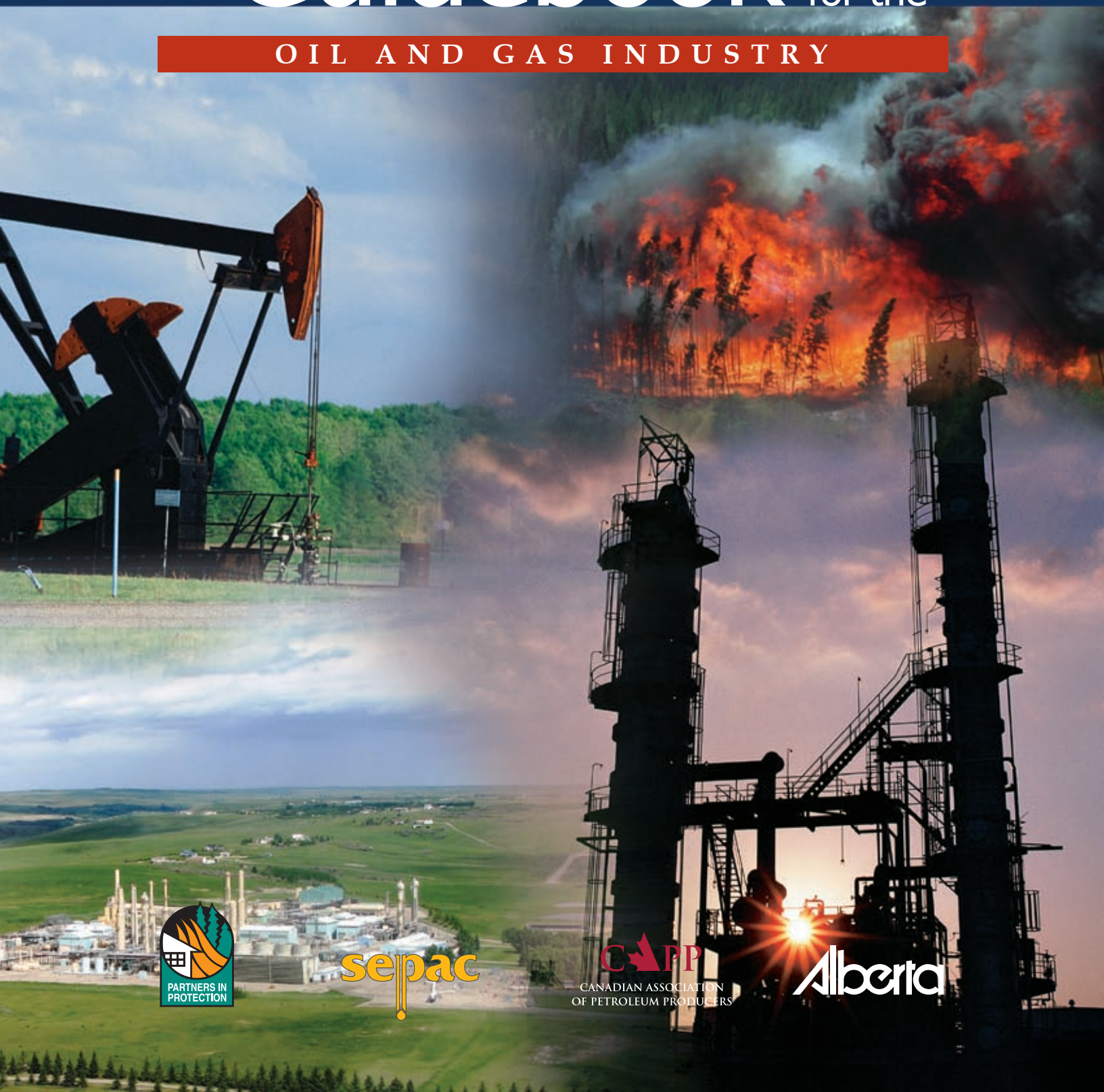
FireSmart® Guidebook for the

OIL AND GAS INDUSTRY



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Foreword

Protecting life, communities, watershed and soils, natural resources and infrastructure from wildfire has been Alberta Sustainable Resource Development's (SRD) priority for many decades. Since the 1990s the provincial FireSmart program has been accepted nationally as a proactive prevention program. FireSmart introduces steps to mitigate wildfire impacts while embracing the ecological role of wildfire. Wildfire is a natural process that helps maintain healthy and vibrant forests. However, uncontrolled wildfire can have a devastating impact on industrial developments. The FireSmart program recognizes this delicate balance and presents a number of innovative solutions specifically for the Oil and Gas Industry.

The Partners in Protection Association[1], an Alberta-based, non-profit association with multidisciplinary membership developed the, "FireSmart, Protecting Your Community from Wildfire (Second Edition)" Manual in 2003 to provide direction primarily in the development of residential homes in the wildland/urban interface. Based on the success and acceptance of its wildfire threat assessment and mitigation chapters (including forms and illustrations), the community-focused FireSmart Manual was used as a template for the *FireSmart Guidebook for the Oil and Gas Industry*. The Guidebook addresses both the threat of wildfire to Oil and Gas Industry values as well as the potential liability of the oil and gas industry. This document is intended as a guide for industry planning engineers and safety program managers throughout the province. The Alberta Department of Sustainable Resource Development and the Canadian Association of Petroleum Producers (CAPP) have co-sponsored the Guidebook. In conjunction, CAPP has developed Best Management Practices (BMP) in recognition of the importance of protecting the oil and gas industry developments and the continuous operation of production facilities. These BMPs will (1) assist the oil and gas industries in the prevention of industry-caused wildfires; and (2) help mitigate the impact of catastrophic fires on industry infrastructure, operations, liability, personnel safety and the environment.

It should be noted that the Guidebook's FireSmart mitigation options may at times conflict with the broad industry objective of reducing development footprints. Therefore, a balance between the two objectives should be considered. Readers are encouraged to review legislation to guide FireSmart activities.[2] FireSmart should be given priority consideration where human life and personnel safety may be impacted.

In the future, an abbreviated Operations Manual integrating the FireSmart Guidebook, Best Management Practices and Industrial Wildfire Control and Prevention Plan will be developed.

Overview

The Forest Protection Area (FPA) is a vast tract of public land that covers approximately 58 percent of Alberta's landmass (38 million hectares of forested land). Within the FPA, Sustainable Resource Development is responsible for protecting the forest from wildfire, insects, disease and other harmful agents. Social, cultural, recreational and economic activities are carefully managed within the FPA to ensure the benefits Albertans enjoy today are sustained for future generations.

Wildfire incidences related to human activities are increasing as development pressures on the land base intensify. Overall, these activities combined with changes in climate and forest conditions are contributing to a rise in wildfire ignitions and the associated liabilities and economic losses. The predominant causes of wildfire ignitions are lightning, recreational activities, residents, industry activities **(Industry category is ranked the third highest human-caused ignition source**), railroads or other agents, which collectively contribute to significant social and financial impacts.

Forest Protection Area of Alberta

[1] *The Partners in Protection Association is committed to raising awareness, providing information and developing forums to address common problems that encourage initiatives to reduce the risk of fire losses and enhance safety in the wildland/urban interface.*
[2] *Alberta legislation, such as the Forest and Prairie Protection Act, Forests Act, Timber Management Regulations and Public Lands Act, is available at http://www.qp.gov.ab.ca/custom_page.cfm?page_id=34*

The Industrial Wildfire Control and Prevention Plan is a requirement of the Forest and Prairie Protection Act, and the *FireSmart Guidebook for the Oil and Gas Industry* and Best Management Practices are intended to supplement these plans. In addition, Alberta has adopted a proactive approach to addressing the serious and recurring threat of wildfires to Albertans' values and industrial developments. The program, known as FireSmart, is one of several wildfire management initiatives developed in Alberta. FireSmart has received national and international recognition and is now being adopted by other jurisdictions worldwide.

The philosophy behind FireSmart recognizes that:

- Through assessments, the level of wildfire threat can be quantified to establish priorities at various spatial scales;
- FireSmart mitigation options can be identified and applied to manage liability and reduce wildfire impacts based on those priorities;
- Linkages to wildfire suppression activities can be integrated through FireSmart initiatives that fall within the Wildland Urban Interface Zone, FireSmart Community Zone or FireSmart Landscape Zone (see FireSmart Zones image);
- Linkages to land management activities can be integrated through Best Management Practices.

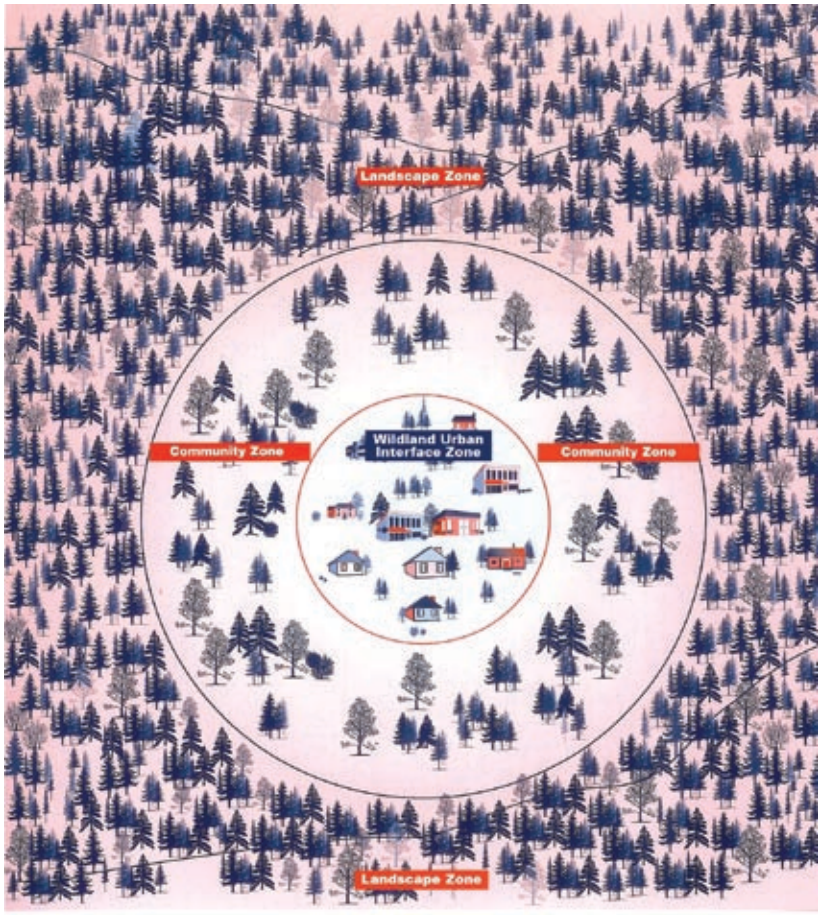
Benefits of the FireSmart Guidebook

In relation to Oil and Gas Industry, FireSmart is a proactive initiative that enhances safety and stewardship through the creation of best management practices aimed at the prevention and mitigation of wildfires. This ***FireSmart Guidebook for the Oil and Gas Industry*** introduces a **new dimension** in wildfire management at the disposition level by:

- Enhancing personnel safety during a wildfire event;
- Enhancing emergency response capability;
- Mitigating economic impact during shutdowns;
- Mitigating infrastructure loss or damage;
- Reducing liability for industry-caused ignitions.

