Executive Summary

The 2018-2020 air zone reporting period is the first to apply the 2020 Canadian Ambient Air Quality Standards (CAAQS) for fine particulate matter and ozone, and the first to include nitrogen dioxide and sulphur dioxide. In this report, the Northeast Air Zone is assigned "yellow" management levels for fine particulate matter ($PM_{2.5}$), ozone, and sulphur dioxide (SO_2), and assigned "orange" management level for nitrogen dioxide (NO_2). It achieved the 2020 CAAQS for all four pollutants.

Table 1. Management levels in the Northeast Air Zone based on the 2018-2020 air zone reporting period**.**

Air Zone	$PM_{2.5}$	Ozone	NO_2	SO_2
Northeast	Yellow	Yellow	Orange	Yellow

Introduction

This is the sixth annual air zone report for the Northeast Air Zone. Air zone reporting is a commitment under the national Air Quality Management System (AQMS). This report describes achievement of the Canadian Ambient Air Quality Standards (CAAQS) for fine particulate matter ($PM_{2.5}$), ground-level ozone (O_3), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2), the associated management levels and recent actions to improve air quality.

Air Quality Management System

The AQMS is the comprehensive and collaborative approach of managing air quality by federal, provincial, and territorial governments in Canada. Under the AQMS, the CAAQS are developed to drive actions to protect human health and the environment based on the principles of continuous improvement and keeping clean areas clean. Air zones are defined under the AQMS as areas with similar air quality characteristics, issues, and trends, and serve as the basis for monitoring, reporting, and actions to improve air quality. Under the AQMS, progressively more rigorous actions are expected as air quality approaches or exceeds the CAAQS. The level of action is guided by the Air Zone Management Framework (Table 2).

Table 2. AQMS management levels and objectives for air pollutants based on the 2020 CAAQS.

Management Level	Objectives	$PM_{2.5}$		Ozone	NO_2		SO_2	
		Annual ($\mu g/m^3$)	24-hour ($\mu g/m^3$)	8-hour (ppb)	Annual (ppb)	1-hour (ppb)	Annual (ppb)	1-hour (ppb)
Red	Achieve CAAQS	>8.8	>27	>62	>17.0	>60	>5.0	>70
Orange	Prevent CAAQS Exceedance	>6.4 and ≤8.8	>19 and ≤27	>56 and ≤62	>7.0 and ≤17.0	>31 and ≤60	>3.0 and ≤5.0	>50 and ≤70
Yellow	Prevent Air Quality Deterioration	>4.0 and ≤6.4	>10 and ≤19	>50 and ≤56	>2.0 and ≤7.0	>20 and ≤31	>2.0 and ≤3.0	>30 and ≤50
Green	Keep Clean Areas Clean	≤4.0	≤10	≤50	≤2.0	≤20	≤2.0	≤30

Northeast Air Zone

The Northeast Air Zone (see Figure 1) is one of seven broad air zones across B.C. It is located in the northeast region of the province bordering the Rocky Mountains to the west, Alberta to the east, and Yukon and the Northwest Territories to the north The Northeast Air Zone includes the cities and communities in the Peace River Regional District including Fort St. John, Dawson Creek, Fort Nelson, the Districts of Chetwynd, Tumbler Ridge, Taylor, and Hudson's Hope, the Village of Pouce Coupe; and the Treaty 8 First Nations communities of Blueberry River, Doig River, Halfway River, Prophet River, Saulteau, West Moberly and McLeod Lake. The largest population centre, Fort St. John, is home to the Ministry-operated air quality monitoring station. Other monitoring stations in the air zone are operated to monitor industrial activities such as oil and gas, and forestry products processing.

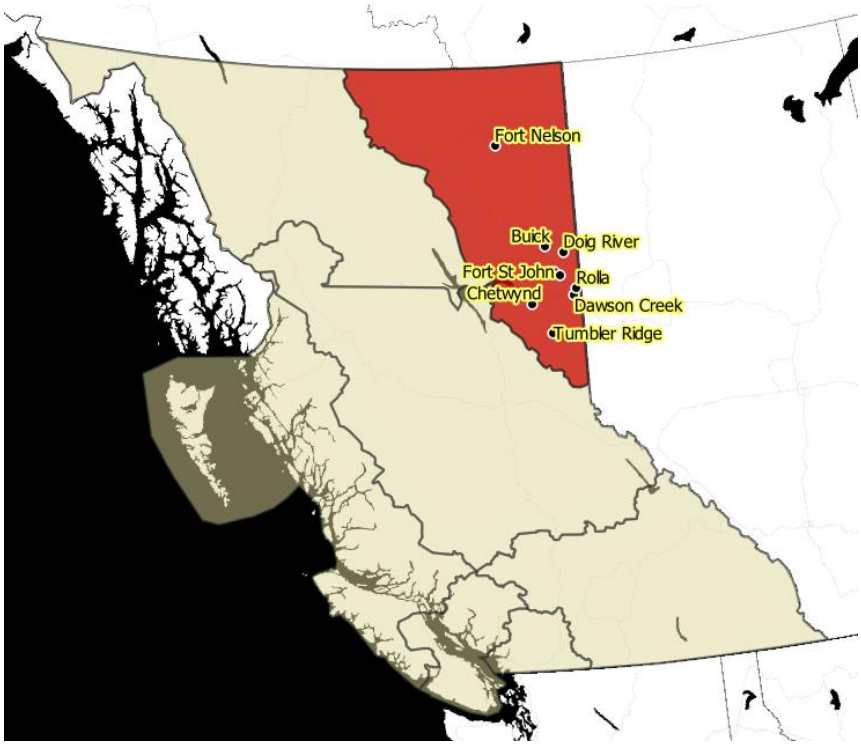


Figure 1. Map of B.C. highlighting the Northeast Air Zone and its major population centres.

$PM_{2.5}$ Levels

$PM_{2.5}$ or fine particulate matter refers to inhalable particles that are smaller than or equal to 2.5 microns (µm) in diameter. These particles when inhaled, travels deep into the lungs and the bloodstream, and can cause adverse health effects like cardiovascular and respiratory diseases. $PM_{2.5}$ is considered a non-threshold pollutant, that is, there are no safe limits for exposure.

