and MPB generated Fuel Types: It has been estimated that by 2010 17.5 million hectares of BC had been affected by the MPB infestation (Westfall and Ebata, 2011) and by 2017, it is estimated that there will be 787.8 million cubic meters of pine that have been killed in the province (Walton, A. 2012). Recent fire behaviour analysis has shown that the observed rate of spread in predominantly MPB affected fuel types is 2.6 times faster than in healthy green stands and can reach rates of 66 meters per minute (Perrakis D., et al 2012). Dead pine stands have created a new fuel type in British Columbia that is estimated to be increasing at a rate of 808,327 ha annually (Hvenegaard, S., 2012) and will be present for decades to come. Changes associated with this fuel type include rapid crown fire initiation, high intensity fires and mass spotting (Perrakis, D., et al, 2012). Since rate of spread can be roughly correlated to fire intensity these fires may be 3 times more intense than what could have been expected for a similar but healthy stands. It can also be expected that wildfires in MPB affected stands will generate extreme wildfire behaviour reducing suppression success and increasing burned area.

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[1] Doubling from an average of 7,961 ha to 19,076 ha
[2] By 40% in spring, 95% in summer and 30% in fall
[3] By 30%
[4] By 4% to 7%
[5] By - 39%

Wildfire Suppression Success and Wildfire Response Priorities: With 7,271,044 ha of hazardous fuels in full response zones provincially, (Hvenegaard, S., 2012) Wildfire Management Branch will not be able to respond to all wildfires in a major wildfire event. Accordingly, wildfire response priorities may limit suppression actions to the protection of communities and critical infrastructure during mass wildfire starts, often triggered by lightening. Protection of natural resource values (aka timber) will be a very low priority. This was experienced during the 2009 wildfire season when wildfire response was often focussed solely on interface fires resulting in lost timber values. Furthermore, at an intensity that exceeds 4,000 kW/m most fire control efforts (direct fire control) are unlikely to be successful and may be limited to a flank attack or curtailed completely until extreme wildfire behaviour ameliorates (Hirsh, K., Martell, D. 1996). Due to the predicted extreme intensity of some MPB fuel fires, suppression success may be very limited until major weather changes occur. This was evident in the 2010 wildfires that affect the Cariboo.

Trends in Wildfire Impacts:
Between 2003 and 2010 a total of 1.14M ha was impacted by wildfire provincially and 819,000 ha or 72% of all fires occurred within the 23 MPB impacted units. This damage occurred largely within the 2004, 2009 and 2010 seasons during which 414,000 ha was affected (Resource Practices Branch, 2012). Of the total burned area, 340,000 ha were within the Timber Harvesting Land Base (THLB) (Resource Practices Branch, 2012). Using an approximation of 150 m3 per ha, this equates roughly with 51,000,000 m3 of volume affected by wildfires. According to Forests for Tomorrow – over $100M has been invested by the government across BC (but primarily in MPB impacted units), assessing and reforesting productive areas that have been impacted by wildfire since 2003. During this time period a further $33M was paid out by government to date with another $3M pending to BCTS/Licensees *under Forest and Range Practices Act* s.108 payments to restore impacted harvested areas across the province. The provincial cost of wildfire suppression for 2009 and 2010 was approximately $600M.

Potential Wildfire Impacts on Mid Term Timber Supply
As noted above, changing weather and climate and fuel types will result in longer fire seasons, more area burned and more extreme wildfire behaviour that will reduce wildfire suppression success. Reduced suppression success and response priorities that focus on protecting interface values will result in increased area burned. Using a midterm projection of +40 years to 2052 puts the province roughly half of the way through the expected climate change scenario. Using a relatively conservative estimate of 25% increase in burned area for each decade in the four decades during this time period, and basing the projection upon the recent burned over areas in the 23 MPB impacted units (340,000 in the THLB since 2003) the projected impact on the THLB impact within the 23 MPB units is:

25% increase in area burned: 2012 – 2022: 425,000 ha
50% increase in area burned: 2022 – 2032: 510,000 ha
75% increase in area burned: 2032 – 2042: 595,000 ha
100% increase in area burned: 2042 – 2052: 680,000 ha
Estimated total Area: 2,210,000 ha. Estimated total volume: 331,500,000 m3

Landscape Wildfire Management Planning
Landscape wildfire management planning can be used to reduce impacts to the THLB. Modelling can be used to predict wildfire probabilities and high wildfire risk areas (Parisien et al., 2005). These areas can then be managed to reduce wildfire risks and threats through targeted harvesting and modified forest management practices. This will produce short term fibre opportunities as well as reduce impacts on midterm timber supplies.

References

Forest Analysis and Inventory Branch. Provincial 2003 to 2010 Wildfire Mapping Update Project Data Tables. Ministry of Forests, Lands and Natural Resource Operations. Province of British Columbia. Canada.

Haughian, S., Burton, P., Taylor, S., Curry, C. 2012. Expected Effects of Climate Change on Forest Disturbance Regimes in British Columbia. BC Journal of Ecosystems and Management 13 (1) 1 – 24. Published by Forrex: Forest Extension for Research and Natural Resources. British Columbia. Canada.

Hirsh, K., Martell, D. 1996. A Review of Initial Attack Fire Crew Productivity and Effectiveness. Int. J. Wildland Fire 6 (4): 199 – 215. IAWF. USA.

Hvenegaard, S., 2012. National Wildland Fuels Management Survey: Contract Report CR 729. FP Innovations. Hinton, Alberta. Canada.

National Research Council, 2011. Climate Stabilization Targets: Emissions, Concentrations, and Impacts over Decades to Millennia. Washington, D.C.: National Academies Press.

Parisien et al., 2005. Mapping Wildfire Susceptibility with the Burn-P3 Simulation Model. Information Report NOR-X-405. Canadian Forest Service. Northern Forestry Center. Government of Canada.

Perrakis, D., Lanoville, R.A., Hick, D., Taylor, S.W., Lavoie, N., Kubian, R. 2012. Recent Observations of Fire Behaviour in Mountain Pine Beetle-Affected Forest Stands in British Columbia, Canada. In Progress.

Resource Practices Branch, 2012. Provincial 2003 to 2010 Wildfire Mapping Update Project Data Tables. Ministry of Forests, Lands and Natural Resource Operations. Province of British Columbia. Canada.

Walton, A. 2012. Provincial Level Projection of the Current Mountain Pine Beetle Outbreak: Update of infestation projection based on the Provincial Aerial Overview Surveys of Forest Health conducted from 1999 to 2011 and the BCMPB (year 9). Ministry of Forests, Lands and Natural Resource Operations. Province of British Columbia.

Westfall, J. and T. Ebata. 2011. Summary of forest health conditions in British Columbia (2010). Pest Management Report No. 15, Ministry of Forests, Mines and Lands, Victoria, BC.

Pages 175 through 176 redacted for the following reasons:
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Not Responsive

Quesnel TSA – Type 4 Silviculture Strategy

Silviculture Strategy

Version 1.0

June 2013

Project 419-23

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BRITISH COLUMBIA

Strategy at a Glance

Strategy at a Glance		
Historical Context	The most recent timber supply review completed in 2011 lowered the uplift harvest level from 5.280 million m^3/yr to 4.000 million m^3/yr, with 650,000m^3/yr attributable to non-pine volume. An analysis of the mid-term timber supply was completed in 2012 that showed that without mitigation, this uplift harvest could be maintained until 2020, decline to 3.600 for five years before falling to 1.150 million m^3/yr for 46 years.	
Objective	Mitigate impacts from past mountain pine beetle (MPB) and wildfires on mid-term timber supply.	
General Strategy	Attempt to harvest the current AAC and non-pine volumes concentrating harvest on salvageable MPB-impacted pine stands. Apply an appropriate mix of silviculture activities aimed to achieve the working targets stated below.	
Working Targets	**Timber Volume Flow Over Time:**	**Short-Term** (1-5yrs): Maximize salvage of dead pine using current AAC of 4.0 million m3. **Mid-Term** (6-60yrs): Maximize mid-term harvest levels by accepting decreased long-term harvest levels of up to 10%. **Long Term** (61-200yrs): Harvest at nearly the productive capacity of the landbase (2.8 -2.9 million m^3/yr).
	Timber Quality:	Throughout the planning period, harvest stands once they achieve minimum merchantability (~ 120 m^3/ha) and maintain a supply of peeler logs (200,000m^3/yr of Sx/Df 8"top, 17'2"). **Short-Term** (1-5yrs): Capture economically viable sawlog volumes before stands deteriorate. **Mid-Term** (6-60 yrs): Maximizing stand values to the extent possible within a volume focused strategy. **Long Term** (61-200yrs): Regenerate newly harvested areas with silviculture practices that improve timber quality.
	Habitat Supply:	Throughout the planning period minimize negative impacts to water resource, ecosystems and species by meeting current legal objectives with respect to terrestrial biodiversity, aquatic, and riparian values through both operational and silviculture activities.
Major Silviculture Strategies	**Timber Volume Flow Over Time:**	**<u>Years 2013-2017</u>** • Focus fertilization on stands closest to harvest eligibility. • Begin rehabilitating eligible stands considered low priority for salvaging. • Employ enhanced basic silviculture practices on stands currently being salvaged. • Pre-commercial thin eligible stands as a set-up treatment for fertilization. **<u>Years 2018-2022</u>** • Apply various fertilization regimes (single and multiple treatments) to the limited number of eligible pine and Douglas-fir stands, with a focus on young spruce stands. • Increase rehabilitation of eligible stands and begin shifting to stands that provide additional merchantable volume. • Lower the priority of enhanced basic silviculture practices. • Continue to pre-commercial thin eligible stands as a set-up treatment for fertilization. • Start to explore opportunities for partial cutting within constrained areas while maintaining the appropriate non-timber values.
	Timber Quality:	• Continue to monitor timber profiles being harvested with particular attention on minimum merchantability criteria. • Encourage enhanced basic silviculture practices and monitor stand performance to ensure that objectives are being met.
	Habitat Supply:	• Prioritize silviculture treatments based on how they might impact designated habitat areas. • Retain coarse woody debris and wildlife trees where practicable. • Explore opportunities for partial cutting within constrained areas while maintaining the

Strategy at a Glance

appropriate non-timber values.

Silviculture Program Scenarios

Potential Program

The following sections summarize the target treatment areas adopted from the preferred scenario modelled at a $5 Million per year funding level.

Years 2013-2017

Priority	Treatment	Target Area (ha)	Unit Cost ($/ha)	Target Funding ($M/yr)
1	Fertilize	1,850	540	1.000
2	Rehab	500	1,000	0.500
3	Enhanced Basic	6,500	500	3.250
4	PCT + Fert	170	1,500	0.250

Years 2018-2022

Priority	Treatment	Target Area (ha)	Unit Cost ($/ha)	Target Funding ($M/yr)
1	Fertilize	2,780	540	1.500
2	Rehab	1,500	1,000	1.500
3	Enhanced Basic	3,500	500	1.750
4	PCT + Fert	170	1,500	0.250

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Constrained Program

The following sections summarize the target treatment areas adopted from the preferred scenario modelled at a $2 Million per year funding level.

Years 2013-2017

Priority	Treatment	Target Area (ha)	Unit Cost ($/ha)	Target Funding ($M/yr)
1	Fertilize	460	540	0.250
2	Rehab	200	1,000	0.200
3	Enhanced Basic	3,000	500	1.500
4	PCT + Fert	30	1,500	0.050

Years 2018-2022

Priority	Treatment	Target Area (ha)	Unit Cost ($/ha)	Target Funding ($M/yr)
1	Fertilize	830	540	0.450
2	Rehab	600	1,000	0.600
3	Enhanced Basic	1,800	500	0.900
4	PCT + Fert	30	1,500	0.050

.

Outcomes

Timber Volume Flow Over Time:

Short Term (years 2013-2017)
- No forecasted changes relative to the base case scenario.

Midterm (years 2018-2053)
- Harvest level increase of 16% relative to base case scenario.

Timber Quality:
- Targets were not implemented as the analysis focused on maximizing mid-term volume.

Habitat Supply:
- Assumptions applied to capture stand- and forest-level impacts from MPB and associated wildfire also suggest there are substantial risks to habitat in both the short and mid-term.

Related Plans and Strategies

Climate Change	Ecosystem Restoration	Range Management
Tree Species Deployment	Enhanced Retention	Invasive Plants
Land Use Plans	Secondary Structure	Tree Improvement and Seed Transfer
Landscape Level	Watershed Management	Forest Inventory
Biodiversity	Wildlife Habitat	
Forest Health	Recreation	
Wildfire Management		

Recommendations | **Implementing**
- Enhanced Basic Silviculture – Establish a task force to explore administrative options that

<table>
<tr><th colspan="3">Strategy at a Glance</th></tr>
<tr><td rowspan="5"></td><td>Strategies</td><td>provide incentives for improving forest productivity.</td></tr>
<tr><td>Data Gaps and Information Needs</td><td>
• Forest Inventory – Work to strengthen the inventory update process to reflect available RESULTS data and impacts from natural disturbances (e.g., harvesting, fire, insects, disease) wherever possible.
• Forest Inventory – Use the VRI and apply adjustments to account for MPB impacts for (rather than LVI).
• Forest Health Impacts – Confirm estimates of live volume estimates on MPB-impacted stands that are critical for harvesting over the mid-term.
• Forest Health Impacts – Improve yield assumptions for understory regeneration by identifying where it exists and how it develops.
• Site Index – Monitor manage stand yields against predicted yields.
• Past Treatments – Streamline the process for retrieving past incremental silviculture treatments and verify that the data is accurate and complete.
• Genetic Worth – Continue to support tree improvement and seed transfer programs and closely monitor genetic gains to apply in future analyses.
• Product Profiles – Investigate linkages between desired product profiles, minimum merchantability, and harvest ages.
• Riparian Management – Update the spatial assignment of riparian management areas.
• Road Network – Update the spatial road network and widths for estimating non-forest areas.
• Retention Areas – Capture and verify the spatial extent of areas retained from harvesting.</td></tr>
<tr><td>Modelling Approaches</td><td>• Defining Treatment Areas – Streamline the aggregation of polygons in the model that better-represent spatially and operationally feasible treatment areas.</td></tr>
<tr><td>Related Plans and Strategies</td><td>• General – Continue to explore ways to align silviculture activities with related plans and strategies that maximize benefits to all forest users.
• Access – Ensure that road systems are maintained to access stands for treatment.</td></tr>
<tr><td>Monitoring</td><td>• Develop a monitoring program to ensure outputs meet expectations over time.</td></tr>
<tr><td>References</td><td colspan="2">1. Type 2 Silviculture Strategy Development Quesnel TSA – Initial Workshop Background Document, January 2012.
2. Quesnel TSA Type 4 Silviculture Strategy – Data Package, June 2013.
3. Quesnel TSA Type 4 Silviculture Strategy – Modelling and Analysis Report, June 2013.
4. Quesnel TSA Type 4 Silviculture Strategy – Data Package, June 2013.</td></tr>
</table>

Acknowledgements

The authors would like to acknowledge and thank the following individuals who contributed in the completion of this project:

Michelle Archand, Resource Manager, BC MFLNRO (Williams Lake)
Bryce Bancroft, Symmetree (Victoria)
Tim Barker, Practices Forester, BC MFLNRO (Quesnel)
Allan Bennett, Forestry Supervisor / TFL Forester, West Fraser (Quesnel)
Rob Brockley, Research Silviculturalist (Retired)
Cam Brown, Manager Forest Planning and Analysis, Forsite (Salmon Arm)
Patrick Bryant, Strategic Planning Forester, Forsite (Salmon Arm)
Dale Bubela, Tenures Officer, BC MFLNRO (Quesnel)
Rob Cochrane, TFL Silviculture Forester, West Fraser (Quesnel)
Lauri Como, Resource Manager, BC MFLNRO (Quesnel)
Sean Curry, Strategic Planning Forester, Forsite (Kamloops)
Nola Daintith, Regional Silviculture Specialist, BC MFLNRO (Williams Lake)
Vincent Day, Planning Coordinator, Canfor (Prince George)
Steve Dodge, District Manager, BC MFLNRO (Quesnel)
Krista Dunleavey, Resource Manager, BC MFLNRO (Quesnel)
Chris Elden, Forester, Porcupine Designs (Quesnel)
Curtis Fenton, Forester, C&C Wood Products (Quesnel)
Paul Galliazzo, Operations Forester, Nazko Logging (Quesnel)
Jeremy Hachey, Forest Analyst, Forsite (Salmon Arm)
Tom Hoffman, Woodlands Manager, Tolko (Williams Lake)
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Bryan Jakubec, Senior Planning Forester, Tolko (Williams Lake)
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Monty Locke, Forest Investment Specialist, BC MFLNRO (Victoria)
Bob Merta, Woodlands Supervisor, BC MFLNRO (Quesnel)
Simon Moreira-Munoz, Forest Analyst, Forsite (Salmon Arm)
Gordon Nienaber, Timber Supply Forester, BC MFLNRO (Nanaimo)
Kelly Osbourne, Fire Management Planning Forester, BC MFLNRO (Victoria)
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Susan Pelletier, Senior Licenced Compliance and Enforcement Officer, BC MFLNRO (Quesnel)
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Julie Steciw, Wildlife Biologist, BC MFLNRO (Williams Lake)
Jim Thrower, Sophostats Data Services (Kamloops)
Mei-Ching Tsoi (Victoria)
Ryan Weltz, Silviculture Forester, Canfor (Grand Forks)
Phil Winkle, Decision Tree Forestry (Bowser)
Ralph Winter, Stand Management Officer & Data Custodian, BC MFLNRO (Victoria)
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1 Introduction

In 2012, the British Columbia Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) initiated a Type 4 Silviculture Strategy for the Quesnel Timber Supply Area (TSA) to help government and licensees better understand the current and future timber and habitat supply situation in the Quesnel TSA, and what can be done to improve it.

1.1 Project Objectives

In support of government objectives to mitigate impacts from past mountain pine beetle (MPB) and wildfires on mid-term timber supply, the project aims to:

1. Provide a realistic, forward-looking assessment of timber and habitat supply under a range of scenarios that will produce a preferred silviculture strategy supported locally and provincially. This strategy will clearly identify the activities that will provide the best return on investment to government.
2. Provide products that will support operational implementation of the strategy (e.g., a tactical plan).
3. Inform licensees and government on the alternative outcomes that could be achieved through different approaches to basic (mandatory) silviculture in the TSA.
4. Provide context information or indicators that would be useful to support future management decisions in the TSA.
5. Where appropriate, illustrate how the recommended treatments link with other landscape-level strategies while considering treatment risk.

1.2 Context

This document is the fourth of four documents that make up a Type 4 Silviculture Strategy:

- Situational Analysis – describes in general terms the current situation for the unit.
- Data Package – describes the information that is material to the analysis including the model used, data inputs and assumptions.
- Modelling and Analysis Report – describes modelling outputs and provides a rationale for choosing a preferred scenario.
- **Silviculture Strategy –provides treatment options, associated targets, timeframes and benefits.**

1.3 Landbase

This section summarizes material from the data package report[1] and modelling and analysis report[2] for this project. Further discussion on this summary can be accessed from these sources.

[1] Forsite Consultants Ltd. 2013. *Quesnel TSA - Type 4 Silviculture Strategy, Data Package.* Technical Report.

[2] Forsite Consultants Ltd. 2013. *Quesnel TSA - Type 4 Silviculture Strategy, Modelling and Analysis Report.* Technical Report.

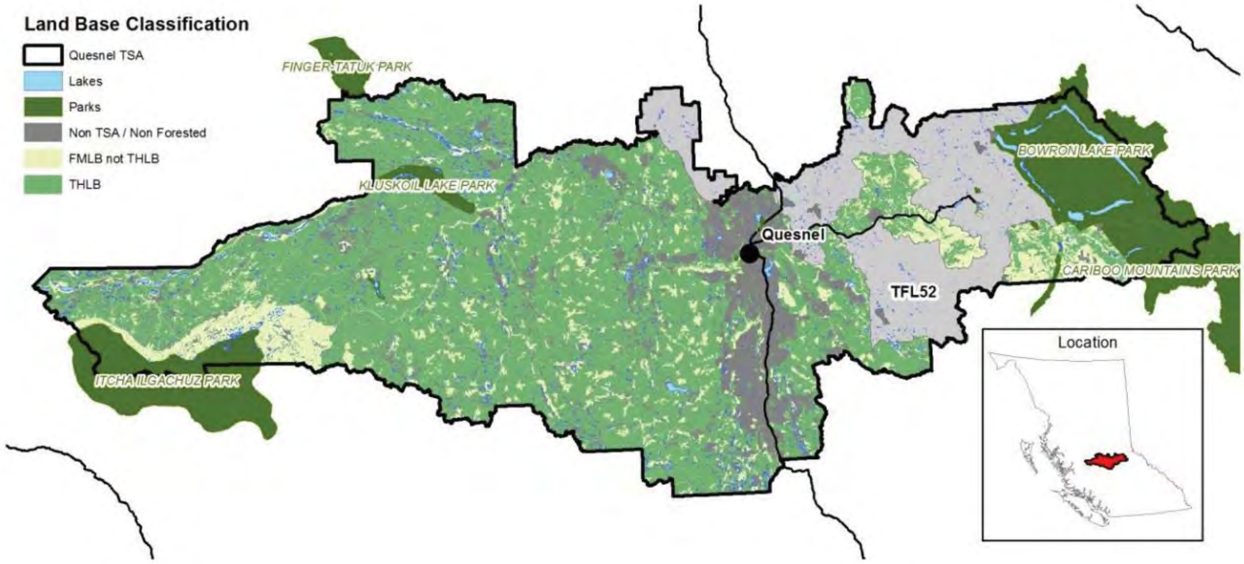


Figure 1 Quesnel TSA overview map

Including TFL areas and parks, the TSA covers about 2.08 million ha (

Figure 1) of which approximately 1.4 million is considered the Forest Management Land Base (FMLB). Areas set aside as parks, protected areas, Old growth Management Areas, Caribou no-harvest areas, and other areas considered unavailable for timber harvesting account for roughly 393,000 ha. The Timber Harvesting Land Base (THLB) is approximately 1.01 million ha or 49% of the total area in the Quesnel TSA.

Table 1 TSA land base area summary

	Area (Ha)	Percent of Total Area (%)	Percent of FMLB (%)	TSR4 Areas
Total Area	**2,082,528**	**100.0%**		**2,077,289**
less:		0.0%		
Non TSA (TFL 52, Woodlots, Private, other Non-Crown	458,293	22.0%		452,035
Non-Forest / Non-Productive	214,134	10.3%		225,151
Forest Management Land Base	**1,410,101**	**67.7%**	**100.0%**	**1,400,103**
less:		0.0%	0.0%	
Protected	108,491	5.2%	7.7%	108,066
Caribou No-Harvest	65,929	3.2%	4.7%	66,317
OGMA	82,651	4.0%	5.9%	83,139
Unstable	12,093	0.6%	0.9%	12,290
Excluded Species	5,357	0.3%	0.4%	5,570
Low Site Index	13,652	0.7%	1.0%	16,248
Riparian Reserve Zone	11,360	0.5%	0.8%	14,934
CCLUP	18,832	0.9%	1.3%	3,120
Environmentally Sensitive Areas	N/A	0.0%	0.0%	12,495
Roads, Trails, and Landings (Aspatial) 3%	32,752	1.6%	2.3%	42,003
Riparian Management Zone (Aspatial)	9,186	0.4%	0.7%	14,230
Timber Harvesting Land Base	**1,049,797**	**50.4%**	**74.4%**	**1,023,757**
less:				
Future Roads, Trails, and Landings (Aspatial) 1%	10,498	0.5%	0.7%	10,238
Future Timber Harvesting Land Base	**1,039,300**	**49.9%**	**73.7%**	**1,013,519**

1.3.1 Age Class Distribution

After adjusting ages of stands dying from MPB attack[3], the age class structure for both the NHLB and THLB are shown in Figure 2. The significant age class imbalance between 20 and 100 years indicates potential future timber supply challenges.

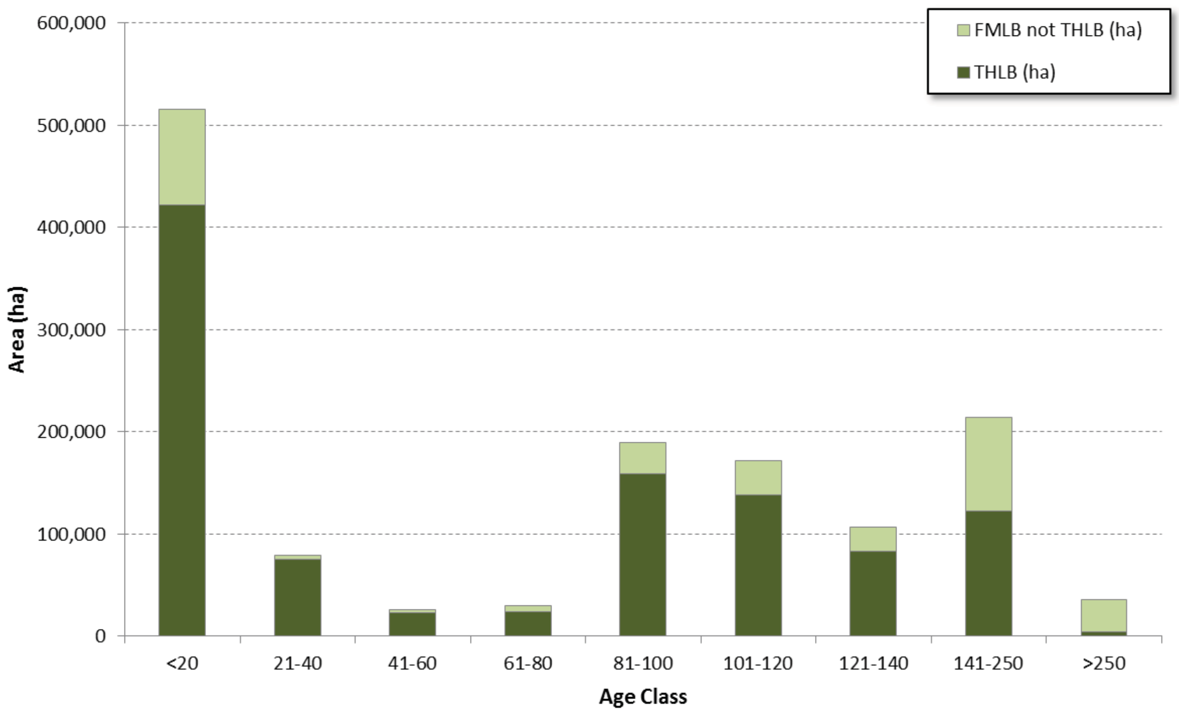
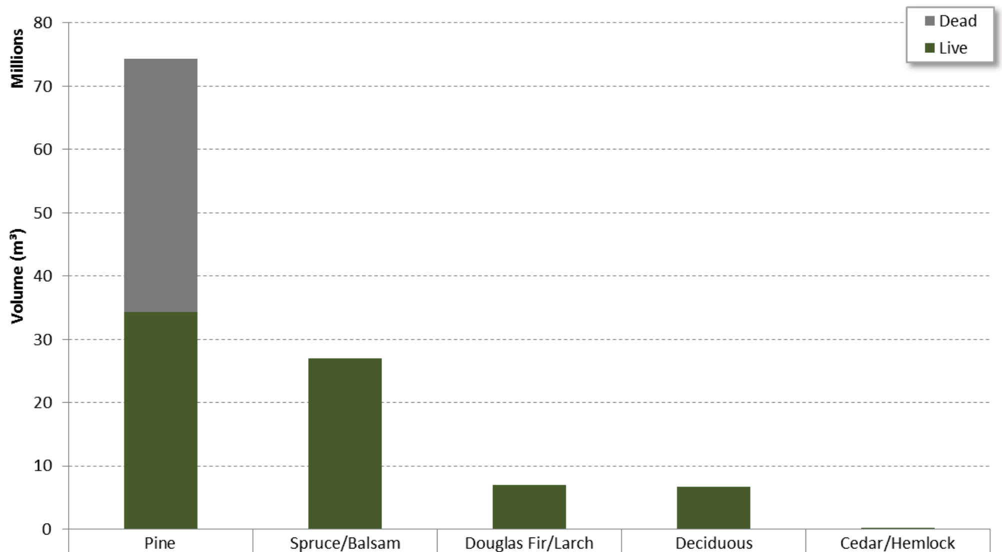


Figure 2 Age class distribution by leading species on the timber harvesting land base

1.3.2 Growing Stock and Volume Profile

The total and merchantable growing stock is currently 115 million m^3 of which approximately 102 million m^3 is considered currently eligible for harvest (i.e., ≥120 m^3/ha sawlog volume). Figure 3 shows the distribution of total growing stock on the THLB by species group. Pine comprises the majority of the volume on the land base but over 2/3 of this volume is dead.

3 Unsalvaged stands with ≥60% MPB mortality had their ages set to zero in the year of maximum infestation (typically 2006).



	Pine	Spruce/Balsam	Douglas Fir/Larch	Deciduous	Cedar/Hemlock
Dead	39,997,000				
Live	34,285,000	26,985,000	6,978,000	6,711,000	189,000

Figure 3 Total growing stock on the timber harvesting land base by species

1.3.3 Site Productivity Profile

Figure 4 shows the distribution of site productivity used for existing natural stands (inventory SI in red) relative to the adjusted estimates for managed stands (SIBEC SI in green).

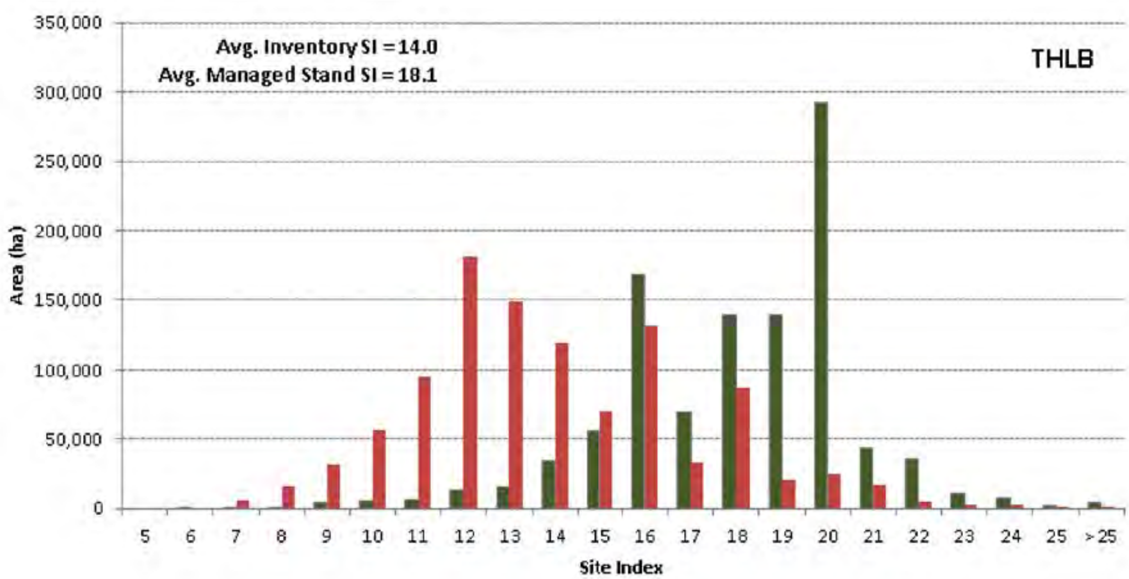


Figure 4 Site productivity distributions on the timber harvesting landbase

1.4 Key Issues and Considerations

This section summarizes material from the data package report[4] for this project. Further discussion on this summary can be accessed from that source.

1.4.1 Harvest Levels

Over the past 3 decades, the allowable annual cut (AAC) for the Quesnel TSA has been fairly dynamic (Table 2) as it reflects several MPB outbreaks, the establishment of partition cuts, and the inclusion of deciduous stands and problem forest types. The current AAC in effect is 4.0 million m^3/yr and allows for a limited harvest of non-pine species (up to 650,000 m^3/yr or 16.25%).

Table 2 Historical and current AAC

	1981	1985	1989	1990	1992	1996	2001	2004	2011
AAC (000,000m3)	2.3	3.45	3.5	2.45	2.35	2.34	3.248	5.28	4.0

Figure 5 shows that harvesting performance over the past several years has often not logged the full AAC (averaged ~3.7 million m^3/yr), but has been largely focused on pine (83%[5]).

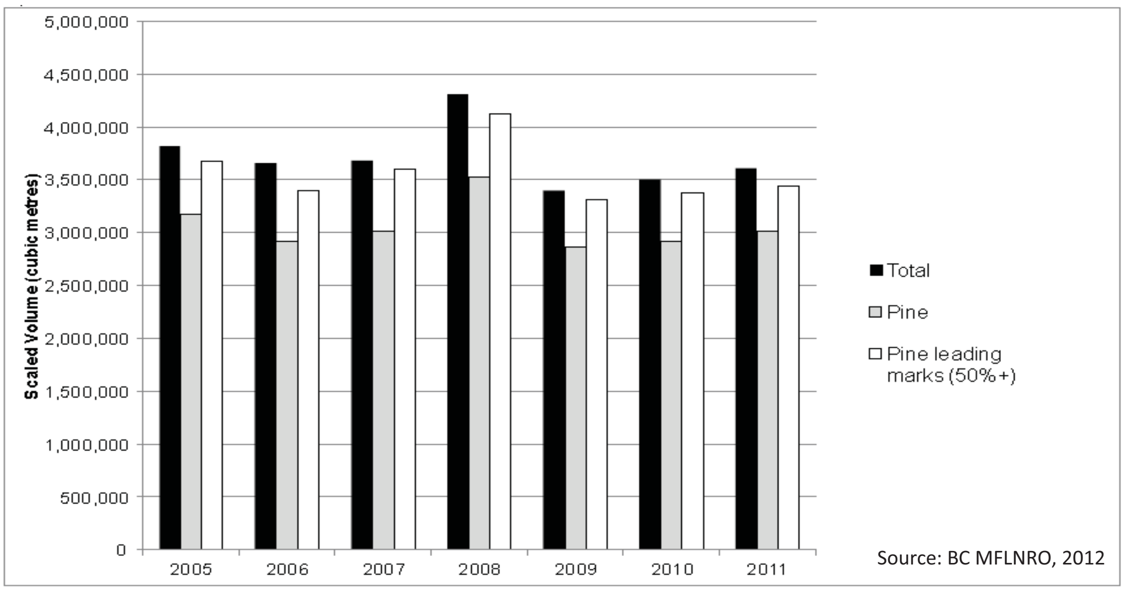


Figure 5 Total harvest, pine harvest and harvest from pine-leading marks

1.4.2 Forest Inventory

The existing forest inventory is comprised of several projects spanning many years. While assumptions are made to account for disturbance from harvesting, fires and forest health issues, there is considerable uncertainty regarding how well the adjusted inventory reflects current forest conditions (e.g., LVI stand volumes, dead %). While the MFLNRO is working to investigate these concerns, the information used here is considered the best available for the scale and timing of this project.

[4] Forsite Consultants Ltd. 2013. *Quesnel TSA - Type 4 Silviculture Strategy, Data Package.* Technical Report.

[5] BC Ministry of Forests, Lands and Natural Resource Operations. 2012. *Monitoring Harvest Activity Across 28 Mountain Pine Beetle impacted Management Units.*

1.4.3 Timber Supply

The prevalence of pine-leading stands on the TSA (67% of the forested landbase), and very high mortality rates (81%) in mature Pl result in severe implications on timber supply. Figure 6 shows projections of the cumulative pine volume killed by the MPB assuming no management intervention[6].

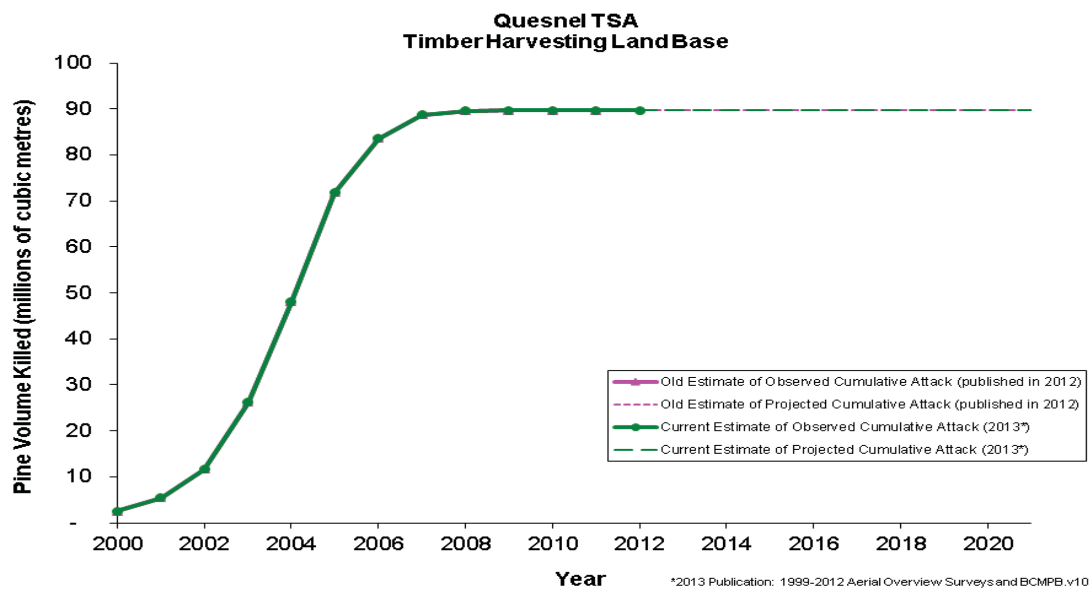


Figure 6 Data and projections of cumulative volume killed by the MPB.

Key timber supply issues that arise as a result of the severe MPB outbreak include:

- While the current harvest is focused on severely attacked stands in the TSA, it is likely that a large number of stands will die and remain unsalvaged. This will lead to a period of high fire hazard due to the high incidence of standing dead timber and/or impaired regeneration. The MPB fuel hazard will continue to be an issue for up to 50 or 60 years depending on the site characteristics.
- As a result of growing stock losses from MPB, the forecasted harvest flow exhibits a significant mid-term trough for 40-60 yrs. How fast managed stands can be brought online directly affects the size and depth of this trough.
- Shelf life refers to the time period over which dead Pl stands degrade until they are no longer economically viable. While varying throughout the landbase, dead Pl tends to retain at least a portion of its value for sawlogs for 14 years after attack.
- It is probable that many immature Pl stands impacted by the MPB have little or poor natural regeneration and will require some form of rehabilitation to remove existing stems, prepare the site and reforest.
- Some unsalvaged MPB-attacked stands contain sufficient understory advanced regeneration and non-pine trees as secondary stand structure to contribute to the mid-term timber supply. Section 43.1 of the FPPR requires protection of this secondary stand structure.

[6] BC Ministry of Forests, Lands and Natural Resource Operations. 2013. *Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: Update of the infestation projection based on the Provincial Aerial Overview Surveys of Forest Health conducted from 1999 through 2012 and the BCMPB model (year 10).*

- Given the magnitude of area affected by MPB across many age classes there will be a significant shift of stands into a narrow range of age classes leading to increased fuel continuity across the landbase which can result in more severe wildfires. In turn, these stands, unless impacted by wildfire, will all become available for harvest again at the same time period in the future and, once again, become susceptible to a future MPB infestation.

1.4.4 Timber Quality

Key timber quality issues that arise as a result of the severe MPB outbreak and subsequent dead pine salvage include:

- Dead standing pine trees will gradually decay and eventually fall down or burn up. Shelf life assumptions are used to estimate the average rate of this process.
- The salvage period for MPB-killed pine is generally expected to yield low harvest volumes with small piece sizes mixed with incidental harvest of live trees.
- After the salvage period, as the harvesting enters the mid-term period, green stands will become available and timber quality is expected to improve.
- Near the end of the mid-term (approximately 50 years from now), the harvest is expected to again consist of young, low volume, small piece sizes from stands that are 40 to 60 years old.
- Minimum merchantability criteria reflect the smallest average piece size or stand volume acceptable for harvesting. Reducing the minimum timber quality expectations can often support a higher mid-term harvest level. Typically, this becomes critical towards the end of the mid-term period as harvesting transitions from existing natural stands to managed stands. The desired quality of available timber during this critical period is therefore associated with these minimum merchantability criteria and shorter rotation ages that lead to decreasing piece sizes.

1.4.5 Habitat Supply

Key habitat supply issues that arise as a result of the severe MPB outbreak include:

- Lands currently reserved to protect sensitive species, riparian habitat, wildlife tree patches, designated wildlife habitat areas and old growth management areas are affected both directly and indirectly.
- In the mid-term, when timber availability is at its lowest, harvesting will be forced into non-pine stands that are also important for their non-timber values.
- In many cases, the pattern of pine mortality has reduced the structure and value associated with existing plans for landscape connectivity.
- Some wildlife species will be negatively affected by the increased relative road density required to salvage dead pine.
- Cattle use within riparian areas and newly planted areas will continue to be a concern for managing both habitat and timber supply.

1.4.6 Landscape and Watershed

Key landscape and watershed issues that arise as a result of the severe MPB outbreak include:

- The loss of mature and old pine will likely increase risks of higher peak flow and impacts to aquatic species/ecosystems and supply of domestic water.

- Accelerated harvest rates for salvaging dead pine stands increases road densities and overstory removal that can alter water quality and quantity aspects within watersheds.
- Development and monitoring of a landscape retention strategy on retaining forest structure in large-scale salvage operations was identified as means to maintain non-timber values that contributes towards increasing mid-term harvest levels.
- Land use plans may no longer be synchronized with the current status of the productive forest. Updating these plans could significantly impact the availability of short- and mid-term volumes.
- Increased wildfire activity coupled with harvesting impacts will result in less standing timber and vertical structure for the range of ecosystem services it provides.

1.4.7 Climate Change

The exact timing, location and magnitude of future climate change and the unavoidable impacts associated with increased climate variability and extreme events are uncertain – but we expect them to occur. Examples of how climate change is affecting forests and forest ecosystems include:

- Some tree species are increasingly vulnerable to damage and mortality on specific sites:
  - Spruce in the SBS from drought stress and forest health;
  - Pine in the IDF and SBPS from Elytroderma needle cast and drought stress;
  - Douglas-fir in grassland-forest interfaces from drier conditions; and
  - Whitebark pine in the ESSF from blister rust and MPB.
- Some ecosystems are becoming increasingly vulnerable to damage:
  - Salmon streams from low flow, warmer temperatures and little opportunity to shift to better habitat;
  - High elevation forests trapped between unproductive alpine areas and the upward shift of lower elevation forests;
  - Spruce in wetter subzones of the SBS from decreased precipitation;
  - Forested wetlands turning to productive forest from dropping water tables
- Weather is the main influencing factor on:
  - Fire starts with lightening as a major cause;
  - Fire spread, as many major fires are the result of a combination of extended drought drying fuels, and wind that pushes fire spread;
- Weather is quite unpredictable from year-to-year (e.g., 2009 and 2010 were record extreme fire years, while 2011 was a record for being a non-forest fire year);
- Future conditions as a result of climate change remain somewhat uncertain and depend upon numerous factors, one of which is which global emission scenario plays out. Even with optimistic carbon reduction projections, significant impacts are predicted for the southern interior of BC.
- Haughian, S. et al (2012) predicts an increase of 4^0C by 2080 will:
  - increase fire size (doubling from an average of 7,961 ha to 19,076 ha);
  - increase fire severity (by 40% in spring, 95% in summer and 30% in fall);

  - increase fire season length and fire frequency (by 30%);
  - increase crown fire ignition and severe fire behaviour (by 4% to 7%) and,
  - decrease the extent of fire free areas (by -39%).

- Haughian, S. et al (2012) also predicts the annual area burned in the boreal ecozones will increase by 50% to 300% in the next 100 years. This estimation is supported by research done in the US National Research Council that shows an increase in median area burned for a 1^0C increase in global average temperature from 241% for northern rocky mountain forest to 428% for cascade mixed forest – both forest types that extend into the southern portion of British Columbia (National Research Council, 2011).

Long-term adaptation strategies for climate change must complement short- and medium-term strategies for mitigating impending timber supply and environmental challenges resulting from the MPB epidemic.

1.4.8 Uneven-aged management in dry-belt Douglas-fir

For decades, Douglas-fir stands in dry-belt ecosystems were harvested using partial cutting systems and restocked by natural regeneration. However, little reliable information is available for these uneven-aged stands that will become a necessary portion of the harvest profile moving forward.

2 Silviculture Strategy

2.1 Working Targets

Provincial Timber Management Goals and Objectives (under development) will provide context and direction for the Quesnel TSA. Local timber goals and objectives rationalize the provincial priorities and goals in the context of local conditions, needs and local values. These objectives will be linked to a set of management targets. Provincial timber management targets (e.g., for timber volume flow over time, timber quality, tree species compositions and productivity and growing stock, inherent site capacity) derived from the TSR or similar processes must be achieved at the management unit level unless there is a rationale for not doing so.

Working targets were created and used to influence modelling decisions and in-turn, outcomes for all of the modelled scenarios in this project. Not all targets are achievable because of limited budgets or conflicts between targets, but they are still presented in Table 3 to frame the high level objectives of the Quesnel TSA:

Table 3 Working Targets

Indicator	Working Targets
Timber Volume Flow Over Time:	**Short-Term** (1-5yrs): Maximize salvage of dead pine using current AAC of 4.0 million m3. **Mid-Term** (6-60yrs): Maximize mid-term harvest levels by accepting decreased long-term harvest levels of up to 10%. **Long Term** (61-200yrs): Harvest at nearly the productive capacity of the landbase (2.8 -2.9 million m^3/yr).
Timber Quality:	Throughout the planning period, harvest stands once they achieve minimum merchantability (~ 120 m^3/ha) and maintain a supply of peeler logs (200,000m^3/yr of Sx/Df 8”top, 17’2”).
	Short-Term (1-5yrs): Capture economically viable sawlog volumes before stands deteriorate. **Mid-Term** (6-60 yrs): Maximizing stand values to the extent possible within a volume focused strategy. **Long Term** (61-200yrs): Regenerate newly harvested areas with silviculture practices that improve timber quality.

Habitat Supply:	Throughout the planning period minimize negative impacts to water resource, ecosystems and species by meeting current legal objectives with respect to terrestrial biodiversity, aquatic, and riparian values through both operational and silviculture activities.

2.2 Overview of Scenarios

Three base case sensitivities and eight silviculture scenarios were modelled and assessed for their impact on timber quantity, quality, and habitat supply (see Table 4). Each silviculture strategy was assigned a maximum budget (typically $5 million/yr) for implementation of incremental treatments. Input assumption and details for each scenario or silviculture activity are provided in the Quesnel Type 4 Data Package and/or Modelling and Analysis Report.

