Introduction

This is the third air quality report for the Northeast Air Zone. Annual 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 ground-level ozone (O_3) and fine particulates ($PM_{2.5}$), the associated management levels and recent actions to improve air quality. A province-wide summary can be found at: http://www.env.gov.bc.ca/soe/indicators/air/.

Background

The AQMS is the national approach to managing air quality in Canada. Under the AQMS, the CAAQS are developed to drive action to protect human health and the environment. Air zones are areas that exhibit similar air quality characteristics, issues and trends, and that form the basis for monitoring, reporting and taking action on air quality. The Northeast Air Zone (see Figure 1) is one of seven broad air zones across the province. 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 outlined in Table 1.

Figure 1. Northeast Air Zone.

Table 1. Air zone management framework for ground-level ozone and $PM_{2.5}$. The CAAQS define the upper threshold, separating the "red" and "orange" management levels.

Management Level	O_3 (ppb)		$PM_{2.5}$ – Annual ($\mu g/m^3$)		$PM_{2.5}$ - 24h ($\mu g/m^3$)	
	2015	**2020**	**2015**	**2020**	**2015**	**2020**
Red	Actions for Achieving Air Zone CAAQS					
Threshold (CAAQS)	63	62	10	8.8	28	27
Orange	Actions for Preventing CAAQS Exceedance					
Threshold	56		6.4		19	
Yellow	Actions for Preventing Air Quality Deterioration					
Threshold	50		4		10	
Green	Actions for Keeping Clean Areas Clean					

Ozone Levels

Ozone monitoring at the Fort St. John Key Learning Centre was initiated in late 2014 and has been operated continuously since early 2015. Ozone monitoring in Taylor and Rolla began in 2016. Based on data collected between 2015 and 2017, ozone concentrations at the three sites ranged from 50-53 ppb. These levels were below the national standard of 63 ppb.[1]

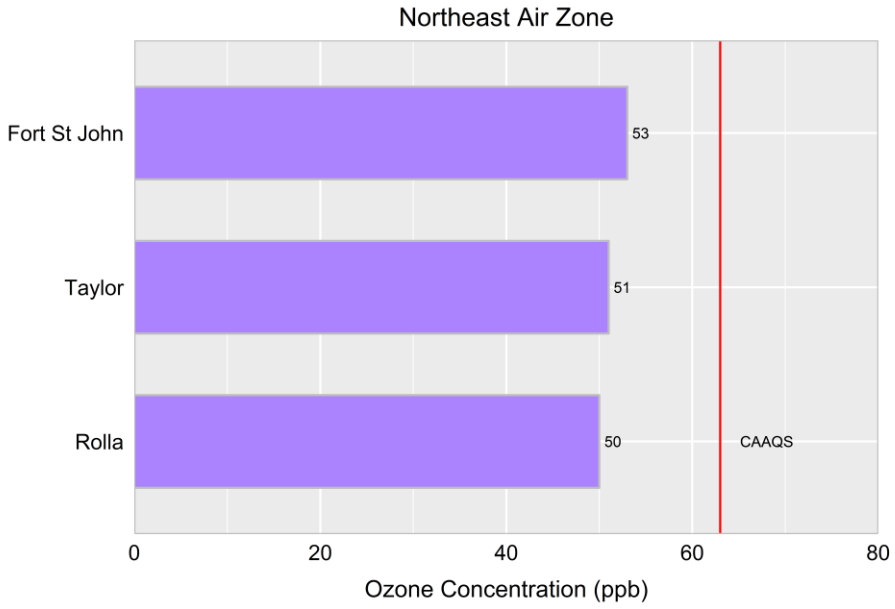


Figure 2. Ozone concentrations in the Northeast Air Zone, based on annual 4th highest daily 8-hour maxima, averaged over 2015-2017. Red dashed line identifies the CAAQS of 63 ppb.

