Case studies of wildfire evacuations in Canada between 2020 and 2023 using publicly available sources

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ABSTRACT

An increasing number of communities are affected by wildfires in the wildland-urban interface (WUI) in Canada. While statistical information about wildfire evacuations in Canada is available, systematic descriptions of individual incidents are rare. However, case studies can be useful to illustrate and understand aspects unique to affected communities. Using an established reporting template, this paper provides an overview of five case studies that led to community evacuations across Canada between January 2020 and August 2023: (1) the White Rock Lake wildfire in 2021 (British Columbia), (2) the Edson Forest Area wildfire in 2023 (Alberta), (3) the Lebel-sur-Quévillon wildfire in 2023 (Québec), (4) the Tantallon wildfire in 2023 (Nova Scotia), and (5) the Behchokǫ̀-Yellowknife wildfire in 2023 (Northwest Territories). Information from publicly available resources was used to describe the communities, environmental conditions, incidents and evacuation. Information gaps where no data was publicly accessible are also highlighted. The case studies suggest that communities faced several challenges during the wildfire evacuations, most commonly related to communication. The case studies help better understand the context in which wildfire evacuations occur and how communities respond and manage wildfire evacuations in Canada.

Keywords

Canada wildfire, Case study, Evacuation, Wildfire, Wildland-urban interface.

INTRODUCTION

The frequency, scale, and severity of wildfires is increasing (Gwynne et al., 2023), including in Canada (Hanes et al., 2018). Due to increasing population and urban areas expanding into wildlands, more communities are affected by fires in the wildland-urban interface (WUI). In Canada, wildfires have led to approximately 20 evacuations per year after 2010 (Bénichou et al., 2021). In 2023 alone, wildfires forced approximately 232,000 Canadians to evacuate their homes (Jain et al., 2024). Although several publications have documented wildfire evacuations that occurred in the United States, Europe, Asia, Australia, and New Zealand (e.g., Ronchi et al., 2021; Wang et al., 2022), few have covered wildfire evacuations in Canada.

Two notable publications that focused on the Canadian context are Beverly and Bothwell (2011) and Christianson et al. (2024). Beverly and Bothwell (2011) analyzed wildfire evacuations that occurred from 1980 to 2007. They found that most wildfire evacuations took place in British Columbia, Alberta, and Manitoba. Christianson et al. (2024) analyzed wildfire evacuations that occurred from 1980 to 2021. They reported that the frequency, size, and duration of wildfire evacuations increased from 1980 to 2021. In addition, they showed that although wildfire evacuations took place across Canada, they occurred most frequently in central British Columbia and in areas within the boreal forest zone.

Case studies allow to investigate an event in depth (e.g., how, why, and where it occurred) and provide a comprehensive overview of the event. Ronchi et al. (2021) and Wang et al. (2022) developed a case study

reporting template and published 28 (Ronchi et al.) and 26 (Wang et al.) unique case studies, respectively, on wildfire evacuations that took place in North and South America, Europe, Asia, Australia, and South Africa from 1976 to 2021. An internal report by Gwynne and Bénichou (2022) included several case studies on wildfire evacuations that occurred in Canada until 2021, such as the Slave Lake wildfire evacuation in 2011 and the Fort McMurray wildfire evacuation in 2016. However, to the authors' knowledge, no publication has yet covered more recent wildfire evacuations (i.e., after 2021) that occurred in Canada.

Aim and Objectives

This paper provides an overview of recent wildfires in Canada that led to community evacuations by completing the case study reporting template developed by Ronchi et al. (2021). A second objective was to discuss any patterns or trends observed between the case studies to help better understand the context in which community wildfire evacuations occur.

METHODS

The authors compiled a list of wildfire evacuations that occurred in Canada between January 2020 and August 2023 by performing a search on the general web, in news archives, and through government resources. As of October 6, 2023, the authors identified a total of 112 wildfires that led to evacuations in the aforementioned timeframe. Due to the large number of wildfires that occurred during the timeframe of interest, the list is likely not comprehensive.

The authors reviewed the list of wildfire evacuations and selected five case studies based on the following criteria:

1. Data availability (e.g., in news articles, reports)
2. Number of people evacuated
3. Duration of the evacuation
4. Number of structures and infrastructures affected
5. Economic impact
6. Size of the wildfire

The list of wildfire evacuations suggested that some provinces and territories were affected more than others (in particular British Columbia and Alberta). As the aim of the paper was to cover cases across Canada, only one wildfire evacuation per province within the same year was selected. The authors retrieved information on the case studies in scientific publications (when available), reports, and news articles.

Note that the type of forest (i.e., forest region) involved in the wildfire was retrieved from Natural Resources Canada (NRCan)'s Forest classification (NRCan, 2024). Average weather conditions were retrieved from Environment and Climate Change Canada (ECCC)'s Historical data (ECCC, 2024) using the nearest weather station to the area of interest. Finally, different sources were used to identify geographical highlights and natural fire breaks, depending on the province: iMapBC for British Columbia (Government of British Columbia, 2024), GeoDiscover Alberta for Alberta (Government of Alberta, n.d.), the Geospatial Portal for Québec (Ministère des Ressources naturelles et des Forêts, n.d.), the Provincial Landscape Viewer for Nova Scotia (Government of Nova Scotia, n.d.), and the Administration of the Territorial Lands Act System (ATLAS) for the Northwest Territories (Department of Environment and Climate Change, n.d.). All geographical highlights and natural fire breaks were identified by visually inspecting the area of interest on the relevant map.

CASE STUDIES

White Rock Lake Wildfire 2021, BC, Canada

On July 13, 2021, lightning ignited the White Rock Lake fire in the Douglas Lake Ranch area in the Thompson-Okanagan region of British Columbia. Initially 0.1 km^2 (10 ha) when it was detected, the fire spread quickly due to hot and dry conditions and led to the evacuation of over 2,000 residents in multiple jurisdictions in the Thompson-Okanagan region from the end of July 2021 to mid-August 2021. Several agencies were involved in firefighting and rescue operations. One firefighter assisting with firefighting operations sustained injuries. The fire burned approximately 833.42 km^2 (83,342 ha) and damaged or destroyed at least 78 properties. The Insurance Bureau of Canada (IBC) estimated the fire to have caused $[a]77 million in insured damage. Some challenges were encountered related to the management of the evacuation.

[a] Note that all monetary values are presented in Canadian Dollars.