Table 4 Scenario Overview

Scenario Type	Scenario	Scenario Description / Objective
Base Case	Base Case	Models current practice as best as possible using best available information.
Base Case Sensitivities	Lower 1st period	Examines the effect on mid-term harvest levels from an immediate reduction in the current AAC uplift.
	Longer MHAs	Explores the effects of applying MHAs based on culmination of mean annual increment to achieve the maximum long term harvest level.
	Longer MHAs & Commercial thin	Explores the combined effects of longer MHAs and a commercial thinning program to gain access to volume earlier.
Silviculture Scenarios	Single Fertilization	Examines the effects of fertilizing eligible Pl, Sx, Fd stands once prior to being harvested.
	Multiple Fertilization	Examines the effects of fertilizing eligible Pl, Sx, Fd stands multiple times prior to being harvested.
	Rehabilitation	Examines the effects of rehabilitating MPB impacted stands considered un-merchantable after shelf-life expiration in order to establish improved forest crops (knock down and plant).
	Pre-Commercial Thinning	Investigates the effect on harvest flow when high density stands are thinned to remove the least desirable trees and make room for expected crop trees.
	Enhanced Basic Silviculture	Investigates the effect on harvest flow when regeneration practices aimed at maximizing stand productivity are implemented on good-to-medium sites.
	Partial Cut	Investigates the change in harvest flow realized from partial harvesting stands (by 30%) that would otherwise be constrained from clearcut harvesting due to visuals, mature seral goals, or caribou constraints.
	Combined Silviculture ($5 M/yr)	Model is allowed to choose from all of the above-mentioned silviculture strategies within a budget of $5million/yr.
	Combined Silviculture ($2 M/yr)	Model is allowed to choose from all the above-mentioned silviculture strategies within a budget of $2 million/yr. Meant to guide silviculture expenditures under a relatively constrained budget.

Table 5 provides a summary of the relative impacts to timber quality, quantity, and habitat supply indicators resulting from scenarios/activities investigated. The number of arrows represents the magnitude of change relative to the base case, where three arrows represent the maximum change. The Quesnel Type 4 Analysis Report provides more quantitative details.

Table 5 Summary of impacts to indicator categories for each scenario

Scenario	Timber Supply Short	Timber Supply Mid	Timber Supply Long	Timber Quality	Caribou & Deer	Old + Mat Seral	Watershed ECAs	Visuals
Low 1st Period	↓	↑	Nil	Nil	↑	↑	↓	↑
Longer MHAs	↓	↓	↑	↑↑↑	↑	↑↑↑	↓↓↓	↓
Long MHA & Comm. Thin	Nil	↓	↑	↑↑	↑	↑↑	↓↓	↓
Single Fert	Nil	↑	↑	Nil	Nil	↓	↑	↓
Multiple Fert	Nil	↑↑	↑↑	↑	Nil	↓	↑	↓
Rehabilitation	Nil	↑	↑	Nil	Nil	↓	↑	↑
PCT plus fert	Nil	↑	Nil	↑/↓	Nil	↓	↑	↓
Enhanced Basic	Nil	↑↑	↑↑	↑	Nil	↓	↑	↓
Partial cutting	Nil	↑	Nil	Nil	↑	↑	↓	↓
Combined ($5 M)	Nil	↑↑↑	↑↑↑	↑	Nil	↓	↑	↓
Combined ($2 M)	↓	↑↑	↑	↑	Nil	↓	↑	↓

The following points summarize some of the key trends learned from this exercise:

- Reducing salvage immediately leaves more green timber on the landbase that can be harvested throughout the mid-term. However, this benefit comes at the cost of increased loss of dead Pl (less salvage) and the economic loss of a reduced short-term harvest level.
- Waiting longer to harvest managed stands (i.e., age based on culmination of MAI versus the minimum stand volume criteria of > 120 m³/ha) significantly lowers and prolongs the projected mid-term but improves the long-term harvest level, product profile, and harvest costs (also reduces hectares harvested per year and increases age classes distribution).
- Longer harvest ages combined with commercial thinning 50-70 years from now (transition to harvesting managed stands) could be used to achieve long term benefits while also improving the midterm relative to just using longer harvest ages alone. If implemented, nearly half of the harvest area must be commercial thinning 50-70 yrs from now. This is a relatively expensive harvest method so technological advances and use of smaller equipment is likely required to make this more economically viable.
- Despite the number of times stands can be fertilized, there are limited opportunities for fertilization in the short-term (next 20 years). This is due, in part, to the current lack of stands in suitable age classes (20-60 year old stands) and forest health conditions for this treatment. Fertilization opportunities increase 20-40 years from now.
- Single-fertilization treatments are best carried out closer to harvest to maximize the NPV and minimize risk – but government budgets should be utilized whenever they are available to ensure the benefit is captured.
- While more opportunities for multiple-fertilization treatments are available sooner, risk of investment loss are increased as costs are carried longer.
- Cumulative gains from multiple-fertilization of spruce stands make this treatment the most economically favourable. Still, fertilization of pine stands should not be overlooked given the relative abundance of these stands.
- Rehabilitation of marginally-economic stands as the salvage period expires (towards the end of shelf-life) should provide some harvest volume at the time of treatment while also producing regenerated volume at the end of the mid-term (50-60 years from now) and into the long-term

(80+ years). The eligible area for this strategy is largely dependent on market prices for fibre plus innovative funding mechanisms being available (ITSLs, FLTCs).

- Given some uncertainty with regenerated stand densities, there are limited opportunities for pre-commercial thinning in the short-term (next 20 years) and future opportunities are difficult to predict. While this treatment provides little direct benefit to timber supply, it can contribute by improving timber quality and preparing suitable stands for other treatments, like fertilization.
- The enhanced basic silviculture strategy (e.g. planting at higher densities, increased brushing, etc.) results in significant timber supply gains near the end of the mid-term (50-60 years from now) and into the long-term (80+ years). With elevated harvest levels in the short-term (next 5-10 years), significant opportunities exist for this strategy. While licensees may be able to move more toward target stocking levels within existing frameworks, administrative changes that incent excellence (vs. regulate minimums) will be required to get significant engagement from forest companies. This strategy aligns well with the need to incent any higher cost treatments that may be required to best adapt to climate change.
- The partial harvesting within constrained areas strategy is most opportune near the end of the mid-term when available merchantable volumes are low. Provided forest cover and ecosystem functions remain intact, or improve, this strategy can provide access to volume within areas otherwise constrained by non-timber values such as landscape biodiversity, visuals, wildlife habitat and watersheds.
- Regardless of the budget allocated to alleviate the mid-term timber supply shortage, a combination of scheduled activities produces the highest overall gains in timber supply and return on investment.

2.3 Preferred Silviculture Strategy

The forest estate model used in this analysis applied a goal-seeking approach that schedules numerous activities across time and space to arrive at the best solution for the defined targets. Consequently, for any given funding level, the combined silviculture treatments strategy should produce a preferred silviculture strategy.

Compared to all other strategies explored, the $5 million /yr budget strategy produced the:

- Highest increase in the mid-term harvest level (277,000 m^3/yr or 16.2%),
- Highest increase in the long-term harvest level (258,000 m^3/yr or 9.4%), and
- Highest total net present value (NPV) over the planning horizon.

Figure 7 shows the increases in harvest forecast resulting from the preferred silviculture strategy.

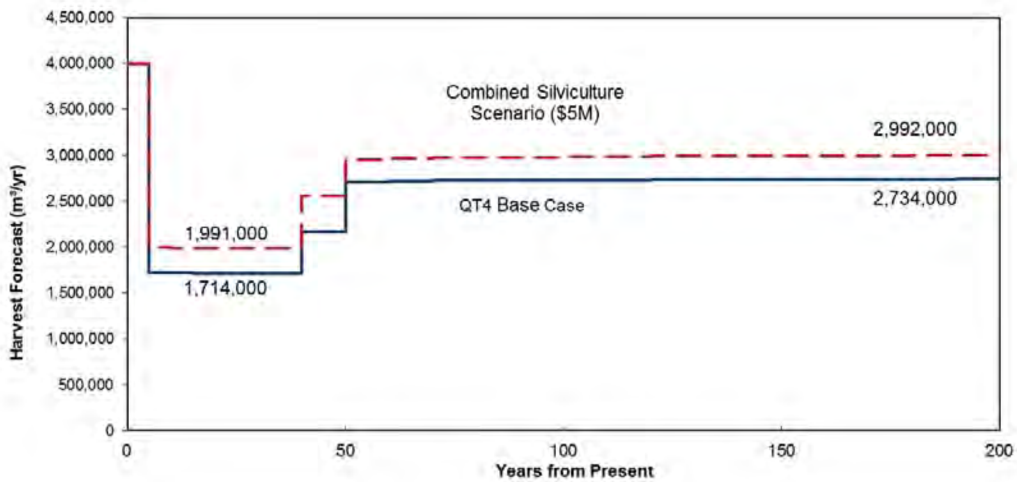


Figure 7   Harvest flow over time for the preferred silviculture strategy

Figure 8 shows the preferred scenario's silviculture expenditures over time by treatment activity. Due largely to lack of currently eligible stands to fertilize, rehabilitate, or pre-commercial thin within the TSA, the majority of budget in the first 15 years was spent on enhanced basic silviculture activities to maximize the growth potential of harvested areas. This activity is expected to increase timber supply near the end of the mid-term trough (50-60 years from now) and into the long-term (60+ years from now). As more stands became eligible for fertilization and rehabilitation, the relative expenditures on these activities also increased.

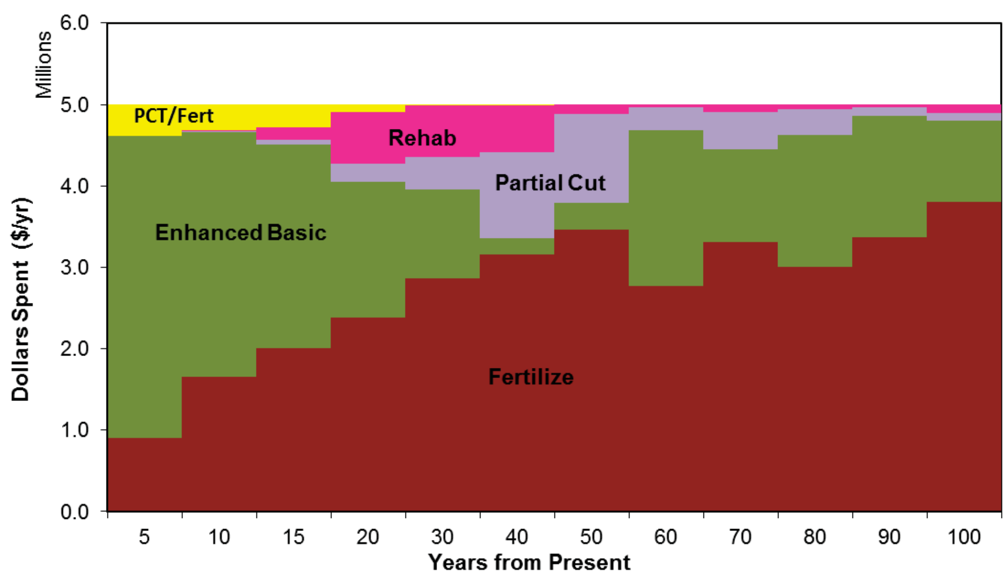


Figure 8   Silviculture expenditures by silviculture activity for the preferred silviculture strategy

A modelling artifact prevented the model from implementing the rehabilitation strategy sooner; MPB impacted stands first need to undergo the transition to a post-shelf life stands before they are eligible for rehabilitation (as opposed to a regular clearcut or salvage harvest treatment). This delay created a brief period where some stands were ineligible for salvage, clear cut or rehabilitation treatments. Rehabilitation may also be delayed because although relatively little volume is harvested from this treatment type, the volume that is captured still contributes to improving the mid-term harvest level when merchantable timber volume is scarce.

Adapting outputs from the strategic plan into a tactical plan requires interpretation of the learning achieved from the individually modelled silviculture scenarios, as well as, an understanding of the modelling assumptions and limitations. Figure 9 shows the silviculture expenditures levels used to inform the tactical plan for the next 20 years.

The primary goal of the strategy is to deliver more timber volume at the end of the mid-term trough (40-60 yrs from now), thereby increasing the entire mid-term harvest level.

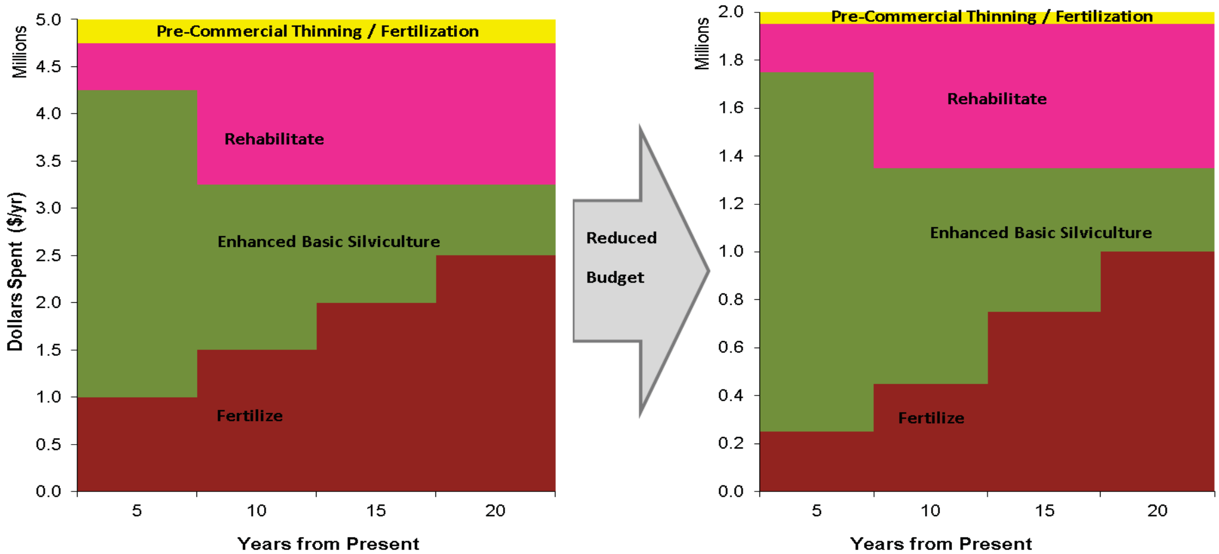


Figure 9 Silviculture expenditure levels used to inform the tactical plan ($5M vs. $2M budgets)

The following rationale was used to determine this appropriate mix of silviculture activities aimed to achieve the working targets:

- **Fertilization** should be the top priority that focuses on stands closest to harvest eligibility within the next 5-10 years – this will minimize risk of loss, maximize financial return, and slow the rate of logging currently-available stands. The next priority is to fertilize young spruce-leading stands in the next 10-20 years to put them on an intensive multiple fertilization regime. Then silviculture budgets should be directed towards Douglas-fir-leading stands eligible for treatment, and finally pine-leading stands. Pine has been shown to be less responsive to fertilization and also poses a higher risk of loss.
- **Rehabilitation** should be regarded as a high priority since converting poorly performing stands into productive ones will provide more harvest opportunities during the critical timber supply pinch point forecasted within 40 to 60 years. The relatively low level of rehabilitation shown over the first 5 years reflects the current salvage (and regeneration) program making rehab candidates more challenging to identify. Ideally, stands with the highest site productivity would be treated first after ensuring they are unlikely to be salvage harvested (i.e., low unit volumes due to age). A more significant rehabilitation program can occur once salvage operations have largely completed.
- **Pre-Commercial Thinning** should be used to set-up future fertilization activities and may be considered as a treatment for cleaning-up stands for success. Currently, limited opportunities

exist for the PCT treatment on existing managed stands and it is difficult to forecast opportunities on future stands. This activity is regarded as a lower priority due to the limited opportunities and questionable timber quality benefits.

- **Partial Cutting** in constrained areas is not expected to be useful right away but will be effective to leverage volume from areas that are otherwise inaccessible throughout the midterm, when fiber supply is tight. Given a limited budget, this treatment is best left for the next 20 years or so. Other than a few trials, this activity does not inform the tactical plan in the short-term – but could be useful to licensees in the short-term if appraisal allowances render it as a 'no incremental cost' scenario.
- **Enhanced Basic Silviculture** treatments on stands currently being salvaged is a high priority in the near term. This is due, in part, to the lack of candidate stands for other treatments such as fertilization and rehabilitation, but also because it delivers volume into the back end of the midterm trough allowing for an Allowable Cut Effect (ACE). In addition to the timber supply benefits, the higher density stands with this activity could result in timber quality improvements such as lower knot sizes, reduced risks from damaging agents and climate change, and provide options for further stand management.

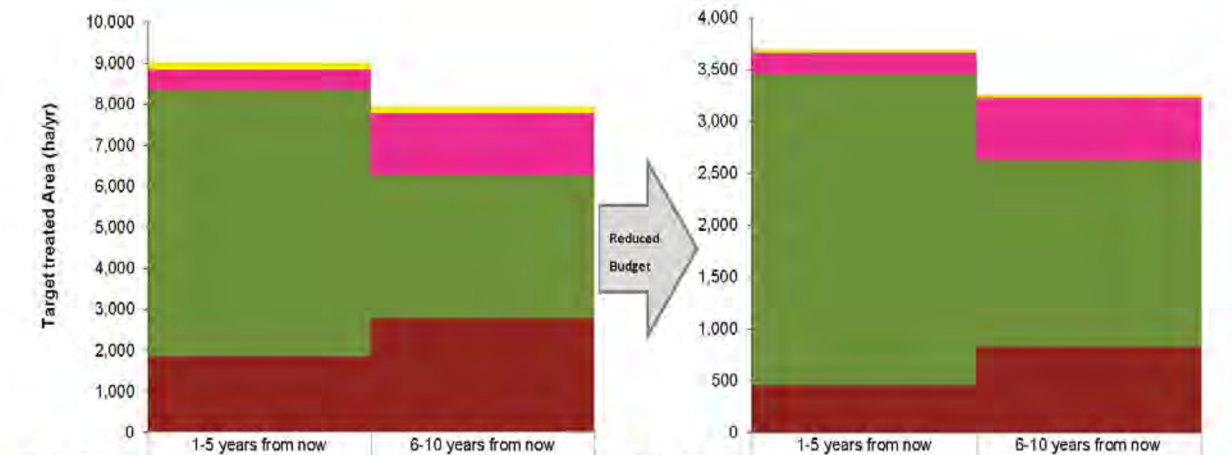
If budgets are more constrained (e.g., $2 Million/yr), pre-commercial thinning and fertilization are reduced at the expense of enhanced regeneration, while rehab remains similar. This occurs because enhanced regeneration delivers additional volume into the back of the mid-term trough that supports a higher mid-term harvest level (ACE occurring). Enhanced regeneration represents a longer time frame between investment and stand level gains, but the ACE allows benefits to be realized much sooner (at the front of the mid-term trough). This should be viewed with caution because the risk of investment loss is not factored into the assessment. Fertilizing should still be considered an important element of this strategy due to its immediate impact and therefore reduced risk of loss (fewer years of exposure to natural disturbance). Overall though, a diverse mix of investments will help to minimize these potential losses.

3 Tactical Plan

The tactical plan for this project is comprised of target treatment areas and spatially explicit treatment layers selected for a given funding level – in this case, the preferred silviculture strategy was established at a funding level of $5 Million/year so that sufficient opportunities are highlighted for whatever funding level actually occurs.

3.1 Target Treatment Areas

Figure 10 shows the target treatment area by activity developed from the preferred silviculture strategy (Section ?). This is a key component of the tactical plan generated from the model as a spatial treatment schedule of candidate stands. This tactical plan will be used to support the preparation of operational plans.



	1-5 years from now	6-10 years from now
PCT + Fert	170	170
Rehab	500	1,500
Enhanced Basic	6,500	3,500
Fertilize	1,850	2,780

	1-5 years from now	6-10 years from now
PCT + Fert	30	30
Rehab	200	600
Enhanced Basic	3,000	1,800
Fertilize	460	830

Figure 10 Target Treatment Areas for the Tactical Plan ($5M vs. $2M budgets)

3.2 Treatment Layers

Two spatially explicit layers were prepared for producing the tactical plan map for this project: priority stands and eligible stands. These were both produced from model-generated spatial treatment schedule (STS) for the preferred silviculture strategy, but further interpretation was required to translate the model's selection of candidate stands into operationally feasible treatment areas.

The spatial resolution for the modelling was quite fine (average polygon size = 4.0 ha), due in part to the number of spatial layers, but mostly from the resolution of the forest cover[7] in the central portion of the TSA. Treatment areas were not actively clustered in the model so in many cases, only small portions of larger openings were selected for treatments even though conditions in neighbouring polygons also met eligibility criteria.

Rather than using the model's resultant polygons to generate treatment layers, GIS post-processing and visual confirmation steps were taken to identify stands that are more appropriate for operational planning. Treatment layers were created from the original forest cover polygons that joined to the model selections. The non-THLB was then dissolved and used to erase areas from the treatment layers.

Eligible Stands

For each planning period, the model identified candidate blocks as a list of polygons that met the predefined eligibility criteria. Using the approach described above to generate treatment layers, the candidate blocks areas identified in the STS were used to create **eligible stands** for each treatment.

Priority Stands

For each planning period, the model's scheduled treatments were used to create **priority stands** for each treatment (again using the post-processing approach described above).

[7] Landscape Vegetation Inventory (LVI)

The next sections describe how **priority** and **eligible** stands were represented for each treatment. Sources of information on the treatment layers for creating and downloading maps are provided in Table 6.

Table 6 Sources for information on treatment layers

Source	Link
Silviculture Strategies	www.for.gov.bc.ca/hfp/silstrat/strategy%20index.htm#SIFR
ArcServer Treatment Layers (Tactical Plan)	View in ArcGIS Explorer or View in ArcGIS Webmap

3.2.1 Fertilization

Because of the limited number of eligible stands identified for this treatment in the short-term, plus the relatively narrow eligibility window, fertilization treatments are more sensitive to time. Treatment layers for the first 10 years were separated into two 5-year periods. Each fertilization regime (number of fertilizer applications) is also attributed in these layers.

3.2.2 Pre-Commercial Thinning

Opportunities for pre-commercial thinning were difficult to extract from the forest cover so there may be more opportunity on the ground than reported here. Only the priority stand treatment layer was prepared because there were no additional eligible stands identified by the model.

3.2.3 Rehabilitation

Although rehabilitation was not selected in the modelling for another 20 years, it is prudent to rehabilitate stands as soon as possible. At a forest level, due to variable market conditions, declining merchantable volumes for MPB-killed pine, and the absence of a current inventory with enough resolution to assess timber quantity and quality conditions, identification of stands for rehabilitation over salvage (clearcut) harvesting cannot be done with much certainty. Accordingly, a spatial treatment schedule for this activity was not created.

Rehabilitation treatments improve the mid-term harvest flows in two ways. For example, some stands rehabilitated early (within the next 5 years) can alleviate some pressure on merchantable growing stock at a critical point in the harvest forecast - the end of the mid-term. More significantly, rehabilitation treatments conducted throughout the mid-term add incidental harvest volumes that would otherwise be left standing and susceptible to further damage from other forest health agents.

Ways to identify candidate stands for a rehabilitation treatment are:

- Conduct rehabilitation treatments where fire hazard abatement is a priority. Knocking down and removing standing dead trees will reduce the fire hazard of these stands.
- Low-volume stands with high pine and/or dead stand percentages (i.e., ≥80%) with little natural regeneration or understory stocking are good candidates for early rehabilitation because they are unlikely to provide much green volume in the mid-term when timber availability is limited.
- Identify stands that were checked for harvesting but were not actually pursued. These stands were likely considered because they appeared to provide enough live and dead merchantable volume but upon closer inspection and assessment of extraction costs and values recovered, were determined to be uneconomic to harvest. This suggests that at least some volume and value may be recovered from the rehab treatment to offset the costs.

Other criteria that should be considered to identify or prioritize stands for rehabilitation treatments include, but are not limited to: potential benefits to non-timber values, the amount of remaining green volume, site productivity, distance from communities, access difficulties, and proximity to appropriate seed sources.

3.2.4 Enhanced Basic Silviculture

The silviculture expenditures used to inform the tactical plan (Figure 10) shows most of the budget allocated to enhanced basic silviculture treatments. However, the location of this treatment depends entirely on where harvest has occurred, so a spatial treatment schedule for this activity was not created.

While there are many techniques to enhance basic silviculture treatments, the modelling assumptions were adjusted in two general ways: increased planting densities with lower operational adjustment factors (OAF1); and more reliance on planting with shorter regeneration delays and genetic gains.

Ideally, enhanced basic silviculture should be prioritized for stands that will realize the largest incremental gains (e.g., more productive stands assumed to be naturally regenerated). Ultimately, local silviculture practitioners are best positioned to identify potential stands that will provide the greatest incremental gains.

The enhanced basic silviculture treatment strategy does not currently fall under any incremental funding arrangement. To some extent, incentives for this strategy are in place for area-based tenures, but are unavailable to volume-based licensees. Until this is addressed, it is unlikely that enhanced basic silviculture will become a viable silviculture strategy – despite the obvious gains associated. It is recommended that a task force be formed to explore administrative options that provide incentives for enhanced basic silviculture.

3.3 Applying the Tactical Plan

Target treatment areas (Section 3.1) together with treatment layers (Section 3.2) form the tactical plan developed from this project. With an aim to mitigate the lower harvest levels throughout the mid-term, this tactical plan provides a schedule of activities, at ideal and constrained funding levels.

This tactical plan is intended to guide silviculture practitioners in developing operational plans that identify specific stands for treatment. Points presented in following sections should be considered when applying the tactical plan for preparing an operation plan.

3.3.1 Translate budget to area

- Prioritize and schedule treatments for the operational time-line by considering the annual budget against the recommended treatment proportion from the tactical plan (Figure 10).
- Calculate target areas based on relative costs for each treatment. Cost assumptions used to develop this tactical plan are provided in the data package for this analysis.

3.3.2 Consider treatment risk

- Assess the financial risk associated with the proposed suite of activities by considering the time these treatments are exposed to natural disturbance events before becoming eligible for harvesting.
- Review local wildfire management plans (section 4.6) to identify areas where priorities for specific treatments are lower or higher. This should include visiting the wildfire management

website where plans are being made to show this tactical plan alongside wildfire management strategies.

3.3.3 Consider related plans and strategies

- Check how the treatments considered align with related plans and strategies – particularly for forest health, wildfire management, ecosystem restoration, and watersheds (see section 4 below). Identify locations or conditions that might protect or improve timber and non-timber values.
- Periodically update information on related strategies to ensure they are current.
- Identify locations or conditions that might be explored to help inform future treatments and strategies.

3.3.4 Verify data

- Determine whether new or better information is available for key spatial layers such as: ownership, old growth management areas, wildlife habitat areas, ungulate winter ranges, and visual landscape polygons.
- Check silviculture history records to identify stands where similar treatment activities have occurred in the past (Note: this may be included on the silviculture strategy mapping website).

3.3.5 Identify candidate treatment areas

- Review candidate treatment areas presented on the silviculture strategy mapping website.
- Use the treatment layers to identify candidate stands that will be assessed in the field[8]. Polygons may be relatively small and isolated from other potential treatment areas making them impractical on their own.
    - Identify **priority stands** for the specific treatment
    - Include **eligible stands** close to the priority stands to guide field survey crews in developing logical treatment programs
    - Add other stands that meet the treatment eligibility criteria but were excluded based on deficient or inaccurate forest inventory data.

3.3.6 Assess candidate treatment areas

- Assess candidate treatment areas in the field. Survey crews may include neighbouring eligible stands for a treatment program when visiting the priority stands identified.
- Track all assessments to explore trends with the data and record the outcomes for areas that have already been assessed.
- Develop a mechanism to identify and track miscellaneous stands that are not already represented spatially (e.g., rehabilitation, pre-commercial thinning)
- Determine whether there are any timing issues that must be incorporated (e.g., linkages to related activities, road access, restoration and rehabilitation treatments).

[8] While the best available forest-level data were used to develop the silviculture strategy and tactical plan, these data are not considered to be accurate at a stand level. All candidate stands must be assessed in the field before treatments are prescribed.

4 Related Plans and Strategies

When implementing the silviculture strategy described above, it will be important to consider and incorporate elements from other related strategies into these implementation plans. The following section provides a brief introduction to these initiatives, an explanation of how and where they might influence or integrate with planned silviculture treatments or actions, a discussion on how they might be impacted by climate change, and references to more information. Future iterations of projects like this one are intended to integrate these issues more fully.

4.1 Climate Change

The rate of change in climate over the last 100 years is equivalent to the rate of change of the preceding 1000 years. Rapid change in climate is an overarching pressure on the forest, affecting both timber and environmental values. Table 7 provides links to sources for information on climate change.

Table 7 Sources for information on climate change

Source	Link
Overview of Guidance to Adapt Forest Management for Climate Change in the Kamloops TSA	www.for.gov.bc.ca/ftp/HFP/external/!publish/Web/FFESC/reports/NelsonrevisedK2adaptationguidanceoverview120607.pdf
Successional Responses to Natural Disturbance, Forest Management, and Climate Change	jem.forrex.org/index.php/jem/article/viewFile/171/113
Climate-based seed transfer modelling	www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr048.htm
Tree species regeneration vulnerability assessment for the central Interior of BC	www.for.gov.bc.ca/ftp/hfp/external/!publish/web/ffesc/reports/FFESC-Technical-Report_ProjectA2_Nitschke.pdf
Kamloops Future Forest Strategy II	www.for.gov.bc.ca/ftp/HFP/external/!publish/Web/FFESC/reports/Nelsonfinalreport.pdf
Transdisciplinary vulnerability assessment, Nadina Forest District	bvcentre.ca/research/project/a_multi-scale_trans-disciplinary_vulnerability_assessment
Stand/landscape level decision-support to reduce drought & disturbance risks	www.for.gov.bc.ca/hfp/future_forests/council/#completed-projects
Climate Change in Prince George Summary of Past Trends and Future Projections 31 August 2009	pacificclimate.org/sites/default/files/publications/Werner.ClimateChangePrinceGeorge.Aug2009.pdf
Preliminary Analysis of Climate Change in the Cariboo-Chilcotin Area of British Columbia	pacificclimate.org/sites/default/files/publications/Werner.ClimateChangeCaribooChilcotin.Sep2008.pdf
Effects of Climate on Mortality of Young Planted Lodgepole Pine	foothillsresearchinstitute.ca/Content_Files/Files/FGYA/FGYA_2008_12_Qknte12_EffectsClimateMortalityYoungLodgepolePine.pdf
Impacts of Climate on Forest Health - Lodgepole pine ecosystems 2010	foothillsresearchinstitute.ca/Content_Files/Files/FGYA/FGYA_2010_10_Poster_ImpactsClimateChangeOnForestHealth.pdf
Managing Risk and Uncertainty in Lodgepole Pine – A Shifting Paradigm	www.growthmodel.org/wmens/m2011/Dempster.pdf
Pacific Climate Impacts Consortium	www.pacificclimate.org/tools-and-data/plan2adapt
ClimateBC Map – UBC Centre for Forest Conservation Genetics	www.genetics.forestry.ubc.ca/cfcg/ClimateBC40/Default.aspx

To encourage more discussion and possible modelling in future silviculture strategies, the sections below include a brief discussion of how climate change might affect each related plan and strategy.

4.2 Tree Species Deployment

Concerns have been expressed about the diversity of tree species over time and the lack of clear objectives (e.g., Auditor General's report[9]). A recent report from FLRNO[10] focuses on the harvested landbase and provides an assessment of the species distribution from a variety of data sources and points in time.

Table 8 summarizes the direction towards a desired percentage by species by Biogeoclimatic subzone. This guidance was informed by ecological benchmarks based on historical levels as well as the plausible impacts of climate change as interpreted by local ecologists and silviculturalists. These trends will be tracked yearly and evaluated to determine if the trends are being achieved. A narrative describing progress will be provided. This is meant as a first step in management of species at the landscape scale. Future iterations may recommend finer scales and promote not only species direction but provenances as well. Sowing requests will be used to help track direction in the short term.

Table 8 Guidance for tree species deployment on harvested areas

Biogeoclimatic variant	Desired Trend			Comments
	Sx	Pl	Fd	
SBSdm	⇩	-	⇧	
SBSmc	⇩	-	-	Manage Bl as naturals
SBSwk	-	-	⇧	
SBPSdc	-	-	-	Manage At as naturals
MSxv	-	-	-	
ESSFwk	-	-	-	Manage Bl as naturals

Table 9 provides links to sources for information on tree species deployment.

Table 9 Sources for information on tree species deployment

Source	Link
Species Monitoring Report - Province	www.for.gov.bc.ca/hfp/sof/species/Spp%20Monitoring%20Report%20-%20Province%20(May%2010,%202012).pdf
A Short History of the Control of Species Selection for Reforestation in BC	www.for.gov.bc.ca/hfp/silviculture/Stocking_stds/How%20Species%20Have%20Been%20ControlledDraftver2%20(2).pdf

4.3 Land Use Plans

The Central Cariboo Land Use Plan (CCLUP), legal orders and Forest Stewardship Plans (FSP) provide a framework for land use and forest management in the Quesnel TSA and establish areas for non-timber values. However, MPB impacts are not limited to areas available for timber harvest. Lands reserved to provide protection for sensitive species, riparian, wildlife tree recruitment, and old growth representation, are also affected both directly by increased mortality of pine and indirectly by impacts of roads, water quality and quantity, and associated habitat impacts.

Until land use plans and other strategies are revisited and amended to address the severe changes in forest structure, prescribing foresters are guided by the established objectives.

[9] http://www.bcauditor.com/pubs/2012/report11/timber-management

[10] Species Monitoring Report Quesnel TSA, May 2012, MCMFLNRO Resource Practices Branch

Climate change is not expected to impact land use plans directly but rather influence objectives applied in future plans.

Table 10 provides links to sources for information on land use plans.

Table 10 Sources for information on land use plans

Source	Link
CCLUP	ilmbwww.gov.bc.ca/slrp/lrmp/williamslake/cariboo_chilcotin/index.html
Quesnel SRMP	www.ilmb.gov.bc.ca/slrp/srmp/north/quesnel/index.html

4.4 Landscape Level Biodiversity

The loss of mature and old forest (pine and pine mixed with other species) over recent years will have significant impacts on associated aquatic, terrestrial and water values. The partial cut scenario was explored as a silviculture strategy for extracting some timber throughout the mid-term while maintaining or improving current and/or future condition of established mature seral management areas and other identified areas. Thinning has the potential to accelerate old growth attributes.

Stand structures that serve to connect habitats across a landscape will be impacted by accelerated salvage harvesting, reduced retention and the risk of large-scale fires and can result in disproportionate impacts to species at risk or those confined to isolated pockets of suitable habitat. Connectivity is provided in the Quesnel TSA through various mechanisms including strategies that prescribe retention for specific resource management zones, conservation legacy areas, mature and old seral retention, and riparian management provisions.

Prescribing foresters can enhance connectivity by increasing retention levels in large cutblocks within riparian areas, gullies, connectivity corridors for Caribou and surrounding wildlife habitat features.

Climate change is expected to impact landscape biodiversity through increased forest disturbance. This may be mitigated by treatments designed to reduce risk of damage from wildfire or pests.

Table 11 provides links to sources for information on landscape level biodiversity.

Table 11 Sources for information on landscape level biodiversity

Source	Link
Successional Responses to Natural Disturbance, Forest Management, and Climate Change	jem.forrex.org/index.php/jem/article/viewFile/171/113
Current State of Knowledge Regarding Secondary Structure in MPB Impacted Landscapes	www.for.gov.bc.ca/hts/pubs/MPB_Impacted_Stands_Report_January_20_2012.pdf

4.5 Forest Health

The forest health strategy [11] aims to recommend actions to address forest health issues. A list of significant forest health agents and current strategies is provided in Table 12.

[11] Quesnel Forest District, Quesnel Timber Supply Area Forest Health Strategy 2011-2012, May 2011, 26p.

Table 12 Forest health agents and strategies

Category	Agent	Strategy
Bark Beetles	**Douglas-fir beetle** (1)	Aggressive suppression action.
	Spruce beetle(1)	Aggressive suppression action.
	Mountain pine beetle (2)	Salvage action.
	Western balsam bark beetle	Contain and ground-truth the extent of the infestation. Harvesting the current attack is a feasible means of control.
	Ips Engraver Beetle	Monitor stands for population build up. Dispose of slash in a timely manner.
Defoliators	**Western spruce budworm** (2)	Contain and treat moderate and severely defoliated high-value stands of Douglas-fir with B.t.k..
	Two year cycle budworm (2)	Containment, treat moderate and severely defoliated high-value stands with B.t.k..
	Forest Tent Caterpillar	Monitor outbreaks and re-foliation response of trees.
	Gypsy moth	Monitor with pheromone traps and eradicate known infested sites with B.t.k..
Rusts	**Comandra blister rust, Stalactiform blister rust, and Western gall rust** (2)	Contain and treat detected infestation areas.
Dwarf Mistletoe	Pl dwarf mistletoe	Aggressive Suppression action.
Root Diseases	Armillaria, Tomentosus	Monitor and treat as prescribed in best management practices.
Woody Tissue Feeders	Warren's root collar weevil	Contain and treat individual blocks to maintain stocking. Planting spruce near timber edges may discourage the weevil from entering the plantation.
Abiotic Injuries	Weather related	Salvage harvest merchantable timber within one year of the catastrophic event.
	Windthrow (2)	Aggressive Suppression action. Harvest Douglas-fir and spruce windthrow within one year of the event to reduce opportunities for bark beetle build-up.
	Wildfire (2)	Aggressive Suppression action.
Animal Damage	Hare and vole	Monitor and recommend treatment when required.

(1) Very high priority forest health agent (Bold text)
(2) High priority forest health agent (Bold text)

One of the key forest health strategies that can protect stands contributing to the mid-term timber supply is to treat Douglas-fir stands attacked by western spruce budworm (283 ha) and spruce stands attacked by spruce beetle (67 ha).

Climate change is expected to increase the frequency and intensity of severe wind-throw events and outbreaks of insects - particularly bark beetles[12], and pathogens [13]; undoubtedly leading to more challenging decisions regarding silviculture investments and priorities.

Table 13 provides links to sources for information on forest health.

[12] Carroll, A. 2012 Predicting Forest Insects Disturbance under Climate Change. http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Web/FFESC/reports/Carrollfinalreport.pdf

[13] Woods, A.J., Heppner, D., Kope, H.H., Burleigh, J. and Maclauchlan, L. 2010. Forest health and climate change: A British Columbia perspective, The Forestry Chronicle, Volume 86, Number 4. 11p.

Table 13 Sources for information on forest health

Source	Link
Quesnel Forest Health Strategy	www.for.gov.bc.ca/hfp/health/TSA_strategies.htm
MFLNRO Forest Health Program	www.for.gov.bc.ca/hfp/health/index.htm
Forest health and climate change: A BC perspective	bcwildfire.ca/ftp/HFP/external/!publish/ClimateChange/FRPA/Workshop/Forest_Health_CC.pdf

4.6 Wildfire Management

The BC Wildfire Management Strategy [14] aims to encourage healthier ecosystems, reduce the risk of loss to communities, address climate change and enable more cost-effective fire response. The five strategies that aim to achieve these goals are to:

- Reduce the hazards and risks associated with wildland fire in and around communities and other high-value areas.
- Plan and implement careful use of controlled burning in appropriate ecosystems under suitable conditions to reduce hazards and risks and achieve healthy forests and grasslands (also see Section 4.7).
- Monitor wildfires occurring in areas where there is minimal risk to identified values and intervene when appropriate to reduce hazards and risks and ensure optimum use of fire suppression budgets and personnel.
- Ensure that plans adequately consider the management of wildland fire at all appropriate scales in order to reduce hazards and risks, achieve healthy forests and grasslands and ensure resource-efficient fire suppression.
- Develop a high level of public awareness and understanding about wildland fire and its management in order to garner support for proactive and resource-efficient wildland fire and fuels management (including policies, planning and on-the-ground actions).

Burn probability modelling is used help prioritize areas at risk, set objectives for wildfire risk reduction on the landscape, and support subsequent operational management planning over the next few years. The Wildfire Management Branch goals are to complete this initiative for all management units in BC by 2015.

4.6.1 Trends in Wildfire Impacts

Changing weather, climate and fuel types are expected to result in longer fire seasons, more area burned and more extreme wildfire behaviour. Reduced suppression success and shifting response priorities that focus on protecting interface values, will result in more areas and timber values lost to wildfire.

With over 7 million ha of hazardous fuels in full response zones provincially, (Hvenegaard, S., 2012) Wildfire Management Branch is not capable to respond to all wildfires in a major wildfire event. Consequently, wildfire response priorities may limit suppression actions to the protection of communities and critical infrastructure during mass wildfire starts, often triggered by lightening. In these situations, protecting natural resource values will become a very low priority; as was experienced during the 2009 wildfire season when wildfire response was often focused entirely on interface fires. At

[14] British Columbia Wildland Fire Management Strategy, September 2010, 21p.

fire intensities exceeding 4,000 kW/m most fire control efforts (direct fire control) are unlikely to be successful and may be limited to flank attacks or curtailed completely until extreme wildfire behaviour ameliorates (Hirsh, K., Martell, D. 1996).

Due to the predicted extreme intensity of some MPB fuel fires, suppression success may be very limited until major weather changes occur. This was evident in the 2010 wildfires that affected the Cariboo.

Climate changes are expected to increase the frequency and intensity of wildfires[15]; undoubtedly leading to more challenging decisions regarding silviculture investments and priorities. Table 14 shows the expected impacts on wildfires due to climate change using a relatively conservative estimate of 25% increase in burned area each decade over the next 4 decades (i.e., into the mid-term period) and the projection of recently burned areas in the Quesnel TSA (62,200ha in the THLB since 2003). The projected total impact on the THLB is 404,200 ha, or over 60.6 million m^3 (at 150 m^3/ha).

Table 14 Expected impacts on wildfires due to climate change

Increase in Area Burned	Period	Area Burned (ha)
25%	2012 – 2022	77,700
50%	2022 – 2032	93,300
75%	2032 – 2042	108,800
100%	2042 – 2052	124,400

4.6.2 A Landscape Perspective

A landscape perspective on the likely occurrence and impacts of wildfire is critical to protecting the longer term viability of an adequate timber supply, as well as, non-timber values (e.g., habitat, properly functioning watersheds). A risk assessment is initially developed to identify hazards in proximity to key values across the landbase. Using the risk assessment, landscape-level fire management objectives (e.g., reduce fire size, reduce fire intensity) are prepared from which specific steps are identified to help "protect" timber supply – or at least make areas more resistant or resilient to wildfire.

The following steps can contribute to ameliorating aspects of wildfire management, such as burn probability, which can ultimately reduce the impacts of fire:

- Prioritize silviculture programs and ecosystem restoration (including BCTS FFT ITSLs) onto areas that align with landscape-level objectives to reduce wildfire risk to communities and other values, including timber.
- Ensure silviculture projects are located within areas of reduced fire risk and are strategically aligned in larger, more cohesive units that can be easily identified as a priority value for suppression.
- Direct reforestation and pre-commercial thinning activities onto areas that can buffer both high value mid-term timber supply and silviculture investment areas by reducing the potential of crown fires and promoting more effective suppression techniques.

[15] Woods, A.J., Heppner, D., Kope, H.H., Burleigh, J. and Maclauchlan, L. 2010. Forest health and climate change: A British Columbia perspective, The Forestry Chronicle, Volume 86, Number 4. 11p.

- Ensure that management unit timber objectives, silviculture regimes and standards, include a wildfire component that allows for modified harvesting or promotes the use of alternative species in areas forecasted with high or very high wildfire probability.
- Employ the strategic use of fire management activities based stocking standards (under development) and/or changes in practices (e.g. silvicultural activities as thinning, spacing with slash reduction, etc.).
- Support better integration of Ecosystem Restoration, Forests For Tomorrow and Fuel Management program planning to ensure that the right treatments are occurring in the right stands, and that they incorporate the historical and future patterns of open forest and grassland ecosystem expansion in the interior of BC.
- Build linkages between fire and forest management at the District stewardship level so that fire is recognized as part of the ecological process and a major driver on the landscape that is paramount for consideration in the planning process.

Key to this process is the continued development and use of fire management plans that address fire at both landscape- and stand-levels. If a fire management plan does not exist for a candidate silviculture activity, then the fire management planning program should be included to aid in the assessment and evaluation of silvicultural strategy options from a fire perspective.

4.6.3 General Considerations from a Fire Management Perspective

A spatially explicit product(s) for silvicultural activities is required to adequately plan for and protect values from the effects of fire. The tactical plan described in section 3 should be used to consider silviculture priorities in light of fire management plans and inform fire management plans (i.e., response priority) in light of planned silviculture treatments.

Table 15 illustrates the relationship between forest management activities and fire management where treatments are either promoted to reduce risk or caution is directed in high risk areas for treatments that require time to provide benefits. It describes silviculture treatment priorities given wildfire management considerations by using various Burn-P3 parameters to identify potential fire risk. This matrix is intended to assist prescribing foresters to consider fire risk when planning silviculture treatments. For example, a lower priority might be assigned to silviculture activities that are likely to contribute to the fire hazard or where there is a high probability that significant silviculture investments may be lost. Alternatively, a higher priority might be assigned to activities that mitigate the risk of loss due to wildfire.

Table 15 Forest management priorities for wildfire management

Treatments		Lower priority where…	Higher priority where…
Harvesting	Clearcut		• High values and high hazards exist; create fuel breaks
	Partial cut		• High risk interface area [(2)] identifies a need to treat fuels; mitigate risk
Silviculture	Enhanced Reforest	• Burn probability is highest; avoid lost silviculture investments	
	Alternate Reforest [(1)]		• Burn probability is highest; mitigate losses and protect values
	Prescribed Burn / Ecosystem Restoration		• High values exist with high hazard and risk; treat fuels and improve forest health/habitat

Treatments		Lower priority where…	Higher priority where…
	Spacing	• Burn probability is highest; avoid lost silviculture investments	
	Spacing & Cleaning		• High values exist to protect community and Infrastructure • High risk interface area (2) identifies a need to treat fuels; mitigate risk • Burn probability and fire intensity criteria are the highest; mitigate fuel loading
	Fertilization	• Burn probability is highest; avoid lost silviculture investments	
Rehabilitate	Knockdown and site preparation		• High risk interface area (2) identifies a need to treat fuels; mitigate risk
	Plant and brush	• Burn probability is highest; avoid lost silviculture investments	

(1) encourage deciduous or other fire resistant species
(2) identified through a Community Wildfire Protection Plan (CWPP) or Provincial Strategic Threat Analysis (PSTA)

To illustrate how wildfire management might be considered to prioritize silviculture treatments, Figure 11 shows an example of two types of treatments: fertilization (green) and pre-commercial thinning (pink). Applying the direction in Table 15, would influence priorities accordingly:

1. Fertilization within the high burn probability and interface area is a lower priority.
2. Fertilization within the moderate burn probability and outside the interface is a higher priority.
3. Spacing and cleaning within the high burn probability and interface area is a higher priority.

