Chapter 23
Environment—Detecting Wildfires

1.0 Main Points

Over one-half of Saskatchewan is forested, with the people of Saskatchewan owning most of those forests (crown lands).[1] These forests are vital to the province's economy and environment.

The Ministry of Environment is responsible for detecting wildfires in Saskatchewan. Costs in managing wildfires can vary significantly from year to year (e.g., $123 million in 2015-16 and $48 million in 2016-17). Detecting these wildfires quickly can reduce the impact on people, the environment, and the economy.

This chapter reports on the effectiveness of the Ministry of Environment's processes to detect wildfires in Saskatchewan wildfire management areas. While the Ministry is doing a number of things well, the chapter identifies two key areas for improvement. It recommends that the Ministry:

- Work actively with other government sources to obtain up-to-date information on values-at-risk (i.e., human life, communities, significant public and industrial infrastructure, commercial timber, remaining structures, natural resources and commercial/industrial operations, wildlife habitats).

- Actively obtain wildfire prevention and preparedness information from industrial and commercial operators that the law requires them to submit. This information is to set out the location of operations and personnel, and related contact information.

Not having complete and up-to-date information about values-at-risk increases the risk of the Ministry not prioritizing its wildfire detection activities appropriately and not developing suitable fire suppression strategies.

2.0 Introduction

2.1 Wildfires Place Saskatchewan Forests at Risk

Saskatchewan forests provide wildlife habitats, watershed protection, erosion control, ecosystem stability, recreational opportunities, employment, carbon storage, and aesthetic values. Saskatchewan's forests are a vital part of the province's economy and environment.

Approximately 11.7 million hectares of the provincial forest are viable for timber harvesting and receive the most impact from human activities. Each year, the forest industry generates over $1 billion in forest product sales, over $800 million in exports, and 6,000 direct jobs.[2] In addition, boreal forests store carbon and purify air and water.[3]

[1] www.saskatchewan.ca/business/invest-and-economic-development/key-economic-sectors/forestry (7 December 2016).
[2] www.saskatchewan.ca/business/invest-and-economic-development/key-economic-sectors/forestry (16 December 2016).
[3] Ministry of Environment, *2017 State of the Environment Report,* p. 15.

Experts predict increases in precipitation and annual temperatures to occur from 2015 to 2100 in Saskatchewan. Due to their northern locations, Saskatchewan forests are exposed to greater increases in temperature than the global average.[4] Experts also expect Saskatchewan to remain vulnerable to periodic drought in that they expect much of the projected increase in precipitation to occur in the cooler months. Furthermore, they predict longer wildfire seasons with drier, more intense burning conditions and larger areas of burn.[5]

2.2 Responsibility for Detecting Wildfires

Wildfires are unplanned fires that burn organic soil, grasses, forbes, shrubs, trees, and associated vegetative fuels in their natural or modified state. They do not include structural, vehicle, or landfill fires.[6]

Under *The Wildfire Act*, the Ministry of Environment is responsible for the prevention, detection, control, suppression, and investigation of wildfires within provincial wildfire management areas, including provincial forests. In addition, the Ministry's responsibility includes keeping the public informed of wildfires in Saskatchewan.

Provincial wildfire management areas include provincial forests, parkland, vacant Crown land, and every quarter section of land lying wholly or partly within 4.5 kilometres of the boundaries of a provincial forest.[7,8]

The Wildfire Management Branch within the Ministry manages wildfires. The Branch has about 127 full-time equivalent employees excluding front-line staff (e.g., fire fighters). The Wildfire Management Branch has three fire centres located in La Ronge, Buffalo Narrows, and Prince Albert. These centres oversee 12 forest-protection areas.[9]

In 2016-17, the Ministry spent almost $48 million in managing wildfires.[10] **Figure 1** shows the variability in annual costs to suppress wildfires for the last 10 years. Suppression costs exclude costs of aiding fire fighters in communities, other provinces, or other countries (if requested).[11] They also do not include costs associated with evacuating and sheltering people from wildfires, or costs to replace private property lost to a wildfire.

2.3 Wildfires in Saskatchewan

Wildfires are the single largest source of natural disturbance in the boreal forest in Saskatchewan.[12] As shown in **Figure 2**, lightning and humans are the only causes of wildfires. In 2015, lightning caused about half of all wildfires but accounted for almost 97% of the total area of forests burned.[13] Over the last 10 years, humans (resident, recreation, incendiary, and industry) caused half of Saskatchewan wildfires.[14]

[4] Ministry of Environment, *2015 State of the Environment Report,* p. 25.
[5] Ibid.
[6] *The Wildfire Act*, s. 2.
[7] *The Wildfire Act*, s. 2(gg).
[8] According to *The Wildfire Act,* the Ministry is not responsible for detection on land within any city, town, village, hamlet, northern village, northern hamlet, northern settlement, regional park, and resort village or resort subdivision.
[9] The Wildlife Management Branch has divided the province into 12 forest protection areas.
[10] Ministry of Environment, *2016 Wildfire Statistics Report*, p. 35.
[11] The Ministry recovered about $2.165 million of the 2016 fire season costs (2015: $0.6 million), primarily from Alberta. The Ministry also recovers costs from commercial operators if an investigation determines an operator started a fire.
[12] Ministry of Environment, *2015 State of the Environment Report*, p. 56.
[13] Ministry of Environment, *2017 State of the Environment Report*, p. 20.
[14] Ibid.

