Introduction

This is the fourth annual quality report for the Lower Fraser Valley (LFV) 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 Lower Fraser Valley (LFV) 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. Lower Fraser Valley 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 measurements in the LFV Air Zone are summarized in Figure 2. Concentrations ranged from 34 ppb in downtown Vancouver to 60 ppb in Hope.[1] All sites achieved the national standard of 63 ppb.

Trends in ozone levels are shown in Figure 3.[2] Ozone levels in 2016 were among the lowest observed over the 10-year period.

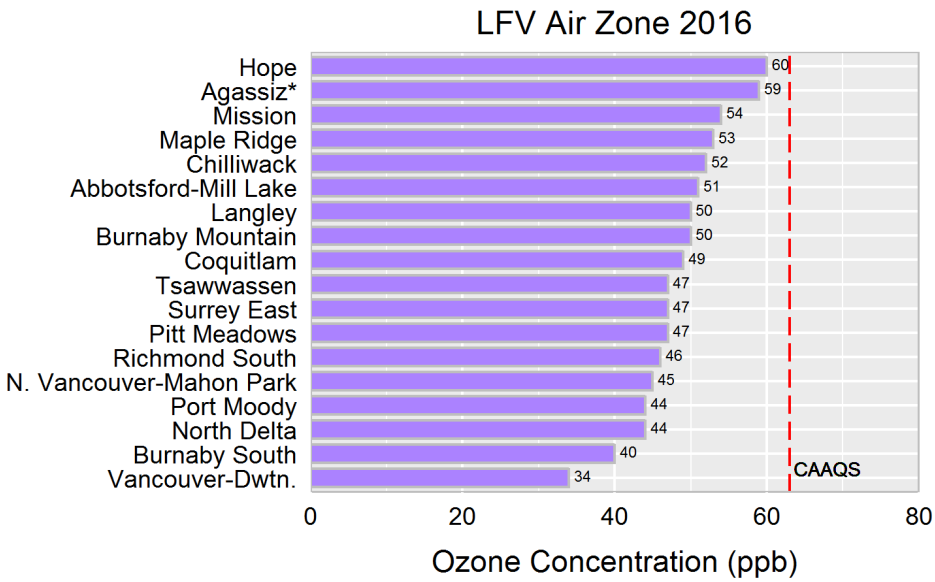

Figure 2. Ozone concentrations in the LFV Air Zone, based on annual 4th highest daily 8-hour maxima, averaged over 2014-2016. Red dashed line identifies the CAAQS of 63 ppb. *flags that a slightly lower value of 58 ppb was reported for Agassiz in the Metro Vancouver "Caring for the Air Report 2017", with differences a result of rounding procedures used.

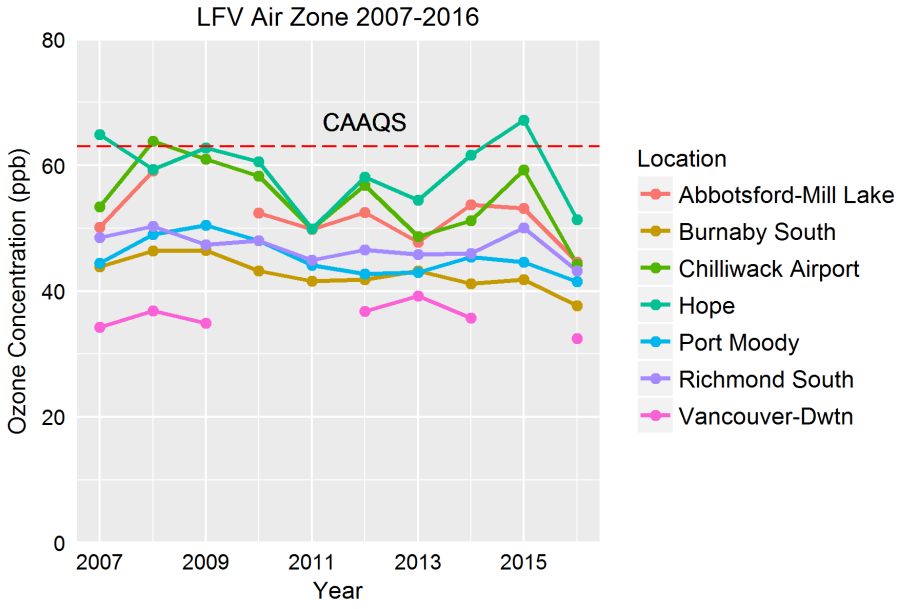

Figure 3. Trends in ozone concentrations (2007-2016), based on annual 4th highest daily 8-hour maxima for a single year. Red dashed line identifies CAAQS of 63 ppb.