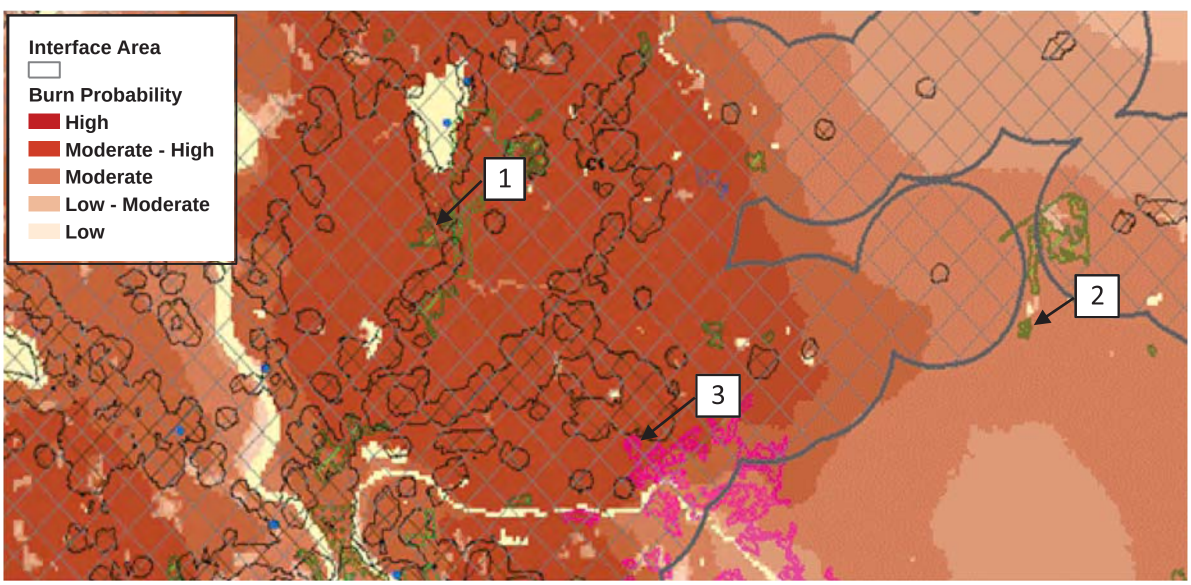


Figure 11 Map showing burn probability, interface areas and candidate treatment areas

Climate change is expected to increase the frequency and intensity of wildfires [16]; which will make decisions regarding silviculture investments and priorities much more challenging.

[16] Woods, A.J., Heppner, D., Kope, H.H., Burleigh, J. and Maclauchlan, L. 2010. Forest health and climate change: A British Columbia perspective, The Forestry Chronicle, Volume 86, Number 4. 11p.

Table 16 provides links to sources for information on wildfire management.

Table 16 Sources for information on wildfire management

Source	Link
BC Wildland Fire Management Strategy	bcwildfire.ca/prevention/PrescribedFire/
Provincial Strategic Threat Analysis	ground.hpr.for.gov.bc.ca/maps/cariboo/index.htm
Cariboo Regional District Community Wildfire Protection Plan	www.crd-director.com/section.php?cid=163
Quesnel Community Wildfire Protection Plan	www.quesnelfire.ca/cwpp/
Burn-P3 Modelling	cfs.nrcan.gc.ca/pubwarehouse/pdfs/25627.pdf
Forest health and climate change: A BC perspective	bcwildfire.ca/ftp/HFP/external/!publish/ClimateChange/FRPA/Workshop/Forest_Health_CC.pdf
Innovative Timbre Sale Licences (ITSL) – Stand Selection Policy	www.for.gov.bc.ca/hcp/fia/landbase/fft/ITSL-FLTC-Stand-Selection-Policy-20120920.docx.
Silvicultural Regimes for Fuel Management in the Wildland Urban Interface or Adjacent to High Landscape Values	www.for.gov.bc.ca/ftp/HFP/external/!publish/LBIS_web/Guidance/FFT%20guidance%20-Silvicultural%20Regimes%20for%20Fuel%20Management%20in%20the%20WildLand%20Urban%20Interface_V2.3.pdf

4.7 Ecosystem Restoration

In fire-maintained ecosystems of BC's interior, decades of fire suppression and the absence of prescribed burning has contributed to trees encroaching into areas that were historically grassland, as well as, increased tree densities in areas previously considered to be open forests. This type of ecological change reduces ecosystem resiliency to climate change pressures and contributes to many other negative trends.

The current ecosystem restoration plan[17] established a grassland benchmark used to facilitate the restoration of open-grassland habitat and legally established under the Cariboo-Chilcotin Land Use Plan. The ecosystem restoration plan also prioritized locations for restoration treatments, including prescribed burning and /or mechanical thinning. Most priority areas identified for treatment are located within the western part of the TSA.

Ecosystem restoration is not a direct, obvious or significant strategy to mitigate the falldown in mid-term timber supply and was therefore not included with this analysis. However, there may be instances where stands currently outside of the THLB could undergo certain restoration treatments, such as partial harvesting or commercial thinning, to return them to an open forest or even grassland condition. In this case, if the timing is appropriate, these harvested volumes might then contribute to the mid-term timber supply.

Difficulties will arise when attempting to fit natural ranges of variability into modern concerns of a changing climate. Climate change concepts must then be applied as best as possible into restoration processes.

Table 17 provides links to sources for information on ecosystem restoration.

[17] B.A. Blackwell & Associates Ltd., Cariboo-Chilcotin Ecosystem Restoration Plan: Grassland Benchmark, November 2007, 47p. (plus maps)

Table 17 Sources for information on ecosystem restoration

Source	Link
Provincial Ecosystem Restoration Strategy	www.for.gov.bc.ca/hra/Restoration/index.htm
Cariboo-Chilcotin Grasslands Strategy and Cariboo-Chilcotin Ecosystem Restoration Plan	www.ilmb.gov.bc.ca/slrp/lrmp/williamslake/cariboo_chilcotin/news/files/reports/grasslands_strat/index.html
Ecosystem Restoration Guidelines	www.env.gov.bc.ca/fia/documents/restorationguidelines.pdf

4.8 Enhanced Retention

In a previous AAC rationale[18], the Chief Forester encouraged district staff and licensees to resolve ways to implement forest stewardship recommendations[19] operationally. This eventually led to the development of an enhanced retention strategy[20] to provide guidance in selecting and distributing conservation legacy areas (CLA) during the salvage of MPB impacted pine leading stands.

The enhanced retention strategy presented a combination of stand- and landscape-level recommendations, supporting maps to identify areas suitable for CLAs, and recommended best management practices (BMP) which provide guidance for selecting additional CLAs. It was also expected that forest stewardship plans (FSP) would reflect these management practices. CLAs are tracked spatially through RESULTS as reserves on the WTP layer.

In this silviculture strategy, CLAs were modelled as a forest cover constraint for the first 30 years. These areas should be identified to ensure that planned silviculture treatments will not conflict with accessing these areas for harvesting in the future. Otherwise, no silviculture treatments are recommended within CLAs.

By encouraging heterogeneity across the landscape, enhanced retention strategies should improve the resiliency of forest ecosystems in the face of changing climate [21] .

Table 18 provides links to sources for information on the enhanced retention.

Table 18 Sources for information on enhanced retention

Source	Link
Forest Stewardship in the Context of Large-Scale Salvage Operations	www.for.gov.bc.ca/hfd/pubs/docs/tr/tr019.pdf
Quesnel Forest District Enhanced Retention Strategy	www.for.gov.bc.ca/dqu/policies/

4.9 Secondary Structure

Section 43.1 of the Forest and Range Practices Act Forest Planning and Practices Regulation requires forest licensees to protect secondary structure (i.e., understory advanced regeneration and non-pine

18 Quesnel Timber Supply Area – Rationale for Allowable Annual Cut (AAC) Determination, Effective October 1, 2004, Larry Pedersen, Chief Forester.

19 BC Ministry of Forests, Forest Science Program, Forest Stewardship in the Context of Large-Scale Salvage Operations: An Interpretation Paper, Technical Report 19, 2004, 18p.

20 Quesnel Forest District Enhance Retention Strategy Committee, Quesnel Forest District Enhanced Retention Strategy for Large Scale Salvage of Mountain Pine Beetle Impacted Stands – Release 1.0, February 2006.

21 Gayton, D., and P. Lara Almuedo. 2012. Post-disturbance management of biodiversity in BC forests. BC Journal of Ecosystems and Management 13(1):1–9.

canopies) in MPB affected areas. Harvesting in areas with little to no secondary stand structure and retaining areas with good densities of high-quality secondary stand structure is expected to improve the mid-term timber supply as areas with suitable secondary structure should develop into merchantable stands sooner than if they were clearcut and reforested. Secondary structure is typically considered during operational planning. Suitable stands are either excluded from proposed cutblocks or harvested in a way that protects the understory regeneration.

Since protecting secondary structure is a legal requirement, licensees are expected to incorporate results and strategies into their respective FSPs. However, a formal process for reporting these areas was not clearly identified.

Ideally, stands protected with secondary structure would be identified within CLAs as described above (section 4.8). Accordingly, these areas should be identified to ensure that planned silviculture treatments will not conflict with accessing these areas for harvesting in the future. Otherwise, no other silviculture treatments are considered within these stands.

Since areas temporarily protected for secondary structure will ultimately be harvested, they were considered within the THLB in this analysis and no further constraints or treatments were applied.

Table 19 provides links to sources for information on protecting secondary structure.

Table 19 Sources for information on protecting secondary structure

Source	Link
Mid-Term Timber Supply assessment	www.for.gov.bc.ca/hfp/mountain_pine_beetle/mid-term-timber-supply-project/secondary%20stand%20structure_summary_june_11.pdf
Silviculture Survey Reference Documents	www.for.gov.bc.ca/hfp/silviculture/Silviculture_Surveys.html

4.10 Watershed Management

Changes in hydrology can be estimated by equivalent clear cut area (ECA) and road density. Significant increases in ECA, road density, kilometres of road ditches, and numbers of stream crossings, increase the risk of increased peak flows and impacts on channel morphology. Risk can be reduced by accelerating hydrological green-up and an increased emphasis on maintaining vegetation within riparian ecosystems. This is especially important for all fish-bearing streams, wetlands, fishery-sensitive watersheds and community watersheds.

Assessment of watershed risk requires a sound understanding of watershed hazards or the likelihood of events taking place (e.g., landslide, high peak flows) and the values or consequence that are at risk (e.g., fish/fish habitat, highways or life & limb). Recently, a GIS-based watershed risk analysis[22] prioritized management activities based on their potential positive or negative influence of watershed risk. This risk analysis was used to designate “priority watersheds” and flag stands that warrant consideration for silviculture or other treatments that provide both increased timber supply benefits and decreased watershed risk.

Priority watersheds were identified as basins and sub-basins that are:

- high risk to fish and fish habitat
- high risk to social values, and

[22] Forsite Consultants Ltd. 2012. Cariboo GIS-Based Watershed Risk Analysis . Ministry of Forests Lands and natural Resource Operations.

- high equivalent clearcut area (ECA) (>30% based on the methodology implemented within the risk analysis).

In addition to the watersheds identified in the GIS-based approach, the district included the Bazaeko River as a priority watershed because of the associated MPB impact and anticipated future ECAs. Over one third of the total area for the TSA was identified as being with a priority watershed.

The original intent was to incorporate watershed priorities into this silviculture strategy analysis, but after a series of discussions, it was decided to simply describe the silviculture treatments impacts on ECA in general terms. Table 20 describes how these treatment impacts can be used to prioritize stands for tactical and operational planning.

Table 20 Silviculture impacts on ECA

Treatment	Impact on ECA	Rationale
Fertilizing	Positive	Fertilizing will increase the growth rates of treated stands, and reduce the time to canopy closure, thus potentially expediting hydrological recover of ECA areas. This is expected to have a positive impact towards reducing ECA.
Spacing and Fertilizing	Negative	Though fertilizing is anticipated to have a beneficial impact, removal of stems will lengthen time to canopy closure and thus slow hydrologic recovery.
Shortened Rotation	Negative	Increased % of landbase in a non-recovered condition due to the reduction in rotation age will keep ECA levels higher.
Knockdown and Plant (salvage)	Negative in short- term; Positive in the mid-term.	Increased ECA due to the additional salvage harvest. Negative impact is shorter term (5-10 years), however it does result in an expedited recovery in the mid-term (i.e. >10 years)
Commercial Thinning	Nil	Assuming that Commercial Thinning maintains a stocked stand and decent crown closure, the impacts of removing individual trees should (in theory) not increase or decrease the amount of ECA within a priority watershed. As a result the anticipated impact is considered nil.
Planting	Positive	Where there are NSR areas, for example, just doing planting will help increase the rate of recovery and earlier reduction in ECA.

Climate change is expected to have many important effects on watershed processes that in turn will affect values such as water quality, water supplies, slope stability, and terrestrial and aquatic habitats [23]. Developing effective responses to these effects will likely involve local-level strategies. Table 21 provides links to sources for information on watershed priorities.

Table 21 Sources for information on watershed priorities

Source	Link
Cariboo Watershed Risk Analysis	ftp://ftp.geobc.gov.bc.ca/pub/outgoing/Cariboo%20Watershed%20Risk%20Assesment/Cariboo%20Watersheds%20Risk%20Analysis%20Report%20Final_Mar2012.pdf
Fisheries Sensitive Watersheds	www.env.gov.bc.ca/wld/frpa/fsw/index.html

[23] R.G. Pike, T.E. Redding, R.D. Moore, R.D. Winkler, and K.D. Bladon. 2010. Compendium of forest hydrology and geomorphology in British Columbia. FORREX Forum for Research and Extension in Natural Resources (Chapter 19 Climate Change Effects on Watershed Processes in British Columbia).

4.11 Wildlife Habitat

The Identified Wildlife Management Strategy (IWMS) provides direction, policy, procedures and guidelines for managing species at risk and regionally important wildlife. Legal objectives are also established for ungulate winter ranges (UWR) for mule deer and wildlife habitat areas (WHA) for American White Pelican, Data Sensitive Species, Northern Caribou and Mountain Caribou. The Cariboo-Chilcotin Land Use Plan (CCLUP) identified grizzly bear habitat, high value wetlands for moose and critical fish habitat.

Many species at risk and those of management concern are negatively affected by roads which will increase significantly to salvage MPB. Given the vulnerability of forest-dependent species and large areas of MPB impacted timber, increased emphasis on managing road impacts is warranted.

While this analysis incorporated landbase netdowns and forest cover constraints to address UWRs, WHAs and critical fish habitat, it did not incorporate any further constraints associated with the additional wildlife species identified in the CCLUP.

Based on predictive ecosystem mapping, the BC Ministry of Environment (MoE) has been working to create habitat models for moose, mountain caribou, northern caribou, mule deer, elk, white-tailed deer, grizzly bear, marten, lynx, three-toed woodpecker, and northern goshawk. Draft habitat maps from these models were not available in time for inclusion with this analysis however, our results may later be incorporated back into the habitat model to identify areas where silviculture treatments might benefit or degrade habitat.

No direct linkages appear to exist between these wildlife habitat strategies and the silviculture treatments explored in this project. However, prescribing foresters should consider how these designated habitat areas might be impacted by the silviculture treatments and prioritize them accordingly.

Wildlife trees are managed through results and strategies stipulated in FSPs, the Chief Forester's guidance, licensee discretion and stewardship principles. While MPB impacts can enhance the availability of wildlife trees and CWD, at least in the short- to medium-terms, actions such as salvage, road building, and safety issues associated with roads, replanting and stand tending can result in the loss of non-pine wildlife trees and CWD. These features are also vulnerable to intense fires promoted by large areas of dead pine and climate change. Strategies to retain coarse woody debris and wildlife trees through time should be considered when planning silviculture treatments.

Climate change will likely impact wildlife habitat through increased forest disturbance reducing live structure while creating additional dead trees. This may be mitigated by treatments designed to reduce risk of damage from wildfire or pests.

Table 22 provides links to sources for information on wildlife habitat.

Table 22 Sources for information on wildlife habitat

Source	Link
Identified Wildlife Management Strategy	www.env.gov.bc.ca/wld/frpa/iwms/index.html
Ungulate Winter Ranges	www.env.gov.bc.ca/wld/frpa/uwr/index.html
Fisheries Sensitive Watersheds	www.env.gov.bc.ca/wld/frpa/fsw/index.html
CCLUP	ilmbwww.gov.bc.ca/slrp/lrmp/williamslake/cariboo_chilcotin/index.html
Quesnel SRMP	www.ilmb.gov.bc.ca/slrp/srmp/north/quesnel/index.html

4.12 Recreation

Whereas the CCLUP does not establish objectives specifically for recreation, there are three related objectives:

- maintain visual quality objectives for scenic areas
- maintain visual quality objectives for lakeshore management zones
- maintain a 50 meter management zone on either side of designated trails

As well, the CCLUP final report provides further direction on significant recreation corridors and a tourism sector strategy that considers access and visual quality. The SRMP proposes objectives and strategies for recreation corridors and trails, backcountry recreation areas and scenic areas.

In this analysis, modelling approaches to address the legal objectives for scenic areas, lakeshore management zones and designated trails were incorporated as either forest cover constraints or a landbase netdown. No changes were incorporated to incorporate recreation activities within the silviculture treatment scenarios.

While direct linkages do not appear to exist between recreation plans and the silviculture treatments explored in this project, prescribing foresters should consider any recreation features that may be affected either positively or negatively.

Climate change is not expected to have any direct impacts on recreation features. It is more likely that these values will be affected indirectly through increased forest disturbance and changes in ecosystem processes such as increased stream temperatures and the subsequent impacts on fish. In some cases treatments to address these processes may be available and should be considered in tactical and operational planning.

Table 23 provides links to sources for information on recreation values.

Table 23 Sources for information on recreation values

Source	Link
CCLUP	ilmbwww.gov.bc.ca/slrp/lrmp/williamslake/cariboo_chilcotin/index.html
Quesnel SRMP	www.ilmb.gov.bc.ca/slrp/srmp/north/quesnel/index.html
(Archived) Recreation Corridor Management Strategy	archive.ilmb.gov.bc.ca/slrp/lrmp/williamslake/cariboo_chilcotin/docs/rec_cor.html

4.13 Range Management

The MFLNRO range program allocates and administers, through range use plans, hay cutting and grazing agreements as well as grazing leases on Crown range across the Province. A formal range management strategy or plan is currently unavailable for the TSA.

While direct linkages do not appear to exist between range management activities and the silviculture treatments explored in this project, prescribing foresters should consider how these treatments might affect or be affected by range activities. For example, cattle use within riparian areas and newly planted areas will continue to be a concern for managing both habitat and timber supply. Silviculture treatments could help to retain and enhance existing barriers to cattle accessing these riparian areas.

Table 24 provides links to sources for information on the range program, BC Cattlemen's association and the Guide Outfitters Association of BC.

Table 24 Sources for information on the range management

Source	Link
MFLNRO Range Program	www.for.gov.bc.ca/hra/index.htm
BC Cattlemen's Association	www.cattlemen.bc.ca/default.htm
Guide Outfitters Association of BC	www.goabc.org/

4.14 Invasive Plants

The MFLNRO addresses invasive plant management through operational inventory, survey, treatment, and monitoring activities, and the development of new biological control agents for effective long-term control and rehabilitation of heavily infested areas. To prevent the introduction or spread of prescribed species of invasive plants, the MFLNRO reviews operational plans to ensure that invasive plant concerns are adequately addressed by the plan holder before approval .

Millennium Ecosystem Assessment [24] has identified invasive alien species as a major threat to the resilience of ecosystems in the presence of climate change. Given the substantial environmental and economic costs associated with the risk of biological invasion, prescribing foresters should pay considerable attention to the management of invasive plant species, especially under projected climate change scenarios.

While direct linkages do not appear to exist between invasive plant strategies and the silviculture treatments explored in this project, prescribing foresters can contribute to the program by reporting invasive plant sightings and where appropriate, collaborating with the Invasive Species Council of BC and the MFLNRO on specific treatment and research initiatives[25].

Table 25 provides links to sources for information on strategies for addressing invasive species.

Table 25 Sources for information on invasive species

Source	Link
MFLNRO Invasive Alien Plant Program	www.for.gov.bc.ca/hra/plants/
Invasive Species Council of BC	www.bcinvasives.ca/
Cariboo Chilcotin Coast Invasive Plant Committee	www.cccipc.ca/

4.15 Tree Improvement and Seed Transfer

The Forest Genetics Council of BC is appointed by B.C.'s chief forester to guide the full range of forest genetic resource management activities, including tree improvement (tree breeding and seed orchards), genetic conservation, genecology, climate-based seed transfer, and seed-use policy in the province. The Council provides a forum for stakeholder representatives to set goals and objectives, and to oversee the development and delivery of business plans to fulfill them. The annual FGC Business Plan outlines the activities and budgets of the seven subprograms that constitute the provincial forest genetic resource management program.

Direct linkages between tree improvement and the silviculture treatments explored in this project exist where planting is a component of the silviculture treatment (e.g., rehabilitation scenario). In these

[24] Millennium Ecosystem Assessment, 2005. Ecosystems and human well-being: multiscale assessments, 4: OisLAND press, London.

[25] Numerous tools are available including an App to report invasives, e.g., http://www.bcinvasives.ca/special-events/fight-against-invasive-species-right-at-your-fingertips

cases, planting trees germinated from select seed can significantly increase volume production that contributes to addressing mid-term timber supply issues. Prescribing foresters commonly use of select seed in normal operations so no further considerations are expected in adapting these practices for the silviculture treatments or actions described above.

Climate based seed transfer is one of the key features of BC's overarching Climate Change Adaptation Strategy. Planting seedlings adapted to future climates (assisted migration) is recognized as a key strategy to address climate change, as it will help maintain healthy, productive forests, and ensure capture of gains obtained from decades of selective breeding.

Table 26 provides links to sources for information on tree improvement and seed transfer.

Table 26 Sources for information on tree improvement and seed transfer

Source	Link
Forest Genetics Council of BC	www.fgcouncil.bc.ca/
MFLNRO Tree Improvement Branch	www.for.gov.bc.ca/hti/index.htm
Climate Change Adaptation Strategy	www.for.gov.bc.ca/het/climate/actionplan/index.htm
Forest Stewardship Action Plan for Climate Change Adaptation	www.for.gov.bc.ca/ftp/HFP/external/!publish/ClimateChange/Adaptation/MFLNR_CCAdaptation_Action_Plan_2012_final.pdf

4.16 Forest Inventory

The MFLNRO's forest inventory program includes both forest inventory and stand growth modelling sub-programs. Data and models produced by this program are used to characterize current, and forecast future, forest condition. This includes the recently completed LVI product used to represent the state of the forest in the western half of the TSA. Validation of this product is occurring in 2013/2014.

While direct linkages do not appear to exist between the forest inventory and the silviculture treatments explored in this project, information derived from this program is critical to the design of silviculture regimes. Reliability of the forest inventory demands continuous updates to reflect changes in the forest from harvesting, silviculture, pests, fire and other catastrophic events.

To address the impacts of climate change a concerted effort to capture baseline information and relate it to climate variables and growth is needed. This is an area that requires further direction to inform modeling and future yield projections.

Table 27 provides links to sources for information on the forest inventory program.

Table 27 Sources for information on the forest inventory program

Source	Link
Forest Inventory Strategic Plan	www.for.gov.bc.ca/hts/vri/

5 Recommendations

With any forest level analysis and planning process, opportunities for improvement are recognized throughout the process. This section provides recommendations to improve data sources, analysis approaches, or other issues that could lead to improvements in the next forest-level analysis. This section offers suggestions for special funding initiatives or needs for a full-phase approach to manage a specific issue (e.g., best management practices for dry-belt Douglas-fir stands).

New developments in silviculture practices and strategies are sometimes listed as adaptive management documents[26] prepared under the Forests for Tomorrow (FFT) program, as well as, standard operating procedures for undertaking Type 4 analyses (currently being developed).

5.1 Recommendations for Implementing Strategies

Enhanced Basic Silviculture

Despite the obvious gains, it is unlikely that enhanced basic silviculture will become a viable silviculture strategy until incentives are available to licensees for undertaking the related activities. Options to consider include a change to the appraisal system or a cost share arrangement. We recommended that a task force be established to explore administrative options that provide incentives for enhanced basic silviculture.

5.2 Recommendations for Data Gaps and Information Needs

Further information and research are needed to support or refine silviculture strategies for the Quesnel TSA. Recommendations for these data and research needs are described below.

Forest Inventory

The forest inventory for this analysis was based on an amalgamation of a several separate projects completed over many years, using three distinct standards: Forest Inventory Projection (FIP), Vegetation Resource Inventory (VRI) and Landscape Vegetation Inventory (LVI). All forest-level analyses rely most heavily on the forest inventory to assign the operable landbase, determine an appropriate starting inventory and describe how existing stands develop through the short and mid-terms. Given the dynamic nature of our forests, it is unreasonable to expect this inventory to provide an accurate depiction of stands at a large scale. However, the modifications described below should improve these estimates for developing tactical plans.

Updating the forest inventory with disturbance impacts from harvesting, fire, insects and disease is clearly essential for estimating forest conditions at the beginning of a harvest forecast as well as for applying stand regeneration assumptions. Moreover, silviculture strategies typically require key forest attributes (e.g., species composition, age and stand density) to determine stands that are eligible for various treatments. The forest update process, therefore, is a very important component of these analyses that currently requires much effort to complete; mostly due to poor or missing data that is highly complex and often disjointed. We recommend that the ministry work to strengthen the inventory update process to reflect available RESULTS data and impacts from natural disturbances (e.g., harvesting, fire, insects, disease) wherever possible.

The current standards for undertaking forest-related inventories aim to provide reasonable estimates at a management unit level (small scale). Less emphasis is placed on estimating stand

[26] www.for.gov.bc.ca/hcp/fia/landbase/fft/adaptive_management.htm

boundaries and attributes appropriate at larger scales. Consequently, unique stands, such as those with repressed pine or insufficient stocking, are often overlooked. Identifying these unique stands in the forest inventory would help in developing silviculture strategies for tactical plans.

While the LVI is designed to be appropriate for strategic-level analyses, it is not an appropriate source for developing tactical plans. Besides the general uncertainty associated with data accuracy, the detailed features of this raster dataset create a significant challenge for spatially representing candidate treatment areas. Instead, we recommend using the VRI and applying adjustments to account for MPB impacts.

Forest Health Impacts

It quite apparent from the results of this analysis that assumptions used to model MPB impacts have profound effects on forest dynamics – particularly assumptions for percent mortality, shelf-life and understory regeneration.

Estimates of tree mortality from fire, insects and disease are based on a combination of overview flights and ground assessments in both old and young stands. These data are essential for adjusting stand yield predictions for the current inventory and projecting future growth, as well as, estimating non-salvaged losses. Live volume estimates in MPB-impacted stands played a significant role in defining the mid-term harvest level in this analysis. Confirmation of live volume estimates on MPB-impacted stands is highly recommended.

In this analysis, yield projections for the post-attack regenerating stands were assumed to regenerate like their original natural stand but were adjusted to remove attacked trees and to include a 20-year regeneration delay. Improving yield assumptions for understory regeneration by identifying where it exists and how it develops, would enhance how some strategies (e.g., rehabilitation) are applied.

Site Index

Site index is a key variable for projecting the growth of existing and future managed stands. The SIBEC data used in this analysis provides average site indices for specific ecosystems at the site series level (as identified using ecosystem or biophysical mapping). In comparison to a site index adjustment project[27], the SIBEC estimates show consistently higher estimates of productivity for managed stands.

Applying averages across the forest causes some loss of resolution at a stand-level, particularly on the extreme sites (for both moisture and nutrients). As a result, some candidate stands may actually be inappropriate for specific treatments. Improving site index estimates across a full spectrum of site series and verifying the ecosystem mapping would enhance future silviculture strategies.

To ensure that Quesnel TSA volumes are not being overestimated by SIBEC and extreme sites are identified, we recommend ongoing monitoring of managed stand yields against predicted yields.

Past Incremental Silviculture Treatments

Ideally, silviculture strategies would incorporate past treatments to ensure that appropriate stands are selected for future treatments (e.g., multiple fertilization). As a minimum, the tactical plan should include the spatial extent of past treatments to improve how operational plans are prepared. Unfortunately, spatial and attribute data for past incremental silviculture treatments is not readily available and must be captured or derived through a combination of methods. We recommend

[27] JS Thrower and Associates, 2007.

streamlining the process for retrieving information on past incremental silviculture treatments and verifying that the data is accurate and complete.

Genetic Worth

Tree improvement and seed transfer guidelines play a significant role in the transition and long-term periods of the harvest forecast. Provided adequate seed supply is maintained, benefits will be realized as volume gains, increased survivability linked to assisted migration, and reduced forest health impacts. We recommend continued support for the tree improvement program and that genetic gains are closely monitored and applied in future forest-level analyses.

Product Profiles

In this analysis, product profiles were based on rather general assumptions. Future silviculture strategies could be improved by exploring opportunities with identified models (.e.g., SYLVER) and tracking harvested products over time. Alternatively, product profiles could be derived separately based on the species and age class distributions from the harvest forecast.

Studies on product profiles and harvested material are also valuable to inform criteria used to assign minimum harvest age, which can have a profound impact on mid-term harvest levels and future product profiles. As this has a major influence on mid-term harvest levels, we recommend further investigation of the linkages between desired product profiles, minimum merchantability and harvest ages.

Riparian Management

Riparian buffers were used as spatial netdowns to the operable landbase. Areas identified for riparian management were derived by buffering classified linear and polygon features for stream, lakes and wetlands. Since the classification was completed in 2005, it is very likely that better information is now available from various sources. While this may be a lower priority than other initiatives, updating riparian management areas would improve identification of treatable areas for silviculture strategies.

Road Network

In this analysis, landbase netdowns for existing and future roads were done aspatially. Improving estimates of average road widths (i.e., non-forest area) could improve the landbase netdown process. Moreover, a current and classified road network with associated widths could potentially improve future modelling of silviculture strategies by aggregating stands into treatment blocks or assigning roads to harvest blocks and assigning more detailed economic criteria such as haul distance.

Retention Areas

Section 4.4 discusses aspects of landscape-level biodiversity that will be negatively impacted over the next decade. Mapping the current retention areas would help to identify deficiencies and focus priorities for additional retention and silviculture treatments.

5.3 Recommendations for Modelling Approaches

Defining Treatment Areas

Among other objectives, this project aimed to provide products that will support operational implementation of the strategy. The tactical plan described above generates a map based on a combination of the model's spatial selection of stands treated and the associated forest inventory polygons. Tactical plans for future silviculture strategies could likely be streamlined by first aggregating polygons through blocking or by implementing more spatial controls within the model.

5.4 Recommendations for Related Plans and Strategies

General

Approaches for aligning with or at least considering related plans and strategies are discussed in section 4. In most cases, it is not clear how these initiatives should be integrated. A key to coordination is a consistent map base for all values. Everyone involved with these strategies needs to work with appropriate agencies to align or integrate strategies (particularly forest health, wildfire and wildlife) into a coordinated map base where queries to promote multiple objectives, or to avoid or mitigate risk, can be derived.

As emphasized in section 3.3, prescribing foresters using the tactical plan from this analysis to assist in preparing operational plans should carefully consider the related plans and strategies.

Links in section 4 to sources for information on related plans and strategies should be periodically updated for this report (or on the FFT website) to ensure that none have broken and that new initiatives are incorporated.

Access

It is well-accepted that harvest levels in the Quesnel TSA will soon be reduced to less than half the current uplift AAC of 4 million m^3/yr; lasting 3 or 4 decades. During this period, one of the challenges will be maintaining access throughout the TSA. This is disconcerting because some activities (e.g., fertilization) require well-maintained road systems for hauling the fertilizer products. Road access is also a key consideration in deciding fire-fighting priorities.

By far, the best way to maintain road systems is by supporting economic opportunities over the landbase. This provides a clear benefit to silviculture strategies that would otherwise require road maintenance to be added to treatment costs.

5.5 Recommendations for Monitoring

This plan is intended to be periodically updated using results from ongoing implementation efforts and better data as it becomes available.

A monitoring program should be developed to ensure outputs meet expectations over time. This should also examine how appropriate the input assumptions were for each strategy and recommend whether they should be revised for a future silviculture strategy.

Pages 224 through 226 redacted for the following reasons:
- -
Not Responsive

Wildland Fire and the Changing Landscape

The future of wildland fire in British Columbia

A discussion paper

The context and motivation for landscape fire management
and engagement with communities to minimize risk.

Wildfire Management Branch
Ministry of Forests, Lands and Natural Resource Operations

Executive summary

Public and government concerns have been escalating in the face of wildfire[1] control efforts and costs incurred. Wildfire threatens public and firefighter safety, private and business property, human infrastructure and employment. This paper discusses wildland fire impacts and possible strategies to contain future costs and risks to provincial and regional economies. There is a strong case for developing cost-effective solutions.

Increasingly, local and international news has covered wildfires. In British Columbia, sensitivity to the potential impacts of wildfires heightened during 2003 when 50 thousand people were evacuated and over 300 families lost their homes to fire. At the time, public safety and direct wildfire impacts (to homes, businesses and infrastructure) were the major concerns. However, a background burden was the financial and economic impact of that fire season which exceeded $1 billion.

Since 2003, most fire seasons in British Columbia have created public discussion of wildfire threats and links to climate change and other contributing factors. In 2011, the Alberta fire season (especially the wildfire that destroyed one third of the town of Slave Lake) heightened the debate about wildfire policies, prevention, and preparations, as well as fire control actions.

Key solutions to wildfire challenges include strengthened partnerships with local fire departments, Office of the Fire Commissioner, and the Union of British Columbia Municipalities (UBCM). Such partnerships can promote the benefits of the FireSmart and Structure Protection Units programs for increased security of homes, businesses and communities.

Forest management, including wildland fire planning and practices, will require an increased emphasis on land-use planning, and can result in reduced risks of wildfire ignitions and extreme fire behaviour.

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[1] Definitions.
Wildfire: An unplanned or unwanted natural or human-caused fire, where the intent is to suppress the fire.
Wildland fire: A non-structure fire that occurs in the wildland (areas of native vegetation); wildland fire includes wildfires, prescribed fires (controlled burns), and burns where only a portion of the fire will be suppressed.
Fire: In this report, the word “fire” is used generically.

Introduction

Moving into the 21st century, a number of factors combine to shift management of British Columbia wildland fires. While several aspects are positive, other factors continue to challenge fire management agencies, communities, and commercial sectors.

For organizations dealing with wildland fires, positive factors include increased effectiveness of technology and personnel. Tactical developments help organizations and communities respond to wildfire threats. Examples of these tactical advancements include: the Incident Command System; the FireSmart and Structure Protection Units programs; and Community Wildfire Protection Plans.

In addition, at strategic levels, guidance has been developed by federal and provincial agencies. In 2005, the Canadian Wildland Fire Strategy was released; across the country, all provincial forest ministers endorsed the Strategy. The goals of the Strategy are: resilient communities and an empowered public; healthy and productive forest ecosystems; and modern business practices. These goals continue to provide guidance to federal, provincial and territorial agencies and support the principles within the 2010 British Columbia Wildland Fire Management Strategy. In 2012, the British Columbia Forest Stewardship Action Plan for Climate Change Adaptation was completed; in part, this plan identifies actions for building fire-resilient landscapes.[2]

However, especially in western Canada, an assemblage of adverse factors will challenge the response capabilities of the organizations dealing with wildland fire. The key adverse factors include expanding areas of wildland-urban interface, industrial development across the landscape, accumulating forest fuels, and climate change.

Individually, any single factor might be addressed effectively through improvements and expansion of wildfire response capabilities, but it is becoming apparent that the combination of factors is beginning to overtake wildfire response strategies. This has led to the realization that wildfire control alone does not make social, economic or ecological sense. This Discussion Paper is intended to frame the key issues and provide solutions to move British Columbia forward.

[2] Web addresses for these tactical and strategic initiatives are in the References section.

Background

Wildland fires have been a significant force in shaping the ecological, social and economic landscape of British Columbia. Fire was the predominant stand-replacement disturbance and a First Nations' management tool[3] until fire suppression and forest harvesting were implemented to attempt a more "managed" forest regime. However, during recent years, under this "managed" regime, insects and wildland fire have played a much larger role than was anticipated by many people.

Before significant European influence, British Columbia forests and open spaces were thought to have been in a state of relative stability, renewed with some regularity by natural burns and First Nations' use of fire. That is consistent with reports from early explorers of western Canada that fires were often observed, resulting from lightning, or from intentional burning by First Nations, or as a result of human accidents.

This historic level of disturbance was a key ecological process affecting the broad-scale structure and composition of ecosystems and specific flora and fauna. Considering the past 80 years, Figure 1 illustrates the extent of wildland fire disturbance and shows that potentially over 1 million hectares burned per year, with .5 million in stand-replacement fires. However, over the past 100 years, several factors have inexorably altered this assumed equilibrium.

In British Columbia, about 100 years ago, European forest management principles were introduced. By the 1940s and 1950s, British Columbian forest managers applied the concepts of sustainable timber yield and even-aged management. These concepts implied that strictly managed forest harvesting could replace natural disturbance. A key principle aimed to minimize natural disturbances (including those caused by fire and insects) to create a regimented stand age distribution.

During the decades of intensive forest management, with the exception of the two relatively recent mountain pine beetle (MPB) outbreaks, difference between the area disturbed through harvesting, insects, and wildland fire is well below the 333 to 534 thousand hectares anticipated for significant stand replacement events.[4] Thus, in the interior of British Columbia, this has led to an assumption that there is a build-up of large "reserves" of undisturbed forest (in the millions of hectares) that has taken the forest out of equilibrium. The following sections will discuss linkages among wildland fires and insects as well as implications for the future and proposed solutions.

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[3] Parminter 1995.
[4] Ministry of Forests, Lands and Natural Resource Operations 2013.

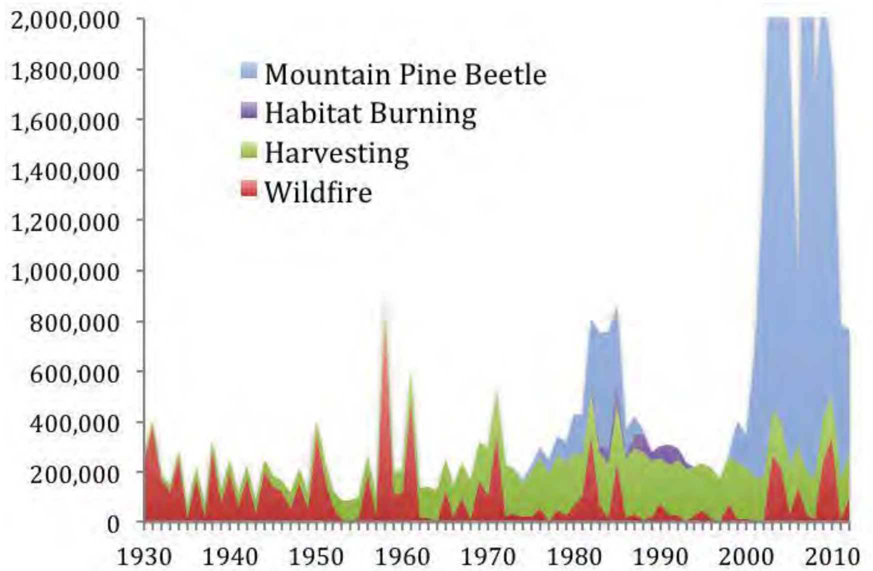

Figure 1. Historical stand-replacement disturbances in British Columbia's wildlands (Ministry of Forests, Lands and Natural Resource Operations 2013).

As evidenced in eastern North America (in the early 1800s) and at Sayward (Vancouver Island) in 1938[5], early forest harvesting lessons indicated that timber residues (e.g., logging slash, branches) could become extreme fire threats to communities. This threat led to the development of slash burning requirements for harvested areas. Subsequently, concerns arose about slash burning practices (e.g., site damage, loss of biodiversity, and smoke); thus there were pressures to reduce the amount slash burning.

Prescribed fire (or controlled burning), originally used broadly by First Nations, underwent a renewal following the Sayward fire. In the 1980s, prescribed fire practices were refined and designed to be more ecologically sensitive. By the end of the 1990s however, in numerous instances prescribed fire stimulated a public backlash against these practices. This resulted in fewer controlled burns being planned and implemented.

In British Columbia, the practice of fire suppression began in the early 1900s and has progressed to the point where the area burned annually has averaged less than 30 thousand hectares during the 1980s and 1990s. During the 20th century, across forest landscapes, the significant effect of human activity can be summed up as a shift away from the "natural" change agents (such as wildland fire and other disturbances) to forest harvesting as the major agent of change.

However, there are important distinctions. Forest harvesting is constrained to the 23 million hectares of Timber Harvesting Land Base (THLB). On the other hand, forest insects may affect the full 60 million hectares of British Columbia's forests. As well, wildland fire can affect approximately 86 million hectares of forest and shrubland.

[5] Ministry of Forests. No Date.

Although there are large areas affected by other insects, this paper will focus on MPB due to its potential for high tree mortality within large portions of British Columbia's forests.

Current state

As a result of changing and expanding human activities and resource management, British Columbia's ecosystems have diverged significantly from the "equilibrium" or "natural state" that existed before European settlement. Probably the most significant impact resulted from exclusion of wildland fire. Figure 2 illustrates the extent of fire across British Columba for a period of 80 years.[6]

Figure 2. Spatial distribution of British Columbian forest fires greater than 20 ha, from 1920 to 2000 (Taylor and Thandi 2003).

For many years, the predominant point of view deemed fire to be almost universally negative in its effects. Policies and programs have virtually eliminated the First Nations' use of fire and, to the extent possible, minimized wildland fire on the landscape.

The original expectation was that less area burned would benefit timber harvesting

[6] Taylor and Thandi 2003.

and related employment, and make other investments and communities safer. Especially where fire-dependent ecosystems are involved, it is now understood there are significant negative implications to the strategy of suppressing all wildland fires (e.g., increased forest density and ladder fuels, altered insect and pathogen dynamics).

During recent years, the reduction of natural disturbances on the landscape has been viewed as an important factor in the expansion and intensity of both the MPB epidemic and increasingly destructive wildfires.

<u>Forest conditions, including fire disturbances and age-class distributions</u>

Over a period of many decades, natural forest fire regimes have been altered; this, in turn, has altered British Columbia's forest-age distribution.

Up to the year 2000, large portions of British Columbia's forests have been increasing in age as a result of reduced natural disturbances, particularly wildland fires. This is clearly evident from a comparison of inventoried forest ages in the 1957 and 2000 (Figure 3)[7]. In 1957, 58% of the areal extent of forest stands was under 100 years old. By 2000, this was reduced to 41%. The recent MPB infestation has changed this proportion, although MPB attacks were concentrated in forests dominated by lodgepole pine.

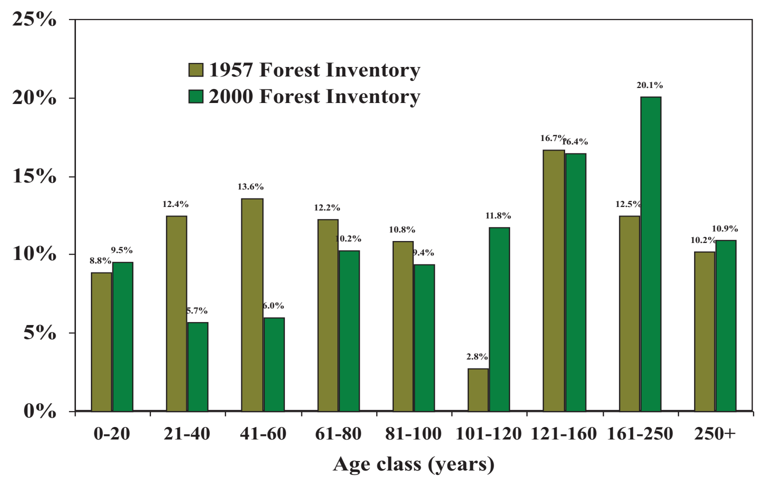

Figure 3. Contrasting the Forest Inventories of 1957 and 2000 (Ministry of Forests 2001).

To further explore the historic disturbance, techniques have been developed to provide disturbance timelines. On a broad scale, in simple terms, forest fire disturbances are considered either 1) stand-replacing fires (killing the overstory by crown fire) or 2) surface fires. Fire scars on trees provide evidence of burns that are not so intense as to replace forest stands (or at least not at the location of the scarred trees).[8]

As well, studies of the distribution of forest age classes provide strong clues about how much natural- and human-caused disturbance exists on the land base. An analysis of forest-age classes can provide insights about historic and current forest age-class distribution[9] and can help explain changes in rates of disturbance. For example, Figure 4 indicates that relatively recent changes in policy and programs (e.g., fire suppression and exclusion) have altered the age-class distribution of our forests,

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[7] Ministry of Forests 2001.
[8] Arno and Sneck 1977; Barrett and Arno 1988; Wong et al. 2003a; Wong et al. 2003b; and others.
[9] Sometimes referred to as age-class structure

especially since the 1940s.[10]

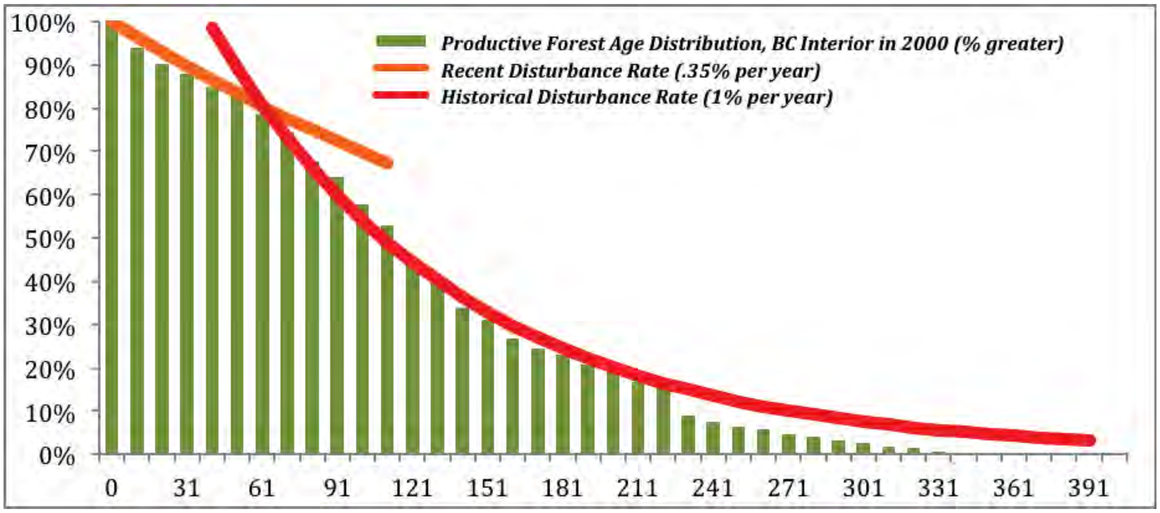

Figure 4. Age-class distribution of interior forests of British Columbia with superimposed theoretical stand-replacement disturbance rates. These figures were compiled in 2000, before the most significant impacts of the recent MPB epidemic (Ministry of Forests 2001).

Collectively these studies indicate a wide range of historical rates of fire disturbance in land areas within each ecological zone of the British Columbia Biogeoclimatic Ecosystem Classification (BEC) (see Table 1).[11]

Table 1. Fire types, estimated fire-return intervals, and estimated annual area burned, by Biogeoclimatic Zone (John Parminter, Pers. Comm. 2013).