Table 1. Details about the White Rock Lake Wildfire 2021, Canada

ID	Information sought	Information
1	Where?	Thompson-Okanagan region, British Columbia, Canada
2	When?	July 13, 2021 – September 7, 2021 (fire listed as under control)[1,2]
3	How was the fire started?	Lightning[3]
4	Initial fire size (km^2)	0.1 km^2 (10 ha)[4]
5	Area affected (km^2)	833.42 km^2 (83,342 ha)[1]
6	Type(s) of forest involved in wildfire (Fuel type)	Montane forest region: Douglas-fir, lodgepole pine, ponderosa pine, trembling aspen.[5,6]
7	WUI, urban, wildland or informal settlement fires?	WUI fire: forest burned and multiple jurisdictions affected by the fire, including Regional District of North Okanagan to Thompson-Nicola Regional District, Regional District of Central Okanagan, Columbia-Shuswap Regional District, and Okanagan Indian Band lands. Multiple structures were destroyed.[7]
8	Average weather conditions (temperature, wind, humidity, etc.)	Nearly no precipitation in July 2021, with an average high temperature of 32.6°C. On several days during the month, the maximum daily temperature reached at least 33°C. During August, 2021, there was little precipitation, with an average high temperature of 26.6°C. The maximum daily temperature reached at least 33°C on several days in the first half of the month.[8]
9	Geographical highlights (any particularities)	Several lakes in the area, such as Douglas Lake, Nicola Lake, Chapperon Lake, Stump Lake, and Okanagan Lake. Large forested areas.[9]
10	Was there any natural or artificial fire break?	Natural fire break: Lakes[9] Artificial fire break: Fire guards,[10,11] Highway 97.[12]
11	Did the Fire Service / Department report extreme fire behavior?	Not reported by the Fire Service/Department, but aggressive and extreme fire behavior was reported by the media[13,14,15] and BC Wildfire Service.[11]
12	Number of structures and infrastructures affected	As of August 24, 2021, 78 properties destroyed.[12,16] In August 2022, a year after the fire, an article reported that over 100 homes in communities from Monte Lake to Killiney Beach had been damaged or destroyed by the fire.[17]
13	Estimated direct and indirect economic damage	As of September 23, 2021, the Insurance Bureau of Canada (IBC) estimated the fire to have caused $77 million in insured loss and expected over 800 claims, most of which for residential properties.[18]
14	Did it occur in conjunction with multiple fires in the country?	Yes, the fire occurred in conjunction with multiple fires in British Columbia and elsewhere in Canada.[19,20,21]
15	Countries involved	Canada. Out-of-province and international firefighters.[22,23]
16	Brief timeline of key events	- July 13, 2021: Fire detected. - July 18, 2021 at 21:53 PDT: Evacuation order issued.[24] - July 20, 2021: Provincial state of emergency declared.[12] - July 30, 2021: Local state of emergency declared.[25] - August 17, 2021 at 19:00 PDT: Evacuation complete (last evacuation order lifted).[26] - September 2, 2021: Fire listed as being held.[7,27] - September 7, 2021: Local state of emergency lifted and fire listed as under control.[7,28,29] - September 14, 2021: Provincial state of emergency lifted.[30]
17	Time of initial order to evacuate and locations	At 21:53 PDT, July 18, 2021, evacuation order issued for several properties in the Thompson-Nicola Regional District.[24]
18	Time when evacuation was considered completed	19:00 PDT, August 17, 2021, the last evacuation order lifted for areas in the Thompson-Nicola Regional District.[28]
19	Deaths/Injuries	One firefighter sustained injuries while helping to fight the wildfire.[31,32] It appears that there were no other injuries or fatalities.
20	Number of people evacuated	As of August 5, 2021, over 2,000 residents were evacuated.[33,34]
21	Location people initially evacuated	Areas in the Thompson-Nicola Regional District.[24]
22	Reasons why people decided to evacuate	Residents were ordered to evacuate the area (evacuation order) as the fire was near the community.[24] Unclear whether there were other reasons why

		residents decided to evacuate. Some residents decided not to evacuate.[35]
23	Evacuation type	Private vehicles, though it appears that residents could request assistance with transportation if required.[36]
24	Any drill/education/instructions on large outdoor fires provided beforehand?	Additional data required
25	Personnel involved in rescue operations	Royal Canadian Mounted Police (RCMP),[37] firefighters,[38] BC Wildfire Service,[17] police.[39]
26	Did the smoke hinder significantly the evacuation because of low visibility or health problems?	Additional data required
27	Possible causes of issues in management operations	Residents expressed frustration with the management of the evacuation.[40,41] Several residents reported confusion and not receiving an evacuation alert or order and remained updated on the situation through social media platforms.[35] In addition, residents reported being evacuated for a long period of time and felt like there was a lack of support for evacuees.[42,43,44,45] On August 26, 2021, the Central Okanagan Regional District organized a virtual information session to respond to residents' questions.[46] Following the fire, a document obtained through a freedom of information request raised some questions.[17] It does not appear that an after-action report for the fire was published.
28	References[b]	**Websites:** 1 https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary 2 https://globalnews.ca/news/8172603/white-rock-lake-wildfire/#:~:text=Nearly%20two%20months%20from%20the,said%20in%20a%20Monday%20update. 3 https://globalnews.ca/news/8726867/white-rock-wildfire-2021-investigation/ 4 https://www.radionl.com/2021/08/06/local-ranchers-reportedly-told-not-to-fight-white-rock-lake-fire-on-day-it-started-when-it-was-only-10-hectares/ 5 https://natural-resources.canada.ca/our-natural-resources/forests/sustainable-forest-management/measuring-and-reporting/forest-classification/13179 6 https://natural-resources.canada.ca/maps-tools-and-publications/maps/forest-maps/16874 7 https://www.castanetkamloops.net/news/Vernon/345066/White-Rock-Lake-wildfire-a-timeline-from-start-to-its-control 8 https://climate.weather.gc.ca/climate_data/daily_data_e.html?hlyRange=%7C&dlyRange=1925-03-01%7C2022-05-22&mlyRange=1925-01-01%7C2007-02-01&StationID=1032&Prov=BC&urlExtension=_e.html&searchType=stnProv&optLimit=specDate&StartYear=1840&EndYear=2024&selRowPerPage=25&Line=155&Month=7&Day=1&lstProvince=BC&timeframe=2&Year=2021 9 https://www2.gov.bc.ca/gov/content/data/geographic-data-services/web-based-mapping/imapbc 10 https://infotel.ca/newsitem/fire-guards-challenged-by-growth-at-white-rock-lake-wildfire-near-westwold/it84569 11 https://www.castanetkamloops.net/news/Vernon/341427/The-White-Rock-Lake-fire-is-difficult-to-map-due-to-smoke-blocking-visibility-fire-behaviour-is-aggressive 12 https://www.cbc.ca/news/canada/british-columbia/bc-wildfires-2021-timeline-1.6197751

[b] To improve readability, all references for the case studies are listed in the tables.