Trends in annual ozone levels are shown in Figure 3.[2] Concentrations have remained well below the level of the national standard over the period of record.

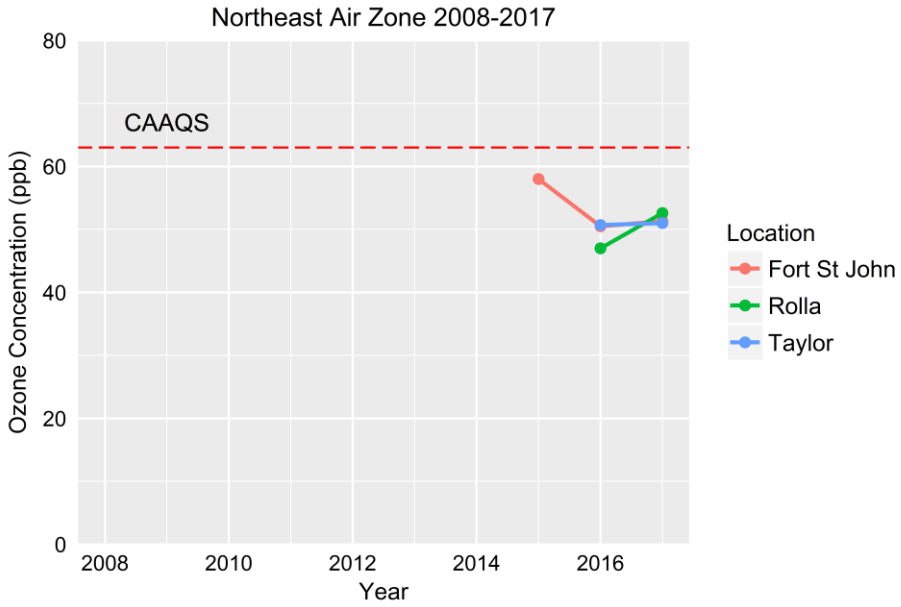


Figure 3. Annual trends in ozone concentrations (2008-2017), based on annual 4th highest daily 8-hour maxima for a single year. Red dashed line identifies CAAQS level of 63 ppb.

[1] Concentrations based on 4th highest daily 8-hour maximum, averaged over three years (2015-2017).
[2] Concentrations based on 4th highest daily 8-hour maximum, averaged over a single year.

$PM_{2.5}$ Levels

$PM_{2.5}$ refers to inhalable particles up to 2.5 micrometres in diameter. $PM_{2.5}$ monitoring was initiated in 2015 at the Fort St. John Key Learning Centre, and measurements are summarized in Figure 4. All measurements for this reporting period were based on the Federal Equivalent Method (FEM), which provides a more complete measure of $PM_{2.5}$ than the older TEOM instruments.

Between 2015 and 2017, only two complete years of data were collected. A 24-hour average value of 17 μg/m^3 and an annual mean of 5.8 μg/m^3 were obtained,[3] indicating that $PM_{2.5}$ levels at this site are below those of the national standards of 28 and 10 μg/m^3, respectively.

Trends in annual mean concentrations for 2016-2017 are shown Figure 5.[4]

