

Introduction

This is the second annual air quality report for the Central Interior 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 (O₃) 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 Central Interior 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. Central Interior 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 (µg/m ³)		PM _{2.5} - 24h (µg/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 measurements in the Central Interior Air Zone are summarized in Figure 2.

Concentrations ranged from 50-55 ppb.¹ All sites achieved the national standard of 63 ppb.

Trends in ozone levels are shown in Figure 3.² With the exception of Williams Lake in 2006, concentrations have remained below the level of the national standard throughout this period.

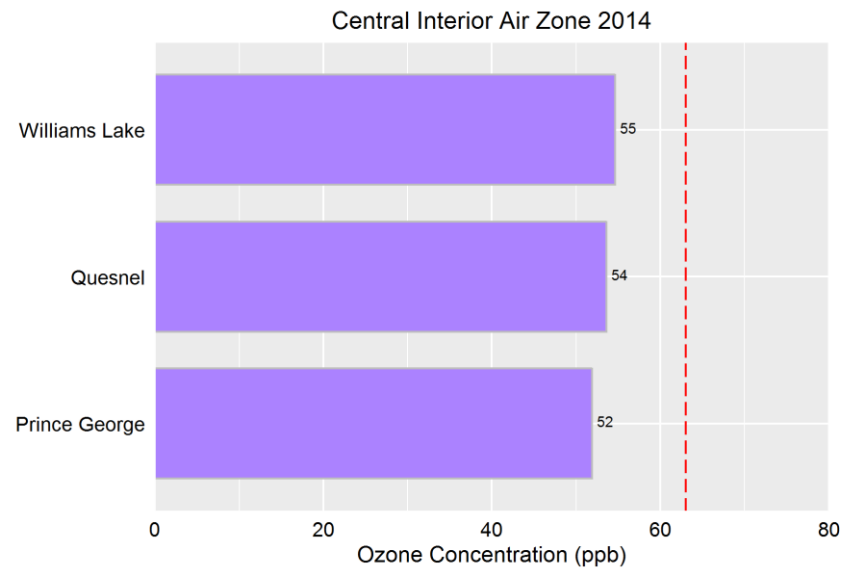


Figure 2. Ozone concentrations in the Central Interior Air Zone, based on annual 4th highest daily 8-hour maxima, averaged over 2012-2014. Red dashed line identifies the CAAQS of 63 ppb.

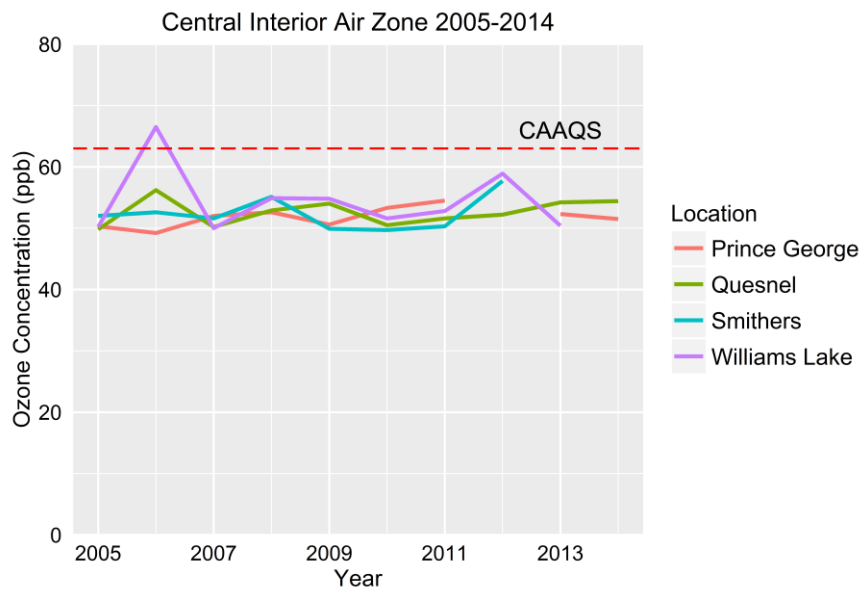


Figure 3. Trends in ozone concentrations (2005-2014), based on annual 4th highest daily 8-hour maxima over a single year. The red dashed line identifies the CAAQS level of 63 ppb.

