Community Wildland Fire Protection Plan for the District of Tumbler Ridge

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Executive Summary

The community was founded in association with the province's last resource "mega-project". Located on the eastern foothills of the Rocky Mountains in northeastern BC, planning for Tumbler Ridge began in 1975. The Provincial Government, through the Ministry of Municipal Affairs, managed the design and the community opened in 1986. While projections originally suggested that the population growth could exceed 10,500 people, the 1991 population was 4,500 and the 1996 population was 3,800. The population has currently stabilized at just over 3,200.

The forest within the Fire Protection District has significant amounts of lodgepole pine. The mountain pine beetle (MPB) that has infested pine species in epidemic proportions in BC during the last few years, crossed the Rockies to settle in the Protection District in 2002. Localized MPB outbreaks have occurred in the Wolverine, Bullmoose and Murray drainages. Based on information supplied by Brian Pate of Chetwynd Forest Industries, West Fraser Mills Ltd. there is likely to be a spread of MPB toward the town unless -40C winter temperatures or cold spring temperatures are experienced for several weeks in the next few years.

BC provincial regional districts, municipalities, and fire departments are currently creating wildland interface fire management plans because weather patterns and flammable vegetation have created a high-risk for interface fires. Planning, fire hazard assessment mapping and interface hazard mitigation through fuel reduction have been the focus of protection plans.

The overall objectives of BC wildland fire protection plans are to:

- Empower communities to organize, plan, and take action on issues impacting community safety,
- Enhance levels of fire resistance and protection to the community,
- Identify hazards related to wildland/urban fires in the area, and
- Identify strategies to reduce the hazards in homes and businesses in the community.

As a result of the potential mountain pine beetle infestation, the general lack of accessible water outside the town site, the nature of the forests and the high recreational and industrial use in the Protection District, Tumbler Ridge sought a fire protection plan that would address mountain pine beetle issues and provide recommendations to reduce fire hazard in the interface. The Fire Department, under the auspices of Fire Chief Dan Golob, forwarded an application for a grant from UBCM to create the plan.

In response, this protection plan offers:

- Hazard assessment with Ministry of Forests standard criteria,
- GIS hazard map production,
- Generation of wildland fire hazard mitigation recommendations and
- A series of mountain pine beetle preventive treatment recommendations.

The term fire hazard is based on physical conditions rather than on fire weather and human behaviour whereas fire risk is the probability of a fire starting determined by the presence of causative agents. An assessment of fire hazard includes fuel load, condition of herbaceous vegetation and presence of ladder fuels.

The Tumbler Ridge Fire Protection Plan is based upon the hazard assessment ratings established for the Protection District, and interactions with Tumbler Ridge's Fire Chief, civic employees, and several other agencies including Ministry of Forests and West Fraser Mills Ltd. Robin Clark, assisted by Sophie Gerbaud, completed field hazard assessments; Sharon Hope collaborated in mapping as well as contacted stakeholders about strategies. She sought information from local Tumbler Ridge representatives and compiled specific information within the report concerning the hazard assessments, the policy review and educational strategies. Ken Cheung and Naa Lanquaye of ASIM collected baseline files from a number of sources and produced the GIS files related to the hazard zones. They created the map portraying these hazard zones.

The wildland interface hazard mitigation recommendations for the Protection District of Tumbler Ridge are:

1) Formation of a Wildland Fire Protection Committee for the Protection District to include representation from the provincial government, particularly Ministry of Forests, Ministry of Highways, the Regional District, representatives from the coal/oil and gas industries, the forest industry, BC Parks, land developers, the Fire Chief, and other non-government organizations as appropriate. The group would use the Wildland Protection Plan as a starting point for collaboration on wildland fire protection concerns and mountain pine beetle preventive treatment. Five and ten year plans are encouraged.

2) Through the Wildland Fire Protection Committee, to consider incorporating wildland fire mitigation goals into the District's Plan (OCP), as well as to consider introducing restrictive by laws or ordinances for fire safe building materials in certain locations such as the proposed rural development sector.

3) Through the Committee, to recognize a 2 km radius and an additional 8 km radius about the town site and industrial area respectively, as main areas of concern and treatment. The 2 km radius is the theoretical spotting distance from a fire based on modeling conducted by Ministry of Forests.

4) Through the Committee to appoint a qualified professional, to space trees appropriately and prune to 2.5 m height about the perimeter area of the town site (within a 2 km radius) and to make prescription recommendations for the 8 km radius monitoring area. Prescribed burns could be conducted to remove grass in the spring along roadsides and greenspaces about the town site.

5) To discuss modifying the tree density in the small parks in the suburban and/or residential areas in the town. Spacing of 2.5 m between crowns is recommended

as well as the removal of ladder fuels. Sign posting for fire hazard in the access trails in the recognized trail system would be desirable.

6) The Committee could explore the possibility of a planned network of greenspace/firebreaks for the town site and Protection District as a whole. The town site has a number of green open spaces and expansion of this concept is recommended. The Hourglass Creek fire has resulted in a firebreak near the town.

7) As town site expansion occurs, the Committee could review water supply sources for the Protection District including its commercial and rural development areas. The creation of several cisterns, storage tanks or other methods of water storage could be an interim solution for these neighbourhoods. Static water bodies could be mapped.

8) To explore through the Wildland Fire Protection Committee, the creation of a wildland fire educational strategy that would include mountain pine beetle symptom recognition. The cooperation and support of MOF Forest Protection officers would be useful for part of the education component.

9) To work with BC Hydro on a review of hazard mitigation policy on transmission lines, as well as to collaborate with Ministry of Forests, BC Parks, Ministry of Highways and other large tract property owners, on a review of systems for maintaining wildland fire hazard free transportation, easement and seismic corridors.

10) To work with developers and industry to resolve issues of fire vehicle access, general woody fuel mitigation, and fire safe building materials. Creating cleared buffers of 10-20m about the perimeters of large properties in the designated industrial area of the town site is encouraged as appropriate.

11) To engage in media coverage and enhanced website postings for wildland interface hazard mitigation.

12) To consider demonstration areas as part of an overall educational strategy.

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1. Introduction

Forest fires have shaped the world's forests and will continue to be a major agent of change. On average, 9,500 forest fires burn more than 3 million hectares of Canadian forests annually. British Columbia, with approximately 2000 wildland fires yearly, has the highest risk of interface fires in Canada because of its climate and topography. The risks are increasing as a result of two key factors-the continuing growth in the number of people choosing to live in or near forests and grasslands and the significant build up of forest fuels resulting from years of successful fire suppression activities. The current epidemic proportion of mountain pine beetle infestation in BC's Interior is contributing to greater fire hazard.

The Protection District of Tumbler Ridge, with a population just over 3,200, supports tourism, mining, forestry and agriculture. Ownership in Tumbler Ridge is mixed consisting of municipal, Crown lands, small private lots and large resource industry holdings. Property values in Tumbler Ridge town site vary but are increasing; single-family homes are typically valued from approximately $165,000 - $250,000. There are several condominium complexes and several large mobile home camps that cater to mine workers. The town site is very compact but on the periphery there is a golf course, cemetery, several playing fields, stable, water treatment facility and landfill as well as other open space use. Tumbler Ridge District places high value on its beautiful scenery and wishes to preserve the aesthetics of the town site.

The Protection District of Tumbler Ridge is home to coal mining and the oil and gas industries. Western Coal Company (WCC) began operating in Tumbler Ridge in December 2004. In 2005, WCC was granted a permit for the Wolverine Coal mine 25 km west of the Tumbler Ridge town site. It is an open-pit type that is expected to produce 2.4 million tonnes per year. This project has created 250 construction jobs and will create 220 full time production jobs over 11-years. NEMI is a coal development company that owns the Trend and Saxon Properties both located south of Tumbler Ridge. NEMI received approval to develop the Trend Mine site in May 2005. Production began in 2005 and is expected to increase to 2 million tonnes per year by 2008. Hillsborough Resources Ltd.'s project, known as the Horizon project, started drilling in March 2005. Production should start at the end of 2006. The Canadian Coal Trust is considering reopening the Quintette Coal mine closed in 2000.

In terms of oil and gas companies, the most active companies in Tumbler Ridge are: Encana Corporation, Burlington Resources Canada, Canadian Natural Resources Ltd., Talisman, Devon ARL Corporation, Shell, PetroCanada and Imperial Oil. Suncor Energy has recently purchased significant assets from Dominion Exploration in the Tumbler Ridge area.

Wildland interface fires in Tumbler Ridge Protection District are problematic because:

- They can be more difficult to control due to the access problems in the Protection District and the extent of continuous forest,
- They behave differently than structural fires,

- The inhabitants of interface areas often have come directly from other localities or are transient and may not be aware of the fire hazards associated with their community and,
- The community faces the possibility of a major mountain pine beetle infestation close to or within the town site within the next two years (Brian Pate personal communication 2006).

In 1994, the Garnet fire near Penticton destroyed 18 homes and many other structures and caused the evacuation of more than 3,500 people. It damaged more than 5,500 hectares and cost the provincial government more than $5 million to engage. The FireStorm of 2003 in the Central Interior caused the destruction of over 300 homes. These phenomena may be repeated in future within other BC jurisdictions such as Tumbler Ridge. In fact, on July 3rd 2006, Tumbler Ridge was evacuated due the Hourglass Creek fire that had grown to approximately 11,000 ha and had moved close to the town. In an interview, Fire Information Officer Dean Fenn remarked: "It's more the fuel types that are presenting the problem"... "The drying during the day is pre-heating the fuel and that's creating the difficulty."

Weather is a dominant factor in wildland fire. The last ten years' average fire weather shows an index with an equivalent fire hazard less than Rank 4. The 2003 fire weather patterns are above the ten-year average reaching Rank 5 for extended periods; patterns for 2004 and 2005 are, so far, quite similar to 2003. **The next few years are predicted to be drier than the ten-year average and, as a result, BC municipalities, Protection Districts and improvement districts are concerned about the impact of wildland fire on their respective communities.**

Figure 1: Fire Weather Index: Ten -Year Average and 2003.
Source: BC Forest Service Protection Branch.

The prevalence of fires during a particular period of the fire season differs across the province. Tumbler Ridge District, in the boreal forest region, for example, is more likely to have fires in early spring in stands of old growth spruce when the sphagnum is dry and the ground is frozen. On the other hand, in the late fall, lodgepole pine stands are more likely to be dry and fires could occur after the night temperatures have dropped below freezing. Unfortunately, there is virtually no information about how these forests will respond to fire if the mountain pine beetle infestation spreads in the District.

While recognizing the unique differences between Tumbler Ridge and other communities in the province, the Protection Plan for the District will address several avenues for wildland interface fire hazard mitigation:

- Community Interface Hazard Assessments,
- Hazard Mapping and,
- Technical, Policy, and Educational Strategies.

Procedurally, Tumbler Ridge Fire Department liaises or requests the services of the Ministry of Forests Protection Officers for all wildland fires. However, if the manpower and equipment has already been allocated to a fire with a greater imminent danger to a population and consequently a higher priority, the agency may limit a call for the Tumbler Ridge area. Since wildland fires can travel rapidly, the District of Tumbler Ridge must be able to respond quickly to potential fires, have in place ordinances that address wildland fire hazard mitigation and develop public relations programs that successfully engage the public in reducing hazards. Tumbler Ridge has only two major exit routes and given the expanse of forest surrounding the town site, evacuation could be a problem.

According to Stan Harvey of the Prince George Fire Centre, the Hourglass Creek fire advanced to within 8 km of Tumbler Ridge. Due to a dry northeast wind, it moved at a rate of 33 m/minute. The fire burned through young cut blocks that slowed it slightly but it progressed rapidly through the old growth white spruce and lodgepole pine that contained heavier fuels. Stan commented that he had not seen fire behaviour of this type for many years. He stated that the south west side of town also should be a concern in terms of fuels and future fires.

The purpose of the District of Tumbler Ridge's Wildland Interface Fire Protection Plan is to consider alternatives and strategies that will generally follow or expand upon, BC Ministry of Forests FireSmart recommendations. These strategies involve silviculture, regulation and education. The recommendations for each of these categories have been tailored to either the larger District or the town site. The Protection Plan seeks to integrate wildland interface fire protection treatment in general and preventative treatment recommendations for potential mountain pine beetle infection in lodgepole pine-dominant stands.