This Guidebook is comprised of four parts that are integral to assessing the threat of wildfire on individual or multiple dispositions, and mitigating the social and financial impacts to the oil and gas industry.

- Part I – FireSmart industrial zone assessment process.
- Part II – Assessing liability on your disposition(s).
- Part III – Assessing emergency response capability on your disposition(s).
- Part IV – FireSmart mitigation options.

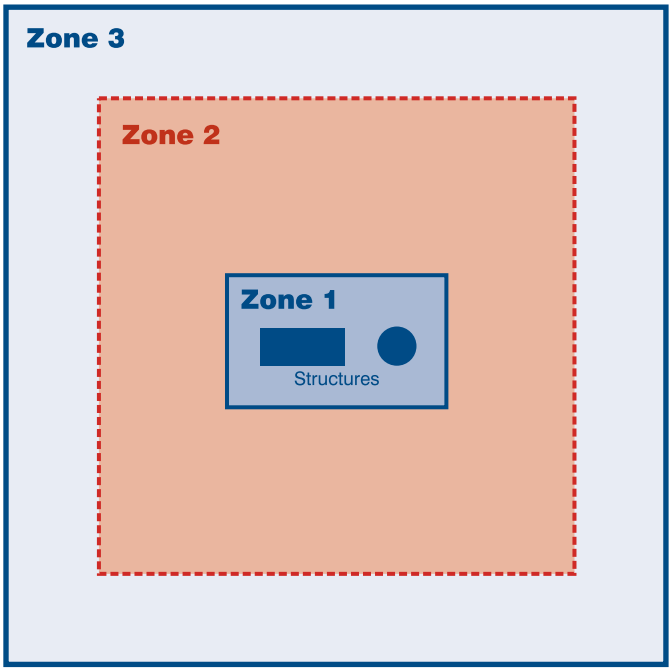


FireSmart Zones
These 3 FireSmart zones are the basis for FireSmart planning.

This FireSmart Guidebook provides a step-by-step process for assessing the threat of wildfire on individual or multiple dispositions and introduces mitigation options to minimize risk and liability to the oil and gas industry.

PART I. FireSmart Industrial Zone Assessment Process

The FireSmart Guidebook identifies a spatial scale for assessing the threat of wildfires on oil and gas dispositions. Part 1 of the FireSmart Guidebook describes the process for assessing wildfire threat and impacts using three specific FireSmart Industrial Zones.



FireSmart Industrial Zones

PHOTO: ROD HOULE

FireSmart Industrial Zone 1:
0-10 metres from structure(s) on the disposition. **(Priority One - personnel and structures are at risk from radiant heat and ember transport associated with a wildfire.)**

PHOTO: MARGRIET BERKHOUT

FireSmart Industrial Zone 2:
10-30 metres from structure(s) on the disposition. **(Priority Two - personnel and structures are at risk from ember transport associated with a wildfire.)**

PHOTO: ROD HOULE

FireSmart Industrial Zone 3:
30+ metres, extensive forest area surrounding individual or multiple dispositions. **(Priority Three - evacuation routes and evacuation staging areas can be impacted by smoke and wildfire activity outside the disposition.)**

FireSmart Industrial Zone 3

FireSmart Industrial Zone 3 focuses on the extended area (approximately 10 km) surrounding oil and gas dispositions. This zone typically includes multiple dispositions and other land use activities to be considered when assessing the threat of wildfire, evacuation staging areas and evacuation routes at a broad landscape scale. By ranking dispositions according to both wildfire threat information and industrial information, priorities can be established for achieving FireSmart goals in FireSmart Industrial Zone 1 and Zone 2.

Procedure

Step 1. Administration

Begin by conducting an administrative overview:

- Develop a framework identifying FireSmart goals (see Benefits of FireSmart on page 5).
- Form a FireSmart Industrial Committee with membership comprising key stakeholders and SRD Staff (local or provincial) for the applicable dispositions, or contact applicable representatives for input, discussion and/or guidance.

Step 2. Industrial Information
(broad landscape scale)

Collect required data and information for individual or multiple dispositions:

- Inventory and identify spatially the current dispositions by industrial region.
- Assess and evaluate the potential for personnel safety concerns during evacuation orders, infrastructure loss or damage, liability for industry-caused ignitions, production disruption and current emergency response capability (i.e., values at risk). Code these dispositions by low, moderate or high-risk potential.

Step 3. Wildfire Threat Assessment Information
(broad landscape scale)

Wildfire Threat Assessment information evaluates four key components (wildfire behavior potential, historical wildfire occurrence risk, values at risk and suppression capability) to identify critical wildfire environment characteristics. It provides a ranking level of low, moderate, high and extreme wildfire threat potential for a specific area. FIREWEB[2], hardcopy maps or digital spatial grids are available for your areas of interest to assist with this step.

- Combine the industrial information with SRD's Wildfire Threat Assessment information to identify the level of wildfire threat potential to individual or multiple dispositions and associated values at risk. Using FIREWEB, or hardcopy maps, identify the level (low, moderate, high or extreme) of wildfire threat to the applicable disposition(s).
- If there are multiple dispositions, prioritize the dispositions by using a ranking process. Setting priorities of these dispositions will help to establish a sequence (to address highest risk), budget proposal and resource needs for achieving FireSmart goals.
- SRD, Forest Protection Branch staff will be useful in providing wildfire management expertise.

Commence the next steps in FireSmart Industrial Zone 2. This will help lead to the incorporation of FireSmart mitigation options, achievement of FireSmart goals and Best Management Practices.

FireSmart Assessment Process

[1] *The Alberta FIREWEB is an "easy to use" web based map service system developed by SRD to provide both daily wildfire operational information and wildfire prevention information. Wildfire threat assessment information for the Forest Protection Area is available spatially at a provincial scale. An Application form to access and utilize this free map service can be acquired at http://www.srd.gov.ab.ca/wildfires/fpd/st_fma.cfm This link also includes user guide information.*

FireSmart Industrial Zone 2 (indvidual disposition)

FireSmart Industrial Zone 2 facilitates assessments 10-30 m from structure(s) on an individual oil and gas disposition. Zone 2 assessments evaluate the various types and flammability of forest vegetation, ladder fuels, slope and ember transport to help towards determining the appropriate FireSmart mitigation options.

FireSmart Assessments and mitigation options within Zone 2 will reduce the intensity and rate of spread of a wildfire encroaching on or originating from an industrial disposition. **If Zone 2 (10-30 m) exceeds the disposition boundary, approval for vegetation management is required. Contact the local SRD office for the approval process.**

PHOTO: ROD HOULE

Mitigation options completed for Zones 1 and 2.

Overview of Industrial Assessments

The purpose of the industrial assessments section is to provide guidance for completing the assessment tables in Zones 2 and 1, thereby determining the ranking and mitigation options.

Vegetation - Fuel Types

When describing wildland fire behaviour, the vegetation is classified into 12 basic Forest Fire Behavior Prediction (FBP) fuel types (see Appendix 2 on page 32 for images and fuel type descriptions).

Surface Vegetation - Horizontal Continuity

The presence and continuity of surface vegetation contribute to increased wildfire intensity. This factor will determine if the wildfire remains as a surface fire or becomes a crown fire. Assessing surface vegetation conditions is accomplished using the following categories:

1. Grass/shrub,
2. Debris from clearing,
3. Dead and down woody debris.

Grass/shrub

Debris from clearing

Dead and down woody debris

Ladder Fuels - Vertical Continuity

If abundant, ladder fuel described as vegetation that will help carry a surface fire up the tree to the crowns/tops can create a crown fire (typically in coniferous fuel types). Crown fires produce the highest fire intensity creating a risk for long-distance spotting. *Note: If ladder fuels and surface fuels are reduced or eliminated, the risk of crown fire is significantly reduced.*

Ladder fuels absent

Ladder fuels scattered

Ladder fuels abundant

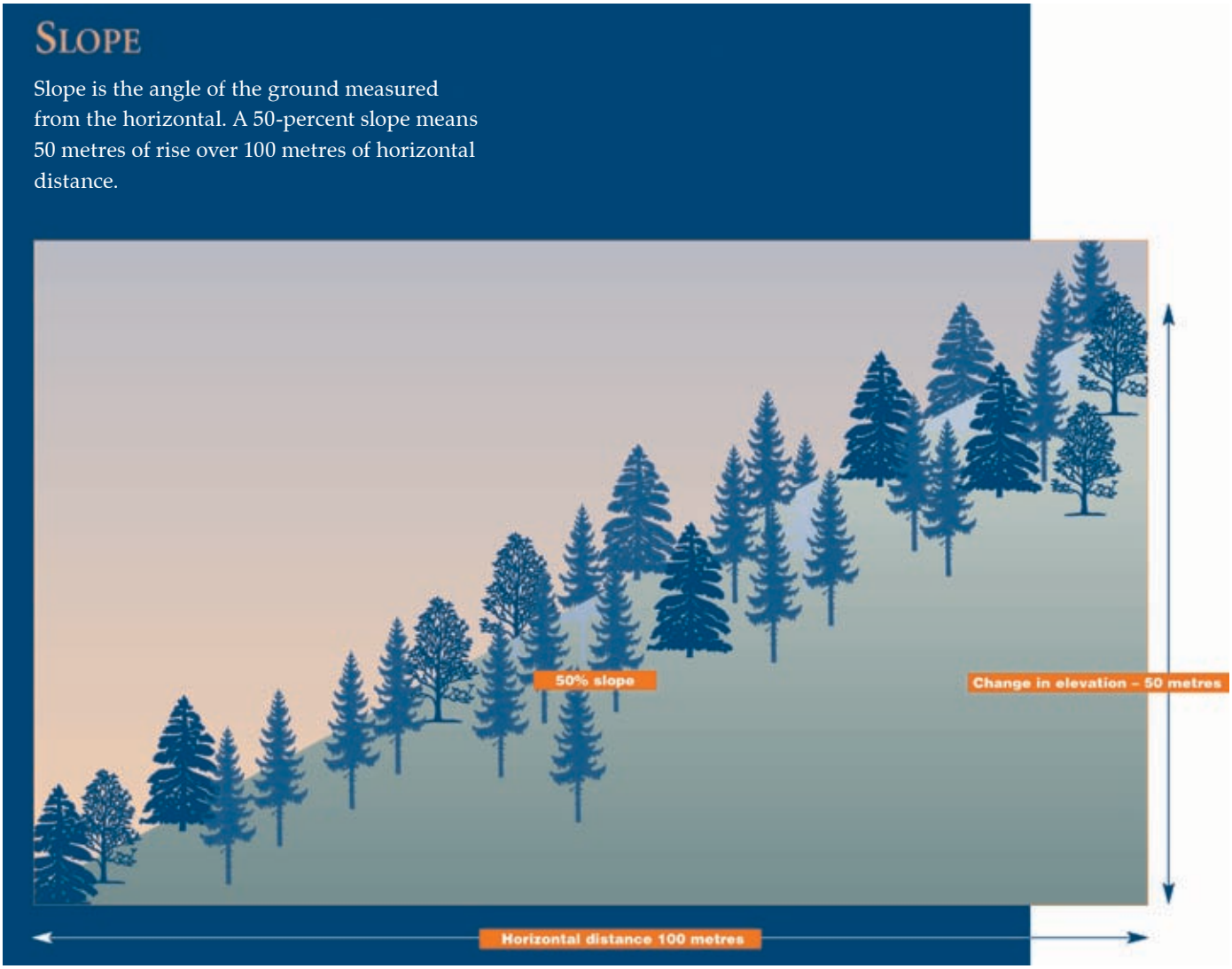
Location of Structures and Ignition Potential

The distance between structures and flammable vegetation can affect structural ignition potential through ember transport or radiant heat exposure to structures or vegetation.