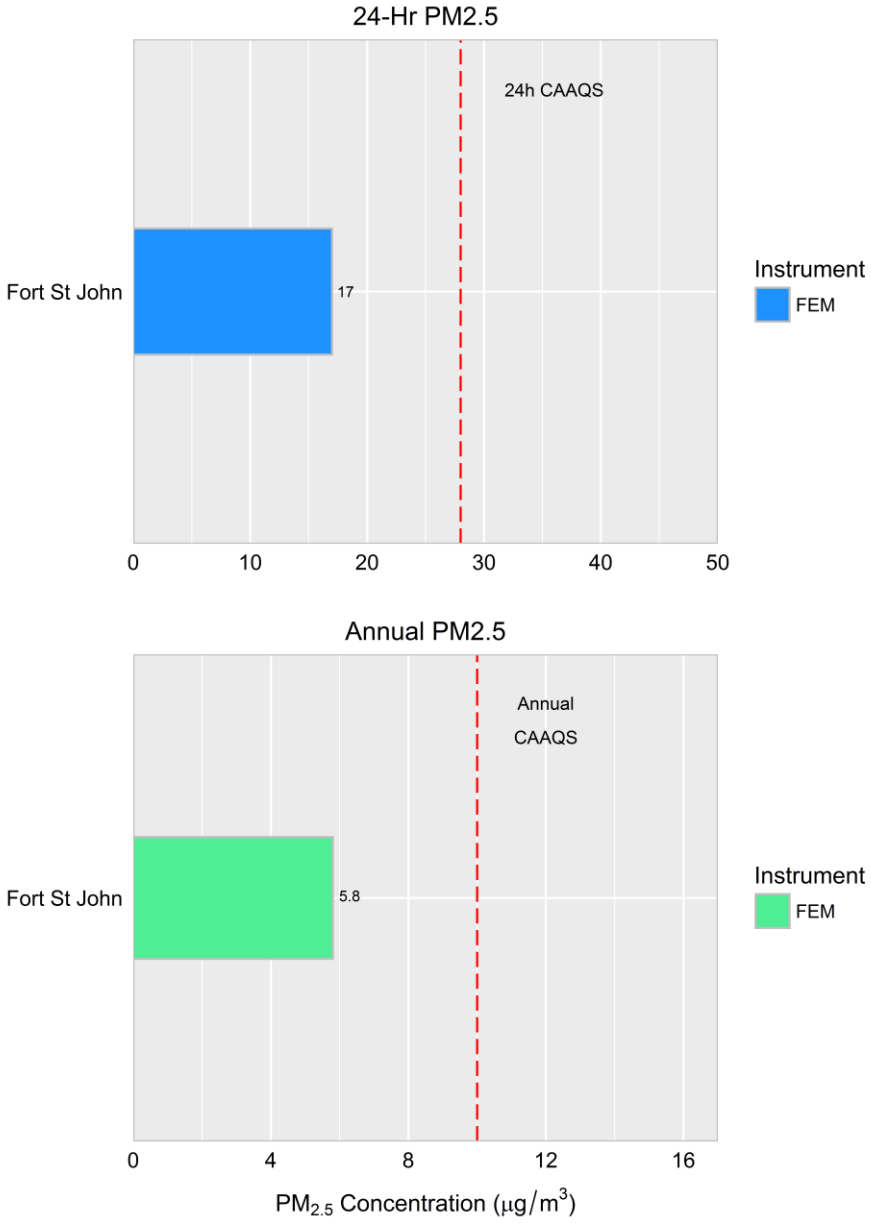


Figure 4. $PM_{2.5}$ concentrations in the Northeast Air Zone. Upper plot based on 24-hour concentration (annual 98th percentile, averaged over 2015-2017). Lower plot based on annual mean concentration (averaged over 2015-2017). The red dashed lines identify CAAQS of 28 μg/m^3 (upper plot) and 10 μg/m^3 (lower plot).

[3] The 24-hour concentration is based on the annual 98th percentile of 24-hour values, averaged over three years (2015-2017). The annual mean concentration is based on the annual average of 24-hour values, averaged over three years (2015-2017).

[4] Concentrations based on the annual average of 24-hour values over single year.