	Land Area	Mean Fire-Return Interval (Years)			Stand Replacement Fires (Hectares/Year)	
Biogeoclimatic Zone	(Hectares)	Type*	Low	High	High	Low
Boreal Altai Fescue Alpine	5,479,715	S	300	400		
Boreal White and Black Spruce	15,890,111	S+C	100	150	158,901	105,934
Bunchgrass	236,470	S	5	15		
Coastal Douglas-Fir	257,147	S+C	100	300	2,571	857
Coastal Mountain-heather Alpine	2,212,059	S	300	400		
Coastal Western Hemlock	10,307,254	S+C	150	350	68,715	29,449
Engelmann Spruce – Subalpine Fir	17,137,681	S+C	200	300	85,688	57,126
Interior Cedar – Hemlock	5,214,356	S+C	150	250	34,762	20,857
Interior Douglas-Fir	4,307,760	S+C	150	250	28,718	17,231

[10] Ministry of Forests 2001.
[11] Parminter, Pers. Comm. 2013.

Interior Mountain-heather Alpine	951,855	S	300	400		
Montane Spruce	2,795,470	S+C	175	275	15,974	10,165
Mountain Hemlock	3,855,350	S+C	350	450	11,015	8,567
Ponderosa Pine	356,286	S	5	15		
Spruce – Willow – Birch	8,419,136	S+C	200	350	42,096	24,055
Sub-Boreal Pine – Spruce	2,196,705	S+C	125	175	17,574	12,553
Sub-Boreal Spruce	9,571,255	S+C	100	150	95,713	63,808
Grand Total	89,188,609				561,728	350,603

In interior forest stands, there is a discrepancy between the area of land identified by age-class analysis, and the area of forestland indicated by the Biogeoclimatic Zones on the previous page. Based on the Mean Fire-Return Intervals for interior stands (Table 1), the expected average fire rate would be 0.5 to 0.7% per year versus the 1.0% shown by age-class analysis portrayed in Figure 4.

It is reasonable to assume that harvesting has been able to maintain relative age class balance on the THLB. However, for areas outside the THLB, as a result of wildland fire exclusion, the forest-age distribution (and in some instances the forest composition) has been forced out of balance.

This imbalance has been a prominent discussion topic among forest and fire professionals, and is a likely contributor to current wildfire management challenges. The imbalance has also contributed to ecological responses such as the MPB epidemics in British Columbia's lodgepole pine forests during the 1980s and 2000s.

Forest health – insects and pathogens

As an outcome of fire exclusion, large areas of forest become older. Collectively, this can result in vast areas of relatively old forests and thus improve habitat conditions for insects and pathogens. Changes in weather variables (e.g., precipitation, winds) can exacerbate this situation. The recent MPB epidemic provides a dramatic example of what can happen with shifting forest, regional weather, and overall climatic conditions.

Since the late-1990s, the MPB epidemic has significantly altered forest conditions across a vast area of the British Columbia interior. By 2010, an estimated 17.5 million hectares of lodgepole pine had been affected by the beetle.[12] By 2017, it is estimated, that 787.8 million cubic meters of lodgepole pine will have been killed in the province.[13]

Major salvage harvesting efforts continue in British Columbia and it is projected that up to 7 million hectares will be harvested and reforested. However, that leaves well over 10 million hectares of unharvested dead lodgepole pine stands. Fire behavior and control challenges will likely increase as dead stands start to collapse.

[12] Westfall and Ebata 2011.
[13] Walton 2012.

Wildfire risk and public safety

In early 2003, a study of British Columbia’s southern interior forests evaluated the effect of shifting forest age on fuel conditions and wildfire risk; this research assessed and identified “Condition Classes” for fire-dependent forest types.[14] Large portions of the study area were deemed to be overdue for surface- or stand-replacement fires. It was no surprise to the researchers that many of the challenging 2003 fires occurred in areas that were most divergent from the historic natural fire regime (and thus within Condition Class 3). See Figure 5.

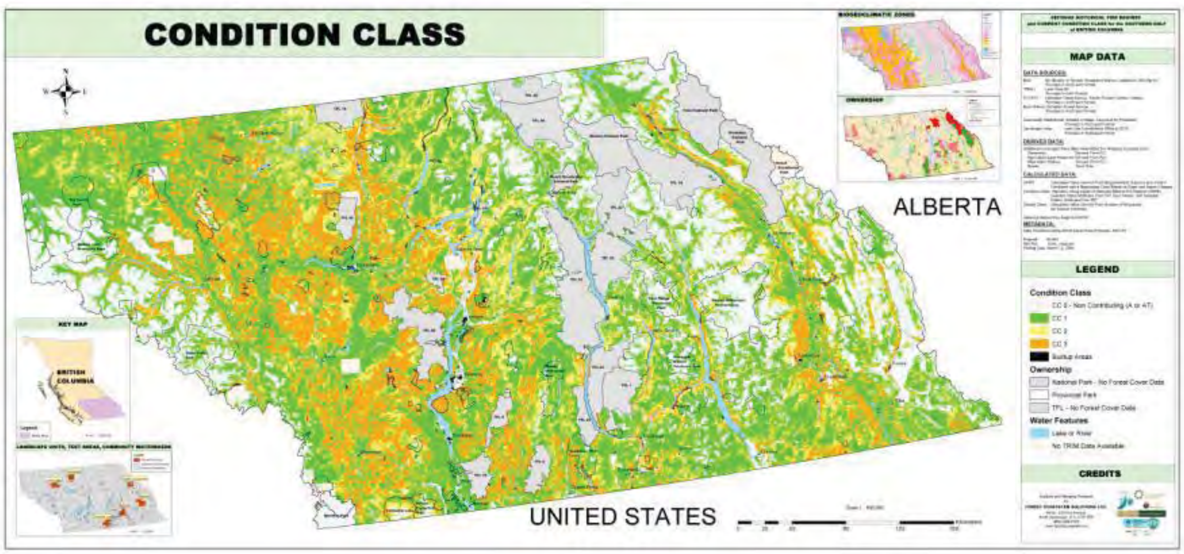

Figure 5. Forest fuels and Condition Classes for the southern interior of British Columbia (B.A. Blackwell and Associates Ltd. et al. 2003).

Those were the types of conditions that led to the extremely difficult fire control challenges during the 1998 fire that triggered home evacuations and caused significant home losses at Salmon Arm.

There were disastrous fires in eastern Canada in the late 1880s and in western Canada during the early 1900s. Following that, fire control measures were implemented and for a number of decades, wildfire damages were reduced. Across Canada, during the 1970s, loss of homes due to wildfire was rare.

However, the 1973 Eden Fire, adjacent to Salmon Arm, destroyed 16 homes and surprised wildfire professionals. In the 1980s, across the country, there were several

[14] B.A. Blackwell and Associates Ltd. et al. 2003.

instances where homes were damaged during wildfires. During the 1994 and 1998 fire seasons, two British Columbia wildfires destroyed a total of 32 homes). During the 2003 fire season, 334 homes and businesses were destroyed in British Columbia. Throughout the 2000s, many homes and cabins were destroyed by wildfire in Alberta and Saskatchewan.

In 2011, the fast-advancing Slave Lake fire in Alberta resulted in the loss of 700 residences, and amounted to insured losses of $700 million.[15] Combined with home losses in British Columbia in 2010 and 2012 this may indicate a significant escalation of home and business losses for the 2010s and beyond.

Fatalities are of even greater concern to wildland fire managers. Major fires around to world have resulted in deaths (e.g., Australia, U.S., Portugal, Greece, Russia). Also troubling are the health impacts of concentrations of fire-caused smoke and heat stress that can result in hospitalizations or mortality.

In Canada, for several decades no civilian lives have been lost; however, in Ontario, 20 people were killed in the 1938 Dance Township wildfire. Firefighters are particularly vulnerable as they work to quell wildfires. Between 1986 and 2005, a total of 34 Canadian fire control personnel have been killed during fire suppression operations.[16] There are strong concerns that firefighter lives are at increasing risk as they become more committed to fighting larger and more intense wildfires threatening communities.

<u>Timber supply</u>

There are two major concerns about wildland fire impacts on timber supply in British Columbia. First, as the risk of fire increases in areas outside the THLB, the overall threat to the THLB will also increase. This concern is increasing as the MPB-affected areas are beginning to enter a significant second phase of fire hazard during which swaths of dead trees fall. Secondly, when AAC determinations are set, it has been well documented that the traditional process for deducting fire-related volume losses is a relatively inaccurate estimation.[17] The significance of this inaccuracy is not high when wildfire losses are limited and pressures on available harvest areas minimal. However, in the British Columbia interior, the combination of increased fire losses and high commitments of timber supply leads to major concerns.

<u>Economic impacts of wildfire</u>

In addition to widely publicized impacts on forests and the public, extreme wildfire seasons are increasingly recognized as having impacts on the broader economy. In the case of the 2003 fire season in British Columbia, a consultant compiled direct losses at over $1 billion.[18] This includes $438 million (M) in fire suppression costs to

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[15] Institute for Catastrophic Loss Reduction 2012.
[16] Canadian Interagency Forest Fire Centre 2006.
[17] Van Wagner 1982; Reed and Errico 1986.
[18] Grant Thompson LLP 2004.

> *"Oil and gas extraction decreased by 4.2% as wildfires in Northern Alberta as well as maintenance shutdowns resulted in reduced production at oil fields."* (Statistics Canada 2011)

the province, another $87M in provincial costs, and insured losses at $200M ($130M residential and $70M business).

This 2004 analysis covers immediate costs and business losses. However, it does not cover the broader economic impacts of lost business opportunities and activities such as immediate and ongoing reduced tourism and wildland resource extraction. During 2011, fires across Alberta caused significant reductions in business activity in the oil and gas industry.[19] Additionally, over recent years, increased attention has been focused on health-care costs related to human inhalation of wildland fire smoke.

Regulations and responsibilities

In British Columbia, the *Wildfire Act*[20] permits but does not obligate the province to take action on wildland fires. It does, however, obligate individuals and companies present within or managing wildlands to take reasonable measures to prevent wildfire ignitions and suppress wildfires if they occur. Forest managers must base planning and management of forestlands on requirements stipulated in the *Forest and Range Practices Act*[21] (FRPA) and the Government Actions Regulation[22] (GAR). Neither FRPA nor GAR refers to wildfire risks. Further, FRPA does not apply to private lands.

Members of the public and industries at risk from wildfires need to take precautions, and local governments are obligated under the *Emergency Program Act*[23] to plan for and respond to emergencies. In some cases, local governments have created bylaws that require development proponents to specify wildfire mitigation measures.[24]

Recently, wildfire response assistance has been offered under agreement through Wildfire Management Branch. In the past, the Ministry of Forests, Lands and Natural Resource Operations (in its Service Plan) has committed to prepare for and contain wildfires where reasonable. It is important to recognize that this is a clear statement that wildfire control cannot be guaranteed.

Other agencies such as the government of Canada have jurisdiction over federal lands.

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[19] Statistics Canada 2011.
[20] Government of B.C. *Wildfire Act*
[21] Government of B.C. *Forest and Range Practices Act*
[22] Government of B.C. Government Actions Regulation
[23] Government of B.C. *Emergency Program Act*
[24] For example, the City of Chilliwack 2011.

Future state

<u>Expanding development</u>

As the population of British Columbia continues to expand (Figure 6)[25], communities are spreading (frequently into former wildlands). There are also increased demands for recreational opportunities and properties as well as access to wildlands.

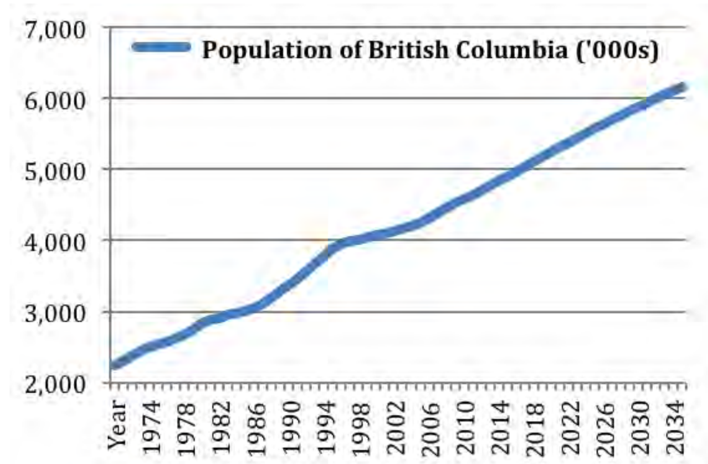

Figure 6. Population of British Columbia 1970 to 2036 (British Columbia Statistics 2013).

Increasing numbers of people are relocating to homes and communities that are in (or near) forested areas. These areas, known as the Wildland-Urban Interface (WUI), frequently provide scenic venues, wildlife habitat, and privacy from neighbours. Often, the forests and the relative isolation make these settings vulnerable to wildfires. When wildfires break out, there can be more economic and political pressures to suppress WUI fires, and this can increase fire protection costs.[26]

This trend is universal across North America and results in rapidly escalating risks of fire starts and expectations of wildfire control agencies, especially when homes and cottages are threatened. However, in spite of these increasing risks and expectations, it has been difficult to initiate and maintain the interest of residents and communities; thus it has been challenging to get residents to do what is required to minimize wildfire hazards on their properties.

The economic future for British Columbia is expected to be positive as indicated by the levels of personal and corporate investment in the province (for example, see Figure 7[27]). When combined with an increasing population, much of this investment is putting increased demand on the land base. Current industrial pressures include a full commitment of the timber and fibre supply, expanded

Figure 7. Potential British Columbia hydro-power sites (Private Power Watch).

[25] British Columbia Statistics 2013.
[26] Gorte 2013.
[27] Private Power Watch.

investments in energy and mineral development, as well as commercial recreation and rural commercial lodges. All of these activities present increased risks of fire ignitions as well as amplifying the demands on wildfire prevention and firefighting capacity.

Forest conditions

Within the THLB, young stands are being regenerated after forest harvesting. Thus, in areas of active forest management, the extent of old forests is of less concern than with forests outside the THLB. However, within the THLB, there are two concerns. First, within cutblocks, in numerous instances, harvest-debris (such as tree tops and branches) is not piled and burned. Compounding that, there are guidelines recommending retention of coarse woody debris within harvested areas. Thus, post-harvest logging slash may make wildfire control more challenging. Second, in many areas of the province, THLB areas adjacent to communities are often subject to less harvesting which can result in fuel buildups.

Of more concern are the areas outside of the THLB. Attempts to maintain relatively undisturbed forests (to address biodiversity, old-growth and riparian conditions, wildlife, and visual quality objectives) will exacerbate fuel buildups in fire-dependent forest types.

In 2010, The State of British Columbia's Forests report[28] forecast an age imbalance in forests within the THLB versus forests outside the THLB (Figure 8).

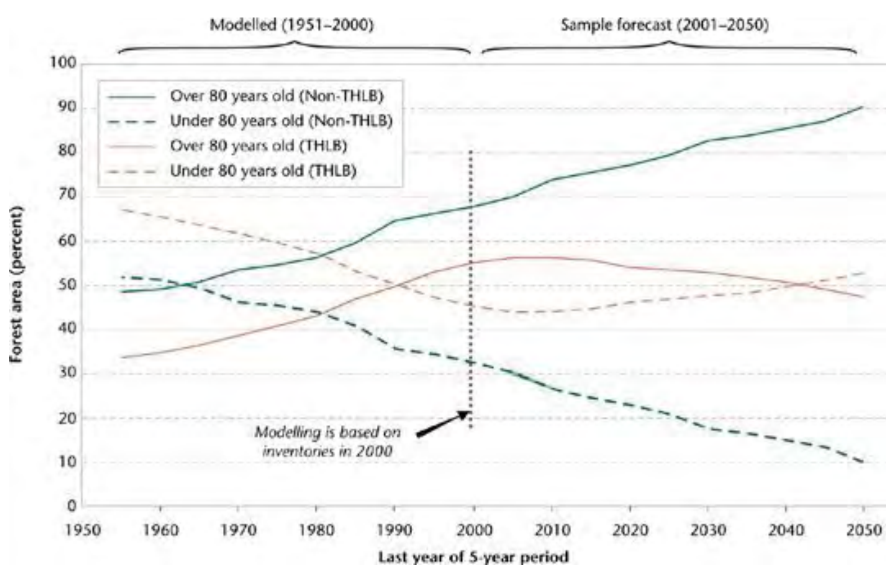

Figure 8. Percent of forest area over and under 80 years of age modeled and forecast for the British Columbia THLB and non-THLB, 1950–2050. THLB = Timber Harvesting Land Base (Ministry of Forests, Mines and Lands 2010).

[28] Ministry of Forests, Mines and Lands 2010.

Wildfire challenges are becoming increasingly difficult while the impacts of insects, pathogens and invasive species continue across the landbase. In the British Columbia interior, taking the MPB beetle epidemic as an example, at a broad scale, age class distortions have improved. However, these improvements have been concentrated in lodgepole pine stands. To add to the challenges, starting in the next 5 years, unharvested dead lodgepole pine stands (estimated at over 10 million hectares) will begin to collapse and create fuel conditions that will be far worse than those that existed just after the MPB attacks.

Indeed, dead pine stands have been classified as new fuel type in British Columbia. This fuel type is estimated to be increasing at a rate of over 800,000 hectares annually[29] and will be present for decades to come.

Changes associated with this fuel type include rapid crown-fire initiation, high intensity fires, mass spotting, and quickly spreading fires. Recent analysis has shown that the observed rate of spread in predominantly MPB-affected fuel types is 2.6 times faster than in healthy green stands and can reach rates of 66 meters per minute.[30]

Since rate of spread can be roughly correlated to fire intensity these fires may be three times more higher than what could have been expected for a similar but healthy stands.

It can be expected that wildfires in MPB affected stands will generate extreme wildfire behaviour reducing suppression success and increasing burned area.

Special Committee on Timber Supply[31]

Within the British Columbia interior, because of the major MPB-caused timber mortality, a Special Committee of the Legislature was formed to look at timber supply issues. The Committee clearly identified that forest conditions in the Wildland-Urban Interface and broader forest landscape are of concern. The Committee recognized the financial implications of preparing for and suppressing wildfires as well as the costly treatments to mitigate fuel loads and fire risks around communities. At the landscape level, the Committee recommended tenure holders help manage fuels. However, within a given Timber Supply Area

Recommendation 3.3

The [Special Committee on Timber Supply] recommends to the Legislative Assembly that the Ministry [of Forests, Lands and Natural Resource Operations]:

a) Continue to fund strategies and activities for the reduction of fuel in the Wildland-Urban Interface. Where these investments reduce overall fire suppression risks and costs, then the Ministry might best fund these expenditures from the fire suppression budget, thereby reducing overall cost to the Province.

b) Ensure that tenure holders help to manage fuels across the broader forest landscape in addition to the urban interface.

c) Work closely with tenure holders by linking fuel management programs to type-4 silvicultural strategies.

[29] Hvenegaard 2012.
[30] Perrakis et al. Report in progress.
[31] Special Committee on Timber Supply.

(TSA), often there is land that is not included a tenure holder's THLB (e.g., very steep slopes); thus there are concerns about fuel management of those portions of the TSA.

Climate change

There has been extensive discussion regarding the linkage between climate change and wildland fires (Figure 9).[32] Beyond obvious concerns about increased temperatures and severe drought (extended periods of dry weather), there are other factors that will add to wildland fire management challenges.

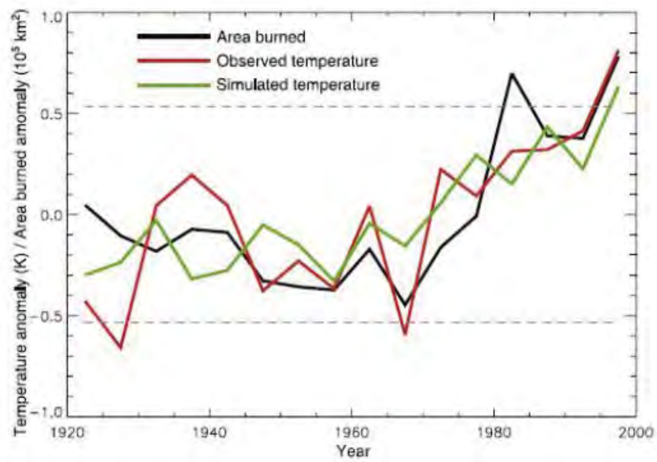

Figure 9. Observed and simulated temperatures and burned areas between 1920 and 2000 in Canada (Gillett et al. 2004).

Climate change contributes to lengthened fire seasons.[33] Figure 10 illustrates that British Columbia fire seasons are expanding each year by about 2 days (beginning 1.20 days earlier in the spring and extending 0.74 days later in the fall).[34] This means that since 1980, fire seasons have expanded by 68 days (from 225 days in 1980 to 293 days currently).

Thus, the duration between fire seasons is now shorter. Within that shortened time, during the post-fire fall season, many fire-related activities must occur. For example, field workers must assess and rehabilitate fire suppression impacts and mitigate concerns about landslides and sediment flow. In addition, between fire seasons, professionals need to prepare for the subsequent season (e.g., recruit and train firefighters and repair and deploy equipment).

[32] Gillett et al. 2004; Nitschke and Innes 2008; and others.
[33] Westerling et al. 2006.
[34] Ministry of Forests and Range 2006.

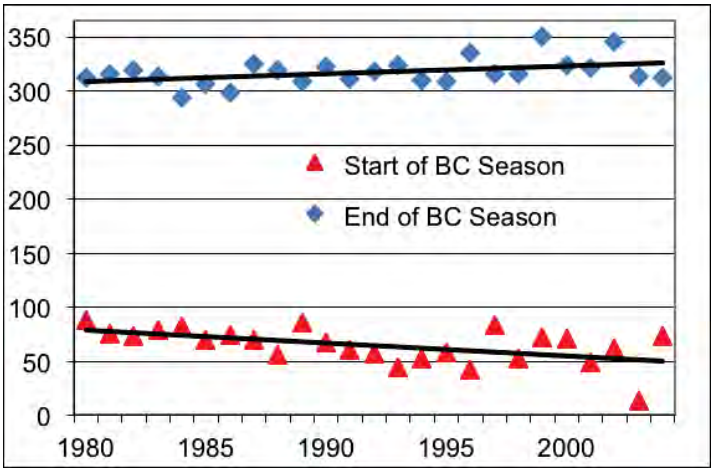

Figure 10. Over recent decades, the length of the British Columbia fire season has increased (Ministry of Forests and Range 2006).

Climate change can contribute to altered wind, precipitation and drought conditions. At Alberta's 2011 Slave Lake fire, high winds contributed to the extreme fire behavior. In some areas, increased precipitation may contribute to wildfire risk. In these instances, more moisture can enhance growing conditions for vegetation; during subsequent dry periods, fire ignitions may result in worse fire behavior. For British Columbia, the key wildfire threat is most often associated with drought conditions; desiccating winds often dry forest fuels even more.

Importantly, the links between climate change and total costs of fires, especially in relation to protection of communities has been highlighted in a recent study of large wildfires in Montana (Figure 11).[35]

[35] Gude et al. 2009.

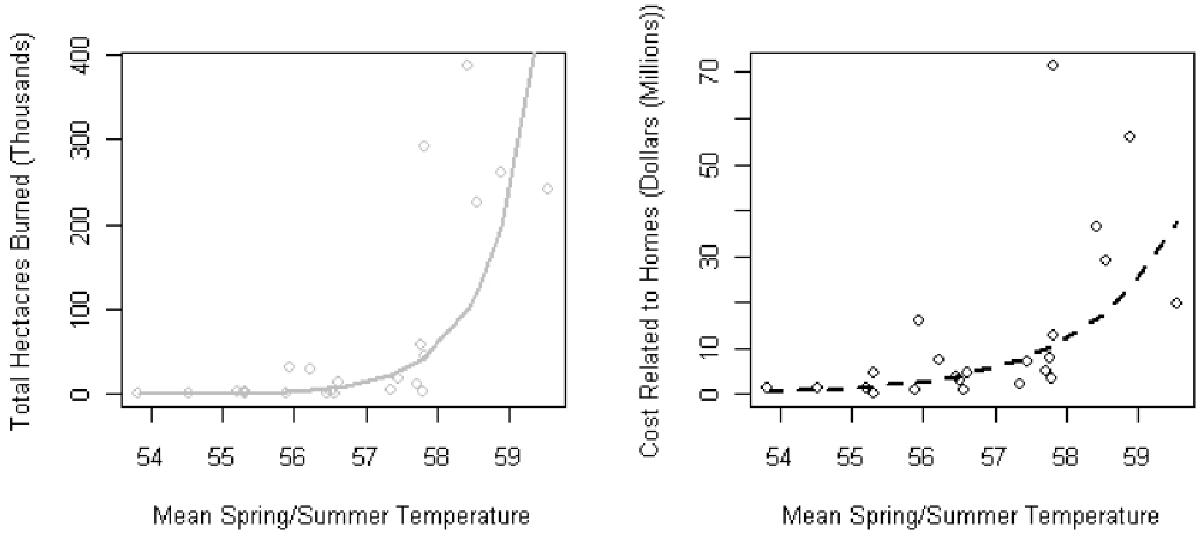

Figure 11. In Montana, increased summer temperatures have been factors that have increased the area burned by large fires and the costs associated with damage and destruction of homes by wildfires (Gude et al. 2009).

Economic impacts of extreme wildfire events

There is also a trend for the number of large damaging fires to steadily increase. Thus, beyond the costs and direct losses, the total impacts for some large fires have been examined.

Recent wildfire studies examined fire suppression and other direct costs and contrasted those with the total costs and damages. Results indicate that total financial impacts are several times those of fire suppression costs. In British Columbia, a consultant investigated and reported the full costs and impacts of extreme fire events.[36] This investigation showed that total financial impacts were about three times the fire suppression costs.

In Alberta, during the 2011 fire season, total economic impacts were in the order of 10 times the fire suppression costs; the total costs were driven largely by insured losses of $700 million.[37] During that Alberta fire season, if the economic impacts on wildland industries (especially petroleum) were assessed, that ratio would be much higher. Recognition of these escalating economic impacts is critical for future planning.

Summary of projected impacts

To summarize, increasing wildland fire challenges are projected to result in higher fire

[36] Grant Thompson LLP 2004.
[37] Institute for Catastrophic Loss Reduction 2012.

suppression costs, more damage to wildland and community developments, significant economic disruptions (including unanticipated impacts on timber supply), larger areas burned, and increased risk to the public and those working in fire suppression operations.

Adverse changes in climate and fuel conditions will combine with increased investments, developments, and other pressures on wildlands. This combination will result in a disproportionate increase of negative wildfire impacts on physical assets (Figure 12).

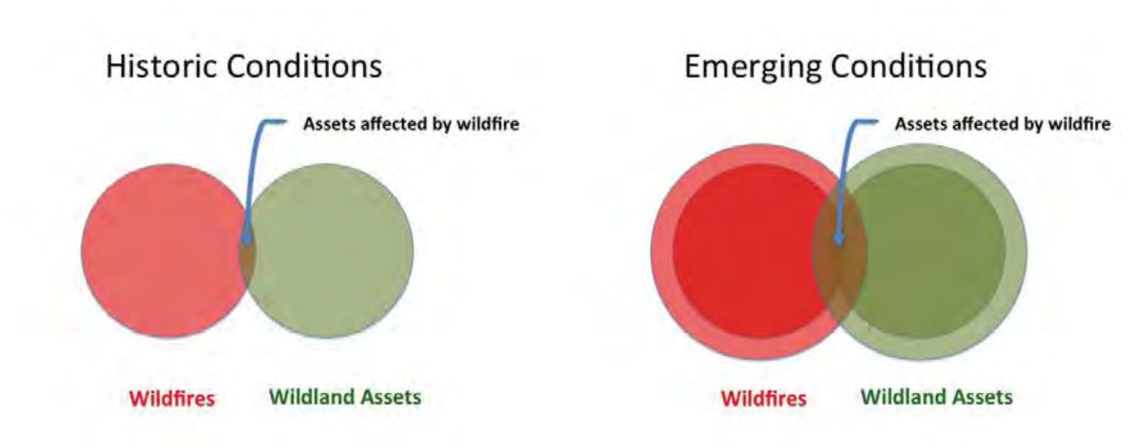

Figure 12. Schematic representation of emerging fire, fuel, and climate and weather conditions resulting in disproportionately more wildland assets affected by wildfire.

Within the THLB, any increases in disturbance could compromise AAC determinations. Disturbance in the areas outside of the THLB could compromise objectives for protection of biodiversity, riparian and old-growth conditions, wildlife, and visual quality objectives.

Given the changes in fuel conditions associated with MPB infestations and climate change, it is likely that fire intensity will likely be higher than historical fire regimes and that there will be more large fire events. In addition, after intense fires, it is likely there will be increased reforestation challenges and costs.

> "… severe wildfires are expected to increase significantly throughout British Columbia's forests, perhaps increasing by 50% or more over the period through 2050. There is high confidence in this forecast." (Institute for Catastrophic Loss Reduction 2012)

In addition, it is important to recognize that during the 2003 British Columbia fire season, essentially all resources available in Canada were brought to bear on the wildfires. During August 2003, in British Columbia, 800 fires were burning under the extreme drought conditions. In spite of the planned actions of 7,700 firefighters, 2,000 Canadian military personnel, and 36 airtankers, managing those fires was essentially beyond the capabilities of the combined national resources. The combination of resources mustered for the 2003 fires may never be available again, especially the inclusion of military personnel, given other Canadian commitments.

The 2011 wind-driven wildfire at Slave Lake spread so rapidly, only limited support could be immediately mobilized from outside the area. In the British Columbia and Alberta cases noted, the scale of the fires overwhelmed local fire departments, even with aid from other jurisdictions. Without significant preparation by local and regional fire services, such events will be repeated.

Solutions

At the global level, there is increasing recognition of the impacts of population growth and climate change. The specter of extreme wildfire events overlapping with expanding urban and industrial development is now clearly occurring in the western U.S. The same trends are occurring in western Canada.

In British Columbia, to meet the challenges, a number of initiatives are under way or in development stages. These initiatives address fire at local, landscape, and provincial scales.

<u>Local solutions</u>

Over the past 10 years, significant progress has been made to address the recommendations contained in the FireStorm 2003 report.[38] To address identified concerns, fire managers have developed strategies, plans, and overarching principles. As well, tactical tools and approaches have been expanded.

As wildfire challenges continue to increase, the need for increased cooperation and partnerships is becoming more apparent. In fact, the British Columbia Wildfire Management Branch is not a land manager or owner. Therefore, to build solutions, the Branch needs to work with emergency response organizations, local governments, First Nations, industry sectors, business owners, land managers, and private landowners. High levels of cooperation to prevent, prepare for, and respond to wildfires.

The FireSmart program provides clear guidance for the public and businesses to protection them from the rising threat of wildfires. Given the significant costs of some activities listed within the FireSmart Manual, the province developed the Strategic Wildfire Prevention Initiative in cooperation with the Union of British Columbia Municipalities, the First Nations Emergency Services Society, and the Office of the Fire Commissioner.

To date, to reduce threats to communities, the Initiative has helped fund fuel management plans and treatments on nearly 50 thousand hectares. However, this amounts to only about 7% of the total area needing fuel reduction treatments; in addition, there will be an on-going need to repeat fuel reductions over time. Based on the progress to date, it will take many years for communities to catch up with the backlog of needed fuel treatments. Therefore, there are significant benefits to providing short-term community protection while individual Community Wildfire Protection Plans are being implemented.

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[38] Filmon 2004.

To supplement protection of communities, the province has supported development of the Structure Protection Units program, administered by the UBCM. The program is supported by a Steering Committee comprised of representatives from UBCM, MFLNRO, British Columbia Fire Chiefs, Canadian Forestry Service, and the Office of the Fire Commissioner. There are significant benefits to providing short-term community protection while individual Community Wildfire Protection Plans are being implemented. Based on the progress to date, it will take many years for communities to catch up with the backlog of needed fuel treatments.

Provincial solutions leading to local actions

British Columbia has been proactive by developing the forest management initiatives, strategies, and plans described below.

In the face of climate change, the Future Forest Ecosystems Initiative (FFEI) has helped to frame the issues and priorities for managing British Columbia forests.

Future Forest Ecosystems Initiative

The Future Forest Ecosystems Initiative is adapting British Columbia's forest and range management framework so that it continues to maintain and enhance the resilience and productivity of B.C.'s ecosystems as our climate changes.

Under the 2006 Forest Ecosystem Renewal Strategy, there are plans to annually restore 12,000–17,000 hectares of land (0.025% of province/year), which will require future maintenance treatments and apply controlled burning to 10,000–12,000 hectares of land.

The Ecosystem Restoration Initiative provides guidance for appropriately restoring fire-maintained ecosystems while addressing fuel management concerns.

"*In the fire maintained ecosystems of British Columbia's interior, a lack of wildfire due to decades of suppression, the absence of prescribed fire and applying no other intervention or disturbance processes as an adequate surrogate for the role of fire, has contributed to trees encroaching onto historic grasslands, as well as, excessive in-growth of trees in previously open forests*."[39]

[39] Ecosystem Restoration Initiative.

The Wildland Fire Management Strategy, developed during the era of the FFEI, proposes proactive shifts to address fire-related concerns and the considerable threats to communities, infrastructure, and wildland investments (Table 2).

Table 2. Shifts to be achieved under the British Columbia Wildland Fire Management Strategy (Ministry of Forests, Lands and Natural Resource Operations 2010).

Wildland Fire Management Strategy		
From	**Strategic Shift**	**To**
• Limited response to build-up of hazardous fuels	→	• Proactive management of fuel build up
• Passive approach to ecological benefits of fire		• Active management for the ecological benefits of fire
• Limited inter-agency management of wildland fire		• Collaborative inter-agency planning and management
• Rapidly escalating costs for response		• More efficient response to wildfire outbreaks

Government recently completed a comprehensive Forest Stewardship Action Plan for Climate Change Adaptation (2012–2017). This plan established goals and objectives. Included in Objective 2.1 is an Action to: *Build fire-resilient landscapes: Conduct landscape wildfire risk assessments, and implement treatments for fire resilient landscapes on priority areas.*[40]

Meanwhile, the Special Committee on Timber Supply has reiterated the need for fuel management, both in regard to protecting communities and for addressing escalating wildfire issues affecting timber supply.

[40] Ministry of Forests, Lands and Natural Resource Operations 2012.

To address the needs of land managers, a planning framework is being developed. This framework will help managers address the issues identified in the local and provincial initiatives noted above. This framework includes:

1. A science-based hazard and risk assessment process and tools.
2. A consultation process to ensure alignment of land use and management plans to meet risks and opportunities.
3. An objective relating to wildland fire under the *Forest and Range Practices Act*
4. Guidebooks for planning and implementing wildland fire objectives in land management
5. Wildland fire considerations in Type 4 Silviculture Strategies
6. Coordination with the Strategic Wildfire Prevention Initiative
7. Cooperation with the Association of British Columbia Forest Professionals as that organization develops Professional and Practice Standards relating to FRPA fire and fuel objectives.

Within this planning framework, the types of forest and land management solutions could include:

1. Using available fuel breaks to protect wildland investments and communities.
2. Creating linear landscape-level fuelbreaks (described below)
3. Harvesting priority high-hazard stands
4. Breaking up contiguous fuels (such as connected MPB-affected stands) through harvesting
5. Reforesting with species that tend to be less flammable (such as aspen)
6. Ensuring that coarse woody debris is not contiguous
7. Clearing fuels from the base of wildlife trees (dead snags can be hazardous to workers during wildfires and controlled burns)
8. Working with communities to achieve fuel management treatments identified in Community Wildfire Protection Plans

Landscape solutions leading to local actions

Landscape fire management can further mitigate the impacts of extreme wildfire events and associated losses of communities, critical infrastructure and natural resource values. Landscape fire management of provincial forests would supplement community fire management initiatives that are applied within 2 km of municipal lands.

The objective of landscape fire management is to stop the development of extreme "mega" fires by creating landscape-level fuelbreaks. A number of steps can be followed to accomplish this. The steps include using computer models to assess wildfire risk and threat[41]; analyzing the options available to land and fire managers; and creating landscape-level fuelbreaks that are contiguous and linear in pattern.

Linear landscape-level fuelbreaks can be created by targeting particular forests to harvest and modifying forest management practices. The targeted forests may be

[41] Parisien et al. 2005.

adjacent to human developments that are more fire-resistant (e.g., roads, golf courses, and agricultural fields) or natural areas that cannot burn (e.g., water bodies) or tend to be less flammable (e.g., wetlands, avalanche paths, talus slopes, and alpine areas)

Often, even simple management actions such as widening road right of ways or realigning cut block patterns can have significant beneficial effects for mitigating extreme wildfire behaviour.

These activities can also support creation of local employment, provide harvest opportunities, and protect mid-term timber supply. Landscape fire management can support other key programs such as ecological restoration and the emerging biofuel economy in British Columbia.

Outcomes and implications

Within and around communities, there are significant benefits to providing short-term wildfire protection while individual Community Wildfire Protection Plans are being implemented. Based on the progress to date, it will take many years for communities to catch up with the backlog of needed fuel treatments.

The benefits of investing in fuel management include avoiding or reducing costs created by increasing demands to protect assets and maintain public safety. Importantly however, the level of investment and the choice of actions may significantly affect the amount of time it will take to achieve these economic and social benefits.

Evidence provided by the wildland fire science community (both within British Columbia and elsewhere) indicates that wildfire costs and impacts will escalate, especially in the event of extreme fire seasons. In British Columbia, if the doubling of burned area over the next 25 years is allowed to materialize, it is reasonable to expect that the negative impacts will more than double. With expanding areas of Wildland-Urban Interface and wildland development, economic losses (e.g., homes, businesses, and community infrastructure) will increase disproportionately.

In British Columbia, risks to lives will also increase, although it is hoped that when wildfires threaten, the practice of early evacuation will help to avoid the fatalities encountered in Australia, Europe and the U.S.

Accountability for what happens in the future will be attributed to those who start fires, those with responsibility for wildland fire management, and those managing lands and communities where wildland fires occur.

Over the past decade, increasing firefighting costs and negative impacts and risks to firefighters and public justify a shift in response from <u>all</u> stakeholders. The expected escalation of an increased threat adds urgency to the situation. By supporting land and fire management that focuses on wildfire prevention and mitigation, the province will restrain rapidly escalating fire-suppression costs, economic damages, and social disruptions from wildfires.

Communities and local fire departments will benefit from the Strategic Wildfire Prevention Initiative and FireSmart and Structure Protection Units programs. There is strong evidence that that the 200+ Community Wildfire Protection Plans and implemented fuel reduction treatments have had a measureable effect on wildfire behaviour and threats to structures.[42] As well, proactive communities can benefit from establishing bylaws that promote FireSmart principles for any new development, thus addressing future challenges.

Wildland and fire professionals will benefit from landscape fire management planning

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[42] Ministry of Forests, Lands and Natural Resource Operations 2013.

and by taking appropriate actions. Benefits include reduced risks to assets landscape (e.g., investments in infrastructure, forest plantations, intensive silvicultureal treatments) and reduced liability for fire-related damages to communities, the public and workers.

From recent wildland fire experiences and current science, the key lesson is that prudent measures are needed to prepare for the future. Wildfire organizations have some of the capability for dealing with escalating wildfire conditions, but it is essential that land managers and communities make a concerted and consistent effort to prepare for wildfires. Without such measures, Canada will be subject to increasingly frequent wildfire disasters and unnecessary escalating costs, economic losses, social disruptions, and risks to the public.

References

Arno, S. and K. Sneck. 1977. A method for determining fire history in coniferous forests of the mountain west. U.S. Forest Service, General Tech. Report GTR-INT-042. http://www.fs.fed.us/rm/pubs_int/int_gtr042.pdf (Accessed Aug 10, 2013).

B.A. Blackwell and Associates Ltd., R.W. Gray Consulting Ltd., Compass Resource Management Ltd., and Forest Ecosystem Solutions Ltd. 2003. Developing a coarse scale approach to the assessment of forest fuel conditions in southern B.C. Submitted to Natural Resources Canada, Canadian Forest Service. http://www.bablackwell.com/fii-report.pdf (Accessed Aug. 10, 2013).

Barrett, S. and S. Arno. 1988. Increment-borer methods for determining fire history in coniferous forests. U.S. Forest Service General Tech. Report GTR-INT-244. http://www.fs.fed.us/rm/pubs_int/int_gtr244.pdf (Accessed Aug 10, 2013).

Burton, P., C. Messier, D. Smith, and W. Adamowicz (editors). 2003. Towards sustainable management of the boreal forest. National Research Council, NRC Research Press.

Canadian Interagency Forest Fire Centre. 2006. http://www.ciffc.ca/index.php?option=com_frontpage&Itemid=1 (Accessed Aug. 10, 2013).

Canadian Wildland Fire Strategy Assistant Deputy Ministers Task Group. 2005. Canadian Wildland Fire Strategy: A vision for an innovative and integrated approach to managing the risks. Prepared for the Canadian Council of Forest Ministers. http://www.ccfm.org/pdf/Vision_E_web.pdf (Accessed Aug. 10, 2013).

City of Chilliwack, B.C. 2011. A bylaw to require development approval information, Bylaw No. 3815. http://www.chilliwack.ca/main/attachments/Files/363/BL%203815%20Development%20Approval%20Information%20Bylaw%203815%20-%20Tracked%20July%202013.pdf (Accessed Aug. 11, 2013).

Filmon, G. 2004. Firestorm 2003: Provincial review. Prepared for the Government of B.C. http://bcwildfire.ca/History/ReportsandReviews/2003/FirestormReport.pdf (Accessed Aug. 10, 2013).

Flannigan, M., B. Amiro, K. Logan, B. Stocks, and B. Wotton. 2005. Fires and climate change in the 21st century. Mitigation and Adaptation Strategies for Global Change 11(4): 847-859. http://link.springer.com/article/10.1007%2Fs11027-005-9020-7 (Accessed Nov. 7, 2013).

Gillett, N., A. Weaver, F. Zwiers and M. Flanagan. 2004. Detecting for the effect of climate change on Canadian forest fires. Geophysical Research Letters 31(18): L18211, doi:10.1029/2004GL020876.

http://onlinelibrary.wiley.com/doi/10.1029/2004GL020876/abstract;jsessionid=C616C0A2F81E030C9FA2A90787E84095.f03t02 (Accessed Aug. 10, 2013).

Gorte, R. 2013. The Rising Cost of Wildfire Protection. Headwaters Economics, Research Paper. http://headwaterseconomics.org/wphw/wp-content/uploads/fire-costs-background-report.pdf (Accessed Nov. 14, 2013).

Government of B.C. *Emergency Program Act.*

Government of B.C. *Forest and Range Practices Act.*

Government of B.C. Government Actions Regulation.

Government of B.C. *Wildfire Act.*

Grant Thornton LLP. 2004. Incremental economic/financial impacts of the 2003 forest fires in B.C. Prepared for the Government of B.C.

Gude, P., A. Cookson, M. Greenwood, and M. Haggerty. Homes in wildfire-prone areas: An empirical analysis of wildfire suppression costs and climate change. Headwaters Economics.

Hvenegaard, S. 2012. National wildland fuels management survey. FPInnovations, Contract Report CR 729.

Institute for Catastrophic Loss Reduction. 2012. Telling the weather story. Prepared for the Insurance Bureau of Canada. http://www.ibc.ca/en/natural_disasters/documents/mcbean_report.pdf (Accessed Aug. 10, 2013).

Ministry of Forests. No Date. The Sayward Forest – Past to Present. Forest Practices Branch. http://www.for.gov.bc.ca/hfp/publications/00137/saytext.htm (Accessed Aug. 10, 2013).

Ministry of Forests. 2001. Forest inventories for 1957 and 2000. Resources Inventory Branch.

Ministry of Forests and Range. 2009. 2009/10 Service Plan. Government of B.C.

Ministry of Forests and Range. 2010. B.C. Wildland Fire Management Strategy. Wildfire Management Branch. http://bcwildfire.ca/prevention/PrescribedFire/docs/BCWFMS.pdf (Accessed Aug. 10, 2013).

Ministry of Forests, Lands and Natural Resource Operations. 2012. Forest Stewardship Action Plan for Climate Change Adaptation (2012–2017). Resource Stewardship Division and Tenures, Competitiveness and Innovation Division. http://www.for.gov.bc.ca/ftp/HFP/external/!publish/ClimateChange/Adaptation/MFLNR_CCAdaptation_Action_Plan_2012_final.pdf (Accessed Aug. 10, 2013).

Ministry of Forests, Lands and Natural Resource Operations. 2013. Wildfire Management Branch.

Ministry of Forests, Mines and Lands. 2010. The State of British Columbia's Forests – Third edition. Forest Practices and Investment Branch. http://www.for.gov.bc.ca/hfp/sof/2010/SOF_2010_Web.pdf (Accessed Aug. 10, 2013).

Ministry of Labour, Citizens' Services and Open Government. 2011. B.C. Population Projections 2011-2036. BCStats. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/PopulationProjections.aspx (Accessed Aug. 10, 2013).

National Roundtable on the Environment and the Economy. 2011. Paying the price: the economic impacts of climate change for Canada. Climate Prosperity Series Report 04. http://coastalchange.ca/download_files/external_reports/NRTEE_(2011)_%20ClimateProsperity_1.pdf (Accessed Aug. 10, 2013).

Nitschke, C. and J. Innes. 2008. Climatic change and fire potential in south-central British Columbia, Canada. Global Change Biology 14(4): 841–855.

Parminter, J. 1995. Human influence on landscape pattern in the Pacific Region: impacts of burning by First Nations and early European settlers. In Proceedings of the Pacific Division, American Association for the Advancement of Science 76th Annual Meeting of the Pacific Division. Program with Abstracts - Volume 14, Part 1: 13 pages. http://www.for.gov.bc.ca/hre/pubs/docs/aaas.pdf (Accessed Aug 11, 2012).

Parisien, M., V. Kafka, K. Hirsch, J. Todd, S. Lavoie, and P. Maczek. 2005. Mapping wildfire susceptibility with the Burn-P3 Simulation Model. Canadian Forest Service, Northern Forestry Centre, Information Report NOR-X-405. http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/25627.pdf (Accessed Nov. 14, 2013).

Perrakis, D., R. Lanoville, D. Hick, S. Taylor, N. Lavoie, and R. Kubian. Report in progress. Recent observations of fire behaviour in mountain pine beetle-affected forest stands in British Columbia, Canada. Ministry of Forests, Lands and Natural Resource Operations.

Reed, W. and D. Errico. 1986. Optimal harvest scheduling at the forest level in the presence of the risk of fire. Canadian Journal of Forest Research 16(2): 266–278.

Taylor, S. and G. Thandi. 2003. Development and analysis of a provincial natural disturbance database. Natural Resources Canada, Pacific Forestry Centre, Annual Operational Report, Forestry Innovation Investment, Reference #RO-28.

Van Wagner, C. 1983. Simulating the effect of forest fire on long-term annual timber supply. Canadian Journal of Forest Research 13(3): 451–457.