Air zone reporting of $PM_{2.5}$ summarizes the 24-hour[1] and annual[2] metrics to estimate the short-term and long-term exposures of the pollutant, respectively. In the 2018-2020 reporting period, the monitoring station at Fort St. John Key Learning Centre (referred to here as Fort St. John) has enough data to report CAAQS metrics for the 2018-2020 reporting period. These metrics are based on two of the three years required since Fort St. John did not have enough data in 2019.

A 24-hour metric of 32 µg/m^3 was reported from Fort St. John, which exceeds the national 2020 CAAQS of 27 µg/m^3 for this metric (Figure 2). When adjusted for the influence from wildfire smoke following the methodology for transboundary flow exceptional event (TF/EE) adjustments, the 24-hour metric decreases to 18 µg/m^3 for the 24-hour and achieves the standard.

An annual metric of 7.0 µg/m^3 was also reported from Fort St. John, achieving the 2020 CAAQS of 8.8 µg/m^3 for this metric. When adjusted for wildfire smoke, the annual metric decreases to 5.8 µg/m^3.

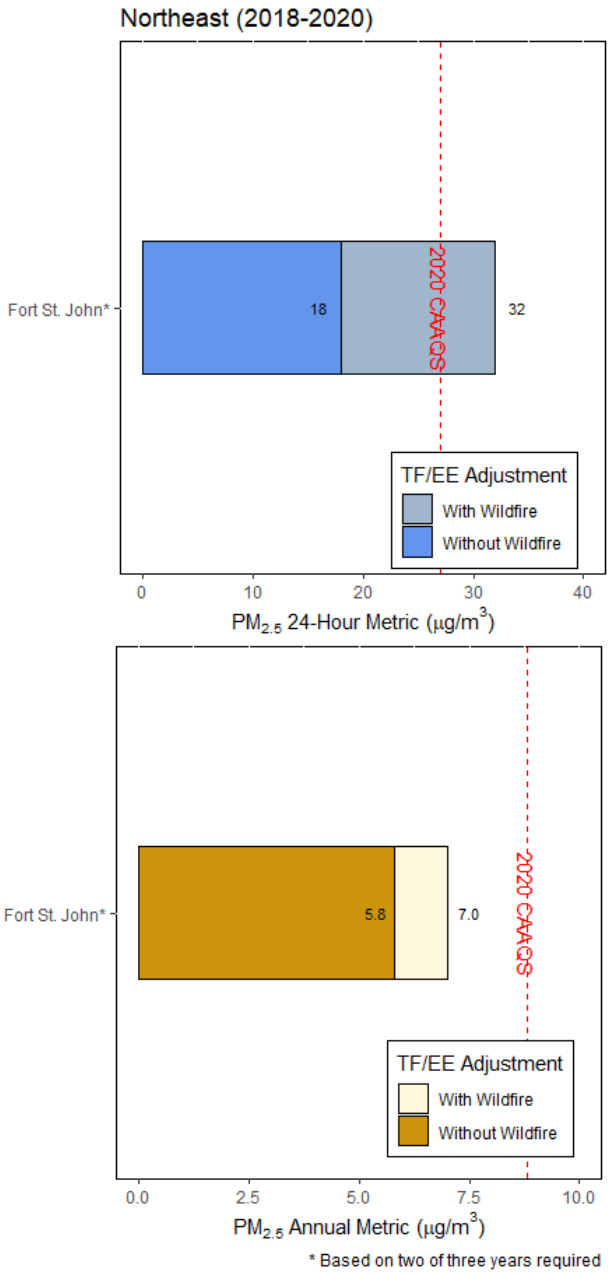


Figure 2. $PM_{2.5}$ concentrations in the Northeast Air Zone. Upper plot based on 24-hour concentration (annual 98th percentile, averaged over 2018-2020). Lower plot based on annual mean concentration (averaged over 2018-2020). The red dashed lines identify the 2020 CAAQS of 27 µg/m^3 (upper plot) and 8.8 µg/m^3 (lower plot).

[1] $PM_{2.5}$ 24-hour metric are based on the annual 98th percentile of the 24-hour value, averaged over three years (2018-2020).

[2] $PM_{2.5}$ annual metric are based on the annual average of 24-hour values, averaged over three years (2018-2020).

Figure 3 shows the wildfire adjusted levels and trends of the 24-hour and annual metric from Fort St. John in the Northeast Air Zone. The figure features the 2015 and 2020 CAAQS and the reporting period where these standards apply. Figure also shows the recommended management levels based on either metrics. Table 2 shows the AQMS management at Fort St. John and the entire air zone.

The Northeast Air Zone had been under "yellow" management level since the 2015-2017 period. In this 2018-2020 reporting period, the Northeast Air Zone remains under "yellow" management level based on the metrics at Fort St. John. Under a "yellow" management level, the more stringent 2020 CAAQS for $PM_{2.5}$ are achieved but air quality management actions for $PM_{2.5}$ are recommended to prevent the deterioration of air quality.