2. Description of Tumbler Ridge's Wildland Interface

General Characteristics

Since the municipal and Protection District boundaries of Tumbler Ridge are identical, we have used the Protection District as our focus. The District is large, consisting of slightly more than 159,000 ha; it contains some steeper slopes, gently rolling terrain, broad benches and alluvial floodplains. Inaccessible forest by road occurs in many locations. Tumbler Ridge, a distinctive feature on the landscape, lies to the east of the town. The biogeoclimatic classification for the Protection District falls into three major zones. Engelmann Spruce Subalpine Fir covering 50% mostly in the southwest portion of the District, Boreal White and Black Spruce (BWBS) in the northeast portion, surrounding the town of Tumbler Ridge and covering 40% of the District and the Sub Boreal Spruce (SBS) in the valley bottoms of the Murray and Wolverine Rivers covering 15% of the District. Since the area surrounding the town is of highest importance, the BWBS zone and the associated subzones are discussed in more detail.

The Boreal White and Black Spruce zone covers most of the Alberta Plateau in British Columbia's northeast. It is one of the largest ecological zones covering about 10% BC's total area. Winters in this zone are long and extremely cold and the summer growing season is short but warm. Trees and most other plants grow slowly in the cold climate and dead plants decompose slowly. The topography of the zone ranges from flat on the Alberta Plateau to rolling in the Rocky Mountains foothills and the mountains of BC's northwest.

The boreal nature of the BWBS climate is reflected in the vegetation of the zone. True climax forests are largely unknown in the BWBS as few (if any) areas have escaped fire for several hundred years. Hypothetical climax forests may be dominated by white spruce and/or black spruce or perhaps subalpine fir (rare, probably because of repeated burnings and lack of seed). Fire has had a major influence on the development of many plant communities. Seral (non-climax) stands of predominately aspen or balsam poplar dominates the lower elevations, whereas seral lodgepole pine stands are common at the higher elevations and on coarse-textured soils.

The BWBS zone within the District consists of two subzones or variants. The area that surrounds the town is called the Peace Moist Warm variant BWBS mw1 and the adjacent area, at slightly higher elevation, is called the Murray Wet Cool variant BWBS wk1. The BWBS mw1 is found in the 750 to 1050 metres range of elevation and has seasonal precipitation from May to September averaging 290 mm and 485 mm annually. The BWBS wk1 is found in the 1050 to 1200 metre elevation range with seasonal precipitation of 320 mm and annual precipitation of 645 mm.

Specific Characteristics

Residents of Tumbler Ridge are outdoor-oriented. They make frequent use of the interface and have created informal trails for all terrain vehicles, mountain biking, horses and hiking. They make use of secondary roads for fishing, hunting and camping. There are several designated parks near by and a series of recognized and sign-posted hiking trails exist.

Available water in interfaces for fire fighting is an issue because hydrants are located near the denser clusters of residences in the town site and there are no hydrants in the Protection District beyond the industrial development just outside the town. The oil and gas resource industry provides its own fire fighting crew.

Large tracts of lodgepole pine can be found on slopes near the Murray River as well as in the Wolverine and Bullmoose drainages. Windthrow is quite common in the older lodgepole pine stands. The Murray River northwest of the town forms a steep canyon that parallels Highway 29. This area is largely inaccessible by road from the highway. The sides of canyon have old growth spruce forests with ample woody debris and deep sphagnum. Older mature pine and white spruce stands with woody debris and deep sphagnum can be found near Highways 29 and 52 within the District boundaries.

The Town Site

The town site has a similar vegetation pattern to the District. It is surrounded by either main canopy lodgepole pine, or lodgepole pine with a subcanopy of white spruce. There are also mixes of aspen, lodgepole pine and white spruce. Some almost pure aspen stands are found close to the Murray River and Flatbed Creek. In more moist, ponded conditions, black spruce can be found. This vegetation type exists near the industrial site approximately 10 km from town adjacent to the airport.

There are several neighbourhoods or designated activity areas in or near the Tumbler Ridge town site:

Commercial Area

Tumbler Ridge's commercial area, south west of town, contains a number of businesses and several churches. The area is generally flat but the forest at the interface is located on mild to steeper slopes close to the commercial buildings. The stands are mostly mixed coniferous and deciduous types with some debris and ladder fuels. Fire response and hydrant coverage are good, since it is in close proximity to town. The area also has evidence of recreational use.

Golf Course and Stables

These two locations are situated north of town, the golf course to the northwest and the stables northeast. Both locations have surrounding forest with predominantly conifer or mixed stands. The litter layer in some locations is moderately deep due to sphagnum moss and there is some woody debris. The proximity of these recreational facilities to the town is a concern for wildland interface fire occurrence. The stables in particular have buildings that may not meet fire code. It has hay storage and the buildings are surrounded by coniferous or mixed stands. Grassy openings are found on the edge of the forest in the stable location. Both of the areas are within 15 minutes fire response time but have low hydrant coverage.

Mobile Trailer Camps, Cemetery, Sewage Treatment and Landfill

Mixed dense stands with ladder fuels exist on the road to the cemetery. There is partial hydrant coverage for this location. The landfill and treatment plant are located in an open area but the landfill may have fires burning from time to time and these could produce firebrands that could affect the surrounding forest. There is a supervisor on site, however. The mobile home or "man" camps are located in open areas but do have wildland interface adjacent. The major concern here would be accidental fire starts that could spread to nearby stands.

Industrial Area

This area, located south of town has a 15-minute fire response time but has only one hydrant. This site has several industries with high fuel potential. There is a sawmill site, for example, near the interface that has sawdust piled close to the forest and stacks of logs distributed about the site. The topography of the industrial area is generally flat; the surrounding stands are predominantly coniferous with woody debris and variable litter depths. A fire occurred this year on the sawmill site and scorched the adjacent stands at the perimeter of the property. As a result of the conditions at the industrial site, it is a priority for interface fire hazard rating assessment and mitigation.

Residential Neighbourhoods

The residential neighbourhoods have high-density housing. In this area, there can be at times, relatively dense conifers or mixed stands that are adjacent to gardens, or close to the houses. There are scattered small parks with coniferous stands and potential ladder fuels throughout. These parks are well used by residents. In terms of structures, log garden sheds, wood fences, and houses with wood siding may be a concern in some cases but there are few if any cedar shake roofs. The houses are close together indicating that if one house catches fire that it might be difficult to control the spread to others. The response time is very short in these areas and they have good hydrant coverage. Front yards are usually free of shrubs and trees. One multifamily complex lies in an area almost completely surrounded by interface and has had several fires in the buildings. Along Mackenzie Way there are lots for sale in mixed or coniferous interface that could be spaced and ladder fuels removed.

Rural Property Development

This area lies to the north of the industrial site and has been logged recently. At the moment, there are no houses on the site and there is no available water. No potential evacuation plans have been formulated in case of fire and consideration has not been given as yet to the use of FireSmart building materials or future development restrictions.

Firebreaks

There are natural and manmade firebreaks in Tumbler Ridge District, including large vegetation-free zones that have been made surrounding the mines and gas rigs. There are a number of seismic lines, buried gas lines and other corridors that could act as firebreaks but at the same time some of these may be classified as hazards. Current firebreaks could be mapped and incorporated into a planned firebreak network over the

next 10 years. For example, as a result of the Hourglass Fire, the Bear Hole road has been widened.

This would provide a framework for future planning in the design of the town and its protection.

To summarize, Tumbler Ridge's current low, moderate and high wildland interface fire hazard ratings are related to several factors.

The Protection District of Tumbler Ridge:

- ***Is treed with conifers and has steep terrain in some locations,***
- ***Has had fire suppression in effect for many decades,***
- ***Has only two main access roads with narrow dead end roads branching from the main roads,***
- ***Has no past community interface fire hazard assessments***
- ***Has poor or limited available water supply for engaging interface fires (few hydrants) in some cases,***
- ***Has an average response time of 15 minutes for the town and industrial site but some areas in the Protection District response times are over one half hour,***
- ***Is a recreation destination and has potential for population growth and***
- ***Has a potential for mountain pine beetle infestation in or close to the town site over the next two years.***

As a result of these factors, specific strategies are necessary to respond to wildland interface fire hazards.

Figure 2: Debris In An Interface. Source: Robin Clark and Sophie Gerbaud.

Figure 3: Common Tumbler Ridge Ladder Fuels. Source: Robin Clark and Sophie Gerbaud

Figure 4: A Mixed Stand Typical of Moderate Hazard in the Wolverine Drainage. Source: Robin Clark and Sophie Gerbaud

3. Background Information

The purpose of this section is to give a brief summary of several aspects affecting BC wildland interface fire dynamics and the Tumbler Ridge Protection District: these include fire behaviour, fire spread, natural succession after fire and mountain pine infestation.

General descriptions of wildfire behavior focus on where the fire occurs in the vegetation: underground, on the surface, and in tree crowns. Underground fires are those fires that burn below the surface such as peat fires. Here dead plant materials burn and smolder below the surface in dry wetlands. These fires can occur in boreal forests. During surface fires, fuels at or near ground level, such as grass, shrubs, and/or fallen leaves and branches, carry the fire. Crown fires burn through the treetops usually carried there by understory vegetation. In general, the relative intensity, or amount of heat released, of the different types of wildfire increases from ground to surface to crown fires. Firebrands that may carry the fire several kilometers can originate from either surface fires or crown fires.

Fire Behaviour and Fire Spread

Three elements must be present to have a fire: *fuel*, *oxygen* and the *ignition source*. Fuel consists of any organic matter such as logs, needles, and dead branches on the forest floor. The atmosphere provides the oxygen necessary. The ignition source is normally considered either lightening or man. The most effective way to control fire is to remove one of these sources.

Fires spread is governed by nature of the fuels, the weather or the topography. Generally dead grass, needles, brush and fine twigs can ignite more quickly than larger logs or stumps. Fire from heavy fuels spreads more slowly, burns longer and throws off large volumes of heat. Fires can also start in dead standing trees known as snags. These may be hollow and dry. The more continuous the fuels, the more likely that fire can move quickly through it. Barriers such as streams, cleared space, and bare rock will slow a fire.

Weather is typically the most critical factor influencing fire intensity (heat energy released during a fire) and spread. Temperature, relative humidity, precipitation, and wind all affect the moisture content of the fuels, which in turn influence the fire. In addition, wind provides the oxygen needed to sustain combustion, as well as most of the energy needed for fire spread.

Topography refers to the landscape of a given area. Steep slopes offer greater potential for increased fire intensity than flat ground. Additionally, steep slopes make fire suppression more difficult by limiting strategies and tactics that can be utilized. South and southwest facing slopes typically will have lower fuel moisture regimes as a result of solar heating. Topographic features that channel wind and heat energy such as chutes, saddles, and box canyons all are potentially dangerous situations. Fires, given normal weather patterns, usually move upslope.

Fire and forest succession in the Boreal Black and White Zone

During the warm summer months, wildfires are frequent especially in the drier areas. Usually started by lightning, these fires are often intense enough to kill most of the

trees over a large area. After this type of fire, plants that re-vegetate the area are those that are adapted to surviving fires. These plants are often herbs, shrubs and deciduous trees such as aspen and willow. These species can remain in place for a long period but they are often gradually replaced by black and white spruce. In some cases, conifers such as lodgepole pine and black spruce may reseed and dominate the area directly after the fire, eliminating the deciduous stage. The high occurrence of fires in the area creates a mosaic of forest stands of various types and ages.

Fire and forest succession in the Sub-Boreal Spruce Zone

Fire also plays an important role in the natural regeneration of the forest in the Sub-Boreal Spruce Zone. Lightening-caused fires trigger certain processes in forest succession. If the fire is not too severe, deciduous trees sprout from their underground roots (aspen) or from the base of the trunk (birch), or from seeds that survive in the soil. The first plants to grow are often herbs such as fireweed and shrubs such as willow and thimbleberry. The frequent fires in upland forests leave irregular patches that grow back at different rates, creating a mosaic of forests of various types and ages. In some places, lodgepole pine may reseed and dominate an area directly after the fire. Lodgepole pine is particularly adapted to survive in a fire zone. When fires sweep through the forest, the heat causes the cones to open, making it possible for the seeds to drop on the forest floor. With the right available nutrients and moisture, these seeds sprout and begin the process of succession that leads ultimately to a mature forest dominated by lodgepole pine.