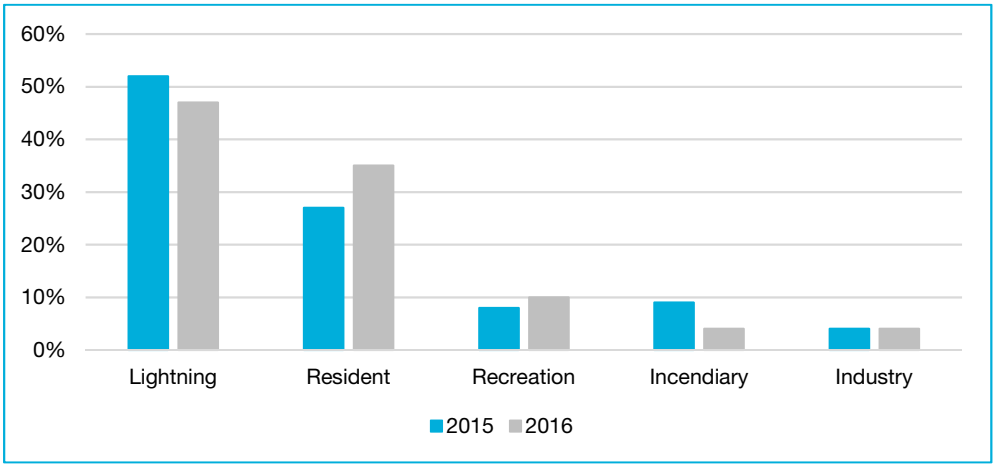
Figure 1—Number of Wildfires, Hectares Burned, and Costs (2007-2016)

Fire Season	Number of Wildfires[A]	% Caused by Lightning	Total Hectares[B] Burned (in thousands)	Hectares Burned in High Values-at-Risk Areas (in thousands)	Wildfire Management Costs[C] (in millions)
2007	370	36	213	1	$43.5
2008	599	47	1,130	385	$67.1
2009	511	36	38	16	$48.1
2010	571	40	1,735	14	$56.1
2011	303	21	344	53	$46.6
2012	409	49	228	16	$48.0
2013	429	37	364	44	$43.7
2014	403	49	343	16	$47.3
2015	720	52	1,722	679	$123.1
2016	364	53	242	14	Not yet available

Source: Ministry of Environment *2017 State of Environment Report*, p. 20.
[A] In both primary and secondary areas. Primary areas include community, primary timber area, wildfire management area, and federal land area. Secondary areas include secondary timber area, rural/urban land base, and area north of primary area.
[B] A hectare is 10,000 square metres—about the size of a baseball field.
[C] Wildfire Management costs exclude recoverable fire suppression operations and forest fire capital projects (Government of Saskatchewan, *Public Accounts Volume 2, 2007-08* to *2016-17*).

Also, as shown in **Figure 1**, the number, hectares burned, and cost of wildfires in Saskatchewan varies significantly from year-to-year. This variability is attributable to variation in weather patterns, particularly precipitation, temperature, and lightning activity. In some years, wildfires were located in areas that threaten more values-at-risk.

Figure 2—2015 and 2016 Saskatchewan Wildfires by Cause



Source: Ministry of Environment, Wildfire Management Branch.

The recent severe wildfire seasons in Saskatchewan (2015), Alberta (2016), and British Columbia (2017) have highlighted the potential threat that wildfires can pose to public safety, property, and vital natural resources. Detection warnings must get to those at risk in a timely manner, and must contain clear, useful information to enable proper responses.

2.4 Importance of Wildfire Detection

Detecting wildfires early allows timely decisions on a strategic response to threats. Early detection and timely decisions can reduce the impact on people, the environment, and the economy. This includes decisions on when to suppress wildfires and when to allow them to burn.

Wildfires can play a natural and beneficial role on the boreal landscape if values-at-risk are minimal. Saskatchewan's wildfire strategies recognize the ecological benefits of wildfire in the management of forests.[15]

Timely initial detection can also help keep fire suppression costs to a minimum. Fast and effective initial detection of wildfires can significantly shorten the reaction time and limit wildfires to smaller, manageable sizes.

Firefighters have the best chance of putting out a wildfire if they can react quickly when it ignites. Quick response time allows the Ministry to position crews to attack the wildfires and to warn the public to be extra cautious in those areas, or evacuate early if needed.