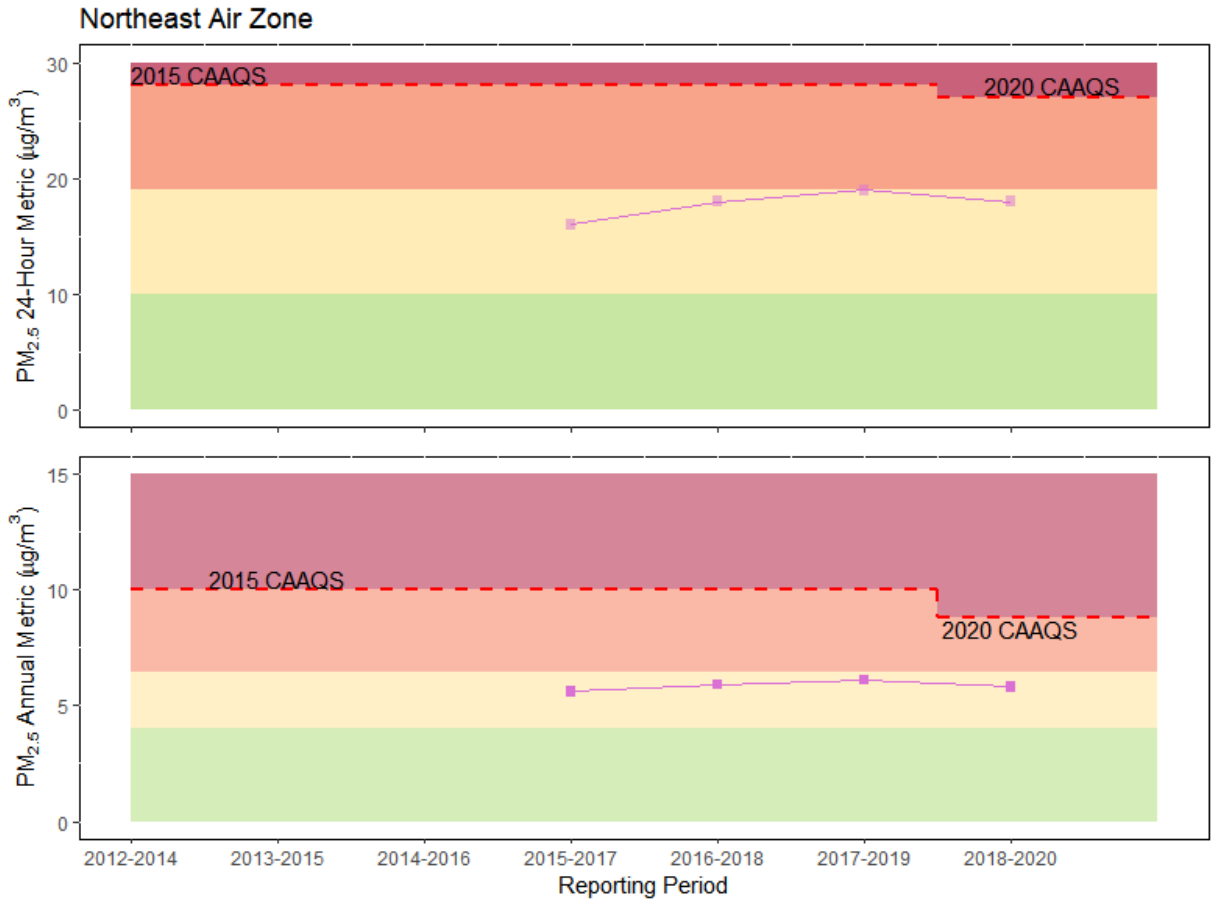


Figure 3. Wildfire-adjusted trends in the 24-hour and annual metrics of $PM_{2.5}$ at Fort St. John throughout the 2015-2017 until the 2018-2020 periods. The red dashed lines and background colours define the applicable CAAQS and AQMS management levels based on the metric.

Table 2. Summary of $PM_{2.5}$ metrics (shown below in 24-hour/annual metrics) and air zone management levels for the Northeast Air Zone.

	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020
NORTHEAST (CAAQS)				YELLOW	YELLOW	YELLOW	**YELLOW**
Fort St. John				16/5.6	18/5.9	19/6.1	18/5.8

Management Goals for $PM_{2.5}$ based on the Air Quality Management System

Achieve CAAQS	Prevent CAAQS Exceedance	Prevent Air Quality Deterioration	Keep Clean Areas Clean	Not Available

Ozone Levels

Ground-level ozone is a colourless and irritating gaseous pollutant. It forms just above the earth's surface through chemical reactions between "ozone precursor" emissions. Unlike naturally occurring ozone in the ozone layer, ground-level ozone can be harmful to people, animals, and plants.

Figure 4 summarizes ozone levels in the Northeast Air Zone for the 2018-2020 reporting period. Concentrations based on the 8-hour metrics[3] from three reporting stations are comparable, with measurements varying narrowly between 51-52 parts per billion (ppb). At these levels, the 2020 CAAQS for ozone are achieved.

Annual trends and associated AQMS management levels in the ozone metric are presented in Figure 5 and summarized in Table 3. All the CAAQS - reporting stations for ozone in the

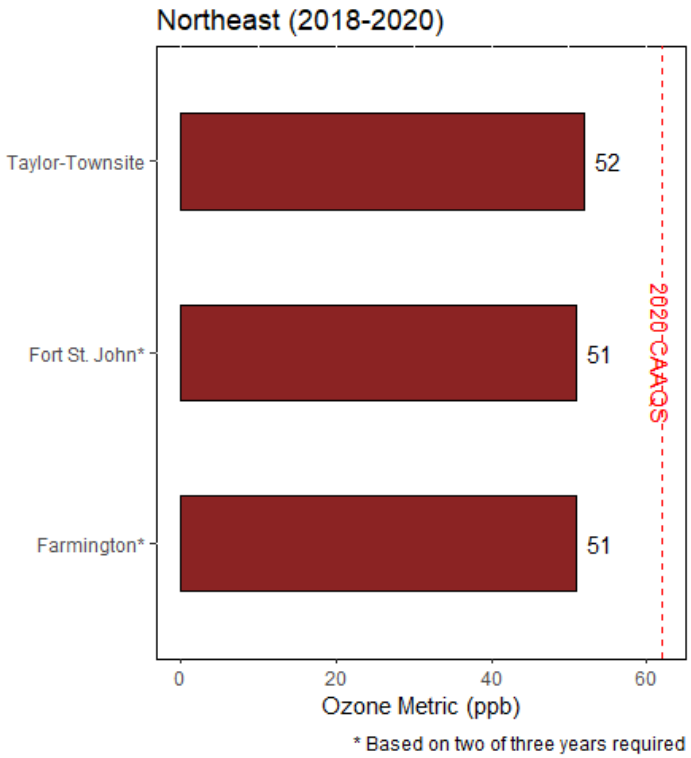


Figure 4. Ozone concentration in the Northeast Air Zone based on the annual 4th highest daily 8-hour maximums averaged over 2018-2020. Red dashed line identifies the 2020 CAAQS of 62 ppb.

[3] Ozone 8-hour metric are based on the 4th highest daily 8-hour maximum, averaged over three years (2018-2020).

Northeast Air Zone measured within 50-54 ppb throughout their reporting periods. This means levels are within “green” or “yellow” management levels. As a result, the Northeast Air Zone has been and still remains under “yellow” management level for ozone. A “yellow” management level indicates that any ozone-related actions should focus on preventing further air quality deterioration.