Walton, A. 2012. Provincial-level projection of the current mountain pine beetle outbreak: Update of infestation projection based on the provincial aerial overview surveys of forest health conducted from 1999 to 2011 and the B.C. mountain pine beetle (year 9). Ministry of Forests, Lands and Natural Resource Operations, Forest Analysis Branch.

Westerling, A., H. Hidalgo, D. Cayan, and T. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfire activity. Science 313: 5789: 940–943.

Westfall, J. and T. Ebata. 2011. Summary of forest health conditions in British Columbia (2010). Ministry of Forests, Mines and Lands, Pest Management Report No. 15.

Wong, C., B. Dorner, and H. Sandmann. 2003a. Estimating historical variability of natural disturbances in B.C. B.C. Ministry of Forests and B.C. Ministry of Sustainable Resource Management, Land Management Handbook 53. http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh53.pdf (Accessed Aug. 10, 2013).

Wong, C., H. Sandmann, and B. Dorner. 2003b. Historical variability of natural disturbances in B.C.: A literature review. FORREX–Forest Research Extension Partnership, FORREX Series 12. www.forrex.org/publications/forrexseries/fs12.pdf (Accessed Aug. 10, 2013).

Referenced internet resources

Community Wildfire Protection Plans. https://ground.hpr.for.gov.bc.ca/cwpps.htm

Ecosystem Restoration Initiative. http://www.for.gov.bc.ca/hra/Restoration/index.htm

FireSmart program. http://www.embc.gov.bc.ca/ofc/interface/index.htm

Future Forest Ecosystems Initiative. https://www.for.gov.bc.ca/HFP/future_forests/

Incident Command System. http://www.env.gov.bc.ca/eemp/resources/icsintro.htm#13

Private Power Watch. http://www.ippwatch.info/w/

Provincial Strategic Wildfire Prevention Initiative. http://www.ubcm.ca/EN/main/funding/community-safety/strategic-wildfire-prevention.html and http://fness.bc.ca/forest/provincial-strategic-wildfire-prevention-initiative/

Special Committee on Timber Supply. http://www.leg.bc.ca/timbercommittee/

Structure Protection Units. http://www.ubcm.ca/EN/main/services/structural-protection-units.html

INTRODUCTION

As a result of climate change; new fuel types created by the mountain pine beetle (MPB) infestation; and, increasing urban development, it is expected that wildfire threats to communities and natural resource values will increase significantly. The cost of wildfire suppression is also rapidly increasing and resources available to respond are consistently being challenged. Suppression costs were approximately $500 million in 2003, $400 million in 2009 and over $200 million in 2010. 2009 was a record for the most wildland urban interface (WUI) fires (213); and 2010 set a record for the most area burned in one fire season (330,000 ha). Altering forest management practices, to prevent or mitigate the impact and severity of wildfires in areas that have been designated as high risk (probability and consequence), can be an effective means of proactive wildfire management. Resource activities have the potential to directly affect the fire environment by adding, removing, or altering fuel characteristics on the landscape. They can increase or decrease the amount of fuel; change the composition and arrangement of fuel which can impact both the development, spread and intensity of a forest fire.

Successful wildfire management goals require an integrated approach where the risks of wildland fire are fully recognized and considered in resource management decisions at all levels. By integrating wildfire, forest and resource management planning; values at risk across the landbase and communities will benefit through the mitigation of large scale, high intensity, and high severity wildfires. Without increased proactive management to break up fuel continuity and loading, wildfire spreads between landscapes, communities and the WUI easier and with negative effects. In addition, when multiple fire situations occur across BC, and WMB's suppression capability is fully utilized, not all values will be protected. Government will be forced to prioritize values; it is not possible to protect them 100% of the time. It is fundamental that both the managed and passive or "unmanaged" landbase be taken into account when considering wildfire management objectives and other applicable policy and legislative changes. Ongoing challenges related to MPB fuel types, and Climate Change mean that forest management has to be aligned toward a clearly identified forest state that is interwoven with wildfire objectives.

The variability of ecosystem types, wildfire behaviour and history, values at risk, and resource management practices across BC results in a multitude of policy challenges that affect the development wildfire resilient landscapes over the long term. Currently there is no comprehensive suite of policy and legislation tools available that will lead to the development of resilient landscapes. Additionally, at times there is conflict occurring between current resource management policy and wildfire management; such as the lack of identified areas where the goal of maximizing timber production through necessitating fully stocked sites in drier fire dependent ecosystems could be superseded by an objective to restore mixed fire regime ecosystems. As a result it is difficult for Delegated Decision Makers (DDMs) to balance competing resource uses, manage potential conflicts, and optimize wildfire mitigation opportunities. Options that will provide onsite and landscape level flexibility are the most effective policy regime. This requires a shift towards the integration of wildfire considerations into most aspects of resource management in BC. The successful implementation of Landscape Fire Management Planning

(LFMP) is also required to identify landscape risks and threats. The overall goal of this document is to assess how the current BC legislative, regulatory and policy framework could be modified with initial recommendations and options.

Table 1: Summary of Actions and Options

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Pages 261 through 278 redacted for the following reasons:
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WILDFIRE MANAGEMENT BRANCH
Fire and Fuels Management Program

Communications Plan

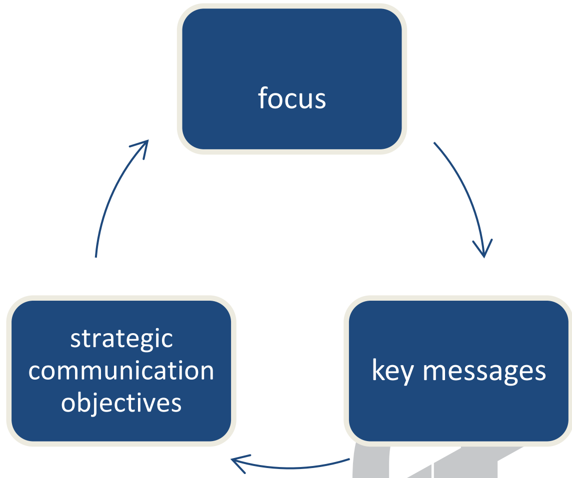
2013

To educate and promote internal and external audiences about Fire and Fuel Management program goals

BRITISH COLUMBIA

Contents

Background



In 2013, the Wildfire Management Branch (WMB) developed the Fire and Fuel Management Communication Strategy. The purpose of this document was to pull together various communications planning strategies for fire and fuel management in WMB and to clearly define each program's focus, key messages, strategic communication objectives, and how they related to each other. These programs include FireSmart in B.C., the Strategic Wildfire Prevention Initiative (Fuel Management), and Landscape Fire Management Planning.

The Fire and Fuel Management Communication Plan 2013 is the implementation of the WMB Fire and Fuel Management Communication Strategy for the 2013-2014 fiscal year, and sets out an operational guide for moving the strategy forward with the WMB Communications Working Group. Currently, internal communications for WMB Fuel and Fire Management Planning programs are achieved through reports from the Wildfire Leadership Team (WLT), Fire Centre Leadership teams, the WMB Strategic Plan 2012-2017, and the fire management planning and fuel program staff. This communication plan is intended to produce a coordinated communication delivery.

Historically, external fire and fuels management communication objectives are achieved by WMB staff interacting with the public and stakeholders. Information officers with WMB also utilize public and media interest in current fire activity to disseminate pre-existing key messages, and also use other public communication tools (newsletters, social media, etc.) to promote local fuel management activities and FireSmart information.

Communication goals outside the above process are through website links (WMB, Union of BC Municipalities UBCM, and First Nations Emergency Services Society FNESS, and FireSmart Canada), local government and community meetings, through key message or backgrounder sheets. Interested staff can view updated messaging, and use them as needed to support internal and external communications.

There are currently three key message sheets that cover FireSmart initiatives: construction, landscaping, and protecting your community. These are co-authored by the Provincial Fire Information Officer(PFIO) and the Deputy Fire Commissioner of the Office of the Fire Commissioner (OFC). There are four key message sheets that cover fuel management: fire hazard in northern B.C. impacting First Nations, fuel management and prescribed burning, and beetle kill. These are co-authored by the fuels management superintendent, Government Communications and Public Engagement (GCPE), and the PFIO. There is one key message sheet that covers fire management planning. Due to this, communication content varies depending on the staff and local concerns. This is both its strength and weakness.





The purpose of this communication plan is to provide yearly communication goals for fuel and fire management staff and WMB Information Officers, which will help to achieve the long term vision in the Fire and Fuel Management Communication Strategy.

Strategic Alignment

Two strategic goals are supported through this communication plan, which identifies WMB as leading the implementation for wildfire management, and communication to public and staff.

- Lead the implementation of the B.C. Wildland Fire Management Strategy through wildfire management planning and practices to achieve our mission.
- Ensure that Wildfire Management Branch directions, expectations and actions are clearly communicated and understood, both internally and externally .

Communication Objectives for 2013

Long term communication objectives are outlined in the Fire and Fuel Management Communication Strategy. The following communication objectives have been selected for 2013.

1. Increase awareness about the long-term benefits of the proactive management of wildland fire (all audiences).
2. Increase awareness of a comprehensive fire and fuels management strategy in place to assist all people who live in B.C., in mitigating the risk and impacts of wildfire to themselves, and to help understand how they can get involved to further mitigate risk and the impacts of wildfire to their community and province (all audiences).
3. Build a common understanding of wildfire terms, wildfire trends, and the relevance of this to our partners, clients, and stakeholders (primary audience).
4. Raise the profile of fuel and fire management, and FireSmart and their initiatives (secondary audience).

Target Audience for 2013

An extensive audience list has been developed in the Fuel and Fire Management Communication Strategy. For 2013, the following audience groups have been targeted to achieve the communication objectives. The primary audiences are those most directly linked to and/or affected by fuels and fire management principles. The secondary audiences are those responsible for supporting initiatives.

Primary audiences

- Homeowners and businesses in Wildland Urban Interface areas
- First Nations Communities, Municipalities and Regional Districts that have Wildland Urban Interface areas
- Ministry of Forests, Lands and Natural Resource Operations (FLNRO) key Branches

Secondary audiences

- Agencies responsible for supporting fire and fuels management initiatives (Ministry of Environment)

Communication audiences

Following is a list of audiences that have a vested interest in fire and fuels management initiatives. Each require information about these initiatives, and various groups will be involved to provide input, guidance, decision making, and to provide support to further program objectives and communication goals.

	Who	Responsibility	Interests
1	FLNRO Deputy Minister and FLNRO and WMB managers; Ministry of Justice, Officer of the Fire Commissioner	Provides input and feedback; guidance, advice and support to initiatives. Approves deliverables. Communicates planning and implementation information to staff in business areas. Reviews status, progress and interdependencies and gives direction.	• Program objectives • Communication objectives • Status of initiatives • Milestone accomplishments • Cross-organizational dependencies and/or linkages • Issues • Key decisions
2	WMB, FLNRO, OFC staff involved or supporting initiatives	Communication to program level stakeholders.	• Program objectives • Communication objectives • Status of initiatives • Linkages into job duties • Milestone accomplishments
3	Participating B.C. governmental agencies and staff, and other governmental agencies	Integrating fire management planning and fuel management principles into business practices. Participation in initiatives and projects.	• Program objectives • Communication objectives • Milestone accomplishments • Status of initiatives
5	Assisting agencies	Coordinating messaging and supporting initiatives	• Program objectives • Communication objectives • Milestone accomplishments
6	Natural resource business and professional stakeholders	Impact of fire management planning and fuel management principles on business interests	• Program objectives • Communication objectives • Milestone accomplishments
7	Public groups	Impact of fire management planning and fuel management principles on personal property and business interests	• Program objectives • Communication objectives • Milestone accomplishments
8	Communications groups	Communications experts to provide expertise and facilitate communication objectives. Provide issues management advice. Disseminate information and promote communication opportunities.	• Program objectives • Communication objectives • Status of initiatives • Milestone accomplishments • Cross-organizational dependencies and/or linkages • Issues • Integration of key messaging to maximize impacts • Key decisions

Key Messages for 2013

These messages are derived from the more detailed Communication Strategy. They provide context to specific priority areas of education and engagement (for example: Prescribed Fire and Modified Response benefits).

Challenges

1. Pressure on wildfires suppression capabilities is increasing along with increased development (residential and industrial) on the forested lands base – the highest public values are often located in the highest risk areas.
2. Fire is a natural and essential part of ecological processes of B.C. forest and range lands, and fire suppression may result in unintended consequences for these ecosystems (e.g., increased fuel loading resulting in larger more intense fires).
3. Wildfire intensity varies based on fuels, weather and topography. People have the ability to alter fuels. High intensity wildfires are costly and difficult to control, and cause the most damage to homes, communities, and values (e.g. infrastructure and timber). Lower intensity wildfires are easier and less costly to control, cause less damage to homes, communities and values and may provide additional l benefits to keeping forests healthy in fire dependent ecosystems.
4. Climate change research indicates the incidence and severity of wildfires will increase over the next few decades.
5. Recognizing the need to address the potential presence, threats and benefits of fire during the land use planning process is the most effective and efficient means of integrating fire into resource management decisions.
6. Wildfires are a natural and reoccurring activity within forested lands
   a. Excluding fire from forests may results in unhealthy forests of reduced bio-diversity.
7. Past Forest management practices including decades of fire suppression has created the current fuel management challenges that we now face. These challenges will not be solved quickly. It will take a large degree of cooperation, planning and funding to address these challenges.
8. The expansion of urban and rural development into wildland areas has increased the risk of human caused wildfires. This increased wildfire risk results in increased threats to property, human safety, and air quality.

FireSmart

1. Applying FireSmart concepts within your neighbourhood will result in less property damage, less impact to business, and make your community more resilient to wildfire.
2. Funding for community wildfire protection plans and fuels management projects in interface areas have increased for 2013.
3. FireSmart initiatives will make a real difference if a wildfire approaches your home or cabin.
4. Neighbours helping neighbours will help keep everyone's homes or cabins safe this summer.
5. The FireSmart program is an initiative focused on reducing the risk of wildfire around homes and communities.

a. Applied FireSmart principles are the single biggest reason homes survive or do not survive wildfires.
b. Supporting and undertaking FireSmart initiatives will result in communities being more resilient to wildfire.
c. Communities benefit when they adopt programs of interface fire awareness and work together on effective preventative solutions.
d. A FireSmart Canada initiative also supports the implementation of the FireSmart Canada Community Recognition Program in 2012. This recognizes good work being accomplished in communities across B.C.

    https://www.firesmartcanada.ca/https://www.firesmartcanada.ca/firesmart-communities/community-recognition-program/

e. Participation in FireSmart Canada community recognition programs could have a positive impact on local tourism, by promoting FireSmart environments in communities.

Fuel Management Program

1. Fuel management projects are being conducted across the province. For example, WMB fire crews have been extended at times to help with fuel management treatments.
2. In 2006, the Ministry created a Forestry License to Cut, a new type of tenure to facilitate fuel management. This tenure provides more flexibility to manage high-risk forest fuels identified by local Community Wildfire Protection Plans.

Fire Management Planning Program

1. Success of this initiative requires participation from all levels of FLNRO including tenures, pricing, stewardship, and regional operations in partnership with First Nations and Forest Industry.
2. Regional Districts, communities, parks and protected areas, as well as forests with high timber values can benefit from a landscape fire assessment.
3. Landscape fire planning and management benefits include;
    a. Reduced risk of impacts from fire to communities, public and private infrastructure,
    b. Reduced risk of high severity fires and subsequent damage to community watersheds, water sources, range grasslands, and associated infrastructure, and
    c. Reduced risk of damage to high value timber and loss of silviculture investments (spacing, pruning, and fertilization treatments).
4. Wildland fire is oblivious to administration, land ownership and jurisdictional boundaries.

Benefits of Prescribed fire and Ecological Beneficial fire

1. Prescribed Fire and Ecological Beneficial Fire are planning tools used by the Land Manager to designate areas where fire is beneficial on the landscape.
2. The use of fire as a land management tool will provide for a vibrant, healthy forests that are more resilient to the negative impacts of wildfire.
3. Supporting efforts to rejuvenate B.C.'s forests through planned fire and managed wildfire, will result in forests which are returned to more natural fire pattern on the landscape.

a. Prescribed fire events take place normally in the spring and fall to allow for better control to meet the objectives, reduce the risk of escape, and have fewer impacts on general public than a wildfire would in the summer.
b. Prescribed fires are exempt from the Ministry of Environment's venting legislation, but practitioners should mitigate the effects of smoke from prescribed burns

The use of fire as a land management tool will provide vibrant, healthy forests that are more resilient to the negative impacts of wildfire.

4. Land managers recognize the need for fire on forested lands, and are working actively with the WMB to achieve their goals through the use of prescribed and ecological good fires.
   f. Prescribed fires are fires that are set by professionals to meet local land management objectives.
      i. These fires are extensively planned by professional collaboration between local land managers and fire experts.
   g. Ecological good fires are fires which occur in areas where the Land Manager has designed fire is ecologically good to meet the land management objectives in a given area.
      i. These fires are usually unplanned ignitions that are managed for predefined objectives.
      ii. Examples of these areas that are being managed could be: wildlife habitat, ecosystem restoration, natural fire regimes or traditional use areas.

Modified Response

1. The Modified Response decision-making process is used by wildfire operations/ response staff to alter fire response from full suppression to a more balanced approach of managing wildfire.
   a) A fundamental assumption of this process recognizes that the modified response wildfire areas can accommodate free burning fires for an extended period and that resulting fire will meet land based objectives.
      i. When wildfires occur, the WMB consults with local land managers as soon as possible during initial response.
      ii. If it is possible to modify the fire response to meet local land manager's goals, while at the same time protecting first responder and public safety and other values that might be at risk, a Fire Analysis will be developed to manage the fire within certain criteria.

Strengths, weaknesses, opportunities and threats (SWOT)

Strengths	Weaknesses
• Fuels management initiatives and the FireSmart program are well represented in the WMB strategic plan and are supported corporately. The strategic plan also stresses the need for strong communication to the public, and re-emphasises the need for wildfire risk and mitigation communication initiatives. • The Superintendent of Fuels Management has strong linkages with partners, stakeholders and clients. This provides a wealth of communication tools involving FireSmart initiatives, reference materials and best practices. • Each Fire Centre has a Fuels Management Specialist, who is well informed of provincial level initiatives, via conference calls and e-mail discussions. • Communications undertaken by local Fire Centre and Zone staff reflect local concerns and issues, and are therefore relevant to local public interest and concerns. • Each Fire Centre has an Information Officer in the summer, who is responsible for communications to the media and public about WMB programs and activities. Information Officers are aware of the location of the key message sheets in the library, and these are utilized as needed during media interviews, if there are local fires or concerns regarding project work.	• WMB zone staff wear 'multiple hats', and communication to other staff about fuels management initiatives are dependent upon opportunity, workload, and participation in fuels management project work. • Communication to Fire Centre staff is fragmented and inconsistent throughout the province. • Local messaging to the public is dependent upon staff's involvement and interest in a particular fuels management project, and the engagement of the Information Officer in the project. This varies from Fire Centre to Fire Centre. • Overarching communications goals have not been delivered to staff in a coherent manner. • Communication topics within this document have multiple interested parties, each with their own competing issues. Coordination can be problematic.

Opportunities	Threats
• Development of an annual internal and external communication plan will provide a yearly focus of key messages, and coherence of messaging. • Further, this communication plan will provide strong coherent messages to the public, outlining the benefits of supporting thoughtful, professional fuel and fire management activities. It will allow for cross-program communication initiatives, and could further raise the profile of WMB as the professional voice of fuels management initiatives. • Development of a provincial level internal communication venue to engage middle management, fire centre and zone staff that do not have access to leadership team meetings will enhance internal communications. • Support and assist with public educational programs that involve fuels management / FireSmart objectives. • Develop an evaluation method to assist WMB communications staff with polished messaging for maximum impact.	• Inability to gather timely information of fuels management projects and initiatives (both leading up to and during the event). • Inadequate information staffing during the winter (planning) months in three Fire Centres that contain a high percentage of fuels management initiatives, which limits IO involvement in communication planning. • Lack of provincial staffing to undertake a provincial level communication venue to engage staff in fuels management and other program areas. • Lack of funding for advertising and promotion of fuels management initiatives.

Strategies

1. The Provincial Fire Information Officer (PFIO) will seek approval from WLT, and then implement an internal staff newsletter for 2013. The contacts below will insure the content in the newsletter contains timely and topical content to support the fuel and fire management program goals.
2. The PFIO will utilize fire management planning and fire management content in planned public communication, including social media (Facebook, Twitter), and news releases.
3. Develop communication tools, such as brochures, newsletters and websites for distributing fuel and fire management information and messaging.

Tactics

Tactic	Details / steps	Responsible	Timing
Develop: WMB Fire Management Planning Embedded Page	Preliminary concept approval sought: WMB; GCPE (FLNRO); GCPE (MoJ)	WMB Kelly Aly Couch	Nov 1, 2013
	Funding sought for website development	WMB Kelly Osbourne	May 1, 2014
	Story Board draft submitted to group for approval	WMB Aly Couch	May 15, 2014
	Finalized story board to website developers	WMB Aly Couch	Jun 1, 2014
	Website roll out	WMB Aly Couch	Oct 1, 2014
Outreach Strategy for Fire and Fuel Management Plans, Landscape Level	Develop coordinated communications strategy for FMP landscape level and discussing options for Fire Mitigation for the Landscape Fire Management Planning pilots	WMB Aly Couch Kelly Osbourne GCPE (FLNRO Vivian Thomas GCPE (MoJ, EMBC, OFC) Julianne McCaffrey	Apr 1, 2014
	Produce communication plan for 2013.		Apr 1, 2014
	Provide support for local Fire Mgmt Planning Tables to occur in the various regions. Identify and outline local level key players, their roles and the process for information gathering, sharing and consultation.	WMB Ed Korpela Dana Hicks Kelly Osbourne	Jul 31, 2014 for the Pilot areas
	Develop strategies, presentations and materials for information sharing.	WMB Kelly Osbourne Aly Couch GCPE (FLNRO) Vivian Thomas	ongoing
	Hold community meetings, public outreach sessions and audience specific meetings as required.	WMB Ed Korpela Dana Hicks Kelly Osbourne	April 2014 for Pilot areas
Create "Best Management Practices (BMP) papers	Develop BMP for Fuel Mitigation Treatments and Fuel Management Stocking Standards Guidance from current Research Project. Create Standard Operating Procedure for FMP that can be posted on public website. Target for one or two in 2014.	WMB FMP Group Dan Perrakis	Two by Apr 1, 2014
Articles and	Submit articles, and develop presentation	WMB Lyle Gawalko	Ongoing

Presentations	materials for various forestry and fire management conferences and trade shows. EX include NSC, CSC, Sic, ABCFP AGM, and Western Wildfire Conferences.		(lead and assign as required) Aly Couch (consultation)	
Create a brochure ready for distribution during high fire risk	Introduce and summarize fire management strategy. Current situation (problem) benefits (solution), funding, and plans for moving forward (Way Ahead). Program components, committees, role of stakeholders, and the public. Used for distribution at events, tradeshows, conferences etc.	WMB	Kelly Osbourne Aly Couch	Ongoing 2013 - 2014
Create FLNRO and broader Multi – Agency Newsletters / Program Updates / Highlights	Provide information to groups linked to above document. Provide timely and meaningful program updates.	WMB	Kelly Osbourne Aly Couch (deliver & report)	Report: Nov 30, 2013
	WMB Fuels Mgmt staff to develop distribution lists for communications.	WMB	Peter Hisch Aly Couch	Preliminary list: May 1, 2013
	Collaborate to utilize opportunities presented by projects to highlight public education and understanding.	WMB	Kelly Osbourne Aly Couch (deliver & report)	Report: Nov 30, 2013
Create Media Releases for Fire & Fuel Management Planning projects	Work with GCPE to announce significant funding and achievements with FMP Landscape and key partnerships with Industry, Fuels Mgmt and/or BCTS to modify fuel.	WMB GCPE (FLNRO)	Aly Couch Lyle Gwalko Vivian Thomas	As required/ requested
Increase profile with WMB staff: meetings	Attend regional mgmt team meetings, staff conference calls. Discuss issues; solicit feedback; direct staff. Report to FMWG.	WMB	Fire Management Planning staff Fuels Management Working Group	Report: Nov 30, 2013
Plan and hold multi program area briefings / meetings	Identify key staff from Ministry program areas (Regional Operations, Fire Centers and Zones, and HQ) and hold annual briefings / one day meetings to review program success to date, opportunities for Improvement, standards, and new program initiatives. Hold monthly conference calls with program staff. Report to FMWG.	WMB	Fire Mgmt staff Fuels Management staff	Apr 1, 2014
Develop file sharing location	Build SharePoint site for FMP that is accessible to FLNRO staff with links policy and procedures, current FMP, and the Information data base access point for GIS.	WMB WMB GIS	Fire Mgmt staff Jennifer Naylor	April 1, 2013
Build on success	Develop review process to continue to build partnerships, internally and externally.	WMB	Kelly Osbourne Peter Hisch Aly Couch	Annual report: Jan 31, 2014 Comm Plan yearly by Apr 1

Evaluation

The PFIO will provide a report of fire and fuel management internal and external communications activities for 2013 by December 31, 2013. This report will include delivered key messages, their timing and delivery methods and audiences reached.

The PFIO will assist the Fire and Fuel Superintendents to develop a feedback tool to check for understanding of delivered messaging, and look for improvements for future staff communications.

Contacts

Wildfire Management Branch
• Wildfire Fire Mgmt Planning Forester, Kelly Osbourne • Fuels Management Superintendent, Peter Hisch • Provincial Fire Information Officer, Aly Couch • Fuel Geomantics Analyst, Jennifer Naylor
Ministry of Justice
• Fire Commissioner, Rebecca Denlinger
Union of BC Municipalities
• Policy & Programs Officer, Local Government Program Services, Danyta Welch
GCPE
• Communications Manager, FLNRO, Vivian Thomas • Communications Manager, Ministry of Justice (OFC + EMBC), Julianne McCaffrey

FIRESMART PLANNING AND PRACTICES ASSESSMENT

MFLNRO WILDFIRE MANAGEMENT BRANCH

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Executive Summary

B.A. Blackwell and Associates Ltd. (B.A. Blackwell) were retained by the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) Wildfire Management Branch (WMB) to complete an assessment of current FireSmart Planning and Practices within British Columbia (BC) and abroad, including a comprehensive review of fire policy across Canada, the United States (US) and Australia.

The review found that despite all three of these countries having world-class fire suppression organizations heavily supported by substantial human and financial resources, wildfires throughout these countries are increasing in size (area burned), severity, and damages to property and other important resource values. This project attempts to compile a comprehensive list of large wildfires within Canada, the US and Australia to demonstrate the trends in resources allocated (suppression costs) and the associated fire losses (including human lives).

All of the factors that contribute to wildfires (including ignitions sources, fuel types, and development, in combination with a variable and or changing climate) have created an alignment of factors likely to promote more frequent, larger, and more damaging fires that have the potential to threaten properties and people.

British Columbia is leading Canada, and is in step with both the US and Australia, in trying to tackle this large and difficult problem. Since the publication of the Filmon report in 2004 the Province has taken major steps to develop Community Wildfire Protection Plans (CWPPs), develop a mapping tool to assess wildfire risk to communities, initiate a fuel management program on crown land, and work with communities to promote FireSmart principles. While these are considered sound achievements there is still lots that can and should be done.

In our review of fire management planning to protect interface communities it is evident that interface wildfires are a problem that continues to grow and all jurisdictions reviewed are challenged with this. Various models and approaches have been applied in the three countries reviewed; however communities in these countries are consistently:

1. documenting fuel hazards through inventory,
2. completing Community Wildfire Protection Plans,
3. implementing fuel management treatments, and
4. promoting the principles of FireSmart.

There is a significant divergence in approaches around more stringent development regulation in hazardous wildfire areas. In both Australia and the US, some state governments have developed legislation that restricts development in hazardous areas with the intent of limiting losses from wildfire.

In BC, many local and regional governments have participated in the Strategic Wildfire Prevention Initiative (SWPI) through the Union of BC Municipalities (UBCM) by completing CWPPs and undertaking small-scale fuel treatment projects. The Province of BC has been actively developing fuel type inventory and has developed a Provincial scale risk assessment to identify communities at risk. However, following CWPP development, many communities have lacked resources and/or the political will to move beyond the planning phase. While the Filmon report tried to promote engagement of local and regional governments through a cost-shared model, it has generally not affected the level of change to address the fire problems communities' face in BC.

Regional governments are further challenged by unincorporated communities with small dispersed populations that are typically more exposed to hazardous fuels and associated wildfire risk. Regional governments are mandated to provide local funded services and when an issue like wildfire does not fit within part of the service profile there is limited ability for a Regional Government to fund and resource something like wildfire protection of the interface. The Regional District of Central Kootenay (RDCK) is currently studying this issue and looking at its ability to fund an effective, long-term program.

The next logical step in wildfire management policy in BC should be to enforce a comprehensive and consistent standard of development in high hazard wildfire zones of the Province – similar to both flood plain and geotechnical hazard areas. [redacted] s.13, s.17

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1 Introduction

B.A. Blackwell and Associates Ltd. (B.A. Blackwell) were retained by the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) Wildfire Management Branch (WMB) to complete an assessment of current FireSmart Planning and Practices within British Columbia (BC) and abroad. The focus of the assessment is on BC; however comparisons to other jurisdictions are included, and policies and practices successful in achieving wildfire mitigation strategies that protect communities from widespread damage from fire are documented.

British Columbia has experienced a number of severe wildfire seasons over the last decade (2003, 2004, 2009, and 2010). These fires destroyed more than 300 homes and businesses and caused evacuations of more than 50,000 people. The overall suppression cost of these three fire seasons was 1 billion dollars and the overall economic losses associated with these fires was at a minimum two times the suppression costs (Impact DataSource, 2013). The most extensive fire damage occurred in 2003 within the City of Kelowna, where 238 homes were destroyed and more than 33,000 people were evacuated.

The long-term effects of fire suppression and resulting increase in landscape level fuel loadings have been well documented in BC (Blackwell et al. 2003, Forest Practices Board, 2006, Ministry of Forests, Lands, and Natural Resource Operations, 2010). Fire suppression has been a long-standing and, in general, extremely effective policy in BC. While suppression is necessary in areas where fire is likely to endanger human life and property, there is a conflict between this policy and the natural environment. This conflict is particularly critical in fire-prone ecosystems because fuel builds up in the forest over time. Without frequent, low-severity fire, the fuel load continues to increase rather than being reduced naturally by fire. If an ignition occurs after a long period of fuel build up and when weather conditions have allowed the forest fuels to dry sufficiently, then a high severity (high tree mortality) fire occurs. High severity fires tend to have much more extreme fire behaviour and are more difficult to control. Due to their severity, these fires have negative consequences for both humans and the environment.

Our historic response to wildfires has been focused on minimizing area burned, suppression cost, property loss, and resource damage while maintaining public and firefighter safety. These measures have been the basis for our evaluation of fire management success. This strategy implies that our resource capacity can be increased to a limitless level with increasing values at risk. In reality, our experiences with severe wildfire seasons have demonstrated that both our human resource and economic capacity is limited, and it is becoming increasing difficult to suppress all wildfires and protect values at risk.

While strategic fuel reduction activities on public land in Canada will substantially decrease the risk of extreme wildfire behaviour, it will not eliminate it. In order to effectively reduce risk in the Wildland Urban Interface (WUI), these actions must be complemented by mitigation activities on private forested land, around individual homes and on structures. To achieve tangible success, policy at all levels of government needs to support these activities. For the purposes of this report, policy is defined as a statement based on beliefs or intentions that are used to rationalize a course of action or inaction.

Our future focus must be to maintain adequate suppression resources, while increasing effort on developing both preventive and protection measures related to the policy and design of our communities. Our adoption of FireSmart, for individual home protection, is a stepping stone to broader and more widely applied policy and legislation that mandates communities are safe from wildfire.

2 Objective

The scope of this assessment is focused on FireSmart planning practices for the WUI which can be employed proactively:

- By local governments (municipalities, regional districts) and/or community organizations, neighbourhoods or individual property owners;
- At the community and site scale (as opposed to landscape level); and
- With the greatest effect limiting the impacts of wildfire on communities and properties in the interface.

3 Scope

This report is intended for use by the Province of BC for an analysis of, and consultation on the options to build, support, and maintain fire-adapted communities throughout BC.

4 Terms

Over the last 100 years, large wildfires have impacted human settlements on continents throughout the world, including Asia (China, Indonesia, Japan, Israel, and South Korea), Australia, Europe (Germany, Greece, Italy, France, Poland, Portugal, Russia, and Spain), North America, and South America. Since the early 1980's, the number, area burned and losses associated with WUI fires have been increasing.

This review focuses primarily on policy in countries with similar political and socio-economic profiles to Canada. This is because the WUI problems and potential solutions identified in these countries, namely the US and Australia, were thought to be more applicable to the Province.

4.1 Wildland Urban Interface Background

The classical definition of WUI is the place where the *"forest meets the community"*. Other configurations of the WUI can be described as intermixed. Intermixed areas include smaller, more isolated developments that are embedded within the forest. An example of an intermixed interface is shown in Figure 1. In each of these cases, fire has the ability to spread from the forest into the community or from the community out into the forest. Although these two scenarios are quite different, they are of equal importance when considering interface fire risk. Within the City of Kelowna, the probability of a fire moving out of the community and into the forest is equal or greater to the probability of fire moving from the forest into the community. Regardless of which scenario occurs, there will be consequences for the City and this will have an impact on the way in which the community plans and prepares for interface fires.

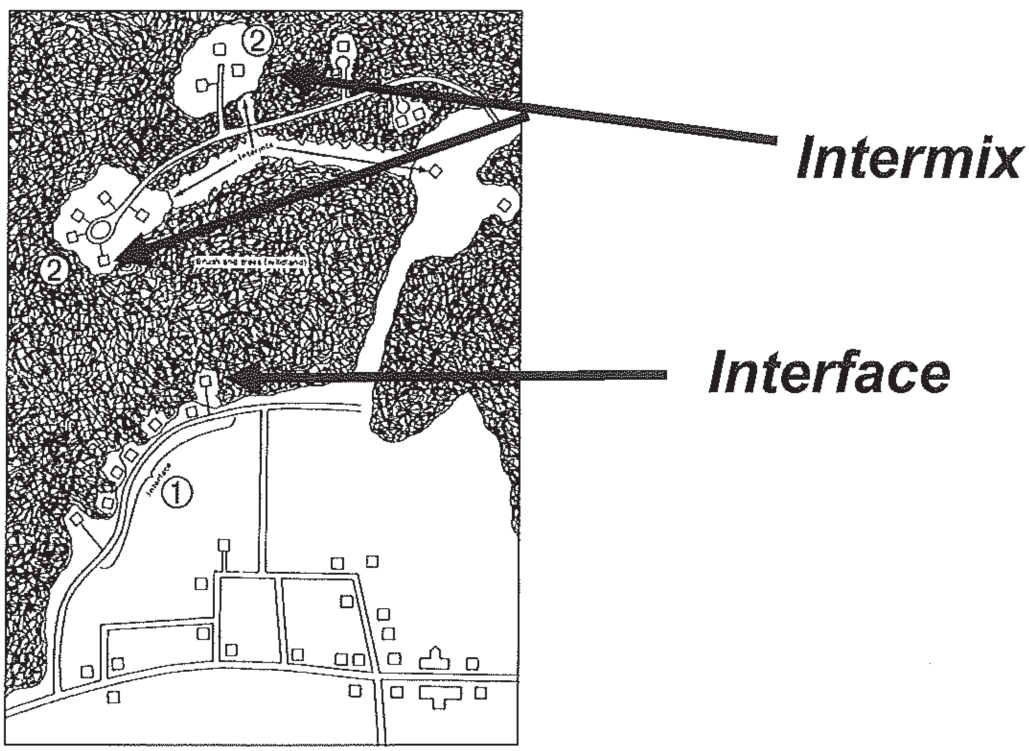

Figure 1. Graphical example showing variation in the definition of interface.

4.2 Definition of the Issue

The Institute for Catastrophic Loss Reduction (ICLR) (2009) has reported that in an average year in Canada, 2.5 million hectares are burned by 8,500 individual wildfires, with the area burned varying widely from year to year. The ICLR highlighted that the majority of wildfires are human caused (approximately 60%), and the remainder are caused by natural events (i.e., lightning strikes). Furthermore, ICLR states that wildfires pose a significant risk to life and property in Canada and although monetary damages from wildfires have historically been lower when compared to other climate and hydrologic hazards, wildfires are one of the most commonly reported disasters in Canada. According to the Canadian Disaster Database, a total of 49 wildfire disasters have been reported since 1900, and is the second most common natural hazard following flooding.

4.2.1 Number and Values of Properties Lost or Exposed

The number and value of properties lost to wildfire has been increasing in Canada, the US, and Australia over the last two decades. Losses from fires in the three countries have been summarized in Table 1. The Table documents the name, area burned in hectares, date, numbers of fires, estimated costs, reported losses, evacuations, and fatalities. This information has largely been summarized from Wikipedia (Wikipedia, 2013) and data was supplemented by searches of numerous other internet, news reports and publications. While there is conflicting information about the size, costs (suppression and losses), and structure losses in general, the information provides valuable insight into the trends in wildland urban interface (WUI) fires over the past two decades and allows for comparisons of large damaging wildfire events. The largest most damaging events include the following:

- **Slave Lake-Alberta (2011)** - the most devastating wildfire in Canada with 374 properties destroyed at a total cost of $1.8 billion (suppression and estimated losses in 2011 dollars).
- **Oakland Hills –California (1991)** the most damaging and deadly wildfire in the US with 25 fatalities, 3354 homes and 437 apartments destroyed at a total cost reported at $2.5 dollars for suppression and losses (estimated in 2006 dollars) (Keeley, 2009).
- **Black Saturday Bushfires – Australia (2009)** the most damaging and deadly wildfire season on record in Australia with 174 fatalities, 400 injuries, destroyed 2298 homes, with 11,800 livestock killed. The area burned during the 2009 season reached 450,000 ha and the total recorded damages were $4.5 billion.

One of the most telling observations is that some of the costliest fires have been associated with a relatively small area burned. For example, the total area burned in the Oakland Hills wildfire was only 620 ha yet the damages exceeded $1.5 billion (1991). Similarly the area burned in the Slave Lake wildfire was less than 5,000 ha where damages exceeded $1.8 billion (2011 dollars). This suggests that the proximity of a wildfire and the associated values at risk are a more important driver in evaluating the risk to public safety and property. Research by Morton et al. (2003) emphasized that the wide variability in wildfire related impacts is dependent on location, severity, and length of the fire.
Similar to wildfire costs, property losses are highly variable ranging from no structure losses for a large fire greater than 700,000 ha (Alberta 2009 – Richardson wildfire) to 3,354 structures in the Oakland Hills

wildfire. No single fire event comes close to the losses associated with Oakland Hills, California; however the Black Saturday wildfires in Australia burned 450,000 ha over the fire season and destroyed 2,298 structures. Similarly the 2007 October wildfires in California resulted in an area burn of 400,000 ha and over the course of the fire season 2,180 homes and 922 outbuildings were destroyed. Most recently the Bastrop wildfire in Texas resulted in 1,691 destroyed.

4.2.2 Community Infrastructure Lost

Wildfires frequently damage infrastructure, including highways, communication facilities, power lines, and water delivery systems. Restoring basic services often results in significant restoration costs after a fire.

The only comparative study documenting infrastructure losses in the US were for the Florida wildfires of 1998 and San Diego wildfires in 2003. Researchers found that infrastructure losses only accounted for 1% of the total losses. Total losses for business and community impacts were 31% and 61% respectively (Diaz, 2012). Similarly, infrastructure losses in Australia have been documented for four large fire seasons 1) 2009 Black Saturday fires 2) 2006-07 Great divide fires, 3) 2005-06 Grampians fire, and 4) 2003 Alpine fires where infrastructure losses as a percentage of total losses were 5%, 0%, 0% and 3% respectively, with dollar values measured as $140, $0, $0, and $84 million.

One of the most significant direct impacts of a wildfire can be to municipal water supply, and this may occur through contamination of ash and debris during the fire, destruction of aboveground delivery lines, and soil erosion or debris deposits into waterways post-fire. Long-term water managers may be required to deal with water supply impacts, including rehabilitation and slope stabilization, and additional water treatments required to address changes in water quantity and quality. In 1996, the Buffalo Creek fire burned approximately 4,900 ha and in 2002 the Hayman fire (largest fire in Colorado's history) burned an additional 56,000 ha. These two fires were followed by significant rainfall events that resulted in greater than 765,000 m^3 of sediment accumulating in the Strontia Springs Reservoir. The increased sediment resulted in operational challenges, caused water quality issues and clogged downstream treatment facilities. Denver Water spent $26 million to address problems associated with water quality treatment, sediment and debris removal, and watershed reclamation and infrastructure projects. Additionally, the U.S. Forest Service has spent $37 million on restoration and stabilization treatments. The combined impacts of these two fires cost more than $63 million to address the associated environmental damage (Denver Water, 2013).

Damage may also occur to utilities and communication infrastructure. Following the 1998 wildfire season, Florida facilitated repairs to its damaged electrical and communication network by increasing sales tax across the 16 counties impacted by the fires. Total revenue raised through this taxation levy to repair the damages exceeded $43 million. The San Diego fires in 2003 resulted in significant electrical distribution damage that included loss of 3,200 utility power poles, 400 miles of wire, 400 transformers, and damage to 100 other pieces of related utility equipment. The total economic impact of the 2003 San Diego fires on utilities infrastructure was $147.3 million.

The Texas fires in 2011 resulted in documented damages to ranch and industry infrastructure which represented the largest portion of fire losses. Fencing losses alone were estimated at $60 million (Texas AgriLife Extension Service, 2011).

Overall, our research and ability to find documented exposure and losses to community infrastructure for Canada was limited. Similar to accounting for total losses associated with wildfires, there are few published studies that incorporate this information. Certainly in BC there have been some substantial infrastructure losses associated with the 2003, 2009, 2010, and other wildfire seasons including damage to transmission lines and substations (various locations in 2003), watersheds (Lillooet 2009), and fencing infrastructure associated with the ranching community (Williams Lake 2010). Documented infrastructure losses in other parts of Canada include the Hydro Quebec shutdowns affecting delivery of power to over 500,000 customers for an extended period when the fire was too close to transmission lines (Government of Canada, 2003).

It is well recognized that there are increasing infrastructure risks, particularly to oil and gas development in BC and Alberta. Recently the author conducted an overview flight of oil sands developments in Central Alberta that were embedded in high risk fuel types. Within an area of approximately 100 km^2 there were six Sag-D plants, each valued at approximately $800 million. Each plant produces approximately 100,000 barrels of oil per day representing approximately $10,000,000 of economic output per day. These types of oil and gas facility pose an extreme evacuation threat as there is typically one road in and out, and are vulnerable to complete shutdown from smoke and/or a wildfire threatening the plant. The combined values at risk in this situation (human life and property) are larger than any suppression agency has had to address in the past and consequences of large fires around these facilities could be catastrophic to the economy.

In a study conducted in 2012 for a large utility in Alberta, B.A. Blackwell researched the wildfire risk profile of four different size communities in Alberta. These communities were all embedded in heavily forested area of Alberta and were all associated with the utilities electrical grid. The results of the study demonstrated that tax assessed property values for the four communities could be summarized as follows:

- Town of Slave Lake: $796,561,273
- Town of Whitecourt: $1,480,742,425

- Regional Municipality of Wood Buffalo (including Fort McMurray): $35,115,251,168
- Town of Fox Creek: $223,500,000

The Town of Slave Lake was included to validate the values and the wildfire risk based on historic ignitions, fuel types, spotting, and fire behaviour after the fire of 2011. The insured property losses were estimated at $700,000,000 which is close the assessed tax assessed values. This did not include the impacts to business interruption (availability, reliability and consequence of property damage) which can only be classified as substantial.

4.2.3 Suppression Costs

Firefighting is one of the most expensive aspects of forest management in Canada, where approximately $400 to $800 million is spent annually by provincial/territorial governments and the federal government on forest fire fighting, including fire suppression, prevention and prescribed burning (ICLR 2009). The Natural Resources Canada (NRC) website states that fire suppression costs over the last decade in Canada have ranged from about $500 million to $1 billion a year (NRC, 2013). Table 1 provides a summary of the recorded suppression costs for large fires in Australia, US, and Canada. These costs are highly variable, but what is apparent from the data is it is not uncommon for large fires to exceed $10's of millions on any given fire, and expenditures by these countries have exceeded more than a billion dollars per fire season during extreme years.

Overall, for the countries reviewed in this report the number of large fires (described by area burned) and complex fires (described by high values at risk) have been increasing, and the associated wildfire suppression costs are also increasing.

The three major drivers for increases in wildfire costs, as documented by the Wildland Fire Leadership Council (2004) are:

- Climate
- Fuels
- Social changes

Changing climate, fuel accumulations and the expansion of the wildland urban interface have all been well documented in the literature. Each of these elements makes a unique and fire specific contribution to the costs of fire suppression. Climate, fuels, and human development patterns are all aligning to form ideal conditions for increasing numbers of large damaging wildfires.

The Office of Policy Analysis (2012) in the US outlined that the combination of US disaster relief from government agencies such as FEMA combined with below market private insurance, served to reduce individual responsibility for fire risk reduction and this was also a contributing factor in increasing fire suppression costs.

4.2.4 Deaths and Injuries

The only details that could be gathered on deaths and injuries related to wildfires came from research on large fires listed on Wikipedia, and associated reports, publications and media links on the internet. There was no comprehensive documentation of wildfire related fatalities and or injuries summarized in a comprehensive publication or in the public accounts. Often the number of fatalities and or injuries was conflicted between different reports. Considering this, high level trends were identified that are considered valuable within the context of this report.

Deaths and injuries from wildfires were highly variable throughout the major wildfire incidences reviewed. Certainly, the highest number of civilian related fatalities occurred in the Australia Black Saturday bushfires of 2009 where 174 people were killed and 400 hundred people were injured. According to wildfire statistics, more people have been killed or injured in bushfires in Australia compared to the US and Canada. Seventy-five people were killed in the Ash Wednesday bushfires in 2003 and 62 people were killed in the Tasmanian bushfires in 1967. The large number of deaths in Australian bushfires can largely be explained by the fire environment where extremely high rates of spread occur within a very volatile fuel type complex.

In the US, the Oakland Hills wildfire resulted in the largest number of fatalities reported at 25 for the period of record reviewed. Two other fires 1) the 1994 South Canyon wildfire (Colorado) and 2) 2003 Cedar Creek wildfire (California) resulted in 14 and 15 deaths respectively. The South Canyon wildfire (otherwise known as Storm King Mountain) fatalities were all fire fighters who were trapped in the fire.

In Canada, there were no recorded civilian deaths for the list of fires reviewed. However, there have been nine recorded fatalities since 2003, associated with wildfires and specifically related to aircraft. These include (from "Line of Duty Death", 2013):

- 2003- three lives lost fighting BC wildfires
- 2006 – an Ontario pilot killed fighting wildfires in Northern Alberta
- 2007 – a Quebec pilot fighting fires in Alberta
- 2009 – a helicopter pilot fighting a fire near Lillooet, BC
- 2010 - two pilots killed on a tanker drop near Boston Bar, BC

4.2.5 Size of Populations at Risks

CoreLogic, a financial and real estate company that provides data analytics information has some of the best information on the number of properties at risk within the US. The company has collected or converted (from a boundary on a paper map to a digital outline) data on more than 131.2 million properties in the US, representing more than 97% of the total properties in the country. Their analysis has shown that approximately 40% of the 115 million single family homes in the US (as of 2008) are located within the WUI (Botts et al., 2012).