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Edson Forest Area Wildfire (EWF031) 2023, AB, Canada

On May 4, 2023, a wildfire (EWF031) was detected 25 km west of Lodgepole and 20 km northwest of Brazeau Dam in Alberta. Authorities suspected that a lightning strike caused the fire. When discovered, the fire was approximately 0.5 km^2 (50 ha) and grew to approximately 2,019.13 km^2 (201,913 ha) over the following weeks. High temperatures, dry conditions, and strong winds contributed to the spread of the fire. On May 5, 2023, over 8,000 residents evacuated. On May 7, 2023, fire EWF031 and two nearby fires (EWF039 and RWF034/040) were renamed the Pembina Wildfire Complex. The fires led to a second evacuation of the community on June 9, 2023. Multiple agencies were involved in extinguishing the wildfires. The fires damaged or destroyed at least 25 homes and the overflow campground in Willmore Park in Edson and had a heavy financial toll on residents due to loss of income and unexpected expenses. One pilot who was helping to fight wildfires in the area sustained minor injuries while landing his helicopter. Recommendations were made after the wildfire and centered around communication (e.g., establishing common terminology, enhancing information available to residents), coordination (e.g., establishing a more formal/unified command structure to decrease confusion), and education and training (e.g., developing community training).

Table 2. Details about the Edson Forest Area Wildfire (EWF031) 2023, Canada

ID	Information sought	Information
1	Where?	Edson, Alberta, Canada
2	When?	May 4, 2023 – July 21, 2023 (fire EWF031 listed as under control)[1,2,3,4,5]
3	How was the fire started?	Lightning[4]
4	Initial fire size (km^2)	0.5 km^2 (50 ha) when discovered on May 4, 2023.[3]
5	Area affected (km^2)	Fire EWF031: 2,019.13 km^2 (201,913 ha) on July 21, 2023 when fire was classified as being under control.[4]
6	Type(s) of forest involved in wildfire (Fuel type)	Boreal forest region: white spruce, black spruce, balsam fir, jack pine, white birch, trembling aspen, tamarack, willow.[6,7]
7	WUI, urban, wildland or informal settlement fires?	WUI fire: forest burned and some homes in the areas surrounding Yellowhead County were destroyed by the fire.[8]
8	Average weather conditions (temperature, wind, humidity, etc.)	No precipitation and high temperatures in early May 2023, with a maximum high of 28.1°C with gusts up to 67 km/h on May 4. Some precipitation and decrease in temperature from May 7 to May 11. However, some days with high temperatures (26°C-27°C) and no precipitation from May 13 to May 20. Also, several days in June and a few days in July where temperatures reached between 27°C and 29°C. A few days with heavy precipitation in June.[9]
9	Geographical highlights (any particularities)	McLeod River to the east and south of Edson; Canadian Rockies, Sundance Provincial Park, and Obed Lake Provincial Park to the west of Edson.[10]
10	Was there any natural or artificial fire break?	Natural fire break: The McLeod River.[10,11] Artificial fire break: Fire guards.[12]
11	Did the Fire Service / Department report extreme fire behavior?	Alberta Wildfire reported in an Edson Forest Area Wildfire Update on June 8, 2023 that "Over the next 72 hours, sustained extreme wildfire behaviour will be occurring throughout areas of EWF031."[13] Alberta Wildfire reported multiple days of extreme wildfire behavior between June 9 and June 11, 2023 in Edson Forest Area Wildfire Updates.[14,15,16,17,18,19,20] On June 9, the fire spread up to 35 metres per minute.[15,16]
12	Number of structures and infrastructures affected	On May 8, 2023, at least 25 homes were destroyed by the fire in the areas surrounding Yellowhead Country.[21] As of May 6, 2023, the Town of Edson has not sustained any damage.[22] On June 9, 2023, the overflow campground in Willmore Park in Edson sustained damage.[23] It is unclear whether additional structures or properties were destroyed in the following weeks.

13	Estimated direct and indirect economic damage	2,019.13 km^2 (201,913 ha) burned.[4] Insured loss unknown – however, financial strain on residents due to loss of income and unexpected expenses (e.g., hotel rooms).[24]
14	Did it occur in conjunction with multiple fires in the country?	Yes, fire EWF031 occurred in conjunction with multiple fires in Alberta and elsewhere in Canada.[25] The fire is part of the Pembina Wildfire Complex.[1]
15	Countries involved	Canada. Out-of-province and international firefighters (e.g., United States, South Africa, and New Zealand) arrived in Alberta to help fight wildfires, but it is unclear where they were posted within the province.[26]
16	Brief timeline of key events	- May 4, 2023: Fire (EWF031) detected 25 km west of Lodgepole and 20 km northwest of Brazeau Dam.[3] - May 5, 2023 at 17:37 MDT: Evacuation order issued.[27] - May 6, 2023: Second fire (EWF039) detected near Carrot Creek.[1] - May 6, 2023: Provincial state of emergency declared.[28] - May 6, 2023: Local state of emergency declared.[29] - May 7, 2023: Fires EWF031, EWF039, and RWF034/040 were renamed the Pembina Wildfire Complex.*[1,30] - May 8, 2023 at 0:800 MDT: Evacuation complete (evacuation order lifted).[31] - May 10, 2023: Fire EWF039 classified as being held.[32] - June 3, 2023: Provincial state of emergency lifted.[33] - June 9, 2023: Second evacuation order issued.[15] - June 15, 2023: Second evacuation complete (evacuation order lifted).[34,35] - June 20, 2023: Fires EWF031, RWF034, and RWF040 classified as being held.[5] - July 21, 2023: All fires from Pembina Complex classified as under control.[4] * It is unclear when fires RWF034 and RWF040 ignited and were detected. Fire RWF034 was located near the O'Chiese First Nation and grew to approximately 874.92 km^2 (87,492 ha) on June 17, 2023 (which seems to be the maximum size it reached before being contained).[36] On May 1, 2023, 103 residents of the northern area of the reserve evacuated (although it is unclear whether the evacuation was directly due to fire RWF034 – it was not specified in the news article).[37] Fire RWF040 was located 6 km northeast of the Forestry Trunk Road and Brown Creek Provincial Recreational Area[38] and grew to approximately 50.89 km^2 (5,089 ha) on June 17, 2023 (which seems to be the maximum size it reached before being contained).[36] It is unclear whether fire RWF034 led to any evacuations.
17	Time of initial order to evacuate and locations	17:35 MDT, May 5, 2023, evacuation order issued for Town of Edson and parts of Yellowhead County.[27]
18	Time when evacuation was considered completed	08:00 MDT, May 8, 2023, evacuation order lifted for Marlboro to the Chip Lake area, including Town of Edson.[31] Note that a second evacuation order was issued for the Town of Edson and parts of Yellowhead County on June 9, 2023.[15] The second evacuation order was lifted for the Town of Edson and Yellowhead County on June 15, 2023.[34,35]
19	Deaths/Injuries	One pilot who was helping to fight wildfires in the area received minor injuries while landing his helicopter.[39] It appears that there were no other injuries or fatalities.
20	Number of people evacuated	8,400 residents from Town of Edson and an estimated 5,000 residents from Yellowhead County.[40,41]
21	Location people initially evacuated	Town of Edson and parts of Yellowhead County.[40,41]
22	Reasons why people decided to evacuate	Residents were ordered to evacuate the area (evacuation order) as the fire was near the community.[27,42] Unclear whether there were other reasons why