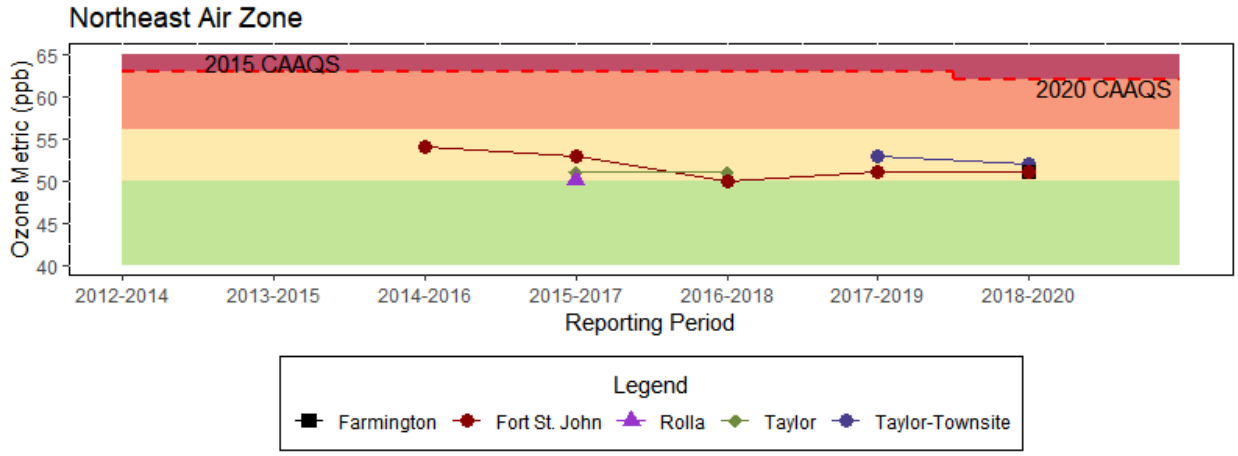


Figure 5. Trends in ozone concentrations based on the annual 4th highest daily 8-hour maximums averaged over three consecutive years. Red dashed line identifies the 2015 and 2020 CAAQS on the reporting period where it applies**.** Background colour shows management levels for the metric.

Table 3. Summary of ozone metrics and air zone management levels for the Northeast Air Zone.

	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	**2018-2020**
NORTHEAST (CAAQS)			YELLOW (2015)	YELLOW (2015)	YELLOW (2015)	YELLOW (2015)	**YELLOW (2020)**
Farmington							51
Fort St. John			54	53	50	51	51
Rolla				50			
Taylor				51	51		
Taylor-Townsite						53	52

Management Goals for Ozone based on the Air Quality Management System

Achieve CAAQS	Prevent CAAQS Exceedance	Prevent Air Quality Deterioration	Keep Clean Areas Clean	Not Available

Nitrogen Dioxide Levels

Nitrogen Dioxide (NO_2) is a gaseous pollutant formed along with other nitrogen oxides (NO_x) during the high temperature combustion of fossil fuels. It plays a major role in atmospheric reactions that form ground-level ozone and smog. There are three locations in the Northeast Air Zone that are equipped to report NO_2 for the 2018-2020 CAAQS-reporting period. These measurements are summarized in Figure 6 showing 1-hour metric ranging widely from 22 ppb at Farmington to 49.8 ppb at Fort St. John, and annual metric ranging from 2.1 ppb at Farmington to 5.9 ppb at Fort St. John. These are below the 2020 CAAQS of 60 ppb for the 1-hour metric[4], and 17 ppb for the annual metric.

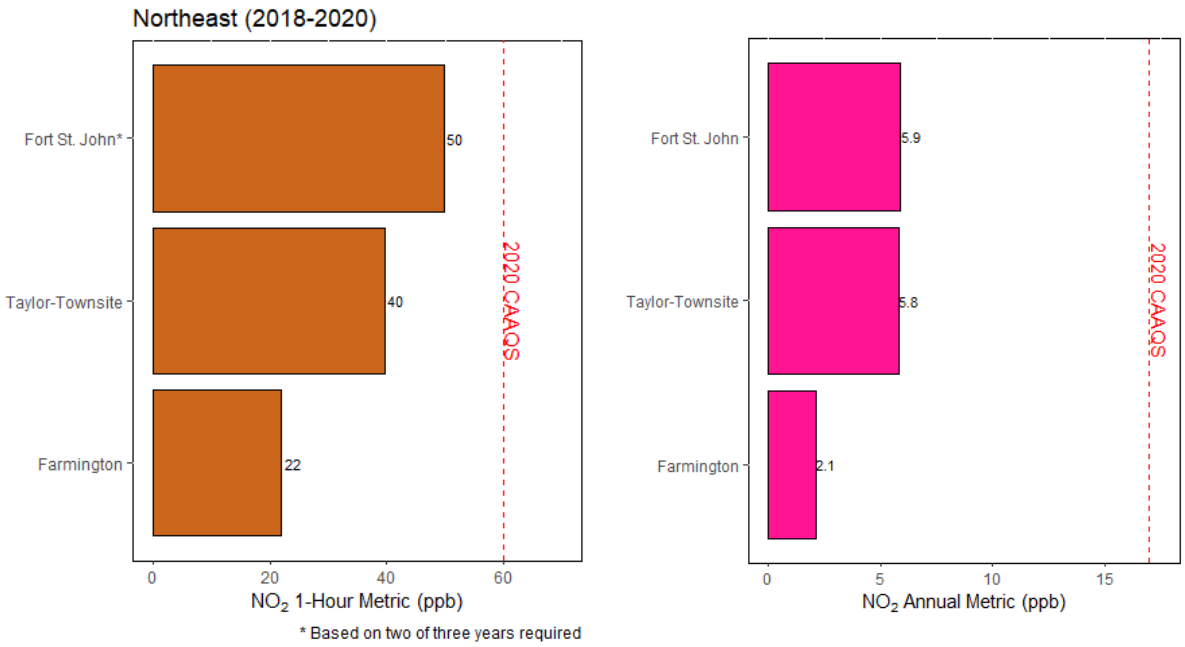


Figure 6. NO_2 concentrations in the Northeast Air Zone based on the 1-hour (left) and annual (right) metrics. The red dashed lines identify the 2020 CAAQS of 60 ppb for the 1-hour metric, and 17 ppb for the annual metric.

Figure 7 and Table 4 contains summary of NO_2 metrics, CAAQS achievement, and management levels. Reporting periods from 2015-2017 to 2018-2020 are all included to illustrate annual trends even though 2020 CAAQS for NO_2 are not implemented before the 2018-2020 reporting period. There were no TF/EE adjustments to the NO_2 metrics because influence from wildfire events were not observed. In the Northeast Air Zone, Taylor-Townsite and Fort St. John had been reporting "orange" levels for NO_2 while Farmington reports yellow throughout the recent two to three reporting periods.