If not detected and acted upon at an early stage, wildfires become increasingly difficult to control which can result in significantly increased suppression costs. For example, in 2015 suppression costs for fires less than 100 hectares were on average less than $10,000 per fire (460 fires; total cost $4.5 million). Suppression costs for fires greater than 100 hectares were over $700,000 per fire (72 fires; total cost $50.2 million).[16]

The impacts of wildfires and costs are large and diverse. They can threaten lives, structures and homes.

3.0 Audit Conclusion

We concluded that, for the 12-month-period ended March 31, 2017, the Ministry of Environment had, except in the following areas, effective processes to detect wildfires in Saskatchewan wildfire management areas. The Ministry needs to actively obtain wildfire prevention and preparedness information from industrial and commercial operators that the law requires them to submit. In addition, the Ministry needs to actively work with other government sources to obtain information on values-at-risk.

Figure 3—Audit Objective, Criteria, and Approach

Audit Objective: The objective of this audit was to assess whether the Ministry of Environment had effective processes, for the 12-month period ended March 31, 2017, to detect wildfires in Saskatchewan wildfire management areas.

[15] *FireSmart*: The Benefits of Fire www.environment.gov.sk.ca/Default.aspx?DN=c0cc8a8a-da75-451b-a14c-4160bdcf92e7 (18 July 2017).
[16] Ministry of Environment, Wildfire Management Branch, *Program Charter 2016-17*. p. 10. (cost and number of fire statistics are for the primary area only).

Audit Criteria:

Processes to:

1. Determine detection needs
   - 1.1 Identify vulnerabilities (e.g., fuel loads and fuel moisture content, values-at-risk)
   - 1.2 Systematically collect data on vulnerabilities identified (e.g., develop risk maps)
   - 1.3 Prioritize detection needs (e.g., camera placement, daily aerial patrols)
   - 1.4 Develop detection strategy

2. Implement detection system for wildfires
   - 2.1 Systematically search for wildfires (e.g., focused surveillance)
   - 2.2 Monitor wildfire spread and behaviour (e.g., current weather prediction)
   - 2.3 Continuously update wildfire status to suppression decision-makers

3. Communicate risk information and early warnings to public and commercial operators
   - 3.1 Have clear protocols for issuing accurate and timely warnings
   - 3.2 Identify tools/channels for communication of information to those at risk
   - 3.3 Disseminate information in a clear and understandable manner
   - 3.4 Notify local authorities in a timely manner for high-risk fires

Audit Approach:

To conduct this audit, we followed the standards for assurance engagements published in the *CPA Canada Handbook – Assurance* (CSAE 3001). We examined the Ministry's detection policies and procedures that relate to detecting wildfires. We interviewed relevant Ministry staff. We discussed and observed detection methods and systems. We tested a sample of wildfires reported by Ministry staff or third parties to assess whether wildfires were detected timely, monitored, and their risks communicated with stakeholders.

To evaluate the Ministry's processes, we used criteria based on our related work, reviews of literature, and consultation with experts in the area of wildfire. Ministry's management agreed with the above criteria.

4.0 Key Findings and Recommendations

In this section, we describe our key findings and recommendations related to the audit criteria in **Figure 3**.

4.1 Clear Wildfire Detection Priorities Set

The Wildfire Management Branch provides clear direction in its Wildfire Management Operational Policy and Procedure Manual (Manual) on wildfire detection priorities.

The Branch annually reviews the Manual's policies and procedures regarding detection. We found that it had appropriately approved all policies.

The Manual requires a values-at-risk approach to decision-making relating to prioritizing wildfire activities, including detection, and when competing priorities exist. The Manual sets clear principles for detecting fires. They are the protection of the following: human life, communities, significant public and industrial infrastructure, commercial timber, remaining structures, natural resources and commercial/industrial operations, and wildlife habitat (i.e., values-at-risk).

The Manual assigns responsibility to the Forest Protection Officers, Fire Centre Duty Officers, and Provincial Duty Desk for developing daily preparedness plans, which include detection activities. It includes detailed policies and procedures related to preparedness planning and detection.

Given the dynamic nature of the Branch's operations during a wildfire season, the Branch prepares preparedness plans (including detection) daily during the wildfire season (typically from April 1 to September 30).

4.2 Up-to-Date Values-at-Risk Information Needed for Prioritizing Wildfire Activities

The Wildfire Management Branch updates values-at-risk information based on voluntary submission of information instead of systematically.

The Ministry classifies values-at-risk from wildfires into two categories—temporary and permanent. Temporary values-at-risk include forestry, tree planting, and mining exploration work camps. Permanent values-at-risk include the name and location of communities, major public and industrial infrastructure, commercial timber, structures, natural resources, commercial industrial operations, cottages, and cabins.

The Branch records key information about values-at-risk in its Wildfire Management database. Capturing this information makes it available for making decisions about managing fires. For example, the Branch creates interactive maps[17] from this database. These maps include pertinent information for both detecting and managing fires such as the location and specifications of values-at-risk, contact information of owners, etc.