[1] Concentrations based on 4th highest daily 8-hour maximum, averaged over three years (2014-2016).
[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. $PM_{2.5}$ 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.

Daily concentrations (upper plot) ranged from 11 to 19 µg/m^3.[3] All sites achieved the national standard of 28 µg/m^3. Annual concentrations (lower plot) ranged from 4.4 to 6.3 µg/m^3.[4] All monitoring sites achieved the national standard of 10 µg/m^3. For both measures, the highest $PM_{2.5}$ concentrations were observed in Langley.

Trends in annual mean concentrations between 2007 and 2016 are shown in Figure 5 for a subset of these sites.[5] A shift to higher reported concentrations is seen with the change from TEOM to FEM instruments from 2013 onward but concentrations have remained below the CAAQS level.

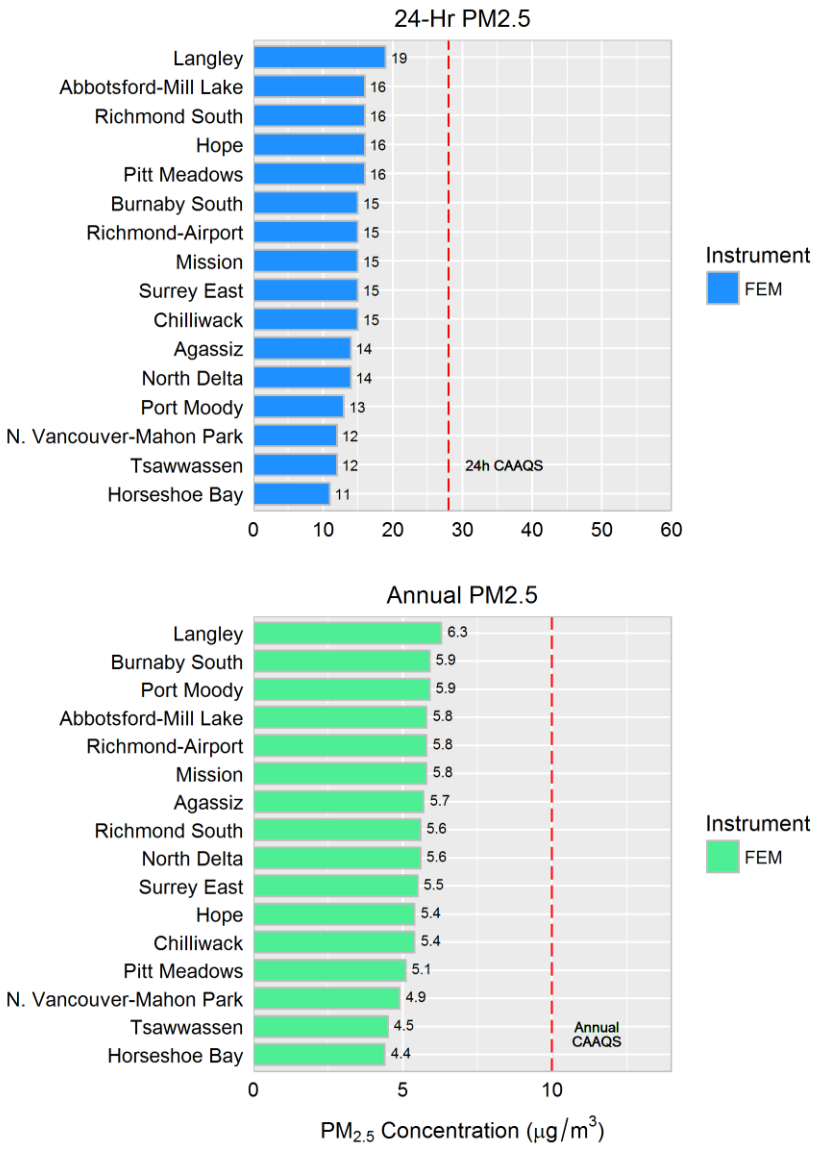

Figure 4. $PM_{2.5}$ concentrations in the LFV Air Zone. Upper plot based on 24-hour concentration (annual 98th percentile, averaged over 2014-2016). Lower plot based on annual mean concentration (averaged over 2014-2016). The red dashed lines identify CAAQS of 28 µg/m^3 (upper plot) and 10 µg/m^3 (lower plot).