[4] NO_2 1-hour metrics are based on the 98th percentile of daily 1-hour maximum over three consecutive years (2018-2020).

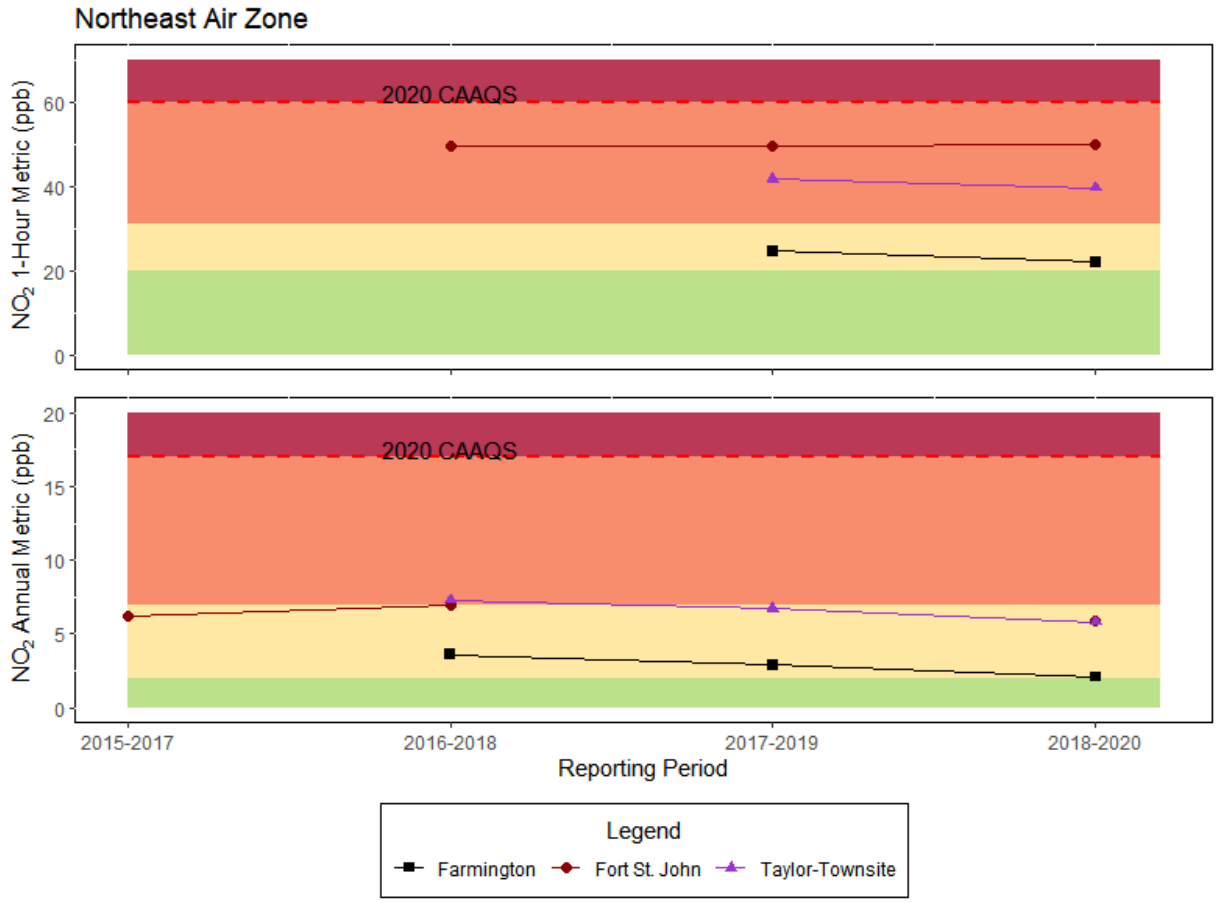


Figure 7. Trends in the 1-hour and annual metrics of NO_2 in the Northeast Air Zone. The 2020 CAAQS for NO_2 (red dashed lines) only applies during the 2018-2020 reporting period but presented throughout all reporting periods to visualize trends. The background colour shows the AQMS management levels.

Overall, the Northeast Air Zone is assigned an “orange” management level for the 2018-2020 reporting period based on measurements at Fort St. John. This means actions are recommended to prevent future exceedance of CAAQS. To improve to the “yellow” management levels, the NO_2 levels will have to reduce below 31 ppb for the 1-hour metric and remain under 7 ppb for the annual metric.

Table 4. Summary of NO_2 metrics and air zone management levels for the Northeast Air Zone.

	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020
NORTHEAST (CAAQS)	2020 CAAQS for NO_2 not applicable before 2018-2020 period. Data shown for illustration only.						**ORANGE (2020)**
Farmington					-/3.6	25/2.9	22/2.1
Fort St. John				-/6.2	50/7	50/-	50/5.9
Rolla			-/2.1	19/1.8			
Taylor				-/3.4			
Taylor-Townsite					-/7.3	42/6.7	40/5.8

Management Goals for NO_2 based on the Air Quality Management System

Achieve CAAQS	Prevent CAAQS Exceedance	Prevent Air Quality Deterioration	Keep Clean Areas Clean	Not Available

Sulphur Dioxide Levels

Sulphur dioxide (SO_2) is a toxic gas produced from volcanic eruptions, use of sulphur-bearing fossil fuels, and industrial emissions. Aside from toxicity, SO_2 can also form secondary fine particulate matter and acid rain.