Information on Values-at-Risk of Industrial and Commercial Operators Not Actively Sought

The Branch does not actively obtain wildfire prevention and preparedness plans from industrial and commercial operations or request information from other Ministry of Environment branches to help it do so. The Branch estimates that industry caused, on average, 6% of wildfires over the last 10 years.[18] But beyond that, all workers are at risk from wildfires from any cause.

At March 2017, the Wildfire Management database included 336 commercial and industrial values-at-risk. Other Ministry of Environment branches issue temporary work-camp permits to some of these operators. These branches estimate they issue up to 50 permits for temporary work camps each year.

Since March 31, 2015, *The Wildfire Act* (s.20) requires industrial and commercial operators, operating during the wildfire season, to submit wildfire prevention and preparedness plans. These plans are to include the location, number of people, structures, and equipment at the operation and their contact information. Wildfire Management Branch management indicated it is developing the Industrial Wildfire Prevention Code based on best practice for wildfire prevention and preparedness plans. It expects to complete the Code in 2017-18.

The Wildfire Management Branch receives wildfire prevention and preparedness plans from some commercial operators, but not all. The Branch received 13 plans in 2016. The

[17] Interactive maps are live online maps that the Ministry can use to view, query, and print Geographic Information System (GIS) maps, databases, and images using an internet browser. The interactive design makes it easy to pinpoint a given location. The interactive maps offer more functionality than regular maps, including zoom and pan, and show data on mouse-over. The Branch overlays wildfires on the map so staff can see what is potentially threatened.

[18] Ministry of Environment, *2016 Wildfire Statistics Report*, p. 12.

Branch does not keep a list of operators required to submit plans. Management indicated that some of these operators do not notify the Branch for proprietary reasons (e.g., a mining operation may not want others to know where they are exploring).

In addition, the Act allows the Ministry to levy administrative penalties for operators not complying with the Act (i.e., not submitting their preparedness plans). It has not levied administrative penalties against industrial and commercial operations who have not submitted plans as the law requires. Laws to allow it to levy administrative penalties came in effect on March 31, 2015.

Wildfire prevention and preparedness plans of temporary industrial and commercial operations are especially important as the plans contain information to help the Ministry assess the risk of wildfires and to notify the operators in the event of wildfire threats. Not having complete information about temporary values-at-risk increases the risk of the Branch not prioritizing its wildfire detection activities appropriately, and not developing suitable related suppression strategies.

1. **We recommend that the Ministry of Environment actively seek wildfire prevention and preparedness information from industrial and commercial operators that they are required by law to submit.**

Information on Permanent Values-at-Risk Obtained on Ad-Hoc Basis

As shown in **Figure 4**, at March 31, 2017, Wildfire Management's database included over 3,200 permanent values-at-risk. The majority of these are recreational properties.

Figure 4—Number of Permanent Values-at-Risk in Ministry Database at March 2017

Type of Permanent Values-at-risk	Number by Type	% of Total
Commercial (e.g., Outfitter camp)	298	9.2
Crown (e.g., Provincial Park infrastructure)	141	4.3
Industrial (e.g., mine)	36	1.1
Traditional (e.g., First Nations sweat lodge)	348	10.6
Recreational (e.g., cabins)	2,445	74.8
Total	3,268	

Source: Ministry of Environment, Wildfire Management Branch.

The Ministry advised us that it aims to update its database on a five-year cycle. Our analysis of when permanent values-at-risk were last updated found the Branch had updated all items listed in its database within the last six years. It updated almost two-thirds of the items more than four years ago, about one-quarter of them between two to four years ago, and the remaining items within the last two years.

We found the Branch had added only 15 new values-at-risk to its database in the last three years. This small number of additions differed from prior years. For the prior 8 years (2006 to 2013), the Branch had added on average 108 properties annually to its database. In addition, the small number of additions in the last three years seems contrary to the growth in the provincial economy during this period. This suggests that the Branch did

not spend as much effort in the last three years in keeping its database current as it did previously.

To update its database, in the 2016 wildfire season, the Branch primarily relied on information provided by firefighters, operations staff on the ground, the public, and commercial operators. The Branch acknowledged that it did not actively seek information from other government sources (e.g., other Ministry of Environment branches that issue building permits, the Ministry of the Economy that issues mining permits, SaskPower for location of and changes to power infrastructure).

In addition, we noted the Branch had identified 6% (194) of the values-at-risk in the database as "destroyed." Most of these values-at-risk were destroyed in the 2015 wildfires. As evident in **Figure 1**, the province had an unprecedented number of wildfires in 2015 with 43 communities evacuated, and 679,000 hectares burned in areas with a high number of values-at-risk. The Branch acknowledged that it had not actively determined if structures identified as "destroyed" had been replaced by March 2017.