Mountain Pine Beetle Infestations and Fire

Because standing dead trees with needles attached form a serious fire hazard in interfaces, UBCM has supported grants to mitigate this problem. In the past, British Columbia has suffered from several major mountain pine beetle (*Dendroctonus ponderosa*), infestations located in the Okanagan and Merritt areas, as well as in Kootenay National Park. Outbreaks have also been documented near Takla and Babine lakes in the 1950s, and through much of the southern interior, Chilcotin Plateau and the Skeena and Nass river areas in the late 1970s and 1980s. In more recent years, outbreaks have occurred in the north central portions of the province. In 2002, Greg Jadezyk President of the Northern Forest Products Association, described the mountain pine beetle (MPB) condition as an epidemic that has increased by almost 80 per cent, covering an area of more than 8 million hectares or more than 72 million cubic meters of lodgepole pine. He estimated that it had spread to more than 17 per cent of the provincial working forest and had consumed enough timber to keep every sawmill in BC operating for one year. As levels of standing dead timber grew, both forest agencies and the forest industry wished to evaluate potential changes to species mix, rates of succession, stand densities and volumes.

Research scientists of the Pacific Forestry Centre and FERIC have been active in establishing a number of research projects to map epidemic patterns, evaluate current effects, predict rates of spread and determine preventive treatments. One project related to stand dynamics and MPB-infected areas was initiated by CFS researchers Brad Hawkes, Steve Taylor, Terry Shore and Chris Stockdale. The objective of the study was to assess the impacts of MPB infestations on stand and woody debris dynamics, residual stand mortality, growth, regeneration/recruitment, and fall down rates of standing dead

trees. Research in stand dynamics has found that there often is a decrease in mean annual increment, episodic pulses of regeneration and increased fire intensity and frequency in infested areas.

The preventive treatments that are most relevant to Tumbler Ridge are selective harvesting, burning or transporting away small clusters of infected trees from the site, and spacing. The preventive actions that should slow the rate of spread of the beetle depend on the fact that the insect prefers dense stands and that they are poor fliers. Beetle proofing is the term given to thinning from below in previously unmanaged mature lodgepole pine to create a more open and uniformly spaced stand. The objective is to improve vigour of individual trees and to alter stand microclimate by increasing temperature, light intensity, and air movement in the clear bole zone. Research suggests that a combination of these factors decreases both stand and tree susceptibility to attack by mountain pine beetle.

The specifics for assessing susceptible pine stands for treatment are based on the following characteristics:

- moderate density (<1400 stems/ha merch.)
- many large stems (mean dbh > 20cm)
- <10% infestation
- windfirm
- healthy, no root rot and that the
- spacing prescription fits landscape plans

4. Community Models for Fire Protection Plans

General Response to Wildland Interface Fire Hazards

Canadian responses to potential wildland interface fires usually involve four components of hazard reduction:

- hazard mapping,
- fuel management,
- adoption and enforcement of stricter building and fire codes, and
- educating the public about what they can do to make their property safer.

The Ministry of Forest's wildland interface fire mitigation manual, FireSmart, has been designed to give recommendations to developers, planners, private owners, local governments, the insurance industry, utility representatives and fire departments. It consists of a comprehensive overview of the issues, assessment, emergency procedures, wildland interface fire training, communications and public education, land use planning and models of success. It outlines fire behaviour as well as some case study interface fires; it describes fire hazard assessment priority zones and the modifications to residential structures that can be taken.

The manual describes the terrain and vegetation factors that create potential hazard conditions as well as suppression factors such as access and water availability. It outlines in considerable detail the modifications that can be made to landscapes surrounding residences in terms of fuel reductions and the types of plants for landscaping that may lower fire potential. The manual suggests debris disposal alternatives including chipping, composting, burning on site and landfill disposal. Under planning, it covers design and layout, such as road ingress and egress, signage, water supply sources, and utility safety features. It features emergency preparedness protocols and firefighting training needs. Finally, it describes effective communication tools.

Specific Wildland Fire Protection Plans

The community wildland fire protection plan for Langford sets out a model process and a model development permit by-law that communities can follow. For the Langford municipality, the by laws have allowed the community to implement measures to reduce the hazard associated with an interface fire while at the same time providing strong rationales for compact, higher density urban development as opposed to rural sprawl. Prince George wildland fire protection plan strategies were more forestry oriented and based on zones at given distances from buildings:

Williams Lake developed an extensive community wildland fire protection plan as a result of a large committee of diverse members that met regularly. The plan included recommendations for a pilot fuel management project to determine the best treatments, obtaining monies to implement management options, identifying water sources, fuel reduction through stand management and grazing, and streamlining selling of small quantities of wood. The document also covered the expansion of protection services, improving vehicle access, creating firebreaks, removing smaller stems and encouraging aspen and birch rather than lodgepole pine. The committee was concerned that habitat values would not be compromised by fuel reduction. Other recommendations included

creating a logo and slogan for wildland interface fire protection and expanding current website coverage. In terms of education, creating portable displays was also mentioned. The committee suggested detailed mapping of each interface unit so that not only would treatments be clear but that archeological information and species at risk could be identified.

The Prince George wildland fire protection plan has focused on the mountain pine beetle infestation within the City and available forest science that could be relevant for mitigating MPB presence. Prince George received $70,000 dollars to remove infected pine in the municipality. The City of Prince George, like the Tumbler Ridge Protection District, is unique in the province in that it contains many hectares of forested Crown land within its municipal boundaries. The Prince George wildland fire protection plan advocates fire behaviour modeling to determine what treatments should be undertaken. Some of the recommendations included:

- Mowing annual grasses within 10 m of buildings,
- Removal of downed trees,
- Removal of all piled debris,
- Introduction of fire resistant species,
- Promotion of deciduous composition,
- Thinning to 200-300 stems/ha,
- Pruning branches on stems to 3-4 m height and,
- Chipping or composting materials generated from thinning and debris removal.

The US has also produced wildland fire protection plans. Among Idaho's Kootenai County strategies are:

- Requirements for adequate water supply,
- Two means of egress and ingress,
- Incentives for building with fire resistant material,
- Additional fire protection measures for large structures,
- Supplying real estate professionals, insurance providers, and building contractors with information so that both buyers and sellers will be better informed, and
- Working with educators to provide a wildland interface fire hazard public school program.

From these protection plans common trends can be discerned. These involve removal of fuels, disposing of debris, establishing adequate water supplies, providing adequate access, and educating the public.

5. Approach/Methods

The following steps were conducted to create a Wildland Interface Fire Protection Plan for Tumbler Ridge. As contractors we:

Step One	Met with Staff,
Step Two	Identified Lands of High Priority and Reviewed Relevant Documents,
Step Three	Established Plots and Completed Hazard Assessment,
Step Four	Collected Data and Produced the GIS Map,
Step Five	Provided Recommendations in a Plan, and
Step Six	Recommended Work for 2007.

Step 1:

Sharon Hope, and Sophie Gerbaud initially met with Fire Chief Dan Golob and Fuels Management Specialist Mike Dittaro from the Prince George Fire Centre, to discuss key points that would direct the approach of the community plan. They briefly toured the Tumbler Ridge interface with the Fire Chief. Sharon met with municipal employees and contacted a number of MOF and Regional District officers.

Step 2:

Sharon Hope in conjunction with Dan Golob, established high priority lands. Robin Clark working with Sophie Gerbaud established 20, 20 m X 20 m semi permanent plots representative of the wildland interface and delineated the boundaries of the hazard zones as a first approximation. A series of plots were clustered about the town site to insure more detailed coverage of this area. The plots were distributed across the landscape as access permitted and were geo-positioned. Robin Clark and Sharon Hope rechecked the hazard zone boundaries subsequently. These boundaries can be further refined over time to include more detail.

Step 3:

Wildland interface hazard assessments were conducted using the form found in Appendix 10.1. For those questions that could not be answered in the field such as the Fire Weather Index over the fire season and fire history, MOF personnel, Fire Department staff and others were asked to supply the information. Silvicultural treatment recommendations were based on the hazard zones and discussions with professionals.

Step 4:

A number of GIS map layers were provided by the town and by MOF District Office personnel. These layers were combined with our field data to form the hazard map through the work of Ken Cheung and Naa Lanquaye of ASIM Ltd.

Step 5:

Sharon Hope reviewed literature pertinent to Tumbler Ridge, fire protection plans for other localities, the FireSmart manual and other documents. She had discussions with MOF, and Fire Chief Dan Golob and then combined this information with the experiences of other BC fire departments and municipalities. She provided recommendations that were forestry, policy and education-oriented. All preliminary recommendations were reviewed with the Fire Chief.

Step 6:

Sharon Hope provided 2007 wildland interface potential work goals.

Formation of Tumbler Ridge Hazard Zones

The categories were based on factors within the standard MOF wildland interface fire hazard assessment form. The key characteristics that determined the rating were the vegetation mix, debris or litter, slope, aspect and proximity to industry. The factors listed on the current hazard assessment form are:

- fire weather potential during the fire season,
- community density,
- duff and litter depth,
- fine and coarse woody debris,
- forest stand types,
- understory vegetation,
- terrain features such as slope and aspect,
- wildland values,
- recreational use, industrial proximity and,
- fire potential on adjacent lands.

On the form each of the above categories has an assigned point rating. The total points within each category form the basis for the hazard zone level. The ratings are classified in the following manner: 0-53 Low, 54-68 Moderate, 69-83 High, and 84+ Extreme.

The MOF wildland interface hazard assessment that was used in our 2006 assessment did not account for structure assessment. The question of structural hazard assessments in the moderate and high zones could be pursued in future years. For those who are not familiar with wildland interface or silvicultural terms, Appendix 2 provides definitions that may be helpful. Data taken from the plots can be found in Appendix 3; descriptions and characteristics of the zones are given below.

Summary of Hazard Assessment Results

The 20 plots were classified as high, moderate, or low. The fire weather danger rating for the area was low (the weather data is in the Appendices). Since the potential fire weather affects the overall rating substantially, physical attributes had less affect on the over all sum. Some plots close to the town site were classified as high due to their proximity to industrial, commercial or recreational sites. Although lack of debris and the presence of deciduous stands usually resulted in

moderate to low ratings, the steeper slopes, the number of fires in the last five years, the activity associated with certain areas, windthrow and lack of available water over most of the District, moved these ratings upward. These higher ratings indicate that some action should be taken. The map on page 58 has a legend that explains the distribution of hazard classes and displays the areas of concern.

Areas of Concern

There are two goals in establishing the areas of concern (denoted as dark, circular dashed lines on the map in the Appendices). The 2 km radius encircling the town site and industrial area represents a delineation that could protect the town and interface from firebrands. It is based on the spotting distance or the distance that airborne embers can affect the town and its interface. The second outer 8 km radius provides a means of establishing an early warning system for the imminent arrival of mountain pine beetle infestations.

The first area of concern is closest to the town. Because of the potential for ignition, and the need for immediate attention to the appearance of mountain pine beetle, active treatments should focus on this area. The second radius represents an area that should receive careful monitoring for both vegetative fire hazards and for evidence of mountain pine beetle but no active treatment need occur until the first radius treatment is underway. The selection of the 8 km radius was to give approximately two years of warning for the town given that the beetle usually travels 2-3 km per year. MOF Protection Officers should be consulted about designing firebreaks in this area.

In addition to the areas of concern, the characteristics of low, moderate and high hazard zones were established based on our data collection.

Tumbler Ridge High Hazard Zone Characteristics

The High Hazard Zone is usually in continuous forest. The litter is often 5-13 cm deep; coarse woody debris can be of scattered branches with logs grouped or crossed. The forest is generally coniferous and windthrow debris can be common. The understory is brush in most cases. The highest ratings for the zone are near some type of industrial, commercial or recreational activity. There is usually a lack of hydrants and a poor water supply for interface fires, although response time to a fire within the Tumbler Ridge town site is good. Examples of high ratings near the town site are: areas adjacent to the stable and the industrial park.