- Ember Transport: Wildfires produce airborne embers that are lofted into the air and travel great distances, often igniting spot fires ahead of the main fire. Embers that land on combustible materials of structures may consume the structure or ignite adjacent structures or vegetation.
- Radiant Heat: Direct flame contact or radiant heat exposure can ignite combustible materials.

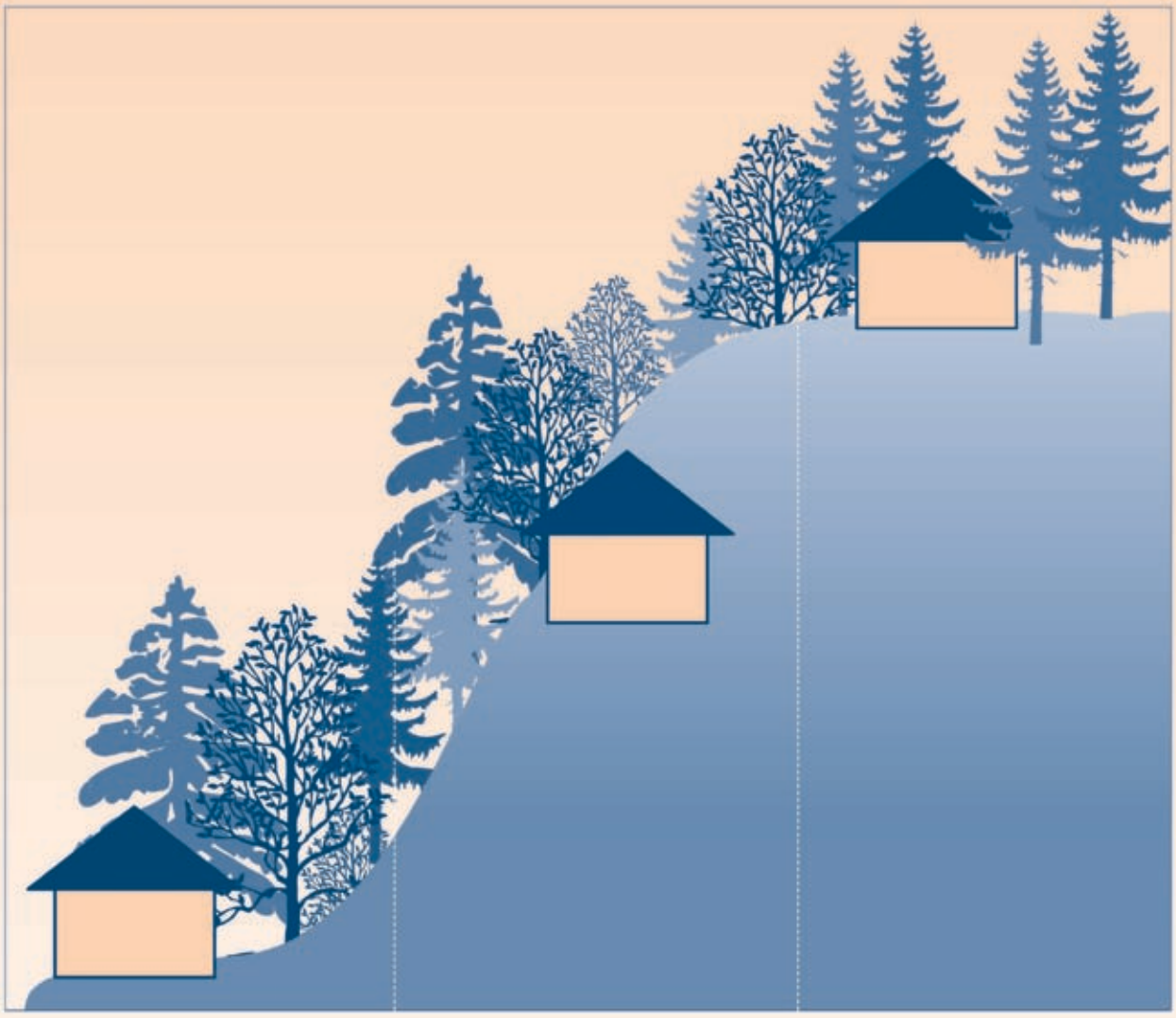
Slope

A wildfire will burn more rapidly and intensely uphill compared to flat or level ground. Consequently, structures on or adjacent to a slope are more susceptible. In general, structural locations higher up on a slope (with vegetation below) face a significantly higher probability of ignition due to increased radiant heat exposure.



Position on Slope

The location of the structure(s) on the slope will affect susceptibility.



▲ Base of slope

Areas of development on flat ground or valley bottoms, extending as high as one-third of the way up the slope.

▲ Mid-slope

Areas of development on slopes with forested areas or grasslands below, extending as high as mid-way up the slope.

▲ Upper-slope

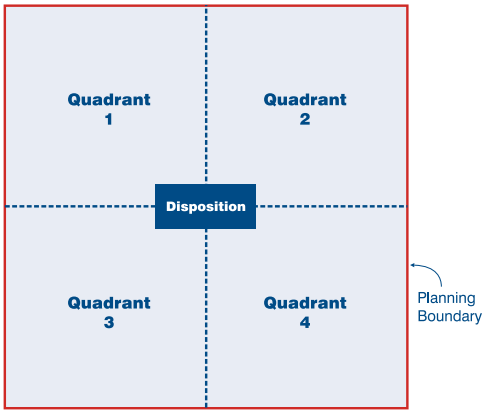
Areas of development located on the top half or crest of slopes with forested areas or grasslands below them.

Procedure for Industrial Assessments

Zone 3

Step 1. Vegetation - Fuel Types

- A planning boundary should delineate the quadrant scale to assess vegetation flammability. Typically a quadrant size of 1-3 km is recommended. Split the planning boundary into 4 quadrants and total the values within each quadrant.
- Using the following table, assess the vegetation flammability components.
- See Appendix 2 for fuel types (vegetation species).



Vegetation Assessment								
Q1 - SW Fuel Types	Deciduous D1		Mixedwood M1			Coniferous C2 – C3		Total
	Young Age (0-70 yrs)	Old Age (70+ yrs)	<30% Coniferous composition	30-70% Coniferous composition	>70% Coniferous composition	Trees are well spaced or separated	Trees have no space between them - all touching	
	3	10	5	10	15	10	20	
Surface Vegetation	Wild Grass/Shrubs		Debris from Clearing			Dead and Down Woody Material		Total
	Standing	Matted	Light	Moderate	Heavy	Scattered	Abundant	
	5	10	5	10	25	10	20	
Ladder Fuels	Absent		Scattered			Abundant		Total
	0		5			10		
Q1 Quadrant Flammability Ranking	**Low 0-20**		**Moderate 21-39**			**High 40+**		**Total**

Q2 - SE Fuel Types	Deciduous D1		Mixedwood M1			Coniferous C2 – C3		Total
	Young Age (0-70 yrs)	Old Age (70+ yrs)	<30% Coniferous composition	30-70% Coniferous composition	>70% Coniferous composition	Trees are well spaced or separated	Trees have no space between them - all touching	
	3	10	5	10	15	10	20	
Surface Vegetation	Wild Grass/Shrubs		Debris from clearing			Dead and Down Woody Material		Total
	Standing	Matted	Light	Moderate	Heavy	Moderate	Heavy	
	5	10	5	10	15	10	20	
Ladder Fuels	Absent		Scattered			Abundant		Total
	0		5			10		
Q2 Quadrant Flammability Ranking	**Low 0-20**		**Moderate 21-39**			**High 40+**		**Total**

Q3 – NW Fuel Types	Deciduous D1		Mixedwood M1			Coniferous C2 – C3		Total
	Young Age (0-70 yrs)	Old Age (70+ yrs)	<30% Coniferous composition	30-70% Coniferous composition	>70% Coniferous composition	Trees are well spaced or separated	Trees have no space between them - all touching	
	3	10	5	10	15	10	20	
Surface Vegetation	Wild Grass/Shrubs		Debris from clearing			Dead and Down Woody Material		Total
	Standing	Matted	Light	Moderate	Heavy	Scattered	Abundant	
	5	10	5	10	15	10	20	
Ladder Fuels	Absent		Scattered			Abundant		Total
	0		5			10		
Q3 Quadrant Flammability Ranking	**Low 0-20**		**Moderate 21-39**			**High 40+**		**Total**

Q4 -NE Fuel Types	Deciduous D1		Mixedwood M1			Coniferous C2 – C3		Total
	Young Age (0-70 yrs)	Old Age (70+ yrs)	<30% Coniferous composition	30-70% Coniferous composition	>70% Coniferous composition	Trees are well spaced or separated	Trees have no space between them - all touching	
	3	10	5	10	15	10	20	
Surface Vegetation	Grass/Shrubs		Debris from clearing			Dead and Down Woody Material		Total
	Standing	Matted	Light	Moderate	Heavy	Moderate	Heavy	
	5	10	5	10	25	10	20	
Ladder Fuels	Absent		Scattered			Abundant		Total
	0		5			10		
Q4 Quadrant Flammability Ranking	**Low 0-20**		**Moderate 21-39**			**High 40+**		**Total**

Note: Assign the predominant fuel type conditions that best describe the quadrant.

If the quadrant ranking is **low** – no FireSmart mitigation options need to be applied.
If the quadrant ranking is **moderate or high** – go to the associated mitigation options in Part IV.

Step 2. Location Assessment of Structures and Ignition Potential
Zone 1 & 2

- Use the following table to assess the location of structures in relation to forest vegetation.

Location of Structures on the Disposition Assessment				
Distance from forest vegetation	Structure within 20 to 30 metres of forest	Structure within 10 to 20 metres of forest	Structure within 10 metres of forest	Total
	0	10	20	
Hazard Level	**Low 0**	**Moderate 10**	**High 20**	

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

Step 3. Slope Assessment

Zone 1 & 2

- Use the following table to assess the slope influence.

Slope Assessment						
Slope impact	Structures >100 metres from crest of slope	Structure <100 metres from crest of slope	Position of disposition and structures on slope			Total
Structure	Adequate	Indequate	Base of slope	Mid-slope	Upper slope	
	0	5	0	5	10	
Hazard Level	**Low 0**	**Moderate 10**		**High 20**		

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

FireSmart Industrial Zone 1 (Structures within individual dispositions)

FireSmart Industrial Zone 1 focuses on a 0-10 m radius around each structure on an individual disposition. Key assessment components critical to mitigating impacts are:

- Structure materials;
- Flammable material storage units (e.g., hydrocarbon storage tanks);
- On-site vegetation.

Overview of Industrial Assessments

Structural Materials

The roof of a structure is the most vulnerable component for fire ignition. Roofs catching fire are the main cause of structural losses. Embers and flaming debris from wind-driven fires can travel great distances, and embers landing on a combustible roof surface can start a new fire.