¹ Concentrations based on 4th highest daily 8-hour maximum, averaged over three years (2012-2014).

² Concentrations based on 4th highest daily 8-hour maximum, 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} measurements are summarized in Figure 4. A distinction is made between data collected using the new Federal Equivalent Method (FEM) technology and the older TEOM instruments that are in the process of being phased out. The FEMs are the preferred instruments as they provide a more complete measure of PM_{2.5} than the TEOMs.

Daily concentrations (upper plot) ranged from 19 to 38 µg/m³.³ Four sites exceeded the national standard of 28 µg/m³: Vanderhoof, Smithers, and two sites in Quesnel. Annual concentrations (lower plot) ranged from 5.2 to 11.3 µg/m³, with Vanderhoof the only site to exceed the national standard of 10 µg/m³.⁴

Trends in annual mean concentrations between 2005 and 2014 are shown for a subset of sites in Figure 5.⁵ A shift to higher reported concentrations is seen with the change from TEOM to FEM instruments from about 2010 onward.

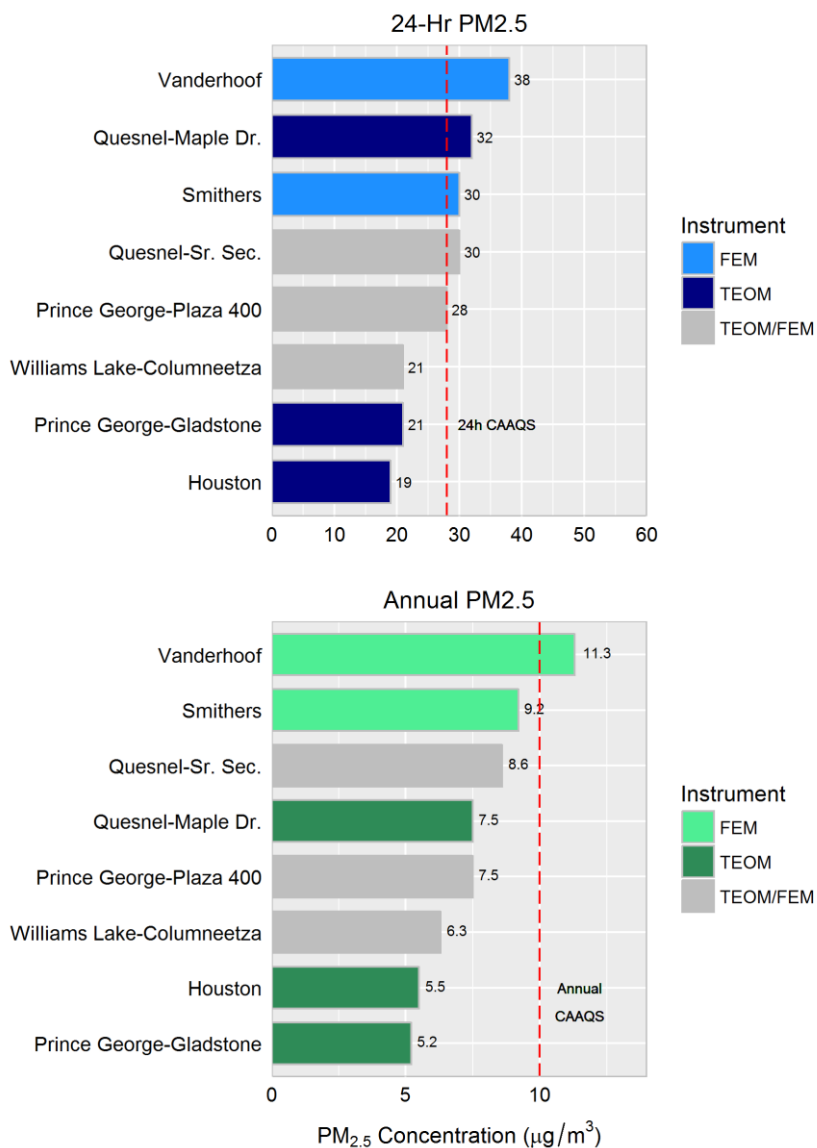


Figure 4. PM_{2.5} concentrations in Central Interior Air Zone. Upper plot based on 24-hour concentration (annual 98th percentile, averaged over 2012-2014). Lower plot based on annual mean concentration (averaged over 2012-2014). The red dashed lines identify CAAQS of 28 µg/m³ (upper plot) and 10 µg/m³ (lower plot).