Tumbler Ridge Moderate Hazard Zone Characteristics

The Moderate Hazard Zone can occur in scattered interface and litter is more likely to be < 5 cm deep. The woody debris consists of widely scattered branches and rarely in groups or can be nonexistent. The understory is brush; the topography tends to be gently sloping or flat. The lot sizes tend to be 1 ha or greater and there is fire potential on most but not all adjacent lands. In this zone, there is usually a lack of available water but, like the high zone near the town site, the average response time to the fire is usually below 15 minutes. There are some access problems but slopes tend to be under 25%. Outside the town site the response time can be up to ¾ of an hour. In this zone, neither large recreational or industrial projects are anticipated. Fuel loading from logging is not expected. Few utilities lie in the interface. Examples of moderate classification include

extensive areas adjacent to Highways 29 and 52, as well as the Bullmoose and Wolverine drainages away from industrial development.

Tumbler Ridge's Low Hazard Zone Characteristics

These stands consist almost exclusively of deciduous trees in moist to wet localities. Aspen is the major species but the presence of cottonwood is a factor that also identifies the low hazard zone. This type occupies gentle toe slopes as well. There is little or no woody debris and only a thin litter layer. Examples of low rated interface are the stands in valley bottoms near the Tumbler Ridge's Flatbed Creek, Murray River and Wolverine drainages.

Figure 5. Broad Valleys and Moderate Slopes of the Tumbler Ridge Protection District. Source: Robin Clark and Sophie Gerbaud.

Figure 6: A Coniferous Plot. Source: Robin Clark and Sophie Gerbaud

GIS Methodology

The GIS component was completed in 3 phases: (1) base data compilation, (2) delineation of hazard zones, and (3) map production. All spatial data layers used to produce the final Hazard Zone map was created using ESRI (Environmental Systems and

Research Institute) Arcinfo 8.0.1 software and stored in Arcinfo coverage format. The 3 main data layers are (1) base planimetric data, (2) hazard zones, and (3) plot data.

Base data compilation included conversion of Autocad and Arcview (ESRI) shape file formats to Arcinfo coverage format; and the organization of base information such as planimetry (transportation network and other city infrastructure features), hydrology (lakes, rivers, and wetlands), and topography (contours). Hazard zones, including non-wildland and firebreaks, were digitized from hard copy paper maps delineated by Robin Clark, Sophie Gerbaud, and Sharon Hope with the aide of topographic information on base maps and field ground truthing data. High-resolution aerial photography was also used to identify sensitive zones such as riparian and agricultural areas. Fire hazard assessment plot locations were collected using a GPS device and digitally transferred onto maps. The Hazard Zone Map was created using Arcinfo's AML (Arc Macro Language) scripting language. The final map was produced at a 1:70,000 map scale on an Architectural E size page (approximately 35" by 52"). An insert map of the Tumbler Ridge town site was included at a larger 1:17,000 map scale.

Forest Stands Susceptible To Mountain Pine Beetle

Identification and prioritization of infested and susceptible stands is one management tool for treating the current epidemic. A Mountain Pine Beetle Susceptibility Index has been formulated based on four factors: stand age, stand density, percentage of susceptible pine (basal area) and location. The amalgamated distribution of the highest classes (high, extreme and very extreme) for the Dawson Creek portion of the Peace Forest District has been shown on the hazard zone map as part of basic knowledge for Tumbler Ridge wildland fire hazard planning. The purpose in including this information was to indicate where stands for potential attention and treatment might be located.

Recommendations

Recommendations were formulated using a combination of strategies for minimizing the potential impact of mountain pine beetle on lodgepole pine near the town site and suggestions for mitigating fire hazard in the District as a whole. The action plan was created by reviewing FireSmart manual recommendations, engaging in discussions with individuals in Tumbler Ridge, drawing on ecological experience, and reviewing protection models and plans conducted in the United States and Canada.

Table 1. Data Acquired and Displayed on the Hazard Zone Map (see Appendix 10. 5 for the Hazard Zone Map).

Data Inventory List
Community Wildfire Protection Plan - District of Tumbler Ridge

File Name	Description	Feature Class	Source	Format	Date Received
Planimetric Data:					
Municipal_boundaries.shp	District of Tumbler Ridge	Poly	Peace Forest District (Ref: Craig Hartel)	Arcview	5-Jun-06
Basemap.dxf	Insert map of townsite (not georeferenced)	Line, Point, Poly, Annotation	Tumbler Ridge Townsite (Ref: Clark Hazelhurst)	Autocad	30-May-06
Forest-B.dxf	Overview map of district (not georeferenced)	Line, Point, Poly, Annotation	Tumbler Ridge Townsite (Ref: Clark Hazelhurst)	Autocad	30-May-06
Ortho Photos:					
{mapsheet.tif}	Black & White Ortho Photos	Image (tif, tfw)	Peace Forest District (Ref: Craig Hartel)	TIF	30-May-06
Example: bc_093p001_xb1m_utm10_1996.tif	50 Map Sheets: 093i081-093i090 093i091-093i100 093p001-093p010 093p011-093p020 093p021-093p030				
TRIM Data:					
{mapsheet.igds}	As per TRIM standards	Line, Point, Poly, Text	Peace Forest District (Ref: Craig Hartel)	Microstation	15-May-06
Example: 093p011.igds	50 Map Sheets: 093i081-093i090 093i091-093i100 093p001-093p010 093p011-093p020 093p021-093p030				
Beetle Susceptibility:					
haz_ddc.e00	Beetle Susceptibility Hazard Mapping	Poly	(Ref: Marnie Duthie-Holt)	Arcinfo	5-Jun-06

6. Action Plan Strategies

The hazard mitigation plan is based on the results of interface fire hazard mapping, proposed silvicultural treatments and two other avenues: planning and public oriented strategies. Development and planning actions for wildland fire hazard mitigation are quite similar across BC where the focus has been on modifying various Official Community Plans, by laws and variances. The District of Kamloops' Official Community Plan recognizes the risk of building in wildland-urban interface areas of the community. This is accomplished through the steps that are taken to obtain a building permit for individual properties or through the specific criteria that must be met when applying to develop a subdivision. There is a requirement that a covenant go on an individual property to be developed in the interface identifying the use of specific roofing materials, spark arrestors and other fire-retardant features. The District of Salmon Arm has placed restrictive covenants, as a condition of subdivision approval, on properties that have been created by subdivision in the past five years. This process alerts purchasers that their property is in an area with high risk of interface fire and instructs them as to what they can do to be safer (e.g., clearing and keeping combustibles away from their homes).

Each community undertakes different strategies. In a US case, rodeo grounds were expanded but had to conform to best forest management practices and wildfire prevention within open space areas of the grounds. These included the removal of accumulations of dead vegetative materials to reduce fuel loads, the thinning and lifting of the forest canopy, and the establishment of proper setbacks to adjacent structures.

Recommendations for mitigating the potential for mountain pine beetle are problematic for this geographic location because:

Little or no research exists on the impact of the additional fuel loading of dead pine on fire behaviour in these boreal forests, the spacing of trees to reduce fire hazard and mountain pine beetle spread has not been tested in this setting and there is no information on the results of encouraging aspen rather than white spruce as an alternative to lodgepole pine stands.

The strategies for Tumbler Ridge are grouped into three classes:

- *Technical and Silvicultural Strategies*-This component consists of reviewing potential landscape modification that could be implemented in wildland interface continuous forest, scattered forest interface and forest interface on the perimeters of suburban developments. This aspect is based primarily on the hazard zones and plots established in Tumbler Ridge's interface.

- *Planning or Policy Strategies*-These strategies involve reviewing, exploring and potentially modifying current governance policies and construction "best practices" to be compatible with interface hazard mitigation. This component examines potential modification to current by-laws, permit requirements and plans.

- *Public Strategies* -This avenue consists of engaging residents, non government organizations, agencies, corporations and public works in mitigating structural and vegetation hazards on residential, commercial and public property.

Before work can be done in addressing wildland interface fire mitigation strategies for Tumbler Ridge, a means of conducting reviews and actions should be created. Committees have been used by many jurisdictions. For example, the Thompson-Okanagan Interface Committee membership consists of all agencies having jurisdiction over any events associated with wildland fires. The Committee, reporting to the Co-Chairs, meet to discuss, review, evaluate, plan, coordinate, propose and express viewpoints on matters that evolve from the Wildland Urban Interface as well as to educate and share information. Williams Lake produced a plan through the work of a large active committee that generated many recommendations for hazard mitigation.

In the District of Tumbler Ridge, there is a need for the formation of a Wildland Interface Fire Protection Committee or working group comprised of town officials, Regional District personnel, Forest, Oil, Gas and Coal Industry representatives, BC Parks, Ministry of Highways, Ministry of Forests, BC Hydro, and the Tumbler Ridge Fire Department Chief.

The list of stakeholders given above is not meant to be comprehensive and further discussion would be required to determine the composition of the committee. The formation of a committee would expedite collaborative long-term planning and increase communication among coal, oil and gas stakeholders when addressing wildland interface fire mitigation. Subcommittees could be struck as required to address specific issues such as educational strategies. The Community Wildland Fire Protection Plan is meant to be a starting point for discussion among the Committee members.

I Silviculture-Oriented Strategies for Tumbler Ridge

One goal of interface fire hazard reduction is to create defensible space using the natural landscape and vegetation. To realize this goal, actions on both public and private lands in other communities have focused on:

- Building and maintaining fireguards,
- Modifying green spaces,
- Clearing transmission lines and,
- Modifying vegetation adjacent to homes.

Canopy types and terrain characteristics largely determine the treatment designs mentioned in BC's FireSmart manual. The treatment options involve pruning the lower branches of conifers to 2.5 m and implementing several thinning intensities. The designs in FireSmart describe thinning to 40% of crown cover and having at least 6 m between crowns on gentle slopes. CFS Fire Behaviour Specialist Marty Alexander in Alberta has

produced a paper, however, that suggests that a single spacing to reduce hazard is not necessarily applicable to all species. In BC, according to Mike Dittaro Fuels Specialist Prince George Fire Centre, the FireSmart provincial spacing recommendations may be reviewed in the near future.

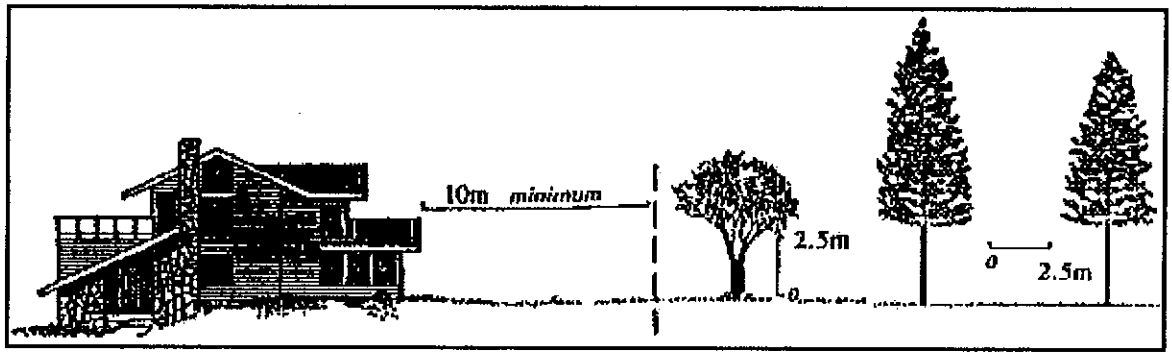

Figure 7: Landscape Design from MOF Protection Branch Fire Hazard Mitigation Website. Source: http://www.for.gov.bc.ca/protect/safety/Landscape.htm

Mountain Pine Beetle Mitigation Strategies

The following is a short summary of strategies available through the Canadian Forest Service. The list applies to preventive situations.

- Older age classes of dense pure lodgepole pine are most susceptible (as a result the District should target pure pine stands as the first priority).
- Uniform 4-5 m spacing is recommended for lodgepole pine to open the stand-in order to increase temperatures, light and air turbulence-since the mountain pine beetle prefers dense shady stands. They fly poorly so increasing air turbulence even slightly will deter them.
- Thin from below while leaving the largest and most windfirm stems-the healthiest trees will withstand infection more successfully. They have thicker bark for example.