		residents decided to evacuate.
23	Evacuation type	Private vehicles and buses.[43,44]
24	Any drill/education/instructions on large outdoor fires provided beforehand?	Additional data required – however, the report by 9Zero Solutions Ltd. recommended to implement community education on wildfires.[1,45]
25	Personnel involved in rescue operations	Royal Canadian Mounted Police,[41] firefighters, support staff.[46]
26	Did the smoke hinder significantly the evacuation because of low visibility or health problems?	Additional data required
27	Possible causes of issues in management operations	9Zero Solutions Ltd. administered a survey to Yellowhead County residents and staff (e.g., protective services, community services). The report listed some challenges and opportunities for improvement (e.g., related to effective communication). The detailed results are presented in the report.[1]
28	References	**Academic:** 1 9Zero Solutions Ltd. (2023). *Beyond the fires and flood: Understanding the impacts of the 2023 disasters on Yellowhead County*. https://yhcounty.ca/county-office/news/spring-2023-wildfire-flood-after-action-report/ **Other:** 2 https://www.cbc.ca/news/canada/edmonton/alberta-wildfire-edson-evacuation-1.6874804 3 https://srd.web.alberta.ca/edson-area-update/2023-05-04-230pm 4 https://srd.web.alberta.ca/edson-area-update/2023-07-21 5 https://srd.web.alberta.ca/edson-area-update/2023-06-20-1230pm 6 https://natural-resources.canada.ca/our-natural-resources/forests/sustainable-forest-management/measuring-and-reporting/forest-classification/13179 7 https://natural-resources.canada.ca/maps-tools-and-publications/maps/forest-maps/16874 8 https://globalnews.ca/news/9678527/alberta-wildfire-evacuation-order-edson/ 9 https://climate.weather.gc.ca/climate_data/daily_data_e.html?hlyRange=2010-09-20%7C2024-03-27&dlyRange=2010-09-23%7C2024-03-27&mlyRange=%7C&StationID=48948&Prov=AB&urlExtension=_e.html&searchType=stnProv&optLimit=yearRange&StartYear=2023&EndYear=2023&selRowPerPage=25&Line=81&lstProvince=AB&timeframe=2&time=LST&Year=2023&Month=5&Day=4 10 https://geodiscover.alberta.ca/geoportal/#toc-1 11 https://srd.web.alberta.ca/edson-area-update/2023-05-07-930am 12 https://edmontonjournal.com/news/local-news/wildfire-forces-edson-residents-from-their-homes-for-second-time 13 https://srd.web.alberta.ca/edson-area-update/2023-06-08-900pm 14 https://srd.web.alberta.ca/edson-area-update/2023-06-09-430pm 15 https://srd.web.alberta.ca/edson-area-update/2023-06-09-1030pm 16 https://srd.web.alberta.ca/edson-area-update/2023-06-09-1130pm 17 https://srd.web.alberta.ca/edson-area-update/2023-06-10-1130pm-0 18 https://srd.web.alberta.ca/edson-area-update/2023-06-10-430pm 19 https://srd.web.alberta.ca/edson-area-update/2023-06-10-900pm 20 https://srd.web.alberta.ca/edson-area-update/2023-06-11-330pm 21 https://globalnews.ca/news/9681550/alberta-wildfires-edson-evacuation-lifted-yellowhead-county/ 22 https://www.edson.ca/town-office/town-news/post/town-update-may-11-2023-01-00-p-m 23 https://www.cbc.ca/news/canada/edmonton/this-fire-is-a-beast-wildfire-threatening-edson-less-than-2-km-from-the-town-1.6872528 24 https://edmonton.citynews.ca/2023/06/10/alberta-wildfire-edson-evacuated-second-time/

		25 https://www.firefightingincanada.com/canada-on-fire/ 26 https://edmonton.ctvnews.ca/how-firefighters-from-several-countries-have-been-enlisted-to-battle-wildfires-in-alberta-1.6439876 27 https://www.alberta.ca/aea/cap/2023/05/05/2023-05-05T17_37_18-06_00=YellowheadCounty=625834CA-6B91-4733-885B-D4D48DDF879B.htm 28 https://www.cbc.ca/news/canada/edmonton/alberta-wildfires-evacuations-1.6834665 29 https://srd.web.alberta.ca/edson-area-update/2023-05-06-1200pm-0 30 https://srd.web.alberta.ca/edson-area-update/2023-05-07-400pm 31 https://srd.web.alberta.ca/edson-area-update/2023-05-08-1130am 32 https://srd.web.alberta.ca/edson-area-update/2023-05-10-230pm 33 https://edmonton.citynews.ca/2023/06/03/alberta-ends-state-of-emergency-wildfires/#:~:text=Last%20Updated%20June%203%2C%202023,northern%20parts%20of%20the%20province. 34 https://www.alberta.ca/aea/cap/2023/06/15/2023-06-15T18_04_53-06_00=TownofEdson=B6F8AD92-D34B-4D96-AD00-277ADD5144C8.htm 35 https://www.alberta.ca/aea/cap/2023/06/15/2023-06-15T18_14_25-06_00=YellowheadCounty=DBB25D28-1AFD-4A9A-BE02-3306F7C30A38.htm 36 https://srd.web.alberta.ca/edson-area-update/2023-06-17-100pm 37 https://www.reddeeradvocate.com/news/part-of-ochiese-first-nation-evacuated-due-to-fire-6826420 38 https://srd.web.alberta.ca/edson-area-update/2023-05-09-1030am 39 https://globalnews.ca/news/9675945/alberta-wildfire-edson-airport-helicopter-crash/ 40 https://www.cbc.ca/news/canada/edmonton/alberta-wildfire-update-edson-1.6877637#:~:text=More%20than%208%2C000%20residents%20were,to%20the%20threat%20of%20wildfire. 41 https://edmonton.ctvnews.ca/get-out-now-officials-urge-people-in-yellowhead-county-evacuation-zone-to-leave-as-fire-tears-through-the-county-1.6436050 42 https://globalnews.ca/news/9762035/alberta-wildfires-edson-residents-evacuated-fire-slows/ 43 https://srd.web.alberta.ca/edson-area-update/2023-05-05-0230-0 44 https://cfjctoday.com/2023/06/09/town-west-of-edmonton-with-8400-residents-evacuated-due-to-wildfire-danger/ 45 https://www.cbc.ca/news/canada/edmonton/independent-review-of-yellowhead-county-wildfires-response-calls-for-more-planning-provincial-support-1.7168622 46 https://globalnews.ca/news/9762035/alberta-wildfires-edson-residents-evacuated-fire-slows/

Lebel-sur-Quévillon Wildfire (Fire 344) 2023, QC, Canada

On June 1, 2023, a wildfire near Lebel-sur-Quévillon was discovered. The fire spread quickly, and on June 2, 2023, two thousand residents from the town and surrounding areas were ordered to evacuate. On June 18, 2023, residents were allowed to return home, but rapidly changing conditions led to a second full evacuation on June 22, 2023. Several agencies were involved in firefighting and rescue operations. The fire burned approximately 4,819.91 km^2 (481,991 ha) and destroyed several secondary residences in Lebel-sur-Quévillon. The fire did not directly lead to any fatalities or injuries; however, the air quality was poor for several weeks due to smoke and fog, which impacted people' health. The duration of the evacuation also took a heavy financial toll on residents due to loss of income and expenses.