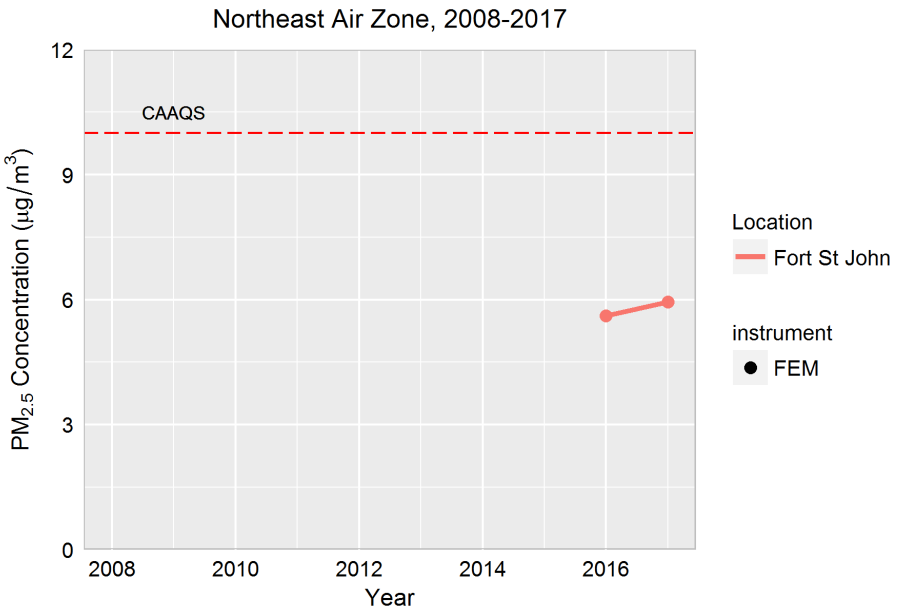


Figure 5. Trends in $PM_{2.5}$ concentrations (2008-2017), based on annual mean concentrations from a single year. The CAAQS value of 10 µg/m^3 is shown by the dashed line.

Air Zone Management Levels

Air zone management levels are assigned on the basis of the highest concentrations within an air zone, excluding contributions from transboundary flows (TF) and exceptional events (EE) such as wildfires. This is done so that long-term management strategies are not developed on the basis of events that are beyond local or provincial control.

In the Northeast Air Zone, wildfires are the primary contributor to TF/EE. The methodology for identifying wildfire-influenced data is provided in Appendix I.

Table 2 summarizes ozone concentrations as measured and after consideration of any TF/EE influences. TF/EE influences did not affect management levels. Consequently, the Northeast Air Zone is assigned a "yellow" management level, based on ozone levels in Fort St. John. This indicates that any ozone-related actions should focus on preventing further air quality deterioration.

Table 3 summarizes both as-measured $PM_{2.5}$ concentrations and management levels once estimated wildfire influences have been removed. As discussed further in Appendix II, wildfire influences were identified, but the impact on management levels was small. The air zone is assigned a "yellow" management level for $PM_{2.5}$. This means that $PM_{2.5}$-related actions should focus on preventing air quality deterioration.

Table 2. Summary of ozone concentrations as measured and air zone management levels for the Northeast Air Zone (based on 2015-2017 data).

Location	No. Valid Years	4th Highest Daily 8-hour Maxima (ppb)		Air Zone Management Level
		As Measured	TF/EE Influences Removed	
Fort St. John-Key Learning Centre	3	53	53	**Goal: Preventing Air Quality Deterioration**
Rolla	2	50	50	
Taylor-Lone Wolf Golf Course	2	51	51	

Table 3. Summary of $PM_{2.5}$ concentrations as measured and air zone management levels for the Northeast Air Zone (based on 2015-2017 data).

Location	Monitor Type	No. Valid Years	Daily Mean (98th Percentile)		Annual Mean		Air Zone Management Level
			As Measured	TF/EE Removed	As Measured	TF/EE Removed	
Fort St. John – Key Learning Centre	FEM	2	17	16	5.8	5.6	**Goal: Prevent Air Quality Deterioration**

Actions to Protect Air Quality

Air quality activities in the Northeast Air Zone have largely focussed on characterizing air quality in this region and identifying potential impacts from the oil and gas sector. As part of the Northeast Air Quality Monitoring Project, surveillance monitoring was conducted in a number of smaller communities that are closer to oil and gas production. An analysis of this monitoring data is summarized in the "Northeast Air Quality Monitoring Report" (see: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/northeast_bc_air_quality_assessment_report.pdf).