Over the long-term the following may be implemented:

- Broadening the species and age range of stands.
- Nurturing white spruce where its height is close to the main canopy and encouraging retention of aspen and birch where significant numbers appear in the canopy.
- According to conversations and written information provided by CFS, underplanting has been tested: Over the first 6 years of a CFS trial, underplantings maintained medium to good vigour in spaced areas. While growing less quickly than seedlings planted in adjacent clearcuts, they were growing well. These trees may well provide a significant head start for the next stand - reducing time to effective green-up in addition to increasing stand diversity.

One of the most important priorities is to **remove any single or group of mountain pine beetle infested trees immediately** to prevent spread of the infestation.

To this end, monies should be spent on rigorous monitoring and removing and destroying infested trees.

Summary of Interface Technical Issues:

High wildland interface fire hazards often occur when there is a combination of terrain and vegetative characteristics such as:

- A continuous dense coniferous canopy with ladder fuels (the rationale being that continuous canopy is more flammable than deciduous tree cover and tends to retain branches low to the ground),
- An abundance of dry logs, branches and/or tall, dry grasses about town sites and,
- Locations that are rocky, steep (more than 25%), or gullied slopes because fires usually burn more rapidly upslope and vegetation is often more slow growing leading to the creation of ladder fuels.

Tumbler Ridge Vegetation and Debris Issues:

1) **Reducing the fire hazards about the town site and preparing for possible mountain pine beetle infection,**
2) **Ladder fuel reduction and windthrow or woody debris removal in high and moderate hazard zones,**
3) **Application of FireSmart landscaping to future rural residences, current green spaces and town parks,**
4) **Removal of debris piles, including wood and sawdust in commercial/industrial locations and,**
5) **Reviewing Fire Codes and Building by laws that affect wildland interface hazard.**

Town Site Priority Locations for the 2 km radius:
Highest Priority-Stands surrounding the Industrial Site, Stables and Commercial Area
Second Priority-Stands surrounding the Landfill, Golf Course, and the stands of the Residential Parks

In the Tumbler Ridge Protection District, mountain pine beetle presence is very light at present compared to other parts of the province. This circumstance means there are more silvicultural options available to prepare the stands in advance for the beetle's arrival at the town site. It also means that immediate treatment of any single or cluster of infected lodgepole pine as it shows symptoms might slow the spread.

According to measures of crown widths conducted by us in a preliminary fashion on lodgepole pine near the town site, the spacing of 2.5 m between crowns is approximately equivalent to the 4 m spacing between stems-the spacing recommended by CFS for mountain pine beetle control. The other treatment that CFS has used in their trials is 5 m spacing. The ultimate choice of spacing and species replacement would be in the hands of the qualified professional implementing treatment.

In terms of general fire hazard conditions, treed acreages, ladder fuel understories, tall grasses, windthrow conditions, and decayed surface fuels are most vulnerable to a

wildland fire. Removal of subcanopy ladder fuels could return the forest to some semblance of natural fire regimes and restore wildlife habitat found in more open situations. However, because lodgepole pine stands are often subject to windthrow, removal of the main canopy must consider susceptibility to wind and prevailing wind direction. **A qualified professional should be appointed to devise specific treatment operations for the area immediately surrounding the town. Operational treatment monies are available through UBCM that will address hazard mitigation.**

Long Term Treatment Goals

We recommend a gradual shift in species from lodgepole pine to aspen or white spruce using single-tree harvesting of lodgepole to reduce the impact on soil and understory vegetation. Fire Chief Dan Golob has suggested that there are horse loggers in the town that would be willing to implement tree removal. This action could minimize damage to remaining stems during treatment implementation. Winter logging also could be conducted if appropriate. The situations where white spruce has almost reached the main canopy, such as near the golf course are complex and will require consideration by the qualified professional to determine spruce retention. Retention of the aspen where it occurs is recommended.

In the face of limited science on the subject of lodgepole pine removal for the Dawson Creek District, we encourage Tumbler Ridge to apply for funds to conduct appropriate treatments for fuel hazard mitigation that could be considered research pilots and the Committee could contact research agencies to determine their latest findings.

Over time, zones of concern should be toured and monitored regularly for wildland interface hazards. It is anticipated that individuals (those with ranches for example) residing in wildland interfaces may be initially reluctant to accept removal of substantial amounts of vegetation. However, thinning to about 2 m between crowns on gentle terrain, removal of ladder fuels (smaller saplings and pruning lower branches to 2.5 m height), the creation of a 10 m to 20 m defensible space about interface subdivisions and disposal of slash and debris do appear to be reasonable initial goals given the public desire to retain a natural setting about their homes and community.

Various districts and municipalities in BC have adopted chipping and debris removal programs to assist residents in modifying their acreages; there is a composting project in Tumbler Ridge that may be able to use the increased natural debris from ladder fuel removal. We recommend the use of spring prescribed burns if appropriate for the tall grass on roadsides in the Protection District. Care must be taken to avoid any damage to wildlife habitat or to soil properties. The configuration of the burns should be discussed with experts such as MOF Protection Branch representatives.

Summary Targets for Stand Modification in Order of Importance:

1) Highest overall priority: Lodgepole pine stands with mountain pine beetle symptoms-in the 2 km radius should have single trees or clusters removed and disposed of as soon as possible.
2) The highest priority for preventive treatment: the densest ladder fuel, oldest and densest pure lodgepole pine stands. Thin to 2-3 m spacing between crowns and prune trees to 2.5 m height. Remove ladder fuels.

3) Second priority: Lodgepole pine spruce mixes- to shift species to spruce where it is appropriate by thinning and thin remaining pine and white spruce to appropriate spacing. Prune lower branches of remaining trees to 2.5 heights as described earlier.
4) Lowest priority: where aspen-lodgepole pine stands occur, aspen being dominant. In these stands retain aspen where possible.

Figure 8: Lodgepole Pine Stand with White Spruce Understory near the Town Site. Source: Robin Clark and Sophie Gerbaud.

Figure 9: Mixed Stand near Tumbler Ridge Town Site. Source: Robin Clark and Sophie Gerbaud.

Figure 10: Coniferous Stand on Slope with Low Amounts of Woody Debris. Source: Robin Clark.

Figure 11: Low Lying Deciduous-Dominant Stands. Source: Robin Clark and Sophie Gerbaud.

Young stands that have not yet reached canopy closure are a future priority that will require long-term planning.

Figure 12. A Young Stand. Source: Robin Clark and Sophie Gerbaud.

Specific Silvicultural Strategy Summary (assuming the initial formation of a Wildland Interface Fire Committee)

1) *The Committee should seek a qualified professional knowledgeable in boreal forestry, fuel management and mountain pine beetle infestation to implement treatments within two areas of concern: a 2 km radius of the town site and an 8 km radius beyond the initial area. UBCM grant monies should be applied for to implement pilot treatments.*

2) *The Committee should explore the creation of FireSmart buffers about perimeters of forested land similar to residence defensible spaces. The discussion could include the regulations that might be appropriate and the establishment of recognized standards for operation. Wildland interfaces should be cleared of brush and ladder fuels within 10 m to 20 m of residence fencing, buildings or property boundaries as appropriate (this applies particularly to the industrial areas near the town site).*

3) *Small public demonstration areas of appropriate design and spacing with permanent signage could be established. The small parks in residential subdivisions could be used.*

4) *The Committee should encourage the use of spacing. The prime target would be mixed stands and those with dense pure lodgepole cover. Soil erosion assessments should be included in those areas that have a potential erosion hazard.*

5) *The Committee, possibly through the above forestry professional, should consider maintaining firebreak corridors in the Protection District.*

6) *By means of the Committee, private companies should be contacted directly to discuss mountain pine beetle monitoring, removal of ladder fuels and the creation of defensible spaces about industrial buildings as appropriate.*

7) *BC Hydro should be encouraged to review policies of brush removal on transmission lines and the installation of FireSmart vegetation types.*

8) *For private residences, the Committee could recommend a list of FireSmart native plants and provide the locations where these plants and shrubs might be available.*

II Planning-Oriented Strategies for Tumbler Ridge

The Municipality of Tumbler Ridge has produced an Official Community Plan (OCP). The plan encompasses preservation and conservation principles including

planning for parks and natural areas. The plan does not contain any mention of wildland interface fire hazard potential or exploration of interface fire mitigation strategies.

Our recommendations under the heading of planning encompass general planning and modifications to the OCP, as well as other types of development planning. The suggestions pertain to the introduction of wildland interface fire mitigation in planned and existing residential neighbourhoods as well as in new development, rural, greenway and environmentally sensitive areas.

9) *With the collaboration of the forest, oil and gas industries, a review could be undertaken to systematically map, define, assess and maintain a firebreak network for the Tumbler Ridge Protection District. This review could include detailed descriptions as well as planning for, and the addition of, other areas to the firebreak network. The use of current ortho-photos may assist the process.*

Figure 13:Typical Stand Surrounding the Town Site of Tumbler Ridge. Source: Robin Clark and Sophie Gerbaud.

10) *The Committee and Fire Department representatives should explore whether public local parks and natural areas in the Tumbler Ridge town site and District have appropriate access for fire protection and that frequently used locations for recreation such as trails and playing fields have minimal ladder and ground fuels. Additional measures could be taken in very heavily used locations. For example, along frequented trails, signs denoting "Fire Hazard-Protect our Forest-No Smoking" could be installed.*

Future Development Plans:

According to the FireSmart manual, area structure plans contain information about land uses and density, access (rights of way) and public utilities. Standard by laws and subdivision guidelines usually specify:

- Shape,
- Water supply and,
- Perimeter protection buffers.

Protection buffers have been mentioned. Some lands in or near the Tumbler Ridge town site are currently without an adequate water supply within close proximity. This particularly applies to lands in the south portions of Tumbler Ridge.

11) It would be appropriate to review water availability in the interface locations near the Tumbler Ridge town site. If water availability is not sufficient for adequate fire protection, to take precautionary measures as deemed necessary. This may include establishing water towers or cisterns and/or mapping suitable lakes and ponds as a static water supply.

Information required for development permits can be used to assess the wildfire risk. This information includes:

- Use of the lot or building,
- Placement of the building,
- Landscaping,
- Access and internal traffic circulation,
- Exterior building material and,
- Location of fire suppression infrastructure.

In terms of larger developments such as subdivisions, several factors are of concern in terms of interface fire:

- Topography,
- Parcel density,
- Layout (including driveway width and gradient) and,
- Infrastructure such as road access and internal traffic circulation.

12) In order to address the potential for wildland interface fire hazard mitigation, the planning aspects listed above could be reviewed with respect to the Municipality/Protection District.

13) We suggest that a review could take place through the Wildland Interface Fire Committee to insure standard two-way access routes, appropriate fire road access on properties, adequate road widths and conditions for fire trucks, posting of dead ends, and provision of turnarounds on dead ends where appropriate for the lands of the town site and Protection District.

Subdivision authorities can require information that is related to wildland interface fire mitigation:

- Use of lots,
- Slope,
- Location of buildings,

- The specific location of water sources for fire suppression purposes for the subdivision and,
- Access and internal traffic circulation information insures safe evacuation and access of fire fighting equipment.

According to the FireSmart manual, high-density wildland development can generate a more extreme hazard condition depending on how susceptible the building materials are to ignition. At least 15-20 m is necessary between buildings. Buildings on slopes should be spaced further apart because fires tend to spread more rapidly upslope. Subdivision staging can be conducted in a way to keep fire hazards to a minimum.

14) A review could be undertaken to determine if subdivision by laws are sufficient to mitigate wildland interface fire hazards with respect to the above factors for the town site. This aspect has relevance to future rural development just outside the current town limits.

Residence Building Materials and Wildland Interface Fire Mitigation Planning

The FireSmart Manual, considers 11 residence, 5 terrain factors and some ignition factors. The following is a short summary of the FireSmart list:

Residence Factors:

- Factors 1-3: Roofing material with the lowest hazard rating is noncombustible tile, asphalt or metal; shakes are not recommended because firebrands may ignite the roof. Roofs should be clean and gutters should contain no debris; siding like stucco or metal provide a better defense; log, shake or vinyl siding provides poor radiation or direct flame resistance.

- Factors 4-6: Eaves should be enclosed, vents screened, and balconies or decks should be composed of noncombustible material; the underside of decks or balconies should be sheathed in.