Building codes have long recognized the role roofing plays in the spread of fires. These codes use roofing classifications A, B and C based on the combustibility of the exterior roofing surface. Fire rating class A is the best classification assigned to roofing, and it includes materials such as metal roofing.

Flammable Material Storage

Storage of flammable materials on site, such as hydrocarbons or propane tanks, creates additional threat to structures on the disposition based on:

- Presence or absence of hydrocarbons on site;
- Flammable material rating;
- Potential for accumulation of airborne embers on tanks;
- Distance from storage sites to forest vegetation.

Vegetation

Refer to vegetation description in Zone 2 on page 8.

PHOTO: ROD HOULE

Procedure

Step 1. Structural Assessment

- Use the following table to assess the structural ignition potential (rooftops, building exterior, eaves, etc.).

Structural Assessment				
Roofing material	Metal, tile, asphalt, or non-combustible material		Wood	Total
	0		20	
Building exterior	Non-combustible concrete or metal siding		Wood or vinyl siding	Total
	0		10	
Eaves, vents and openings	No eaves, vents are screened and opening is turned down		Open eaves, unscreened vents can trap embers	Total
	0		5	
Loading docks base enclosed	None or fire resistant material sheathed in	Combustible material sheathed in	Combustible material not sheathed in	Total
	0	2	5	
Location of petroleum products and combustibles	None or >10 m from structures	3-10 m from structure	<3 m from structure	Total
	0	5	10	
Hazard Level	**Low 0-2**	**Moderate 3-20**	**High 21+**	

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

Step 2. Flammable Material Storage Assessment

- Use the following table to assess the flammable storage materials.

Flammable Material Storage Assessment				
Hydrocarbon storage on site	Absent		Present	Total
	0		10	
Tank top	Top cone shaped, vents turned down, will not trap embers at vents and openings		Flat top, vents open, can trap embers at vents and openings	Total
	0		10	
Distance from forest vegetation	Structure within 20 to 30 m of forest	Structure within 10 to 20 m of forest	Structure within 10 m of forest	Total
	0	10	20	
Propane tanks	Vegetation within 10 to 20 m of tank	Vegetation within 3 to 10 m of tank	Vegetation within 3 m of tank	Total
	0	10	20	
Hazard Level	**Low 0-10**	**Moderate 11-19**	**High 20+**	

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

Step 3. On-Site Vegetation Assessment

Zone 1

- Use the following table to assess vegetation. (*Note: Grass/shrubs and trees inside fence line.)*

Vegetation Assessment on Disposition				
Site vegetation	None or >10 m from structure(s)	3-10 m from structure(s)	<3 m from structure(s)	Total
	0	5	10	
Hazard Level	**Low 0**	**Moderate 5**	**High 10**	

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

PART II. Assessing Liability

On average, industry activities are categorized and ranked as the third highest human-caused ignition sources. Liability from ignitions specifically includes:

- Flaring;
- Use of All Terrain Vehicles (ATVs);
- Power lines;
- Disposal of debris piles by burning.

PHOTO: BRIAN MOTTUS

Flare stack

Overview of Industrial Assessments

Flare Stacks and Pits

Carbon buildup (inside flare stack from pilot up) can be prevented through following operational guidelines and routine maintenance. Flare knockout drums need to be maintained to avoid liquid carry over.

PHOTO: FERIC

ATV activity

All Terrain Vehicle Activities

ATVs used for operations, surveying, construction or maintenance activities can cause wildfire ignitions when dry forest conditions are present. During the normal operation of ATVs, vegetation accumulates around exhaust systems. The temperature of the exhaust system can heat the accumulated vegetation near the manifold or heat shield of the exhaust system to the point of ignition. The ignited vegetation can fall to the ground (through vibration), possibly igniting surface vegetation when the ATV is in motion, or can fall off after the ATV is parked after use. Parking the ATV on gravel, pavement or bare mineral soil greatly reduces the potential for starting such fires.

PHOTO: PHIL GOLDSNEY

Powerlines

Powerlines

Power interruption and wildfire ignition can be caused by falling trees coming in contact with the powerline conductors. Burned wooden power poles can also cause interruption in the distribution lines. Trees that come in contact with powerlines may cause a ground arc, which can result in power outages and/or cause a wildfire ignition. Disruption of a continuous electrical source of power during a wildfire incident may have a significant impact on industrial activities. To address risks of ignition on the powerline right of way, **contact your local utility company to establish maintenance schedules and responsibilities.**

PHOTO: BRIAN MOTTUS

Disposal of debris

Disposal of Debris

If not monitored or extinguished correctly, disposal of debris piles through burning can result in holdover fires. Debris piles burned over deep organic soils can cause a ground fire that can persist over the entire winter period. In the spring when the snow melts and forest vegetation and soil conditions become dry, the holdover fire can surface and spread rapidly to surrounding vegetation.

Procedure

Step 1. Flare Stacks and Pits

- Use the following table to assess flare stacks and flare pits.

Flare Stacks and Pits Assessment					
Flare stack/flare pit	Distance from base of flare stack to closest vegetation/ debris is 2.5 x the length of flare stack		Cleared, bare mineral soil extends at least 8 m around flare pit		Total
	Yes	No	Yes	No	
	0	10	0	10	
Hazard Level	**Low 0**	**Moderate 10**	**High 20**		

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

Step 2. ATV Activity

- Use the following table to assess ATV operations.

ATV Operations Assessment					
ATV activity	ATV's exhaust system inspected regularly for burning material during fire season		ATV's parked or operated on mineral soil/gravel or flammable vegetation		Total
	Regular	Occasional	Mineral Soil/Gravel	Forest Vegetation	
	5	10	0	10	
Hazard Level	**Low 0**	**Moderate 10**	**High 20**		

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

Step 3. Disposal of Debris by Burning

- Use the following table to assess debris piles that may be disposed of through burning.
  Note: Refer to the following website for information on understanding the Fire Weather Index.
  http://www.srd.gov.ab.ca/wildfires/fpd/w_wfo_understanding.cfm

Debris Disposal Assessment					
Disposal of woody debris piles through burning	Woody debris piled on organic or mineral soils (holdover potential)		Winter burning - assessing risk for hold over fires using the Fire Weather Index for the fall season		Total
	Mineral Soils	Organic Soil	Drought Code <350 (low, moderate or high)	Drought Code >350 (very high or extreme)	
	0	10	0	10	
Disposal of woody debris piles through burning	Woody debris piles burning inspected for extinguishment (if burned over the winter, inspected prior to the upcoming fire season)				Total
	Extinguished	IR Scanned	Manual Check	Not Inspected	
	0	3	5	10	
Hazard Level	**Low 0-5**	**Moderate 6 -10**	**High 11+**		

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

PART III. Assessing Emergency Response Capability

Directive 071 provides the minimum EUB emergency preparedness and response requirements for upstream petroleum industry. However, these requirements do not include **wildfire preparedness** and response.

Overview of Industrial Assessments

Personnel Safety

Employees should know what to do during a wildfire emergency. During a wildfire emergency: (1) determine minimum number of personnel required to operate during a wildfire threat; (2) issue evacuation alerts.

Wildfire Evacuation Routes

Evacuation routes are critical for evacuating personnel from a disposition during a wildfire emergency. (*Note: Visibility may be drastically reduced due to smoke drifting across access roads.*) When identifying evacuation routes:

- Identify safe helicopter landing areas for air lift evacuation. Where road access has been cut off, helicopters may provide the only means of evacuation.
- Identify adjacent waterways that can be accessed by boat if applicable.
- Identify current roads into the disposition. Assess the threat of wildfire on the potential evacuation routes.

Access Roads

During a wildfire, all-weather gravel roads can be used as access or act as evacuation routes for emergency vehicles or workers. Narrow or dead-end roads without proper turnarounds (hammerhead Ts) are a particular problem for wildfire suppression vehicles since they may not be able to turn around when necessary (ring roads are optimal). Whenever possible, access or evacuation routes should double as barriers to fire spread to help slow or impede the spread of wildfire.

Water Sources

Wildfire suppression needs substantial volumes of water from a dependable source. If a disposition is not serviced by a water system, alternative water sources can be developed or identified. (*Note: Water sources will enhance both the wildfire and structural fire suppression capability.)*

PHOTO: ROD HOULE

Wildfire evacuation route

PHOTO: ROD HOULE

Multiple access routes

PHOTO: MARGRIET BERKHOUT

Water source

Procedure

Step 1. Personnel Safety

Smaller plant sites

- Use the following table to assess personnel safety.

Assessing Personnel Safety				
	Operated from control room (no personnel on site)	Number of personnel on daily workshift less than 5	Number of personnel on daily workshift greater than 5	Total
	0	5	10	
Hazard Level	**Low 0**	**Moderate 5**	**High 10**	

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

Step 2. Wildfire Evacuation

Determine if evacuation plans are in place and if evacuation alerts have been identified for each facility. In the Forest Protection Area, SRD has decision support tools to help determine evacuation alerts (e.g., Prometheus Wildfire Growth Model).[1]

Step 3. Access Roads and Water Sources

- Use the following table to assess road access and water sources.

Road Access and Water Source Assessment								
Infrastructure Access Roads	Access to facility; road surface width		Access to area through:			Site ring road		Total
	>6.1 m	<6.1 m	D1 fuels	O1 fuels	C2 fuels	Yes	No	
	0	5	1	5	5	0	5	
Water supply	Hydrant service		Pits, tanks, natural source			Alternative water supply available		Total
	Yes		With pump and hoses		Not with pump & hose	Yes	No	
	0		0		5	5	10	
Hazard Level	**Low 0-5**	**Moderate 6-10**		**High 11+**				
Remarks:								

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

Step 4. Evacuation Routes

- Use the following table to assess evacuation routes.

Evacuation Routes/Plans Assessment							
Employee Safety	Evacuation Routes (roads) Identified		Evacuation Staging Area		Helicopter Landing Area		Total
	Yes	No	Identified	Not Identified	Identified	Not Identified	
	0	5	0	5	0	5	
Evacuation Plans	Evacuation Plans in Place		Employees Briefed on Evacuation Plans				Total
	Yes	No	Yes	No			
	0	5	0	5			
Hazard Level	**Low 0-5**	**Moderate 6-10**		**High 11+**			

If the total ranking is **low** – no FireSmart mitigation options need to be applied.
If the total ranking is **moderate or high** – go to the associated mitigation options in Part IV.

[1] Prometheus Canadian Wildland Fire Growth Model: http://www.firegrowthmodel.com/index.cfm

PART IV. FireSmart Mitigation Options

An extreme wildfire event in Alberta has the potential to spread over 60 km in one day and produce the equivalent energy of 1000 barrels of oil in the same period. The combination of rapid and unpredictable wildfire spread and high energy release rates produces super heated air currents, ember transport and smoke columns that can impact human health and safety many kilometres from the actual fire front. The oil and gas industry can ensure that wildfire threat and liability are minimized through FireSmart mitigation options which include current and future Best Management Practices.

PHOTO: BRIAN MOTTUS

FireSmart Industrial Zone 3

Integrated Planning

Integrated planning includes a strong partnership and communication component with stakeholders in Zone 3 to reduce the overall threat of wildfire.