[3] Concentrations based on the annual 98th percentile of 24-hour values, averaged over three years (2014-2016).
[4] Concentrations based on the annual average of 24-hour values, averaged over three years (2014-2016).
[5] Concentrations based on the annual average of 24-hour values over single year.

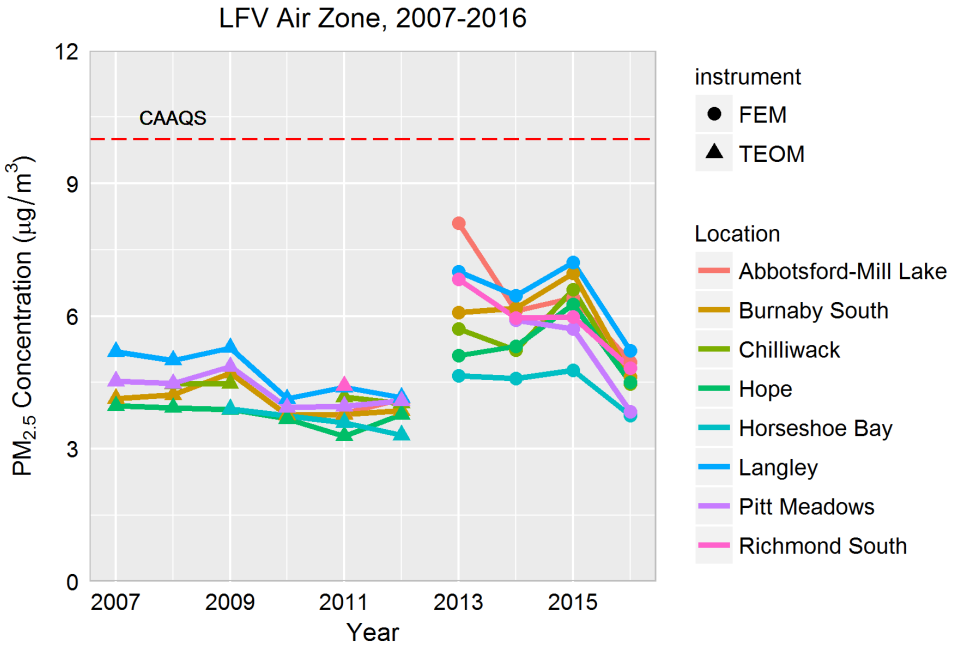

Figure 5. Annual trends in $PM_{2.5}$ concentrations (2007-2016), based on annual mean concentrations from a single year. The CAAQS value of 10 µg/m^3 is shown by the dashed line. $PM_{2.5}$ measurements prior to 2011 are reported at 25^{o}C and 1 atm. From 2011 onward, measurements are reported at local 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.

Across B.C., wildfires are the primary contributor to TF/EE. The methodology for identifying wildfire-influenced data is provided in Appendix I and excluded data are summarized in Appendix II. The summer of 2015 was characterized by hot, dry conditions and an above-average number of hectares burned. These fires created smoky conditions and periods of degraded air quality in several communities across the air zone.

Table 2 summarizes ozone concentrations as measured and after TF/EE influences have been considered. The LFV Air Zone is assigned an “orange” management level on the basis of ozone concentrations in Agassiz and Hope.

Table 3 summarizes $PM_{2.5}$ concentrations as measured and with TF/EE influences removed for each monitoring site. Overall, the LFV Air Zone is assigned a “yellow” management level, based on the

prevailing $PM_{2.5}$ management level across the air zone. This indicates that $PM_{2.5}$-related actions should focus on actions to prevent air quality deterioration.

Table 2. Summary of ozone concentrations as measured and air zone management levels for the LFV Air Zone (based on 2014-2016 data).