As previously noted, the Ministry requires a values-at-risk approach to prioritizing wildfire activities. Under this approach, knowing the nature and location of values-at-risk is the first step to protecting them. Not having current information or a correct understanding of the types of values-at-risk from wildfires increases the risk of the Branch not developing appropriate daily plans (including detection) and suppression strategies, and not prioritizing wildfire detection activities appropriately. In addition, including destroyed properties as values-at-risk may result in the Branch expending activities and resources for non-existent values-at-risk.

2. **We recommend that the Ministry of Environment actively work with other government sources to obtain information on values-at-risk from wildfires.**

4.3 Data on Identified Fire Hazards Systematically Collected and Used for Detecting Fires

The Wildfire Management Branch appropriately uses a risk-based approach for detecting wildfires.

Under this risk-based wildfire detection approach, the Branch identifies hazards (e.g., fuels, weather conditions). It systematically collects (e.g., seasonally, daily) and analyzes data on the identified hazards to focus its detection activities on areas with higher risks and monitors those areas for potential breakout of wildfires.

Key hazards include types of fuels, weather conditions, and topography. The Branch maintains current data on each of these primarily in its Geographic Information System (GIS). GIS integrates weather, fuels, and topography data to produce hazard maps.

For fuels, we found the Branch actively collects information on various vegetation types, trees, and forests. It uses satellite imagery, forest inventory maps, and topography to identify types of fuels (e.g., grass, boreal spruce).

Weather plays a major role in the ignition, growth, and extinguishing of a wildfire. For example, drought leads to extremely favorable conditions for wildfires, winds aid a

wildfire's progress, and rain can extinguish a wildfire. As described in **Figure 5**, temperature, wind, moisture, and lightning are four weather conditions that can affect wildfires.

Figure 5—Four Weather Conditions Affecting Wildfires

The following four weather conditions can affect wildfires:

- Temperature affects the sparking of wildfires. The sticks and trees on the ground receive radiant heat from the sun, which heats and dries potential fuels. Warmer temperatures allow fuels to dry, ignite, and burn faster.
- Wind has the biggest impact on wildfire's behaviour. Winds supply the fire with additional oxygen, further dry potential fuel, and push the fire across the land at a faster rate.
- Moisture works against the fire. Moisture, in the form of humidity and precipitation, can slow the fire down and reduce its intensity. Potential fuels can be hard to ignite if they have high levels of moisture, because the moisture absorbs the fire's heat. When the humidity is low, meaning that there is a low amount of water vapor in the air, wildfires are most likely to start. The higher the humidity, the less likely the fuel is to dry and ignite.
- Lightning is the only source of fire not ignited by people.

Source: Adapted by Provincial Auditor of Saskatchewan.

We found the Branch actively collects the following weather information: weather observations from its 75 provincial weather stations located throughout the province,[19] digital weather data from external sources such as NASA, and lightning data from Environment Canada. The Branch, through a contract with Environment Canada, electronically receives lightning data (latitude, longitude, and time) every time there is a strike.

The Branch meteorologists create different weather forecasts. Each day during wildfire season (typically April 1 to September 30), Branch GIS specialists create two lightning maps—a lightning map for the last 24 hours and a lightning map for the last five days. They overlay these on a fire danger map because a wildfire caused by a lightning strike may not be detectible for several days.

In addition, we found the Branch meteorologists forecast detailed weather up to two days in advance. Using this data, they provide twice-daily weather briefings to all Branch staff responsible for preparedness planning, including wildfire detection. Furthermore, the Branch uses weather data and fuel information to create about 18 different wildfire hazard maps. See **Figure 6** for examples of types of maps. These maps are colour coded daily to indicate areas with high risk of wildfires. During the fire season, the Branch GIS specialists create maps every day.

Figure 6—Examples of Maps Used in Wildfire Management Branch

The following are examples of the maps the Branch uses for wildfire management:

- Fine Fuel Moisture Code (FFMC): the dryness of the smallest forest fuels (surface litter, leaves, needles, small twigs, etc.) – classified into five categories
- Duff[A] Moisture Code (DMC): the dryness of the medium-sized surface fuels and upland duff layers (approximately 2 to 10 cm) – classified into five categories
- Drought Code (DC): the dryness of the largest surface fuels and deep duff layers – classified into five categories

Source: Ministry of Environment, Wildfire Management Branch.
[A] Duff is decaying vegetable matter covering the ground under trees.

[19] These stations automatically collect weather data and send hourly weather information to the fire centre in Prince Albert. Weather data includes temperature, relative moisture of the air, wind direction and speed, rain, and atmospheric pressure.

The Branch uses maps for different aspects of fire management operations. The Branch uses information on hazard maps to help monitor fire danger, predict fire behaviour, and detect fires.

All staff at the Branch can readily access the hazard maps through the Ministry's Wildfire Management website. Branch staff responsible for detection use the maps when planning detection activities. The Branch holds daily conference calls during fire season to develop a preparedness plan for the day, and to prepare for the next day.