PHOTO: BRIAN MOTTUS

Recommendations:

- Support forest management plans to reduce the threat of wildfire and to help collaboratively implement FireSmart mitigation options.
- Support Integrated Land Management Program (ILM)[1] and approaches to reduce the threat of wildfire, collective footprint and to help implement FireSmart migitation options.
- Consider joint FireSmart mitigation options with other land use planners, which may include utility companies, municipalities, forest industry and government, to achieve a reduction in wildfire threat.
- Through integrated planning (or FireSmart Committee), identify and where possible, collaboratively develop potential long-term barriers to fire spread (containment lines, vegetation removal, enhancement of linear disturbances) on the landscape surrounding your disposition.
- In addition identify concentrations (i.e., windrows, debris piles, dense coniferous stands) of forest vegetation that contribute to ember transport. Short range ember transport (up to 200 m) is a common feature of most wildfires. Low density, moderate ember transport (200-500 m) is less common, and long range ember transport (500-2000 m) is occasionally observed under extreme fire behavior conditions (Alexander 2004).[2]
- ***Any vegetation management treatment outside your approved disposition requires authorization and approval from SRD.***

[1]For more information on Integrated Land Management (ILM) visit the following link at: http://www.srd.gov.ab.ca/lands/usingpublicland/integratedlandmanagement/default.aspx

[2]Alexander, M.E.; Tymstra, C.; Frederick, K.W. 2004. Incorporating breaching and spotting considerations into PROMETHEUS – the Canadian wildland fire growth model. Foothills Model Forest, Hinton, AB. Chisholm/Dogrib Fire Research Initiative Quicknote 6. 2 pp.

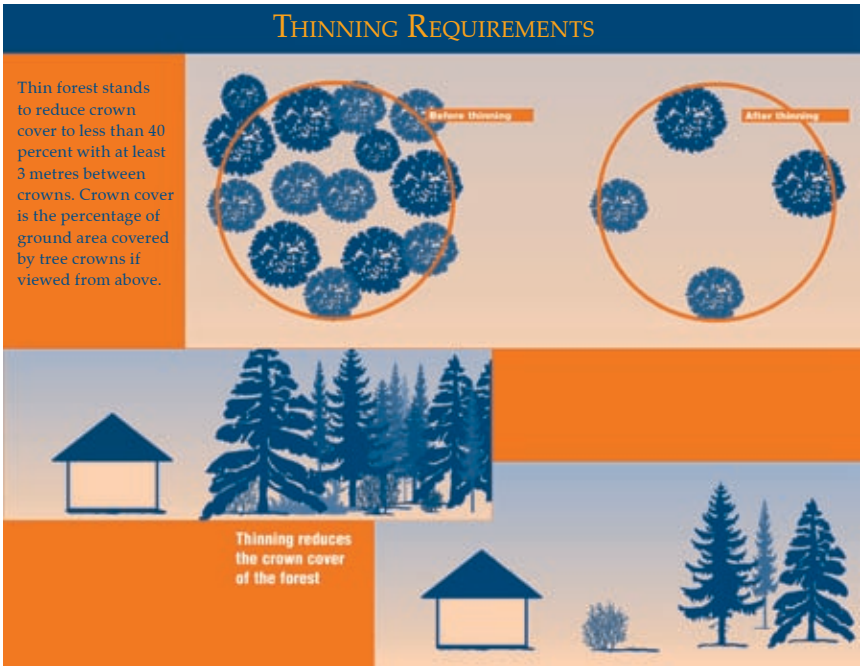
FireSmart Industrial Zone 2

Vegetation Management

The goal of vegetation management is to create a forest vegetation complex that will not support high-intensity crown fires.

The three options of vegetation management are:

- **Vegetation removal** — total removal of all flammable vegetation to eliminate the potential ignition of a wildfire.
- **Vegetation conversion** — converting the vegetation species from highly flammable coniferous forest vegetation to less flammable deciduous forest vegetation.
- **Vegetation reduction** — partially removing flammable coniferous forest vegetation to reduce the crown fire potential and lower the wildfire intensity, spread and spotting, etc.



Vegetation differs in its flammability as some species are MORE resistant to burning, while others are LESS resistant to burning. The flammability rating of different tree species is shown below.

Recommendations:

- If values at risk warrant, maintain this zone as a vegetation-free zone where all woody debris is totally disposed of and the site is maintained as bare mineral soil or gravel; or
- Maintain this zone as grass mowed down to 10 cm or less.
- If values at risk do not warrant a vegetation-free zone, then implement vegetation reduction.

PHOTO: BRAD BAILEY

Example of vegetation reduction

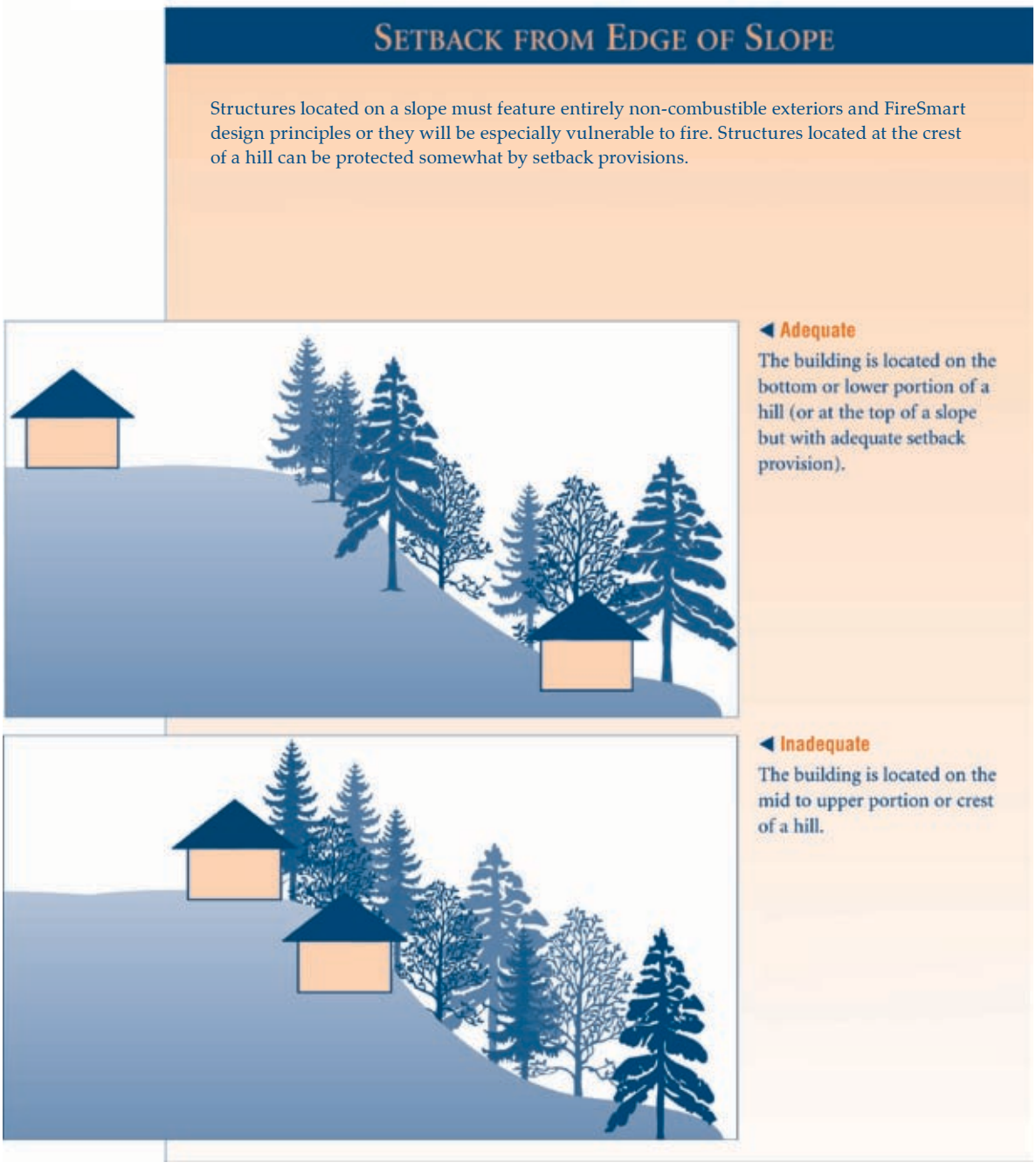
Species	Flammability	Fuel Type
Black spruce	EXTREME	C2
Cured/dead grass and slash	EXTREME	01,S1, S2, S3
Lodgepole or jack pine	HIGH	C3
White spruce	HIGH	M1, M2
Western larch	LOW	C1
Young and mature aspen (has clean forest floor present)	VERY LOW	D1

Location of Structure and Slope Influence

In general, location of structures on the disposition higher up on the slopes with vegetation below face a significantly higher wildfire threat. Slope influence on wildfire spread is similar to wind effect (for every 10% increase in slope; fire spread will double).

Recommendations:

- Aggressive vegetation reduction and vegetation conversion is the preferred strategy on slopes.
- The distance from structures to forest edge should be doubled where the slope below the disposition is 30 percent or greater.
- Ensure applicable approvals are acquired from local SRD office prior to vegetation management treatments.



FireSmart Industrial Zone 1

Structural Protection

Ideally FireSmart options should be incorporated during the planning stage of disposition development; however, on existing developments mitigation of wildfire threat can still be accomplished.

Recommendations:

- Complete industrial assessments preferably during the planning stages and implement FireSmart options during the development stages to mitigate wildfire threat.
- Rank all structures in descending order in terms of asset/value, wildfire threat, and susceptibility to radiant heat and ember transport.
- To prevent entry of airborne embers, screen all eaves and vents with corrosion-resistant non-combustible 3 mm wire mesh, and turn the vent openings downward.
- Install a sprinkler system on structures that are vulnerable to accumulating embers and are at high risk for ignition.
- Ensure sprinkler systems are functioning 30 minutes prior to spotting occurring.
- Monitor site for ignitions from embers and extinguish them to ensure personnel safety if evacuation orders have not been issued.
- Construct all new structures on the disposition with a metal roof and siding. The base of the structure must be closed in with metal, concrete or earth fill.

Hydrocarbon Storage Tanks and Propane Tanks

Petroleum storage tanks containing hydrocarbons are at risk of ignition by airborne embers.

Recommendations:

- Keep the disposition area free of spilled flammable petroleum products, especially around storage tanks.
- To reduce the potential of a storage tank ignition from airborne embers, the tank top should be cone shaped and designed in such a way that airborne embers will not become lodged around tank openings or vents.

PHOTO: BRIAN MOTTUS

- Vent openings must be turned downward to prevent airborne embers from falling into the vent opening.
- Use of floating top storage tanks should be minimized; floating tops will catch large amounts of embers.
- Store flammable petroleum products in containers that resist accumulation of airborne embers on the container's surface or at the base of the container.
- Remove vegetation away from storage tanks (grass, shrubs, trees, etc.)
- Turn propane tanks off. Propane tanks should be maintained vegetation free for a minimum of 3 m to reduce radiant heat exposure.
- Equip the tank tops with water or foam sprinkler systems, and turn the sprinklers on during a wildfire incident to prevent ignition from airborne embers.

Vegetation on the Disposition

Vegetation removal is the recommended vegetation management strategy for FireSmart Industrial Zone 1.