A description of other activities underway in B.C. air zones can be found in the "Air Zone Management Response for British Columbia" (see: www.gov.bc.ca/bcairquality).

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 are emitted from wildfires, including $PM_{2.5}$ and gases that include nitrogen oxides and volatile organic compounds (VOCs) 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 $PM_{2.5}$ or ozone. Criteria used to flag and evaluate wildfire-influenced data included the following:

- 24-hour $PM_{2.5}$ concentrations exceeded the CAAQS level of 28 $\mu g/m^3$ or 8-hour daily maximum ozone levels exceeded the CAAQS level of 63 ppb between May and September,
- Wildfires of interest were identified based on data from B.C. Wildfire Management Branch,
- Wildfire smoke advisories had been issued by the Ministry of Environment & Climate Change Strategy during the period of interest,
- NASA satellite images indicated smoke impacts over the region,
- Multiple monitoring sites in the area of concern exhibited similar air quality characteristics, suggesting a common source or contributing source, and
- Modelling studies identify enhanced pollutant concentrations due to wildfire smoke.

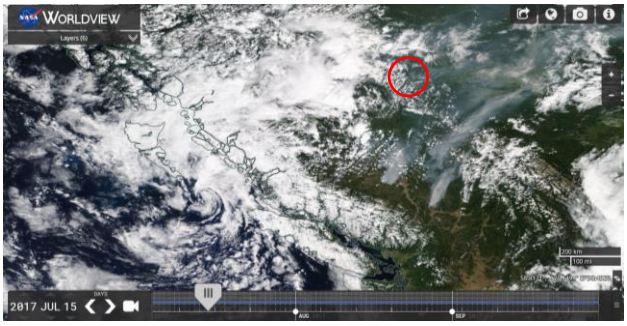
Appendix II – Wildfire-influenced Data in the Northeast Air Zone (2015-2017)

Ozone and $PM_{2.5}$ data from 2015-2017 for the Northeast Air Zone were evaluated based on the criteria set out in Appendix I for TF/EE influences. Wildfire-influenced $PM_{2.5}$ data are summarized in Table II-1. Supporting evidence included the following:

- In mid-July 2017, there were several large wildfires burning in the central interior of the province, with satellite images showing smoke being transported to the northeast (see Fig. II-1a).
- By mid-August 2017 and into September 2017, satellite images showed extensive plumes of smoke that covered wide swaths of the province, including parts of the northeast (see Figs. II-1b and II-1c).
- Wildfire-influenced days coincided with days that the Ministry of Environment & Climate Change Strategy had issued a smoke-related advisory that included the south Peace area.

Table II-1 Wildfire-influenced $PM_{2.5}$ data from 2017.

Location	Date	24-hr $PM_{2.5}$ ($\mu g/m^3$)	Wildfire Smoke-Related Air Quality Advisory?
Fort St. John - Key Learning Centre	2017-07-15	28.3	Y
Taylor - Lone Wolf Golf Course	2017-07-15	29.0	Y
Fort St. John – Key Learning Centre	2017-08-13	46.7	Y
Fort St. John – Key Learning Centre	2017-09-07	49.4	Y
Peace Valley - Attachie Flat	2017-09-07	30.2	Y



a. NASA Worldview, Jul. 15, 2017

b. NASA Worldview, Aug. 13, 2017

c. NASA Worldview, Sep. 7, 2017

Figure II-1. Satellite images from Jul. 15, Aug. 13 and Sep. 7, 2017, showing wildfire smoke (grey plumes) over parts of B.C. including the northeast of the province. Red circles show approximate location of Fort St. John. Source of images: NASA Worldview at: https://worldview.earthdata.nasa.gov/.