Figure 14: Typical Suburban Residence in Tumbler Ridge. Source: http://www.tumblerridgerealty.com/

- Factors 7-9: Combustible fuels such as chopped wood, lumber or logs should be at least 10 m from the home. Houses should be set back 10 m from the crest of a slope or follow all FireSmart building recommendations. In terms of landscaping, deciduous tree canopies are recommended within 10-30 m of the house because they are less likely to sustain a crown fire.

- Factors 10-11: Lawns and noncombustible surface materials are recommended within 10 m of a home. Tall dry grass, branches, logs and twigs on the ground are a hazard. The presence of ladder fuels (trees or shrubs that can carry a flame into the tree canopy) is hazardous.

Local Terrain Factors:

- Factor 1: The overstory vegetation: Deciduous canopy is more desirable than coniferous canopy (the latter is more flammable and tends to retain branches low to the ground).

- Factor 2: Surface fuels: An abundance of dry logs, branches and tall, dry grasses near homes is hazardous.

- Factor 3: Fuel assessment: Dense conifer cover with branches close to the ground is a greater hazard than scattered park-like landscaping with the lower branches of trees removed.

- Factor 4: Terrain type: Steep (more than 25%) or gullied slopes constitute a greater risk because fires usually burn more rapidly upslope.

- Factor 5: Position on slope: Homes on upper slopes are at greater risk.

Fire Ignition – south aspects, areas with high human activity, unscreened chimneys (no spark arrestors), chimneys with over hanging branches, inadequate burning barrels, propane tanks near vegetation, and vegetation near powerlines may contribute to fire ignition.

15) Wildland Interface Fire Committee representatives should insure that real estate agents, insurance agents and building contractors in the town of Tumbler Ridge are conversant with FireSmart recommendations. Copies of FireSmart Residence manuals could be provided to individuals in these and similar occupations.

16) Although this issue has been investigated in the past in other communities, the Wildland Interface Fire Committee could explore whether it would be possible for residents to receive insurance reductions if they are using FireSmart building materials and landscaping their homes to conform with FireSmart recommendations.

To summarize, it is recommended that permits, by laws and variances be reviewed to determine if developers and residents should be required to use FireSmart building materials and to implement FireSmart landscape design recommendations with respect to wildland interface fire hazard. This applies particularly high hazard locations.

III Public-Oriented and Education Strategies for Tumbler Ridge

In general, the public does not perceive a risk from fire in the wildland/urban interface. Furthermore, property owners usually believe that insurance companies or disaster assistance will cover their losses. When people believe the government will protect them from natural hazards, the damage potential of a catastrophic event increases.

At lower fire intensities, the following factors determine a structure's prospects for survival:

- The amount of cleared space around the structure,
- The structure's construction,
- Access to the site and,
- Whether anyone takes defensive action.

This section addresses several alternatives for engaging the public in wildland interface hazard mitigation. In discussions Sharon Hope has had with Fire Chiefs throughout the province of BC, very few of them reported successful public meetings. Public meetings may be poorly attended for a number of reasons: the homeowners may believe that wildland fire is not an issue for their community, that their houses and properties are safe from fire or they may not have the money or ability to modify their houses or landscapes. In the day-to-day lives of most homeowners who are in the workforce, or in active retirement, attending a public meeting about the chance of wildland interface fires takes a low priority.

The public may respond more positively to activities considered to be fun or educational or ones that provide incentives.

17) A sub committee within the Wildland Interface Fire Committee could be struck to address public education aspects. Members of emergency preparedness, conservation groups, fire department personnel, public education and public works personnel could be invited to participate.

18) Given the fact that public education is a major component of wildland interface fire mitigation, an over all strategy should be developed for the town of Tumbler Ridge.

19) Since there will be a number of educational projects linked to wildland interface fire hazard reduction and formulation of an overall strategy, Tumbler

Ridge should explore appointing a public liaison officer to undertake these activities and to form relationships with stakeholders in Tumbler Ridge Protection District. Monies may have to be allocated by the municipality to implement an educational strategy or to appoint an individual.

20) The potential for establishing a demonstration area has been mentioned under another section. Because of the size of the Tumbler Ridge Protection District, more than one location would be desirable. The locations can become part of community education, school trips and youth excursions. Local service or environmental groups could become involved in creating the scenarios. Self-instructing signs can be mounted.

21) In some cases, a personal contact approach to hazard mitigation is recommended beginning with the areas of highest priority such as the industrial area.

22) Community newsletters, and other local service group letters are additional avenues to present FireSmart recommendations to local residents. Community events such as barbecues offer an opportunity for posters and additional contact with both permanent and seasonal residents.

23) The Tumbler Ridge town and the Fire Department websites could be expanded to include what the public could do in terms of wildland interface fire hazard mitigation. Photos of the interface hazards could appear on the website. Before and after shots are very effective. The designated public liaison individual could be responsible for developing these aspects on official websites. The City of Chilliwack's website may be viewed at ***http://www.chilliwack.com*** */main/page.cfm?id=627*

24) Local service and environmental groups are quite often looking for community level projects. Having neighbours that can be seen actively modifying their properties is a powerful incentive for others to become involved. A series of local groups including the residents associations could be asked for their help in implementing the Protection Plan. Those groups willing to assist in the assessment of individual homes for the public would be ideal.

There are a few isolated residents living outside the town of Tumbler Ridge. Residents living in isolated areas with wells should consider having an additional electric generator. Residents should insure that their driveways are sufficiently wide for a fire truck to enter and that there is sufficient space at the end for a truck to turn. Residents should be made aware of the difficulties in servicing them during an interface fire and that several precautions as outlined in the FireSmart manual should be taken. These measures could include having barrels of water on hand.

Open houses could be used to reach the public. The public's attitudes and perceptions tend to shift with events. The aftermath of FireStorm 2003 has changed BC residents' perceptions of wildland interface. The communicator's message should be tailored to public attitudes and perceptions. The recent evacuation of Tumbler Ridge is no doubt fresh in the minds of the residents.

Some of the topics that could be discussed in the open house setting besides those already covered are:

- Disposing of stove or fireplace ashes and charcoal briquettes after soaking them in a metal pail of water,
- Storing gasoline in an approved safety can away from occupied buildings,
- Locating propane tanks far enough away from buildings for valves to be shut off in case of fire,
- Storing all combustibles such as firewood, picnic tables, and boats away from structures and,
- Keeping a garden hose connected to an outlet during the fire season.

25) A recent review of school programs on the Internet has shown that Ontario, Alberta and the US have developed elementary and middle school curricula that involve some of the FireSmart principles. By contacting local school science teachers and educators, the potential use of the demonstration area and awareness of the FireSmart principles could be enhanced.

26) Special help could be offered to seniors and those on low income through volunteers from service groups-firewood could be provided for those who wish it.

27) Ministry of Forests personnel could be asked to demonstrate appropriate thinning techniques to local Tumbler Ridge employees, conservation and environmental groups, private developers, industry and landscapers.

28) Related businesses and industries could offer discounts, free materials, clean up and other types of assistance will send a clear message to the public that the project has community support.

29) The Wildland Fire Protection Committee, the Fire Chief or the Fire Liaison Officer could address the effectiveness of the hazard mitigation process through surveys.

7. Choice of Strategies and Future Steps

The amount of information in the FireSmart manual is considerable and creating operational strategies from the recommendations can be difficult for the following reasons:

- A resistance from property owners and developers,
- Expense incurred in fuel management,
- The development and land use patterns in the wildland/urban interface,
- The diffusion of responsibility among a wide range of government agencies,
- Priorities and jurisdictional issues and,
- Constraints imposed by law on fuel reduction and other mitigation efforts.

We recognize that some of these impediments are more difficult to overcome than others. The choice of a collaborative approach to planning should be of assistance in gaining greater support for an overall plan.

In BC communities, when controlled burning is suggested (to reduce the density of fuel), concern over smoke is raised. When tree and vegetation removal is proposed (to provide a fire break), the public voices concern about aesthetics around individual residences or within the community. When local authorities present by laws and restrictive covenants that require the use of non-flammable building materials or limit the type of vegetation that can be planted on private property, residents question the need.

However, if measures can be taken to prevent the occurrence of a fire or at least reduce its intensity, those preventative actions are far more cost-effective than fighting fires and addressing the property loss subsequently.

We suggest that the Wildland Interface Fire Committee consider five-year and ten-year comprehensive strategies for silvicultural, policy and educational aspects of wildland interface fire protection.

Presentation of the Plan

Once the draft plan has been approved through Tumbler Ridge's Fire Department, we offer, subject to budget, to present the plan at an open house on an appropriate date. We will present the plan separately to Council at a special meeting or other venue on the same date. Should we present the Protection Plan, it is understood that we will not lead the town's Wildland Interface Fire Protection Committee nor are our recommendations in any way binding to the Committee or to Council.

Activities for 2007

Once recommendations have been reviewed and chosen, the following implementation activities could be undertaken in 2007:

1) *Training of town public works employees and volunteers in forest ecology and treatments as deemed appropriate.*

2) *Training of neighbourhood leaders in FireSmart information as deemed appropriate.*

3) *Our approach was to address initial areas of immediate concern. Over time, the hazard map should be refined to include additional firebreaks and non-wildland locations. Additional map layers could include the areas treated.*

4) *The demonstration areas could be formally established and interaction with stakeholders pursued.*

Figure 15: Deciduous–Dominant Stands Near Tumbler Ridge. Source: http://www.bcadventure.com/janlee/northern/northern.htm

5) *Representative structural hazard assessments (building materials assessments) could be carried out in moderate and high hazard zones to supplement the current focus on vegetation.*

8. Summary of Recommendations

1) Formation of a Wildland Fire Protection Committee for the Protection District to include representation from the provincial government, particularly Ministry of Forests, Ministry of Highways, the Regional District, representatives from the coal/oil and gas industries, the forest industry, BC Parks, land developers, the Fire Chief, and other non-government organizations as appropriate. The group would use the Wildland Protection Plan as a starting point for collaboration on wildland fire protection concerns and mountain pine beetle preventive treatment. Five and ten year plans are encouraged.

2) Through the Wildland Fire Protection Committee, to consider incorporating wildland fire mitigation goals into the District's Plan (OCP), as well as to consider introducing restrictive by laws for fire safe building materials in certain locations such as the proposed rural development sector.

3) Through the Committee, to recognize a 2 km radius and an additional 8 km radius about the town site and industrial area respectively as main areas of concern and treatment. The 2 km radius is the theoretical spotting distance from a fire based on modeling conducted by Ministry of Forests.

4) Through the Committee to appoint a qualified professional, to space trees appropriately and prune to 2.5 m height about the perimeter area of the town (within a 2 km radius of the town limit) and to make prescription recommendations for the 8 km radius monitoring area. Prescribed burns could be conducted to remove grass in the spring along roadsides and greenspaces about the town site.

5) To discuss modifying the tree density in the small parks in the suburban and/or residential areas. Spacing of 2.5 m between crowns is recommended as well as the removal of ladder fuels. Sign posting for fire hazard in the access trails in the recognized trail system would be desirable.

6) The Committee could explore the possibility of a planned network of greenspace/firebreaks for the town site and Protection District as a whole. The town site has a number of green open spaces and expansion of this concept is recommended. The presence of the Hourglass Creek fire initiated some firebreak construction.

7) As town site expansion occurs, the Committee could review water supply sources for the Protection District including its commercial and rural development areas. The creation of several cisterns or other methods of water storage could be an interim solution for these neighbourhoods. Natural static water bodies could be mapped.

8) For the Protection District, to explore through the Wildland Fire Protection Committee, the creation of a wildland fire educational strategy that would include mountain pine beetle symptom recognition. The cooperation and support of MOF Forest Protection officers would be useful for part of the education component.

9) To work with BC Hydro on a review of hazard mitigation policy on transmission lines, as well as to collaborate with Ministry of Forests, BC Parks, Ministry of Highways and other large tract property owners, on a review of systems for maintaining wildland fire hazard free transportation, easement and seismic corridors.

10) To work with developers and industry to resolve issues of fire vehicle access, general woody fuel mitigation, and fire safe building materials. Creating cleared buffers of 10-20m about the perimeters of large properties in the designated industrial area of the town site is encouraged as appropriate.

11) To engage in media coverage and enhanced website postings for wildland interface hazard mitigation.

12) To consider demonstration areas as part of an overall educational strategy.