When we examined the Branch's Wildfire IT system and website, we found it contained all expected fire hazard information (e.g., maps, weather forecasts, wildfire chronologies). In addition, the Ministry had made the system and website available to appropriate staff, and appropriately restricted the system and website from unauthorized access or changes.

4.4 Wildfires Systematically Searched For

The Wildfire Management Branch systematically looks for potential wildfires and identifies active wildfires.

The Branch has established aerial (fixed wing aircraft) and staff ground patrols, and its ForestWatch System (wildfire detection cameras) as the primary methods of its controlled detection program. As shown in **Figure 7**, detection patrols and cameras typically detect about one-third of the fires. Its Manual contains guidance on the reporting and monitoring expected of these methods.

Figure 7—Percentage of Wildfires Detected By Method By Wildfire Season

Detection Method	Wildfire Season	
	% detected in 2015	% detected in 2016
Aircraft Detection Patrols	12	11
Wildfire Management Staff on Ground Patrols	11	16
Cameras Located in Towers [A]	4	7
Sub-total	27	34
Public [B]	32	36
Other Aircraft - Other Ministry of Environment personnel	27	16
Other, including monitoring satellite imagery	9	6
Aircraft, private and commercial [C]	5	8
Total	100%	100%

Source: Ministry of Environment, Wildfire Management Branch, http://publications.gov.sk.ca/documents/66/89626-12df5641-728b-47a4-8092-393f450d90c2.pdf (26 October 2016).
Shading indicates detection methods controlled by the Wildfire Management Branch.
[A] In 2014, the Ministry completed its installation of 42 wildfire detection remote cameras across the province's northern forests and discontinued its use of human wildfire tower observers.
[B] Percentage includes calls to 911 or Ministry wildfire hotline.
[C] Percentage includes commercial air traffic, bush pilots, and non-Ministry of Environment government aircraft used for different purposes.

The Branch has four aircraft on contract (three contracted for 100 days and one for 75 days during wildfire season) located in three bases—La Ronge, Buffalo Narrows, and Stony Rapids. Aerial staff are trained in detecting wildfires. Also, the Branch has seven

helicopters on contract (for 90 days during wildfire season). While it uses these aircraft and helicopters primarily to fight fires, it may use them to detect or verify reports of fires.

Each day during wildfire season, the Branch develops wildfire detection patrols plans, using information on forecasted weather and identified areas of concern (e.g., lightning, high fire hazard areas). It determines the frequency, routes, and type of aircraft for aerial detection patrols based on the potential for ignition, predicted fire starts (e.g., lightning paths), and known values-at-risk (see **Section 4.2** for our concerns about the currency of some of this information). If planes are not available, the Branch directs its staff on the ground to survey specific areas at risk.

We examined detection plans for nine days during the wildfire season, and noted evidence that daily detection planning appropriately integrated risk information (e.g., patrol routes flew over lightning patterns).

Forty-two cameras and the related IT system form the Ministry's ForestWatch system (detection camera system). The cameras are located on the towers originally used by human observers and are near high priority known values-at-risk. The Branch's staff located in Prince Albert monitor all camera images in real time during the wildfire season.

As noted in **Figure 7**, in the last two wildfire seasons, the public detected and reported over one-quarter of the wildfires. To encourage public reporting of wildfires, the Branch maintains a public webpage[20] and a 24-hour Firewatch Line (Report a Forest Fire). It makes this number readily available on the webpage and through use of posters and signage.

The Branch logs key information about wildfires in its Wildfire Integrated Information Network (Wildfire IT system). Key information includes who reported the wildfire and when, geographic location, description of the fire, fuels, smoke colour, fire size, report type, values threatened, etc.

The Ministry tracks, as a key indicator, the size of fires when detected (i.e., less than 100 hectares), as it is less expensive to suppress fires when detected early.

For 21 wildfires detected by Ministry of Environment staff that we tested, two were larger than 100 hectares based on size recorded when detected. For each of these fires, the Branch had sensible documented reasons for the fire being over 100 hectares on detection. For example, for one case, the municipality who was responsible for detecting and managing the fire asked the Branch to help them fight the fire when it grew large.

4.5 Wildfires Reported by Third Parties Verified

The Wildfire Management Branch consistently tracks and verifies reports of wildfires by third parties such as the public and commercial/private aircraft operators.

It verifies wildfires reported by other sources through its own patrols or camera system. The Branch does not have a set timeframe for verifying reports of wildfires. Rather it appropriately varies the timeframe based on its assessment of the probability of a fire, the extent of threat the fire presents, and staff or aircraft availability for verification. When

[20] www.saskatchewan.ca/fire#utm_campaign=q2_2015&utm_medium=short&utm_source=%2Ffire (12 May 2017).

making this assessment, it uses information from its daily hazard maps, known values-at-risk, etc.