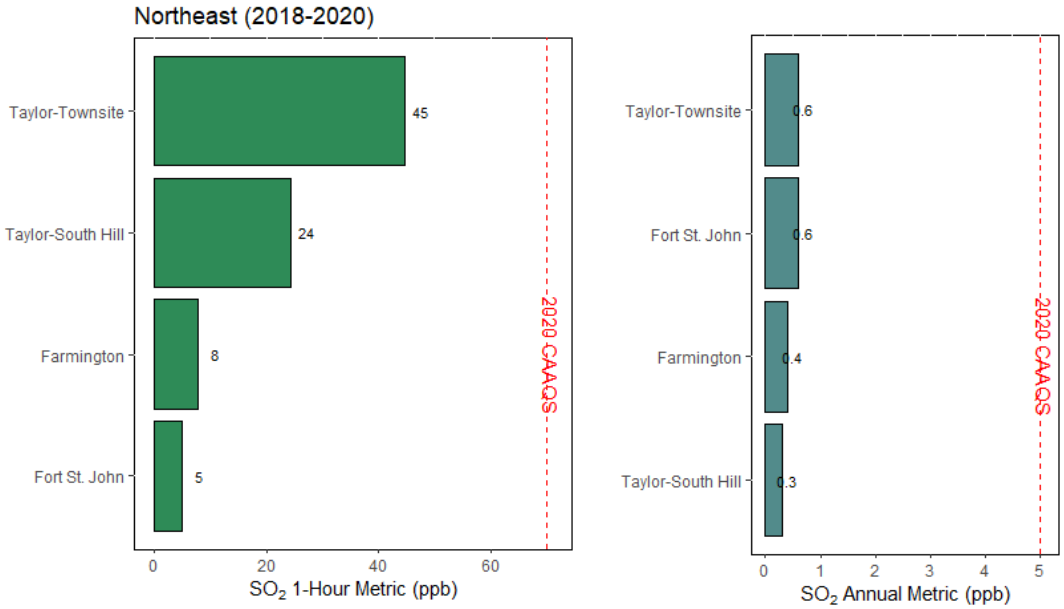


Figure 8. SO_2 concentrations in the Northeast Air Zone based on the 1-hour (left) and annual (right) metrics. The red dashed lines identify the 2020 CAAQS of 70 ppb for the 1-hour metric, and 5ppb for the annual metric.

There are several stations in the Northeast Air Zone that are equipped to measure SO_2. Some are located inside plant boundaries to monitor industrial emissions, but only those near populated areas or sensitive ecosystems are used for CAAQS reporting[5]. Stations reporting CAAQS for the 2018-2020 period are summarized in Figure 8. The figure shows 1-hour metric in the Northeast Air Zone varies widely from 5 ppb at Fort St. John to 44.6 ppb at Taylor-Townsite. These are well below the 70 ppb defined for the 2020 CAAQS for NO_2 for the 1-hour standard. For the annual metric, all four Northeast locations are less than 1 ppb, far below the national standard of 5 ppb.

The 2018-2020 air zone report is the first to implement the 2020 CAAQS and include SO_2. The assessment for CAAQS achievement of SO_2 and assignment of management levels on earlier reporting periods are not required but presented in Figure 9 and Table 5 to illustrate trends.

Table 5. Summary of SO_2 metrics and air zone management levels for the Northeast Air Zone.

	2012-2014	2013-2015	2014-2016	2015-2017	2016-2018	2017-2019	2018-2020
NORTHEAST (CAAQS)	2020 CAAQS for SO_2 not applicable before 2018-2020 period. Data shown for illustration only.						**YELLOW (2020)**
Bessborough 237 Road			-/0.6	7/0.4	7/0.4	12/0.4	22/0.5
Doig River Cultural Centre	-/0.1	3/0.1					
Farmington	-/0.4	5/0.3	5/-		-/0.3	9/0.3	8/0.4
Fort St. John				-/0.3	5/0.3	5/0.3	5/0.6
Pine River Hasler	9/0.2	7/0.2	6/0.3	5/0.2	6/0.2	5/0.2	5/0.4
Taylor			-/0.3	21/0.5	21/-		
Taylor-South Hill	23/0.7	18/0.5	15/0.3	14/0.3	22/0.4	28/0.4	24/0.3
Taylor-Townsite	59/-	52/1.1	39/0.7	39/0.7	37/0.9	47/1	45/0.6
Tomslake 197 Rd East	-/0.4	-/0.3					

Management Goals for SO_2 based on the Air Quality Management System

Achieve CAAQS	Prevent CAAQS Exceedance	Prevent Air Quality Deterioration	Keep Clean Areas Clean	Achieve CAAQS

[5] See: https://www.ccme.ca/en/res/gdadforcaaqsfornitrogendioxide_en1.0.pdf

Table 5 summarized the management levels for SO_2. The CAAQS for SO_2 are first implemented in this 2018-2020 reporting period. The assignment of management levels on previous periods are not required but are presented in the table for the purposes of trend analysis and comparisons. Throughout 2012-2014 reporting period until 2018-2020, all the non-fenceline sites in the Northeast reported the least stringent or "green" management levels for SO_2. However, Taylor-Townsite has been reporting the highest SO_2 metrics in the air zone and will be the basis for assigning the management level for the entire Northeast Air Zone. Overall, the Northeast Air Zone is assigned "yellow" management level based on the metrics at Taylor-Townsite. A "yellow" management level means that the air zone achieved the 2020 CAAQS for SO_2 but actions are recommended to prevent the deterioration of air quality.