- Remove all vegetation within 10 m of structures in Zone 1 and maintain as bare mineral soil, gravel or mowed grass.

Managing Liability on your Disposition

Debris Disposal

Winter burning can be a high risk for ignition of a wildfire if burning debris piles are not properly extinguished prior to the spring fire season, particularly if the burn piles are not on bare mineral soil.

The Drought Code (DC) can provide an indication of the potential for winter holdover ground fires. If a weather station's closing fall (DC) is greater than 350 (very high), it indicates a high risk for holdover fires.

PHOTO: RAPIDFIRE & RESCUE SERVICES

Debris disposal by burning.

Recommendations:

- If alternative disposal options are feasible (i.e., mulching), avoid burning. If burning is conducted to manage debris, the following recommendations apply.
- Access SRD's website to determine what the closing fall Drought Code Index number is prior to winter burning (http://www.srd.gov.ab.ca/wildfires/fpd/maps_tfhdc.cfm). For burning during the fire season –check the daily fire weather index codes and indices.
- Prior to burning debris piles during the fire season, ensure a permit is obtained.
- Ensure legislative requirements are met.
- To ensure burned piles are properly extinguished, three methods may be used to check for residual embers:
  1. Manual approach — use a bare hand to check for hot embers (referred to as cold trailing).
  2. Use a temperature probe or metal rod to detect heat within the piles.
  3. Use infrared technology to scan the debris piles for residual hot embers.
- Where feasible, utilize a portable burning sled to reduce holdover potential and accelerate burning combustion.
- Reduce the amount of soil contained in the woody piles to allow for more efficient burning and help reduce the chance for holdover fires.

Flare Stacks and Pits

Flaring of petroleum by-products is essential for operational and safety reasons; however, improperly constructed or maintained sites and flaring during high and extreme fire danger levels can cause wildfire ignitions.

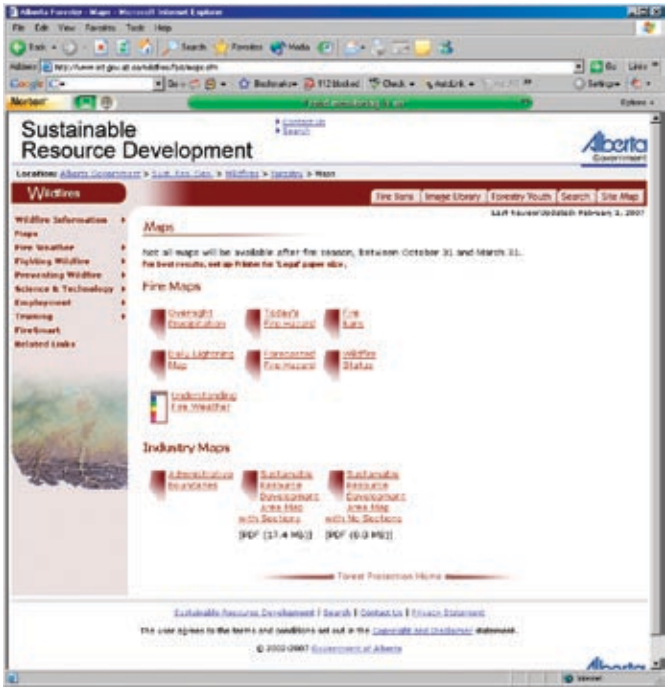
PHOTO: BRIAN MOTTUS

Flaring

Recommendations:

- Notify your local SRD office during the fire season prior to flaring (provide location and time) to avoid unnecessary dispatching of suppression resources.
- Get further clarification on vegetation removal distances from your local SRD office when dealing with flarestacks and pits where fuel types are primarily coniferous (i.e., C2, C3, M1, etc.).
- Before burning any materials produced from oil and gas wells in a flare pit, ensure a cleared, bare mineral soil surface extends at least 8 m around the flare pit. Refer to the Forest Prairie Protection Regulations, Part I Regulation – Alberta Regulation Section 14(b).
- In a non-emergency event, do not use flare devices to ignite flare stacks. It is in contravention of the Forest Prairie Protection Act. Refer to the Forest Prairie Protection Regulations, Part I Regulation – Section 10.

- In preparing to flare from a vertical pipe in a forested area, ensure the distance from the base of the vertical pipe to the closest vegetation/debris is 2.5 times the length of the vertical pipe (refer to the Forest Prairie Protection Regulations, Part I Regulation – Alberta Regulation Section 15).
- Locate flare stack towards the center of the site to avoid excess clearing to achieve the 2.5 X requirement.
- Prior to flaring operations, obtain a fire weather forecast from the SRD website to ensure the fire danger rating is not high or extreme http://www.srd.gov.ab.ca/wildfires/fpd/maps.cfm
- Reduce flare stack carbon buildup through technology upgrades and routine maintenance.
- Maintain flare knockout drums to avoid liquid carry over.
- Try to avoid flaring during times when the Fire Danger Rating is high or extreme – see SRD website.
- Avoid flaring during late morning, mid day and early evening when temperatures are higher and the relative humidity is lower. Also avoid flaring when winds exceed 20 km/hr.



http://www.srd.gov.ab.ca/wildfires/fpd/maps.cfm

All Terrain Vehicle Activity

All terrain vehicle activity during high and extreme fire danger levels can be a high-risk liability.

Recommendations:

- Brief personnel on proper inspection and cleaning of the ATV's exhaust system at regular intervals.
- Inspect more frequently when traveling through muskeg and peat areas.
- Park on sites with bare mineral soil, gravel or cement.
- Carry a small container of water (10-20 liters) that can be used to extinguish any fire starts.
- Obtain travel permits during forest closures.
- Consider restricting use of ATVs in forested areas during prolonged periods of extreme fire danger levels and forest closures.
- For more information, refer to a paper published on the FERIC website entitled *Evaluating the fire ignition potential of all-terrain vehicles in Alberta Forests*, Vol 5 No. 8 February 2004.[1]
- In addition to ATVs, do not park vehicles (light trucks) with catalytic converters in areas where tall dry grass is prevalent.
- Travel during the early morning and later evening when relative humidity is usually higher.

Heavy Equipment

Exhaust systems associated with heavy equipment use can cause wildfire ignition by one of two means:

- Clearing forest vegetation with heavy equipment can cause an accumulation of very fine organic material on the exhaust systems. This organic material dries and if heated on exhaust systems to temperatures greater than 240 - 260°C, may ignite. Through vibrations, the ignited materials can then fall to the forest floor and ignite vegetation, causing a wildfire.
- Diesel engines that idle for long periods build up carbon in the exhaust system. When the engine is throttled up and placed under load, small, hot carbon pieces can be expelled, causing a wildfire ignition. During windy days, particles can be carried longer distances from the equipment.

Recommendations:

- Ensure contractors inspect and clean their heavy equipment exhaust systems on a regular basis.
- While cleaning the equipment, park it on bare mineral soil if possible or spray the area with water before driving the equipment over the wet area to clean.
- Place heavy equipment with diesel engines over mineral soil or other non-flammable material. Then throttle up and place the diesel engine under load to expel any loose carbon particles (note: consider wind speed first).

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[1] http://fire.feric.ca/36222002/ATVFinal.pdf

Powerline Ignitions and Interruptions

In most cases, the utility companies are responsibile for powerline assessments and mitigation strategies. However, if the easement is the direct responsibility of the oil and gas disposition holder, consider the recommendations below. Use the powerline hazard assessment[1] as your guide to determine where powerlines are at risk. The ranking (low, moderate, high, extreme) from the powerline hazard assessment on the easement will dictate which strategies are most suitable.

PHOTO: ROD HOULE

Illustration of hazard tree removal on powerline.

Recommendations:

- Use roadways or pipelines as extra width and place powerlines on the downwind side.
- To address risks of ignition on the powerline right of way, contact your local utility company to establish maintenance schedules and responsibilities.
- As part of regular powerline right of way maintenance, and to address risks of ignition, the powerline owner will:
  - Maintain vegetation along powerline rights of way to reduce vegetation accumulation and rapid wildfire spread;
  - Remove flammable vegetation down to bare mineral soil or gravel surface at the base of power transformers, switches or at distribution sites;
  - Identify and remove hazard trees to reduce powerline ignitiions and interruptions.

Enhancing Emergency Response Capability

Industrial emergency response capability should include planning components specific to wildfires. EUB – Directive 071 provides a minimum EUB emergency preparedness and response requirements for the upstream petroleum industry. However, these requirements do not include **wildfire preparedness** and response.

Personnel Safety

Personnel working in forested areas should know what to do **during** a wildfire emergency.

Recommendations:

- Obtain and maintain emergency contact lists.
- Decrease the number of personnel onsite during a wildfire event.
- Identify evacuation staging areas in evacuation plans for use during a wildfire event.
- Ensure personnel are aware of evacuation alerts, evacuation routes and evacuation staging areas away from the wildfire.
- Identify methods of transportation for evacuation (air, ground, water).
- Make arrangements for short-term food and safe lodging.
- Perform mock-up exercises to test evacuation plans and train personnel.
- Communicate evacuation plans to personnel, external agencies and adjacent disposition holders.

[1]The powerline hazard assessment can be found at http://www.srd.gov.ab.ca/wildfires/information/forms.aspx

Evacuation Staging Areas

If the potential exists for industry personnel to become trapped by an approaching wildfire, the individuals should be trained to recognize and utilize adequate evacuation staging areas.

Recommendations:

- Identify and communicate pre-planned evacuation staging areas. To properly identify those areas, refer to the following criteria:
  - Clean burn site, natural cleared area or constructed site free of vegetation (i.e., gravel pit, plant site, etc.);
  - Quickly and safely accessed from worksite;
  - Free of hazardous materials;
  - Radiant heat and preheated air associated with wildfire flame fronts must be considered in evacuation staging area selection and size.
- Identify airstrips or landing sites in close proximity to be utilized for evacuation procedures. In isolated/remote areas, consider a landing site for helicopters to support evacuation procedures. Ensure the landing site has a minimum of 2 drums of fuel in close proximity to the evacuation site.

Wildfire Emergency Response Planning

Immediate response to a wildfire is critical. Many incidents that result in tragic and costly losses from wildfire are attributed to substandard communication and lack of proactive emergency response planning.

Recommendations:

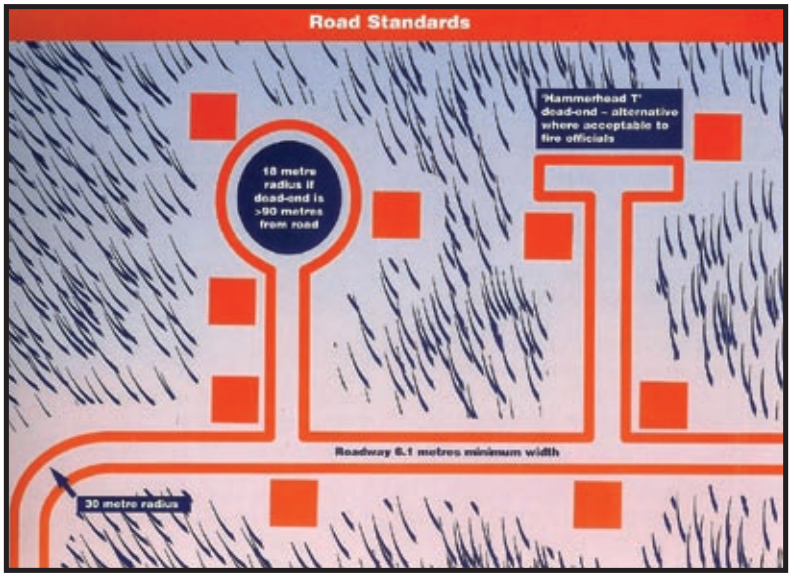
Open Spaces

- Incorporate open spaces (i.e., borrow pits, lay down yards, spoil piles, parking lots) for staging equipment and personnel in wildfire emergencies.
- Place open spaces downslope and/or upwind of a disposition (use the prevailing wind as a guideline).
- If using open spaces as a barrier to fire spread, they should be at least 30 m wide on level ground and up to 50 m wide when located near slopes.
- Open spaces should have trimmed short grass, gravel or mineral soil.