For the sample of nine wildfires we tested where a third party reported the fire, the Branch verified each of them within a reasonable timeframe. For six of those nine fires, the Branch verified the fire and started its initial attack within one to four hours. For the other three, it documented a reasonable explanation why the verification did not occur until the next day (e.g., fire was reported in the area north of the primary and secondary areas and not an immediate threat to known values-at-risk).

4.6 Wildfire Spread and Behaviour Monitored

The Branch actively monitors the spread and behaviour of wildfires using daily hazard maps and current weather information.

Each day, Forest Protection Officers enter the status of active wildfires in its Wildfire IT system. The Branch consistently uses its Wildfire IT system to track key information about active wildfires (e.g., status of the fire, fire behaviour, progress made, actions taken, communication with the local authorities or affected parties). The IT system tracks all of the key information that we expected.

During the wildfire season, weather, detection and suppression personnel attend morning briefings. In addition, all have access to the Wildfire IT system. Daily briefings and information in the IT system provides personnel with real-time knowledge of detected fires, likelihood of spread (fuel moisture, weather, etc.) and known values-at-risk (see **Section 4.2** for our concerns about the currency of some of this information). Receiving up-to-date information daily helps them determine priorities and monitor individual wildfires for spread or movement. Not having current information about values-at-risk may result in them not prioritizing wildfire activities properly. See **Recommendations 1** and **2** about actively keeping values-at-risk information current.

In addition, the Branch may use fire modelling to project fire behaviour (e.g., fire growth) for high-risk fires (e.g., those threatening communities or commercial operations). It has access to two applications—Prometheus and Pegasus. See **Figure 8** for a brief description of each.

Figure 8—Examples of Wildfire Modelling Applications Available to the Ministry

Prometheus is a software application available to Saskatchewan's Forest Protection Officers through an agreement with the Government of Alberta. It is a fire growth modelling application initially developed by Canadian Forest Service. Ministry GIS specialists can access Prometheus to predict wildfire behaviour and spread. For example, it may be used for large wildfires where significant values are at risk.
Pegasus is an online version of Prometheus. It is a simplified version on a web application. Personnel in the Branch can use Pegasus to do wildfire growth simulations.

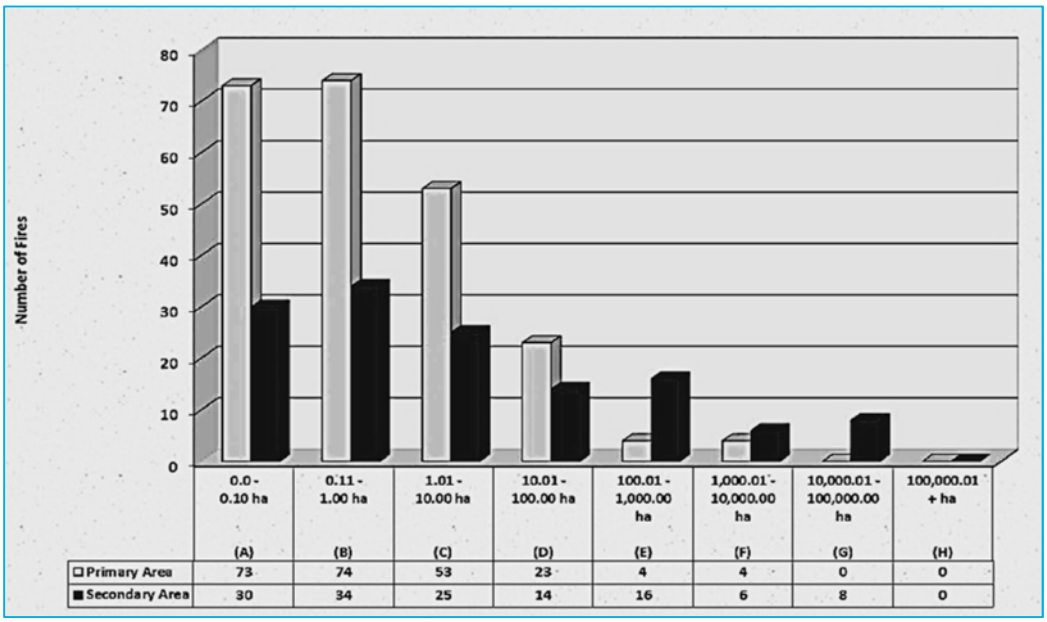
Source: Ministry of Environment, Wildfire Management Branch.

The Branch did not use modelling during the 2016 fire season. It indicated that none of the wildfires detected in 2016 significantly threatened communities or commercial operations.

In the 2016 wildfire season, the Ministry responded to 364 fires (2015: 720). **Figure 9** shows the number of fires by size which the Ministry responded to in 2016. As **Figure 9**

shows, in 2016, only 4% of wildfires in the primary area were larger than 100 hectares. This suggests the Branch successfully monitored the behaviour of existing wildfires.