Location	No. Valid Years	4th Highest Daily 8-hour Maxima		Air Zone Management Level
		As Measured	TF/EE Influences Removed	
Abbotsford-Airport	3	49	49	**Goal: Preventing CAAQS Exceedance**
Abbotsford-Mill Lake	3	51	51	
Agassiz	3	59[6]	58	
Burnaby Mtn	3	50	50	
Burnaby South	3	40	40	
Burnaby-Kensington	3	43	43	
Chilliwack	3	52	52	
Coquitlam	3	49	49	
Hope	3	60	60	
Langley	3	50	50	
Maple Ridge	3	53	53	
Mission	2	54	54	
N. Vancouver-2nd Narrows	3	40	40	
N. Vancouver-Mahon Park	3	45	45	
North Delta	3	44	44	
Pitt Meadows	3	47	47	
Port Moody	3	44	44	
Richmond South	3	46	46	
Richmond-Airport	3	43	43	
Surrey	3	47	47	
Tsawwassen	3	47	47	
Vancouver-Dwtn	2	34	34	

[6] Due to different rounding procedures, a slightly different value (58 ppb) for Agassiz was reported in the Metro Vancouver "Caring for the Air Report 2017".

Table 3. Summary of $PM_{2.5}$ concentrations as measured and air zone management levels for the LFV Air Zone (based on 2014-2016 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	
Abbotsford-Airport	FEM	3	18	17	5.9	5.9	**Goal: Preventing AQ Deterioration**
Abbotsford-Mill Lake	FEM	3	16	16	5.8	5.8	
Agassiz	FEM	3	14	14	5.7	5.6	
Burnaby South	FEM	3	15	14	5.9	5.8	
Burnaby-Kensington	FEM	3	14	13	5.8	5.7	
Chilliwack	FEM	3	15	15	5.4	5.3	
Hope	FEM	3	16	15	5.4	5.2	
Horseshoe Bay	FEM	3	11	10	4.4	4.2	
Langley	FEM	3	19	19	6.3	6.2	
Mission	FEM	2	15	14	5.8	5.7	
N. Vancouver-2nd Narrows	FEM	3	13	13	6.1	6.0	
N. Vancouver-Mahon Park	FEM	3	12	12	4.9	4.7	
North Delta	FEM	3	14	14	5.6	5.5	
Pitt Meadows	FEM	3	15	15	5.1	5.1	
Port Moody	FEM	3	13	13	5.9	5.8	
Richmond South	FEM	3	16	16	5.6	5.5	
Richmond-Airport	FEM	3	15	15	5.8	5.8	
Surrey	FEM	3	15	15	5.5	5.4	
Tsawwassen	FEM	3	12	11	4.5	4.5	

Actions to Protect Air Quality

Through delegated authority under the *Environmental Management Act*, Metro Vancouver has responsibility for managing air emissions within its boundaries.

Metro Vancouver developed an Integrated Air Quality Management and Greenhouse Gas Management Plan in 2011.[7] This plan contains 12 strategies, 81 actions and 10 performance measures. It seeks to reduce levels of $PM_{2.5}$, ground-level ozone, and other priority pollutants to protect human health and the environment, improve visual air quality and minimize contributions to climate change. The first progress report on plan implementation was released in 2014,[8] and Metro Vancouver will begin

[7] http://www.metrovancouver.org/services/air-quality/AirQualityPublications/IntegratedAirQualityGreenhouseGasManagementPlan-October2011.pdf
[8] http://www.metrovancouver.org/services/air-quality/AirQualityPublications/2014IAQGGMPProgressReport.pdf

updating this plan in 2017. More information on air quality-related activities in Metro Vancouver can be found at: http://www.metrovancouver.org/services/air-quality/Pages/default.aspx.

The Fraser Valley Regional District (FVRD) is in the process of updating its Air Quality Management Plan that was first developed in 1998.[9] This plan highlights several air quality issues, including ground-level ozone and $PM_{2.5}$. The FVRD is currently reviewing options for developing alternatives to open burning.

Regional air quality agencies including Metro Vancouver and the Fraser Valley Regional District developed a Regional Ground-Level Ozone Strategy in 2014.[10] This strategy identifies goals and strategic policy direction for the LFV. The strategy is currently in the implementation phase.

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).

[9] http://www.fvrd.ca/assets/Services/Documents/FVRD%20AQManagementPlan.pdf
[10] http://www.metrovancouver.org/services/air-quality/AirQualityPublications/RGLOS2014.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. 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 $PM_{2.5}$ 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 $\mu g/m^3$ or 8-hour daily maximum ozone concentrations 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-related air quality advisories had been issued by Metro Vancouver 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.