The company's research has highlighted that between 1990 and 2008, there were close to 17 million new homes built in the US, of which 10 million were constructed in the WUI. They suggest that while the large majority of these homes would be classified as 'urban' due to their location within an urban setting, there is a strong likelihood that homes in the WUI may have a higher wildfire risk due to their proximity to high-wildfire-risk zones. The company website highlights that the number of homes that have been destroyed in recent years has increased dramatically. They attribute this increase in homes destroyed to an increase in residential development in the WUI.

Analysis completed by CoreLogic reveals the potential for property damage to 13 western States, extending from Washington to Texas, and from Montana to California. The company's 2012 wildfire analysis concludes that more than 740,000 residences in the western US are currently rated in the High or Very High Risk categories. The value of those structures is estimated at more than $136 billion. Narrowing the evaluation to just homes in the Very High Risk category, there are just under 168,000 residences with a combined value of more than $32 billion.

A comparison of properties at risk for wildfire in individual western states revealed that the states most commonly associated with wildfires also contain the most properties at risk. They highlighted California, Colorado and Texas as having the largest number of properties categorized as Very High Risk.

CoreLogic additionally highlighted six US cities with the highest wildfire risk profiles which are:

- Los Angeles, California
- San Diego California
- Boulder Colorado
- Albuquerque New Mexico
- Austin Texas
- Salt Lake City Utah

4.2.6 Insurance Losses

Historically, wildfire events have infrequently resulted in large insurance payouts. Only one severe wildfire event is listed in the Insurance Bureau of Canada (IBC) Facts Books, from 1983 to 2008: The 2003 BC wildfire season, where $200 million in insured damages were incurred (IBC, 1998; 2008). However, the Public Safety Canada (PSC) Canadian Disaster Database reports 49 wildfire events that have resulted in damages, from 1911 to 2005 (PSC, 2007). Many of these events have required the evacuation of a large number of residents, and have resulted in considerable damages to infrastructure and private property (ICLR 2009).

The Institute for Catastrophic Loss Reduction (2009) reported internationally, that wildfires do not result in the same level of damages as other natural hazards, including flooding, windstorms and earthquakes (Munich Re. 2006). Similarly in the US, insured damages from wildfires are generally exceeded by other natural and human-caused hazards. Though other hazards have resulted in greater damages, the costs of wildfire damages are still considerable. For example, there have been several damaging fire events in the US in the past 40 years. Four of the events, when adjusted to 2007 dollars, resulted in insurance payouts of over $1 billion each. Further, the Witch Fire of 2007 resulted in the 5th highest insured loss event for a natural catastrophe in the world that year (Insurance Information Institute, 2008).

4.2.7 Socio-Economic Impacts

In assembling information on wildfire socio and economic impacts, it became apparent there was limited data available that allowed for a full assessment of the cost of WUI wildfires. For the majority of fires, suppression costs were available, however other costs and economic data was typically not reported.

Wildfire impacts, specifically interface fires, have broad social impacts that go well beyond the costs of suppressing the fire. These can include:

- Damage to watersheds and water supply
- Damage to public recreation facilities
- Evacuation of adjacent communities
- Tourism impacts
- Damage to timber resources
- Destruction of cultural and archaeological sites
- Costs of rehabilitation and restoration
- Alteration of wildlife habitat
- Public health impacts
- Transportation Impacts

As discussed, costs depend on location and severity of the fire, and wildfires often have impacts that extend beyond the specific time of the fire. Human health, tourism disruptions, wildlife habitat alteration, and watershed impacts are only a few of the potential impacts that could persist well beyond the year of the fire.

Specifically, the Western Forestry Leadership Coalition (2010) categorized costs as 1) direct, 2) indirect, 3) costs associated with rehabilitation, and 4) additional costs. Direct costs are those associated with the suppression of the fire and relate costs associated with aviation, fire-fighting, and emergency support services. Indirect costs are usually those associated with the long-term losses, including business and tourism losses, lost tax revenues, devaluation in property values and long-term site degradation associated with severe fire behaviour. Rehabilitation is associated with restoring, re-vegetating, and or long-term treatments required to stabilize slopes and or slope stability in sensitive watersheds. Additional costs are typically those that are difficult to quantify for example loss of life, loss of ecosystem services, and or impacts to visually important landscapes.

In the few studies that attempt to quantify the complete costs of large wildfires to society, they report that suppression represents only a fraction of the true costs. Of the six largest fires studied by the Western Forestry Leadership Coalition (2010) they found that total costs ranged from two to 29 times greater than suppression costs. For the six fires included in the study, the fire estimated to have the greatest ratio of total costs to suppression costs (with total costs 29 times the suppression cost) took place in New Mexico – the Cerro Grande fire in 2000. Across all case studies, the ratio of total costs to suppression costs was 12.7. The study outlined that suppression costs accounted for only 7.9% of the total wildfire costs while nearly 39% of the costs were attributed to other direct costs such as private property losses (insured and uninsured), damage to utility lines, damage to recreation facilities, loss of timber resources, and aid to evacuated residents. Most of these costs were incurred during or immediately following the fire.

The results of the Western Forestry Leadership Coalition (2010) are consistent with the wildfires summarized in Table 1, where quantified total losses for property, evacuations and other values were multiple times greater than suppression costs alone.

An Australian study (Stephenson, 2010) comparing losses from five large fire seasons (1983 Ash Wednesday fire, 2003 Alpine fire, 2005-06 Grampians fires, 2006-07 Great Divide fires, and the 2009 Black Saturday fires) quantified values including: 1) residential buildings and contents, 2) commercial buildings and contents, 3) park buildings contents and infrastructure, 4) agriculture (stock, feed, crops, buildings, and fencing), 5) timber, 6) emergency response operations, 7) fatalities, 8) injuries, 9) equipment, and 10) environment. It is worthy to note that each of the five fire years had distributions of loss that were different from one another. For example, the great losses for the Ash Wednesday fires were represent by residential buildings and contents (45%), the Alpine fires by timber (50%), and the Grampians fires by environment (71%).

Stephenson (2010) concluded that when accounting for bushfire losses a number of specific impacts contribute to high value losses and that more efforts should be made to mitigate these losses. Specifically the study highlighted human lives, ecosystem services, agriculture, and timber as values that required special attention. While these results are specific to Australia, the study results highlight that agencies managing wildfire should be more concerned with economic values impacted beyond the fire suppression activities.

4.2.8 Policy and Practices

This review focuses primarily on policy in countries with similar political and socio-economic profiles to Canada. This is because the WUI problems and potential solutions identified in these countries, namely the US and Australia, were thought to be more applicable to BC. Canada, the US and Australia are all experiencing increased growth in the WUI, negative consequences of long-term fire suppression and increasing costs associated with wildfire. These three countries' existing mechanisms for dealing with increased wildfire risk are similar, as are their vulnerabilities.

None of the literature reviewed indicated that any jurisdiction had been successful in completely solving the WUI problem. However, it is unrealistic to expect that wildfire risk could be completely mitigated in any interface community. There is intrinsic wildfire risk associated with living in the WUI because, by definition, interface is human development within a matrix of forest fuels. However, there are also intrinsic amenity values associated with interface that compel people to live in the WUI despite the wildfire risk. The same is true for people who, for example, choose to live in flood prone and earthquake prone areas. The challenge for communities located in 'at-risk' areas is to be adequately prepared so that, when a disturbance event occurs, their risk is reduced such that their chance of survival is maximized

While strategic fuel reduction activities on public land in Canada will substantially decrease the risk of extreme wildfire behaviour, it will not eliminate it. In order to effectively reduce risk in the WUI, these actions must be complemented by mitigation activities on private forested land, around individual homes and on structures. To achieve tangible success, policy at all levels of government needs to support these activities. For the purposes of this report, policy is defined as a statement based on beliefs or intentions that are used to rationalize a course of action or inaction.

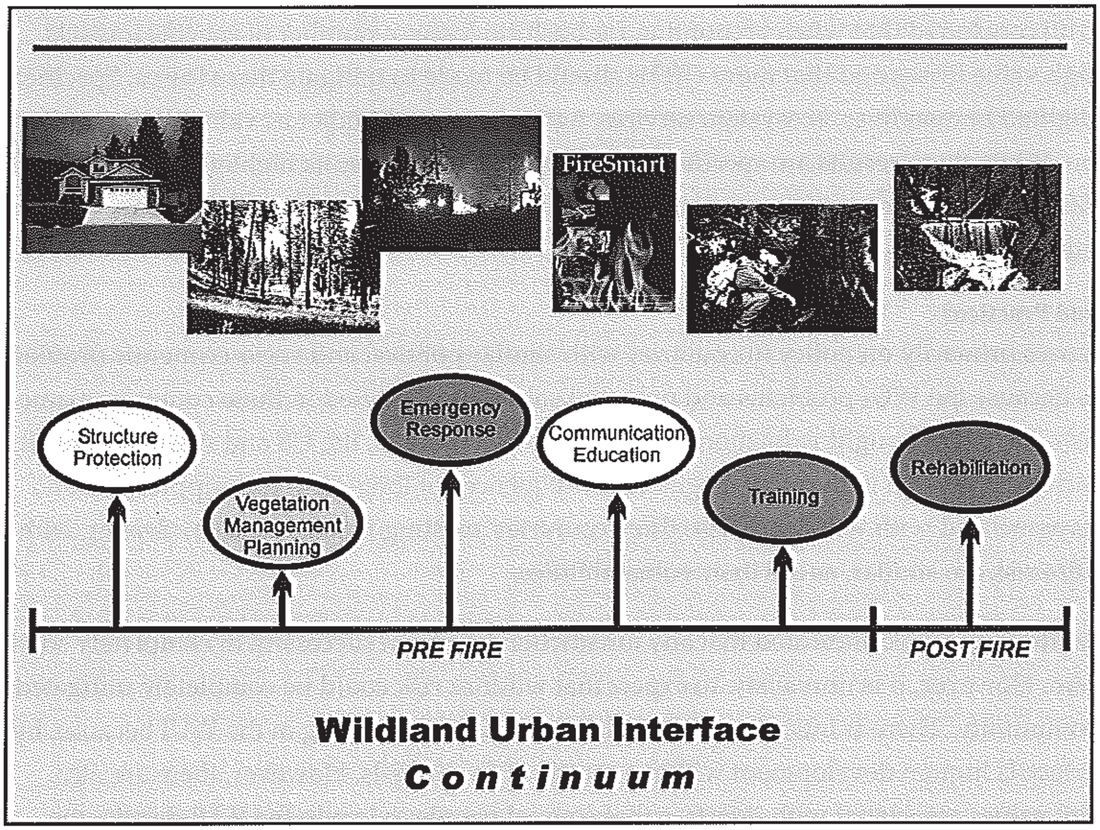

Figure 2. Wildland urban interface continuum.

The appropriate management response to a given wildfire risk profile is based on the combination and level of emphasis on several key elements: communication and education, training, emergency response, structure protection, and vegetation management. For example, in an interface area with a high-risk profile, equal weight may be given to all elements. Alternatively, in this same high-risk example, active intervention through vegetation management may be given a higher emphasis. This change in emphasis is based on the values at risk (consequence) and level of desired protection required. In a low risk situation the emphasis may be on communication and education combined with emergency response and training. In other words, varieties of management responses in different jurisdictions and/or within the same jurisdiction are appropriate and can be defined by the wildfire risk profile.

Historically, policy relating to wildfire in Canada, the US and Australia has primarily consisted of fire suppression under all circumstances. This policy has been, for the most part, extremely successful; however, it has generated a legacy of problems for today's interface communities. These problems consist of the increased fire hazard associated with decades of fuel build-up and a widely held negative view of fire in the environment. The challenge for policy makers now, and in the future, will be to develop and implement policy that takes an integrated approach to mitigating wildfire risk, rather than a unilateral 'suppress all fires' approach.

Australia and some States, such as California, have implemented building policies that restrict building design and define the types of external materials used in construction in order to reduce the ignitability of buildings (Australian Standard AS3959, 1999; California Department of Forestry and Fire Protection, 2005). In Australia, several problems were identified with these approaches when applied at the national level, including inconsistent development outcomes, inconsistent site assessment using different processes, and compromised policies due to commercial pressure (Zillante and Hamnett, 2005; Cottrell and Lowe, 2005). There is a great deal of evidence to support the use of more fire resistant building materials and the development of policies that implement their use (Dombeck et al., 2003; Bradshaw, 1988; Leonard and Bowditch, 2003). However, it is important that policy supports well-defined, consistent and tested standards for hazard mapping and hazard assessments so that communities are not subject to overly restrictive or inadequate building requirements.

In Australia, fire risk mapping at the federal level determines where the AS3959 standard for building in bushfire areas applies. However, experience has led to calls for system reforms that require mapping to occur at a local scale and be updated on a regular basis. Due to the costs associated with performing a mapping analysis, Zillante and Hamnett (2005) recommended that the frequency of mapping updates be based on the extent of changes over the previous period. In other words, if the mapping boundaries remained largely the same between the first and second mapping analysis, the period of time between the second and third mapping analysis could be lengthened. A coarse scale (federal or provincial) mapping exercise is not appropriate for determining where building regulations will apply within a municipality because it is likely to over- or under-state the risk in some areas.

Much of the literature has discussed the need to not only focus on changes such as building codes and bylaws, but to also consider the values of the specific interface community where the policies are to be implemented. Permanent and seasonal residents, absentee landowners, industry, visitors and public land management agencies share both wildfire risk and the consequences of a wildfire event (Winter and Fried, 2000). Therefore, policies need to address this broad stakeholder group. A number of authors note that the success of wildfire risk mitigation policy is dependent on collaborative partnerships between the stakeholders affected by wildfire in an interface community (Talberth et al., 2005; Dale, 2006; Nelson et al., 2005; Bradshaw, 1988; Cohen, 1988). In general, public attitudes can vary widely with geographic location, past experience, residency status, residential choice factors, length of residency, environmental knowledge, trust in land management agencies and mitigation effects on adjacent homeowners (Blanchard and Ryan, 2004). A number of studies have found that people tend to perceive "others" or "nature" as the primary contributors to wildfire risk and prefer policies that shift the responsibility for wildfire risk mitigation to government authorities (Winter and Fried, 2000; Kumagai et al., 2002; Leonard and Bowditch, 2003). However, other studies have found that people consider the reduction of wildfire risk to be a joint responsibility and are willing to take voluntary action to reduce their risk (Winter and Fried 2000). Local government policy should be tailored to the values of the specific community to which it applies.

Emphasis has also been placed on the need for different levels of government (municipal, provincial and federal) and individual landowners to work together in order to successfully reduce their risk (Dombeck et al., 2003; Dale, 2006; Winter and Fried, 2000). Considering fire does not recognize property or government boundaries, actions taken within one boundary, if not complemented and supported by actions 'next door', are likely to fail. Provincial governments affect what types of policies are possible at a municipal level through legislation. Private landowners and industry, through values held and perceptions of risk, determine whether a municipal policy can be successfully implemented. For example, people who value the aesthetic and conservation aspects of their surrounding forested environment are unlikely to support a policy that requires them to clear their property of all trees. This kind of policy could also result in slope stability hazards. While some tree removal is likely warranted to reduce wildfire risk in most communities, policy must be designed to ensure that it is implemented in an appropriate way. When designing policy, it is important to be aware of all stakeholder values and activities so that policies will not fail when implemented, or have unforeseen long-term consequences.

There are two types of wildfire safety regulations most commonly used by local governments: Type 1) regulations that restrict the use of fire; and Type 2) regulations that restrict building materials, require setbacks or restrict zoning. Generally, homeowners find the first type of regulation more acceptable because the onus is on the individual to refrain from high fire risk behaviours for the common good (Winter and Fried, 2000). The second type of regulation imposes restrictions on the choices people can make about the placement and aesthetic qualities of their homes. It is potentially challenging to convince people that Type 2 regulations are beneficial, particularly when full insurance is available. However, other jurisdictions (Australia and California) have adopted Type 2 regulations because their risk reduction benefits outweigh their unpopularity (Australian Standard AS3959, 1999; California Department of Forestry and Fire Protection, 2005).

Several Type 2 policy options are generally available to local governments. These primarily include:

- Voluntary fire risk reduction for landowners (building materials and landscaping)
- Bylaws for building materials and subdivision design
- Covenants requiring set-backs and vegetation spacing
- Site assessments that determine the imposition of fire protection taxes

- Education
- Zoning in fire prone areas
- Treatments on private and public land (commercial thinning, non-commercial mechanical thinning, clear-cut commercial harvesting or prescribed burning)

According to a study by Winter and Fried (2000), homeowners most prefer voluntary, preventative mechanical vegetation treatments at the landscape scale and educational policies. Least favoured were coercive strategies that required homeowners to change aspects of their properties and prescribed burning.

Policies must strive to ensure that the cost of wildfire risk reduction is shared fairly between residents so that there are no cases of some people enjoying a reduction in risk at no cost, while others are constrained but do not receive any benefit. Winter and Fried (2000) also state that: "wildland fire management is a non-excludable public good in that it is a service that must be provided to everyone living in the WUI if it is provided to anyone".

Blackwell and Needoba (2006) describe in detail the focus of current policy measures as they impact wildfire risk and the effectiveness of these policies. Key areas that are currently the focus of policy makers across jurisdictions reviewed include;

- Structure Ignitability
- Fuel Mitigation on Public and Private Land
- Sub-Division Design
- Community Surveys on Wildfire
- Subdivision Considerations
- Management of City Parks and Green Spaces

The development of communities with lower risk from wildfire requires a combination of policies that encourage defensible space and discourages development outside existing urban growth boundaries and subdivisions. Regulatory approaches that would achieve these goals are challenging for local governments to enact as they typically restrict or constrain development. Policy tools such as zoning and/or covenants are often controversial as they burden developers with additional costs. In the US the focus has been on enacting legislation that encourages counties to prepare plans that would reduce wildfire problems and, in some cases, clarifies that counties can legally deny subdivisions that do not mitigate or avoid threats to public health and safety from wildfire.

Wildfire covenants have been in place to deal with new developments and subdivisions. Covenants that have been applied to new developments and require wildfire risk reduction measures have been difficult to apply and enforce due to lack of authority and budget for enforcement of risk reduction measures. Additionally the covenant approach requires long-term monitoring to ensure that the covenant applies to changing vegetation and environmental conditions over time.

The ICLR has identified that local governments bear the most direct and severe impacts of disaster events. It is local governments that provide the first responders, are directly involved in reconstruction and have experienced direct damage to infrastructure and must deal with the loss of lives and property (Reddy, 2000). As well, many of the most effective hazard mitigation tools are applied at the local level, including local building code by-laws, public education programs, and land-use planning practices (Steelman, 2007).

Since municipalities control development patterns through bylaws and zoning they have the ability to effect the greatest change on where and what type of housing is built within a hazardous area of the community. Municipalities and regional districts must take a more active role in controlling development in hazardous areas within their jurisdiction.

Table 1. Summary of wildfires in Australia, United States and Canada, and the associated losses.

Country	State/Province	# of Fires	Year	Name	Suppression Cost ($)	Damage Cost ($)	Total Losses ($)	Area Burned (ha)	Homes Lost	Structures Lost	Fatalities	Other
Australia		Multiple	1851	Black Thursday	None reported	None reported	None reported	5,000,000	None reported	None reported	12	N/A
Australia		Multiple	1939	Black Friday	None reported	None reported	None reported	2,000,000	1,300	69 sawmills; 3,700 buildings	71	N/A
Australia		Multiple	1955	Black Sunday			4,000,000	None reported			2	N/A
Australia		Multiple	1961	Western Australian Bushfires	None reported	None reported	None reported	2,000,000	None reported	None reported	0	900 injured; 7,000 homeless
Australia		Multiple	1967	Tasmanian fires	None reported	None reported	None reported	264,000	None reported	None reported	62	
Australia		Multiple	1980	Ash Wednesday			34,000,000	3,770	51	25 buildings	0	40 injured; 150 homeless
Australia		Multiple	1983	Ash Wednesday - South Australia and Victoria	770,500,000	176,000,000	946,500,000	520,000	2,545	N/A	75	8,000 evacuated
Australia		Multiple	1994	Eastern Seaboard fires			58,000,000	800,000	225	N/A	4	127 injured; 27,000evacuated 100 homeless
Australia		Multiple	2001-2002	Black Christmas bushfires			181,000,000	300,000	109	437 buildings; 29 industrial & commercial premises	0	N/A
Australia		Multiple	2003	Canberra bushfires	None reported	250,000,000	250,000,000	165,100	500	N/A	4	N/A
Australia		Multiple	2005	Black Tuesday bushfires			100,000,000	145,000	665	N/A	9	113 injured; 46,780 livestock destroyed
Australia		Multiple	2006	Mount Lubra bushfire	None reported	None reported	None reported	184,000	25	N/A	2	1500 km of fencing destroyed; 62,000 sheep & 500 cattle destroyed
Australia		Multiple	2009	Black Saturday bushfires			4,400,000,000	450,000	2,298	N/A	174	414 injured; 11,800 livestock destroyed
United States	California	Single	1970	Laguna fire	None reported	None reported	None reported	70,992	382	N/A	8	N/A
United States	Wyoming - Montana	Multiple	1988	Yellowstone fires	120,000,000	3,000,000	123,000,000	321,270			0	N/A
United States	California	Single	1991	Oakland Hills fire			1,500,000,000	620	3,354	437 apartment /condominiums	25	N/A
United States	Colorado	Single	1994	South Canyon fire (Storm King Mtn	None reported	None reported	None reported	856	None reported	None reported	14	N/A

United States	Florida	Multiple	1998	Unamed - 2200 fires			130,000,000; 390,000,000 timber losses	120,000	150	N/A	0	80,000 evacuated
United States	New Mexico	Single	2000	Cerro Grande fire			1,000,000,000	19,000	420	>100 buildings	0	
United States	Washington	Single	2001	Thirty Mile fire	None reported	None reported	None reported	3,800 (wilderness area)			4	
United States	California	Single	2002	McNally fire	45,700,000	None reported	45,700,000	61,000		14 buildings	0	
United States	Arizona	Single	2002	Rodeo-Chediski fire			308,403,000	189,015	400	N/A	0	8,000 evacuated
United States	Colorado	Single	2002	Hayman fire			207,700,049	55,750	132	N/A	6	5,340 evacuated
United States	Oregon	Single	2002	Biscuit fire	155,000,000	None reported	155,000,000; 309,000,000 timber losses	202,240	4	10 buildings	0	15,000 evacuated
United States	Arizona	Single	2003	Aspen fire	None reported	4,100,000	4,100,000	34,300	340	N/A	0	
United States	California	Single	2003	Old fire			1,276,933,224	36,940			0	
United States	California	Single	2003	Cedar fire	32,000,000	None reported	32,000,000	113,424	2,232	N/A	15	
United States	Oregon	Single	2003	B&B Complex fires			38,000,000	36,733	N/A	13 buildings	0	13 injured
United States	California	Multiple	2006	Esperanza fire	16,000,000	9,000,000	25,000,000	16,300	34	20 buildings	5	
United States	Georgia	Single	2007	Sweat Farm Road			18,000,000	189,277	22	N/A	0	N/A
United States	California	Single	2007	Angora fire	12,000,000	None reported	12,000,000	1,400	254	75 buildings	0	2 injured
United States	Florida	Single	2007	Florida Bugaboo fire	12,300,00	None reported	12,300,000	50,417			0	
United States	Utah	Single	2007	Milford Flat fire	None reported	None reported	None reported	146,922	None reported	None reported	0	N/A
United States	Idaho - Nevada	Single	2007	Murphy Complex fire			10,500,000	264,300	None reported	None reported	0	
United States	California	Single	2007	Zaca fire	117,000,000	None reported	117,000,000	97,208	None reported	1 building	0	N/A
United States	California	Multiple	2007	October wildfires	N/A	N/A	N/A	400,000	2,180	922 buildings	9	61 injured; 1,000,000 evacuated
United States	New Mexico	Single	2008	Trigo fire	11,000,000		11,000,000	5,558	59	40 buildings	0	
United States	California	Multiple	2008	Summer 2008 wildfires	40,000,000	1,260,000,000	1,300,000,000	630,214	None reported	937 buildings	4	9 injuries

United States	California	Single	2009	Station fire	93,800,000	None reported	93,800,000	63,620	89	120 buildings; threatened numerous TV, radio & cellular telephone antennas, plus Mount Wilson Observatory	2	N/A
United States	Arizona - New Mexico	Single	2011	Wallow fire	109,000,000	None reported	109,000,000	217,741	32	40 buildings	0	1 building & 5 houses damaged; 6,000 evacuated
United States	Texas	Single	2011	Bastrop County Complex fire			500,000,000	14,000	1,691; $325-500Million in property losses (estimates conflicted)		2	
United States	New Mexico	Single	2011	Las Conchas fire	48,300,000	None reported	48,300,000	63,250	63	49 buildings	0	
United States	New Mexico	Single	2012	Whitewater-Baldy fire	23,000,000		23,000,000	117,148	None reported	None reported	0	N/A
United States	New Mexico	Single	2012	Little Bear fire	19,400,000	22,000,000	41,400,000	17,940		254 structures	0	
United States	Colorado	Single	2012	High Park fire			135,000,000	35,323			1	
United States	Colorado	Single	2012	Waldo Canyon	38,400,000	97,000,000	367,000,000	7,384		259 structures	0	
Canada	BC -Alberta	Single	1950	Chinchaga fire				1,400,400			0	
Canada	BC	Single	2003	Okanagan Mountain Park fire	33,800,000	200,200,000	234,000,000	26,000	239		0	
Canada	BC	Single	2009	West Kelowna fires	None reported	None reported	None reported	9,877	4		0	
Canada	Alberta	Single	2011	Slave Lake fire			1,800,000,000	4,900	374		0	54 structures damaged
Canada	Alberta	Single	2011	Richardson fire	None reported	None reported	None reported	700,000			0	Several evacuations; threatened oil sands infrastructure

4.2.9 Climate Change

The interface issue in BC is complex and influenced by a number of factors which ultimately makes management of the problem more difficult. Climate change science suggests that BC will likely see the following by mid-century (2050s)(Carlson, 2012):

- Average mean annual temperatures across BC will be 1.4°C to 3.7°C warmer.
- Extremely warm temperatures will become more frequent.
- More growing degree days and frost free days will increase the potential for plant growth.
- In winter, most of BC will likely receive more precipitation (up to 26% more in some locations).
- In summer, northern BC maybe up to 15% wetter, while southern BC may be up to 20% drier.
- In winter and spring, snowfall will decrease.

These changes in climate are likely to influence ecosystems and associated fire exposure as follows:

Impacts on forest productivity:

- Many aspects of climate change will influence the productivity of forests, specifically increases in temperature, precipitation and increases in carbon dioxide may increase forest biomass if nutrients and moisture are not limiting.
- Higher levels of productivity may increase fuel biomass in some ecosystems resulting in increased fire severity
- Warming temperatures have the potential to increase growing season and influence both species and distribution of tree species on the edge of their currents ranges. Those species that are at high elevation or species like Douglas-fir in the sub-boreal region of Prince George may be impacted.
- Drought is likely to increase in the southern part of the Province and more specifically in the arid portions of the Province.
- Higher temperatures combined with drought area likely to increase tree stress and the likelihood of disease or insect attack or levels of mortality.

Impacts on forest disturbance

- Current insect outbreaks in BC including the mountain pine beetle, spruce budworm and other bark beetles that have been linked to climate change.
- The severity of future insect outbreaks could be increased by changes in temperature and precipitation.
- Higher temperatures change the timing and reproductive cycles, accelerate insect development and expand distribution patterns and ranges.

- Changes in climate may provide a niche for invasive plant species which displace important native vegetation as the invasive species may be better adapted to wider changes in environmental conditions and or there are no natural predators.

Along with the ecological changes discussed above it is expected that climate change will change the length of the fire season, increasing the number of high and extreme fire danger days. As the number of fire danger days go up so too does 1) the probability of ignition and 2) the potential fire behaviour. In combination these two factors are likely to increase both the number of escaped fires and the number of fires that become large fires. The issues discussed above are not new and BC is thought to be experiencing many of the factors outlined above. However, if forecasts of climate change are true then fire managers in BC must expect an increasing number of difficult fire seasons over the coming decade.

4.2.10 Ignition Sources

In BC, historical natural ignitions by lightning were the most frequent cause of wildfire. However over the past two decades the numbers of human ignitions have been slowly increasing to the point where in some fire seasons human ignitions are almost equivalent to lightning ignitions. In the US, a larger proportion of fire ignitions are associated with human causes when compared to lightning. However in both countries the majority of large escaped fires are more often associated with lightning ignitions.

Human ignition trend is typically related to the movement of development into the wildland urban interface and a growing population using these areas more frequently for recreation. Many unassuming human activities have the ability to start a wildfire under extreme conditions, for example a lawn mower striking a rock, an electrical conductor touching vegetation, magnification of light from a discarded plastic or glass bottle, a recreation vehicle fire along a road site, and abandoned campfire as just a few of the types of human caused fires that have been responsible for the ignition of large expensive fires. Similar to the trends in the US, as the population continues to grow and development expands into the forested areas of the Province we can only expect that the number of human caused ignitions will trend upward and in all likelihood exceed those fires caused by lightning.

4.2.11 Fuel Types / Loads

Blackwell *et al.* (2003) documented changes in the natural historic fire regime and the changes in fuel loads (condition class). Overall the analysis of sixteen million hectares in the southern portion of the Province showed that more than 45% of the study area was within condition class 2 (21%) and 3 (26%) suggesting that fuel loads were departed (higher) than those prior to human settlement. These changes in fuel loads are associated with successful fire suppression and have resulted in ingrowth of trees into historically open forests and or encroachment of trees onto the grasslands. In 2003 the Okanagan Mountain Park fire burned in an area dominated by condition class 3 fuels and similarly the West Kelowna fires of 2009 and the Terrace Mountain fire were all dominated by fuels in condition Class 3.

The Provincial Strategic Threat Analysis summarized hazardous fuel types in relation to interface (Beck and Simpson 2007). The following summarizes those results:

> *Approximately 1.72 million ha potentially pose a threat to interface areas in of British Columbia and may require fuel treatment. Moreover, as a result of the current mountain pine beetle epidemic, it is projected that 80 percent of the merchantable pine in British Columbia could be killed by 2013, and well over half that pine could be dead by the summer of 2007. Further analysis, based on the presence of greater than 20 percent pine for stands 60 years and older, also suggests that mountain pine beetle (Dendroctonus ponderosae) is likely to accelerate the need to treat 460,000 of the 1.72 million ha identified.*

4.2.12 Development in the Wildland Urban Interface

It has been well-documented earlier in this report and in other studies that the wildland urban interface is extensive and growing within the three countries (Australia, the US and Canada). This development, until recently has largely been unregulated with regard to wildfire hazards and this has led to the creation of large numbers of homes, that for various reason (type of construction, house location, topography, and adjacent fuel types) are considered high risk. Only since the 2003 fire season have some communities begun to task this risk seriously through the development of CWPPs, fuel treatments, and in a handful of local government changes to policies and bylaws as they relate to development in wildfire hazard zones.

5 Description of Regulatory Approaches

Many communities have developed WUI regulations in response to a wildfire event in their community or in response to an event in a nearby community located in similar climate/forest ecosystem regime. Examples of this reactive response to developing preventative measures and regulations are witnessed across North America and these responses are not limited to wildfire as a natural hazard. The Corporation of the District of North Vancouver (CDNV) experienced a fatal landslide in 2005 and in response developed slope hazard and other natural hazard development permit regulations, hazard specific disaster response plans, and a suite of land-use planning measures to prevent a recurrence of this tragic event.

There appears to be an acceptance that existing development in WUI or intermix may present a higher risk profile than new development even if new development proceeds without regulation. This appears to be the case where older developments may have proceeded with lower standards of infrastructure (roads, water supply) and the prevailing building codes at the time were not as strict. Additionally, the FireSmart/FireWise message has been extensively conveyed over recent years, raising awareness and encouraging requirements for higher infrastructure standards and building code regulations.

There appears to be a disparity across jurisdictions in terms of which municipal departments take the lead on the development and implementation of WUI regulations. Planning and Fire Departments tend to be the most frequent champions for the regulations which is interesting considering that Parks departments are most often the active land managers in the municipal setting. There are many examples of community volunteer led initiatives to reduce WUI fire hazards, especially in rural areas and small communities (FireSmart Canada, 2013).

The level of sophistication of the regulatory controls developed by agencies sampled in this report varies widely, from a minimal statement in official community plans (OCP) (as illustrated by Pitt Meadows), to a very sophisticated set of regulations, flow charts and enforcement tools, as developed by the Orange County Fire Authority in California. However, there are examples of small communities which have adopted an aggressive set of regulatory controls to ensure WUI risk is minimized over the long-term (Town of Creston).

To aid in analysis of the effectiveness of planning tools and resources used to reduce the WUI risk profile, a broad hierarchy is illustrated in Figure 3.

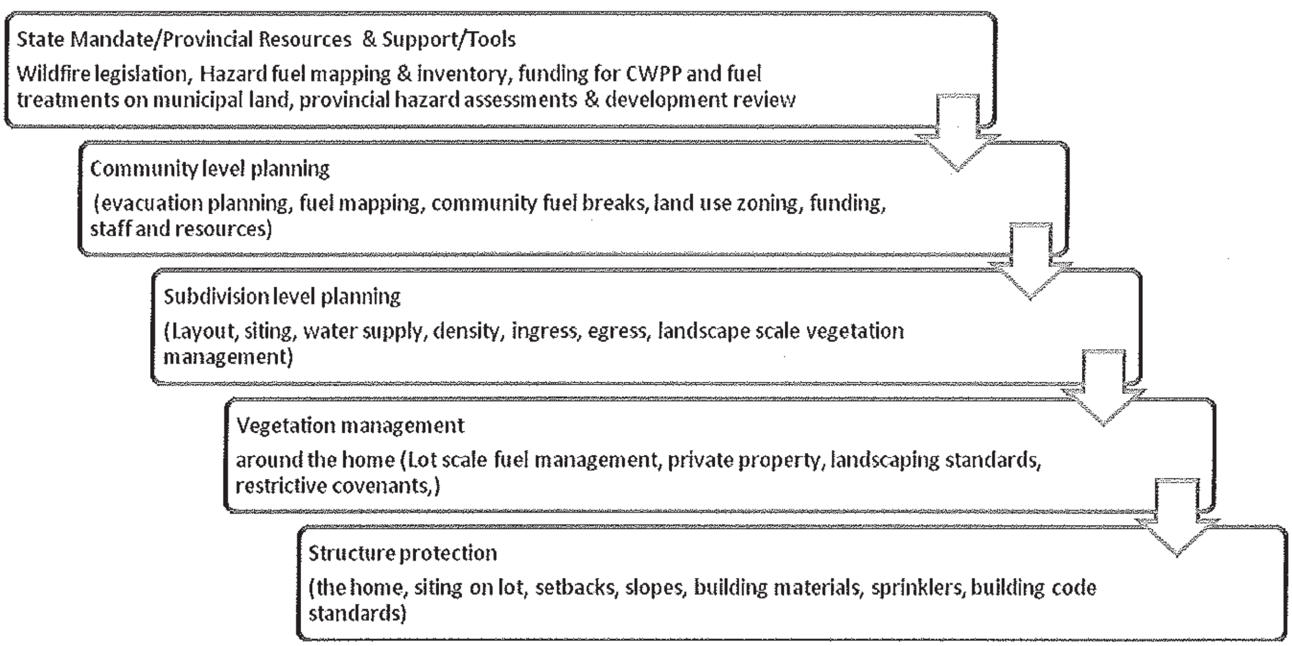

Figure 3. Wildland urban interface regulation hierarchy.

5.1 State/Provincial Regulatory Tools and Resources

In North America, a significant number of States/Provinces have coarse scale fuel type mapping available, in addition they have world class suppression capability and strong wildfire legislation. Fuel type mapping is usually made available to regional and municipal governments at little or no cost, and higher level governments provide strategic planning, training, support and memorandums of understanding relating to prevention, detection, suppression responsibilities, the application of fire as a management tool and cost recovery. Across Canadian Provinces, there is inventory and hazard fuel mapping variability. Some Provinces have high quality data available online, while for other Provinces the available data is low resolution or only available at a coarse scale and for the managed forest land holdings. For a few select Provinces, the lack of up-to-date inventory data for hazardous fuels poses a challenge for regional and local jurisdictions, and limits Canada's-development of national fuel mitigation and planning initiatives (Hvenegaard 2012).

Saskatchewan has rewritten their provincial wildfire legislation (Wildfire Act) and under the proposed new legislation, provincial officials will be more involved in reviewing and approving development at a regional/municipal level in certain classified areas of the Province. Under the new Wildfire Act, prior to construction of any new development, a WUI assessment would be required by the Ministry. The assessment would be used as the basis for establishing an interface wildfire hazard rating and subsequently determine the degree of mitigation measures relative to planning, construction, and vegetation management. This is the first example of a provincial government in Canada being directly involved in community WUI development and planning measures.

In Quebec, according to the Law on Fire Safety and Law on Civil Safety, the county municipal regions (MRC) and the municipalities within it, have the obligation to prepare a risk management plan and a plan for civil safety. In the interest of helping local and regional governments in fulfilling this responsibility, the Minister of Natural Resources and Wildlife (MRNF) and the Society for Protection of Forests Against Fire (SOPFEU) have prepared the Guide "PareFEU" (or Firebreak in English), "Advice to Diminish the Risks attached to Forest Fires". It is understood that development of WUI regulations in Quebec are at an early stage of development at this time (Hvenegaard 2012).

In the US where WUI regulations are mandated by a small number of States, communities appear to have developed more sophisticated regulations for development control (i.e., Orange County, California). In addition to fuel type mapping and regulations, several state/provincial governments have also provided cost shared funding for the development of CWPPs and implementation of operational fuel treatments. In these instances there appears to be more community engagement and evidence of WUI planning regulations.

Canada is moving toward developing a national fuel management strategy. A recent report by Hvenegaard (2012) has identified a number of issues, and made recommendations to help guide this process as it moves forward. One of the more significant issues is the current disparity of hazardous fuel inventory data and related mapping, and the variability in this information which presents a significant challenge and additional costs to regional districts and local authorities developing a CWPP, fuel management strategies, and development control regulations.

5.2 Community-Wide Regulatory Tools and Planning

The following discussion provides an overview of the community level tools and resources available for the development of WUI regulations.

5.2.1 Community Scale Fuel Type Mapping

The first step for any community is to document the fuel hazards present on the surrounding landscape. In some cases communities rely on federal, provincial/state or regional mapping. Often this coarse resolution fuel type mapping is freely available and provides baseline identification of potential areas of fuel hazards. Communities may also leverage funding from provincial or regional programs to refine relatively coarse scale mapping, and thereby produce more accurate information that can be used to develop community-wide planning initiatives. For example, this could include extensive fuel management, provision of landscape scale fuel breaks, and/or land-use re-zoning to provide community buffers (i.e., golf courses, airports, perimeter roads, or modified forest management practices at the edge of the community).

In the case of Saskatchewan, the Saskatchewan Forest centre and Saskatchewan Environment worked together to develop the Saskatchewan Community Wildfire Risk Assessment Project (SCWRAP). The SCWRAP represents a systematic assessment, and subsequent ranking, of communities at risk to wildfire. Communities were ranked as being low, moderate, high, very high, or at extreme risk from wildfire. The SCWRAP team conducted assessments of more than 100 communities which are embedded in the boreal forest (an example for Elk Ridge community is included in Figure

4).

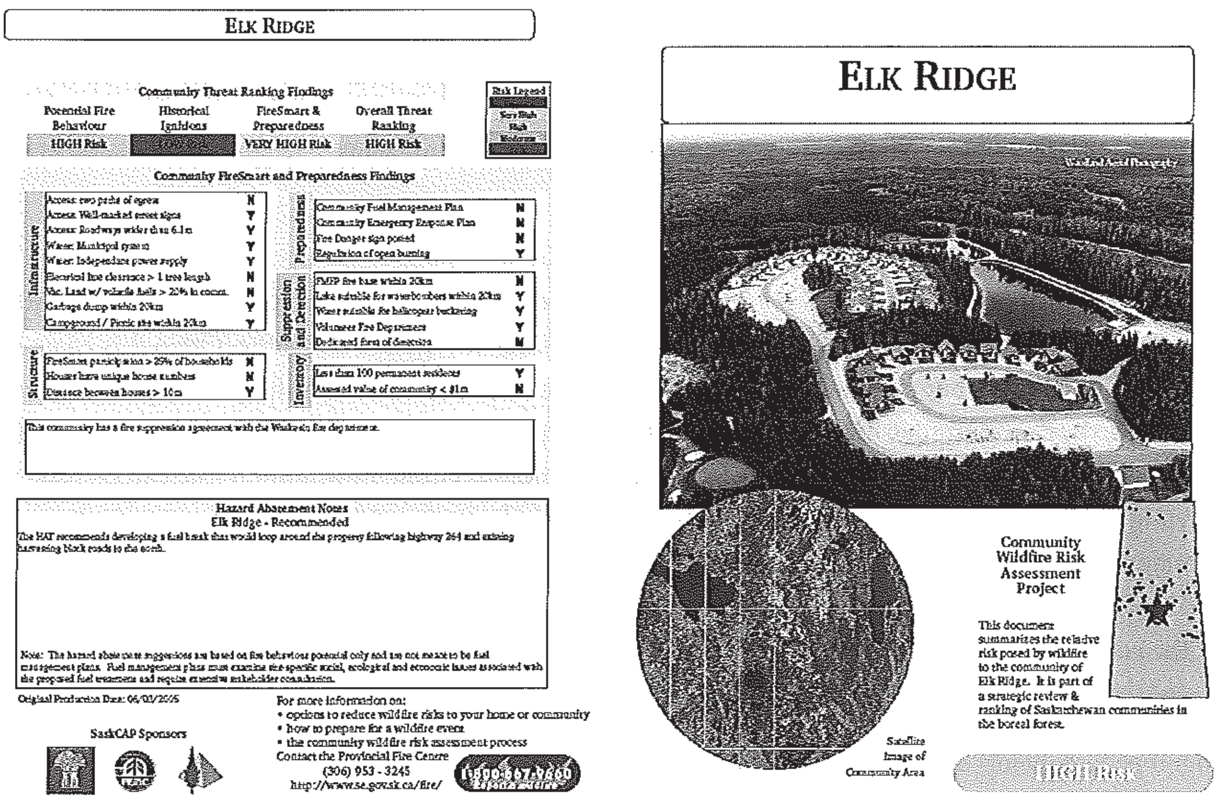

Figure 4

These assessments are intended to educate community planners and provide them with baseline, coarse scale assessments to help guide the development of local CWPPs, and sustainable community fire and fuel management plans (Johnson *et al.* 2005).

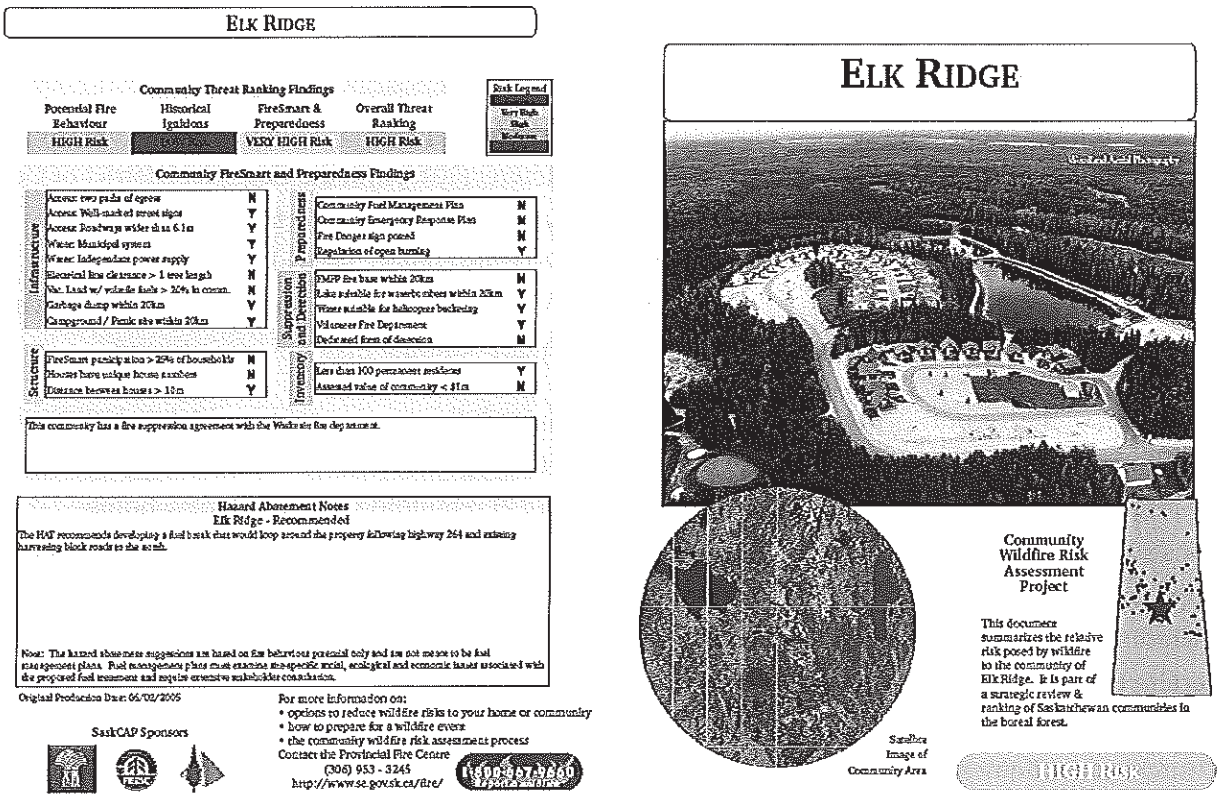

Figure 4. Saskatchewan community wildfire risk assessment for the community of Elk Ridge.

5.2.2 Applicability

Generally, most communities are applying changes to building codes and regulations to new developments but do not require older homes to retrofit with new materials. Some communities are encouraging or even regulating vegetation management around older homes to provide defensible space and reduced fuel hazards with the goal of minimizing the chance of structure ignitions moving readily through the community (i.e. City of Langford). This illustrates the simplest method in which communities can achieve short-term hazard reduction at a relatively low cost, versus enforcing stringent retrofit regulations, and risking the potential to alienate the community and have the regulations reversed by politicians. A recent example in North Saanich seems to illustrate this point, where it appears politicians may have received pressure from the development community to reverse the wildfire development permit area (WDPA) requirements which had been in place since 2007/2008 in order to streamline development applications. Without additional information it is difficult to identify the core reason that triggered the regulation reversal that had been in place for five years. This demonstrates the fragile nature of restrictive regulations in communities which have not experienced a significant or recent wildfire event.