Note that many of the references retrieved for this wildfire are in French – the information from these references was translated to English in the table below.

Table 3. Details about the Lebel-sur-Quévillon Wildfire (Fire 344) 2023, Canada

ID	Information sought	Information
1	Where?	Lebel-sur-Quévillon, Québec, Canada
2	When?	June 1, 2023 – July 27, 2023 (fire listed as under control)[4,5]
3	How was the fire started?	Lightning[4,6]
4	Initial fire size (km^2)	On June 3, 2023, it appeared that the fire was 14 km^2 (1,400 ha). However, the exact initial fire size is unclear.[6]
5	Area affected (km^2)	4,819.91 km^2 (481,991 ha).[7]
6	Type(s) of forest involved in wildfire (Fuel type)	Boreal forest region: white spruce, black spruce, balsam fir, jack pine, white birch, trembling aspen, tamarack, willow.[4,8,9]
7	WUI, urban, wildland or informal settlement fires?	WUI fire: forest burned and secondary residences in Lebel-sur-Quévillon were destroyed by the fire.[10,11]
8	Average weather conditions (temperature, wind, humidity, etc.)	May and June were abnormally hot and dry in Québec, with higher-than-normal temperatures across the province.[7]
9	Geographical highlights (any particularities)	Lac Quévillon to the east and north of Lebel-sur-Quévillon; Lac Misamiko to the northeast of Lebel-sur-Quévillon; Rivière Bell to the west and southwest of Lebel-sur-Quévillon; Rivière Quévillon and Rivière Cuvillier to the south of Lebel-sur-Quévillon.[12]
10	Was there any natural or artificial fire break?	Natural fire break: Lac Quévillon[12] Artificial fire break: Artificial fire breaks,[2] Highway 113[6,13,14]
11	Did the Fire Service / Department report extreme fire behavior?	Not reported by the Fire Service/Department, but the fire spread very quickly: the first evacuation took place the day after the fire was discovered.[4]
12	Number of structures and infrastructures affected	Several secondary residences in Lebel-sur-Quévillon were destroyed.[10,11] However, the exact number is unclear.
13	Estimated direct and indirect economic damage	4,819.91 km^2 (481,991 ha) burned.[7] Insured loss unknown – however, heavy financial toll on residents due to loss of income and expenses (e.g., mortgage/rent).[15]
14	Did it occur in conjunction with multiple fires in the country?	Yes, the fire occurred in conjunction with multiple fires in Québec and elsewhere in Canada.[16]
15	Countries involved	Canada. Out-of-province and international firefighters (e.g., United States, Portugal, and South Korea).[7,17,18]
16	Brief timeline of key events	- June 1, 2023: Fire ignited near Lebel-sur-Quévillon.[4] - June 2, 2023 at 16:40 EDT: First evacuation order issued.[19,20] - June 4, 2023: Local state of emergency declared.[21] - June 18, 2023: First evacuation order lifted.[13] - June 22, 2023 at 15:30 EDT: Second evacuation order issued.[22] - July 1, 2023: Second evacuation order lifted.[23] - July 3, 2023: Fire classified as being held.[18] - July 6, 2023: Local state of emergency lifted.[24] - July 27, 2023: Fire classified as under control.[5]
17	Time of initial order to evacuate and locations	16:40 EDT, June 2, 2023, first evacuation order issued for Lebel-sur-Quévillon.[19,20] 15:30 EDT, June 22, 2023, second evacuation order issued for Lebel-sur-Quévillon.[22]
18	Time when evacuation was considered completed	June 18, 2023, first evacuation order lifted for Lebel-sur-Quévillon.[13] July 1, 2023, second evacuation order lifted for Lebel-sur-Quévillon and residents were permitted to return home.[23]
19	Deaths/Injuries	As of June 8, 2023, it did not appear that there were fatalities or serious injuries.[25] However, it is unclear whether there were any fatalities or injuries later in June and in July. A separate source reported that there were no fatalities directly linked to the 2023 fires in Québec.[2]

20	Number of people evacuated	Approximately 2,000 residents from Lebel-sur-Quévillon and surrounding areas (all residents were ordered to evacuate during both the first and second evacuations).[26]
21	Location people initially evacuated	Lebel-sur-Quévillon and surrounding areas.[26]
22	Reasons why people decided to evacuate	Residents were ordered to evacuate the area (evacuation order) as the fire was near the community.[27] Unclear whether there were other reasons why residents decided to evacuate.
23	Evacuation type	Private vehicles, buses, airplanes, ambulances.[6,22]
24	Any drill/education/instructions on large outdoor fires provided beforehand?	Additional data required
25	Personnel involved in rescue operations	Canadian Armed Forces,[28] police officers, Société de protection des forêts contre le feu (SOPFEU).[1,6]
26	Did the smoke hinder significantly the evacuation because of low visibility or health problems?	It does not appear that smoke significantly hindered the evacuation per se. However, there was dense smoke and smog and the air quality worsened significantly,[3] which impacted people's health, in several regions due to this fire.[29,30] One resident of Lebel-sur-Quévillon reported that the sky was orange and that it was windy during the evacuation.[6]
27	Possible causes of issues in management operations	Additional data required
28	References	**Academic:** 1 Société de protection des forêts contre le feu. (2023). *Rapport annuel 2023 : Une saison de tous les records*. https://sopfeu.qc.ca/publications/rapport-annuel-2023-une-saison-de-tous-les-records/ 2 Boulanger, Y., Arseneault, D., Bélisle, A. C., Bergeron, Y., Boucher, J., Boucher, Y., Danneyrolles, V., Erni, S., Gachon, P., Girardin, M. P., Grant, E., Grondin, P., Jetté, J.-P., Labadie, G., Leblond, M., Leduc, A., Puigdevall, J. P., St-Laurent, M.-H., Tremblay, J., & Waldron, K. (2024). The 2023 wildfire season in Québec: An overview of extreme conditions, impacts, lessons learned and considerations for the future. *Canadian Journal of Forest Research*. https://doi.org/10.1139/cjfr-2023-0298 3 Jain, P., Barber, Q. E., Taylor, S., Whitman, E., Acuna, D. C., Boulanger, Y., Chavardès, R. D., Chen, J., Englefield, P., Flannigan, M., Girardin, M. P., Hanes, C. C., Little, J., Morrison, K., Skakun, R. S., Thompson, D. K., Wang, X., Parisien, M.-A. (2024). Canada under fire – Drivers and impacts of the record-breaking 2023 wildfire season. *ESS Open Archive*. https://doi.org/10.22541/essoar.170914412.27504349/v1 **Other:** 4 https://www.lapresse.ca/actualites/regional/2023-06-22/lebel-sur-quevillon/ca-aurait-fait-boum.php 5 https://www.lsq.quebec/fr/nouvelles/10638-etat-de-situation-27-juillet-2023.html 6 https://www.lapresse.ca/actualites/regional/2023-06-03/incendie-de-foret-a-lebel-sur-quevillon/c-etait-surrealiste.php 7 https://sopfeu.qc.ca/communiques/bilan-de-la-saison-2023-une-saison-de-tous-les-records-pour-la-sopfeu/#:~:text=En%202023%2C%20le%20Qu%C3%A9bec%20a,481%20991%20ha%20de%20for%C3%AAt. 8 https://natural-resources.canada.ca/our-natural-resources/forests/sustainable-forest-management/measuring-and-reporting/forest-classification/13179 9 https://natural-resources.canada.ca/maps-tools-and-publications/maps/forest-maps/16874