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10. Appendices

Appendix 10.I
Tumbler Ridge Wildland Fire Hazard Assessment Form

Location:

Completed by:
Date: _____

DESCRIPTION OF THE COMMUNITY

Important Factors	Potential Hazard	Point Rating	Your Score
Fire Weather Potential	Moderate Danger Class or higher < 25% during fire season	0	
	Moderate Danger Class or higher 25%-42% during fire season	4	
	Moderate Danger Class or higher 42%-60% during fire season	10	
	Moderate Danger Class or higher >60% during fire season	20	
Area Description	Strictly urban	0	
	Suburban with scattered forests	2	
	Rural with scattered forests	4	
	Rural with continuous forests	6	
Duff and Litter Layer	< 5 centimetres	1	
	5 to 13 centimetres	3	
	13 to 20 centimetres	5	
	>20 centimetres	6	
Fine and Coarse Debris	None or spread more than 5 metres apart and not elevated	1	
	Scattered branches and tops close to the ground	2	
	Scattered branches and logs grouped and crossed	5	
	Continuous branches and logs grouped and crossed	6	
Forest Stand Description	Generally deciduous	0	
	Mixed deciduous and coniferous	3	
	Generally coniferous	6	
Other Vegetation	Primarily domestic	0	
	Primarily domestic and wildland grasses	2	
	Primarily wildland brush	4	
	Primarily broom	6	
Topographic Features	Generally flat	0	
	Gently rolling and even	2	

	Rolling and gullied	4	
	Many steep areas or rock outcrops	6	
Values Protected	No significant development, primarily wildland values	2	
	Complete development, perimeter fire potential only	4	
	Incomplete development, fire potential throughout	6	
	Lot sizes larger than one hectare, homes at risk	6	
Recreational Use	No obvious use	2	
	Infrequent use, difficult access and few trails	4	
	Frequent use, signs of obvious use, well-tramped trails	6	
	High use, well-tramped trails, parks, private recreation areas	8	
	High use and the area has a history of recreational fire starts	10	
Fire Potential on Adjacent Lands	No significant fire potential	0	
	Low fire potential	2	
	Medium fire potential, small industrial development	4	
	High fire potential, garbage dump, school, campground, high-use	6	

FIRE SUPPRESSION

Important Factors	**Potential Hazard**	**Point Rating**	**Your Score**
Availability of Water	Good hydrant coverage, available water within 200 metres	1	
	Partial hydrant coverage, available water within 350 metres	2	
	No hydrants but good water supply within 500 metres	4	
	No hydrants and poor water supply	6	
Response Time to Fire	15 minutes	0	
	30 minutes	2	
	60 minutes	4	
	90 minutes	10	
Access for Emergency Vehicles	Fully accessible by pumpers and tankers	2	
	Some areas have access problems but can drive within 50 metres of fire location, grades less than 25%	4	
	Narrow winding road or bridge load limit but can drive within 50 metres of fire location, grades less than 25%	5	
	Significant areas of inaccessibility, air or foot access only	6	
Fire History	Fewer than 3 fires within the previous five years	0	
	3 to 5 fires within the previous five years	3	
	6 to 15 fires within the previous five years	6	
	More than 15 fires within the previous five years	11	

OTHER FACTORS

Important Factors	Potential Hazard	Point Rating	Your Score
Frequent high winds over 30 km/h		0 - 6	
Extensive areas of steep, south or west exposure slopes		0 - 6	
Large-scale industrial or construction projects anticipated		0 - 6	
Large-scale recreational activity project anticipated		0 - 6	
Fuel loading increase due to logging or land clearing activity		0 - 6	
Utilities within the interface area		0 - 6	
TOTAL POINTS			

Interface Fire Hazard Risk Rating

0 - 53 Low
54 - 68 Moderate
69 - 83 High
84+ Extreme

[AREA MAP]

Notes

Guidelines

Area Description

- Urban-strictly urban, high structure density and no trees,
- Suburban with scattered forests-communities adjacent to a city, moderate structure density, scattered forested areas,
- Rural with scattered forests-small communities and farmland with scattered structures and forest and,
- Rural with continuous forests-small communities and farmland with continuous forest throughout, some isolated structures.

Duff and Litter Layer

The duff and litter represent the decomposed, semi-decomposed, and freshly fallen material that makes up the upper layers of the forest floor. This includes fallen twigs, leaves, needles, cured grasses, herbs, and, any other combustible material present. To determine the point rating for the thickness of duff/litter, use the following procedure:

- Use a sharp shovel to cut through the litter and duff, creating a soil profile,
- The depth should be measured from the top of the first mineral soil horizon to the height of the upper littler as it occurs naturally,
- Do not compress fresh needles or other recently fallen material,
- Create soil profiles in at least three different locations, and record the average reading on the form in the right hand margin and,
- Avoid squirrel caches, rotten materials, and abnormal fuel accumulations.

Add one point to this factor rating if pockets of thick duff or litter occur at least every 10 metres.

Fine and Coarse Debris

Debris represents the amount of all types of ground fuels, including all combustible and woody material, even rotten wood, and their distribution. Debris ranges in size from branches and treetops, to logs and fallen trees.

- Scattered branches and tops-scattered material is found where the fuels are one to five metres apart, and 10% to 20% of the fuel is in contact with other material in this debris class. A majority of the fuel is close to the ground and,
- Continuous branches and tops-continuous debris is found at least every one metre, and more than 20% of the material is in contact with other material in this debris class. Debris may be elevated; an under-layer of branches and twigs with an over-layer of needles creates air pockets and the debris dries out more quickly.

Forest Stand Description

The forest stand description reflects the general composition of the surrounding area forest and the density of the upper canopy. Forest stand descriptions should be determined by a combination of air photo interpretation and local knowledge.

- Fuel Type-a recognizable fuel complex of sufficient homogeneity of characteristics and aerial extent, that steady state equilibrium fire behaviour can be predicted, and, be expected to be maintained over a considerable period of time,
- Deciduous-refers to moderately well stocked stands of semi-mature to mature deciduous trees; 75% of the upper canopy is deciduous,
- Coniferous-refers to well-stocked stands of mixed maturity conifers; full crown closure or not and,
- Ladder Fuels-low brush, branches, and, immature trees that provide access for ground fire to the upper canopy of the forest stand.

  Add one point to this factor rating if ladder fuels are present.

Other Vegetation
Refers to fuels in the area other than mature trees. It includes grasses, shrubs, brush, and immature trees that are not part of the canopy. Other vegetation and fuel types within the interface area should be determined through the use of aerial photographs and local knowledge.

- Domestic-includes lawns, shrubbery, golf courses, farmlands, etc., which are maintained by human activity,
- Wildland-wild, natural grasses, shrubs, brush, and scattered, downed woody materials and,
- Broom-introduced species, especially common on disturbed sites, and very hard to get rid of. Considered alone because of its properties as fuel type. It is a very flammable shrub because of its oiliness.

Topographic Features
The general topography of an area includes the slope of the ground measured from the horizontal and whether the slope is even or gullied. The general topography and terrain of the interface areas should be determined using aerial photography and by ground survey.

- Even slopes-have a smooth or gently rolling texture.
- Gullied slopes-have cuts running up the slope, which can provide funnels for up-slope, wind-driven fire spread.

Values Protected
The values at risk, including both structural and timber values, if a fire were to ignite and spread. Proximity to wildland is assumed. The values protected should be determined using aerial photograph and ground surveys.

Recreational Use
Recreational use levels are determined by old fire pits, well-tramped trails, signs of 4x4, motorcycle or bicycle use, local knowledge, and the size of the local population. A

combination of aerial photography, recreation maps, local knowledge and ground surveys should be used to determine recreation use levels within the interface zones. No obvious use-no access and no signs trails.

- Infrequent use-difficult access and few trails.
- Frequent use-signs of obvious use, easy access routes, well-tramped trails, evidence of camping, as well as any area within one kilometre of a high use area.
- High use-as above, also include parks, private recreation sites and areas with permanent fire pits.

Add two points to this factor rating if the area has a history of recreational fire starts.

Fire Potential on Adjacent Lands
Consider the risk of accidental ignition by such land usage as nearby schools, garbage dumps, campgrounds, parks, industry, or airports. An area fire history should approximate the number of human-caused fires in the past. Risk of accidental ignition should be determined through air photo interpretation, local knowledge of land-use, and ground surveys.

Availability of Water
The distance to available water is measured from the actual location that the forested area meets the development, to the first accessible location of the available water source. Air photos should show water sources such as lakes, rivers, and oceans. Municipal planning maps will show hydrant coverage.

The following criteria are used to assess available water:

- The water source must be present year round,
- Fire hydrants and/or standpipes must be in working condition with adequate flow,
- High volume community wells or irrigation systems can be considered if they are accessible for quick hook-up by firefighters,
- Residential wells should NOT be considered and,
- Seasonal creeks should NOT be considered.

Subtract one point from this factor rating if the area is provided with an independent water system usable by firefighters.

Response Time to Fire
The time it takes for emergency response (fire department, wildland crews, etc.) to respond to the fire. Local knowledge should be used to determine the response time to fires.

Access for Emergency Vehicles
Refers to the ease of accessibility for emergency equipment to respond to a fire. Air photo interpretation and ground surveys should determine access for emergency equipment. Consider locked and unlocked fire gate accesses.

- Pumpers and tankers-Very limited in their mobility, normally limited to paved or major gravel roads. Most full tanker trucks have trouble negotiating adverse grades over 15%. Loaded tanker trucks will also have trouble negotiating curves with a radius of less than 30 metres where the curve occurs in conjunction with a gradient over 10%. Tanker truck accessibility is considered good if it can get within 100 metres of a fire location. If a bridge is present, consider weight restrictions.
- Air/Foot-Ground crews or air attack should be considered where vehicles cannot travel to within 100 metres of a fire location.

Fire History
Refers to the number of fires within the area over the previous five years.

Frequent High Winds Over 30 km/h
The stronger the wind, the faster the spread of fire. Utilize local knowledge and historical weather information.

Extensive Areas of Steep, South, or West Exposure Slopes
Southern aspects receive the most direct sun, are the driest, and provide the best conditions for fires to ignite and spread. Western aspects receive direct sunlight during the heat of the day, creating easy afternoon burning conditions. The steepness of a slope can also affect fire spread. Wind currents are normally uphill and this tends to push heat and flames into new fuels. Convection heat rising along a slope causes a draft that further increases the rate of spread. Air photo interpretation and local knowledge should be used to determine south and west exposure slopes. Ground surveys should determine the point rating.

Large-Scale Industrial or Construction Projects Anticipated
Creates disturbance of the land and increases the risk of accidental ignition through the use of machinery and increased human activity. Examples include residential development, industrial park expansion, new garbage dump site, and road construction. Local knowledge and air photo interpretation should be used to determine what major projects exist in the interface area. Ground surveys and the above resources should determine what, if any, major industrial projects are anticipated or currently happening.

Large-Scale Recreational Activity Project Anticipated
Increased risk of accidental ignition due to increase in human activity in immediate area, as well as adjacent lands. Examples include park development, new campsites and increased tourist traffic from such activities as hiking, fishing and hunting. Local knowledge and advertised projects should determine what projects are happening in the interface zones. Utilize the same resources as above, and possibly community and special interest groups.

Fuel Loading Increase Due to Logging or Land Clearing Activity
Increased risk of accidental ignition due to equipment use. Increased ground fuel accumulations due to slash. A combination of air photo interpretation, local knowledge and ground surveys should be used to determine amounts of logging or land clearing activity in the interface area.

Utilities Within the Interface Area
Consider hydro rights-of-way, overhead wires, gas pipelines, etc., within the interface area or adjacent areas. Air photos and topographic maps should be used to determine where and what utilities exist in the interface area. Ground surveys and topographic maps should determine the point ranking for this factor.

Source: Wildland Fire Hazard Assessment
British Columbia Ministry of Forests Protection Branch May 2004

Appendix 10.2
Definitions for Wildland Interface Fire Hazard Mitigation

- **Fuel** – Combustible structures and wildland vegetative materials. It includes dead plants, parts of living plants, duff, and other accumulations of flammable vegetation.

- **Fuels Management** – The practice of planning, manipulating or reducing fuels to obtain conditions that permit protection forces to meet fire suppression objectives.

- **Highly Flammable Fuels** –Plants differ in how readily they ignite and how hot or long they burn. Flammability depends on plant size, arrangement of branches and leaves.