5.2.3 Site Specific Fuel Type Mapping

Most WUI regulations require site specific fuel type hazard mapping. Exceptions include the streamlined application process adopted by the District of West Kelowna (2013) and the Regional District of Central Okanagan. For example, these authorities will exempt an applicant from performing a site level assessment if they sign a restrictive covenant agreeing to fully comply with all of the WDPA requirements and guidelines. Other WDPAs, such as Pitt Meadows (2013) do not require fuel hazards to be mapped at the site level, and only require that FireSmart building materials are utilized.

The primary means of triggering WUI regulations is through the requirement to obtain a building permit. Building permits are typically required for 1) building an addition to an existing dwelling (varies by jurisdiction and is specific to the area of the addition), 2) rebuilding a home, 3) new home construction and 4) when a home is destroyed accidentally or by natural hazard. One exception to this applies in California, where state mandated requirements apply to a broad spectrum of development including when new commercial uses occur in an existing building in the WUI. In some jurisdictions certain types of buildings, designated as a vulnerable population use, may trigger a specific WUI regulation. Buildings considered within the category of vulnerable population use include; schools, churches, rest homes, institutional buildings, hospitals and even large retail malls in California are subject to these regulations.

5.2.4 Community Fuel Management

Many communities are pro-actively engaged in modifying fuel types to reduce wildfire risk. This can take the form of shaded fuel breaks, or modified harvesting practices implemented by industry partners and/or modified vegetation management along utility corridors. Alberta and BC are good examples of this where approximately 2,300 ha per year have been treated (Hvenegaard, 2012).

5.2.5 Land-Use Designation Strategies

Communities experiencing rapid growth have the opportunity to change or designate strategic land-use zoning to encourage development such as golf courses, airports and agriculture to provide strategic fuel breaks across the landscape and to protect the community.

5.2.6 Evacuation planning

Communities are engaged in developing comprehensive evacuation and emergency response plans and are using these analyses to inform infrastructure planning, road networks, community layout and infrastructure hardening (resilience) against natural hazards (i.e., Corporation of District of North Vancouver).

5.3 Subdivision-level Regulatory Tools and Planning

5.3.1 Housing density

Housing density regulations are more common in the US than in Canada; however, application of this tool appears to be quite varied with some communities applying fairly rigid maximum density standards in high risk fuel hazard areas and others applying a less rigid formula, or may be offsetting density reduction with more aggressive vegetation management programs or other mitigation measures.

5.3.2 Subdivision layout

Subdivision layout regulation appears to be less commonplace than housing density but it may be integrated into the planning process as good practice for multiple reasons other than being singled out as beneficial to WUI fire risk reduction. A well-known subdivision layout principle in wildfire prone communities is to provide dual ingress/egress routes to ensure unencumbered evacuation of residents and deployment of suppression crews. The same principle likely applies to more than one community planning scenario, including efficiencies for public transit, perimeter roads for commercial and non-residential traffic, snow plowing, and infrastructure maintenance. Some communities in the US require the provision of perimeter roads and or fuel breaks, or clustering of structures in low risk areas. There are some rural communities in the US and Alberta that are anchoring fuel breaks using existing natural or man-made fuel breaks (lakes, wetlands, transmission lines, golf courses).

5.3.3 Water supply

Included in subdivision approvals, several communities in the US (see Douglas County, Colorado, 2013) require the provision of an adequate water supply for both consumption and fire-fighting purposes. Although this appears to be a reasonable requirement, it may be fostering an over-reliance on suppression capabilities which in the event of a wildfire can be easily overwhelmed. The optimal goal for WDPA regulations should be that a high percentage of FireSmart structures are capable of surviving a wildfire event with minimal or no suppression effort applied. Fire hydrant frequency and capacity may also be a requirement of subdivisions, and where development occurs beyond the extent of municipal services, developers may be required to provide minimum capacity wells, cisterns or above ground storage tanks. External and internal building sprinklers may also be required in structures located in inaccessible or remote terrain (where fire truck access is limited).

5.3.4 Access

Subdivision access regulations will often include:

- Minimum road width, passing pullouts at a minimum frequency, hammer heads/turning circles;
- Maximum gradients, surfacing requirements and minimum turning radius for switch backs;
- Minimum vertical clearance to roadside trees and structures;

- Minimum horizontal clearance in the case of some California communities, minimum setbacks for gates or barriers, and provision of keys for emergency responders;
- Fire hydrants must be clearly marked and cleared of vegetation; and
- Road signs made of non-flammable materials.

5.3.5 Vegetation Management / Defensible Space

Generally, the regulations reviewed require the submission of a fuel type hazard assessment and vegetation management plan. In some communities only large developments must submit a plan, however, the primary purpose of vegetation management plans is to show how vegetation requirements will be met for a specific user and site layout. Where vegetation controls include "defensible space" provisions, regulations often require that the vegetation management plan demonstrate compliance with different standards for three different zones (Orange County Fire Authority, 2013).

Zone 1

Zone 1 generally extends 10 metres or 30 feet from the values or structure at risk, and while standards vary, this zone is generally accepted as a flammable vegetation free zone to avoid the possibility of a structure fire migrating to the forest or vice versa. Vegetation management maintenance standards in this zone include but are not limited to:

- Removal of all dead materials, dry grasses, and ladder fuels;
- Thinning of trees (crown separation of at least 3-6 metres, with closer spacing allowed for less fire prone trees (i.e.,. aspen, cottonwood);
- Pruning of trees to variable heights between 2-5 metres or no more than 1/3 of the live crown;
- Removal of most shrubs, with clumps allowed if separated by at least twice the shrub height;
- Cutting grasses to 3 or 4 inches maximum height, but sometimes allowing taller vegetation on steeper slopes to retain soil;
- Keeping trees 3 to 5 metres from the roof or chimney; and
- Maintaining vegetation further than 3 metres from combustible fences/decks and from utility lines (with distance depending on voltage).

Zone 2

Typically zone 2 extends from the outer limit of zone 1 to a distance of 30 metres or 100 feet from the values or structure at risk. Typical requirements include removal of most dead material; stand thinning and pruning of trees, pruning of shrubs, and irrigated grass or similar less flammable landscaping. In most cases the standards are similar to zone 1 but less stringent.

Zone 3

Requirements are typically more lenient in this zone. Requirements vary from thinning of trees, cleaning up fine fuels and debris, to not allowing open fires. Zone 3 terminates at property lines; however, some jurisdictions require buffers to extend to a specified distance, regardless of ownership. Other jurisdictions only encourage maintaining buffers which cross property lines if an easement can be obtained to perform maintenance. Certain jurisdictions may allow for alternative solutions where compliance with vegetation buffers or defensible space provision is difficult to achieve. For example, external building sprinklers may be fitted to help reduce ignition potential in situations where vegetation management is not desirable or achievable (District of West Vancouver pers comm. 2013).

5.3.6 Structure Protection Regulatory Tools

Structure protection regulatory tools are required regulations the public and developers expect when developing in the WUI. A broad spectrum of structure protection measures can be implemented including but not limited to:

- Rated roofing material;
- Approved gutters that do not accumulate debris;
- Fire resistive building envelope and deck materials;
- Protective screening on vents, spark arrestors on chimneys;
- Double or triple glazed windows;
- External sprinklers; and
- Vegetation free zone around the building.

In addition, accessory buildings may be required to be built to FireSmart standards or a minimum distance from the habitable structure

6 Description of Current Practices

6.1 Regulatory Measures Overview

The Office of the Auditor General British Columbia follow-up report *Managing Interface Fire Risk* (2005) states:

> *"There was also a firm recognition that many subdivisions in the interface were not designed to mitigate wildfire risks, nor were the dwellings constructed to reduce wildfire hazards. We believe that local governments and individual homeowners have recognized the risks and are now prepared to follow the best information available to correct for past inaction. We believe they will accept strong direction and leadership on this issue".*

Several municipalities and regional districts across BC have developed and implemented WDPA regulations to control development in WUI areas. The large majority of these WDPA regulations were developed from CWPP recommendations; however it appears at least two communities are an exception and they include the City of Langford and City of Pitt Meadows. Conversely, the District of North Saanich adopted WDPA regulations in 2007/2008 and subsequently the municipality removed the regulation as part of an OCP amendment. The intent was to *"streamline"* the development approval process through *"removing unnecessary regulations"* (District of North Saanich, 2012).The level of sophistication varies greatly among the reviewed WDPA regulations. Regulations range from basic objectives and guidelines in an OCP, to sophisticated regulations that require submission of Qualified Professional (QP) reports, letters of undertaking, restrictive covenants, and include a comprehensive set of guidelines, thorough review process and defined exemptions.

The earliest example of a WDPA in BC appears to be the City of Langford (2003) and Regional District of North Okanagan (Rural Vernon OCP 2004). More recent examples include the City of Coquitlam (Draft) and District of North Vancouver(adopted 2012). According to statistics for the Strategic Wildfire Prevention Initiative (SWPI), more than 280 communities have developed, or are in the process of developing, CWPPs (all governments), with more than 340 fuel management prescriptions developed, and more than 200 fuel treatment projects completed (UBCM, 2013).

6.2 WDPA Regulation component review summary

The WDPA regulations reviewed include common elements typical of municipal and regional district development control regulations. Some include all of the components whereas others are less complete, and there also tends to be variability on the emphasis placed on each component.

6.3 Designation of WDPA Land and Application

WDPA are generally designated based on mapping provided by a CWPP, although some jurisdictions appear to have relied on the provincial fuel type mapping and have not developed a CWPP. This includes the City of Chilliwack which has adopted a custom set of development permit regulations for different geographical areas of the city, some areas require a wildfire hazard assessment and others do not (City of Chilliwack, 2013). In the City of Chilliwack example there does not appear to be a stand-alone WDPA regulation; instead the City appears to have adopted a different approach with multiple requirements for geotechnical, environmental, wildfire and form and character all stated in a single area specific DPA.

The majority of WDPA's appear to designate both public and private lands within the community or regional growth boundary.

6.4 Purpose and Justification

The stated justification for WDPA regulations can range from a short paragraph describing the historic fire incidence and the vulnerable nature of rural development. The WDPA is designated through provision of a comprehensive rationale and justification that must be approved by Council. The DPA may be only one component of a comprehensive natural hazard management program including the establishment of community risk tolerance criteria for all hazards including floods, landslides, and wildfire (Corporation of the District of North Vancouver, 2013a).

6.5 Objectives

Most WDPAs include clearly defined objectives such as risk reduction to the community at large, subdivisions, residential and rural property, and may also include objectives to protect sensitive ecosystem values and wildlife habitat. The range and detail of the stated objectives can vary widely between jurisdictions; the exception to this rule is exemplified in the central Okanagan where neighbouring municipalities and the RDCO appear to share a similar range of objectives in individual WDPAs.

Common objectives include but are not limited to:

- Protection of development from hazardous conditions;
- Protection of the natural environment, its ecosystems and biodiversity; and
- Protection of the community from the elevated risk of landslide post wildfire.

6.6 Applicability of Regulations

A wide range of applicability is evidenced across the spectrum of WDPA's reviewed. Application may include but is not limited to the following:

- Subdivision;
- New development;
- Large parcels; and
- Alteration of land including site grading vegetation removal, beach construction and even riparian area restoration works.

6.7 Exemptions

Exemptions can range from a single exemption to a long list of exemptions including but not limited to the following:

- Agriculture forestry and mining;
- Public works;

- Emergency response and works;
- Land assessed by the QP as low/moderate risk;
- Small development and certain categories of development;
- Maintenance repairs and renovations;
- New buildings less than a certain size;
- Parkland and stream restoration works; and
- Construction of trails and bridges.

6.8 Guidelines

Wildfire development permit area guidelines vary between jurisdictions, with some WDPA guidelines being more concise or detailed than others.

Concise Example: City of Pitt Meadows (2013)

Wildfire Hazards

- New developments should use fire-resistant materials and design that increase houses' longevity. Suggested materials are steel, asphalt, tile and ULC treated shanks for roofs, and stucco, metal, brick, concrete, aluminum or steel for siding;
- Roofs should be steep in order not to collect leaves or tree needles. The eaves around roofs should be boxed in and a screen should cover attic vent openings.

Detailed Example: District of Elkford (2013)

- Fire hazard assessment by QP;
- FireSmart building design;
- Shall ensure sufficient supply of water
- Develop roads and trails to create fire breaks;
- Repair maintenance and alterations to FireSmart standards;
- Use energy efficient materials wherever possible;
- Landscape maintenance; and
- Vegetation management and regular fuel reduction.

6.9 Qualified Professional (QP) Reports

A range of requirements are applied to QP reports. Some jurisdictions stipulate the requirement of a Registered Professional Forester (RPF) with specialist knowledge and experience in the wildfire discipline, whereas others simply require an RPF or Registered Forest Technician to conduct the assessment. Some including the City of Parksville (2009) even allow for the QP to be a P. Eng. with training in fire protection engineering

6.10 Application process

The CDNV has adopted a two-tier approach to the application process, either preliminary or detailed and is dependent on the complexity of the property and associated wildfire hazards. In the RDCO and District of West Kelowna (DWK) the application process is either classified as streamlined or regular. The streamlined application allows the applicant to accept a restrictive covenant on the subject property requiring that all guidelines must be met, whereas the regular process requires a QP report and assessment that may recommend only specific guidelines must be met based on the assessment. In some instances, such as the Regional District of East Kootenay, the restrictive covenant appears to be required for all applications regardless of the QP assessment. Likewise some jurisdictions require a letter of undertaking to comply and/or retain the QP for follow up (post development assessment).

6.11 Application fees

Application fees range from modest sums of \$200-\$300 for many jurisdictions, to reasonably high fee structures for the City of Prince George (\$1200 < 1 hectare to \$1800 > 1 hectare).

Draft criteria and performance indicators have been developed to provide benchmark indicators of success in the development and implementation of effective WDPA regulations (Table 3).

Despite differences in the sophistication and implementation of WDPA regulations in BC, there are common goals, strategies and objectives that can be exploited in the development of a BC specific or Canada-wide WDPA regulatory strategy. Adoption of a national strategy could create opportunities for governments (local or regional) with well-established regulations to play a leading role in the national program, and allow other governments to capitalize on the successful development of comprehensive regulatory frameworks (Hvenegaard, 2012).

Table 2 Summary of sampled British Columbia Wildfire Development Permit Area regulations providing a relative strength and weakness analysis.

Jurisdiction (Year Adopted)	Wildfire DP Defined In	Wildfire DP Required For	Exemptions	Application Fee	QP report Required	RC Required	FireSmart Building Materials	FireSmart Landscape Plans	Letter of Undertaking to Comply	Strength /Weakness Ranking
RDEK (2010)	Rockyview OCP	Subdivisions New SF Dwellings		$300	Required RPF	Required	Required	Required for Zone 1	Required	Strong
District of Elkford (2010)	OCP	All new developments	Land outside DPA area determined by BC land surveyor or QP	Unknown	Required QP	OCP is silent	Required Sufficient water supply also required	Landscaping to FireSmart standards and regular fuel management	Not Required	Moderate
District of West Kelowna (2011)	OCP	New residential developments; Large additions	BP indicating full compliance; Small additions; Complies with existing RC	Unknown	Not required for streamlined option with voluntary RC RPF or P.Eng. reports required if owner does not want to abide by guidelines	Required under streamlined option	FireSmart BMP's in Guidelines	FireSmart BMP's in Guidelines	N/A	Strong
City of Kelowna (2006)	OCP	Subdivision; New construction	Signed off by QP as no wildfire hazard; Small additions; Replacement of building destroyed by natural causes as long as new building is identical	Unknown	RPF, RFT or P. Eng.	May be required, determined by staff	FireSmart BMP's in Guidelines	FireSmart BMP's in Guidelines	Staff decide	Strong
RDCO (2006)	OCP	New residential developments; Large additions	BP indicating full compliance Small additions Complies with existing RC	Unknown	Not required for streamlined option with voluntary RC RPF or P. Eng. reports required if owner does not want to abide by guidelines	Required under streamlined option	FireSmart BMP's in Guidelines	FireSmart BMP's in Guidelines	Bonding required	Strong

Jurisdiction (Year Adopted)	Wildfire DP Defined In	Wildfire DP Required For	Exemptions	Application Fee	QP report Required	RC Required	FireSmart Building Materials	FireSmart Landscape Plans	Letter of Undertaking to Comply	Strength /Weakness Ranking
City of Coquitlam (DRAFT)	DRAFT in OCP	All types of developments	Unknown	Unknown	Not required if developer applies all guidelines; RPF, RFT or P. Eng. reports required if owner does not want to abide by guidelines	Not required	Roofing, siding and deck materials only (very brief guidelines)	Abbreviated guidelines	Not required	Weak
City of Pitt Meadows (2008)	OCP	New developments	Renovations, accessory building	Unknown	Not Required	Not required	Use fire resistant materials	Not required	Not required	Weak
City of Prince George (2010)	OCP	All new developments	Temp buildings; Alteration of land; Small additions	< 1ha = $1,200 >1 ha = $1,800	Wildfire interface assessment report sealed by the appropriate professional	No mention in DP regulations	FireSmart manual standards	Required	Not required	Strong
City of Langford (2003)	OCP	All new developments including temp use permits	N/A	Unknown	Required	Vegetation management covenants	N/A	N/A	N/A	Moderate
City of Parksville (2009)	OCP	Any developments	Small parcels, small additions Temporary use Subdivision where parcels <1000m² or	Unknown	RPF, RFT or P. Eng. reports required	May be required by staff	FireSmart manual standards	FireSmart manual standards	N/A	Moderate
Regional District of North Okanagan (Rural Vernon) (2004)	Rural Vernon OCP	Any rural developments	None stated	Unknown	Not required	Required for all developments	None stated	Fireguards and vegetation management conditions	N/A	Weak

Jurisdiction (Year Adopted)	Wildfire DP Defined In	Wildfire DP Required For	Exemptions	Application Fee	QP report Required	RC Required	FireSmart Building Materials	FireSmart Landscape Plans	Letter of Undertaking to Comply	Strength /Weakness Ranking
City of Chilliwack (Date)	Area specific DPA	All development	None stated	Included in overall DP application fees	RPF required fire hazard assessment	Not Required	Not Required	Not Required	Not Required	Weak
District of North Saanich (2007 DPA3 - Repealed Dec 2012)	OCP (Repealed 2012)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 3. Draft criteria and performance indicators for wildfire development permit application regulation components.

Criteria	Performance indicators				Key objective
	Low	Moderate	Good	Optimal	
Fuel Type Mapping	No access to fuel type mapping	Provincial government mapping	Ortho image interpretation	Detailed fuel type mapping including ground truthing	Clear definition of land inside DPA
Community Wildfire Protection Plan	No plan	Existing plan limited by scope and implementation	Community wide plan, accepted and implemented	Community wide plan accepted and implemented	Develop and implement comprehensive plan for the community
Community-wide Funding	Funding allotted by crisis management	Limited funding for implementation plan	Adequate funding to achieve most recommendations	Adequate funding to maximize benefits of comprehensive implementation plan	Develop and maintain adequate funding to implement a community-wide management plan
Staffing	No staff	Limited staff No training	Registered professional on staff	Registered professional on staff and capacity for peer review	Employ and train adequate staff to implement city-wide management plan
Assessment and Monitoring Tools	No ongoing assessment	Partial inventory/mapping	Complete inventory assessment and updated mapping	Community-wide GIS database	Develop methods to collect information about the wildland urban interface forest on a routine basis

Criteria	Performance indicators				Key objective
	Low	Moderate	Good	Optimal	
Application Process	Basic information only available to applicant, no staff expertise	Application process including guidance notes is available to applicants at municipal hall, limited staff training, no online resources	Tried and tested application process with online forms and staff are trained to provide guidance	Online screening process, clearly defined requirements for all scenarios; Well-defined staff and QP education and training	Clearly defined requirements and review process
Wildfire Development Permit Application Guidelines	Few if any guidelines included in WDPA	Modest set of guidelines available to applicants and developers; Guidelines leave development vulnerable to wildfire risk (weak)	Set of well-developed guidelines available to applicants, developers and QP Guidelines are focused on structure protection only	Comprehensive set of guidelines which are clearly communicated covering structure protection, landscaping, vegetation management; Guidelines are available online together with Q&A and explanatory notes	Comprehensive set of guidelines which ensure development is safe from hazardous conditions
Wildfire Development Permit Application Guidelines Exemptions	Too many exemptions which leave development vulnerable to wildfire risk	Fewer exemptions which allow for unusual circumstances; Exemptions do not severely compromise WDPA objectives	Few exemptions with good supporting rationale; Exemptions do not compromise WFDPA objectives	Clearly defined and communicated exemptions which do not contribute to increased community wildfire risk	Comprehensive set of exemptions which have been tested to ensure they do not compromise WFDPA objectives

6.12 First Nations Communities Initiatives FNESS (BC)

Up to March 31, 2009, 54 First Nation communities had initiated the preparation of a CWPP and of those; nine had been completed (British Columbia First Nations, 2009).

Figure 5 is posted on the First Nations' Emergency Services Society (FNESS) website and provides a graphic overview of the BC FN communities engaged in the SWPI. These appear to be the most recent statistics available publicly for FN communities.

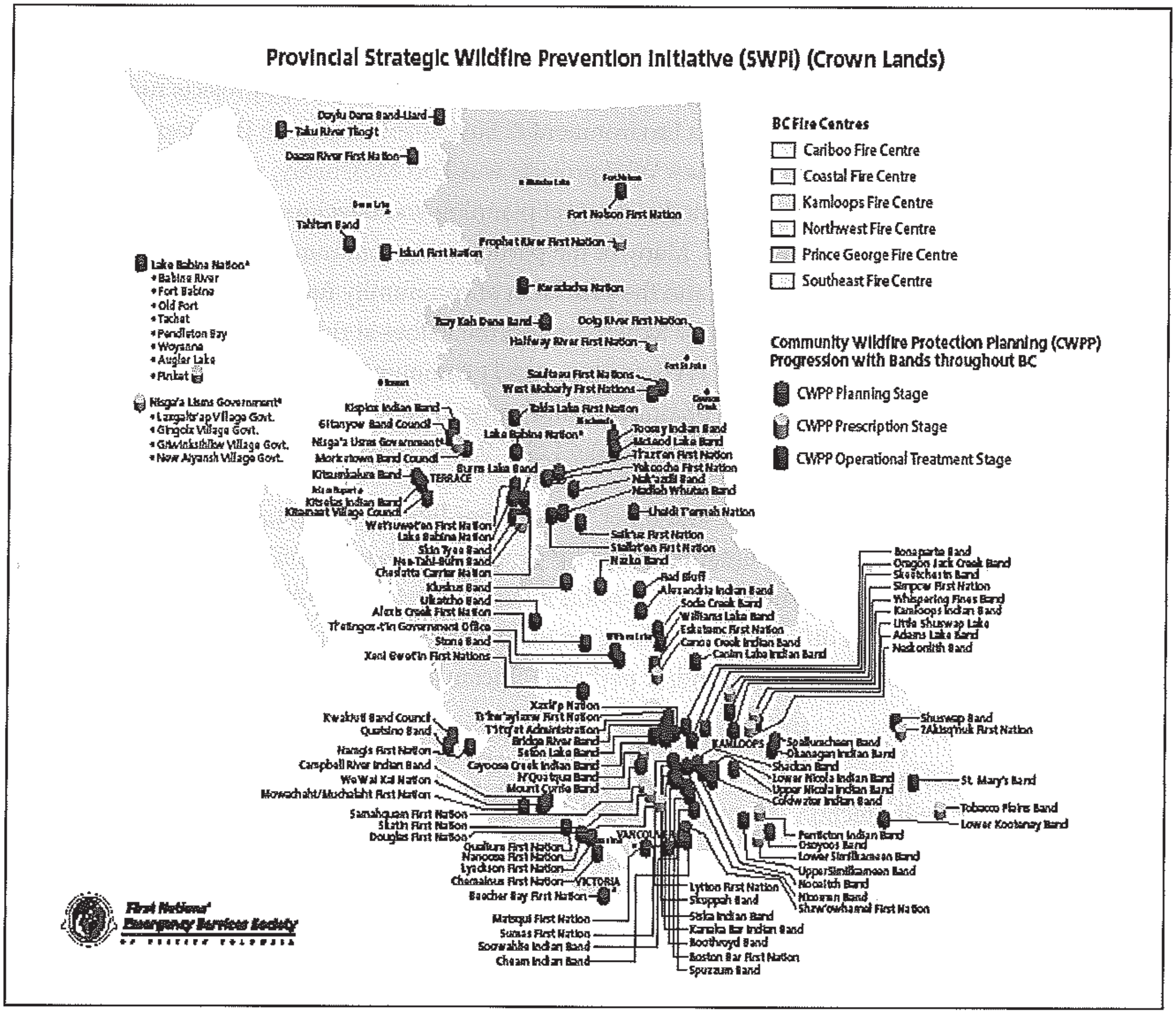

Figure 5. BC FNESS strategic wildfire prevention initiative map of participating communities (2009).

6.13 Canadian Provinces

6.13.1 Alberta

Alberta municipalities appear to incorporate wildfire hazard planning regulations in the Land Use Bylaws rather than developing stand-alone development permit regulations. An example is the Town of Banff which incorporates FireSmart principles in the Land Use Bylaw No. 31-3 (Town of Banff, 2013). Requirements appear to be relatively modest, including the provision of a wildfire hazard assessment of the vegetation on a development property and general guidance that suitable exterior building materials should be used to reduce or minimize the ignition potential of a building.

Many communities in Alberta are taking advantage of, and participating in WUI projects funded and supported by the Province through Alberta Environment & Sustainable Resource Development (ESRD). One of the early participants in the FireSmart WUI projects was Fort McMurray, which developed its WUI plan in 1997 and has since implemented municipal planning and development of FireSmarting architectural controls in new subdivisions. Many of the participating communities presently appear to be focusing on fuel management operations and the provision of community fuel breaks, enhancing water supply and emergency response capabilities to help protect the values at risk from wildfire. The ESRD website lists 29 communities involved in WUI projects and 11 communities that have developed zone plans, of which six include development planning components in various formats (Banff, Bow Corridor/Canmore, Nordegg, Fort McMurray, Smoky Lake, Whitecourt/Blueridge) (Alberta ESRD, 2013).

The emphasis in Alberta differs from BC and other jurisdictions like Australia and the US where it appears that emphasis in the implementation of CWPP's includes a heavier weighting on planning and regulatory controls to ensure that new development is given the best opportunity possible to survive a wildfire event. This apparent differential weighting of the program components could be in part due to the community administration capacity and/or perhaps reluctance to intervene in private property rights.

6.13.1.1 Provincial Legislation (Alberta)

The Forest and Prairie Protection Act and Forest and Prairie Protection Regulations Part I & II forms the regulatory framework in Alberta, guiding operational practices and protection measures employed by agriculture, forestry, oil and gas, and mining industries. There does not appear to be any specific legislation in the Act or Regulation to help plan for, manage or reduce WUI fire hazard.

Application of Act

This Act applies to all land within Alberta except:

a) land within the boundaries of an urban municipality where there is no specific provision in this Act to the contrary, and

b) land owned by the Government of Canada in respect of which the Minister has not entered into a fire control agreement under section 6(b) RSA 2000 cF-19 s2;2003 c20 s3;2007 c15 s1.

6.13.2 Ontario

The Federation of Ontario Cottagers' Association (FOCA) and the Ministry of Natural Resources (MNR) appear to be promoting the FireSmart Canada program, disseminating information and education outreach materials to owners of homes in rural areas. Unfortunately there does not appear to be much evidence of municipalities enacting regulatory controls for development at this time.

6.13.2.1 Provincial Legislation (Ontario)

The main legislation controlling the use of fire is the Forest Fires Prevention Act (Ontario Ministry of Natural Resources, 2011). The Act applies to two fire regions divided into 36 zones set out in regulation. The fire season is from April 1st to October 31st, and may be extended by regulation. This Act and its regulations have requirements aimed at reducing forest fires and ensuring public safety. The Act and its regulations spell out safety standards and measures governing the use of fire in the forests and establishes penalties to deter violators and careless users. It also provides powers to fire officers and allows the Ministry to create 'restricted fire zones' when the fire hazard is extreme, and 'emergency areas' when the danger to human life is high. By establishing these temporary zones and areas, MNR can restrict access and take whatever measures necessary to protect human life and manage the fire.

The current legislation does not appear to have any relevance to WUI or synergies with municipal regulations. In municipalities the regulations default to provisions under the Municipal Act, and allow the local municipalities to develop regulations and bylaws to control activities under their jurisdiction. Section 21 states that a municipality is responsible for the expense of extinguishing grass, brush and forest fires within its limits.

6.13.3 Manitoba

FireSmart Canada Program details are included on the Manitoba Office of the Fire Commissioner (Province of Manitoba, n.d.)and Manitoba Conservation Fire Program (Province of Manitoba, 2013) websites. Presently there does not appear to be any community based initiatives which are advertised for funding support or recognition. There is an evacuation brochure available on the Manitoba Conservation Website which appears to be helpful for residents.

6.13.3.1 Provincial Legislation (Manitoba)

Under the Wildfire Act a municipality is responsible for wildfire protection operations within its boundaries and may appoint fire guardians to carry out its wildfire protection responsibilities under this

Act, the regulations or a municipal by-law. The Crown is not obliged to reimburse a municipality for costs and expenses incurred in wildfire protection operations, but it may reimburse a municipality for costs or expenses incurred in wildfire protection operations made necessary by a wildfire that started on unoccupied Crown land. Current legislation does not appear to recognize the WUI situation and as such the municipalities are left to their own devices to develop appropriate regulations for municipal and private lands under their jurisdiction

6.13.4 Saskatchewan

Saskatchewan's Ministry of Environment has a fairly comprehensive set of resources on the Wildfire Management website with links to FireSmart Canada publications and other useful information (Government of Saskatchewan, 2013). In addition, there are 44 Community Wildfire Risk Profiles posted on the website.

The Saskatchewan Wildfire Management Strategy states:

> **Community Full Response Zones:**
>
> Under Saskatchewan's fire management strategies, communities are afforded the highest level of protection. Within 20 kilometres of communities all fires that pose a threat are managed with the intent of extinguishing them in order to relieve the danger they pose to communities.
>
> **Modified Response Zones**
>
> Modified response zones have been designated in southern portions of the Northern Provincial Forest. 'Modified response zones' are areas where there are fewer values at risk and areas that would benefit ecologically from fire. In these areas, fire fighting considerations are based on an assessment of values at risk. When efforts to suppress fires in 'modified response zones' are unsuccessful, fire management staff will concentrate on protecting 'full response zones' in the area.

The Provincial Fire Centre has prepared community wildfire risk profiles. It is part of a strategic review & ranking of Saskatchewan communities in the boreal forest. These community wildfire risk profiles are published on the Ministry website, which serves as valuable information for residents and community officials. The risk profile also includes suggestions to improve the community wildfire risk profiles.

The focus appears to be largely on vegetation management and provision of landscape-level fuel breaks as the main methods for reducing the community risk profile.

6.13.4.1 Provincial Legislation (Saskatchewan)

The Prairie and Forest Fires Act (1982) was adopted in the 1950's at a time when large tracts of land were being cleared and burned for agricultural use. Although the Act was completely updated in 1982, it is still one of the oldest pieces of wildfire legislation in Canada and has not kept pace with current wildfire management practices. A complete rewrite is now required in order to align with the Ministry's current results-based regulatory initiative (Government of Saskatchewan, 2013).

The new legislation promotes the government goals of sustainable economic growth and ensuring public safety in the following areas:

- Increases efficiency and reduction of administrative requirements;
- Places responsibility appropriately shared by government with individuals, stakeholders or other jurisdictions;
- Enhances protection for public safety and the environment;
- Clarifies responsibility for wildfire administration and suppression within municipal jurisdictions;
- Enhances prevention initiatives within wildland urban interface areas; and
- Administers industrial and commercial operations under a results-based regulatory framework.

It is encouraging that the proposed Wildfire Act will clarify and enhance wildfire administration and prevention in municipal jurisdictions and WUI areas. A WUI program chapter based on FireSmart practices will be developed along with supporting standards and guidance.

Under the new Wildfire Act, prior to construction of any new development a WUI assessment would be required by the Ministry. The assessment would be used as the basis for establishing an interface wildfire hazard rating and subsequently determine the degree of mitigation measures relative to planning, construction, and vegetation management. This is the first example of a provincial government in Canada being directly involved in community development and planning measures.

6.13.5 Quebec (translated from PareFEU website)

Each year, Quebec's forests are affected by hundreds of fires, including those in the WUI or peri-urban areas (i.e., wildfire which can reach the outskirts of the municipalities and threaten infrastructure such as buildings, bridges and facilities). In Quebec, about 70% of forest fires are caused by human negligence (Government of Quebec, 2013). An increasing number of individuals are settling in forested landscapes or using these areas for recreation; this is not without risk. Recreational fires and burning by residents are the main causes of fires.

Within Quebec the WUI or peri-urban zone is defined as an area where combustible forests are adjacent to habitation or buildings, in Quebec it is broken down into two zones.

- Zone 1: the residential development and the combustible forest are adjacent (interface zone); and
- Zone 2: can be considered rural; the buildings are surrounded by combustible forests (intermix).

This type of fire can cause heavy material losses, and sometimes those of human lives. The economic consequences of such fires are also disastrous. The past years have been striking in this regard for Australia, France, California, British Columbia, and Alberta.

According to the Law on Fire Safety and Law on Civil Safety, the county municipal regions (MRC) and the municipalities within it now have the obligation to prepare a risk management plan and another for civil safety. In the interest of helping local and regional governments in fulfilling this responsibility the Minister of Natural Resources and Wildlife (MRNF) and the Society for Protection of Forests against Fire (SOPFEU) have prepared the Guide "PareFEU" (or Firebreak in English), "Advice to Diminish the Risks attached to Forest Fires"(SOPFEU, 2013).

PareFEU has been translated from documents such as FireSmart, and the US publication FireWise.

6.13.5.1 Community Safety Plans

To assist regional municipalities to develop their civil safety plan, a simplified guide to interpretation of forest fuels was produced jointly by MRNF and the SOPFEU. This guide identifies the types of forest fuels in peri-urban areas (Quebec WUI) contains information on the forest fire danger rating, categories of fire, and recommendations on suppression. It is a useful source of information for owners of infrastructure located in the forest or nearby.

Geographical data on forest fuels and fire history are available at the regional county municipality (RCM) on the system of information and management planning (SIGAT). SIGAT is a Government Extranet where government and municipal agencies view the geographical data on forest fuels and fire history. Metropolitan communities and regional municipalities that signed an agreement with the Ministry of Municipal Affairs and Regions and Occupation of Territory (MAMROT), have access to these datasets for their needs as well as those of the participating local municipalities. Adequate information appears to be available to local and regional municipalities to help guide the development of the mandated equivalent of CWPP's.

Table 4 Summary of Canada-wide wildland urban interface programs.

Province	Provincial Resources, Tools & Funding	Local Government/FN Engagement	Community Wildfire Protection Plans	Wildland Urban Interface Regulations	Active Fuel management Programs in the Wildland Urban Interface
BC	Extensive established (SWPI) program established in 2004; Diverse Funding programs; Good inventory data, annual updates	High/High	280 plus communities have CWPPs including large number of FN	High; 20 plus communities have WDPA regulations	200 projects completed >2,300ha/annum*
Alberta	Extensive program with regular funding for communities; FireSmart community grant program; Good inventory data, annual updates	High	Modest	Modest municipal bylaws and land use bylaws	Good participation >200ha/annum*
Yukon Territory	Extensive program; FireSmart funding programs in place; Some remote areas are modified or no response zones and has little or no inventory coverage; Inventory is available for community and other VAR zones	Good participation	Unknown	Early stages of implementation Yukon government is taking the lead in developing community initiatives	Good participation >120ha/annum*
Northwest Territories	Young program early stages of development, limited staff; Some communities self-fund FireSmart projects; Limited inventory coverage and some areas are allowed to burn naturally except in community zones or other VAR present	Extensive uptake and engagement	All communities within the tree-line	Under development	Early stages Small projects but good community uptake >210 ha/annum*
Saskatchewan	Extensive program; Staff conduct wildfire hazard assessments for new development in the provincial forest zone; Inventory coverage for full response community zones	Good uptake and participation	Less emphasis at this time	Province determines requirements	Small project but good uptake >110 ha/annum*
Manitoba	Early stages of developing a program, starting to introduce FireSmart; Full inventory available	Early signs are good	Unknown early stages of development	Unknown	No data; New program

Province	Provincial Resources, Tools & Funding	Local Government/FN Engagement	Community Wildfire Protection Plans	Wildland Urban Interface Regulations	Active Fuel management Programs in the Wildland Urban Interface
Ontario	Early stages of program development, currently developing policy and legislation to support FireSmart program (pers. comm. Murphy J. 2013); Partial inventory coverage mostly in managed forest units	Unknown	Unknown	Unknown	No data
Quebec	PareFEU is modelled on FireSmart program; A different model appears to be emerging where municipalities are mandated to develop plans; Backyard burning has been an issue historically for wildfire ignitions	Unknown	Unknown	Unknown	No data
New Brunswick	Early stages of discussion; Good inventory data for hazardous fuel; Focused on enforcement of open burning practices	Unknown	Unknown	Unknown	No data
Nova Scotia	Early stages of being promoted and discussed; Good hazardous fuels data; Focused on enforcement of open burning practices	Unknown	Unknown	Unknown	No programs
Prince Edward Island	No evidence of a program; Full inventory coverage available	Unknown	Unknown	Unknown	No data
Newfoundland & Labrador	No evidence of a program; No inventory coverage available currently	Unknown	Unknown	Unknown	No data

*Hvenegaard 2012

6.14 United States

FireWise Communities/USA® is an initiative of the National Fire Protection Association (NFPA) which announced a milestone in participation on October 26, 2012. The NFPA secured their 800th FireWise community. Participation in the program includes communities across 40 States. The NFPA program is aimed at homeowners and encourages local solutions for safety by encouraging residents to take individual responsibility for preparing their homes from the risk of wildfire. Such preparedness actions include removing brush and debris from yards, cleaning up neighbourhood common areas and disposing of green waste. This grassroots level initiative also helps to promote the use of NFPA standards in protecting communities from the risk of wildfire.

6.14.1 Examples from the United States FireWise Program

Following catastrophic losses in the early 2000's due to wildfire, the United States Department of Agriculture compiled a searchable US database documenting 284 programs. Program disciplines include:

- Biomass utilization - companies/projects producing products from small-diameter wood materials and biomass;
- Community planning and CWPP's - development of wildfire protection plans;
- Demonstration projects - FireSafe public gardens, defensible space demonstration homes and fuel breaks;
- Designation of high risk areas - wildfire hazard assessments and mapping;
- Education - community outreach, classroom resources, and workshops;
- FireWise community recognition programs;
- Homeowner assistance - home site evaluations, vegetation treatment services;
- Property Insurance - programs that address insurance availability and cost; and
- Regulatory - State laws, ordinances, regulations, and guidelines.

The database is intended to be a resource library for communities that are initiating community fire planning. The database has extensive information on the programs researched but has not been updated since 2010 (USDA Forest Service, 2010).

6.14.2 Orange County Fire Authority, California

Some wildfire prevention programs have been in existence for many years, others have been initiated after a wildfire catastrophe. An example of a long established program is the Orange County Fire Authority (OCFA, 2013), California.

> *"Orange County Fire Authority interacts with developers, architects, and engineers to meet the fire protection requirements for buildings and developments by reviewing all architectural blue prints,*

development plans, and proposals submitted in OCFA's jurisdiction. This includes tract and parcel maps, permits for conditional use, site development, coastal development, environmental impact reports, and other items related to the developmental process".

This program includes a stringent set of regulations for developers to follow in the design, layout and prevention measures. A flow chart is provided to help inform new applicants of the requirements for each category of development. This ranges from single family residences to commercial and industrial buildings. A common requirement for all applications is the provision of a master fire plan for the property.

The OCFA requirements for development, in the State of California, designated Fire Hazard Severity Zones which are comprehensive and focused on development standards to achieve the highest NFPA standards. Retrofitting older homes is voluntary but homeowners can request a home assessment. The Ready Set Go program provides a resource library of information brochures, video's and an interactive mapping application (Wildland Ignition Zone Education (WIZE)), where homeowners can update their home assessment as FireWise/NFPA upgrades are completed and monitor wildfire notifications. The OCFA program also includes best management construction practices and a permitting system to ensure flammable materials and construction activities do not put adjacent homes or forest at risk. Standards are included for subdivision access, road turning points, gradients and fire hydrant location and frequency (WIZE, 2013).

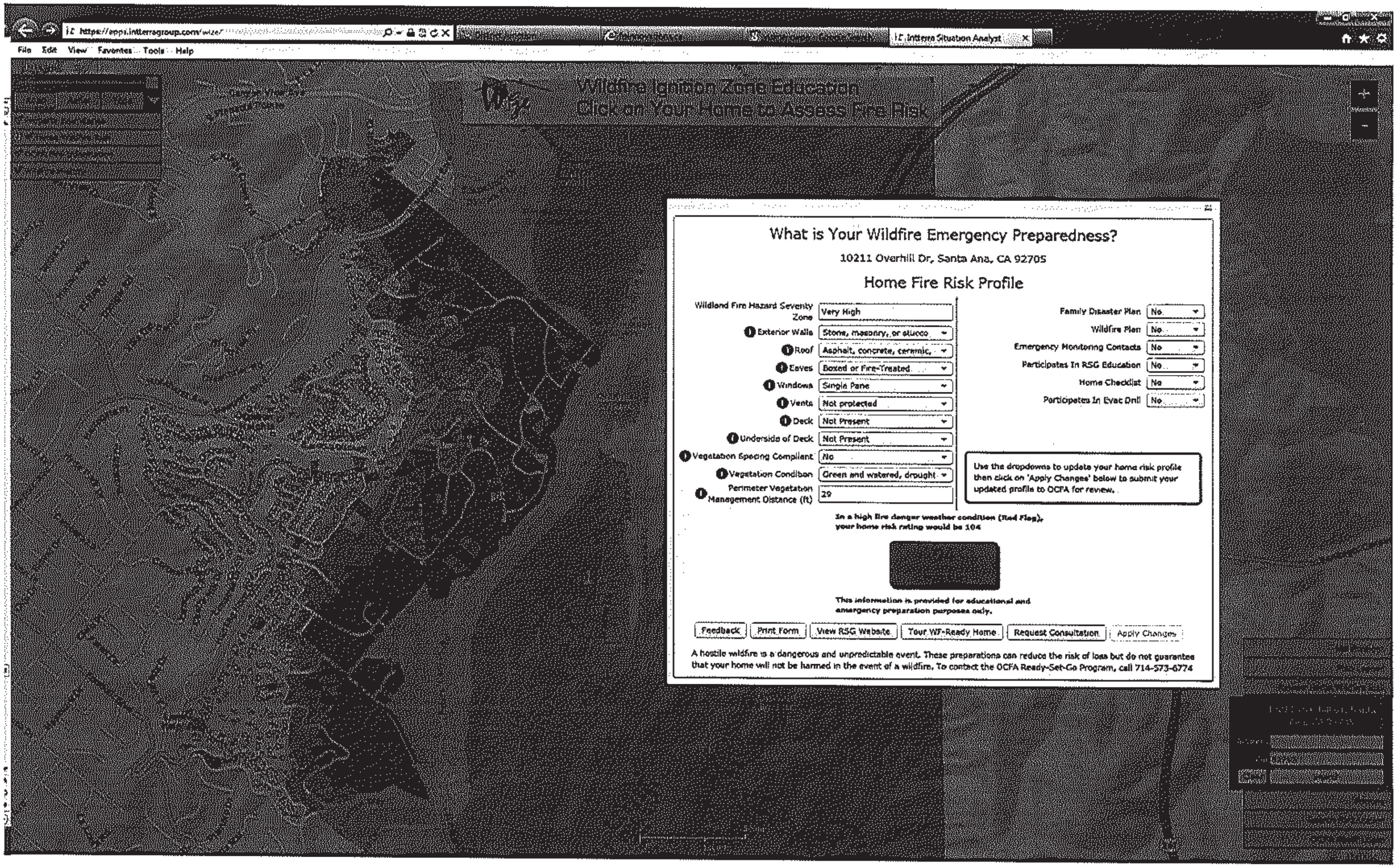

Figure 6. Screen capture of the wildfire ignition zone education website utilized by Orange County Fire Authority.

This online application WIZE provides regulatory agency/community communication and an education framework that appears to have a high probability of success in educating communities. Furthermore, this application provides emergency response authorities with up-to-date information on home wildfire risk assessment scores for each structure and neighbourhood, providing strategic planning and deployment information during a wildfire event.

The California Fair Access to Insurance Requirements (FAIR) Plan is designed to provide fair access to insurance for property owners in areas where natural hazards such as wildfire are a concern; this scheme has been implemented by participating insurance companies (California FAIR Plan Association, 2009). It is designed to increase insurance rates in those areas with extremely hazardous fire potential or to require additional "brush exposure" charges to customers who do not remove dangerous vegetation. The rationale for this differential is that policyholders in areas with less risk of damage from catastrophic wildfire should not be expected to "subsidize" the insurance payments of policyholders in areas of much higher risk. The FAIR plan essentially introduces economic incentives for property owners to remove dangerous vegetation that increases the risk of damage from large wildfires.

The Brush/Wildfire mitigation requirements to reduce premiums are quite stringent, including a provision for a neighbouring property owner to be notified and charged an additional premium where fuel hazards on their lands are affecting the premiums paid by a neighbouring property owner where fuel hazards have been abated.

The California Insurance Code (Section 10100.2) states that, "If the FAIR Plan policy of a property owner would be subject to a surcharge solely because of an adjacent property owner's failure to comply with the applicable law, ordinances, and regulations regarding brush clearance requirements, the surcharge shall instead be imposed on the policy of the adjacent property owner if the adjacent property owner is also insured through the FAIR Plan."

6.14.3 State of Oregon

The Oregon Forestland-Urban Interface Fire Protection Act, through legislation encourages property owners with the goal of turning fire-vulnerable WUI areas into less hazardous areas that would allow firefighters to safely and effectively defend homes from wildfires. The law requires property owners in identified urban interface or intermix areas to reduce excess vegetation that could fuel a wildfire around structures and along driveways (Oregon Department of Forestry, 2013).

> *"The Oregon Department of Forestry (ODF) supplies information about the act's fuel-reduction standards to forestland-urban interface property owners. ODF also mails each of these property owners a certification form, which may be signed and returned to ODF after the fuel-reduction standards have been met.*

Returning this card to ODF is an important step. Certification relieves a property owner from the act's fire cost-recovery liability. This takes effect on properties that are within a forestland-urban interface area and for which a certification card has not been received by the Department of Forestry. In these situations, the state of Oregon may seek to recover certain fire suppression costs from a property owner if a fire originates on the owner's property, the fuel reduction standards have not been met, and ODF incurs extraordinary suppression costs. The cost-recovery liability under the Oregon Forestland-Urban Interface Fire Protection Act is capped at $100,000. Certification cards become void whenever a property is sold, a structure is added, or a county's classification committee has convened and reclassified forestland-urban interface lands".