³ Concentrations based on the annual 98th percentile of 24-hour values, averaged over three years (2012-2014).

⁴ Concentrations based on the annual average of 24-hour values, averaged over three years (2012-2014).

⁵ Concentrations based on the annual average of 24-hour values over single year.

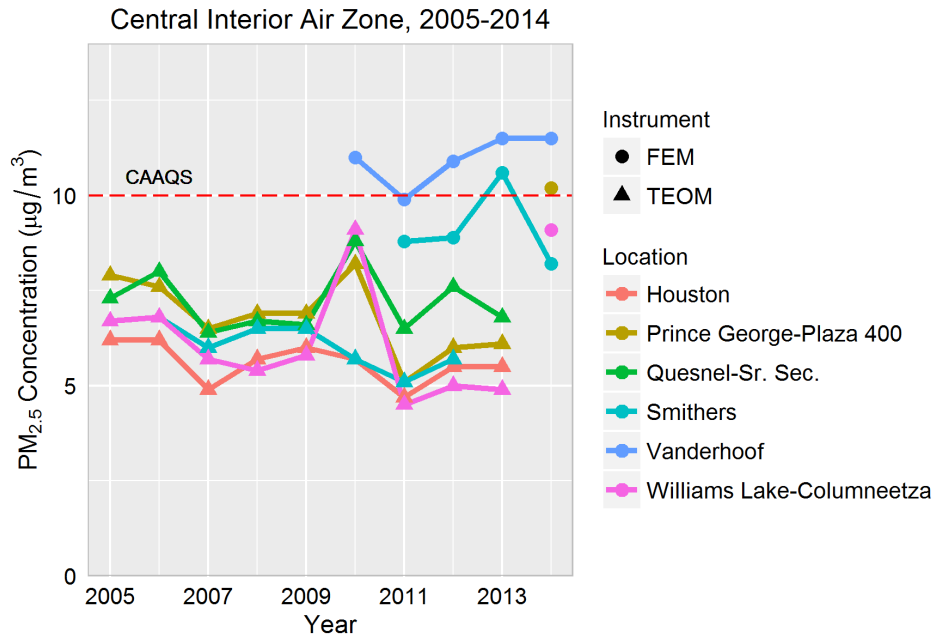


Figure 5. Trends in PM_{2.5} concentrations (2005-2014), based on annual mean concentrations from a single year. The CAAQS value of 10 µg/m³ is shown by the dashed line. PM_{2.5} measurements prior to 2011 are reported at 25°C and 1 atm. From 2011 onward, measurements are reported at local conditions.

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 Central Interior Air Zone, wildfires are the primary contributor to TF/EE. The methodology for identifying wildfire-influenced data is provided in Appendix I. Excluded data are summarized in Appendix II, along with supporting information on specific wildfire influences. Examples include the long-range transport of wildfire plumes from Siberia and Alberta in 2012, and local wildfires in 2012 and particularly 2014, when hot, dry conditions led to an above-average number of hectares burned in the province.

Table 2 summarizes ozone concentrations as measured and after consideration of TF/EE. No TF/EE influences were identified for ozone. Consequently, the air zone is assigned a “yellow” management level for ozone, based on concentrations in Prince George and Williams Lake. This indicates that ozone-related actions should focus on preventing further air quality deterioration.

Table 2. Summary of ozone concentrations as measured and air zone management levels for the Central Interior Air Zone (based on 2012-2014 data).

Location	No. Valid Years	4 th Highest Daily 8-hour Maxima (ppb)		Air Zone Management Level
		As Measured	TF/EE Influences Removed	
Prince George	3	52	52	Goal: Preventing Further Deterioration
Quesnel	3	54	54	
Williams Lake	2	55	55	

Table 3 summarizes PM_{2.5} concentrations as measured and with TF/EE influences removed for each monitoring site. Overall, the Central Air Zone is assigned a “red” management level as a result of elevated PM_{2.5} levels in Smithers and Vanderhoof. This indicates that PM_{2.5}-related actions should continue to focus on achievement of the CAAQS in these communities. Although as-measured PM_{2.5} concentrations in Quesnel also exceeded the CAAQS level, this was determined to be a result of wildfire influence. For more information on these analyses, see Appendix II.