PHOTO: RON HOULE

Main Access Roads

- The road surface should provide two-way access with a travel surface of not less than 6.1 m.
- Fire service access routes should be identified and should connect to principal roadways.
- The roadway curvature radius should be at least 30 m, measured from the centerline. This is a standard for Fire Department access.
- Road gradients should not exceed 10 percent.
- Dead-end roadways that are more than 90 m in length should be constructed with a turnaround at the terminus having no less than 18 m turning radius or a hammerhead "T" alternate turnaround (useful for long-term planning). A site loop or ring road is the best option within the disposition for short-term planning.
- All gates should be located at least 9 m off the main roads and should not open outward. Gate openings should provide a clear opening of not less than 0.6 m wider than the traveled way.
- Fire service personnel should be provided with ready access to any locking mechanisms.



Example of access route that may act as evacuation route.

- Bridges should be designed and built with an all-weather surface capable of supporting heavy pieces of equipment traveling across the bridge. Weight limits should be clearly posted at the approaches to each bridge.
- If the main access road is cut off by a wildfire, alternative emergency evacuation routes should be identified.

Water sources

- Identify natural water sources such as streams and small lakes.
- Ensure access to natural water sources for tanker trucks and portable pump set-up is developed and identified.
- If natural water sources are not available, a water storage facility can be developed on high value sites such as tank farms and plant sites. Non-draining borrow pits or large tanks may be used for storing large volumes of water.

PHOTO: ROD HOULE

PART V. Communication

Communication of these guidelines should occur wthin the Oil and Gas Industry as well as between stakeholders such as Forest Industry, Municipalities and SRD.

Effective communication is the key to wildfire prevention. Political leaders, community and industrial planners, and people in the public and private sectors should have the necessary information to address wildfire threat and achieve FireSmart goals.

Internal Communication within Oil and Gas Industry

Successful implementation of FireSmart mitigation options for wildfire prevention requires the understanding, cooperation and participation of all employees.

Recommendations:

- In the spring of each year, review wildfire safety issues.
- Inform employees of the implications of wildfire in the forest environment.
- Inform employees of emergency procedures in preparation for a wildfire event and/or entrapment.
- Instruct employees on the protocols of reporting a wildfire. If they see smoke or fire, call 310-FIRE.
- Inform employees of the wildfire trends and obtain/monitor weather information in the surrounding area on days when fire danger is high or extreme.
- Inform employees when fire danger ratings are high and extreme and relay any restrictions that may be in effect (i.e., forest closures, permits, road closures, etc.).

Industrial Wildfire Control Plans

The Industrial Wildfire Control Plan is mandatory under the *Forest Prairie and Protection Act*. The intent of this annually updated plan is to proactively identify and update your values at risk and your wildfire prevention strategies in an effort to reduce the potentially negative impacts of wildfire during the upcoming fire season.

The information you provide to your local SRD staff is critically important to enhance local knowledge and communications between local SRD staff and industry field/office staff.

Recommendations:

- Access industrial wildfire control plans at http://www.srd.gov.ab.ca/wildfires/fpd/mfp/mfp_forms.cfm
- Ensure understanding of legislative requirement referenced in the Wildfire Control Plan.
- Prepare and submit plans to SRD, prior to the **end of February of each year**.

External Communications with Other Stakeholders

Successful implementation of FireSmart mitigation options for wildfire prevention requires the understanding, cooperation and participation of all external stakeholders. Successful incorporation of these guidelines benefits the general public, industry and Alberta Government.

Recommendations:

- During active wildfires, establish and maintain close contact with SRD's industry liaison person, local SRD office or with the Incident Command Center in the event of a threatening wildfire.
- Assess opportunities for interagency cooperation, cross training and emergency response planning to support communications with stakeholders.

Interagency Cooperation

Interagency cooperation between all stakeholders is necessary to coordinate an effective response to a wildfire, and to ensure cooperative and effective implementation of FireSmart mitigation options.

Wildfire issues impact industry stakeholders, government agencies, disaster relief agencies and other organizations. All should be involved in integrated planning to ensure the best cooperation and Best Management Practices between each agency.

Recommendations:

- Identify the types of interagency cooperation, which include cooperative agreements (i.e., industrial wildfire control plans or mutual aid agreements), to ensure assigned commitments and responsibilities are in place and regularly reviewed.
- Develop strategies that can be used in integrated land management (i.e. ILM Program) for a specified area to assist with FireSmart initiatives.
- Ensure that items relating to wildfire administration, prevention, presuppression, wildfire operations, and training are understood and agreed to by both parties.

Training

Training prepares personnel for a more coordinated and educated approach to both wildfire prevention and wildfire emergency response. Training is essential for firefighter safety, equipment compatibility, integrating communications, understanding procedures and wildfire incident command structures, understanding wildfire management and fire behavior, and developing and implementing consolidated emergency response plans.

Recommendations:

- The Incident Command System (ICS) process recommends the provision of an agency representative with a safety background to look after the industry interests during a wildfire event.
- Various types of training available may range from informal presentations to formal courses, interactive CDs, guidelines or protocols, and wildfire emergency response strategies and tactics.

Suggested topics include the following:

- SRD Wildland Fire Safety on the Fireline CD
- SRD Principles of Fire Behavior CD
- SRD Wildfire Orientation
- SRD Wildfire Prevention Course – Hinton Training Center
- H2S Alive
- Industry Pipeline Crossing Protocols
- Industry Worksite Entry Protocols
- SRD ATV Exhaust Inspection Protocols
- SRD FIREWEB Tutorial

APPENDIX 1. Wildfire Management Expertise and Decision Support Tools

Incident Command System (ICS)

The ICS is an emergency response management system commonly used by fire agencies, particularly when more than one type of emergency response discipline is present at an incident. ICS is also widely used by industry and transportation agencies throughout much of North America. ICS is the emergency management system for all provincial and federal wildfire agencies, and it allows agencies to operate on a single or multiple incidents without being hindered by jurisdictional boundaries.

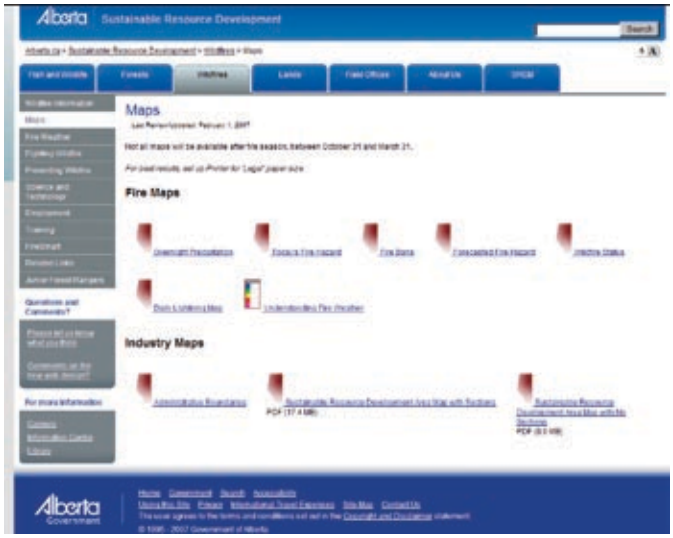
ICS allows different agencies to work together effectively and efficiently toward a common goal. The system consists of procedures for managing and controlling personnel, facilities, equipment and communications.

ICS begins developing from the start of an incident and continues until the need for operations management ends. It usually comprises the five major management activities of command, operations, planning, logistics, and finance/administration.

When the wildfire incident threatens a disposition, the industrial safety officer should become the liaison person to the ICS team and have access to information at the incident command center. The industrial safety officer will also coordinate any evacuation of workers or keep the workers informed of the wildfire threat at all times.

Decision Support Tools

Wildfire management information for the Forest Protection Area can be obtained from the following website: http://www.srd.gov.ab.ca/wildfires/default.aspx. This site provides excellent map information, fire weather information, situation reports, education and training information.



Wildfire information can be obtained for the non Forest Protection Area of Alberta and other provinces at http://cwfis.cfs.nrcan.gc.ca/en/current/cc_fdr_e.php.

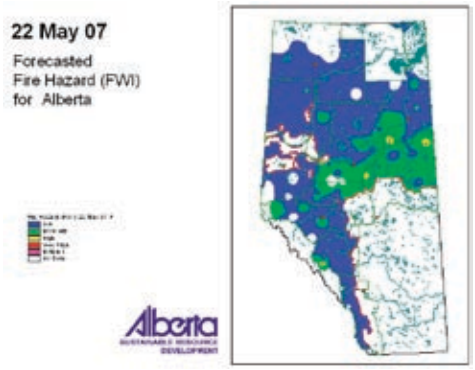
The Natural Resources Canada web page provides excellent examples of fire behavior in jack pine fuel types and a description of fire behavior fuel types which include photos. These examples and other information can be found under the heading “Background”. The website is http://cwfis.cfs.nrcan.gc.ca/en/current/cc_fdr_e.php

Daily Canadian Forest Fire Danger Rating System (CCFDRS FWI)

The daily Fire Weather Index (FWI) can be obtained from SRD's Wildfire Website at http://www.srd.alberta.ca/wildfires/maps/todaysfirehazard.aspx. To better understand the Daily Fire Weather Index visit http://srd.alberta.ca/wildfires/weather/understanding.aspx

Use provincial daily fire danger information to monitor the current situation. *(Note: The daily fire danger rating is generated from the daily weather data collected from all weather stations within the provincial Forest Protection Area.)*

Hazard Rating	FFMC Fine Fuel Moisture Code	DMC Duff Moisture Code	DC Drought Code	ISI Initial Spread Index	BUI Build Up Index	FWI Fire Weather Index	HFI Head Fire Intensity
Low	0-76	0-21	0-79	0-1.5	0-24	0-4.5	1-2
Moderate	77-84	22-27	80-189	2-4	25-40	4.5-10.5	3
High	85-88	28-40	190-299	5-8	41-60	10.5-18.5	4
Very High	89-91	41-60	300-424	9-15	61-89	18.5-29.5	5
Extreme	92+	61+	425+	16+	90+	29.5+	6

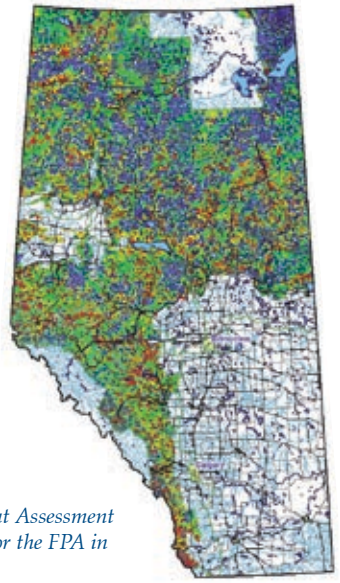


Fire Weather Index values over 30 are associated with extreme burning conditions in Alberta. Most major wildfire disasters are associated with values greater than 50 *(1985 Butte Fire –Alexander [1991]).*[1]

Provincial Wildfire Threat

Wildfire threat assessment information can be obtained by utilizing FIREWEB at http://www.srd.alberta.ca/wildfires/information/forms.aspx.