Figure 9—Number of Fires by Size Class in 2016



Source: Ministry of Environment, Wildfire Management Branch, *Wildfire Statistics Report 2016.*

For all 30 wildfires we sampled, we noted evidence of staff actively monitoring fire behaviour and spread. We noted Forest Protection Officers updated the wildfires status to "finalized" in the Branch's Wildfire IT system when the fire was out.

4.7 Clear Protocols to Issue Warnings of Wildfire Threats in Place

The Wildfire Management Branch uses clear and understandable policies to communicate information about potential wildfire threats to the public and other stakeholders (e.g., community leaders, local authorities, commercial operators, media).

One policy requires the Branch to ensure community leaders, local authorities, and the appropriate stakeholders receive immediate notification when a wildfire is threatening or may threaten an area where a community meets a forest (i.e., a wildland-urban interface).

This policy includes protocols for providing information to the public on potential wildfire threats. For example, it sets out who is responsible for issuing notifications, what information to convey about the wildfire (e.g., wildfire direction and speed, any potential road closures, how far the wildfire is from the community). It also requires documentation of communications (e.g., who approved the information, who presented the information, when the information was released and its details).

Another Branch policy provides clear guidance for communication with the media on high-risk wildfires.

All the Branch staff have ready access to Branch policies.[21]

[21] Staff can access Ministry policies through the Web-library within the Branch's internal Wildfire Management website.

4.8 Threat of Wildfires Communicated

The Branch communicates risk of wildfires to stakeholders and the public in various ways.

In case of potential danger, the Branch notifies and provides updates to local authorities, commercial operators, or other stakeholders primarily by phone calls, emails, and the Ministry website. The Ministry of Environment is not responsible to order evacuations. Stakeholders make decisions to evacuate. In the event a wildfire threatens a community, the local authority may order an evacuation and collaborate with the ministries of Social Services, Health, and Government Relations to facilitate the evacuation.

The Fire Protection Officers in each Forest Protection Area are responsible for communicating risk information concerning particular communities, commercial operators, or other stakeholders (e.g., Ministry of Highways in the event a wildfire is expected to cross a highway, requiring road closure).

While the Branch does not have an established timeframe to contact local authorities, commercial operators, or other stakeholders, it aims to communicate wildfire risks as soon as it knows there is a potential hazard to people or values-at-risk as recorded in its Wildfire IT database. In the 2016 wildfire season, one commercial operator decided to evacuate personnel at a work camp due to a wildfire threat.

For 30 wildfires we tested, 2 fires were potential hazards to a community and an industry respectively. For these 2 fires, we found the following:

- Forest Protection Officers documented their communications with external stakeholders in their personal logbooks, as the Ministry requires and the Ministry had recorded key information about these communications in its Wildfire IT system
- The Branch had communicated with affected parties as soon as it recognized the potential hazard of the fire, provided regular updates on the status of the fire, and was in continuous contact with the local authorities and affected parties
- The Branch adjusted its suppression plan based on additional information about values-at-risk obtained from an affected party

The Branch publishes current wildfire information on the Ministry's website. In addition, for high-risk situations, it issues notices to the public through social media (e.g., Facebook, Twitter) or SaskAlert,[22] and, if needed, through local media outlets.

We found that the Ministry's website (i.e., www.saskatchewan.ca/fire) includes:

- Interactive Map, which is updated hourly; it shows the location and information on current wildfires.
- Current Wildfire Activity, which is updated hourly; it shows the status of active wildfires.

[22] The Government of Saskatchewan's emergency public-alerting program that provides critical information on emergencies in real time, so people can take action to protect themselves, families, and property. www.saskatchewan.ca/residents/emergency/saskalert (17 May 2017).

- Daily Fire Danger Maps, which are available during the fire season (April to September). They show the forecasted fire hazards for the current and following day. These maps show the ease of fire ignition, and how quickly a wildfire will likely spread. They cover the agricultural, forest fringe, and forested areas of the province.

- Cumulative Wildfires to Date, which are updated hourly during the wildfire season; it shows location of active and extinguished wildfires.

5.0 Glossary

Boreal Forest—Forests located in northern regions with predominantly evergreens and shrubs (coniferous).

Digital Weather Data—Weather data collected from satellite imagery, radar imagery, and weather information from around the world.

Fire Modelling—Mathematical models used to understand and predict wildfire behaviour. Examples of models used in Saskatchewan are Prometheus and Pegasus.

Forbes—Any herbaceous plants other than grass.

Forest Inventory Maps—Maps that provide information about forest cover such as the predominant types of vegetation and trees at different locations in Saskatchewan.

Fuel—Fuel is any organic material that is living or dead that can ignite and burn. Wildfires spread based on the type and quantity of fuel that surrounds it. Smaller fuels such as leaves, twigs, and grasses are more readily available for combustion as they dry out quicker than larger fuels such as branches and logs.

Incendiary—Purposefully started fires (e.g., burning scrub brush).

Topography—Topography is a detailed map of the surface features of a place, region, or land (for example, its hills, valleys, or rivers).

6.0 Selected References

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