Table 3. Summary of PM_{2.5} concentrations as measured and air zone management levels for the Central Interior Air Zone (based on 2012-2014 data).

Location	Monitor Type	No. Valid Years	Daily Mean (98 th Percentile, µg/m ³)		Annual Mean (µg/m ³)		Air Zone Management Level
			As Measured	TF/EE Removed	As Measured	TF/EE Removed	
Houston	TEOM	2	19	19	5.5	5.5	Goal: Achieving the CAAQS
Prince George-Gladstone	TEOM	3	21	20	5.2	5	
Prince George-Plaza 400	TEOM/FEM	3	28	22	7.5	7.0	
Quesnel-Maple Dr.	TEOM	3	32	24	7.5	7.0	
Quesnel-Sr. Sec.	TEOM/FEM	3	30	24	8.6	8.0	
Smithers	FEM	3	30	30	9.2	9.2	
Vanderhoof	FEM	3	38	38	11.3	11.1	
Williams Lake	TEOM/FEM	3	21	19	6.3	6.1	

Actions to Protect Air Quality

The reduction of PM_{2.5} emissions has been a top air quality priority across the Central Interior Air Zone over the past several years. Strategies and actions to reduce PM_{2.5} emissions have been documented in local airshed plans that have been developed and implemented for the Bulkley Valley-Lakes District,⁶ Prince George,⁷ Quesnel^{8,9} and Williams Lake¹⁰.

The Provincial Wood Stove Exchange Program encourages residents to change out their older, smoky wood stoves for low-emission appliances including new CSA-/EPA-certified clean-burning wood stoves. Between 2012 and 2014, wood stove change-out programs were supported in the Bulkley Valley, Prince George and Mackenzie.

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).

⁶ <http://www.cleanairplan.ca/cleanairplan2012.pdf>

⁷ http://www.pgairquality.com/uploads/PGAIR_PhaseIII.pdf

⁸ http://www.quesnelairshed.org/wp-content/uploads/2012/09/airshed_management_plan2.pdf

⁹ http://www.env.gov.bc.ca/epd/bcairquality/reports/pdfs/airshed_review_2011.pdf

¹⁰ https://breatheasywilliamslake.files.wordpress.com/2015/03/wlairshed_mgt_plan_final.pdf

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 such as 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} levels. Criteria used to flag and evaluate wildfire-influenced data included the following:

- 24-hour PM_{2.5} concentrations exceeded the CAAQS level of 28 µg/m³ 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,
- MODIS 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.

Wildfire-influenced data were excluded from the calculation of air zone management levels. Excluded data are as summarized in Appendix II, along with supporting information on specific wildfire influences.

Appendix II – Wildfire-influenced Data in the Central Interior Air Zone (2012-2014)

PM_{2.5} data from 2012-2014 for the Central Interior Air Zone were evaluated based on the criteria set out in Appendix I for TF/EE influences.¹¹ Wildfire-influenced data are summarized in Table II-1. These data were excluded from the calculation of management levels, and resulted in a change in management levels for the Quesnel Senior Secondary and Quesnel Maple Drive monitoring sites from “red” to “orange”. Supporting evidence included the following:

Summer 2012:

- A study by Teakles et al. (2017) that reported on an intense wildfire plume from Siberia that contributed to PM_{2.5} enhancements (24-hour rolling average) of approximately 24 µg/m³ in Quesnel and 23 µg/m³ in Prince George between July 6-11, 2012.
- Elevated PM_{2.5} concentrations that coincided with wildfire smoke advisories issued by the Ministry of Environment & Climate Change Strategy (see Table II-1), including a July 16 event that was attributed to smoke from Alberta wildfires.

Summer 2014:

- Elevated PM_{2.5} concentrations that coincided or overlapped with wildfire smoke advisories issued by the Ministry of Environment & Climate Change Strategy (see Table II-1);
- The number of very large wildfires exceeding 20,000 ha in central/northern B.C. that burned for weeks (see Table II-2);
- MODIS satellite images that showed smoke plumes in the vicinity of affected monitoring locations (see Figures II-1 and II-2 for examples).