For more information describing Wildfire threat, visit: http://www.srd.gov.ab.ca/wildfires/firesmart/informationprojects.aspx#doc.



Wildfire Threat Assessment Information for the FPA in FIREWEB

Daily Provincial Wildfire Information

The daily Wildfire Reports can be viewed graphically or in a report form at http://www.srd.alberta.ca/wildfires/information/reports.aspx.

- To view the daily fire situation graphically, go to http://www.srd.alberta.ca/wildfires/pdf/firemap.pdf
- To view the daily fire situation in report form, go to http://www.srd.alberta.ca/wildfires/information/reports.aspx. Then choose "Provincial Active Fires Report For", and choose the date and type of data format.

Glossary of Terms

For a glossary of fire management terms, visit :http://www.srd.gov.ab.ca/wildfires/firesmart/pdf/Draft2002GlossaryEng.pdf.

[1] *Alexander, M.E. 1991. The 1985 Butte Fire in central Idaho: a Canadian perspective on the associated burning conditions. Pages 334-343 in S.C. Nodvin and T.A. Waldrop, editors. Proceedings of International Symposium Fire and the Environment: Ecological and Cultural Perspectives (March 20-24, 1990, Knoxville, TN). USDA Forest Service, Southeastern Experiment Station, Asheville, NC. General Techical Report SE-69.*

APPENDIX 2. Wildfire behavior associated with forest fuel types and fuel type descriptions

Examples of FBP system Fuel Types – Standard photographs and descriptions

Example FBP Fuel Types

The Canadian Forest Fire Behavior Prediction (FBP) System models the rate of spread, fuel consumption, fire intensity, and fire growth for 16 national benchmark fuel types. Detailed descriptions of the FBP System fuel types can be found in Forestry Canada Information Report ST-X3, Development and Structure of the Canadian Forest Fire Behavior Prediction System (Forestry Canada Fire Danger Group 1992).[1]

About the Photos:
The pole-mounted logo of the Canadian Forest Fire Danger Rating System (CFFDRS) found in most of the photos was used for scale. The sign is 30 x 30 cm and the alternate markings on the pole are 30 cm in length. The quadrant used in the Open Fuel Type Group close-up photos are 1 m x 1 m with alternate markings 30 cm in length. Photos were supplied by B.J. Stocks, B.D. Lawson, C.E. Van Wagner, K.G. Hirsch, and W.J. De Groot.

FBP System Fuel Typical Fuel Complex	
Coniferous	
C-1	Spruce Lichen Woodland
C-2	Boreal Spruce
C-3	Mature Jack or Lodgepole Pine
C-4	Immature Jack or Lodgepole Pine
C-5	Red and White Pine
C-6	Red Pine Plantation
C-7	Ponderosa Pine/Douglas Fir
Deciduous	
D-I	Leafless Aspen
Mixed Wood	
M-1	Boreal Mixedwood - Leafless
M-2	Boreal Mixedwood - Green
M-3	Dead Balsam Fir/Mixedwood - Leafless
M-4	Dead Balsam Fir/Mixedwood - Green
Slash	
S-1	Jack or Lodgepole Pine Slash
S-2	White Spruce/Balsam Fir Slash
S-3	Coastal Cedar/Hemlock/Douglas-fir Slash
Open	
O-1a	Matted Grass
O-1b	Standing Grass

[1] *Forestry Canada Fire Danger Group. 1992. Development and structure of the Canadian Forest Fire Behavior Prediction System. Forestry Canada, Science and Sustainable Development Directorate, Ottawa, ON. Information Report ST-X-3. 63 p.*

Standard photographs of CFFDRS FBP System fuel types

C-1

C-2

C-3

C-4

C-5

C-6

C-7

D-1

Description of CFFDRS FBP System fuel types

Summary of Canadian Forest Fire Behavior Prediction (FBP) System fuel type characteristics.

Forest floor and organic layer	Surface and ladder fuels	Stand structure and composition
Fuel Type C-1 (Spruce-Lichen Woodland)		
Continuous reindeer lichen; organic layer absent or shallow, uncompacted.	Very sparse herb/shrub cover and down woody fuels; tree crowns extend to ground.	Open black spruce with dense clumps; assoc. sp. jack pine, white birch; well-drained upland sites.
Fuel Type C-2 (Boreal Spruce)		
Continuous feather moss and/or *Cladonia;* deep, compacted organic layer.	Continuous shrub (e.g., Labrador tea); low to moderate down woody fuels; tree crowns extend nearly to ground; arboreal lichens, flaky bark.	Moderately well-stocked black spruce stands on both upland and lowland sites; *Sphagnum* bogs excluded.
Fuel Type C-3 (Mature Jack or Lodgepole Pine)		
Continuous feather moss; moderately deep, compacted organic layer.	Sparse conifer understory may be present; sparse down woody fuels; tree crowns separated from ground.	Fully stocked jack or lodgepole pine stands; mature.
Fuel Type C-4 (Immature Jack or Lodgepole Pine)		
Continuous needle litter; moderately compacted organic layer.	Moderate shrub/herb cover; continuous vertical crown fuel continuity; heavy standing dead and down, dead woody fuel.	Dense jack or lodgepole pine stands; immature.
Fuel Type C-5 (Red and White Pine)		
Continuous needle litter; moderately shallow organic layer.	Moderate herb and shrub (e.g., hazel); moderate dense understory (e.g., red maple, balsam fir); tree crowns separated from ground.	Moderately well-stocked red and white pine stands; mature; assoc. sp. white spruce, white birch, and aspen.
Fuel Type C-6 (Conifer Plantation)		
Continuous needle litter; moderately shallow organic layer.	Absent herb/shrub cover; absent understory; tree crowns separated from ground.	Fully stocked conifer plantations; complete crown closure regardless of mean stand height; mean stand crown base height controls ROS and crowning.
Fuel Type C-7 (Ponderosa Pine-Douglas fir)		
Continuous needle litter; absent to shallow organic layer.	Discontinuous grasses, herbs, except in conifer thickets, where absent; light woody fuels; tree crowns separated from ground except in thickets.	Open ponderosa pine and Douglas fir stands; mature uneven-aged; assoc. sp western larch, lodgepole pine; understory conifer thickets.
Fuel Type D-1 (Leafless Aspen)		
Continuous leaf litter; shallow, uncompacted organic layer.	Moderate medium to tall shrubs and herb layers; absent conifer understory; sparse, dead, down woody fuels.	Moderately well-stocked trembling aspen stands; semi-mature; leafless (i.e., spring, fall or diseased).

Standard photographs of CFFDRS FBP System fuel types

M-1

M-2

M-3

M-4

S-1

S-2

S-3

O-1

Description of CFFDRS FBP System fuel types

Summary of Canadian Forest Fire Behavior Prediction (FBP) System fuel type characteristics.

Forest floor and organic layer	Surface and ladder fuels	Stand structure and composition
Fuel Types M-1 and M-2 (Boreal Mixedwood)		
Continuous leaf litter in deciduous portions of stands; discontinuous feather moss and needle litter in conifer portions of stands; organic layers shallow, uncompacted to moderately compacted.	Moderate shrub and continuous herb layers; low to moderate dead, down woody fuels; conifer crowns extend nearly to ground; scattered to moderate conifer understory.	Moderately well stocked mixed stand of boreal conifers (e.g., black/white spruce, balsam/subalpine fir) and deciduous species (e.g., trembling aspen, white birch). Fuel types are differentiated by season and percent conifer/ deciduous sp. composition.
Fuel Types M-3 and M-4 (Dead Balsam Fir Mixedwood)		
Continuous leaf litter in deciduous portions of stands; discontinuous feather moss, needle litter and hardwood leaves in mixed portions of stands; organic layers moderately compacted, 8-10 cm.	Dense continuous herbaceous cover after green up; down woody fuels low initially, but becoming heavy several years after balsam mortality; ladder fuels dominated by dead balsam understory.	Moderately well stocked mixed stand of spruce, pine and birch with dead balsam fir, often as an understory. Fuel types differentiated by season and age since balsam mortality.
Fuel Type S-1 (Jack or Lodgepole Pine Slash)		
Continuous feather moss and needle litter; moderately deep, compacted organic layer.	Continuous slash, moderate loading and depth; high foliage retention; absent to sparse shrub and herb cover.	Slash from clearcut logging; mature jack or lodgepole pine stands.
Fuel Type S-2 (White Spruce-Balsam Slash)		
Continuous feather moss and needle litter; moderately deep, compacted organic layer.	Continuous to discontinuous slash (due to skidder trails); moderate foliage retention; moderate loading and depth; moderate shrub and herb cover.	Slash from clearcut logging; mature or overmature white spruce, subalpine fir or balsam fir stands.
Fuel Type S-3 (Coastal Cedar-Hemlock-Douglas-fir Slash)		
Continuous feather moss or compacted old needle litter below fresh needle litter from slash; moderately deep to deep, compacted organic layer.	Continuous slash, high foliage retention (cedar), moderate for other species; heavy loading, deep slash; sparse to moderate shrub and herb cover.	Slash from clearcut logging; mature to overmature cedar, hemlock, or Douglas-fir stands.
Fuel Type 0-1 (Grass) Subtypes: O-1a – matted grass, O-1b – standing grass		
Continuous dead grass litter; organic layer absent to shallow and moderately compacted.	Continuous standing grass (current year crop). Standard loading is 0.3 kg/m^2, but other loading can be accommodated; percent cured or dead must be estimated. Sparse or scattered shrubs and down woody fuel. Subtypes for both early spring matted grass (O-1a) and late summer standing cured grass (O-1b) are included.	Scattered trees, if present, do not appreciably affect fire behavior.

Fuel Type		Wildfire Behavior under High Wildfire Danger Level
C-1	Spruce Lichen Woodland	Surface, Torching and Crowning
C-2	Boreal Spruce	Almost always a Crown Fire
C-3	Mature Jack/Lodgepole Pine	Surface and Crown Fire
C-4	Immature Jack/Lodgepole Pine	Almost always a Crown Fire
C-6	Conifer Plantation	Surface, Torching and Crowning
D-1	Leafless Deciduous	Always a Surface Fire
M-1	Boreal Mixedwood Leafless	Surface, Torching and Crowning
M-2	Boreal Mixedwood Green	Surface, Torching and Crowning
S-1	Jack/Lodgepole Pine Slash	Always an intense Surface Fire
S-2	Spruce/Balsam Slash	Always an intense Surface Fire
O1a	Matted Grass	Intense Surface fire
O1b	Standing Grass	Rapid Spreading Intense Surface Fire

Notes