Appendix II – Wildfire-influenced Data in the Lower Fraser Valley Air Zone (2014-2016)

Ground-level Ozone

During late June/early July 2015, elevated ozone concentrations were observed in the LFV Air Zone, particularly at the Agassiz monitoring site. As described in the LFV Air Zone Report (2013-2015), elevated ozone concentrations on July 8-9, 2015 were attributed to the influence of smoke from wildfires burning to the north of the region.[11] Excluded data are shown in Table II-1. Please see the LFV Air Zone Report (2013-2015) for further information.[12]

Table II-1. Wildfire-influenced ozone data.

EMS_ID	Location	Date	8-Hr Value Daily Maximum (ppb)
E293810	Agassiz Municipal Hall	2015-07-08	76.0
E293810	Agassiz Municipal Hall	2015-07-09	77.5

$PM_{2.5}$

Air quality advisories were issued by Metro Vancouver from July 5-10, 2015 as a result of elevated $PM_{2.5}$ levels associated with wildfires burning to the north of the air zone. A further air quality advisory was issued on August 23, 2015 as a result of wildfire smoke from fires in Washington State. Wildfire-influenced data are summarized in Table II-2.

Table II.2 – Wildfire-influenced $PM_{2.5}$ data.

Location	Date	Daily Mean ($\mu g/m^3$)	Wildfire Smoke-related Air Quality Advisory?
Abbotsford-Airport	2015-07-05	35	Y
Burnaby South	2015-07-05	55.6	Y
Burnaby-Kensington Park	2015-07-05	78.3	Y
Chilliwack	2015-07-05	30.4	Y
Horseshoe Bay	2015-07-05	65.9	Y
Langley	2015-07-05	45.7	Y
Mission	2015-07-05	29.8	Y
North Delta	2015-07-05	57.3	Y
North Vancouver-2nd Narrows	2015-07-05	46.0	Y
North Vancouver-Mahon Park	2015-07-05	59.9	Y
Pitt Meadows	2015-07-05	50.8	Y
Port Moody	2015-07-05	56	Y

[11] http://www2.gov.bc.ca/gov/content/environment/air-land-water/air/reports
[12] http://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality-management/aqms

Table II-2 (continued).

Location	Date	Daily Mean ($\mu g/m^3$)	Wildfire Smoke-related Air Quality Advisory?
Richmond South	2015-07-05	49.3	Y
Richmond-Airport	2015-07-05	54.2	Y
Surrey	2015-07-05	58.3	Y
Tsawwassen	2015-07-05	56.8	Y
Abbotsford-Airport	2015-07-06	44.9	Y
Abbotsford-Mill Lake	2015-07-06	82.5	Y
Agassiz	2015-07-06	37.4	Y
Burnaby South	2015-07-06	48.3	Y
Burnaby-Kensington Park	2015-07-06	49.8	Y
Chilliwack	2015-07-06	36.6	Y
Hope	2015-07-06	28.4	Y
Horseshoe Bay	2015-07-06	59.6	Y
Langley	2015-07-06	35.9	Y
Mission	2015-07-06	62.1	Y
North Delta	2015-07-06	34.6	Y
North Vancouver-2nd Narrows	2015-07-06	35.2	Y
North Vancouver-Mahon Park	2015-07-06	53.3	Y
Pitt Meadows	2015-07-06	41.5	Y
Port Moody	2015-07-06	56.4	Y
Surrey	2015-07-06	33.2	Y
Burnaby-Kensington Park	2015-07-08	28.7	Y
Hope	2015-07-08	31	Y
Horseshoe Bay	2015-07-08	33	Y
North Vancouver-2nd Narrows	2015-07-08	28.9	Y
North Vancouver-Mahon Park	2015-07-08	34.5	Y
Port Moody	2015-07-08	29.4	Y
Agassiz	2015-07-09	34	Y
Burnaby-Kensington Park	2015-07-09	28.7	Y
Hope	2015-07-09	35.8	Y
Horseshoe Bay	2015-07-09	32.7	Y
North Vancouver-Mahon Park	2015-07-09	31.7	Y
Abbotsford-Airport	2015-08-23	30.1	Y
Agassiz	2015-08-23	43.7	Y
Chilliwack	2015-08-23	39.9	Y
Hope	2015-08-23	42.5	Y