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		11	https://www.tvanouvelles.ca/2023/06/30/des-chalets-brules-a-lebel-sur-quevillon
		12	https://vgo.portailcartographique.gouv.qc.ca/
		13	https://montrealgazette.com/news/local-news/smog-alert-issued-for-montreal-as-quebec-forest-fires-continue-to-burn
		14	https://www.lsq.quebec/fr/nouvelles/10576-etat-de-situation-mise-a-jour-du-13-juin-2023-18-30.html
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		18	https://www.lsq.quebec/fr/nouvelles/10614-etat-de-situation-3-juillet-2023.html
		19	https://www.facebook.com/photo.php?fbid=636947418478041&id=100064883640017&set=a.627944972711619
		20	https://ottawa.citynews.ca/2023/06/16/residents-of-quebec-town-emptied-two-weeks-ago-because-of-fire-to-return-home-sunday/
		21	https://www.publicationsduquebec.gouv.qc.ca/fileadmin/gazette/pdf_encrypte/lois_reglements/2023F/80355.pdf
		22	https://www.lsq.quebec/fr/nouvelles/10602-avis-d-evacuation-obligatoire-et-complete-22-juin-2023-a-15-h-30.html
		23	https://montrealgazette.com/news/local-news/despite-rain-and-reinforcements-fighting-quebec-forest-fires-remains-a-colossal-job
		24	https://www.lapresse.ca/actualites/regional/2023-07-07/incendies-de-foret/l-etat-d-urgence-leve-a-lebel-sur-quevillon.php
		25	https://www.journaldequebec.com/2023/06/08/feux-de-foret-intenses---exceptionnel-davoir-aucun-deces-signale-legault
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		27	https://www.cbc.ca/news/canada/montreal/quebec-forest-fire-evacuation-lebel-1.6885536
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Tantallon Wildfire 2023, NS, Canada

Note that some sources refer to the fire as "Tantallon fire" and others as "Upper Tantallon fire". This paper refers to the fire as "Tantallon fire" to remain consistent with the terminology used by local emergency services.

On May 28, 2023, a wildfire caused by an unextinguished fire in an outdoor patio fireplace was detected in Upper Tantallon, a region near Halifax in Nova Scotia. Due to hot and dry conditions, the fire spread quickly. Approximately an hour after the fire was detected, an evacuation order was issued for 16,400 residents in the Upper Tantallon/Hammonds Plains area and a local state of emergency was declared. Several residents reported poor visibility due to smoke during the evacuation. Several agencies were involved in firefighting and rescue operations. Despite its relatively short duration, the fire had significant structural and financial impacts. The fire burned approximately 9.5 km^2 (950 ha) and damaged or destroyed at least 200 properties, including 151 homes. The fire caused over $165 million in insured loss. A report noted some challenges during the fire, such as challenges with communication and confusion about different agencies' responsibilities.

Table 4. Details about the Tantallon Wildfire 2023, Canada

ID	Information sought	Information
1	Where?	Upper Tantallon, Nova Scotia, Canada
2	When?	May 28, 2023 – June 4, 2023 (fire listed as 100% contained)[3,4]

3	How was the fire started?	Unextinguished fire in a small outdoor patio fireplace[5]
4	Initial fire size (km^2)	Additional data required
5	Area affected (km^2)	9.5 km^2 (950 ha)[6]
6	Type(s) of forest involved in wildfire (Fuel type)	Acadian forest region: red spruce, balsam fir, yellow birch.[7] Softwoods and mixed woods, such as spruce, fir, hemlock, and white pine.[1]
7	WUI, urban, wildland or informal settlement fires?	WUI fire: forest burned and properties and homes in the Upper Tantallon/Hammonds Plains area were destroyed by the fire.[4]
8	Average weather conditions (temperature, wind, humidity, etc.)	No precipitation in late May and early June 2023, with temperatures around 30°C and wind gusts up to 40 km/h. Precipitation on June 2 and June 3, 2023.[8]
9	Geographical highlights (any particularities)	The Upper Tantallon/Hammonds Plains area is surrounded by forest and small lakes. St Margarets Bay to the southwest of Upper Tantallon.[9]
10	Was there any natural or artificial fire break?	Natural fire break: Some small lakes in the area.[9] Artificial fire break: Hammonds Plains Road, Highway 103.[9]
11	Did the Fire Service / Department report extreme fire behavior?	The Halifax Fire district chief reported that the fire was out of control and jumping roads. He also mentioned that the fire was spreading very quickly.[10]
12	Number of structures and infrastructures affected	At least 200 properties, including 151 homes were damaged or destroyed; thousands more residents without electricity.[11]
13	Estimated direct and indirect economic damage	9.5 km^2 (950 ha)[6] The Insurance Bureau of Canada (IBC) estimated the fire to have caused over $165 million in insured loss.[4]
14	Did it occur in conjunction with multiple fires in the country?	Yes, the fire occurred in conjunction with another fire in Nova Scotia and multiple fires elsewhere in Canada.[12]
15	Countries involved	Canada. Out-of-province[13] and international firefighters (e.g., United States).[14]
16	Brief timeline of key events	- May 28, 2023 at 15:28 ADT: Fire detected.[1] - May 28, 2023 at 16:27 ADT: Evacuation order issued.[1] - May 28, 2023 at 23:00 ADT: Local state of emergency declared.[15] - June 1, 2023: Provincial state of emergency declared.[16] - June 4, 2023: Evacuation complete (last evacuation order lifted).[17] - June 4, 2023 at 10:30 ADT: Fire listed as 100% contained.[18] The report "*Upper Tantallon wildfire: After-action report*" provides a detailed timeline of key events on pages 5-6.[1]
17	Time of initial order to evacuate and locations	15:28 ADT, May 28, 2023, evacuation order issued for several subdivisions in the Upper Tantallon/Hammonds Plains area.[15]
18	Time when evacuation was considered completed	16:00 ADT, June 4, 2023, evacuation order lifted.[18]
19	Deaths/Injuries	As of May 29, 2023, there were no injuries or fatalities.[15] It does not appear that there were any injuries or fatalities due to the fire following May 29, 2023.[17]
20	Number of people evacuated	Approximately 16,400 residents.[11]
21	Location people initially evacuated	Several subdivisions in the Upper Tantallon/Hammonds Plains area.[15]
22	Reasons why people decided to evacuate	The fire was near the community. One resident reported seeing flames outside her home (before an evacuation alert or evacuation order was issued), which prompted her to evacuate.[20] An evacuation order was issued soon afterwards.[1] Unclear whether there were other reasons why residents decided to evacuate.
23	Evacuation type	Private vehicles and buses[1,21]
24	Any drill/education/instructions on large outdoor fires provided beforehand?	Additional data required
25	Personnel involved in rescue operations	Canadian Armed Forces,[22] Department of National Defence (DND),[13] Royal Canadian Mounted Police (RCMP), Halifax Search and Rescue volunteers,