- **Ladder fuels**– Shrubs or small trees of intermediate height, act as ladders carrying the flames from the forest surface up into the tops of trees.

- **Thinning**- Cutting trees from a young stand so that the remaining trees will have more room to grow to marketable size. The primary intent is to improve growth potential for the trees left after thinning but in this case it is also to remove potential ladder fuels.

- **Pre-Fire Mitigation** – Prior to wildland fire ignition, a systematic application of risk assessment, fire safety, fire prevention, and fire hazard reduction techniques may be undertaken to reduce wildland fires, damages and cost of suppression.

- **Silviculture**-manipulation of forest vegetation to accomplish a specified set of objectives. It controls forest establishment, composition, and growth.

- **Slope** – A piece of ground that is not flat or level, but may rise or fall in percent; where one percent of slope means a rise or fall of one foot of elevation within a distance of 100 feet; 45% would equal 45 feet of rise in 100 feet.

- **Wildland** – An area that has low-density development. It can include hobby farms cattle ranches and forests managed for timber production.

- **Wildland Interface** – The geographical meeting point of two diverse systems, wildland and structures. At this interface, structures and vegetation are sufficiently close that a wildland fire could spread to structures or a structure fire could ignite vegetation.

Appendix 10.3 Tumbler Ridge Wildland Interface Hazard Plot Characteristics

Factors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Fire Weather	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area Descript	6	6	6	6	6	6	6	6	6	6	2	2	6	6	6	6	4	6	6	6
Litter	5	3	5	5	3	5	5	5	3	3	3	5	3	3	3	3	5	5	3	1
Woody Debris	5	5	6	5	5	5	6	5	5	5	2	5	5	2	2	2	6	6	5	5
Forest Stand	6	3	6	6	3	6	6	6	6	6	3	6	6	6	3	3	3	6	3	0
Under-Story	4	4	4	6	4	4	4	4	4	4	4	4	6	4	4	4	4	4	4	4
Topo. Features	0	2	4	6	0	2	2	2	2	2	6	2	4	6	6	2	2	2	2	0
Values	2	6	2	4	2	2	2	2	2	2	6	6	6	2	2	2	6	2	2	2
Rec. Use	6	4	4	4	4	2	2	2	4	4	8	6	2	2	2	2	4	2	4	4
Fire Potent.	4	4	4	4	2	4	4	4	4	5	5	6	4	4	4	4	4	5	4	2
Avail. Water	6	6	6	6	6	6	6	6	6	6	1	1	6	6	6	6	6	6	6	6
Resp. Time	0	0	2	2	2	2	0	2	0	0	0	0	2	2	4	4	2	2	4	2
Access	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	4	6	6	6
Fire History	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Wind over 30 km	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Steep, South, West Expos.	0	0	3	4	0	0	0	2	2	0	2	1	3	4	5	5	0	3	2	0
Future Indust. D.	2	2	0	2	0	0	0	0	5	6	5	5	2	0	0	0	6	0	0	0
Future Rec. Proj.	0	2	0	0	0	0	0	0	2	3	2	4	0	0	0	0	0	0	0	0
Future Fuels	0	0	2	0	0	0	0	0	2	3	0	0	0	0	0	0	3	2	0	0
Utilities in interfce	0	0	0	0	0	0	0	0	0	3	2	2	3	3	3	3	0	0	0	0
Total Points	**64**	**61**	**68**	**73**	**51**	**58**	**57**	**60**	**67**	**70**	**65**	**68**	**69**	**64**	**64**	**60**	**68**	**65**	**59**	**46**

Appendix 10.4 Fire Resistant Plants

(The MOF Protection Branch Website)

Fire Resistant Plants

Trees

Maple (Acer species)
Trembling Aspen (Populus tremuloides)
Willow (Salix species)
Birch (Betula species)
Cottonwood (Populus trichocarpa)
Mountain Ash (Sorbus species)

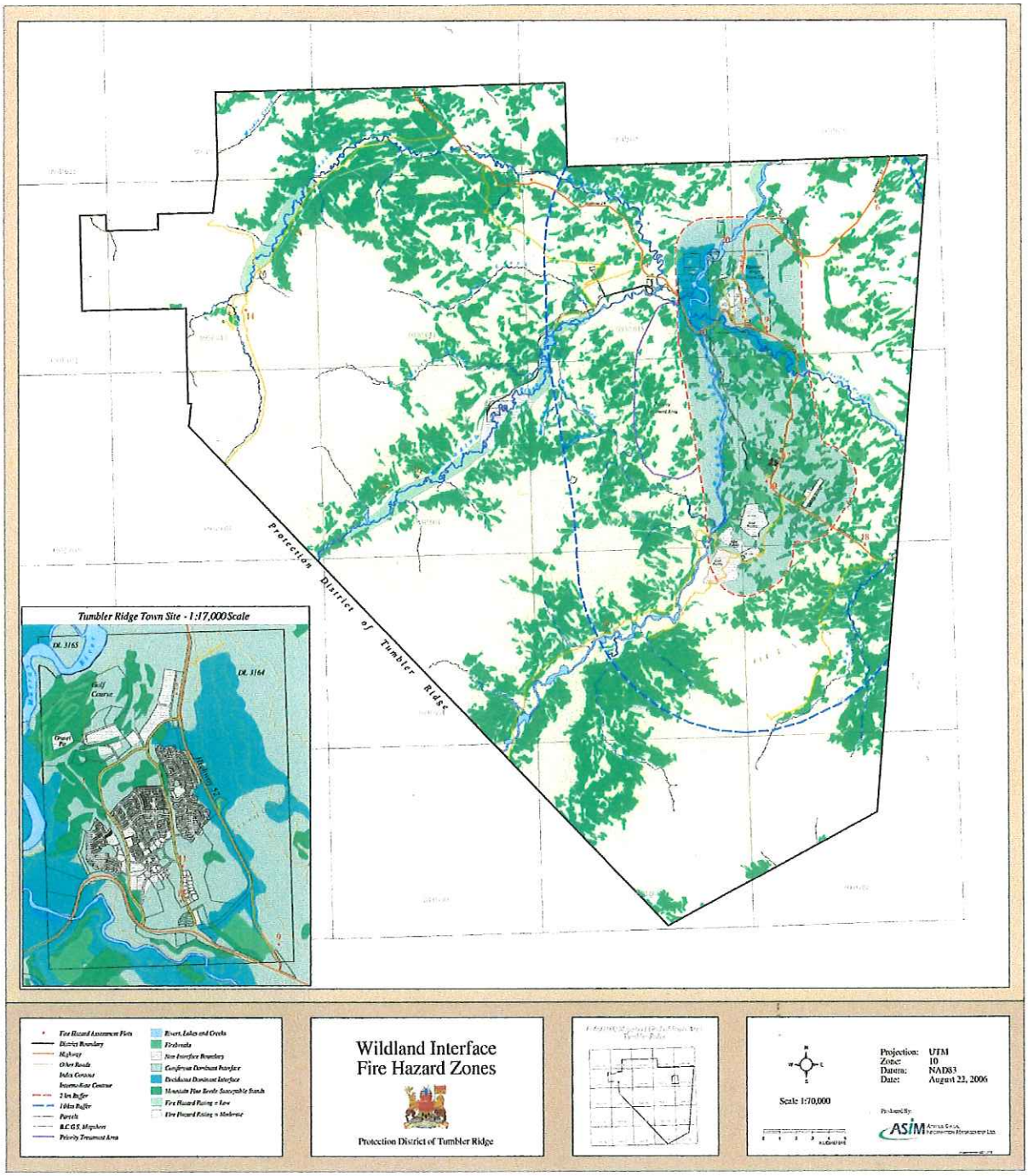
Shrubs and Woody Vines

Kinnikinnick (Arctostaphylos uva-ursi)
Cotoneaster (Cotoneaster species)
Honeysuckle (Lonicera species-low shrubs/vines)
Virginia Creeper (Parthenocissus quequefolia)
Rose (Rosa species - bush/hedges)
Periwinkle (Vinca species)
Snowbrush (Ceanothus species)
English Ivy (Hedera helix)
Buckthorn (Rhamnus species)
Sumac (Rhus species)
Lilac (Syringa species)
Currant/Gooseberry (Ribes species)

Herbaceous Perennials

Yarrow (Achillea species)
Thrift (Armeria species)
Snow-in-summer (Cerastium tomentosum)
Dianthus (Dianthus species)
Hardy Geranium (Geranium species)
Coral Bells (Heuchera)
Iris (Iris species & hybrids)
Lavender (Lavendula species)
Penstemon (Penstemon species & hybrids)
Stonecrop/Sedum (Sedum species)
Lamb's Ear (Stachys byzantina)
Poppy (Papaver species)
Columbine (Aquilegia species)
Wormwood (Artemesia species)
Coreopsis (Coreopsis species)
Blanket Flower (Gaillardia species)
Daylily (Hemerocallis species)
Candytuft (Iberis species)
Red-hot Poker (Kniphofia species)
Flax (Linum species)
Salvia (Salvia species & hybrids)
Hen & Chicks (Sempervivum species)
Yucca (Yucca species)

Appendix 10.5 Map Tumbler Ridge Wildland Interface Fire Hazard Zones



Brief Legend Summary of Tumbler Ridge Wildland Interface Fire Hazard Map

Turquoise Green-Deciduous Vegetation
Dark Green-Mountain Pine Beetle Susceptible Stands
Medium Grass Green-Coniferous Stands
Light Green-Low Hazard Zone
Yellow-Moderate Hazard Zone
Bright Green-Fuel Breaks
Grey-Non Interface

Appendix 10.6: Tumbler Ridge Weather Data.

Fire Weather System

Danger History in the Forest

Year	Danger Class	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total days
11 TUMBLER(DENISON)														
Average	Extreme	0	0	0	0	0	0	0	0,6	0,4	0	0	0	1
Average	High	0	0	0	0	1,2	3	3,8	3,9	2,4	0,6	0	0	14,9
Average	Moderate	0	0	0	1,1	6,9	9,3	11,4	9,8	6,7	4,3	0	0	49,5
Average	Low	0	0	0	2,9	12,4	12	9,9	11,3	11,4	10,4	3,1	0,6	74,2
Average	Very Low	0	0	0	0,5	4,4	5,4	5,9	5,4	9,1	8,2	3	1,2	43,1
	Extreme													0
	High						3	5	4					12
	Moderate					6	11	9	16	2				44
	Low				11	10	16	9	9	11	19	4		89
1996	Very Low				3	15		8	2	17	12	3		60
	Extreme													0
	High													0
	Moderate					7	7	10	5	5				34
	Low					13	14	12	21	12				72
1997	Very Low					7	9	9	5	13	14			57
	Extreme								6	4				10
	High					7	2	8	18	13				48
	Moderate				5	10	5	10	2	7	3			42
	Low				9	13	20	7	5	6	13	1		74
1998	Very Low				1	1	3	6			15	1		27
	Extreme													0
	High					1	5	4	6	6	4			26
	Moderate					7	13	13	17	17	15			82
	Low						8	13	7	7	11			46
1999	Very Low						4	1	1					6
	Extreme													0
	High													0
	Moderate					2	9	9	1	3				24
	Low					15	14	11	12	10	10			72
2000	Very Low					2	7	11	18	17	5			60
	Extreme													0
	High					2		2	5	1				10
	Moderate					7	4	9	17	18	6			61
	Low					11	13	9	6	11	10			60
2001	Very Low						13	11	3					27
	Extreme													0
	High						8	6						14
	Moderate					1	17	20	7	6	1			52
	Low					16	5	5	14	10	19			69
2002	Very Low					6			10	14	7			37
2003	Extreme													0

	High						7	10	6	3	2			28
	Moderate					13	13	12	11	3	14			66
	Low					15	9	8	13	20	4	14		83
	Very Low					3		1	1	4	11	8		28
	Extreme													0
	High					2	5	3						10
	Moderate					8	10	11	14		4			47
	Low					16	7	9	10	11	13	12	6	84
2004	Very Low					2	8	8	7	19	14	18	12	88
	Extreme													0
	High									1				1
	Moderate				6	8	4	11	8	6				43
	Low				9	15	16	16	16	16	5			93
2005	Very Low				1	8	10	4	7	7	4			41