Wildfire-influenced PM_{2.5} data were removed and management levels re-calculated. These adjustments resulted in minor changes in the management levels for the majority of sites. In the case of the Quesnel-Senior Secondary and Quesnel-Maple Drive sites, these changes were large enough to yield a lower management (i.e. “orange” instead of “red”). Affected data are identified in Tables II-1 and II-3. This did not change the overall status of the air zone, which remained “red” on the basis of PM_{2.5} levels in Vanderhoof and Smithers.

¹¹ Wildfire influences on ozone concentrations were not assessed given that as-measured concentrations were well below the CAAQS.

Table II-1. Wildfire-influenced data that were excluded from the determination of management levels.

Location	Date	24-Hr PM _{2.5} (µg/m ³)	Wildfire Smoke-related Air Quality Advisory?
Prince George Plaza 400	2012-07-09	30.9	Y – Siberian wildfire smoke
Quesnel Senior Secondary	2012-07-09	29.4	
Vanderhoof Courthouse	2012-07-09	37.3	
Quesnel Maple Drive	2012-07-16	35.3	Y – Alberta wildfire smoke
Quesnel Senior Secondary	2012-07-16	31.3	
Quesnel West Correlieu School	2012-07-16	30	
Quesnel West Correlieu School	2012-08-13	31.3	
Quesnel Senior Secondary	2012-08-13	29.3	
Vanderhoof Courthouse	2012-09-13	31.3	
Prince George Plaza 400	2012-09-21	31.2	Y
Prince George Plaza 400	2014-07-11	39.2	Y
Quesnel Maple Drive	2014-07-11	32.5	
Quesnel West Correlieu School	2014-07-11	28.1	
Prince George Gladstone School	2014-07-15	86.7	Y
Prince George Plaza 400	2014-07-15	79.8	Y
Quesnel Maple Drive	2014-07-15	39.9	Y
Quesnel Senior Secondary	2014-07-15	36.5	Y
Quesnel West Correlieu School	2014-07-15	53.5	Y
Williams Lake Columneetza School	2014-07-15	36	Y
Quesnel Maple Drive	2014-07-16	67.7	Y
Quesnel Senior Secondary	2014-07-16	66.9	Y
Quesnel West Correlieu School	2014-07-16	90.3	Y
Williams Lake Columneetza School	2014-07-16	79.3	Y
Quesnel Maple Drive	2014-07-17	101.4	Y
Quesnel Senior Secondary	2014-07-17	105.8	Y
Quesnel West Correlieu School	2014-07-17	121	Y
Williams Lake Columneetza School	2014-07-17	59.9	Y
Quesnel Senior Secondary	2014-07-18	57.7	Y
Quesnel West Correlieu School	2014-07-18	75.2	Y
Williams Lake Columneetza School	2014-07-18	42.8	Y
Prince George Gladstone School	2014-08-03	41.6	Y
Prince George Plaza 400	2014-08-03	52.1	Y
Quesnel Maple Drive	2014-08-03	56.5	
Quesnel Senior Secondary	2014-08-03	45.3	
Vanderhoof Courthouse	2014-08-03	28.3	

Table II-1 (continued)