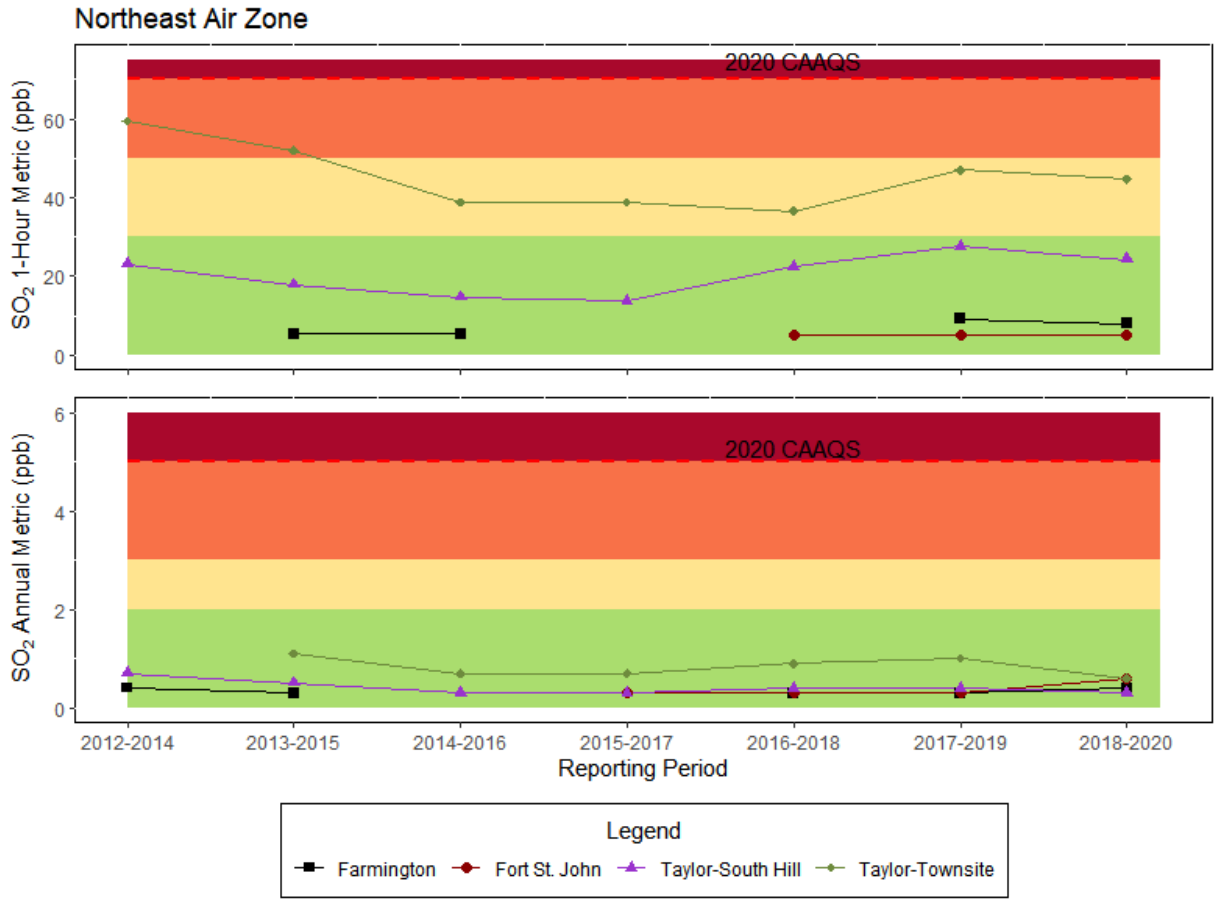


Figure 9. Trends in the 1-hour and annual metrics of SO_2 in the Northeast Air Zone. The 2020 CAAQS for SO_2 (red dashed lines) only applies during the 2018-2020 reporting period but presented throughout all reporting periods to visualize trends. The background colour shows the AQMS management levels.

Actions to Protect Air Quality

The reduction of $PM_{2.5}$ emissions continues to be a major air quality priority in many areas of B.C., including the Northeast Air Zone.

In 2016, the Province adopted a new Solid Fuel Burning Domestic Appliance Regulation that requires nearly all wood burning appliances sold in B.C. to be certified to meet particulate emissions standards set by the US Environmental Protection Agency (EPA) in 2015, or similar standards set by the Canadian Standards Association (CSA) in 2010. The regulation also specifies the types of fuels that can be burnt and has provisions around the sale and installation of outdoor wood boilers. For more information on the regulation, see: https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-pollution/smoke-burning/regulations/solid-fuel-burning-domestic-appliance-regulation.

Between 2013 and 2017, multiple air quality monitoring stations were operated throughout the Northeast air zone as part of a monitoring study. The study was the result of a partnership between the Province and the B.C. Oil and Gas Commission to address public concerns on air quality from oil and gas development. An assessment report was published in 2017 summarizing measured levels of air pollutants including $PM_{2.5}$, ozone, NO_2, SO_2, hydrogen sulphide, and total reduced sulphur. For more information on the Northeast Monitoring Project, see: https://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality/measuring/monitoring-ne-bc

In 2019 the Ministry updated the Open Burning Smoke Control Regulation (OBSCR) to reduce the smoke from open burning. The revised OBSCR has shorter burn periods to discourage smoldering piles. It also increases the required setbacks between open burning and neighbouring residences and businesses. The OBSCR allows a Ministry director to prohibit open burning when there is a risk of pollution and also to vary requirements of the regulation when doing so is necessary to protect the environment or to meet the intent of the regulation.

Appendix I – Approach to Identify Wildfire-influenced Data

Summertime air quality in British Columbia is periodically influenced by wildfire smoke – from local fires as well as long-range transport from outside of the province. The wildfire season in B.C. typically occurs between May and September, when warm and dry conditions prevail.

A myriad of different pollutants is emitted from wildfires. These include $PM_{2.5}$ and gases such as nitrogen oxides and volatile organic compounds that can react in the atmosphere to form ground-level ozone and additional $PM_{2.5}$.

Given that smoke-affected areas may be extensive, and that smoke may linger for days before being fully dispersed from an airshed, the current analysis has focussed on those periods when wildfire smoke may have contributed to an exceedance of the CAAQS levels for ground-level ozone or $PM_{2.5}$. Criteria used to flag and evaluate wildfire-influenced data included the following:

- 24-hour $PM_{2.5}$ concentrations in excess of the CAAQS level of 27 $\mu g/m^3$ and/or 8-hour daily maximum ozone concentrations in excess of the CAAQS level of 62 ppb between May and September;
- Wildfires of interest identified based on data from the B.C. Wildfire Management Branch;
- Smoky Skies bulletins issued by the Ministry to notify the public of rapidly changing smoke conditions;
- NASA satellite images showing smoke impacts over the region; and
- Multiple monitoring sites in the area of concern showing elevated pollutant levels, suggesting a common source or contributing source.

Wildfire-influenced data were excluded from the calculation of air zone management levels. Excluded data are as summarized in Appendix II.

Appendix II – Wildfire-influenced Data in the Southern Interior Air Zone (2018-2020)

Ozone and $PM_{2.5}$ data from 2018-2020 for the Central Interior Air Zone were evaluated based on the criteria set out in Appendix I for TF/EE influences. Various pieces of evidence were used to support identification of wildfire-influenced periods. These included the following:

- Wildfires of note – either due to size or proximity to populated areas – are tracked by the BC Wildfire Service.
    - The 2018 wildfire season was a record-breaking year for B.C. with 1.35 million hectares of land area burned from several large fires, mostly in the Central Interior[6] (see Table II-1)
    - The 2019 wildfire was one of the worst on record in Alberta in terms of the land area burned. Over 880,000 hectares of land was burned from three major complex fires[7].
- Days flagged as wildfire-influenced (Table II-2) coincided with Smoky Skies Bulletins issued by the Ministry of Environment and Climate Change Strategy.
- Satellite images during this period (see Figures II-1 to II-4) provide additional information on both the number of wildfires and the spatial extent of wildfire smoke in and adjacent to the Central Interior Air Zone.