		Halifax Regional Police officers, Halifax Regional Fire and Emergency employees.[23]
26	Did the smoke hinder significantly the evacuation because of low visibility or health problems?	Yes, one resident reported that they had to take an alternative evacuation route due to the smoke and flames.[15] Several other residents reported poor visibility due to smoke.[11,24]
27	Possible causes of issues in management operations	Some challenges with communication and confusion about different agencies' responsibilities. Lack of follow-up after community meetings. Delay in dissemination of evacuation alerts. Maps were often ambiguous. Some residents felt unsupported during the evacuation. The report "*Upper Tantallon wildfire: After-action report*" includes additional details on pages 10-11.[1] A separate report published in 2024 (addressing several wildfires in Nova Scotia, not only the Tantallon wildfire) made some recommendations, such as increasing training and exercises for staff and firefighters and improving information management.[2] Not an issue in management operations, but a councilor has been advocating for additional emergency exits to be built following the wildfire.[25]
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Behchokǫ̀-Yellowknife Wildfire 2023, NT, Canada

In late June 2023, a wildfire ignited to the north of Behchokǫ̀ and Yellowknife in the Northwest Territories. Due to hot, dry, and windy conditions, the fire spread rapidly towards both areas. On July 24, 2023, an evacuation order was issued for Behchokǫ̀ and surrounding areas. On August 15, 2023, an evacuation order was issued for Yellowknife and surrounding areas. In total, approximately 20,000 residents and nearby First Nations communities evacuated. Residents were evacuated via private vehicles and emergency evacuation flights. Several agencies were involved in firefighting and rescue operations. The fire burned approximately 1,670 km^2 (167,000 ha) and caused over $30 million in insured loss. The fire jumped natural and artificial fire breaks and destroyed several cabins and homes in the Behchokǫ̀ and Rae areas. In addition, air quality was poor during the fire and residents experienced prolonged exposure to smoke. Some residents expressed concerns about the management of the 2023 wildfires in the Northwest Territories and requested an independent and public inquiry.

Table 5. Details about the Behchokǫ̀-Yellowknife Wildfire 2023, Canada

ID	Information sought	Information
1	Where?	Behchokǫ̀-Yellowknife, Northwest Territories, Canada
2	When?	June 28, 2023 – August 28, 2023 (fire listed as being held)[2,3]
3	How was the fire started?	Lightning[2]
4	Initial fire size (km^2)	Additional data required
5	Area affected (km^2)	Around August 21, 2023, the fire was estimated to be 1,670 km^2 (167,000 ha).[4]
6	Type(s) of forest involved in wildfire (Fuel type)	Boreal forest region: white spruce, black spruce, balsam fir, jack pine, white birch, trembling aspen, tamarack, willow.[5]
7	WUI, urban, wildland or informal settlement fires?	WUI fire: forest burned and homes were destroyed by the fire.[2]
8	Average weather conditions (temperature, wind, humidity, etc.)	Temperatures between 19°C and 30°C (on most days) and little to no precipitation in June, July, and August, 2023. Maximum wind gusts between 30 km/h and 50 km/h in June, July, and August, 2023. Several data points are missing at the end of August, 2023.[6]
9	Geographical highlights (any particularities)	Behchokǫ̀ and Yellowknife surrounded by several lakes. Great Slave Lake to the south of Behchokǫ̀ and Yellowknife. Marian Lake and Russell Lake to the north and west of Behchokǫ̀.[7]
10	Was there any natural or artificial fire break?	Natural fire break: Several lakes in the area.[7] Artificial fire break: Fire break, sprinklers, water cannons.[8,9,10]
11	Did the Fire Service / Department report extreme fire behavior?	The Fire Service did not directly report extreme fire behavior, but the Government of Northwest Territories reported extreme fire behavior due to high temperatures, strong winds, and very dry conditions.[11,12]
12	Number of structures and infrastructures affected	Fifteen cabins destroyed in Behchokǫ̀ area.[2] Four homes destroyed in the Rae area.[3] The fire caused a fibre line outage.[13]