Location	Date	24-Hr PM _{2.5} (µg/m ³)	Wildfire Smoke-related Air Quality Advisory?
Prince George Gladstone School	2014-08-04	39.4	Y
Prince George Plaza 400	2014-08-04	47.6	Y
Quesnel Maple Drive	2014-08-04	44	Y
Quesnel Senior Secondary	2014-08-04	37.2	Y
Vanderhoof Courthouse	2014-08-04	68.7	
Prince George Plaza 400	2014-08-05	29.6	Y
Quesnel Maple Drive	2014-08-05	42.8	Y
Quesnel Senior Secondary	2014-08-05	43.2	Y
Vanderhoof Courthouse	2014-08-05	37	
Quesnel Maple Drive	2014-08-06	40.4	Y
Quesnel Senior Secondary	2014-08-06	41.7	Y
Williams Lake Columneetza School	2014-08-06	42.6	Y
Prince George Gladstone School	2014-08-12	31.1	Y
Prince George Plaza 400	2014-08-12	50.5	Y
Prince George Plaza 400	2014-08-13	34.1	Y
Quesnel Senior Secondary	2014-08-13	29.1	Y
Prince George Plaza 400	2014-08-15	38.2	Y
Quesnel Senior Secondary	2014-08-15	35.1	Y
Vanderhoof Courthouse	2014-08-15	45	Y
Quesnel Maple Drive	2014-08-16	40.6	Y
Quesnel Senior Secondary	2014-08-16	34.5	Y
Quesnel Maple Drive	2014-08-17	39.1	Y
Quesnel Senior Secondary	2014-08-17	52.1	Y
Williams Lake Columneetza School	2014-08-17	29.6	Y
Prince George Gladstone School	2014-08-18	40	Y
Prince George Plaza 400	2014-08-18	43.6	Y
Quesnel Maple Drive	2014-08-18	39	Y
Quesnel Senior Secondary	2014-08-18	43.3	Y
Vanderhoof Courthouse	2014-08-18	34.6	Y
Prince George Plaza 400	2014-08-25	33.2	
Prince George Plaza 400	2014-09-17	42.3	
Quesnel Maple Drive	2014-09-17	30.6	
Quesnel Senior Secondary	2014-09-17	34.2	
Vanderhoof Courthouse	2014-09-17	30.9	
Vanderhoof Courthouse	2014-09-18	36.8	
Vanderhoof Courthouse	2015-05-13	28.6	
Vanderhoof Courthouse	2015-05-15	31.7	
Quesnel Senior Secondary	2015-05-17	34	
Williams Lake Columneetza School	2015-07-11	39.9	

Table II-2. Summary of notable 2014 wildfires in central/northern B.C.¹²

Fire #	Latitude	Longitude	Discovered	Size (ha)	Geographic	Description
G60096	56 48.040	125 43.130	01 Jun 2014	33,068	Forres Mountain	50 km NW of Williston Lake
G60195	56 17.157	125 17.265	08 Jul 2014	61,285	Tenakihi - Mesilinka	50 km west of Williston Lake
G40198	53 08.540	124 21.118	NULL	21,518	Euchiniko Lakes	120 km west of Quesnel
R10070	53 23.890	125 44.075	08 Jul 2014	133,100	Chelaslie River	7 km south of Chelaslie River, including sections of Entiako Provincial Park
G70221	55 49.070	122 29.380	NULL	26,281	Mount McAllister	56 km west of Chetwynd

¹² Source: <http://www2.gov.bc.ca/gov/content/safety/wildfire-status/wildfire-statistics/wildfire-season-summary>.



Figure II-1. MODIS image over B.C. on July 16, 2014. (Source: NASA GSFC).

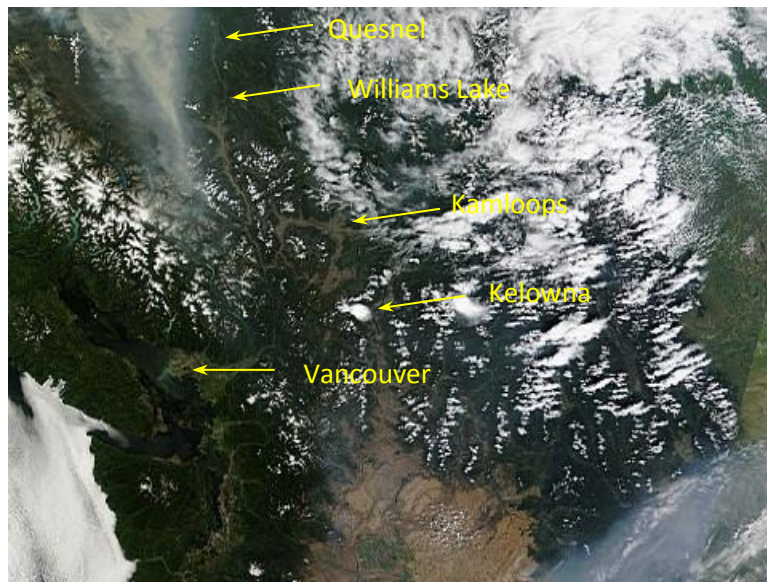


Figure II-2. MODIS image over B.C. on Aug. 4, 2014. (Source: NASA GSFC).