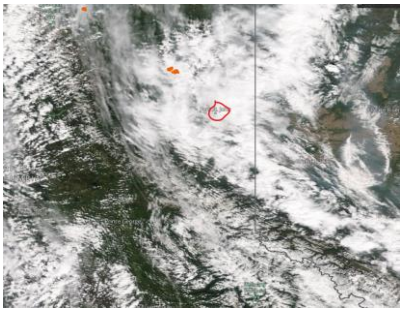
Table II-1. Examples of notable wildfires in the central and southern interior during 2018.[8]

Date Discovered	Size (ha)	Geographic Location	Description
2018-08-01	9,284	Syringa Complex-Meachen Creek	Located within Kianuko Provincial Park, 25.5 km southwest of St. Mary's Lake; lightning-caused
2018-08-02	3,015	Syringa Complex-Cross Creek	23 km northeast of Radium; lightning-caused
2018-08-07	6,798	Syringa Complex-Blazed Creek	20 km west of Creston; lightning-caused
2018-08-12	1,181	Syringa-Randal Creek	17 km southeast of Yahk, on Canada/U.S. border; lightning-caused
2018-08-09	642	Okanagan Complex-Gottfriedsen Mountain Creek	24 km west of West Kelowna, 8 km north of Hwy 97; lightning-caused
2018-08-11	2,227	Syringa Complex-Bulldog Mountain	5 km south of Renata; lightning-caused
2018-08-15	13,626	Placer Mountain Complex-Cool Creek	20 km northeast from Eastgate; lightning-caused
2019-05-12	350,135	Chuckegg Creek wildfire HWF042 – High Level, Alberta	Lightning-caused; uncontrolled over 98 days due to extremely dry conditions

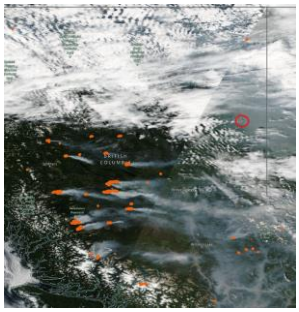
[6] See: https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary
[7] See: https://wildfire.alberta.ca/resources/reviews/documents/af-spring-2019-wildfire-review-final-report.pdf
[8] https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary

Table II-2 – Wildfire-influenced $PM_{2.5}$ data from 2018-2020. All dates shown coincided with a Smoky Skies Bulletin over the specified location.

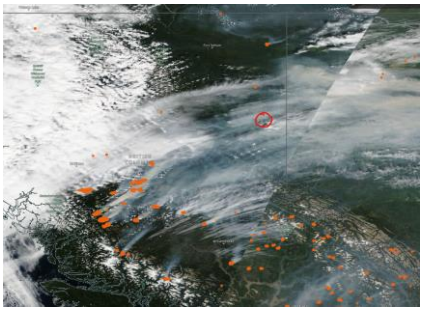
Location	Date	Daily $PM_{2.5}$ ($\mu g/m^3$)
Fort St. John	2018-05-24	29.2
Fort St. John	2018-08-07	28.1
Fort St. John	2018-08-08	50.1
Fort St. John	2018-08-09	116.5
Fort St. John	2018-08-10	92.1
Fort St. John	2018-08-14	44.4
Fort St. John	2018-08-15	36.4
Fort St. John	2018-08-16	67.9
Fort St. John	2018-08-17	66.2
Fort St. John	2018-08-21	102.6
Fort St. John	2018-08-22	178.3
Fort St. John	2018-08-24	57
Fort St. John	2018-08-25	49.4
Fort St. John	2019-05-24	24
Fort St. John	2019-05-25	24
Fort St. John	2019-05-31	18



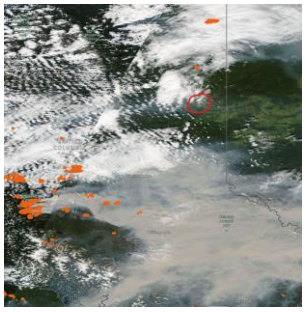
a. NASA EOSDIS, 24 May 2018



b. NASA EOSDIS, 7 August 2018

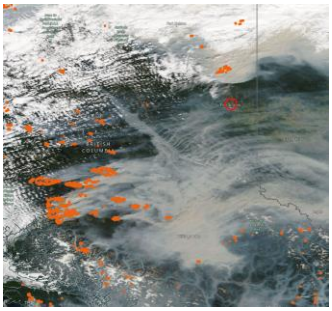


c. NASA EOSDIS, 9 August 2018

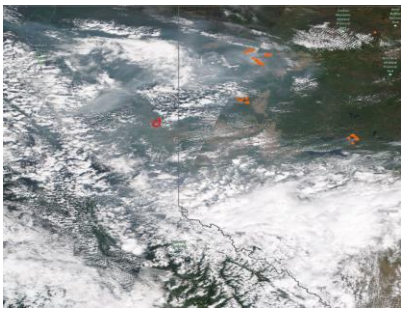


d. NASA EOSDIS, 14 August 2018

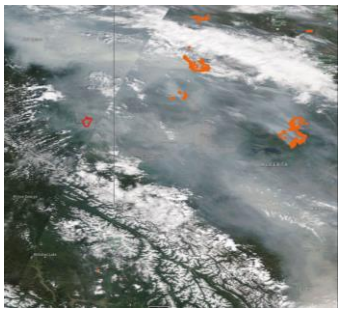
e. NASA EOSDIS, 20 August 2018



f. NASA EOSDIS, 22 August 2018



g. NASA EOSDIS, 24 May 2019



h. NASA EOSDIS, 31 May 2019

Figure II-1. Corrected reflectance satellite images from NASA's Earth Observing System Data and Information System (EOSDIS) showing smoke (grey plumes) over the Northeast Air Zone in 2018 and 2019. In 2018, smoke over the air zone came from fires in B.C.'s Central Interior. In 2019, smoke came from fires in Alberta. Red dots indicate fires and thermal anomalies. Large red circle identifies the municipality of Fort St.John. Source of images: NASA EOSDIS Snapshots at: https://worldview.earthdata.nasa.gov/.