At the local authority level, land use and development ordinances (LUDO) set out detailed requirements for development in the WUI. Standards include water supply (minimum gallon capacity), road access width, gradient, turning circle radius, defensible space (10-30 m), fire resistive material standards, roofing sprinklers, and maintenance of fuel breaks..

Counties and local authorities have developed CWPPs and the State provides fuel hazard mapping and staff resources to aid in administration and enforcement of the legislation. There does not appear to be any interactive mapping tools or resources at this time for residents of Oregon State, however the development standards are exacting and expected to ensure that new developments in the WUI are built to comply with NFPA or similar standards.

6.14.4 Colorado

Several severe wildland fires in Colorado have influenced development of progressive and comprehensive WUI regulations. Fuel hazard mapping in Colorado varies from several other states in that local community fuel hazard maps are derived through refinements of state WUI hazard mapping. This technique is also applied in California. For example the application of WUI regulations based on existing overlays or regulations (i.e., a hillside overlay zone for steep slopes). In Douglas County overlay maps are applied to generally known high fire risk areas and County regulations require site-specific evaluations for each property in that overlay to verify localized risks.

Post Fire Rehabilitation:

Regulations requiring post wildfire re-vegetation are relatively rare in the WUI regulations reviewed. One exception includes La Plata County, CO which requires post-fire rehabilitation of vegetation and soil in burned areas (La Plata County Colorado, 2013). La Plata and Archuleta County, CO also provide reverse 911 notification services where homeowners can register their mobile devices to receive emergency notifications, including evacuation orders.

In a 2011 analysis of WUI regulations, Douglas County was considered to maintain high standards in WUI regulations across all levels, including access to State WUI mapping. The primary regulatory official is a fire specialist employed by the building department, and all levels of regulatory tools and resources (community, subdivision, lot and structure protection tools and resources) are considered to attain high standards of protection for the community and values at risk. These regulation standards compare favourably with California where a State mandate for WUI regulations has led to the development of detailed standards and a high level of community compliance and enforcement. One item on the Official's wish list in Douglas County was for the provision of a regulation for the ongoing maintenance of defensible space around homes (Duerksen et al., 2011). It appears that this regulation update has been incorporated in the Douglas County building code amendments 2012, whereas section 3.2.5. states that landowners are responsible for the clearing and maintenance of defensible space around buildings and structures, including thinning tree stands, pruning, and cleaning up of flammable debris.

Incentives for Wildfire Mitigation:

As authorized by S39-22-104(4)(n), C.R.S., for income tax years 2009 through 2013, individuals, estates and trusts may subtract 50% of the costs incurred in performing wildfire mitigation measures from federal taxable income(Colorado Department of Revenue, 2009). The following qualifications and limitations must be met:

- The taxpayer must own the property upon which the wildfire mitigation measures are performed.
- The property upon which the wildfire mitigation measures are performed must be located in Colorado.
- The property upon which the wildfire mitigation measures are performed must be located in a wild land-urban interface area.
- The wildfire mitigation measures must be authorized by a community wildfire protection plan adopted by a local government within the interface area.
- The total amount of the subtraction may not exceed $2,500.

Slash/Mulch Program:

Douglas County provides a free slash/mulch pick up program once a year for qualifying wildfire mitigation projects. This helps residents and landowners dispose of fine fuel hazards and the County recycles the materials for use in soil amendment products which in turn provides revenue to offset the program costs. Douglas County also goes as far as prohibiting the use of wood shakes and wood shingles within the boundaries of the wildfire hazard overlay district (Douglas County Government, 2012. Section 7.2.1 of Exhibit B).

Water Supply:

Douglas County WUI regulations include specific standards and minimum specifications for the provision of water supply for fire-fighting purposes. In comparison to similar regulations in Oregon the Colorado standards appear more detailed.

6.14.5 Florida

Unlike California and Oregon which both adopted state laws to reduce the risk of losses due to WUI fires, the state of Florida has WUI mapping but currently no state laws which are specific to WUI regulations. Florida has enacted some progressive legislation to reduce hazard fuels accumulations on private lands.

While most communities limit vegetation management regulations to the subject property there are a few examples in the US where WUI regulations require vegetation management to extend onto adjacent properties. Palm Coast requires a 30 foot defensible space buffer around all structures, even if this buffer area extends onto adjacent properties. The building department officials who manage WUI regulations then check to ensure that all affected properties, including vacant lots, are maintained to meet this standard (Duerksen et al., 2011).

Tax Incentives:

The State of Florida's Model Wildfire Mitigation Ordinance (Karels and Putnam, 2010) allows local governments to grant a one-time *ad valorem* tax exemption to all improvements to real property, made by or for the purpose of wildfire mitigation, and completed in accordance with the wildfire mitigation plan (Florida Department of Agriculture and Consumer Services, 2010):

> *Ad Valorem Tax Exemption. The City or County of…shall grant a one-time ad valorem tax exemption to Landowners in the Overlay District. The exemption shall apply to all improvements to real property made by or for the purpose of wildfire mitigation and conducted in accordance with a Wildfire Mitigation Plan. The amount of the exemption shall be equal to the costs for improvements made by or for the use of wildfire mitigation and in accordance with the Wildfire Mitigation Plan. The exemption shall be assessed, one-time, against the Landowner's ad valorem tax for the following year.*

Conversely, Arizona Insurance companies are using Prescott AZ Fire Department's inspection reports for individual homes to evaluate wildfire risks; the level of risk determined may affect insurance rates and availability. Homeowners are given two years to comply with the risk reduction recommendations.

The insurance industry in the US has indicated to the International Code Council (ICC) WUI committee that it intends to develop and implement a WUI homeowner inspection program for WUI policyholders. Example of these initiatives is State Farm Insurance's commitment in over 13 states, including CO, ID, UT, NV, WY, MT, AZ, NM, WA, OR, AK, CA and FL, in a new WUI homeowner inspection program (ICC 2008).

Fuel Hazard Mitigation Legislation:
The City of Palm Coast Ordinance No. 2001-11 (City of Palm Coast, 2013) provides for wildfire hazard mitigation through vegetation management. This legislation targets hazardous vegetation on undeveloped lots located within 30 feet of adjacent structures where fuel build-up is considered excessive; the ordinance deems such properties a public nuisance. The City of Palm Coast and the Florida Division of Forestry identify areas of relatively severe risk of wildfire and prioritize areas for systemic mitigation planning and implementation.

Implementation:
To implement the ordinance, the Urban Forestry Department with the City of Palm Coast identifies undeveloped lots that present a fire hazard. Affected property owners are mailed a notice of violation where fire hazards are present. Hazard mitigation practices include prescribed burning, brush removal, and thinning trees.

Penalties and Appeals:
Failure to comply with the notice of violation results in misdemeanor charges. Property owners may protest the violation notice through the Fire Mitigation Review Board. If unsuccessful, the property owner has 10 days to take corrective action. If a property owner does not take corrective actions specified in the notice, the City will do so and bill the property owner for the expenses plus a $100.00 administrative fee.

6.15 Australia

The Fire Protection Association (FPA) in Australia has developed and administers a *Bushfire Planning and Design Accreditation (BPAD)* scheme to ensure that practitioners engaged in delivering bushfire assessment, planning, and design, and that advisory service practitioners are properly accredited and knowledgeable in this field of expertise (Fire Protection Association, 2013). It accredits practitioners who meet criteria based on specific accreditation and competency requirements, including a detailed knowledge of, and ability to practically apply the relevant planning, development and building legislation as outlined in the Building Code of Australia and Australian Standard AS 3959 for construction of buildings in bushfire prone areas. This accreditation scheme appears to be comprehensive, robust and provides a grassroots practitioner accreditation scheme that will ensure there is public confidence in the advice and assessments performed and the design and advisory services will lead to more resilient development in bushfire prone areas.

The stated benefits of the accreditation scheme for the community and government are listed as follows:

a) Increased safety and reliability for the community resulting from professional assessment of bushfire risk and determination of appropriate mitigation measures.
b) Opportunity to improve the efficiency of the planning and building approval process by confidently relying on the reports and recommendations of accredited professionals.
c) Confidence that planning and building applications are compliant with the relevant regulatory requirements and consistent with their stated objectives.
d) Community has confidence that an accredited practitioner will have the skills, knowledge and experience to undertake their project and be protected through public liability and professional indemnity insurance.
e) Utilization of a proven accreditation program administered by a peak national body with appropriate safeguards that maintain the integrity and credibility of accredited practitioners.

Upon completion of the training and examination bushfire planning and design professionals are accredited to one of the following levels:

BPAD – Level 1: Recognizes practitioners who determine Bushfire Attack Levels using simplified methods and provide advice on the applicable Deemed-to-Satisfy construction requirements.

BPAD – Level 2: Recognizes practitioners who develop planning and building applications by applying prescribed design requirements in accordance with local regulatory requirements in addition to the activities described for a Level 1 Practitioner.

BPAD – Level 3: Recognizes practitioners who develop planning and building applications by developing alternative design solutions in accordance with local regulatory requirements in addition to the activities described for a Level 1 and Level 2 practitioner.

6.15.1 The State of Victoria

Southern Australia, including Victoria, has one of the most fire-prone environments in the world, owing to its particular combination of climate, vegetation and topography. Wildfire is a normal feature of the Victorian environment and plays a key role in the regeneration and regrowth of many plant species.

Victoria has experienced a high frequency and severity of fires in the last decade, including major bushfires in 2003, 2007 and 2009. As Victoria's population has increased and more people live in close proximity to forested and other fire-prone landscapes, the focus of land managers has been the suppression of wildfire to protect human life and assets, and the management of fuel loads.

6.15.2 2009 Victorian Bushfires Royal Commission

The 2009 Victorian Bushfires Commission (VBRC) was established in response to the bushfires that devastated parts of Victoria (CITATION). The bushfires of February 7, 2009 resulted in the loss of 173 lives, with over 2,000 homes being destroyed and 430,000 hectares of land burnt. The VBRC conducted an extensive investigation into the preparation, causes, response and impact of the 2009 bushfires. It concentrated on gaining an understanding of what took place and how the risks of such a disaster recurring might be reduced. One of the key findings of the VBRC was the need to prioritise the protection of human life over all other policy objectives. Planning Scheme Amendment VC83 introduced the new bushfire planning provisions. The resulting changes to the planning system were designed to reflect the new priority as well as the shared responsibility of governments, fire agencies, communities and individuals for minimizing the potential for a tragedy as experienced in 2009.

6.15.3 Bushfire Management Overlay

This is the terminology used to describe an area similarly designated in BC as a Wildfire Development Permit Area.

The Bushfire Management Overlay (BMO) (State Government of Victoria, 2013a) consists of WUI mapping resources and an interactive guide showing the areas affected by the BMO, measures homeowners can take to protect their homes and written provisions which set out:

- The types of development which require a planning permit;
- The information that must be submitted with a planning permit application; and
- The decision guidelines that the council must consider when they assess a planning permit application.

The purpose of the BMO is very similar to WDPA regulations and the stated purpose is to:

- Identify areas where the bushfire hazard requires minimum bushfire protection measures for subdivisions and buildings, and works to be specified;
- Ensure that the location, design and construction of development and the implementation of bushfire protection measures are considered; and
- Ensure that development does not proceed unless the risk to life and property from bushfire is managed to an acceptable level.

Sterilization of Land to Development:
One essential difference to Canadian WUI regulations is that the local government has the authority to prevent development from taking place in an area where risk to life and property from a bushfire is assessed and deemed to be at an unacceptable level, and cannot be mitigated through treatment or preventive measures.

State of Victoria WUI Regulations:
To support a comprehensive state mandate for WUI regulations the State of Victoria department of Planning and Community Development provide mapping resources, education outreach materials, support and guidance documents from which local authorities can develop WUI planning regulations (State Government of Victoria, 2013b). The resources provided include but are not limited to:

- Interactive mapping tool resources for bushfire prone areas this mapping tool appears to use a similar web platform to BC's Mapview.
- Bushfire prone area reports are available online.
- Minimum construction standards apply to all buildings in bushfire prone areas.

A comprehensive set of regulations have been implemented to control development through the Victoria planning provisions. State planning policy has been included in every planning scheme in Victoria, and this policy provides the State-wide regulatory framework and local governments with direction for implementing bushfire measures in a planning scheme. The state regulations provide development control strategies for areas affected by bushfire hazard.

6.16 Other Jurisdictions:

FireWise South Africa (SA) (2012) has been modelled on components of FireWise USA and adapted to leverage volunteerism of less affluent communities. A delegation of SA officials visited Denver, Colorado and learned about the FireWise USA program and took the ideas, concepts and principles back to SA to develop their own program.

The success of this relatively young FireWise SA program is demonstrated by the fact that by the year 2012, 30 SA communities had signed up for entry level (Module 1) "Voluntary FireWise Community Program" and seven communities had signed up for Module 2. These voluntary FireWise communities are spread geographically across seven distinct SA regions. The voluntary FireWise community approach emphasizes community responsibility for planning in the design of a safe community. The community becomes responsible for effective emergency response, and the individual in the community is responsible for safer home construction and design, landscaping, and maintenance.

The voluntary FireWise community aims to:

- Improve safety in the wildland/urban interface by learning to share responsibility;
- Create and nurture local partnerships for improved decision making; and
- Encourage the integration of FireWise concepts into community and disaster alleviation planning.

Essentially the FireWise SA program appears to concentrate on grassroots level training, and education outreach materials for core community members who are then expected to train others, spread the word, and gradually foster self-reliant and well informed community groups to assess wildfire risks around their communities and work with volunteers to reduce risk profile.

Table 5. Summary of tools and resources, plans, regulations, and fuel management applied at the community level in the Unities States, Australia and South Africa.

Jurisdiction	State/Provincial Resources & Tools	Community Tools and Resources	Community Wildfire Protection Plans	Wildland Urban Interface Development Regulations	Wildland Urban Interface Fuel Management Projects
California	State Mandate; State forest inventory mapping resources; High quality inventory data	Fire Authorities/county administrations; Strict development controls; Interactive mapping online; WUI home assessments	Comprehensive coverage	Detailed ordinances administered by Federal Authority and County administration	Good participation at community level
Oregon	State Mandate; State forest inventory; Mapping resources and natural hazard program	County/local authorities administer WDPA regulations; Strict development controls	Comprehensive coverage and regularly updated	Detailed development control ordinances administered by local authorities	Good participation and state support for local initiatives
Colorado	State forest inventory and WUI mapping resources High quality inventory data	County building authorities administer WUI regulations Comprehensive county planning initiatives and education outreach materials.	Comprehensive coverage	Detailed codes include WUI regulations Reverse 911 disaster notification service Strict minimum water supply regulations are imposed Post-fire rehabilitation regulations	Good community participation Federal tax incentives offered for wildfire mitigation measures Douglas County offers slash/mulch pick up
Florida	State WUI mapping State model WUI ordinance provides mandate for local authorities to provide a tax incentive for wildfire mitigation measures	Building and Fire departments administer WUI regulations	Comprehensive coverage	City of Palm coast ordinance for wildfire hazard mitigation targets hazardous fuels on vacant land. Overall WUI regulations are considered weak to moderate in comparison to communities in other states.	The City of palm Coast model ordinance for wildfire hazard mitigation appears to have been a catalyst for implementation of local fuel management projects
South Africa	Unknown	FireWise/SA aims to improve safety in the WUI through partnerships	Unknown	Unknown	Good community participation

Jurisdiction	State/Provincial Resources & Tools	Community Tools and Resources	Community Wildfire Protection Plans	Wildland Urban Interface Development Regulations	Wildland Urban Interface Fuel Management Projects
		education and disaster alleviation planning introduced in 2004			
Australia	State Government Victoria Interactive mapping tools and resources State WUI Regulations	Victoria Planning Provisions local authorities are delegated power to control development in the WUI	Bushfire Management Overlay Online tools and resources	Strictly enforced, local authority has power to sterilize lots from development under extreme circumstances	Good community participation and enforcement of vegetation management regulations on private land

7 Assessment of Practices and Regulatory Approaches

7.1 Performance and Results

The true performance and results of the wide variety of WUI regulations in existence across North America and Australia will only be tested during a wildfire event, or as a result of simulation research. In the absence of these test cases it is challenging to offer an objective opinion of regulation performance and results. However the Fire Protection Research Foundation (FPRF) in cooperation with NFPA commissioned a comprehensive review and assessment of WUI regulatory and planning tools in the US (Duerksen et al., 2011). This report highlights the variability in WUI regulations across 40 diverse communities and identifies a higher level of regulatory control being achieved in communities where there is a state mandate for WUI regulation. The current variability in strength of WUI regulations in BC tends to suggest that in the absence of a provincial mandate for WUI regulations, BC may be trending towards a similar situation as described in the referenced report.

7.2 Ability and Cost to Implement

Wildland urban interface regulation and planning resources across BC are highly variable and the current model appears to be for WUI regulations (where they occur) to be included in the next available OCP updates. Typically this model for regulatory additions and amendments provides the most cost efficient option for the local or regional government. Smaller local governments will rely on consultant planners to draft and effect these amendments; hence including a provincially sponsored package of regulatory changes could provide cost efficiencies.

The cost of implementation may be a significant factor in the variable implementation of WUI regulations; many local authorities do not currently have the capacity or staff resources (such as a community forester) to support implementation. The majority of authorities therefore rely on fire department and planning staff to implement new regulations, and depending on community growth characteristics, hiring part-time staff to implement new regulations may be prohibitive. There is no consistent model in the US for which specific departments take the lead in developing and implementing WUI regulations, currently these duties and responsibilities may be assumed by either fire, building, forestry, planning or code enforcement staff depending on the community (Duerksen et al., 2011).

7.3 Impacts on Local Resources

Staff responsible for developing and implementing WUI regulations are often performing these functions in addition to their regular duties and responsibilities. Conversely, in the US it appears that many more communities now have access to specialist WUI planning staff to promote and implement regulations at a state, county and local level.

7.4 Acceptance by Local Authorities/Residents

In the US, the public process for adoption of WUI regulations was reported to be significantly smoother in communities where the state required or strongly incentivized local communities to adopt WUI regulations such as California and Oregon (Duerksen et al., 2011). Additionally, the Healthy Forest Restoration Act (HFRA, 2003) in the US appears to have provided a catalyst in the development of many CWPPs which have in turn lead to the development of WUI regulations

7.5 Best Management Practices for Land Use and Development

7.6 Incentives

There should be incentives for private property owners to practice FireSmart principles and abide by WUI regulations. In the US, incentives have been provided through reduced insurance premiums or tax reductions for eligible vegetation management in the WUI. Incentives have provided for increased participation in many initiatives in recent history and also help provide recognition and peer pressure to do the right thing, as evidenced in the California FAIR insurance program.

7.7 Community Forest Agreements/Proactive Forest Management

If more communities had access to community forest agreements or a similar mechanism to manage the wildland forests adjacent to the community, it would be reasonable to expect that thinning and appropriate silviculture operations would provide an opportunity to reduce fuel hazards and re-connect community members with the forest industry as well as provide socio-economic benefit over the long-term. Community forests that implement appropriate forest management regimes should also reduce the communities' dependency on operational fuel treatment funding currently provided by UBCM. Many communities and regional districts have lost touch with pro-active forest management activities and as a result there are perceived or actual barriers to reinitiating forest stewardship (i.e., Metro Vancouver) and a preference to leave the forests unmanaged or in their "natural state" even when this "natural state" may present increased fuel hazard.

7.8 Bylaws (Zoning, Building, Subdivision)

Australia promotes a different model of bushfire (wildfire) prevention and suppression than the US by emphasizing personal risk and responsibility (if you own the fuel you own the fire). Australia's Rural Fires Act gives the rural fire service the power to order removal of hazardous fuels across both public and private lands; homeowners can be fined if they fail to perform hazardous fuel reduction (Government of New South Wales, 1997).

7.9 Planning Policies/Guidelines

The Province should consider developing a pilot project to demonstrate how existing WUI regulations and best management practices can be seamlessly dovetailed into land use, subdivision, and zoning regulations of a model community. The goal of this pilot project would be to 'embed' WUI regulations into community level planning and zoning, subdivision level planning controls, and structure protection and vegetation management regulations. Some of the lessons learned could be integrated into a best practices guide for local government and QP practitioners.

7.10 Wildfire Development Permit Area Regulations

Currently the level of sophistication and application of WUI regulations in BC is highly variable and the disparity and lack of relevant provincial level regulations is seen as an impediment to more extensive implementation to mitigate and prevent WUI fire impacts and create disaster resilient communities. The Riparian Area Regulations (RAR) provides a good example of provincial regulations which have encouraged local and regional governments to either adopt these RAR regulations or to develop local regulations which meet or exceed the provincial standards (Fish Protection Act, 2010). These regulations have also unified assessment standards and provided communities with an incentive to hire RAR trained staff to administer the regulations. In the absence of provincial WUI regulation, communities are left to determine the regulatory priority of wildfire exposure and the level of effort required to manage that exposure relative to other natural hazards that impact the community. In the absence of a provincial mandate for WUI regulations it is anticipated there will continue to be variable uptake and implementation of WUI regulations.

7.11 Natural Hazard Planning

Despite the well documented history of natural disasters, including wildfire across BC, institutional memory is considered short-term and as a result communities may move from response to recovery mode and then resume normal business without consideration of adopting a pro-active natural hazard management program. There are exceptions to this including the District of North Vancouver which has adopted sophisticated risk tolerance criteria (CDNV, 2013)and implemented a comprehensive natural hazard management program which includes three new natural hazard development permit regulations (landslide, debris flow and wildfire). An approach such as this ensures that development control regulations are enacted to ensure new development is safe from identified hazards and that risk is managed to a level termed 'As Low as Reasonably Possible' (ALARP).

7.12 Legal Instruments (Restrictive Covenants, Other)

With a few exceptions there appears to be reluctance in local government to use restrictive covenants (RC) for the regulation of present and future land-use decisions. This is in part due to a lack of enforcement capacity and easily retrievable database and tracking system for these instruments (typically a local authority has to perform a search through land titles to retrieve RC details, this can be onerous and a disincentive to the application of RC's). Wildfire Development Permit Area regulations provide better clarity and consistency of application in this regard and as such are more efficiently administered by the regulating authority. Exceptions include the District of West Kelowna and the RDCO both of which offer a streamlined development approval process where the landowners voluntarily sign an RC stating they will abide by all of the DPA requirements and guidelines. It is too early at this stage to make an assessment of the efficacy of this technique.

7.13 Infrastructure Planning

Opportunities for better infrastructure planning are limited in some aspects. For example, the pattern of road networks (road allowances) in communities was designated at the time communities were incorporated; for most communities in BC this was several decades ago. Hence there is a legacy of planned road networks within communities which at the time of drafting did not benefit from BMP's developed through FireSmart principles. This legacy may lead communities to develop in such a manner that one way ingress/egress roads are prevalent and it is difficult to correct these issues later in the community development processes. An example is provided with Berkley Road in North Vancouver where an evacuation planning assessment (B.A. Blackwell and Associates, 2006) identified serious challenges in the event of a wildfire. An associated challenge occurs where underground and overhead utilities have been installed along opened and unopened road allowances and the cost of relocating these services would be prohibitive and therefore restrict a community's ability to respond to current FireSmart BMP's.

7.14 Fire Protection Services and Infrastructure

There are examples of many communities across BC where there are limited water supply resources in the WUI and intermix areas, even large communities such as the District of Maple Ridge have large portions of the community which are not yet serviced by municipal water supply. Other communities like the Resort Municipality of Whistler rely on storage reservoirs (that store only enough water to suppress three or four house fires). During a wildfire event that cuts off electricity, the storage reservoirs cannot be recharged. This would severely limit the fire departments capability during a wildfire event.

In the absence of appropriate legislation this will almost certainly mean that municipal fire and rescue services and wildland fire-fighters will at some time in the future not have access to adequate water supply for deployment of sprinkler protection units and suppression purposes.

The US WUI regulations in Colorado, Oregon and California place significant emphasis on new developments providing adequate water supply for WUI fire-fighting, structure protection and suppression purposes. Currently, similar regulations are not evidenced in BC and this is seen as a limiting factor in WUI suppression and response capabilities.

7.15 Interface Mapping/Polygon Identification

Municipal and regional district resources and mapping capabilities across BC are currently variable and limited in capacity to process, interpret and refine the provincial WUI mapping data. A small number of local authorities have very sophisticated GIS departments and registered professionals on staff capable of interpreting and refining the provincial fuel hazard mapping resources. Others are solely reliant on outside consultants to perform these functions, and the associated financial burden can often lead to WUI fuel mapping and regulation development being given a lower priority for funding.

It is anticipated that if the Province were to provide training and support and refinements to the current WUI fuel hazard mapping this could provide more communities with more easily accessible resources to define areas of the community where WDPA regulations are most needed.

An alternative approach may be for the Province to consider providing community assessments similar in nature to those provided in Saskatchewan. Other benefits may be derived through this approach, including consistency of assessments, additional opportunities for dialogue between provincial and municipal staff, and cost savings based on the economy of scale of assessments. For example, the province of Alberta recently advertised a competitive contract similar in nature, defining the WUI around rural communities.

7.16 Emergency Communications Plans

The example of reverse 911 emergency notification services provided by La Plata and Archuleta County, CO where a family can register up to five mobile devices demonstrates the potential to leverage technology and communicate with a large population in the event of any emergency. However, there is concern amongst municipal emergency management staff that failure of a system such as this could expose the authority to litigation if citizens were not notified and came to harm as a result. Emergency management staff in BC continue to work towards developing comprehensive plans for natural hazards which can affect their particular jurisdiction; however, variability in available funding and resources can severely limit the sophistication of the plans. The WMB has proactively participated and contributed significant emergency management knowledge and resources across the Province, including but not limited to the provision of sprinkler protection units (SPU), fire danger ratings, staff liaison, and facilitating interface committee meetings and inter-disciplinary training and education/outreach materials.

7.17 Critical Issues and Impediments Affecting Community Interface Fire Management in BC

In our review of fire management planning to protect interface communities it is clear that interface wildfire is a problem that continues to grow and all jurisdictions reviewed are struggling with this. Various models and approaches have been applied in the countries reviewed, however communities in Australia, the US and Canada are consistently: 1) documenting fuel hazards through inventory, 2) completing CWPPs, 3) implementing fuel management treatments and 4) promoting the principles of FireSmart. Where there is a significant divergence in approaches it is around more stringently regulating development in hazardous wildfire areas. In both Australia and the US some state governments have developed legislation that restricts development in hazardous areas with the intent of limiting losses from wildfire.

In BC, many local and regional governments have participated in the SWPI through the UBCM by completing CWPP's and undertaking small scale fuel treatment projects. The Province has been actively developing fuel type inventory and has developed a provincial scale risk assessment to identify communities at risk. However, after completing CWPPs many communities have lacked resources and/or the political will to move beyond the planning phase. While the Filmon report (Filmon, 2004) tried to promote engagement of local and regional governments through a cost shared model it has not really affected the level of change to address the fire problems communities' face in BC.

Regional governments are further challenged by unincorporated communities with small dispersed populations that are typically more exposed to hazardous fuels and associated wildfire risk. Regional governments are mandated to provide local funded services and when an issue like wildfire does not fit within part of the service profile there is limited ability for a regional government to fund and resource something like wildfire protection of the interface. The RDCK is currently studying this issue and looking at its ability to fund an effective, long-term program.

Our review of municipal and regional governments in BC demonstrated that a limited number of communities have adopted regulations (WDPA) that enforce development standards to address wildfire hazards and community protection. While well intentioned, several communities have developed a regulatory framework that is classified as weak. In addition to municipalities some regional governments have also developed regulations that address wildfire community protection.

Other areas of concern include the amount and importance of infrastructure that communities depend on that is at risk from wildfire. Community recovery and resilience depends on minimizing the damage to critical infrastructure like water, electrical, and communications, yet there are numerous examples in BC communities that have substantial vulnerability to infrastructure loss. Additionally, more work is required to address significant egress and ingress requirements for evacuation and firefighting. Numerous CWPP's have identified infrastructure risk, significant evacuation issues, and identified areas of the community that would not be safe for structural and wildland firefighters during an interface incident.

The scale of the problem as identified in the 2004 Provincial Strategic Threat Analysis is also considered a major impediment to protecting communities. To date, the Province has implemented fuel management on a fraction of the area identified. If the size of the program is to increase to implement treatments at a scale that will reduce the overall threat to communities, more financial and resource capability will be required at all three levels of government (provincial, regional and municipal). Increases in capacity also include the need for more trained professionals to work with communities and affect treatment.

Studies in the US have shown that the current level of development within the WUI represents only 14% of the total developable WUI area. This is of great concern as it validates that the area of interface throughout North America and including BC is only going to increase overtime.

The next logical step in wildfire management policy should be to enforce a comprehensive and consistent standard of development in high hazard wildfire zones of the Province. [redacted] s.13

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s.13, s.17

8 References

Alberta ESRD, 2013. *Alberta Environment and Sustainable Resource Development. Wildland Urban Interface Plans and Projects.* http://srd.alberta.ca/Wildfire/Default.aspx (accessed March 2013

Australian Standard AS3959 1999. Amdt 1, 2000. Amdt 2, 2001. Standards Australia.

B.A. Blackwell and Associates. 2006. Greater Vancouver Regional District FireSmart Regional Joint Pilot Project. *Considerations for Wildland Urban Interface Management in North and West Vancouver.* http://www.dnv.org/upload/documents/Council_Reports/GVRD_FireSmart_Regional_Pilot_Project.htm#_Toc133317637 (accessed March 2013)

Beck, J. and Simpson, B. 2006. *Wildfire Threat Analysis and the Development of a Fuel Management Strategy for British Columbia.* Victoria: British Columbia Ministry of Forests and Range, Protection Program.

B.A. Blackwell and Associates Ltd., R.W. Gray Consulting Ltd., Compass Resource Management Ltd., and Forest Ecosystem Solutions Ltd.. (2003). Developing a Coarse Scale Approach to the Assessment of Forest Fuel Condition in Southern British Columbia. http://www.bablackwell.com/fii-report.pdf

Blackwell, B.A. and Needoba, A. 2006. *Review of Policies, Procedures and Bylaws Relating to Wildland Fire.* Prepared for the City of Kelowna.

Blanchard, B. and R.L. Ryan. 2004. *Community perceptions of wildland fire risk and fire hazard reduction strategies at the wildand-urban interface in the northeastern United States.* Proceedings of the 2003 Northeastern Recreation Research Symposium. Gen. Tech. Rep. NE- **317**:285-294.

Botts, H., T. Jeffery, S. Kolk, S. McCabe, and L. Suhr. 2012. CoreLogic Wildfire Hazard Risk Report: *Residential Wildfire Exposure Estimates for the Western United States.* CoreLogic . http://www.corelogic.com/about-us/researchtrends/asset_upload_file126_16426.pdf (accessed March 2013)

Bradshaw, W.D. 1988. Fire protection in the urban/wildland interface: who plays what role? *Fire Technology.* 195-203.

British Columbia First Nations. 2009. *Forest Fuel Management Working Group Annual Report 2008-2009.* http://fness.bc.ca/uploads/pdfs/forest/FFMWG_AR09R.pdf (accessed March 2013)

California Department of Forestry and Fire Protection. 2005. Riverside Unit Fire Management Plan. http://www.fire.ca.gov/fire_protection/downloads/airbase_relocation_09_apx_riverside_mgt_plan.pdf.

California FAIR Plan Association. 2009. Policy Holders: Brush/Wildfire Information. http://www.cfpnet.com/BrushWildfireInfo_Sept.html (accessed March 29, 2013)

Carlson, D. 2012. *Preparing for Climate Change: An Implementation Guide for Local Governments in British Columbia.* Vancouver: West Coast Environmental Law

City of Chilliwack. 2013. Development Permits. http://www.chilliwack.ca/main/page.cfm?id=2182 (accessed March 2013)

City of Palm Coast (CPC) Florida. 2013. Division of Community Development. http://www.palmcoastgov.com/Government/Departments/Community_Development/ (accessed March 2013)

City of Parksville. 2009. *Official Community Plan Part 5 Development Permit Area No. 27 Wildfire Interface Management Area Regulations.* https://parksville.civicweb.net/Documents/DocumentDisplay.aspx?ID=432 (accessed February 2013)

City of Pitt Meadows. 2013. *City of Pitt Meadows Official Community Plan. Part B: Area Specific Guidelines. Development Permit Area No. 1-Environment and Wildfire Protection Area.* http://www.pittmeadows.bc.ca/assets/Planning/pdfs/Section_6_-_DP_Area_No__1.pdf (accessed March 2013)

Cohen, J.P. 1988. *A site-specific approach for assessing the fire risk to structures at the wildland/urban interface.* USDA Forest Service Fire Research. 5pp

Colorado Department of Revenue. 2009. FYI: Wildfire Mitigation Measures Subtraction. Denver: Colorado

Corporation of the District of North Vancouver. 2012. *DNV Official Community Plan. Schedule B. Wildfire Hazard.* http://www.dnv.org/upload/pcdocsdocuments/1tp7l01_.pdf (accessed March 2013)

Corporation of the District of North Vancouver. 2013a. *Building and Development. Natural Hazards Management Program.* http://www.dnv.org/article.asp?a=5625 (accessed February 2013)

Corporation of the District of North Vancouver. 2013b. *Natural Hazards Management Program. Risk Tolerance.* http://www.dnv.org/upload/documents/Engineering/Risktolerance.pdf (accessed March 2013)

Cottrell, A. and D. Lowe. 2005. Policy, planning, practice, politics and the COAG natural disasters review: delivering to bushfire risk communities – a Queensland Perspective. Briefing Paper No. 3. Bushfire Cooperative Research Centre, James Cook University. pp 1-29.

Dale, L. 2006. Wildfire Policy and Fire Use on Public Lands in the United States. Society and Natural Resources. 19(3): 275-284.

Denver Water. 2013. From Forests to Faucets: U.S. Forest Service and Denver Water Watershed Management Partnership. http://www.denverwater.org/supplyplanning/watersupply/partnershipUSFS/ (accessed March 2013)

Diaz, J.M. 2012. Economic Impacts of Wildfire. Southern Fire Exchange. http://www.southernfireexchange.org/factsheets/2012-7.pdf (accessed March 2013)

District of Elkford. 2013. *Official Community Plan – Schedule "A". Chapter 7.0 Resilient Infrastructure and Diverse Opportunities. Section 7.4 Natural Hazards: Fire Protection and Wildfire Interface.* https://elkford.civicweb.net/Documents/DocumentList.aspx?ID=3917 (accessed February 2013)

District of North Saanich (DNS). 2012. District of North Saanich Referral-Official Community Plan (OCP) 2012-03 Amendment Bylaw NO. 1309, A Bylaw to Amend OCP Bylaw No. 1130. http://www.crd.bc.ca/reports/planningtransportati_/2012_/10oct24_/24october2012northsa/24october2012northsa.pdf (accessed February 2013)

District of West Kelowna (DWK). 2013. *A Guide to Wildfire Development Permit Requirements in the District of West Kelowna (Accompanies "Development Permits, A Guide to the Development Permit Process")* www.districtofwestkelowna.ca (accessed March 2013)

Dombeck, M.P., J.E.Williams and C.A. Wood. 2003. Wildfire policy and public lands: integrating scientific understanding with social concerns across landscapes. *Conservation Biology*. **18**:883-889

Douglas County Government. 2012. Building Code Amendments. Exhibit B: Wildfire Mitigation Standards. http://www.douglas.co.us/building/documents/2012-code-amendments.pdf

Douglas County Government. 2013. Wildfire Hazard Regulation for Building and Development. http://www.douglas.co.us/zoning/zoning-resolutions/section_17_wildfire_hazard_-_overlay_district/ (accessed February 2013)

Duerksen, C., D. Elliott, and P. Anthony. 2011. Addressing Community Wildfire Risk: A Review and Assessment of Regulatory and Planning Tools. Fire Protection Research Foundation.

Filmon, G. 2004. *Firestorm 2003-Provincial Review*. Report to the Premier of British Columbia. http://bcwildfire.ca/History/ReportsandReviews/2003/FirestormReport.pdf (accessed March 2013)

Fire Protection Association Australia (FPAA). 2013. Bushfire Planning and Design training and accreditation. www.fpaa.com.au/bpad.aspx (accessed March 2013)

FireSmart Canada. 2013. A project of Partners in Protection www.firesmartcanada.ca (accessed March 2013)

FireWise South Africa (SA). 2012. The FireWise Communities Program. www.firewisesa.org.za (accessed March 2013)

First Nations Emergency Services Society. 2009. Provincial Strategic Wildfire Prevention Initiative (SWPI)(Crown Lands). http://fness.bc.ca/uploads/pdfs/forest/swpi_crownlands_may2012.pdf (accessed March 2013)

Fish Protection Act. 2004 (amended 2010). Riparian Areas Regulation. B.C. Reg. 376/2004. Queen's Printer: Victoria, BC

Forest Practices Board. 2006. *Post-Wildfire Hazard Assessment and Risk Management*. Special Report. FPB/SR/24. http://www.fpb.gov.bc.ca/SR24_Post_Wildfire_Hazard_Assessment_and_Risk_Management.pdf (accessed March 2013)

Government of Canada. 2003. *Threat Analysis: Threats to Canada's Critical Infrastructure*. Office of Critical Infrastructure Protection and Emergency Preparedness. Report No. TA03-001.

Government of New South Wales. 1997. New South Wales Rural Fires Act 1997 No. 65.

Government of Quebec. 2013. *Forest Fires.* http://www.urgencequebec.gouv.qc.ca/portail/quebec/pgs/commun/urgence-quebec/que-faire/incendie-foret/?lang=en (accessed March 2013)

Government of Saskatchewan. 2013. *Wildfire Management. Proposed Wildfire Act.* http://www.environment.gov.sk.ca/Default.aspx?DN=a4fd9403-facf-42e6-8469-4d224f4e52a2

Healthy Forest Restoration Act (HFRA). 2003. Full text: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=108_cong_public_laws&docid=f:publ148.108.pdf

Hvenegaard, S. 2012. National Wildland Fuels Management Survey (Revised) Contract Report CR-729(R)

Impact DataSource. 2013. The Full Cost of New Mexico Wildfires. http://pearce.house.gov/sites/pearce.house.gov/files/6%20Full_Cost_of_New_Mexico_Wild_Fires_1-24-13.pdf (accessed March 2013)

Insurance Bureau of Canada (IBC). (1998). Facts Book 1998. Insurance Bureau of Canada, Toronto.

Insurance Bureau of Canada (IBC). (2008). Facts Book 2008. Insurance Bureau of Canada, Toronto.

Insurance Information Institute. 2008. International Insurance Fact Book: World Rankings. Insurance Information Institute, Accessed June 4, 2008 from: http://www.iii.org/international/rankings/

International Code Council (ICC). 2008. National Wildland Urban Interface Council. www.iccsafe.org (accessed March 2013)

Johnson, K., P. Maczek, and L. Fremont. 2005. Saskatchewan Community Wildfire Risk Assessment Project. www.environment.gov.sk.ca (accessed March 2013)

Karels, R. J. and A. Putnam. 2010. *Wildfire Risk Reduction in Florida: Home, Neighborhood, and Community Best Practices*. Florida Department of Agriculture and Consumer Services. Division of Forestry. Forest Protection Bureau. http://www.floridaforestservice.com/wildfire/wf_pdfs/Wildfire_Risk_Reduction_in_FL.pdf

Keeley, J.E. 2009. Adapting to Wildfires on the Urban Edge in Southern California. UCLA, Department of Ecology and Evolutionary Biology http://www.environment.ucla.edu/media/files/Oppenheim-Keeley-Oct09.pdf (accessed March 2013)

Kumagai, Y., J.C. Bliss, S.E. Daniels, and M.S. Carroll. 2002. Research on causal attribution of wildfire: an exploratory multiple-methods approach. Society and Natural Resources. 17:113-127.

La Plata County Colorado (LPCCO). 2013. Emergency Management Office. http://laplatacountyoem.blogspot.ca/ (accessed March 2013)

Leonard, J. and P. Bowditch. 2003. Findings of studies of houses damaged by bushfire in Australia. Presentation to 3rd International Wildland Conference. Sydney, Australia.

Line of Duty Death Canadian Firefighters. 2013. http://www.firefightingnews.com/lodd-CA.cfm (accessed March 2013)

Ministry of Forests, Lands and Natural Resource Operations. 2010. *Wildland Fire Management Strategy. Achieving Global Excellence in Fire Management.* http://bcwildfire.ca/prevention/PrescribedFire/docs/BCWFMS.pdf (accessed March 2013)

Morton, D.C., M.E. Roessing, A.E. Camp, and M.L. Tyrrell. 2003 Assessing the Environmental, Social, and Economic Impacts of Wildfire. Global Institute of Sustainable Forestry Research Paper 001. (59 pages) http://environment.yale.edu/gisf/files/pdfs/wildfire_report.pdf

Munich Re. 2013. 2012 Natural Catastrophe Year Review. PowerPoint presentation. January 2, 2013..

National Fire Protection Association (NFPA). 2013. Firewise Communities/USA Recognition Program. http://www.firewise.org/communities.aspx (accessed March 2013)

Natural Resources Canada (NRC). 2013. *Fire.* http://cfs.nrcan.gc.ca/pages/153 (accessed March 2013)

Nelson, K.C., M.C. Monroe and J.F. Johnson. 2005. The look of the land: homeowner landscape management and wildfire preparedness in Minnesota and Florida. Society and Natural Resources. 18:321-336.

Office of Policy Analysis. 2012. *Wildland Fire Management Program Benefit-Cost Analysis: A Review of Relevant Literature.* U.S. Department of the Interior.

Office of the Auditor General of British Columbia. 2005. *Joint Follow-up of 2001/2002: Report 1 Managing Interface Fire Risks and Firestorm 2003 Provincial Review.* Victoria: British Columbia. www.bcauditor.com (accessed February 2013)

Ontario Ministry of Natural Resources (MNR). 2011. Aviation, Forest Fire, and Emergency Services. http://www.mnr.gov.on.ca/en/Business/AFFM/2ColumnSubPage/STEL02_165444.html (accessed March 2013)

Orange County Fire Authority (OCFA). 2013. Planning and Development Services Section. http://www.ocfa.org/menu/departments/FirePrevention/PlanningDevelopment.aspx (accessed March 2013)

Oregon Department of Forestry (ODF). 2013. Oregon Forestland-Urban Interface Fire Protection Act. http://www.oregon.gov/odf/pages/fire/sb360/sb360.aspx accessed March 2013

Province of Manitoba. 2013. Manitoba Conservation Fire Program. http://www.gov.mb.ca/conservation/fire/index.html (accessed March 2013)

Province of Manitoba. n.d. Manitoba Office of the Fire Commissioner. Fire and Life Safety Education. http://www.firecomm.gov.mb.ca/safety_education.html (accessed March 2013)

Public Safety Canada (PSC) Canadian Disaster Database (2007) http://www.publicsafety.gc.ca/prg/em/cdd/index-eng.aspx

Reddy S. , 2000. Factors influencingthe incorporation of hazard mitigation during recovery from disaster. Natural Hazards, 22 185-201

Regional District of Central Okanagan (RDCO). 2013. Wildfire Development Permit Area Regulations. www.regionaldistrict.com accessed March 2013

Regional District of East Kootenay (RDEK). 2013. Protection of Development from Hazardous Conditions. www.rdek.bc.ca accessed February 2013

Regional District of North Okanagan. Rural Vernon OCP 2003. http://www.rdno.ca/bylaws/1708_rural_vernon_ocp.pdf

Sandink, D. (2009). *The resilience of the City of Kelowna: Exploring mitigation before, during and after the Okanagan Mountain Fire.* Toronto: Institute for Catastrophic Loss Reduction. http://www.iclr.org/images/ICLR_Report_Kelowna_D4_2.pdf (accessed March 2013)

Society for Protection of Forests Against Fire (SOPFEU). 2013. Advice to Diminish the Risks attached to Forest Fires. http://www.mrn.gouv.qc.ca/publications/enligne/forets/parefeu/index.asp (accessed March 2013)

State Government of Victoria. 2013a. *Bushfire Management Overlay Interactive Guide.* Department of Planning and Community Development. http://www.dpcd.vic.gov.au/planning/plansandpolicies/bushfire-planning-and-building-resource/bushfire-management-overlay/bushfire-management-overlay-interactive (accessed March 2013)

State Government of Victoria. 2013b. *Planning and Building for Bushfire Protection.* Department of Planning and Community Development. http://www.dpcd.vic.gov.au/planning/plansandpolicies/bushfire-planning-and-building-resource/building-for-bushfire-protection (accessed March 2013)

Steelman, T. A. 2007. Addressing the Mitigation Paradox at the Community Level. IN MARTIN, W. E., RAISH, C. & KENT,B. (Eds.) Wildfire Risk: Human Perceptions and Management Implications. Resources for the Future, Washington, DC.

Stephenson, C. 2010. *The impacts, losses and benefits sustained from five sever bushfires in south-eastern Australia: Fire and adaptive management.* Report No. 88. Department of Sustainability and Environment. Bushfire Cooperative Research Centre http://www.dse.vic.gov.au/__data/assets/pdf_file/0020/141815/Impacts-Losses-of-Fire-Report-88.pdf (accessed March 2013)

Talberth, J., R.P. Berrens, M. McKee, and M. Jones. 2005. Averting and insurance decisions in the wildland-urban interface: implications of survey and experimental data for wildfire risk reduction policy. Contemporary Economic Policy. 21pp.

Texas AgriLife Extension Service. 2011. Agriculture Losses from Texas Wildfires Adding Up. Insurance Journal. http://www.insurancejournal.com/news/southcentral/2011/09/30/218065.htm (accessed March 2013)

Town of Banff. 2013. Land Use Bylaw No.31-3. http://www.banff.ca/DocumentCenter/View/643 (accessed February 2013)

Union of BC Municipalities (UBCM). 2013. Strategic Wildfire Prevention Initiative Program. http://www.ubcm.ca/EN/main/funding/community-safety/strategic-wildfire-prevention.html (accessed February 2013)

USDA Forest Service. 2010. National Database of State and Local Wildfire Hazard Mitigation Programs. http://www.wildfireprograms.usda.gov/ (accessed March 2013)

Western Forestry Leadership Coalition. 2010. *The True Cost of Wildfire in the Western U.S.*

Wikipedia. 2013. List of Wildfires. http://en.wikipedia.org/wiki/List_of_wildfires#North_America (accessed March 2013)

Wildland Fire Leadership Council. 2004. Large fire suppression costs, strategies for cost management. Washington D.C.: Wildland Fire Leadership Council. http://www.fs.fed.us/fire/ibp/cost_accounting/costmanagement_aug_04.pdf (accessed March 2013)

Wildland Ignition Zone Education (WIZE). 2013. Online mapping tool. https://apps.intterragroup.com/wize/ (accessed March 2013)

Winter, G. and Fried, J.S. 2000. Homeowner perspectives on fire hazard, responsibility, and management strategies at the wildland-urban interface. *Society & Natural Resources*. 13:33-49.

Zillante, G. and S. Hamnett. 2005. Planning to mitigate environmental risks: An Australian case study of planning for bushfire prone areas. Paper to the Eastern Region Organisation for Planning and Housing Conference, Yogyakarta, 15pp.