13	Estimated direct and indirect economic damage	1,670 km^2 (167,000 ha).[4] The Insurance Bureau of Canada (IBC) estimated the fire to have caused over $30 million in insured loss.[3]
14	Did it occur in conjunction with multiple fires in the country?	Yes, the fire occurred in conjunction with multiple fires in the Northwest Territories (Hay River) and elsewhere in Canada.[14]
15	Countries involved	Canada. Out-of-province (Ontario, Alberta) and international firefighters (South Africa).[9]
16	Brief timeline of key events	- June 28, 2023: Fire detected.[2] - July 24, 2023 around 20:00 MDT: Evacuation order issued for Behchokǫ̀ and surrounding areas.[15,16] - August 14, 2023 at 18:00 MDT: Local state of emergency declared.[17] - August 15, 2023: Territorial state of emergency declared.[18] - August 16, 2023 around 19:30 MDT: Evacuation order issued for Yellowknife and surrounding areas.[19,20] - August 28, 2023: Fire listed as being held.[3] - September 6, 2023: Evacuation order lifted for Yellowknife and surrounding areas.[13] - September 20, 2023 at 17:00 MDT: Evacuation complete (last evacuation alert lifted).[21] - October 2, 2023: Territorial state of emergency lifted.[21,22]
17	Time of initial order to evacuate and locations	Around 20:00 MDT, July 24, 2023, evacuation order issued for Behchokǫ̀ and surrounding areas.[15,16] Around 19:30 MDT, August 16, 2023, evacuation order issued for Yellowknife and surrounding areas.[20,23]
18	Time when evacuation was considered completed	September 6, 2023, Evacuation order lifted for Yellowknife and surrounding areas.[13] 17:00 MDT, September 20, 2023, Last evacuation alert lifted.[24]
19	Deaths/Injuries	As of August 17, 2023, there were no reports of injuries or fatalities due to the fire.[8]
20	Number of people evacuated	Approximately 20,000 residents and nearby First Nations communities.[18]
21	Location people initially evacuated	Behchokǫ̀ and surrounding areas on July 24, 2023; Yellowknife and surrounding areas on August 16, 2023.
22	Reasons why people decided to evacuate	Residents were ordered to evacuate the area (evacuation order) as the fire was near the community.[25] Unclear whether there were other reasons why residents decided to evacuate.
23	Evacuation type	Private vehicles and emergency evacuation flights.[26,27]
24	Any drill/education/instructions on large outdoor fires provided beforehand?	Additional data required – however, in a report published in 2019, the City of Yellowknife recommended to "Develop and deliver a focused, repetitive, long-term FireSmart education and awareness program […]" (pp. 27-28).[28] It is unclear whether this recommendation has been implemented.
25	Personnel involved in rescue operations	Royal Canadian Mounted Police (RCMP)[29,30], Canadian Armed Forces,[8] Northwest Territories wildfire management teams.[31,32]
26	Did the smoke hinder significantly the evacuation because of low visibility or health problems?	There was heavy smoke due to the fire – however, it is unclear whether low visibility significantly hindered the evacuation.[25] In addition, air quality was poor during the fire and residents experienced prolonged exposure to smoke.[33] In September 2023, it was estimated that the 2023 wildfires in the Northwest Territories released over 110 megatonnes of carbon.[34]
27	Possible causes of issues in management operations	Some residents expressed concerns about the management of the 2023 wildfires (including evacuations) in the Northwest Territories and requested an independent and public inquiry.[35] The governments were not prepared for a severe fire season; some issues with communication.[13] The City of Yellowknife launched an online survey to collect feedback from residents

		on the municipality's response to the 2023 wildfire season and organized a public engagement session for residents to provide feedback in-person. The City has hired KPMG to conduct an after-action assessment to help prepare for future events.[36,37,38,39]
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DISCUSSION

The five wildfires presented here had significant structural and financial impacts on communities and displaced large number of people during the evacuations. Together, the fires damaged or destroyed hundreds of homes and businesses and left thousands of residents without electricity. The fires also cost hundreds of millions of dollars in total and led to the evacuation of thousands of residents. Two firefighters sustained injuries while helping to the fight the fires. However, there did not appear to be any other injuries or fatalities. In most cases, lightning ignited the fires and dry, hot, and windy conditions contributed to their rapid spread. Many of the fires occurred in the boreal forest region and burned hundreds of square kilometers.

Several common themes emerged from the case studies. For instance, communities faced several challenges during the wildfire evacuations, the most notable being communication challenges, particularly when multiple agencies were involved in the wildfire response. After-action reports and media articles also suggested that communication challenges occurred between authorities and evacuees. For instance, some evacuees reported receiving little or no notice prior to the evacuation. In addition, some evacuees expressed concerns or frustration with the management of the evacuation, such as finding accommodations. Longer evacuations also put a financial strain on evacuees due to unexpected expenses and loss of income. Many residents also felt like there was a lack of support for evacuees. Most communities evacuated via private vehicles. However, the rapid evacuation of remote and isolated communities is challenging and residents must sometimes be evacuated by air, such as during the Behchokǫ̀-Yellowknife wildfire in the Northwest Territories. The design of a road network in a community (e.g., number of exits) can also impact an evacuation.

Information systems in crisis response could address several challenges identified in the case studies. For example, mobile applications or web-based interfaces might enhance communication and coordination between emergency management agencies and the public (e.g., Grunwald et al., 2024). In addition, analyzing social media data could reveal patterns in information dissemination and topics of discussion during wildfires (e.g., Li et al., 2021; Wang et al., 2016). Future research could explore effective notification and communication strategies, particularly in communities with higher proportions of vulnerable populations, who may struggle with digital tools, or in remote areas with limited cellular or internet access. Furthermore, fire activity forecasting using machine learning (e.g.,

Di Giuseppe et al., 2025) and evacuation modelling (e.g., Wahlqvist et al., 2021) could support planning and decision-making for evacuations. While technology offers many benefits, it is important to consider how different stakeholders perceive and accept these tools, as their perceptions could impact the effectiveness of technology-based solutions.

The authors were unable to retrieve information on community education programs on wildfires and specific risk mitigation actions performed by communities prior to the wildfire. It is unclear whether this information is not publicly available or communities do not currently offer these types of programs. Some programs are available nationally, such as FireSmart programs (FireSmart Canada, 2024) and the Wildfire Resilient Futures Initiative (Government of Canada, 2024). However, financial, logistical, and physical barriers can negatively impact the adoption of risk mitigations programs (e.g., it can be physically difficult for older adults to complete mitigations, Cowan & Kennedy, 2023; York University, 2023). At the provincial level, the Government of British Columbia is developing a new wildfire training and education center at Thompson Rivers University (Government of British Columbia, 2024). Community wildfire evacuation drills can also help improve community preparedness (e.g., the drill in Roxborough Park, Colorado, United States, Gwynne et al., 2023). However, to the authors' knowledge, no communities in Canada have yet organized a wildfire evacuation drill.

One limitation is that the paper only included five case studies, which are not representative of all wildfire evacuations in Canada. A larger database of case studies would allow to perform a more in-depth analysis and make recommendations (e.g., Ronchi et al., 2021; Wang et al., 2022). In addition, documenting and corroborating information on wildfire complexes (i.e., individual fires located in a similar area and grouped for management purposes, CIFFC, 2024; Forthofer, 2020), such as the Pembina Wildfire Complex in Alberta, can be challenging as the situation can evolve rapidly, and individual fires are added or removed from the complex. Furthermore, case studies might not be appropriate to investigate some aspects of wildfire evacuations, such as decision-making. Self-report methods are better suited to understand residents' thought process and decision-making, such as surveys (e.g., Kuligowski et al., 2022; Wong et al., 2023) and interviews (e.g., McGee et al., 2019; McCaffrey et al., 2019). There are also several other limitations to the approach chosen. The present work relied on publicly available information that was retrieved from web searches. It is possible that more detailed information has been recorded that was either not accessible or missed. In addition, geographical highlights and natural fire breaks were identified by visually inspecting the area of interest on the relevant map. This approach is subjective and some fire breaks might be easier to identify than others. Future work could collect a larger sample of case studies and examine aspects of wildfire evacuations where additional data are required, such as whether smoke hindered the evacuation.

ACKNOWLEDGMENTS

The template used to document the case studies in this paper is from Ronchi et al. (2021). This research was supported by the National Research Council of Canada through the RACE Wildfires project.

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